Missouri Clean Water Commission
Meeting

July 22, 2019

Department of Natural Resources
Elm Street Conference Center
East Elm Street
Jefferson City, MO

Missouri Clean Water Commission
Department of Natural Resources
Elm Street Office Building
Roaring River/Bennett Springs Conference Rooms
1730 East Elm St.
Jefferson City, Missouri 65102

July 22, 2019

Call to Order

Issue:

The Missouri Clean Water Commission will be called to order.

Recommended Action:

None

List of Attachments:

None

Missouri Clean Water Commission
Department of Natural Resources
Elm Street Office Building
Roaring River/Bennett Springs Conference Rooms
1730 East Elm St.
Jefferson City, Missouri 65102

July 22, 2019

Approval of Minutes

Issue:

The Missouri Clean Water Commission will review the minutes from the past Clean Water Commission meetings.

Recommended Action:

The Department recommends that the Missouri Clean Water Commission vote to approve past meeting minutes.

Missouri Clean Water Commission Meeting
Elm Street Conference Center
Bennett Springs / Roaring River Conference Room
East Elm Street
Jefferson City, Missouri

July 22, 2019

Approval of Minutes

Issue:

Commission to review the Open Session minutes from the April 29, 2019, Missouri Clean Water Commission meeting.

Recommended Action:

Commission to approve the Open Session minutes from the April 29, 2019, Missouri Clean Water Commission meeting.

Attachments

Official transcripts

MISSOURI
DEPARTMENT OF
NATURAL RESOURCES
WATER PROTECTION PROGRAM

DRAFT MINUTES OF THE
MISSOURI CLEAN WATER COMMISSION MEETING
Lewis and Clark State Office Building
1101 Riverside Drive
Jefferson City, Missouri
April 29, 2019

Present at Lewis and Clark State Office Building
Ashley McCarty, Chair, Missouri Clean Water Commission
Patricia Thomas, Vice-Chair, Missouri Clean Water Commission
Stan Coday, Missouri Clean Water Commission
Tim Duggan, Legal Counsel, Missouri Clean Water Commission
John Reece, Missouri Clean Water Commission
Allen Rowland, Missouri Clean Water Commission
Krista Welschmeyer, Secretary, Missouri Clean Water Commission
Chris Wieberg, Director of Staff, Missouri Clean Water Commission

Michael Abbott, Missouri Department of Natural Resources, Jefferson City, Missouri
Robert Brundage, Newman, Comley, and Ruth, Jefferson City, Missouri
David Carani, Metropolitan Sewer District, St. Louis, Missouri
Sharon Davenport, Missouri Department of Natural Resources, Jefferson City, Missouri
Jane Davis, Missouri Department of Natural Resources, Jefferson City, Missouri
Chelsey Distler, Missouri Department of Natural Resources, Jefferson City, Missouri
Joan Doerhoff, Department of Natural Resources, Jefferson City, Missouri
Eric Fuchs, Missouri Rural Water Association
Tim Geraghty, Alliance Water, Columbia, Missouri
Jodi Gerling, Missouri Department of Natural Resources, Jefferson City, Missouri
Bob Hembrock, NPSD, Fenton, Missouri
Jennifer Hernandez, Attorney General's Office, Jefferson City, Missouri
Jeanne Heuser, Citizen, Jamestown, Missouri
John Hoke, Missouri Department of Natural Resources, Jefferson City, Missouri
Ramona Huckstep, Missouri Municipal League, Jefferson City, MO
Donald Jones, Missouri Rural Water Association, Poplar Bluff, Missouri
Shirley Kidwell, Citizen, Fulton and Columbia, Missouri
Diane Kimber, Citizen, California, Missouri
Misty Lange, Missouri Department of Natural Resources, Jefferson City, Missouri
Carol Lawrence, East West Gateway Council, St. Louis, Missouri
Traci Lichtenberg, Missouri American Water, St. Louis, Missouri
Margot McMillen, Citizen, Fulton, Missouri

Refaat Mefrakis, Missouri Department of Natural Resources, Jefferson City, Missouri
Leasue Meyers, Missouri Department of Natural Resources, Jefferson City, Missouri
Bruce Morrison, Great Rivers Environmental Law Center, St. Louis, Missouri
Morgan Mundell, MLPA, Jefferson City, Missouri
Holly Neill, TNC, Springfield, Missouri
David Nelson, Kansas City Water, Kansas City, Missouri
Randy Norden, MRCRA, Ashland, Missouri
Emilie Peterson, Missouri Department of Natural Resources, Jefferson City, Missouri
Joel Reschly, Missouri Department of Natural Resources, Jefferson City, Missouri
Kristi Savage-Clarke, Missouri Department of Natural Resources, Jefferson City, Missouri
Jason Seger, RCPSD, Imperial, Missouri
Jill Sellenreick, Citizen, Fulton, Missouri
Darrick Steen, Missouri Corn Growers/Soybean Association, Jefferson City, Missouri
Trent Stober, Metropolitan Sewer District, St. Louis, Missouri

CALL TO ORDER

Chair McCarty called the meeting of the Missouri Clean Water Commission (CWC) to order on April 29, 2019, at 10:07 a.m., at the Lewis and Clark State Office Building, 1101 Riverside Drive, Jefferson City, MO.

Chair McCarty introduced the Commissioners, Staff Director, Legal Counsel, and the Commission Secretary.

Approval of Minutes

Approval of the July 16, 2018, Open Session Minutes
Agenda Item B-1

Commissioner Coday made a motion to approve the minutes as amended. Commissioner Reece seconded the motion. The motion passed with a roll call vote:

Commissioner Coday:	**Yes**
Commissioner Reece:	**Yes**
Commissioner Rowland:	**Yes**
Vice Chair Thomas:	**Yes**
Chair McCarty:	**Yes**

<u>Approval of the September 21, 2018, Open Session Minutes</u>
Agenda Item B-2

Commissioner Reece made a motion to approve the minutes as presented. Commissioner Rowland seconded the motion. The motion passed with a roll call vote:

Commissioner Reece:	**Yes**
Commissioner Rowland:	**Yes**
Commissioner Coday:	**Yes**
Vice Chair Thomas:	**Yes**
Chair McCarty:	**Yes**

<u>Approval of the October 18, 2018, Open Session Minutes</u>
Agenda Item B-3

Commissioner Rowland made a motion to approve the minutes as presented. Commissioner Reece seconded the motion. The motion passed with a roll call vote:

Commissioner Rowland:	**Yes**
Commissioner Coday:	**Yes**
Commissioner Reece:	**Yes**
Vice Chair Thomas:	**Yes**
Chair McCarty:	**Yes**

<u>Approval of the December 10, 2018, Open Session Minutes</u>
Agenda Item B-4

Commissioner Reece made a motion to approve the minutes as amended. Commissioner Rowland seconded the motion. The motion passed with a roll call vote:

Commissioner Coday:	**Yes**
Commissioner Reece:	**Yes**
Commissioner Rowland:	**Yes**
Vice Chair Thomas:	**Yes**
Chair McCarty:	**Yes**

<u>Approval of the December 10, 2018, Closed Session Minutes</u>
Agenda Item B-5

Commissioner Coday made a motion to approve the minutes as presented. Commissioner Rowland seconded the motion. The motion passed with a roll call vote:

Commissioner Rowland:	**Yes**
Commissioner Reece:	**Yes**
Commissioner Coday:	**Yes**
Vice Chair Thomas:	**Yes**
Chair McCarty:	**Yes**

<u>Approval of the January 9, 2019, Open Session Minutes</u>
Agenda Item B-6

Commissioner Reece made a motion to approve the minutes as amended. Commissioner Rowland seconded the motion. The motion passed with a roll call vote:

Commissioner Coday:	**Yes**
Commissioner Rowland:	**Yes**
Commissioner Reece:	**Yes**
Vice Chair Thomas:	**Yes**
Chair McCarty:	**Yes**

<u>Approval of the January 9, 2019, Closed Session Minutes</u>
Agenda Item B-7

Commissioner Reece made a motion to approve the minutes as presented. Commissioner Coday seconded the motion. The motion passed with a roll call vote:

Commissioner Rowland:	**Yes**
Commissioner Reece:	**Yes**
Commissioner Coday:	**Yes**
Vice Chair Thomas:	**Yes**
Chair McCarty:	**Yes**

DNR Reports and Updates

Director's Update
Agenda Item C

Chris Wieberg, Director, Water Protection Program, reported the following to the Commission:

- Numeric Nutrient Criteria for Lakes Update
- 2020 Listing Methodology document
- Enforcement Report (FFY 2018)
- Efforts to promote regionalization and consolidation
- July 2019 Commission meeting

Public Hearing

Proposed Amendments to the 1978 St. Louis, Missouri Water Quality Management 208 Plan
Agenda Item D

Court reporter swore in those wishing to testify.

Refaat Mefrakis, WPP Chief of Engineering, presented the request to amend the 208 Plan for the Lower Meramec River System to the Commission due to the technical, economic and environmental conditions changes in the service area.

Jay Hoskins, Metropolitan St. Louis Sewer District, provided the Commission with a presentation about possible challenges and limited water quality benefits to the Lower Meramec River with the plan as written.

Trent Stober, HDR, provided the Commission with a presentation about the costs implications of the current plan and the proposed amendment.

Commission Reece commended MSD on the work they have completed on the plan. Chair McCarty and Commission Rowland has questions for Jay Hoskins.

Written comments on the proposal will be accepted through May 7, 2019. Chair McCarty closed the hearing.

Recommended for Adoption and Actions to be Voted On

Election of Missouri Clean Water Commission Chair
Agenda Item E1

Commissioner Reece made a motion to elect Ashley McCarty as the Missouri Clean Water Commission Chair. Commissioner Rowland seconded the motion. The motion passed with a roll call vote:

Commissioner Reece:	**Yes**
Commissioner Rowland:	**Yes**
Commissioner Coday:	**Yes**
Vice Chair Thomas:	**Yes**
Chair McCarty:	**Abstain**

Fiscal Year 2019 Clean Water State Revolving Fund Intended Use Plan Amendment
Agenda Item E2

Joan Doerhoff, Missouri Department of Natural Resources, Financial Assistance Center, presented an amendment to the Fiscal Year 2019 Clean Water State Revolving Fund Intended Use Plan.

Commissioner Coday made a motion to approve the amendment as proposed. Commissioner Reece seconded the motion. The motion passed with a roll call vote:

Commissioner Coday:	**Yes**
Commissioner Reece:	**Yes**
Commissioner Rowland:	**Yes**
Vice-Chair Thomas:	**Yes**
Chair McCarty:	**Yes**

Application for Award of Attorney's Fees Regarding County Club Homes, LLC, Permit MOG10872 – Appeal No. 18-0498 and Appeal No. 18-0501
Agenda Items E3 and E4

Tim Duggan spoke to the commission and recommended that the issue be further tabled until the case has concluded.

Commissioner Coday made a motion to postpone this issue until the meeting following the finalization of the appeals. Commissioner Rowland seconded the motion. The motion was passed with a roll call vote.

Commissioner Reece:	**Yes**
Commissioner Rowland:	**Yes**
Commissioner Coday:	**Yes**
Vice-Chair Thomas:	**Yes**
Chair McCarty:	**Yes**

New Business

State Stormwater Grant and Loan Program
Agenda Item F1

Emilie Peterson, Missouri Department of Natural Resources, Financial Assistance Center (FAC), made a presentation to the Commission regarding the State Stormwater Grant and Loan Program.

FAC will be offering funds for stormwater projects for first class counties, entitlement cities, and the Metropolitan St. Louis Sewer District. Funds were appropriated through bond sales totaling $45 million. No grants or loans have been issues through this program since 2007 and the funds available have been growing with repayment and interest from previous loans and now total approximately $9 million. Informational letters about project selection and the approval process have been sent out. Applicants are encouraged to form a Stormwater Coordinating Committee to work through the process and submit their application. Questions regarding the program can be directed to Joan Doerhoff, Hannah Humphrey or Emilie Peterson.

Rulemaking Process
Agenda Item F2

Jane Davis, Missouri Department of Natural Resources, Water Protection Program, made a presentation to the Commission on the Rulemaking process and how it relates to the Clean Water Law.

Appeals and Variance Requests

Administrative Hearing Commission's Recommendation Regarding Midwest Forest City, LLC Appeal No. 18-1238

No representation for Midwest Forest City, LLC was present at the Commission meeting. Jennifer Hernandez informed the Commission that Midwest Forest City, LLC was planning to withdraw their appeal. There was a short discussion as to whether or not to proceed with the vote. The Commission decided that Midwest Forest City, LLC has had adequate time to prepare and decide if they wanted to withdraw their appeal since the issue originated in 2012. The Commission then decided to proceed with the vote.

Commissioner Coday made a motion to uphold the decision made by the Administrative Hearing Commission. Commissioner Reece seconded the motion. The motion passed with a roll call vote:

Commissioner Coday:	**Yes**
Commissioner Rowland:	**Yes**
Commissioner Reece:	**Yes**
Vice-Chair Thomas:	**Yes**
Chair McCarty:	**Yes**

Open Comment Session

There were no items during the Open Comment session.

Future Meeting Dates

Missouri Clean Water Commission Meetings
Agenda Item I

- July 22, 2019, Elm Street Conference Center
- October 9, 2019, Elm Street Conference Center
- January 9, 2020, Lewis and Clark State Office Building
- April 2, 2020, Lewis and Clark State Office Building
- July 8, 2020, Lewis and Clark State Office Building
- October 7, 2020, Lewis and Clark State Office Building

Closed Session

There was no closed session during this Clean Water Commission meeting.

Meeting Adjournment

Chair McCarty adjourned the meeting.

Commission adjourned the open meeting at 12:08 p.m.

For more information contact:
Ms. Krista Welschmeyer, Commission Secretary, Missouri Clean Water Commission
Water Protection Program, P.O. Box 176, Jefferson City, MO 65102
Phone: 573-751-6721
Fax: 573-526-1146
E-mail: krista.welschmeyer@dnr.mo.gov

Respectfully Submitted,

Chris Wieberg
Director of Staff

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7 MISSOURI CLEAN WATER COMMISSION MEETING
8 Lewis & Clark State Office Building
9 LaCharrette / Nightingale Conference Rooms
10 1101 Riverside Drive
11 Jefferson City, Missouri 65101
12 APRIL 29th, 2019
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1 APPEARANCES

2 Ms. Ashley McCarty

3 Mr. Stan Coday

4 Mr. Allen Rowland

5 Ms. Patricia Thomas

6 Mr. John Reece

7

8 Also present:

9

10 The Court Reporter:

11 MS. LISA BALLALATAK, CCR
Kansas CSR No. 1670
12 Missouri CCR No. 1336
ALARIS LITIGATION SERVICES
13 2511 Broadway Bluffs, Suite 201
Columbia, Missouri 65201
14 Phone: (573) 449-0561

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1 (The hearing commenced at 9:47 a.m.)
2 MS. McCARTY: This is a public hearing,
3 and the purpose of this public hearing is to provide
4 opportunity before the public to provide comment on
5 the proposed amendment. This hearing, like all
6 others, is not a forum for debate or resolution of
7 issues, and we ask that those commenting limit their
8 testimony to five minutes and not repeat comments
9 others have made.
10 We're first going to hear testimony from
11 the department, and then we will invite the public
12 to have an opportunity to comment. I have two
13 comment cards. If there are others that would like
14 to comment, please fill out a card.
15 We also ask that all individuals please
16 sign in for complete records, and when you come
17 forward to present testimony, please identify
18 yourself to the court reporter.
19 Following the public hearing today, the
20 department will review comments presented and
21 finalize a recommendation for the Clean Water
22 Commission, where we expect to take final action at
23 our next meeting, expected to be in July of 2019.
24 The court reporter will now swear in
25 anyone wishing to testify, and will all of those

1 wishing to comment, please stand.
2 REFAAT MEFFRAKIS, JAY HOSKINS, and
3 TRENT STOBER,
4 being first sworn testified as follows:
5 MS. DISTLER: Good morning, Commissioners.
6 My name is Refaat Mefrakis, and I'm chief of
7 engineering for water protection program. I'm here
8 this morning to present the request to revise the
9 208 plan for the lower Meramec River system. The
10 revision was prepared by the St. Louis Metropolitan
11 Sewer District, MSD, in conjunction with the
12 Northeast Public Sewer District, Rock Creek Public
13 Sewer District, and the East-West Gateway Planning
14 Commission. Among the three districts, they serve
15 1,400 miles of sewer lines and about 170 square
16 miles of area in the lower Meramec watershed basin.
17 In 1978, the 208 plan for the lower
18 Meramec system envisioned one regional wastewater
19 treatment system, the lower Meramec Wastewater
20 Treatment Facility, to provide sewer services via
21 major interceptors for the southern St. Louis County
22 and Northern Jefferson County and one regional
23 sludge processing center for the St. Louis and
24 Jefferson counties located at the lower Meramec
25 Wastewater Treatment Facility.

1 In 1985, the MSD 201 facility plan
2 recommended three interim facilities: the lower
3 Meramec, Fenton, and Grand Glaize until a regional
4 facility and a tunnel are constructed. Today the
5 request proposes the lower Meramec system, which
6 includes the Rock Creek basin, will be served by
7 existing four regional treatment facilities. The 2
8 MSD lower Meramec Wastewater Treatment, MSD Grand
9 Glaize, the Northeast Public Sewer District,
10 Southern Creek Regional Wastewater Treatment, and
11 the Rock Creek Public Sewer District, Kimmswick
12 Wastewater Treatment Facility. It also proposes
13 that biosolids for MSD facilities in the lower
14 Meramec system will be addressed at the Lemay
15 Wastewater Treatment, where MSD plans to build new
16 fluidized bed sewer sludge incinerators, while
17 Northeast Public Sewer District and Rock Creek
18 Public Sewer District will continue their current
19 biosolid management activities.
20 Some relevant and important factors. In
21 2015, the Clean Water Commission approved Northeast
22 Public Service District request to become a Level 2
23 continuing authority to provide sewage collection
24 and services within the lower Meramec basin of
25 Jefferson County. This has provided an opportunity

1 to work on new collection lines and regionalization
2 of smaller treatment facilities. Biosolids from the
3 Northeast Public Sewer District facilities are
4 transported to Saline Creek Regional Wastewater
5 Treatment Facility for processing and final
6 disposal.
7 Currently, MSD is constructing a Phase II
8 tunnel, which result in taking one of the interim
9 facilities, the Fenton Wastewater Treatment, off
10 line and connect to the lower Meramec plant in 2025.
11 The request concludes that since the 208
12 plan was completed in 1978, the technical, economic,
13 and environmental conditions have changed and some
14 of the original recommendations, including a single
15 facility within the lower Meramec system, are no
16 longer appropriate. The request provides supporting
17 documentation for amending the 208 plan to bring it
18 into alignment with the current situation in the
19 lower Meramec system.
20 The East-West Gateway and St. Louis
21 Metropolitan Sewer District placed a draft amendment
22 to the 208 plan on public notice on February 4th,
23 2019 and held a public meeting on February 12, 2019.
24 The Department placed the proposed amendment of
25 public notice on March 29, 2019, and will remain on

1 public notice until May 7, 2019.
2 I appreciate the opportunity to present
3 the proposed request.
4 This concludes my testimony. Thank you.
5 MS. McCARTY: Thank you. Any questions?
6 Move on? Okay. Public comments, then,
7 will be accepted.
8 I have Trent Stober and Jay Hoskins.
9 Jay, would you like to lead off?
10 MR. HOSKINS: Good morning, Commissioners.
11 MS. McCARTY: We are going to work through
12 technical issue and are thankful to the staff to do.
13 Trent, would you like to follow Jay, or
14 can you go ahead and make comments at this time?
15 MR. STOBER: I'm in the middle of the
16 presentation.
17 MS. McCARTY: You're in the middle of the
18 presentation?
19 MR. STOBER: Yeah. It's sort of a
20 tag-team deal.
21 MS. McCARTY: Okay. We will wait just a
22 moment.
23 MR. HOSKINS: Good morning, Commissioners.
24 MS. McCARTY: Good morning.
25 MR. HOSKINS: My name is Jay Hoskins, and

1 I am here on behalf of the Metropolitan St. Louis
2 Sewer District, or commonly known as MSD. With me
3 today are Bob Hembrock, executive director of the
4 Northeast Public Sewer District, and Jason Seger,
5 manager of the Rock Creek Public Sewer District, and
6 Trent Stober, HDR.
7 We are here today to speak on our proposal
8 for the Clean Water Act Section 208 plan for the
9 St. Louis area, and I drew the short straw this
10 morning as the spokesperson.
11 I'd like to start out today with some
12 history to help provide background for why we're
13 here. MSD is a political subdivision of the state
14 created in 1954 under the Missouri Constitution.
15 With the passage of the Clean Water Act in 1972,
16 local governments and regional planning authorities,
17 states, were tasked with developing management plans
18 for improving the water quality in their
19 communities. In 1977, MSD annexed the entirety of
20 the St. Louis County portion of the Meramec River
21 basin into a service area. And then in 1978, the
22 East-West Gateway council and governments prepared
23 the St. Louis, Missouri Water Quality Management
24 Plan Area Wide Treatment Management Study, or 208
25 plan, and that's what I'm going to refer to that

1 hereafter today. And that's the focus of our
2 presentation.
3 The goal of the 208 plan was to meet state
4 water quality standards throughout the entirety of
5 St. Louis County and St. Louis City, St. Charles
6 County, Franklin County, and Jefferson County. The
7 208 plan identified the Meramec River as the
8 St. Louis region's number one priority river. The
9 plan called for a regional treatment system in
10 St. Louis County near the confluence of the Meramec
11 and Mississippi Rivers. This regional facility was
12 to be managed by MSD and be the hub of wastewater
13 service for the lower Meramec basin and the Rock
14 Creek basin in Jefferson County. There was a
15 glitch. By charter, MSD could not annex the
16 Jefferson County portions of the basin into its
17 collection system service area, and, therefore, it
18 was proposed that MSD develop agreements with cities
19 and sewer districts in Jefferson County to treat
20 their wastewater, and those cities and sewer
21 districts would continue to maintain their sewer
22 collection systems.
23 In 1979, both the Northeast Public Sewer
24 District -- I'm going to call them "Northeast" from
25 here out, too -- and the Rock Creek Public Sewer

1 District, or Rock Creek were formed. Each of these
2 sewer districts owns and operates their own
3 collection systems and treatment facilities. Only
4 the city of Arnold developed an agreement with MSD
5 to treat wastewater. MSD constructed the regional
6 treatment facility, which we'll call the Lower
7 Meramec Wastewater Treatment Plan, and operation
8 began there in 2007. Today Missouri-American Water
9 owns and operates the city the Arnold's collection
10 system, and MSD treats that wastewater. A small
11 area of Rock Creek sewers also drain into the Arnold
12 sewers, and, therefore, is also treated by MSD.
13 However, as I mentioned, both Northeast and Rock
14 Creek operate and maintain their collection systems
15 and treatment plan; neither discharges to MSD.
16 Today these two sewer districts operate major
17 wastewater treatment plants on the Meramec and the
18 Mississippi River and also work to further
19 regionalize the smaller wastewater treatment plants
20 within their service area. Notably, Northeast is a
21 Level 2 continuing authority, a higher level of
22 continuing authority than either MSD or Rock Creek.
23 The St. Louis 208 plan for regionalization
24 of wastewater services provided the political
25 foundation for improving water quality, economic

1 growth, and improving quality of life. It
2 facilitated the elimination of 60 wastewater
3 treatment plants and replaced them with modern
4 wastewater treatment facilities. The land in
5 western and southern St. Louis County today is
6 nearly fully developed, and at the same time, the
7 water quality in the Meramec River has improved.
8 It's been a successful plan; however, like any
9 long-range planning document, the 208 plan needs to
10 be updated from time to time. MSD, Northeast, and
11 Rock Creek have worked together to develop this
12 amendment because we believe that completing the 208
13 plan as written will create challenges and provide
14 limited water quality benefit to the Meramec River.
15 We hope you that the information we present to you
16 today will help you draw the same conclusion.
17 We would also like to refer you to the
18 amendment document, which is in your packet as Tab
19 B1. Today, the lower Meramec basin is served by
20 five mayor wastewater treatment plants: The Grand
21 Glaize Treatment Facility -- I'm going -- is it okay
22 if I step up here?
23 MS. McCARTY: Yeah.
24 MR. HOSKINS: The five major facilities
25 are the MSD Grand Glaize Treatment Facility, near

1 Valley Park, Missouri -- or in Valley Park,
2 Missouri; the MSD Fenton Wastewater Treatment
3 Facility in Fenton, Missouri; the lower Meramec
4 facility near the Mississippi and Meramec; the
5 Saline Creek facility in Jefferson County; and the
6 Kimmswick Facility also in Jefferson County that
7 actually is turning into the Mississippi River.
8 In the past, the facility plans for the
9 Grand Glaize, Fenton, Saline Creek, and Kimmswick
10 Treatment Facilities referred to them as "interim
11 facilities" and applied there was that because of
12 the 208 plan, all the interim facilities would
13 eventually be connected by either deep tunnels or
14 pump stations to the lower Meramec plant.
15 So on the map, as the existing 208 -- as
16 the 208 contemplated in 1978 -- as it was presented
17 in '78, only the lower Meramec facility at the
18 confluence of the Meramec and the Mississippi River
19 would remain. All of these other major facilities
20 would be eliminated by tunnels or pump stations.
21 With the amendment that we are proposing
22 today, only one of these major facilities would be
23 eliminated, and that's the Fenton Wastewater
24 Treatment Facility. In essence, the lower Meramec
25 basin would be served by four regional facilities:

1 The Grand Glaize Facility, the Saline Creek, the
2 Kimmswick, and the lower Meramec Facility.
3 For some perspective of the size, the
4 design facility -- the design flows for the Grand
5 Glaize and the lower Meramec plants would be
6 similar, about 20 million gallons per day. Saline
7 Creek design flow is currently 4 million gallons per
8 day, and its design flow could be expanded. The
9 Kimmswick average daily flow is almost 5 million
10 gallons a day.
11 If the 208 plan is amended, then the new
12 plan must be protective of water quality in the
13 Meramec River. The lower Meramec River is listed as
14 impaired for two pollutants: E. coli and lead. The
15 lead impairment is a legacy problem that is related
16 to the history of lead mining in the watershed. The
17 DNR has consistently stated in our operating permits
18 that the lead impairment is unrelated to our
19 wastewater discharges.
20 With regard to E. coli, you may recall
21 that the E. coli criteria is expressed as a
22 geometric mean of the water samples collected
23 between April and October every year. In this
24 chart, you can see that the seasonal geometric since
25 1997 has, at times, exceeded the criteria. The dash

1 line at the top there is the criteria, 426 counts
2 worth of milliliters. And some years you'll see --
3 when the blue bars are above that line, the criteria
4 is exceeded; when the blue bar is below that line,
5 it meets standards.
6 When we looked at the water quality data
7 to understand why these occasionally exceedances are
8 occurring, we found a high correlation between
9 stream flow and the levels of E. coli in the sample.
10 On the X axis of the chart, you see different flow
11 regimes: low flows, dry flows, mid-range flows,
12 moist conditions, high-high flows. On the Y axis or
13 the left side, that's the concentration of E. coli
14 in the sample.
15 When stream flows were highest --
16 generally, the flows that occurred less than
17 10 percent of the time or those high flows --
18 E. coli leveling were highest. And this indicates
19 that the E. coli problem in the Meramec is more of a
20 stormwater problem than a wastewater problem.
21 Finally, we took a look at ammonia levels
22 in the Meramec River and compared them to EPA's 2013
23 proposed ambient water quality criteria. Sometimes
24 these criteria are referred to as "mussel ammonia
25 criteria" because they are intended to be protective

1 of some sensitive species of mussels. The average
2 annual ammonia concentration in the Meramec River
3 for several years has been below these proposed
4 mussel ammonia criteria. The lower Meramec River,
5 in fact, is home to several species of these
6 sensitive mussels; however, what's notable is that
7 beginning in 2009 -- and if you look at the chart,
8 beginning in 1968, all the way moving over to 2008
9 and 2009, with some respect, is right here -- you'll
10 note that the ammonia concentrations, the ambient
11 water quality concentrations of ammonia in the
12 Meramec have been less than 10 percent of these
13 proposed mussel ammonia criteria.
14 In fact, today, the ammonia levels in the
15 lower Meramec are the same upstream and downstream
16 of the major wastewater treatment facilities on the
17 Meramec River. What you have there on this chart is
18 ammonia concentrations at Eureka on the left side
19 and ammonia concentrations at Colonial Hills
20 downstream of all the major wastewater discharges
21 from 2009 and 2018, you'll see they're actually the
22 same or a little bit below what we have coming into
23 the basin.
24 And, therefore, our assessment is that
25 further regionalization of major wastewater

1 treatment facilities in the lower Meramec is
2 unnecessary to protect water quality. And the
3 question is: Is further regionalization
4 cost-effective?
5 I'm now going to turn over the
6 presentation to Trent Stober from HDR, who will
7 compare the cost of our billing out the further
8 regional wastewater facilities to continue to
9 operate the four major facilities today.
10 MR. STOBER: Good morning. I'll just --
11 again, Trent Stober with HDR. We've had the
12 opportunity to support the District through this 208
13 amendment process. And I'll just go over the cost
14 implications, the economic implications of the
15 current plan, as well as our recommended amendment.
16 So first comes down to evaluating the cost
17 of the original recommendations compared to the cost
18 of making an amendment to maintain the existing
19 three facilities at Grand Glaize, Northwest Public
20 Sewer District, and Rock Creek Public Sewer
21 District. So for the existing -- for the original
22 208 recommendations, there would need to be a
23 significant amount of capital investment to convey
24 the wastewater from those three service areas to the
25 Meramec Wastewater Treatment Facility at the

1 Missouri -- or the Mississippi River. There would
2 also be a capital and operational requirement to
3 upgrade or increase the capacity of the lower
4 Meramec Wastewater Treatment plan to accommodate
5 those flows. So that's about a 30 million gallons
6 per day upgrade to the facility to handle those
7 wastewater flows. That is compared to the cost of
8 maintaining the existing facilities with both the
9 plan and anticipated capital projects -- not only
10 with what we see right now with needs to update
11 those facilities for asset management requirements
12 and so forth, but also future regulatory drivers,
13 such as removal. So there's an apples-to-apples
14 comparison of the 208 recommendations and the
15 capital investments for that, versus our assessment
16 of the modification and the economic benefits of
17 that.
18 So first I'll go through, briefly, the
19 cost estimate for the original 208 recommendations.
20 So the total is about $400 million in 2018 dollars,
21 so this is, you know, all based off of the cost in
22 2018, not necessarily what the cost would be when it
23 was -- we implement it in the future as inflation
24 would occur and so forth. So to break those down
25 into the different components to convey all of the

1 wastewater to the lower Meramec system, we're
2 looking at about $210 million distributed between
3 St. Louis MSD, the Northeast Public Sewer District,
4 and Rock Creek. Those are the lines to take there.
5 In some cases, pump stations to pump the wastewater
6 from Rock Creek over to the lower Meramec facility.
7 As I mentioned, this would require about 30 million
8 gallons of additional capacity to be built at the
9 lower Meramec facility, and we estimate that cost to
10 be about $120 million or $4 per gallon per day per
11 capacity. And then, obviously, there's an
12 operational component to manage the wastewater and
13 convey it but then also treat to the lower Meramec
14 facility, and that's about $73 million, all of which
15 has been attributed to MSD, but, practically, it
16 would be attributed to the different entities, if
17 that was to be carried forward.
18 This is our estimate of the cost of
19 maintaining the existing facilities, updating those
20 for, you know, some of the aged equipment and so
21 forth, but then also addressing future regulatory
22 needs. So the capital cost for the -- for updating
23 those facilities is about $37 million. Operation
24 and maintenance is $110 million for a total of
25 147 million. One thing to note is the O&M of

1 running three different facilities, if you -- if
2 you'll remember, the -- is $110 million. If you'll
3 recall, you know, putting those all at the common
4 facility was about $73 million, so it is more
5 expensive to operate those facilities independently;
6 however, the capital cost is greatly different and
7 then ends up resulting in an overall cost savings.
8 So this is the comparison, both by the
9 utilities and as a total. So the comparison between
10 the original 208 recommendation versus the
11 existing -- or maintaining the existing facilities
12 is about $253 million of which about $17 million of
13 cost savings between Rock Creek and the Northeast
14 Public Service District; whereas, MSD would realize
15 about $113 million of cost savings.
16 MR. HOSKINS: Okay. The 208 plan also
17 called for a regional biosolids handing facility to
18 be built at the lower Meramec plant. We would also
19 like to amend the 208 plan in this regard. MSD
20 recently completed a plan for updating its biosolids
21 handling, and we would like to have our Bissell
22 Point and Lemay facilities serve as those regional
23 facilities for all MSD plants, and then under the
24 lower Meramec solids handling facility would not be
25 necessary. Northeast is planning to install a new

1 aerobic digester to handle their biosolids, and Rock
2 Creek is planning to continue to aerobically digest
3 its biosolids.
4 Finally, the 208 plan development process
5 and amendment process is a public process, and we
6 wanted to take a minute to go over the public
7 outreach that we have taken here.
8 We continue to be in close communication
9 about this matter with the Department and with EPA.
10 We have met with elected officials, especially
11 officials in Jefferson County. We've held our only
12 public meeting and public comment earlier this year.
13 By and large, this plan amendment makes sense to
14 most people because there is little water quality
15 benefit and further regionalization of major
16 wastewater treatment on the Meramec River. The
17 East-West Gateway council of governments, our
18 Level I continuing authority, recently wrote a
19 letter of support for the amendment, and now we're
20 asking for your support and for approving the
21 amendment of that 208 plan amendment at the July
22 Clean Water Commission meeting.
23 That's all of the comments I have
24 prepared.
25 Are there any questions that I can answer?

1 MS. McCARTY: Any questions for Jay?
2 Madam Chair, I'd just like to make a
3 comment. I'd like to commend MSD --
4 MR. HOSKINS: Thank you.
5 MR. REECE: -- for updating this 208 plan.
6 This original 208 plan was prepared over 40 years
7 ago, and it's not uncommon to update these plans
8 periodically to bring you to -- you know, up to date
9 with regard to not only affluent quality but cost.
10 And has been indicated here, you know, updating this
11 plan to its present recommendation is going to save
12 the district over $250 million, and I think that in
13 itself is justification for abating this plan and
14 continuing down the road with what you're proposing
15 here today.
16 So I'd just like to commend MSD, and I
17 think you've done an excellent job in staying on top
18 of this information and bringing a plan to the
19 Commission that makes a lot of financial sense and a
20 good job.
21 MR. HOSKINS: I would like to -- first of
22 all, I say thank you to that. I'd also like to
23 mention that, you know, the district is committed to
24 making smart investments. We're investing about
25 $5 billion right now and removing SSO, sanitary

1 sewer overflows, and reducing combined sewer
2 overflows. We have substantial operating plans and
3 improvement plans for our treatment plants. We're
4 about to undergo substantial investment in our
5 emission equipment at our Bissell and Lemay
6 facilities. We spend a lot of money, and we spend
7 money where it's smart, but this is one of those
8 cases where it's just not smart to spend the money
9 for this.
10 MR. REECE: Well, you're under a consent
11 order from EPA over the next -- what is it, 26
12 years?
13 MR. HOSKINS: That's correct. Actually,
14 it's been extended by five years, so it'll be -- the
15 final consent decree will be -- projects will be
16 executed in.
17 MR. REECE: And you're going to spend
18 $5 billion.
19 MR. HOSKINS: Correct.
20 MR. REECE: And, you know, to use your
21 money wisely -- I mean, you've got far more issues
22 than what's being presented here within the MSD
23 collection system, combined sewer overflows, and I
24 just -- I think it's great what you're doing.
25 MR. HOSKINS: Thank you. I appreciate it.

1 MR. ROWLAND: What are the population
2 demographics, I guess, in the last 20 or 30 years?
3 MR. HOSKINS: In the last 20 or 30 years?
4 So St. Louis County has about 1 million residents,
5 and St. Louis City about 300,000 residents
6 currently. Both the city and the county in recent
7 years has seen population decline, mostly to my
8 friends in Jefferson County or to St. Charles
9 County, where they are seeing growth, and that's
10 part of this, is that there is -- in order to deal
11 with the growth -- that the growth that's going to
12 happen in Jefferson County, specifically. You know
13 from a northeast standpoint -- I don't want to speak
14 for northeast, but I've heard Bob say this before,
15 is that, you know -- and this is actually documented
16 in a report as well, is that, you know, not having
17 spent the money to regionalize their major
18 wastewater treatment facility will allow them to
19 make upgrades in their collection system to take
20 these smaller treatment plants out.
21 And Chris mentioned this earlier. This is
22 a big initiative of the department is trying to
23 encourage these smaller facilities to regionalize
24 with these larger guys and folks like Northeast.
25 There's a reason why this is a Level II continuing

1 authority, so it can have some ability to makes
2 these improvements so that as we have economic
3 growth and as we have population growth in these
4 areas, they can find a good wastewater treatment
5 provider that can responsibly deal with the issue.
6 Any other questions?
7 MS. McCARTY: I would just like to echo
8 Commissioner Reece's support for your efforts and
9 say that -- I would say it is time to move forward
10 and get this approved so that management makes
11 sense. My only other question -- that is not very
12 relevant to the amendment of this.
13 MR. HOSKINS: Ask away.
14 MS. McCARTY: So the tunnel that's being
15 built from Saline Creek to the new lower Meramec,
16 why does it go north?
17 MR. HOSKINS: That part is actually not a
18 tunnel. That part would be a pump station and force
19 main. But I believe -- and Bob, you step in, but I
20 believe that there were two alternatives: One was
21 to build a tunnel straight to the plant, the other
22 was -- because it's a 5-million-gallon facility, it
23 can be pumped. And if you don't have to tunnel
24 100 feet in the ground, there's some substantial
25 cost savings with that, right, and so that was the

1 alignment that hitting -- going to Fenton and
2 hitting the drop shot in Fenton wasn't more
3 cost-effective.
4 MS. McCARTY: Curiosity has been making me
5 wonder.
6 MR. HOSKINS: Good.
7 MS. McCARTY: Thank you.
8 MR. HOSKINS: Thank you.
9 MS. McCARTY: Thank you very much.
10 So the Department will take comments on
11 that and present this back to us.
12 So the Department of Natural Resources
13 will continue to accept comments on this proposed
14 amendment until 5:00 p.m. on May 7. Written
15 comments on the proposed amendment can be submitted
16 online through DNR's Web site under
17 dnr.mo.gov/proposed-rules/welcome.action#open or by
18 mail at The Department of Natural Resources, Water
19 Protection Program, P.O. 176, Jefferson City,
20 Missouri 65102, Attention Refaat Mefrakis. Contact
21 information and all comments should include
22 commenter's name, e-mail address, and phone number.
23 And on behalf of the Commission, we thank
24 everyone who has put all of the work into this and
25 who has participated in this process at this time,

1 and the hearing is now closed.

2 (The hearing concluded at 11:22 a.m.)

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1 C E R T I F I C A T E

2

3 I, Lisa D. Ballalatak, a Certified Court
4 Reporter for the State of Missouri, do hereby certify
5 that I appeared at the time and place first
6 hereinbefore set forth, that I took down in shorthand
7 the entire proceedings had at said time and place, and
8 that the foregoing constitutes a true, correct, and
9 complete transcript of my said shorthand notes.
10 Witness my hand and seal this 14th day of May
11 2019
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16 Certified Court Reporter
17 State of Missouri
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A

a.m 3:1 26:2
abating 21:13
ability 24:1
accept 25:13
accepted 7:7
accommodate 17:4
Act 8:8,15
action 3:22
activities 5:19
additional 18:8
address 25:22
addressed 5:14
addressing 18:21
aerobic 20:1
aerobically 20:2
affluent 21:9
aged 18:20
ago 21:7
agreement 10:4
agreements 9:18
ahead 7:14
ALARIS 2:12
alignment 6:18 25:1
Allen 2:4
allow 23:18
alternatives 24:20
ambient 14:23 15:10
amend 19:19
amended 13:11
amending 6:17
amendment 3:5 6:21,24 11:12 11:18 12:21 16:13,15,18 20:5,13,19,21 20:21 24:12 25:14,15
ammonia 14:21 14:24 15:2,4 15:10,11,13,14 15:18,19
amount 16:23
annex 9:15
annexed 8:19
annual 15:2
answer 20:25
anticipated 17:9
APPEARANC... 2:1
appeared 27:5
apples-to-app... 17:13
applied 12:11
appreciate 7:2 22:25
appropriate 6:16
approved 5:21 24:10
approving 20:20
April 1:12 13:23
area 4:16 8:9,21 8:24 9:17 10:11 10:20
areas 16:24 24:4
Arnold 10:4,11
Arnold's 10:9
Ashley 2:2
asking 20:20
assessment 15:24 17:15
asset 17:11
Attention 25:20
attributed 18:15 18:16
authorities 8:16
authority 5:23 10:21,22 20:18 24:1
average 13:9 15:1
axis 14:10,12

B

B1 11:19
back 25:11
background 8:12
Ballalatak 2:11 27:3,15
bar 14:4
bars 14:3
based 17:21
basin 4:16 5:6 5:24 8:21 9:13 9:14,16 11:19 12:25 15:23
bed 5:16
began 10:8
beginning 15:7 15:8
behalf 8:1 25:23
believe 11:12 24:19,20
benefit 11:14 20:15
benefits 17:16
big 23:22
billing 16:7
billion 21:25 22:18
biosolid 5:19
biosolids 5:13 6:2 19:17,20 20:1,3
Bissell 19:21 22:5
bit 15:22
blue 14:3,4
Bluffs 2:13
Bob 8:3 23:14 24:19
break 17:24
briefly 17:18
bring 6:17 21:8
bringing 21:18
Broadway 2:13
build 5:15 24:21
Building 1:8
built 18:8 19:18 24:15

C

C 27:1,1
call 9:24 10:6
called 9:9 19:17
capacity 17:3 18:8,11
capital 16:23 17:2,9,15 18:22 19:6
card 3:14
cards 3:13
carried 18:17
cases 18:5 22:8
CCR 2:11,12
center 4:23
Certified 27:3 27:16
certify 27:4
Chair 21:2
challenges 11:13
changed 6:13
Charles 9:5 23:8
chart 13:24 14:10 15:7,17
charter 9:15
chief 4:6
Chris 23:21
cities 9:18,20
city 1:11 9:5 10:4 10:9 23:5,6 25:19
Clark 1:8
Clean 1:7 3:21 5:21 8:8,15 20:22
close 20:8
closed 26:1
Coday 2:3
coli 13:14,20,21 14:9,13,18,19
collected 13:22
collection 5:23 6:1 9:17,22 10:3,9,14 22:23 23:19
Colonial 15:19
Columbia 2:13
combined 22:1 22:23
come 3:16
comes 16:16
coming 15:22
commenced 3:1
commend 21:3 21:16
comment 3:4,12 3:13,14 4:1 20:12 21:3
commenter's 25:22
commenting 3:7
comments 3:8 3:20 7:6,14 20:23 25:10 25:13,15,21
Commission 1:7 3:22 4:14 5:21 20:22 21:19 25:23
Commissioner 24:8
Commissioners 4:5 7:10,23
committed 21:23
common 19:3
commonly 8:2
communication 20:8
communities 8:19
compare 16:7
compared 14:22 16:17 17:7
comparison 17:14 19:8,9
complete 3:16

27:9
completed 6:12 19:20
completing 11:12
component 18:12
components 17:25
concentration 14:13 15:2
concentrations 15:10,11,18,19
concluded 26:2
concludes 6:11 7:4
conclusion 11:16
conditions 6:13 14:12
Conference 1:9
confluence 9:10 12:18
conjunction 4:11
connect 6:10
connected 12:13
consent 22:10 22:15
consistently 13:17
constitutes 27:8
Constitution 8:14
constructed 5:4 10:5
constructing 6:7
Contact 25:20
contemplated 12:16
continue 5:18 9:21 16:8 20:2 20:8 25:13
continuing 5:23 10:21,22 20:18 21:14 23:25
convey 16:23 17:25 18:13
correct 22:13,19 27:8
correlation 14:8
cost 16:7,13,16 16:17 17:7,19 17:21,22 18:9 18:18,22 19:6 19:7,13,15 21:9 24:25
cost-effective 16:4 25:3
council 8:22 20:17
counties 4:24
counts 14:1
county 4:21,22 5:25 8:20 9:5 9:6,6,6,10,14 9:16,19 11:5 12:5,6 20:11 23:4,6,8,9,12
court 2:10 3:18 3:24 27:3,16
create 11:13
created 8:14
Creek 4:12 5:6 5:10,11,17 6:4 8:5 9:14,25 10:1,11,14,22 11:11 12:5,9 13:1 13:7 16:20 18:4,6 19:13 20:2 24:15
criteria 13:21,25 14:1,3,23,24 14:25 15:4,13
CSR 2:11
Curiosity 25:4
current 5:18 6:18 16:15
currently 6:7 13:7 23:6

D

D 27:3,15
daily 13:9
dash 13:25
data 14:6
date 21:8
day 13:6,8,10 17:6 18:10 27:10
deal 7:20 23:10 24:5
debate 3:6
decline 23:7
decree 22:15
deep 12:13
demographics 23:2
department 3:11 3:20 6:24 20:9 23:22 25:10,12,18
design 13:4,4,7 13:8
develop 9:18 11:11
developed 10:4 11:6
developing 8:17
development 20:4
different 14:10 17:25 18:16 19:1,6
digest 20:2
digester 20:1
director 8:3
discharges 10:15 13:19 15:20
disposal 6:6
DISTLER 4:5
distributed 18:2
district 4:11,12 4:13 5:9,11,17 5:18,22 6:3,21 8:2,4,5 9:24 10:1 16:12,20 16:21 18:3 19:14 21:12,23
districts 4:14 9:19,21 10:2,16
DNR 13:17
DNR's 25:16
dnr.mo.gov/p... 25:17
document 11:9 11:18
documentation 6:17
documented 23:15
doing 22:24
dollars 17:20
downstream 15:15,20
draft 6:21
drain 10:11
draw 11:16
drew 8:9
Drive 1:10
drivers 17:12
drop 25:2
dry 14:11

E

E 13:14,20,21 14:9,13,18,19 27:1,1
e-mail 25:22
earlier 20:12 23:21
East-West 4:13 6:20 8:22 20:17
echo 24:7
economic 6:12 10:25 16:14 17:16 24:2
efforts 24:8
either 10:22 12:13
elected 20:10
eliminated 12:20,23
elimination 11:2
emission 22:5
encourage 23:23
ends 19:7
engineering 4:7
entire 27:7
entirety 8:19 9:4
entities 18:16
environmental 6:13
envisioned 4:18
EPA 20:9 22:11
EPA's 14:22
equipment 18:20 22:5
especially 20:10
essence 12:24
estimate 17:19 18:9,18
Eureka 15:18
evaluating 16:16
eventually 12:13
exceedances 14:7
exceeded 13:25 14:4
excellent 21:17
executed 22:16
executive 8:3
existing 5:7 12:15 16:18,21 17:8 18:19 19:11 19:11
expanded 13:8
expect 3:22
expected 3:23
expensive 19:5
expressed 13:21
extended 22:14

F

F 27:1
facilitated 11:2
facilities 5:2,7 5:13 6:2,3,9

10:3 11:4,24 12:10,11,12,19 12:22,25 15:16 16:1,8,9,19 17:8,11 18:19 18:23 19:1,5,11 19:22,23 22:6 23:23
facility 4:20,25 5:1,4,12 6:5,15 9:11 10:6 11:21 11:25 12:3,4,5 12:6,8,17,24 13:1,2,4 16:25 17:6 18:6,9,14 19:4,17,24 23:18 24:22
fact 15:5,14
factors 5:20
far 22:21
February 6:22 6:23
feet 24:24
Fenton 5:3 6:9 12:2,3,9,23 25:1,2
fill 3:14
final 3:22 6:5 22:15
finalize 3:21
Finally 14:21 20:4
financial 21:19
find 24:4
first 3:10 4:4 16:16 17:18 21:21 27:5
five 3:8 11:20,24 22:14
flow 13:7,8,9 14:9,10
flows 13:4 14:11 14:11,11,12,15 14:16,17 17:5,7
fluidized 5:16
focus 9:1
folks 23:24
follow 7:13
Following 3:19
follows 4:4
force 24:18
foregoing 27:8
formed 10:1
forth 17:12,24 18:21 27:6
forum 3:6
forward 3:17 18:17 24:9
found 14:8
foundation 10:25
four 5:7 12:25 16:9
Franklin 9:6
friends 23:8
fully 11:6
further 10:18 15:25 16:3,7 20:15
future 17:12,23 18:21

G

gallon 18:10
gallons 13:6,7 13:10 17:5 18:8
Gateway 4:13 6:20 8:22 20:17
generally 14:16
geometric 13:22,24
Glaize 5:3,9 11:21,25 12:9 13:1,5 16:19
glitch 9:15
go 7:14 16:13 17:18 20:6 24:16
goal 9:3
going 3:10 7:11 8:25 9:24 11:21 16:5 21:11 22:17 23:11 25:1
good 4:5 7:10 7:23,24 16:10 21:20 24:4 25:6
governments 8:16,22 20:17
Grand 5:3,8 11:20,25 12:9 13:1,4 16:19
great 22:24
greatly 19:6
ground 24:24
growth 11:1 23:9 23:11,11 24:3,3
guess 23:2
guys 23:24

H

hand 27:10
handing 19:17
handle 17:6 20:1
handling 19:21 19:24
happen 23:12
HDR 8:6 16:6,11
hear 3:10
heard 23:14
hearing 3:1,2,3 3:5,19 26:1,2
held 6:23 20:11
help 8:12 11:16
Hembrock 8:3
hereinbefore 27:6
high 14:8,17
high-high 14:12
higher 10:21
highest 14:15,18
Hills 15:19
history 8:12 13:16
hitting 25:1,2
home 15:5
hope 11:15
Hoskins 4:2 7:8 7:10,23,25,25 11:24 19:16 21:4,21 22:13 22:19,25 23:3 24:13,17 25:6 25:8
hub 9:12

I

identified 9:7
identify 3:17
II 6:7 23:25
impaired 13:14
impairment 13:15,18
implement 17:23
implications 16:14,14
important 5:20
improved 11:7
improvement 22:3
improvements 24:2
improving 8:18 10:25 11:1
incinerators 5:16
include 25:21
includes 5:6
including 6:14
increase 17:3
independently 19:5
indicated 21:10
indicates 14:18
individuals 3:15
inflation 17:23
information 11:15 21:18 25:21
initiative 23:22
install 19:25
intended 14:25
interceptors 4:21
interim 5:2 6:8 12:10,12
investing 21:24
investment 16:23 22:4
investments 17:15 21:24
invite 3:11
issue 7:12 24:5
issues 3:7 22:21
it'll 22:14

J

Jason 8:4
Jay 4:2 7:8,9,13 7:25 21:1
Jefferson 1:11 4:22,24 5:25 9:6,14,16,19 12:5,6 20:11 23:8,12 25:19
job 21:17,20
John 2:6
July 3:23 20:21
justification 21:13

K

Kansas 2:11
Kimmswick 5:11 12:6,9 13:2,9
know 17:21 18:20 19:3 21:8,10,23 22:20 23:12 23:15,16
known 8:2

L

LaCharrette 1:9
land 11:4
large 20:13
larger 23:24
lead 7:9 13:14,15 13:16,18
left 14:13 15:18
legacy 13:15

Lemay 5:14 19:22 22:5
letter 20:19
level 5:22 10:21 10:21 20:18 23:25
leveling 14:18
levels 14:9,21 15:14
Lewis 1:8
life 11:1
limit 3:7
limited 11:14
line 6:10 14:1,3,4
lines 4:15 6:1 18:4
Lisa 2:11 27:3,15
listed 13:13
LITIGATION 2:12
little 15:22 20:14
local 8:16
located 4:24
long-range 11:9
longer 6:16
look 14:21 15:7
looked 14:6
looking 18:2
lot 21:19 22:6
Louis 4:10,21,23 6:20 8:1,9,20 8:23 9:5,5,8 9:10 10:23 11:5 18:3 23:4,5
low 14:11
lower 4:9,16,17 4:19,24 5:2,5 5:8,13,24 6:10 6:15,19 9:13 10:6 11:19 12:3 12:14,17,24 13:2,5,13 15:4 15:15 16:1 17:3 18:1,6,9,13 19:18,24 24:15

M

Madam 21:2
mail 25:18
main 24:19
maintain 9:21 10:14 16:18
maintaining 17:8 18:19 19:11
maintenance 18:24
major 4:21 10:16 11:24 12:19,22 15:16,20,25 16:9 20:15 23:17
making 16:18 21:24 25:4
manage 18:12
managed 9:12
management 5:19 8:17,23 8:24 17:11 24:10
manager 8:5
map 12:15
March 6:25
matter 20:9
mayor 11:20
McCarty 2:2 3:2 7:5,11,17,21 7:24 11:23 21:1 24:7,14 25:4,7 25:9
mean 13:22 22:21
meet 9:3
meeting 1:7 3:23 6:23 20:12,22
meets 14:5
MEFFRAKIS 4:2
Mefrakis 4:6 25:20
mention 21:23
mentioned 10:13 18:7 23:21
Meramec 4:9,16 4:18,19,24 5:3 5:5,8,14,24 6:10,15,19 8:20 9:7,10,13 10:7,17 11:7,14 11:19 12:3,4,14 12:17,18,24 13:2,5,13,13 14:19,22 15:2 15:4,12,15,17 16:1,25 17:4 18:1,6,9,13 19:18,24 20:16 24:15
met 20:10
Metropolitan 4:10 6:21 8:1
mid-range 14:11
middle 7:15,17
miles 4:15,16
milliliters 14:2
million 13:6,7,9 17:5,20 18:2,7 18:10,14,23,24 18:25 19:2,4 19:12,12,15 21:12 23:4
mining 13:16
minute 20:6
minutes 3:8
Mississippi 9:11 10:18 12:4,7,18 17:1
Missouri 1:7,11 2:12,13 8:14 8:23 12:1,2,3 17:1 25:20 27:4,17
Missouri-Ame ... 10:8
modern 11:3
modification 17:16
moist 14:12
moment 7:22
money 22:6,7,8 22:21 23:17
morning 4:5,8 7:10,23,24 8:10 16:10
move 7:6 24:9
moving 15:8
MSD 4:11 5:1,8,8 5:13,15 6:7 8:2 8:13,19 9:12,15 9:18 10:4,5,10 10:12,15,22 11:10,25 12:2 18:3,15 19:14 19:19,23 21:3 21:16 22:22
mussel 14:24 15:4,13
mussels 15:1,6

N

name 4:6 7:25 25:22
Natural 25:12,18
near 9:10 11:25 12:4
nearly 11:6
necessarily 17:22
necessary 19:25
need 16:22
needs 11:9 17:10 18:22
neither 10:15
new 5:15 6:1 13:11 19:25 24:15
Nightingale 1:9
north 24:16
northeast 4:12 5:9,17,21 6:3 8:4 9:23,24 10:13,20 11:10 18:3 19:13,25 23:13,14,24
Northern 4:22
Northwest 16:19
notable 15:6
Notably 10:20
note 15:10 18:25
notes 27:9
notice 6:22,25 7:1
number 9:8 25:22

O

O&M 18:25
obviously 18:11
occasionally 14:7
occur 17:24
occurred 14:16
occurring 14:8
October 13:23
Office 1:8
officials 20:10,11
okay 7:6,21 11:21 19:16
online 25:16
operate 10:14,16 16:9 19:5
operates 10:2,9
operating 13:17 22:2
operation 10:7 18:23
operational 17:2 18:12
opportunity 3:4 3:12 5:25 7:2 16:12
order 22:11 23:10
original 6:14 16:17,21 17:19 19:10 21:6
outreach 20:7
overall 19:7
overflows 22:1 22:2,23
owns 10:2,9

P

p.m 25:14
P.O 25:19
packet 11:18
Park 12:1,1
part 23:10 24:17 24:18
participated 25:25
passage 8:15
Patricia 2:5
people 20:14
percent 14:17 15:12
periodically 21:8
permits 13:17
perspective 13:3
Phase 6:7
phone 2:14 25:22
place 27:5,7
placed 6:21,24
plan 4:9,17 5:1 6:12,17,22 8:8 8:24,25 9:3,7 9:9 10:7,15,23 11:8,9,13 12:12 13:11,12 16:15 17:4,9 19:16,19 19:20 20:4,13 20:21 21:5,6,11 21:13,18
planning 4:13 8:16 11:9 19:25 20:2
plans 5:15 8:17 12:8 21:7 22:2 22:3
plant 6:10 12:14 19:18 24:21
plants 10:17,19 11:3,20 13:5 19:23 22:3 23:20
please 3:14,15 3:17 4:1
Point 19:22
political 8:13 10:24
pollutants 13:14
population 23:1 23:7 24:3
portion 8:20
portions 9:16
practically 18:15
prepared 4:10 8:22 20:24 21:6
present 2:8 3:17 4:8 7:2 11:15 21:11 25:11
presentation 7:16,18 9:2 16:6
presented 3:20 12:16 22:22
priority 9:8
problem 13:15 14:19,20,20
proceedings 27:7
process 16:13 20:4,5,5 25:25
processing 4:23 6:5
program 4:7 25:19
projects 17:9 22:15
proposal 8:7
proposed 3:5 6:24 7:3 9:18 14:23 15:3,13 25:13,15
proposes 5:5 5:12
proposing 12:21 21:14
protect 16:2
protection 4:7 25:19
protective 13:12 14:25
provide 3:3,4 4:20 5:23 8:12 11:13
provided 5:25 10:24
provider 24:5
provides 6:16
public 3:2,3,4,11 3:19 4:12,12 5:9,11,17,18,22 6:3,22,23,25 7:1,6 8:4,5 9:23,25 16:19 16:20 18:3 19:14 20:5,6 20:12,12
pump 12:14,20 18:5,5 24:18
pumped 24:23
purpose 3:3
put 25:24
putting 19:3

Q

quality 8:18,23 9:4 10:25 11:1 11:7,14 13:12 14:6,23 15:11 16:2 20:14 21:9
question 16:3 24:11
questions 7:5 20:25 21:1 24:6

R

R 27:1
realize 19:14
reason 23:25
recall 13:20 19:3
recommenda... 3:21 19:10 21:11
recommenda... 6:14 16:17,22 17:14,19
recommended 5:2 16:15
records 3:16
reducing 22:1
Reece 2:6 21:5 22:10,17,20
Reece's 24:8
Refaat 4:2,6 25:20
refer 8:25 11:17
referred 12:10 14:24
regard 13:20 19:19 21:9
regimes 14:11
region's 9:8
regional 4:18 4:22 5:3,7,10 6:4 8:16 9:9,11 10:5 12:25 16:8 19:17,22
regionalization 6:1 10:23 15:25 16:3 20:15
regionalize 10:19 23:17,23
regulatory 17:12 18:21
related 13:15
relevant 5:20 24:12
remain 6:25 12:19
remember 19:2
removal 17:13
removing 21:25
repeat 3:8
replaced 11:3
report 23:16
reporter 2:10 3:18,24 27:4 27:16
request 4:8 5:5 5:22 6:11,16 7:3
require 18:7
requirement 17:2
requirements 17:11
residents 23:4 23:5
resolution 3:6
Resources 25:12,18
respect 15:9
responsibly 24:5
result 6:8
resulting 19:7
review 3:20
revise 4:8
revision 4:10
right 15:9 17:10 21:25 24:25
river 4:9 8:20 9:7,8 10:18 11:7,14 12:7,18 13:13,13 14:22 15:2,4,17 17:1 20:16
Rivers 9:11
Riverside 1:10
road 21:14
Rock 4:12 5:6,11 5:17 8:5 9:13 9:25 10:1,11,13 10:22 11:11 16:20 18:4,6 19:13 20:1
Rooms 1:9
Rowland 2:4 23:1
running 19:1

S

Saline 6:4 12:5 12:9 13:1,6 24:15

sample 14:9,14
samples 13:22
sanitary 21:25
save 21:11
savings 19:7,13 19:15 24:25
seal 27:10
seasonal 13:24
Section 8:8
see 13:24 14:2 14:10 15:21 17:10
seeing 23:9
seen 23:7
Seger 8:4
sense 20:13 21:19 24:11
sensitive 15:1,6
serve 4:14 19:22
served 5:6 11:19 12:25
service 5:22 8:21 9:13,17 10:20 16:24 19:14
services 2:12 4:20 5:24 10:24
set 27:6
sewage 5:23
sewer 4:11,12,13 4:15,20 5:9,11 5:16,17,18 6:3 6:21 8:2,4,5 9:19,20,21,23 9:25 10:2,16 16:20,20 18:3 22:1,1,23
sewers 10:11,12
short 8:9
shorthand 27:6 27:9
shot 25:2
side 14:13 15:18
sign 3:16
significant 16:23
similar 13:6
single 6:14
site 25:16
situation 6:18
size 13:3
sludge 4:23 5:16
small 10:10
smaller 6:2 10:19 23:20 23:23
smart 21:24 22:7,8
solids 19:24
sort 7:19
southern 4:21 5:10 11:5
speak 8:7 23:13
species 15:1,5
specifically 23:12
spend 22:6,6,8 22:17
spent 23:17
spokesperson 8:10
square 4:15
SSO 21:25
St 4:10,21,23 6:20 8:1,9,20 8:23 9:5,5,5,8 9:10 10:23 11:5 18:3 23:4,5,8
staff 7:12
Stan 2:3
stand 4:1
standards 9:4 14:5
standpoint 23:13
start 8:11
state 1:8 8:13 9:3 27:4,17
stated 13:17
states 8:17
station 24:18
stations 12:14 12:20 18:5
staying 21:17
step 11:22 24:19
Stober 4:3 7:8 7:15,19 8:6 16:6,10,11
stormwater 14:20
straight 24:21
straw 8:9
stream 14:9,15
Study 8:24
subdivision 8:13
submitted 25:15
substantial 22:2,4 24:24
successful 11:8
Suite 2:13
support 16:12 20:19,20 24:8
supporting 6:16
swear 3:24
sworn 4:4
system 4:9,18 4:19 5:5,14 6:15,19 9:9,17 10:10 18:1 22:23 23:19
systems 9:22 10:3,14

T

T 27:1,1
Tab 11:18
tag-team 7:20
take 3:22 18:4 20:6 23:19 25:10
taken 20:7
tasked 8:17
technical 6:12 7:12
testified 4:4
testify 3:25
testimony 3:8 3:10,17 7:4
thank 7:4,5 21:4 21:22 22:25 25:7,8,9,23
thankful 7:12
thing 18:25
think 21:12,17 22:24
Thomas 2:5
three 4:14 5:2 16:19,24 19:1
time 7:14 11:6,10 11:10 14:17 24:9 25:25 27:5,7
times 13:25
today 3:19 5:4 8:3,7,11 9:1 10:8,16 11:5,16 11:19 12:22 15:14 16:9 21:15
top 14:1 21:17
total 17:20 18:24 19:9
transcript 27:9
transported 6:4
treat 9:19 10:5 18:13
treated 10:12
treatment 4:19 4:20,25 5:7,8 5:10,12,15 6:2 6:5,9 8:24 9:9 10:3,6,7,15,17 10:19 11:3,4,20 11:21,25 12:2 12:10,24 15:16 16:1,25 17:4 20:16 22:3 23:18,20 24:4
treats 10:10
Trent 4:3 7:8,13 8:6 16:6,11
true 27:8
trying 23:22
tunnel 5:4 6:8 24:14,18,21,23
tunnels 12:13 12:20
turn 16:5
turning 12:7
two 3:12 10:16 13:14 24:20

U

uncommon 21:7
undergo 22:4
understand 14:7
unnecessary 16:2
unrelated 13:18
update 17:10 21:7
updated 11:10
updating 18:19 18:22 19:20 21:5,10
upgrade 17:3,6
upgrades 23:19
upstream 15:15
use 22:20
utilities 19:9

V

Valley 12:1,1
versus 17:15 19:10

W

wait 7:21
want 23:13
wanted 20:6
wasn't 25:2
wastewater 4:18,19,25 5:8 5:10,12,15 6:4 6:9 9:12,20 10:5,7,10,17,19 10:24 11:2,4 11:20 12:2,23 13:19 14:20

15:16,20,25 16:8,24,25 17:4,7 18:1,5,12 20:16 23:18 24:4
water 1:7 3:21 4:7 5:21 8:8,15 8:18,23 9:4 10:8,25 11:7,14 13:12,22 14:6 14:23 15:11 16:2 20:14,22 25:18
watershed 4:16 13:16
way 15:8
we'll 10:6
we're 3:10 8:12 18:1 20:19 21:24 22:3
We've 16:11 20:11
Web 25:16
western 11:5
Wide 8:24
wisely 22:21
wishing 3:25 4:1
Witness 27:10
wonder 25:5
work 6:1 7:11 10:18 25:24
worked 11:11
worth 14:2
written 11:13 25:14
wrote 20:18

X

X 14:10

Y

Y 14:12
Yeah 7:19 11:23
year 13:23 20:12
years 14:2 15:3 21:6 22:12,14 23:2,3,7

Z

0

1

1 23:4
1,400 4:15
10 14:17 15:12
100 24:24
11:22 26:2
110 18:24 19:2
1101 1:10
113 19:15
12 6:23
120 18:10
1336 2:12
147 18:25
14th 27:10
1670 2:11
17 19:12
170 4:15
176 25:19
1954 8:14
1968 15:8
1972 8:15
1977 8:19
1978 4:17 6:12 8:21 12:16
1979 9:23
1985 5:1
1997 13:25

2

2 5:7,22 10:21
20 13:6 23:2,3
2007 10:8
2008 15:8
2009 15:7,9,21
201 2:13 5:1
2013 14:22
2015 5:21
2018 15:21 17:20,22
2019 1:12 3:23 6:23,23,25 7:1 27:11
2025 6:10
208 4:9,17 6:11 6:17,22 8:8,24 9:3,7 10:23 11:9,12 12:12 12:15,16 13:11 16:12,22 17:14 17:19 19:10,16 19:19 20:4,21 21:5,6
210 18:2
250 21:12
2511 2:13
253 19:12
26 22:11
29 6:25
29th 1:12

3

30 17:5 18:7 23:2,3
300,000 23:5
37 18:23

4

4 13:7 18:10
40 21:6
400 17:20
426 14:1
449-0561 2:14
4th 6:22

5

5 13:9 21:25 22:18
5-million-gallon 24:22
5:00 25:14
573 2:14

6

60 11:2
65101 1:11
65102 25:20
65201 2:13

7

7 7:1 25:14
73 18:14 19:4
78 12:17

8

9

9:47 3:1

Missouri Clean Water Commission Meeting
Elm Street Conference Center
Bennett Springs / Roaring River Conference Room
East Elm Street
Jefferson City, Missouri

July 22, 2019

Director's Update

Issue:

Routine update to the Commission

Recommended Action:

Information only.

Missouri Clean Water Commission Meeting
Elm Street Conference Center
Bennett Springs / Roaring River Conference Room
East Elm Street
Jefferson City, Missouri

July 22, 2019

Public Hearing

Issue:

This portion of the meeting allows for information to be presented to the Commission.

Recommended Action:

Information Only

List of Attachments:

None

Elm Street Conference Center
Bennett Springs / Roaring River Conference Room
1730 East Elm Street
Jefferson City, Missouri

July 22, 2019

Recommended for Adoption and Actions to Be Voted On

Issue:

This portion of the meeting allows for the Commission to review and vote on specific actions.

Recommended Action:

It is recommended that the Commission review and vote on the actions presented

List of Attachments:

None

Missouri Clean Water Commission
Department of Natural Resources
Elm Street Office Building
Roaring River/Bennett Springs Conference Rooms
1730 East Elm St.
Jefferson City, Missouri 65102

July 22, 2019

Proposed Amendments to 208 Plan for the Lower Meramec Basin

Issue: The St. Louis Metropolitan Sewer District (MSD), the Northeast Public Sewer District (NPSD), and the Rock Creek Public Sewer District (RCPSD), along with the East West Gateway Planning Commission requested an amendment to the existing 208 Plan which was finalized in 1978.

Background: Section 208 of the Clean Water Act required that Regional Water Quality Management Plans be developed to control water pollution from point and non-point sources in a defined geographic area. In 1975 the Governor of Missouri designated the East-West Gateway Council of Governments (EWGCOG) as the agency responsible for preparing the Water Quality Management Plan for the St. Louis Area, including the City of St. Louis and the counties for Franklin, Jefferson, St. Charles and St. Louis. The federal rules allow plans to be updated to reflect changing water quality conditions, results of implementation actions, new requirements, or to remove conditions in prior conditional or partially-approved plans (40 CFR 130.6).

The Department public noticed the proposed amendment March 29, 2019 through May 7, 2019. A public hearing was held at April 29, 2019 Clean Water Commission meeting, with Mr. Jay Hoskins, MSD, and Mr. Refaat Mefrakis, with the Department testifying in support of the amendment. No written comments were received on the amendment during the public notice process.

Upon Clean Water Commission approval in accordance with RSMO 644.141. 1A(1) (a), the updated plan must be certified by the Governor before submittal to the Environmental Protection Agency (EPA).

Recommended Action: The Department recommends that the Clean Water Commission vote to approve the Amendment to the 1978 St. Louis, Missouri Water Quality Management 208 Plan.

Attachment

Amendment to the 1978 St. Louis, Missouri Water Quality Management 208 Plan

Lower Meramec River Basin

March 15, 2019

Prepared by

Metropolitan St. Louis Sewer District
Northeast Public Sewer District
Rock Creek Public Sewer District

Executive Summary

In 1978, pursuant to Section 208 of the Clean Water Act, East-West Gateway Council of Governments (EWGCOG) completed the St. Louis, Missouri Regional Water Quality Management Plan (hereinafter referred to at the 208 Plan). The goal of the 208 Plan was to meet State water quality standards throughout entirety of St. Louis City and County, St. Charles County, Franklin County, and Jefferson County. The 208 Plan also identified the Meramec River as the region's number one priority river, deserving protection as a drinking water source and because it is biologically diverse and contains important habitat.

The 208 Plan recommended controls to address point and nonpoint sources of pollution and residual waste management throughout the four-county planning area. Within the Lower Meramec Basin, the plan called for a regional secondary treatment system in St. Louis County near the confluence of the Meramec and Mississippi River. This regional facility was to be managed by the Metropolitan St. Louis Sewer District (MSD) and provide services for the Lower Meramec System, which consists of the Lower Meramec Basin (southern St. Louis County and northern Jefferson County) and the entire Rock Creek Basin in Jefferson County. The 208 Plan also recommended designating this facility a regional sludge processing center.

These recommendations were based on an evaluation of cost-effectiveness, water quality effectiveness, management and institutional constraints, and environmental considerations. Since 1978 however, the technical, economic, and environmental conditions have changed and some of the original recommendations are no longer appropriate. The 208 Plan recognizes that updates to the plan may be necessary noting that it "is not a static list of recommendations but represents a dynamic and progressive policy for guiding future wastewater construction activities." Federal regulations (40 CFR 130.6) also allow plans to be updated to reflect changing water quality conditions, results of implementation actions, new requirements, or to remove conditions in prior conditional or partially-approved plans.

This report provides support for amending the 208 Plan to bring it into alignment with the current situation in the Lower Meramec Basin. The analyses justify the following amendments:

- It is more cost-effective to maintain existing facilities ($147 million) within the Lower Meramec System than to construct a single regional WWTF ($400 million). Further, a single regional WWTF is not necessary to meet state water quality standards in the Lower Meramec River. Therefore, the Lower Meramec System should instead be served by four WWTFs: Lower Meramec WWTF, Grand Glaize WWTF, Saline Creek Regional WWTF, and Kimmswick WWTF.
- Due to environmental and management considerations, it is not feasible for the Lower Meramec WWTF to serve as a regional sludge processing center. The plan should be revised to recognize that sludge processing for MSD facilities in the Lower Meramec System will be addressed at the Bissell Point WWTF or Lemay WWTF; the Northeast Public Sewer District and Rock Creek Public Sewer District will continue their current management activities.

Contents

Executive Summary i

1. Introduction 1
   1.1. Lower Meramec System 2
   1.2. MSD's 201 Facility Plan for the Lower Meramec River Basin 3
   1.3. Report Objectives 1

2. System Updates in the Lower Meramec System 2
   2.1. Metropolitan St. Louis Sewer District (MSD) 2
      2.1.1. Lower Meramec WWTF 2
      2.1.2. Grand Glaize WWTF 3
      2.1.3. Fenton WWTF 3
      2.1.4. Future Plans for MSD WWTFs in the Lower Meramec Basin 4
      2.1.5. Collection System Improvements 4
   2.2. Northeast Public Sewer District (NPSD) 5
      2.2.1. 2010 Facility Planning Efforts 5
      2.2.2. Saline Creek Regional WWTF Construction and Upgrade History 6
      2.2.3. Future Improvements 7
   2.3. Rock Creek Public Sewer District (RCPSD) 7
      2.3.1. Historical Facility Planning Efforts and Improvements 8
      2.3.2. Identified Future Improvements 9

3. Meramec River Water Quality Evaluation 10
   3.1. 208 Plan Water Quality Goals 10
   3.2. Existing Water Quality Conditions 10
      3.2.1. Lead 11
      3.2.2. Bacteria 11
      3.2.3. Ammonia 12
   3.3. WWTF Performance for Major Facilities Discharging into the Lower Meramec River 14
      3.3.1. Grand Glaize WWTF Performance 14
      3.3.2. Fenton WWTF Performance 14
      3.3.3. Saline Creek Regional WWTF Performance 15

4. Proposed 208 Plan Amendments 16
   4.1. Lower Meramec System Point Source Amendments 16
   4.2. Lower Meramec Regional Center Sludge Management Amendments 19
      4.2.1 MSD Sludge Management 19
      4.2.2 NPSD Sludge Management 20
      4.2.3 RCPSD Sludge Management 20
   4.3. Summary of Public Information Process 21
   4.4. Summary of Proposed Amendments 21

Tables

Table 1. Proposed Permanent WWTFs in the Lower Meramec System. 16
Table 2. Comparison between Costs to Implement Original 208 Point Source Recommendations and Costs to Maintain Existing Facilities in the Lower Meramec System..... 18

Figures

Figure 1. 208 Planning Area for the St. Louis Region. 1
Figure 2. Lower Meramec System as Identified in the 208 Plan and Interim WWTF Outfalls and Tunnel Identified in 201 Plan. 4
Figure 3. Average (Geometric Mean) Recreational Season (April – October) *E. coli* Levels in the Meramec River at Paulina Hills (1997-2016). 11
Figure 4. Distribution of Average (Geometric Mean) Recreational Season (April – October) *E. coli* Levels by Flow Regime in the Meramec River at Paulina Hills (2005 – 2018). 12
Figure 5. Average Annual Ammonia in the Meramec River at Paulina Hills (1968 – 2018). 13
Figure 6. Average Annual Ammonia Levels in the Meramec River at Eureka (Upstream of the 201 Planning Area) and Paulina Hills (Downstream of Major WWTFs in the 201 Planning Area)..... 13
Figure 7. Proposed 208 Plan Amendment for the Lower Meramec System. 17

Attachments

Attachment A. Process and Proposed Schedule for Updating the 208 Plan.

