Missouri Clean Water Commission Meeting
Chateau on the Lake Resort
415 N. State Hwy. 265
Branson, Missouri

October 7, 2015

Multi-Discharge Variance for Ammonia

Issue: This is an informational only agenda item related to the work that the department has been conducting related to the creation of a multi-discharge variance for ammonia.

Background: In late July department staff public noticed a multi-discharge variance for ammonia framework. This document set forth justification, applicability criteria and timeframes for the variance. Comments were received and the framework was updated accordingly. The updated variance framework and response to comments will be provided to the Commission. Additionally staff will present to the Commission an overview of the multi-discharge variance for ammonia summarizing the comments received during the public notice. An update on the next steps in the process will be given as well.

Staff Recommendation: This item informational only.

List of Attachments:

- Revised Multi-discharge Variance Framework including public notice comments and responses:
  - Framework Document, Page 1
  - Appendix A: Highest Attaninable Effluent Conditions Analysis - Lagoon, Page 10
  - Appendix B: Multiple-Discharger Variance Application, Page 20
  - Appendix C: Highest Attainable Effluent Conditions Analysis – Media Filters, Page 41
  - Appendix D: Cost Analysis for Compliance, Page 47
  - Appendix E: Public Notice Comments and Responses, Page 56

Multiple-Discharger Variance Request CWC-MDV-1-15
State of Missouri
Department of Natural Resources

The Missouri Department of Natural Resources (department) is requesting a multiple-discharger variance for qualifying minor municipalities within the State of Missouri with a functional lagoon intended to facilitate compliance with water quality standards (WQS) for total ammonia nitrogen, as implemented through their National Pollutant Discharge Elimination System (NPDES) permit.

The applications submitted by the qualifying municipalities are pursuant to Section 644.061, RSMo. The request for the multiple-discharger variance is intended to cover minor municipalities that are Publicly Owned Treatment Works (POTW) within the State with a current technology of a lagoon that if upgraded to meet the WQS for total ammonia nitrogen, the residents of the municipality would experience a substantial and widespread economic and social impact. All facilities included within this multiple-discharger variance meet the design requirements of 10 CSR 20-8.020 (13)(A)2. and 10 CSR 20-8.200(5)(C-D).

Department Recommendation

The department recommends that the Missouri Clean Water Commission (CWC) approve the multiple-discharger variance for the selected communities based on the following justifications:

The Missouri Clean Water Commission is among other things, legally authorized to grant individual variance from the requirements of the Missouri Clean Water Law and the regulations adopted under Section 644 RSMo, unless a variance is prohibited by any federal water pollution control act. (See 644.061, RSMo)

The department believes that the granting this multiple-discharger variance will cause a long term sustainable benefit to the people and the environment without causing a substantial and widespread economic and social impact to the qualifying minor municipal dischargers. In order to meet the WQS for total ammonia nitrogen as shown in 10 CSR 20-7.031(5)(B)7.C. and 10 CSR 20-7 Table B3, economically distressed municipalities would be required increase the user rates of the residents to an amount over two percent (2%) of their median household income. The U.S. Environmental Protection Agency (EPA) published a guidance in 1995 titled; Interim Economic Guidance for Water Quality Standards, which states, "...if the average annual cost per household exceeds 2.0 percent of median household income, then the project may place an unreasonable financial burden on many of the households within the community."

The department does not believe that the effect of this multiple-discharger variance will permit the continuation of a condition that unreasonably poses a present or potential threat to human health or the environment. The multiple-discharger variance requires the highest attainable effluent conditions that can be achieved without causing widespread social and economic impact. The values for the highest attainable effluent conditions for total ammonia nitrogen were

determined as described in the attached fact sheet titled, Highest Attainable Demonstration for a Wastewater Lagoon (Appendix A). This analysis provides a detailed report of the approach to determine the highest attainable effluent conditions for total ammonia nitrogen with lagoon treatment. The department recommends the seasonal average benchmark for total ammonia nitrogen effluent concentrations to be 2.2 mg/L for the summer season and 3.2 mg/L for the winter season. Each municipality will receive a monthly sampling frequency and calculate the seasonal average in order to determine if the lagoon is meeting the seasonal benchmarks. The benchmark concentrations are not effluent limitations; benchmark exceedance, therefore, will not be considered a permit violation. However, failure to take reasonable action to achieve the benchmarks is a violation of the permit. Benchmark monitoring data is used to determine the overall effectiveness of the technology and to assist the permittee in knowing when additional corrective action(s) may be necessary to comply with the highest attainable effluent conditions established by this multiple-discharger variance. Staff from the department will routinely check the discharge monitoring reports of the permits under the MDV to ensure that the benchmark for the highest attainable effluent conditions is being met. Each monthly sample will be monitored by department staff. If staff notices the highest attainable effluent concentration has not been met for total ammonia nitrogen, a follow up call and/or visit will be made to the permit holder to determine the immediate actions that need to be made to meet the benchmark. The highest attainable effluent conditions have been determined to be feasible and affordable.

All facilities included within this multiple-discharger variance meet the design requirements pursuant to 10 CSR 20-8.020 (13)(A)2., and 10 CSR 20-8.200(5)(C-D).

It is the department's opinion that this multiple-discharger variance will not relieve any qualifying community from any liability imposed by any other provision of the Missouri Clean Water Law or other statutes of Missouri for the commission or maintenance of a nuisance. Each facility received an on-site verification engineer evaluation by department staff prior to qualifying for the multiple-discharger variance. This evaluation was completed in order to ensure that each lagoon had been designed and constructed in accordance with regulations (10 CSR 20-8.020) and has the potential to meet the highest attainable effluent conditions for total ammonia nitrogen. Additionally, each NPDES permit requires all facilities to follow general criteria listed in 20 CSR 7.031(4).

The department believes a 10-year time period is necessary and reasonable to mitigate the substantial and widespread economic and social impact caused by the requirement to meet WQS for total ammonia nitrogen (10 CSR 20-7.031(5)(B)7.C. and 10 CSR 20-7 Table B3). The ten year time period will allow the qualifying communities to maintain existing water quality protections while allowing time for the following; adaptive management approaches, advances in treatment technologies, control practices, evaluation and removal of inflow and infiltration, sludge removal, pursue an increase in residential user rates to an appropriate level to help mitigate substantial and widespread economic and social impact, and other changes in circumstances. The department has established the highest attainable effluent conditions for well-operated and maintained lagoon systems as the benchmarks described in Appendix A.

While each facility will be covered under this multiple-discharger variance, every facility will have an individual set of milestones necessary to ensure the highest attainable effluent conditions are met throughout the timeframe of the MDV. An annual report will be required of each municipality detailing each milestone that has been made during that year, including changes to

elected officials. The qualifying municipalities will be reviewed annually to ensure that the municipality has taken the appropriate steps to achieve the highest attainable effluent conditions and to establish responsible financial management goals in order to make the necessary wastewater treatment facility investments that will achieve the WQS for total ammonia nitrogen.

Examples of milestones are as follows:

- sludge removal,
- removal of inflow and infiltration,
- number of active connections,
- population increases or decreases,
- an increase of sales and/or property taxes,
- the steps taken to pursue an increase in user rates,
- if an election year has occurred a list and contact information of the newly elected officials, and
- status of commercial connections.

This variance request requires approval by EPA as it is a variance from Missouri WQS. The recent WQS amendment approved by the Commission states that a permittee or an applicant for a National Pollutant Discharge Elimination System (NPDES) for Missouri State Operating Permit may pursue a temporary variance to a WQS pursuant to either Section 644 RSMo. In order to obtain EPA approval for a WQS variance for purposes of the federal Clean Water Act, the following additional provisions apply (40 CFR 131):

1. "A variance applies only to the applicant identified in such variance and only to the water quality standard specified in the variance. A variance does not modify an underlying water quality standard."

This is a request to vary the water quality standards that apply to total ammonia nitrogen for the applicants listed in Appendices F - ? of this document. The water quality standards for total ammonia nitrogen will remain as stated in 10 CSR 20-7.031(5)(B)7.C. and 10 CSR 20-7 Table B3.

In Appendices F - ? each appendix contains the following for the qualifying municipality:

- Draft Missouri State Operating Permit and Fact Sheet for Public Notice,
- Department written cost analysis for compliance,
- Complete Multiple-Discharger Variance application
  - application page,
  - signed certification page,
  - Uses and Variances – Evaluating Substantial and Widespread Economic and Social Impacts spreadsheet,
  - alternatives analysis (discharge relocation, decentralization, regionalization), and
  - natural heritage review report indicating no threatened or endangered species will be impacted as a result of the multiple-discharger variance.

2. "A variance shall not be granted if water quality standards will be attained by implementing technology-based effluent limits required under 10 CSR 20-7.015 of this rule and by implementing cost effective and reasonable best management practices for nonpoint source control."

The qualifying municipalities within this multiple-discharger variance currently have a lagoon that is capable of meeting the technology based effluent limits listed in 10 CSR 7.015. However, it is well documented that meeting the technology based effluent limits for biochemical oxygen demand, total suspended solids and pH may not provide sufficient treatment necessary to reduce the amount of total ammonia nitrogen in the effluent to meet WQS.

The WQS for total ammonia nitrogen are not attainable through nonpoint source control. Each treatment works that is covered under this multiple-discharger variance does not receive excessive inflow and infiltration as defined by 40 CFR 133.103 (d)(3). (see Appendices F –?))

3. "A variance shall not be granted that would likely jeopardize the continued existence of any endangered or threatened species listed under section 4 of the Endangered Species Act or result in the destruction or adverse modification of such species' critical habitat."

It is not anticipated that the granting of this multiple-discharger variance to qualifying municipalities will jeopardize threatened or endangered species or result in the destruction or adverse modification of such species' critical habitat. All communities that qualify for the multiple-discharger variance have provided results from a Natural Heritage Review of the facility and the discharge location indicating that no federally-listed and state-listed threatened or endangered species (including those proposed for listing) or critical habitat (designated or proposed) is known to occur at or near the site of discharge. If the results show that a federally-listed and/or state-listed threatened or endangered species and/or their critical habitat is currently at or near the location of discharge, the qualifying municipality has provided a list of the threated or endangered species (including those proposed for listing) and the justifications of why the issuance of the multiple-discharger variance does not jeopardize their continued existence and/or the existence of their habitat. (see Appendices F –?))

4. "A variance may be granted if the applicant demonstrates that achieving the water quality standards is not feasible as supported by an analysis based on the factors provided in 40 CFR 131.14(b)(2)(i), or other appropriate factors."

The basis for this multiple-discharger variance request is 40 CFR §131.10(g) Factor 6, in that meeting the WQS for total ammonia nitrogen would result in substantial and widespread economic and social impact. Each qualifying municipality has received a Cost Analysis for Compliance (CAFCom) written by the department that concludes the residents of the community will incur a "high financial burden" and will result in residential user rates greater than two percent (2%) of the municipality's median household income in order to comply with the WQS for total ammonia nitrogen. The estimated costs within the CAFCom include treatment technologies that will meet a total ammonia nitrogen monthly average of 0.6 mg/L and a daily maximum of 1.7 mg/L. The department written CAFCom uses CapDet to estimate the cost for the following treatment technologies: an extended aeration package plant, an extended aeration

with triangular basin, an extended aeration oxidation ditch, and sequencing batch reactor as well as a no discharge option of a land application system (See Appendix D for details). In support of the department's CAFCom, each qualifying community has completed the EPA written Uses and Variances – Evaluating Substantial and Widespread Economic and Social Impacts: Public Sector Entities spreadsheet which is from *EPA's 1995 Interim Economic Guidance for Water Quality Standards (1995 Guidance)* with a result stating "impact is likely to be substantial." Each community has also completed an alternatives analysis which consisted of determining the estimated costs to decentralize the utility, the estimated cost to regionalize, and the estimated cost to relocate the outfall to a receiving stream with appropriate mixing considerations in order to meet the WQS for total ammonia nitrogen. The estimated cost for regionalization and discharge relocation include the estimated costs of pipes, manholes, pump stations and an effluent forcemain. The alternatives analysis is provided by the qualifying communities and indicates that each alternative option will also result in residential user rates that will cause a substantial and widespread economic and social impact. (see Appendices F –?)

5. "In granting a variance, conditions and time limitations shall be set by the department with the intent that progress be made toward attaining water quality standards."

The department believes a 10-year time period is necessary to mitigate the substantial and widespread economic and social impact caused by the requirement to meet WQS for total ammonia nitrogen. The ten year time period allows the qualifying municipalities to maintain existing water quality protections in order to comply with the benchmark values that the department has established as the highest attainable effluent conditions for total ammonia nitrogen that a lagoon can meet. The highest attainable effluent conditions for total ammonia nitrogen capable of well operated and maintained lagoons were determined by the department to be seasonal averages of 2.2 mg/L for the summer season and 3.2 mg/L for the winter season. (See Appendix A) All municipalities have committed to maintain their existing lagoon infrastructure during the ten year timeframe of this multiple-discharger variance in accordance with the facility design requirements pursuant to 10 CSR 20-8.020 (13)(A)2. and 10 CSR 20-8.200(5)(C-D). None of the treatment works listed within this multiple-discharger variance receive excessive inflow and infiltration as defined in 40 CFR 133.103 (d)(3).

The department believes allowing a community with substantial socioeconomic challenges a ten year time period to maintain their existing infrastructure, and responsibly plan for investments related to wastewater infrastructure will ultimately achieve higher water quality at the point of discharge. The qualifying municipalities have committed to pursuing an increase to their current residential user rates to an appropriate level to help mitigate substantial and widespread economic and social impact on or before year five of this multiple-discharger variance. This will allow each municipality an opportunity to build capital to put towards an upgrade, decentralization and/or close the existing infrastructure if an alternative to meet the WQS is known at that time. After the variance expires each qualifying municipality will receive a schedule of compliance within their NPDES permit to meet WQS or, if necessary, the community can re-apply for a variance. Upon expiration of the MDV any consideration for future variance will be under a new variance term and condition thus requiring both CWC and EPA approval.

6. "Each variance shall be granted only after public notification and opportunity for public comment. Once any variance to water quality standards is granted, the Department shall submit the variance, with an Attorney General Certification that the Clean Water Commission adopted the variance in accordance with state law, to the U.S. Environmental Protection Agency for approval."

The multiple-discharger variance application, alternatives analysis, Natural Heritage Review completed by the Missouri Department of Conservation, the EPA written Uses and Variances – Evaluating Substantial and Widespread Economic and Social Impacts: Public Sector Entities spreadsheet (Factor 6 evaluation spreadsheet), department-written CAFCom, and department recommendation will be placed on the department's website for public notice for a period of 30 days. The multiple-discharger variance and responses to comments will be provided to the Commission for their decision and forwarded to the Missouri Attorney General for certification. The multiple-discharger variance and supporting documentation will then be forwarded to EPA for approval.

USEPA has approved the use of variance when the state demonstrates that the following items are fulfilled:

1. There are individual variance provisions included in WQS.

Variance approval language is in WQS at 10 CSR 20-7.031(12). The EPA's regulations do not require states to have a variance authorizing provision in their WQS in order to issue variances. States can issue variances under their existing authority to adopt WQS and submit them to EPA for approval.

2. The variance is subject to the same public review as other changes in WQS.

Section 303(c) of the CWA and the applicable federal regulations at 40 CFR § 131.20 describe the states' requirement to hold a public hearing for the purpose of reviewing WQS and notes that the information should be made available to the public prior to the hearing for the purpose of reviewing WQS. It is EPA's belief that variances from WQS require the same opportunity for public review and comment. Prior to accepting applications, the department placed the framework for the multiple-discharger variance on public notice for 30 days. Comments were received and answered through a formal process. At the October, 2015 CWC meeting, the department will present the MDV framework recommendation, along with the public notice comments and responses. Once the facilities that qualify for the multiple-discharger variance have submitted a complete application, the department will place the Multiple-Discharger Variance along with appendices F - ? on public notice for 30 days. At the January 6, 2016 CWC meeting, the department will present the final MDV recommendation, along with the public notice comments and responses. Once approved, the department will seek approval from EPA.

This multiple-discharger variance will be subject to additional public review during the next WQS triennial review as well as subsequent triennial reviews conducted by the department until the multiple-discharger variance expiration.

3. Meeting the WQS is unattainable based on one or more of the factors listed in 40 CFR § 131.10(g) for removing the designated use.

As described in Section 5.3 of the EPA Water Quality Standards Handbook (Second Edition, 1994), variances from WQS involve the same substantive and procedural requirements as removing a designated use, but specifically identify the applicable discharger(s), pollutant(s), and time limit. The substantive and procedural requirements include a use attainability demonstration identifying one of the factors listed in federal regulations (40 CFR § 131.10(g)) for removing a designated use and target achievement of the stream's highest attainable use and the associated criteria during the variance period. As described above, the basis for this variance request is 40 CFR § 131.10(g) Factor 6, meaning each qualifying municipality has submitted justification that complying with the total ammonia nitrogen WQS would result in a widespread economic and social impact. The multiple-discharger variance application includes the following for each community: the department written CAFCom, the community completed alternatives analysis, and the community completed Uses and Variances – Evaluating Substantial and Widespread Economic and Social Impacts: Public Sector Entities spreadsheet (Factor 6 evaluation spreadsheet). Each of these documents describes in detail each municipality's unique financial situation and how the WQS for total ammonia nitrogen would cause a substantial and widespread economic and social impact. (see Appendices F - ?)

4. The variance secures the highest level of water quality attainable short of achieving the standard.

This multiple-discharger variance has been sought since the technologies available to meet the WQS for total ammonia nitrogen, specifically 10 CSR 20-7.031(5)(B)7.C. and 10 CSR 20-7 Table B3, would cause substantial and widespread economic and social impact. The technologies that the department currently estimates the cost for within our CAFCom are: an extended aeration oxidation ditch, sequencing batch reactor, extended aeration with triangular basin and an extended aeration package plant. All technologies listed have the capability to meet the current WQS and the future WQS (where mussels of the family Unionidae are present or expected to be present) for total ammonia nitrogen. There is also an opportunity to convert to a no discharge land application system. Each community has also completed an alternatives analysis which analyzes the estimated costs of decentralization of the wastewater utility, relocation of the outfall, and regionalization. However, each qualifying municipality has provided significant information to show the cost of the preceding technologies and alternatives would result in substantial and widespread economic and social impact. (see Appendices F - ?)

The department has determined the highest attainable effluent conditions to be seasonal averages of 2.2 mg/L for summer and 3.2 mg/L for winter as described in the attached fact sheet titled, Highest Attainable Demonstration for a Wastewater Lagoon (Appendix A). The highest attainable effluent conditions will be required within the MSOP permit as a seasonal benchmark with monthly sampling requirements, as explained above.

The ten year variance will allow each municipality time to work on improving their existing infrastructure while working toward the goal of responsible financial planning to make informed decisions on future improvements or plans to upgrade, decentralize, regionalize or another alternative that will be known at that time. Each qualifying municipality will commit to pursuing

an increase in residential user rates to an appropriate level to help mitigate substantial and widespread economic and social impact by the end of the fifth year of the multiple-discharger variance. Each municipality will commit to maintaining the design guidelines for optimization of lagoon treatment.

5. That advanced treatment and alternative effluent control strategies have been considered.

The qualifying communities for this multiple-discharger variance do not have the financial capabilities to consider advanced treatments, as the basis for this multiple-discharger variance application is 40 CFR § 131.10(g) Factor 6. The qualifying communities have provided the department with justifications of why alternative control strategies are not feasible for their communities (see Appendices F - ?). The alternative control strategies considered by each municipality, included are but not limited to: relocation of the existing outfall to a receiving stream that has the loading capacity in which the discharge will not cause an excursion of WQS, decentralization of the utility, and regionalization of the utility.

Variance Timeframe:

The timeframe for this multiple-discharger variance shall be for ten years, beginning upon variance incorporation in the qualifying communities' NPDES permit. The timeframe as well as other aspects of this variance are subject to review during each WQS triennial review during the duration of this multiple-discharger variance. The MDV framework is to act as a general guide for the site specific permits that will be under the variance for total ammonia nitrogen. Each site specific permit under the MDV will have requirements specific to their facility and financial situation within their issued Missouri State Operating Permit (MSOP). The specific requirements/ milestones written within the MSOP will ensure the highest attainable effluent conditions for the receiving stream during the 10 year timeframe of the MDV.

If during review of the annual report, department staff notice that the municipality has failed to maintain the highest attainable effluent conditions for total ammonia nitrogen and has not implemented additional actions in order to meet and maintain the highest attainable effluent conditions, the community will no longer qualify for the multiple-discharger variance and will receive the current WQS for total ammonia nitrogen and applicable schedules of compliance in their NPDES permit at that time.

Cost Analysis for Compliance (CAFCom):

The CAFCom is based on data available to the department as provided by the permittee and data obtained from readily available sources. For the most accurate analysis, it is essential that the permittee provides the department with current information about the City's financial and socioeconomic situation. The permittee provides the department with a completed financial questionnaire during the renewal application process. The department uses software to estimate the cost for reconstruction of a treatment plant titled CAPDETWORKS (CapDet). CapDet is a preliminary design and costing software program from Hydromantis for wastewater treatment plants that uses national indices, such as the Marshall and Swift Index and Engineering News

Records Cost Index for pricing in development of capital, operating, maintenance, material, and energy costs for each treatment technology. CapDet is used to estimate the cost to construct and install an extended aeration oxidation ditch, an extended aeration package plant, an extended aeration with triangular basin, a sequencing batch reactor, as well as a no discharge land application system. The CAFCom incorporates eight criteria regarding the community's financial capabilities, project user rates as a percentage of the residential median household income, socioeconomic data and other relevant information. The Financial Capability Matrix as described in USEPA's 1997 Combined Sewer Overflows Guidance for Financial Capability Assessment and Schedule Development is used within the document to evaluate the level of financial burden the upgrade could potentially place on a community. The department uses all information within the CAFCom to determine the financial burden the residents of the community may endure as a result of the new requirements of the permit. An appropriate schedule of compliance to meet the final effluent limits is derived once the financial burden has been determined. Each permit (Appendix section F - ?) has been drafted with a CAFCom that concludes the upgrades necessary to comply with the final effluent limits will result in a "High Burden" with projected user rates above 2 % of the residential median household income. Please see Appendix D for more details on Missouri's Cost Analysis for Compliance.

Additional Consideration:

If, during the term of this multiple-discharger variance, less expensive pollution control technology is developed and determined to be technologically and economically feasible, the department will evaluate and consider options associated with the additional pollution controls. Consideration must be given if prohibitive upgrades and financial commitments have occurred on the part of the City as set forth in the permit or this variance. Also, a community that qualifies for the MDV utilizing financial information prior to receiving grant funding will have MDV applicability re-evaluated upon the receipt of grant funding. If the receipt of grant funding changes the indication of widespread and substantial social and economic impacts for any alternative, MDV applicability would be in question.

Highest Attainable Demonstration for a Wastewater Lagoon

Intent

Wastewater pond systems (lagoons) are an important wastewater treatment technology in terms of cost effectiveness and operational viability. Lagoons that are properly designed, operated, and maintained can be protective of water quality where instream assimilative capacity exists. The intent of this memo is to establish highest attainable effluent conditions for ammonia to support the multiple-discharge variance request for disadvantaged communities that will experience a substantial and widespread economic and social burden with respect to costs associated with compliance with total ammonia nitrogen water quality standards. Many of the existing neglected systems can pose a threat to surface water. Therefore, it is imperative that the highest attainable effluent conditions are established to protect the highest attainable water quality.

The analysis below provides a detailed report of the approach to determine the highest attainable effluent conditions for total ammonia nitrogen. The department recommends the benchmark for total ammonia nitrogen effluent concentrations to be 2.2 mg/L for the summer season and 3.2 mg/L for the winter season.

Statement of Issue

Small communities have a small rate base and lack the funds to build and maintain advanced treatment system, such as activated sludge, to achieve the current and EPA recommended ammonia water quality criteria within the time period afforded by a compliance schedule.

The U.S. Environmental Protection Agency (EPA) published a wastewater ponds design and operation manual in 2011 which describes their finding of performance achievements associated with design details that might be employed for existing lagoons. Possible improvements include sludge removal and enhanced aerations. EPA has stated their support for lagoons as a treatment option particularly for communities that could not afford to match even the construction grants that were offered at that time to bring communities of all sizes some level of wastewater treatment.

Highest Attainable Determination Approach

The department's approach utilizes the most recent design document published by EPA in 2011, entitled "Principles for Design and Operations for Wastewater Treatment Pond Systems for Plant Operators, engineers, and managers" (EPA/600/R-11/088). EPA recognizes that well designed lagoons provide reliable, low cost, and relatively low maintenance wastewater treatment for municipalities. Although the basic design of lagoons has not changed for the last 30 years, the

department has also examined some of the innovations and improvements in light of the economic considerations. This document will allow communities that are struggling financially to make the most cost effective improvements to their wastewater treatment facilities and achieve the highest attainable effluent conditions during the period of the multiple-discharger variance. It is expected that these treatment improvements will not result in degradation to existing water quality, but instead will improve water quality by allowing disadvantaged municipalities time to utilize their existing infrastructure at a level that produces the highest attainable effluent conditions. This approach will allow these communities time to financially prepare for future upgrades or other alternatives available after the variance expires. This determination is not intended to address facilities that discharge to waters that are on the 303(d) list or where a Total Maximum Daily Load (TMDL) is developed.

