## NOTICE OF OPEN MEETING

Notice is given that a **Regular Meeting** of the Board of Directors of the Barton Springs/Edwards Aquifer Conservation District will be held at the **District office**, located at 1124 Regal Row, Austin, Texas, on **Thursday, June 27, 2019,** commencing at **6:00 p.m.** for the following purposes, which may be taken in any order at the discretion of the Board.

Note: The Board of Directors of the Barton Springs/Edwards Aquifer Conservation District reserves the right to meet in Executive Session at any time during the course of this meeting to discuss any of the matters listed on this agenda, as authorized by the Texas Government Code Sections §551.071 (Consultation with Attorney), 551.072 (Deliberations about Real Property), 551.073 (Deliberations about Gifts and Donations), 551.074 (Personnel Matters), 551.076 (Deliberations about Security Devices), 551.087 (Economic Development), 418.183 (Homeland Security). No final action or decision will be made in Executive Session.

1. **Call to Order.**

2. **Citizen Communications (Public Comments of a General Nature).**

3. **Routine Business**

   a. **Consent Agenda.** *(Note: These items may be considered and approved as one motion. Directors or citizens may request any consent item be removed from the consent agenda, for consideration and possible approval as a separate item of Regular Business on this agenda.)*

      1. Approval of Financial Reports under the Public Funds Investment Act, Directors' Compensation Claims, and Specified Expenditures greater than $5,000. **NBU**

      2. Approval of minutes of the Board's June 13, 2019, Regular Meeting. **Not for public review at this time**

   b. **General Manager's Report.** *(Note: Topics discussed in the General Manager's Report are intended for general administrative and operational information-transfer purposes. The Directors will not take any action unless the topic is specifically listed elsewhere in this agenda for consideration. A Director may request an individual topic that is presented only under this agenda item be placed on the posted agenda of some future meeting for Board discussion and possible action.)*

      **Topics**

      1. Personnel matters.
      2. Aquifer conditions and status of drought indicators.
      3. Upcoming public events of possible interest.
      4. Update on projects and activities of individual teams.
      5. Update on Board Committee activity.
      6. Update on development activities over aquifer recharge and contributing zones.
      7. Update on activities related to area roadway projects.
      8. Update on the Permian Highway Pipeline project. **Pg. 8**

9. Update on GMA and regional water planning activities.
10. Update on the State Office of Administrative Hearings proceedings for the Electro Purification LLC permit applications.

## 4. Discussion and Possible Action.

**a.** Discussion and possible action related to amending the FY 2019 Budget with Revision 2. **Pg. 21**

**b.** Discussion and possible action on proposed amendments to the fee schedule and setting a Public Hearing for July 11, 2019. **Pg. 27**

**c.** Discussion and possible action related to the Sawyer-Cleveland Wastewater Treatment Plant. **Pg. 33**

## 5. Adjournment.

**Please note:** This agenda and available related documentation, if any, have been posted on the District website, www.bseacd.org. If you have a special interest in a particular item on this agenda and would like any additional documentation that may be developed for Board consideration, please let staff know at least 24 hours in advance of the Board Meeting so that we can have those copies made for you.

The Barton Springs/Edwards Aquifer Conservation District is committed to compliance with the Americans with Disabilities Act (ADA). Reasonable accommodations and equal opportunity for effective communications will be provided upon request. Please contact the District office at 512-282-8441 at least 24 hours in advance if accommodation is needed.

# Item 1

# Call to Order

# Item 2

# Citizen Communications

# Item 3

# Routine Business

## a. Consent Agenda

*(Note: These items may be considered and approved as one motion. Directors or citizens may request any consent item be removed from the consent agenda, for consideration and possible approval as a separate item of Regular Business on this agenda.)*

1. **Approval of Financial Reports under the Public Funds Investment Act, Directors' Compensation Claims, and Specified Expenditures greater than $5,000.**

2. **Approval of minutes of the Board's June 13, 2019, Regular Meeting.**

## Item 3

## Routine Business

b. **General Manager's Report.** *(Note: Topics discussed in the General Manager's Report are intended for general administrative and operational information-transfer purposes. The Directors will not take any action unless the topic is specifically listed elsewhere in this agenda.)*

### Topics

1. **Personnel matters.**
2. **Aquifer conditions and status of drought indicators.**
3. **Upcoming public events of possible interest.**
4. **Update on projects and activities of individual teams.**
5. **Update on Board Committee activity.**
6. **Update on development activities over aquifer recharge and contributing zones.**
7. **Update on activities related to area roadway projects.**
8. **Update on the Permian Highway Pipeline project.**
9. **Update on GMA and regional water planning activities.**
10. **Update on the State Office of Administrative Hearings proceedings for the Electro Purification LLC permit applications.**

Item 3b. 8.