Attachment B. Summary of Water Quality Management Plan Elements Required by 40 CFR 130.6(c).

1. Introduction

Section 208 of the Clean Water Act (CWA) requires that Regional Water Quality Management Plans be developed to control water pollution from point and nonpoint sources in a defined geographic area. In 1975, the Governor of Missouri designated the East-West Gateway Council of Governments (EWGCOG) as the agency responsible for preparing the Water Quality Management Plan for the St. Louis area, including the City of St. Louis and the counties of Franklin, Jefferson, St. Charles and St. Louis (Figure 1).

The St. Louis, Missouri Regional Water Quality Management Plan[1] (hereinafter referred to at the 208 Plan) was subsequently completed in 1978. The objective of the 208 Plan was to ensure that the water quality of rivers and streams of the St. Louis area meets state standards and that the negative effects of growth on water quality be kept to a minimum. The 208 Plan also identified the Meramec River as the region's number one priority river and watershed area, deserving protection as a drinking water source and because it is biologically diverse and contains important habitat.

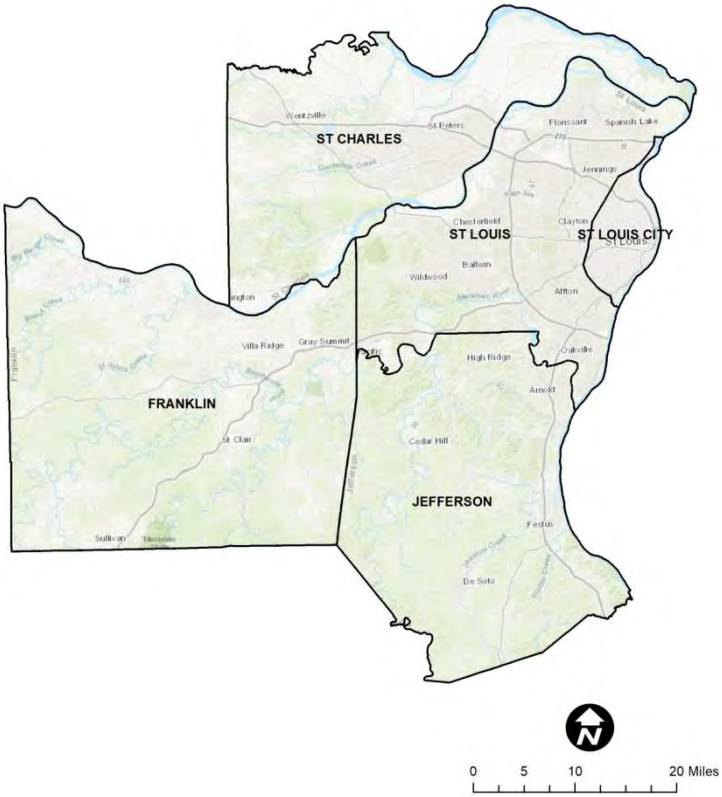


Figure 1. 208 Planning Area for the St. Louis Region.

The 208 Plan proposed multiple control alternatives, with each alternative evaluated using four major criteria: 1) cost-effectiveness, 2) water quality effectiveness, 3) management/institutional constraints, and 4) environmental considerations. After evaluation against these criteria, the best of the alternatives at the time was chosen as a goal for the region. The 208 Plan included a mixture of structural and non-structural control alternatives to address point sources, nonpoint sources, and residual waste (sludge) throughout the four county region, which are summarized as follows:

- *Point sources* – The 208 Plan delineated 40 service area recommendations across the four county planning area and identified a number of secondary wastewater treatment

[1] East-West Gateway Coordinating Council (EWGCOG). 1978. St. Louis, MIssouir Water Quality Management Plan: Areawide Waste Treatment Management Study (208). St. Louis, Missouri. https://www.ewgateway.org/wp-content/uploads/2017/07/208Rpt-Part1.pdf

facilities (WWTF) to serve as regional treatment facilities within each of the service areas.

- *Nonpoint sources* – The 208 Plan recommended nonpoint source control measures for each of the four counties in the planning area. Controls addressed both individual home treatment systems (septic systems) and urban stormwater runoff. Recommendations for septic systems included design and operational guidelines and implementation measures. Recommendations for urban stormwater runoff were divided into three categories of control designed to address the quantity and quality aspects of urban runoff. These include control of stormwater runoff, onsite detention, and urban cleanliness programs.

- *Sludge management* – The 208 Plan delineated 14 regional sludge processing centers across the four county planning area.

Since the 208 Plan was completed in 1978, the technical, economic, and environmental conditions have changed and some of the original recommendations are no longer appropriate. This report and the proposed amendment address updates to the original point source and sludge management recommendations within the Lower Meramec System, which is one of 40 areas defined by the 208 Plan. Information regarding the Lower Meramec System, MSD's 201 planning efforts, and objectives of the current report are discussed in the remainder of this section.

1.1. Lower Meramec System

The Lower Meramec System is one of 40 service areas delineated within the St. Louis 208 planning region. The Lower Meramec System of the 208 Plan included the Lower Meramec Basin (southern St. Louis County and northern Jefferson County) and the entire Rock Creek Basin in Jefferson County (Figure 2). Plan recommendations within the Lower Meramec System were intended to address pressing water quality issues of the time in the Meramec River.

The main recommendation of the 208 Plan for the Lower Meramec System was the construction of a regional secondary treatment system in St. Louis County near the confluence of the Meramec and Mississippi River (see pages 62 and 91 of the 208 Plan). The proposed Lower Meramec facility was to be managed by the Metropolitan St. Louis Sewer District (MSD) and provide sewer services via major interceptors for the entire Lower Meramec System. The 208 Plan also recommended that the facility serve as the regional sludge processing center for St. Louis and Jefferson counties (see pages 148-149 and 151 of the 208 Plan). Sludge processing would include the use of dissolved air flotation, anaerobic digestion, and final disposal in twenty year storage lagoons. The plan alternatively considered pumping and hauling residuals from the regional treatment facility to MSD's Lemay WWTF to be incinerated. However, this alternative was ultimately rejected based on the preliminary economic analysis conducted at that time.

Recommendations for a single regional facility within the Lower Meramec System to be serviced and managed by MSD never came to fruition. In 1977, MSD annexed the entirety of the St.

Louis County portion of the Lower Meramec River Basin into its service area. By charter, MSD could not annex the Jefferson County portions of the Lower Meramec River Basin, so in 1979 it was proposed that the northern Jefferson County's newly-formed Northeast Public Sewer District (NPSD) contract with MSD for treatment at the proposed regional treatment facility. A similar suggestion was made for the newly-formed Rock Creek Public Sewer District (RCPSD) and the City of Arnold. MSD currently accepts and treats flow from the Arnold Pump Station, but not from NPSD. Nearly all of RCPSD's flow is treated at the Kimmswick WWTF, with a small amount of area ultimately being served (via the Arnold Pump Station) by the Lower Meramec WWTF.

1.2. MSD's 201 Facility Plan for the Lower Meramec River Basin

In conjunction with the 208 Plan, MSD developed the 201 Facility Plan (hereinafter referred to as the 201 Plan) for the Lower Meramec River Basin in September 1979[2] and updated the plan in 1985[3]. Consistent with the 208 Plan, the 201 Plan concluded that the most cost-effective solution to improve water quality in the Lower Meramec Basin was through the consolidation of wastewater treatment to one regional WWTF discharging to the Mississippi River with a major interceptor serving the entire basin. However, for unexpressed reasons, the 201 area was limited to the Lower Meramec Basin and did not include Rock Creek as called for in the 208 Plan.

Additionally, the 201 Plan acknowledged that MSD has no legal or jurisdictional authority for operation within Jefferson County. By charter, MSD's service area boundaries are limited to St. Louis City and St. Louis County. The effect of this is to limit the sewer collection system that MSD is responsible for operating and maintaining to these areas. MSD and Missouri-American Water (the agency that operates Arnold's sewer collection system) have an interagency agreement whereby MSD treats wastewater from the City of Arnold. RCPSD has a similar agreement with Missouri American Water to allow flow through to MSD. NPSD currently maintains authority over most of the Lower Meramec Basin in Jefferson County.

In 1985 when the 201 Plan was updated, MSD recognized that construction of the regional treatment facility and its associated collection system could take significantly longer than anticipated because of decreases in federal funding, and therefore proposed interim solutions. These interim solutions included the construction of three secondary treatment facilities, Grand Glaize, Fenton, and Lower Meramec, within the St. Louis County area of the Lower Meramec River Basin. The intent of the 201 Facility Plan was to phase out the interim treatment facilities upon the construction of the regional facility and the Lower Meramec Tunnel (LMT), which was to be completed in three distinct phases (Figure 2). MSD has since been implementing the 201 Facility Plan recommendations in the Lower Meramec Basin. Details regarding specific actions and progress are discussed further in Section 2.1.

[2] Metropolitan St. Louis Sewer District (MSD). 1979. Final 201 Facility Plan: Lower Meramec River Basin. St. Louis, MO. 462 pp.
[3] Havens and Emerson, Inc. 1985. 201 Facility Plan Update: Lower Meramec River Basin. St Louis, MO. 193 pp.

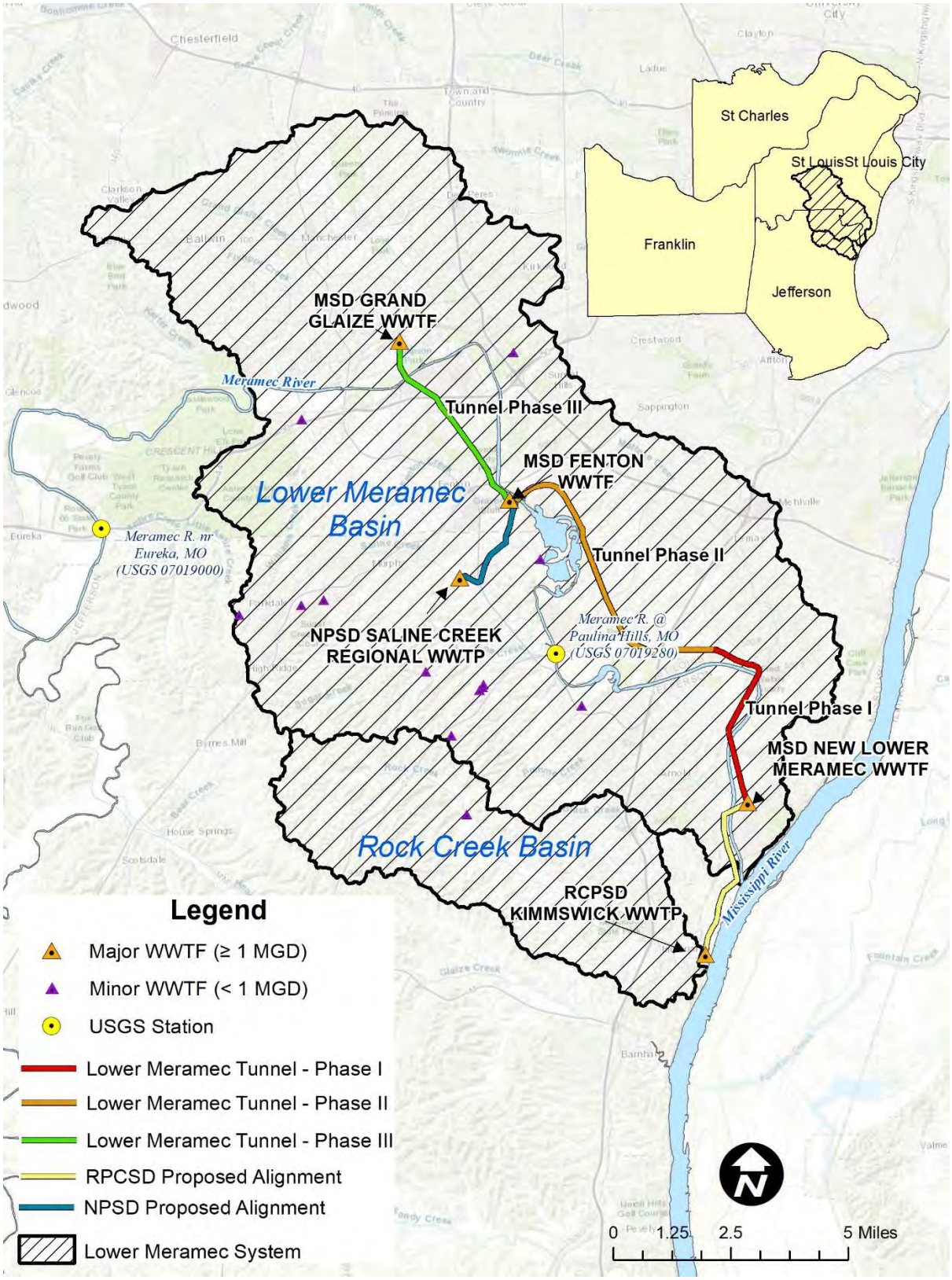


Figure 2. Lower Meramec System as Identified in the 208 Plan and Interim WWTF Outfalls and Tunnel Identified in 201 Plan.

1.3. Report Objectives

As discussed above, the objective of the 208 Plan was to ensure that the water quality of rivers and streams of the St. Louis area meets state standards and mitigate the negative effects of population growth on water quality. Circumstances have changed since 1978 and construction of a single regional treatment facility in the Lower Meramec Basin is no longer necessary to achieve these objectives. Water quality in the Meramec River itself has generally improved and point sources in the Basin currently meet all applicable discharge permit requirements. Remaining water quality challenges in the Basin are primarily related to nonpoint source control issues and cannot be remedied through further point source consolidation.

The original 208 Plan recognizes that updates to the plan may be necessary, noting that it "is not a static list of recommendations but represents a dynamic and progressive policy for guiding future wastewater construction activities." Further, federal regulations (40 CFR 130.6(e)) allow water quality management plans to be updated to reflect changing water quality conditions, results of implementation actions, new requirements, or to remove conditions in prior conditional or partially-approved plans. The process for amending the 208 Plan is included in Attachment A. A summary of necessary plan elements required by 40 CFR 130.6(c), and their relationship to the modifications proposed in this report is included in Attachment B.

The purpose of this report is to amend the 208 Plan recommendation for the Lower Meramec Basin and bring it into alignment with the current situation. The decision criteria used to evaluate alternatives and develop recommendations in the original 208 Plan were

- Cost-effectiveness,
- Water quality effectiveness,
- Management and institutional constraints, and
- Environmental considerations.

These same criteria are applicable in the context of the current situation and support the need to amend some of the original 208 Plan recommendations for the Lower Meramec Basin. It is important to note that the proposed amendments in this report only address one point source service area (identified as the Lower Meramec System in the 208 Plan) and one regional sludge processing center (identified as the Lower Meramec Regional Center in the 208 Plan). The proposed amendments do not impact point source, nonpoint source, or sludge management recommendations for the remainder of the four-county planning area.

2. System Updates in the Lower Meramec System

Wastewater treatment and planning efforts of the three regional control authorities responsible for the Lower Meramec System are discussed below. These include MSD, NPSD, and RCPSD.

2.1. Metropolitan St. Louis Sewer District (MSD)

MSD incorporated the entirety of the St. Louis County portion of the Lower Meramec River Basin in 1977, inheriting hundreds of miles of sewers and over sixty treatment plants, most of which were small, overburdened, and failing due to construction under limited to no regulation. Much of the inherited collection system was old and inadequately sized for future development. MSD shaped its goals for the Lower Meramec River Basin around rehabilitating, maintaining, and improving this inherited collection system and eliminating numerous treatment plants.

Through the use of its sewer use ordinance, MSD has been able to regulate dischargers within its service area in order to protect the sewer system, treatment processes, residuals management processes, and receiving waters. MSD has a variety of regulatory abilities including requiring connection to the MSD system, connection permitting, pretreatment limits, effluent monitoring, and reporting requirements. These regulatory abilities have given MSD the opportunity to eliminate nearly all of the inherited treatment plants and replace them with three well operated treatment facilities, as well as to rehabilitate much of its collection system.

In 2012, MSD entered into a Consent Decree with the United States EPA (EPA), the state of Missouri, and the Missouri Coalition for the Environment Foundation. In this Consent Decree, MSD committed to spending $4.7 billion in order to make infrastructure improvements to the sanitary and combined collection systems.[4] The major improvements to MSD's collection system that the Consent Decree includes are inflow and infiltration (I/I) reduction remediation projects, elimination of all constructed sanitary sewer overflows (SSOs), elimination of all known SSOs, and elimination of building backups. These efforts have and will continue to make a significant impact in ensuring that the Lower Meramec River Basin achieves Clean Water Act goals.

Since the 1985 201 Plan update, MSD has constructed the three recommended WWTFs and made significant progress with respect to maintaining and improving their sanitary sewer collection systems. These activities, as well as planned future WWTF modifications, are described below.

2.1.1. Lower Meramec WWTF

The Lower Meramec WWTF was constructed in 2007 with a design flow of 15 million gallons per day (MGD) and a peak hour design capacity of 40 MGD. Currently, the facility has an average dry weather daily flow of 11 MGD, which includes wastewater flows from the City of Arnold, and discharges to the Mississippi River (Figure 2). MSD intends to expand the Lower

[4] *United States of America and the State of Missouri, and Missouri Coalition for the Environment Foundation v. Metropolitan St. Louis Sewer District*, No. 4:07-CV-1120-CEJ, The original Consent Decree required improvements over a twenty-three year period. In 2018, the parties agreed to modify the duration of improvements to twenty-eight years.

Meramec WWTF to accommodate additional flows from the Fenton WWTF when it is eliminated. The Lower Meramec WWTF is currently served by a 31 square mile sanitary sewer collection, consisting of approximately 1.75 million feet of public sewers and 34 active pump stations owned and maintained by MSD.

The Lower Meramec WWTF uses sludge grit removal, gravity sludge thickeners, sludge belt filter presses, and cake storage hoppers for sludge management, and produces approximately 2,000 dry tons of sludge annually. MSD currently hauls its sludge from the Lower Meramec WWTF to MSD's Bissell Point WWTF for incineration or to the IESI Champ Landfill to be landfilled.

2.1.2. Grand Glaize WWTF

In an effort to improve wastewater treatment in the Lower Meramec River Basin, MSD constructed the Grand Glaize WWTF in 1986 and expanded the facility in 2006. This expansion resulted in an average design flow of 21 MGD and peak hour design capacity of 40 MGD. In addition to the treatment capacity directly available, the facility can store influent flows above 40 MGD in its 49.7 million gallon wet weather storage lagoon. The Grand Glaize WWTF discharges to the Meramec River (Figure 2). The Grand Glaize WWTF serves a 45 square mile sanitary collection system consisting of approximately 3 million feet of public sewers, with pipe diameters ranging from 6 to 54 inches. The collection system also includes 20 active pump stations owned and maintained by MSD.

The Grand Glaize WWTF uses gravity sludge thickeners and belt filter presses for residuals management and produces approximately 3,000 dry tons of sludge annually. MSD hauls its residuals from Grand Glaize to MSD's Bissell Point WWTF for incineration or to the IESI Champ Landfill to be landfilled.

2.1.3. Fenton WWTF

The Fenton WWTF was constructed in 1987. This facility has a design flow of 6.75 MGD and currently has an average dry weather daily flow of 4.85 MGD that discharges to the Meramec River. The Fenton WWTF currently discharges to the Meramec River but MSD anticipates taking it offline and sending flows to the Lower Meramec WWTF once Phase II of the LMT is complete (Figure 2). The Fenton WWTF has a 19 square mile sanitary collection system consisting of approximately 850,000 feet of public sewers. The Fenton collection system also includes 21 active pump stations owned and maintained by MSD.

The Fenton WWTF uses a gravity sludge thickener and a sludge belt filter press for residuals management and produces approximately 1,000 dry tons of sludge annually. MSD hauls its residuals from the Fenton treatment facility to MSD's Bissell Point treatment facility for incineration or to the IESI Champ Landfill to be landfilled.

2.1.4. Future Plans for MSD WWTFs in the Lower Meramec Basin

MSD plans to expand the Lower Meramec WWTF to accommodate future flows from the offline Fenton WWTF. This expansion is scheduled to be completed in 2023. The Fenton WWTF facility is currently scheduled to be taken offline in 2025 once the Phase II LMT extension is complete.

The Grand Glaize WWTF will continue to operate, as the treatment facility has more than enough capacity to accommodate future flows and has demonstrated continual high-quality treatment. MSD is also planning to spend $2.75 million for additional flood protection infrastructure, including earthen berms and a floodwall. This work is important for making the Grand Glaize maintenance yard and treatment facilities more resilient to regional flooding created by the Meramec River.

As described further herein (see Section 3.1.1), MSD is planning major improvements to its sewer sludge incineration facilities at the Lemay WWTF and Bissell Point WWTF. MSD estimates $340 million is needed to replace its sewer sludge incinerators with fluidized bed incinerator technology that substantially reduces emissions. MSD estimates an additional $50 million is needed for pumping stations and piping needed to transport sludge from the Meramec basin facilities to the Lemay WWTF.

2.1.5. Collection System Improvements

MSD has taken significant steps to study and characterize its collection system in order to identify the best strategy to maintain and rehabilitate the collection system. In 2013, MSD produced sewer system evaluation surveys (SSES) for the following watersheds: Fenton Creek, Lower Meramec Sub Areas, Mattesse Creek, Fishpot Creek, Kiefer Creek, and Grand Glaize Creek. These watersheds make up the entirety of the MSD service area portion of the Lower Meramec River Basin. SSES reports were produced discussing the various aspects of the collection system, including constructed SSO outfalls, known SSOs, building backups, gravity sewers, pump stations, force mains, CCTV inspections, I/I evaluations, and flow and rainfall monitoring,

MSD has made substantial efforts towards maintaining and rehabilitating its collection system. The Capacity, Management, Operations and Maintenance (CMOM) Program Plan is a Consent Decree requirement that allows MSD to better understand how its sewer system works under various conditions, and identifies maintenance and improvements needed to achieve established goals. The CMOM program has been in place since 2012. The goal of the CMOM program is to preserve capital investment while minimizing building backups and non-capacity SSOs. The CMOM program includes the following control measures: scheduled cleaning and inspection of gravity sewers, especially for sewer lines with historic Fats, Oils, and Grease (FOG) blockages; sewer lining to minimize root intrusion and I/I and to prevent structural damage, SSOs, and building backups; manhole inspection, repair, rehabilitation, and replacement; utilization of a computerized maintenance management system; recording, investigating, and resolving customer complaints to correct system problems; CCTV of sewer

lines and manholes to rate the condition; pump station inspections, maintenance, repair, and testing; scheduled force main visual and non-destructive testing; and proactive inspection of FOG generating facilities and source investigation of excessive FOG in sewer lines. These CMOM control measures have target service levels for MSD to maintain, all of which have been consistently met since the program was implemented.

2.2. Northeast Public Sewer District (NPSD)

NPSD was established in 1979 under the provisions of Chapter 204 of the Missouri Revised Statutes and is governed by a five member Board of Trustees appointed by the Jefferson County, Missouri government. The day-to-day operations of NPSD are managed by the Executive Director. As a Chapter 204 Sewer District, NPSD does not levy taxes and receives income from user fees and connection fees. NPSD covers 42.8 square miles of northern Jefferson County, serving over 12,000 customers. NPSD operates and maintains a collection system consisting of 161.5 miles of gravity sanitary sewer, 49 pump stations, 29.78 miles of force mains, 4,948 manholes, and 298 lampholes.

In 1980, the service area of NPSD contained five privately owned sewer companies and 80 permitted wastewater disposal systems. In 1980, and reaffirmed in 1991, NPSD signed a management agreement designating NPSD as a Management Agency for the Northeast Facility Planning Area (FPA) with the boundaries of the FPA conterminous with the boundaries of NPSD. This designation made NPSD responsible for the planning, design, construction, acquisition, operation and maintenance of any public wastewater system with the NPSD service area. In 2015, NPSD was granted Level 2 Continuing Authority classification by the Missouri Clean Water Commission, which permits NPSD to provided sewage collection and service on a regional basis within the NPSD service area. NPSD is currently the only Level 2 Continuing Authority in the Lower Meramec Basin.

Today, there is one privately owned sewer company (Missouri American Water Company), and 14 permitted wastewater disposal systems in the NPSD service area. Four (4) of these permitted systems are NPSD facilities, and NPSD also has a no-discharge pump and haul site.

2.2.1. 2010 Facility Planning Efforts

NPSD completed a comprehensive Facility Plan for the entire collection and treatment system in 2010, with an amendment in 2013. The Facility Plan identified NPSD's future wastewater needs and identified improvements that will support growth within the service boundaries. The Facility Plan recommended the Saline Creek WWTF become a regional facility for NPSD. The plant was designed for an average daily flow of 4 MGD and a peak daily flow of 10 MGD. Provisions were made in the plant design to accommodate expanding capacity to an average daily flow of 8 MGD and a peak daily flow of 20 MGD by adding additional process equipment.

The Facility Plan also recommended to re-rate the Saline Creek Regional WWTF as follows:

1. Design Average Daily Flow = 6.56 MGD
2. Design Maximum Flow = 17.97 MGD
3. Organic Loading BOD5 = 11,341 lb/d
4. Total Suspended Solids Loading TSS = 12,203 lb/d

2.2.2. Saline Creek Regional WWTF Construction and Upgrade History

The Saline Creek Regional WWTF was constructed in two phases with the headworks and overflow basin completed in 2004, and the remainder of the existing facility including lab building, oxidation ditch, clarifiers and UV disinfection system completed in 2009. The WWTF was constructed adjacent to the old Ron Rog plant, which itself was converted to a temporary aerobic digester for the Saline Creek Regional WWTF. In 2017 construction was completed on a new blower building, electrical improvements to the headworks facility to comply with NEC (NFPA 70) Class I, Division 1 requirements, and a new perforated plate screen. The Saline Creek WWTF discharges to the Meramec River (Figure 2).

Biosolids from NPSD's satellite WWTFs are transported to the Saline Creek Regional WWTF for processing and final disposal. The Saline Creek Regional WWTF has an aerobic digester which is a recycled plant from the old Ron Rog WWTF adjacent to Saline Creek Regional WWTF and two (2) biosolids holding ponds. Biosolids are land applied annually by a contractor on fields near Byrnes Mill, MO. The aerobic digester was intended to be a temporary facility until a more in-depth study for improvements to NPSD's biosolids process could be completed.

The Biosolids Facility Plan was completed in February 2014 and NPSD conducted pilot studies on several different types of equipment as part of the development of the plan. The recommendation of the Biosolids Facility Plan was to construct a new aerobic digester with a membrane thickener and continue land application. NPSD applied for a SRF loan ($5 million) to fund most of the cost of the Biosolids project with the remainder to be funded by NPSD's capital improvement fund. NPSD's biosolids project was included in the FY 2019 Intended Use Plan approved by the Missouri Clean Water Commission on October 18, 2018 as a $5 million loan. The project is in final design with anticipated bidding in Spring 2019. The total capital cost of the biosolids project will be approximately $6.4 million.

Between May 2012 and May 2015 NPSD completed $9.75 million in work to eliminate known sources of I/I and regionalize the service area by eliminating eight of NPSD's wastewater treatment facilities. The flow from seven of these eliminated facilities was redirected to the Saline Creek Regional WWTF, and the flow from the remaining facility was redirected to the collection and treatment system of the RPCSD. Approximately $9.3 million of this expenditure was funded by a loan from the State Revolving Fund (SRF) program, with the remainder funded by NPSD revenue.

Some of the work completed during this time period also provided improved access to the public sewer system for unsewered areas of NPSD's service area. Four years ago, NPSD eliminated eight facilities. Of the three satellite facilities remaining, two are in the Antire Valley. Sewering of the Antire Valley will be completed in phases. NPSD staff is currently working on design of Phases 1A and 1B. While Phases 1A and 1B will not consolidate treatment or make sewers accessible to additional properties, it must be completed prior to other phases of the work. Phase 2 will eliminate one WWTF (Walnut Ridge WWTF, MO-0095281), remove two pump stations and make public sewers accessible to a private treatment facility (Pembrooke Apartments, MO-0091359) and numerous homes with onsite systems. Phase 3 will eliminate one WWTF (Antire Springs WWTF, MO-0099252) and makes sewers accessible to the lower Antire Valley because the major infrastructure will be in place. Sewer main extensions may be required by property owners with onsite systems and they would bear the cost for the sewer main to serve their property. The use of sanitary sewer improvement area financing could aid property owners with financing the cost of sewer main extensions.

2.2.3. Future Improvements

In addition to the planned biosolids project and reduction of unsewered areas, NPSD has begun efforts to evaluate and improve their collection system to eliminate sources of I/I, eliminate sanitary sewer overflows and enhance customer service reliability. While the 2010 Facility Plan improved parts of the collection system and removed I/I, this work concentrated on the interceptors of NPSD's collection system. With that work completed, NPSD can concentrate on the collection sewer mains. As NPSD inspects the system, needed improvements will be added to NPSD's capital improvement planning. At this time, it is anticipated that the work identified by NPSD's systemic inspection program will be completed on a pay-as-you-go basis as funding is available.

In addition to NPSD's planning for its existing assets, NPSD is working to improve management of wastewater on a watershed basis. Many areas of NPSD's territory are not served by public sewers. They are either served by on-site (septic) systems or private treatment facilities. NPSD works with MDNR, Jefferson County and residents to facilitate extending public sewer service to these areas. The introduction of the use of SSIAs is one step that aids in the process of extending public sewers to areas with on-site systems by providing a financing mechanism for the construction. NPSD believes that their current efforts and future planning are the best way to regionally manage wastewater collection and treatment in its service area and improve water quality.

2.3. Rock Creek Public Sewer District (RCPSD)

RCPSD was established on August 7, 1979 under the provisions of Chapter 204 of the Missouri Revised Statutes and is governed by a five member board of trustees appointed by the Jefferson County, Missouri government. The day-to-day operations of RCPSD are managed by the RCPSD Administrator. As a Chapter 204 Sewer District, RCPSD does not levy taxes and receives income from user fees and connection fees. RCPSD was designated the management

agency for the Rock Creek drainage area as a result of the 208 Plan. RCPSD had accepted this responsibility by an agreement signed in March 1980.

RCPSD currently owns and operates the Kimmswick WWTF which services the Rock Creek Basins and includes the cities of Arnold, High Ridge, House Springs, Kimmswick and Imperial. RCPSD area contains approximately 32 square miles or approximately 20,750 acres. The RCPSD area is divided into four service areas: Imperial/Kimmswick, New Towne, Seckman Valley, and West Elm Place. RCPSD operates and maintains a collection system consisting of 150 miles of gravity sewer lines, six pump stations, five miles of force main, 5,000 manholes, and 65 grease traps for commercial customers.

RCPSD also owns and operates the Kimmswick WWTF. The facility is a four basin sequencing batch reactor system with UV disinfection and three aerobic sludge digesters. It has a design flow of 4.8 MGD and discharges directly to the Mississippi River. Under an intergovernmental agreement between RCPSD and MSD, RCPSD also collects sewer flows from the Pomme Creek watershed in Arnold and sends them to MSD's Lower Meramec WWTF.

2.3.1. Historical Facility Planning Efforts and Improvements

Since being established in 1979, RCPSD has worked to improve wastewater treatment and eliminate and regionalize small treatment facilities throughout the Rock Creek Basin. Historical facility planning efforts in 1983, 1985, 1993, 2000, and 2009 have focused on cost-effectively consolidating existing facilities while meeting discharge permit requirements.

The Kimmswick WWTF was constructed in 2003 to facilitate regionalization in the watershed. At the time, RCPSD evaluated the cost to build the new treatment facility against the cost to construct sewers and pump to MSD, as outlined in the original 208 Plan. RCPSD found that the new facility was the most cost effective alternative (Table 1). Construction of the new facility led to the elimination of nine smaller WWTFs in the basin.

Table 1. Estimated RCPSD Treatment Alternative Construction Costs Developed during Previous Facility Planning Efforts (in 2000 Dollars).

Project	RCPSD Cost
Original 208 Plan Recommendation - Connect to MSD	
Original 208 Plan Recommendation – Connect to MSD	$26.2 million
Construct Kimmswick WWTF	$16.7 million

Source: Don Daniel, RCPSD District Administrator

In 2009, new permit requirements for disinfection, potential future treatment and collection system improvements, and significant inflow and infiltration reduction challenges necessitated phased upgrades to the Kimmswick WWTF. Upgrades included the addition of a UV disinfection system and the addition of mixers within the existing sequencing batch reactor to achieve partial

nutrient removal in Phase 1. Phase 1 also included improvements to the collection system including elimination of two pump stations, several creek bank stabilizations, sewer relocations, the closure of the Seckman School Lagoon, a significant inflow and infiltration investigation, and manhole lining and rehabilitation. Future Phase 2 improvements may include two additional sequencing batch reactors and the addition of a deep bed sand filter to achieve high effluent quality.

2.3.2. Identified Future Improvements

RCPSD is currently working through a Facility Plan Amendment in the FY 2019 and have identified approximately $5.7 million in necessary capital improvements at the existing WWTF. Projects include a new influent screen, influent pump replacement, new high efficiency blowers, and a new maintenance garage. These projects will continue to be refined as the Facility Plan Amendment is developed.

3. Meramec River Water Quality Evaluation

Since 1978, water quality impacts caused by WWTFs have been eliminated in the Lower Meramec Basin. However, the Meramec River remains a high priority area in need of improvement from other pollutant sources. A summary of the original 208 Plan water quality goals, existing water quality conditions, and WWTF performance is provided below.

3.1. 208 Plan Water Quality Goals

Three different approaches to water pollution control were defined and evaluated for the original 208 Plan. Each approach or level of pollution control was predicted to produce different water quality in the study area at a different cost. The three levels of water quality used in the 208 Plan in ascending order of stringency are summarized below:

- Level 1 – Provided for the secondary treatment of point sources and a continuation of existing practices and controls for nonpoint sources;
- Level 2 – Required the control of point and nonpoint sources necessary to meet the State of Missouri's water quality standards; and
- Level 3 – Called for more stringent control of point and nonpoint sources of pollution in order to meet the water quality goals developed during the 208 study. This included establishing a new criterion of 0.05 mg/L for phosphate and new, more stringent criteria for fecal coliform and ammonia than were proposed by the State at the time the plan was developed.

As part of the 208 planning process, control strategies and their costs were developed for each water quality level. Results of this analysis were presented to the public at workshops held in 1977. Workshop participants overwhelmingly chose Level 2 water quality, which was subsequently selected as the target for the 208 Plan. In essence, the goal of the 208 Plan was to implement a combination of point and nonpoint source controls such that the rivers and streams of the St. Louis area meet Missouri's water quality standards. Water quality standards consist of three basic elements: 1) designated uses (e.g., recreation, aquatic life, public water supply), 2) numeric and narrative water quality criteria to protect designated uses by limiting chemical constituents that may be present in the water body, and 3) an antidegradation policy to maintain and protect existing uses and high quality waters.

3.2. Existing Water Quality Conditions

Section 303(d) and 305(b) of the CWA require each state to report to EPA on the status of their waters every two years. Waters that do not meet water quality standards and for which adequate water pollution controls have not been required are included on the state's 303(d) List. Missouri's 2018 303(d) List of impaired waters identifies the Lower Meramec River as impaired for both lead in sediment and bacteria (*Escherichia coli or E. coli)*. There are currently no other identified 303(d) impairments in the Meramec River. Additional information regarding existing lead and *E. coli* levels in the Meramec River is included below. Because total ammonia nitrogen (ammonia) is a common pollutant discharged by WWTFs and Missouri's water quality criteria for ammonia will likely become more stringent in the near future, an analysis of historic and current

ammonia levels in the Meramec River is also included. Data used for this analysis were obtained from United States Geological Survey (USGS) monitoring stations at Paulina Hills (07019280) and Eureka (07019000). Paulina Hills is downstream of all major point discharges. Eureka is located upstream of the Lower Meramec basin system.

3.2.1. Lead

The most likely source of lead impairments to the Meramec River is old lead belt tailings. The Meramec River region is a former lead producing area with over 200 years of lead mining pollution. EPA and the U.S. Army Corps of Engineers (USACE) currently serve on a task force to facilitate the cleanup, restoration, and remediation efforts on the Meramec River[5]. DNR concluded that the Fenton WWTF, Grand Glaize WWTF, and Saline Creek WWTF were not a source of lead or the impairment.[6]

3.2.2. Bacteria

E. coli data collected in the Meramec River at Paulina Hills (USGS station 07019280) since 1997 supports MDNR's findings that the Meramec River is impaired for bacteria. The *E. coli* criterion on the Meramec River is 126 cfu/100 mL, which is expressed as a recreational season (April – October) geomean. Since 1997, the *E. coli* criterion has been exceeded at this location six times (Figure 3).

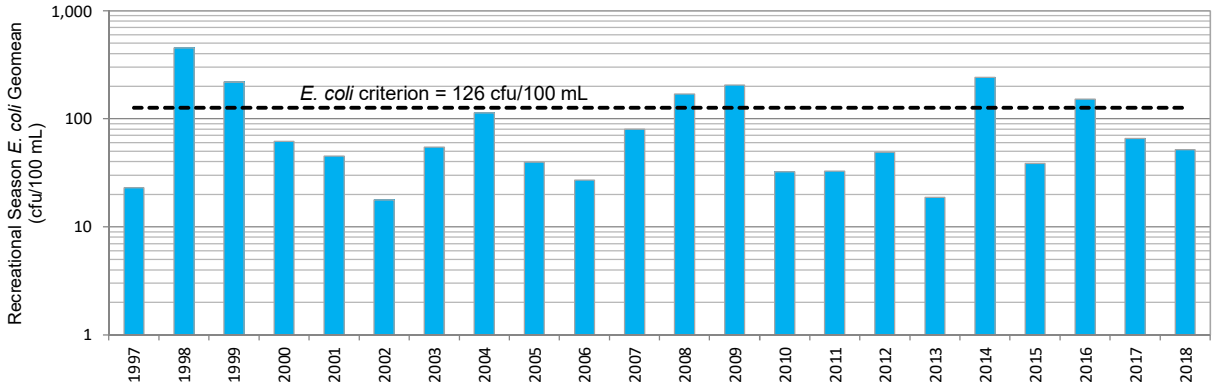


Figure 3. Average (Geometric Mean) Recreational Season (April – October) *E. coli* Levels in the Meramec River at Paulina Hills (1997-2016).

At the time the 208 Plan was developed, WWTFs were considered a significant source of bacteria. However, since then most treatment facilities in the Lower Meramec Basin have been either been eliminated or are required to disinfect. This suggests that high bacteria levels in the Meramec River are primarily a result of nonpoint sources in the watershed. This finding is supported by data from Paulina. Recent *E. coli* data (collected since 2005) from the Paulina Hills station were grouped and summarized by the following flow regimes:

[5] https://www.epa.gov/urbanwaterspartners/urban-waters-and-meramec-and-big-rivers-missouri
[6] See fact sheets for Missouri State Operating Permits MO-0086126, MO-0101362, and MO-0128490.

- High Flows: 0 to 10% flow exceedance
- Moist Conditions: >10 to 40% flow exceedance
- Mid-Range Flows: >40 to 60% flow exceedance
- Dry Conditions: >60 to 90% flow exceedance
- Low Flows: >90% flow exceedance

The data show that bacteria levels and the flow regime are positively correlated (Figure 4). This relationship is most apparent during high flow conditions, which has an *E. coli* recreational season geometric mean of 398 cfu/100 mL during these wet weather conditions. *E. coli* levels in all other flow regimes range from 40 to 83 cfu/100 mL, which are below the criterion of 126 cfu/100 mL. Because the high flow regime is dominated by stormwater runoff, nonpoint sources are likely the primary source of bacteria during this condition.

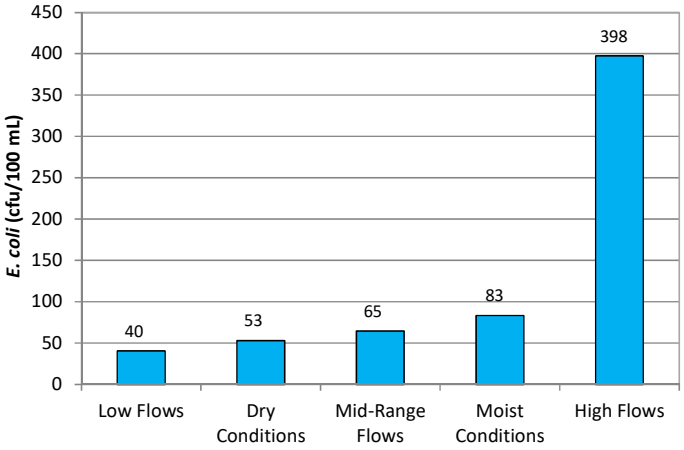


Figure 4. Distribution of Average (Geometric Mean) Recreational Season (April – October) *E. coli* Levels by Flow Regime in the Meramec River at Paulina Hills (2005 – 2018).

3.2.3. Ammonia

Since 1968, average ammonia levels in the Meramec River at the Paulina Hills station have consistently remained below EPA's new recommendations[7] for summer (April – September) and winter (October – March) water quality criteria of 0.7 and 2.3 milligrams per liter (mg/L), respectively, which are based on a pH of 7.8 and assume a summer temperature of 26°C and a winter temperature of 6°C (Figure 5). During this period, average summer ammonia levels have been below 0.1 mg/L and average winter levels have been below 0.2 mg/L. There is no clear, long-term trend in ammonia levels at the Paulina Hills station.

[7] EPA's 2013 ammonia criteria recommendations are based on new toxicity data which demonstrate that some organisms, particularly some species of gill-breathing snails and freshwater mussels, are more sensitive to ammonia than other organisms in the national toxicity dataset used in previous criteria recommendations (EPA 2013). Depending on pH and temperature assumptions, the revised recommendations represent a decrease of 50% or more for existing ammonia criteria.

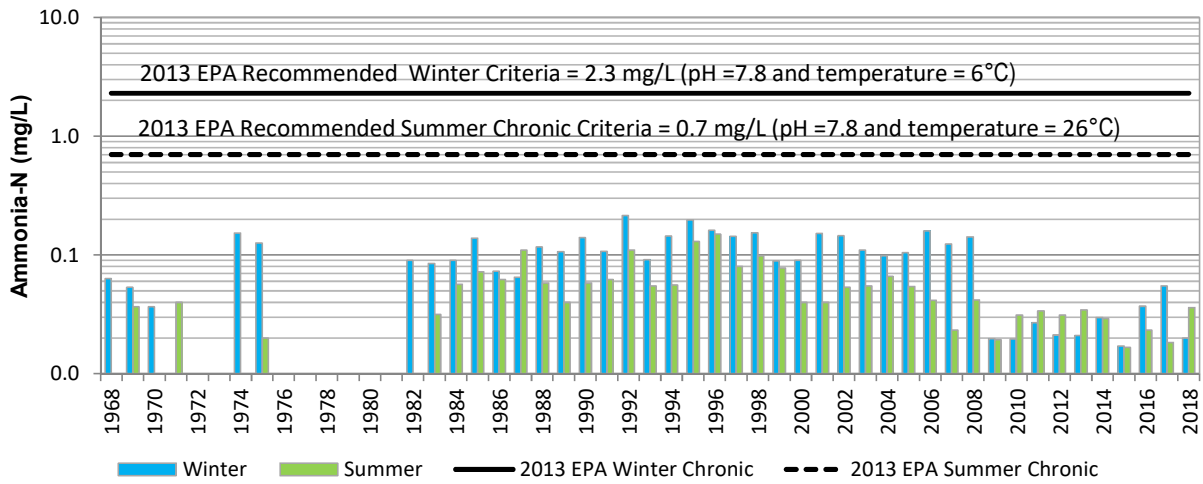


Figure 5. Average Annual Ammonia in the Meramec River at Paulina Hills (1968 – 2018).

Since 2009, average ammonia levels at the Paulina Hills station dropped by approximately 50% and 75% during the summer and winter seasons, respectively. The net result of these changes was that ammonia returned to background levels measured at the upstream Eureka station (Figure 6). This reduction is likely attributable to upgrades made at the Grand Glaize WWTF during the period. However, reduced ammonia levels may also be partly attributable to improvements at the NPSD Saline Creek Regional WWTF, which completed its second phase of construction in 2009.

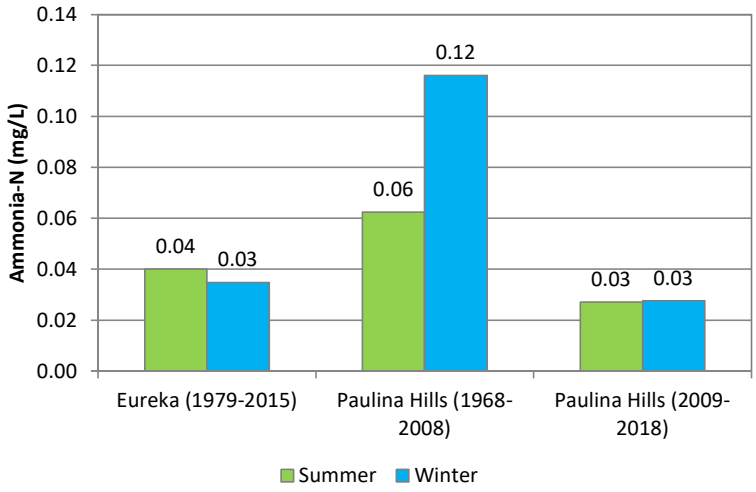


Figure 6. Average Annual Ammonia Levels in the Meramec River at Eureka (Upstream of the 201 Planning Area) and Paulina Hills (Downstream of Major WWTFs in the 201 Planning Area).

3.3. WWTF Performance for Major Facilities Discharging into the Lower Meramec River

In the 1970s, discharges from point sources were directly attributed to elevated levels of phosphorus and fecal coliform in the Meramec River. At that time, the Lower Meramec Basin was serviced by numerous lagoons and septic systems, which did not meet secondary treatment standards or require disinfection. Effluent quality was generally insufficient to meet water quality standards. Since this time, most of these facilities and septic tanks have been consolidated into a small number of major secondary treatment facilities with disinfection. Major facilities that discharge to the lower Meramec River include MSD's Grand Glaize WWTF, and Fenton WWTF, and NPSD's Saline Creek Regional WWTF. All three of these facilities typically meet their National Pollutant Discharge Elimination System (NPDES) permit requirements, which were designed to protect water quality standards.

3.3.1. Grand Glaize WWTF Performance

The Grand Glaize WWTF (MO-0101362) uses a treatment process that includes equalization, coarse screening, influent pumping, fine screening, grit removal, primary clarification, aeration, secondary clarification, and disinfection during the recreation season. This treatment process has been well operated since the facility's expansion in 2007. Over the past decade, both BOD and TSS effluent concentrations have consistently achieved minimum average monthly removal requirement. High wet weather flows significantly affect BOD and TSS removal, so continual achievement of the average monthly removal indicates the Grand Glaize WWTF's ongoing exceptional performance.

Since final ammonia effluent limits came into effect in 2010, the Grand Glaize WWTF has never exceeded daily maximum or monthly average ammonia effluent limits. *E. coli* effluent limits were consistently achieved. In 2018, the National Association of Clean Water Agencies gave the Grand Glaize WWTF a Gold Peak Performance Award.

3.3.2. Fenton WWTF Performance

The Fenton WWTF (MO-0086126) uses a treatment process of fine screening, influent pumping, grit removal, primary clarification, aeration, secondary clarification, and disinfection during the recreation season. In the past five years, there has been one exceedance of *E. coli* limits in May 2017, which occurred during a period of historic flooding and flows into the plant that exceeded the rated capacity of the disinfection equipment. There was one exceedance of lead effluent limits in December 2013. It is anticipated that the Fenton WWTF will be taken offline in 2025 and the Fenton influent flow will be sent to the Lower Meramec WWTF. In 2018, the National Association of Clean Water Agencies gave the Fenton WWTF a Platinum Peak Performance Award.

3.3.3. Saline Creek Regional WWTF Performance

The Saline Creek Regional WWTF (MO-0128490) currently features a multi-channel oxidation ditch with biological nutrient reduction capabilities, two secondary clarifiers, and UV disinfection. The facility used to consist of two separate treatment plants with a separate outfall – the Ron Rog site and the Highway 141 site. The Highway 141 plant was eliminated in 2013 and replaced with a lift station sending all effluent to the Ron Rog site now referred to as the Saline Creek Regional WWTF. Since 2013, there have been no permit limit exceedances. Although nutrient removal is not currently required at the facility, it can be operated to remove nitrogen and phosphorus biologically.

4. Proposed 208 Plan Amendments

As discussed in Section 1, the original 208 Plan made recommendations regarding point source, nonpoint source, and sludge management alternatives across the four-county planning area. These recommendations were based on an evaluation of cost-effectiveness, water quality effectiveness, management and institutional constraints, and environmental considerations.

Technical and economic considerations have changed since the 1978 analysis and the original 208 Plan point source and sludge management alternatives for the Lower Meramec Basin are not necessary for meeting the overall planning objectives. The 208 Plan recognizes that updates to the plan may be necessary noting that it "is not a static list of recommendations but represents a dynamic and progressive policy for guiding future wastewater construction activities."

The purpose of this section is to identify changes necessary to amend the 208 Plan recommendations and bring it into alignment with the current situation in the Lower Meramec Basin. The proposed changes in this report only address one point source service area (identified as the Lower Meramec System in the 208 Plan) and one regional sludge processing center (identified as the Lower Meramec Regional Center in the 208 Plan), but do not impact point source, nonpoint source, or sludge management recommendations for the remainder of the four-county planning area.

4.1. Lower Meramec System Point Source Amendments

The existing 208 Plan calls for MSD to serve as the designated management agency of a regional treatment facility to provide sewer services via major interceptors for the Lower Meramec area (southern St. Louis County and northern Jefferson County) and the entire Rock Creek Basin in Jefferson County. At the time the 208 Plan was developed, the construction of separate facilities within this area was considered impractical from both a technical and economic standpoint. Technical and economic considerations have evolved since 1978 and it is currently more practical to make the existing major facilities permanent. Also, only NPSD is a Level 2 Continuing Authority whereas MSD and RCPSD are Level 3 Continuing Authorities. Therefore, the 208 Plan recommendations should be amended to state that the Lower Meramec System will be served by four WWTFs and their designated management agencies (Table 1, Figure 7).

Table 1. Proposed Permanent WWTFs in the Lower Meramec System.

Treatment Facility	Service Area	Management Agency
Lower Meramec WWTF	Lower Meramec (St. Louis County)*	MSD
Grand Glaize WWTF	Grand Glaize (St. Louis County)	MSD
Saline Creek Regional WWTF	Lower Meramec (Jefferson County)	NPSD
Kimmswick WWTF	Rock Creek (Jefferson County)	RCPSD

*Includes serving portions of the City of Arnold and RCPSD (Pomme Creek Watershed) in Jefferson County.

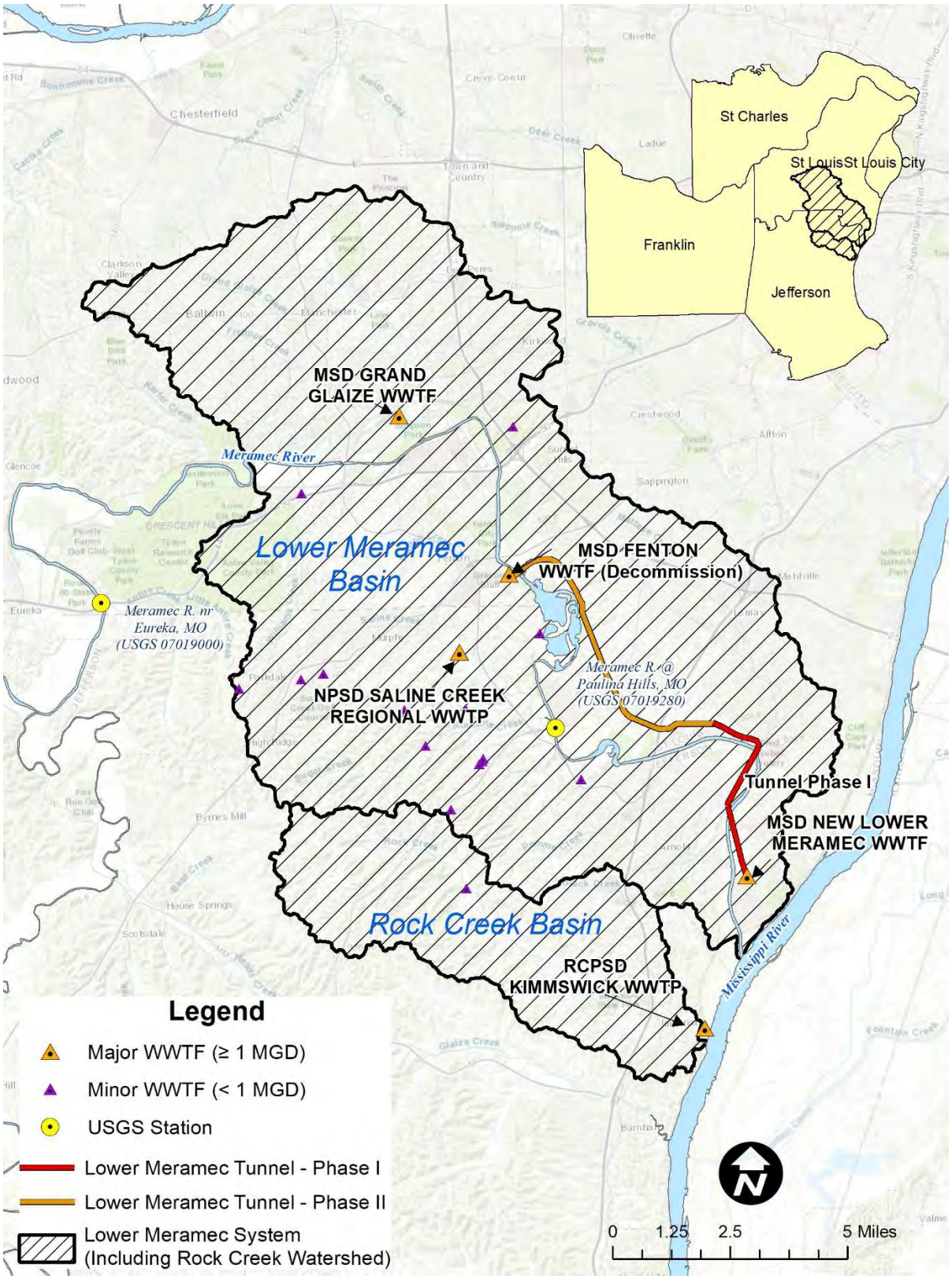


Figure 7. Proposed 208 Plan Amendment for the Lower Meramec System.

Amending the 208 Plan to maintain the four major WWTFs within the Lower Meramec System will not impact water quality standards attainment. Unlike in 1978, there are currently no impairments in Meramec River that are attributable to WWTF discharges, and the existing WWTFs are producing high quality effluent that meets NPDES permit conditions. Additionally, both the Lower Meramec and the Kimmswick WWTF discharge directly to the Mississippi River with no impact to the Meramec River. Therefore, from a water quality perspective, there is little difference between the original 208 Plan and this proposed amendment.

In addition to the Continuing Authority and jurisdictional issues, the overriding consideration for maintaining separate WWTFs in the Lower Meramec System is cost-effectiveness. The 20-year present worth costs for implementing the original 208 recommendations (connecting to the Lower Meramec WWTF) greatly exceed the cost to maintain current facilities for each of the three agencies. Implementing the original 208 recommendations would include annual operation and maintenance, constructing the Phase III Lower Meramec Tunnel, expanding the Lower Meramec WWTF, and decommissioning parts or all of the Grand Glaize, Saline Creek, and Kimmswick WWTFs. The combined estimated cost to implement these projects is approximately $400 million (Table 2).

Table 2. Comparison between Costs to Implement Original 208 Point Source Recommendations and Costs to Maintain Existing Facilities in the Lower Meramec System.

Estimated 20-Year Present Worth Cost to Implement Original 208 Recommendations (in 2018 dollars)[1]				
Cost Component	**MSD**	**NPSD**	**RCPSD**	**Total**
Phase III Lower Meramec Tunnel	$134,900,000	--	--	$134,900,000
Phase III Lower Meramec WWTF Expansion	$82,200,000	--	--	$82,900,000
Grand Glaize WWTF Decommissioning	$2,000,000	--	--	$2,000,000
O&M Present Worth	$73,300,000	--	--	$73,300,000
Cost of Tunnels to Connect to Lower Meramec System	--	$57,500,000	$14,300,000	$71,800,000
Cost of Lower Meramec WWTF Upgrades[2]	--	$15,800,000	$19,000,000	$34,800,000
Total Cost to Implement 208 Recommendations	**$293,100,000**	**$73,300,000**	**$33,300,000**	**$399,700,000**
Estimated 20-Year Present Worth Cost to Maintain Existing Facilities (in 2018 dollars)[1]				
Cost Component	**MSD Grand Glaize WWTF[3]**	**NPSD Saline Creek Regional WWTF**	**RCPSD Kimmswick WWTF**	**Total**
Capital Improvements	$24,700,000	$6,400,000	$5,650,000	$31,550,000
O&M Present Worth	$88,500,000	$10,700,000	$11,200,000	$95,200,000
Total Cost to Maintain Existing Facilities	**$113,200,000**	**$17,100,000**	**$16,850,000**	**$147,150,000**
Final Cost Savings	**$179,900,000**	**$56,200,000**	**$16,450,000**	**$252,550,000**

[1] 20-year present worth based on an inflation rate of 2.5%.
[2] Does not include annual O&M, as these costs would be defined through future intergovernmental agreements.
[3] Includes costs ($5.1 million capital, $15.3 OM) for future nitrogen and phosphorus removal.

By comparison, costs to maintain the existing facilities would include annual operation and maintenance and capital costs to replace aging equipment at the Grand Glaize WWTF, improve biosolids facilities at the Saline Creek Regional WWTF, and implement preliminary improvements identified for the Kimmswick WWTF. The combined estimated cost to implement these projects is approximately $147 million (Table 2). Overall, maintaining the existing facilities results in a cost savings of nearly $253 million.

Existing user rates at each of the three sewer districts do not account for the increased costs necessary to implement the original 208 Plan projects. For MSD, existing (FY 2020) residential user rates include a base charge of $26.53 and a volume charge that varies depending on whether a home is metered or unmetered. At the current rates, a typical residential bill would be $55.57 per month. MSD is requesting a 1.9% rate increase in FY 2021, and a 3.8% rate increase in each of FY 2022, FY 2023, and FY 2024. NPSD customers pay a $31.73 per month base charge and $3.17 per thousand gallons of water usage. At the current rates, an average NPSD customer would pay $47.58 per month. NPSD has no planned rate increases at this time. RCPSD just completed a district wide rate increase. RCPSD charges a base fee of $24.43 per month or $73.29 per quarter and a volumetric fee of $2.57 per thousand gallons. A typical RCPSD customer would pay approximately $88.79 per quarter or $29.60 per month, depending on the billing structure.

4.2. Lower Meramec Regional Center Sludge Management Amendments

The existing 208 Plan recommended designating the Lower Meramec WWTF as a regional sludge processing center. Alternatives, including transporting the sludge to the Lemay WWTF for incineration, were determined to be more expensive and ultimately ruled out of consideration for this reason. However, more recent analyses and activities in the watershed indicate that the original recommendation is no longer applicable. The 208 Plan recommendations should be amended to state that MSD, NPSD, and RCPSD will be responsible for sludge management at their respective facilities, as discussed below.

4.2.1 MSD Sludge Management

In the Lower Meramec Basin, sludge from the Grand Glaize WWTF and Lower Meramec WWTF is currently thickened and hauled off-site for incineration and/or landfill disposal. Sludge from MSD facilities outside of the Lower Meramec Basin are currently incinerated at the Bissell Point WWTF or Lemay WWTF. In 2018, MSD evaluated four potential future sludge management alternatives[8].

[8] Metropolitan St. Louis Sewer District (MSD). 2018. Solids Handling Technical Memorandum, Fluidized Bed Incinerators. Project 12565. St. Louis, MO. 24 pp.

Sludge management alternatives included the following:

1) Locating all incineration activities at the Bissell Point WWTF,
2) Retaining incineration facilities at the Bissell Point WWTF and constructing new facilities at the Lower Meramec WWTF to handle sludge from the Lower Meramec and Grand Glaize WWTFs,
3) Retaining incineration facilities at the Bissell Point WWTF and constructing new facilities at the Lower Meramec WWTF and Grand Glaize WWTFs to handle sludge from MSD's facilities in the Lower Meramec Basin, and
4) Retaining incineration facilities at the Bissell Point and Lemay WWTFs. The Lemay WWTF would accept sludge from the Grand Glaize and Lower Meramec WWTFs. Incinerators at Bissell Point would provide redundancy for sludge produced at the Grand Glaize and Lower Meramec WWTFs.

MSD concluded that Alternative 4 was the most environmentally sustainable and socially feasible future course of action. This cost between the alternatives was not statistically different, but Alternative 4 provided MSD with the most certainty with respect to unexpected increases in future capital or operational costs. Per the Second Material Amendment to the Consent Decree, the incinerators at both Bissell Point and Lemay WWTFs will be upgraded from multiple hearth incinerators to fluidized bed incinerators by 2026, which will result in a yearly reduction of 2,109 tons of air emissions.

Alternative 4 assumes that sludge from the Grand Glaize and Lower Meramec WWTFs may initially be hauled, but eventually will be transported to the Lemay WWTF via force main. Transportation of raw sludge via hauling will be phased out of use because hauling has potential for both spills and odor complaints. Landfilling of raw sludge will only be used minimally.

The 208 Plan should be amended to state that MSD will manage sludge generated at the Grand Glaize and Lower Meramec WWTFs at the Lemay WWTF, as described above in alternative 4.

4.2.2 NPSD Sludge Management

Biosolids from NPSD's satellite WWTFs are transported to the Saline Creek Regional WWTF for processing and final disposal. The Saline Creek Regional WWTF has an aerobic digester which is a recycled plant from the old Ron Rog WWTF adjacent to Saline Creek Regional WWTF and two (2) biosolids holding ponds. Biosolids are land applied annually by a contractor on fields near Byrnes Mill, Missouri. As described in Section 2.2.2, NPSD is in the process of construction a new aerobic digester with a membrane thickener and will continue land application. The 208 Plan should be amended to state that NPSD will continue the current activities.

4.2.3 RCPSD Sludge Management

In previous facility planning efforts, RCPSD evaluated the cost to haul sludge to MSD's facilities against the cost to retain a contract hauler and land apply them. RCPSD found that the cost to

land apply was approximately half the cost to dispose of them at MSD ($0.07 per gallon versus $0.17 per gallon). RCPSD selected the most cost effective alternative and currently land applies residual sludge in accordance with their NPDES permit and MDNR-approved biosolids management plan. The 208 Plan should be amended to state that RCPSD will continue the current activities.

4.3. Summary of Public Information Process

As of the date of this report, the three management agencies proposing to amend the 208 Plan have conducted significant public information and outreach activities. These include:

- January 8, 2019 – Coordination meeting with MDNR staff.
- January 16, 2019 – Informational meeting with Senator Weiland, Representative Shaul, and Representative Ruth.
- February 4, 2019 – Initiated 30-day public comment period for interested parties to review and comment on the draft report and provided update to MSD board at the Program Manager Committee Meeting.
- February 8, 2019 – Informational meeting with Dennis Gannon, Jefferson County Executive.
- February 11, 2019 – Provided update at Jefferson County Council meeting.
- February 12, 2019 – Hosted public hearing.
- March 8, 2019 – Coordination meeting with EPA Region 7 staff.

Additional outreach and public review will occur as the proposed amendment when the proposed amendment is finalized and presented to the Clean Water Commission for review and approval. The planned schedule of remaining outreach activities is included in Attachment A.

4.4. Summary of Proposed Amendments

This report provides support for amending the 208 Plan to bring it into alignment with the current situation in the Lower Meramec Basin. The analyses support the following amendments:

- It is more cost-effective to maintain existing facilities ($147 million) within the Lower Meramec System than to construct a single regional WWTF ($400 million). Further, a single regional WWTF is not necessary to meet state water quality standards in the Lower Meramec River. Therefore, the Lower Meramec System should instead be served by four WWTFs: Lower Meramec WWTF, Grand Glaize WWTF, Saline Creek Regional WWTF, and Kimmswick WWTF.
- Due to environmental and management considerations, it is not feasible for the Lower Meramec WWTF to serve as a regional sludge processing center. The plan should be revised to recognize that sludge processing for MSD facilities in the Lower Meramec System will be addressed at the Bissell Point WWTF or Lemay WWTF; the Northeast Public Sewer District and Rock Creek Public Sewer District will continue their current management activities.

ATTACHMENT A

Process and Proposed Schedule for Amending the 208 Plan

State regulations do not currently specify a process or requirements for amending existing 208 plans. According to federal regulations (40 CFR 130.6(f)), updated water quality management plan sections must be consistent with all other parts of the plan. The updates must also be certified by the Governor (or Governor's designee before being sent to EPA for approval.

In the fall of 2015, the EWGCOG met with MDNR, EPA Region 7, and NPSD to identify a process for amending the plan in accordance with the federal regulations. From these discussions, EWGCOG prepared a detailed Process to Amend 208 Water Quality Management Plan. In general, the process stipulates that the requesting agencies (MSD, NPSD, RCPSD) will prepare a documentation report (this document) and amendment request and, with EWGCOG's support, submit it to the Missouri Clean Water Commission (CWC) for their approval following a public notice period. The CWC shall consider recommendations on the proposal from MDNR and hold a public hearing before submitting final recommendations to the Governor or appropriate designee. The detailed process identified by the EWGCOG is outlined below. The proposed schedule for amending the 208 Plan recommendations, through the vote by the CWC to take action on the plan, is included in Figure A-1.

EWGCOG Process for Amending 2018 Plan Recommendations

1. Applicant(s) notify EWGCOG of their interest in an amendment to the 1978 208 Water Quality Management Plan.

2. Applicant(s) communicate with interested parties including and MDNR and receives feedback concerning proposed amendment.

3. Applicant(s) prepare **documentation report** supporting proposed amendment.

4. While Applicant(s) are preparing their **documentation report**, EWGCOG considers request and can prepare a **background report** (if needed) with recommendation and letter.

5. Applicant(s) sends draft **documentation report** to MDNR Engineering Section, Water Pollution Control Branch of Water Protection Program for feedback.
   Applicant(s) receives feedback and makes adjustments, if necessary.

6. Applicant(s) hold public meeting
   Schedule meeting.
   Post meeting announcement and request/documentation on Applicant(s) website.
   Comment period should begin at time of announcement and end 7 days after public meeting.
   Publicize meeting announcement.
   Public meeting held and feedback on proposed amendment is solicited.
   Meeting documentation is assembled – announcement, where publicized, meeting sign-in sheet and notes and comments received.

7. Applicant(s) prepare packet including: letter requesting amendment to plan; **documentation report**; and public meeting information.

8. Applicant(s) send packet to EWGCOG and to Clean Water Commission.

9. EWGCOG sends letter of recommendation to Clean Water Commission. EWG's **background report** (if needed) will be attached.

MISSOURI CLEAN WATER COMMISSION ACTIONS

1. MDNR receives request letter and packet from Applicant(s).
2. MDNR receives EWG recommendation letter with **background report** (if needed).
3. MDNR/Clean Water Commission places request on Clean Water Commission meeting schedule and identify public hearing/comment period.
4. Clean Water Commission meeting with request on Agenda, as information item.
5. Clean Water Commission holds public hearing about request from MSD.
6. Clean Water Commission meeting with request as action item on Agenda.
7. At this meeting, MDNR will make recommendation to Clean Water Commission on request.
8. Clean Water Commission will take action on request to amend 208 Plan.
9. MDNR staff drafts document to record Commission's recommendation and asks them to sign.
10. MDNR staff prepares memo to Governor requesting action to amend 208 Plan and attaches Commission's recommendation.

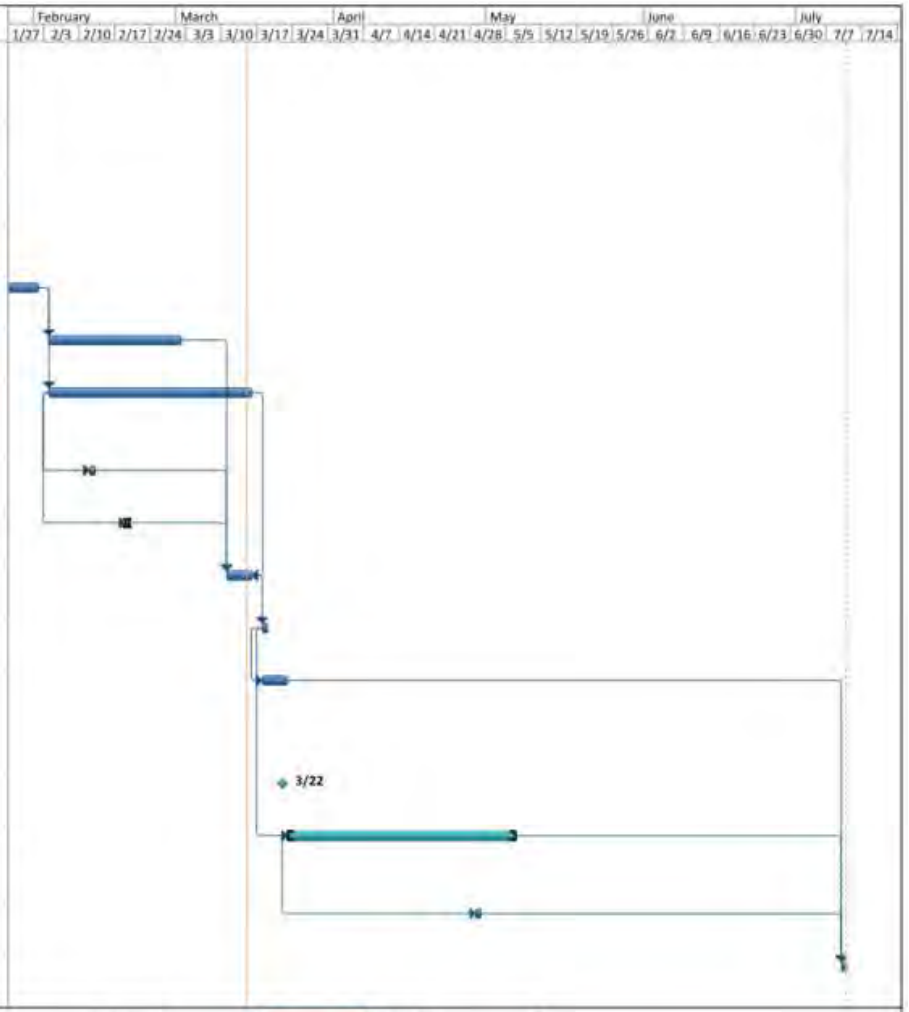
GOVERNOR ACTIONS

1. Governor reviews recommendations from Clean Water Commission/MDNR and issues 208 Plan certification and sends to EPA Region 7 for review and approval.

EPA ACTIONS

1. EPA reviews certification and takes action.
2. EPA communicates with MDNR on their action.
3. MDNR informs MSD.

ID	Task Mode	Task Name	Duration	Start	Finish	Predecessors
1		MSD notifies EWG of interest in 208 plan modification	1 day	Wed 8/1/18	Wed 8/1/18	
2		Stakeholder communication	100 days	Thu 8/2/18	Wed 12/19/18	1
3		MSD prepares draft documentation report	100 days	Thu 8/2/18	Wed 12/19/18	1
4		EWG reviews draft background report	10 days	Mon 12/24/18	Fri 1/4/19	1,3
5		MSD & partners revise draft, consult with DNR	20 days	Mon 1/7/19	Fri 2/1/19	4
6		MDNR reviews documenation report	20 days	Mon 2/4/19	Fri 3/1/19	5
7		MSD & partners provide report for public comment	30 days	Mon 2/4/19	Fri 3/15/19	5
8		MSD & partners hold public meeting	1 day	Tue 2/12/19	Tue 2/12/19	7SS+6 days
9		MSD & partners, EWGW, & DNR meet with EPA	1 day	Tue 2/19/19	Tue 2/19/19	7SS+11 days
10		MSD & partners revise documentation report	5 days	Mon 3/11/19	Fri 3/15/19	6,7FF,8,9
11		MSD & partners submits package to DNR/CWC	1 day	Mon 3/18/19	Mon 3/18/19	10
12		EWGCOG prepares & sends letter of recommendation to CWC	5 days	Mon 3/18/19	Fri 3/22/19	11SS
13		CWC briefing packets due	0 days	Fri 3/22/19	Fri 3/22/19	
14		DNR Public Notice Period-Post 208 Plan on DNR webpage	45 edays	Fri 3/22/19	Mon 5/6/19	11SS+5 days
15		CWC holds public hearing on the request	1 day	Mon 4/29/19	Mon 4/29/19	14SS
16		CWC votes on the plan amendment	1 day	Wed 7/10/19	Wed 7/10/19	15,14,12



Project: 208 plan revision schedul
Date: Fri 3/15/19

Task		External Tasks		Manual Task		Finish-only	
Split		External Milestone		Duration-only		Deadline	
Milestone		Inactive Task		Manual Summary Rollup		Progress	
Summary		Inactive Milestone		Manual Summary			
Project Summary		Inactive Summary		Start-only			

Figure A-1. Proposed Process and Schedule for Amending the 208 Plan.