Lagoon Enhancement Options

There are a number of emerging technologies for retrofitting lagoon systems to address ammonia. These systems involve various ways of adding oxygen, increasing biomass, covering to retain heat, and using various configurations and equipment to provide areas within the lagoon for fixed film growth. Several of these systems are being piloted in Missouri. However, all of these technologies are associated with considerable expense. For the universe of smaller lagoon systems that are being addressed by the multiple-discharger variance, land application systems have proven to be less expensive than these enhanced options. The department expects the technology of lagoon enhancements will continue to evolve, but at this time the department is not aware of any that will reliably meet water-quality based ammonia limits that are universally affordable.

Discussion on Types of Lagoons

EPA sponsored studies on nitrogen removal in both facultative and aerated lagoons. Ammonia removal in lagoons can be carried out through volatilization, assimilation into algal biomass, and biological nitrification. Nitrogen removal is dependent upon pH, detention time, and temperature. Data from these studies show that the reduction of ammonia increases when pH exceeds 8.0. However, as pH increases the amount of un-ionized ammonia, which is toxic to fish, increases. Inadequate detention time is believed to be a major factor in poor ammonia removal. According to the EPA, typical detention times range from 20 to 180 days for facultative lagoons and 10 to 20 days for aerated or partial mix lagoons. Temperature is not a factor which can easily be manipulated for ammonia removal in lagoons.

Facultative lagoons are effective in removing settleable solids, BOD, pathogens, fecal coliform, and, to a limited extent, ammonia. They are easy to operate and require little energy. Due to their shallow design depth, a large amount of land is required to construct a facultative lagoon and sludge accumulation tends to be higher than deeper systems. Ammonia levels fluctuate in facultative lagoons. Increasing the surface area of the facultative pond will improve the performance of the system. A well operating facultative lagoon can achieve and occasionally exceed 90% ammonia removal.

Aerated lagoons can provide significant nitrification of ammonia if they provide adequate resident time. They are typically shallow, allowing light to penetrate the full depth. Oxygen is provided by photosynthesis and surface reaeration. Mechanical oxygen addition can allow for more treatment in less space. Nitrogen can undergo a number of chemical and physical processes. Ammonia removal in aerated lagoons varies depending on detention time and typically is not as effective as facultative lagoons because they are operated with less detention time and the conditions favor heterotrophic bacteria instead of nitrifiers.

Lagoon Design Guide Sizing (10 CSR 20-8.020(13)(A)2. or 10 CSR 20-8.200(5)(C-D)

Facultative lagoons are designed for a minimum of 120 day total storage. The first cell must be designed with a minimum surface area at 3 foot depth based on Biochemical Oxygen Demand (BOD) loading of 34 pounds per acre. BOD is assumed to be 0.17 pounds per person. The minimum area ratio of the second and third cell to the first is 0.3 and 0.1 respectively with a minimum surface area requirement of 1000 ft^2.in the third cell. This surface area will normally equate to about 90 days detention time in the first cell with about 25 days in the second and 5 in the third cell, Facultative lagoons normally have a depth between three and six feet in the first and second cells with a depth of up to eight feet in the third cell.

On lagoons that have been in operation for over twenty years, measurement of the sludge depth is required, as sludge removal is recommended when the sludge depth is greater than 1/3 of the operating depth of the lagoon cell. Most lagoons are constructed with an inside berm slope of three horizontal to one vertical. Lagoons are designed to meet equivalent-to-secondary effluent limitations for BOD and total suspended solids and with this treatment is limited ammonia removal, but no actual design criteria for ammonia treatment.

In Table A-1 and summarized below is a table of approximate sizes of a three-cell lagoon treatment system. The assumptions used in the calculations were 3:1 berm slopes, 2:1 length to width, and 5.5 foot water depth. Although actual dimensions of individual lagoon systems vary, the actual volumes and surface areas of the lagoons should be comparable with the calculated values for surface areas and volumes. The first cell surface area is based on the three-foot water depth. The surface areas of the second and third cells are the top operating depth water levels.

Design		First Cell		Second Cell		Third Cell	
Pop Equiv.	Flow (gpd)	Surface Area (ft^2)	Volume (gal)	Surface Area (ft^2)	Volume (gal)	Surface Area (ft^2)	Volume (gal)
100	10,000	21,780	891,524	8,100	247,848	2,700	51,189
200	20,000	43,560	1,768,563	15,128	510,979	5,043	120,132
300	30,000	65,340	2,658,452	22,110	739,060	7,370	194,511
400	40,000	87,120	3,549,304	29,021	973,187	9,674	271,281
500	50,000	108,900	4,440,773	35,888	1,218,563	11,963	349,578
600	60,000	130,680	5,332,679	42,722	1,474,897	14,241	428,961
750	75,000	163,350	6,671,137	52,931	1,861,211	17,644	549,519
1,000	100,000	217,800	8,903,025	69,863	2,508,470	23,288	753,238
1,500	150,000	326,700	13,369,441	103,534	3,810,976	34,511	1,167,220

Aerated lagoons are normally smaller and only have two cells. The first cell normally has approximately 44 days of storage volume. Aerated cells shall be followed by a polishing cell with a volume of 0.3 of the volume of the aerated cell. Therefore the volumes of an aerated lagoon are about half the volumes listed of the first two cells in the table above or Appendix A. The design guide differs on the actual volumes with the second cell of small lagoons being smaller in accordance with 10 CSR 20-8.020(13)(A)2.B. and the first cell of large lagoons being

smaller in accordance with 10 CSR 20-8.200(5)(D). Aeration equipment must be sized for 1.3 pounds of oxygen per pound of BOD and to maintain a dissolved oxygen level of two milligram per liter in the aerated cell. Again, note the design guide does not have criteria for ammonia treatment. Minimum size for mechanical aerators is ten horsepower per million gallons in the aerated cell. Oxygen transfer efficiency of the aeration equipment must be accounted for.

Other Lagoon Design Guide Requirements (10 CSR 20-8.020(13)(A)3.- 6. or 10 CSR 20-8.200(6)):

1. Lagoon seal constructed of compacted clay soil or other impermeable material.
2. Diversion of surface water runoff from the lagoon via berms, ditches, terraces, etc.
3. Berm Height provides two feet of freeboard above water level.
4. Regular mowing of lagoon area, which has good vegetated cover. No deep rooted vegetation.
5. Transfer and discharge piping must withdraw below water surface to prevent discharge of scum or floating materials.

Development of Benchmark Limits

The department is currently unaware of any suitable or accepted method to determine the highest attainable effluent conditions for total ammonia nitrogen for lagoons. This analysis examines current lagoon performance in an attempt to determine the highest attainable effluent conditions for total ammonia nitrogen that a well operating lagoon could achieve. Total ammonia nitrogen, total suspended solids (TSS) and biochemical oxygen demand (BOD) effluent concentrations from discharge monitoring report (DMR) data reported by publically owned Missouri lagoons with design flows of less than 150,000 gallons per day were gathered into a dataset. While the final multiple-discharger variance will not have a limit on flow, 150,000 gallons was used for the data analysis because it was assumed that municipalities with smaller lagoons would be in need of the variance and the data from these lagoons would provide the most accurate scenario of the highest attainable effluent conditions. All facility types included in the dataset of 143 facilities can be found in Table A-3. The dataset did not include any facilities that had an additional treatment system that the department is aware of. Several communities throughout Missouri are facing new water quality requirements for ammonia that were not factored into design specifications when many of the existing ponds were constructed. It is assumed that the existing ponds provided some ammonia treatment when they were initially constructed, but over time as sludge built up in their systems, ammonia removal effectiveness decreased. According to Metcalf and Eddy[1], total concentrations of organic and ammonia nitrogen in municipal wastewaters is typically in the range from 25 to 45 mg/L as nitrogen based on a flowrate of 380 L/capita·d (100

[1] Metcalf & Eddy, Inc., *Wastewater Engineering: Treatment and Resource Recovery.* 5th ed. (New York: McGraw Hill Education, 2003), 618.

gal/capita·d). Therefore, in this data analysis, an influent ammonia concentration of 35 mg/L was assumed.

The entire lagoon DMR dataset was evaluated using only the monthly average concentrations for Ammonia. The monthly average was chosen because several of the facilities in this data set are small facilities, which typically only collect samples once a month. While effluent limits are often based off of monthly averages and daily maximums, there was not enough data to generate daily limits. The effluent concentrations had a range from 0 milligrams per liter (mg/L) to 83.4 mg/L of ammonia and an average of 5.2 mg/L. The data was then organized by facility and averaged. The averages of all of the facilities were then evaluated and found to have a range from 0.1 mg/L to 28 mg/L and an average of 4.8 mg/L
Current ammonia effluent limits utilized by the department are based on seasons, with summer being from April to September and winter being from October to March. Since the goal of this technical review is to determine benchmark effluent limits, the original dataset was organized and divided into these two season categories, separated by facility, and then averaged. In the summer averages dataset, which was made up of 131 facilities, the minimum was 0.1 mg/L, the average was 3.1 mg/L and the maximum was 20 mg/L. The winter averages dataset had 136 facilities and a minimum of 0.1 mg/L, an average of 6.2 mg/L and a maximum of 39.9 mg/L.

The data was then narrowed down further with only those facilities that have DMR data within compliance for BOD and TSS being included in the dataset. In order to determine if a facility was in compliance with BOD and TSS limits the monthly average effluent concentrations reported in the DMR were organized by facility and averaged and then evaluated against the BOD limit of 45 mg/L and the facility's respective TSS limits given in the DMR report, which ranged from 30 mg/L to 80 mg/L. Any facility that had an average that exceeded the limits for either BOD or TSS was removed from both the summer and winter datasets. It was found that 7 of the 143 facilities evaluated, or 4.9%, were out of compliance with either BOD or TSS. The summer averages dataset now only included 127 facilities, but still had the same range of 0.1 mg/L to 20 mg/L and now an average of 3.2 mg/L. The winter dataset was reduced to 130 facilities and also had the same range of 0.1 mg/L to 39.9 mg/L, but averaged 6.3 mg/L.

In an attempt to get a better representation of the highest attainable effluent conditions for lagoons the dataset was narrowed down to only include facilities with average effluent concentrations below 10 mg/L. A concentration of 10 mg/L was used because it is known that lagoons can achieve single digit effluent concentrations of ammonia. Graphs A-1 through A-4 display an example of the facilities that can consistently meet total ammonia nitrogen levels of lower than 10 mg/L. This removed 10 facilities out of the 127 facilities in the summer dataset, or 8%, and 25 facilities out of the 130 facilities in the winter dataset, or 19%. The removal of these facilities does not mean that they will not be eligible for the multiple-discharger variance, but were removed in an attempt to determine the highest attainable effluent conditions or total ammonia nitrogen a lagoon can achieve. The summer dataset had a range from 0.1 mg/L to 8.6 mg/L and an average of 2.2 mg/L. The winter dataset had a range from 0.1 mg/L to 9.5 mg/L and an average of 3.2 mg/L. The percentile breakdown of this dataset can be found in Table A-4. Also, the dataset only included facilities near or in compliance for TSS and BOD and had average effluent ammonia concentrations less than 10 mg/L, which is known to be achievable for lagoons.

It is the department's opinion that though the final average ammonia values are suitable for the multiple-discharger variance due to the fact that they are based off of current lagoon performance and are seasonally based in the same manner as current water quality standards.

In conclusion the department recommends a benchmark for total ammonia nitrogen effluent concentrations of 2.2 mg/L for the summer season and 3.2 mg/L for the winter season.

Table A-1: Approximate Lagoon Sizing for Three-Cell Lagoon

Three-Cell Lagoon (Based on Design Guides – 10 CSR 20-8)

Design		First Cell		Second Cell		Third Cell	
Pop Equiv.	Flow (gpd)	Surface Area (ft^2)	Volume (gal)	Surface Area (ft^2)	Volume (gal)	Surface Area (ft^2)	Volume (gal)
50	5,000	10,890	452,766	4,455	118,812	1,485	25,075
100	10,000	21,780	891,524	8,100	247,848	2,700	51,189
150	15,000	32,670	1,324,209	11,594	378,611	3,865	84,407
200	20,000	43,560	1,768,563	15,128	510,979	5,043	120,132
250	25,000	54,450	2,213,353	18,630	619,754	6,210	156,938
300	30,000	65,340	2,658,452	22,110	739,060	7,370	194,511
350	35,000	76,230	3,103,785	25,572	852,092	8,524	232,666
400	40,000	87,120	3,549,304	29,021	973,187	9,674	271,281
450	45,000	98,010	3,994,975	32,459	1,090,866	10,820	310,272
500	50,000	108,900	4,440,773	35,888	1,218,563	11,963	349,578
550	55,000	119,790	4,886,679	39,308	1,346,588	13,103	389,153
600	60,000	130,680	5,332,679	42,722	1,474,897	14,241	428,961
700	70,000	152,460	6,224,916	49,533	1,732,234	16,511	509,165
800	80,000	174,240	7,117,416	56,324	1,990,366	18,775	590,020
900	90,000	196,020	8,010,131	63,100	2,249,146	21,033	671,406
1,000	100,000	217,800	8,903,025	69,863	2,508,470	23,288	753,238
1,100	110,000	239,580	9,796,072	76,614	2,768,258	25,538	835,450
1,200	120,000	261,360	10,689,253	83,356	3,028,447	27,785	917,991
1,350	135,000	294,030	12,029,237	93,453	3,419,379	31,151	1,042,333
1,500	150,000	326,700	13,369,441	103,534	3,810,976	34,511	1,167,220
1,750	175,000	381,150	15,603,519	120,306	4,464,862	40,102	1,376,367
2,000	200,000	435,600	17,838,012	137,048	5,120,003	45,683	1,586,544
2,250	225,000	490,050	20,072,844	153,765	5,776,171	51,255	1,797,561
2,500	250,000	544,500	22,307,960	170,461	6,433,197	56,820	2,009,282

Table A-2: Approximate Lagoon Sizing for One- and Two-Cell Lagoons

Alternate Lagoons – One- and Two-Cell Lagoons (Not per Design Guides – 10 CSR 20-8)

Design		Two-Cell Lagoon				One-Cell Lagoon	
		First Cell		Second Cell		Single Cell	
Pop Equiv.	Flow (gpd)	Surface Area (ft^2)	Volume (gal)	Surface Area (ft^2)	Volume (gal)	Surface Area (ft^2)	Volume (gal)
50	5,000	10,890	493,590	4,560	108,307	10,890	600,000
100	10,000	21,780	982,333	8,100	228,684	21,780	1,200,000
150	15,000	32,670	1,471,077	11,969	369,063	32,670	1,800,000
200	20,000	43,560	1,959,820	15,556	503,804	43,560	2,400,000
250	25,000	54,450	2,448,563	19,105	639,961	54,450	3,000,000
300	30,000	65,340	2,937,306	22,627	777,123	65,340	3,600,000
350	35,000	76,230	3,426,049	26,129	915,047	76,230	4,200,000
400	40,000	87,120	3,914,793	29,614	1,053,573	87,120	4,800,000
450	45,000	98,010	4,403,536	33,086	1,192,592	98,010	5,400,000
500	50,000	108,900	4,892,279	36,547	1,332,023	108,900	6,000,000
550	55,000	119,790	5,381,022	39,999	1,471,806	119,790	6,600,000
600	60,000	130,680	5,869,765	43,442	1,611,894	130,680	7,200,000
700	70,000	152,460	6,847,252	50,308	1,892,840	152,460	8,400,000
800	80,000	174,240	7,824,738	57,151	2,174,638	174,240	9,600,000
900	90,000	196,020	8,802,225	63,975	2,457,133	196,020	10,800,000
1,000	100,000	217,800	9,779,711	70,783	2,740,210	217,800	12,000,000
1,100	110,000	239,580	10,757,197	77,578	3,023,784	239,580	13,200,000
1,200	120,000	261,360	11,734,684	84,361	3,307,789	261,360	14,400,000
1,350	135,000	294,030	13,200,913	94,518	3,734,491	294,030	16,200,000
1,500	150,000	326,700	14,667,143	104,655	4,161,906	326,700	18,000,000
1,750	175,000	381,150	17,110,859	121,514	4,875,577	381,150	21,000,000
2,000	200,000	435,600	19,554,575	138,338	5,590,594	435,600	24,000,000
2,250	225,000	490,050	21,998,291	155,131	6,306,712	490,050	27,000,000
2,500	250,000	544,500	24,442,007	171,900	7,023,750	544,500	30,000,000

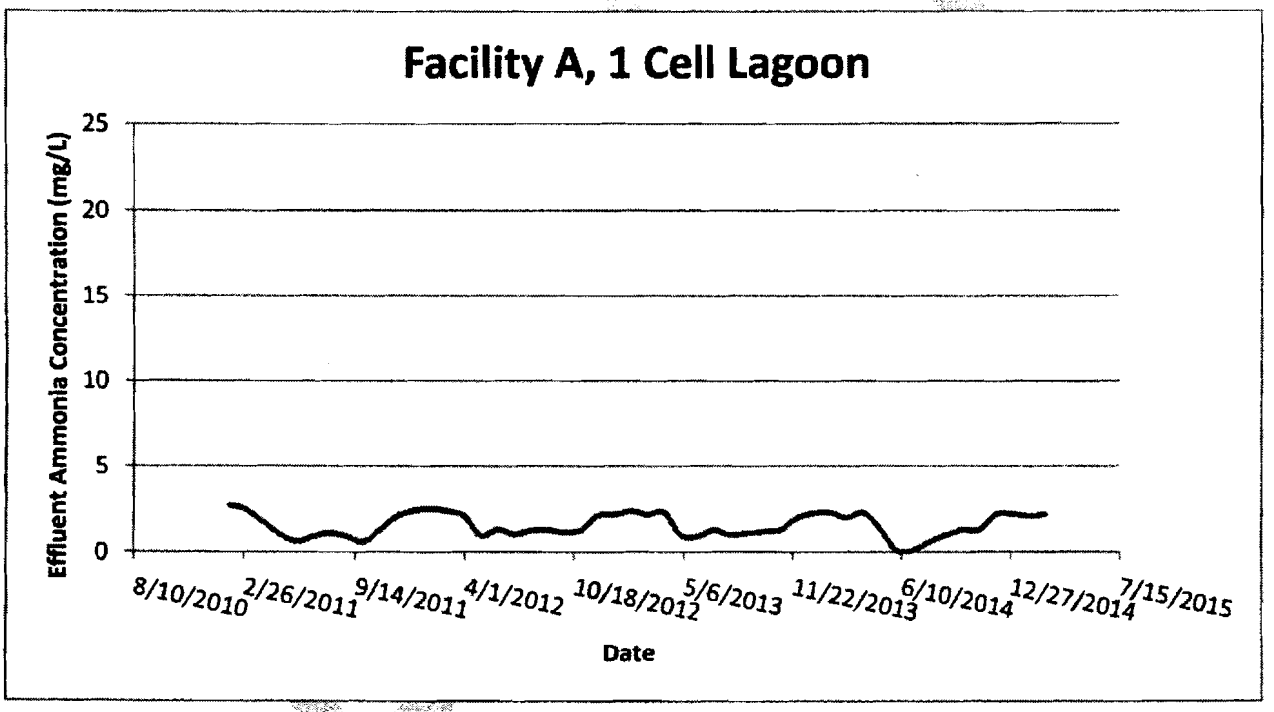
Assume
3:1 side slopes
2:1 Length to Width
6 foot depth for Two-Cell Lagoon
Minimum Surface Area of First Cell calculated based on
10 CSR 20-8.020(13)(A)2.A. or 8.200(5)(C)

Table A-3: Types of Facilities Included in Lagoon Data Analysis

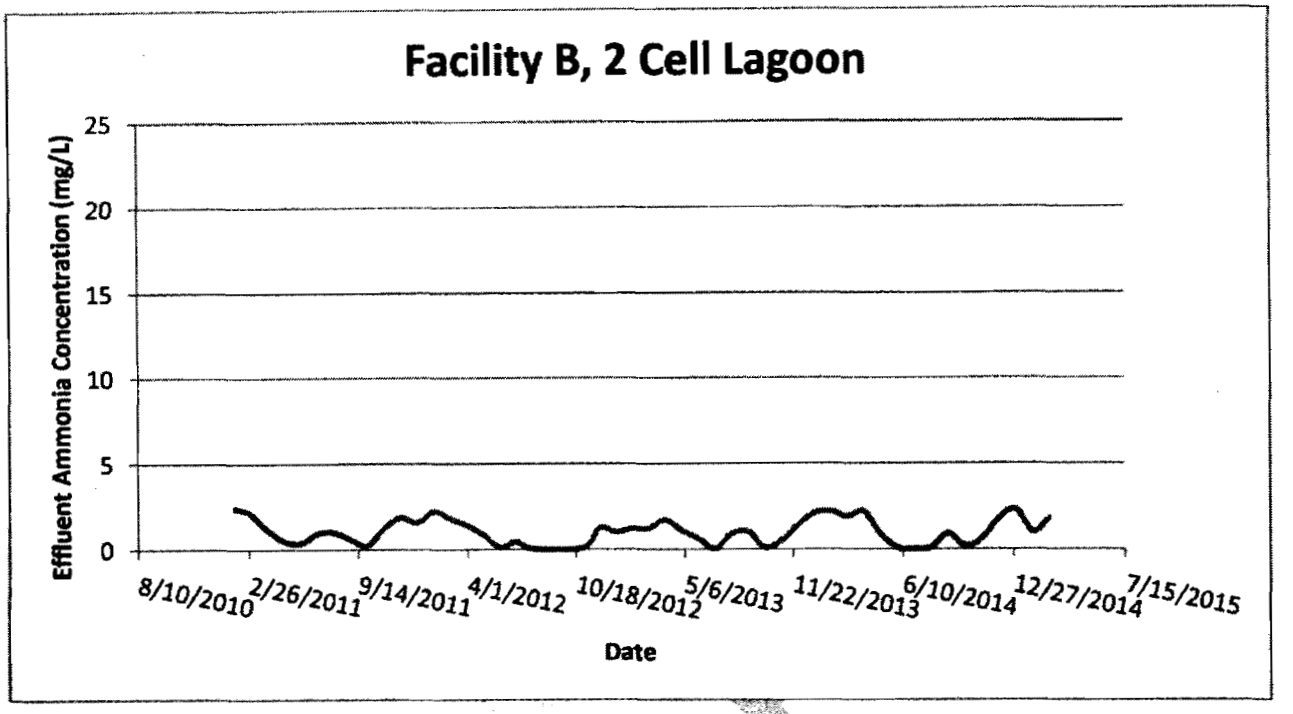
Treatment Type	Aerated	Facultative	Total
1 cell	4	11	15
2 cell	17	14	31
3 cell	15	95	110
4 cell	3	17	20
5 cell	1	1	2
Aerated Lagoon	3	0	3
	43	138	181

Graphs of Effluent Concentrations at Facilities over Time: The facility graphs are examples of different types of lagoon performance in Missouri. Facility graphs have normalized y-axis with a maximum of 25 mg/L to display lagoon performance.