# RESOLUTION NO.

**WHEREAS,** Kinder Morgan and Exxon Mobil, in partnership with EagleClaw Midstream Ventures (the "Private Partnership"), have begun the process of routing a 42-inch buried natural gas pipeline, known as the Permian Highway Pipeline (the "PHP") from Coyanosa, Texas, to Sheridan, Texas, through the Texas Hill Country across the Edwards and Trinity aquifers; and

**WHEREAS,** the PHP will carry a quantity of hydrocarbons for export that, when burned, will produce more carbon pollution than the entire Austin area, which will contribute to climate change with all its deleterious effects on the people of Austin and the world; and

**WHEREAS,** the PHP is currently proposed to transport natural gas and may, at any time in the future and without regulatory or public input, transport crude oil, gasoline, diesel, and liquefied natural gas; and these products, including natural gas, present significant environmental and public safety risks; and

**WHEREAS,** the laws of Texas provide for little oversight of the routing of private pipelines, such as the PHP pipeline, to ensure public safety and limit environmental impacts; and

**WHEREAS,** the Private Partnership has not performed a formal Environmental Impact Study evaluating the potential impact to the Trinity and Edwards aquifers, other groundwater sources, erosion, drainage, subsidence, and other generally detrimental impacts to the surrounding communities; and

**WHEREAS,** the City of Austin has an interest in the protection of its natural resources including the Edwards Aquifer and Barton Springs, and an interest in how the PHP may affect its citizens; and

**WHEREAS,** the Edwards Aquifer serves as a major source of drinking water for two million people, is a vital resource to the general economy and welfare of Central Texas, and forms the only known habitat for the endangered Barton Springs Salamander and the Austin Blind Salamander; and

**WHEREAS,** the PHP will be constructed within karst geology through the recharge zone of the Edwards Aquifer for the purpose of transporting natural gas; however, other hydrocarbons including liquids could be transported, and even a natural gas-only pipeline will include some amounts of liquid hydrocarbons; and

**WHEREAS,** the Barton Springs/Edwards Aquifer Conservation District performed dye tracing studies within the area of the PHP route, and the results indicate that a release of hydrocarbons along the proposed route will result in potential harm to Barton Springs, and the karst formation would make it nearly impossible to adequately clean up hydrocarbon leaks from the pipeline; and

**WHEREAS,** with the review by the Barton Springs/Edwards Aquifer Conservation District, there is not reasonable assurance that the Edwards Aquifer and Barton Springs will be protected during the construction and operation of the PHP; **NOW, THEREFORE,**

**BE IT RESOLVED BY THE CITY COUNCIL OF THE CITY OF AUSTIN:**

The City Council opposes the Permian Highway Pipeline on behalf of the interests of the citizens of the City of Austin in recognition of the potential harm the PHP poses to Austin's natural and economic resources; and in recognition of the danger to people, wildlife, and ecosystems along its route, and through its transport and subsequent export of hydrocarbons, to the health of global ecosystem services including a stable climate.

**BE IT FURTHER RESOLVED:**

The City Manager is directed to study the potential water quality impacts a pipeline transporting hydrocarbons would have on the Trinity and Edwards aquifers and report back to Council by August 30, 2019.

**BE IT FURTHER RESOLVED:**

The City Manager is directed to study legislative or other legal avenues to effectively oppose the pipeline in ways that could include requesting the State of Texas to protect landowners, landowners' property rights, and communities from the negative impact of PHP and other potential oil and gas pipelines by the following measures:

1. Creating a state regulatory process for oil and gas pipeline routing that enables affected landowners and communities to provide input on the routing process, similar to the practice followed by the Public Utility Commission of Texas regarding the routing of electric transmission lines.
2. Requiring environmental and economic impact studies for all intra-state oil and gas pipelines, including the participation of local governmental entities, and making these studies available for review by the public.
3. Requiring governmental oversight over the power of eminent domain delegated to private companies and/or rescinding the unlimited power of eminent domain delegated to private companies.