ATTACHMENT B

Summary of Water Quality Management Plan Elements Required by 40 CFR 130.6(c)

Federal regulations (40 CFR 130.6(c)) outline the planning elements that must be included in a water quality management (WQM) plan, or referenced as part of the WQM plan if contained in separate documents when they are needed to address water quality problems. A summary of the regulatory planning elements and their relationship to the information and changes requested in this report is included below.

1) **Identify relevant total maximum daily loads (TMDLs) and associated requirements.** There are five TMDLs within the Lower Meramec System. These include biochemical oxygen demand (BOD) and ammonia TMDLs for Rock Creek and Saline Creek, a chlordane and PCB TMDL for the Mississippi River, a lead and zinc TMDL for the Missouri River, and a bacteria TMDL for Fishpot Creek. The issues leading to the Rock Creek and Saline Creek TMDLs have been addressed through regionalization by the Northeast Public Sewer District and Rock Creek Public Sewer District. None of the remaining TMDLs directly address water quality in the Meramec River or impact any recommendations or changes suggested in this report.

Existing TMDLs in the Lower Meramec System				
Stream	**Year**	**Pollutant**	**Source**	**Document Link**
Rock Creek	1999	BOD and Ammonia	WWTPs	https://dnr.mo.gov/env/wpp/tmdl/docs/1714-rock-ck-tmdl.pdf
Saline Creek	2001	BOD and Ammonia	WWTPs	https://dnr.mo.gov/env/wpp/tmdl/docs/2190-saline-ron-rog-tmdl.pdf
Mississippi River	2006	Chlordane and PCBs	Many point and nonpoint sources	https://dnr.mo.gov/env/wpp/tmdl/docs/0001-1707-3152-mississippi-r-tmdl.pdf
Mississippi River	2010	Lead and Zinc	Herculaneum Smelter	https://dnr.mo.gov/env/wpp/tmdl/docs/1707-miss-r-tmdl.pdf
Fishpot Creek	2016	Bacteria	Urban runoff	https://dnr.mo.gov/env/wpp/tmdl/docs/tmdl-bacteria-fishpot-cr-final.pdf

2) **Identify effluent limitations and schedules of compliance.** According to MDNR's most recent (2015) NPDES permit shapefiles, there are 26 permitted facilities (excluding general permits) in the Lower Meramec System. These include major and minor municipal and non-municipal facilities, one state facility, and one industrial stormwater facility. MDNR generally applies new permit limits, compliance schedules, and other requirements for every facility on a five year cycle. A list of facilities in the Lower Meramec Basin and links to their permits (if available) is included in the table below.

   As the recommendations included in this report are implemented, MDNR will update permit requirements for the Grand Glaize WWTP, Lower Meramec WWTP, Saline Creek Regional WWTP, and Kimmswick WWTP to reflect the plan amendment and meet water quality standards in the Meramec River.

Existing NPDES Discharges in the Lower Meramec System (Excludes General Permits)			
Category	**Permit ID**	**Facility Name**	**Link to Permit**
Major Municipal	MO0101362	MSD Grand Glaize WWTP	https://dnr.mo.gov/env/wpp/permits/issued/docs/0101362.pdf
Major Municipal	MO0086126	MSD, Fenton WWTP	https://dnr.mo.gov/env/wpp/permits/issued/docs/0086126.pdf
Major Municipal	MO0127949	MSD, Lower Meramec WWTF	https://dnr.mo.gov/env/wpp/permits/issued/docs/0127949.pdf
Major Municipal	MO0128490	NPSD, Interim Saline Creek Regional WWTF	https://dnr.mo.gov/env/wpp/permits/issued/docs/0128490.pdf
Major Non-Municipal	MO0000361	Ameren Missouri- Meramec Power Plant	https://dnr.mo.gov/env/wpp/permits/issued/docs/0000361.pdf
Minor Municipal	MO0092649	NPSD, Terry Jean Acres WWTF	https://dnr.mo.gov/env/wpp/permits/issued/docs/0092649.pdf
Minor Non-Municipal	MO0090484	Big Valley Mobile Home Court	Permit not available online
Minor Non-Municipal	MO0001627	Bohn and Dawson, Inc.	https://dnr.mo.gov/env/wpp/permits/issued/docs/0001627.pdf
Minor Non-Municipal	MO0107981	Brennens Point Apartments	https://dnr.mo.gov/env/wpp/permits/issued/docs/0107981.pdf
Minor Non-Municipal	MO0088846	BROOKSHIRE COURT APTS	https://dnr.mo.gov/env/wpp/permits/issued/docs/0088846.pdf
Minor Non-Municipal	MO0123358	KOLLER CRAFT PLASTIC PROD	https://dnr.mo.gov/env/wpp/permits/issued/docs/0123358.pdf
Minor Non-Municipal	MO0127515	LIVING WELL VILLAGE	Permit not available online
Minor Non-Municipal	MO0091162	MAWC, Meramec Sewer	https://dnr.mo.gov/env/wpp/permits/issued/docs/0091162.pdf
Minor Non-Municipal	MO0094374	McArthy Homesites #2 WWT	https://dnr.mo.gov/env/wpp/permits/issued/docs/0094374.pdf
Minor Non-Municipal	MO0106569	Meramec Heights Shopping Center	https://dnr.mo.gov/env/wpp/permits/issued/docs/0106569.pdf
Minor Non-Municipal	MO0120910	Motomart	https://dnr.mo.gov/env/wpp/permits/issued/docs/0120910.pdf
Minor Non-Municipal	MO0090956	Murphy Ann Apartments WWTP	Permit not available online
Minor Non-Municipal	MO0110779	PEERLESS DEMOLITION LF	https://dnr.mo.gov/env/wpp/permits/issued/docs/0110779.pdf
Minor Non-Municipal	MO0001341	Reichhold, LLC 2	https://dnr.mo.gov/env/wpp/permits/issued/docs/0001341.pdf
Minor Non-Municipal	MO0088897	SIR THOMAS MANOR APTS	Permit not available online
Minor Non-Municipal	MO0114413	Tesson Hills Apartments	https://dnr.mo.gov/env/wpp/permits/issued/docs/0114413.pdf
Minor Non-Municipal	MO0123021	Valley Park TCE Site - Wainwright	https://dnr.mo.gov/env/wpp/permits/issued/docs/0123021.pdf
Minor Non-Municipal	MO0084930	Woodglen Apartments WWTP	Permit not available online
Minor Non-Municipal	MO0040347	Woodridge Apartments	https://dnr.mo.gov/env/wpp/permits/issued/docs/0040347.pdf
Minor State	MO0109975	MDC, Powder Valley Cons. Nature Center	https://dnr.mo.gov/env/wpp/permits/issued/docs/0109975.pdf
Site-Specific Industrial SW	MO0113000	Advanced Disposal Oak Ridge Landfill	Permit not available online

3) **Identify anticipated municipal and industrial waste treatment works, construction priorities, and schedules.** The relevant information for this planning element is addressed in Section 2 of this report.

4) **Describe the regulatory and non-regulatory programs, activities and Best Management Practices (BMPs) which the agency has selected as the means to control nonpoint source pollution where necessary to protect or achieve approved water uses. Identify BMPs for the following nonpoint sources:**
    - **Residual waste.** Proposed residual management amendments for the Lower Meramec System are outlined in Section 4.2 of this report.
    - **Land disposal.** Proposed residual management amendments for the Lower Meramec System are outlined in Section 4.2 of this report.
    - **Agricultural and silvicultural.** This is not applicable, as the proposed amendments included in this report do not impact or suggest changes to existing plan requirements.
    - **Mines.** This is not applicable, as the proposed amendments included in this report do not impact or suggest changes to existing plan requirements.
    - **Construction.** This is not applicable, as the proposed amendments included in this report do not impact or suggest changes to existing plan requirements.
    - **Saltwater intrusion.** This is not applicable, as the proposed amendments included in this report do not impact or suggest changes to existing plan requirements.
    - **Urban stormwater.** This is not applicable, as the proposed amendments included in this report do not impact or suggest changes to existing plan requirements.

5) **Identify management agencies necessary to carry out the plan.** As discussed throughout the report, the management agencies responsible for implementing the 208 Plan and associated amendments described include the East-West Gateway Council of Governments, Metropolitan St. Louis Sewer District, Northeast Public Sewer District, and Rock Creek Public Sewer District.

6) **Identify implementation measures necessary to carry out the plan, including financing, the time needed to carry out the plan, and the economic, social and environmental impact of carrying out the plan.**
    - Financing – Although the proposed amendment will save the agencies and their customers $253 million, the cost to implement the plan is still extensive. The agencies will work with their financial advisors and boards of directors to develop and pursue long-term financing strategies and tools that facilitate successful implementation of the amended plan, as proposed. Financing will likely include a combination of municipal bonds, loans, and pay as you go rates.
    - Point Source Amendment Timelines – Implementation timelines are included in the attached report for each agency as follows:
        - MSD – Section 2.1.4 describes planned Lower Meramec Tunnel and WWTP project timelines
        - NPSD – Section 2.2.2 describes planned biosolids improvement timelines. Section 2.2.3 describes future improvements that may be pursued as needs are identified.
        - RCPSD – Section 2.3.2 describes potential future improvements. RCPSD is still working to develop the facility plan amendment that will inform future implementation schedules.
    - Sludge Management Amendment Implementation Timelines – Implementation timelines are included in the attached report for each agency as follows:

    - MSD – Section 4.2.1 describes planned Bissel Point and Lemay WWTF project timelines.
    - NPSD and RCPSD – These agencies will continue their current sludge management activities.
- Economic and Social Impacts – The economic impacts are addressed in Section 4.2.1. The proposed amendment will result in a cost savings of $253 million.
- Environmental Impacts – The water quality impacts are addressed in Section 3. The analysis shows that the point sources meet their discharge limits and do not contribute to water quality impairments in the Meramec River.

7) **Identify and develop programs for the control of dredge or fill material.** This is not applicable, as the proposed amendments included in this report do not impact or suggest changes to existing dredge or fill requirements.

8) **Identify any relationship to applicable basin plans developed under section 209 of the Clean Water Act.** Section 209 of the Clean Water Act encourages basin-wide planning through coordination of area-wide plans developed under Section 208, facility plans developed under Section 201, or water quality standards implementation plans developed under Section 303. The relationship of the proposed amendment to the existing 201 Facility Plan for the Lower Meramec System is described in Section 1.2 of this report. Recent facility planning efforts for the individual sewer districts are also described in Sections 2.1, 2.2.1, and 2.3.1. Once approved, the 201 Facility Plan for the Lower Meramec System will be updated to reflect the amended 208 Plan. MDNR's approach to 209

9) **Identify and develop programs for control of ground-water pollution.** This is not applicable, as the proposed amendments included in this report do not impact groundwater or suggest changes to any existing groundwater requirements.

Missouri Clean Water Commission Meeting
Elm Street Conference Center
Bennett Springs / Roaring River Conference Rooms
Jefferson City, MO 65101
July 22, 2019

Proposed 2020 Listing Methodology Document

Issue: The Listing Methodology Document (LMD) is the document that describes how the Missouri Department of Natural Resources will use water quality data to determine if waters of the state are impaired. Department staff meet with stakeholders and other interested members of the public approximately every two years to revise this document as needed.

Background: The Department has a public participation process for revision of the 303(d) LMD. The draft 2020 LMD was placed on public notice February 1 through April 3, 2019. A summary of the public availability meetings held on February 22 and March 15, 2019, are available in the commission packet as well as on the Department's website: http://dnr.mo.gov/env/wpp/waterquality/303d/303d.htm.

The draft 2020 LMD is a revision of the 2020 LMD approved by the Commission on July 16, 2018. The April 4, 2019, revision of the 2020 LMD includes changes relating to the 13-step process for identifying candidate reference streams for the purposes of biological assessment. These revisions involve reordering step 10 and the inclusion of land use considerations into the 13-step process. Additionally the assessment of test streams against candidate reference streams was revised.

Public Comment: All public comments and the Department's responses are part of the administrative record for the LMD. Comments and responses are available on the Department's website. Comments were received from 13 different parties.

Summary of Department actions as a result of public comments:

1. The Department will clarify that fIBI metrics only apply to the Ozarks ecoregion on page 28.
2. The Department will change the word "robust" to "scientifically defensible" on page 29.
3. The Department will remove the following sentence from page 29, "These candidate reference streams will be used to create EDU specific localized criteria until EDU wide criteria are developed."
4. The Department will change the procedure for proposing changes to the LMD.
    a. The Department will have a 30 day public comment period to request topics to be considered for change or addition to the LMD.
    b. Based on the responses received, the Department will hold public work group meetings for in-depth topics. Topics and meeting dates will be announced publicly and on the Departments website after the 30 day comment period.

c. Any minor grammatical or clarification changes, as well as changes resulting from the work group meetings, will be public noticed for 60 days.

Recommended Action: Approval of the proposed 2020 LMD incorporating changes as a result of public comments is requested.

Suggested Motion Language: None

List of Attachments:

- Proposed 2020 303(d) LMD. Changes are shown in-line.
- Summaries of Public Availability Meeting discussions held on February 22 and March 15, 2019.
- Summary of public comments received as well as the Department's responses to those comments.
- All public comments received.

Methodology for the Development of the 2020 Section 303(d) List in Missouri

~~Approved by the Clean Water Commission on July 16, 2018~~

~~September 20~~Final

~~January 29, 2019, 2018.~~ April 4, 2019

Missouri Department of Natural Resources
Division of Environmental Quality
Water Protection Program

MISSOURI
DEPARTMENT OF
NATURAL RESOURCES

Table of Contents

I. Citation and Requirements 1
A. Citation of Section of Clean Water Act 1
B. U.S. EPA Guidance 1
II. The Methodology Document 7
A. Procedures and Methods Used to Collect Water Quality Data 7
- Department Monitoring 7
- Coordination with Other Monitoring Efforts in Missouri 7
- Existing Monitoring Networks and Programs 7
- Identification of All Existing and Readily Available Water Quality Data Sources 11
- Laboratory Analytical Support 12

B. Sources of Water Quality Data 13
C. Data Quality Considerations 15
D. How Water Quality Data is Evaluated to Determine Whether or Not Waters are Impaired for 303(d) Listing Purposes 19
I. Physical, Chemical, Biological and Toxicity Data 19
II. Weight of Evidence Approach 19
III. Biological Data 20
IV. Other Biological Data ..... 39~~38~~
V. Toxic Chemicals ..... 40~~39~~
VI. Duration of Assessment Period ..... 44~~43~~
VII. Assessment of Tier Three Waters ..... 44~~43~~
VIII. Other Types of Information ..... 45~~44~~
E. Other 303(d) Listing Considerations ..... 46~~45~~
F. Prioritization of Waters for TMDL Development ..... 47~~46~~
G. Resolution of Interstate/International Disagreements ..... 47~~46~~
H. Statistical Considerations ..... 47~~46~~
- Description of Analytical Tools ..... 48~~47~~
- Rationale for the Burden-of-Proof ..... 48~~47~~
- Level of Significance Used in Tests ..... 49~~48~~
- Use of the Binomial Probability Distribution for Interpretation of the 10 Percent Rule ..... 49~~48~~
- Other Statistical Considerations ..... 50~~49~~
- Examples of Statistical Procedures ..... 50~~49~~

I. References ..... 52~~51~~
Appendix A ..... 54~~53~~
Appendix B ..... 57~~56~~
Appendix C ..... 61~~60~~
Appendix D ..... 66~~65~~
Appendix E 72
Appendix F 74

I. Citation and Requirements

A. Citation of Section of Clean Water Act

The Missouri Department of Natural Resources (MDNR) is responsible for the implementation and administration of the Federal Clean Water Act in Missouri. Pursuant to Section 40 CFR 130.7, States, Territories or authorized Tribes must submit biennially to the United States Environmental Protection Agency (EPA) a list of water quality limited (impaired) segments, pollutants causing impairment, and the priority ranking of waters targeted for Total Maximum Daily Load (TMDL) development. Federal regulation at 40 CFR 130.7 also requires States, Territories, and authorized Tribes to submit to EPA a written methodology document describing the State's approach in considering, and evaluating existing readily available data used to develop their 303(d) list of impaired water bodies. The listing methodology must be submitted to the EPA each year the Section 303(d) list is due. While EPA does not approve or disapprove the listing methodology, the agency considers the methodology during its review of the states 303(d) impaired waters list and the determination to list or not to list waters.

Following the Missouri Clean Water Commission approval, Section 303(d) is submitted to EPA. This fulfills Missouri's biennial submission requirements of an integrated report required under Sections 303(d), 305(b) and 314 of the Clean Water Act. In years when no integrated report is submitted, the department submits a copy of its statewide water quality assessment database to EPA.

B. U.S. EPA Guidance

In 2001 the Office of General Counsel and the Office of Wetlands, Oceans, and Watersheds developed a recommended framework to assist EPA regions in the preparation of their approval letters for the States' 2002 Section 303(d) list submissions. This was to provide consistency in making approval decisions along with guidance for integrating the development and submission of the 2002 Section 305(b) water quality reports and Section 303(d) list of impaired waters[1].

The following sections provide an overview of EPA Integrated Report guidance documents from calendar year 2002 through 2015.

The 2002 Integrated Water Quality Monitoring and Assessment Report Guidance was the first document EPA provided to the States, Territories, and authorized Tribes with directions on how to integrate the development and submission of the 2002 305(b) water quality reports and Section 303(d) list of impaired waters.

The guidance recommended that States, Territories and authorized Tribes submit a combined integrated report that would satisfy the Clean Water Act requirements for both Section 305(b) water quality reports and Section 303(d) list. The 2002 Integrated Report was to include:

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[1] Additional information can be obtained from EPA's website: http://water.epa.gov/lawsregs/lawsguidance/cwa/tmdl/guidance.cfm).

- Delineation of water quality assessment units based on the National Hydrography Dataset (NHD);
- Status of and progress toward achieving comprehensive assessments of all waters;
- Water quality standard attainment status for every assessment unit;
- Basis for the water quality standard attainment determinations for every assessment unit;
- Additional monitoring that may be needed to determine water quality standard attainment status and, if necessary, to support development of total maximum daily loads (TMDLs) for each pollutant/assessment unit combination;
- Schedules for additional monitoring planned for assessment units;
- Pollutant/assessment unit combinations still requiring TMDLs; and
- TMDL development schedules reflecting the priority ranking of each pollutant/ assessment unit combination.

The 2002 EPA guidance described the requirements under Section 303(d) of the Clean Water Act where states were required to describe the methodology used to develop their 303(d) list. EPA's guidance recommended the states provide: (1) a description of the methodology used to develop Section 303(d) list; (2) a description of the data and information used to identify impaired and threatened waters; (3) a rationale for not using any readily available data and information; and (4) information on how interstate or international disagreements concerning the list are resolved. Lastly (5), it is recommended that "prior to submission of its Integrated Report, each state should provide the public the opportunity to review and comment on the methodology." In accordance with EPA guidance, the department reviews and updates the Listing Methodology Document (LMD) every two years. The LMD is made available to the public for review and comment at the same time the state's 303(d) impaired waters list is published for public comment. Following the public comment period, the department responds to public comments and provides EPA with a document summarizing all comments received.

In July 2003, EPA issued new guidance entitled "Guidance for 2004 Assessment, Listing and Reporting Requirements Pursuant to Sections 303(d) and 305(b) of the Clean Water Act." This guidance gave further recommendations about listing of 303(d) and other waters.

In July 2005, EPA published an amended version entitled "Guidance for 2006 Assessment, Listing and Reporting Requirements Pursuant to Sections 303(d), 305(b) and 314 of the Clean Water Act" (see Appendix A for Excerpt).

In October 2006, EPA issued a memorandum entitled "Information Concerning 2008 Clean Water Act Sections 303(d), 305(b) and 314 Integrated Reporting and Listing Decisions." This memorandum serves as EPA's guidance for the 2008 reporting cycle and beyond. This guidance recommended the use of a five-part categorization scheme and that each state provides a comprehensive description of the water quality standards attainment status of all segments within a state (reference Table 1 below). The guidance also defined a "segment" as being used synonymous with the term "assessment unit" used in previous Integrated Report Guidance. Overall, the selected segmentation approach should be consistent with the state's water quality standards and be capable of providing a spatial scale that is adequate to characterize the water quality standards attainment status for the segment.

It was in the 2006 guidance that EPA recommended all waters of the state be placed in one of five categories described below.

Table 1. Placement of Waters within the Five Categories in the 2006[2] EPA Assessment, Listing and Reporting Guidance

Category 1	All designated uses are fully maintained. Data or other information supporting full use attainment for all designated uses must be consistent with the state's Listing Methodology Document (LMD). The department will place a water in Category 1 if the following conditions are met: • The water has physical and chemical data (at a minimum, water temperature, pH, dissolved oxygen, ammonia, total cobalt, and total copper for streams, and total nitrogen, total phosphorus and secchi depth for lakes) and biological water quality data (at a minimum, *E. coli* or fecal coliform bacteria) that indicates attainment with water quality standards. • The level of mercury in fish fillets or plugs used for human consumption is 0.3 mg/kg (wet weight) or less. Only samples of higher trophic level species (largemouth, smallmouth and spotted bass, sauger, walleye, northern pike, trout (rainbow and trout), striped bass, white bass, flathead catfish and blue catfish) will be used. • The water is not rated as "threatened."
Category 2	One or more designated uses are fully attained but at least one designated use has inadequate data or information to make a use attainment decision consistent with the state's LMD. The department will place a water in Category 2 if at least one of the following conditions are met: • There is inadequate data for water temperature, pH, dissolved oxygen, ammonia, total cobalt or total copper in streams to assess attainment with water quality standards or inadequate data for total nitrogen, total phosphorus or secchi depth in lakes. • There is inadequate *E. coli* or fecal coliform bacteria data to assess attainment of the whole body contact recreational use. • There are insufficient fish fillet, tissue, or plug data available for mercury to assess attainment of the fish consumption use. Category 2 waters will be placed in one of two sub-categories. Category 2A: Waters will be placed in this category if available data, using best professional judgement, suggests compliance with numerical water quality criteria of Tables A or B in Missouri's Water Quality Standards (10 CSR 20-7.031) or other quantitative thresholds for determining use attainment.

[2] http://www.epa.gov/sites/production/files/2015-10/documents/2006irg-report.pdf

	Category 2B: Waters will be placed in this category if the available data, using best professional judgment, suggests noncompliance with numeric water quality criteria of Tables A or B in Missouri's Water Quality Standards, or other quantitative thresholds for determining use attainment, and these data are insufficient to support a statistical test or to qualify as representative data. Category 2B waters will be given high priority for additional water quality monitoring.
Category 3	Water quality data are not adequate to assess any of the designated beneficial uses consistent with the LMD. The department will place a water in Category 3 if data are insufficient to support a statistical test or to qualify as representative data to assess any of the designated uses. Category 3 waters will be placed in one of two sub-categories. Category 3A. Waters will be placed in this category if available data, using best professional judgment, suggests compliance with numerical water quality criteria of Tables A or B in Missouri's Water Quality Standards (10 CSR 20-7.031) or other quantitative thresholds for determining use attainment. Category 3A waters will be tagged for additional water quality monitoring, but will be given lower priority than Category 3B waters. Category 3B. Waters will be placed in this category if the available data, using best professional judgment, suggest noncompliance with numerical water quality criteria of Tables A or B in Missouri's Water Quality Standards or other quantitative thresholds for determining use attainment. Category 3B waters will be given high priority for additional water quality monitoring.
Category 4	State water quality standards or other criteria, as per the requirements of Appendix B & C of this document, are not attained, but a Total Maximum Daily Load (TMDL) study is not required. Category 4 waters will be placed in one of three sub-categories. Category 4A. EPA has approved a TMDL study that addresses the impairment. The department will place a water in Category 4A if both the following conditions are met: • Any portion of the water is rated as being in non-attainment with state water quality standards or other criteria as explained in

	Appendix B & C of this document due to one or more discrete pollutants or discrete properties of the water[3], and • EPA has approved a TMDL for all pollutants that are causing non-attainment. Category 4B. Water pollution controls required by a local, state or federal authority, are expected to correct the impairment in a reasonable period of time. The department will place a water in Category 4B if **both** of the following conditions are met: • Any portion of the water is rated as being in non-attainment with state water quality standards or other criteria as explained in Appendix B & C of this document due to one or more discrete pollutants or discrete properties of water[3], and • A water quality based permit that addresses the pollutant(s) causing the designated use, impairment has been issued, and compliance with the permit limits will eliminate the impairment; or other pollution control requirements have been made that are expected to adequately address the pollutant(s) causing the impairment. This may include implemented voluntary watershed control plans as noted in EPA's guidance document. Category 4C. Any portion of the water is rated as being in non-attainment with state water quality standards or other criteria as explained in Appendix B & C of this document, and a discrete pollutant(s) or other discrete property of the water[3] does not cause the impairment. Discrete pollutants may include specific chemical elements (e.g., lead, zinc), chemical compounds (e.g., ammonia, dieldrin, atrazine) or one of the following quantifiable physical, biological or bacteriological conditions: water temperature, percent of gas saturation, amount of dissolved oxygen, pH, deposited sediment, toxicity or counts of fecal coliform or *E. coli* bacteria.
Category 5	At least one discrete pollutant has caused non-attainment with state water quality standards or other criteria as explained in Appendix B & C of this document, and the water does not meet the qualifications for listing as either Categories 4A or 4B. Category 5 waters are those that are candidates for the state's 303(d) List[4].

[3] A discrete pollutant or a discrete property of water is defined here as a specific chemical or other attribute of the water (such as temperature, dissolved oxygen or pH) that causes beneficial use impairment and that can be measured quantitatively.
[4] The proposed state 303(d) List is determined by the Missouri Clean Water Commission and the final list is determined by the U.S. Environmental Protection Agency.

	If a designated use is not supported and the segment is impaired or threatened, the fact that a specific pollutant is not known does not provide a basis for excluding a segment from Category 5. Category 5. These segments must be listed as Category 5 unless the state can demonstrate that no discrete pollutant(s) causes or contributes to the impairment. Pollutants causing the impairment will be identified through the 303(d) assessment and listing process before a TMDL study is written. The TMDL should be written within the time frame preferred in EPA guidance for TMDL development, when it fits within the state's TMDL prioritization scheme. Category 5-alt. A water body assigned to 5-alt is an impaired water without a completed TMDL but assigned a low priority for TMDL development because an alternative restoration approach is being pursued. This also provides transparency to the public that a state is pursuing restoration activities in those waters to achieve water quality standards. The addition of this sub-category will facilitate tracking alternative restoration approaches in 303(d) listed waters in priority areas.
Threatened Waters	When a water is currently attaining all designated uses, but the data shows an inverse (time) trend in quality for one or more discrete water quality pollutants indicating the water will not continue to meet these uses before the next listing cycle. Such water will be considered "threatened." A threatened water will be treated as an impaired water and placed in the appropriate Category (4A, 4B, or 5).

In subsequent years, EPA has provided additional guidance, but only limited new supplemental information has been provided since the 2008 cycle.

In August 2015, the EPA provided draft guidance that would include a Category 5-alternative (5-alt) (reference Table 1 above). Additional information can be found at EPA's website: http://water.epa.gov/lawsregs/lawsguidance/cwa/tmdl/guidance.cfm.

II. The Methodology Document

A. Procedures and Methods Used to Collect Water Quality Data

- Department Monitoring

The major purposes of the department's water quality monitoring program are to:

- characterize background or reference water quality conditions;
- better understand daily, flow event and seasonal water quality variations and their underlying processes;
- characterize aquatic biological communities;
- assess trends in water quality;
- characterize local and regional effects of point and nonpoint sources pollutants on water quality;
- check for compliance with water quality standards and/or wastewater permit limits;
- support development of strategies, including Total Maximum Daily Loads, to return impaired waters to compliance with Water Quality Standards. All of these objectives are statewide in scope.

- Coordination with Other Monitoring Efforts in Missouri

To maximize efficiency, the department routinely coordinates its monitoring activities with other agencies to avoid overlap, and to give and receive feedback on monitoring design. Data from other sources are used for meeting the same objectives as department-sponsored monitoring. The data must fit the criteria described in the data quality considerations section of this document. The agencies most often involved are the U.S. Geological Survey, the U.S. Army Corps of Engineers, EPA, the Missouri Department of Conservation (MDC), and the Missouri Department of Health and Senior Services. The Department of Natural Resources also tracks the monitoring efforts of the National Park Service; the U.S. Forest Service; several of the state's larger cities; the states of Oklahoma, Arkansas, Kansas, Iowa, and Illinois; and graduate level research conducted at universities within Missouri. For those wastewater discharges where the department has required instream water quality monitoring, the department may also use monitoring data acquired by wastewater dischargers as a condition of discharge permits issued by the department. In 1995, the department also began using data collected by volunteers that have passed Volunteer Water Quality Monitoring Program Quality Assurance/Quality Control tests.

- Existing Monitoring Networks and Programs

The following is a list and a brief description of the kinds of water quality monitoring activities presently occurring in Missouri.

1. Fixed Station Network

a) Objective: To better characterize background or reference water quality conditions, to better understand daily, flow events, and seasonal water quality variations and their underlying processes, to assess trends and to check for compliance with water quality standards.

b) Design Methodology: Sites are chosen based on one of the following criteria:
- Site is believed to have water quality representative of many neighboring streams of similar size due to similarity in watershed geology, hydrology and land use, and the absence of any impact from a significant point or discrete nonpoint water pollution source.
- Site is downstream of a significant point source or discrete nonpoint source area.

c) Number of Sites, Sampling Methods, Sampling Frequency, and Parameters:
- MDNR/U.S. Geological Survey cooperative network: approximately 70 sites statewide, horizontally and vertically integrated grab samples, four to twelve times per year. Samples are analyzed for major ions (e.g. calcium, magnesium, sulfate, and chloride), nutrients (e.g. phosphorus and nitrogen), temperature, pH, dissolved oxygen, specific conductance, bacteria (e.g. *Escherichia coli (E. coli)* and fecal coliform) and flow on all visits, two to four times annually for suspended solids and heavy metals, and for pesticides six times annually at four sites.
- MDNR/University of Missouri-Columbia's lake monitoring network. This program has monitored about 249 lakes since 1989. About 75 lakes are monitored each year. Each lake is usually sampled four times during the summer and about 12 are monitored spring through fall for nutrients, chlorophyll, turbidity and suspended solids.
- Department routine monitoring of finished public drinking water supplies for bacteria and trace contaminants.
- Routine bacterial monitoring for *E. coli* of swimming beaches at Missouri's state parks during the recreational season by the department's Missouri State Parks.
- Monitoring of sediment quality by the department at approximately 10-12 discretionary sites annually. Sites are monitored for several heavy metals (e.g. arsenic, cadmium, copper, lead, mercury, nickel, zinc, etc.) and/or organic contaminants (e.g. polycyclic aromatic hydrocarbons, etc.).

2. Special Water Quality Studies

a) Objective: Special water quality studies are used to characterize water quality effects from a specific pollutant source area.

b) Design Methodology: These studies are designed to verify and measure the contaminants of concern based on previous water quality studies, effluent sampling and/or Missouri State Operating Permit applications. These studies employ multiple sampling stations downstream and upstream (if appropriate). If contaminants of concern have significant seasonal or daily variation, the sampling design must account for such variation.

c) Number of Sites, Sampling Methods, Sampling Frequency and Parameters: The department conducts or contracts up to 10 to 15 special studies annually, as funding allows. Each study has multiple sampling sites. The number of sites, sampling frequency and parameters all vary greatly depending on the study. Intensive studies would also require multiple samples per site over a relatively short time frame.

3. Toxics Monitoring Program

The fixed station network and many of the department's intensive studies monitor for acute and chronic toxic chemicals[5]. In addition, major municipal and industrial dischargers must monitor for acute and chronic toxicity in their effluents as a condition of their Missouri State Operating Permit.

4. Biological Monitoring Program

a) Objectives: The objectives of the Biological Monitoring programs are to develop numeric criteria describing "reference" aquatic macroinvertebrate and fish communities in Missouri's streams, to implement these criteria within state water quality standards and to maintain a statewide fish and aquatic macroinvertebrate monitoring program.

b) Design Methodology: Development of biocriteria for fish and aquatic marcoinvertebrates[6] involves identification of reference streams in each of Missouri's aquatic ecoregions and 17 ecological drainage units, respectively. It also includes intensive sampling of invertebrate and fish communities to quantify temporal and spatial variation in reference streams within ecoregions and variation among ecoregions, and the sampling of chemically and physically impaired streams to assess the aquatic community.

c) Number of Sites, Sampling Methods, Sampling Frequency and Parameters: The department has conducted biological sampling of aquatic macroinvertebrates for many years. Since 1991, the department's aquatic macroinvertebrate monitoring program has consisted of standardized monitoring of approximately 45 to 55 sites twice annually. In addition, the MDC presently has a statewide fish and aquatic macroinvertebrate monitoring program, the Resource Assessment and Monitoring (RAM) Program, designed monitor and assess the health of Missouri's stream resources on a rotating basis. This program samples a minimum of 450 random and 30 reference sites every five years.

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[5] As defined in 10 CSR 20-7.031(1)
[6] For additional information visit: http://dnr.mo.gov/env/esp/wqm/biologicalassessments.htm

5. Fish Tissue Monitoring Program

a) Objective: Fish tissue monitoring addresses two objectives: (1) the assessment of ecological health or the health of aquatic biota (usually accomplished by monitoring whole fish samples); and (2) the assessment of human health risk based on the level of contamination of fish tissue plugs, or fillets.

b) Design Methodology: Fish tissue monitoring sites are chosen based on one of the following criteria:
- Site is believed to have water and sediment quality representative of many neighboring streams or lakes of similar size due to similarity in geology, hydrology and land use, and the absence of any known impact from a significant point source or discrete nonpoint water pollution source.
- Site is downstream of a significant point source or discrete nonpoint source area.
- Site has shown fish tissue contamination in the past.

c) Number of Sites, Sampling Methods, Sampling Frequency and Parameters:

The department plans to maintain a fish tissue monitoring program to collect whole fish composite samples[7] at approximately 13 fixed sites. In previous years, this was a cooperative effort between EPA and the department through EPAs Regional Ambient Fish Tissue (RAFT) Monitoring Program. Each site will be sampled once every two years. The preferred species for these sites are either Common Carp (*Cyprinus carpio*) or one of the Redhorse (a.k.a. sucker) species (*Moxostoma* sp.).

The department, EPA, and MDC also sample 40 to 50 discretionary sites annually for two fish fillet composite samples or fish tissue plug samples (mercury only) from fish of similar size and species. One sample is of a top carnivore such as Largemouth Bass (*Micropterus salmoides*), Smallmouth Bass (*Micropterus dolomieu*), Walleye (*Sander vitreus*), or Sauger (*Sander canadensis*). The other sample is for a species of a lower trophic level such as catfish, Common Carp or sucker species (Catostomidae). This program occasionally samples fish eggs for certain fish species at selected locations. Both of these monitoring programs analyze for several chlorinated hydrocarbon insecticides, PCBs, lead, cadmium, mercury, and fat content.

6. Volunteer Monitoring Program

Two major volunteer monitoring programs generate water quality data in Missouri. The data generated from these programs are used for statewide 305(b) reporting on general water quality health, used as a screening level tool to determine where additional monitoring is needed, or used to supplement other water quality data for watershed planning purposes.

- Lakes of Missouri Volunteer Program[8]. This cooperative program consists of persons from the department, the University of Missouri-Columbia, and volunteers who monitor

[7] A composite sample is one in which several individual fish are combined to produce one sample.
[8] For additional program information visit: http://www.lmvp.org/

approximately 137 sites on 66 lakes, including Lake Taneycomo, Table Rock Lake and several lakes in the Kansas City area. Lake volunteers are trained to collect samples for total phosphorus, total nitrogen, chlorophyll and inorganic suspended sediments. Data from this program is used by the university as part of a long-term study on the limnology of mid-western reservoirs.

- Volunteer Water Quality Monitoring Program. The Volunteer Water Quality Monitoring Program[9] is an activity of the Missouri Stream Team Program, which is a cooperative project sponsored by the department, the Missouri Department of Conservation, and the Conservation Federation of Missouri. The program involves volunteers who monitor water quality of streams throughout Missouri. There are currently over 5,000 Stream Teams and more than 3,600 trained water quality monitors. Approximately 80,000 citizens are served each year through the program. Since the beginning of the Stream Team program, 494,232 volunteers have donated about 2 million hours valued at more than $38 million to the State of Missouri.

  After the Introductory class, many attend at least one more class of higher level training: Levels 1, 2, 3 and 4. Each level of training is a prerequisite for the next higher level, as is appropriate data submission. Data generated by Levels 2, 3, and 4 and the Cooperative Stream Investigation (CSI) Program volunteers represent increasingly higher quality assurance. For CSI projects, the volunteers have completed a quality assurance/quality control workshop, completed field evaluation, and/or have been trained to collect samples following department protocols. Upon completing Introductory and Level 1 and 2 training, volunteers will have received the basic level training to conduct visual stream surveys, stream discharge measurements, biological monitoring, and collect physical and chemical measurements for pH, conductivity, dissolved oxygen, nitrate, and turbidity.

  Of those completing an Introductory course, about 35 percent proceed to Levels 1 and 2. The CSI Program uses trained volunteers to collect samples and transport them to laboratories approved by the department. Volunteers and department staff work together to develop a monitoring plan. All Level 2, 3, and 4 volunteers, as well as all CSI trained volunteers, are required to attend a validation session every 3 years to ensure equipment, reagents and methods meet program standards.

- <u>Identification of All Existing and Readily Available Water Quality Data Sources</u>

Data Solicitation Request

In the calendar year 2 years prior to the current listing cycle, the department sends out a request for all available water quality data (chemical and biological). The data solicitation requests water quality data for approximately a two year timeframe prior to and including the current calendar year (up to October 31st of the current year). The data solicitation request is sent to multiple agencies, neighboring states, and organizations. In addition, and

[9] For additional program information visit: http://dnr.mo.gov/env/wpp/VWQM.htm

as part of the data solicitation process, the department queries available water quality data from national databases such as EPA's Storage and Retrieval (STORET)/Water Quality Exchange (WQX) data warehouse[10], and the USGS Water Quality Portal[11].

The data must be spatially and temporally representative of the actual annual ambient conditions of the water body. Sample locations should be characteristic and representative of the main water mass or distinct hydrologic areas. With the exception of the data collected for those designated uses that require seasonally based data (e.g., whole body contact recreation, biological community data, and critical season dissolved oxygen), data should be distributed over at least three seasons, over two years, and should not be biased toward specific conditions (such as runoff, season, or hydrologic conditions).

Data meeting the following criteria will be accepted.

- Samples must be collected and analyzed under a Quality Assurance/Quality Control (QA/QC) protocol that follows the EPA requirements for quality assurance project plans.
- Samples must be analyzed following protocols that are consistent with the EPA or Standard Method procedures.
- All data submitted must be accompanied by a copy of the organization's QA/QC protocol and standard operating procedures.
- All data must be reported in standard units as recommended in the relevant approved methods.
- All data must be accompanied by precise sample location(s), preferably in either decimal degrees or Universal Transverse Mercator (UTM).
- All data must be received in a Microsoft Excel or compatible format.
- All data must have been collected within the requested period of record.

All readily available and acceptable data are uploaded into the department's Water Quality Assessment Database[12], where the data undergoes quality control checks prior to 303(d) or 305(b) assessment processes.

- Laboratory Analytical Support

Laboratories used:

- Department/U.S. Geological Survey Cooperative Fixed Station Network: U.S. Geological Survey Lab, Denver, Colorado
- Intensive Surveys: Varies, many are done by the department's Environmental Services Program
- Toxicity Testing of Effluents: Many commercial laboratories

[10] http://www.epa.gov/storet/dw_home.html
[11] http://www.waterqualitydata.us/
[12] http://dnr.mo.gov/mocwis_public/wqa/water bodySearch.do

- Biological Criteria for Aquatic Macroinvertebrates: department's Environmental Services Program and Missouri Department of Conservation
- Fish Tissue: EPA Region VII Laboratory, Kansas City, Kansas, and miscellaneous contract laboratories (Missouri Department of Conservation or U.S. Geological Survey's Columbia Environmental Research Center)
- Missouri State Operating Permit: Self-monitoring or commercial laboratories
- Department's Public Drinking Water Monitoring: department's Environmental Services Program and commercial laboratories[13]
- Other water quality studies: Many commercial laboratories

B. Sources of Water Quality Data

The following data sources are used by the department to aid in the compilation of the state's integrated report (previously the 305(b) report). Where quality assurance programs are deemed acceptable, additional sources would also be used to develop the state's Section 303(d) list. These sources presently include, but are not limited to:

1. Fixed station water quality and sediment data collected and analyzed by the department's Environmental Services Program personnel.
2. Fixed station water quality data collected by the U.S. Geological Survey under contractual agreements with the department.
3. Fixed station water quality data collected by the U.S. Geological Survey under contractual agreements to agencies or organizations other than the department.
4. Fixed station water quality, sediment quality, and aquatic biological information collected by the U.S. Geological Survey under their National Stream Quality Accounting Network and the National Water Quality Assessment Monitoring Programs.
5. Fixed station raw water quality data collected by the Kansas City Water Services Department, the St. Louis City Water Company, the Missouri American Water Company (formerly St. Louis County Water Company), Springfield City Utilities, and Springfield's Department of Public Works.
6. Fixed station water quality data collected by the U.S. Army Corps of Engineers. The Kansas City, St. Louis, and Little Rock Corps Districts have monitoring programs for Corps-operated reservoirs in Missouri.
7. Fixed station water quality data collected by the Arkansas Department of Environmental Quality, the Kansas Department of Health and Environment, the Iowa Department of Natural Resources, and the Illinois Environmental Protection Agency.
8. Fixed station water quality monitoring by corporations.
9. Annual fish tissue monitoring programs by EPA/Department RAFT Monitoring Program and MDC.
10. Special water quality surveys conducted by the department. Most of these surveys are

[13] For additional information visit: http://dnr.mo.gov/env/wpp/labs/

focused on the water quality impacts of specific point source wastewater discharges. Some surveys are of well-delimited nonpoint sources such as abandoned mined lands. These surveys often include physical habitat evaluation and monitoring of aquatic macroinvertebrates as well as water chemistry monitoring.

11. Special water quality surveys conducted by U.S. Geological Survey, including but not limited to:
    a) Geology, hydrology and water quality of various hazardous waste sites,
    b) Geology, hydrology and water quality of various abandoned mining areas,
    c) Hydrology and water quality of urban nonpoint source runoff in metropolitan areas of Missouri (e.g. St. Louis, Kansas City, and Springfield), and
    d) Bacterial and nutrient contamination of streams in southern Missouri.
12. Special water quality studies by other agencies such as MDC, the U.S. Public Health Service, and the Missouri Department of Health and Senior Services.
13. Monitoring of fish occurrence and distribution by MDC.
14. Fish Kill and Water Pollution Investigations Reports published by MDC.
15. Selected graduate research projects pertaining to water quality and/or aquatic biology.
16. Water quality, sediment, and aquatic biological data collected by the department, EPA or their contractors at hazardous waste sites in Missouri.
17. Self-monitoring of receiving streams by cities, sewer districts and industries, or contractors on their behalf, for those discharges that require this kind of monitoring. This monitoring includes chemical and sometimes toxicity monitoring of some of the larger wastewater discharges, particularly those that discharge to smaller streams and have the greatest potential to affect instream water quality.
18. Compliance monitoring of receiving waters by the department and EPA. This can include chemical and toxicity monitoring.
19. Bacterial monitoring of streams and lakes by county health departments, community lake associations, and other organizations using acceptable analytical methods.
20. Other monitoring activities done under a quality assurance project plan approved by the department.
21. Fixed station water quality and aquatic macroinvertebrate monitoring by volunteers who have successfully completed the Volunteer Water Quality Monitoring Program Level 2 workshop. Data collected by volunteers who have successfully completed a training Level 2 workshop is considered to be Data Code One. Data generated from Volunteer Training Levels 2, 3 and 4 are considered "screening" level data and can be useful in providing an indication of a water quality problem. For this reason, the data are eligible for use in distinguishing between waters in Categories 2A and 2B or Categories 3A and 3B. Most of this data are not used to place waters in main Categories (1, 2, 3, 4, and 5) because analytical procedures do not use EPA or Standard Methods or other department approved methods. Data from volunteers who have not yet completed a Level 2 training

workshop do not have sufficient quality assurance to be used for assessment. Data generated by volunteers while participating in the department's Cooperative Site Investigation Program (Section II C1) or other volunteer data that otherwise meets the quality assurance outlined in Section II C2 may be used in Section 303(d) assessment.

The following data sources (22-23) **cannot** be used to rate a water as impaired (Categories 4A, 4B, 4C or 5); however, these data sources may be used to direct additional monitoring that would allow a water quality assessment for Section 303(d) listing.

22. Fish Management Basin Plans published by MDC.
23. Fish Consumption Advisories published annually by the Missouri Department of Health and Senior Services. Note: the department may use data from data source listed as Number 9 above, to list individual waters as impaired due to contaminated fish tissue.

As previously stated, the department will review all data of acceptable quality that are submitted to the department prior to the first public notice of the draft 303(d) list. However, the department will reserve the right to review and use data of acceptable quality submitted after this date if the data results in a change to the assessment outcome of the water.

C. Data Quality Considerations

- DNR Quality Assurance/Quality Control Program

  The department and EPA Region VII have completed a Quality Management Plan. All environmental data generated directly by the department, or through contracts funded by the department, or EPA require a Quality Assurance Project Plan[14]. The agency or organization responsible for collecting and/or analyzing environmental data must write and adhere to a Quality Assurance Project Plan approved through the department's Quality Management Plan. Any environmental data generated via a monitoring plan with a department approved Quality Assurance Project Plan are considered suitable for use in water quality assessment and the 303(d) listing. This includes data generated by volunteers participating in the department's CSI Program. Under this program, the department's Environmental Services Program will audit select laboratories. Laboratories that pass this audit will be approved for the CSI Program. Individual volunteers who collect field samples and deliver them to an approved laboratory must first successfully complete department training on how to properly collect and handle environmental samples. The types of information that will allow the department to make a judgment on the acceptability of a quality assurance program are: (1) a description of the training, and work experience of the persons involved in the program, (2) a description of the field meters and maintenance and calibration procedures, (3) a description of sample collection and handling procedures, and (4) a description of all analytical methods used in the laboratory for analysis.

[14] For additional information visit: http://www.epa.gov/quality/qapps.html

- Other Quality Assurance/Quality Control Programs

  Data generated in the absence of a department-approved Quality Assurance Project Plan may be used to assess a water body if the department determines that the data are adequate after reviewing and accepting the quality assurance procedures plan used by the data generator. This review would include: (1) names of all persons involved in the monitoring program, their duties, and a description of their training and work related experience, (2) all written procedures, Standard Operating Procedures, or Quality Assurance Project Plans pertaining to this monitoring effort, (3) a description of all field methods used, brand names and model numbers of any equipment, and a description of calibration and maintenance procedures, and (4) a description of laboratory analytical methods. This review may also include an audit by the department's Environmental Services Program.

- Data Qualifiers

  Data qualifiers will be handled in different ways depending upon the qualifier, the analytical detection limit, and the numeric WQS.

  - Less Than Qualifier "<" – For this qualifier the department will use half of the reported less than value. Unless circumstances cause issues with assessment. Examples of this include but are not limited to:
    - Less than values for bacteria. Since we calculate a geometric mean any value less than 1.0 could cause the data to be skewed if using the geometric mean calculation method of multiplying the values then dividing by the nth root.
    - Less than values below the criterion but still close to the criterion, less than values that are above the criterion. In these cases the department will not use the data for assessments.
  - Non-detection Qualifier "ND" – The department treats these same as less than ("<") qualifiers, with the exception that a value is not reported. For these cases the department will use the method detection limit as the reported less than value.
  - Greater Than Qualifier " >" – The department will only consider data with these qualifiers for assessments when it pertains to bacteria. In the cases of bacteria data the reported greater than (" >") value is doubled then used in the assessment calculation. In circumstances where this practice is the sole reason for impairment then the greater than value(s) will be used at the reported value (i.e. not doubled) in the assessment calculation.
  - Estimated Values "E" – These values are usually characterized as being above the laboratory quantification limit but below the laboratory reporting limit and are thus reported as estimated ("E"). Sometimes bacteria values are reported as estimated ("E") at the high end and due to the particular method used for analysis this usually means a dilution of the sample was used because the true bacteria count is higher than the method reporting maximum. The department will not use estimated ("E") values if the value reported is near the criterion. If the value is well above or well below the criterion then it will be used in assessments.

- Data Age

  For assessing present conditions, more recent data are preferable; however, older data may be used to assess present conditions if the data remains representative of present conditions.

  - If the department uses data older than seven years to make a Section 303(d) list decision a written justification for the use of such data will be provided.

  - If a water body has not been listed previously and all data indicating an impairment is older than 7 years, then the water body shall be placed into Category 2B or 3B and prioritized for future sampling.

  - A second consideration is the age of the data relative to significant events that may have an effect on water quality. Data collected prior to the initiation, closure, or significant change in a wastewater discharge, or prior to a large spill event or the reclamation of a mining or hazardous waste site, for example, may not be representative of present conditions. Such data would not be used to assess present conditions even if it was less than seven years old. Such "pre-event" data can be used to determine changes in water quality before and after the event or to show water quality trends.

- Data Type, Amount and Information Content

  EPA recommends establishing a series of data codes, and rating data quality by the kind and amount of data present at a particular location (EPA 1997[15]). The codes are single-digit numbers from one to four, indicating the relative degree of assurance the user has in the value of a particular environmental data set. Data Code One indicates the least assurance or the least number of samples or analytes and Data Code Four the greatest. Based on EPA's guidance, the department uses the following rules to assign code numbers to data.

  - Data Code[16] One: All data not meeting the requirements of the other data codes.

  - Data Code Two: Chemical data collected quarterly to bimonthly for at least three years, or intensive studies that monitor several nearby sites repeatedly over short periods of time, or at least three composite or plug fish tissue samples per water body, or at least five bacterial samples collected during the recreational season of one calendar year.

[15] *Guidelines for the Preparation of the Comprehensive State Water Quality Assessments (305b) and Electronic Updates*, 1997. (http://water.epa.gov/type/watersheds/monitoring/repguid.cfm)
[16] Data Code One is equivalent to data water quality assurance Level One in 10 CSR 20-7.050 General Methodology for Development of Impaired Waters List, subsection (2)(C), Data Code Two is equivalent to Level 2, etc.

- Data Code Three: Chemical data collected at least monthly for more than three years on a variety of water quality constituents including heavy metals and pesticides; or a minimum of one quantitative biological monitoring study of at least one aquatic assemblage (fish, macroinvertebrates, or algae) at multiple sites, multiple seasons (spring and fall), or multiple samples at a single site when data from that site is supported by biological monitoring at an appropriate control site.

- Data Code Four: Chemical data collected at least monthly for more than three years that provides data on a variety of water quality constituents including heavy metals and pesticides, and including chemical sampling of sediments and fish tissue; or a minimum of one quantitative biological monitoring study of at least two aquatic assemblages (fish, macroinvertebrates, or algae) at multiple sites.

In Missouri, the primary purpose of Data Code One data is to provide a rapid and inexpensive method of screening large numbers of waters for obvious water quality problems and to determine where more intensive monitoring is needed. In the preparation of the state's Integrated Report, data from all four data quality levels are used. Most of the data is of Data Code One quality, and without Data Code One data, the department would not be able to assess a majority of the state's waters.

In general, when selecting water bodies for the Missouri 303(d) List, only Data Code Two or higher are used, unless the problem can be accurately characterized by Data Code One data.[17] The reason is that Data Code Two data provides a higher level of assurance that a Water Quality Standard is not actually being attained and that a TMDL study is necessary. All water bodies placed in Categories 2 or 3 receive high priority for additional monitoring so that data quality is upgraded to at least Data Code Two. Category 2B and 3B waters will be given higher priority than Categories 2A and 3A.

EPA suggests that states use these codes as a way of describing the type of information collected, the frequency of collection, spatial/temporal coverage, and quality. Missouri has followed this guidance for the most part, but where Missouri differs is that we use the data codes to explain the type of information collected, the frequency it is collected, and the spatial/temporal coverage. For data quality the department reviews the data on a project specific basis and looks at the laboratory analysis and collection methods used to generate the data. If the data is of acceptable quality we mark the project and all of its underlying data as QA acceptable. We should only be using QA acceptable data for assessments, unless that data provides additional corroboration of impairment or attainment status.

[17] When a listing, amendment or delisting of a 303(d) water is made with only Data Code One data, a document will be prepared that includes a display of all data and a presentation of all statistical tests or other evaluative techniques that documents the scientific defensibility of the data. This requirement applies to all Data Code One data identified in Appendix B of this document.

- Dissolved Oxygen and Flow

Dissolved oxygen in streams is highly dependent on flow. For the assessment of streams dissolved oxygen measurements must be accompanied by a flow measurement taken on the same day as the dissolved oxygen measurement. The dissolved oxygen measurements must also be collected from the flowing portion of the stream and must not be influenced by flooding or backwater conditions.

- pH Data Considerations

The criterion for pH will be clarified at some point in the Missouri WQS as a chronic criterion. Assessment will be handled in the following ways:

- Continuous Sampling (i.e. time series or sonde data collection)
  - Data collected in a time series fashion will be looked at on a 4 day period. If an entire 4 day period is outside of the 6.5 – 9.0 criterion range that will count as a chronic toxicity event. More than one of these events will constitute an impairment listing of the stream.
- Grab Samples
  - Data collected as grab samples will be treated as is and the binomial probability calculation will be used for assessment. See Appendix D for further information.

D. How Water Quality Data is Evaluated to Determine Whether or Not Waters are Impaired for 303(d) Listing Purposes

I. Physical, Chemical, Biological and Toxicity Data

During each reporting cycle, the department and stakeholders review and revise the guidelines for determining water quality impairment. The guidelines shown in Appendix B & C provide the general rules of data use and assessment and Appendix D provides details about the specific analytical procedure used. In addition, if trend analysis indicates that presently unimpaired waters will become impaired prior to the next listing cycle, these "threatened waters" will be judged as impaired. Where antidegradation provisions in Missouri's Water Quality Standards apply, those provisions shall be upheld. The numerical criteria included in Appendix B have been adopted into the state water quality standards, 10 CSR 20-7.031, and are used, as described in Appendix B to make use attainment decisions.

II. Weight of Evidence Approach

When evaluating narrative criteria described in the state water quality standards, 10 CSR 20-7.031, the department will use a weight of evidence analysis for assessing numerical translators that have not been adopted into state water quality standards (see Appendix C). Under the weight of evidence approach, all available information is examined and the greatest weight is given to data providing the "best supporting evidence" for an attainment decision. Determination of "best supporting evidence" will be made using best professional judgment, considering factors such as data quality, and site-specific

environmental conditions. For those analytes with numeric thresholds, the threshold values given in Appendix C will trigger a weight of evidence analysis to determine the existence or likelihood of a use impairment and the appropriateness of proposing a 303(d) listing based on narrative criteria. This weight of evidence analysis will include the use of other types of environmental data when it is available or collection of additional data to make the most informed use attainment decision. Examples of other relevant environmental data might include physical or chemical data, biological data on fish [Fish Index of Biotic Integrity (fIBI)] or aquatic macroinvertebrate [Macroinvertebrate Stream Condition Index (MSCI)] scores, fish tissue, or toxicity testing of water or sediments.

Biological data will be given greater weight in a weight of evidence analysis for making attainment decisions for aquatic life use and subsequent Section 303(d) listings. Whether or not numeric translators of biological criteria are met is a strong indicator for the attainment of aquatic life use. Moreover, the department retains a high degree of confidence in an attainment decision based on biological data that is representative of water quality condition.

When the weight of evidence analysis suggests, but does not provide strong scientifically valid evidence of impairment, the department will place the water body in question in Categories 2B or 3B. The department will produce a document showing all relevant data and the rationale for the attainment decision. All such documents will be available to the public at the time of the first public notice of the proposed 303(d) list. A final recommendation on the listing of a water body based on narrative criteria will only be made after full consideration of all comments on the proposed list.

III. Biological Data

Methods for assessing biological data typically receive considerable attention during the public comment period of development of the Listing Methodology Document. Currently, a defined set of biocriteria[18] are used to evaluate biological data for assessing compliance with water quality standards. These biological criteria contain numeric thresholds, that when exceeded relative to prescribed assessment methods, serve as a basis for identifying candidate waters for Section 303(d) listing. Biocriteria are based on three types of biological data, including: (1) aquatic macroinvertebrate community data; (2) fish community data; and, (3) a catch-all class referred to as "other biological data."

In general, for interpretation of macroinvertebrate data where Stream Habitat Assessment Project Procedure (SHAPP) (MDNR 2016b) assessment scores indicate habitat is less than 75 percent of reference or appropriate control stream scores, and in the absence of other data indicating impairment by a discrete pollutant, a water body judged to be impaired will be placed in Category 4C. When interpreting fish community data, a

[18] This refers to Missouri's Water Quality Standards (10 CSR 20-7.031) Section 5 (Specific Criteria) (R) (Biocriteria). Although the Department uses the term "criteria" in association with biological metrics and indices throughout this document, numeric biological criteria have not been promulgated in the rule. This document uses the developed numerical biological metrics and indices as translators for the Biocriteria portion of 10 CSR 20-7.031(5)(R) [3/31/2018].

provisional multi-metric habitat index called the QCPH1 index is used to identify stream habitat in poor condition. The QCPH1 index separates adequate habitat from poor habitat using a 0.39 threshold value; whereby, QCPH1 scores < 0.39 indicate stream habitat is of poor quality, and scores greater than 0.39 indicate available stream habitat is adequate. In the absence of other data indicating impairment by a discrete pollutant, impaired fish communities with poor habitat will be placed in Category 4C. Additional information about QCPH1 is provided in the *Considerations for the Influence of Habitat Quality and Sample Representativeness* section.

The sections below describe the methods used to evaluate the three types of biological data (macroinvertebrate community, fish community, and other biological data), along with background information on the development and scoring of biological criteria, procedures for assessing biological data, methods used to ensure sample representativeness, and additional information used to aid in assessing biological data such as the weight of evidence approach.

Aquatic Macroinvertebrate Community Data

The department conducts aquatic macroinvertebrate assessments to determine macroinvertebrate community health as a function of water quality and habitat. The health of a macroinvertebrate community is directly related to water quality and habitat. Almost all macroinvertebrate evaluation consists of comparing the health of the community of the "target" to healthy macroinvertebrate communities from reference streams of the same general size and usually in the same Ecological Drainage Unit (EDU).

The department's approach to monitoring and evaluating aquatic macroinvertebrates is largely based on *Biological Criteria for Wadeable/Perennial Streams of Missouri* (MDNR 2002). This document provides the framework for numerical biological criteria (biocriteria) relevant to the protection of aquatic life use for wadeable streams in the state. Biocriteria were developed using wadeable reference streams that occur in specific EDUs as mapped by the Missouri Resource Assessment Partnership (reference Figure 1 below). For macroinvertebrates, the numerical biocriterion translator is expressed as a multiple metric index referred to as the MSCI. The MSCI includes four metrics: Taxa Richness (TR); Ephemeroptera, Plecoptera, and Trichoptera Taxa (EPTT); Biotic Index (BI); and the Shannon Diversity Index (SDI). These metrics are considered indicators of stream health, and change predictably in response to the environmental condition of a stream.

Metric values are determined directly from macroinvertebrate sampling. To calculate the MSCI, each metric is normalized to unitless values of 5, 3, or 1, which are then added together for a total possible score of 20. MSCI scores are divided into three levels of stream condition:

- Fully Biologically Supporting (16-20),
- Partially Biologically Supporting (10-14), and
- Non-Biologically Supporting (4-8).

Partially and Non-Biologically Supporting streams may be considered impaired and are candidates for Section 303(d) listing.

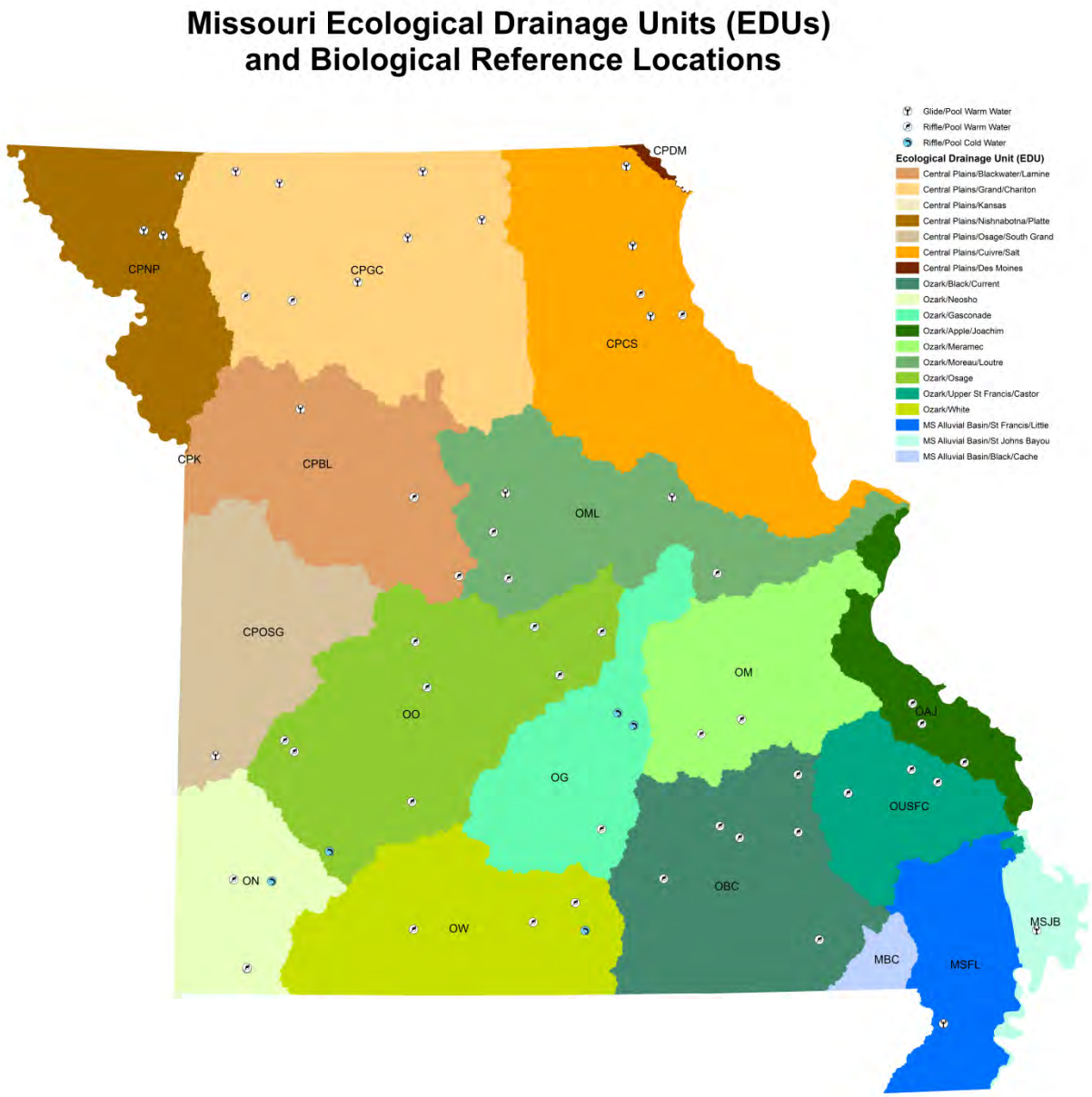


Figure 1: Missouri Ecological Drainage Units (EDUs) and Biological Reference Locations

Unitless metric values (5, 3, or 1) were developed from the lower quartile of the distribution of each metric as calculated from reference streams for each EDU. The lower quartile (25th percentile) of each metric equates to the minimum value still representative of unimpaired conditions. In operational assessments, metric values below the lower quartile of reference conditions are typically judged as impaired (United States Environmental Protection Agency 1996, Ohio Environmental Protection Agency 1990, Barbour *et al.* 1996). Moreover, using the 25th percentile of reference conditions for each metric as a standard for impairment allows natural variability to be filtered out. For metrics with values that decrease with increasing impairment (TR, EPTT, SDI), any value above the lower quartile of the reference distribution receives a score of five. For the BI, whose value increases with increasing impairment, any value below the upper quartile (75th percentile) of the reference distribution receives a score of five. The remainder of each metric's potential quartile range below the lower quartile is bisected, and scored either a three or a one. If the metric value is less than or equal to the quartile value and greater than the bisection value it is scored a three. If the metric value is less than or equal to the bisection value it is scored a one.

MSCI scores meeting data quality considerations may be assessed for the protection of aquatic life using the following procedures.

Determining Full Attainment of Aquatic Life Use:

- For seven or fewer samples, 75% of the MSCI scores must be 16 or greater. Fauna achieving these scores are considered to be very similar to biocriteria reference streams.
- For eight or more samples, results must be statistically similar to representative reference or control streams.

Determining Non-Attainment of Aquatic Life Use:

- For seven or fewer samples, 75% of the MSCI scores must be 14 or lower. Fauna achieving these scores are considered to be substantially different from biocriteria reference streams**.**
- For eight or more samples, results must be statistically dissimilar to representative reference or control streams.

Data will be judged inconclusive when outcomes do not meet requirements for decisions of full or non-attainment.

As noted, when eight or more samples are available, results must be statistically similar or dissimilar to reference or control conditions in order to make an attainment decision. To accomplish this, a binomial probability with an appropriate level of significance (α=alpha), is calculated based on the null hypothesis that the test stream would have a similar percentage of MSCI scores that are 16 or greater as reference streams. The significance level is set at $\alpha=0.1$, meaning if the p-value of the hypothesis test is less than α, the hypothesis is considered statistically significant. The significance level of α is in fact the probability of making a wrong

decision and committing a Type I error (rejecting a true null hypothesis). When the Type I error rate is less than α=0.1, the null hypothesis is rejected. Inversely, when the Type I error rate is greater than α=0.1, the null hypothesis is accepted. For comparing samples from a test stream to samples collected from reference streams in the same EDU, the percentage of samples from reference streams scoring 16 or greater is used to determine the probability of "success" and "failure" in the binomial probability equation. For example, if 84% of the reference stream MSCI scores in a particular EDU are 16 or greater, then 0.84 would be used as the probability of success and 0.16 would be used as the probability of failure. Note that Appendix D states to "rate a stream as impaired if biological criteria reference stream frequency of fully biologically supporting scores is greater than five percent more than the test stream," thus, a value of 0.79 (0.84 - 0.05) would actually be used as the probability of success in the binomial distribution equation.

Binomial Probability Example:
Reference streams from the Ozark/Gasconade EDU classified as riffle/pool stream types with warm water temperature regimes produce fully biologically supporting streams 85.7% of the time. In the test stream of interest, six out of ten samples resulted in MSCI scores of 16 or more. Calculate the Type I error rate for the probability of getting six or fewer fully biologically supporting scores in ten samples.

The binomial probability formula may be summarized as:

$$p^n + (n!/ X!(n-X)!*p^n q^{n-x}) = 1$$

Where,
Sample Size (n) = 10
Number of Successes (X) = 6
Probability of Success (p) = 0.857 - 0.05 = 0.807
Probability of Failure (q) = 0.193

Excel has the BINOM.DIST function that will perform this calculation.

=BINOM.DIST(number_s,trials,probability_s,cumulative)
=BINOM.DIST(6,10,0.807,TRUE)

Using Excel's Binomial Function	
Probability of Success	0.807
Sample Size	10
# of Successes	6
Type 1 Error Rate	0.109

Since 0.109 is greater than the test significance level (minimum allowable Type I error rate) of α= 0.1, we accept the null hypothesis that the test stream has the same percent of fully biologically supporting scores as the same type of reference streams from the Ozark/Gasconade EDU. Thus, this test stream would be judged as unimpaired.

If under the same scenario, there were only 5 samples from the test stream with MSCI scores of 16 or greater, the Type I error rate would change to 0.028, and since this value is less than the significance level of α=0.1, the stream would be judged as impaired.

Within each EDU, MSCI scores are categorized by sampling regime (Glide/Pool vs. Riffle/Pool) and temperature regime (warm water vs. cold water). The percentage of fully biologically supporting scores for the Mississippi River Alluvial Basin/Black/Cache EDU is not available due to the lack of reference sites in this region. Percentages of fully biologically supporting samples per EDU is not included here, but can be made available upon request. The percentage of reference streams per EDU that are fully biologically supporting may change periodically as additional macroinvertebrate samples are collected and processed from reference samples within an EDU.

Sample Representativeness

The departments field and laboratory methods used to collect and process macroinvertebrate samples are contained in the document *Semi-Quantitative Macroinvertebrate Stream Bioassessment* (MDNR 2015). Macroinvertebrates are identified to levels following standard operating procedures contained in *Taxonomic Levels for Macroinvertebrate Identifications* (MDNR 2016b). Macroinvertebrate monitoring is accompanied by physical habitat evaluations as described in the document *Stream Habitat Assessment* (MDNR 2016a). For the assessment of macroinvertebrate samples, available information must meet data code levels three and four as described in Section II.C of this LMD. Data coded as levels three and four represent environmental data providing the greatest degree of assurance. Thus, at a minimum, macroinvertebrate assessments include multiple samples from a single site, or samples from multiple sites within a single reach.

It is important to avoid situations where poor or inadequate habitat prohibits macroinvertebrate communities from being assessed as fully biologically supporting. Therefore, when assessing macroinvertebrate samples, the quality of available habitat must be similar to that of reference streams within the appropriate EDU. The department's policy for addressing this concern has been to exclude MSCI scores from an assessment when accompanying habitat scores are less than 75 percent of the mean habitat scores from reference streams of the appropriate EDU. The following procedures outline the department's method for assessing macroinvertebrate communities from sites with poor or inadequate habitat.

Assessing Macroinvertebrate Communities from Poor/Inadequate Habitat:

- If less than half the macroinvertebrate samples in an assessed stream segment have habitat scores less than 75 percent of the mean score for reference streams in that EDU, any sample that scores less than 16 and has a habitat score less than 75 percent of the mean reference stream score for that EDU, is excluded from the assessment process.

- If at least half the macroinvertebrate samples in an assessed stream segment have habitat scores less than 75 percent of the mean score for reference streams in that EDU and the assessment results in a judgment that the macroinvertebrate community is impaired, the assessed segment will be placed in Category 4C impairment due to poor aquatic habitat.

  - If one portion of the assessment reach contains two or more samples with habitat scores less than 75 percent of reference streams from that EDU while the remaining portion does not, the portion of the stream with poor habitat scores could be separately assessed as a category 4C stream permitting low MSCI scores.

Macroinvertebrate sampling methods vary by stream type. One method is used in riffle/pool predominant streams, and the other method is for glide/pool predominant streams. For each stream type, macroinvertebrate sampling targets three habitats.

- For riffle/pool streams, the three habitats sampled are flowing water over coarse substrate, non-flowing water over depositional substrate, and rootmat substrate.
- For glide/pool streams, the three habitats sampled are non-flowing water over depositional substrate, large woody debris substrate, and rootmat substrate.

In some instances, one or more of the habitats sampled can be limited or missing from a stream reach, which may affect an MSCI score. Macroinvertebrate samples based on only two habitats may have an MSCI score equal to or greater than 16, but it is also possible that a missing habitat may lead to a decreased MSCI score. Although MDNR stream habitat assessment procedures take into account a number of physical habitat parameters from the sample reach (for example, riparian vegetation width, channel alteration, bank stability, bank vegetation protection, etc.), they do not exclusively measure the quality or quantity of the three predominant habitats from each stream. When evaluating potentially impaired macroinvertebrate communities, the number of habitats sampled, in addition to the stream habitat assessment score, will be considered to ensure MSCI scores less than 16 are properly attributed to poor water quality or poor/inadequate habitat condition.

Biologists responsible for conducting biological assessments will determine the extent to which habitat availability is responsible for a non-supporting (<16) MSCI score. If it is apparent that a non-supporting MSCI score was due to limited habitat, these effects will be stated in the biological assessment report. This limitation will then be considered when deciding which Listing Methodology category is most appropriate for an individual stream. This procedure, as part of an MDNR biological assessment, will aid in determining whether

impaired macroinvertebrate samples have MSCI scores based on poor water quality conditions versus habitat limitations.

To ensure assessments are based on representative macroinvertebrate samples, samples collected during or shortly after prolonged drought, shortly after major flood events, or any other conditions that fall outside the range of environmental conditions under which reference streams in the EDU were sampled, will not be used to make an attainment decision for a Section 303(d) listing or any other water quality assessment purposes. Sample "representativeness" is judged by Water Protection Program (WPP) staff after reading the biomonitoring report for that stream, and if needed, consultation with biologists from the department's Environmental Services Program. Regarding smaller deviations from "normal" conditions, roughly 20 percent of reference samples failing to meet a fully biologically supporting MSCI score were collected following weather/climate extremes; as a result, biological criteria for a given EDU are inclusive of samples collected during not only ideal macroinvertebrate-rearing conditions, but also during the weather extremes that Missouri experiences.

Assessing Small Streams

Occasionally, macroinvertebrate monitoring is needed to assess streams smaller than the typical wadeable/perennial reference streams listed in Table I of Missouri's Water Quality Standards. Smaller streams may include Class C streams (streams that may cease flow in dry periods but maintain permanent pools which support aquatic life) or those that are unclassified. Assessing small streams involves comparing test stream and candidate reference stream MSCI scores first, to Wadeable/Perennial Reference Stream (WPRS) criteria, and second to each other.