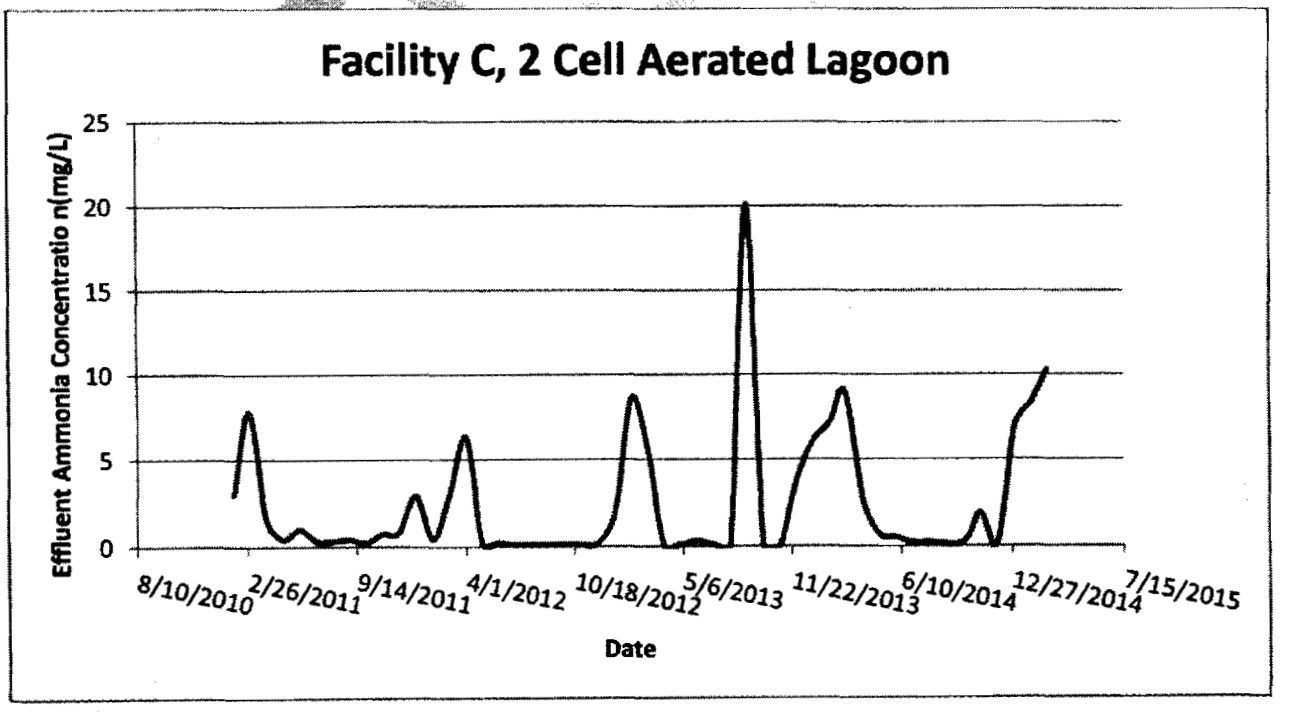
Graph A-1: One-Cell Lagoon



Graph A-2: Two-Cell Lagoon



Graph A-3: Two-Cell Aerated Lagoon



Graph A-4: Three-Cell Aerated Primary Lagoon

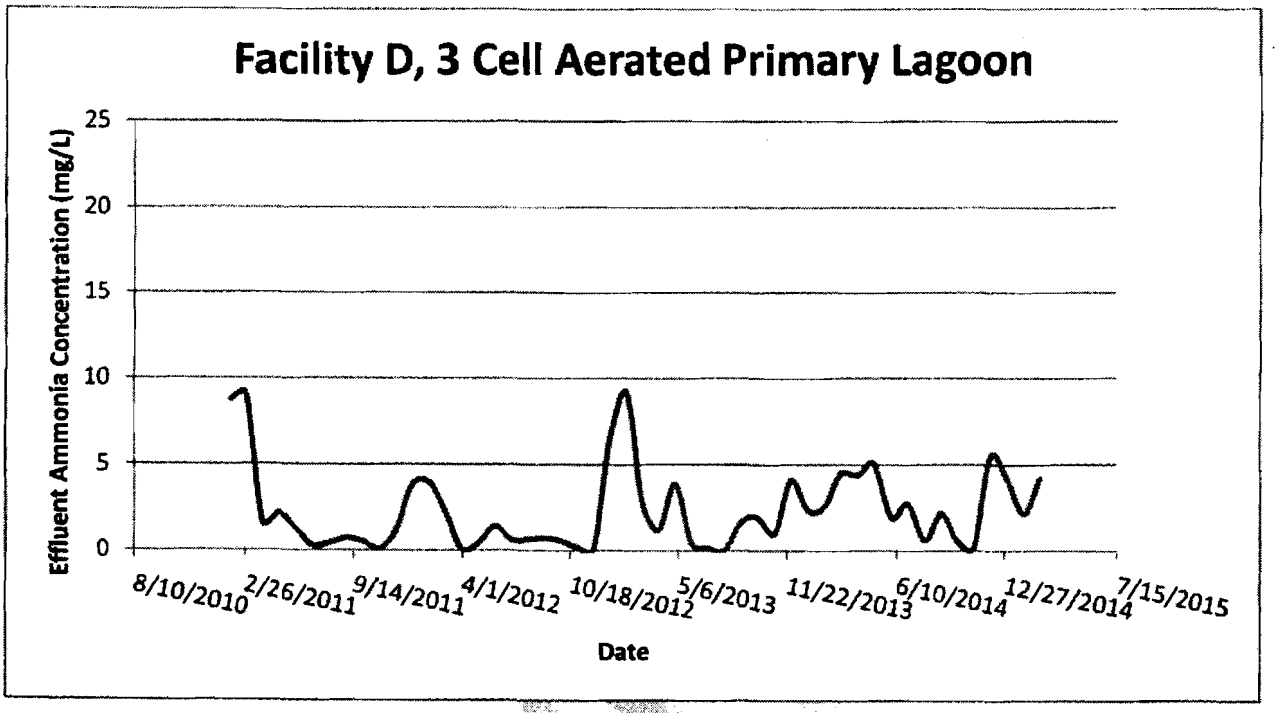


Table A-4: Percentile Breakdown of Final Ammonia Effluent Concentration Data

PERCENTILE	ALL DATA	SUMMER	WINTER
20	0.8	0.5	0.7
25	0.9	0.7	0.9
50	2.1	1.5	2.5
75	3.7	3.1	4.8
80	4.7	3.7	6.0
90	5.8	5.6	7.1
95	7.0	6.9	7.8

Appendix B: Multiple – Discharger Variance Application

MISSOURI DEPARTMENT OF NATURAL RESOURCES
WATER PROTECTION PROGRAM

MULTIPLE-DISCHARGER VARIANCE APPLICATION

NOTE ▶	**Any Municipal Publicly Owned Treatment Works with a functional lagoon is eligible for the Multiple-Discharger Variance.**

1. GENERAL INFORMATION

FACILITY NAME	PERMIT NUMBER (S) #MO-
MAILING ADDRESS	COUNTY

2. GENERAL INFORMATION

2.1 Is this facility a Municipal Publicly Owned Treatment Works? ☐ Yes ☐ No *If No, this facility does not qualify for the multiple-discharger variance. If necessary, please apply for a site-specific variance.*	
2.2 Population served:	
2.3 Design Flow in gallons per day:	
2.4 Actual Flow in gallons per day: *Inflow and Infiltration ≥ 275 gallons per capita per day is considered excessive.*	
2.5 Wastewater Treatment Facility Type: *To qualify for the multiple-discharger variance, the current treatment type must fit one of the listed categories.*	☐ Lagoon: ☐ Single Cell ☐ Multi-Cell
2.6 Age(s) of current Wastewater Treatment Facility Infrastructure(s):	
2.7 Receiving Stream at the point of discharge from the wastewater treatment facility:	

3. CURRENT NPDES PERMIT INFORMATION

3.1 Does your municipality currently have an application for renewal of your NPDES permit submitted to the Department of Natural Resources? *(If No, please submit an application for renewal 180 days before the expiration date of your current permit, along with the completed financial questionnaire and this multiple-discharger variance applicant questionnaire)*	☐ Yes ☐ No
3.2 Does your site-specific NPDES permit currently contain final effluent limits for Ammonia as N? *(If Yes, answer 3.3, If No, skip to 4.1)*	☐ Yes ☐ No
3.3 Is the municipality currently working toward meeting the NPDES permitted schedule of compliance to comply with the final effluent requirements for Ammonia as N? *(If Yes, please attach a document that includes the steps taken to meet these requirements)*	☐ Yes ☐ No

4. FINANCIAL INFORMATION

4.1 Has the department provided your municipality with a draft or final version of a "Cost Analysis for Compliance" (CAFCom) or previously titled "Affordability Analysis," that anticipates an upgrade to a land application system or a mechanical treatment plant will result in residential user rates **above two percent (2%) of the municipality's median household income**? *CAFCom/Affordability Analysis is found in the appendix section of the most recent draft of the NPDES permit Fact Sheet*	☐ Yes ☐ No

4.2 Please complete and submit the EPA spreadsheet; Uses and Variances – Evaluating Substantial and Widespread Economic and Social Impacts: Public Sector Entities. Does the Substantial Impacts Matrix indicate the pollution control options are likely to impose a substantial and economic and social impact on the residents of the municipality? Projected cost information from the most recent draft of the CAFCom/Affordability Analysis can be used to complete this form. *EPA spreadsheet can be found at:* http://water.epa.gov/scitech/swguidance/standards/economics/upload/usespublic.xlsx	☐ Yes ☐ No
4.3 In order to qualify for the multiple-discharger variance, each municipality will need to pursue an increase in residential sewer rates at an amount of two percent (2%) of the median household income (MHI) by the end of the fifth year of the multiple-discharger variance. Is your current residential user rate at or above 2% of your MHI?	☐ Yes ☐ No

5. Threatened or Endangered Species

5.1 Provide an attached list of all federally and state-listed threatened or endangered species (designated or proposed) and/or the critical habitats of those species (designated or proposed) that are known to occur on or near the site of discharge. *(Please see Fact Sheet below titled; Natural Heritage Review Report. Attach additional sheets as necessary and include the response letter from the Missouri Department of Conservation)*

5.2 Provide justification about how the multiple-discharger variance will not cause an impact to the federally-listed and/or stated-listed threated or endangered species (designated or proposed) or their critical habitat that are known to be present at the point of discharge for your facility. *(Please see Fact Sheet below titled; Natural Heritage Review Report. Attach additional sheets as necessary and include the response letter from the Missouri Department of Conservation)*

6. Alternative Effluent Control Analysis

6.1 Provide an attached analysis of the alternative effluent controls examined, including but not limited to; discharge relocation alternative, land application or decentralization of the utility (or other no discharge options), and regionalization of the utility. *(Please see Fact Sheet below titled; Reasonable Alternatives Analysis. Please include an aerial map outlining the current location of the outfall, the potential wastewater treatment facility (WWTF) effluent line, the potential WWTF discharge location and the mileage of line)*

7. Lagoon Design Profile

7.1 Please refer to Attachment A. Complete Attachment A and submit with the completed application.

8. CERTIFICATION

FACILITY CONTACT	OFFICIAL TITLE
EMAIL ADDRESS	TELEPHONE NUMBER WITH AREA CODE

I certify under penalty of law that I have personally examined and am familiar with the information submitted in this application and all attachments and that based on my inquiry of those individuals immediately responsible for obtaining this information, I believe that the information is true, accurate and complete. I am aware that there are significant penalties for submitting false information including the possibility of fine or imprisonment.

OWNER OR AUTHORIZED REPRESENTATIVE	OFFICIAL TITLE
SIGNATURE	DATE SIGNED

MULTIPLE-DISCHARGER VARIANCE APPLICATION

1. Application form is complete.
2. $250.00 filing fee paid.
3. Submit the EPA spreadsheet; Uses and Variances – Evaluating Substantial and Widespread Economic and Social Impacts: Public Sector Entities. (4.2)
4. Submit the Natural Heritage Review Report from Missouri Department of Conservation (5)
5. Submit the Alternatives Analysis (6)
6. Submit Completed Attachment A found below (7)
7. This completed form and any attachments should be submitted electronically and by mail to:

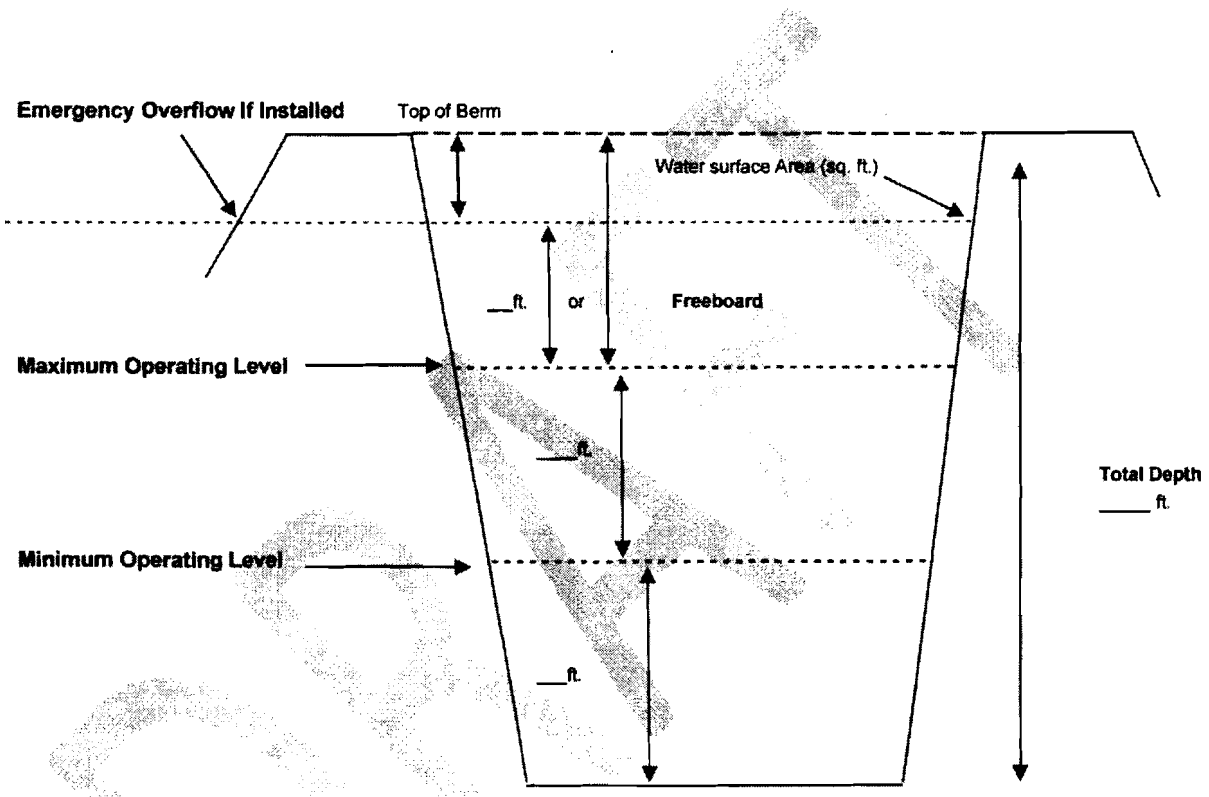
Department of Natural Resources
Water Protection Program
ATTN: MDV Team
P.O. Box 176
Jefferson City, MO 65102
WPSC.MultidischargerVariance@dnr.mo.gov

For additional guidance, see the following:

- http://colowqforum.org/pdfs/standards-framework/01-2009/R7-State%20Variance%20Process.pdf
- http://water.epa.gov/scitech/swguidance/standards/upload/Discharger-specific-Variances-on-a-Broader-Scale-Developing-Credible-Rationales-for-Variances-that-Apply-to-Multiple-Dischargers-Frequently-Asked-Questions.pdf
- http://water.epa.gov/learn/training/standardsacademy/upload/2007_11_15_standards_academy_basic_course_15-variances-11-15-07.pdf
- http://www.werf.org/i/c/DecentralizedCost/Decentralized_Cost.aspx
- For assistance in completing this form or the EPA form, please contact WPSC.MultidischargerVariance@dnr.mo.gov
- For more information, contact the department's Water Protection Program at 573-751-1300.

ATTACHMENT A
(To be included with the application)

Lagoon Design Profile*



DEFINITION OF TERMS (REFER TO THE PROFILE SKETCH ABOVE).

A. Freeboard is depth from the water level to the point on the lagoon where a discharge from the cell would occur. This could be a constructed emergency spill way or the lowest point of the lagoon berm;
B. Maximum Operating Level is at the top of outlet pipe or maximum weir setting.
C. Minimum Operating Level is at the lowest outlet pipe or weir setting.
D. Total Depth is from top of berm to bottom of basin berm to the bottom elevation.

* If the facility utilizes multiple cells, a separate lagoon design profile must be completed for each cell.

REASONABLE ALTERNATIVES ANALYSIS

Each municipality must consider all viable treatment options available to meet water quality standards for total ammonia nitrogen. The Cost Analysis for Compliance (CAFCom) provided the estimated costs for a site specific wastewater lagoon to upgrade to a land application system and/or a mechanical treatment plant based on the design flow (in some cases, if appropriate, the average flow) and the number of connections to the facility. The estimated costs provided within the analysis are the total present worth, capital cost of the project, annual cost of operation and maintenance, and the estimated resulting cost per household (all definitions are provided below). Each CAFCom uses software to estimate the cost for reconstruction of the treatment plant titled CAPDETWORKS (CapDet). CapDet estimates the complete reconstruction of the following treatment types depending on flow:

- Land application system – up to 150,000 gallons per day(gpd)
- Extended Aeration with a triangular basin – up to 10 million gallons per day(MGD)
- Sequencing Batch Reactor – flow range of 20,000 gpd to 10 MGD
- Oxidation Ditch – flow range of 20,000 gpd to 10 MGD
- Extended Aeration Package Plant – up to 50,000 gpd

All treatment technologies listed above are capable of meeting total ammonia nitrogen effluent limits of a 0.6 mg/L monthly average in the summer season and a 2.1 mg/L monthly average in the winter season. Based on the CAFCom, the department has determined that the construction, installation and operation and maintenance of each of the treatment technologies listed above would cause a substantial and widespread economic and social impact for the residents of the municipality.

The alternatives analysis found below must be completed as part of the application process. The alternatives listed below are; regional treatment, discharge relocation, and decentralization. Each municipality should use the estimated costs provided by the department that most closely resemble how each alternative would be achieved for their site specific facility. Each applicant can then determine if one or more of the treatment scenarios below are reasonable alternatives in order to achieve water quality standards for total ammonia nitrogen.

REGIONAL TREATMENT

Regional treatment is considered a reasonable alternative if the authority receiving the wastewater has adequate surplus treatment capacity available to receive the additional wastewater while remaining within its current permitted design capacities for both flow and loading. That is, the wastewater addition occurs within the design capacity of the receiving treatment plant and a separate antidegradation review is not required. However, this option may or may not be an economically feasible option for your community. If this alternative treatment is not an option for your community, please include a statement based on one of the statements provided below when submitting your application for the multiple-discharger variance.

Choose the estimated costs closest to your situation from the spreadsheet below and include in the statement below. Please include a statement attached to your application based on one of the statements provided below:

If under 10 miles:

1. *The City of or Regional Treatment* ***(insert closest City or regional treatment facility with a facility capable of receiving your design flow)*** *'s treatment plant is the nearest facility that would be capable of accepting* ***(insert your municipal name here)*** *wastewater. The total present worth for pipes, manholes, pump stations and effluent forcemain to pump the community's entire wastewater flow were estimated to be* ***(insert present worth costs here, $X.XX)*** *to pump WWTF effluent to* ***(insert closest City with a facility capable of receiving your design flow)****. The total present worth costs assume a five percent interest rate over a 20 year term of loan and include the capital cost plus the annual operation and maintenance cost. To implement this alternative, the wastewater from* ***(insert your municipal name here)*** *would have to be pumped approximately* ***(insert number of miles here)*** *miles. The higher cost of this alternative is primarily due to the lengthy force main and associated pumping costs that would be required. The estimated cost per user per month for this alternative is* ***(See example below and calculate the user cost and insert here, $X.XX)****. The estimated residential user cost as a percent of the median household income (MHI) is calculated to be* ***(See example below and calculate the percentage and insert here, X.X%)****. According to EPA's financial capability assessment guidance, "Combined Sewer Overflows: Guidance for Financial Capability Assessment and Schedule Development," a residential user cost as a percent of MHI of over two percent will result in a "high financial impact." Therefore, regionalization is not a feasible alternative for the* ***(insert municipal name here)*** *at this time. The inclusion of easement costs were not included in the estimated costs, however it is known the cost of easements can substantially raise the capital cost for the project. The estimates provided by the department anticipate the costs incurred from this alternative would result in a substantial and widespread economic and social impact for the residents of our community.*

If over 10 miles

2. *The City of or Regional Treatment* ***(insert closest City or regional treatment facility capable of receiving your design flow)*** *'s treatment plant is the nearest facility that would be capable of accepting the* ***(insert your municipal name here)*** *'s wastewater. To implement this alternative, the wastewater from* ***(insert your municipal name here)*** *would have to be pumped approximately* ***(insert number of miles here)*** *miles. The department has determined the total present worth associated with pipes, manholes, pump stations and effluent forcemain to pump the community's entire wastewater flow to a location farther than ten miles is a cost that will result in substantial and widespread economic and social impact. Regionalization of the wastewater treatment facility is not a feasible alternative at this time.*

DISCHARGE RELOCATION

A discharge relocation alternative should be considered by communities facing costly treatment upgrades. Please provide an attached aerial map to the multiple-discharger variance application outlining the current location of the outfall, the potential wastewater treatment facility (WWTF) effluent line, the potential WWTF discharge location and the mileage of effluent line it would take to get there. The alternative receiving stream will most likely need to be a class P (river) stream or a lake in order to receive higher effluent limits for Ammonia as N. If this alternative is not an option for your community, please include a statement based on one of the statements provided below when submitting your application for the multiple-discharger variance.

Choose the estimated costs closest to your situation from the spreadsheet below and include in the statement below. Please include a statement attached to your application based on one of the statements provided below:

If under 10 miles:

1. *The provided map outlines a potential routing strategy for the* ***(your facility's wastewater treatment facility name here)*** *alternate discharge location. This proposed alternative would convey WWTF effluent* ***(miles of necessary pipe)*** *miles to the* ***(new receiving stream)*** *through the addition of a new pipes, manholes, pump station(s) and effluent forcemain. A 10 percent contingency cost has been assumed for this project. However, due to the high level planning of this alternative and the potential unknown impacts regarding the proposed general alignment of the force main, the department has observed contingency costs up to 30 percent as appropriate for this project. The department has provided an estimate for the total present worth of this project to be* ***(insert present worth here, $X.XX)****. The total present worth costs assume a five percent interest rate, 20 year term of loan, and includes capital costs plus annual costs for operation and maintenance. In order for* ***(insert municipal name here)*** *to pipe WWTF effluent to the closest alternative stream it could cost up to* ***(See user rate equation below and calculate the user cost and insert here, $X.XX)*** *per residential user per month. The estimated residential user cost as a percent of the median household income (MHI) is calculated to be* ***(See user rate as a % of MHI equation below and calculate the percentage and insert here, X.X%)****. According to EPA's financial capability assessment guidance, "Combined Sewer Overflows: Guidance for Financial Capability Assessment and Schedule Development," a residential user cost as a percent of MHI of over two percent will result in a "high financial impact." Therefore, the relocation of the receiving stream is not a feasible alternative for the* ***(insert municipal name here)*** *at this time. The inclusion of easement costs were not included in the estimated costs, however it is known the cost of easements can substantially raise the capital cost for the project. Based on the cost estimates provided by the department, the anticipated project costs would result in a substantial and widespread economic and social impact for our community.*

If over 10 miles

2. *The provided map outlines a potential routing strategy for the* ***(your facility's wastewater treatment facility name here)*** *alternate discharge location. This proposed alternative would convey WWTF effluent* ***(miles of necessary pipe)*** *miles to the* ***(new receiving stream)*** *through the addition of a new pipes, manholes, pump station(s) and effluent forcemain. The department has determined the total present worth associated with pipes,*

manholes, pump stations and effluent forcemain to pump the community's entire wastewater flow to a location farther than ten miles is a cost that will result in substantial and widespread economic and social impact. An alternate discharge location of the wastewater treatment facility is not a feasible alternative at this time.

Estimated Present Worth Cost Matrix: to use as the cost estimate in the statements above. Chose the flow closest to your facilities design flow (flow is listed as gallons per day) and pair with the distance (listed in miles). Please round up to the nearest design flow for the most accurate cost estimate. If your distance in greater than 10 miles it is assumed the projected cost associated with regionalization and/or diverting effluent to an alternative receiving stream will result in a substantial and widespread economic and social impact.

Present Worth											
	Distance (miles)										
Flow (mgd)	0.5	1	2	3	4	5	6	7	8	9	10
0.01	$405,141	$543,618	$919,871	$1,029,460	$1,641,143	$1,918,096	$2,195,050	$2,472,003	$2,748,957	$3,025,910	$3,302,863
0.02	$420,385	$558,861	$1,117,722	$1,394,676	$1,671,629	$1,948,583	$2,225,536	$2,502,489	$2,779,443	$3,056,396	$3,333,350
0.03	$830,934	$1,075,011	$1,563,164	$2,051,318	$2,539,471	$3,027,625	$3,515,778	$4,003,931	$4,492,085	$4,980,238	$5,468,392
0.04	$845,963	$1,090,040	$1,578,194	$2,066,347	$2,554,500	$3,042,654	$3,530,807	$4,018,961	$4,507,114	$4,995,267	$5,483,421
0.05	$857,952	$1,102,029	$1,590,182	$2,078,335	$2,566,489	$3,054,642	$3,542,796	$4,030,949	$4,519,102	$5,007,256	$5,495,409
0.06	$868,694	$1,112,771	$1,600,924	$2,089,078	$2,577,231	$3,065,384	$3,553,538	$4,041,691	$4,529,845	$5,017,998	$5,506,151
0.07	$880,689	$1,124,765	$1,612,919	$2,101,072	$2,589,226	$3,077,379	$3,565,532	$4,053,686	$4,541,839	$5,029,993	$5,518,146
0.08	$891,088	$1,135,165	$1,623,318	$2,111,472	$2,599,625	$3,087,778	$3,575,932	$4,064,085	$4,552,239	$5,040,392	$5,528,545
0.09	$899,512	$1,143,589	$1,631,742	$2,119,896	$2,608,049	$3,096,203	$3,584,356	$4,072,509	$4,560,663	$5,048,816	$5,536,970
0.1	$906,940	$1,151,016	$1,639,170	$2,127,323	$2,615,477	$3,103,630	$3,591,783	$4,079,937	$4,568,090	$5,056,244	$5,544,397
0.11	$913,918	$1,157,995	$1,646,149	$2,134,302	$2,622,455	$3,110,609	$3,598,762	$4,086,916	$4,575,069	$5,063,222	$5,551,376
0.12	$922,897	$1,166,974	$1,655,127	$2,143,281	$2,631,434	$3,119,587	$3,607,741	$4,095,894	$4,584,048	$5,072,201	$5,560,354
0.13	$929,627	$1,173,703	$1,661,857	$2,150,010	$2,638,164	$3,126,317	$3,614,470	$4,102,624	$4,590,777	$5,078,931	$5,567,084
0.14	$971,086	$1,215,162	$1,703,316	$2,191,469	$2,679,622	$3,167,776	$3,655,929	$4,144,083	$4,632,236	$5,120,389	$5,608,543
0.15	$977,317	$1,221,393	$1,709,547	$2,197,700	$2,685,853	$3,174,007	$3,662,160	$4,150,314	$4,638,467	$5,126,620	$5,614,774

User Rate Equation: to use as the cost estimate in the statements above.