**ADOPTED:** ____________, 2019 **ATTEST:** ______________________________

Jannette S. Goodall
City Clerk

# *Kinder Morgan, the Blind Eyes of Texas Salamanders Are Upon You*

*By* KAYLA MEYERTONS
*Reporting Texas*


A salamander specimen is seen in a jar at the J.J. Pickle Research Campus on Feb. 22, 2019. Isaiah Zaragoza/Reporting Texas

Opponents of a proposed $2 billion natural gas pipeline through the Texas Hill Country worry about the potential for damage to fragile aquifers during construction or, once it's operating, contamination from leaks.

The proposed 42-inch steel pipeline, to be built by the energy infrastructure company Kinder Morgan, would stretch 430 miles from West Texas to Houston. It would cut as deep as 9 feet into the ground over certain areas of the Edwards and Hays Trinity aquifers and the sinkholes and caves that allow surface water to trickle down into the aquifers.

"Given the nature of surface and groundwater relationships, especially in northern Hays County, it's extremely risky," said Andy Gluesenkamp, a biologist and director of conservation at the San Antonio Zoo.

An environmental impact study examining the risks would ease Gluesenkamp's concerns, but because the pipeline would be located entirely within Texas, Kinder Morgan is not required to do one.

Thanks to some endangered salamanders that call these ecosystems home, Gluesenkamp may get a reasonable facsimile of the study. Under the Endangered Species Act, Kinder Morgan must provide a biological assessment of species threat levels to U.S. Fish & Wildlife Service, which then provides its biological opinion of the proposal. To get approval for the pipeline, Kinder Morgan must show it will minimize damage to species habitat and mitigate any damage it cannot avoid.

"You can't design a project that is going to exceed the regulatory requirements, not just for salamanders but for all endangered species," said Allen Fore, vice president of public affairs for Kinder Morgan.

Kinder Morgan operates about 26,000 miles of natural gas, CO2, crude and refined products pipelines and 15 terminals in Texas, Fore said. The Kinder Morgan Texas Pipeline, a 2,100-mile intrastate natural gas pipeline, has been operating through Blanco County for 60 years.

The proposed pipeline would capture the large amounts of natural gas being flared, or extracted and burned off, in the Permian Basin, Fore said. Pure natural gas is mostly methane, an odorless greenhouse gas that, when released directly into the air, contributes to global warming.

Fore said environmental specialists will survey the land along a 600-foot corridor even though Kinder Morgan needs only 50 feet to install the pipeline. To sample below ground, the company will use ground-penetrating radar and boring technology, he said.

Gluesenkamp said that along the proposed route, aquifer depths range from surface outcroppings to hundreds of feet deep and that groundwater salamanders can inhabit springs, spring runs, spring-fed creeks, caves, aquifers and underground streams or pools deep in limestone rock. He argued that trenching and drilling bores can directly impact subsurface salamander habitats and groundwater flow routes.

A construction hat sits on a post on Opal Lane in Kyle, Texas, on March 3, 2019, near where the future Kinder Morgan pipeline is set to be constructed. Isaiah Zaragoza/Reporting Texas

"[Boring] through underlying limestone to install a pipeline can … disrupt those existing recharge patterns or stop flow entirely," Gluesenkamp said. "It raises the possibility if there's a leak into the aquifer of these extremely toxic substances, that will destroy all these organisms very quickly."

Salamanders depend on a constant supply of cool, clean aquifer water to survive, according to the Texas Parks & Wildlife Department website. Threatened or endangered salamanders in aquifers along the pipeline route include the San Marcos, Comal blind, Barton Springs, Austin blind, Blanco blind and Texas blind.