In MDNR's Biological Criteria Database, there are 16 candidate reference streams labeled as Class P, 23 labeled as Class C, and 24 labeled as Class U. In previous work by MDNR, when the MSCI was calculated according to WPRS criteria, the failure rate for such candidate reference streams was 31% for Class P, 39% for Class C, and 70% for Class U. The data trend showed a higher failure rate for increasingly smaller high quality streams when scored using WPRS biological criteria. This trend demonstrates the need to include the utilization of candidate reference streams in biological stream assessments.

Prior to the 2014 revision of the Missouri Water Quality Standards there was no size classification for streams. The 2014 revision codified size classification for rivers and streams based on five size categories for Warm Water, Cool Water and Cold Water Habitats. The size classifications are defined as Headwater, Creek, Small River, Large River and Great River. Water permanence continues to be classified as Class P (streams that maintain permanent flow even in drought periods); Class C (streams that cease flow in dry periods but maintain permanent pools which support aquatic life); and the newly adopted Class E (streams that do not maintain permanent surface flow or pools, but have surface flow or pools in response to precipitation events).

Table I of Missouri's Water Quality Standards lists 62 wadeable/perennial reference streams that provide the current basis for numeric biological criteria. Wadeable/perennial reference streams are a composite of Creek and Small River size classes. Interpretation of Creek (Size Code 2) and Small River (Size Code 3) is based on the Missouri Resource Assessment Partnership Shreve Link number found in Table 2. These wadeable/perennial reference streams were selected previous to the 2014 revision of the Missouri Water Quality Standards and were based on the former Table H (Stream Classifications and Use Designations). All, or a portion, of seven wadeable/perennial reference streams are Class C; and all, or a portion, of 57 wadeable/perennial reference streams are Class P.

As part of the 2014 revision of the Missouri Water Quality Standards, classified streams were changed from Table H to a modified version of the 1:100,000 National Hydrography Dataset. This dataset provides a geospatial framework for classified streams and is referred to as the Missouri Use Designation Dataset (MUDD). The streams and rivers now listed in MUDD contain approximately 100,000 miles of newly classified streams, many of which are the Headwater size class. Interpretation of Headwater size (Size Code 1) is based on the Missouri Resource Assessment Partnership Shreve Link number found in Table 2

Table 2.
Missouri Resource Assessment Partnership Shreve Link Number for Stream Size Code

Stream Size	Size Code	Plains Shreve Link Number	Ozark Shreve Link Number
Headwater	1	1-2	1-4
Creek	2	3-30	5-50
Small R~~r~~iver	3	31-700	51-450
Large River	4	701-maximum	451- maximum
Great River	5	Missouri & Mississippi	Missouri & Mississippi
Unknown	0		

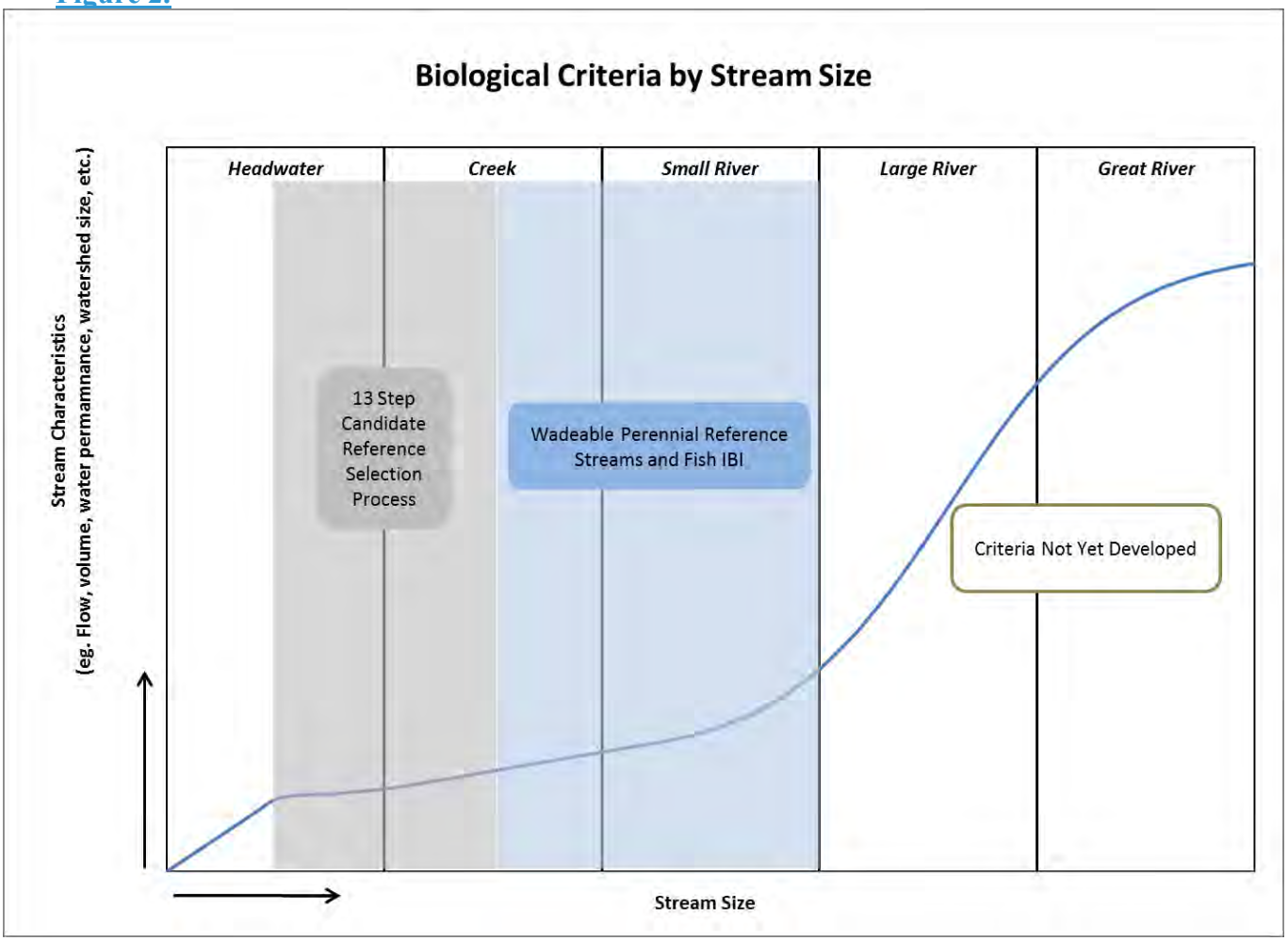
In natural channels, biological assessments will be based on criteria established from comparable stream size and permanence. The need for alternate criteria is supported by the higher failure rate (70%) for small size streams when scored using wadeable/perennial reference stream biological criteria (MDNR, unpublished data). The 2014 revision of Missouri's Water Quality Standards codified size classification for rivers and streams based on five size categories for Warm Water, Cool Water and Cold Water Habitats. The size classifications are defined as Headwater, Creek, Small River, Large River and Great River.

Biological criteria have not been established for the size categories of Great River, Large River, or Headwater. Current WPRS criteria and the MDC fIBI ~~criteria~~metrics apply to Creek and Small River size categories. MDC fIBI metrics apply only in the Ozarks ecoregion.

Since headwater stream biological criteria have not been established, the utilization of candidate headwater reference streams and draft criteria will be necessary to perform

biological stream assessments of headwater size streams until ~~robust~~scientifically defensible criteria have been developed.

Figure 2.



For test streams that are smaller than wadeable perennial reference streams, MDNR ~~also~~ samples five candidate reference streams ~~(small control streams)~~ of same or similar size and Valley Segment Type (VST) in the same EDU twice during the same year the test stream is sampled (additional information about the selection small control streams is provided below). Although in most cases the MDNR samples small candidate reference streams concurrently with test streams, existing data may be used if a robust candidate reference stream data set exists for the EDU.

~~These candidate reference streams will be used to create EDU specific localized criteria until EDU wide criteria are developed.~~

If the ten small candidate reference stream scores are similar to wadeable perennial reference stream criteria, then they and the test stream are considered to have a Class C or Class P general warm water beneficial use, and the MSCI scoring system in the LMD should be used. If the small candidate reference streams have scores lower than the wadeable perennial reference streams, the assumption is that the small candidate reference streams, and the test stream, represent designated uses related to stream size that are not yet approved by EPA in the state's water quality standards. The current assessment method for test streams that are smaller than reference streams is stated below.

- If ~~the~~ 75% of the ten candidate reference stream ~~(small control stream)~~ scores are 16 or greater ~~similar~~ when compared to WPRS~~s~~ criteria ~~and meet LMD criteria for an unimpaired macroinvertebrate community~~, then the test stream will be assessed using MSCI based procedures in the LMD.

- If ~~the~~75% of the ten candidate reference stream scores are ~~lower than those of~~below 16 when compared to WPRS~~s~~ criteria ~~and do not meet the LMD criteria for an unimpaired macroinvertebrate community,~~ then:

  ~~a) The test stream will be assessed as having an unimpaired macroinvertebrate community if the test stream scores meet the LMD criteria for an unimpaired community;~~

  ~~b)~~a) The test stream ~~data~~ will be judged "~~inconclusive~~ unimpaired" if test stream scores ~~are similar~~meet criteria developed from ~~to~~ the candidate reference stream scores.~~;~~ If 75% of the test stream scores are 16 or greater when compared to criteria developed from the candidate reference streams, the stream will be judged "unimpaired".

  ~~c) The test stream will be assessed as having a "suspect" macroinvertebrate community if its scores are found to be low but statistically close to candidate reference streams; or,~~

  b) The test stream will be assessed as having an "impaired" macroinvertebrate community ~~if its scores are found to be statistically lower than the candidate reference streams.~~ if test stream scores do not meet criteria developed from the candidate reference stream scores. If 75% of the test stream scores are below 16 when compared to criteria developed from the candidate reference streams, the stream will be judged "impaired".

  ~~d)~~c) The test stream will be judged "inconclusive" if the requirements in a) and b) are not met.

~~This method of assessing small streams will be used only until such time as the aquatic habitat protection use categories based on watershed size classifications of Headwater, Creek, Small River, Large River and Great River are is promulgated into Missouri Water Quality Standards and appropriate biological metrics are established for stream size and permanence.~~

~~The approach for determining a "suspect" or "impaired" macroinvertebrate community will be made using a direct comparison between all streams being evaluated, which may include the use of percent and/or mean calculations as determined on a case by case basis.~~ All work will be documented on the macroinvertebrate assessment worksheet and be made available during the public notice period.

Selecting Small Candidate Reference Streams

Accurately assessing streams that are smaller than reference streams begins with properly selecting small candidate reference streams. Candidate reference streams are smaller than WPRS streams and have been identified as "best available" reference stream segments in the same EDU as the test stream according to watershed, riparian, and in-channel conditions. The selection of candidate reference streams is consistent with framework provided by Hughes *et al.* (1986) with added requirements that candidate reference streams must be from the same EDU and have the same or similar values for VST parameters. If candidate reference streams perform well when compared to WPRS, then test streams of similar size and VST are expected to do so as well. VST parameters important for selection are based on temperature, stream size, flow, geology, and relative gradient, with emphasis placed on the first three parameters.

The stepwise process for candidate reference stream selection is listed below. Documentation of the steps in this process will be available upon request and will include but are not limited to: GIS layers used, segment IDs eliminated at the various steps, candidate stream list for field verification, etc.

1. Determine test stream reaches to be assessed. *Missouri Department of Natural Resources staff in the Water Protection Program's Monitoring and Assessment Unit will use data that indicates potential impairment to determine where additional studies are needed. Department staff with the Environmental Services Program's Aquatic Bioassessment Unit will be used to conduct studies requested by the WPP.*

2. Identify appropriate EDU. *The Ecological Drainage Unit in which the test stream is located will be identified so that applicable biological criteria can be used to score macroinvertebrate data collected by Department biologists.*

3. Determine five variable VST of test stream segments (1st digit = temperature; 2nd digit = size; 3rd digit = flow; 4th digit = geology; and 5th digit = relative gradient). *This five-digit VST code provides a description of the test stream for later use in selecting appropriate candidate reference streams that are similar to the test stream (giving temperature, size, and flow the highest importance).*

4. Filter all stream segments within the same EDU for the relevant five variable VSTs (1st and 2nd digits especially critical for small streams). *The five VST features of the test stream will be determined by checking the "AQUATIC.STRM_SEGMENTS" layer in GIS software (e.g. ArcMap). This layer has an associated Attribute Table that has, among*

many other features, the five-digit VST code for classified Missouri streams. During the filtering process, the five-digit code (listed as "VST_5VAR" in the Attribute Table) of the test stream is chosen in an ArcMap tool called "Select by Attributes." The five-digit code of the test stream is entered into this ArcMap tool, which can then be used to list only streams with the same five VST variables while excluding (i.e. "filtering out") all other streams with different variables.

5. Filter all potential VST stream segments for stressors against available GIS layers (e.g. point sources, landfills, CAFOs, lakes, reservoirs, mining, etc.). *A GIS layer that includes the stream segments selected in Step 4 will be created. The proximity of these selected stream layers will be evaluated relative to stressor layers cataloged in GIS using filtering steps similar to those described above. Stream segments with stressors having documented impacts will be eliminated from further consideration. The presence of a single potential stressor will not automatically lead to a stream reach being rejected; rather, the aggregate of potential stressors in a watershed will be evaluated.*

6. Filter all potential VST stream segments against historical reports and databases. *Past accounts of occurrences that may result in a stream failing to meet the "best available, least impaired" criteria will be evaluated. These incidents may include events such as fish kills, combined sewer overflows, or past environmental emergencies (e.g. releases of toxic substances). Exceptions can be made when the cause of the incident no longer exists and there are no lingering effects. In contrast, historical reports may also include studies by other biologists that support the use of a stream segment as a candidate reference stream.*

7. Calculate land use categories of candidate reference streams (e.g. percentage of forest, grassland, impervious surface, etc.) in GIS mapping software using available land cover datasets (Sources of land use data that are currently used are NLCD 2011 and MoRAP 2005[19]). Candidate reference streams with the same or similar AES type as the test stream (within the EDU) will be given preference throughout the selection process. In addition, candidate reference streams should also be chosen from candidate reference stream watersheds whose land use composition is representative of test stream's AES, and generally representative of EDU land uses. Candidate reference stream watersheds will be excluded if impervious area covers greater than 10% of the watershed area *(Center for Watershed Protection, 2003).*

8. Develop candidate stream list with coordinates for field verification.

9~~8~~. Field verify candidate list for actual use (e.g. animal grazing, in-stream habitat, riparian habitat), migration barriers (e.g. culverts, low water bridge crossings) representativeness, (gravel mining, and other obvious human stressors). *Biologists can make additional fine-scale adjustments to the list of candidate streams by visiting sites in*

[19] Missouri Resource Assessment Partnership 2005 Landcover project. https://morap.missouri.edu/index.php/land-cover/

person. Certain features visible on-site may have been missed with GIS and other computer based filtering. Stream flow must be field verified to be similar to test streams.

10~~9~~. *Of the sites remaining after field verification and elimination, at least five of the top ranked candidate sites will be subjected to additional evaluation outlined below.*

> *For steps 4-9: These steps occur at the EDU level identified in step 2. These steps look at all streams within the identified EDU including those in the same Aquatic Ecological System (AES) Type as the test stream. Streams in the same AES Type as the test stream (within the identified EDU) will be given preference and be selected to go through the remaining steps (10-13) below.*

~~10. Calculate land use categories of candidate reference streams (e.g. percentage of forest, grassland, impervious surface, etc.) in GIS mapping software using available land cover datasets (Sources of land use data that are currently used are NLCD 2011 and MoRAP 2005[20]). Candidate reference stream land use will be compared to the EDU as a whole looking for atypical conditions that would not be representative of the EDU. An example would be circumstances where percentages of land use exceed thresholds that have been documented to show adverse effects on the aquatic invertebrate community *(Center for Watershed Protection, 2003).*~~Calculate land use-land cover ~~*of stream watershed* and compare to EDU. *Streams within the same EDU tend to be more similar to each other than to streams in different EDUs. A reference stream should be representative of the best available conditions in an EDU and should have similar land use-land cover compared to the EDU as a whole. This approach will ensure that waters with similar habitats are compared, provided that the candidate reference is representative of the least impaired and best available condition in the EDU.*~~

11. Collect chemical, biological, habitat, and possibly sediment field data. *Collection of physical samples is the ultimate manner in which the quality of a stream is judged. Although factors evaluated in the previous steps are good indicators of whether a stream is of reference quality, it is the evaluation of chemical, physical and biological attributes in relation to other candidate reference streams that is the final determinant. If chemical sampling documents an exceedance of water quality standards, the candidate reference stream will be eliminated from consideration.*

12. After multiple sampling events evaluate recent field data against available historical chemical, physical, biological, and land use data from each corresponding candidate reference stream. *Aquatic systems are subject to fluctuation due to weather, stream flow, and other climatic conditions. Land use in the watershed of a candidate reference also can change over time. It is therefore important to compare recent data to available historical data to evaluate if watershed conditions have changed over time. If this evaluation indicates that the candidate reference stream conditions are similar to or have*

~~[20] Missouri Resource Assessment Partnership 2005 Landcover project. https://morap.missouri.edu/index.php/land-cover/~~

improved relative to historical conditions, they will be retained. If historical data are not available to make the comparisons, the candidate reference streams will be retained. ~~It is therefore important to collect multiple samples over time that are reflective of a variety of conditions to adequately judge a candidate stream's macroinvertebrate community.~~

13. If field data are satisfactory, retain candidate reference stream label in database. *Reference streams and candidate reference streams are label~~l~~ed as such in a database maintained by the Department's Aquatic Bioassessment Unit in Jefferson City, Missouri*

Fish Community Data

The department utilizes fish community data to determine if aquatic life use is supported in certain types of Missouri streams. When properly evaluated, fish communities serve as important indicators of stream health. In Missouri, fish communities are surveyed by the MDC. MDC selects an aquatic subregion to sample each year, and therein, surveys randomly selected streams of 2nd to 5th order in size. Fish sampling follows procedures described in the document *Resource Assessment and Monitoring Program: Standard Operational Procedures--Fish Sampling* (Combes 2011). Numeric biocriteria for fish are represented by the fish Index of Biotic Integrity (fIBI). Development of the fIBI is described in the document *Biological Criteria for Stream Fish Communities of Missouri* (Doisy *et al.* 2008).

The fIBI is a multi-metric index made up of nine individual metrics, which include:

- number (#) of native individuals;
- # of native darter species;
- # of native benthic species;
- # of native water column species;
- # of native minnow species;
- # of all native lithophilic species;
- percentage (%) of native insectivore cyprinid individuals;
- % of native sunfish individuals; and,
- % of the three top dominant species.

Values for each metric, as directly calculated from the fish community sample, are converted to unitless scores of 1, 3, or 5 according to criteria in Doisy *et al.* (2008). The fIBI is then calculated by adding these unitless values together for a total possible score of 45. Doisy *et al.* (2008) established an impairment threshold of 36 (where the 25th percentile of reference sites represented a score of 37), with values equal to or greater than 36 representing unimpaired communities, and values less than 36 representing impaired communities. For more information regarding fIBI scoring, please see Doisy *et al.* (2008).

Based on consultation between the department and MDC, the fIBI impairment threshold value of 36 was used as the numeric biocriterion translator for making an attainment decision for aquatic life (Appendix C). Work by Doisy *et al.* (2008) focused on streams 3rd to 5th order in size, and the fIBI was only validated for streams in the Ozark ecoregion, not for streams in the Central Plains and Mississippi Alluvial Basin. Therefore, when assessing streams with the fIBI, the index may only be applied to streams 3rd to 5th order in size from the Ozark ecoregion. Assessment procedures are outlined below.

Full Attainment

- For seven or fewer samples and following MDC RAM fish community protocols, 75% of fIBI scores must be 36 or greater. Fauna achieving these scores are considered to be very similar to Ozark reference streams.

- For eight or more samples, the percent of samples scoring 36 or greater must be statistically similar to representative reference or control streams. To determine statistical similarity, a binomial probability Type I error rate (0.1) is calculated based on the null hypothesis that the test stream would have the same percentage (75%) of fIBI scores greater than 36 as reference streams. If the Type I error rate is more than the significance level α=0.1, the fish community would be rated as unimpaired.

Non-Attainment

- For seven or fewer samples and following MDC RAM fish community protocols, 75% of the fIBI scores must be lower than 36. Fauna achieving these scores are considered to be substantially different than regional reference streams.

- For eight or more samples, the percent of samples scoring 36 or less must be statistically dissimilar to representative reference or control streams. To determine statistical dissimilarity, a binomial probability Type I error rate is calculated based on the null hypothesis that the test stream would have the same percentage (75%) of fIBI scores greater than 36 as reference streams. If the Type I error rate is less than 0.1, the null hypothesis is rejected and the fish community would be rated as impaired.

Data will be judged inconclusive when outcomes do not meet requirements for decisions of full or non-attainment.

With the exception of two subtle differences, use of the binomial probability for fish community samples will follow the example provided for macroinvertebrate samples in the previous section. First, instead of test stream samples being compared to reference streams of the same EDU, they will be compared to reference streams from the Ozark ecoregion. Secondly, the probability of success used in the binomial distribution equation will always be set to 0.70 since Appendix D states to "rate a stream as impaired if biological criteria reference stream frequency of fully biologically supporting scores is greater than five percent more than the test stream."

Although 1st and 2nd order stream data will not be used to judge a stream as impaired for Section 303(d) purposes, the department may use the above assessment procedures to judge 1st and 2nd order streams as unimpaired. Moreover, should samples contain fIBI scores less than 29, the department may judge the stream as "suspected of impairment" using the above procedures.

Considerations for the Influence of Habitat Quality and Sample Representativeness
Low fIBI scores that are substantially different than reference streams could be the result of water quality problems, habitat problems, or both. When low fIBI scores are established, it is necessary to review additional information to differentiate between an impairment caused by water quality and one that is caused by habitat. The collection of a fish community sample is also accompanied by a survey of physical habitat from the sampled reach. MDC sampling protocol for stream habitat follows procedures provided by Peck *et al.* (2006). With MDC guidance, the department utilizes this habitat data and other available information to assure that an assessment of aquatic life attainment based on fish data is only the result of water quality, and that an impairment resulting from habitat is categorized as such. This section describes the procedures used to assure low fIBI scores are the result of water quality problems and not habitat degradation. The information below outlines the department's provisional method to identify unrepresentative samples and low fIBI scores with questionable habitat condition, and ensure corresponding fish IBI scores are not used for Section 303(d) listing.

a) Following recommendations from the biocriteria workgroup, the department will consult MDC about the habitat condition of particular streams when assessing low fIBI scores.

b) Samples may be considered for Section 303(d) listing ONLY if they were collected in the Ozark ecoregion, and the samples were collected during normal representative conditions, based upon best professional judgment from MDC staff,. Samples collected from the Central Plains and Mississippi Alluvial Basin are excluded from Section 303(d) listing.

c) Only samples from streams 3rd to 5th order in size may be considered for Section 303(d) listing. Samples from 1st or 2nd order stream sizes are excluded from Section 303(d) consideration; however, they may be placed into Categories 2B and 3B if impairment is suspected, or into Categories 1, 2A, or 3A if sample scores indicate a stream is unimpaired. Samples from lower stream orders are surveyed under a different RAM Program protocol than 3rd to 5th order streams.

d) Samples that are ineligible for Section 303(d) listing include those collected from losing streams, as defined by the Department of Geology and Land Survey, or collected in close proximity to losing streams. Additionally, ineligible samples may include those collected on streams that were considered to have natural flow issues (such as streams reduced predominately to subsurface flow) preventing good fish IBI scores from being obtained, as determined through best professional judgment of MDC staff.

e) Fish IBI scores must be accompanied by habitat samples with a QCPH1 habitat index score. MDC was asked to analyze meaningful habitat metrics

and identify samples where habitat metrics seemed to indicate potential habitat concerns. As a result, a provisional index named QCPH1 was developed. QCPH1 values less than 0.39 indicate poor habitat, and values greater than 0.39 suggest adequate habitat is available. The QCPH1 comprises six sub-metrics indicative of substrate quality, channel disturbance, channel volume, channel spatial complexity, fish cover, and tractive force and velocity.

The QCPH1 index is calculated as follows:

$$\text{QCPH1} = ((\text{Substrate Quality} * \text{Channel Disturbance} * \text{Channel Volume} * \text{Channel Spatial Complexity} * \text{Fish Cover} * \text{Tractive Force \& Velocity})^{1/6})$$

Where sub-metrics are determined by:

Substrate Quality = [(embeddedness + small particles)/2] * [(filamentous algae + aquatic macrophyte)/2] * bedrock and hardpan

Channel Disturbance = concrete * riprap * inlet/outlet pipes * relative bed stability * residual pool observed to expected ratio

Channel Volume = [(dry substrate+width depth product + residual pool + wetted width)/4]

Channel Spatial Complexity = (coefficient of variation of mean depth + coefficient of variation of mean wetted width + fish cover variety)/3

Fish Cover = [(all natural fish cover + ((brush and overhanging vegetation + boulders + undercut bank + large woody debris)/4) + large types of fish cover)/3]

Tractive Force & Velocity = [(mean slope + depth * slope)/2]

Unimpaired fish IBI samples (fIBI ≥36) with QCPH1 index scores below the 0.39 threshold value, or samples without a QCPH1 score altogether, are eliminated from consideration for Category 5 and instead placed into Categories 2B or 3B should an impairment be suspected. Impaired fish communities (fIBI <36) with QCPH1 scores <0.39 can be placed into Category 4C (non-discrete pollutant/habitat impairment). Impaired fish communities (fIBI <36) with adequate habitat scores (QCPH1 >0.39) can be placed into Category 5. Appropriate streams with unimpaired fish communities and adequate habitat (QCPH1 >0.39) may be used to judge a stream as unimpaired.

Similar to macroinvertebrates, assessment of fish community information must be based on data coded level three or four as described in Section II.C of this document. Data coded as

levels three and four represent environmental data with the greatest degree of assurance, and thus, assessments will include multiple samples from a single site, or samples from multiple sites within a single reach.

Following the department's provisional methodology, fish community samples available for assessment (using procedures in Appendix C & D include only those from 3rd to 5th order Ozark Plateau streams, collected under normal, representative conditions, where habitat seemed to be good, and where there were no issues with inadequate flow or water volume.

IV. Other Biological Data

On a case by case basis, the department may use biological data other than MSCI or fIBI scores for assessing attainment of aquatic life. Other biological data may include information on single indicator aquatic species that are ecologically or recreationally important, or individual measures of community health that respond predictably to environmental stress. Measures of community health could be represented by aspects of structure, composition, individual health, and processes of the aquatic biota. Examples could include measures of density or diversity of aquatic organisms, replacement of pollution intolerant taxa, or even the presence of biochemical markers.

Acute or Chronic Toxicity Tests

If toxicity tests are to be used as part of the weight of evidence then accompanying media (water or sediment) analysis must accompany the toxicity test results. (e.g. Metals concentrations in the sediment sample used for an acute toxicity test must accompany the toxicity test results if metals are a concern; or if PAHs are a concern then TOC must accompany toxicity test results). The organism, its developmental stage used for the toxicity test, and the duration of the test must also accompany the results.

Other biological data should be collected under a well vetted study that is documented in a scientific report, a weight of evidence approach should be established, and the report should be referenced in the 303(d) listing worksheet. If other biological data is a critical component of the community and has been adversely affected by the presence of a pollutant or stressor, then such data would indicate a water body is impaired. The department's use of other biological data is consistent with EPA's policy on independent applicability for making attainment decisions, which is intended to protect against dismissing valuable information when diagnosing an impairment of aquatic life.

The use of other biological data in water body assessments occurs infrequently, but when available, it is usually assessed in combination with other information collected within the water body of interest. The department will avoid using other biological data as the sole justification for a Section 303(d) listing; however, other biological data will be used as part of a weight of evidence analysis for making the most informed assessment decision.

V. Toxic Chemicals

Water

For the interpretation of toxicity test data, standard acute or chronic bioassay procedures using freshwater aquatic fauna such as, but not limited to, *Ceriodaphnia dubia,* Fathead Minnows (*Pimephales promelas*), *Hyalella azteca*, or Rainbow Trout (*Oncorhynchus mykiss)*[21] will provide adequate evidence of toxicity for 303(d) listing purposes. Microtox®toxicity tests may be used to list a water as affected by "toxicity" only if there are data of another kind (freshwater toxicity tests, sediment chemistry, water chemistry, or biological sampling) that indicate water quality impairment.

For any given water, available data may occur throughout the system and/or be concentrated in certain areas. When the location of pollution sources are known, the department reserves the right to assess data representative of impacted conditions separately from data representative of unimpacted conditions. Pollution sources include those that may occur at discrete points along a water body, or those that are more diffuse.

Chronic Toxicity Events

Parameters in WQS that are labeled as chronic criterion can be assessed in two ways:

1. Continuous Data Sondes
    a. For data that has been collected consecutively over time, (eg. A data sonde collecting pH every 15 minutes or a two week time period) the data will be used as is after QA/QC procedures.
2. Grab Samples
    a. For samples that have not been collected consecutively, (eg. Grab sample collected once a week) the hydrologic flow conditions of the stream or the closest USGS gage will be used to verify the sample was collected during stable flow conditions. If the flow conditions were unstable then the sample will not be assessed against the chronic criterion. If the flow conditions were stable then the sample will be assessed against the chronic criterion. There are three categories of stable flow conditions: High, Medium, and Low.
        i. High Stable Flow – is greater than the 50th percentile exceedance flow and less than 10% change in flow over a 48 hour period.
        ii. Medium Stable Flow – is between the 90th percentile exceedance flow and the 50th percentile exceedance flow and less than 15% change in flow over a 48 hour period.
        iii. Low Stable Flow – is less than the 90th percentile exceedance flow or less than one cubic foot per second and less than 20% change in flow over a 48 hour period.

Sediment

For toxic chemicals occurring in benthic sediments, data interpretation will include calculation of a geometric mean for specific toxins from an adequate number of samples, and comparing that value to a corresponding Probable Effect Concentration (PEC) given by MacDonald *et al.* (2000). The PEC is the level of a pollutant above which harmful effects

[21] Reference 10 CSR 20-7.015(9)(L) for additional information

on the aquatic community are likely to be observed. MacDonald (2000) gave an estimate of accuracy for the ability of individual PECs to predict toxicity. For all metals except arsenic, pollutant geometric means will be compared to 150% of the recommended PEC values. These comparisons should meet confidence requirements applied elsewhere in this document When multiple metal contaminants occur in sediment, toxicity may occur even though the level of each individual pollutant does not reach toxic levels. The method of estimating the synergistic effects of multiple metals in sediments is described below.

The sediment PECs given by MacDonald *et. al.* (2000) are based on some additional data assumptions. Those assumptions include a 1% Total Organic Carbon (TOC) content and that the sample has been sieved to less than 2mm.

The department uses 150% of the PEC values to account for some variability in our assessment of sediment toxicity. Also see the ***Equilibrium Partitioning Sediment Benchmark*** section on page 39 for information on TOC and sulfide considerations for metals toxicity in sediment.

For the sample sieving assumption, the department will use non-sieved (bulk) sediment concentrations for screening level data (Data Code One). Current impairments that have used bulk sediment data as evidence for impairment will remain on the list of impaired streams until sieved data can be collected to show either that it should remain on the list or that the sieved concentrations are below the 150% PEC values. Data that has been sieved to less than 2mm or smaller will be used for comparison to the 150% PEC values.

The Meaning of the Sediment Quotient and How to Calculate It

Although sediment criteria in the form of a PEC are given for several individual contaminants, it is recognized that when multiple contaminants occur in sediment, toxicity may occur even though the level of each individual pollutant does not reach toxic levels. The method of estimating the synergistic effects of multiple pollutants in sediments given in MacDonald *et al.* (2000) includes the calculation of a PECQ. PECQs greater than 0.75 will be judged as toxic.

This calculation is made by dividing the pollutant concentration in the sample by the PEC value for that pollutant. For single samples, the quotients are summed, and then normalized by dividing that sum by the number of pollutants in the formula. When multiple samples are available, the geometric mean (as calculated for specific pollutants) will be placed in the numerator position for each pollutant included in the equation.

Example: A sediment sample contains the following results in mg/kg:

Arsenic 2.5, Cadmium 4.5, Copper 17, Lead 100, and Zinc 260.

The PEC values for these five pollutants in respective order are:

33, 4.98, 149, 128, and 459 mg/kg.

PECQ =

$$[(2.5/33) + (4.5/4.98) + (17/149) + (100/128) + (260/459)]/5 = 0.488$$

Using PECQ to Judge Metals Toxicity

Based on research by MacDonald *et al.* (2000) 83% of sediment samples with a PECQ less than 0.5 were non-toxic while 85% of sediment samples with a PECQ greater than 0.5 were toxic. Therefore, to accurately assess the synergistic effects of sediment contaminants on aquatic life, the department will judge PECQ greater than 0.75 as toxic**.**

Using Total PAHs to Judge Toxicity

Polycyclic Aromatic Hydrocarbons (PAHs) are organic compounds containing carbon and hydrogen forming aromatic rings (cyclic molecular shapes). The presence of PAHs in the environment when not expected (natural sources can be coal and oil deposits) result from the use and breakdown hydrocarbon compounds. There are three different sources of hydrocarbon compounds: plants (Phytogenic), petroleum (Petrogenic), and the combustion of petroleum, wood, coal etc. (Pyrogenic). Most common sources of PAHs in stream are sealants (coal tar) and other treatments of roads, driveways, and parking lots.

Mount *et al.* (2003) indicates that individual PAH sediment guidelines (PECs) are based on the samples also having an elevated presence of additional PAHs, potentially overestimating the actual toxicity of an individual PAH PEC value. The use of a Total PAH guideline (PEC) reduces variability and provides a better representation of toxicity than the use of individual PAH PECs.

Based on research by MacDonald *et.al* (2000) 81.5% of sediment samples with a Total PAH value less than 22.8 mg/kg (ppm) were non-toxic while 100% of sediment samples with a Total PAH value greater than 22.8 mg/kg (ppm) were toxic. Therefore, to accurately assess the toxicity to aquatic life of total PAHs in sediment, the department will judge Total PAH values greater than 150% of the PEC value (34.2 mg/kg) as toxic. For PAHs the sum of the geometric means for all PAH compounds will be compared to 150% of the recommended PEC value for total PAHs.

What compounds are considered in calculating Total PAHs and how will they be compared to the 150% PEC value?

To calculate Total PAHs for a sample, Mount *et.al.* (2003) recommends following United States Environmental Protection Agency, Environmental Monitoring Assessment Program's definition of Total PAHs. This definition includes 34 PAH compounds; 18 parent PAHs and 16 alkylated PAHs. (See Table 3 below for a list of these compounds.) Mount *et.al.* (2003) shows that using less than the 34 PAH compounds can underestimate the toxicity of PAHs in sediment. Total Organic Carbon (TOC) has the potential to affect the bio-

availability of PAHs. Organic carbon can provide a binding phase for PAHs, but the extent of that binding capacity is unknown. Through the Weight of Evidence approach (see section D II) the department will consider the effects of TOC on a case by case basis.

Commonly only 14 to 18 of the 34 PAH compounds are requested for analysis. Therefore the process to judge toxicity due to total PAHs is as follows:

- If samples are analyzed for fewer than the 34 PAH compounds then
  - If the sum (sum of the geometric means for more than one sample) of those compounds is greater than the 150% PEC then the sample(s) will be judged as toxic.
  - If the sum (sum of the geometric means for more than one sample) of those compounds is greater than the 100% PEC but less than 150% of the PEC then the sample(s) will be judged as inconclusive.
  - If the sum (sum of the geometric means for more than one sample) of those compounds is less than the 100% PEC then the values will be judged as non-toxic.
- If samples are analyzed for the 34 PAH compounds then
  - If the sum (sum of the geometric means for more than one sample) of those compounds is greater than the 150% PEC then the sample(s) will be judged as toxic.
  - If the sum (sum of the geometric means for more than one sample) of those compounds is less than the 150% PEC then the values will be judged as non-toxic.

Table 3. List of 34 polycyclic aromatic hydrocarbon (PAH) compounds that are considered for the calculation of total PAHs.

Parent PAHs	Alkylated PAHs
Acenaphthene	C1-Benzanthracene/chrysenes
Acenphthylene	C1-Fluorenes
Anthracene*	C1-Naphthalenes
Benz(a)anthracene*	C1-Phenanthrene/anthracenes
Benzo(a)pyrene*	C1-Pyrene/fluoranthenes
Benzo(b)fluoranthene	C2-Benzanthracene/chrysenes
Benzo(e)pyrene	C2-Fluorenes
Benzo(g,h,i)perylene	C2-Naphthalenes
Benzo(k)fluoranthene	C2-Phenanthrene/anthracenes

Chrysene*	C3-Benzanthracene/chrysenes
Dibenz(a,h)anthracene	C3-Fluorenes
Fluoranthene*	C3-Naphthalenes
Fluorene*	C3-Phenanthrene/anthracenes
Indeno(1,2,3-cd)pyrene	C4-Benzanthracene/chrysenes
Naphthalene*	C4-Naphthalenes
Perylene	C4-Phenanthracene/anthracenes
Phenanthrene*	
Pyrene*	
**Listed in Table 3 of MacDonald et.al (2000)*	

Equilibrium Partitioning Sediment Benchmark (ESB) Data

Another type of analysis of the toxicity of metals in sediment is based on the EPA (2006) paper that discusses ESBs and their use. The department will not be collecting this type of data but will consider the data under the weight of evidence approach. To be considered the data must be accompanied by the name of the laboratory that completed the analysis and a copy of their laboratory procedures and QC documentation. Sieved sediment samples will be judged as toxic for metals in sediment if the sum of the simultaneously extracted metals minus acid volatile sulfides then divided by the fractional organic carbon [(ΣSEM-AVS)/FOC] is greater than 3000. If additional sieved sediment samples also show toxicity for a particular metal(s) then that particular metal(s) will be identified as the cause for toxicity.

Pictorial Representations (flow charts) for how these different sediment toxicity procedures could be used in the weight of evidence procedure are displayed in Appendix E.

VI. Duration of Assessment Period

Except where the assessment period is specifically noted in Appendix B, the time period during which data will be used in making the assessments will be determined by data age and data code considerations, as well as representativeness considerations such as those described in footnote 14.

VII. Assessment of Tier Three Waters

Waters given Tier Three protection by the anti-degradation rule at 10 CSR 20-7.031(2) shall be considered impaired if data indicate water quality has been reduced in comparison to its historical quality. Historical quality is determined from past data that best describes a

water body's water quality following promulgation of the anti-degradation rule and at the time the water was given Tier Three protection.

Historical data gathered at the time waters were given Tier Three protection will be used if available. Because historical data may be limited, the historical quality of the waters may be determined by comparing data from the assessed segment with data from a "representative" segment. A representative segment is a body or stretch of water that best reflects the conditions that probably existed at the time the anti-degradation rule first applied to the waters being assessed. Examples of possible representative data include 1) data from stream segments upstream of assessed segments that receive discharges, and 2) data from other water bodies in the same ecoregion having similar watershed and landscape characters. These representative stream segments also would be characterized by receiving discharges similar to the quality and quantity of historic discharges of the assessed segment. The assessment may also use data from the assessed segment gathered between the time of the initiation of Tier Three protection and the last known time in which upstream discharges, runoff, and watershed conditions remained the same, provided that the data do not show any significant trends of declining water quality during that period.

The data used in the comparisons will be tested for normality and an appropriate statistical test will be applied. The null hypothesis for statistical analysis will be that water quality at the test segment and representative segment is the same. This will be a one-tailed test (the test will consider only the possibility that the assessed segment has poorer water quality) with the alpha level of 0.1, meaning that the test must show greater than a 90 percent probability that the assessed segment has poorer water quality than the representative segment before the assessed segment can be listed as impaired.

VIII. Other Types of Information

1. Observation and evaluation of waters for noncompliance with state narrative water quality criteria. Missouri's narrative water quality criteria, as described in 10 CSR 20-7.031 Section (3), may be used to evaluate waters when a quantitative (narrative) value can be applied to the pollutant. These narrative criteria apply to both classified and unclassified waters and prohibit the following in waters of the state:
    a. Waters shall be free from substances in sufficient amounts to cause the formation of putrescent, unsightly, or harmful bottom deposits or prevent full maintenance of beneficial uses;
    b. Waters shall be free from oil, scum, and floating debris in sufficient amounts to be unsightly or prevent full maintenance of beneficial uses;
    c. Waters shall be free from substances in sufficient amounts to cause unsightly color or turbidity, offensive odor, or prevent full maintenance of beneficial uses;
    d. Waters shall be free from substances or conditions in sufficient amounts to result in toxicity to human, animal, or aquatic life;

e. There shall be no significant human health hazard from incidental contact with the water;

f. There shall be no acute toxicity to livestock or wildlife watering;

g. Waters shall be free from physical, chemical, or hydrologic changes that would impair the natural biological community;

h. Waters shall be free from used tires, car bodies, appliances, demolition debris, used vehicles or equipment, and solid waste as defined in Missouri's Solid Waste Law, section 260.200, RSMo, except as the use of such materials is specifically permitted pursuant to sections 260.200–260.247, RSMo;

2. Habitat assessment protocols for wadeable streams have been established and are conducted in conjunction with sampling aquatic macroinvertebrates and fish. Methods for evaluating aquatic macroinvertebrate and fish community data include assessment procedures that account for the presence or absence of representative habitat quality. The department will not use habitat data alone for assessment purposes.

E. Other 303(d) Listing Considerations

- Adding to the Existing List or Expanding the Scope of Impairment to a Previously Listed Water.

  The listed portion of impaired water bodies may be increased based on recent monitoring data following the guidelines in this document. One or more new pollutants may be added to the listing for a water body already on the list based on recent monitoring data following these same guidelines. Waters not previously listed may be added to the list following the guidelines in this document.

- Deleting from the Existing List or Decreasing the Scope of Impairment to a Previously Listed Water

  The listed portion of an impaired water body may be decreased based on recent monitoring data following the guidelines in this document. One or more pollutants may be deleted from the listing for a water body already on the list based on recent monitoring data following guidelines in Appendix D. Waters may be completely removed from the list for several reasons[22]; the most common being (1) water has returned to compliance with water quality standards, or (2) the water has an approved TMDL study or Permit in Lieu of a TMDL.

- Listing Length of Impaired Segments

  The length of a 303(d) listing is currently based on the WBID length from the Missouri WQS. The department is using the WBID as the assessment unit to report to USEPA.

[22] See, "Guidance for 2006 Assessment, Listing and Reporting Requirements Pursuant to Sections 303(d), 305(b) and 314 of the Clean Water Act". USEPA, Office of Water, Washington DC.

When the department gains the database capability to further refine assessment units into segments smaller than WBIDs while maintain a transparent link to the WBID and Missouri's WQS, then the department will do so and will provide justification for splitting the WBID up into smaller assessment units in the assessment worksheets and can be discussed during the public notice process.

F. Prioritization of Waters for TMDL Development

Section 303(d) of the Clean Water Act and federal regulation 40 CFR 130.7(b)(4) requires states to submit a priority ranking of waters requiring TMDLs. The department will prioritize development of TMDLs based on several variables including:

- social impact/public interest and risk to public health
- complexity and cost (including consideration of budget constraints), availability of data of sufficient quality and quantity for TMDL modeling
- court orders, consent decrees, or other formal agreements
- source of impairments
- existence of appropriate numeric quality criteria
- implementation potential and amenability of the problem to treatment, and
- Integrated Planning efforts by municipalities and other entities

The department's TMDL schedule will represent its prioritization. The TMDL Program develops the TMDL schedule and maintains it at the following website: http://www.dnr.mo.gov/env/wpp/tmdl/.

G. Resolution of Interstate/International Disagreements

The department will review the draft 303(d) Lists of all other states with which it shares a border (Missouri River, Mississippi River, Des Moines River and the St. Francis River) or other interstate waters. Where the listing for the same water body in another state is different than the one in Missouri, the department will request the data and the listing justification. These data will be reviewed following the evaluation guidelines in this document. The Missouri Section 303(d) list may be changed pending the evaluation of this additional data.

H. Statistical Considerations

The most recent EPA guidance on the use of statistics in the 303(d) listing methodology document is given in Appendix A. Within this guidance there are three major recommendations regarding statistics:

- Provide a description of analytical tools the state uses under various circumstances
- When conducting hypothesis testing, explain the various circumstances under which the burden of proof is placed on proving the water is impaired and when it is placed on proving the water is unimpaired, and
- Explain the level of statistical significance (α) used under various circumstances.

- Description of Analytical Tools

  Appendix D, describes the analytical tools the department will use to determine whether a water body is impaired and whether or when a listed water body is no longer impaired.

- Rationale for the Burden-of-Proof

  Hypothesis testing is a common statistical practice. The procedure involves first stating a hypothesis you want to test, such as "the most frequently seen color on clothing at a St. Louis Cardinals game is red" and then the opposite or null hypothesis "red is not the most frequently seen color on clothing at a Cardinals game." Then a statistical test is applied to the data (a sample of the predominant color of clothing worn by 200 fans at a Cardinals game on July 12) and based on an analysis of that data, one of the two hypotheses is chosen as correct.

  In hypothesis testing, the burden-of-proof is always on the alternate hypothesis. In other words, there must be very convincing data to make us conclude that the null hypothesis is not true and that we must accept the alternate hypothesis. How convincing the data must be is stated as the "significance level" of the test. A significance level of $\alpha=0.10$ means that there must be at least a 90 percent probability that the alternate hypothesis is true before we can accept it and reject the null hypothesis.

  For analysis of a specific kind of data, either the test significance level or the statement of null and alternative hypotheses, or both, can be varied to achieve the desired degree of statistical rigor. The department has chosen to maintain a consistent set of null and alternate hypotheses for all our statistical procedures. The null hypothesis will be that the water body in question is unimpaired and the alternate hypothesis will be that it is impaired. Varying the level of statistical rigor will be accomplished by varying the test significance level. For determining impairment (Appendix D) test significance levels are set at either $\alpha=0.1$ or $\alpha=0.4$, meaning the data must show at minimum 90% or 60% probability, respectively that the water body is impaired. However, if the department retained these same test significance levels in determining when an impaired water body had been restored to an unimpaired status (Appendix D) some undesirable results can occur.

  For example, using a 0.1 significance level for determining both impairment and non-impairment, if the sample data indicate the stream had a 92 percent probability of being impaired, it would be rated as impaired. If subsequent data were collected and added to the database, and the data now showed the water had an 88 percent chance of being impaired, it would be rated as unimpaired. Judging as unimpaired a water body with only a 12 percent probability of being unimpaired is clearly a poor decision. To correct this problem, the department will use a test significance level of 0.4 for some analytes and 0.6 for others. This will increase our confidence in determining compliance with criteria to 40 percent and 60 percent, respectively under the worst case conditions, and for most databases will provide an even higher level of confidence.

- Level of Significance Used in Tests

The choice of significance levels is largely related to two concerns. The first concern is with matching error rates with the severity of the consequences of making a decision error. The second addresses the need to balance, to the degree practicable, Type I and Type II error rates. For relatively small number of samples, the disparity between Type I and Type II errors can be large. The tables 4 and 5 below shows error rates calculated using the binomial distribution for two very similar situations. Type I error rates are based on a stream with a 10 percent exceedance rate of a standard, and Type II error rates are based on a stream with a 15 percent exceedance rate of a standard. Note that when sample size remains the same, Type II error rates increase as Type I error rates decrease (Table 4). Also note that for a given Type I error rate, the Type II error rate declines as sample size increases (Table 5).

Table 4.
Effects of Type I error rates on Type II error rates. Type I error rates are based on a stream with a 10 percent exceedance rate of a standard and Type II error rates for a stream with a 15 percent exceedance rate of a standard.

Total No. of Samples	No. Samples Meeting Std.	Type I Error Rate	Type II Error Rate
18	17	0.850	0.479
18	16	0.550	0.719
18	15	0.266	0.897
18	14	0.098	0.958
18	13	0.028	0.988

Table 5.
Effects of Type I error rates and sample size on Type II error rates. Type I error rates are based on a stream with a 10 percent exceedance rate of a standard and Type II error rates for a stream with a 15 percent exceedance rate of a standard.

Total No. of Samples	No. Samples Meeting Std.	Type I Error Rate	Type II Error Rate
6	5	0.469	0.953
11	9	0.303	0.930
18	15	0.266	0.897
25	21	0.236	0.836

- Use of the Binomial Probability Distribution for Interpretation of the 10 Percent Rule

There are two options for assessing data for compliance with the 10 percent rule. One is to simply calculate the percent of time the criterion value is not met, and to judge the water to be impaired if this value is greater than 10 percent. The second method is to use some evaluative procedure that can review the data and provide a probability statement regarding compliance

with the 10 percent rule. Since the latter option allows assessment decisions relative to specific test significance levels and the first option does not, the latter option is preferred. The procedure chosen is the binomial probability distribution and calculation of the Type I error rate.

- Other Statistical Considerations

Prior to calculation of confidence limits, the normality of the data set will be evaluated. If normality is improved by a data transformation, the confidence limits will be calculated on the transformed data.

Time of sample collection may be biased and interfere with an accurate measurement of frequency of exceedance of a criterion. Data sets composed mainly or entirely of storm water data or data collected only during a season when water quality problems are expected could result in a biased estimate of the true exceedance frequency. In these cases, the department may use methods to estimate the true annual frequency and display these calculations whenever they result in a change in the impairment status of a water body.

For waters judged to be impaired based on biological data where data evaluation procedures are not specifically noted in Table 1, the statistical procedure used, test assumptions, and results will be reported.

- Examples of Statistical Procedures

Two Sample "t" Test for Color

Null Hypothesis: Amount of color is no greater in a test stream than in a control stream. As stated, this is a one-sided test, meaning that we are only interested in determining whether or not the color level in the test stream is greater than in a control stream. If the null hypothesis had been "amount of color is different in the test and control streams," we would have been interested in determining if the amount of color was either less than or greater than the control stream, a two-sided test.

Significance Level: $\alpha=0.10$

Data Set: Platinum-Cobalt color units data for the test stream and a control stream samples collected at each stream on same date.

Test Stream	70	45	35	45	60	60	80
Control Stream	50	40	20	40	30	40	75
Difference (T-C)	20	5	15	5	30	20	5

Statistics for the Difference: Mean = 14.28, standard deviation = 9.76, n = 7
Calculated "t" value = (square root of n)(mean)/standard deviation = 3.86

Tabular "t" value is taken from a table of the "t" distribution for 2 alpha (0.20) and n-1 degrees of freedom. Tabular "t" = 1.44.

Since calculated "t" value is greater than tabular t value, reject the null hypothesis and conclude that the test stream is impaired by color.

Statistical Procedure for Mercury in Fish Tissue

Data Set: data in µg/Kg 130, 230, 450. Mean = 270, Standard Deviation = 163.7
The 60% Lower Confidence Limit Interval = the sample mean minus the quantity:
((0.253)(163.7)/square root 3) = 23.9. Thus the 60% LCL Confidence Interval is 246.1 µg/Kg.

The criterion value is 300 µg/Kg. Therefore, since the 60% LCL Confidence Interval is less than the criterion value, the water is judged to be unimpaired by mercury in fish tissue, and the water body is placed in either Category 2B or 3B.

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Appendix A

Excerpt from *Guidance for 2006 Assessment, Listing and Reporting Requirements Pursuant to Sections 303(d), 305(b) and 314 of the Clean Water Act.* July 29, 2005. USEPA pp. 39-41.

The document can be read in its entirety from the US. EPA web site:
http://water.epa.gov/lawsregs/lawsguidance/cwa/tmdl/upload/2006irg-report.pdf

G. How should statistical approaches be used in attainment determinations?

The state's methodology should provide a rationale for any statistical interpretation of data for the purpose of making an assessment determination.

- *Description of statistical methods to be employed in various circumstances*

The methodology should provide a clear explanation of which analytic tools the state uses and under which circumstances. EPA recommends that the methodology explain issues such as the selection of key sample statistics (arithmetic mean concentration, median concentration, or a percentile), null and alternative hypotheses, confidence intervals, and Type I and Type II error thresholds. The choice of a statistic tool should be based on the known or expected distribution of the concentration of the pollutant in the segment (e.g., normal or log normal) in both time and space.

Past EPA guidance (1997 305(b) and 2000 CALM) recommended making non-attainment decisions, for "conventional pollutants[23]" — TSS, pH, BOD, fecal coliform bacteria, and oil and grease — when more than "10% of measurements exceed the water quality criterion." (However, EPA guidance has not encouraged use of the "10% rule" with other pollutants, including toxics.) Use of this rule when addressing conventional pollutants, is appropriate if its application is consistent with the manner in which applicable WQC are expressed. An example of a WQC for which an assessment based on the ten percent rule would be appropriate is the EPA acute WQC for fecal coliform bacteria, applicable to protection of water contact recreational use. This 1976-issued WQC was expressed as, "...no more than ten percent of the samples exceeding 400 CFU per 100 ml, during a 30-day period." Here, the assessment methodology is clearly reflective of the WQC.

On the other hand, use of the ten percent rule for interpreting water quality data is usually not consistent with WQC expressed either as: 1) instantaneous maxima not to be surpassed at any time, or 2) average concentrations over specified times. In the case of "instantaneous maxima (or minima) never to occur" criteria use of the ten percent rule typically leads to the belief that segment conditions are equal or better than specified by the WQC, when they in fact are considerably worse. (That is,

[23] There are a variety of definitions for the term "conventional pollutants." Wherever this term is referred to in this guidance, it means "a pollutant other than a toxic pollutant."

pollutant concentrations are above the criterion-concentration a far greater proportion of the time than specified by the WQC.) Conversely, use of this decision rule in concert with WQC expressed as average concentrations over specific times can lead to concluding that segment conditions are worse than WQC, when in fact they are not.

If the state applies different decision rules for different types of pollutants (e.g., toxic, conventional, and non-conventional pollutants) and types of standards (e.g., acute vs. chronic criteria for aquatic life or human health), the state should provide a reasonable rationale supporting the choice of a particular statistical approach to each of its different sets of pollutants and types of standards.

1. *Elucidation of policy choices embedded in selection of particular statistical approaches and use of certain assumptions EPA strongly encourages states to highlight policy decisions implicit in the statistical analysis that they have chosen to employ in various circumstances. For example, if hypothesis testing is used, the state should make its decision-making rules transparent by explaining why it chose either "meeting WQS" or "not meeting WQS" as the null hypothesis (rebuttable presumption) as a general rule for all waters, a category of waters, or an individual segment. Starting with the assumption that a water is "healthy" when employing hypothesis testing means that a segment will be identified as impaired, and placed in Category 4 or 5, only if substantial amounts of credible evidence exist to refute that presumption. By contrast, making the null hypothesis "WQS not being met" shifts the burden of proof to those who believe the segment is, in fact, meeting WQS.*

Which "null hypothesis" a state selects could likely create contrasting incentives regarding support for additional ambient monitoring among different stakeholders. If the null hypothesis is "meeting standards," there were no previous data on the segment, and no additional existing and readily available data and information are collected, then the "null hypothesis" cannot be rejected, and the segment would not be placed in Category 4 or 5. In this situation, those concerned about possible adverse consequences of having a segment declared "impaired" might have little interest in collection of additional ambient data. Meanwhile, users of the segment would likely want to have the segment monitored, so they can be ensured that it is indeed capable of supporting the uses of concern. On the other hand, if the null hypothesis is changed to "segment not meeting WQS," then those that would prefer that a particular segment not be labeled "impaired" would probably want more data collected, in hopes of proving that the null hypothesis is not true.

Another key policy issue in hypothesis testing is what significance level to use in deciding whether to reject the null hypothesis. Picking a high level of significance for rejecting the null hypothesis means that great emphasis is being placed on avoiding a Type I error (rejecting the null hypothesis, when in fact, the null hypothesis is true). This means that if a 0.10 significance level is chosen, the state wants to keep the chance of making a Type I error at or below ten percent. Hence, if the chosen null hypothesis is "segment meeting

WQS," the state is trying to keep the chance of saying a segment is impaired – when in reality it is not – under ten percent.

An additional policy issue is the Type II errors (not rejecting the null hypothesis, when it should have been). The probability of Type II errors depends on several factors. One key factor is the number of samples available. With a fixed number of samples, as the probability of Type I error decreases, the probability of a Type II error increases. States would ideally collect enough samples so the chances of making Type I and Type II errors are simultaneously small. Unfortunately, resources needed to collect such numbers of samples are quite often not available.

The final example of a policy issue that a state should describe is the rationale for concentrating limited resources to support data collection and statistical analysis in segments where there are documented water quality problems or where the combination of nonpoint source loadings and point source discharges would indicate a strong potential for a water quality problem to exist.

EPA recommends that, when picking the decision rules and statistical methods to be utilized when interpreting data and information, states attempt to minimize the chances of making either of the two following errors:

- *Concluding the segment is impaired, when in fact it is not, and*
- *Deciding not to declare a segment impaired, when it is in fact impaired.*

States should specify in their methodology what significance level they have chosen to use, in various circumstances. The methodology would best describe in "plain English" the likelihood of deciding to list a segment that in reality is not impaired (Type I error if the null hypothesis is "segment not impaired"). Also, EPA encourages states to estimate, in their assessment databases, the probability of making a Type II error (not putting on the 303(d) list a segment that in fact fails to meet WQS), when: 1) commonly-available numbers of grab samples are available, and 2) the degree of variance in pollutant concentrations are at commonly encountered levels. For example, if an assessment is being performed with a WQC expressed as a 30-day average concentration of a certain pollutant, it would be useful to estimate the probability of a Type II error when the number of available samples over a 30 day period is equal to the average number of samples for that pollutant in segments state-wide, or in a given group of segments, assuming a degree of variance in levels of the pollutant often observed over typical 30 day periods.

Appendix B

METHODS FOR ASSESSING COMPLIANCE WITH WATER QUALITY STANDARDS USED FOR 303(d) LISTING PURPOSES: NUMERIC CRITERIA THAT ARE INCLUDED IN STATE WATER QUALITY STANDARDS (10 CSR 20-7.031)

DESIGNATED USES	DATA TYPE	DATA QUALITY CODE	COMPLIANCE WITH WATER QUALITY STANDARDS[i]	Notes
Overall use protection (all designated uses)	No data. Evaluated based on similar land use/ geology as stream with water quality data.	Not applicable	Given same rating as monitored stream with same land use and geology.	**Data Type Note:** This data type is used only for wide-scale assessments of aquatic biota and aquatic habitat for 305(b) Report purposes. This data type is not used in the development of the 303(d) List.
Any designated uses	No data available or where only effluent data is available. Results of dilution calculations or water quality modeling	Not applicable	Where models or other dilution calculations indicate noncompliance with allowable pollutant levels and frequencies noted in this table, waters may be added to Category 3B and considered high priority for water quality monitoring.	
Protection of Aquatic Life	Dissolved oxygen, water temperature, pH, total dissolved gases, oil and grease.	1-4	Full: No more than 10% of all samples exceed criterion. Non-Attainment: Requirements for full attainment not met. Requirements: A minimum sample size of 10 samples during the assessment period (see Section VI above).	**Compliance with Water Quality Standards Note:** Some sampling periods are wholly or predominantly during the critical period of the year when criteria violations occur. Where the monitoring program presents good evidence of a demarcation between seasons where criteria exceedances occur and seasons when they do not, the 10% exceedance rate will be based on an annual estimate of the frequency of exceedance. Continuous (e.g. sonde) data with a quality rating of excellent or good will be used for assessments. Chronic pH will be used in the ~~2018~~ LMD only if these criteria appear in the Code of

Appendix B

METHODS FOR ASSESSING COMPLIANCE WITH WATER QUALITY STANDARDS USED FOR 303(d) LISTING PURPOSES: NUMERIC CRITERIA THAT ARE INCLUDED IN STATE WATER QUALITY STANDARDS (10 CSR 20-7.031)

DESIGNATED USES	DATA TYPE	DATA QUALITY CODE	COMPLIANCE WITH WATER QUALITY STANDARDS[i]	Notes
				State Regulations, and approved by the U.S. Environmental Protection Agency.
Losing Streams	*E. coli* bacteria	1-4	Full: No more than 10% of all samples exceed criterion. Non-Attainment: Requirements for full attainment not met. The criterion for *E. coli* is 126 counts/100ml. 10 CSR 20-7.031 (4)(C)	
Protection of Aquatic Life	Toxic chemicals	1-4	Full: No more than one acute toxic event in three years that results in a documented die-off of aquatic life such as fish, mussels, and crayfish (does not include die-offs due to natural origin). No more than one exceedance of acute or chronic criterion in the last three years for which data is available. Non-Attainment: Requirements for full attainment not met.	**Compliance with Water Quality Standards Note:** For hardness based metals with eight or fewer samples, the hardness value associated with the sample will be used to calculate the acute or chronic thresholds. For hardness based metals with more than eight samples, the hardness definition provided in state water quality standards will be used to calculate the acute and chronic thresholds.
Protection of Aquatic Life	Nutrients in Lakes (total phosphorus, total nitrogen, ~~plus~~ and chlorophyll-a)	1-4	Full: Nutrient levels do not exceed water quality standards following procedures stated in Appendix D and F. Non-Attainment: Requirements for full attainment not met.	**Compliance with Water Quality Standards Note:** Ecoregional ~~N~~nutrient criteria will be used ~~in the 2020 LMD~~ only if these criteria ~~appear in the Code of State Regulations, and~~ are approved by the U.S. Environmental Protection Agency.
Human Health - Fish Consumption	Chemicals (water)	1-4	Full: Water quality does not exceed water quality standards following procedures stated in -Appendix D. Non-Attainment: Requirements for full attainment not met.	

Appendix B

METHODS FOR ASSESSING COMPLIANCE WITH WATER QUALITY STANDARDS USED FOR 303(d) LISTING PURPOSES: NUMERIC CRITERIA THAT ARE INCLUDED IN STATE WATER QUALITY STANDARDS (10 CSR 20-7.031)

DESIGNATED USES	DATA TYPE	DATA QUALITY CODE	COMPLIANCE WITH WATER QUALITY STANDARDS[i]	Notes
Drinking Water Supply -Raw Water.	Chemical (toxics)	1-4	Full: Water Quality Standards not exceeded following procedures stated in Appendix D. Non-Attainment: Requirements for full attainment not met.	**Designated Use Note:** Raw water is water from a stream, lake or groundwater prior to treatment in a drinking water treatment plant.
Drinking Water Supply- Raw Water	Chemical (sulfate, chloride, fluoride)	1-4	Full: Water quality standards not exceeded following procedures stated in Appendix D. Non-Attainment: Requirements for full attainment not met.	
Drinking Water Supply-Finished Water	Chemical (toxics)	1-4	Full: No Maximum Contaminant Level (MCL) violations based on Safe Drinking Water Act data evaluation procedures. Non-Attainment: Requirements for full attainment not met.	**Compliance with Water Quality Standards Note:** Finished water data will not be used for analytes where water quality problems may be caused by the drinking water treatment process such as the formation of Trihalomethanes (THMs) or problems that may be caused by the distribution system (bacteria, lead, copper).
Whole-Body-Contact Recreation and Secondary Contact Recreation	Fecal coliform or *E. coli* count	2-4	Where there are at least five samples per year taken during the recreational season: Full: Water quality standards not exceeded as a geometric mean, in any of the last three years for which data is available, for samples collected during seasons for which bacteria criteria apply. Non-Attainment: Requirements for full attainment not met.	**Compliance with Water Quality Standards Note:** A geometric mean of 206 cfu/100 ml for *E. coli* will be used as a criterion value for Category B Recreational Waters. Because Missouri's Fecal Coliform Standard ended December 31, 2008, any waters appearing on the 2008 303(d) List as a result of the Fecal Coliform Standard will be retained on the list with the pollutant listed as "bacteria" until sufficient *E. coli* sampling has determined the status of the water.

Appendix B

METHODS FOR ASSESSING COMPLIANCE WITH WATER QUALITY STANDARDS USED FOR 303(d) LISTING PURPOSES: NUMERIC CRITERIA THAT ARE INCLUDED IN STATE WATER QUALITY STANDARDS (10 CSR 20-7.031)

DESIGNATED USES	DATA TYPE	DATA QUALITY CODE	COMPLIANCE WITH WATER QUALITY STANDARDS[i]	Notes
Irrigation, Livestock and Wildlife Water	Chemical	1-4	Full: Water quality standards not exceeded following procedures stated in Appendix D. Non-Attainment: Requirements for full attainment not met.	

[i] See section on Statistical Considerations, Appendix C & D.

Appendix C

METHODS FOR ASSESSING COMPLIANCE WITH WATER QUALITY STANDARDS USED FOR 303(d) LISTING PURPOSES: NARRATIVE CRITERIA BASED ON NUMERIC THRESHOLDS NOT CONTAINED IN STATE WATER QUALITY STANDARDS (10 CSR 20-7.031)

BENEFICIAL USES	DATA TYPE	DATA QUALITY CODE	COMPLIANCE WITH WATER QUALITY STANDARDS[ii]	Notes
Overall use protection (all beneficial uses)	Narrative criteria for which quantifiable measurements can be made.	1-4	Full: Stream condition typical of reference or appropriate control streams in this region of the state. Non-Attainment: The weight of evidence, based on the narrative criteria in 10 CSR 20-7.031(3), demonstrates the observed condition exceeds a numeric threshold necessary for the attainment of a beneficial use. For example: Color: Color as measured by the Platinum-Cobalt visual method (SM 2120 B) in a water body is statistically significantly higher than a control water. Objectionable Bottom Deposits: The bottom that is covered by sewage sludge, trash, or other materials reaching the water due to anthropogenic sources exceeds the amount in reference or control streams by more than 20 percent. Note: Waters in mixing zones and unclassified waters that support aquatic life on an intermittent basis shall be subject to acute toxicity criteria for protection of aquatic life. Waters in the initial Zone of Dilution shall not be subject to acute toxicity criteria.	

Appendix C

METHODS FOR ASSESSING COMPLIANCE WITH WATER QUALITY STANDARDS USED FOR 303(d) LISTING PURPOSES: NARRATIVE CRITERIA BASED ON NUMERIC THRESHOLDS NOT CONTAINED IN STATE WATER QUALITY STANDARDS (10 CSR 20-7.031)

BENEFICIAL USES	DATA TYPE	DATA QUALITY CODE	COMPLIANCE WITH WATER QUALITY STANDARDS[ii]	Notes
Protection of Aquatic Life	Toxic Chemicals	1-4	Full: No more than one acute toxic event in three years (does not include die-offs of aquatic life due to natural origin). No more than one exceedance of acute or chronic criterion in three years for all toxics. Non-Attainment: Requirements for full attainment not met.	**Compliance with Water Quality Standards Note**: The test result must be representative of water quality for the entire time period for which acute or chronic criteria apply. For ammonia the chronic exposure period is 30 days, for all other toxics 96 hours. The acute exposure period for all toxics is 24 hours, except for ammonia which has a one hour exposure period. The department will review all appropriate data, including hydrographic data, to ensure only representative data are used. Except on large rivers where storm water flows may persist at relatively unvarying levels for several days, grab samples collected during storm water flows will not be used for assessing chronic toxicity criteria. **Compliance with Water Quality Standards Note:** In the case of toxic chemicals occurring in benthic sediment rather than in water, the numeric thresholds used to determine the need for further evaluation will be the Probable Effect Concentrations proposed in "Development and Evaluation of Consensus-Based Sediment Quality Guidelines for Freshwater Ecosystems" by MacDonald, D.D. *et al.* Arch. Environ. Contam. Toxicol. 39,20-31 (2000). These Probable Effect Concentrations are as follows: 33 mg/kg As; 4.98 mg/kg Cd; 111 mg/kg Cr; 149 mg/kg Cu; 48.6 mg/kg Ni; 128 mg/kg Pb; 459 mg/kg Zn; 561 µg/kg naphthalene; 1170 µg/kg phenanthrene; 1520 µg/kg pyrene; 1050 µg/kg benzo(a)anthracene, 1290 µg/kg chrysene; 1450 µg/kg benzo(a)pyrene; 22,800 µg/kg total polycyclic aromatic hydrocarbons; 676 µg/kg total PCBs; chlordane 17.6 ug/kg; Sum DDE 31.3 ug/kg; lindane (gamma-BHC) 4.99 ug/kg. Where multiple sediment contaminants exist, the Probable Effect Concentrations Quotient shall not exceed 0.75. See Appendix D and Section II. D for more information on the Probable Effect Concentrations Quotient.

Appendix C

METHODS FOR ASSESSING COMPLIANCE WITH WATER QUALITY STANDARDS USED FOR 303(d) LISTING PURPOSES: NARRATIVE CRITERIA BASED ON NUMERIC THRESHOLDS NOT CONTAINED IN STATE WATER QUALITY STANDARDS (10 CSR 20-7.031)

BENEFICIAL USES	DATA TYPE	DATA QUALITY CODE	COMPLIANCE WITH WATER QUALITY STANDARDS[ii]	Notes
Protection of Aquatic Life	Biological: Aquatic Macro-invertebrates sampled using DNR Protocol.	3-4	Full: For seven or fewer samples and following DNR wadeable streams macroinvertebrate sampling and evaluation protocols, 75% of the stream condition index scores must be 16 or greater. Fauna achieving these scores are considered to be very similar to regional reference streams. For greater than seven samples or for other sampling and evaluation protocols, results must be statistically similar to representative reference or control stream. Non-Attainment: For seven or fewer samples and following DNR wadeable streams macroinvertebrate sampling and evaluation protocols, 75% of the stream condition index scores must be 14 or lower. Fauna achieving these scores are considered to be substantially different from regional reference streams. For more than seven samples or for other sampling and evaluation protocols, results must be statistically dissimilar to control or representative reference streams.	**Data Type Note:** DNR invert protocol will not be used for assessment in the Mississippi Alluvial Basin (bootheel area) due to lack of reference streams for comparison. **Data Type Note:** See Section II.D. for additional criteria used to assess biological data. **Compliance with Water Quality Standards Note:** See Appendix D. For test streams that are significantly smaller than bioreference streams where both bioreference streams and small candidate reference streams are used to assess the biological integrity of the test stream, the assessment of the data should display and take into account both biocriteria reference streams and candidate reference streams.
Protection of Aquatic Life	Biological: MDC Fish Community (RAM) Protocol (Ozark Plateau only)	3-4	Full: For seven or fewer samples and following MDC RAM fish community protocols, 75% of the fIBI scores must be 36 or greater. Fauna achieving these scores are considered to be very similar to regional reference streams. For greater than seven samples or for other sampling	**Data Type Note:** See Section II.D. for additional criteria used to assess biological data. **Compliance with Water Quality Standards Note:** MDC fIBI scores are from "Biological Criteria for Streams and Fish Communities in Missouri" by Doisy et al. (2008). If habitat limitations (as measured by either the QCPH1 index or other appropriate methods) are judged to contribute to low fish

Appendix C

METHODS FOR ASSESSING COMPLIANCE WITH WATER QUALITY STANDARDS USED FOR 303(d) LISTING PURPOSES: NARRATIVE CRITERIA BASED ON NUMERIC THRESHOLDS NOT CONTAINED IN STATE WATER QUALITY STANDARDS (10 CSR 20-7.031)

BENEFICIAL USES	DATA TYPE	DATA QUALITY CODE	COMPLIANCE WITH WATER QUALITY STANDARDS[ii]	Notes
			and evaluation protocols, results must be statistically similar to representative reference or control streams. Suspected of Impairment: Data not conclusive (Category 2B or 3B). For first and second order streams fIBI score < 29. Non-Attainment: First and second order streams will not be assessed for non-attainment. When assessing third to fifth order streams with data sets of seven or fewer samples collected by following MDC RAM fish community protocols, 75% of the fIBI scores must be lower than 36. Fauna achieving these scores are considered to be substantially different from regional reference streams. For more than seven samples or for other sampling and evaluation protocols, results must be statistically dissimilar to control or representative reference streams.	community scores and this is the only type of data available, the water body will be included in Category 4C, 2B, or 3B. If other types of data exist, the weight of evidence approach will be used as described in this document. **Compliance with Water Quality Standards Note:** For determining influence of poor habitat on those samples that are deemed as impaired, consultation with MDC RAM staff will be utilized. If, through this consultation, habitat is determined to be a significant possible cause for impairment, the water body will not be rated as impaired, but rather as suspect of impairment (categories 2B or 3B). **Compliance with Water Quality Standards Note:** See Appendix D. For test streams that are significantly smaller than bioreference streams where both bioreference streams and small candidate reference streams are used to assess the biological integrity of the test stream, the assessment of the data should display and take into account both biocriteria reference streams and candidate reference streams.
Protection of Aquatic Life	Other Biological Data	3-4	Full: Results must be statistically similar to representative reference or control streams. Non-Attainment: Results must be statistically dissimilar to control or representative reference streams.	**Data Type Note:** See Section II.D. for additional criteria used to assess biological data

Appendix C

METHODS FOR ASSESSING COMPLIANCE WITH WATER QUALITY STANDARDS USED FOR 303(d) LISTING PURPOSES: NARRATIVE CRITERIA BASED ON NUMERIC THRESHOLDS NOT CONTAINED IN STATE WATER QUALITY STANDARDS (10 CSR 20-7.031)

BENEFICIAL USES	DATA TYPE	DATA QUALITY CODE	COMPLIANCE WITH WATER QUALITY STANDARDS[ii]	Notes
Protection of Aquatic Life	Toxicity testing of streams or lakes using aquatic organisms	2	Full: No more than one test result of statistically significant deviation from controls in acute or chronic test in a three-year period. Non-Attainment: Requirements for full attainment not met.	
Human Health - Fish Consumption	Chemicals (tissue)	1-2	Full: Contaminant levels in fish tissue levels in fillets, tissue plugs, and eggs do not exceed guidelines. Non-Attainment: Requirements for full attainment not met.	**Compliance with Water Quality Standards Note**: Fish tissue threshold levels are; chlordane 0.1 mg/kg (Crellin, J.R. 1989, *"New Trigger Levels for Chlordane in Fish-Revised Memo"* Mo. Dept. of Health inter-office memorandum. June 16, 1989); mercury 0.3 mg/kg based on "Water Quality Criterion for Protection of Human Health: Methylmercury" EPA-823-R-01-001. Jan. 2001. http://www.epa.gov/waterscience/criteria/methylmercury/merctitl.pdf; PCBs 0.75 mg/kg, MDHSS Memorandum August 30, 2006 *"Development of PCB Risk-based Fish Consumption Limit Tables*;" and lead 0.3- mg/kg (World Health Organization 1972. *"Evaluation of Certain Food Additives and the Contaminants Mercury, Lead and Cadmium."* WHO Technical Report Series No. 505, Sixteenth Report on the Joint FAO/WHO Expert Committee on Food Additives. Geneva 33 pp. Assessment of Mercury will be based on samples solely from the following higher trophic level fish species: Walleye, Sauger, Trout, Black Bass, White Bass, Striped Bass, Northern Pike, Flathead Catfish and Blue Catfish. In a 2012 DHSS memorandum (not yet approved, but are being considered for future LMD revisions) threshold values are proposed to change as follows: chlordane 0.2 mg/kg ; mercury 0.27 mg/kg ; and PCBs = 0.540 ; lead has not changed, but they do add atrazine and PDBEs **(Fish Fillet Advisory Concentrations (FFACs) in Missouri).**

[ii] **See section on Statistical Considerations and Appendix D.**

Appendix D

DESCRIPTION OF ANALYTICAL TOOLS USED FOR DETERMINING THE STATUS OF MISSOURI WATERS (11" X 14" FOLD OUT)

			Determining when waters are impaired			Determining when waters are no longer impaired			
Designated Use	**Analytes**	**Analytical Tool**	**Decision Rule/ Hypothesis**	**Criterion Used with the Decision Rule[iii]**	**Significance Level (α)**	**Decision Rule/ Hypothesis**	**Criterion Used with the Decision Rule**	**Significance Level (α)**	**Notes**
Narrative Criteria	Color	Hypothesis Test: Two Sample, one tailed t-Test	Null Hypothesis: There is no difference in color between test stream and control stream.	Reject Null Hypothesis if calculated "t" value exceeds tabular "t" value for test alpha	0.1	Same Hypothesis	Same Criterion	Same Significance Level	
	Bottom deposits	Hypothesis Test, Two Sample, one tailed "t "Test	Null Hypothesis: Solids of anthropogenic origin cover less than 20% of stream bottom where velocity is less than 0.5 feet/second.	Reject Null Hypothesis if 60% Lower Confidence Limit (LCL) of mean percent fine sediment deposition (pfsd) in stream is greater than the sum of the pfsd in the control and 20 % more of the stream bottom. i.e., where the pfsd is expressed as a decimal, test stream pfsd > (control stream pfsd)+(0.20)	0.4	Same Hypothesis	Same Criterion	Same Significance Level	**Criterion Note:** If data is non-normal a nonparametric test will be used as a comparison of medians. The same 20% difference still applies. With current software the Mann-Whitney test is used.