Estimated monthly residential user rate = Present Worth / 20 years / 12 months / # of active connections to WWTF

Note: The # of connections is specific to your community and can be found on the Cost Analysis for Compliance written by the department based on information provided by the community.

User rate as a % of MHI Equation: to use as the cost estimate in the statements above.

Estimated monthly user rate as a % of MHI = [Estimated monthly residential user rate / (Median Household Income/12)] 100

Note 1: The estimated monthly residential user rate is calculated using the user rate equation

Note 2: The Median Household Income is specific to your community and can be found of the Cost Analysis for Compliance written by the department.

For your reference:

Assumptions made by the department to calculate the estimated costs:

- Construction Labor $32 per hour
- Operator $25 per hour
- 15 manholes per miles of pipe
- $2.50 per foot for cleaning/maintenance (annual inspection for complete line)
- 10 year pump replacement
- 1 pump station for 0.01 and 0.02 flows, everything else 2 pump stations
- $60 for 8 inch pipe (installation)
- $20 for 6 inch pipe (used for 0.01 and 0.02 flows)
- 5% interest, 20 years
- 1 year construction period
- 0% profit
- 10% design fee
- 10% contingency

DRAFT

Estimated Capital Cost Matrix:

Capital Cost											
	Distance (miles)										
Flow mgd	0.5	1	2	3	4	5	6	7	8	9	10
0.01	$155,528	$211,755	$423,510	$535,965	$648,420	$760,875	$873,330	$985,785	$1,098,240	$1,210,695	$1,323,150
0.02	$156,228	$212,455	$424,910	$537,365	$649,820	$762,275	$874,730	$987,185	$1,099,640	$1,212,095	$1,324,550
0.03	$365,828	$527,655	$851,310	$1,174,965	$1,498,620	$1,822,275	$2,145,930	$2,469,585	$2,793,240	$3,116,895	$3,440,550
0.04	$365,828	$527,655	$851,310	$1,174,965	$1,498,620	$1,822,275	$2,145,930	$2,469,585	$2,793,240	$3,116,895	$3,440,550
0.05	$365,828	$527,655	$851,310	$1,174,965	$1,498,620	$1,822,275	$2,145,930	$2,469,585	$2,793,240	$3,116,895	$3,440,550
0.06	$365,828	$527,655	$851,310	$1,174,965	$1,498,620	$1,822,275	$2,145,930	$2,469,585	$2,793,240	$3,116,895	$3,440,550
0.07	$367,828	$529,655	$853,310	$1,176,965	$1,500,620	$1,824,275	$2,147,930	$2,471,585	$2,795,240	$3,118,895	$3,442,550
0.08	$369,828	$531,655	$855,310	$1,178,965	$1,502,620	$1,826,275	$2,149,930	$2,473,585	$2,797,240	$3,120,895	$3,444,550
0.09	$369,828	$531,655	$855,310	$1,178,965	$1,502,620	$1,826,275	$2,149,930	$2,473,585	$2,797,240	$3,120,895	$3,444,550
0.1	$369,828	$531,655	$855,310	$1,178,965	$1,502,620	$1,826,275	$2,149,930	$2,473,585	$2,797,240	$3,120,895	$3,444,550
0.11	$369,828	$531,655	$855,310	$1,178,965	$1,502,620	$1,826,275	$2,149,930	$2,473,585	$2,797,240	$3,120,895	$3,444,550
0.12	$371,828	$533,655	$857,310	$1,180,965	$1,504,620	$1,828,275	$2,151,930	$2,475,585	$2,799,240	$3,122,895	$3,446,550
0.13	$371,828	$533,655	$857,310	$1,180,965	$1,504,620	$1,828,275	$2,151,930	$2,475,585	$2,799,240	$3,122,895	$3,446,550
0.14	$399,828	$561,655	$885,310	$1,208,965	$1,532,620	$1,856,275	$2,179,930	$2,503,585	$2,827,240	$3,150,895	$3,474,550
0.15	$399,828	$561,655	$885,310	$1,208,965	$1,532,620	$1,856,275	$2,179,930	$2,503,585	$2,827,240	$3,150,895	$3,474,550

Estimated Annual Operation and Maintenance:

Annual O&M											
	Distance										
Flow	0.5	1	2	3	4	5	6	7	8	9	10
0.01	$20,030	$26,630	$39,830	$39,600	$79,660	$92,860	$106,060	$119,260	$132,460	$145,660	$158,860
0.02	$21,197	$27,797	$55,594	$68,794	$81,994	$95,194	$108,394	$121,594	$134,794	$147,994	$161,194
0.03	$37,322	$43,922	$57,122	$70,322	$83,522	$96,722	$109,922	$123,122	$136,322	$149,522	$162,722
0.04	$38,528	$45,128	$58,328	$71,528	$84,728	$97,928	$111,128	$124,328	$137,528	$150,728	$163,928
0.05	$39,490	$46,090	$59,290	$72,490	$85,690	$98,890	$112,090	$125,290	$138,490	$151,690	$164,890
0.06	$40,352	$46,952	$60,152	$73,352	$86,552	$99,752	$112,952	$126,152	$139,352	$152,552	$165,752
0.07	$41,154	$47,754	$60,954	$74,154	$87,354	$100,554	$113,754	$126,954	$140,154	$153,354	$166,554
0.08	$41,828	$48,428	$61,628	$74,828	$88,028	$101,228	$114,428	$127,628	$140,828	$154,028	$167,228
0.09	$42,504	$49,104	$62,304	$75,504	$88,704	$101,904	$115,104	$128,304	$141,504	$154,704	$167,904
0.1	$43,100	$49,700	$62,900	$76,100	$89,300	$102,500	$115,700	$128,900	$142,100	$155,300	$168,500
0.11	$43,660	$50,260	$63,460	$76,660	$89,860	$103,060	$116,260	$129,460	$142,660	$155,860	$169,060
0.12	$44,220	$50,820	$64,020	$77,220	$90,420	$103,620	$116,820	$130,020	$143,220	$156,420	$169,620
0.13	$44,760	$51,360	$64,560	$77,760	$90,960	$104,160	$117,360	$130,560	$143,760	$156,960	$170,160
0.14	$45,840	$52,440	$65,640	$78,840	$92,040	$105,240	$118,440	$131,640	$144,840	$158,040	$171,240
0.15	$46,340	$52,940	$66,140	$79,340	$92,540	$105,740	$118,940	$132,140	$145,340	$158,540	$171,740

DECENTRALIZATION

This section examines the approximate cost of subsurface soil dispersal (absorption) systems for a small community's domestic wastewater system. This is not intended to be an all-inclusive evaluation of the cost of these systems in the State of Missouri nor does the department endorse one type of dispersal system over another.

The primary costs discussed within this section were gathered from the Water Environment Research Foundation (WERF) Fact Sheets (D1, D2 & D3) for Decentralized Wastewater Systems, Performance & Cost of Decentralized Unit Processes, Dispersal Series. Copies of those Fact Sheets can be found at:
http://www.werf.org/i/c/DecentralizedCost/Decentralized_Cost.aspx. Costs given in the WERF Fact Sheets reflect 2009 estimate dollars. The Cost Estimation Tool developed by WERF was not used as part of the cost estimations shown below; however, the tool listed above can be used to calculate what the primary estimated cost to decentralize the sewer utility for your specific community. The following documentation provides several examples of the estimated cost to install a variety of systems including; individual onsite wastewater treatment systems, large scale subsurface soil dispersal systems, as well as the cost of cluster with individual onsite wastewater treatment systems.

ESTIMATED COST OF LAND ACQUISITION (BY REGION):

In some cases, the municipality will be required to acquire land in order to decentralize the current sewer utility. Unfortunately, while the Cost Estimation Tool can aid in calculating the rough amount of land required for the soil treatment it was not developed to estimate the cost of the land. Once the amount of soil treatment area is determined the approximate cost of the land can be calculated using the estimated cost of land per acre listed below. (calculation shown below) The estimated cost of land per acre was determined using the 2015 Agricultural Economics Newsletter in an article titled "Missouri Farm Land Values Opinion Survey" written by the University of Missouri Extension.

The department estimated the cost of land by separating the State into four regions by highways and basing the values on the "good cropland" in an effort to be conservative with the estimated price of land per acre. The estimated cost of land per acre is shown below.

- North of Highway 36: $6,588 per acre
- Between Highway 36 and Highway 50: $6,316 per acre
- Between Highway 50 and Highway 60: $6,208 per acre
- South of Highway 60: $7,572 per acre

The cost to purchase additional land could be a substantial increase to the estimated costs of the treatment alternatives listed.

Total cost of land = (amount of land calculated using the WERF tool (in acres)) (cost of land per acre listed above)

The subsurface soil dispersal systems described below are for domestic wastewater (sewage) only as defined in RSMo 701.025(12) Definitions "sewage" or "domestic sewage" "...Human excreta and wastewater, including bath and toilet waste, residential laundry waste, residential kitchen waste and other similar waste from household or establishment appurtenances."

INDIVIDUAL ONSITE WASTEWATER TREATMENT (SEPTIC) SYSTEMS:
While the use of individual onsite wastewater treatment systems (OWTS) can be considered as an option, it should be noted that a detailed thorough systematic evaluation of each lot must be conducted by a qualified individual to ensure all of the soil and site limitations are addressed in the specific design and installation. It should also be noted that because of the complexity of the soils/landscape model throughout the state, a one-size-fits-all design is not a practical solution whenever using individual onsite wastewater treatment systems within any community.

The methodology used within 10 CSR 20-6.030 Disposal of Wastewater in Residential Housing Developments for determining minimum lots size within a residential housing (subdivision) development can be used as a guide when initially investigating if OWTS are an alternative.

Please note that 10 CSR 20-6.030 (1)(D) states that "For residential housing developments with lots less than forty thousand (40,000) square feet, (0.92 acres) only centralized sewage collection and treatment are acceptable..." In those cases where the lots are less than 0.92 acres or have limited amount of available space with suitable soils/landscapes, a centralized or cluster system should be considered.

If individual OWTS are chosen as the method of wastewater treatment, a continuing authority (responsible management entity) must be established to ensure they are a sustainable solution. Construction permits, installation and operation of the OWTS will require multiple agency cooperation to ensure the process proceeds in a timely manner. To understand what regulatory agencies may be involved in permitting OSTS, a copy of the department's Fact Sheet, "Who Regulates Domestic Wastewater in Missouri?" can be found at the following link: http://dnr.mo.gov/pubs/pub1296.pdf

The costs in Table 1 (below) should be used for cost estimation purposes only. As described within the WERF Fact Sheets (D1, D2 & D3) the costs are for the materials, installation and maintenance of the dispersal system only. They do not include the cost of installation, maintenance, total life cycle of the septic tanks(s), advanced treatment components or disinfection devices. Cost presumed to include 20 % overhead and profit for contractor and there are no sales taxes on materials. Engineering fees and other professional services are not included. The actual costs can very significantly depending upon site conditions and local economic factors. Costs given presented in the WERF Fact Sheets reflect 2009 dollars.

TABLE 1
Single Family Dispersal System Cost Estimates

FACTORS	Gravity Distribution Fact Sheet D1	Low Pressure Pipe Fact Sheet D2	Drip Distribution Fact Sheet D3
Wastewater Flows	450 gallons/day (gpd)	450 gpd	450 gpd
Topography	Relatively Flat	Relatively Flat	Relatively Flat
Application Rate	0.4 gpd/sq. ft.	0.2 gpd/sq. ft.	0.3 gpd
Soil Treatment Area	1,125 sq. ft.*	2,250 sq. ft.*	1,500 sq. ft.*
Lateral Line	562 linear feet*	1.125 linear feet*	750 linear feet*
Material & Installation	$4,600 - $6,900	$9,000 - $14,000	$8,000 - $12,000
Annual O&M	$200 - $400	$540 - $800	$500 - $740

NOTE: It is extremely rare that a drip distribution system within the state is designed with an application rate of 0.3 gpd/sq. ft. a more common application rate is 0.15 gpd per sq. ft.

The costs in Table 2 (below) should be used for cost estimation purposes only. The costs are presumed to include all components for an OWTS serving a single family home on an individual lot and were compiled as part of a cursory survey of professionals within the onsite wastewater industry within the state. No specific documentation was collected as part of that survey. The actual costs can very significantly depending upon site conditions and local economic factors. Engineering fees and other professional services are not included. A single family residence in the state is designed at 120 gpd/bedroom*, averaging three (3) bedrooms.

TABLE 2
Individual Onsite Wastewater Treatment System Cost Estimates

FACTORS	Gravity Distribution	Low Pressure Pipe	Drip Distribution
Wastewater Flows	360 gpd	360 gpd	360 gpd
Application Rate	0.4 gpd/sq. ft.	0.2 gpd/sq. ft.	0.15 gpd
Soil Treatment Area	900 sq. ft.*	1,800 sq. ft.*	2,400 sq. ft.*
Lateral Line	450 linear feet*	900 linear feet*	1,200 linear feet*
Material & Installation	$5,000 - $8,000	$9,000 - $20,000	$15,000 – $25,000

LARGE SCALE SUBSURFACE SOIL DISPERSAL SYSTEMS:
The cost listed in Tables 3, 4 and 5 (below) should be used for cost estimation purposes only. As described within the WERF Fact Sheets (D1, D2 & D3), the costs reflect only those associated with the dispersal system itself and do not include cost for any part of the wastewater treatment prior to the dispersal system. The estimated costs below do not include the cost of engineering, other professional fees, the cost to close the current wastewater treatment facility or the cost of land acquisition. Cost includes 20% for overhead and profit for contractor. The actual costs can very significantly depending upon site conditions and local economic factors. Costs given within the WERF Fact Sheets reflect 2009 dollars.

TABLE 3
5,000 Gallons per Day or 20 Home Cost Estimates

FACTORS	Gravity Distribution Fact Sheet D1	Low Pressure Pipe Fact Sheet D2	Drip Distribution Fact Sheet D3
Topography	Relatively Flat	Relatively Flat	Relatively Flat
Application Rate	0.4 gpd/sq. ft.	0.2 gpd/sq. ft.	0.3 gpd
Soil Treatment Area	12,5000 sq. ft.*	25,000 sq. ft.*	16,666 sq. ft.*
Lateral Line	6,250 linear feet*	12,500 linear feet*	8,333 linear feet*
Material & Installation	$54,000 - $81,000	$84,000 - $127,000	$37,000 – $56,000
Annual O&M	$2,300 - $3,400	$4,900 - $7,400	$3,00 - $5,000

TABLE 4
10,000 Gallons per Day or 40 Home Cost Estimates

FACTORS	Gravity Distribution Fact Sheet D1	Low Pressure Pipe Fact Sheet D2	Drip Distribution Fact Sheet D3
Topography	Relatively Flat	Relatively Flat	Relatively Flat
Application Rate	0.4 gpd/sq. ft.	0.2 gpd/sq. ft.	0.3 gpd
Soil Treatment Area	25,000 sq. ft.*	50,000 sq. ft. or 1.1 ac*	33,333 sq. ft.*
Lateral Line	12,500 linear feet*	25,000 linear feet*	16,666 linear feet*
Material & Installation	$105,000 - $158,000	$184,000 - $275,000	$85,000 - $127,000
Annual O&M	$4,400 - $6,600	$10,000 - $15,000	$6,900 - $10,000

TABLE 5
50,000 Gallons per Day or 200 Home Cost Estimates

FACTORS	Gravity Distribution Fact Sheet D1	Low Pressure Pipe Fact Sheet D2	Drip Distribution Fact Sheet D3
Topography	Relatively Flat	Relatively Flat	Relatively Flat
Application Rate	0.4 gpd/sq. ft.	0.2 gpd/sq. ft.	0.3 gpd
Soil Treatment Area	2.9 acres*	5.7 acres*	3.8 acres*
Lateral Line	62,500 linear feet*	125,000 linear feet*	83,333 linear feet*
Material & Installation	$517,000 - $776,000	$1,365,000 - $2,047,000	$329,000 - $494,000
Annual O&M	$21,000 - $31,000	$66,000 – $98,000	$31,000 – $47,000

NOTE: There are no known gravity distribution systems within the state of the size represented in Tables 3, 4, or 5 (above). It is also extremely rare that a drip distribution system within the state is designed with an application rate of 0.3 gpd per sq. ft. A more common application rate is 0.15 gpd per sq. ft.

The estimated costs listed in Table 6 (below) should be used for cost estimations only and were compiled from a preliminary engineering report submitted to the department. The costs reflect only those associated with the dispersal system itself and do not include cost for any part of the

wastewater treatment prior to the dispersal system. The estimated costs below do not include the cost of engineering, other professional fees, the cost to close the current wastewater treatment facility or the cost of land acquisition. Costs are presumed to include overhead and profit for contractor.

TABLE 6
Actual Cost Submitted within a Preliminary Engineering Report

FACTORS	Drip Distribution
Wastewater Flows	49,000 gpd
Population	490 persons
Topography	0 to 8 percent
Application Rate	0.15 gpd
Soil Treatment Area	7.5 acres*
Lateral Line	164,000 linear feet*
Material & Installation	$795,000

COMPARITIVE COST:

Individual Onsite Wastewater Treatment Systems

Using only the estimated cost as presented in the WERF Fact Sheets (D1, D2 & D3), using 200 homes and/or a maximum daily flow of 50,000 gallons per day, the following scenarios can be used for comparison purposes only. Please remember the cost discussed below reflect only those of the dispersal system only. They do not include installation, maintenance and total lifecycle costs for septic tank(s), advanced treatment components, cost to close the current wastewater treatment system and disinfection devices.

As stated above there is not a one-size-fits-all system for individual OWTS for any community within the state for a number of reasons, ranging from limited space, suitable soils, to landscapes. But if they are able to be installed on all of the individual lots, the cost presented in Table 7 can be used for comparison purposes only. The actual costs can vary significantly depending upon site conditions and local economic factors.

TABLE 7
Single Family Dispersal Systems Cost Estimates

TYPE of Individual OWTS	Total Number Homes & Cost/Home	APPROXIMATE COSTS
Gravity Distribution	40 homes @ $6,900 each	$276,000.00
Low Pressure Pipe	110 homes @ $14,000 each	$1,540,000.00
Drip Distribution	150 homes @ $12,000 each	$1,800,000.00
TOTAL		$3,616,000.00

Cluster with Individual Onsite Wastewater Treatment System

Cluster systems can also be considered as an alternative in situations where individual onsite systems will not work by themselves, but where combinations of those systems are proposed to replace an existing centralized collection and treatment system. The cost in Table 8 is one scenario and should be used only for comparison purposes. The actual costs can very significantly depending upon site conditions and local economic factors. As previously stated,

the costs reflect those for the dispersal system only and do not include cost estimates for installation, maintenance and total lifecycle costs for septic tank(s), advanced treatment components, or cost to close the current wastewater treatment system and disinfection devices.

TABLE 8
Cluster and Single Family Dispersal Systems Cost Estimates

TYPE of DISPERSAL SYSTEM	Number of Systems	Gallons per Day/System	Approximate Costs
Single Family using Gravity Distribution	5 @ $6,900.00 each		$34,500.00
Single Family using Low Pressure Pipe	15 @ $14,000.00 each		$210,000.00
Single Family using Drip Distribution	20 @ $12,000.00 each		$240,000.00
Cluster using Drip Dispersal	2 @ $56,000.00 each	5,000 gpd	$112,000.00
Cluster using Drip Dispersal	3 @ $127,000.00 each	10,000 gpd	$381,000.00
TOTAL			$[illegible]

CENTRALIZED:
When estimating the cost of converting an existing centralized domestic wastewater collection and treatment system from a point discharge to a subsurface soil dispersal system, refer to Table 3, 4 or 5 (above) for the different systems and daily wastewater flow they service.

CURRENT WASTEWATER SYSTEM CLOSURES:

1. **Lagoon:** If the municipality chooses to proceed with decentralizing the wastewater treatment utility, the current lagoon or sand filter will need to be properly closed according to Standard Conditions Part III the current NPDES operating permit. The department has estimated the cost of a lagoon closure to be approximately $30,000. The cost of sludge removal varies, depending on the total amount of sludge in the lagoon; however, each municipality can use the following equation to estimate the cost of sludge removal.

   Using actual documented costs to the department:

- Dredging and disposal: $750.00 per dry ton
- Mobilization and set up: $25,000 flat rate

Estimated Cost for Sludge Removal = (Dry tons of sludge per year x Life span of lagoon in years x $750 per dry ton of sludge) + $25,000 mobilization fee.

2. **Media Filters:** The department has estimated the cost to close a media filter to be a total of approximately $30,000. The municipality is required to ensure that their current lagoon or media filter is properly terminated which will be a substantial added cost to cost estimates shown above.

* Calculations made using standards set forth by the Missouri Clean Water Law (Chapter 644) and its regulations along with those set forth by RSMo 701.025 through 701.059 and the regulations promulgated under it.

Use the Cost Tool provided on http://www.werf.org/i/c/DecentralizedCost/Decentralized_Cost.aspx, or a cost estimate from the examples provided above to determine what an estimated cost would be for your municipality to decentralize. Please include the estimated cost to properly close your current wastewater treatment system. If it is determined that the cost to decentralize the current sewer utility will result in a substantial and widespread social and economic impact, please include a statement attached to your application based on the statement provided below:

1. *The City of **(insert your municipal name here)** has considered the cost to decentralize the current sewer utility. Based on the estimates provided by the department, the city has determined the cost to properly close the current **(choose one: media filter / lagoon)** to be **(include the cost to close current facility plus the cost to remove slude/pump out septic tank, $X.XX)**. With the city's current flow of **(Insert design flow here XXXXX gpd)** the estimated primary cost to install the onsite wastewater treatment system is **($x.xx , use an example shown above or the cost tool provided by WERF at: http://www.werf.org/i/c/DecentralizedCost/Decentralized_Cost.aspx).** This cost would result in residential user rates of **(See user rate equation below and calculate the user cost and insert here, $X.XX.)** per residential user per month. The estimated residential user cost as a percent of the median household income (MHI) is calculated to be **(See user rate as a % of MHI equation below and calculate the percentage and insert here, X.X%)**. The city will also need to acquire land to be able to install the onsite wastewater treatment systems. The price of land has not been incorporated into these equations; however, the acquisition of land will substantially raise the estimated cost per residential user provided above. According to EPA's financial capability assessment guidance, "Combined Sewer Overflows: Guidance for Financial Capability Assessment and Schedule Development," a residential user cost as a percent of MHI of over two percent will result in a "high financial impact." Therefore, decentralization of the sewer utility is not a feasible alternative for the **(insert municipal name here)** at this time. The estimates provided by the department anticipate the costs incurred from this alternative would result in a substantial and widespread economic and social impact for the residents of our community.*

User Rate Equation:

Estimated monthly residential user rate = Present Worth / 20 years / 12 months / # of active connections to WWTF

Note: The # of connections is specific to your community and can be found on the Cost Analysis for Compliance written by the department.

User rate as a % of MHI Equation:

Estimated monthly user rate as a % of MHI = [Estimated monthly residential user rate / (Median Household Income/12)] 100

Note 1: The estimated monthly residential user rate is calculated using the user rate equation

Note 2: The Median Household Income is specific to your community and can be found of the Cost Analysis for Compliance written by the department.

Sludge Removal Equation:

Estimated Cost for Sludge Removal = (Dry tons of sludge per year x Life span of lagoon in years x $750 per dry ton of sludge) + $25,000 mobilization fee.

Definitions:

Present Worth: Present Worth includes a five percent interest rate to construct and perform annual operation and maintenance of the new treatment plant over the term of the loan.