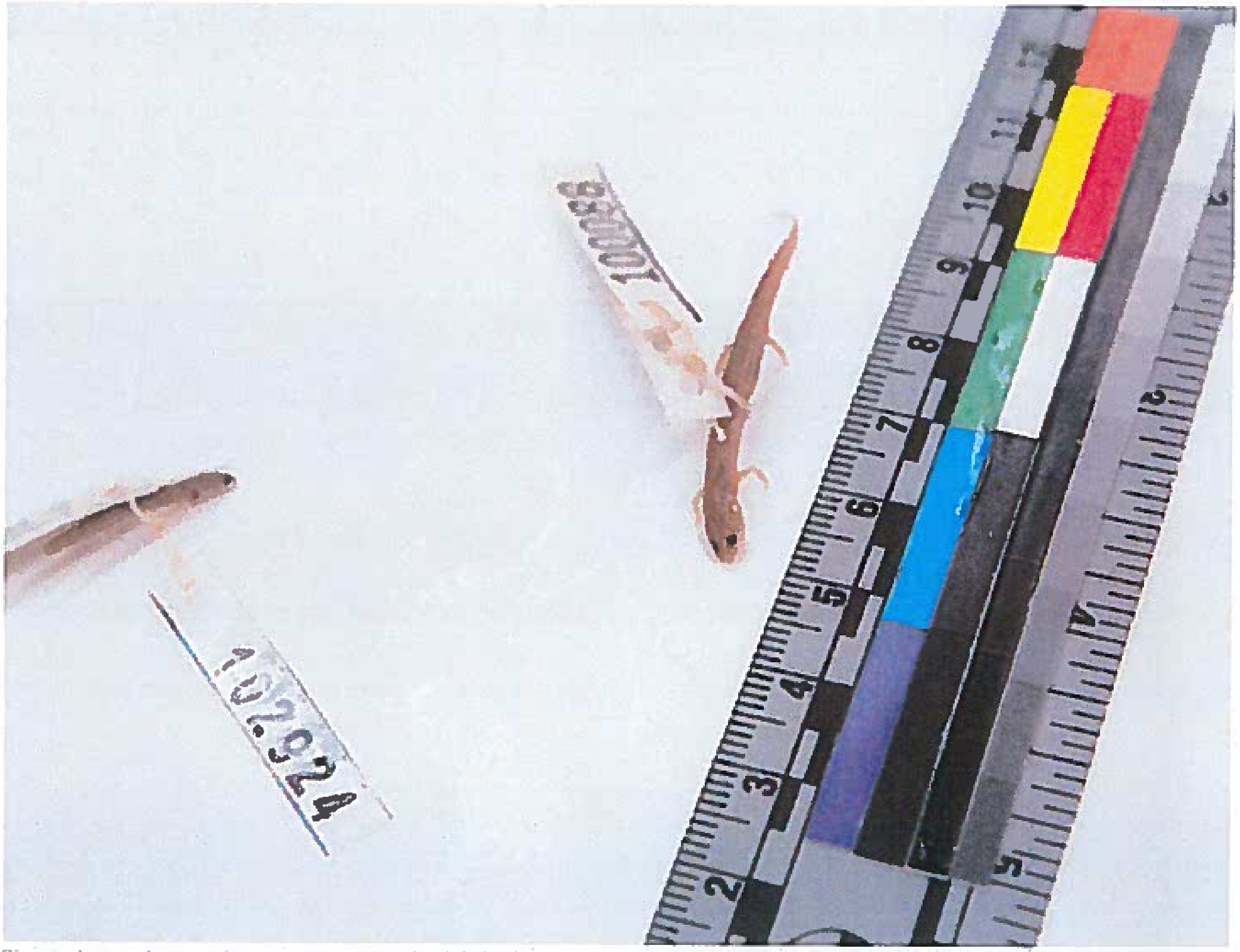
Gluesenkamp said the aquifers also are home to other federally endangered species, including the San Marcos gambushia, fountain darters, Comal Springs riffle beetles and dryopid beetles.

Lesli Gray, a public affairs specialist for Fish & Wildlife, said the department will work with Kinder Morgan to identify risks to the protected species and devise ways to protect them. Part of the job is to anticipate any incidental takes, or consequences of the project that are not purposeful or direct, Gray said.

Fish & Wildlife is awaiting complete information on alignment, construction methods and trenching depths before entering any formal consultation process with the company, she said.

Gluesenkamp said he is encouraged by Fish & Wildlife's role given the agency's access to resources.

It "definitely provides a backstop for oversight on where and how they build this pipeline," Gluesenkamp said. "I'm happy to hear that's the situation. Kinder Morgan is not required to tell us that, but I think it would make people feel a lot more comfortable if they knew that U.S. Fish & Wildlife was involved."




Two salamander specimens are seen at the J.J. Pickle Research Campus on Feb. 22, 2019. Isaiah Zaragoza/Reporting Texas

The Wimberley Valley Watershed Association, a nonprofit environmental group, is circulating a petition to reroute the pipeline out of the Hill Country and away from aquifers and waterways. The petition has received about 3,900 signatures as of early April with a goal of 10,000.