Appendix D

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Designated Use	**Analytes**	**Analytical Tool**	**Decision Rule/ Hypothesis**	**Criterion Used with the Decision Rule[iii]**	**Significance Level (α)**	**Decision Rule/ Hypothesis**	**Criterion Used with the Decision Rule**	**Significance Level (α)**	**Notes**
Aquatic Life	Biological monitoring (Narrative)	For DNR Invert protocol: Sample sizes of 7 or less, 75% of samples must score 14 or lower.	Using DNR Invert. Protocol: Null Hypothesis: Frequency of full sustaining scores for test stream is the same as for biological criteria reference streams.	Reject Null Hypothesis if frequency of fully sustaining scores on test stream is significantly less than for biological criteria reference streams.	Not Applicable	Same Hypothesis	Same Criterion	Same Significance Level	
		For RAM Fish IBI protocol: Sample sizes of 7 or less, 75% of samples must score less than 36.							
		For DNR Invert protocol and sample size of 8 or more: Binomial Probability	A direct comparison of frequencies between test and biological criteria reference streams will be made.	Rate as impaired if biological criteria reference stream frequency of fully biologically supporting scores is greater than five percent more than test stream.	0.1	Same Hypothesis	Same Criterion	Same Significance Level	**Criterion Note:** For inverts, the reference number will change depending on which EDU the stream is in (X%-5%), for RAM samples the reference number will always be 70 (75%-5%).
		For RAM Fish IBI protocol and sample size of 8 or more: Binomial Probability.							
		For other biological data an appropriate parametric or	Null Hypothesis, Community metric(s) in test	Reject Null Hypothesis if metric scores for test stream are	0.1	Same Hypothesis	Same Criterion	Same Significance Level	
Aquatic Life									

Appendix D

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			Determining when waters are impaired			Determining when waters are no longer impaired			
Designated Use	**Analytes**	**Analytical Tool**	**Decision Rule/ Hypothesis**	**Criterion Used with the Decision Rule[iii]**	**Significance Level (α)**	**Decision Rule/ Hypothesis**	**Criterion Used with the Decision Rule**	**Significance Level (α)**	**Notes**
(cont.)		nonparametric test will be used.	stream is the same as for a reference stream or control streams.	significantly less than reference or control streams.					
			Other biological monitoring to be determined by type of data.	Dependent upon available information.	Dependent upon available information.	Same Hypothesis	Same Criterion	Same Significance Level	
	Toxic chemicals in water: (Numeric)	Not applicable	No more than one toxic event, toxicity test failure or exceedance of acute or chronic criterion in 3 years.	Not applicable	Not applicable	Same Hypothesis	Same Criterion	Same Significance Level	
	Toxic chemicals in sediments: (Narrative)	Comparison of geometric mean to PEC value, or calculation of a PECQ value.	Waters are judged to be impaired if parameter geomean exceeds PEC, or site PECQ is exceeded.	For metals use 150% PEC threshold. The PECQ threshold value is 0.75.	Not applicable	Water is judged to be unimpaired if parameter geomean is equal to or less than PEC, or site PECQ equaled or not exceeded.	For metals use 150% of PEC threshold. The PECQ threshold value is 0.75.	Not applicable	**Compliance with Water Quality Standards Note:** In the case of toxic chemicals occurring in benthic sediment rather than in water, the numeric thresholds used to determine the need for further evaluation will be the Probable Effect Concentrations proposed in "Development and Evaluation of Consensus-Based Sediment Quality Guidelines for Freshwater Ecosystems" by MacDonald, D.D. *et al.* Arch. Environ. Contam. Toxicol. 39,20-31 (2000). These Probable Effect Concentrations are as follows: 33 mg/kg As; 4.98 mg/kg Cd; 111 mg/kg Cr; 149 mg/kg Cu; 48.6 mg/kg Ni; 128 mg/kg Pb; 459 mg/kg Zn; 561 µg/kg naphthalene; 1170

Appendix D

DESCRIPTION OF ANALYTICAL TOOLS USED FOR DETERMINING THE STATUS OF MISSOURI WATERS (11" X 14" FOLD OUT)

			Determining when waters are impaired			Determining when waters are no longer impaired			
Designated Use	**Analytes**	**Analytical Tool**	**Decision Rule/ Hypothesis**	**Criterion Used with the Decision Rule[iii]**	**Significance Level (α)**	**Decision Rule/ Hypothesis**	**Criterion Used with the Decision Rule**	**Significance Level (α)**	**Notes**
Aquatic Life (cont.)									µg/kg phenanthrene; 1520 µg/kg pyrene; 1050 µg/kg benzo(a)anthracene, 1290 µg/kg chrysene; 1450 µg/kg benzo(a)pyrene; 22,800 µg/kg total polycyclic aromatic hydrocarbons; 676 µg/kg total PCBs; chlordane 17.6 ug/kg; Sum DDE 31.3 ug/kg; lindane (gamma-BHC) 4.99 ug/kg. Where multiple sediment contaminants exist, the Probable Effect Concentrations Quotient shall not exceed 0.75. See Appendix D and Section II. D for more information on the Probable Effect Concentrations Quotient.
	Temperature, pH, total diss. gases, oil and grease, diss. oxygen (Numeric)	Binomial probability	Null Hypothesis: No more than 10% of samples exceed the water quality criterion.	Reject Null Hypothesis if the Type I error rate is less than 0.1.	Not applicable	Same Hypothesis	Same Criterion	Same Significance Level	Continuous Sampling (i.e. time series or sonde data collection): Data collected in a time series fashion will be looked at on a 4 day period. If an entire 4 day period is outside of the 6.5 – 9.0 criterion range that will count as a chronic toxicity event. More than one of these events will constitute an impairment listing of the stream. Grab Samples: Data collected as grab samples will be treated as is and the binomial probability calculation will be used for assessment.
Losing Streams	*E.coli*	Binomial probability	Null Hypothesis: No more than 10% of samples exceed the water quality criterion.	Reject Null Hypothesis if the Type I error rate is less than 0.1.	0.1	Same Hypothesis	Same Criterion	Same Significance Level	

Appendix D

DESCRIPTION OF ANALYTICAL TOOLS USED FOR DETERMINING THE STATUS OF MISSOURI WATERS (11" X 14" FOLD OUT)

			Determining when waters are impaired			Determining when waters are no longer impaired			
Designated Use	**Analytes**	**Analytical Tool**	**Decision Rule/ Hypothesis**	**Criterion Used with the Decision Rule[iii]**	**Significance Level (α)**	**Decision Rule/ Hypothesis**	**Criterion Used with the Decision Rule**	**Significance Level (α)**	**Notes**
Human Health – Fish Consumption	Toxic chemicals in water (Numeric)	Hypothesis test: 1-sided confidence limit	Null Hypothesis: Levels of contaminants in water do not exceed criterion.	Reject Null Hypothesis if the 60% LCL is greater than the criterion value.	0.4	Same Hypothesis	Reject Null Hypothesis if the 60% UCL is greater than the criterion value.	Same Significance Level	
	Toxic chemicals in tissue (Narrative)	Four or more samples: Hypothesis test 1-sided confidence limit	Null Hypothesis: Levels in fillet samples or fish eggs do not exceed criterion.	Reject Null Hypothesis if the 60% LCL is greater than the criterion value.	0.4	Same Hypothesis	Reject null hypothesis if the 60% UCL is greater than the criterion value.	Same Significance Level	
Drinking Water Supply (Raw)	Toxic chemicals (Numeric)	Hypothesis test: 1-sided confidence limit	Null Hypothesis: Levels of contaminants do not exceed criterion.	Reject Null Hypothesis if the 60% LCL is greater than the criterion value.	0.4	Same Hypothesis	Reject null hypothesis if the 60% UCL is greater than the criterion value.	Same Significance Level	
	Non-toxic chemicals (Numeric)	Hypothesis test: 1-sided confidence limit	Null Hypothesis: Levels of contaminants do not exceed criterion.	Reject Null Hypothesis: if the 60% LCL is greater than the criterion value.	0.4	Same Hypothesis	Reject null hypothesis if the 60% UCL is greater than the criterion value.	Same Significance Level	
Drinking Water Supply (Finished)	Toxic chemicals	Methods stipulated by Safe Drinking Water Act.	Methods stipulated by Safe Drinking Water Act.	Methods stipulated by Safe Drinking Water Act.	Methods stipulated by Safe Drinking Water Act.	Same Hypothesis	Same Criterion	Same Significance Level	

Appendix D

DESCRIPTION OF ANALYTICAL TOOLS USED FOR DETERMINING THE STATUS OF MISSOURI WATERS (11" X 14" FOLD OUT)

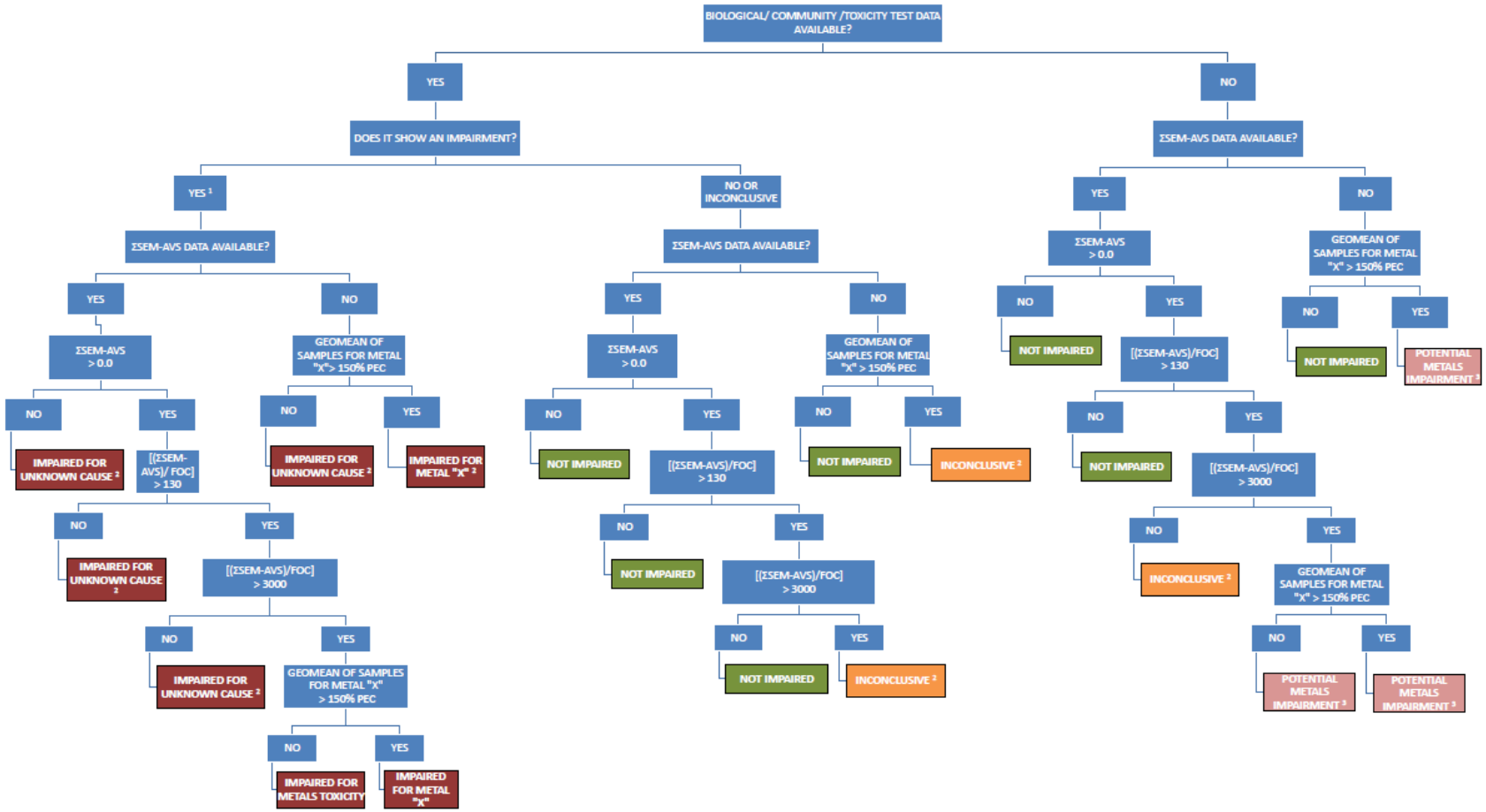
			Determining when waters are impaired			Determining when waters are no longer impaired			
Designated Use	**Analytes**	**Analytical Tool**	**Decision Rule/ Hypothesis**	**Criterion Used with the Decision Rule[iii]**	**Significance Level (α)**	**Decision Rule/ Hypothesis**	**Criterion Used with the Decision Rule**	**Significance Level (α)**	**Notes**
Whole Body Contact and Secondary	Bacteria (Numeric)	Geometric mean	Null Hypothesis: Levels of contaminants do not exceed criterion.	Reject Null Hypothesis: if the geometric mean is greater than the criterion value.	Not Applicable	Same Hypothesis	Same Criterion	Not applicable	
Irrigation & Livestock Water	Toxic chemicals (Numeric)	Hypothesis test 1-Sided confidence limit	Null Hypothesis: Levels of contaminants do not exceed criterion.	Reject Null Hypothesis if the 60% LCL is greater than the criterion value.	0.4	Same Hypothesis	Reject null hypothesis if the 60% UCL is greater than the criterion value.	Same Significance Level	
Protection of Aquatic Life	Nutrients in lakes (Numeric – Site Specific)	Hypothesis test	Null hypothesis: Criteria are not exceeded.	Reject Null Hypothesis if 60% LCL value is greater than criterion value.	0.4	Same Hypothesis	Same Criterion	Same Significance Level	**Hypothesis Test Note:** State nutrient criteria require at least four samples per year taken near the outflow point of the lake (or reservoir) between May 1 and August 31 for at least four different, not necessarily consecutive, years.
Protection of Aquatic Life	Nutrients in lakes (Numeric – Ecoregional)	See Nutrient Implementation Plan	Methods stipulated by Nutrient Implementation Plan	Methods stipulated by Nutrient Implementation Plan	Methods stipulated by Nutrient Implementation Plan	Same Hypothesis	Same Criterion	Same Significance Level	Nutrient Implementation Plan was developed as an additional aspect of the Lake Nutrient Criteria package submitted to EPA. This implementation plan spells out how ecoregional lake nutrient criteria will be assessed. See Appendix F for the implementation plan.

[iii] Where hypothesis testing is used for media other than fish tissue, for data sets with five samples or fewer, a 75 percent confidence interval around the appropriate central tendencies will be used to determine use attainment status. Use attainment will be determined as follows: (1) If the criterion value is above this interval (all values within the interval are in conformance with the criterion), rate as unimpaired; (2) If the criterion value falls within this interval, rate as unimpaired and place in Category 2B or 3B; (3) If the criterion value is below this interval (all values within the interval are not in conformance with the criterion), rate as impaired. For fish tissue, this procedure will be used with the following changes: (1) it will apply only to sample sizes of less than four and, (2) a 50% confidence interval will be used in place of the 75% confidence interval.

Appendix E

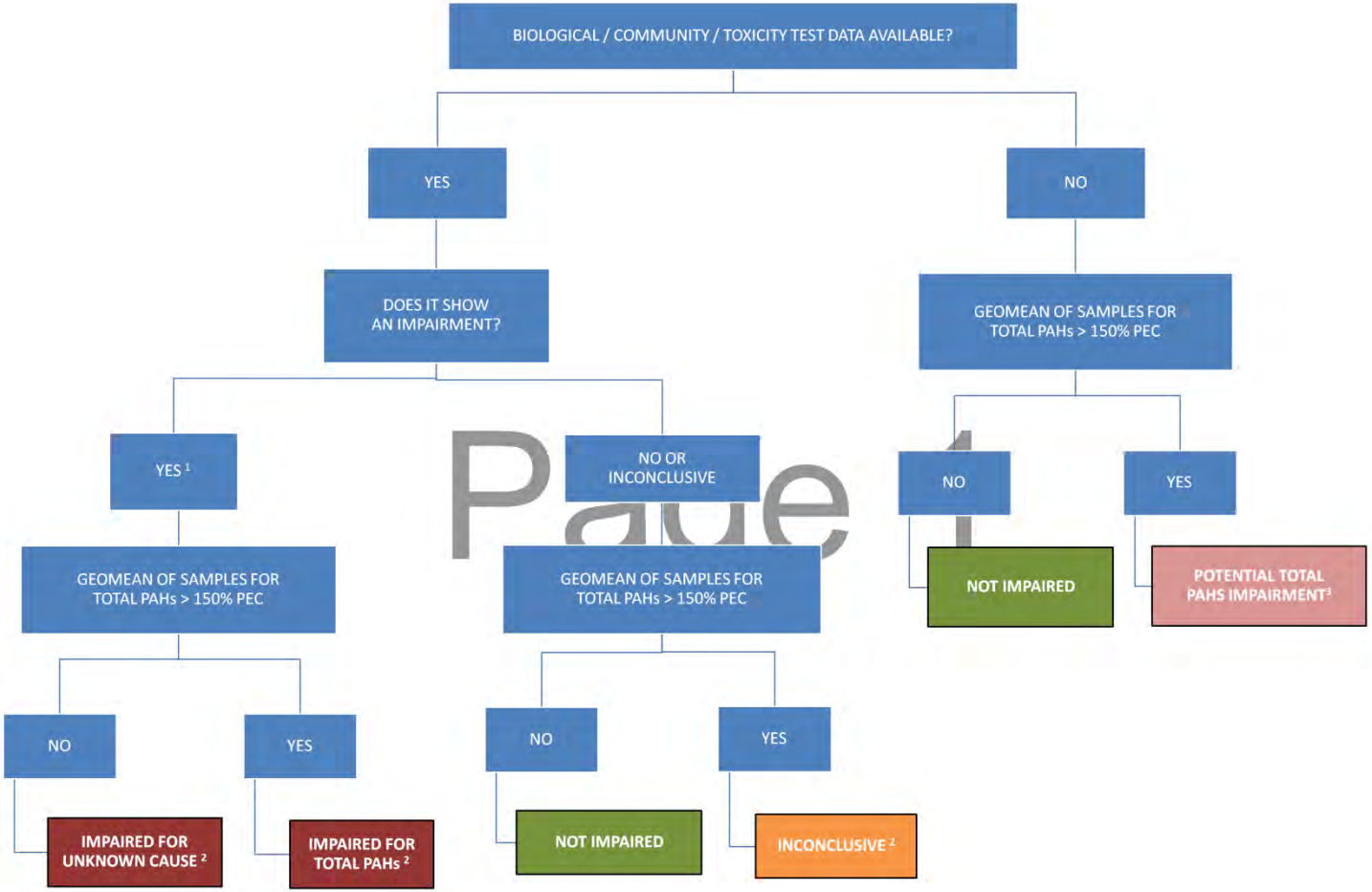
PICTORIAL REPRESENTATIONS OF THE WEIGHT OF EVIDENCE PROCEDURE FOR JUDGING TOXICITY OF SEDIMENT DUE TO METALS AND PAHS

Biological Weight of Evidence Decision Chart - Sediment Toxicity (Metals)



Notes:
1 - If there are Numeric WQS violations (unrelated to sediment) then follow LMD Procedure in LMD Appendix B. **Do Not Continue.**
2 - Note waterbody for further investigation related to metals or habitat issues.
3 - Note waterbody for Biological Sampling.

Biological Weight of Evidence Decision Chart - Sediment Toxicity (PAHs)



Notes:

1 - If there are Numeric WQS violations (unrelated to sediment) then follow LMD Procedure in LMD Appendix B. Do Not Continue.

2 - Note waterbody for further investigation.

3 - Note waterbody for Biological Sampling.

Appendix F

NUTRIENT CRITERIA IMPLEMENTATION PLAN

MISSOURI
DEPARTMENT OF
NATURAL RESOURCES

Nutrient Criteria Implementation Plan

July 27, 2018

Table of Contents

Purpose of Document 3

Background 3

Missouri's Nutrient Criteria 4

Missouri Lakes and Reservoirs 4
Numeric Criteria for Lakes [10 CSR 20-7.031(5)(N)] 4
Narrative Criteria [10 CSR 20-7.031(4)] 5
Site-Specific Criteria [10 CSR 20-7.031(5)(N)] 5

Part I. Monitoring and Assessment 6

Monitoring Efforts 6

Lakes of Missouri Volunteer Program (LMVP) 6
Statewide Lake Assessment Program (SLAP) 7

Data Requirements for Assessment 8

Criteria for Assessment 8

Assessment Methodology 10

Trend Analysis 20

Total Maximum Daily Load Development for Nutrient Impaired Waters 24

Part II. Permit Implementation 26

Effluent Regulation [10 CSR 20-7.015(3)] 26
Effluent Regulation [10 CSR 20-7.015(9)(D)7.] 26

Implementing a Three-Phase Approach 26

Phase 1 – Data Collection and Analysis 27
Phase 2 – Plant Optimization 28
Phase 3 – Final Effluent Limitations 29

Impaired Lakes 30

New and Expanding Sources and Antidegradation Review Requirements 31

Potential Flexibilities for Permittees 32

Incentives for Early Nutrient Reduction 33

References 34

Appendices 35

A – Missouri Department of Conservation Fish Stocking Information Letter 36

B – Methodology for the Development of the 2020 Section 303(d) List in Missouri 39

Purpose

Section 304(a) of the federal Clean Water Act provides the framework for states to develop Water Quality Standards (WQS) that protect the physical, chemical, and biological integrity of their waters. The Missouri Department of Natural Resources (Department) is fully delegated by the US Environmental Protection Agency (EPA) to conduct WQS revisions pursuant to the federal Clean Water Act. Changes to Missouri's WQS [10 Code of State Regulations (CSR) 20-7.031] were published on March 31, 2018. One major revision to the WQS is the incorporation of numeric nutrient criteria for lakes.

This plan describes how the Department intends to implement nutrient criteria in accordance with the newly revised WQS. This plan does not prohibit establishing alternative methods of analysis, permit limits, or requirements provided that the alternatives are technically sound, consistent with state and federal regulations, and are protective of water quality. All permitting will be consistent with federal and state requirements.

Background

Eutrophication is the process by which a body of water becomes enriched in nutrients, such as nitrogen and phosphorus, which stimulate the excessive growth of algae and other plants. Eutrophication may be accelerated by human activities. It is well documented that enrichment of nutrients can lead to increased production of algae and aquatic plants in freshwater systems. This increased production may result in nonattainment of beneficial uses under certain environmental conditions. Aquatic life protection uses can be negatively impacted by excess nutrient loading, which may increase the likelihood of fish kills caused by the depletion of dissolved oxygen (DO). Aquatic diversity can be undermined by creating conditions favorable to fast-growing species, such as carp and other benthivores, at the expense of other species (Edgertson and Downing, 2004).

The Department utilizes regulatory and incentive-based approaches to ensure excessive nutrients do not impair or degrade beneficial uses. Regulatory approaches such as nutrient effluent limitations and nutrient WQS are implemented by the Department's Water Protection Program. Incentive-based approaches to nutrient reduction through education, outreach, and the execution of best management practices are implemented by the Department's Soil and Water Conservation Program using federal and state funds.

Missouri's Nutrient Criteria

Missouri Lakes and Reservoirs
For the purposes of Missouri's nutrient criteria and this document, all lakes and reservoirs are referred to as "lakes" [10 CSR 20-7.031(5)(N)1.A.]. Missouri's lakes are more appropriately classified as impoundments and have very different physical, chemical, and biological characteristics when compared to naturally-formed glacial or mountainous lakes found in other states. Many of Missouri's major lakes were constructed primarily for flood control, hydroelectric power, and water supply. The riverine habitats and species that existed before impoundment over time transitioned into the current state of aquatic life dominated by self-sustaining populations of sport and non-sport fishes. The numeric nutrient criteria and implementation methods proposed by the Department are structured to ensure the deleterious impacts of nutrient enrichment to Missouri's lakes are mitigated without adverse impacts to the health and vitality of the self-sustaining populations of aquatic life that live there.

Missouri's nutrient criteria apply to all lakes that are waters of the state and have an area of at least ten (10) acres during normal pool condition, except the natural lakes (oxbows) in the Big River Floodplain ecoregion [10 CSR 20-7.031(5)(N)2.]. The criteria apply to, and assessments will be conducted for, the entire water body as found in Missouri's WQS regulation. As noted in the *Rationale for Missouri Lake Nutrient Criteria* (DNR, 2017), the Department has structured Missouri's nutrient criteria as a decision framework that applies at an ecoregional basis. This decision framework integrates causal and response parameters into one water quality standard that accounts for uncertainty in linkages between causal and response parameters. The decision framework includes response impairment thresholds, nutrient screening thresholds, and response assessment endpoints. This framework appropriately integrates causal and response parameters and is based on the bioconfirmation guiding principles that EPA (2013) has suggested as an approach for developing nutrient criteria.

Numeric Criteria for Lakes [10 CSR 20-7.031(5)(N)]
Missouri's WQS contain response impairment threshold values for chlorophyll-a (Chl-a) and screening threshold values for total nitrogen (TN), total phosphorus (TP), and Chl-a, all of which vary by the dominant watershed ecoregion. Lakes are determined to be impaired if the geometric mean of samples taken between May and September in a calendar year exceeds the Chl-a response impairment threshold value more than once in three years' time. A duration of three or more years is necessary to account for natural variations in nutrient levels due to climatic variability (Jones and Knowlton, 2005). If a lake exceeds a screening threshold value, it will be designated as impaired if any of five response assessment endpoints also are identified in the same calendar year.

Lake Ecoregion	Chl-a Response Impairment Thresholds (µg/L)	Nutrient Screening Thresholds (µg/L)		
		TP	TN	Chl-a
Plains	30	49	843	18
Ozark Boarder	22	40	733	13
Ozark Highland	15	16	401	6

The five response assessment endpoints are:

- Occurrence of eutrophication-related mortality or morbidity events for fish and other aquatic organisms
- Epilimnetic excursions from dissolved oxygen or pH criteria
- Cyanobacteria counts in excess of 100,000 cells/mL
- Observed shifts in aquatic diversity attributed to eutrophication
- Excessive levels of mineral turbidity that consistently limit algal productivity during the period of May 1 – September 30

All scientific references used for numeric nutrient criteria derivation are contained in the *Rationale for Missouri Lake Nutrient Criteria* (DNR, 2017) and supplemental materials maintained by the Department. The Department maintains a copy of these references and makes them available to the public for inspection and copying at no more than the actual cost of reproduction.

Narrative Criteria [10 CSR 20-7.031(4)]

Missouri's WQS contain general (narrative) water quality criteria that are used to protect waters from nutrient enrichment caused by excessive nitrogen and/or phosphorous loading. Missouri's general criteria protect waters from "unsightly or harmful bottom deposits" and "unsightly color or turbidity," which are potential consequences of excess nutrients in freshwater systems. Narrative criteria do not provide numeric thresholds or concentrations above which impacts to designated uses are likely to occur. However, because the bioconfirmation approach integrates causal and response variables to ensure attainment of the aquatic habitat protection use, the proposed numeric nutrient criteria and screening thresholds serve as an enforceable interpretation of Missouri's general criteria at 10 CSR 20-7.031(4). Additionally, implementation of the numeric nutrient criteria and screening thresholds also will ensure protection of downstream waters as required by 10 CSR 20-7.031(4)(E) and 40 CFR 131.10(b).

Site-Specific Numeric Criteria [10 CSR 20-7.031(5)(N)]

Missouri's WQS also contain numeric nutrient criteria for specific lakes. Each of the lakes listed in Table N of the WQS have site-specific criteria for TN, TP, and Chl-a, based on the annual geometric mean of a minimum of three years of data and characteristics of the lake. Additional site-specific criteria may be developed to account for the unique characteristics of a water body.

Part I. Monitoring and Assessment

Monitoring Efforts

The Department currently has data on approximately 12% of Missouri lakes, representing 83% of lake acres. Based on past resources and progress, the Department expects to have data on most lakes that are subject to the WQS within ten years. The Department will prioritize data collection on lakes without sufficient data by identifying relevant bodies of water that, because of location or activity, are most likely to have an impairment or are most vulnerable to the impacts of nutrients. Missouri has identified this gap (GAP 5.2) in our Monitoring Strategy Document found at https://dnr.mo.gov/env/wpp/waterquality/303d/docs/2015-monitoring-strategy-final.pdf. The Department coordinates with EPA to update the Monitoring Strategy Document every five years.

The Department has a cooperative agreement with the University of Missouri (MU) to collect data on lakes statewide. This cooperative agreement utilizes Section 319 funds, as well as match funds from MU, to collect data sufficient to characterize and assess lake water quality in accordance with Sections 303(d) and 305(b) of the federal Clean Water Act. MU operates two programs that are funded through the cooperative agreement: 1) the Statewide Lake Assessment Program, and 2) the Lakes of Missouri Volunteer Program. MU has been collecting and analyzing data on lakes throughout the state since 1989.

As part of the cooperative agreement, these programs submit, and the Department approves, Quality Assurance Project Plans (QAPPs) that detail the following:

- Parameters – data to be collected
- Sampling Methods – how the data are collected
- Personnel – who collects the data
- Analytical Methods – how the data are analyzed
- Laboratory – who analyzes the data
- Quality Assurance Review – who quality assures the data
- Reporting – to whom the data are reported

Lakes of Missouri Volunteer Program (LMVP)

The LMVP identifies volunteers to assist MU in collecting information on lakes across Missouri. Volunteers are trained by MU staff and follow the approved protocols in the QAPP. The samples collected are analyzed by the MU laboratory. Volunteer data are checked through MU audits to ensure their data are of the same quality as data collected by MU staff. These data typically are collected 4-8 times per year from April through September.

The samples collected by LMVP volunteers are analyzed for:

- Total Nitrogen
- Total Phosphorus
- Total Chlorophyll
- Chlorophyll-a
- Pheophytin-a
- Inorganic Suspended Solids
- Organic Suspended Solids
- Total Suspended Solids
- Microcystin
- Cylindrospermopsin

*Water temperature and Secchi depth also are recorded with each sample.

Statewide Lake Assessment Program (SLAP)

The SLAP is composed of MU staff who collect water samples, as well as depth profiles, on lakes across the state.

The samples collected by SLAP staff are analyzed for:

- Total Nitrogen
- Total Phosphorus
- Total Chlorophyll
- Chlorophyll-a
- Pheophytin-a
- Inorganic Suspended Solids
- Organic Suspended Solids
- Total Suspended Solids
- Microcystin*
- Cylindrospermopsin*
- Anatoxin-a*
- Saxitoxin*

*Algal toxins started in summer of 2018.

The depth profiles consist of a composite sample of the epilimnion and include continuous sonde measurements for:

- Depth
- Temperature
- Dissolved Oxygen % Saturation
- Dissolved Oxygen Concentration
- Conductivity
- pH
- Turbidity
- Phycocyanins
- Chlorophyll
- Oxidizing/Reducing Potential

In addition to these parameters, in 2018 MU will begin collecting light-availability data through the use of a Li-Cor quantum sensor. Data collected with this equipment consist of light attenuation and photosynthetically active radiation (PAR).

The SLAP collects long-term data on 38 lakes throughout the state to assess water quality and to conduct long-term trend analysis. The SLAP also collects data on approximately 40 lakes which can be rotated every 3-4 years. Starting in 2019, the Department will work with the SLAP to expand monitoring or add priority lakes for additional data collection needs. See Assessment Methodology Section for identification of priorities during assessment.

Data Requirements for Assessment

In order to assess a lake against the numeric nutrient criteria in 10 CSR 20-7.031(5)(N), the following data requirements must be met:

1. At least four samples collected between May 1 and September 30 under representative conditions;
2. Each sample must have been analyzed for at least Chl-a, TN, TP, and Secchi depth;
3. At least three years of samples (years do not have to be consecutive). Data older than seven years will not be considered, consistent with the Department's Listing Methodology (see Appendix B);
4. Data collected under a QAPP.

If these requirements are not met, the lake will be placed into Category 3 of Missouri's Integrated Water Quality Report (i.e., Missouri's 305(b) Report) until further information can be collected. In the case of lakes that have some data, but not enough to make an assessment, these lakes will be prioritized for additional sampling. Lakes with limited data where water quality trends or field observations point to possible impairment will receive the highest priority.

Criteria for Assessment

Each lake will be evaluated against the appropriate ecoregional or site-specific criteria located in Tables L, M, and N of 10 CSR 20-7.031 (reproduced below).

Table L: Lake Ecoregion Chl-a Response Impairment Threshold Values (µg/L)

Lake Ecoregion	Chl-a Response Impairment Thresholds
Plains	30
Ozark Border	22
Ozark Highland	15

Table M: Lake Ecoregion Nutrient Screening Threshold Values (µg/L)

Lake Ecoregion	Nutrient Screening Thresholds		
	TP	TN	Chl-a
Plains	49	843	18
Ozark Border	40	733	13
Ozark Highland	16	401	6

Table N: Site-Specific Nutrient Criteria

Lake Ecoregion	Lake	County	Site-Specific Criteria (µg/L)		
			TP	TN	Chl-a
Plains	Bowling Green Lake	Pike	21	502	6.5
	Bowling Green Lake (old)	Pike	31	506	5
	Forest Lake	Adair	21	412	4.3
	Fox Valley Lake	Clark	17	581	6.3
	Hazel Creek Lake	Adair	27	616	6.9
	Lincoln Lake – Cuivre River State Park	Lincoln	16	413	4.3
	Marie, Lake	Mercer	14	444	3.6
	Nehai Tonkaia Lake	Chariton	15	418	2.7
	Viking, Lake	Daviess	25	509	7.8
	Waukomis Lake	Platte	25	553	11
	Weatherby Lake	Platte	16	363	5.1
Ozark Border	Goose Creek Lake	St Francois	12	383	3.2
	Wauwanoka, Lake	Jefferson	12	384	6.1
Ozark Highland	Clearwater Lake	Wayne-Reynolds	13	220	2.6
	Council Bluff Lake	Iron	7	229	2.1
	Crane Lake	Iron	9	240	2.6
	Fourche Lake	Ripley	9	236	2.1
	Loggers Lake	Shannon	9	200	2.6
	Lower Taum Sauk Lake	Reynolds	9	203	2.6
	Noblett Lake	Douglas	9	211	2
	St. Joe State Park Lakes	St Francois	9	253	2
	Sunnen Lake	Washington	9	274	2.6
	Table Rock Lake	Stone	9	253	2.6
	Terre du Lac Lakes	St Francois	9	284	1.7
	Timberline Lakes	St Francois	8	276	1.5

Assessment Methodology

The Department requests and actively seeks out readily available data on all waters within the state. These data are reviewed for proper quality assurance and quality control measures, and then the data are compiled by the Department into Missouri's Water Quality Assessment database.

Every two years, the Department assesses the designated uses of all waters protected by 10 CSR 20-7.031. Once assessments have been completed, the Department creates spreadsheets of data for all impaired (303(d) List) and delisted waters. The Department then places the spreadsheets, as well as the list of impaired waters, on the Department's website for a 90-day public notice period. After the public notice period ends, the Department responds to any public comments and makes any applicable changes to the spreadsheets or the list of impaired waters. The Department then asks the Missouri Clean Water Commission to approve the impaired waters list. After the Commission's approval, the Department submits all of the information used in the assessment decision process to EPA for approval.

1. Site-Specific Lake Nutrient Criteria
   Lakes with site-specific numeric nutrient criteria (see Table N of 10 CSR 20-7.031) will be assessed using the current listing methodology. Missouri has a state regulation, 10 CSR 20-7.050, which requires a methodology be created and followed for the development of an impaired waters list. Missouri develops and provides public notice of the methodology every two years concurrently with the 303(d) List. The methodology is approved by the Missouri Clean Water Commission before the Department can use it for assessments. The Department currently assesses against the existing site-specific lake nutrient criteria in the water quality standards (now Table N of 10 CSR 20-7.031). See the Department's 2020 Listing Methodology in Appendix B for details. Table 1 below shows the current list of impaired lakes assessed according to the site-specific criteria.

Table 1. List of Impaired Lakes with Site-Specific Criteria

Year	WBID	Waterbody	WB Size	Units	IU	Pollutant
2014	7003	Bowling Green Lake - Old	7	Acres	AQL	Chl-a
2012	7003	Bowling Green Lake - Old	7	Acres	AQL	TN
2012	7003	Bowling Green Lake - Old	7	Acres	AQL	TP
2014	7326	Clearwater Lake	1635	Acres	AQL	Chl-a
2016	7326	Clearwater Lake	1635	Acres	AQL	TP
2016	7334	Crane Lake	109	Acres	AQL	Chl-a
2016	7334	Crane Lake	109	Acres	AQL	TP
2010	7151	Forest Lake	580	Acres	AQL	Chl-a
2010	7151	Forest Lake	580	Acres	AQL	TN
2010	7151	Forest Lake	580	Acres	AQL	TP
2018	7324	Fourche Lake	49	Acres	AQL	Chl-a
2018	7324	Fourche Lake	49	Acres	AQL	TN
2014	7008	Fox Valley Lake	89	Acres	AQL	Chl-a
2014	7008	Fox Valley Lake	89	Acres	AQL	TN
2010	7008	Fox Valley Lake	89	Acres	AQL	TP
2010	7152	Hazel Creek Lake	453	Acres	AQL	Chl-a
2018	7152	Hazel Creek Lake	453	Acres	AQL	TN
2018	7049	Lake Lincoln	88	Acres	AQL	Chl-a
2018	7301	Monsanto Lake	18	Acres	AQL	Chl-a
2016	7301	Monsanto Lake	18	Acres	AQL	TN
2018	7301	Monsanto Lake	18	Acres	AQL	TP
2014	7316	Noblett Lake	26	Acres	AQL	Chl-a
2014	7316	Noblett Lake	26	Acres	AQL	TP
2002	7313	Table Rock Lake	41747	Acres	AQL	Chl-a
2002	7313	Table Rock Lake	41747	Acres	AQL	TN
2012	7071	Weatherby Lake	185	Acres	AQL	Chl-a
2010	7071	Weatherby Lake	185	Acres	AQL	TN
2014	7071	Weatherby Lake	185	Acres	AQL	TP

2. Ecoregional Lake Nutrient Criteria
   Lakes with ecoregional nutrient criteria (see Tables L and M of 10 CSR 20-7.031) will be assessed using the following methodology:

   a. For lakes with ecoregional criteria, a yearly geometric mean for Chl-a, TN, and TP will be calculated for the period of record. The latest three years (do not have to be consecutive) of data will be used for assessment. These data are collected by the SLAP and the LMVP.

   b. If the geometric mean of Chl-a exceeds the response impairment threshold in more than one of the latest three years of available data, the lake will be placed into Category 5 of Missouri's Integrated Report (IR) and go on the 303(d) List for Chl-a. If only two years of data are available and the geometric mean of Chl-a exceeds the response impairment threshold in both years, the lake will be placed into Category 5 of Missouri's IR and go on the 303(d) List for Chl-a.

c. If the geometric mean of Chl-a, TN, or TP exceeds the nutrient screening threshold, then additional response assessment endpoints will be evaluated (see Assessment Methodology Section #3 "Additional Lake Response Assessment Endpoints" below). If data for any of the response assessment endpoints indicates impairment in the same year that Chl-a, TN, or TP exceeds the nutrient screening threshold, the lake will be placed into Category 5 of Missouri's IR. If sufficient data are not available to assess the response assessment endpoints or they do not show impairment, then the water will be placed into Category 3B or 2B, respectively (assuming other uses are attaining) and prioritized for additional monitoring and ongoing evaluation of response assessment endpoints (see Monitoring Efforts Section). If a lake that is sampled in the LMVP is placed in Category 3B or 2B, then it may be moved to the SLAP to ensure all nutrient screening threshold data needed to complete a full assessment are available. The Department is committed to providing the data needed to complete the full assessment.

d. If the geometric mean of Chl-a, TN, or TP does not exceed the nutrient screening threshold, the water will be placed into the appropriate IR category based on the attainment of the other uses.

e. The period of record for the lake will be reviewed for the purpose of determining long-term trends in water quality. If a lake is determined to be trending towards potential impairment, the lake will be further scrutinized and prioritized for additional monitoring (see Monitoring Efforts and Trend Analysis Sections).

f. The Department's Listing Methodology Document will be updated to reflect the methodology outlined in this implementation plan as soon as possible after EPA approval of the ecoregional lake nutrient criteria.

3. <u>Additional Lake Response Assessment Endpoints</u>
For lakes where the geometric mean of Chl-a, TN, or TP exceeds the ecoregional nutrient screening thresholds, the additional response assessment endpoints listed below will be evaluated. Each of these endpoints is linked to the protection of the aquatic habitat designated use and will be used to assess compliance with the numeric nutrient criteria when screening values are exceeded. When one of these endpoints indicate a eutrophication impact in the same year as a nutrient screening threshold exceedance, the lake will be placed into Category 5 and on the 303(d) List.

Response assessment endpoints observed in lakes without sufficient data for Chl-a, TP, or TN will be prioritized highest for additional sampling of Chl-a, TP, and TN.

a. 10 CSR 20-7.031(5)(N)6.A. – Occurrence of eutrophication-related mortality or morbidity events for fish and other aquatic organisms (i.e., fish kills)

- Following the Department's Listing Methodology Document (see Appendix B), two or more fish kills within the last three years of available data will result in the water being placed into Category 5 as well as the 303(d) List.

- Fish kills as a result of nutrient enrichment (eutrophication) in a lake indicate that current water quality may not be protective of the aquatic habitat designated use. The Department maintains contact with the Missouri Department of Conservation (MDC) on fish kills that occur throughout the state. MDC, as well as the Department's Environmental Emergency Response and Water Protection Program, receive notifications of observed fish kills. MDC investigates all reported fish kills and provides a summary report of the species, size, and number of fish and other aquatic organisms killed. These reports are provided shortly after the investigation. Annual fish kill reports are compiled and provided to the Department.

  One such example of a fish kill annual report is MDC's Missouri Pollution and Fish Kill Investigations 2017 (published April 2018). The Department will continue to request these data and annual reports from MDC. This document includes fish kill data and causes as well as describes the methods used by MDC to assess fish kills.

- The Department will review reports for information pertaining to the cause of death as well as the potential sources. Fish populations can have seemingly random small die-offs related to disease, virus, or other natural causes. The Department will focus on die-offs related to dissolved oxygen, temperature, pH, algal blooms, and the toxins associated with algal blooms. More than one fish kill within ten years or one large (>100 fish and covering more than ten percent of the lake area) fish kill documented to be caused by dissolved oxygen excursions, pH, algal blooms, or the toxins associated with algal blooms will constitute evidence of impairment.

b. 10 CSR 20-7.031(5)(N)6.B. – Epilimnetic excursions from dissolved oxygen or pH criteria

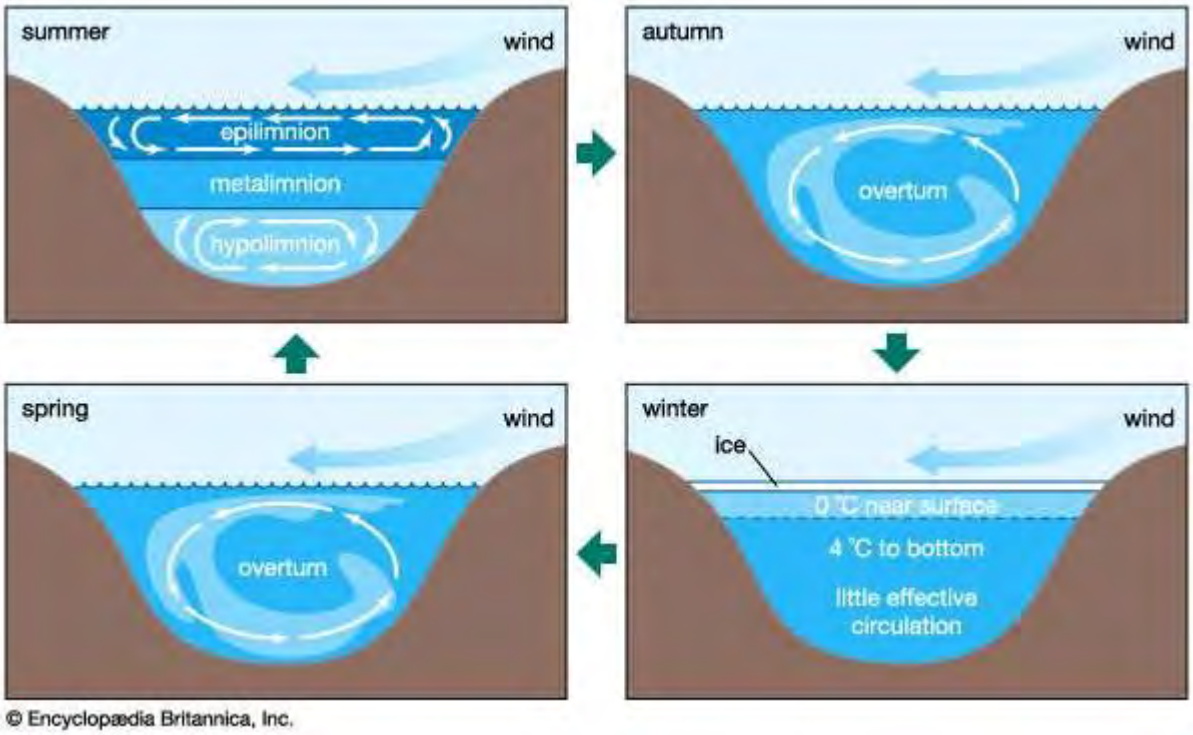
In lakes, DO is produced by atmospheric reaeration and the photosynthetic activity of aquatic plants and consumed through respiration. DO production by aquatic plants (primarily phytoplankton in Missouri reservoirs) is limited to the euphotic zone where sufficient light exists to support photosynthesis. In some lakes, reaeration and photosynthesis may be sufficient to support high DO levels throughout the water column during periods of complete mixing. Missouri lakes however, do not stay completely mixed and thermally stratify during the summer (Figure 1). The duration, depth, and areal extent of stratification in any lake is a function of site-specific lake variables and environmental factors. During the stratified period, the epilimnion (surface water layer) receives oxygen from the atmosphere and is dominated by primary production from phytoplankton and other aquatic plants. In contrast, the hypolimnion (deep, cool water zone) is largely separated from the epilimnion (surface layer) and is dominated by respiratory processes that use organic matter derived from autochothonous (in-lake) and allochthonous (watershed) sources. The strong temperature gradient between the epilimnion and hypolimnion generally restrict gas and nutrient circulation and limits the movement of phytoplankton between the layers. As a result, respiration in the hypolimnion creates hypoxic conditions during the stratification period.

Data collected by the MU demonstrates that hypoxic hypolimnetic conditions (absent of DO) consistently occur during the summer in Missouri lakes regardless of trophic

condition. Further, anoxic hypolimnetic conditions have even been measured in Missouri's high-quality oligotrophic lakes. It is apparent from the science and available data that low hypolimnetic DO conditions are the result of natural processes and should be expected in all lakes across the state. Thermal stratification and resulting anoxic hypolimnia limit the area where some more sensitive fish species thrive to the epilimnion. Assessment of DO in the epilimnion of lakes will ensure the protection of aquatic life and aquatic habitat designated use and the maintenance of a robust aquatic community. Therefore, it would be inappropriate to apply the 5.0 milligrams per liter DO criterion throughout the entire water column.

DO and pH criterion will apply only to the epilimnion during thermal stratification. DO and pH criteria will apply throughout the water column outside of thermal stratification.

Figure 1. Diagram of Typical Lake Stratification in Missouri



Excess nutrient input into lakes causes an increase in primary productivity of a lake. This increase in productivity comes with an increasing demand for DO through both the living and the decaying portions of aquatic life. Increased productivity also causes algal populations to have exponential growth and decay rates that can cause swings in DO concentrations. Sudden drops in DO concentrations or low levels of DO concentrations can cause fish kills.

Similar to DO, water column pH levels are linked to photosynthesis and impacted by thermal stratification. During periods of high photosynthesis, carbon dioxide (CO_2) is removed from the water column and pH increases. Conversely, when respiration and decomposition is high, CO_2 levels increase and pH decreases. As described above, the natural temperature gradients during the summer growing season create conditions whereby the epilimnion is dominated by primary production and the hypolimnion is dominated by respiration. Therefore, the pH

levels will typically be higher in the epilimnion and lower in the hypolimnion. Because the nutrient criteria are focused on the biological response variable Chl-a, which is highest in the epilimnion in the summer, it is appropriate to limit pH assessments to the epilimnion.

Excessive algal production can cause the pH of the epilimnion to rise above 9.0 in some cases. When pH falls outside of this range due to algal blooms and their eventual decomposition, aquatic life which requires a stable range of pH conditions to survive can suffer. As mentioned for dissolved oxygen, assessment of pH in the epilimnion of lakes against WQS will ensure the protection of aquatic life and the aquatic habitat designated use, and the maintenance of a robust aquatic community.

- At the time of sample collection, DO, water temperature, and pH will be measured near the surface as well as via sonde probe throughout the depth of the epilimnion (water surface to the thermocline). The sonde probe continuously collects data for a short period of time as it is lowered through the water column. This data is currently collected by the SLAP.

- Following the Listing Methodology Document procedure for DO: If more than 10% of the measurements are below the 5.0 mg/L minimum to protect aquatic life, the binomial probability will be used for to determine whether the criterion has been exceeded.

- Following the Listing Methodology Document procedure for pH: If more than 10% of the measurements are outside the 6.5 to 9.0 range to protect aquatic life, the binomial probability will be used to determine whether the criterion has been exceeded.

c. 10 CSR 20-7.031(5)(N)6.C. – Cyanobacteria counts in excess of one hundred thousand (100,000) cells per milliliter (cells/mL)

   Cell counts of cyanobacteria (blue-green algae) greater than 100,000 can be indicative of a harmful algal bloom (HAB) and the increased probability of algal toxins in the lake. Certain species of blue-green algae can produce toxins harmful to both aquatic life and terrestrial life (including humans and pets). *Microcystis* can produce microcystin (liver toxin) and anatoxin-a (neurotoxin). *Dolichospermum*, in addition to producing microcystin and anatoxin-a, also can produce cylindrospermopsin (liver toxin) and saxitoxin (nerve toxin). These toxins can cause adverse effects on aquatic life, as well as humans recreating on surface waters. The Oregon Health Authority has developed recreational guidelines for issuing public health advisories in relation to algal toxins (Oregon Health Authority, 2018). Until EPA develops Section 304(a) criteria for algal toxins, the values contained in the Oregon Health Authority document will serve as a surrogate indicator that Section 101(a) uses (i.e., aquatic habitat protection and recreational uses) are not being met. Direct measurement of cyanobacteria cell counts is limited and currently prohibitively expensive. Until this method becomes more widely adopted or technology improves to reduce the cost, the Department will collect data on algal toxin concentrations as a surrogate indicator for cyanobacteria counts.

- Cyanobacteria counts greater than 100,000 cells/mL suggest the presence and impact of a HAB in the water body. HABs and the algal toxins they produce pose a threat to the aquatic habitat protection and recreational designated uses (Oregon Health Authority, 2018). This data may be collected by agencies or county governments and, when available, the Department will request and use this information. The cyanobacteria cell count is based on the threat of unacceptable levels of algal toxins, which are currently being collected by the SLAP and the LMVP.

- Any algal toxin values exceeding the following thresholds during the same year one of the nutrient screening levels was exceeded will constitute evidence of impairment. Two of these toxins currently are collected by the SLAP and the LMVP. The SLAP will begin collecting all four in 2018.

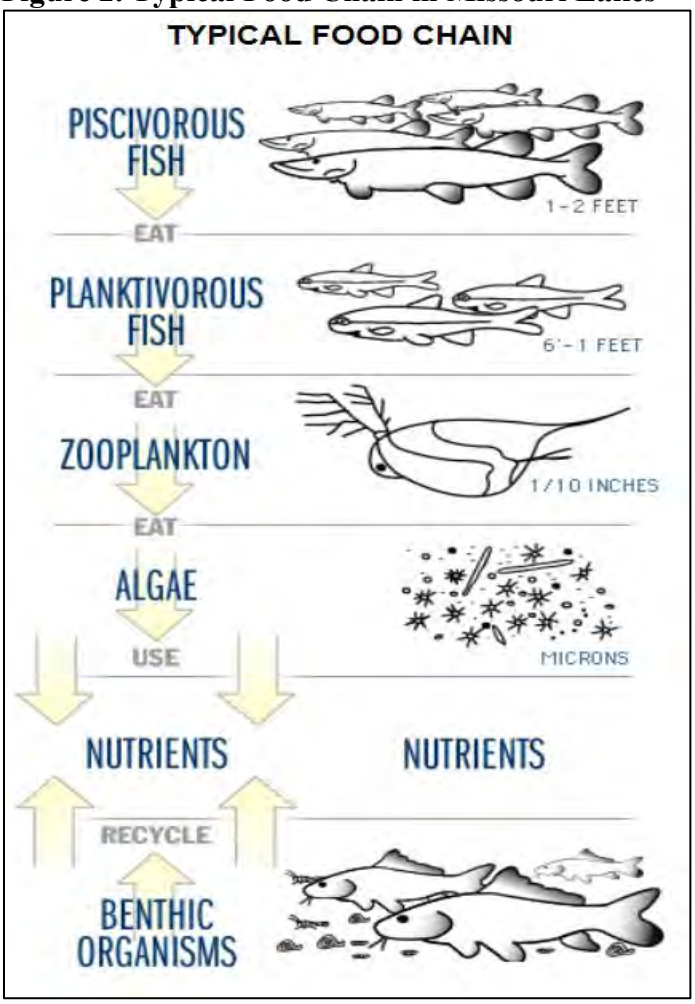
Microcystin	4.0 µg/L
Cylindospermopsin	8.0 µg/L
Anatoxin-a	8.0 µg/L
Saxitoxin	4.0 µg/L

  These toxin levels are associated with a total toxigenic algal species cell count greater than or equal to 100,000 cells/mL. They also are associated with an algal cell count of greater than or equal to 40,000 cells/mL of Microcystis or Planktothrix species.

d. 10 CSR 20-7.031(5)(N)6.D. – Observed shifts in aquatic diversity attributed to eutrophication

The health of an ecosystem can be assessed by looking at different aspects, one of which is the food web or chain (Figure 2). Chemical measurements can be taken to assess the nutrients and chlorophyll (as a surrogate for algae). Relative abundances of fish at the various levels of the food chain can be surveyed to see if it is in balance. High nutrient inputs along with high levels of suspended solids can cause a decrease in the number of sight-feeding predators and an increase in the number of the prey that the predators are unable to catch. More numerous prey put a strain on the resources available, resulting in smaller prey and smaller, less numerous predators. This imbalance in the number and/or size of fish, or a shift to less sight-feeding fish in favor of bottom-feeding fish such as carp, due to eutrophication is a cause for concern.

Figure 2. Typical Food Chain in Missouri Lakes



http://www.lakeaccess.org

As the state agency responsible for the protection and management of fish, forest, and wildlife resources, MDC regularly monitors populations of primary sport fishes (black bass, crappie, catfish) in major reservoirs (typically annually) to ensure the agency has appropriate regulations in place to manage these fish populations for today and into the future. These populations of piscivorous (i.e., fish eating) sport fish, and the many planktivorous (i.e., plankton eating) non-sport fish that are their prey, are self-sustaining in Missouri's major reservoirs. Correspondence with MDC Fisheries Division confirms the agency does not conduct supplemental stocking for primary sport fishes (i.e., apex predators), nor does the agency conduct supplemental stocking of non-sport fish lower down the food chain (MDC, 2018).

Although MDC does not stock the primary sport and non-sport fishes noted above, MDC does stock additional fish species to provide a "bonus" or "specialty" sport fishing opportunity. Species included in the bonus or specialty fishing opportunities include (but are not limited to) paddlefish, rainbow trout, brown trout, striped bass, hybrid striped bass, walleye, and muskellunge. Many of these fish species are non-native and would not be capable of reproducing or sustaining populations in Missouri lakes.

MDC uses various sampling techniques including electrofishing, netting, creel surveys, and angler surveys to collect information related to fish populations and angler satisfaction over time. These data help to inform MDC's regulations for the capture of fish within Missouri lakes to ensure self-sustaining populations of sport- and non-sport fishes. The Department, in consultation with MDC, will use these data to determine whether shifts in aquatic diversity attributed to eutrophication are occurring in a lake. These data are contained within MDC's Fisheries Information Network System (FINS) and annual reports of fish stocking activities such as the "Fish Stocking for Public Fishing and Aquatic Resource Education." In support of this approach, the last eight calendar year reports (CY 2010 – 2017) generated by MDC and supporting data have been included with this submittal.

- The Department will request any available information on the potential biological shifts in fish or invertebrate communities related to eutrophication. This includes data from other agencies (such as the U.S. Fish and Wildlife Service) that monitor the populations of game fish.
- The MDC regularly monitors fish populations of primary sport fishes (black bass, crappie, and catfish) in major reservoirs (typically annually) to ensure the agency has appropriate regulations in place to manage these fish populations for today and into the future. These populations of sport-fish, and the non-sportfish that are their prey, are self-sustaining in Missouri's major reservoirs.
- The MDC uses various sampling techniques including electrofishing, netting, creel surveys, and angler surveys to collect information related to fish populations and angler satisfaction over time. These data in consultation with MDC will be used to determine whether shifts in aquatic diversity attributed to eutrophication are occurring in a lake.
- The MDC produces annual fishery management reports for Missouri's major lakes and reservoirs that detail the health of the fishery and includes number of species, catch per unit effort, relative density of fish and measures of fish condition and population size structure. One such example of an annual fishery management report is the Stockton Reservoir 2017 Annual Lake Report (published March 2018). The data supporting MDC's annual fishery management reports can also be made available to the Department. The Missouri Department of Natural Resources will request these annual reports and data from MDC.

e. 10 CSR 20-7.031(5)(N)6.E. – Excessive levels of mineral turbidity that consistently limit algal productivity during the period May 1 – September 30 (i.e., light limitations)

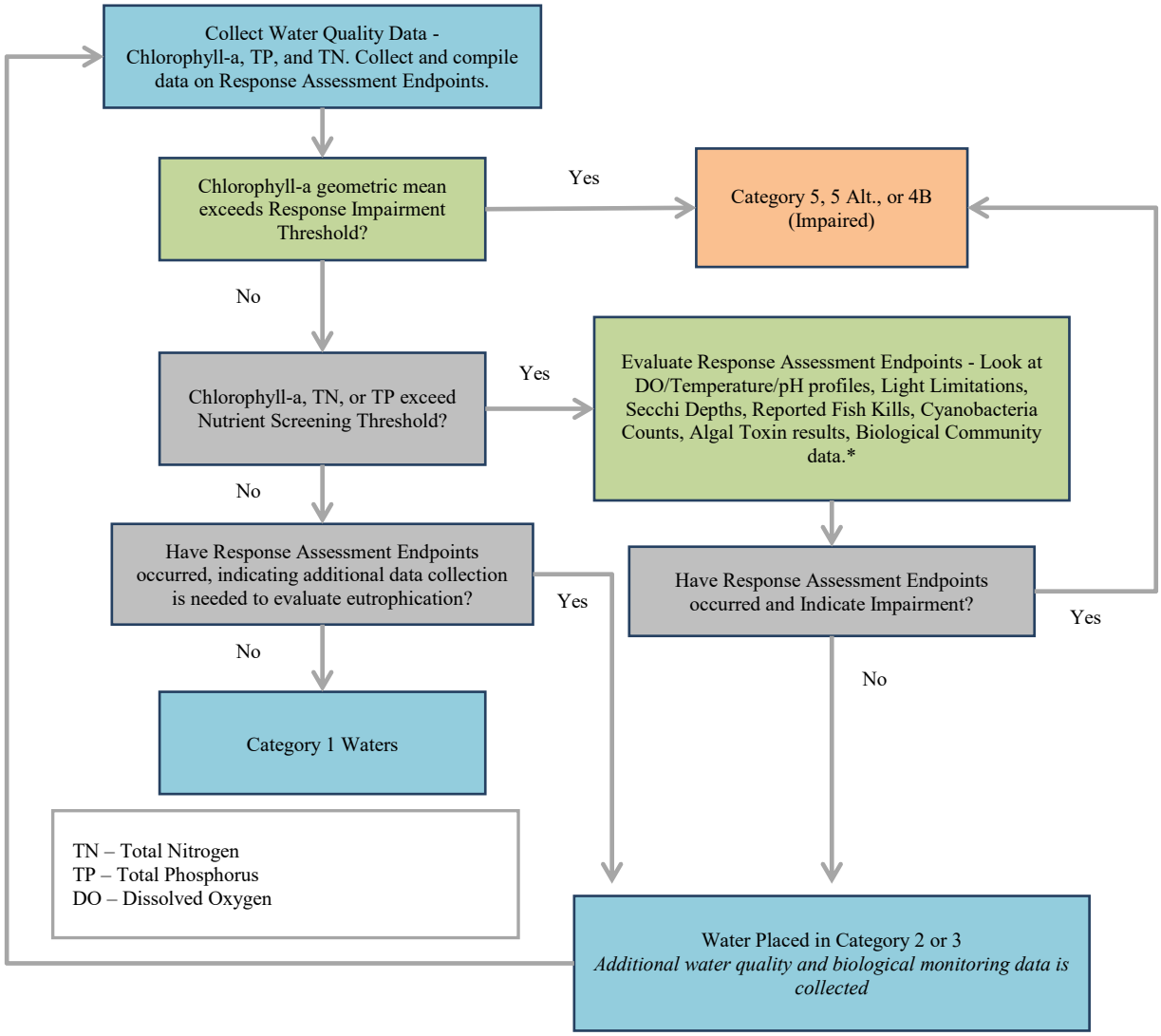
It is widely recognized that mineral turbidity reduces transparency and thereby limits algal production (Jones and Hubbart, 2011). Excessive mineral turbidity and reduced water column transparency can suppress Chl-a levels despite high levels of nutrients. Pronounced and extended turbidity events could have the effect of reducing Chl-a on an average annual basis but still allow for periodically high peaks or algal blooms after sedimentation of mineral turbidity and increased transparency. Under such conditions, waterbodies experiencing harmful algal blooms may go undetected when assessed as an

average annual geomean. The intent of this response variable is to identify such waterbodies that might otherwise go unidentified as impaired.

There are several ways to determine light availability in a lake. Some examples include: Secchi depth, light attenuation and photosynthetically active radiation (PAR), Chl-a/TP ratios, and measurements for turbidity and suspended sediments. All of these methods can provide additional information on the amount of light available in the epilimnion and how deep it penetrates into the lake. These data will be used to determine whether the lake has excess sediment in relation to nutrients for eutrophication impacts to occur.

- Excessive mineral turbidity can reduce light penetration within the photic zone of lakes and limit algal productivity due to the lack of sunlight. Water clarity can be expressed through measurements such as Secchi depth, turbidity, and suspended solids. These data are collected by the SLAP and the LMVP under a cooperative agreement with the Department.
- Measured lake Secchi depths less than 0.6 meters in the Plains, 0.7 meters in the Ozark Border, and 0.9 meters in the Ozark Highlands is likely an indicator of excessive mineral turbidity that limits algal productivity in the water body (MDC 2012). This data is collected by the SLAP and the LMVP under a cooperative agreement with the Department. Yearly average Secchi depths below the applicable ecoregional value may constitute evidence of impairment. Additional analysis of average Chl-a/TP ratios will also be conducted before determining impairment status, as described below.
- The ratio of the average Chl-a to the average TP is an additional indicator of chlorophyll suppression in lakes due to mineral turbidity. A mean Chl-a/TP ratio less than or equal to 0.15 and a mean inorganic suspended solids value greater than or equal to 10 mg/L is suggestive of excessive mineral turbidity which limits algal productivity (Jones and Hubbart, 2011). Unless attributed to other physical factors, Chl-a/TP ratios at or below 0.15 and an ISS value greater than or equal to 10 mg/L as determined by yearly means will serve as an indicator of excessive mineral turbidity and constitute evidence of impairment. Assessment threshold values for Secchi depth, Chl-a/TP ratio, and ISS shall all be exceeded before determining a water is impaired.
- The Department will use data collected using a Li-Cor quantum sensor. Data collected with this equipment consists of light attenuation and photosynthetically active radiation (PAR). Until scientific literature on this new technology can be developed, the Department will rely on best professional judgment for when the data indicate light availability is limiting algal production to the point that if there were less or no limitation then the Chl-a values would be likely to exceed the criterion. This data will be collected by the SLAP starting in 2018 under a cooperative agreement with the Department.

Figure 3. Missouri Ecoregional Numeric Nutrient Criteria Decision Framework based on the Bioconfirmation Approach.



Trend Analysis

The Department currently reports on physiographic region trends in Missouri's 305(b) Report. The latest version as well as past versions can be found on Missouri's 303(d) website: https://dnr.mo.gov/env/wpp/waterquality/303d/303d.htm. These trends have been reported every cycle in the 305(b) Report since 1990. Trends for the physiographic regions are calculated based on at least 20 years of data. Trends are developed for Secchi depth, total phosphorus, total nitrogen, total chlorophyll, nonvolatile suspended solids, and volatile suspended solids.

The Department will evaluate individual lake trends for total phosphorus, total nitrogen, and Chl-a. Nutrients and chlorophyll can be seasonally variable, as well as wet and dry weather dependent. A minimum of ten years of data will be necessary to confidently evaluate water quality trends in Missouri lakes due to significant annual variability and differing hydrologic conditions. Longer time periods are needed for more accurate predictions of impairment.

- When evaluating trends, confounding, or exogenous variables, such as natural phenomena (e.g., rainfall, flushing rate and temperature), must be controlled for.
- The trend must be statistically significant. This process involves standard statistical modeling, such as least squares regression or Locally Weighted Scatterplot Smoothing (LOWESS) analysis. To be considered statistically significant, the p value associated with the residuals trend analysis must be less than 0.05.
- Impairment decisions based on trend analysis should, at a minimum, demonstrate that the slope of the projected trend line is expected to exceed the chlorophyll criterion within 5 years and that there is evidence of anthropogenic nutrient enrichment. If the slope of the projected trend line is expected to exceed the chlorophyll criterion in greater than 5 years, the lake will be prioritized for additional monitoring and identified as a potential project for a 319 protection plan. A list of lakes that have increasing trends of nutrients or Chl-a will be added as an appendix to Missouri's future 305(b) Reports.

The Department will look for statistically significant trends in the DO/pH profile of lakes throughout the entire water column. Areas the Department will look at may include, but are limited to: mixing volumes, mixing depths, and severity of anoxia in the hypolimnion.

Examples of Assessments

Example 1

Lake Girardeau is in the Ozark Border ecoregion of Missouri. The Chl-a response impairment threshold for the Ozark Border is 22µg/L. The nutrient screening thresholds for the Ozark Border are: Chl-a = 13µg/L; TP =40µg/L; and TN = 733µg/L. Lake Girardeau was sampled in 1994, 2004, 2005, 2008, and 2015. The geometric means for Chl-a, TN, and TP are in Table 2. The Chl-a geometric mean was higher than the response impairment threshold in 2015. The nutrient screening thresholds for TN and TP were also exceeded that year.

- The sample data do not show any excursions of the DO and pH criteria
- The average Secchi depths during both years of nutrient screening threshold exceedance are greater than 0.7 meters
- Chl-a/TP ratio is above 0.15 and inorganic suspended solids/nonvolatile suspended solids (ISS/NVSS) is less than or equal to 10 mg/L

There is not enough data to evaluate a trend. Therefore, Lake Girardeau would be placed into category 2B and would be placed into the high priority list for additional data collection.

Table 2. Lake Girardeau Yearly Geometric Means

Year	Chl-a Geomean (µg/L)	TN Geomean (µg/L)	TP Geomean (µg/L)	Avg. Secchi Depth (m)
1994		1266	68	0.6
2004	21.5	582	30	0.89
2005	10.5	541	24	1.58
2008	18.5	528	28	1.27
2015	34.2	853	40	0.87

Example 2

Lake DiSalvo is in the Ozark Highlands ecoregion of Missouri. The Chl-a response impairment threshold for the Ozark Highlands is 15µg/L. The nutrient screening thresholds for the Ozark Highlands are: Chl-a = 6µg/L; TP =16µg/L; and TN = 401µg/L. Lake DiSalvo was sampled in 2011, 2012, 2014, 2015, and 2016. The geometric means for Chl-a, TN, and TP are in Table 3. The geometric mean for Chl-a exceeded the response impairment threshold every year since 2011.

Lake DiSalvo would be placed into category 5 and the 303(d) list for Chl-a.

Table 3. Lake DiSalvo Yearly Geometric Means

Year	Chl-a Geomean (µg/L)	TN Geomean (µg/L)	TP Geomean (µg/L)
2011	47.7	768	77
2012	58.7	941	107
2014	105.8	1508	119
2015	82.8	1079	82
2016	44.1	928	77

Example 3

Henry Sever Lake is in the Plains ecoregion of Missouri. The Chl-a response impairment threshold for the Plains is 30µg/L. The nutrient screening thresholds for the Plains are: Chl-a = 18µg/L; TP =49µg/L; and TN = 843µg/L. Henry Sever Lake was sampled in 2011, 2012, 2014, 2015, and 2016. The geometric means for Chl-a, TN, and TP are in Table 4. The geometric mean for Chl-a did not exceed the response impairment threshold in any of these years. Some or all of the nutrient screening thresholds were exceeded in 2012 and 2014. Figure 4 shows the scatter plot, trend line, Mann-Kendall trend test and the Theil-Sen Slope for Chl-a in Henry Sever Lake.