Capital Cost of Project: Capital Cost includes project costs, design, inspection and contingency costs.

Annual cost of Operation and Maintenance: Operation and maintenance cost is includes operations, maintenance, materials, chemical and electrical costs for the facility on an annual basis. It includes items that are expected to replace during operations, such as pumps. Operation and maintenance is estimated between 15% and 45% of the user cost.

Estimated resulting user cost per household: The Estimated User Cost is composed of two factors, Operation & Maintenance (O&M), and Debt Retirement Costs.

NATURAL HERITAGE REVIEW REPORT

Each applicant is required to provide justification using the Natural Heritage Review Report (NHRR) detailing how the Multiple-Discharger Variance will not cause an impact to federally-listed and/or state-listed threated or endangered species (designated or proposed) or their critical habitat that are known to be present at the point of discharge. The NHRR provides information about that species known to occur in the specified area by the Missouri Department of Conservation (MDC). The initial inquiry should be to be mailed to MDC at:

MDC Natural Heritage Review
Resource Science Division
P.O. Box 180
Jefferson City, MO 65102-0180
(Phone 573-522-4115 ext. 3182)
www.mdc.mo.gov

The NHRR inquiry request should include the following;

- Name, phone number and email the MDC reviewer can contact with questions about the location or project type (wastewater treatment facility contact).
- Statement that requestor wants a "Natural Heritage Review Report" for the project.
- The type of project. For example, "domestic discharge and permitting variance."
- Location: County; Township/Range/Section; Latitude/Longitude in decimal degrees.
- Maps: (1) Location at a scale that the project site can be found with roads/orienting features labeled; (2) Site design showing the project footprint.
- Name of affected water body. (receiving stream)

If a state-listed endangered species is found, the report typically provides best management practices (BMPs) for avoiding and reducing impacts on the species. If a federally-listed endangered species is known to MDC in the vicinity of the project, the United States Environmental Protection Agency (USEPA) will contact the U.S. Fish and Wildlife Service (USFWS) during their review process of the multiple-discharger variance.

Please follow the letter template provided below to complete the inquiry request for the Natural Heritage Review Report and mail to the MDC address provided above.

To Whom It May Concern;

The City of ***(Include your city or village name here)*** *is requesting a Natural Heritage Review Report (NHRR) be completed at our wastewater treatment plant outfall. The type of project being completed is for a variance of the water quality standards for Total Ammonia Nitrogen at the point of discharge from the city's domestic wastewater treatment facility. The location of the outfall is* ***(include Township/Range/Section and the Latitude/Longitude in decimal degrees of the outfall).*** *The facility is currently permitted to discharge to* ***(name of receiving stream)****. Please see the attached map for an aerial view of the location.*

If you have any questions concerning this inquiry for the NHRR, please do not hesitate to contact ***(facility contact name here)*** *by phone at* ***(contact's phone number)*** *or by email at* ***(contact's email address)****.*

Sincerely,

DRAFT

Highest Attainable Demonstration for Recirculating Media Filters

Intent

Recirculating Media Filters (RMFs) are an important wastewater treatment technology in terms of cost effectiveness and operational viability, especially in southern and central Missouri. Recirculating Media Filters that are properly designed, operated, and maintained can be protective of water quality where instream assimilative capacity exists. The intent of this memo is to establish a highest attainable effluent level for ammonia to support the multiple-discharge variance request for disadvantaged communities that will experience a substantial and widespread economic and social burden with respect to costs associated with compliance with ammonia water quality standards. On the other hand, many of the existing neglected systems can pose a threat to surface water. Therefore, it is imperative that the highest attainable effluent conditions be protective of existing water quality.

Statement of Issue

Small communities have a small rate base and lack the funds to build and maintain advanced treatment system, such as activated sludge, to achieve the current and EPA recommended ammonia water quality criteria within the time period afforded by a compliance schedule. In southern and central Missouri, RMFs have been built to meet to remove biochemical oxygen demand and total suspended solids.

Highest Attainable Determination Approach

The department's approach utilizes that RMFs provide a reliable, low cost and relatively low maintenance treatment for municipalities. Although the basic design of RMFs has not changed for the last 30 years, the department will also examine some of the innovations and improvements in light of the economic considerations. This document will allow communities that are struggling financially to make the most effective improvements to their wastewater treatment facilities to operate at the highest attainable effluent conditions during the period of the multiple-discharger variance. It is expected that these treatment improvements will not result in degradation to existing water quality, if any, it will improve water quality by allowing disadvantaged communities time to maintain their existing infrastructure at a level that produces the highest attainable effluent conditions, while financially preparing for future upgrades or other alternatives available at that time, The determination will not address streams that are on the 303(d) list or where a TMDL is developed.

Discussion on Recirculating Media Filters

For RMFs, the use of media filtration in this context employs a combination of physical, chemical and biological processes to produce effluent that may meet requirements for discharge to surface waters, depending on receiving water criteria. The "media" can be any of a number of physical structures whose sole purpose is to provide a surface to support biological growth. Commonly used media includes rock, gravel, sand of various sizes, and textile media. The category of treatment referred to as media filtration includes a number of variations on the process. They can be broken down into subcategories based on how many passes through the filter the wastewater makes, whether the filter surface is open to the air or buried, and the relative size and type of the media (sand, gravel, textile or other).

In all cases, pretreatment of the wastewater to reduce the BOD and suspended solids content of raw sewage is required. Once settling is accomplished, the pre-treated wastewater is applied to the filter surface in small doses, to alternately load and rest the media. As wastewater percolates down through the filter bed, it comes into contact with the bacterial film growing on the media. The media should have a

high surface area to volume ratio, large enough voids to allow air filtration and to minimize fouling, UV resistance if exposed to sunlight, low solubility in water and acidic conditions.

The filtrate is contained by an impermeable liner, and collected in an underdrain. The underdrain pipe directs the filtrate to a flow splitting structure, in which a portion of the flow can be diverted back to the recirculation tank for additional treatment, with the rest discharged as effluent. Where total nitrogen removal is desired, recirculation back through the settling tanks provides contact between the nitrate-laden filtrate and carbon-bearing influent in the presence of bacteria. Figure 1 below provides schematic of how RMFs are normally designed. Figure 2 below is how flows go from influent back through the recirculation tank and then to the outfall; the scenario presented below is considered a 4:1 ratio.

Figure 1: General RMF Schematic

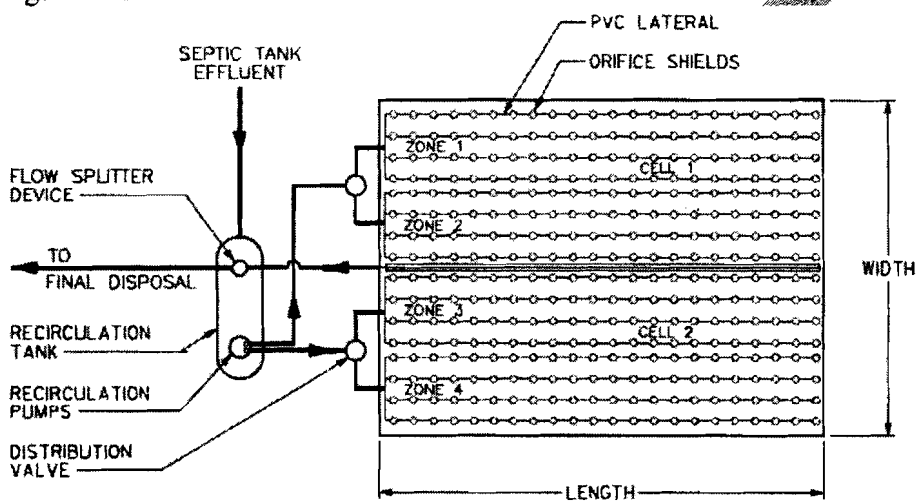
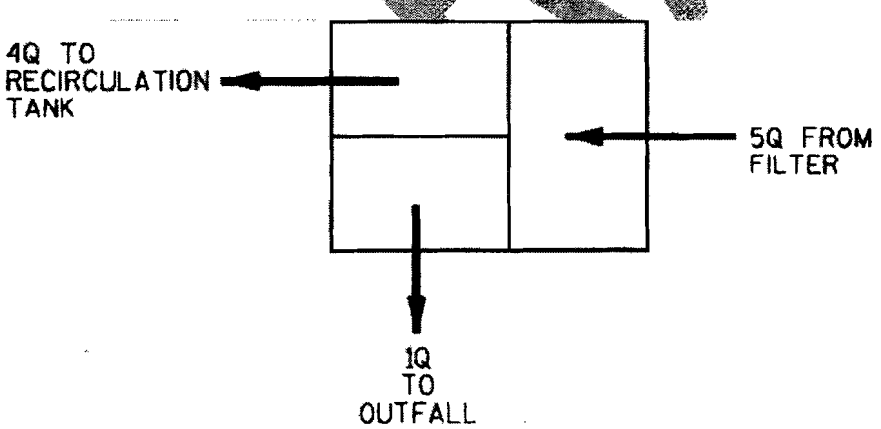


Figure 2: Recirculation Ratio



Recirculating Media Filter Design Guide Sizing
RMFs produce a high quality effluent with approximately 85% to 95% Biochemical Oxygen Demand and Total Suspended Solids removal. In addition, almost complete nitrification is achieved. Denitrification also has been shown to occur in RMFs. Depending on modifications in design and operation, 50% or more of applied nitrogen can be removed. The performance of a RMF system depends on the type and biodegradability of the wastewater, the environmental conditions within the filter, and the design characteristics of the filter. Temperature affects the rate of microbial growth, chemical reactions, and other factors that affect the stabilization of wastewater within the RMFs. Other parameters that affect the performance and design of RMFs are the degree of wastewater pretreatment, the media size, media depth, hydraulic loading rate, organic loading rate, and dosing techniques and frequency.

10 CSR 20-8.020(13)(C) is the department's small system design guide for sand filters. It was last updated in 1979. The design guide focuses on the removal of BOD and TSS, not ammonia. The department is currently in the process of updating the design guides to include ammonia removal as a parameter. While the department has not updated their regulations, EPA released a design memo in 1999 on Recirculating Sand Filters, which included discussion of Ammonia removal. Besides EPA's 1999 memo, the Iowa Department of Natural Resources updated their design criteria for RMFs in 2007, which provides the basis of the design parameters listed in Table 1. The existing facilities should be designed to meet these criteria.

Table 1: Design Parameters and Criteria for RMFs

Parameter	Criteria
Hydraulic Loading	$\leq$5.0 gpd/ft^2
Organic Loading	$\leq$0.002 lb/ft^2/day
Alkalinity	7.1 grams $CaCO_3$ per 1 gram NH_4-N
Recirculation Ratio	$\geq$3:1
Recirculation Tank Capacity	peak design flow
Dosing Time On	2-3 minutes
Dosing Frequency	minimum 48 doses per day
Volume per orifice	1-2 gallons per orifice per dose

Technical Review
Ammonia concentrations from the discharge monitoring report (DMR) for RMFs with design flows of less than 150,000 gallon per day were evaluated. A wide range of ammonia concentrations were observed, with the lowest effluent concentration being 0 milligrams per liter (mg/L) and the highest being 53.5 mg/L. Many of the facilities currently have monitoring only or just received effluent limits; however the data shows that on average, the facilities are operating near the current water quality standard ammonia effluent limits of 1.4 mg/L for summer and 2.9 mg/L for winter. The data shows that while many communities are meeting the current ammonia limit, there are several that are not. These communities are facing new water quality requirements for ammonia that were not factored into design specifications when many of the existing filters were constructed.

In review of the facilities, three communities had higher reported ammonia concentrations that averaged above the water quality standards: PCRSD Red Rock, Diggins, and Allendale. All three showed volatility in the reported concentrations, without further analysis into the operations, maintenances, and events at the facilities, it is hard to determine why the data from these facilities is high.

Development of Benchmark Limits
The department reviewed thirty-six recirculating media filters under 150,000 gallons per day. The only data points removed from the data set were those dates when information was not received, marked in MoCWIS with "DMR Non-receipt," "Conditional Monitoring Not Required," "Frozen Conditions,"

"Operation Shutdown," and "No Discharge." While there are more recirculating media filters than what the department evaluated, the review was limited to publicly owned facilities that are required to perform operational monitoring in accordance with 10 CSR 20-9.010.

The majority of the RMFs had quarterly monitoring for a period of less than five years, providing small data sets for each facility. The information in Table 2 is the statistical analysis of all the data from the 36 facilities used. In Appendix A, a sampling of the facilities with more than ten data points was plotted. The data was divided into the seasonal review, the summer season is April 1-September 30 and the winter season is October 1-March 31.

Table 2: Summary of Publicly Owned Wastewater Treatment Plant Ammonia Effluent Discharges

	Summer (mg/L)	Winter (mg/L)
Maximum	53.3	40.5
Average	4.60	5.0
95th percentile	22	19.2
90th percentile	12	14
80th percentile	6.0	8.2
75th percentile	4.5	6.6
50th percentile	1.3	1.8
25th percentile	0.3	0.4

Operational Measures

For RMFs to continue operating at a high level of treatment, operation and maintenance must occur on a regularly scheduled basis. Under the original construction permit, an Operations and Maintenance Manual was developed with the minimum requirements. The operations and maintenance manual must be reevaluated and updated as items at the facility change, including failure of a component, replacement of pumps, and on a minimum of every five years. To keep the facility operating well, the plant must not be hydraulically or organically overloaded. If it is not hydraulically or organically overloaded, the operations and maintenance activities listed below are ways to maintain the highest level of performance or possibly improve performance:

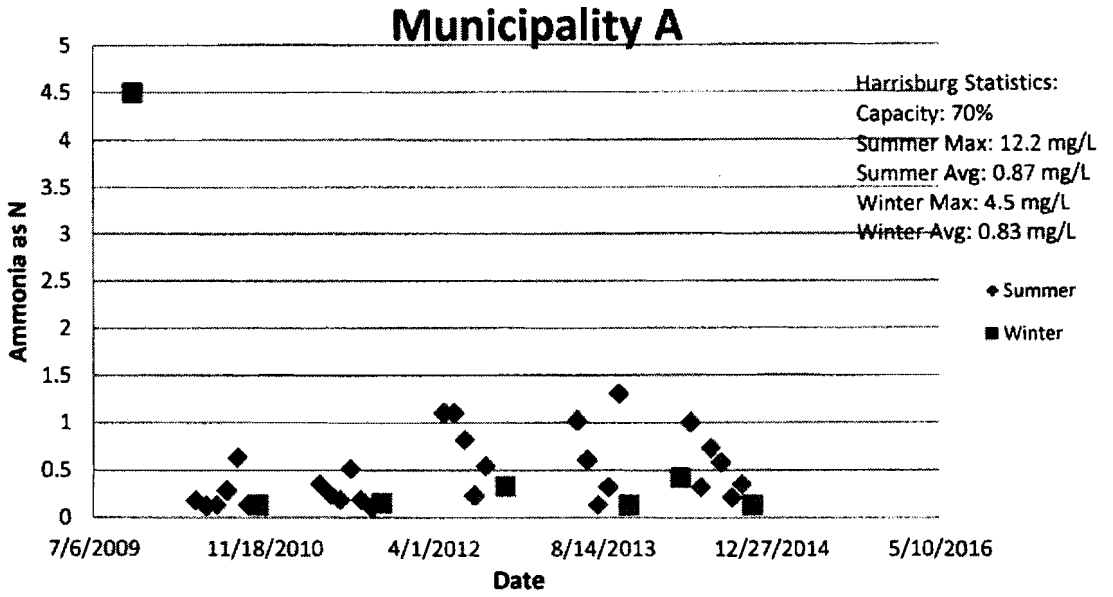
- Regularly schedule pump outs of the preliminary treatment (septic tanks) ;
- Remove vegetation from the filter bed; avoid chemicals to kill vegetation if possible;
- Check spray height to look for clogged dosing panels;
- Provide recirculation through the recirculation tank and pump at a minimum of 3:1 and if possible, increase the recirculation ratio to 4:1 or higher;
- Ensure loading is less than 5 gallons per day per square foot in dosing-if possible reduce that to under 3 gallons per day per square foot; and
- Replace media as necessary.

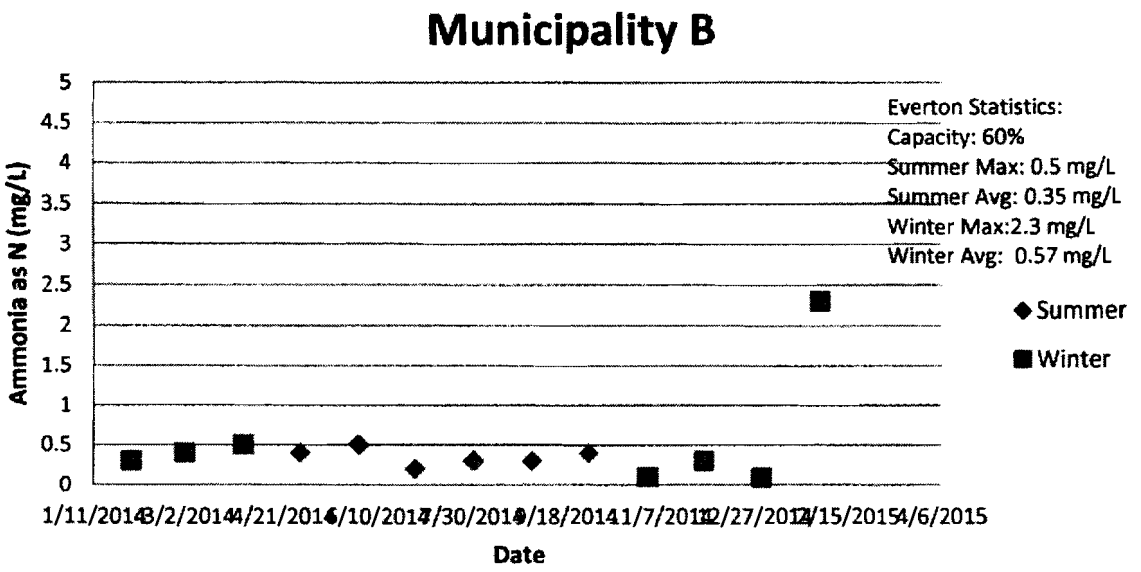
Through the department's Operator Certification Program, classes are held on the operations and maintenance of RMFs; it is a recommendation that the operator attend for additional information on improving the operation and maintenance of their facility.

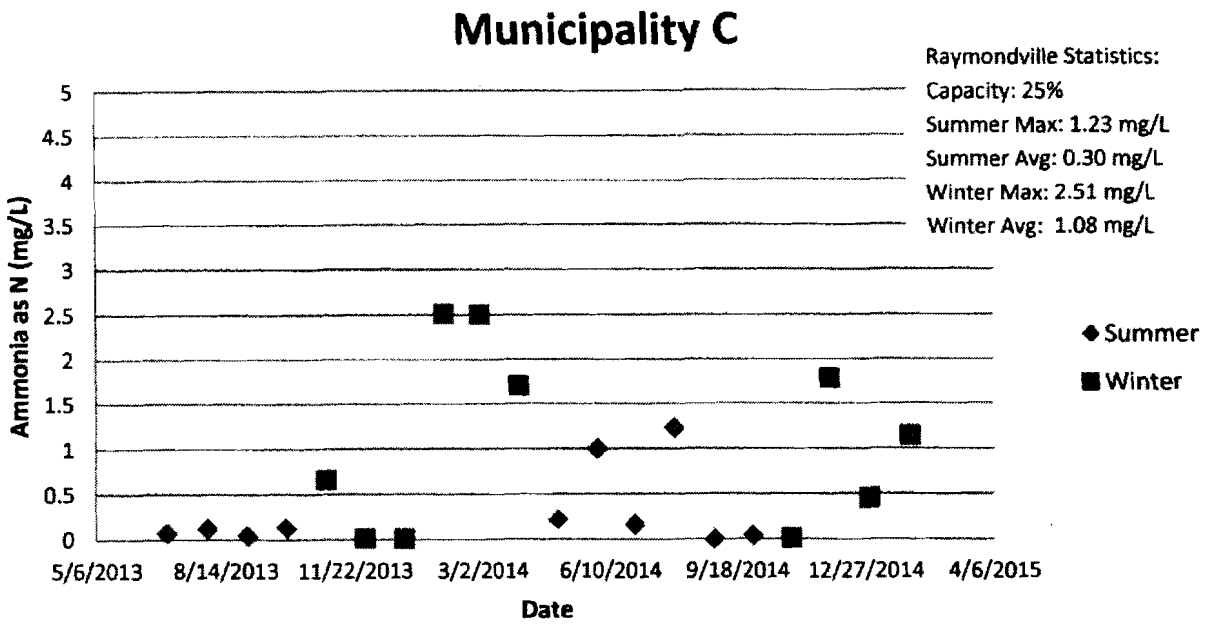
Conclusion:

For recirculating media filters, in review of the data, the highest attainable is meeting water quality standards.

Appendix A: Ammonia DMR summary from POTWs







Appendix C: References

EPA : http://water.epa.gov/infrastructure/septic/upload/finalr_7e6.pdf

Iowa DNR : http://www.iowadnr.gov/InsideDNR/RegulatoryWater/WastewaterConstruction/DesignGuidanceDocuments.aspx

10 CSR 20-8.020: http://www.sos.mo.gov/adrules/csr/current/10csr/10c20-8.pdf

DRAFT

Cost Analysis for Compliance and CAPDETWORKS

A) Cost Analysis for Compliance Discussion:

The Cost of Compliance Analysis completed by the department is based on information provided by the p permittee and data obtained from readily available sources. The Department currently uses software to estimate the cost for reconstruction of a treatment plant titled CAPDETWORKS (CapDet). CapDet is a preliminary design and costing software program from Hydromantis for wastewater treatment plants that uses national indices, such as the Marshall and Swift Index and Engineering News Records Cost Index for pricing in development of capital, operating, maintenance, material, and energy costs for each treatment technology. As the program works from national indices and each community is unique in its budget commitments and treatment design, the estimated costs are expected to be higher than actual costs. The cost estimates located within this document are for the construction of a brand new treatment facility or system that is the most practical to facilitate compliance with new requirements. For the most accurate analysis, it is essential that the permittee provides the Department with current information about the City's financial and socioeconomic situation.

The design parameters for Hydromantis are for larger facilities with flows greater than most Missouri facilities are designed for. CapDet provides a cost estimate based on national averages, not site-specific conditions a community or state may face. The department has been utilizing CapDet for the previous three years to estimate the cost of compliance with upgrades to meet the department's water quality standards for bacteria and ammonia. In developing design parameters, the department's engineers selected ammonia effluent limits less than 1 mg/L, year round disinfection, assumed a peaking factor of 3:1, and assumed normal strength municipal wastewater characteristics.

B) Verification Process:
The cost estimates are verified through the tracking of actual costs from submitted facility plans, engineering reports, bid documents, and loan closures. This verification process allows the engineering section to track costs to see if the assumptions in the Cost of Compliance Spreadsheet and from CapDet are appropriate for the State of Missouri. In the Water Protection Program's three plus years of tracking costs, the numbers in the Cost of Compliance spreadsheet have been higher than the actual costs reported, but not significantly so. The engineering section works to track that the scopes of the actual projects meet the cost of compliance scope of project. For the Cost of Compliance for sampling and for inflow and infiltration work, the cost estimate used is based on actual contracts submitted to the department.

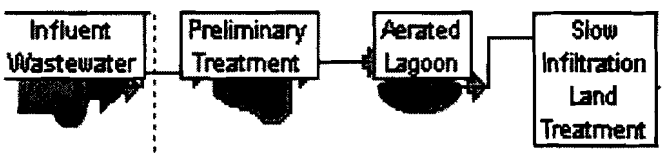
C) Permit Writers Procedure:
The permit writers select the community that they are writing a permit for on the Cost of Compliance Spreadsheet and they input the permitted design flow. From there the spreadsheet auto-calculates the cost of upgrades for that community from the five treatment technologies evaluated. Permit writers select the treatment technology cost estimate that they believe is most appropriate for the community based on size, location, and expected cost estimate. Then the permit writer uses the information from the Cost of Compliance Spreadsheet to complete the Cost of Compliance Appendix in the Operating Permit Factsheet. The Cost of Compliance Evaluation helps set schedules of compliance and demonstrates other commitments a community may have.

D) Treatment Technologies Evaluated:
The treatment technologies evaluated are for a range of flows up to 10 million gallons per day (10 MGD); however the majority of the permits and evaluations are for flows significantly less than that and more on the scale of 0.15 MGD or less. The technologies evaluated are land application utilizing existing basins,

land application requiring new basins, a package plant, an extended aeration plant, an oxidation ditch, and a sequencing batch reactor. Land application is not evaluated for flows greater than 0.15 MGD and package plants are not evaluated for flows greater than 0.05 MGD. As the department regulates thousands of communities with all different flows, the Cost of Compliance spreadsheet could not be developed with every possible design flow, so the spreadsheet utilizes linear interpolation for scenarios not ran.
For treatment technologies, sludge handling, sludge treatment, and disinfection are not included in the capital, operations and maintenance, and annual or present worth costs. All treatment technologies were designed to meet effluent ammonia of less than 1.0 mg/L and losing stream biochemical oxygen demand (BOD) and total suspended solids (TSS) of less than 10 mg/L.

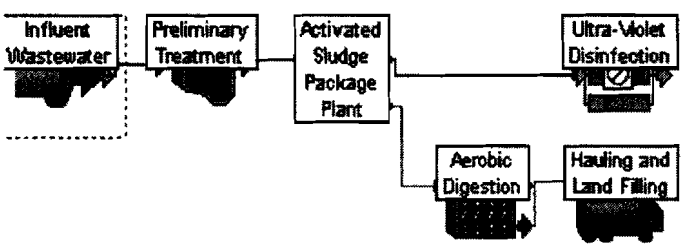
D-1) Land Application:
Elimination of a discharge point is the ultimate goal of the Clean Water Act. As Missouri has approximately 365 publicly owned lagoon systems, the department ran land application scenarios up to 0.15 MGD. While the scenarios were only ran for flows up to 0.15 MGD, there are existing communities in Missouri with higher flows currently using land application. For communities and counties that are divided by the highways, where the majority of the county resides is what was chosen for picking land application storage periods of sixty to one hundred twenty (60-120 days). During the facility planning phase, the engineer will appropriately evaluate the correct minimum storage requirements. The low land application cost is the community not having to build new storage basins or get new operators beyond what they currently employ. The higher land application cost includes land for building new storage basins and new operator costs. The acreage required was based on the default design application rate of 24 inches per year. The acreage required for a land application system is estimated in CapDet and was verified with the department's land application spreadsheet. Center pivots was the chosen land application technology for the spreadsheet as that is commonly used around the state.

Figure D-1: Land Application System



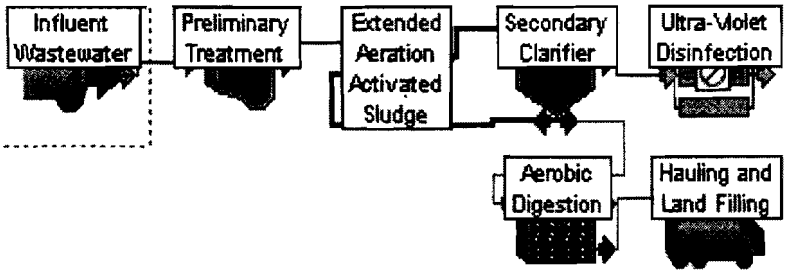
D-2) Package Plant:
Extended aeration package plants are common on the private side and for the smaller Missouri communities may be appropriate treatment technology. Package plants are pre-manufactured treatment facilities. Design flows up to 0.05 MGD were ran based on experience that flows greater than 0.05 MGD usually require site-specific construction components and the costs assumptions for a package plant were very similar to the extended aeration plant at higher flows.

Figure D-2: Package Plant System



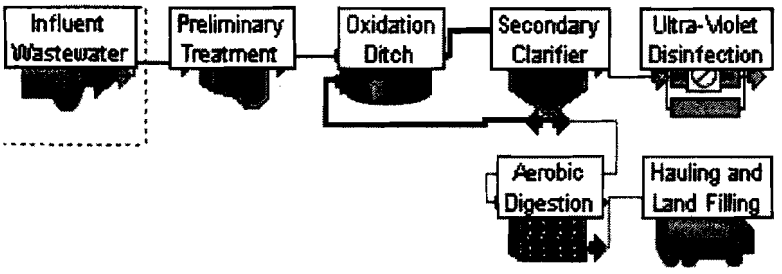
D-3) Extended Aeration:
The extended aeration treatment plant processes the wastewater directly into the aeration tank for treatment, maintaining the aerobic process with long aeration times. In CapDet, scenarios were ran up to 10 MGD.

Figure D-3: Extended Aeration System



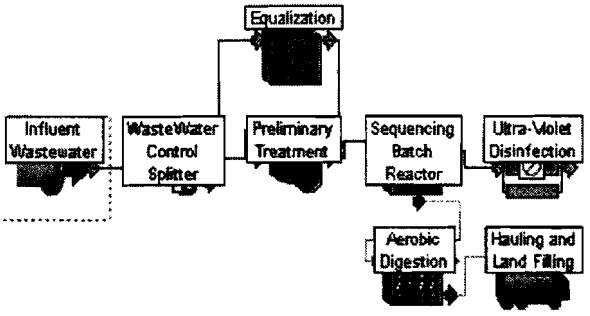
D-4) Oxidation Ditch:
An oxidation ditch is a modified activated sludge biological treatment process that utilizes long solids retention times (SRTs) to remove biodegradable organics. Oxidation ditches are typically complete mix systems, but they can be modified to approach plug flow conditions. Typical oxidation ditch treatment systems consist of a single or multichannel configuration within a ring, oval, or horseshoe-shaped basin. As a result, oxidation ditches are called "racetrack type" reactors. Horizontally or vertically mounted aerators provide circulation, oxygen transfer, and aeration in the ditch.

Figure D-4: Oxidation Ditch System



D-5) Sequencing Batch Reactors (SBR):
The Sequencing Batch Reactor (SBR) is an activated sludge process designed to operate under non-steady state conditions. An SBR operates in a true batch mode with aeration and sludge settlement both occurring in the same tank. The major differences between SBR and conventional continuous-flow, activated sludge system is that the SBR tank carries out the functions of equalization aeration and sedimentation in a time sequence rather than in the conventional space sequence of continuous-flow systems. In addition, the SBR system can be designed with the ability to treat a wide range of influent volumes whereas the continuous system is based upon a fixed influent flowrate. The operating principles of a batch activated sludge process, or SBR, are characterized in six discrete periods: anoxic fill, aerated fill, react, settle, decant, and idle. In the scenarios ran, the SBRs were designed from 0.02 MGD to 10 MGD with flow equalization.

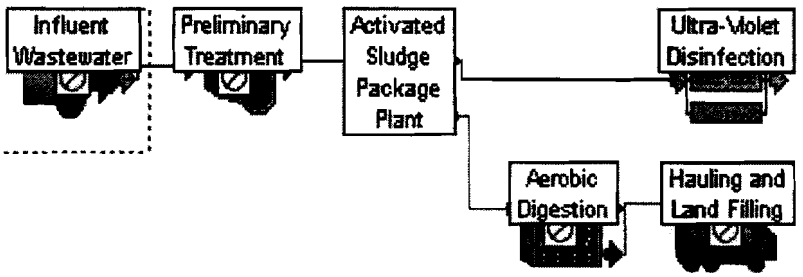
Figure D-5: Sequencing Batch Reactor System



D-6) UV Disinfection:

When UV radiation penetrates the cell wall of an organism, it destroys the cell's ability to reproduce. UV radiation, generated by an electrical discharge through mercury vapor, penetrates the genetic material of microorganisms and retards their ability to reproduce. The effectiveness of a UV disinfection system depends on the characteristics of the wastewater, the intensity of UV radiation, the amount of time the microorganisms are exposed to the radiation, and the reactor configuration. Due to the limitations of CapDet, costs are assumed identical for flow up to 100,000 gpd. For flows less than 10,000 gpd, the capital cost and O&M costs were reduced to half of the 10,000 gpd as this is an interpolation. The design of the UV disinfection system assumes year-round disinfection and meeting 126 colonies per 100 mL coliform effluent limit.

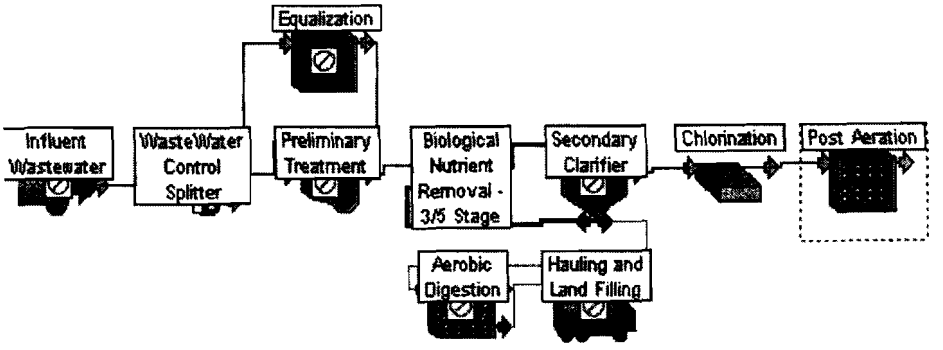
Figure D-6: UV Disinfection System



D-7) Chlorine Disinfection:

Chlorine is the one of the most widely used disinfectants to meet E. Coli effluent limits, especially with smaller facilities and facilities with lagoons. Chlorine is introduced to wastewater in the form of gas, hypochlorites (tablets, solutions, or powder), and other compounds. In Missouri, tablet chlorination and dechlorination is most common. However CapDet does not model tablet chlorination and dechlorination, which inflates the cost. The CapDet design meets the 15 minutes of contact time required per 10 CSR 20-8. The design includes post-aeration following chlorination and dechlorination to increase the dissolved oxygen back towards the water quality standard of 5 mg/L.

Figure D-7: Chlorine Disinfection System



E) Regionalization and Relocation

An option often evaluated by communities is the possibility of regionalization or relocation. Regionalization is combining or connecting with another wastewater treatment plant and having that plant treat all the flows from two communities. This works well for communities located near each other. The other option communities often evaluate is the relocation of the discharge pipe to another stream, usually a larger stream with more mixing or that is not listed as impaired. Both of these options usually involve construction of a pipeline. The cost estimate for the pipeline is based on submitted documentation and from the 10 CSR 20-8 Design Guides. The cost for inspection and minor cleaning of $2.50 per linear foot is from existing contracts provided to the department. The cost of piping, valves, and forcemain was from CapDet Works piping databases and verified with existing cost estimates. 10 CSR 20-8 requires pipes to be a minimum of six inches for small flows and eight inches for flows greater than 0.0225 MGD. The Design Guides set a maximum of four hundred feet (400') per manhole distance, which provides a conservative estimate of fifteen (15) manholes per mile of pipeline.

F) Sample Calculations involved in the Cost of Compliance

F-1) Number of connections

Permit writers are directed to use the number of connections from question 8.3 from Form B (http://dnr.mo.gov/forms/780-1512-f.pdf) or questions 7.5 from Form B-2 (http://dnr.mo.gov/forms/780-1805-f.pdf). If the permit writer does not know the number of connections, the Cost of Compliance Spreadsheet automatically estimates the number of connections based on 10 CSR 20-8 Design Guides. The Cost of Compliance Spreadsheet rounds down the estimated number of connections.

$$\frac{design\ flow\ in\ gallons\ per\ day}{\left(\frac{100\ gallons\ per\ day}{per\ capita}\right) * \left(\frac{3.7\ people}{per\ connection}\right)} = connections$$

$$\frac{100{,}000\ gpd}{\left(\frac{100\ gallons\ per\ day}{per\ capita}\right) * \left(\frac{3.7\ people}{per\ connection}\right)} = 270.3\ connections$$

Table 1: Summary of Daily Design Flow to Default Connections.

Flow (gpd)	Connections
10,000	27
20,000	54
50,000	135
70,000	189
100,000	270
120,000	324
150,0000	406

F-2) Capital Cost Calculation for Land Application Systems, including acreage
Capital costs are fixed, one-time expenses incurred during the construction of pollution control infrastructure. It is the total cost needed to bring a project to an operable status. Capital costs include design, labor, equipment, material costs, and contingency costs. These costs were estimated with the CapDet program. Below is the estimated capital cost for land application system for 0.1 MGD facility with an existing lagoon located in Scotland County. In Scotland County, from the Missouri Land Survey the cost per acre for acreage is $3,858 per acre and a 0.1 MGD system will need an estimated 68 acres.

$$Capital\ Cost\ for\ Land = \$3{,}858 * 68 = \$262{,}344$$

$$Total\ Capital\ Costs = Capital\ Cost\ of\ Land\ Application\ System + Capital\ Cost\ of\ Land$$

$$Total\ Capital\ Cost = \$2{,}163{,}606 + \$262{,}344 = \$2{,}425{,}950$$

F-3) Annualization Factor
The Annualization Factor is calculated, which is the total amount of interest foregone is averaged over the life of the project, so that the resulting figure is the same from year to year. To get the Annualization factor, which is based on the rate of interest (5%) and the expect life of the capital asset (20 years). The Annualization factor is calculated with the equation below:

$$\frac{Interest\ rate * (1 + interest\ rate)^{equipment\ life}}{(1 + interest\ rate)^{equipment\ life} - 1}$$

$$\frac{0.05(1 + 0.05)^{20}}{(1 + 0.05)^{20} - 1} = 0.08024$$

F-4) Annualized Capital Cost
To get the annualized capital cost of the capital cost, the estimated capital cost from CapDet is multiplied by the calculated annualization factor. By annualizing the capital cost, this allows the total amount of interest forgeone is average over the life of the asset, resulting in the same cost over the life of the project.

$$Capital\ Cost * Annualization\ Factor = \$2{,}425{,}950 * 0.08024 = \$194{,}665$$

F-5) Debt retirement
The Cost of Compliance Spreadsheet employs the Microsoft Excel PMT function. The PMT function calculates the payment for a loan based on constant payments and a constant interest rate. The Microsoft Excel function is PMT(rate,nper,pv,fv,type). Rate is the interest rate per period, assumed at 5.0% in the calculation. NPer is the number of periods over which the loan or investment is to be paid, 20 years. PV is the present value of the load/investment, which is the capital cost. FV is an optional argument that

specifies the future value of the loan at the end of nper payments and if omitted has the default value of 0. The default value is used in the debt retirement calculation. Type is an optional argument that defines whether the payment is made at the start or the end of the period. If the type argument is omitted, the default value of 0 is used denoting that payment made at the end of the period.

PMT(rate,nper,pv,fv,type)=> PMT(5.0%, 20 years, $2,425,950,0,0)= $194,665

F-6) Monthly debt retirement per connection

In setting utility rates, the annual debt retirement must be distributed equitably across the year and all users. To calculate the monthly debt retirement cost per connection, the equation below was used. While the debt retirement equation could be modified to set the monthly retirement rate, this equation was used to ensure that the debt retirement equation units were consistently held as annual number.

$$\frac{debt\ retirement\ per\ year}{(number\ of\ connections) * 12\frac{months}{year}} = monthly\ debt\ retirement\frac{cost}{connection}$$

$$\frac{\$194{,}665}{270 * 12\frac{months}{year}} = \$60.02\ monthly\ debt\ retirement\frac{cost}{connection}$$

F-7) Annual Operations and Maintenance Cost

The annual operations and maintenance cost was developed from CapDet and includes the following components: energy, labor, chemical, and material costs. The annual operations and maintenance costs includes an operator of the treatment plant, administrative costs, the electrical costs for running pumps and blowers, maintenance and material cost for replacement, and chemical costs for flocculants and coagulants that may be used. The overall annual operations and maintenance costs were calculated with the following equation.

$$Annual\ (energy\ cost + labor\ costs + chemical\ costs + material\ cost) = overall\ annual\ operations\ and\ maintenance\ cost$$

Table 2: Annual O&M Cost for 0.1 MGD Land Application System

Category	Cost per year
Annual labor costs:	$37,100
Material cost:	$2,660
Chemical cost:	$0
Energy Cost:	$335
Total Annual O& M Costs:	$40,095

F-8) Present worth factor

The formula for the present value factor is used to calculate the present value per dollar that is received in the future. The present value factor formula is based on the concept of time value of money. Time value of money is the idea that an amount received today is worth more than if the same amount was received at a future date. Assuming a 5% interest rate and 20 year period, the present worth factor is 12.46.

$$\frac{(1 + interest\ rate)^{(equipment\ life)} - 1}{(interest\ rate) * (interest\ rate + 1)^{equipment\ life}}$$

$$\frac{(1 + 0.05)^{(20)} - 1}{(0.05) * (0.05 + 1)^{20}} = 12.46$$

F-9) Present Worth

Present worth, also known as net present value, is the sum of the present values of incoming and outgoing cash flows over the period of the loan. This value represents an amount of money at an initial time. The present worth allows for cost comparisons of different alternatives on the basis of a single cost figure for each alternative. The cost estimates were based on the CapDet program. The department assumes a 20-year loan period with an interest rate set at the current rate for bonds on the market at the time of this analysis

$$Present\ Worth = Capital\ Cost + (Present\ Worth\ factor * Annual\ O\&M\ Costs) + (Present\ Worth\ factor * Other\ Costs) - Salvage\ Value$$

Using a 0.1 MGD land application facility with a 5% interest rate and 20 year life, the present worth of the system is

$$Present\ Worth = \$2{,}425{,}950 + (12.462 * 40{,}095) + (12.462 * 0) - 0 = \$2{,}663{,}278$$

F-10) Monthly O&M cost per connection

$$\frac{annual\ operation\ and\ maintenance\ cost}{(number\ of\ connections) * 12\frac{months}{year}} = monthly\ O\&M\ \frac{cost}{connection}$$

$$\frac{\$40{,}095}{270 * 12\frac{months}{year}} = \$12.38\ monthly\ O\&M\ \frac{cost}{connection}$$

F-11) Monthly cost per user

$$\frac{monthly\ OM\ cost}{connection} + \frac{monthly\ debt\ retirement}{connection} = monthly\ user\ cost\ per\ connection$$

$$\frac{\$12.38\ monthly\ O\&M\ cost}{connection} + \frac{\$60.02\ monthly\ debt\ retirement}{connection} = \$72.40\ monthly\ user\ cost\ per\ connection$$

F-12) Overall Assumptions:
Existing user rate from the 2014 Missouri Public Utilities Alliance Survey provided by Mr. Phil Walsack, MPUA Environmental Manager
Land Costs from the Missouri Farm Land Values Survey conducted by University of Missouri Extension, http://agebb.missouri.edu/mgt/landsurv/
The table below provides assumptions that are editable, but were held consistent between all scenarios ran in CapDet treatment technologies. Unit costs come from the Marshall and Swift Index, Engineering News Records Cost Index, Pipe Cost Index, Hydromantis Equipment Cost Index, Hydromantis Construction Cost Index, and the Hydromantis Pipe Cost Index.

Table 3: Assumptions for all CapDet Scenarios

Assumptions in CapDet	
Structural Lifespan	20 years
Pumps	10 years
Electricity	$0.1/kWh
Administrative labor cost	$25/hr
Lab labor cost	$20/hr
Construction labor cost	$32/hr
Legal Cost	2%
Miscellaneous Cost	5%
Engineering Design Cost	10%
Inspection Cost	2%
Contingency Cost	10%
Technical Cost	2%
Profit	0%

While there are thousands of assumptions built into CapDet, below is a summary of the major equipment costs provided. All equipment costs are developed from Hydromantis specific indices that include multiple national indices, including the Marshall and Swift Index and the Engineering News Record.

Table 4: CapDet Unit Costs

Description	Value	Units
Building Cost	110	$/sqft
Excavation	8	$/cuyd
Wall Concrete	650	$/cuyd
Slab Concrete	350	$/cuyd
Crane Rental	250	$/hr
Canopy Roof	20	$/sqft
Electricity	0.1	$/kWh
Hand Rail	75	$/ft
Center Pivot 100 acre system	69,000	$/unit
15 gpm sprinkler	230	$/sprinkler
UV lamp installed	850	$/lamp
UV replacement lamp	75	$/lamp
6 inch PVC pipe	20	$/ft
8 inch PVC pipe	28	$/ft
12 inch butterfly valve	2300	$/valve
16 inch pump	40,000	$/pump
5 hp vertical turbine mixer	10,200	$/mixer
2 ft mechanically cleaned bar screen	138,000	$/unit

Appendix E: Public Notice Comments and Responses Section (07/20/2015 – 08/19/2015)

Association of Missouri Cleanwater Agency comments:

1. We believe the variance should specify that each community reach 1.75 percent of community MHI rather than 2 percent over the five year period from when the variance is included in their NPDES permits. When sewer bills reach two percent of MHI that is a considerable burden for any community, especially when such revenues are targeted at meeting just one effluent limit. We do not believe it is sustainable to force these communities to increase rates up to two percent within the next five years in the name of total ammonia compliance given all the other wastewater (not to mention community public health and environmental needs). We think 1.75 percent is still a very aggressive level of investment yet one that leaves some possible additional revenue for other system needs. In any case, while two percent may be tolerable for smaller systems, AMCA remains adamant that such a sewer charge is not appropriate nor sustainable for larger cities in Missouri.

   The department has changed language in the variance framework to indicate that the time given via the Multiple Discharger Variance (MDV) for ammonia should be used to "to maintain existing water quality protections while allowing time for the following; adaptive management approaches, advances in treatment technologies, control practices, evaluation and removal of inflow and infiltration, sludge removal, pursue an increase in residential user rates ***to an appropriate level to help mitigate substantial and widespread economic and social impact*** and other changes in circumstances." The department also recognizes the funds collected through sewer bills may be different from the amount spent on sewer-related work, and a closer accounting may be necessary.

Missouri American Water Company Comments:

1. The proposed MDV is limited to "minor municipalities that are Publicly Owned Treatment Works (POTW) within the State". Private / PSC regulated facilities, and their customers, face the same "substantial and widespread economic and social impact" described in the MDV. In fact, it may be argued that customers of these systems face more severe impacts as they typically have fewer customers to absorb the costs of the required upgrades which leads to much higher rates. Assuming the private systems meet the same standard / design requirements specified in the MDV they should also be able to utilize the MDV.

   The department agrees that the potential for private facilities to experience substantial and widespread economic and social impact related to increasing sewer rates resulting from expenses associated with complying with ammonia requirements may exist. At this time the department is focusing its resources to develop a Multiple Discharger Variance (MDV) for Publicly Owned Treatment Works. This effort does not preclude a private facility from filing a site specific variance request based upon the factors addressed in the recently public notice MDV. The application for a site specific variance can be found at http://dnr.mo.gov/forms/780-0181-f.pdf. One of the primary aspects of a MDV is that the dischargers are similar regarding the factors affecting the impact. When comparing the fiscal capabilities of a privately owned company to

that of a publicly owned treatment works, the department finds major differences which prohibited the MDV from allowing inclusion of the private sector.

2. The MDV should further reference and clarify procedures for facilities other than lagoons (i.e. re-circulating sand filters). There may be communities that cannot affordably modify non-lagoon facilities to achieve either the existing or updated 2013 ammonia criteria. We ask the Department to revise the MDV to further clarify or reference socioeconomic variance procedures that apply to non-lagoon facilities.

   During the development of the MDV framework the department conducted an analysis of the highest attainable effluent quality that could be achieved by properly designed, operated and maintained lagoon and recirculating media filter facilities. These analysis are included as Appendix A and C. Please note that in the analysis for media filter facilities the highest attainable effluent quality for properly designed and maintained systems is meeting the water quality standards for ammonia. Therefore, inclusion in the MDV is prohibitive when grouping similar facilities together.

3. The MDV should consider costs from other municipal services such as stormwater or drinking water in calculating the 2% MHI affordability threshold. The draft MDV document appears to require applicants to raise wastewater related user rates to a 2% MHI. If true, we request the Department to revise the MDV to allow interested applicants to distribute user rate investments according to environmental benefit as supported by US EPA's municipal integrated planning approach. We believe that in some instances, communities and the environment will benefit more by allocating user rates towards other requirements such as stormwater management.

   The MDV framework is specific to allowing qualifying POTWs a variance from the ammonia water quality standard. It is important to note that the variance is required to focus on the social and economic impact that results from compliance with the specific water quality standard that would not be met. For this reason the inclusion of stormwater (MS4) and/or drinking water obligations is not appropriate when evaluating alternatives for complying with ammonia. That being said any community that wishes to utilize integrated planning in an effort to negotiate a longer schedule of compliance for a water quality requirement is encouraged to do so. This opportunity is afforded through the permitting process. As a result of this and other public notice comments, the department has changed language in the variance framework to indicate that the time given via the MDV for ammonia should be used to "to maintain existing water quality protections while allowing time for the following; adaptive management approaches, advances in treatment technologies, control practices, evaluation and removal of inflow and infiltration, sludge removal, pursue an increase in residential user rates ***to an appropriate level to help mitigate substantial and widespread economic and social impact*** and other changes in circumstances."

Flotron & McIntosh Comments:

1. The second paragraph on page 1 states that the facility must meet the design requirements in the DNR regs. As you know many of the municipal lagoons were constructed in the 70s. When we meet with many of these small communities, they are lucky if they still have parts of the plans and specs for their lagoon systems. Many of them do not. We have then checked with DNR and/or the engineering firm, if

it is still in business, and usually copies are no longer available. So how would a municipality make this demonstration?

Each municipality with a lagoon must submit the completed lagoon design profile as part of the certified multiple-discharger variance application process. Each permitted lagoon should currently meet the design requirements per the issued Missouri State Operating Permit. An engineer from the department will complete an engineering evaluation of the facility to ensure that the lagoon is designed on the basis of thirty- four pounds (34 lbs) of applied BOD per day per acre of water surface area in the primary cell at a water depth of three feet per 10 CSR 20-8.020(13)(A)2A and 10 CSR 20-8.020(15)(D) prior to qualifying for the variance.