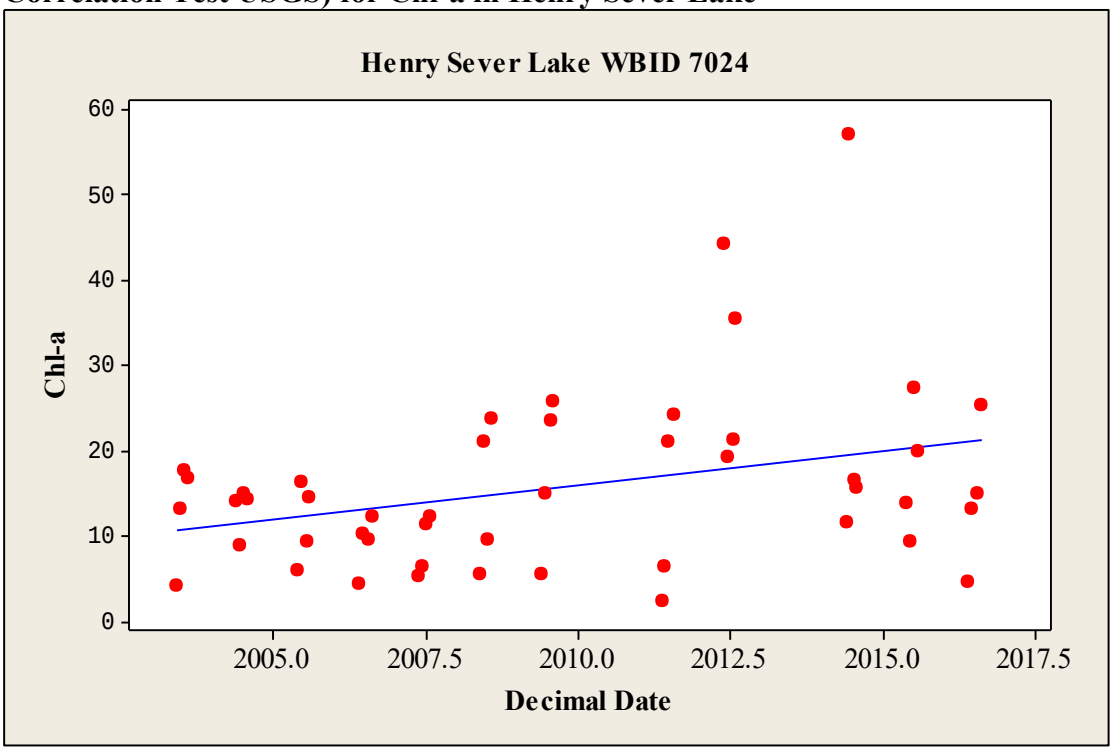
- Half of the pH values in 2012 exceed the pH criteria. None of the DO values exceed the criteria.
- The average Secchi depth during the years of nutrient screening threshold exceedance is 1.12 meters (2012) and 1.11 (2014) meters
- Chl-a/TP ratio is above 0.15
- Mann-Kendall Trend test is significant
- Trend data (Figure 4) shows a scatter plot with a trendline. The Theil-Sen slope of 0.6223 µg/L per year shows it is estimated to reach 30 µg/L theoretically in 2034.

Therefore, Henry Sever Lake would go into category 2B and will be placed into the priority list for additional data collection.

Table 4. Henry Sever Lake Yearly Geometric Means

Year	Chl-a Geomean (µg/L)	TN Geomean (µg/L)	TP Geomean (µg/L)
2003	11.19	742	43
2004	12.79	966	37
2005	10.70	1079	51
2006	8.47	871	43
2007	8.22	725	66
2008	12.61	1354	75
2009	14.90	838	65
2011	9.15	957	42
2012	28.30	898	41
2014	20.28	854	49
2015	16.21	772	36
2016	12.29	737	31

Figure 4. Scatter Plot Trend Line and Mann-Kendall Trend Test (Kendall's Tau Correlation Test USGS) for Chl-a in Henry Sever Lake



Kendall's tau Correlation Test, US Geological Survey, 2005

Data set: Henry Sever Lake Chl-a - Mann-Kendall test, input type 4
The tau correlation coefficient is 0.222
S = 250.0, z = 2.213, p = 0.0269

The relation may be described by the equation (Theil-Sen Slope estimator):
Y = -1235.9 + 0.6223 * X

Total Maximum Daily Load Development for Nutrient Impaired Waters

The Department will address water quality impairments of the numeric nutrient criteria or violations of narrative criteria where evidence shows excess nutrients to be a cause through the development of total maximum daily loads (TMDLs). TMDL development will occur in accordance with the schedules and priority rankings required as part of the biennial submittal of the state's 303(d) list of impaired waters per federal regulations at 40 CFR 130.7(b)(4). When developing TMDL priorities of 303(d)-listed waters, the Department will also consider alternative approaches that may result in attainment of water quality standards more quickly than a TMDL.

As with all TMDLs and in accordance with federal regulations at 40 CFR 130.7(c)(1), TMDLs developed by the Department to address nutrient impairments will be written to meet water quality standards, including narrative criteria or applicable numeric nutrient criteria. TMDLs developed to meet applicable numeric nutrient criteria will consider targets appropriate for attaining chlorophyll-a response impairment thresholds with consideration given to other causal and response parameter concentrations to ensure water quality standards are met and maintained. Depending upon the nature and source of impairment, TMDLs developed to address exceedances of narrative criteria may also target site-specific or reference chlorophyll-a response thresholds or a combination of other factors to ensure water quality standards are met, such as phosphorus, pH, and dissolved oxygen. Such factors and numeric translators used for developing TMDL targets to address a narrative criteria impairment will only be applicable to water bodies for which TMDLs have been developed and approved. As required by Section 303(d)(1)(C) of the Clean Water Act and federal regulations at 40 CFR 130.7(c)(1), all TMDLs will include an implicit and/or explicit margin of safety to provide additional certainty that the calculated TMDL allocations to point and nonpoint sources of nutrients will result in attainment of water quality standards.

During the development of nutrient TMDLs, the Department will evaluate available datasets and other relevant information to determine appropriate modeling approaches for calculating loading targets and estimating existing loads. One such model to be considered is BATHTUB, which was developed by the U.S. Army Corps of Engineers, and is currently in use for nutrient TMDL development by states within EPA Regions 5 and 7 to address lake eutrophication issues. Other models may be considered depending upon complexity and data needs. Estimates of upstream nutrient loading may be calculated directly where nutrient data is available or may be estimated through models, such as the Spreadsheet Tool for Estimating Pollutant Load (STEPL).

In conjunction with TMDL development, the Department also develops supplemental implementation plans for all TMDLs. These plans provide detailed strategies and actions that will achieve the established goals and water quality targets. TMDL implementation should follow an adaptive implementation approach that makes progress towards achieving water quality goals while using new data and information to reduce uncertainty and adjust implementation activities. The Department recognizes that technical guidance and support are critical to achieving the goals of most TMDLs. While a TMDL calculates the maximum loading that an impaired water body can assimilate and still meet water quality standards, the supplemental implementation plan provides additional information regarding best management practices, funding, and potential stakeholders in the watershed. These implementation plans

serve to provide a general guide to permit writers, nonpoint source program coordinators, and other department staff, as well as soil and water conservation districts, local governments, permitted entities, regional planning commissions, watershed managers, and citizen groups for achieving the calculated wasteload and load allocations. Although not required by EPA, TMDL implementation plans will be placed on public notice and made available for public comment along with the corresponding draft TMDLs, which are made available for public review as described in the State Continuing Planning Process as required by federal regulations at 40 CFR 130.7.

Part II. Permit Implementation

The Department is fully delegated by EPA through Section 402(b) of the Clean Water Act to administer its National Pollutant Discharge Elimination System Permitting Program. The "Missouri's Nutrient Criteria" section of this document describes each part of Missouri's WQS that contain nutrient criteria. Notwithstanding, all permitting will be consistent with federal and state requirements. The following are additional regulations that the Department uses to implement point source nutrient reductions.

Effluent Regulation [10 CSR 20-7.015(3)]
The Effluent Regulation requires dischargers to the Table Rock Lake watershed and Lake Taneycomo and its tributaries between Table Rock Dam and Power Site Dam to not exceed 0.5 mg/L of phosphorus as a monthly average.
Exemptions to this requirement:

- Facilities discharging to Lake Taneycomo and its tributaries between Table Rock Dam and Power Site Dam permitted prior to May 9, 1994, and with a design flow less than 22,500 gallons per day (GPD) that have not had an increase in capacity.
- Facilities discharging to the Table Rock Lake watershed permitted prior to November 30, 1999, and with a design flow less than 22,500 GPD that have not had an increase in capacity.

All dischargers to the White River basin are required to monitor for phosphorus.

Effluent Regulation [10 CSR 20-7.015(9)(D)7.]
The Effluent Regulation requires facilities that typically discharge nutrients with a design flow greater than 100,000 GPD to monitor discharges for TN and TP quarterly. Soon the Department will be proposing an amendment to the regulation that would expand the monitoring requirements in various ways. First, facilities with a design flow greater than 1,000,000 GPD will be required to monitor monthly instead of quarterly. Second, instead of reporting TN, facilities will need to report nitrogen's constituents as: total Kjeldahl nitrogen, nitrate plus nitrite, and ammonia. Third, the facility will need to monitor influent for a period of time, in addition to effluent. The Department notes that many publicly-owned treatment works have voluntarily performed nutrient sampling at greater frequencies than required in the regulation.

Implementing a Three-Phase Nutrient Reduction Approach

The following implementation procedures for point source nutrient reduction are divided into three phases: Data Collection and Analysis, Plant Optimization, and Final Effluent Limitations. The three-phase approach is applicable for facilities that discharge to a lake watershed where the new numeric nutrient criteria apply; however, there are exceptions:

- Missouri's effluent regulation [10 CSR 20-7.015(3)] requires phosphorus effluent limitations or monitoring requirements in permits for facilities discharging to the Table Rock Lake and Lake Taneycomo watersheds. The effluent regulation supersedes the implementation procedures of this plan except in situations where this plan is more stringent.
- This plan does not impact permit limitations that were established based on site-specific nutrient criteria found in Table N of the WQS.
- Industrial facilities that discharge elevated concentrations of nutrients may require alternate implementation measures to ensure that water quality is protected.

- Facilities that discharge to impaired lake watersheds based on either new or existing nutrient criteria will follow different procedures. See the "Impaired Lakes" section for further information.

This plan does not prohibit establishing alternative methods of analysis, permit limits, or requirements provided that the alternatives are technically sound, consistent with state and federal regulations, and are protective of water quality.

Phase 1 – Data Collection and Analysis
Nutrient data collection is a necessary first step for multiple reasons.
1) Facilities will use the data to determine current treatment capabilities regarding nutrient removal.
2) Permit writers will use the data in Phase 3 to determine if reasonable potential (RP) for a discharge to cause or contribute to an excursion of the nutrient criteria exists.
3) The data will aid the Department in conducting analyses to determine nutrient loading contributions from point sources versus nonpoint sources into lake watersheds.

The Effluent Regulation [10 CSR 20-7.015] requires facilities that typically discharge nutrients with a design flow greater than 100,000 GPD to monitor discharges for TN and TP quarterly. Currently, the Department is proposing an amendment to the regulation that would expand the monitoring requirements in various ways. First, facilities with a design flow greater than 1,000,000 GPD will be required to monitor monthly instead of quarterly. Second, instead of reporting TN, facilities will need to report nitrogen's constituents as: total Kjeldahl nitrogen, nitrate plus nitrite, and ammonia. Third, the facility will need to monitor influent, for a period of time, in addition to effluent.

The Department will generally not require nutrient monitoring for facilities that discharge less than or equal to 100,000 GPD because it does not anticipate these discharges will contribute a significant portion to the total nutrient load in lake watersheds. The total design flow of Missouri's domestic wastewater facilities is 1,324 million gallons per day. Facilities with a design flow greater than 100,000 GPD discharge 1,288 million gallons per day. While smaller facilities make up 82% of total facilities in number, they contribute only 3% of the total daily flow. Not only do facilities that discharge less than or equal to 100,000 GPD make up a minimal portion of the point source loading, but that contribution is made even more insignificant when considering the total nutrient load from both point and nonpoint sources. The USGS spatially referenced regression on watershed (SPARROW) attributes model provides estimates of sources of TN and TP transported from the Mississippi River Basin to the Gulf of Mexico (Robertson and Saad, 2013). At this basin scale, relative nutrient contribution from wastewater treatment plants is estimated to be only 7% of TN and 13% of TP. The Department will develop nutrient reduction requirements for facilities discharging below 100,000 GPD if localized impacts from specific small facilities are identified.

Permits for facilities that typically discharge nutrients with a design flow greater than 100,000 GPD will require monitoring of the influent and effluent for the following parameters:

- Total Phosphorus
- Total Kjeldahl Nitrogen
- Nitrate plus Nitrite
- Ammonia

Because there are existing numeric criteria for ammonia in the WQS, these facilities likely already have permit monitoring requirements and/or effluent limitations in their permits for ammonia.

Table 5. Sampling Frequency by Design Flow

Design flow in GPD	Sampling frequency
100,001-1,000,000	Quarterly
1,000,001 and greater	Monthly

Phase 2 – Voluntary Plant Optimization and Source Controls

After permittees have completed the data collection process outlined in Phase 1, permittees and the Department will have an understanding of current treatment capabilities of the facility. Permittees can then elect to study and implement plant optimization or source control measures where they anticipate being able to reduce nutrient discharges with minimal capital and/or operational costs. This voluntary phase of plant optimization and/or source controls will provide permittees with time (up to 5 years) to take cost-effective strategies for early nutrient reductions. If permittees elect to not take advantage of this Phase, then the Department will use data collected under Phase 1 to evaluate RP and develop nutrient permit limitations, if needed.

As a part of Missouri's Nutrient Loss Reduction Strategy, the Department will be conducting a study to determine attainable nutrient reduction values based upon various wastewater treatment technologies. This entails an analysis of point source dischargers and available discharge data to determine nutrient removal rates of different technologies throughout the state. Depending on existing treatment process design, operational adjustments can potentially increase the removal efficiency of TN without significant capital investments on plant upgrades. This approach may be more difficult for TP; however, reducing phosphorus from entering the treatment plant can be an effective strategy. These cost-effective efforts may significantly reduce point source loading in the watershed.

Permits for facilities that typically discharge nutrients with a design flow of greater than 100,000 GPD and voluntarily engage into Phase 2 will include a special condition requiring the development and implementation of a Plant Optimization Plan and a Phosphorus Minimization Plan. Because Phase 2 is voluntary, Missouri affordability statutes do not apply to these permit conditions. The Department will develop and provide the following resources to permittees:

- Operator Training Workshops – Engineering staff and water specialists will offer training opportunities to operators on practical methods of improving treatment capabilities in current operations.
- Online Resources – The Department will provide online resources including fact sheets and links to information that will aid in the development of Plant Optimization Plans and

Phosphorus Minimization Plans. Easy-to-use templates for these plans will also be provided by the Department.

- Staff Assistance – Department staff are always available to assist permittees by phone and email. Permittees may request compliance assistance visits on-line at https://dnr.mo.gov/cav/compliance.htm.

During Phase 2, permittees will maintain the monitoring requirements established in Phase 1. With this data, removal efficiency and phosphorus minimization efforts can be tracked throughout Phase 2. Permittees who are able to show significant improvements in treatment plant operations are more likely to be issued permits with less stringent nutrient requirements as the improvements may show that there is no RP to cause or contribute to an excursion of the nutrient criteria. With some effort, plant optimization may be a more economically viable option than costly upgrades. However, depending on treatment processes, plant optimization efforts may detrimentally impact effluent performance for other important pollutants, such as biochemical oxygen demand and ammonia. In addition, plant optimization strategies for facilities below design capacity could use (on an interim or permanent basis) reserved treatment plant capacity (e.g., basin volumes) originally designed to serve community growth. Therefore, the Department will not establish nutrient reduction baselines for future limits based upon optimized plant loading. Rather, the Department will include technology-based effluent goals in permits that support plant optimization and/or source reduction goals.

Phase 3 – Final Effluent Limitations

During the third phase of the plan, final effluent limitations will be established in permits where RP exists. Chl-a data from Missouri's lakes are strongly correlated with TN and TP. However, studies show through regression models that TN accounts for less Chl-a variation compared to TP (Jones and Knowlton, 2005). This suggests that TP is the limiting nutrient in most of Missouri's lakes; therefore, phosphorus reductions made at wastewater facilities will strongly contribute to water quality improvements in lakes with elevated levels of Chl-a and TP. As a Missouri-specific demonstration, permits for facilities discharging to the Table Rock Lake and Lake Taneycomo watersheds have contained technology-based phosphorus effluent limitations for decades per Missouri's Effluent Regulation [10 CSR 20-7.015(3)]. Because of this requirement, most permittees in these areas have installed a chemical feed to their facilities' treatment processes to facilitate phosphorus removal which in turn has greatly reduced the number of algal blooms on these lakes. Water quality in these watersheds has improved since the requirements were first established, suggesting that phosphorus removal technologies from point sources are responsible for the improvement.

By Phase 1, or the voluntary Phase 2, facilities have collected and reported sufficient data for an RP determination to be made. Determining RP for a discharge to cause or contribute to an excursion of the nutrient criteria can be complicated using numeric nutrient criteria for Chl-a. Furthermore, the typical statistical analysis used by permit writers to determine RP for toxics cannot be used to determine RP for Chl-a because it is not a discharged pollutant that can be sampled from a facility's outfall. Because exceedance of the numeric Chl-a criteria is a response to excess TN and/or TP in the water body, regional correlations between nutrients and algal biomass will be used to set in-lake nutrient targets. Then, watershed modeling will be used to identify and estimate sources (both point and nonpoint sources) of TN and TP loads and quantify

the proportion of contributions from these sources into the watershed, which is necessary to make a RP determination for a specific facility.

Facilities that typically discharge nutrients with a design flow of greater than 100,000 GPD will be modeled. If watershed modeling shows that there is RP for a discharge to cause or contribute to an excursion of the Chl-a criteria, TP effluent limits (with a compliance schedule) will be established in the permit requiring the permittee to install phosphorus removal at the facility. This approach will need adjustments in situations where watershed modeling shows TN as the limiting pollutant over TP. Nutrient limits will be set to achieve in-lake nutrient targets based upon source sector contributions and within the point source sector, the relative contribution of each such source. Relative contribution should take into account early nutrient reduction actions by individual dischargers. The Department also intends to provide opportunities for watershed-based, bubble permitting to facilitate cost-effective point source nutrient reductions and compliance as well as fostering collaboration between permittees.

Impaired Lakes

In cases where a facility discharges to a watershed that contains a lake with nutrient impairments, supplemental procedures, in addition to those previously discussed in this plan, will be utilized. The first step is to determine if the facility's discharge is causing or contributing to the nutrient impairment. As discussed in Phase 3, watershed modeling will be used to identify the sources (both point and nonpoint) of TN and TP loads and quantify the proportion of contributions from these sources into the watershed, which is necessary to make the RP determination for specific facilities.

If, through modeling or other means, a determination is made that a particular facility *is not* causing or contributing to the impairment, then effluent limitations are not needed at that time to protect water quality. However, the permit writer may determine that nutrient monitoring is still needed to make future RP determinations.

If it is shown that the facility *is* causing or contributing to the impairment, effluent limitations will be established that are protective of water quality. This can be accomplished in several ways:

- The permit writer can establish TP effluent limitations based on the capabilities of specific treatment technologies with the supporting rationale that potential TP reductions made by the facility are protective of water quality.
- The permit writer can establish effluent limitations based on wasteload allocations identified through watershed and lake modeling based upon point source relative contribution.
- Following TMDL development, wasteload allocations will be established and permit writers will establish effluent limitations from those wasteload allocations.

Other methods of effluent limitation derivation are allowed with appropriate justification by the permit writer.

New and Expanding Sources and Antidegradation Review Requirements

Implementation procedures for new sources differ from those previously listed in this plan. For the purposes of this plan, "new sources" refers to new, altered, or expanding discharges of TP and/or TN. Per Missouri's WQS [10 CSR 20-7.031(3)], for new sources, the Department will document by means of antidegradation review that the use of a water body's available assimilative capacity is justified. Missouri's Antidegradation Implementation Procedures provide a detailed process for conducting antidegradation reviews, which will be applicable to any new or expanding discharges of nutrients into lake watersheds. Permittees must submit an antidegradation review request to the Department prior to establishing, altering, or expanding discharges.

The following procedures for new sources are split between lakes with and without nutrient impairments.

Scenario 1: The new source requests to discharge to a watershed that contains a lake *with* a nutrient impairment. The Department will conduct watershed modeling to determine whether the facility's discharge would cause or contribute to the nutrient impairment. Permitting decisions that fall under this scenario will be based upon a Tier 1 antidegradation review, which are designed to prohibit degradation that may cause or contribute to the impairment of a beneficial use. Increased pollutant loading is allowed as long as the discharge does not cause or contribute to the impairment.

- If the facility's discharge is shown not to cause or contribute to the nutrient impairment, then the permit writer will establish best available technology limits for TP in the permit.
- If the facility's discharge is shown to cause or contribute to the nutrient impairment, then the permittee will be required to utilize a more advanced level of wastewater treatment or find an alternative method of wastewater disposal.

Scenario 2: The new source requests to discharge to a watershed that contains a lake *without* a nutrient impairment. There is little need for the data collection and plant optimization conducted in Phases 1 and 2 for new facilities. Because of this, permits that fall under this scenario will include effluent limitations for TP in their initial permit based upon a Tier 2 antidegradation review.

Potential Flexibilities for Permittees

The Department has multiple tools to aid permittees with permit compliance. As permits are renewed, permittees may find it difficult to meet new effluent limitations and requirements. Depending on the situation, each flexibility listed below offers its own set of results and benefits.

Table 6. Regulatory Flexibilities for Permitting

Permit Flexibility	Quick Facts
Schedules of Compliance 10 CSR 20-7.015(9)(C)	• Allows permittees time to comply with newly established effluent limitations • Establishes yearly (or more frequent) milestones • Established using a cost analysis which takes into account a community's socioeconomic and financial capability status for publicly-owned treatment works • Must comply with 40 CFR 122.47 • May be extended with proper justification • May extend beyond the permit term
WQS Variance 10 CSR 20-7.031(12)	• Variances are paths to improve water quality over the variance term • Provides permittees time to achieve incremental improvements to ultimately work toward compliance with WQS through a Pollutant Minimization Program • Establishes a time-limited WQS, and therefore, must be approved by the Missouri Clean Water Commission and EPA
Watershed-based Permits	• Watershed-based permitting is an approach to develop permits for multiple point sources located within a defined geographic area. • Allows the Department to consider watershed goals and the impact of multiple nutrient sources.
Water Quality Trading Missouri Water Quality Trading Framework	• Trading is a market-based approach for compliance with effluent limitations • Instead of, or in addition to, upgrading facilities, permittees can buy and sell water quality credits to meet effluent limitations • Point to point source trades or nonpoint source to point source trades can be made
Integrated Management Plans Missouri Integrated Planning Framework	• Allows communities to prioritize investments to meet environmental requirements • Plan development is voluntary and the responsibility of the community • Plan development is a method to include utility rate payers in the decision making process • May provide assurance which allows relaxation of timelines for regulatory requirements such as permit requirements, enforcement action, and TMDL development

Incentives for Early Nutrient Reduction

Receiving water quality may benefit from earlier nutrient reductions resulting from wastewater treatment optimization, pilot testing, stress testing, new technology trials, etc. as well as from trading for nutrient reductions or offsets. The Department encourages wastewater utilities to make voluntary reductions of nutrients earlier than required, improving the receiving water quality. In exchange, permittees will receive regulatory flexibilities, such as extended compliance schedules to achieve final effluent nutrient limits or other water quality-based effluent limits. In addition, permittees adopting early nutrient reduction strategies could balance other regulatory obligations through integrated planning. Permittees also may accrue credits for watershed-based trading.

Wastewater utility participation in an early nutrient reduction is voluntary. Any method of achieving early reductions in nutrients is allowable, whether achieved with nutrient removal optimization, a water quality trade, a source reduction plan, watershed nutrient reductions, or capital improvements to implement nutrient removal. If TMDLs or other watershed-based nutrient reduction strategies are developed, baselines for utilities will be established based upon point source sector reduction requirements in the absence of such early actions (i.e., facility-specific early action performance will not be set as the future regulatory requirement). This will eliminate regulatory disincentives for taking early nutrient reduction actions.

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Appendices

A – Missouri Department of Conservation Fish Stocking Information Letter

B – Methodology for the Development of the 2020 Section 303(d) List in Missouri

MISSOURI
DEPARTMENT OF
NATURAL RESOURCES

2020 Listing Methodology Public Meeting Summary
February 22, 2019
Lewis and Clark State Office Building
Jefferson City, Missouri

- Recent changes to the 2020 Listing Methodology Document (LMD) were discussed, including minor grammatical and formatting changes as well as the addition of Appendix F, which is the Nutrient Implementation Plan.

- The addition of a footnote under section III. Biological Data of the 2020 LMD was added to clarify that biological criteria is referred to throughout the document but numeric scores are not specifically stated in Missouri's current Water Quality Standards (WQS). WQS 10 CSR 20-7.031 5 (R) specifically defines biological criteria as "The biological integrity of waters, as measured by lists or numeric indices of benthic invertebrates, fish, algae, or other appropriate biological indicator shall not be significantly different from reference waters." The LMD outlines what numeric criteria or indices will be used and how those numeric criteria or indices were developed.

- Information was added to clarify size classification in relation to Warm Water, Cool Water, and Cold Water stream habitats after the 2014 revision of Missouri's WQS. A visual representation was also inserted to depict the size classification between headwater streams and rivers, which respectively determines biological criteria applied during assessments.

- Wording was removed in order to delineate the difference between "control" and "reference" streams, thus making it clearer as to which is being discussed within the 2020 LMD.

- It was reiterated that the 13 Step Process is currently being used as an interim guideline to define candidate reference streams until a robust dataset for headwater stream criteria is developed by the Missouri Department of Natural Resources.

- Single stressors will not solely eliminate a stream from consideration as a candidate reference stream. An aggregate of stressors, land use calculations, and permitting information followed by field verification will be used for determination.

- If available, historical data will be considered; if an issue has been rectified it will not disqualify a stream from consideration as a candidate reference stream. If historical data is unavailable for comparison, then a potential candidate stream will be subject to WQS prior to inclusion.

- What is currently Step 7 used to be Step 10 in the interim 13 Step Process, and staff also pointed out that not only will the Ecological Drainage Unit (EDU) be utilized, but the Aquatic Ecological System (AES) will be used when determining potential reference streams. Stakeholders noted utilizing the AES might weaken expectation set forth for identifying candidate reference streams, therefore promoting further habitat degradation. Staff explained usage of AES' for determination of potential reference streams to accurately compare streams of similar geology and land use prior to searching the broader EDU. It was requested by stakeholders this process be clarified in text within the 2020 LMD.

- Stakeholders expressed concern that wording in the 2020 LMD was too vague regarding the number of macroinvertebrate sampling events that would take place when creating headwater stream criteria.

- References were inserted to the 2020 LMD where necessary.

- Page 57, Appendix B, chronic pH criteria was updated to reflect current WQS. On page 58 clarification was made to the Lake Nutrient Criteria. Appendix D, Ecoregional Criteria of Lakes, was added to the 2020 LMD, and in the next LMD the assessment pieces of the Nutrient Implementation Plan will be integrated.

- Stakeholders and staff reviewed the monitoring and assessment portion of the Nutrient Implementation Plan, located in Section I. The Department is open to discussion on how to assess and monitor lake trends.

- The Department is also taking suggestions for topics to be considered for the 2022 LMD.

- The next 2020 LMD Public Meeting is from 1:00 p.m. to 4:00 p.m. on March 15, 2019, at the Lewis and Clark State Office Building, Gasconade Camp Conference Room. Public comment period for the 2020 LMD ends April 3, 2019.

MISSOURI
DEPARTMENT OF
NATURAL RESOURCES

2020 Listing Methodology Public Meeting Summary
March 15, 2019
Lewis and Clark State Office Building
Jefferson City, Missouri

The Missouri Department of Natural Resources held an availability session to answer questions regarding the 2020 Listing Methodology Document. Two stakeholders were present. The Department provided an opportunity to review the proposed changes. The stakeholders present attended the previous availability session and did not wish to review the proposed changes. No questions were asked regarding the 2020 Listing Methodology Document.

The Department reminded those in attendance that comments would be accepted until close of business April 2, 2019.

Draft 2020 Listing Methodology Document
Department Responses to Public Comments

Public Notice
February 1 – April 3, 2019

Missouri Department of Natural Resources
Water Protection Program
PO Box 176
Jefferson City, MO 65102-0176
800-361-4827 / 573-751-1300

Introduction

Pursuant to 40 CFR 130.7, States, Territories, and authorized Tribes must submit biennially to the U.S. Environmental Protection Agency (EPA) a list of water-quality limited (impaired) segments, pollutants causing impairment, and the priority ranking of waters targeted for total maximum daily load (TMDL) development. Federal regulation at 40 CFR 130.7 also requires States, Territories, and authorized Tribes to submit to EPA a written methodology describing the state's approach in considering and evaluating existing and readily available data used to develop its 303(d) list of impaired waters. The listing methodology must be submitted to EPA each year the Section 303(d) list is due. While EPA does not approve or disapprove the listing methodology, the agency considers the methodology during its review of the state's 303(d) impaired waters list and the determination to list or not to list waters.

The Missouri Department of Natural Resources placed the draft 2020 Listing Methodology Document (LMD) on public notice from February 1 to April 3, 2019. All original comments received during this public notice period are available online on the Department's website at http://dnr.mo.gov/env/wpp/waterquality/303d/303d.htm. Comments were received from the following groups or individuals:

1. Newman, Comley & Ruth P.C.
2. Conservation Federation of Missouri
3. Stream Teams United
4. Missouri Coalition for the Environment
5. Metropolitan St. Louis Sewer District
6. The Nature Conservancy
7. Ms. Jeanne Heuser
8. Missouri Department of Conservation
9. Newman, Comley & Ruth P.C. on behalf of Missouri Agribusiness Association, Missouri Pork Association, and the Missouri Cattlemen's Association
10. City of Springfield
11. Association of Missouri Cleanwater Agencies
12. U.S. Environmental Protection Agency – Region 7
13. U.S. Fish and Wildlife Service

This document summarizes and paraphrases the comments received, provides the Department's responses to those comments, and notes any changes made to the final draft 2020 LMD resulting from these comments. The final draft LMD will be presented to the Clean Water Commission for their approval. The public will have an additional chance to make a statement on the final draft 2020 LMD at the commission meeting before Clean Water Commission approval.

Summary of Department actions as a result of public comments:

1. The Department will clarify that fIBI metrics only apply to the Ozarks ecoregion on page 28.
2. The Department will change the word "robust" to "scientifically defensible" on page 29.
3. The Department will remove the following sentence from page 29, "These candidate reference streams will be used to create EDU specific localized criteria until EDU wide criteria are developed."
4. The Department will change the procedure for proposing changes to the LMD.
   a. The Department will have a 30 day public comment period to request topics to be considered for change or addition to the LMD.
   b. Based on the responses received, the Department will hold public work group meetings for in-depth topics. Topics and meeting dates will be announced publicly and on the Departments website after the 30 day comment period.
   c. Any minor grammatical or clarification changes, as well as changes resulting from the work group meetings, will be public noticed for 60 days.

Summary of public comments regarding changes to the LMD with the Department's Response:

1. <u>Process for candidate headwater reference stream selection</u>

With the 2020 LMD the Department proposed revisions to the 13-step process for selecting small candidate headwater reference streams. These changes would allow the Department to compare small candidate reference streams whose land use composition is representative of a test stream land use at the Aquatic Ecological System (AES) level and generally representative of land use of the Ecological Drainage Unit (EDU) as a whole. This comparison of land use at step 7 of a 13 step process would reduce potential disparities in land use composition at finer geographic scales.

Several commenters were supportive of these changes, including Newman, Comley & Ruth P.C., individually and on behalf of Missouri Agribusiness Association, Missouri Pork Association, and the Missouri Cattlemen's Association. Also commenting in support of the proposed changes were Metropolitan St. Louis Sewer District, City of Springfield, and the Association of Missouri Cleanwater Agencies. The Department appreciates these comments in support of the change to the 13-step process.

Several commenters raised concerns with the proposed changes to the 13-step process for selecting small candidate headwater reference streams, including Conservation Federation of Missouri, Stream Teams United, Missouri Coalition for the Environment, The Nature Conservancy, Ms. Jeanne Heuser, Missouri Department of Conservation, EPA – Region 7, and U.S. Fish & Wildlife Service. These groups provided comments that reference stream reaches should be representative of *"best available"* and *"provide a baseline of what stream habitat, water quality, and natural communities should resemble with minimal impacts of anthropogenic activities."* Some comments went further to suggest that the proposed changes were a deviation from *"best available representatives of ecoregion waters in a natural*

condition (10 CSR 20-7.031(1)(X))" to stream reaches with similar watersheds of test stream reaches"

The Department understands the comments provided in opposition to the LMD changes. However, the Department maintains the policy decision to modify the 13-step process for identifying candidate headwater reference streams. Stressors identified during the candidate reference selection process will continue to be examined as to their impact on the biological community and the streams viability as a candidate for reference. Those candidate reference waters with verified stressors within their watersheds will be removed from consideration and preference within the 13-step process. The LMD is revised biannually and the Department is committed to having continued discussions on this topic for future revisions of the LMD.

Additionally, assessment conclusions utilizing the 13-step process will be part of the basis for 303(d) listing decisions. These decisions are subject to additional public participation processes and evaluation, as well as Clean Water Commission approval or alteration. This allows for additional evaluation of the candidate references used in making assessment conclusions regarding whether uses are attained and the appropriateness of those conclusions.

2. Public Process

The Missouri Coalition for the Environmental provided a comment that the LMD process for stakeholder input lacked transparency. The Department appreciates the comment and agrees that the process can be improved and intends to modify how input from stakeholders is gathered during future LMD reviews. Every two years, the Department will hold a 30 day public comment period to request topics to be considered for the LMD. If new topics are brought up outside of this time period, the Department will consider those topics under the next public comment period for LMD review. Based on the responses received, the Department will hold public work group meetings for in-depth topics. Topics and meeting dates will be announced publicly and on the Departments website after the 30 day comment period. Any minor grammatical or clarification changes as well as changes resulting from the work group meetings will be public noticed for 60 days.

The Department firmly believes implementation of the above process changes will streamline and enhance the development of future LMDs.

3. Sediment Toxicity

The EPA provided comments regarding sediment toxicity. The Department appreciates the offer of support from EPA and the additional information in regards to sediment toxicity. The Department will contact Region 7 of the EPA for additional information on sediment toxicity for consideration in the 2022 LMD. The Department will remove the following sentence from the LMD on page 29, "These candidate reference streams will be used to create EDU specific localized criteria until EDU wide criteria are developed."

4. Additional clarifications and changes

The Missouri Department of Conservation (MDC) also provided specific changes to be made to the Draft 2020 LMD:

1. *"Page 28: 'Current WPRS criteria and the MDC fIBI criteria apply to Creek and Small River size categories.'*
    a. *Please specify that fIBI criteria are only applicable to streams in the Ozark Aquatic Subregion.*
2. *Page 28-29: 'Since headwater stream biological criteria have not been established, the utilization of candidate headwater reference streams and draft criteria will be necessary to perform biological stream assessments of headwater size streams until robust criteria have been developed.'*
    a. *Suggest changing the word 'robust' to 'scientifically defensible.'*
3. *Page 29: 'These candidate reference streams will be used to create EDU specific localized criteria until EDU wide criteria are developed.'*
    a. *Recommend removal of this addition. If this language is retained, please further define 'localized'.*
4. *Page 32, #6: 'Exceptions can be made when the cause of the incident no longer exists and there are no lingering effects.'*
    a. *Please provide clarity on 'lingering effect.' How is it determined that there are no lingering effects?*
5. *Page 33, #12: 'After multiple sampling events evaluate recent field data against available historical...'*
    a. *Does 'recent' apply to the two sampling events in the same year the test stream is sampled? Please provide more definition for 'recent'."*

In regard to items 1-5 in the comment provided by MDC:

1. The Department will clarify this item and notes that page 32 of the LMD states that the fIBI criteria will only be used for 3-5 order streams in the Ozark ecoregion.
2. The Department will make the revision from "robust" to "scientifically defensible" on pages 28 and 29.
3. The Department will remove the following sentence from page 29: "These candidate reference streams will be used to create EDU specific localized criteria until EDU wide criteria are developed."
4. The Department will look at incidents on a case by case basis, looking at information such as but not limited to: the cause and source of the incident; whether or not the incident is likely to occur again; what kind of documented effects the pollutant or toxicant has on the aquatic community; how long effects have been observed for similar incidents; *etc*.
5. The Department considers any quality assured field data collected within the last seven years to be recent data, as per the LMD.

MISSOURI
DEPARTMENT OF
NATURAL RESOURCES

2020 Listing Methodology Document
Public Comments Received

Public Notice
February 1 – April 3, 2019

Missouri Department of Natural Resources
Water Protection Program
PO Box 176
Jefferson City, MO 65102-0176
800-361-4827 / 573-751-1300

Introduction

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NEWMAN COMLEY RUTH

CATHLEEN A. MARTIN
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STEPHEN G. NEWMAN
JOHN A. RUTH
ALICIA EMBLEY TURNER

March 21, 2019

Via Email Only

Missouri Department of Natural Resources
Water Protection Program
Attention Robert Voss
P.O. Box 176
Jefferson City, MO 65102-0176
robert.voss@dnr.mo.gov

Re: 2020 Listing Methodology

Dear Mr. Voss:

I am offering comments on the January 29, 2019 public notice of the draft *2020 Section 303(d) List in Missouri*. In response to my and other stakeholder comments, the department proposed changes to the 13-step process to select small candidate reference streams. Although not perfect, it is much improved.

I support the department's proposed changes to the 13 steps. Significantly, the department revised former Step 10 and moved it to Step 7. This is an important improvement. This step allows the department to make efforts to initially compare small candidate reference streams whose land use composition is representative of the test stream's AES and is generally representative of EDU land uses.

By placing this initial stream selection process at Step 7, further field verification may take place to confirm proper selection of small candidate reference streams. The department has pledged to closely and carefully document all decisions made during each of the 13 steps.

I appreciate the department's perseverance and dedication to a thorough stakeholder process.

Sincerely,

NEWMAN, COMLEY & RUTH P.C.

By: Robert J. Brundage

Robert J. Brundage
rbrundage@ncrpc.com

Conservation Federation of Missouri

728 West Main Street ♦ Jefferson City MO 65101-1559

573-634-2322 ♦ 800-575-2322 ♦ 573-634-8205 (fax)

Gary Van De Velde
President

Tyler Schwartze
Executive Director

March 27, 2019

Robert Voss
Department of Natural Resources
Water Protection Program
PO Box 176
Jefferson City, MO 65102-0176

Dear Mr. Voss and staff of the Water Protection Program,

The mission of the Conservation Federation of Missouri (CFM) is to ensure conservation of Missouri's wildlife and natural resources and preservation of our state's rich outdoor heritage through advocacy, education, and partnerships. The listing methodology document guides the department's efforts related to "How water quality data is evaluated to determine whether or not waters are impaired for 303(d) listing purposes." We believe several of the proposed changes to the 2020 Listing Methodology Document are not supported by scientific evidence and have the potential to harm Missouri's aquatic resources. Proposed changes to the evaluation or standards used to identify impaired stream reaches are likely to lead to adverse changes in water quality in the state and an inaccurate assessment of state waters. CFM is concerned about proposed changes to which stream reaches are selected for defining reference conditions. Specifically, we oppose the insertion of new text in step 7 on page 32 and the deletion of step 10 on page 33 of the document.

Reference stream reaches are defined as "Stream reaches determined by the department to be the best available representatives of ecoregion waters in a natural condition, with respect to habitat, water quality, biological integrity and diversity, watershed land use, and riparian conditions (10 CSR 20-7.031(1)(X))." Reference stream reaches provide a baseline of what stream habitat, water quality, and natural communities should resemble with minimal impacts of anthropogenic activities. This baseline can then be used to estimate the impacts of human activities on test streams. The newly proposed step 7 in the draft revision of listing methodology contradicts the definition of reference reaches, undermines the scientific foundation of the listing process, and imposes an immense burden on the resources of the Department of Natural Resources (DNR). The proposed insertion shifts the selection of reference stream reaches from those that are the "best available representatives of ecoregion waters in a natural condition (10 CSR 20-7.031(1)(X))" to stream reaches with similar watersheds of test stream reaches, which all could be comparably degraded by intensive land uses and other stressors. The reason for establishing a reference reach is to quantify stream conditions and biotic communities under

relatively natural conditions in order to evaluate the degree of impairment in streams that have been impacted by anthropogenic activities. This proposed change would lead to the selection of reference stream reaches that are not "the best available representatives of ecoregion waters in a natural condition." Instead, the change would lead to streams in areas that have been impacted by anthropogenic land use being held to much lower standards than streams in areas that have not.

In addition to contradicting the definition of a reference reach, establishing reference reaches in the manner prescribed (step 7, page 32) is likely infeasible and unnecessarily expensive. The proposed change would require the DNR to identify reference reaches for innumerable combinations of land-use types for each Aquatic Ecological System Types (AES) within Ecological Drainage Unit's (EDU), which would require an immense and possibly insurmountable amount of effort by DNR biologists to validate. Validation would require long-term repeated sampling to quantify natural variability of reference reaches – a labor intensive process already undertaken for existing reference reaches. Moreover, anthropogenic impacts are often linked and difficult to disentangle. Consequently, the DNR will unlikely be able to identify reference stream reaches with high levels of human land use that are not impacted by other known stressors (such as excessive nutrients, inadequate dissolved oxygen, choking sediment, and toxins), resulting in few, if any reference reaches that are "representative of ecoregion waters in natural condition."

Additionally, we request that the original step 10 (page 33) be retained. The purpose of step 10 is to "ensure that waters with similar habitats are compared, provided that the candidate reference is representative of the least impaired and best available condition in the EDU." The proposed step 7 focuses on AES types to presumably compare similar habitats between test and reference stream reaches. One option would be to prioritize reference reaches that have least-impacted land uses within the same or similar AES type as test reaches. Candidate test reaches could be chosen from the greater EDU if there are no reaches within the test reach's or a similar AES type that are representative of "least impaired and best available condition in the EDU" and with land uses that do not exceed thresholds impacting aquatic invertebrate communities.

We appreciate the efforts of the Missouri Department of Natural Resources and the Water Protection Program in assessing and managing Missouri's waters for the benefit of all Missourians in a scientifically rigorous manner.

The Conservation Federation of Missouri

Gary Van De Velde

Gary Van De Velde
President CFM

PO Box 483
Shelbina, MO 63468
www.streamteamsunited.org

March 26, 2019

Department of Natural Resources
Water Protection Program
Attn: Robert Voss
P.O. Box 176
Jefferson City, MO 65102-0176

Dear Mr. Voss and staff of the Water Protection Program,

The Missouri Stream Team Watershed Coalition (dba Stream Teams United) would like to provide comment on the draft changes to the 2020 Listing Methodology Document for the draft document dated January 29, 2019. Our organization is made up of Missouri citizens that use Missouri streams (for drinking water, harvesting of fish for consumption, recreation, and other beneficial uses). These citizens seek to maintain healthy waterways in their local communities.

Our comment is in regard to a drafted change in the process for the selection of small candidate reference streams that begins on page 31 of the document. We oppose the deletion of step 10 on page 33 and the insertion of the new text in step 7 on page 32 of the document.

10 CSR 20-7.031(1)(X) provides the Definition of **Reference stream reaches** as "Stream reaches determined by the department to be the best available representatives of ecoregion waters in a natural condition, with respect to habitat, water quality, biological integrity and diversity, **watershed land use**, and riparian conditions."

The proposed insertion in step 7 on page 32 states "In addition candidate reference streams should also be chosen from candidate reference stream watersheds whose land use composition is representative of test stream's AES, and generally representative of EDU land uses." This proposed draft step contradicts the definition of reference stream reaches found in 10 CSR 20-7.031(1)(X), which states that watershed land use should be the best available representative of ecoregion waters in a natural condition. By creating a selection step where the reference stream's land use is similar to the larger watershed (AES) of the test stream, the quality of the reference stream may be compromised due to impacts to the reference stream from non-point sources in the reference stream's watershed.

Pollution impairment originates from both point and non-point sources. By creating a step where the reference stream and test streams have watersheds with similar land use compositions, the impacts of non-point sources are not taken into account in the comparison of reference stream reaches to test

stream reaches. It is well known in water quality assessments, that non-point source pollution often contributes the majority of pollution within a watershed.

The current approved Listing Methodology Document selects reference streams with the same five VST variables of the test stream (step 4 on page 31). Therefore, reference stream reaches and test stream reaches have similar characteristics for the variables of temperature, size, flow, geology, and relative gradient. These variables are core abiotic components that affect stream habitat within an ecoregion. Land use in a watershed has the ability to affect stream temperature and flow characteristics, but land use in itself is not an abiotic component of stream habitat. However, land use does affect water quality in a watershed through the contributions of non-point source pollution from altered landscapes (i.e. urban influences, tillage, deforestation, etc.). Therefore, watershed land use of a reference stream should not be required to be similar to the watershed land use of the test stream.

The January 29, 2019 draft Listing Methodology Document essentially lowers the standard at which we assess streams by suggesting that the watershed land use of the reference stream be similar to the watershed land use of the test stream. 10 CSR 20-7.031(1)(X) clearly states that reference stream reaches should be the best available representatives of ecoregion waters in a natural condition, <u>including watershed land use</u>.

Our state should seek to have an accurate, scientific assessment of the streams in this state, and then follow up the accurate assessment with good policy with regulated entities. If the integrity of the assessment process is compromised, the result will be an inaccurate assessment of Missouri streams.

We suggest that draft #7 on page 32 be deleted from the document, and instead step #10 retained and re-written as "Calculate land use categories of candidate reference streams (e.g. percentage of forest, grassland, impervious surface, etc.) in GIS mapping software using available land cover datasets (Sources of land use data that are currently used are NLCD 2011 and MoRAP 2005). Candidate reference stream land use will be compared to the EDU as a whole looking for atypical conditions that would not be representative of the EDU. An example would be circumstances where percentages of land use exceed thresholds that have been documented to show adverse effects on the aquatic invertebrate community (Center for Watershed Protection, 2003). Candidate reference streams with the same or similar AES type as the test stream (within the EDU) will be given preference throughout the selection process, provided that the candidate reference is representative of the least impaired and best available condition in the EDU. If suitable candidate reference streams cannot be found within the same AES type as the test stream, candidate reference streams will be selected from within the larger EDU. A reference stream should be representative of the best available conditions in an EDU."

We appreciate your consideration of our comment and your work to accurately assess streams in the state of Missouri.

Mary Culler
Executive Director
mary@streamteamsunited.org
(573) 586-0747 mobile; (660) 284-6185 office

Missouri Coalition for the Environment
1969 2019

March 29, 2019

Department of Natural Resources
Water Protection Program
Attn: Mr. Robert Voss
P.O. Box 176, Jefferson City, MO 65102-0176

Transmitted via e-mail to robert.voss@dnr.mo.gov

Re: Comment on the *Methodology for the Development of the Section 303(d) List in Missouri* (dated January 29, 2019)

Dear Mr. Robert Voss and Water Protection Program staff:

Missouri Coalition for the Environment (MCE) is grateful for the opportunity to comment on the Methodology for the Development of the Section 303(d) List in Missouri (LMD). MCE is a nonprofit, independent, citizens' environmental organization advocating for clean water, clean air, clean energy, and a healthy environment.

MCE urges the Missouri Department of Natural Resources (MDNR) to compare candidate reference streams to best available conditions, rather than conditions representative of land use, in the procedure for "Selecting Small Candidate Reference Streams" in the proposed LMD. MCE is very concerned that the draft LMD from January 29, 2019[1] puts Missouri's water quality at risk by significantly lowering the standards for reference streams, ignoring the impacts of anthropogenic land use on water quality. MCE also asks MDNR to clarify its process for stakeholder input and increase transparency with all stakeholders about changes to this and future LMD documents.

[1] Missouri Department of Natural Resources. January 29, 2019. Methodology for the Development of the 2020 Section 303(d) List in Missouri. pp. 32.

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I. The updated definition of a reference stream weakens necessary water quality protections

The January 29, 2019 changes to the draft LMD replace the previous directive in the July 16, 2018 draft LMD from "reference stream should be representative of the best available conditions" in the Ecological Drainage Unit (EDU) to "candidate reference streams with the same or similar AES type as the test stream (within the EDU) will be given preference throughout the selection process" and "candidate reference streams should also be chosen from candidate reference stream watersheds whose land use composition is representative of test stream's AES, and generally representative of EDU land uses."

This lowering of the standard from "best available" conditions to land use composition "representative" of the steam's AES and EDU threatens Missouri water quality by increasing the risk of damage to waterways through anthropogenic land use. Agricultural and urban land use demonstrably lower water quality through sedimentation, nutrient enrichment, and pollution[2]. The 303(d) list should not exempt waterways with poor water quality under the reasoning that poor water quality is representative of that designated land use. It should identify waterways with poor water quality without exception to protect the health of Missourians and aquatic life. Reverting to the original method of comparing candidate reference streams to best available conditions would better protect waterways where the designated land use commonly degrades water quality. This approach is standard for water quality protection; Iowa, Missouri's neighbor in EPA Region 7 with similarly substantial agricultural land use, selects candidate reference sites that are located on "least impacted streams" [3]. MDNR uses this approach for the reference streams in the Biological Assessments Sampling Database, defining reference conditions as "characteristics of waterbodies least impaired by anthropogenic activities" that "are used to define attainable habitat and biological conditions" [4].

II. The process for stakeholder input into the LMD lacks transparency

Just one day prior to the Clean Water Commission Work Session on September 21, 2018 changes were made to the draft LMD as the result of special interest influence. Copies of these changes were only provided to members of the Clean Water Commission, and as a result, not all who were in attendance at the Work Session were able to reference these last-minute changes. MCE requests that MDNR increase transparency about the process for making changes to draft documents and suggests that MDNR consistently assess proposed changes through public

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[2] Allan, J. David. 2004. Landscapes and Riverscapes: The Influence of Land Use on Stream Ecosystems. Annual Review of Ecology, Evolution, and Systematics. Vol. 35. pp. 262-267.
[3] Iowa Department of Natural Resources. March 28, 2017. Methodology for Iowa's Water Quality Assessment, Listing, and Reporting Pursuant to Sections 305(b) and 303(d) of the Federal Clean Water Act. pp. 83.
[4] Missouri Department of Natural Resources. February 2002. Biological Criteria for Wadeable/Perennial Streams of Missouri. pp. 7.

comments, rather than private deferments to select special interests. MDNR should provide enough time for other stakeholders to review proposed changes and offer input before inserting those changes into draft documents.

MCE urges MDNR to prioritize protecting Missouri water quality, and therefore the health of humans and aquatic life, in selecting candidate reference streams by upholding the highest standards for reference conditions. MCE asks that MDNR prioritize communication and transparency with all stakeholders in the future, to ensure affected Missourians can readily provide input on critical issues.

Thank you for the opportunity to present these comments. If you have any questions or would like to discuss MCE's comments further, please do not hesitate to reach out at the contact information below.

Sincerely,

Maisah Khan
Water Policy Director, Missouri Coalition for the Environment (MCE)
E-mail: mkhan@moenviron.org Tel.: 314-727-0600 Ext. 113

Sydney Welter
River Protection Organizer Intern, MCE
E-mail: swelter@moenviron.org

Metropolitan St. Louis
Sewer District

Division of Environmental Compliance
10 East Grand Avenue
St. Louis, MO 63147-2913
314-768-6200 www.stlmsd.com

March 29, 2019

By Electronic Mail (robert.voss@dnr.mo.gov)

Mr. Robert Voss
Water Protection Program
Missouri Department of Natural Resources
P.O. Box 176
Jefferson City, MO 65102

RE: 2020 Listing Methodology Document on Public Notice

Dear Mr. Voss:

The Metropolitan St. Louis Sewer District has reviewed the document titled *Methodology for the Development of the 2020 Section 303(d) List in Missouri*. The Metropolitan St. Louis Sewer District appreciates the Department's ongoing commitment to protecting Missouri's waterways through the development and improvement of the methods used to identify impaired waters. Thank you for the opportunity to provide comments during this process. If you have any questions please feel free to contact me at (314) 436-8700.

Sincerely,

Austin Nieman, P.E.
Civil Engineer, Environmental Compliance Program

cc: Jason Peterein - MSD

The Nature Conservancy
P.O. Box 440400
St. Louis, Missouri 63144
Tel (314) 968-1105 nature.org/missouri

March 28, 2019

Missouri Department of Natural Resources
Division of Environmental Quality
Water Protection Program
Attn: Mr. Robert Voss
PO Box 176
Jefferson City, MO 65102

Re: Methodology for the Development of the 2020 Section 303(d) List in Missouri

Dear Mr. Voss,

The Nature Conservancy of Missouri would like to offer the follow comments regarding the proposed changes in Section D of the Methodology for the Development of the 2020 Section 303(d) List in Missouri.

- Page 29 of 74 - We support using Ecological Draining Units (EDUs) as the basis for developing temporary, localized biocriteria for streams that are smaller than wadeable perennial streams; however, we encourage MoDNR to establish a schedule for developing EDU-wide criteria for these smaller streams.

- Page 30 of 74 - Regarding the addition of: "c) The test stream will be judged "inconclusive" if the requirements in a) and b) are not met." We recommend additional language that requires additional sampling within the next year for streams judged "inconclusive" to determine if the test stream is impaired or unimpaired.

- Page 32 of 74 - Paragraph 5 under "Selecting Small Candidate Reference Streams" states "The presence of a single potential stressor will not automatically lead to a stream reach being rejected; rather, the aggregate of potential stressors in a watershed will be evaluated."
    - We are concerned that compounding impacts from multiple potential stressors could create an impaired condition. We recommend additional clarifying language be added to describe how the aggregate potential stressors will be evaluated.
    - We recommend adding **land use changes** to the list of stressors identified parenthetically at the beginning of paragraph 5 (e.g. point sources, landfills, CAFOs, lakes, reservoirs, mining, **land use changes**, etc.). Similar to point sources, landfills and the other stressors listed, land use changes can be stressors that degrade water quality as well. Water quality degradation and impairment of streams resulting from land use changes within their watersheds are well known (e.g., sedimentation and nutrient

The Nature Conservancy
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loading) and thus warrant inclusion to the list of stressors. In addition, streams with land use changes in their watersheds that adversely impact water quality and result in impaired conditions should not be considered for use or designated as a candidate reference stream.

- Page 32 of 74 - Paragraph 6 under "Selecting Small Candidate Reference Streams" states *"Exceptions can be made when the cause of the incident no longer exists and there are no lingering effects."* We recommend adding the following specificity:

  Exceptions can be made when the cause of the incident no longer exists and there are no lingering effects **to the biological community.**

- Page 32 of 74 – The new language in paragraph 7 under "Selecting Small Candidate Reference Streams" is of concern. Candidate reference streams should represent the highest attainable condition for a stream, which may not be the same as the best existing condition. The inclusion of land uses as a measure of similarity may create situations where impaired streams are relied upon as determining the highest attainable condition. We propose the following additions (underlined)/omissions (strikethrough):

  Candidate reference streams should be representative of the highest attainable condition for an EDU. Calculate land use categories of candidate reference streams (e.g. percentage of forest, grassland, impervious surface, etc.) in GIS mapping software using available land cover datasets (Sources of land use data that are currently used are NLCD 2011 and MoRAP 2005). Candidate reference streams with the same or similar AES type as the test stream (within the EDU) will be given preference throughout the selection process. ~~In addition, candidate reference streams should also be chosen from candidate reference stream watersheds whose land use composition is representative of test stream's AES, and generally representative of EDU land uses.~~ Candidate reference stream watersheds will be excluded if impervious area covers greater than 10% of the watershed area (Center for Watershed Protection, 2003).

This approach should ensure that test streams are compared to reference streams representing the highest attainable condition for streams with similar habitats and landscape context.

The Nature Conservancy
P.O. Box 440400
St. Louis, Missouri 63144

Tel (314) 968-1105 nature.org/missouri

The Nature Conservancy appreciates opportunity to comment on the proposed methodology changes. If you have any questions or need additional information, please contact Holly Neill at (417) 827-4864 or e-mail holly.neill@tnc.org.

Respectfully,

Holly Neill, M.S.
External Affairs

Steve Herrington, Ph.D
Director of Science and Impact Measures

2020 Listing Methodology Document

Comments Concerning Proposed Revisions

April 2, 2019

By Jeanne Heuser, Jamestown, MO

Assessing Small Streams

No changes should be made to the following section of the *2020 Listing Methodology Document* (LMD) approved by the Clean Water Commission on July 16, 2018. These methods for assessing candidate reference streams should continue to be used as they clearly include the macroinvertebrate health in streams as a primary component of the process. In the subsequent revisions almost all, if not all, references to macroinvertebrates have been removed. Note the last paragraph below, which is particularly important.

- If the ten candidate reference stream (small control stream) scores are similar to WPRSs and meet LMD criteria for an unimpaired macroinvertebrate community, then the test stream will be assessed using MSCI based procedures in the LMD.

- If the ten candidate reference stream scores are lower than those of WPRSs and do not meet the LMD criteria for an unimpaired macroinvertebrate community, then:

  a) The test stream will be assessed as having an unimpaired macroinvertebrate community if the test stream scores meet the LMD criteria for an unimpaired community;
  b) The test stream data will be judged inconclusive if test stream scores are similar to candidate reference stream scores;
  c) The test stream will be assessed as having a "suspect" macroinvertebrate community if its scores are found to be low but statistically close to candidate reference streams; or,
  d) The test stream will be assessed as having an "impaired" macroinvertebrate community if its scores are found to be statistically lower than the candidate reference streams.

This method of assessing small streams will be used only until such time as the aquatic habitat protection use categories based on watershed size classifications of Headwater, Creek, Small River, Large River and Great River are ~~is~~ promulgated into Missouri Water Quality Standards and appropriate biological metrics are established for stream size and permanence.

The approach for determining a "suspect" or "impaired" macroinvertebrate community will be made using a direct comparison between all streams being evaluated, which may include the use of percent and/or mean calculations as determined on a case by case basis. All work will be documented on the macroinvertebrate assessment worksheet and be made available during the public notice period.

In addition, this description does not reduce water scores by any percentage as has now been added in the revised draft with the "75% of the ten candidate reference streams." Such percentages only serve to allow for additional degradation of water quality in Missouri and should not be allowed.

Selecting Small Candidate Reference Streams

Step 5: Although I agree stressors need to be carefully evaluated, the allowance made for a single "potential" stressor and the evaluation of an aggregate of potential stressors is very vague. As written, step 5 could become mired in value judgements and result in allowing streams with multiple, though intermittent, stressors to be considered as reference streams, which defeats the goal of the designation.

Step 6: This step requires that candidate reference streams be evaluated for past pollution incidents that may have impacted the stream with the caveat that there may be exceptions to this if "the cause of the incident no longer exists and there are no lingering effects." Might not the effects be subtle such as lingering soil chemical contamination or loss of tree canopy or woody debris from the cleanup, which could affect the macroinvertebrate community? How would DNR establish what constitutes "no lingering effects"? Again, this becomes a value judgement and does not have the criteria to properly evaluate.

Step 7: The proposed revision for step 7 should be eliminated as it provides for the lessening of good quality reference streams. This step has bounced around with different descriptions in the revised versions of the LMD. Once it was stated as "best available conditions" for a candidate reference streams that do not have "atypical" conditions. How exactly would that be defined? The definition in 10 CSR 20-7.031(1)(X) for reference streams should be used first and foremost, and the original Step 10 should be returned that just focuses on the EDUs, not the AES.

> 10. Calculate land use-land cover *of stream watershed* and compare to EDU. *Streams within the same EDU tend to be more similar to each other than to streams in different EDUs. A reference stream should be representative of the best available conditions in an EDU and should have similar land use-land cover compared to the EDU as a whole. This approach will ensure that waters with similar habitats are compared, provided that the candidate reference is representative of the least impaired and best available condition in the EDU.*

Step 12: This step should return to the original approved LMD to clarify the importance of macroinvertebrates to this process.

> 12. After multiple sampling events evaluate field data, land use, and historical data in biological assessment report. *Aquatic systems are subject to fluctuation due to weather, stream flow, and other climatic conditions. Land use in the watershed of a candidate reference also can change over time. It is therefore important to collect multiple samples over time that are reflective of a variety of conditions to adequately judge a candidate stream's macroinvertebrate community.*

MISSOURI DEPARTMENT OF CONSERVATION

Headquarters

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SARA PARKER PAULEY, Director

April 2, 2019

Robert Voss
Missouri Department of Natural Resources
Water Protection Program
P.O. Box 176
Jefferson City, MO 65102

RE: Methodology for the Development of the 2020 Section 303(d) List in Missouri

Dear Mr. Voss:

Thank you for the opportunity to review and comment on the Draft 2020 Listing Methodology Document (Draft 2020 LMD). The Missouri Department of Conservation (Department) is the agency responsible for the fish, forest, and wildlife resources of Missouri. As such, we actively participate in the review of projects and proposals that may affect those resources. The Department's comments and recommendations are for your consideration and are offered to reduce impacts to the fish, forest, and wildlife resources in Missouri.

The Draft 2020 LMD revises the methods used for selecting small candidate reference streams. These revisions include new requirements that the watersheds of candidate reference streams would be required to be "*representative of test stream's AES* [Aquatic Ecological System], *and generally representative of EDU* [Ecological Drainage Unit] *land uses*." (Item #7, Page 32, January 29, 2019, Draft 2020 LMD). This requirement promotes reference streams that are expected to have had a history of degradation similar to that of the test stream and, potentially, a comparable or even more extreme depression of aquatic invertebrate communities. This is not an appropriate designation of reference streams for biomonitoring applications, as reference streams are intended to represent highest quality conditions.

The requirement that reference streams' watersheds have the "same or similar" land cover/land use as the test stream's creates a bias toward selection of reference streams that are already impacted by degrading land use and is likely to produce lower quality aquatic invertebrate reference criteria. Under the current and proposed methodology, test streams smaller than wadeable perennial reference streams (WPRS) are judged for impairment based on criteria developed from the candidate reference streams (when the test stream does not score comparably to WPRS criteria). Frequently, due to the natural ecological limitations on aquatic communities, small and headwater streams are judged against the candidate reference stream criteria. If lower quality reference stream criteria are utilized, the likelihood of a declaration of unimpaired for the test stream will increase.

COMMISSION

DON C. BEDELL
Sikeston

MARILYNN J. BRADFORD
Jefferson City

DAVID W. MURPHY
Columbia

Small headwater streams are vital to watershed and stream health. These small streams comprise the majority of stream courses in a watershed and set the stage for the health and productivity of the entire stream system. The higher impairment threshold resulting from the proposed revisions will weaken protections for fish and wildlife and have far reaching effects on water quality of larger streams. The Department encourages the Missouri Department of Natural Resources (MDNR) to remove the language of Item #7 in the Draft 2020 LMD and continue to seek the highest quality streams in an EDU for development of reference stream criteria.

Please consider these additional comments specific to other revisions in the Draft 2020 LMD:

1. Page 28: "*Current WPRS criteria and the MDC fIBI criteria apply to Creek and Small River size categories.*"
    a. Please specify that fIBI criteria are only applicable to streams in the Ozark Aquatic Subregion.
2. Page 28-29: "*Since headwater stream biological criteria have not been established, the utilization of candidate headwater reference streams and draft criteria will be necessary to perform biological stream assessments of headwater size streams until robust criteria have been developed.*"
    a. Suggest changing the word "robust" to "scientifically defensible."
3. Page 29: *"These candidate reference streams will be used to create EDU specific localized criteria until EDU wide criteria are developed."*
    a. Recommend removal of this addition. If this language is retained, please further define "localized".
4. Page 32, #6: *"Exceptions can be made when the cause of the incident no longer exists and there are no lingering effects."*
    a. Please provide clarity on "lingering effect." How is it determined that there are no lingering effects?
5. Page 33, #12: *"After multiple sampling events evaluate recent field data against available historical…"*
    a. Does "recent" apply to the two sampling events in the same year the test stream is sampled? Please provide more definition for "recent".

If you have any questions regarding these comments, please contact me at 573-522-4115 ext. 3191, or by email matt.vitello@mdc.mo.gov.

Sincerely,

MATT VITELLO, PE
POLICY COORDINATOR

ROBERT J. BRUNDAGE
EDWARD C. CLAUSEN
MARK W. COMLEY
KIMBERLY J.Z. GUTHRIE
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CATHLEEN A. MARTIN
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April 2, 2019

Via Email Only

Missouri Department of Natural Resources
Water Protection Program
Attention Robert Voss
P.O. Box 176
Jefferson City, MO 65102-0176
robert.voss@dnr.mo.gov

Re: 2020 Listing Methodology

Dear Mr. Voss:

I am writing you on behalf of the Missouri Agribusiness Association, the Missouri Pork Association and the Missouri Cattlemen's Association offering comments on the January 29, 2019 public notice of the draft *2020 Section 303(d) List in Missouri*.

My clients support the revisions to the 13-step process to select small candidate reference streams. These revisions improve the process to encourage comparison of streams with similar habitat and land use conditions while following additional steps to select the best small candidate reference streams. Revisions to Step 10, which was moved to Step 7, now allow the department to initially compare small candidate reference streams whose land use composition is representative of the test stream's AES and is generally representative of EDU land uses. The process does not end here. A list of small candidate reference streams chosen during Step 7 undergoes further field verification to confirm proper selection of small candidate reference streams. The methodology requires the department to document each step of the selection process to increase clarity and transparency.

My clients appreciate the department's continued efforts to improve the methodology after the Commission's approval of the LMD last year.

Sincerely,

NEWMAN, COMLEY & RUTH P.C.

By: Robert J. Brundage

Robert J. Brundage
rbrundage@ncrpc.com

April 3, 2019

Attn: Robert Voss
Water Protection Program
Missouri Department of Natural Resources
P.O. Box 176, Jefferson City, MO 65102

Re: Comments on Methodology for Development of the 2020 Section 303(d) List in Missouri

Mr. Voss,

The City of Springfield would like to express our support for the revisions that the Missouri Department of Natural Resources (MDNR) has included in the January 2019 draft of the Methodology for Development of the 2020 Section 303(d) List in Missouri (LMD). In particular, we believe that proposed clarifications within the 13-step small candidate reference stream process will provide additional transparency and promote the selection of representative reference streams without lowering protections for small streams. We also support the revisions that clarify how biological data from small streams will be assessed relative to wadeable perennial and small candidate reference streams. The revised assessment approach will support repeatable and defensible decision making while more specific, ecoregional-based biological thresholds are developed.

The City appreciates the time and effort MDNR staff has invested to engage with stakeholders and address these issues during the process. Thank you for the opportunity to comment and please contact me at (417) 864-1910 or ekemper@springfieldmo.gov if you have any questions or would like to discuss these comments further.

Sincerely,

Errin Kemper, P.E.
Director - Department of Environmental Services

Office of the Director
Busch Municipal Building • 840 Boonville Avenue
Springfield, Missouri 65802 • 417-864-1919 • springfieldmo.gov/recycling

CITY OF Springfield
ENVIRONMENTAL SERVICES

ASSOCIATION OF MISSOURI CLEANWATER AGENCIES

April 3, 2019

By Electronic Mail (robert.voss@dnr.mo.gov)

Mr. Robert Voss
Missouri Department of Natural Resources
Water Protection Program
P.O. Box 176
Jefferson City, MO 65102-0176

Re: 2020 Listing Methodology

Dear Mr. Voss:

I write on behalf of the Association of Missouri Cleanwater Agencies (AMCA). Our members comprise public water, sewer, and stormwater utilities statewide. We strive to protect public health and the environment in an affordable and cost-effective manner. It is from this perspective that we offer our support for the Department's most recent draft *2020 Listing Methodology and Section 303(d)*.

In particular, we appreciate the changes which the Department plans regarding the process to select small candidate reference streams. This has been a challenging issue for many of our members and the Department. As public entities, we want to ensure we are targeting the right benchmark with our scarce public dollars. Given a wide range of investment opportunities for our public environmental dollars, we want to make sure we prioritize the investments that will deliver the greatest public health and environmental benefits first. In order to accomplish that we need to ensure we are using appropriate reference streams when making impaired waters determinations.

While we still have some concerns with the methodology, we do believe that the revised multi-step process proposed by the Department will lead to the identification of more appropriate candidate reference streams. In particular, the revised process should ensure that candidate reference streams better represent/mirror the test stream's land use. We think this approach will also facilitate field verification of candidate reference streams – a critical step that has been lacking in our view.

We particularly support the greater transparency which the Department's updated process will allow. Several of our members felt it has been difficult previously to meaningfully engage on appropriate reference streams because the Department's information and decision-making was not readily apparent to stakeholders.

Again, we appreciate the Department's consideration of its local government partners input in this matter. Please let us know if we may provide any further information or should there be any questions.

Sincerely,

F. Paul Calamita
General Counsel

C: AMCA Members

Voss, Robert

From: White, Debby <White.Debby@epa.gov>
Sent: Wednesday, April 3, 2019 2:38 PM
To: Voss, Robert
Cc: Amy Shields; Robichaud, Jeffery
Subject: Comment on MO 2020 Listing Methodology 2nd Public Notice

Follow Up Flag: Flag for follow up
Flag Status: Flagged

Good Afternoon Robert,

The following are EPA's comments on Missouri Department of Natural Resources' draft 2020 Listing Methodology Document that is on public notice until 5:00PM on April 3, 2019.

EPA supports MDNR's willingness to further refine the sediment toxicity assessment procedures. As MDNR engages in efforts to mature the methodology, the EPA would like to extend an offer of availability for scientific and technical assistance. EPA encourages MDNR to contact Region 7 for additional information.

In regard to MDNR's text on page 29 that *candidate reference streams will be used to create EDU specific localized criteria until EDU wide criteria are developed*, EPA notes that for the development of site-specific WQS, there are more steps involved than stated in MDNR's 2020 Methodology, including demonstrating that the candidate streams have a long record (multiple years) of meeting the biological criteria with sample macroinvertebrate, fish data and water quality data. All these collected data would need to meet the reference stream criteria. EPA encourages MDNR to contact Region 7 for additional information and support when developing candidate reference streams.

Sincerely,

Debby White | IR, TMDLs & ATTAINS Data Management Coordinator | 913-551-7886 | EPA, Region 7 | Water Division | 11201 Renner Boulevard, Lenexa, Kansas 66219

The information provided in this email and attachment(s) is intended to be purely informational and reflects EPA staff's best judgment at the time and does not represent a final or official EPA interpretation. The information does not substitute for the applicable provisions of statutes, and regulations, guidance, etc., nor is it a regulation itself. Links to non-EPA sites do not imply any official EPA endorsement of, or responsibility for, the opinions, ideas, data or products presented at those locations, or guarantee the validity of the information provided. Reference herein to any specific commercial products, process, or service by trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government. The EPA and sender accept no responsibility for any loss or damage suffered by any person resulting from any unauthorized use of or reliance upon this Email. If you are not the intended recipient, you are hereby notified that any dissemination, copying or other use of this Email is prohibited. Please notify us of the error in communication by return email and destroy all copies of this Email. Thank you.

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Missouri Ecological Services Field Office
101 Park DeVille Drive, Suite A
Columbia, Missouri 65203-0057
Phone: (573) 234-2132 Fax: (573) 234-2181

April 3, 2019

Mr. Robert Voss
Missouri Department of Natural Resources
Water Protection Program
PO Box 176
Jefferson City, MO 65102

Dear Mr. Voss:

The U.S. Fish and Wildlife Service (Service) has an interest and authority in the federal trust species that inhabit and use the waters of the state of Missouri, such as threatened and endangered species, migratory birds, and interjurisdictional fish species. As the principal federal agency responsible for administering the Endangered Species Act (ESA), we have an interest in recovering endangered and threatened species, and working to conserve other species so that listing under the ESA is not necessary. The Service has reviewed the Missouri 2020 303(d) Listing Methodology Document and offers the following comments pursuant to the ESA.

Missouri has a wealth of mussel species, due, in part, to the high degree of endemism that occurs in the Ozark Plateau physiographic region of the state. Mussels are particularly vulnerable to impacts in water quality because of their inability to move to locations of better water quality to avoid environmental stresses in their adult stage. A number of mussel species that occur in Missouri have declined to such levels that they have been federally listed as threatened or endangered under the ESA including: Spectaclecase (*Cumberlandia monodonta*), Curtis Pearlymussel (*Epioblasma florentina curtisi)*, Snuffbox (*Epioblasma triquetra*), Pink Mucket (*Lampsilis abrupta)*, Higgins Eye *(Lampsilis higginsii)*, Neosho Mucket *(Lampsilis rafinesqueana)*, Scaleshell (*Leptodea leptodon)*, Sheepnose *(Plethobasus cyphyus)*, Fat Pocketbook *(Potamilus capax)*, Rabbitsfoot (*Quadrula cylindrica*), and Winged Mapleleaf (*Quadrula fragosa)*.

Other aquatic dependent endangered and threatened species in our state include the Grotto Sculpin (*Cottus specus*), Niangua Darter (*Etheostoma nianguae*), Topeka Shiner (*Notropis topeka*), Neosho Madtom (*Noturus placidus*), Pallid Sturgeon (*Scaphirhynchus albus*), Ozark Cavefish (*Amblyopsis rosae*), Ozark Hellbender (*Cryptobranchus alleganiensis bishopi*), Cave Crayfish, (*Cambarus aculabrum*), and Tumbling Creek Cavesnail (*Antrobia culveri*). All of these species may be affected directly by changes to water quality in the areas in which they

inhabit, or changes to upstream water quality. Indirectly, these species may be affected by changes to their prey base, or by changes to the structure of the stream that provides shelter.

For the protection of endangered aquatic species, it is imperative that we work to protect the existing quality of water and improve it whenever possible. In order to abide by the General Criteria, 10 CSR 20-7.031(4)(H) "Waters shall be free from physical, chemical, or hydrologic changes that would impair the natural biological community", test streams should be compared with *natural* reference streams. In the 2020 proposed 303(d) methodology, the State proposes to compare test streams to small candidate reference streams that have similar land uses. This is a stark change from using the best natural conditions in an EDU as a standard to using a similarly impacted stream within an EDU as a basis for impairment. Similary impacted streams are likely to produce lower quality aquatic invertebrate reference criteria than a stream with the best natural conditions. Therefore, the Service is concerned that the proposed change would result in a higher impairment threshold and weaker water quality protections for threatened and endangered species in Missouri.

In particular, the endangered Topeka Shiner inhabits small streams that could be directly impacted by the proposed change. If, for example, Topeka Shiners were present in a stream but the population was declining due to agricultural run-off, and the reference used for this stream was changed to a stream with an agricultural watershed, it would be less likely to receive a 303(d) designation because the reference stream is similarly impacted by agricultural run-off. Without the protections stemming from this designation, this population could continue to decline until they became extirpated from this stream. Although most of the other aforementioned federally listed species occur in wadeable streams, we expect the changes to the small candidate reference streams will have far reaching effects downstream.