2. Many communities that we have met with have significant I&I problems as well. Section 6 of the variance would indicate that these communities would not then qualify for the variance. Am I interpreting this correctly?

   If a publicly owned treatment facility experiences <u>excessive</u> inflow and infiltration (I&I), the facility would not qualify for the MDV. Excessive inflow and infiltration is defined as greater than or equal to 275 gallons per capita per day by 40 CFR 133.103(d)(3). Excessive I&I is an indication that collection system and potential operation and maintenance problems exist which would prohibit the system meeting highest attainable effluent conditions as stated in the MDV.

3. With the expansion of the stream classification in the state, many communities are now looking at providing disinfection as well as a schedule of compliance to meet ammonia limits. Since the variance only applies to ammonia, I assume the communities would still need to upgrade to meet the disinfection requirements?

   The MDV will address only the Water Quality Standard for total ammonia nitrogen. Each municipality will need to meet all other requirements and schedules of compliance within their issued Missouri State Operating Permit.

4. There are municipalities with lagoon systems that are border line or occasionally exceed their BOD and TSS limits. So I assume that in this situation the municipality would still need to upgrade their lagoon system to meet BOD and TSS and perhaps disinfection?

   In order to meet and maintain the highest attainable effluent conditions for total ammonia nitrogen, each lagoon system must be in compliance with equivalent to secondary treatment BOD_5 and TSS limits. Each municipality under the variance with a schedule of compliance for *E.coli* is required to meet disinfection schedule and all other requirements of the Missouri State Operating Permit.

5. One of the criteria for the alternatives analysis to be provided by the community is to determine the costs for "decentralization." That is a complete reversal to the department's position for years to encourage unsewered communities to centralize. I assume that the costs to decentralize would then include the cost for each connection to provide their own wastewater treatment?

   Each variance approved by the Missouri Clean Water Commission and the EPA must show that all reasonable alternatives to comply with Water Quality Standards have been evaluated and determined to also cause substantial and widespread economic and social impact if implemented. Decentralization of the wastewater utility is a reasonable alternative if the community has a

severely declined population and is showing continued decline in population. The costs to decentralize include either a cluster system or individual onsite septic systems. The municipalities that would potentially qualify for the variance would need to justify that the cost to decentralize their wastewater utility would still cause a substantial and widespread economic and social impact for the residents of the community. It is the opinion of the department that onsite systems are protective of water quality and public health when designed in accordance with 10 CSR 20-6.030 and the requirements of the Department of Health and Senior Services.

6. Some communities are nearing their compliance dates to meet ammonia limits now. If those communities are in noncompliance before the variance is final, would they still qualify for the variance?

   The department would not be able to consider those municipalities that wish to apply for the variance if final effluent limits for total ammonia nitrogen have become effective within the issued Missouri State Operating Permit. We understand that some municipalities will not be able to meet the final requirements within their permit due to financial hardships. In this case, the permitted entity should contact their regional office in order to seek guidance on how to return to compliance with the permit. This may include entering into a formal administrative order on consent (AOC) with the department. The AOC would then set an appropriate path to compliance and timeframe. Similar consideration such as those in this MDV, could be used in an AOC.

Missouri Municipal League Comments

1. Please keep the hurdles to getting into the program as low as possible. Certainly, the League recognizes the reasonableness of the variances requirement that lagoons systems that are granted a variance must be operated in a manner that provides compliance with other Water Quality Standards. However, requiring municipalities granted the variance to raise their sewer rates to two percent of median household income may be burdensome to some communities.

   The department has changed language in the variance framework to indicate that the time given via the Multiple Discharger Variance (MDV) for ammonia should be used to "to maintain existing water quality protections while allowing time for the following; adaptive management approaches, advances in treatment technologies, control practices, evaluation and removal of inflow and infiltration, sludge removal, pursue an increase in residential user rates ***to an appropriate level to help mitigate substantial and widespread economic and social impact*** and other changes in circumstances."

2. To the extent possible please consider that communities designated as Category 1's in the Wichita State study face an already uncertain future. While, the granting of the variance may provide some relief to these communities, forcing the community to accept increased utility rates may contribute to the already downhill economic spiral the community is facing. Many of these communities have large elderly populations and may also have high numbers of renters. The burdens of increased utility bills may exasperate the economic downturn in these areas as renters may choose to leave the community and a greater burden is placed on those on fixed incomes such as the elderly. This in turn may lead to some of these very small communities disincorporating.

The study completed by Wichita State (Missouri Sustainability Assessment Tool) is used within the department written Cost Analysis for Compliance (CAFCom) in order to express the degree of socioeconomic burden. The CAFCom is the initial factor used to determine the socioeconomic burden that could potentially be placed on the community in order to comply with the WQS for total ammonia nitrogen. The department understands the challenges that may arise if current user rates are raised to amount that is not sustainable by a community facing a population reduction, therefore, the department t has changed language in the variance framework to indicate that the time given via the Multiple Discharger Variance (MDV) for ammonia should be used to "to maintain existing water quality protections while allowing time for the following; adaptive management approaches, advances in treatment technologies, control practices, evaluation and removal of inflow and infiltration, sludge removal, pursue an increase in residential user rates ***to an appropriate level to help mitigate substantial and widespread economic and social impact,*** and other changes in circumstances." Also, it should be noted that as populations decrease the feasibility of certain alternatives such as decentralization may also change given the reduced number of onsites needed.

3. Please consider that applying the EPA's much touted two percent of median household income as a universal standard may result in residents in some communities facing much tougher situations than those in others. Using a range of perhaps 1-2% of median income that takes into how rate increases will impact households in the lower than the median income may provide a fairer option.

The department acknowledges that some communities may want to pursue a variance in situations where the practicable treatment alternative costs are estimated to be below 2% of the MHI. In these situations it is recommended that the community seek a site specific variance to afford the community the opportunity to express their specific impact resulting from compliance without being grouped as part of a MDV. The application for a site specific variance can be found at http://dnr.mo.gov/forms/780-0181-f.pdf. Establishing a moving MHI target for the compliance alternatives would remove the ability for the department to establish compliance alternative assumptions thus prohibiting already disadvantaged communities from expressing that all alternatives will cause substantial and widespread economic and social impact.

Robert Brundage Comments:

1. On page 5 of the draft, it says "none of the treatment works listed within the multiple-discharger variance receive excessive inflow and infiltration as defined in 40 CFR 133.103(d)(3)." Does this mean if a municipality has excessive I & I it may not qualify for the variance? If so, I object to this provision. Many facilities experience excessive I & I. In part, they need a 10-year variance to continue to work on I & I issues and to spend money on these issues.

Publicly Owned Treatment Works that have excessive inflow and infiltration (I&I) will not be eligible for the MDV. Excessive I&I is an indication that collection system and potential operation and maintenance problems exist which would prohibit the system meeting the highest attainable effluent conditions as stated in the MDV. A more appropriate route for communities with excessive I&I would be to consider the development of an integrated plan in order to justify an appropriate schedule of compliance to comply with the final effluent limits for ammonia. This

would allow time for the municipality to responsibly meet the requirements within the Missouri State Operating Permit as well as maximizing their infrastructure improvement dollars through an appropriate sequencing of work.

EPA Comments submitted by John Delashmit, EPA Region 7

GENERAL COMMENTS

1. Under the proposed multiple discharge variance, permittees with lagoon-based wastewater treatment facilities will receive temporary relief from established water quality criteria for total ammonia-N. The proposal repeatedly refers to the Appendices for further information, examples and documentation, yet much of this information is not included or available for review. The proposal asserts that permittees will be able to complete the necessary analyses for determining substantial and widespread social and economic impacts and the highest attainable effluent condition, but it appears to contain no specific instructions or case-specific examples. The proposal speculatively states that municipalities will apply EPA's 1995 Interim Economic Guidance for Water Quality Standards (1995 Guidance) spreadsheet tool to demonstrate widespread and substantial social and economic impacts. Use of the spreadsheet tool implies that municipalities will conduct both the substantial (Municipal Preliminary Screener and Secondary Test) and widespread impact analyses presented in the Guidance. However, no details on these analyses are included in the draft proposal. Qualification for a variance under 40 CFR 131.10(g)(6) requires a demonstration that the impacts of meeting the standard be both substantial and widespread. Insufficient information is provided in the proposal to assess the likelihood that the substantial/widespread analysis will be performed in accordance with the 1995 Guidance.

The MDV framework has been established to allow communities and the department to use facility/system specific data at which time the MDV framework is finalized. The department realizes by conducting a public notice of the framework commenters such as the Environmental Protection Agency (EPA) will be unable to comment on all aspects of the MDV. A future public notice will be conducted when the community/system-specific information is incorporated into the MDV framework. After public notice the department will address comments and seek Clean Water Commission approval and Attorney General's Office certification. After these items are achieved, the department will seek EPA approval on the complete and final variance. As a result of this portion of EPA's comments on the MDV framework, EPA should refer Appendix B of the framework which is the application for the MDV which indicates that communities are to complete EPA's 1995 Interim Economic Guidance for Water Quality Standards (1995 Guidance) spreadsheet tool which will be required to be completed by a municipality in order to be eligible for the MDV. Additionally, the department, prior to qualifying any community for inclusion in the MDV, will have had conducted a cost analysis for compliance (CAFCom) as it pertains to complying with ammonia limits based on the current criteria. The CAFCom mirrors each aspect of the 1995 spreadsheet tool plus evaluates additional socio/economic factors related to sustainability. For example, the CAFCom incorporates the Missouri Sustainability Assessment Tool (MoSAT) in order to determine the socioeconomic burden the residents of a municipality might face in order to meet the Water Quality Standards for total ammonia-N. The study completed to develop MoSAT used modeling analyses in order to determine factors associated

with each rural Missouri community that would predict the future population changes that could occur in each community. The model was applied to 19 factors which were determined as predictors of rural population change in Missouri. The model established a hierarchy of the predicting factors which allowed the model to place a weighted value on each of the factors. A total of 745 rural towns and villages in Missouri received a weighted value for each of the predicting factors. The weighted values for each town / village were then added together to determine an overall decision score. The overall decision scores were then divided into five categories and each town was assigned to a different categorical group based on the overall decision score. It is the opinion of the department that the CAFCom used in conjunction with the MoSAT tool and alternatives analysis clearly indicates whether or not the residents of a municipality will experience a substantial and widespread economic impact in order to meet the current and future criteria for total ammonia nitrogen.

2. The highest attainable effluent condition for ammonia-N was calculated by the MDNR using averaged performance data from one-, two- and three-cell lagoon systems. However, permittees should be grouped under the same variance analysis only if (a) they are similar to one another in terms of type of discharge (public versus private) and in terms of facility design capacity and performance capability, (b) the projected effects of the discharges on receiving waters are comparable and (c) the projected social and economic impacts of meeting the criteria are similar among permittees. Where permittees fall into distinctly different categories, they should be grouped and analyzed accordingly. In the absence of any supporting data, the EPA questions whether the lagoons included in the state's variance analysis are truly comparable to one another, especially in relation to considerations such as facility design flow, maintenance status, quality of final effluent, probable impacts on aquatic life, and socioeconomic conditions in the host community.

   The department is unaware of any federal guidance or regulation that prohibits the state from grouping all publicly owned lagoons that demonstrate that all treatment alternatives for ammonia-N result in widespread and substantial social and economic impacts into one category as it pertains to the inclusion under a MDV. The department based its decision on the fact that the qualifying systems are all publicly owned and would face the same widespread and substantial social and economic impacts. As it pertains to the highest attainable effluent condition for ammonia-N lagoons with design flows less than or equal to 150,000 gallons per day were evaluated. This design flow limit is stated under the "development of benchmark limits" section of the discharger variance document.

   In review of the comments received after public notice, the data used to determine the benchmark limits was reevaluated and found to include both influent data for BOD and TSS, which skewed the facility averages of BOD and TSS, and facilities which had design flows greater than 150,000 gallons per day. The Department conducted the same procedure as previously stated and similar benchmark limits of 2.2 and 3.2 mg/L were calculated. Appendix A of the framework for the multiple-discharger variance document has been revised to reflect these changes.

   The waterbody that receives each facility's discharge was also examined. Overall, 10 facilities were found to discharge to (P) streams, which are those that maintain permanent flow during drought conditions and therefore allow mixing. It was also determined that 6 of the facilities in

the entire data set discharge to streams listed as impaired on the 303(d) list. None of the streams were found to have an impairment related to ammonia or nutrients.

The performance data of each technology type was evaluated and found to have reasonably similar effluent quality. Due to the fact that some of the waterbodies are classified as (P) streams, the effluent data was evaluated both with and without the facilities that discharge to these streams. The tables showing the breakdown of the seasonal data and treatment types are as follows:

Summer Data:

Treatment Type	Number of Facilities	Averages of Effluent Ammonia Concentrations		Number of Streams Classified as (P) Streams	Averages of Effluent Ammonia Concentrations without Facilities that Discharge to (P) Streams	
1 Cell	5	1.16	1.59	1	1.22	1.68
1 Cell Aerated Primary	3	2.29		0	2.29	
2 Cell	8	2.78	3.30	1	2.97	3.42
2 Cell Aerated Primary	8	3.82		0	3.82	
3 Cell	73	2.09	2.16	5	2.16	2.19
3 Cell Aerated Primary	5	3.29		1	2.60	
4 Cell	15	1.36		1	1.33	
TOTAL	*117*	*2.18*		*9*	*2.22*	

Winter Data:

Treatment Type	Number of Facilities	Averages of Effluent Ammonia Concentration		Number of Streams Classified as (P) Streams	Averages of Effluent Ammonia Concentrations without Facilities that Discharge to (P) Streams	
1 Cell	5	1.89	2.73	1	2.00	2.94
1 Cell Aerated Primary	2	4.81		0	4.81	
2 Cell	6	3.33	3.53	1	3.45	3.60
2 Cell Aerated Primary	6	3.73		0	3.73	
3 Cell	65	3.21	3.40	5	3.27	3.42
3 Cell Aerated Primary	6	5.5		1	5.19	
4 Cell	14	2.15		1	2.20	
5 Cell	1	0.53		1	-	
TOTAL	*105*	*3.18*		*10*	*3.24*	

3. The proposal states that the values for the highest attainable effluent conditions will be benchmark concentrations and not enforceable effluent limitations. The highest attainable effluent conditions for permittees must be specified as the interim water quality standard that will be subsequently reflected in permits. This is necessary so that the WQBEL derives from and complies with WQS (122.4(d)). The state should explain why a seasonal average, instead of a monthly average and a daily maximum (the state's current WQ criteria for ammonia is expressed as a monthly average and daily maximum), is consistent with the highest attainable effluent condition. Where a permittee cannot immediately meet the WQBEL derived from the requirements of the WQS variance, the MDNR can choose whether to provide a permit compliance schedule so the permittee can remain in compliance with its NPDES permit.

   While benchmarks are not effluent limits they are values that may require the permittee to conduct additional activities to remain in compliance. This requirement is enforceable and applicable for permitting in conjunction with an approved variance from the water quality standard. The permits for qualifying communities under the approved variance would not have interim limits for two permit cycles given the variance would be for a term longer than the five year permit term and establish the highest attainable effluent quality. The two permit terms would have a final limit of monitoring only for ammonia-N for which the data is to be compared to the highest attainable effluent condition benchmark values which if not met would trigger improvements to the lagoon system. The department does not see a need to include a schedule of compliance in the first and second permit cycle post variance approval if the variance is a 10 year variance. Upon the expiration of the variance the department would renew the permit with a schedule to comply with the ammonia criterion that is in rule at that time and or seek approval of another variance depending on factors affecting whether or not a widespread and substantial social and economic impact continues to exist at that time.

   The state's current water quality standard for ammonia as N is not expressed as a monthly average and daily maximum. The ammonia criterion is expressed as acute and chronic criteria based on pH and temperature. The averaging period for the chronic criteria is as 30 day average and the acute criteria is a 1 day maximum. These values are then used to establish the wasteload allocation which is utilized to calculate a permit limit that is expressed as a daily maximum and monthly average using the methodology from EPA's technical support document. The department believes that a community with an approved MDV can have a monitoring requirement for ammonia in their operating permit for the term of the MDV if they comply with the conditions of the permit that set forth improvements when not achieving the benchmark value and that this type of permit requirement complies with 122.4(d).

4. Lastly, when a state adopts a WQS variance, attainability must be considered in the context of a designated use and associated criterion that fully meet the requirements of 40 CFR 131.10 and 131.11. Missouri's current ammonia criteria are based on Clean Water Act section 304(a) recommendations published by the EPA in 1999. These 304(a) recommendations were updated by the EPA in 2013 to be more protective of freshwater mussels and gill-breathing snails, forms of aquatic life common throughout Missouri. Prior to, or concurrently with, the adoption of a variance as proposed, Missouri should update its ammonia criteria to ensure that the variance is based on a long-term water quality goal that is genuinely protective of the designated use and otherwise compatible with 40 CFR 131.10 and 131.11.

The department is currently working on revising water quality standards for a variety of parameters at this time of which the 2013 ammonia criteria is not included in the short-term changes. This MDV framework is based on the premise that all ammonia compliance alternatives will be protective of the 2013 mussel and gill-breathing snail ammonia criteria. All technologies that have been considered within the CAFCom and reasonable alternatives analysis have the capability to meet the current WQS and the future WQS (where mussels of the family Unionidae are present or expected to be present) for total ammonia nitrogen. Additionally it is the opinion of the department that the status of future Missouri Water Quality Standards has no bearing in the approval of a variance of a water quality standard that is currently approved and promulgated.

SPECIFIC COMMENTS (EPA)

Variance Timeframe

1. On page 3, the proposal describes why the MDNR believes a 10-year time period is "necessary and reasonable to mitigate the substantial and widespread economic and social impact caused by the requirement to meet WQS for total ammonia nitrogen (10 CSR 20-7.031 (5)(B)7.C. and 10 CSR 20-7 Table B3)." Descriptions of the interim tasks addressed in the draft proposal are very general: "...adaptive management approaches, advances in treatment technologies, control practices, evaluation and removal of inflow and infiltration, sludge removal, pursue an increase in residential user rates to two percent (2%) of the municipality's median household income, and other changes in circumstances." The proposal asserts that "The qualifying municipalities will be reviewed at year five of the variance to ensure that the municipality has taken **the appropriate steps to achieve the highest attainable effluent conditions** [emphasis added] and build capital to make the necessary wastewater treatment facility investments that will achieve the WQS for total ammonia nitrogen."
The descriptions of the interim tasks should be expanded in order to justify a 10-year time period as appropriate. The MDNR should describe the pollutant control activities that are needed during the WQS variance term to achieve the highest attainable effluent condition. The general descriptions provided as the basis for the timeframe of the MDV do not sufficiently describe the "appropriate steps" that will be taken to achieve the highest attainable effluent condition. Routine operation and maintenance of the individual facilities, such as evaluation and removal of inflow and infiltration and sludge removal, should be completed as soon as possible to enable each facility to discharge at the highest attainable effluent condition. Please provide estimated timeframes for these and other milestone tasks that will be undertaken by the dischargers during the 10-year time period, and describe how the permittees will report incremental progress in achieving the water quality standard.

The MDV framework is to act as a general guide for the site specific permits that will be under the variance for total ammonia nitrogen. Each site specific permit under the MDV will have guidelines specific to their facility and financial situation within their issued Missouri State Operating Permit (MSOP). The specific guidelines written within the MSOP will ensure the highest attainable effluent conditions for the receiving stream during the 10 year timeframe of the

MDV. The permit incorporating the variance will be public noticed at the same time as the variance to facilitate understanding of the interim steps and their association with the variance.

Also, an engineer from the department will conduct an engineering evaluation of each site prior to qualifying for the MDV. The engineering evaluation is to identify the steps necessary to ensure each community is reaching and/or maintaining the highest attainable effluent conditions as detailed in Appendix A. While each facility will be covered under the MDV, every facility will have an individual set of milestones necessary to ensure the highest attainable effluent conditions are met throughout the timeframe of the MDV. An annual report will be required of each municipality which details each milestone that has been made during that year including changes to elected officials. This will be reviewed by the department annually. Examples of milestones that have been added to the MDV framework are as follows:

- sludge removal,
- removal of non-excessive inflow and infiltration,
- number of active connections,
- population increases or decreases,
- an increase of sales and/or property taxes,
- the steps taken to pursue an increase in user rates,
- if an election year has occurred a list and contact information of the newly elected officials, and
- status of commercial connections.

For example, after the engineering evaluation, if it has been determined that sludge removal is necessary to meet the highest attainable effluent conditions, the municipal must comply and remove the sludge in order to receive a variance. The community will be required to provide a report detailing the characteristics of the sludge including total amount (dry tons) and metal and nutrient concentrations. This will be followed by a sludge removal plan. Then a community will need implement the sludge removal plan in order to meet the highest attainable effluent conditions.

Staff from the department will check the discharge monitoring reports of the permits under the MDV to ensure that the benchmark for the highest attainable effluent conditions is being met. Each monthly sample will be monitored by department staff. If staff notices the highest attainable effluent concentration has not been met for total ammonia nitrogen, a follow up call and/or visit will be made to the permit holder to determine the immediate actions that need to be made to meet the benchmark.

Cost and Alternatives Analysis

2. The proposal addresses the cost of complying with the existing ammonia criteria and treatment alternatives only in very general terms. The EPA cannot provide detailed comments on these aspects of the MDV at this time, because the proposal provides no specific information on the methods that will be used to calculate costs and identify alternatives. Further information would be helpful in determining

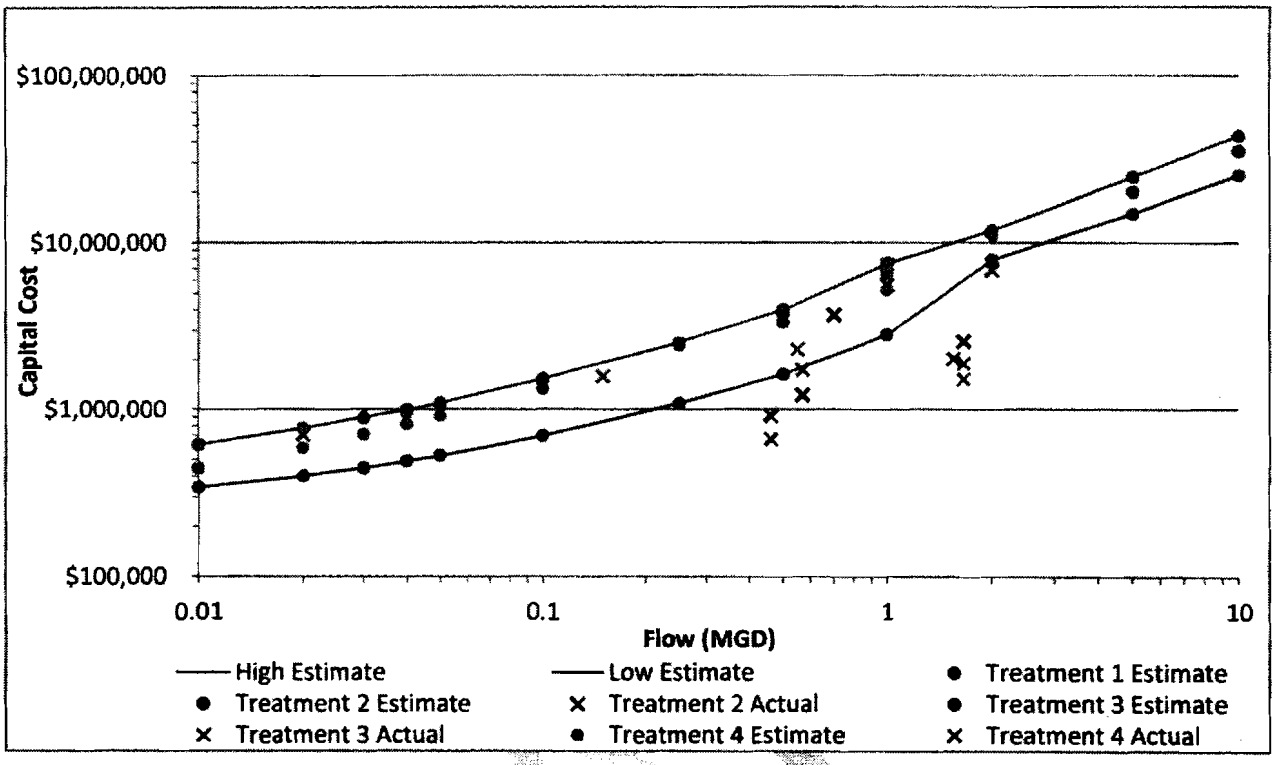
whether the proposed analysis methods are reasonable and credible. While the overall approach presented by the state appears to be sound, there are insufficient details to determine whether the proposed methods of analysis will result in reasonable cost estimates or in the identification of reasonable and affordable alternatives.
Specific recommendations are presented below:

Cost analysis: As indicated in the proposal, the MDNR will prepare an analysis of the cost of compliance for each permittee included in the MDV, using CapdetWorks software. This analysis will estimate the cost incurred by individual permittees as they upgrade to a land application based system and/or a mechanical treatment plant. The proposal would benefit from a more complete description of how the MDNR will apply CapdetWorks. Example calculations would be useful to the reader.