In order to avoid impacts of the proposed 2020 303(d) Listing Methodology Document to federally listed species, the Service recommends that the State remove the language of Item #7 in the Draft 2020 LMD. Reference stream reaches should remain "the best available representatives of ecoregion waters in a natural condition, with respect to habitat, water quality, biological integrity and diversity, watershed land use, and riparian conditions."

We appreciate the opportunity to comment on the proposed methodology changes. If you have any questions, please contact Scott Hamilton at (573) 234-2132 ext 122 or e-mail at Scott_Hamilton@fws.gov. We look forward to working with you on this issue.

Sincerely,

Karen Herrington
Field Supervisor

cc: EPA, Environmental Data and Assessment Branch, Lenexa, KS
MDC, Policy Branch, Jefferson City, MO

Tab F

Missouri Clean Water Commission
Department of Natural Resources
Elm Street Office Building
Roaring River/Bennett Springs Conference Rooms
1730 East Elm St.
Jefferson City, Missouri 65102

July 22, 2019

New Business

Issue:

Any new business can be presented to the Commission.

Recommended Action:

None

List of Attachments:

None

Missouri Clean Water Commission
Department of Natural Resources
Elm Street Office Building
Roaring River/Bennett Springs Conference Rooms
1730 East Elm St.
Jefferson City, Missouri 65102

July 22, 2019

Appeals and Variances

Issue:

This portion of the meeting allows for information to be presented to the Commission. The Commission can review and vote on specific actions as necessary.

Recommended Action:

Information only.

Missouri Clean Water Commission
Department of Natural Resources
Elm Street Office Building
Roaring River/Bennett Springs Conference Rooms
1730 East Elm St.
Jefferson City, Missouri 65102

July 22, 2019

City of Joplin Water Quality Standards Variance
Recommendation to the Missouri Clean Water Commission

Issue: The City of Joplin is requesting a water quality standards (WQS) variance from the total recoverable zinc numeric water quality criteria for the Turkey Creek Wastewater Treatment Plant (TCWWTP) Missouri State Operating Permit #MO-0103349. The Department of Natural Resources (Department) received the City of Joplin's variance application on June 3, 2019 and is making a recommendation to the Missouri Clean Water Commission (CWC) as required by Section 644.061 RSMo. The Department's recommendation is that the CWC approve the variance, following a public notice, at its next meeting on October 9, 2019.

Background: A WQS variance is a tool that may be used to improve water quality over time. Variances establish time-limited criteria that provide dischargers the time and flexibility to make incremental water quality improvements reflecting the best that can be achieved in that given time period. There are seven factors that can be used when considering a WQS variance. The City of Joplin is requesting a variance based on the following factor: Human caused conditions or sources of pollution prevent the attainment of the use and cannot be remedied or would cause more environmental damage to correct than to leave in place.

The City of Joplin is seeking a WQS variance from the total recoverable zinc criteria for the protection of aquatic life use. TCWWTP's permit includes water quality-based effluent limits for zinc that have been difficult for the facility to consistently meet due to the ubiquitous presence of zinc throughout the Joplin area from past mining practices. In addition to direct contamination of soil, groundwater, and surface water by mine wastes, the City of Joplin historically used mine tailings, or "chat", as bedding and backfill for sewer lines. The widespread contamination caused by historic mining activities and associated mine waste disposal within the Tri-State Mining District, and specifically within the Turkey Creek watershed and City of Joplin, is used as justification in the discharger-specific variance.

The City of Joplin has requested a five-year term for this variance. During this term, permit limits that would typically be based on the zinc water quality criteria would be replaced with limits based on the "highest attainable condition" (HAC) of the facility. The City of Joplin will also develop and implement a Pollutant Minimization Program (PMP), which is a structured set of activities to improve processes and pollution controls that will prevent and reduce pollutant loadings. The HAC and PMP will ensure that implementation of the variance will not result in the lowering of existing water quality.

The variance will go on a 30-day public notice following the July 22, 2019 CWC meeting. Comments received during the public notice period will be shared with the CWC prior to the October 9, 2019 meeting where the Department is recommending the CWC approve the variance. Once a WQS variance is approved, it must be incorporated into state regulation, which will include a second public notice period and CWC approval as a part of the rulemaking package.

Recommended Action: Information Only

Attachment: Draft City of Joplin Variance CWC-V-1-19

Missouri Department of Natural Resources
City of Joplin Variance CWC-V-1-19
Joplin, Turkey Creek Wastewater Treatment Plant

The Missouri Department of Natural Resources and the Missouri Clean Water Commission hereby adopts a Water Quality Standards (WQS) variance for Missouri State Operating Permit #MO-0103349 from the numeric water quality criteria for total recoverable zinc for the protection of aquatic life use.

Joplin Turkey Creek Wastewater Treatment Plant (TCWWTP)

Permit Number: MO-0103349
County: Jasper

Treatment Type: Combined fixed growth and activated sludge
Treatment Components: Influent screening, grit removal, primary clarification, trickling filter biotowers, intermediate clarification, oxidation ditch aeration basins, final clarification, tertiary membrane filtration, ultraviolet disinfection, and step aeration
Design Flow: 15 million gallons per day

Turkey Creek

12-digit Hydrologic Unit Code (HUC) and Name: 11070207-0901, Turkey Creek
Water Body Identification (WBID) Number and Hydrologic Class: WBID 3216, Class P
Designated Uses: Protection of aquatic life – warm water habitat, human health protection, irrigation, livestock and wildlife protection, whole body contact recreation, and secondary contact recreation

Impairments: The 2016 Section 303(d) list of impaired waters lists cadmium, lead, and zinc impairments due to contamination from past mining activities associated with the Tri-State Mining District. A Total Maximum Daily Load (TMDL) was developed and approved in 2006 for zinc impairments in Center and Turkey Creek due to the Tri-State Abandoned Mine Lands. The TMDL can be found here: https://dnr.mo.gov/env/wpp/tmdl/docs/3203-center-3216-3217-turkey-cks-tmdl.pdf. The TMDL established wasteload allocations that were calculated using the current water quality criteria for total recoverable zinc for the protection of aquatic life designated use.

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Factor Precluding Attainment

Factor: [40 CFR Section 131.10(g)(3)] Human caused conditions or sources of pollution prevent the attainment of the use and cannot be remedied or would cause more environmental damage to correct than to leave in place. The widespread contamination caused by historic mining activities and associated mine waste disposal within the Tri-State Mining District, and specifically within the Turkey Creek watershed and the City of Joplin, justifies this discharger-specific variance based on this factor. See Appendix C – Evaluations Supporting Application for Discharger-Specific Water Quality Standards Variance for Zinc: City of Joplin, Missouri, Turkey Creek WWTP for supporting information.

Variance Requirements

This variance is the applicable WQS in effect for the purposes of developing Clean Water Act Section 301 National Pollutant Discharge Elimination System (NPDES) permit limits. This is a variance from the total recoverable zinc water quality criteria found in 10 CSR 20-7.031, which was used to calculate wasteload allocations for the Turkey Creek TMDL. The underlying designated use and associated criterion remain applicable for all other Clean Water Act purposes, and all other uses and associated criteria not specified in this variance remain applicable for all Clean Water Act purposes.

Currently Attained Water Quality: Implementation of this WQS variance will not result in the lowering of existing water quality. Pursuant to 40 CFR Section 131.14, TCWWTP is required to implement highest attainable conditions and a pollution minimization program, which are explained below.

Highest Attainable Effluent Conditions (HACs): A WQS variance must reflect the highest attainable condition during the term specified in the variance. Because no additional feasible zinc pollution controls could be identified that would routinely meet zinc water quality-based effluent limits, the effluent condition reflecting the greatest pollutant reduction with optimization of installed treatment was used to calculate the following HACs for total recoverable zinc:

Daily Maximum Effluent Concentration: 396 µg/L
Monthly Average Effluent Concentration: 228 µg/L

Zinc HACs were calculated using the TCWWTP's past five years of reported data for total recoverable zinc from effluent samples. The 95th and 99th percentiles were calculated for the monthly average and daily maximum respectively.

Pollutant Minimization Program (PMP): A PMP is a structured set of activities to improve processes and pollution controls that will prevent and reduce pollution loadings. The City of Joplin will adopt and implement a PMP for zinc per 40 CFR Section 131.14(b)(1)(ii). The Missouri State Operating Permit #MO-0103349 will contain a requirement for the implementation of a PMP with annual reporting to the Department.

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The City of Joplin has included the following activities in their PMP (See Appendix B – Pollutant Minimization Program):

- Sampling within the collection system to identify potential sources
- Continued regulation of industrial contributions through the industrial pretreatment program
- Implementation of the inflow and infiltration reduction activities described in Section 4.4 of Appendix C – Evaluations Supporting Application for Discharger-Specific Water Quality Standards Variance for Zinc: City of Joplin, Missouri, Turkey Creek WWTP
- Continuation of existing requirements for removal of metals in contaminated soils as a part of the City of Joplin's construction contracting process

Additional zinc reduction activities will be considered and included in the PMP as appropriate.

Variance Conditions

Public Participation: Initial public participation prior to the request for approval by the Missouri Clean Water Commission and U.S. Environmental Protection Agency will occur per 10 CSR 20-7.031(12). Also, this variance will be incorporated into 10 CSR 20-7.031 Table J and will be subject to additional public review during the next WQS triennial review, as well as subsequent triennial reviews conducted by the Department until this variance expires. Finally, Missouri State Operating Permit #MO-0103349, which will reflect the conditions and requirements of the variance, will be public noticed per 10 CSR 20-6.020.

Term of Variance: The City of Joplin has requested the term of this variance be five years, which is consistent with the term of Missouri State Operating Permit #MO-0103349 for the TCWWTP.

Reevaluation: The term of this variance does not exceed five years; therefore, a reevaluation is not required per 40 CFR Section 131.14(b)(1)(v).

Other Considerations:
NPDES Permit Limits and Considerations. This variance will be used solely to establish effluent limits for total recoverable zinc and PMP requirements in Missouri State Operating Permit #MO-0103349. This variance will not be used for any other Clean Water Act purposes.

Protections for endangered or threatened species and their critical habitat. It is not anticipated that the granting of this variance will jeopardize threatened or endangered species or result in the destruction or adverse modification of such species' critical habitat. The Missouri Department of Conservation's Natural Heritage Review queries records for species and natural communities of conservation concern. The results of the Natural Heritage Review of the facility and discharge are currently pending. Once a response is received from the Missouri Department of Conservation, the information will be incorporated into this variance.

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Appendices

Appendix A – Crosswalk Table between City of Joplin Variance CWC-V-1-19 and 40 CFR Section 131.14 (Page 5)

Appendix B – Pollutant Minimization Program (Page 11)

Appendix C – Evaluations Supporting Application for Discharger-Specific Water Quality Standards Variance for Zinc: City of Joplin, Turkey Creek WWTP (Page 14)

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Appendix A – Crosswalk Table between City of Joplin Variance CWC-V-1-19 and 40 CFR Section 131.14

40 CFR 131.14	City of Joplin Variance CWC-V-1-19
131.14 Water quality standards variances. States may adopt WQS variances, as defined in § 131.3(o). Such a WQS variance is subject to the provisions of this section and public participation requirements at § 131.20(b). A WQS variance is a water quality standard subject to EPA review and approval or disapproval.	10 CSR 20-7.031 (12) Water Quality Standards Variances. A permittee or an applicant for a National Pollutant Discharge Elimination System (NPDES) or Missouri state operating permit may pursue a temporary variance pursuant to either section 644.061 or section 644.062, RSMo. A variance from water quality standards shall comply with 40 CFR 131.14.
(a) Applicability	
(1) A WQS variance may be adopted for a permittee(s) or water body/waterbody segment(s), but only applies to the permittee(s) or water body/waterbody segment(s) specified in the WQS variance.	This variance only applies to the Turkey Creek Wastewater Treatment Plant Missouri State Operating Permit #MO-0103349.
(2) Where a State adopts a WQS variance, the State must retain, in its standards, the underlying designated use and criterion addressed by the WQS variance, unless the State adopts and EPA approves a revision to the underlying designated use and criterion consistent with §§ 131.10 and 131.11. All other applicable standards not specifically addressed by the WQS variance remain applicable.	This variance request only varies the underlying WQS used for the development of Turkey Creek TMDL wasteload allocations for total recoverable zinc. All other WQS in 10 CSR 20-7.031 remain in-tact. The underlying aquatic life designated use and associated criterion will remain applicable for all other CWA purposes, and all other uses and associated criteria not specified in this WQS remain applicable for all CWA purposes.
(3) A WQS variance, once adopted by the State and approved by EPA, shall be the applicable standard for purposes of the Act under § 131.21(d) through (e), for the following limited purposes. An approved WQS variance applies for the purposes of developing NPDES permit limits and requirements under 301(b)(1)(C), where appropriate, consistent with paragraph (a)(1) of this section. States and other certifying entities may also use an approved WQS variance when issuing certifications under section 401 of the Act.	This WQS variance will be the applicable water quality standard in effect for the purposes of developing CWA Section 301(b)(1)(C) National Pollutant Discharge Elimination System (NPDES) permit limits. The only permit that will receive this variance is #MO-0049506 for the City of Joplin's Turkey Creek Wastewater Treatment Plant.

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(4) A State may not adopt WQS variances if the designated use and criterion addressed by the WQS variance can be achieved by implementing technology-based effluent limits required under sections 301(b) and 306 of the Act.	Technology-based effluent limits will not impact the TCWWTP's ability to achieve effluent quality where the water quality standards for total recoverable zinc will be met.
(b) Requirements for Submission to EPA	
(1) A WQS variance must include:	
(i) Identification of the pollutant(s) or water quality parameter(s), and the water body/waterbody segment(s) to which the WQS variance applies. Discharger(s) - specific WQS variances must also identify the permittee(s) subject to the WQS variance.	The City of Joplin requests a WQS variance from the total recoverable zinc water quality criteria for the protection of aquatic life use. The variance would apply to the City of Joplin's Turkey Creek Wastewater Treatment Plant #MO-0049506, which discharges to Turkey Creek. Turkey Creek is a class P stream with a water body identification number 3216. Turkey Creek is located in the Turkey Creek watershed, 12-digit Hydrologic Unit Code 11070207-0901.
(ii) The requirements that apply throughout the term of the WQS variance. The requirements shall represent the highest attainable condition of the water body or waterbody segment applicable throughout the term of the WQS variance based on the documentation required in (b)(2) of this section. The requirements shall not result in any lowering of the currently attained ambient water quality, unless a WQS variance is necessary for restoration activities, consistent with paragraph (b)(2)(i)(A)(2) of this section. The State must specify the highest attainable condition of the water body or waterbody segment as a quantifiable expression that is one of the following: (A) For discharger(s)-specific WQS variances: (1) The highest attainable interim criterion; or (2) The interim effluent condition that reflects the greatest pollutant reduction achievable; or (3) If no additional feasible pollutant control technology can be identified,	Implementation of this WQS variance will not result in the lowering of existing water quality. Pursuant to 40 CFR Section 131.14, TCWWTP is required to implement highest attainable conditions (HAC) and a pollution minimization program (PMP) throughout the five-year term of the variance. Because no additional feasible zinc pollution controls could be identified that would routinely meet zinc water quality-based effluent limits, the effluent condition reflecting the greatest pollutant reduction with optimization of installed treatment was used to calculate the following HACs for total recoverable zinc. Zinc HACs were calculated using the TCWWTP's past five years of reported data for total recoverable zinc from effluent samples. The 95th and 99th percentiles were calculated for the monthly average and daily maximum respectively. The City of Joplin must follow the PMP – Zinc Minimization Plan detailed in Appendix B of this document. The Missouri State Operating Permit #MO-0103349 will contain a requirement for the implementation of a

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the interim criterion or interim effluent condition that reflects the greatest pollutant reduction achievable with the pollutant control technologies installed at the time the State adopts the WQS variance, and the adoption and implementation of a Pollutant Minimization Program. (B) For WQS variances applicable to a water body or waterbody segment: (1) The highest attainable interim use and interim criterion; or (2) If no additional feasible pollutant control technology can be identified, the interim use and interim criterion that reflect the greatest pollutant reduction achievable with the pollutant control technologies installed at the time the State adopts the WQS variance, and the adoption and implementation of a Pollutant Minimization Program.	PMP with annual reporting to the Department.
(iii) A statement providing that the requirements of the WQS variance are either the highest attainable condition identified at the time of the adoption of the WQS variance, or the highest attainable condition later identified during any reevaluation consistent with paragraph (b)(1)(v) of this section, whichever is more stringent.	Zinc HACs were calculated using the TCWWTP's past five years of reported data for total recoverable zinc from effluent samples. The 95th and 99th percentiles were calculated for the monthly average and daily maximum respectively. These are the highest attainable conditions that the plant can achieve. The term of this variance does not exceed five years; therefore, a reevaluation is not required.
(iv) The term of the WQS variance, expressed as an interval of time from the date of EPA approval or a specific date. The term of the WQS variance must only be as long as necessary to achieve the highest attainable condition and consistent with the demonstration provided in paragraph (b)(2) of this section. The State may adopt a subsequent WQS variance consistent with this section.	The City of Joplin has requested the term of this variance be five years, which is consistent with the term of Missouri State Operating Permit #MO-0103349 for the TCWWTP.
(v) For a WQS variance with a term greater than five years, a specified frequency to reevaluate the highest	The term of this variance does not exceed five years; therefore, a reevaluation is not required.

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attainable condition using all existing and readily available information and a provision specifying how the State intends to obtain public input on the reevaluation. Such reevaluations must occur no less frequently than every five years after EPA approval of the WQS variance and the results of such reevaluation must be submitted to EPA within 30 days of completion of the reevaluation.	
(vi) A provision that the WQS variance will no longer be the applicable water quality standard for purposes of the Act if the State does not conduct a reevaluation consistent with the frequency specified in the WQS variance or the results are not submitted to EPA as required by (b)(1)(v) of this section.	The term of this variance does not exceed five years; therefore, a reevaluation is not required.
(2) The supporting documentation must include:	
(i) Documentation demonstrating the need for a WQS variance. (A) For a WQS variance to a use specified in section 101(a)(2) of the Act or a sub-category of such a use, the State must demonstrate that attaining the designated use and criterion is not feasible throughout the term of the WQS variance because: (1) One of the factors listed in § 131.10(g) is met, or (2) Actions necessary to facilitate lake, wetland, or stream restoration through dam removal or other significant reconfiguration activities preclude attainment of the designated use and criterion while the actions are being implemented. (B) For a WQS variance to a non-101(a)(2) use, the State must submit documentation justifying how its consideration of the use and value of the water for those uses listed in § 131.10(a) appropriately supports the WQS variance and term. A demonstration consistent with paragraph (b)(2)(i)(A) of this section	The basis for this request is 40 CFR § 131.10(g)(3) Human caused conditions or sources of pollution prevent the attainment of the use and cannot be remedied or would cause more environmental damage to correct than to leave in place. The widespread contamination caused by historic mining activities and associated mine waste disposal within the Tri-State Mining District, and specifically within the Turkey Creek watershed and the City of Joplin, justifies this discharger-specific variance based on this factor. See Appendix C – Evaluations Supporting Application for Discharger-Specific Water Quality Standards Variance for Zinc: City of Joplin, Missouri, Turkey Creek WWTP for supporting information.

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may be used to satisfy this requirement.	
(ii) Documentation demonstrating that the term of the WQS variance is only as long as necessary to achieve the highest attainable condition. Such documentation must justify the term of the WQS variance by describing the pollutant control activities to achieve the highest attainable condition, including those activities identified through a Pollutant Minimization Program, which serve as milestones for the WQS variance.	The City of Joplin must follow the PMP – Zinc Minimization Plan detailed in Appendix B of this document. The PMP establishes milestones over the five-year term of this variance.
(iii) In addition to paragraphs (b)(2)(i) and (ii) of this section, for a WQS variance that applies to a water body or waterbody segment: (A) Identification and documentation of any cost-effective and reasonable best management practices for nonpoint source controls related to the pollutant(s) or water quality parameter(s) and water body or waterbody segment(s) specified in the WQS variance that could be implemented to make progress towards attaining the underlying designated use and criterion. A State must provide public notice and comment for any such documentation. (B) Any subsequent WQS variance for a water body or waterbody segment must include documentation of whether and to what extent best management practices for nonpoint source controls were implemented to address the pollutant(s) or water quality parameter(s) subject to the WQS variance and the water quality progress achieved.	This provision does not apply.
(c) Implementing WQS variances in NPDES permits.	
A WQS variance serves as the applicable water quality standard for implementing NPDES permitting requirements pursuant to § 122.44(d) of this chapter for the term of the	This variance will be used solely to establish effluent limits for total recoverable zinc within Missouri State Operating Permit #MO-0103349. The variance will not be used for

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WQS variance. Any limitations and requirements necessary to implement the WQS variance shall be included as enforceable conditions of the NPDES permit for the permittee(s) subject to the WQS variance.	any other Clean Water Act or Missouri Clean Water Law Purposes.

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Appendix B – Pollutant Minimization Program: Zinc Minimization Plan

City of Joplin, Missouri
Turkey Creek Wastewater Treatment Plant
MSOP MO-0103349

ZINC MINIMIZATION PLAN

DRAFT
June 13, 2019

SECTION I - PURPOSE

The purpose of this Zinc Pollutant Minimization Plan ("PMP") is to describe best management practices through which the City of Joplin, Missouri will seek to reduce the amount of zinc discharged into its municipal wastewater system and, ultimately, to the environment. The PMP compiles zinc reduction-related efforts to-date and potential future action items. It is designed to be a working document to help guide the City in its efforts to control zinc loadings discharged into its Publicly-Owned Treatment Works (POTW) by users of the sewer system. Such a reduction in loadings to the sewer system may translate to a reduction in the amount of zinc which is discharged from the treatment plant.

SECTION II – FACILITY DESCRIPTION

The Turkey Creek Wastewater Treatment Plant is a combined fixed growth and activated sludge type treatment facility located on the northwest side of Joplin. The facility was designed for an average flow of 15 million gallons per day (MGD) and currently discharges approximately 8.6 MGD. Treatment consists of influent screening, grit removal, primary clarification, trickling filter biotowers, intermediate clarification, oxidation ditch aeration basins, final clarification, tertiary membrane filtration, ultraviolet disinfection, and step aeration prior to discharge to Turkey Creek. While the WWTP removes considerable amounts of zinc, the facility is unable to meet the effluent limitations due to high influent loadings.

Zinc is not used in the treatment processes at the WWTP. Zinc may be introduced into the sewer system through a variety of sources, such as from industrial users and past mining practices. The zinc loadings to the WWTP are primarily from legacy mining sources, and the City is seeking a water quality standards variance for zinc.

SECTION III – PROGRAM PLAN

A. EVALUATION OF POTENTIAL NON-DOMESTIC SOURCES CONTRIBUTING ZINC TO THE POTW

Within four years of approval of the zinc variance, the City will evaluate available information to assess the potential for non-domestic users of the sewer system to contribute zinc to the system. The information to be reviewed may include: (1) POTW influent and effluent zinc data and trends; (2) industrial user permits and associated zinc monitoring data; (3) Toxics Release Inventory (TRI); (4) data and documents pertaining to the Oronogo-Duenweg Mining Belt Superfund site, which was listed on the National Priorities List in 1990; and (5) monitoring data collected as part of the City's targeted inflow and infiltration (I&I) reduction program.

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Within six months of approval of the variance, the City will develop a detailed monitoring plan to regularly monitor specific locations within the sewer system, to identify contributions of zinc from various sources. The City intends to conduct this monitoring program over the course of two to three years, including regular seasonal monitoring and additional targeted monitoring under wet weather conditions.

The City will continue to require monitoring for significant industrial users, and will conduct strategic sampling on a semi-annual basis to identify potential zinc sources. After two to three years of data collection, the data from both the City's monitoring program and any monitoring required of industrial permittees will be summarized to evaluate patterns and trends, and identify significant sources of zinc.

The City's ongoing efforts to reduce I&I have identified catchments contributing elevated zinc to the sewer system. This information will be used to assess zinc contributions and prioritize areas for potential sewer system renewal.

Based on the information collected, potential sources of zinc will be assessed. The evaluation of potential non-domestic sources of zinc to the sewer system will be updated every five years, as warranted by prior sampling results and any additional new potentially significant sources to the system.

B. ADDITIONAL CONTROL MEASURES

This PMP identifies reasonable and cost-effective control measures to minimize zinc being discharged into the POTW. Below is a listing of initial BMPs for this POTW.

Industrial Users

Should monitoring data identify significant contributions of zinc from an industrial user, City staff will meet with the user and evaluate zinc loadings from the facility. The industry will be asked to incorporate best management practices to minimize zinc discharges. The City will continue diligent enforcement of industrial pretreatment program permits and policies.

Inflow & Infiltration

The City is committed to an I&I program that will minimize entry of zinc-containing infiltration, and will continue to invest in collection system rehabilitation projects in accordance with the 2026 plan. The plan will be revisited and refined following evaluation of progress.

Pollution Prevention

Substances used at the WWTP will be evaluated to determine if they contain zinc or zinc-based compounds. Any such chemicals will be evaluated for substitution with non-zinc-containing substances.

Housekeeping, Spill Control and Collection, and Education

The City will develop procedures to minimize the possibility of any spill or release at the WWTP involving zinc containing substances.

Public Outreach

The City does not plan on doing any public outreach at this time, because household sources are not typically a significant source of excess zinc.

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C. TRACKING AND MONITORING

In order to assess the implementation of the control measures, the City proposes to undertake the following evaluations beginning after the first full year that this PMP is implemented:

1. Survey annually at least ten percent (10%) of any non-domestic users identified as possible significant sources of zinc to the POTW;
2. Track the implementation of the programs outlined above;
3. Monitor influent zinc weekly. Require significant non-domestic sources of zinc to monitor periodically, as warranted; and
4. Measure effluent zinc as required by the NPDES permit.

These efforts will allow the City to establish a baseline of influent and effluent zinc levels to assist in identifying any trends in zinc contributions from domestic and non-domestic users of the sewer system. This baseline will be tracked annually.

SECTION IV - IMPLEMENTATION OF CONTROL MEASURES

The City has already undertaken zinc control efforts through its industrial pretreatment program and I&I reduction efforts. In addition, the City requires removal of metals-contaminated soils as part of its construction contracting process, which further reduces zinc loads to the WWTP. These efforts will continue.

The City will implement the control measures summarized in Section III over the permit term and will update this PMP as warranted.

SECTION V - REPORTING

A summary of the PMP activities will be submitted to MDNR by December 31, 2023. Subsequent reports, as appropriate, will be submitted as part of the NPDES permit renewal process.

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Appendix C - Evaluations Supporting Application for Discharger-Specific Water Quality Standards Variance for Zinc: City of Joplin, Turkey Creek WWTP

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Evaluations Supporting Application for Discharger-Specific Water Quality Standards Variance for Zinc:

City of Joplin, Missouri Turkey Creek WWTP

Prepared for:
City of Joplin

May 1, 2019

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Water Environment | Scientists Engineers

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Evaluations Supporting Application for Discharger-Specific Water Quality Standards Variance for Zinc:

City of Joplin, Missouri
Turkey Creek WWTP

Prepared for:
City of Joplin, Missouri

Under Contract to:
Burns & McDonnell Engineering

May 1, 2019

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TABLE OF CONTENTS

1 Introduction 1
1.1 Turkey Creek WWTP 1
1.2 Turkey Creek Watershed 1
1.3 Regulatory Background 2
1.4 Basis for Variance 3
2 Are the sources of pollution human caused? 5
2.1 History of the Watershed 5
2.1.1 CERCLA Information 5
2.2 Sources of Contamination 7
2.3 Conclusion 8
3 Is attainment of the use prevented? 9
3.1 Applicable Water Quality Criteria 9
3.2 Attainment of Criteria in Turkey Creek 9
3.3 Conclusion 11
4 Can the human caused condition be remedied during the term of the variance? 13
4.1 Turkey Creek WWTP Performance 13
4.2 Treatment Alternatives 15
4.3 Industrial Contributions 16
4.4 Inflow and Infiltration 16
4.5 Remediation Efforts 17
4.6 Conclusion 18
5 Conclusions 19
6 References 21
Attachment 1. TCWWTP Process Diagrams
Attachment 2. Instream Zinc Concentrations
Attachment 3. Influent & Effluent Zinc Data
Attachment 4. Treatment Cost Information
Attachment 5. I&I Program Summary
Attachment 6. USGS Data

LIST OF FIGURES

Figure 1-1. Turkey Creek Watershed 2
Figure 2-1. Historic Mining Contamination within the Joplin Area 7
Figure 3-1. Dissolved Zinc Concentrations in Turkey Creek Upstream and Downstream of the WWTP Discharge, 2012-2018 10
Figure 3-2. Zinc Concentrations (µg/L) Upstream of Turkey Creek WWTP 11
Figure 4-1. Turkey Creek WWTP monthly average zinc concentrations, 2007-2018 13
Figure 4-2. Comparison of TCWWTP monthly average effluent concentrations to anticipated zinc limits 14
Figure 4-3. Removal efficiency vs. influent zinc concentrations at the TCWWTP 15
Figure 4-4. Dissolved zinc concentrations in Turkey Creek Downstream of TCWWTP, 2007-2018 17

LIST OF TABLES

Table 1. Water quality criteria for dissolved zinc 9
Table 2. Median Zinc Concentrations in Turkey Creek (2011-2018) 9
Table 3. Zinc removal efficiencies at POTWs 14
Table 4. Relative Rankings of Zinc Concentrations and Inflow/Infiltration among 51 Catchments 16

1 Introduction

The City of Joplin and Missouri Department of Natural Resources (MDNR) have been in the process of renewing the National Pollution Discharge Elimination System / Missouri State Operating Permit (NPDES/MSOP) permit for the Turkey Creek Wastewater Treatment Plant (TCWWTP). The current permit expired in 2012, but has been administratively continued during the renewal process. Difficulties in developing appropriate and achievable metals limits are the primary reason for the delay in renewing the MSOP. The permit includes water quality-based effluent limitations (WQBELs) for zinc that have been difficult for the facility to consistently meet due to the ubiquitous presence of zinc throughout the Joplin area from past mining practices. The MDNR has developed the WQBELs to meet State water quality standards for aquatic life uses. The limits are, however, much lower than existing upstream background concentrations in Turkey Creek. Upstream zinc concentrations consistently exceed concentrations below the TCWWTP discharge. Turkey Creek zinc concentrations routinely exceed the state water quality standards, due to human-caused conditions from past mining practices. The City of Joplin is therefore applying for a discharger-specific water quality standards variance for zinc in the TCWWTP MSOP, based on 40 CFR 131.10(g) Factor 3 (human-caused conditions). A discharger-specific variance is a temporary form of regulatory relief in comparison to a more permanent Use Attainability Analysis, which could also be an appropriate approach under the circumstances.

1.1 Turkey Creek WWTP

The Turkey Creek Wastewater Treatment Plant is a combined fixed growth and activated sludge type treatment facility located on the northwest side of Joplin (Figure 2-1). The facility was designed for an average flow of 15 million gallons per day (MGD) and currently discharges approximately 8.6 MGD. Treatment consists of influent screening, grit removal, primary clarification, trickling filter biotowers, intermediate clarification, oxidation ditch aeration basins, final clarification, tertiary membrane filtration, ultraviolet disinfection, and step aeration prior to discharge to Turkey Creek. Drawings of the WWTP are provided in Attachment 1. Discharges to Turkey Creek are permitted by MSOP MO-0103349.

1.2 Turkey Creek Watershed

Turkey Creek originates east of the City of Joplin and flows in a northwesterly direction to its confluence with the Spring River in Kansas (Figure 2-1). Turkey Creek (Water Body ID 3216) is a Class P stream in Missouri's Water Quality Standards Regulation and has designated uses for the protection of warmwater aquatic habitat, human health protection, irrigation, livestock and wildlife watering, whole body contact recreation, and secondary contact recreation (fishing, wading, boating). Turkey Creek is located in the Spring River 8-digit hydrologic unit. Turkey Creek and its tributaries are impaired due to exceedances of state water quality criteria to protect aquatic life designated uses; Turkey Creek is listed on Missouri's 2016 Section 303(d) list of impaired waters due to metals (including zinc) from the Tri-State Mining District.

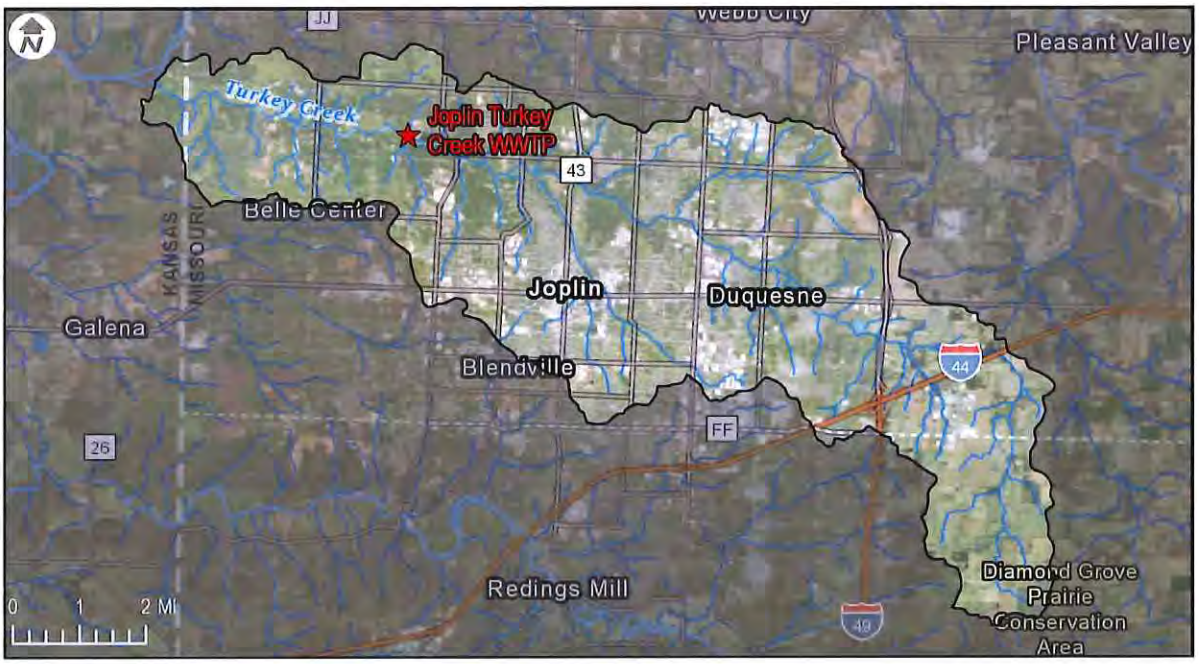

Figure 1-1. Turkey Creek Watershed

1.3 Regulatory Background

A discharger-specific water quality variance is a time-limited water quality criterion change for a specific pollutant, allowing the City of Joplin relief from meeting the zinc WQBEL. Federal and state regulations allow the flexibility to adopt a variance based upon one of the six use attainability factors outlined in 40 CFR §131.10(g). A variance serves as the applicable water quality standard for the permit, and only applies to the permittee (in this case, the City of Joplin) specified in the variance. Federal regulations require that where a state adopts a water quality standards variance, the state must retain the underlying designated use and criterion addressed by the variance; all other applicable standards not specifically addressed by the variance remain in effect.

The six use attainability factors (40 CFR §131.10(g)) that may be used to justify a variance include:

1. Naturally occurring pollutant concentrations prevent the attainment of the use; or
2. Natural, ephemeral, intermittent or low flow conditions or water levels prevent the attainment of the use, unless these conditions may be compensated for by the discharge of sufficient volume of effluent discharges without violating State water conservation requirements to enable uses to be met; or
3. Human caused conditions or sources of pollution prevent the attainment of the use and cannot be remedied or would cause more environmental damage to correct than to leave in place; or
4. Dams, diversions or other types of hydrologic modifications preclude the attainment of the use, and it is not feasible to restore the water body to its original condition or to operate such modification in a way that would result in the attainment of the use; or
5. Physical conditions related to the natural features of the water body, such as the lack of a proper substrate, cover, flow, depth, pools, riffles, and the like, unrelated to water quality, preclude attainment of aquatic life protection uses; or

6. Controls more stringent than those required by sections 301(b) and 306 of the Clean Water Act would result in substantial and widespread economic and social impact.

In this case, the proposed variance is based on Factor 3 (Human caused conditions or sources of pollution prevent the attainment of the use and cannot be remedied or would cause more environmental damage to correct than to leave in place).

1.4 Basis for Variance

The widespread contamination caused by historic mining activities and associated mine waste disposal within the Tri-State Mining District, and specifically within the Turkey Creek watershed and City of Joplin, justifies a discharger-specific variance based on Factor 3, human caused conditions or sources of pollution prevent the attainment of the use and cannot be remedied or would cause more environmental damage to correct than to leave in place. The following sections of this report address specific parts of Factor 3 to support the variance request:

- Is the source of pollution human-caused?
- Is attainment of the use prevented?
- Can the human-caused condition be remedied?

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2 Are the sources of pollution human caused?

The first determination to be made is whether the sources of zinc are human-caused. This section describes the history of the watershed and human activities that have led to the zinc contamination in Turkey Creek.

2.1 History of the Watershed

Joplin is located in the Tri-State Mining District (TSMD), which spans portions of Kansas, Missouri, and Oklahoma. The Missouri portion includes Barry, Christian, Greene, Lawrence, Jasper, and Newton Counties. Commercial mining began in this area in the mid-1800s and continued until the 1970s (EPA, 2003). Commercial smelters were used in all three states. At first, lead was of primary interest; however, the ore was rich in zinc deposits and zinc production became increasingly important over time. The TSMD was historically the top producer of zinc within the United States (USFWS, 2018). As a result of the mining and related activities, large amounts of metals, including cadmium, lead, and zinc, were released into the environment.

Due to the widespread metals contamination, several parts of the TSMD are listed on the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) National Priority List ("Superfund"). The Joplin area is included in the Oronogo-Duenweg Mining Belt Superfund site, which was listed on the National Priorities List in 1990. Approximately 11,000 acres were contaminated with surface mining wastes; over 10 million tons of waste remain on the site (EPA, 2017). Leachate and runoff from the waste piles entered groundwater and surface streams, and sampling showed that soil, groundwater, and surface water were all contaminated with metals, including zinc, from the mining and smelting activities (EPA, 2003).

2.1.1 CERCLA Information

EPA's CERCLA documents provide additional information about the history of the contamination (EPA, 2013):

> *The Oronogo-Duenweg Mining Belt Superfund Site is located in Jasper County and portions of Newton County, Missouri. The Site is a concern because of mining wastes on the surface which constitute a significant source of heavy metals contamination with potential for exposure to people and environmental receptors. Past mining and milling practices resulted in the contamination of surface soil, sediments, surface water, and groundwater in the shallow aquifer with heavy metals, primarily lead, cadmium and zinc. The Site includes the mining wastes in and around 11 former mining areas, or designated areas (DAs), located within about 270 square miles of Jasper and Newton counties. The DAs include Snap, Neck/Alba, Thorns, Joplin, Oronogo/Duenweg, Carl Junction, Klondike, Iron Gates, Iron Gates Extension, Belleville, and Waco....*
>
> *Historically, approximately 160 million short tons of crude ore were mined in the DAs of which approximately 5 percent was recovered as zinc/lead concentrates, leaving an estimated 150 million short tons of discarded mill waste on the surface. Approximately 90 percent of this material has since been removed for various commercial purposes. During the early years of mining, lead concentrates were smelted in a large number of crude log furnaces. Advances in smelter technology and increasing specialization by operators led to Centralization, and by 1873 there were only 17 lead smelters in the Joplin area. By 1894, the number had decreased to three, and was down to one by the 1920s. Most zinc concentrates were shipped to smelters located*

outside the district in areas where fossil fuel was abundant, as the smelting of zinc required considerably more heat than lead.

The EPA listed the Site on the National Priorities List (NPL) in 1990. The NPL is a national list of Superfund sites that prioritizes cleanups in order of the most serious contamination problems and greatest threats to human health and the environment. After listing, the EPA divided the Site into four Operable Units (OUs) for cleanup activities because of the multimedia nature of contamination. The OUs include OU-1, Mining and Milling Waste; OU-2, Smelter Waste Residential Yards; OU-3, Mine Waste Residential Yards; and OU-4, Groundwater. The 2004 ROD and this proposed ROD Amendment address OU-1 and include those areas in and around the DAs where mining, milling and smelter wastes are located.

A site-wide investigation was initiated in 1991, collecting data primarily on mined materials, soils, surface water, groundwater, terrestrial and aquatic biota, land use and demography, air quality, and human food sources. The results of this sampling program were presented in the Remedial Investigation Report (RI) completed in 1995, and document significant contamination levels in soil, surface water and groundwater, as well as in mining wastes themselves. Contamination levels were found in all media at levels presenting an unacceptable risk to human health and environmental receptors. A detailed discussion of the site characteristics, nature of the contamination, and risk to people and the environment are found in the Administrative Record.

A Feasibility Study (FS) was completed in 2003. The FS combined the information about the nature and extent of contamination in and around the DAs described in the RI with the investigations characterizing and evaluating the DAs, and developed alternatives for remedial action for the entire Site. Additional studies were conducted by the EPA, MDNR, and the Potentially Responsible Parties (PRPs) to assist in developing and supporting the remedial alternatives in the FS.

The EPA issued the OU-1 Proposed Plan for public comment in July 2004, and completed the OU-1 ROD in September 2004, after holding a public meeting and receiving and addressing public comments on the Proposed Plan. The cleanup of mining and milling wastes under the ROD is necessary to mitigate the principal threat for OU-1, which is the risk to aquatic and terrestrial ecosystems from exposure to mill wastes, soils, sediments, surface water and groundwater. The main component of the remedy includes excavating and disposing of source materials in selected on-site mine subsidence pits suitable from an engineering perspective for subaqueous disposal. This same remedial component, excavation/disposal, is essential to provide long-term protection of human health from exposure to the mine and mill wastes.

The Oronogo-Duenweg Mining Belt Superfund site encompasses approximately 20 square miles near Joplin. Much of the land in the City has been affected by mining waste and historical smelting activities. Figure 2-1 shows the areas in and around Joplin and the Turkey Creek watershed that have been contaminated by historic mine waste and smelting activities. The figure also shows the Turkey Creek watershed and location of the TCWWTP. From this figure, it is clear that there are large areas of contamination within the Turkey Creek watershed. Further, Turkey Creek upstream of the TCWWTP is impaired by high metals concentrations (MDNR, 2018). The most recent five-year CERCLA review report (EPA, 2017) indicated that completion of the remedy for OU-1 (the mining and milling waste) is expected to take an additional three to five years.

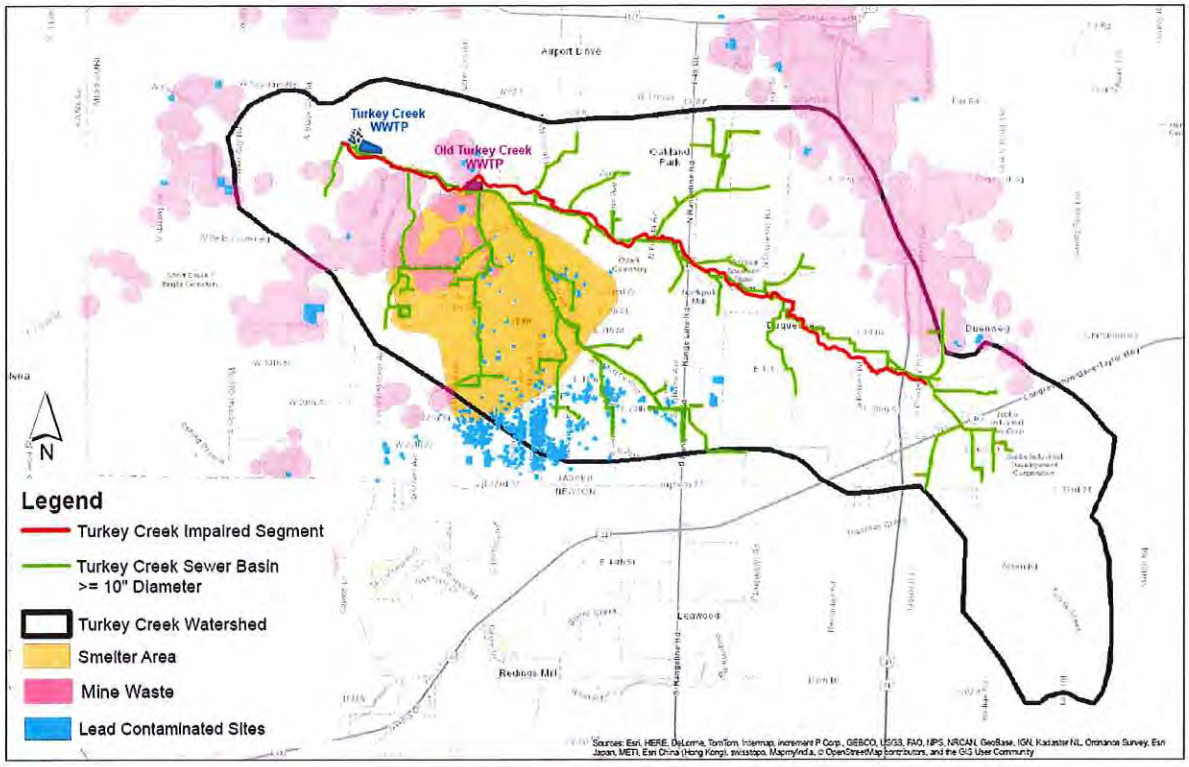

Figure 2-1. Historic Mining Contamination within the Joplin Area

2.2 Sources of Contamination

As noted above, soil and groundwater throughout the TSMD is contaminated by metals, including zinc. As described by the Interstate Technology & Regulatory Council (ITRC):

> *In general, the primary sources of contamination are the residual metal sulfides in the abandoned mine workings, chat piles, and tailing impoundments as well as historical impacts from smelting operations. Upon atmospheric exposure, metal sulfides can become oxidized and mobilize as dissolved metal compounds. These mobilized compounds create mining-influenced water that can further leach metals from bedrock, allowing high concentrations of dissolved metals to migrate into groundwater or run off into surface waters.*
>
> *Mining activities were often conducted below the water table. Groundwater was continually pumped out of this shallow aquifer to enable mining activities to take place. When operations ceased however, pumping ceased and mine shafts refilled by natural recharge. Heavy metals including lead, cadmium, and zinc leached out of the oxidized mine waste and have contaminated shallow groundwater.* (ITRC, 2017)

In addition to direct contamination of soil, groundwater, and surface water by the mine wastes, the TSMD has a long history of using mine tailings, or "chat," for a variety of purposes, including in asphalt and cement (ITRC, 2017). Within the City of Joplin, chat was historically used as bedding and backfill for sewer lines, as well as for storm sewers, house foundations, street construction, and gas lines (Burns & McDonnell, 2017). The ubiquitous use of chat throughout the watershed contributes to the high concentrations of zinc in Turkey Creek.

2.3 Conclusion

Historic mining activities and waste disposal practices have led to widespread contamination throughout the Turkey Creek watershed. The inability of Turkey Creek to attain water quality standards is therefore human-caused.

3 Is attainment of the use prevented?

The second determination to be made in evaluating Factor 3 is whether conditions in Turkey Creek prevent the attainment of the existing statewide water quality criteria. As described below, zinc concentrations in Turkey Creek upstream of the TCWWTP consistently exceed both acute and chronic water quality criteria.

3.1 Applicable Water Quality Criteria

Missouri's water quality standards specify both acute and chronic criteria for zinc that are hardness-dependent. In the most recent proposed draft permit, MDNR used a hardness of 200 mg/l to calculate the criterial. Based on a hardness of 200 mg/l, the statewide water quality criteria for dissolved zinc are shown in Table 1.

Table 1. Water quality criteria for dissolved zinc

	Acute criterion (µg/L)	Chronic criterion (µg/L)
Dissolved Zinc	211	211

Note that for zinc, the acute and chronic water quality criteria are the same. The evaluations described in this section of the report therefore address both acute and chronic criteria.

3.2 Attainment of Criteria in Turkey Creek

The City measures dissolved zinc both upstream and downstream of the TCWWTP discharge on a quarterly basis, dating back to 2011 (data provided in Attachment 2). Concentrations upstream of the discharge consistently exceed water quality criteria (Figure 3-1, Table 2). Downstream concentrations are considerably lower than upstream concentrations due to the TCWWTP discharge, which lowers instream concentrations, but downstream levels still usually exceed the zinc criteria. In-stream zinc concentrations are almost always higher upstream of the TCWWTP discharge point, compared to downstream (again, due to the beneficial impact of the TCWWTP discharge).

Table 2. Median Zinc Concentrations in Turkey Creek (2011-2018)

	Median Concentration Upstream of WWTP (µg/L)	Median Concentration Downstream of WWTP (µg/L)	Water Quality Criterion
Dissolved Zinc	540	310	211

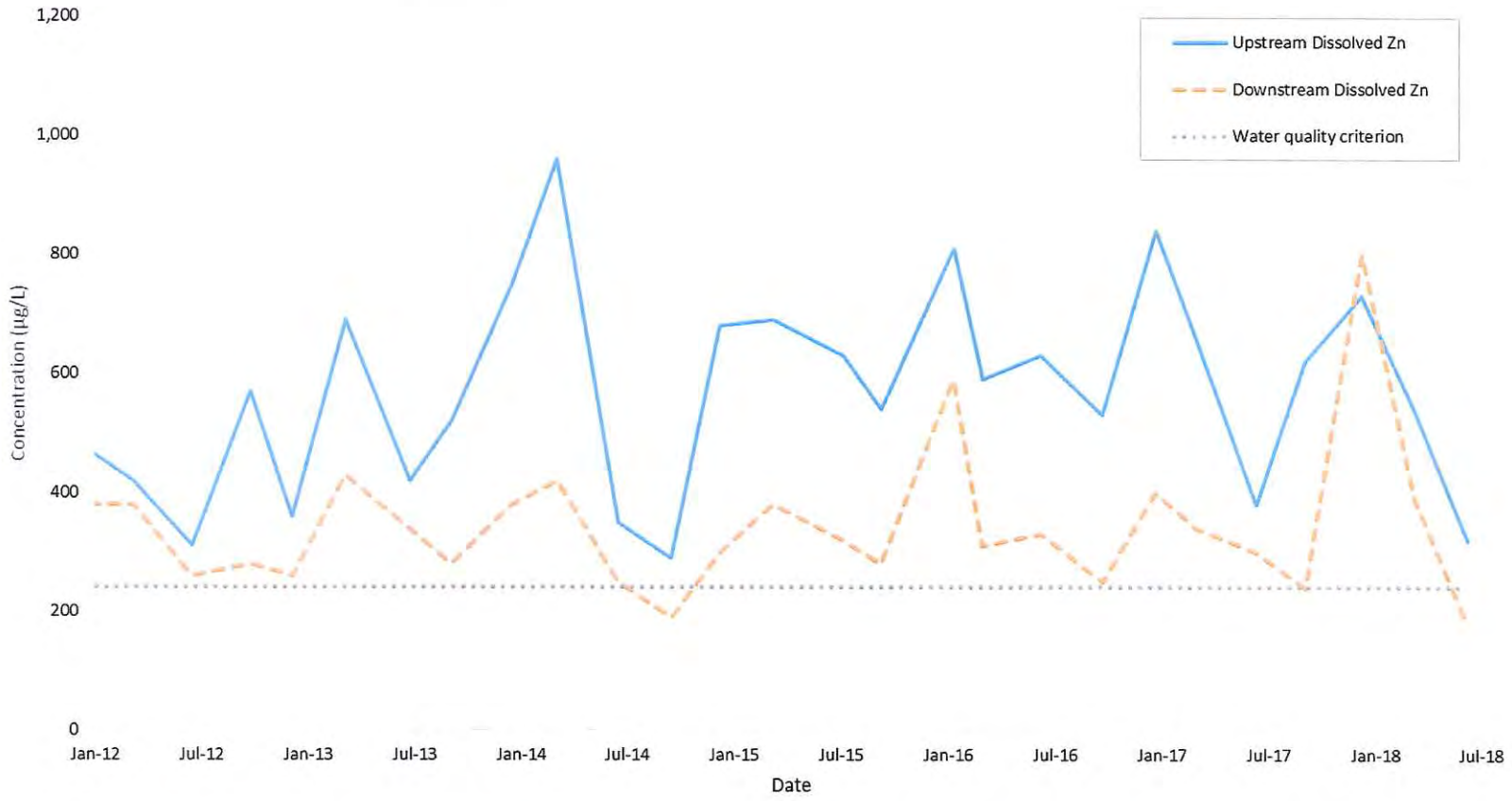

Figure 3-1. Dissolved Zinc Concentrations in Turkey Creek Upstream and Downstream of the WWTP Discharge, 2012-2018

The data show no discernable temporal trend to suggest that the upstream concentrations are improving. Rather, a linear model of concentration and time suggests that the concentrations upstream are increasing (Figure 3-2). Therefore, criteria will not be attained in the foreseeable future without a significant change to the system.

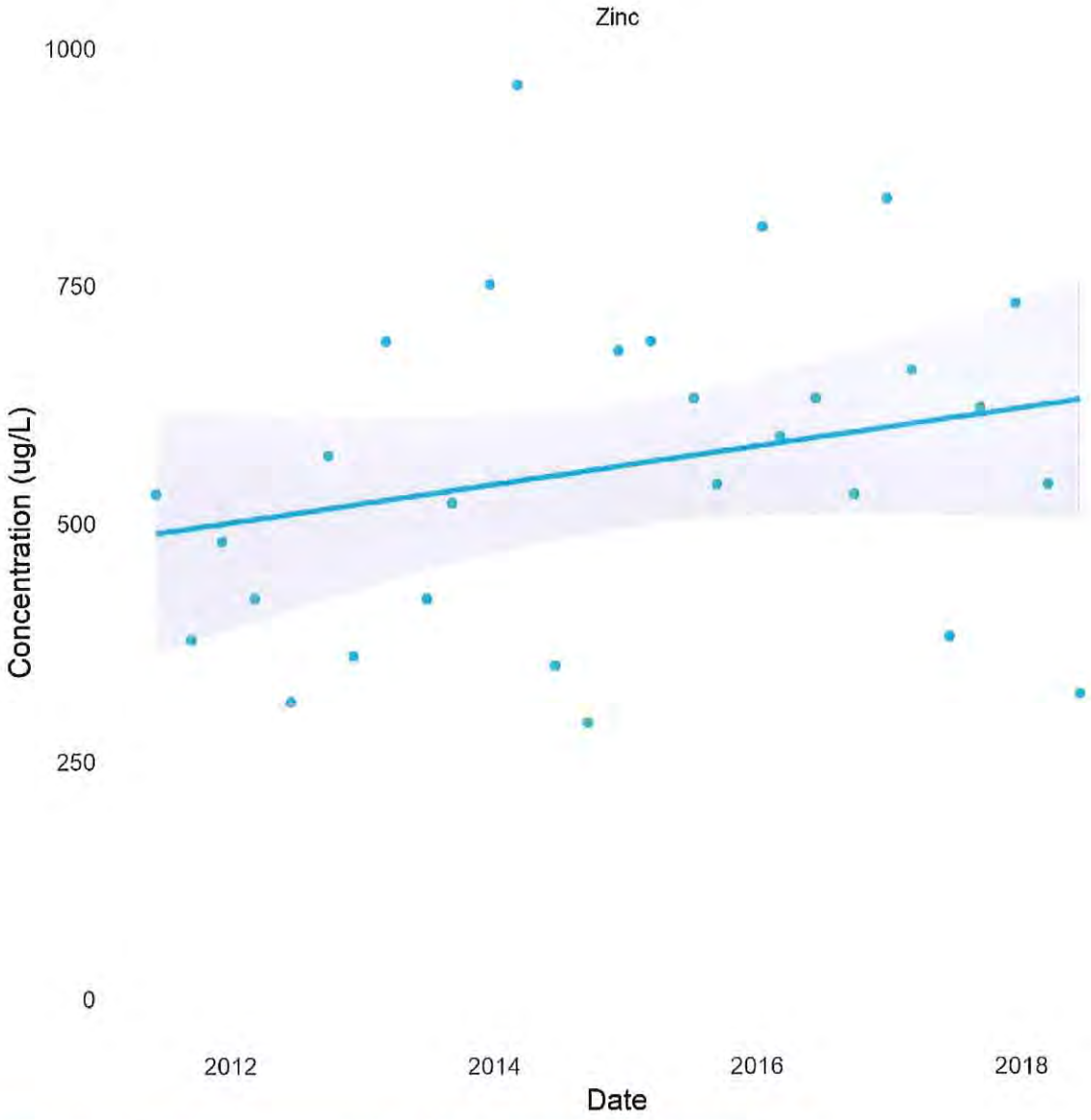

Figure 3-2. Zinc Concentrations (µg/L) Upstream of Turkey Creek WWTP

3.3 Conclusion

Based on the above information, the statewide water quality criteria for zinc are not being attained in Turkey Creek, and are not anticipated to be attained within the term of the proposed variance. Upstream zinc concentrations are much higher than the criteria. In fact, the TCWWTP consistently produces effluent with much lower zinc levels than those upstream of the discharge, and is the reason downstream concentrations are routinely below upstream levels.

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4 Can the human caused condition be remedied during the term of the variance?

The final question to be addressed with regard to Factor 3 is whether the human-caused conditions can be remedied during the term of the variance. The term of the variance would be five years, consistent with the term of the TCWWTP MSOP. It could be renewed, as appropriate, for future permit terms based upon a showing that the factors addressed in this report have not changed. This section of the report discusses TCWWTP performance, treatment alternatives, and remediation activities.

4.1 Turkey Creek WWTP Performance

The median TCWWTP effluent zinc concentration (2007-2018; data provided in Attachment 3) was 120 µg/L. The facility's existing MSOP includes a monthly average limit of 110 µg/L. The facility is unable to meet this limit, with 61% of the monthly average concentrations (2007-2018) exceeding the limit (Figure 4-1). While the TCWWTP removes considerable amounts of zinc, as discussed below, the facility is unable to meet the effluent limitations due to the high influent loadings. Nevertheless, the plant effluent quality is routinely below background levels in Turkey Creek, resulting in lower concentrations downstream.

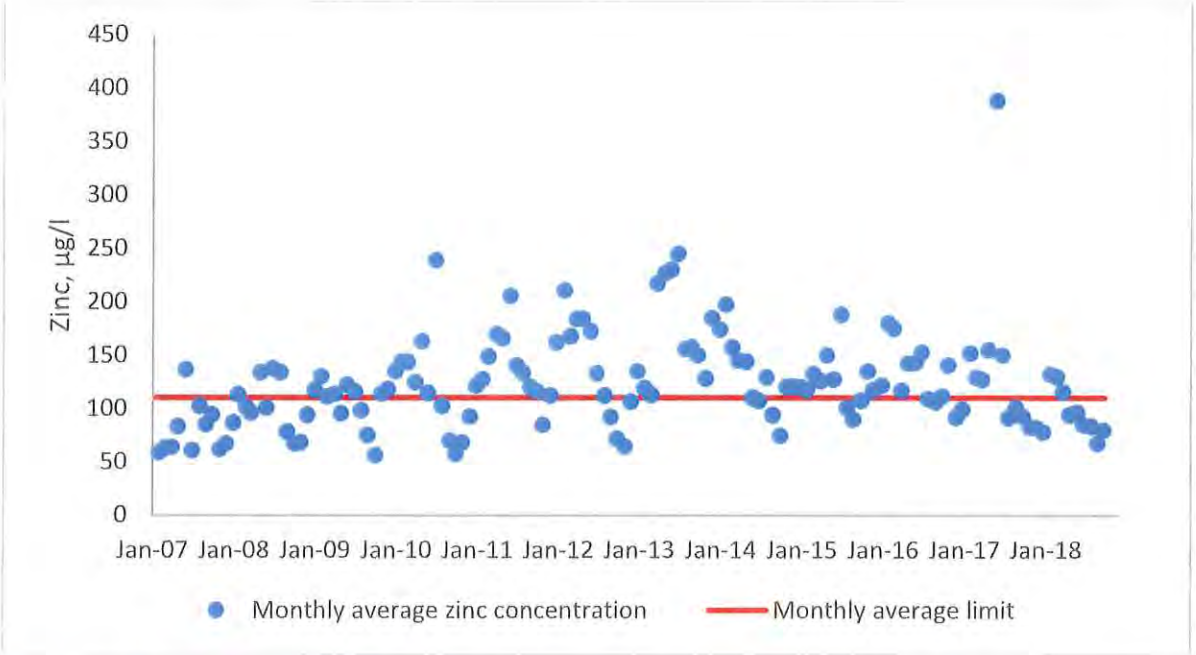

Figure 4-1. Turkey Creek WWTP monthly average zinc concentrations, 2007-2018

MDNR provided the City with a preliminary draft MSOP in 2017 that included revised zinc limits (daily maximum 216 µg/L, monthly average 137.5 µg/L). Recent changes to the Missouri water quality standards provide for use of the median hardness in calculating metals criteria; MDNR is awaiting formal approval of these changes from the U.S. EPA. Calculations indicate that using the median hardness from the USGS station on Turkey Creek near Joplin (237 mg/L) would increase the TCWWTP zinc limits, to a daily maximum of 249 µg/L and a monthly average of 159 µg/L. As shown in Figure 4-2, the facility would not be able to consistently meet even these higher zinc limitations.

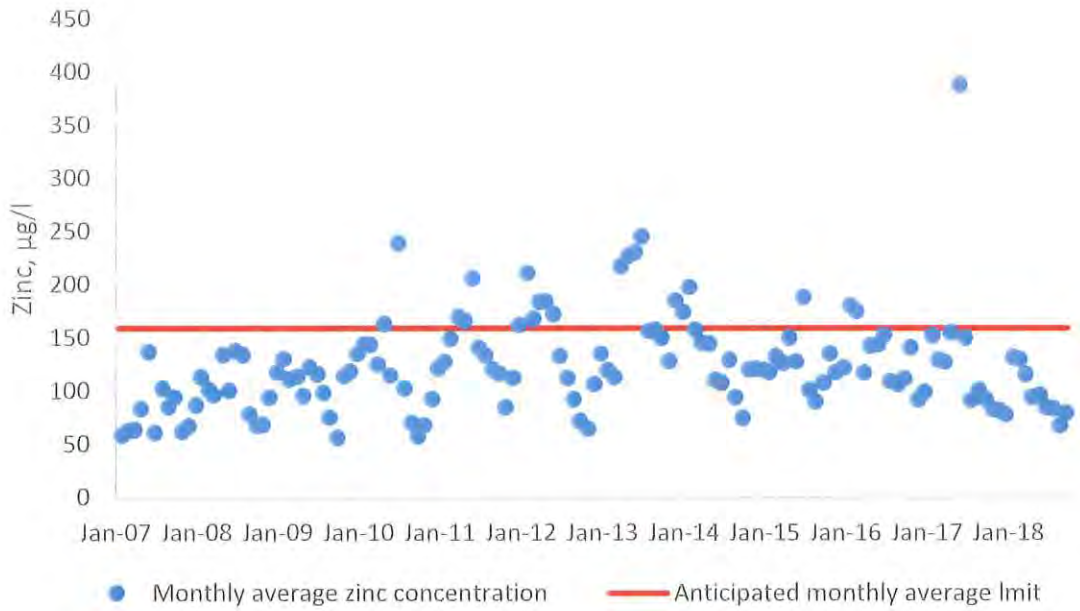

Figure 4-2. Comparison of TCWWTP monthly average effluent concentrations to anticipated zinc limits

The facility's inability to attain WQBELs for zinc is not, however, due to deficiencies at the facility. An evaluation of treatment facility performance indicates that median WWTP removal efficiency is approximately 68% for zinc, with a typical (quartile) range of 58-76%. This is consistent with removals at similar facilities, as shown in Table 3. Evaluation of influent data indicates that removal of more than 90% of influent zinc would be needed to consistently meet the WQBELs in the existing permit, and removal of greater than 80% of influent zinc would be required to attain the anticipated zinc limits in the renewed permit. While the TCWWTP often attains this level of efficiency, it is not a realistic goal for day to day operation of the existing treatment system.

Table 3. Zinc removal efficiencies at POTWs

Type of Facility	Median Removal Efficiency	Efficiency Range	Source
Joplin TCWWTP	68%	23-96%	2005-2018 data
Trickling filter plants	67%	14-90%	U.S. EPA, 2004
Tertiary treatment plants	78%	1-90%	U.S. EPA, 2004

A comparison of zinc removal efficiency with influent concentrations (Figure 4-3) indicates greater removal at higher influent concentrations. This is important from a water quality and compliance standout; the more zinc in the influent, the greater the removal required to achieve limits. The facility typically attains a removal efficiency greater than 60%; Figure 4-3 demonstrates that sampling dates having low zinc removal efficiencies almost always corresponded to days with low influent zinc concentrations. The data indicate that there were only six instances between 2005 and 2018 in which zinc removal was less than 50% and the facility did not meet the existing maximum daily effluent limitation (note also that three of those six instances occurred during May 2017, a particularly wet month in which the TCWWTP experienced significant operational challenges). These data confirm that the TCWWTP is operated appropriately with regard to removing the influent zinc.

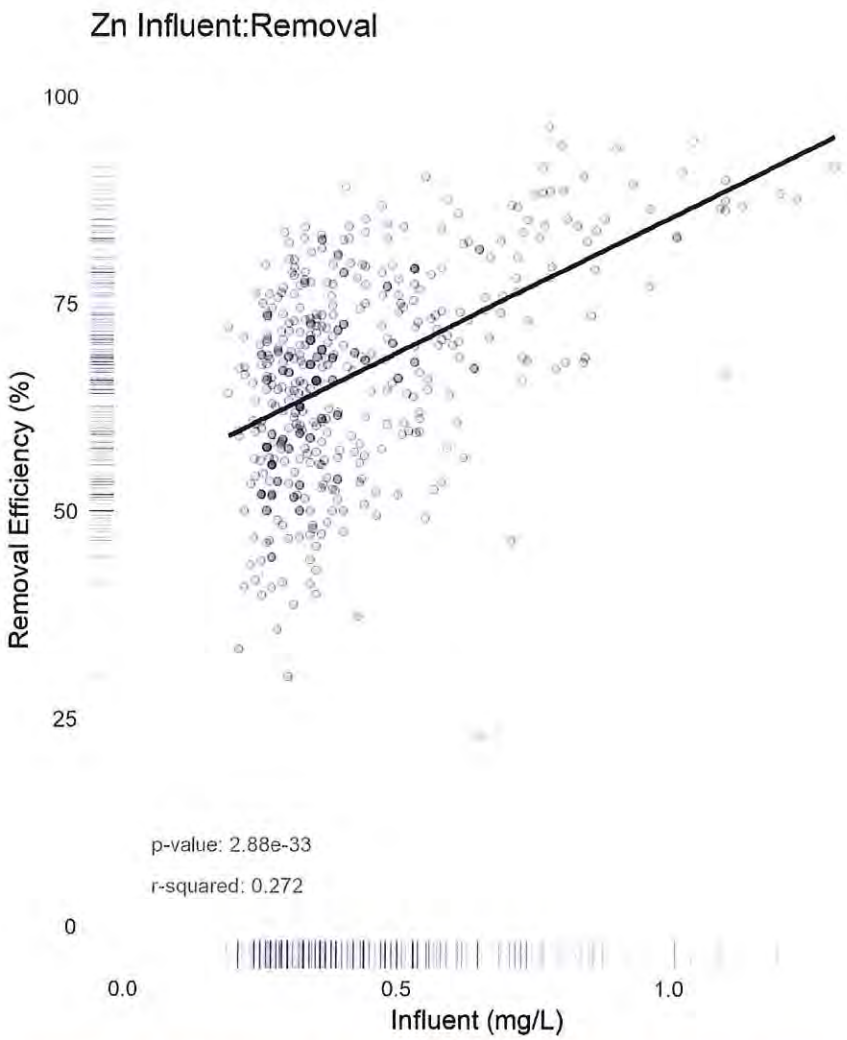

Figure 4-3. Removal efficiency vs. influent zinc concentrations at the TCWWTP

Overall, the TCWWTP monitoring data confirm that the TCWWTP is operated appropriately and consistent with industry standards for metals removal at municipal wastewater treatment facilities; however, the existing treatment technology at the facility cannot consistently meet the WQBELs.

4.2 Treatment Alternatives

Based on experience with facilities designed to remove metals, the City's engineering consultant, Burns & McDonnell performed an evaluation to identify the effectiveness and range of anticipated cost for a zinc-related treatment upgrade for the TCWWTP (Attachment 4). Facilities evaluated for metals reduction included (1) anaerobic biological treatment, (2) membrane bioreactor followed by ion exchange, (3) precipitation and gravity settling, and (4) wetlands. The capital costs for these facilities were extrapolated to account for scale up to a 15 MGD municipal wastewater treatment facility. Extrapolated costs ranged from nearly $50M to over $200M in initial capital costs. Life cycle costs would be substantially higher.

Further, even if the TCWWTP were able to consistently attain greater than 90% removal of influent zinc, the existing upstream zinc concentrations would remain and water quality criteria would still not be attained in Turkey Creek.

4.3 Industrial Contributions

Some municipal WWTPs have significant contributions of metals from wastewater discharges from industrial users. Data from Joplin's industrial pretreatment program were evaluated to assess the zinc contributions from industrial users. Monitoring data for five significant industrial users that monitor zinc (Commercial Metals, Eagle-Picher Couples, Lozier Corporation, Mid America Precision Products, and Modine Manufacturing) indicate that contributions to influent zinc are very low. In 2017, the average load from these industries combined represented only 0.11% of the total influent zinc load to the TCWWTP, while in 2018, the load contributed by these industries was only 0.02% of the total influent load. This evaluation confirms that industrial contributions are an inconsequential source of zinc at the TCWWTP, and do not affect compliance with TCWWTP's WQBELs, nor attainment of water quality criteria in Turkey Creek.

4.4 Inflow and Infiltration

The City has made efforts in recent years to reduce inflow and infiltration (I&I) in the wastewater collection system through a sewer rehabilitation program (Burns & McDonnell, 2017; Attachment 5). As part of a targeted I&I reduction program, the City conducted flow and metals monitoring in 2017. This information was used to identify areas of high I&I and high metals contributions to the sewer system. Initially, it was thought that a direct correlation would be found between I&I and metals concentrations, and that these findings would be used to develop and implement an overall I&I reduction program that would also reduce metals loadings. However, the findings of the investigation determined that there was no consistent relationship between high I&I areas and high zinc levels. Table 4 compares the rankings of the catchments having the five highest zinc concentrations with the rankings of the same catchments in terms of inflow and infiltration (rankings are based on a total of 51 catchments). The areas having the highest zinc concentrations were not necessarily the areas having the highest I&I.

Table 4. Relative Rankings of Zinc Concentrations and Inflow/Infiltration among 51 Catchments

Meter Catchment	Zinc Concentration (µg/L)		Zinc Rank	Rankings of I&I Volumes		
	Maximum	Average		Total I&I	Inflow Only	Infiltration Only
N10-10	84,000	8,248	1	10	16	6
K10-205	4,000	1,737	2	32	40	28
N11-140	3,100	1,188	3	21	20	15
K07-55	2,600	1,390	4	14	15	14
M09-315	2,000	621	5	6	7	5

The flow monitoring data and associated analysis during wet weather events was used to quantify portions of the collection system that experienced significant inflow and infiltration for use in the rehabilitation program. Areas with more significant infiltration may correlate to areas of higher metals loading, as infiltration would first pass through subsurface material and bedding contaminated with zinc. However, there is insufficient data to make a strong correlation between infiltration and metals loading. Reduction in infiltration will likely reduce the conveyance of elevated concentrations of zinc to the collection system. However, this will need to be balanced with collection system rehabilitation needs in areas of higher inflow.

Further, the I&I evaluation determined that, while reducing excessive I&I makes sense for capacity purposes, such reduction actually has the potential to increase metals loadings to Turkey Creek, because the groundwater containing zinc and other legacy metals that currently enters the sewer system and is treated at the TCWWTP, would migrate directly to Turkey Creek (Burns & McDonnell, 2017). Thus,

reductions in I&I to the City's collection system would not facilitate attainment of water quality criteria in Turkey Creek, and might even exacerbate instream metals concentrations.

Nevertheless, the City is committed to an I&I program that will facilitate reduction of peak flows associated with wet weather. The program entails an approach that allocates funding to areas that exhibit the greatest need for system renewal. System renewal via investment in collection system rehabilitation will take place throughout the period of the variance.

4.5 Remediation Efforts

As a CERCLA site, the Oronogo-Duenweg Mining Belt has undergone extensive remediation efforts; these efforts are ongoing. Activities have included excavating mining waste piles, removing contaminated soil and sediments, and plugging mine shafts (EPA, 2017). Cleanup of the mine wastes and piles was initiated in 2007 and is ongoing, with expected completion between 2020 and 2022 (EPA, 2017). However, even with completion of the remediation, Turkey Creek concentrations will remain elevated, because long-term monitoring data suggest that these cleanup activities have not had an apparent effect on zinc concentrations in Turkey Creek. Figure 4-4 shows dissolved zinc concentrations at the USGS monitoring station just downstream of the TCWWTP discharge (USGS 07186600, Turkey Creek near Joplin, MO) from 2007, when remediation started, to the present (data provided in Attachment 6). While there appears to be a declining trend in zinc concentrations over the 11 years since remediation activities were initiated, the data suggest that it will at best be many years before the aquatic life criteria are attained. (Recall also that Joplin's monitoring data, shown in Figure 3-2, indicated increasing zinc concentrations upstream of TCWWTP, further highlighting that attainment of the criteria is unlikely in the near future). Thus, while the CERCLA remediation activities address some of the zinc sources within the Turkey Creek watershed, completion of the remediation is not expected to remedy the exceedances of the water quality criteria over the term of the variance.

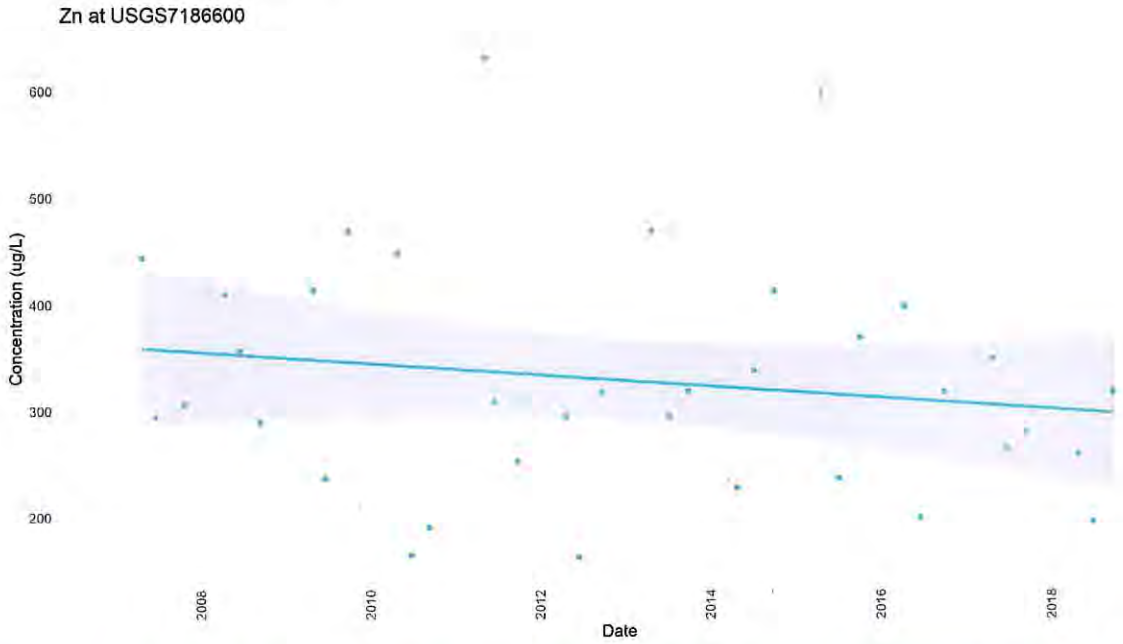

Figure 4-4. Dissolved zinc concentrations in Turkey Creek Downstream of TCWWTP, 2007-2018

As noted previously, mining chat was used extensively throughout the Joplin area, including as sewer bedding, backfill, etc. Thus, even when the CERCLA remediation of the waste piles is completed, there will

still be extensive soil and groundwater contamination throughout the area. This will likely continue to affect water quality in Turkey Creek for the foreseeable future.

4.6 Conclusion

Zinc removal at the TCWWTP and remediation of contaminated areas under the CERCLA program will not provide for attainment of water quality criteria for zinc in Turkey Creek over the life of the variance. The zinc loadings to the TCWWTP are from legacy mining sources that cannot be controlled by the City. The available data suggest that the water quality criteria for zinc are unlikely to be attainable for many years.

5 Conclusions

The widespread contamination caused by historic mining activities and associated mine waste disposal within the Tri-State Mining District, and specifically within the Turkey Creek watershed and City of Joplin, justifies a discharger-specific variance for zinc based on 40 CFR §131.10(g) Factor 3, human caused conditions or sources of pollution prevent the attainment of the use and cannot be remedied or would cause more environmental damage to correct than to leave in place. Specifically, evaluations in this report have demonstrated:

- The source of pollution is human-caused;
- Attainment of the use is prevented; and
- The human-caused condition cannot be remedied over the term of the variance.

The discharger-specific variance for zinc is a limited and narrowly tailored regulatory solution to address the background zinc concentrations in Turkey Creek.

The City of Joplin, in its Variance Application, has proposed Highest Attainable Conditions of 396 µg/l as a daily maximum, and 228 µg/l as a monthly average, based on MDNR's evaluation of the facility's effluent data, which determined that these were 99th and 95th percentile concentrations, respectively. Consistent with Federal Regulations (40 CFR 131.14(b)(1)(ii), the City will adopt and implement a Pollutant Minimization Program (PMP) for zinc. The City anticipates that the renewed NPDES permit will contain a requirement for development and implementation of the PMP. It is anticipated that the PMP will include sampling within the collection system to identify potential sources, continued regulation of industrial contributions through the industrial pretreatment program, implementation of the I&I activities described in Section 4.4 of this report, and continuation of existing requirements for removal of metals-contaminated soils as part of the City's construction contracting process. Additional zinc reduction activities will be considered and included in the PMP as appropriate.

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6 References

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Attachment 1. TCWWTP Process Diagrams

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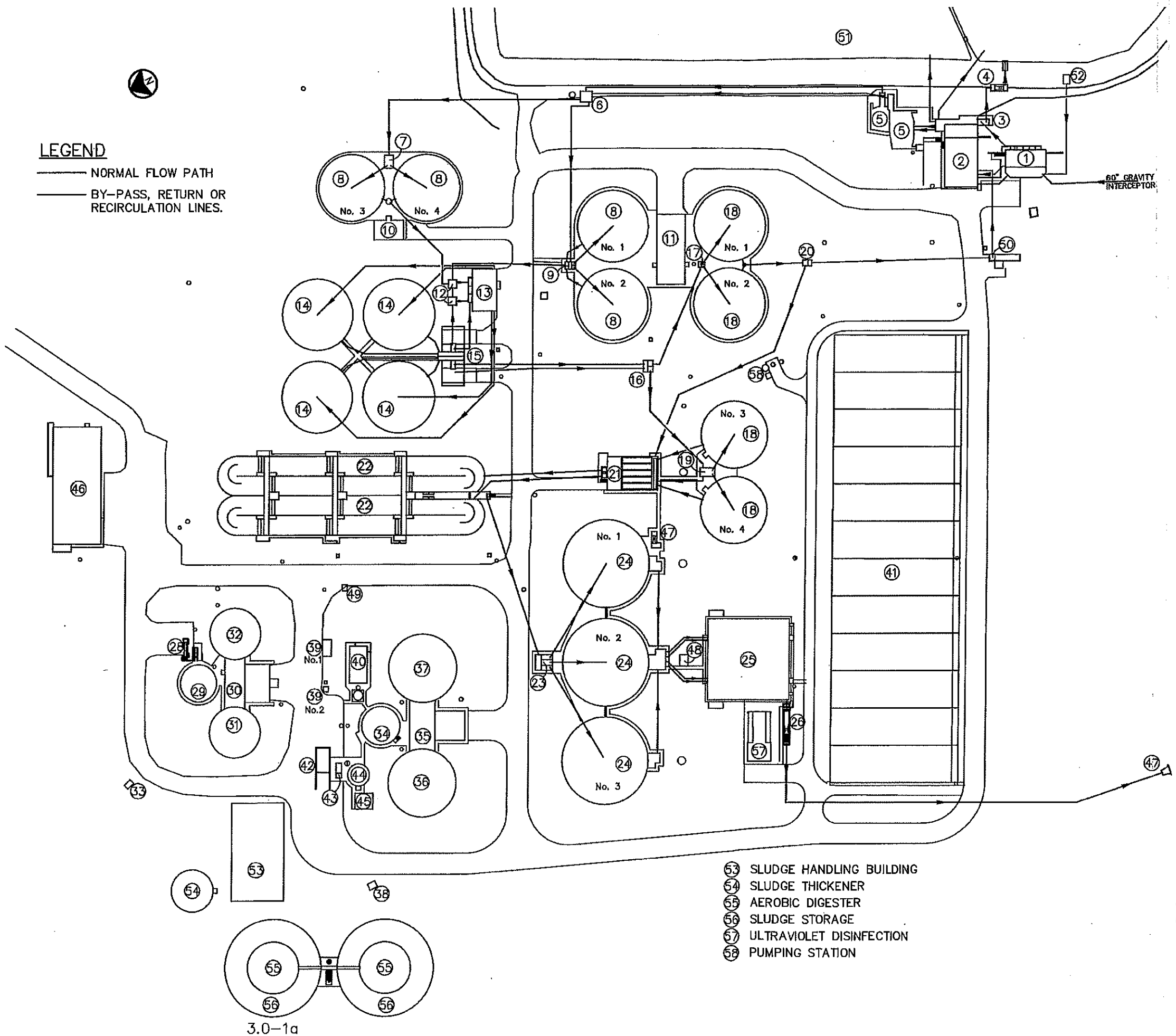
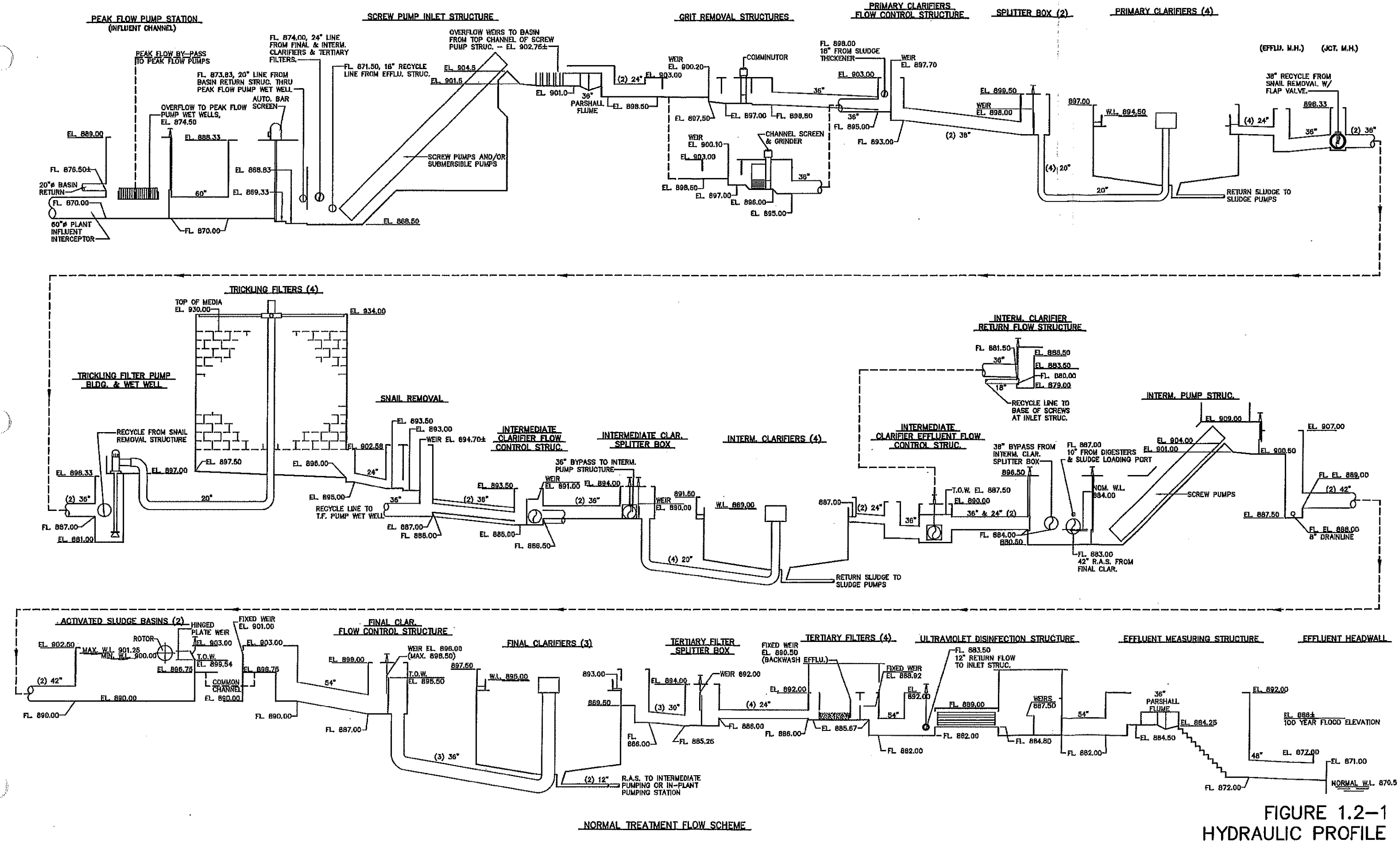


1. PEAK FLOW PUMPING STRUCTURE
2. INLET STRUCTURE
3. PEAK FLOW DIVERSION STRUCTURE
4. PEAK FLOW MEASUREMENT STRUCTURE
5. GRIT REMOVAL STRUCTURE
6. PRIMARY CLARIFIERS FLOW CONTROL STRUCTURE
7. PRIMARY CLARIFIER SPLITTER BOX (Clar. 1 & 2)
8. PRIMARY CLARIFIER(S)
9. PRIMARY CLARIFIER SPLITTER BOX (Clar. 3 & 4)
10. SLUDGE PUMP BUILDING
11. MAINTENANCE & PUMP BUILDING
12. PRIMARY CLARIFIER EFFLUENT FLOW CONTROL STRUCTURE(S)
13. TRICKLING FILTER PUMP BUILDING
14. TRICKLING FILTER(S)
15. SNAIL REMOVAL STRUCTURE
16. INTERMEDIATE CLARIFIERS FLOW CONTROL STRUCTURE
17. INTERMEDIATE CLARIFIER SPLITTER BOX (Clar. 1 & 2)
18. INTERMEDIATE CLARIFIER(S)
19. INTERMEDIATE CLARIFIER SPLITTER BOX (Clar. 3 & 4)
20. INTERMEDIATE CLARIFIER EFFLUENT FLOW CONTROL STRUCTURE
21. INTERMEDIATE PUMPING STRUCTURE
22. ACTIVATED SLUDGE BASIN(S)
23. FINAL CLARIFIER INFLUENT SPLITTER BOX
24. FINAL CLARIFIER(S)
25. TERTIARY FILTER BUILDING
26. EFFLUENT FLOW MEASUREMENT STRUCTURE
27. EFFLUENT HEADWALL
28. CYCLONE GRIT SEPARATOR & GRIT CLASSIFIER
29. NORTH SLUDGE THICKENER
30. NORTH DIGESTER BUILDING
31. NORTH PRIMARY DIGESTER
32. NORTH SECONDARY DIGESTER
33. NORTH WASTE SLUDGE GAS BURNER
34. SOUTH SLUDGE THICKENER
35. SOUTH DIGESTER BUILDING
36. SOUTH PRIMARY DIGESTER
37. SOUTH SECONDARY DIGESTER
38. SOUTH WASTE SLUDGE GAS BURNER
39. SLUDGE TRUCK LOADING PORTS NO. 1 & 2
40. SLUDGE HOLDING TANK & LIME SILO
41. SLUDGE DRYING BEDS
42. SEPTAGE DUMPING STRUCTURE
43. MECHANICAL SCREEN
44. SEPTAGE RECEIVING TANK
45. SEPTAGE PUMPING STRUCTURE
46. LABORATORY & ADMINISTRATION BUILDING
47. R.A.S. FLOW MEASUREMENT STRUCTURE
48. DRAWDOWN STRUCTURE
49. VALVE BOX 4A
50. INTERMEDIATE CLARIFIER RETURN FLOW STRUCTURE
51. FLOW EQUALIZATION BASIN
52. BASIN RETURN FLOW STRUCTURE
53. SLUDGE HANDLING BUILDING
54. SLUDGE THICKENER
55. AEROBIC DIGESTER
56. SLUDGE STORAGE
57. ULTRAVIOLET DISINFECTION
58. PUMPING STATION

FIGURE 3.0-1
PLANT LAYOUT &
WASTEWATER PIPING



NORMAL TREATMENT FLOW SCHEME

FIGURE 1.2–1
HYDRAULIC PROFILE
WASTEWATER FLOW

Attachment 2. Instream Zinc Concentrations

Date	Upstream Dissolved Zinc (µg/L)	Downstream Dissolved Zinc (µg/L)
3/2/2011	-[1]	450
6/7/2011	530	310
9/13/2011	377	197
12/6/2011	480	380
3/6/2012	420	380
6/14/2012	311	260
9/24/2012	570	280
12/4/2012	360	260
3/5/2013	690	430
6/25/2013	420	< 5
9/4/2013	520	280
12/17/2013	750	380
3/4/2014	960	420
6/17/2014	350	250
9/16/2014	290	190
12/9/2014	680	300
3/10/2015	690	380
7/7/2015	630	320
9/10/2015	540	280
1/12/2016	810	590
3/2/2016	590	310
6/9/2016	630	330
9/23/2016	530	250
12/23/2016	840	400
3/2/2017	660	340
6/13/2017	380	300
9/6/2017	620	240
12/12/2017	730	800
3/12/2018	540	390
6/11/2018	320	180
# of samples	29	30
Minimum	290	180
Maximum	960	800
Average	559	341
Median	540	310

[1] Apparent outlier (12 µg/L) not included in analysis. This value was uncharacteristically low, and is not consistent with the downstream concentration (450 µg/L) and the associated effluent contribution that day (181 µg/L).

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Attachment 3. Influent & Effluent Zinc Data

	Influent Zinc (mg/L)	Effluent Zinc (mg/L)
1/11/2005	1.100	0.370
4/12/2005	0.440	0.140
7/12/2005	0.190	0.068
10/18/2005	0.330	0.052
1/17/2006	0.290	0.093
4/11/2006	0.260	0.092
7/11/2006	0.260	0.068
10/10/2006	0.190	0.053
1/2/2007		0.040
1/11/2007		0.059
1/16/2007		0.058
1/25/2007		0.063
1/30/2007		0.073
2/6/2007		0.080
2/13/2007		0.052
2/20/2007		0.064
2/27/2007		0.055
3/6/2007		0.068
3/13/2007		0.070
3/20/2007	0.550	0.053
3/28/2007		0.063
4/3/2007		0.095
4/10/2007		0.110
4/17/2007		0.048
4/24/2007		0.080
5/1/2007		0.056
5/8/2007		0.380
5/15/2007		0.080
5/22/2007		0.100
5/29/2007		0.067
6/5/2007		0.046
6/12/2007		0.044
6/19/2007		0.067
6/26/2007	0.610	0.086
7/3/2007		0.100
7/10/2007		0.120
7/17/2007		0.089
7/24/2007		0.093

	Influent Zinc (mg/L)	Effluent Zinc (mg/L)
7/31/2007		0.110
8/7/2007		0.130
8/14/2007		0.087
8/21/2007		0.059
8/28/2007		0.064
9/11/2007	0.690	0.120
9/18/2007		0.084
9/25/2007		0.078
10/2/2007		0.099
10/9/2007		0.012
10/16/2007		0.071
10/23/2007		0.058
10/30/2007		0.069
11/6/2007		0.067
11/13/2007		0.064
11/20/2007		0.071
11/27/2007		0.066
11/30/2007		
12/4/2007		0.076
12/8/2007		0.079
12/18/2007	0.620	0.110
12/24/2007		0.080
12/31/2007		0.088
1/8/2008		0.099
1/15/2008		0.110
1/22/2008		0.130
2/5/2008		0.120
2/12/2008		0.096
2/19/2008		0.089
2/26/2008		0.100
3/4/2008		0.039
3/11/2008		0.130
3/18/2008	0.810	0.120
4/1/2008		0.110
4/8/2008		0.140
4/15/2008		0.160
4/22/2008		0.140
4/29/2008		0.120

	Influent Zinc (mg/L)	Effluent Zinc (mg/L)
5/6/2008		0.120
5/13/2008		0.013
5/20/2008		0.140
5/27/2008		0.130
6/3/2008		0.110
6/10/2008	0.880	0.130
6/17/2008		0.140
6/24/2008		0.170
7/1/2008		0.150
7/8/2008		0.130
7/15/2008		0.150
7/22/2008		0.120
7/29/2008		0.120
8/5/2008		0.100
8/12/2008		0.073
8/19/2008		0.076
8/26/2008		0.063
9/2/2008		0.070
9/9/2008	0.390	0.074
9/16/2008		0.080
9/23/2008		0.061
9/30/2008		0.051
10/7/2008		0.067
10/14/2008		0.069
10/21/2008		0.077
10/28/2008		0.060
11/4/2008		0.074
11/11/2008		0.097
11/19/2008		0.084
11/25/2008		0.120
12/2/2008	0.247	0.074
12/9/2008		0.120
12/16/2008		0.130
12/23/2008		0.120
12/30/2008		0.110
1/6/2009		0.110
1/13/2009		0.130
1/20/2009		0.130
1/29/2009		0.150
2/3/2009		0.120
2/10/2009		0.110

	Influent Zinc (mg/L)	Effluent Zinc (mg/L)
2/17/2009		0.095
2/24/2009		0.120
3/2/2009		0.120
3/10/2009	0.312	0.108
3/17/2009		0.120
3/24/2009		0.110
3/31/2009		0.110
4/7/2009		0.088
4/14/2009		0.100
4/21/2009		0.097
4/28/2009		0.097
5/5/2009		0.117
5/12/2009		0.122
5/19/2009		0.110
5/26/2009		0.140
6/2/2009		0.148
6/9/2009	0.301	0.107
6/16/2009		0.106
6/23/2009		0.107
6/30/2009		0.104
7/7/2009		0.124
7/14/2009		0.097
7/21/2009		0.095
7/28/2009		0.077
8/4/2009		0.088
8/11/2009		0.084
8/18/2009		0.063
8/25/2009		0.066
9/1/2009		0.057
9/8/2009	0.273	0.114
9/15/2009		0.059
9/22/2009		0.060
9/29/2009		0.061
10/6/2009		0.077
10/13/2009		0.113
10/20/2009		0.144
10/27/2009		0.121
11/3/2009		0.136
11/10/2009		0.086
11/17/2009		0.131
11/24/2009		0.120

	Influent Zinc (mg/L)	Effluent Zinc (mg/L)
12/1/2009		0.132
12/8/2009	0.403	0.044
12/15/2009		0.150
12/22/2009		0.124
12/29/2009		0.122
1/5/2010		0.140
1/12/2010		0.144
1/19/2010		0.155
1/26/2010		0.136
2/2/2010		0.135
2/9/2010		0.134
2/16/2010		0.144
2/23/2010		0.161
3/2/2010	0.471	0.113
3/9/2010		0.129
3/16/2009		0.130
3/23/2010		0.099
3/30/2010		0.152
4/6/2010		0.188
4/13/2010		0.159
4/20/2010		0.146
4/27/2010		0.160
5/4/2010	0.314	0.124
5/11/2010	0.320	0.119
5/18/2010	0.766	0.089
5/25/2010	0.504	0.126
6/1/2010	0.433	0.136
6/8/2010	0.350	0.139
6/15/2010	0.604	0.658
6/22/2010	0.417	0.138
6/29/2010	0.265	0.123
7/6/2010	0.390	0.110
7/13/2010	1.020	0.092
7/20/2010	0.367	0.116
7/28/2010	0.378	0.091
8/3/2010	0.287	0.068
8/10/2010	0.320	0.073
8/17/2010	0.341	0.094
8/24/2010	0.257	0.052
8/31/2010	0.252	0.063
9/8/2010		0.063

	Influent Zinc (mg/L)	Effluent Zinc (mg/L)
9/14/2010	1.040	0.055
9/21/2010		0.053
9/28/2010		0.059
10/6/2010	0.328	0.056
10/12/2010	0.217	0.063
10/19/2010	0.369	0.083
10/26/2010	0.330	0.070
11/2/2010	0.234	0.081
11/9/2010	0.268	0.091
11/16/2010	0.281	0.087
11/23/2010	0.265	0.084
11/30/2010	0.382	0.119
12/7/2010	0.318	0.114
12/15/2010		0.138
12/21/2010	0.328	0.114
12/28/2010	0.312	0.119
1/5/2011	0.332	0.119
1/11/2011	0.269	0.129
1/18/2011	0.288	0.120
1/25/2011	0.265	0.142
2/3/2011	0.293	0.129
2/8/2011	0.761	0.130
2/15/2011	0.864	0.140
2/22/2011	0.554	0.196
3/2/2011	0.612	0.181
3/8/2011	0.573	0.172
3/15/2011	1.010	0.170
3/22/2011	0.694	0.167
3/29/2011	0.614	0.160
4/5/2011	0.539	0.218
4/12/2011	0.531	0.148
4/19/2011	0.536	0.146
4/26/2011	1.230	0.151
5/3/2011	0.807	0.259
5/10/2011	0.538	0.205
5/17/2011	0.528	0.191
5/24/2011	1.090	0.147
5/31/2011	0.855	0.226
6/7/2011	0.566	0.268
6/14/2011	0.489	0.169
6/21/2011	0.528	0.130

	Influent Zinc (mg/L)	Effluent Zinc (mg/L)
6/23/2011		0.120
6/28/2011	0.362	0.142
7/6/2011	0.361	0.118
7/12/2011	0.280	0.143
7/19/2011	0.251	0.151
7/26/2011	0.287	0.122
8/2/2011	0.299	0.127
8/9/2011	0.368	0.143
8/16/2011	0.274	0.120
8/23/2011	0.231	0.108
8/30/2011	0.323	0.103
9/6/2011	0.235	0.092
9/13/2011	0.238	0.104
9/20/2011	0.538	0.125
9/27/2011	0.334	0.144
10/5/2011	0.288	0.101
10/11/2011	0.286	0.081
10/18/2011	0.434	0.088
10/25/2011	0.261	0.069
11/1/2011	0.359	0.060
11/8/2011	0.803	0.091
11/15/2011	0.368	0.103
11/22/2011	0.718	0.157
11/29/2011	0.568	0.150
12/6/2011	0.490	0.146
12/13/2011	1.100	0.138
12/20/2011	1.130	0.149
12/27/2011	0.533	0.216
1/3/2012	0.439	0.216
1/10/2012	0.427	0.268
1/17/2012	0.439	0.190
1/24/2012	0.434	0.200
1/31/2012	0.345	0.180
2/7/2012	0.356	0.158
2/14/2012	0.385	0.183
2/21/2012	0.415	0.170
2/28/2012	0.365	0.160
3/6/2012	0.491	0.146
3/13/2012	0.476	0.151
3/20/2012	1.010	0.172
3/27/2012	0.844	0.266

	Influent Zinc (mg/L)	Effluent Zinc (mg/L)
4/3/2012	0.554	0.189
4/10/2012	0.508	0.207
4/18/2012	0.848	0.148
4/24/2012	0.613	0.193
5/1/2012	0.783	0.161
5/8/2012	0.511	0.201
5/15/2012	0.394	0.168
5/22/2012	0.363	0.170
5/29/2012	ND	0.161
6/6/2012	0.316	0.152
6/12/2012	0.311	0.141
6/19/2012	0.352	0.111
6/26/2012	0.301	0.128
7/3/2012	0.248	0.109
7/10/2012	0.264	0.115
7/17/2012	0.322	0.128
7/24/2012	0.262	0.082
7/31/2012	0.237	0.126
8/7/2012	0.253	0.115
8/14/2012	0.276	0.103
8/21/2012	0.290	0.067
8/28/2012	0.208	0.084
9/5/2012	0.767	0.066
9/11/2012	0.306	0.065
9/18/2012	0.412	0.083
9/25/2012	0.329	0.073
10/2/2012	0.292	0.048
10/9/2012	0.264	0.063
10/16/2012	0.480	0.074
10/23/2012	0.341	0.064
10/30/2012	0.329	0.074
11/6/2012	0.321	0.082
11/13/2012	0.425	0.093
11/20/2012	0.326	0.124
11/27/2012	0.317	0.127
12/4/2012	0.344	0.178
12/11/2012	0.325	0.131
12/20/2012	0.346	0.136
12/26/2012	0.305	0.094
1/2/2013	0.327	0.106
1/9/2013	0.286	0.120

	Influent Zinc (mg/L)	Effluent Zinc (mg/L)
1/15/2013	0.365	0.127
1/22/2013	0.310	0.150
1/29/2013	0.299	0.094
2/5/2013	0.391	0.149
2/12/2013	0.408	0.133
2/19/2013	0.374	0.141
2/26/2013	0.778	0.028
3/5/2013	0.595	0.214
3/12/2013	0.738	0.236
3/19/2013	0.461	0.233
3/26/2013	0.516	0.185
4/2/2013	0.668	0.195
4/9/2013	0.460	0.220
4/16/2013	0.470	0.200
4/23/2013	0.730	0.250
4/30/2013	0.840	0.270
5/8/2013	0.620	0.270
5/14/2013	0.610	0.240
5/21/2013	0.740	0.200
5/28/2013	0.640	0.210
6/4/2013	0.790	0.260
6/11/2013	0.550	0.280
6/18/2013	0.730	0.230
6/25/2013	0.520	0.210
7/2/2013	0.340	0.200
7/9/2013	0.320	0.150
7/16/2013	0.240	0.110
7/23/2013	0.270	0.150
7/30/2013	0.630	0.170
8/6/2013	0.730	0.120
8/13/2013	0.500	0.170
8/20/2013	0.440	0.170
8/27/2013	0.340	0.170
9/4/2013	0.290	0.120
9/10/2013	0.300	0.160
9/17/2013	0.320	0.170
9/24/2013	0.320	0.150
10/2/2013	0.270	0.120
10/8/2013	0.340	0.100
10/15/2013	0.380	0.130
10/22/2013	0.320	0.130

	Influent Zinc (mg/L)	Effluent Zinc (mg/L)
10/29/2013	0.660	0.160
11/5/2013	0.780	0.170
11/12/2013	0.360	0.190
11/19/2013	0.380	0.190
11/26/2013	0.350	0.190
12/3/2013	0.270	0.160
12/10/2013	0.310	0.190
12/17/2013	0.430	0.180
12/24/2013	0.570	0.160
12/31/2013	0.380	0.180
1/7/2014	0.400	0.210
1/14/2014	0.540	0.210
1/21/2014	0.530	0.170
1/28/2014	0.350	0.200
2/4/2014	0.390	0.180
2/11/2014	0.320	0.160
2/18/2014	0.340	0.140
2/25/2014	0.340	0.150
3/4/2014	0.300	0.140
3/11/2014	0.380	0.130
3/18/2014	0.650	0.120
3/25/2014	0.390	0.190
4/2/2014	0.350	0.210
4/8/2014	0.350	0.150
4/15/2014	0.340	0.110
4/22/2014	0.320	0.130
4/29/2014	0.320	0.120
5/6/2014	0.260	0.130
5/13/2014	0.470	0.100
5/20/2014	0.340	0.110
5/27/2014	0.490	0.100
6/3/2014	0.530	0.110
6/10/2014	0.780	0.089
6/17/2014	0.370	0.120
6/24/2014	0.400	0.110
7/2/2014	0.320	0.110
7/8/2014	0.290	0.096
7/15/2014	0.300	0.210
7/22/2014	0.260	0.110
7/29/2014	0.270	0.120
8/5/2014	0.250	0.078

	Influent Zinc (mg/L)	Effluent Zinc (mg/L)
8/12/2014	0.300	0.100
8/19/2014	0.260	0.077
8/26/2014	0.250	0.120
9/3/2014	0.470	0.062
9/9/2014	0.310	0.084
9/16/2014	0.290	0.085
9/23/2014	0.400	0.085
9/30/2014	0.240	0.057
10/2/2014	0.900	0.056
10/7/2014	0.280	0.086
10/14/2014	0.960	0.130
10/21/2014	0.400	0.200
10/28/2014	0.470	0.130
11/4/2014	0.560	0.150
11/11/2014	0.350	0.120
11/18/2014	0.350	0.120
11/25/2014	0.580	0.092
12/2/2014	0.310	0.110
12/9/2014	0.370	0.150
12/16/2014	0.500	0.120
12/23/2014	0.480	0.110
12/30/2014	0.430	0.110
1/6/2015	0.480	0.110
1/13/2015	0.380	0.120
1/20/2015	0.560	0.120
1/27/2015	0.350	0.120
2/3/2015	0.360	0.110
2/10/2015	1.200	0.140
2/17/2015	0.330	0.140
2/24/2015	0.450	0.140
3/3/2015	0.420	0.130
3/10/2015	0.480	0.140
3/17/2015	0.580	0.120
3/24/2015	0.530	0.110
3/31/2015	0.500	0.130
4/7/2015	0.720	0.140
4/14/2015	0.540	0.180
4/21/2015	1.100	0.150
4/28/2015	0.830	0.130
5/5/2015	0.530	0.160
5/12/2015	0.530	0.120

	Influent Zinc (mg/L)	Effluent Zinc (mg/L)
5/19/2015	0.770	0.120
5/29/2015	1.300	0.110
6/2/2015	0.960	0.220
6/9/2015	0.640	0.210
6/16/2015	0.600	0.180
6/23/2015	0.690	0.180
6/30/2015	0.580	0.150
7/7/2015	0.500	0.110
7/14/2015	0.530	0.110
7/21/2015	0.350	0.097
7/28/2015	0.300	0.085
8/4/2015	0.310	0.064
8/11/2015	0.260	0.075
8/18/2015	0.260	0.110
8/25/2015	0.630	0.110
9/1/2015	0.360	0.110
9/8/2015	0.400	0.085
9/15/2015	0.300	0.094
9/22/2015	0.300	0.110
9/29/2015	0.360	0.140
10/6/2015	0.230	0.130
10/13/2015	0.260	0.140
10/20/2015	0.210	0.140
10/27/2015	0.260	0.130
11/3/2015	0.270	0.110
11/10/2015	0.270	0.120
11/17/2015	0.670	0.130
11/24/2015	0.360	0.110
12/2/2015	0.650	0.120
12/8/2015	0.370	0.170
12/15/2015	0.930	0.099
12/22/2015	0.390	0.110
12/29/2015	1.100	0.110
1/5/2016	0.660	0.170
1/12/2016	0.590	0.170
1/19/2016	0.480	0.190
1/26/2016	0.430	0.190
2/2/2016	0.370	0.190
2/9/2016	0.290	0.170
2/16/2016	0.280	0.180
2/23/2016	0.330	0.160

	Influent Zinc (mg/L)	Effluent Zinc (mg/L)
3/2/2016	0.240	0.140
3/8/2016	0.270	0.100
3/15/2016	0.290	0.110
3/22/2016	0.360	0.095
3/29/2016	0.360	0.140
4/5/2016	0.320	0.140
4/12/2016	0.390	0.150
4/19/2016	0.390	0.170
4/26/2016	0.340	0.110
5/3/2016	0.530	0.170
5/10/2016	0.380	0.110
5/17/2016	0.720	0.096
5/24/2016	0.430	0.200
5/31/2016	0.440	0.140
6/7/2016	0.480	0.170
6/14/2016	0.390	0.150
6/21/2016	0.420	0.180
6/28/2016	0.370	0.110
7/5/2016	0.440	0.110
7/12/2016	0.380	0.086
7/19/2016	0.340	0.120
7/26/2016	0.290	0.120
8/2/2016	0.320	0.120
8/9/2016	0.510	0.080
8/16/2016	0.380	0.100
8/23/2016	0.400	0.110
8/30/2016	0.270	0.120
9/6/2016	0.270	0.130
9/13/2016	0.320	0.100
9/20/2016	0.350	0.120
9/27/2016	0.320	0.096
10/6/2016	0.340	0.190
10/11/2016	0.340	0.093
10/18/2016	0.340	0.180
10/25/2016	0.340	0.100
11/1/2016	0.340	0.098
11/8/2016	0.400	0.120
11/15/2016	0.300	0.082
11/22/2016	0.280	0.085
11/29/2016	0.310	0.074
12/6/2016	0.250	0.081

	Influent Zinc (mg/L)	Effluent Zinc (mg/L)
12/13/2016	0.340	0.100
12/20/2016	0.300	0.120
12/27/2016	0.270	0.094
1/3/2017	0.260	0.110
1/10/2017	0.220	0.130
1/17/2017	0.720	0.170
1/24/2017	0.580	0.170
1/31/2017	0.390	0.180
2/8/2017	0.340	0.140
2/14/2017	0.310	0.150
2/21/2017	0.290	0.096
2/28/2017	0.280	0.130
3/7/2017	0.320	0.160
3/14/2017	0.250	0.140
3/21/2017	0.250	0.120
3/28/2017	0.330	0.089
4/4/2017	0.380	0.120
4/11/2017	0.290	0.150
4/18/2017	0.350	0.100
4/25/2017	0.590	0.250
5/2/2017	0.260	0.550
5/9/2017	0.650	0.500
5/16/2017	0.500	0.240
5/23/2017	0.710	0.380
5/30/2017	0.580	0.270
6/6/2017	0.500	0.170
6/13/2017	0.360	0.160
6/20/2017	0.360	0.150
6/27/2017	0.350	0.120
7/5/2017	0.440	0.090
7/11/2017	0.300	0.100
7/18/2017	0.340	0.076
7/25/2017	0.250	0.100
8/1/2017	0.240	0.095
8/8/2017	0.260	0.089
8/15/2017	0.280	0.130
8/22/2017	0.320	0.091
8/29/2017	0.250	0.098
9/6/2017	0.220	0.110
9/12/2017	0.260	0.110
9/19/2017	0.250	0.078

	Influent Zinc (mg/L)	Effluent Zinc (mg/L)
9/26/2017	0.220	0.072
10/3/2017	0.440	0.065
10/10/2017	0.330	0.099
10/17/2017	0.290	0.076
10/24/2017	0.340	0.091
10/31/2017		0.082
11/7/2017	0.260	0.069
11/14/2017	0.220	0.074
11/21/2017	0.260	0.088
11/28/2017	0.240	0.097
12/5/2017	0.240	0.088
12/12/2017	0.210	0.086
12/19/2017	0.260	0.084
12/26/2017	0.360	0.062
1/3/2018	0.270	0.150
1/9/2018	0.280	0.099
1/16/2018	0.250	0.120
1/23/2018	0.360	0.170
1/30/2018	0.320	0.120
2/6/2018	0.310	0.120
2/13/2018	0.270	0.130
2/20/2018	0.750	0.089
2/27/2018	0.860	0.180
3/6/2018	0.510	0.130
3/13/2018	0.420	0.130
3/20/2018	0.350	0.092
3/27/2018	0.740	0.110
4/3/2018	0.440	0.072
4/10/2018	0.350	0.110
4/17/2018	0.360	0.100
4/24/2018	0.350	0.094
5/2/2018	0.360	0.066
5/8/2018	0.380	0.096
5/15/2018	0.450	0.160
5/22/2018	0.480	0.082
5/29/2018	0.380	0.077
6/5/2018	0.840	0.081
6/12/2018	0.710	0.093
6/19/2018	0.310	0.098
6/26/2018	0.310	0.067
7/3/2018	0.260	0.076

	Influent Zinc (mg/L)	Effluent Zinc (mg/L)
7/10/2018	0.002	0.093
7/19/2018	0.270	0.110
7/24/2018	0.210	0.069
7/31/2018	0.280	0.068
8/7/2018	0.260	0.089
8/14/2018	0.400	0.069
8/21/2018	0.800	0.047
8/28/2018	0.410	0.064
9/5/2018	0.410	0.070
9/11/2018	0.590	0.073
9/18/2018	0.440	0.100
9/25/2018	0.390	0.075
10/9/2018	0.300	0.053
10/16/2018	0.310	0.061
10/23/2018	0.300	0.059
10/30/2018	0.270	0.069
11/6/2018	0.360	0.062

Attachment 4. Treatment Cost Information

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DRAFT - MARCH 16, 2017

Flow (gpm)	800	28		833		160			10,400	
Technology	Biological-Anaerobic	MBR & filtration		Precipitation		Wetlands			TBD	
Pollutant	Selenium	Cadmium	Zinc	Lead	Zinc	Selenium	Arsenic	Mercury	Zinc	Cadmium
In	1.64 lb/day	0.018 mg/l	7.9 mg/l	0.49 mg/l	12 mg/l	0.1 mg/L	0.175 mg/L	0.0008 mg/L	0.2 mg/L	0.001 mg/L
Out	0.55 lb/day	0.0017 mg/l	6.0 mg/l	0.005 mg/l	0.14 mg/l	0.00757 mg/L	0.031 mg/L	ND	0.11 mg/L	0.0004 mg/L
Removal Efficiency	66%	91%	24%	99%	99%	92%	82%	ND	45%	60%
Capital Cost	$ 12,000,000	$ 7,000,000		$ 10,000,000		$ 20,000,000			TBD	
Facility Type	Highly Industrial	Commercial		Light Industry		Highly Industrial			Municipal	
TIC Estimate for POTW	$ 55,900,000	$ 243,800,000		$ 45,500,000		$ 244,800,000			TBD	

Attachment 5. I&I Program Summary

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1.0 EXECUTIVE SUMMARY

The City of Joplin (the City) has made efforts in recent years to reduce inflow and infiltration (I&I) in the wastewater collection system through a sewer rehabilitation program based largely on pipe condition data within some older portions of town. As part of a targeted I&I reduction program, the City conducted flow monitoring in the spring of 2017 to evaluate the current condition of the sewer system and to identify remaining areas of high I&I and metals loadings. Assessment of the City's sanitary sewer system has been documented in this memorandum. This memorandum documents how the flows within the City's sanitary sewer system reacts to rainfall. The objective of the first step in the work plan developed for the City was to identify I&I by means of flow metering and rank basins based on quantity of I&I. Metals sampling of zinc, copper, and lead was also completed at manhole locations where flow meters were installed. Metals concentration data was required for evaluating their impact on the sewer system.

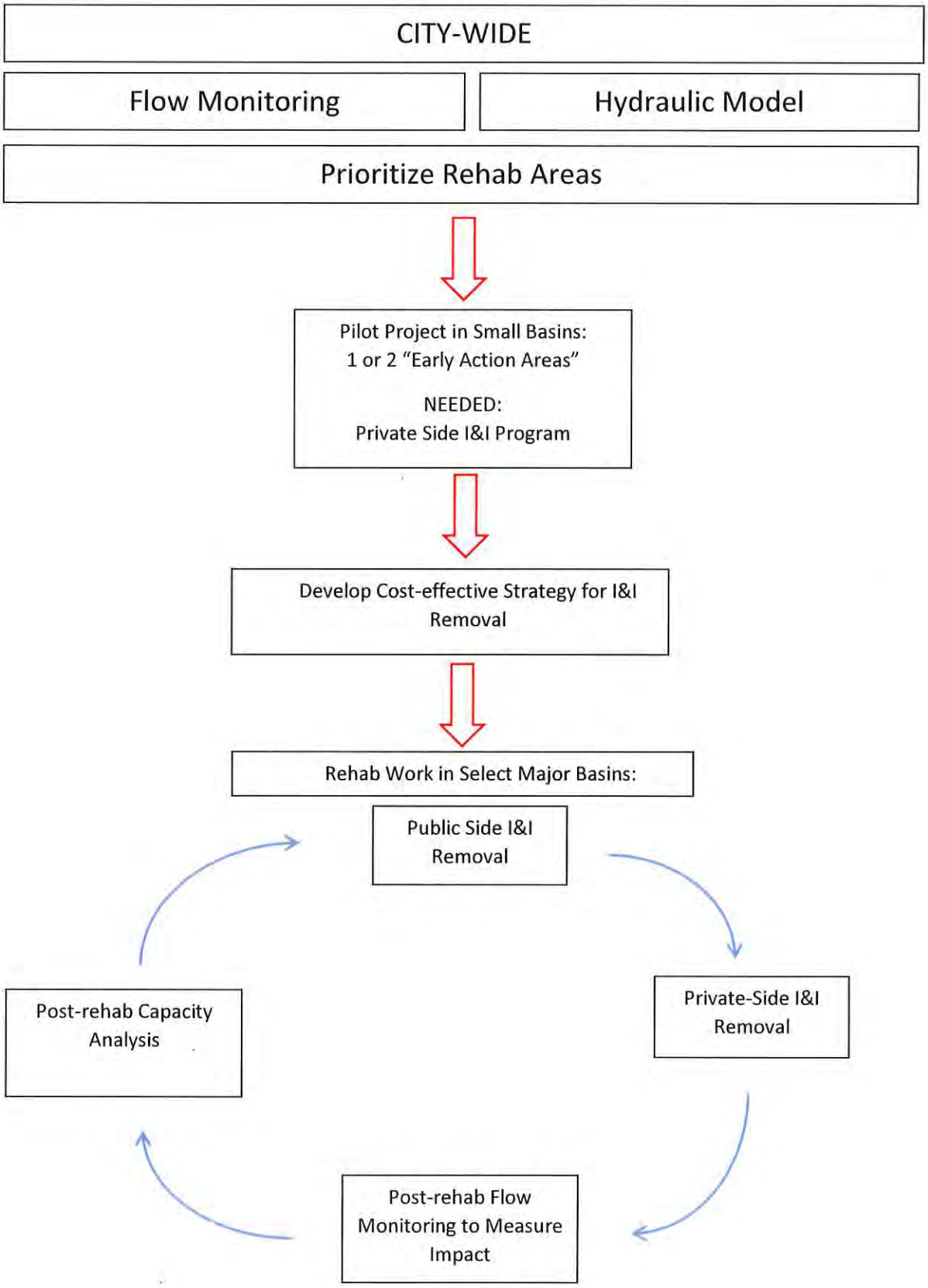
The next steps in the work plan are shown in Figure 1-1. This flow metering data, metals sampling, and I&I analysis will be incorporated into the hydraulic model. The hydraulic model is a tool that can be used to optimize the City's collection system hydraulics.

The hydraulic model will then be used to analyze the system in several ways including:

- Analysis of the metering data will develop a prioritized list of areas for cost-effective I&I removal. The hydraulic model can be used to predict where I&I reduction is more cost effective than other strategies for capital improvements.
- Estimate the incremental and cumulative impacts of I&I reduction efforts to sewer system capacity and level of service.
- Estimate the impacts of rerouting flows from overloaded parts of the system to underutilized parts.
- Evaluate pumping station control logic and SCADA changes and pumping station and/or force main consolidation possibilities.
- Evaluate impacts of future development and population growth on collection system capacity.
- Optimize sewer collection system improvements for size, location, year, and cost.

After the hydraulic model has been developed, reconstruction work can begin in select basins, which will be prioritized by incorporating several factors including, but not limited to, high levels of I&I. As work begins on public infrastructure within any "Early Action Areas", discussions will be initiated regarding efforts to establish a private side I&I program.

FIGURE 1-1


CITY-WIDE
Flow Monitoring
Hydraulic Model
Prioritize Rehab Areas
Pilot Project in Small Basins:
1 or 2 "Early Action Areas"
NEEDED:
Private Side I&I Program
Develop Cost-effective Strategy for I&I Removal
Rehab Work in Select Major Basins:
Public Side I&I Removal
Private-Side I&I Removal
Post-rehab Flow Monitoring to Measure Impact
Post-rehab Capacity Analysis

These three areas (flow monitoring and metals sampling, system hydraulic model and private side I&I program) will all be utilized together to provide the City with additional tools to implement a comprehensive, cost-effective I&I reduction plan for its wastewater collection system.

1.1 Flow and Rainfall Monitoring

Flow and rainfall monitoring was performed to establish a relationship between precipitation (rainfall intensity and rainfall volume) and system flow rates. The system was divided into 51 meter catchments for metering purposes. The flow and rainfall data was collected between March 2017 and June 2017. Figure 3-1 shows the locations of the flow meters.

Flow monitoring was performed to obtain system flow rates during both dry and wet weather conditions. Rainfall monitoring was performed to correlate wet weather flows with rainfall. 35 rainfall events totaling over 25 inches of rain were recorded. Rainfall data is presented in Table 4-3. The flow-rainfall relationship was used to rank the meter catchments by amount of I&I.

1.2 Flow and Rainfall Analysis

The flow analysis deconstructed the flow meter hydrographs into the various components of sanitary sewer system flow (see Figure 4-1.) A typical flow pattern consists of an average daily diurnal pattern where peak flows occur during the morning and late evening.

During rain events, rainwater enters the sanitary sewer collection system through illicit sources. This flow reaction is considered inflow. As the ground becomes saturated, the water begins to seep through additional sources that are further below the surface. This slow seepage is considered infiltration.

1.3 Summary of I&I Assessment

Data from the flow, rainfall and metals testing was analyzed under numerous scenarios and by various methods as described and presented in detail within the report to follow.

Table 1-1 identifies the 5 sewer catchments ranked highest for I&I. within the City sewer system. Figure 1-4 highlights the areas of the system that exceed USEPA's guidelines for infiltration. These rankings can be used to prioritize future investigations and ultimately cost-effective I&I removal projects.

Table 1-1: Top 5 Ranked Total I&I Meter Catchments

Meter Catchment	Basin	Combined I&I Ranking	Combined Inflow Ranking	Combined Infiltration Ranking	Overall Rank
P08-220B	Turkey Creek	1	1	1	1
FMM10-340	Turkey Creek	2	4	2	2
FMK12-170	Turkey Creek	5	5	4	3
FMM09-315	Turkey Creek	6	7	5	4
FMM09-235	Turkey Creek	3	2	16	5
FMM09-255	Turkey Creek	3	2	16	5

The rankings identified in Table 1-1 were produced by evaluating three I&I volume-to-rainfall indices to eliminate biases in the data to specific meter catchment characteristics, such as large meter catchment area or high linear feet of pipes.

Based on the indices of total I&I volume, inflow volume, and infiltration volume, the individual rankings were cumulated and ranked to produce an overall rank for each meter catchment.

Figure 1-2
City of Joplin
Top 5 Catchments
With Excessive I&I

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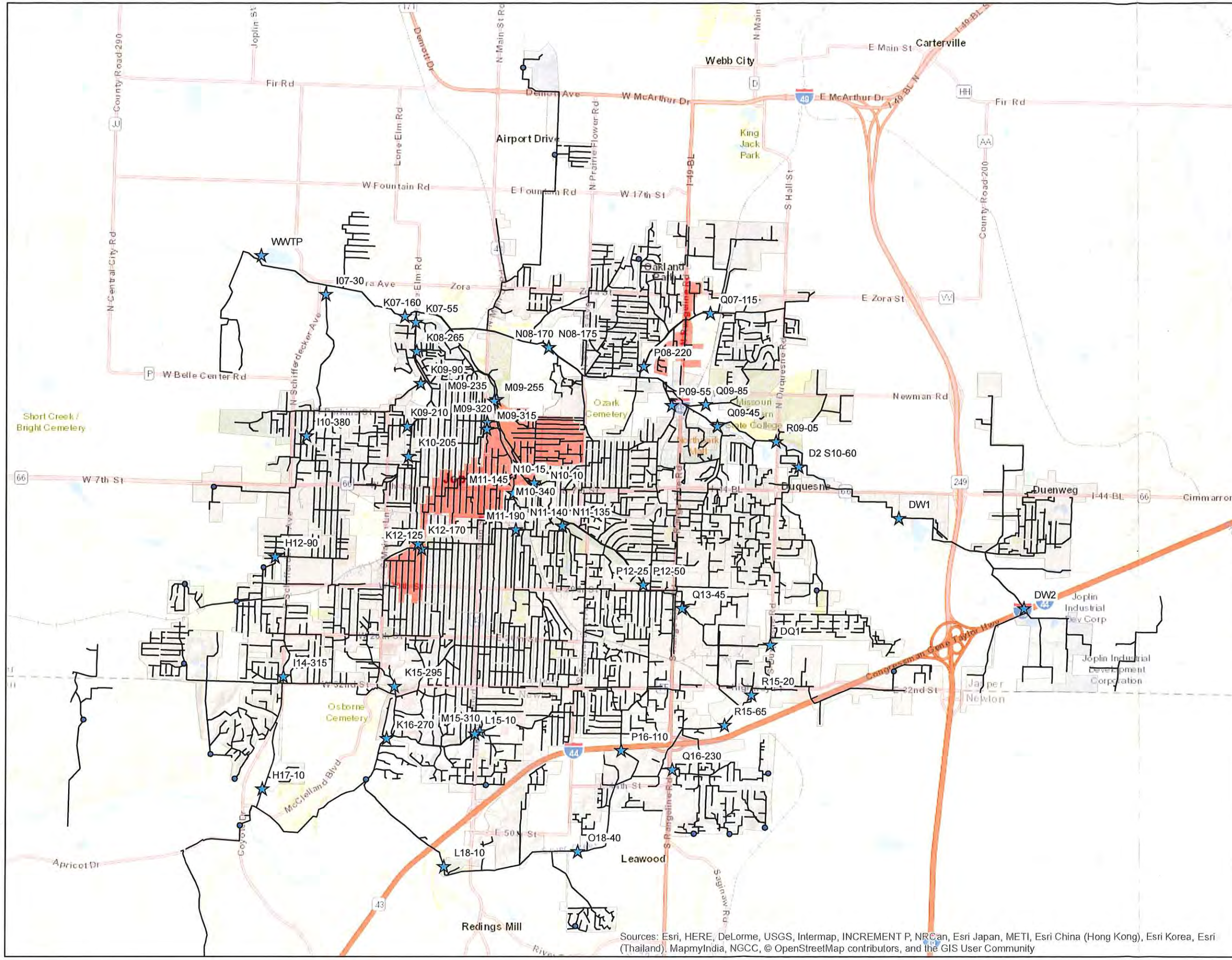


N
W E
S

Legend

- Flow Meters
- Sanitary Sewer
- Tier 1
- Tier 2 and Above

As part of this system-wide flow monitoring effort, metals sampling in the collection system was done to identify basins with high contamination levels of lead, zinc, and copper. Initially, it was thought that a direct correlation would be found between I&I and metals concentrations, and that the findings would be used to develop and implement an overall I&I reduction program which would also reduce the metals loadings. Table 1-2, below, shows that the findings of this investigation do not support this conceptual strategy. Based on the rankings of zinc loadings and I&I, Table 1-2 indicates that there is no relationship between high I&I areas and high metals (zinc) loading areas. Accordingly, reducing excessive I&I for capacity purposes will make sense, but reducing I&I to reduce metals loadings may result in increased metals loadings to area streams, since groundwater tainted with metals would bypass the wastewater treatment process. Thus, the result of removing infiltration from the sewer system may result in persistent, elevated background metals levels in area waters.

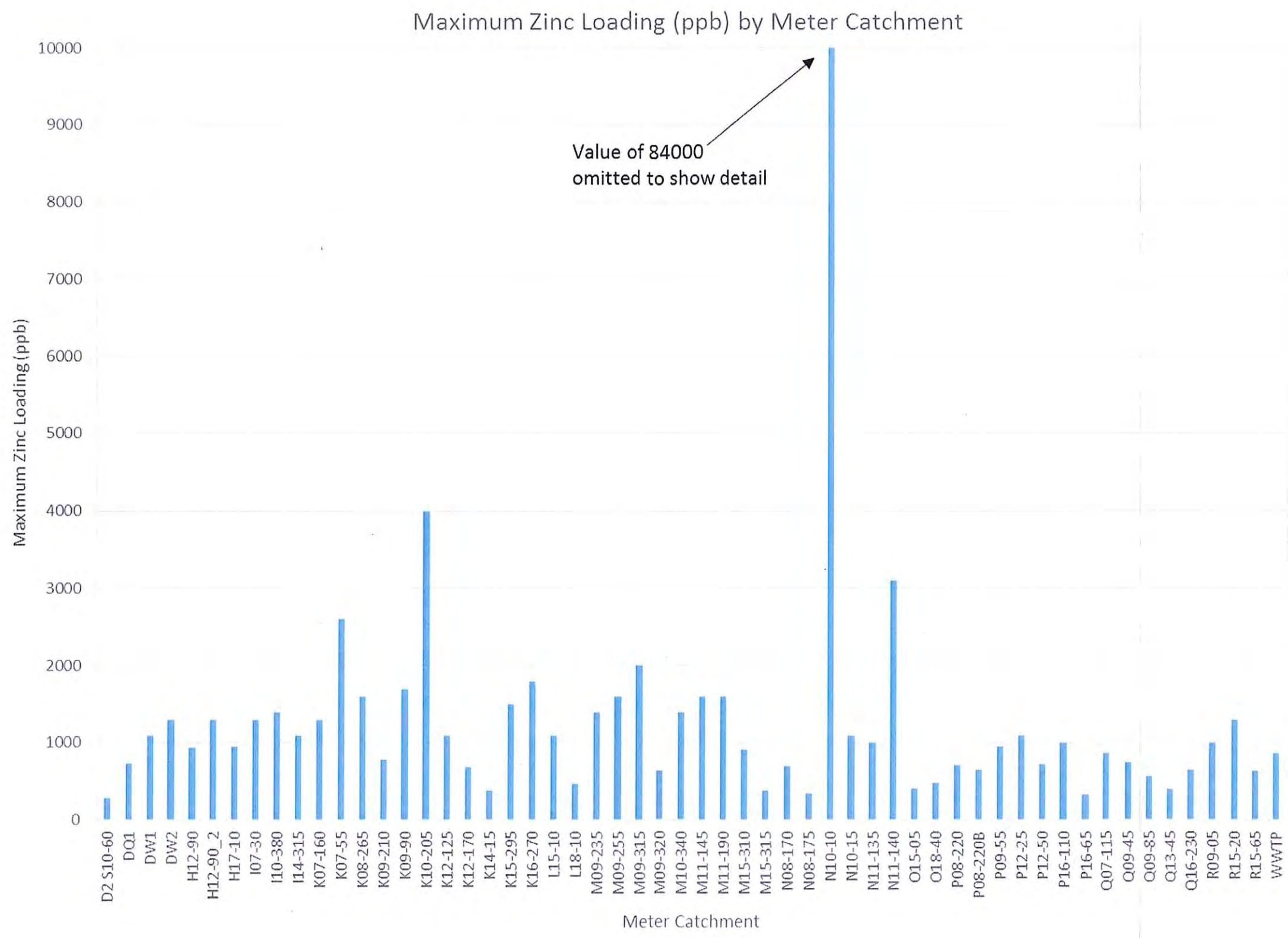
Years ago, local mine tailings or "chat" as it is locally known, were used as bedding and backfill for sewer lines. Metals from those tailings/ 'chat' are now leaching into the sewers and being treated at the treatment plant. In fact, these mine tailings/ 'chat' were prevalently used for all sorts of infrastructure throughout the City in applications such as for storm sewers, house foundations, asphalt, concrete, street construction, gas lines, and other backfill uses. The ubiquitous use of this material around the City is, in part, the reason that the instream concentrations are higher than those in the treatment plant discharge.

Table 1-2 presents the maximum and average zinc loadings in parts per billion (ppb) and ranking of the top five associated meter catchments based on maximum zinc loading. The associated I&I ranking for these meter catchments is also included. Rankings are from highest to lowest priority and are based on cumulative values. Figure 1-3 presents the maximum zinc loadings by meter catchment.

Table 1-2: Top 5 Ranked Zinc Loading Meter Catchments

Meter Catchment	Cumulative Zinc (ppb)		Zinc Rank	I&I Rank
	Maximum	Average		
N10-10	84,000	8,248	1	8
K10-205	4,000	1,737	2	33
N11-140	3,100	1,188	3	21
K07-55	2,600	1,390	4	15
M09-315	2,000	621	5	4

Figure 1-3: Maximum Zinc Loading by Meter Catchment

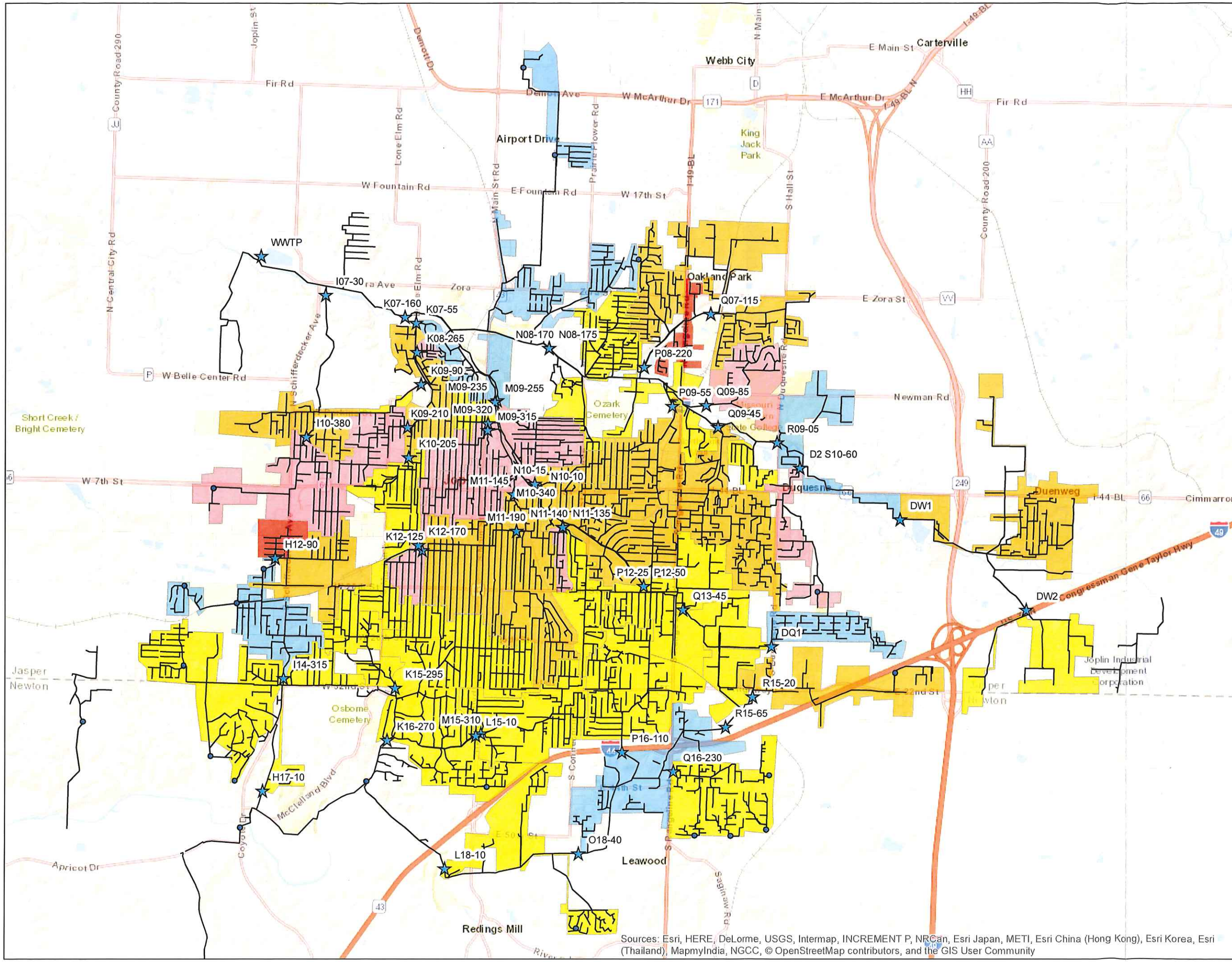


The I&I rankings, not the metals rankings, should serve as a guide for prioritization of future investigation and determination of projects for ultimately cost-effective I&I removal. While the six meter catchments listed in Table 1-1 represent the highest recorded levels of I&I within the system, it should be noted that 47 of the 51 meter catchments were found to have infiltration rates that exceed established USEPA recommended guidelines. Figure 1-4 presents areas of the City's wastewater collection system that exceed the established USEPA infiltration guidelines.

Figure 1-4
City of Joplin Volume of Infiltration per Meter Catchment

CITY OF JOPLIN MISSOURI

BURNS McDONNELL



1.4 Metals Sampling and Analysis

Metals sampling was conducted concurrent with the flow monitoring, and at the same locations. Samples were taken during routine flow monitor maintenance visits and tested for zinc, lead, and copper. The top ten highest prioritized areas were visually compared to rainfall events recorded during the sampling period. Prioritization was based on incremental metal concentrations.

1.5 Metals Sampling Results

The lag time in rainfall peak and zinc loading peak may be indicative of groundwater influences. This is somewhat corroborated by the elevated loadings which are sustained over several weeks. Hydraulic modeling of flows and pollutants may provide clarification of the operational mechanisms causing the elevated readings.

1.6 Zinc Pollutant and I&I Rankings

The meter catchments were ranked in order of severity of I&I and recorded zinc loadings for the purposes of identifying cost-effective locations for proposed sewer improvements and rehabilitation.

Attachment 6. USGS Data

Date	Dissolved Zinc (µg/L)
11/2/1999	408
5/23/2000	336
7/26/2000	236
11/29/2000	377
5/23/2001	275
11/27/2001	199
5/21/2002	457
7/24/2002	383
11/6/2002	413
5/13/2003	382
7/8/2003	320
11/4/2003	304
5/11/2004	488
7/20/2004	255
11/16/2004	503
5/23/2005	150
7/25/2005	190
11/14/2005	257
5/24/2006	336
7/26/2006	168
11/13/2006	185
5/15/2007	443
7/11/2007	294
11/14/2007	306
5/5/2008	409
7/8/2008	356
10/6/2008	288
5/21/2009	413
7/15/2009	236
10/19/2009	468
5/17/2010	447
7/19/2010	164
10/4/2010	190
5/25/2011	630
7/7/2011	308
10/17/2011	252

Date	Dissolved Zinc (µg/L)
5/15/2012	294
7/9/2012	162
10/15/2012	317
5/13/2013	468
7/29/2013	294
10/21/2013	318
5/20/2014	227
7/30/2014	337
10/21/2014	412
5/13/2015	596
7/28/2015	236
10/28/2015	368
5/2/2016	397
7/13/2016	199
10/24/2016	317
5/16/2017	348
7/18/2017	264
10/3/2017	279
5/22/2018	258
7/24/2018	195
10/17/2018	317

Missouri Clean Water Commission
Department of Natural Resources
Elm Street Office Building
Roaring River/Bennett Springs Conference Rooms
1730 East Elm St.
Jefferson City, Missouri 65102

July 22, 2019

Open Comment Session

Issue:

This standing item provides an opportunity for comments on any issue pertinent to the Commission's role and responsibilities. The Commission encourages any and all interested persons to express their comments and concerns.
General Public

Recommended Action:

Information only.

Missouri Clean Water Commission
Department of Natural Resources
Elm Street Office Building
Roaring River/Bennett Springs Conference Rooms
1730 East Elm St.
Jefferson City, Missouri 65102

July 22, 2019

Future Meeting Dates

Information:

Missouri Clean Water Commission Meeting dates and locations:

October 9, 2019
Lewis and Clark State Office Building
1101 Riverside Drive
LaCharrette / Nightingale Conference Rooms
Jefferson City, MO 65101

January 9, 2020
Lewis and Clark State Office Building
1101 Riverside Drive
LaCharrette / Nightingale Conference Rooms
Jefferson City, MO 65101

April 2, 2020
Lewis and Clark State Office Building
1101 Riverside Drive
LaCharrette / Nightingale Conference Rooms
Jefferson City, MO 65101

July 8, 2020
Lewis and Clark State Office Building
1101 Riverside Drive
LaCharrette / Nightingale Conference Rooms
Jefferson City, MO 65101

October 7, 2020
Lewis and Clark State Office Building
1101 Riverside Drive
LaCharrette / Nightingale Conference Rooms
Jefferson City, MO 65101

Recommended Action:

Information only.

Missouri Clean Water Commission
Department of Natural Resources
Elm Street Office Building
Roaring River/Bennett Springs Conference Rooms
1730 East Elm St.
Jefferson City, Missouri 65102

July 22, 2019

Missouri Rural Water Association Wastewater Facility Tour

Issue: Randy Norden, Missouri Rural Water Association, would like to highlight wastewater technical assistance activities and trends – what is working, where the challenges are, and what is being overlooked. To provide the Clean Water Commissioners, and anyone else who may be interested, with the opportunity to view some wastewater facilities in the field, Mr. Norden has organized a tour of three facilities, this tour to take place after the Clean Water Commission meeting on July 22, 2019, has concluded.

The facility tour is open to the public, all are welcome to attend. It will not be considered a "public meeting" as defined by § 610.010(5), RSMo, because it is an informal gathering for ministerial and social purposes and because public business will not be decided, formally discussed, nor voted upon during that time.

Recommended Action: Information only

Attachments

Wastewater Treatment Facility Tour Itinerary

Organized by Randy Norden, Executive Director

Missouri Rural Water Association (MRWA)

417-988-9911 (cell), rnorden@moruralwater.org

The facility tour is open to the public, all are welcome to attend. It will not be considered a "public meeting" as defined by § 610.010(5), RSMo, because it is an informal gathering for ministerial and social purposes and because public business will not be decided, formally discussed, nor voted upon during that time.

The tour will begin at 1 pm and end at 4 pm from the 1730 E. Elm St. Conference Center. A bus is being provided by MO Rural Water. Water will be provided and restrooms will be available on the bus.

Drive time/location visit:

1:00 pm – bus leaves 1730 E. Elm St. for California

1:30 bus arrives at California WWTF

2:00 pm bus leaves California for Prairie Home WWTF

2:30 pm – bus arrives at Prairie Home WWTF

3:00 pm – bus leaves Prairie Home for Jamestown WWTF

3:30 pm – bus leaves Jamestown for Jefferson City, E. Elm St.

Two facilities, California and Jamestown will be viewed from the bus. The second facility, Prairie Home, will be a walking tour. Wear comfortable shoes for walking through grass. Wastewater technicians from MRWA will be available for questions, as well as representatives from the California WWTF, and the Mayor or a Council Member from Prairie Home WWTF. No representative will be available from the Jamestown WWTF.

Facility #1 – California Wastewater Treatment Facility (WWTF)

Description of facility – Bar screen/3-cell flow equalization basin/influent lift station/activated sludge basins/secondary clarifiers/sand filters/UV disinfection/sludge stabilization basin – sludge is land applied. This facility is an example of a wastewater system that is functioning correctly. A representative from California's WWTF will be available for questions and will continue on the tour to the other two sites.

Address – 32746 Theodore Rd., California, MO.

Driving directions – from 1730 E. Elm St – southeast to Eastland Dr., merge onto US-50 W , travel approximately 15 miles , take MO-87 ramp toward Eldon/California, turn left onto Hwy 87/MO-87, turn right onto Big Sky Rd (portions unpaved), take the 1st left onto Theodore Rd (portions unpaved), destination is on right. Approximately 36 minutes, 27.5 miles.

Facility #2 – Prairie Home Wastewater Treatment Facility

Description of facility – 3-cell lagoon/sludge stored in lagoon/wastewater is irrigated via center pivot. This facility is an example of a system that transitioned from a lagoon to a land application process.

Address – No 911 physical address for the facility.

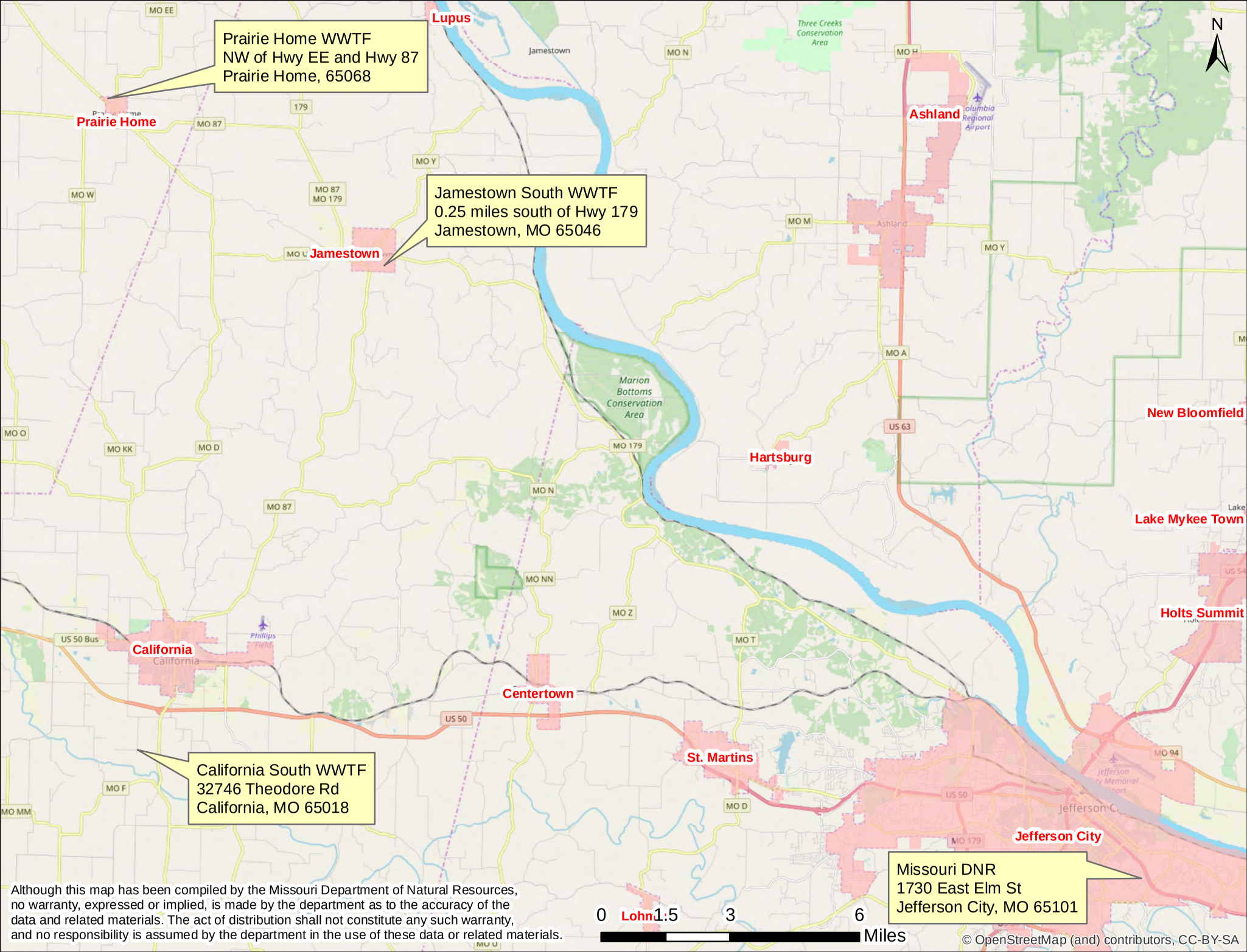
Driving directions – MRWA indicated this facility is .4 miles NW of Hwy EE and Hwy 87 junction (zip code 65068).

Facility #3 – Jamestown Wastewater Treatment Facility

Description of facility – Single-cell lagoon/sludge stored in lagoon. This facility is an example of the challenges small communities face to stay in compliance when their system is

Address – No 911 physical address for the facility

Driving directions – 0.25 miles south of Hwy 179 and School Ave. junction, just past the high school on the right (zip code 65046).



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