Although the proposal lists the unit processes for which costs can be estimated using CapdetWorks (e.g., land application system, extended aeration, sequencing batch reactor), details about the specific combination of unit processes (i.e., the treatment train) assumed for any given permittee (or group of permittees that share similar enough characteristics to be considered together) would be needed to determine whether the cost estimate is reasonable and reflects the upgrades actually required to meet effluent limits. Furthermore, details about the influent assumptions (e.g., flow rate) would be needed to confirm that the CapdetWorks estimate accurately reflects reasonable values for the given permittee. Finally, the analysis should include details about the unit costs and assumptions (e.g., labor rates, land cost, interest rate, contingency percentage) applied by the MDNR in the CapdetWorks estimate. The default unit costs and assumptions contained in CapdetWorks, if unchanged as part of the compliance cost analysis, are likely to be inconsistent with the corresponding values used in the reasonable alternatives analysis (see below).

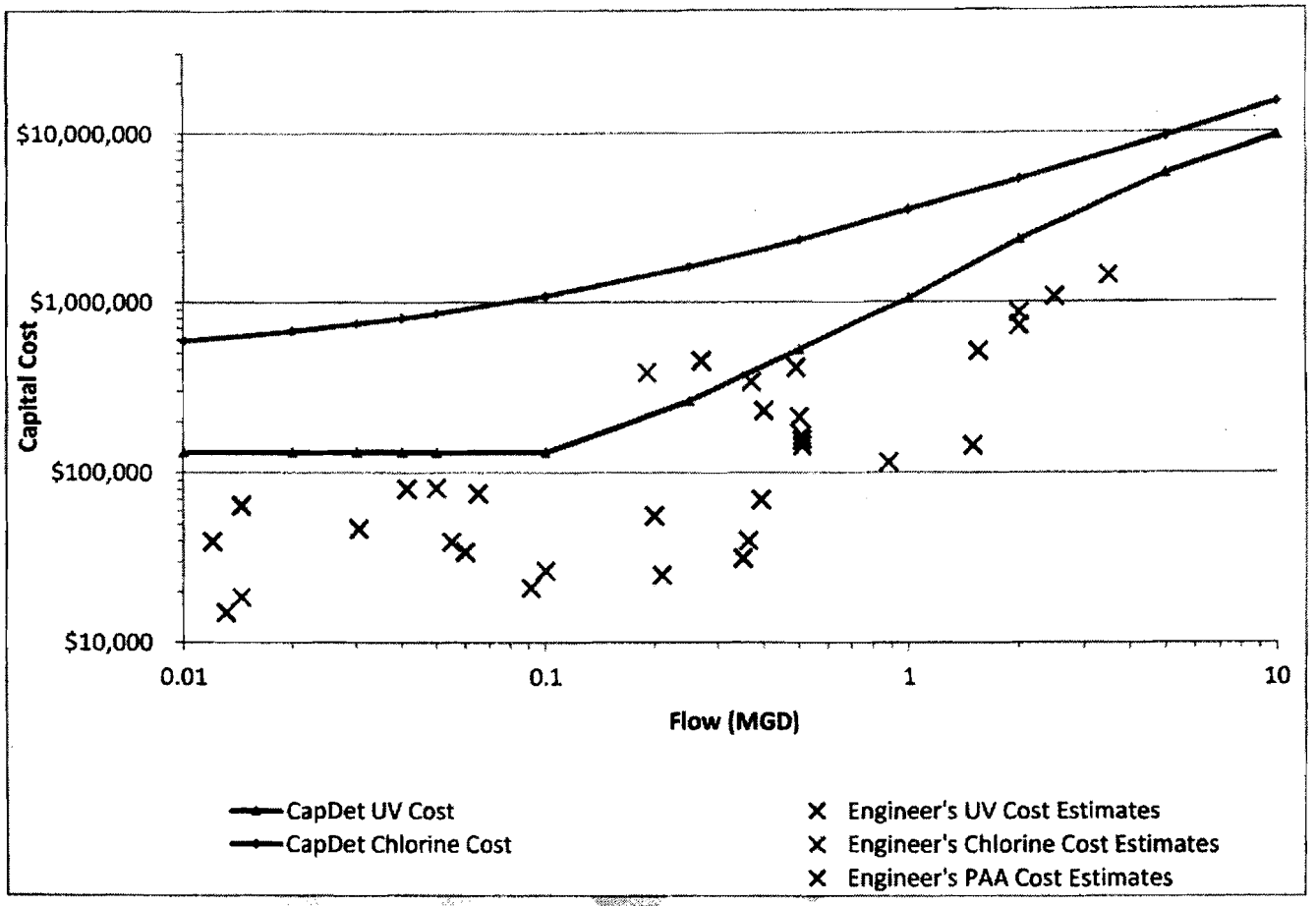
> The department has included a description of the application of CapdetWorks, example calculations, a discussion of applicability and details on cost and assumptions as Appendix D (attached) of the MDV framework. CapDet is a preliminary design and costing software program from Hydromantis for wastewater treatment plants that uses national indices, such as the Marshall and Swift Index and Engineering News Records Cost Index for pricing in development of capital, operating, maintenance, material, and energy costs for each treatment technology. As the program works from national indices and each community is unique in its budget commitments and treatment design, the estimated costs are expected to be higher than actual costs. The cost estimates located within this document are for the construction of a new treatment facility or system that is the most practical to facilitate compliance with new requirements. To ensure the cost estimates are accurate, the department has gathered and continues to gather actual costs or the engineer's specific estimate for a project to verify the CAFCom estimates are reflective and conservative. In the last three years of tracking actual costs, the cost estimates using CAPDETWORKs and the CAFCom process have been higher than the actual costs for both capital and operation and maintenance costs, as seen the Figures 1 and 2 below. The department continues to track costs reported in the engineering reports, facility plans, and bid documents to continuously compare site-specific costs to a cost based on national averages.

Figure 1: Capital Cost of Treatment Plant Technologies, CAPDET Works vs. Actual Costs



DRAFT

Figure 2: Capital Cost of Disinfection Technologies, CAPDET Works vs. Actual Costs



3. Alternatives analysis – relocation or regionalization: The proposal outlines an approach permittees can use to estimate the cost of regional treatment and discharge relocation. Specifically, it provides tables containing cost estimates based on flow rate and the distance (in miles) to the closest alternate treatment facility or discharge point. The draft MDV proposal lists some, but not all, of the underlying assumptions used to develop the cost estimates in the tables. Based on the list of assumptions, it appears the estimates account for certain capital equipment (manholes, pump stations, piping), construction labor for installation, design fees and contingency costs, operator labor for maintenance, a unit cost per foot for cleaning/maintenance, and pump replacement. It is not clear what other costs (if any) are included in the estimates (e.g., capital cost of valves, overhead and profit, electricity costs to operate pumps, charges for use of an alternate treatment facility). The following information also is missing from this analysis: (MDNR response provided with the comments)

• Hours of construction labor to install the alternative and how these hours vary with flow and distance.

> MDNR response: The labor cost is included in the cost per foot of installation. It is an estimate, as flows increase, the size of pipe increases and with distance, the amount of piping increases. The cost estimates were completed for six and eight inch pipe, while communities may use smaller pipe if they install forcemain, but the estimate for regionalization and relocation is based on 1 or 2 pump stations, 15 manholes per mile, and in most cases eight inch cast iron piping. Cast iron piping was selected as it had the higher installation cost and is what may be used when

piping a distance where there may be aerial or stream crossings. The numbers presented are best professional estimates complete by the department's engineering section, due to the varying geography in the state; the estimate for installation of a mile of pipe may vary greatly. There may be additional costs of clearing and grubbing the land or obtaining easements that is not accounted for in the cost estimate.

• Hours of operator labor to operate and maintain the alternative, how these hours vary with flow and distance, and the relationship (if any) between the operator labor rate and the unit cost per foot for cleaning/maintenance

MDNR response: The $2.50 per linear foot per year for cleaning and inspection is based on actual contracts in the state between municipalities and cleaning/inspection crews to evaluate each line.

• Capital cost of manholes

MDNR response: The capital cost of manholes is based on cost from estimates provided in engineering reports and facility plans. The 15 manholes per mile criteria is based on 10 CSR 20-8 which has a maximum distance of 400 feet per manhole.

• Capital cost of pump stations and how these costs vary with flow

MDNR response: The capital cost of the pump station includes the two pumps, construction of the station, and electricity. Costs vary with flow as the size of pump station and the pumps varies based on the flow through the facility. This is a preliminary cost as in some areas of the state, more pump stations would be required for the distance due to the topography.

• Confirmation that the pipe costs listed are in dollars per linear foot and include installation

MDNR response: The pipe costs are cost per linear foot and include installation. The piping costs come from Hydromantis Construction Index, which includes Marshall and Swift Index and Engineering News Records Cost Indices.

• How the pump replacement frequency affects the estimates

The pump replacement frequency affects the estimates, in that the annual operation and maintenance cost annualizes the costs for the pumps over the replacement period to provide money at the time of replacement. While the department acknowledges that pumps often last longer than 10 years, the 10 year replacement frequency was selected to have a replacement during the life of the project. • How the construction period assumption affects the estimates.

MDNR response: A construction period of 1 year for the regionalization system shortens the interest on the project. Construction of collection system is usually shorter than treatment plant construction. The department issues collection system permits for a period less than 2 years in most cases. The three year construction period for treatment plants is based on experience of the time period for municipalities under the State's Revolving Fund projects and the default in CAPDETWORKS.

4. Some of the assumptions listed in the proposal appear to be overly conservative (erring on the side of lower cost). For example, the construction labor cost of $32 per hour is lower than the current Engineering News-Record national average construction wage of $40.78 per hour. The pipe costs listed in the draft variance request are $60 for 8 inch pipe and $20 for 6 inch pipe.

   The $32 per hour is from the 2014 CAPDETWORKS costing indices, Marshall and Swift Index and Engineering News Records Cost Indices which is the national average for construction labor costs. The $25 per hour for operators is also from the Hydromantis Indices, and is a national average. In Missouri, the CAFCom and specifically the multi-discharger variance is drafted for smaller facilities, often located in rural areas that do not pay at the same scale as the national indices. For facilities not covered under the multi-discharger variance, the facility plan developed will detail the site-specific costs, which will include the cost for construction labor, operator labor, and materials.

5. Assuming these are unit costs in dollars per linear foot and include installation, these costs are lower than comparable costs from RS Means of $87.50 per linear foot and $54 per linear foot, respectively. The draft request presents the calculation of the user rate as being: "present worth / 20 years / 12 months / # of connections to WWTF."

   This calculation is slightly different (involving discounting the stream of operations and maintenance costs) from the annual household cost calculation in the 1995 Guidance and spreadsheet template (which is annualized compliance costs plus annual operations and maintenance costs). Additionally, the 1995 Guidance states that the municipality should not use the number of connections in calculating annual household cost, but rather the number of households served.

   The calculation in the regionalization/relocation section was simplified to calculate the user rate to allow the community to calculate the rate and the MHI. In the actual calculation of present worth, the annualization factor was accounted for. However in the previous chart, there were typographical errors present and the Present Worth Cost Matrix, the Capital Cost Matrix, and the Annual Operations and Maintenance Cost Matrix have been updated. The updated matrices start on page 30 of the Multidischarger Variance.

   The CAFCom worksheet used by the permit writers in the initial cost estimate is based on the annualized compliance and annual operations and maintenance costs. For the majority of the communities, the department evaluates in the CAFCom process for permit renewal or for multi-discharger variance, the municipality does not separate the connections between residential and commercial, does not have commercial connections, and frequently has their rate structure set the same for residential and commercial connections. The CAFCom completed by the department automatically calculates the number of connections on the basis of 100 gallons per day per person and 3.7 people per house, based on 10 CSR 20-8.020(11)(B) Table I.

   Based upon this comment Appendix D was developed to document where costs were collected from, how CAPDET Works is used by the permit writers, and the verification process employed by the department in estimating cost. The basis for all projects is a 5% interest rate and 20 year

equipment life, except for pumps, blowers, and UV lamps to ensure that those items are replaced as necessary.

6. Alternatives analysis – decentralization: The proposal outlines an approach by which permittees can estimate the cost of decentralization. Specifically, it provides example costs for individual septic systems or large scale subsurface soil dispersal systems for clusters of residences using various design assumptions. The example costs are taken from Water Environment Research Foundation (WERF) Fact Sheets (Tables 1 and 3 through 5), from a "cursory survey of professionals within the onsite wastewater industry within the state" (Table 2), and from a specific preliminary engineering report submitted to the Department (Table 6).
Permittees are directed by the MDNR to use the example costs provided in Tables 1 through 6, or WERF's spreadsheet cost tool, to develop individualized cost estimates for decentralization. The proposal provides examples of how permittees might document these estimates (Table 7 and 8). It also directs permittees to include the estimated cost to properly close their current wastewater treatment system. The MDV proposal includes assumptions for use in estimating closure costs. Finally, the proposal includes assumptions for estimating the cost of land acquisition, although it does not specifically direct permittees to include or exclude these costs.

In general, this approach (applying example costs and assumptions to develop individualized cost estimates) appears reasonable. The example costs and most of the assumptions also appear reasonable. An exception is the assumption of $750 per dry ton for dredging and disposal of sludge. This cost appears to be too high. Further justification is needed for the application of such a cost in this analysis. For example, an estimate of $207 per dry ton is derived based on the following assumptions:

- $66.20 per cubic yard for landfill disposal of nonhazardous bulk waste
- $0.50 per cubic yard per mile for transportation
- 10 miles to disposal site
- 20 cubic yards dredged per man-day of labor
- Labor rate of $32 per hour
- 30 pounds per cubic foot of sludge.

It should be noted that the proposed approach to estimating the cost of decentralization relies heavily on the permittee, as opposed to the approach for treatment upgrades, which would be generated by the MDNR. It is also more complicated than the proposed approach for regional treatment or discharge relocation, which requires only that the permittee select costs from a single table. Therefore, individual cost estimates for decentralization would require careful review to ensure that: (a) the costs selected and assumptions used accurately reflect what is appropriate for the given permittee, (b) the calculations are performed correctly (particularly the derivation of user rates from estimated capital and operating costs), and (c) the estimates are developed consistently across permittees. The comments provided previously regarding the calculation of user rate also apply to this alternative.

Based upon the above comments the variability and amount of land required the MDV will be revised to cite the 2015 Missouri Farm Land Values Opinion Survey transcribed by the University of Missouri Extension. The amount of land required can be estimated by using the

Cost Estimation Tool developed by WERF along with existing state statutes and regulations. Once the number of acres has been calculated using the tool from WERF, the total cost of land can be determined using the cost per acre as established by the Missouri Farm Land Values Opinion Survey written into the fact sheet. A sample calculation can now be found under the subsection titled "Land Acquisition."

The Department will review each submittal on a case-by-case basis to ensure accurate data was used when comparing the decentralized approach to others including regionalization.

As stated in the MDV framework, the cost of sludge removal was based on documented costs submitted to the department.

Additional Considerations

1. Page 3: Item 3 states: "A variance shall not be granted for actions that will violate general criteria conditions prescribed by 10 CSR 20-7.031(4)." A WQS variance allows water quality to exceed all otherwise applicable WQS for the varied pollutant, including narrative or general criteria, by definition.

   The department agrees with this comment and has revised the MDV accordingly.

2. Page 4: Item 5 states: "A variance may be granted if the applicant demonstrates that achieving the water quality standards is not feasible as supported by an analysis based on the factors provided in **40 CFR 131.10(g)**, or other appropriate factors." (emphasis added) Currently, the only acceptable factors to support the granting of a variance from WQS are those listed in 40 CFR 131.14(b)(2)(i).

   The department agrees with this comment and has revised the MDV accordingly.

3. Page 5: The last paragraph of Section 6 states "After the variance expires each qualifying municipality will receive a schedule of compliance within their NPDES permit to meet WQS or, if necessary, the community can re-apply for a variance." It is unclear how the state will conduct the re-application process, including whether the state intends to submit applications to the EPA.

   Upon expiration of the MDV any consideration for future variance will be under a new variance term and condition thus requiring both CWC and EPA approval. The MDV framework has been revised clarifying this position.

4. Page 5: The proposal states that "USEPA has approved the use of variance[s] when the state demonstrates that the following items are fulfilled: There are individual variance provisions included in the WQS." The EPA's regulations do not require states to have a variance authorizing provision in their WQS in order to issue variances. States can issue variances under their existing authority to adopt WQS and submit them to the EPA for approval.

   The department concurs with this comment and has clarified this point in the MDV.

5. Appendix A: The first paragraph ends with the statement: "Therefore, it is imperative that the highest attainable effluent conditions be protective of existing water quality." The highest attainable effluent conditions are established to protect the highest attainable water quality, not the existing water quality.

   The department concurs with this comment and has clarified this point in the MDV.

Missouri Public Utility Alliance (MPUA) Comments:

1. MPUA suggests that the MDV consider changing the "estimated monthly residential user rate" calculation on page 30 of the MDV document by changing "number of connections" to "number of active connections."

   The department concurs with this comment and has clarified this point in the MDV framework. However, each Missouri State Operating Permit (MSOP) holder under the variance will need to update the number of active connections within the required annual report that is submitted to the department.

2. MPUA suggestion that the assumption of 15 manholes perm mile of pipe found on page 31 of the MDV may or may not be correct given the specific situation.

   The department realizes that some communities may not exactly fit into the assumptions included in the MDV however in an effort to establish a reasonable estimate of the cost of compliance alternative the value of 15 remains unchanged in the document at this time.

3. MPUA asks the department to give an estimate of how many municipalities would be up for consideration in the MDV.

   The first step in consideration is for the department to conduct a cost analysis for compliance (CAFCom) in conjunction with a permit renewal action. If this CAFCom demonstrates that both land application and mechanical treatment options would cause user rates to exceed 2% of the MHI the municipality will be contacted to participate in the MDV and provide additional information. These are the first two of several steps in the qualification process. The MDV is still in the framework developmental stage with only a handful of communities that have been identified as having a CAFCom which has categorized both land application and mechanical treatment options as a high burden with the potential user rates over 2% of the residential median household income. . Staff are also in the process of recalculating old "affordability analysis" with the new and more representative CAFCom analysis to determine any potential candidates as well. At this time staff has identified 3-5 potential candidates for future solicitation and evaluation in the first round of MDV for ammonia approval. There is no expectation of the number of municipalities that may be proposed; the department recognizes there will be significant analysis completed to ensure the MDV is appropriate for any proposed municipality.

4. How does the 604b report impact the variance procedure/framework?

A community that qualifies for the MDV utilizing financial information prior to receiving grant funding will have MDV applicability re-evaluated upon the receipt of grant funding. This will occur during the annual report review process. If the receipt of grant funding changes the indication of widespread and substantial social and economic impacts for any alternative, MDV applicability would be in question.

5. How the Missouri Sustainability Assessment Tool (MoSAT) impacts the percentage of MHI value for the alternative analysis and the MDV process?

The MoSAT analysis classifies communities related to weighted factors focused on sustainability. The MoSAT analysis is part of the CAFCom analysis and further justifies a why a community will experience a substantial and widespread economic and social impact as a result of the upgrades/replacement of treatment necessary to the lagoon in order to meet the underlying water quality standards. However, the MOSAT tool plays no part in the calculation of the projected user rate as a percentage of MHI.

6. How do the Department's Community Services and Our Missouri Waters interact and relate to the MDV?

The department's Community Services Initiative and the MDV are currently independent of one another. However, a community services coordinator in each region is available to assist with the MDV application process if a municipality would like assistance from the department.

The department is currently going through a permit synchronization process that will synchronize permit renewals by watershed consistent with the Our Missouri Waters Initiative. Therefore, it is expected that permits within a specific watershed will be up for renewal during the same calendar year in an effort to be able to understand the unique challenges of each individual watershed. The MDV is designed specifically for minor municipalities that currently use a lagoon system as their wastewater treatment facility and will experience a substantial and widespread economic impact as a result of meeting the WQS for total ammonia nitrogen. Having the permits synchronized by watershed will enable more effective conversations between communities within the same watershed regarding alternative treatment options such as regionalization or relocation of the outfall pipe which are necessary topics during the MDV application process.

7. How does a community's drinking water rate impact or affect qualification for a variance?

The MDV is designed specifically for minor municipalities that currently use a lagoon system as their wastewater treatment facility and will experience a substantial and widespread economic impact as a result of upgrades necessary to meet the WQS for total ammonia nitrogen. If a municipality is having trouble meeting obligations as it relates to the Safe Drinking Water Act, it is the department's opinion that an integrated management plan may be a more appropriate option.

8. MPUA provided a list of communities expressing the percentage of MHI their user rates make up and the rate of population change. MPUA asks the department to consider these communities when evaluating MDV candidates.

   The department is appreciative of the list of communities expressing the user rates as a percentage of MHI and the rate of population change. The department is making every effort to ensure all municipalities that will experience a substantial and widespread economic impact as a result of compliance with the WQS for total ammonia nitrogen have an opportunity to apply for the MDV. The department drafts a CAFCom for every municipal that receives a schedule of compliance for total ammonia nitrogen (among other new requirements). If the potential user rates from all treatment types listed in the CAFCom turn out to be above 2% of the residential MHI and the community is currently using a lagoon treatment system, the department will contact the municipality and schedule a meeting in order to determine if the MDV is the right fit for their community. Each municipality listed in your comment letter will be reviewed to determine if they would be a good candidate for the MDV.

9. MPUA suggests that metering influent is something the department should consider as a requirement of the MDV.

   We agree that the metering of influent and effluent would be beneficial to communities. However, this could be too expensive for the municipalities that will qualify for the MDV. It is the department's opinion that the community manages the limited revenue in a manner that will produce the highest attainable effluent conditions for total ammonia nitrogen while meeting all other requirements of their permit. The municipality's best judgment will determine if metering their influent and effluent is a necessary upgrade in order to achieve either the highest attainable effluent conditions or meet the water quality standards for total ammonia nitrogen.

10. MPUA points out that user rates will be affected by changes in population.

    The department agrees that the user rates will be affected by changes in population. Therefore, the municipality with a permit under the MDV will be required to submit an annual report detailing any significant population increases or decreases as significant population changes could change the applicability of the permitted facility to be under the MDV.

    Also, any municipality with an effective permit can submit an application for modification to the permit if a significant change in their financial situation has occurred due to a population decline.

11. MPUA points out that seeking SRF loan may be an alternative to raising rates during the MDV timeframe.

    The department agrees with MPUA that it is a good idea for a community to seek affordable funding. We have modified the language within the framework to read, "pursue an increase in residential user rates to an appropriate level to help mitigate substantial and widespread economic and social impact." It is the opinion of the department that each municipality charge the residents a rate that will allow for the proper routine operation and maintenance of the current facility as well as room for responsible financial planning for future wastewater infrastructure investments.

12. MPUA points out that a municipality can comingle funds between utilities.

    We agree that it is legal for municipalities to comingle funds between utilities. For this reason, the multiple-discharger variance will require each municipality under the variance to submit an annual report. The annual report is will need to identify that the municipality is on track to allocate revenue responsibly as each municipality will have to maintain the highest attainable effluent conditions during the term of the MDV as well as meet the demands and requirements of the Clean Water Act once the term of the MDV has expired.

13. MPUA points out that municipalities can fund wastewater improvements through mechanisms other than user rate increases such as sales tax and property tax increases.

    The department concurs with this comment and believes that the opportunity for tax rate increases could create utility funding equality across the population in order to pay for infrastructure upgrades and replacements. Each municipality under the MDV will be required to detail within the annual report any sales and/or property tax increases that have occurred in order to pay for the necessary upgrades to wastewater infrastructure.

Additional Information

The multiple-discharger variance has been developed for municipal publicly owned treatment systems with a functional lagoon system. The completed application for the multiple-discharger variance must include justification on why the municipal will experience a substantial and widespread economic impact as a result of the necessary upgrades and/or replacement to the wastewater treatment facility in order to meet the water quality standards for total ammonia nitrogen as well as documentation on how the wastewater treatment facility will meet the highest attainable effluent conditions for total ammonia nitrogen. The necessary justifications and documentations necessary for a complete application are laid out in detail with the multiple-discharger variance framework. Once a completed application is received, the department will add the applicant to the candidate list for approval from the Missouri Clean Water Commission and the United States Environmental Protection Agency. If a community cannot exhibit that their current lagoon system cannot meet and maintain the highest attainable effluent conditions, the

department encourages the community to contact their designated regional community services coordinator in order to determine the best route to gain compliance with the final effluent conditions for total ammonia nitrogen.

DRAFT