The Hill Country is simply not the place for a pipeline, said Ashley Waymouth, managing director of the association.

"In the event of a leak or an explosion or whatever the case may be in the future, we'll all be affected," Waymouth said. "The more people that we can get to sign this, then the more people that we can get to stand in solidarity against Kinder Morgan devastating our ecosystems [and] devastating our aquifers."

The federal Pipeline and Hazardous Materials Safety Administration keeps records of pipeline incidents in the United States, and from 1999 to 2018, there were 11,991 incidents, 318 deaths and 1,305 injuries across the nation. Over this 20-year period, Texas alone had 2,952 pipeline incidents, 37 deaths and 145 injuries.

According to the records, hazardous liquids like crude oil make up most pipeline incidents, but gas distribution lines, pipelines that bring gas to consumers, caused more than half of the cumulative damage in injuries, deaths and explosions.

Alicia Reinmund-Martinez, general manager of the Barton Springs Edwards Aquifer Conservation District, said she worries Kinder Morgan will convert the pipeline to crude oil or another liquid petroleum product in the future. A leak that allowed crude oil to enter a karst feature, an opening where groundwater conduits form in dissolved rock, could drastically impact aquifer species, especially salamanders.

Dye tracing tests have shown that during drought conditions, shallow water levels in the Trinity aquifer have been seen to pass water into San Marcos Springs and Barton Springs, Reinmund-Martinez said. The conservation district wants to make sure "there's no liquid product making its way into a karst feature that could end up in the springs … and they have an expert if they do the construction."

The conservation district board is investigating the potential impact of the pipeline before making a decision in support of any rerouting petition, Reinmund-Martinez said.

A field on the side of Opal Lane in Kyle, Texas, on March 3, 2019. Isaiah Zaragoza/Reporting Texas

Fore said Kinder Morgan has hired a karst expert to oversee the pipeline and prepare a mitigation plan in the event the pipeline hits a void space in the aquifer. The project also has a long-term contract for natural gas, he said. Converting to crude oil would require retrofitting the pipeline, building pump stations and going through an entirely new regulatory process.

Pipelines make up less than a hundredth of 1 percent of all transportation accidents in the United States and are the safest and most efficient way to transport natural gas, according to the National Transportation Safety Board. There are about 300,000 miles of natural gas transmission pipelines in the United States and more than 328,100 total intrastate pipeline miles in Texas.

"Leaks are extremely rare, and incidents on pipelines are extremely rare," Fore said. "It's like getting hit by lightning twice. That's the rarity."

The project will have a 24/7 monitoring system to shut down the pipeline remotely and valves that close automatically in the event of a leak, Fore says. A protection system also pulls corrosive agents away from the pipeline.

In February 2017, a Kinder Morgan natural gas pipeline exploded in Refugio, creating a massive fire. Kinder Morgan's El Paso natural gas pipeline exploded Aug. 1, 2018, killing one and injuring at least five others.

"Why would it be in Kinder Morgan's interest to build a pipeline that wasn't compatible and was going to have problems? That would be pretty stupid," Fore said. "We wouldn't be proposing it unless we were confident from detailed engineering studies and detailed environmental studies that we can do this."

If approved, construction of the pipeline is set to begin in fall 2019.

## Item 4

## Board Discussions and Possible Actions

**a. Discussion and possible action related to amending the FY 2019 Budget with Revision 2.**

Barton Springs Edwards Aquifer CONSERVATION DISTRICT

# FY 2019 BUDGET REVISION 1 (3.14.2019)

**DRAFT REVISION 2**

Budgeted Permitted Pumpage 3,413,728,170 Gallons

| | | | | | |
|---|---|---|---|---|---|
| **I. INCOME** | | | | | |
| **A.** | **Water Use Fee and Production Fees:** | **GALLONS** | | | |
| | Actual Authorized Pumpage Revenue (17¢ per 1,000 gallons) | 2,789,971,353 | $474,295 | | $474,295 |
| | Actual Authorized Pumpage Revenue (44¢ per 1,000 gallons) | 326,287,748 | $143,567 | | $143,567 |
| | Actual Authorized Agriculture Pumpage Revenue ($1.00/acre-foot) | 180,065,440 | $553 | | $553 |
| | **Total Actual Authorized Pumpage** | 3,296,324,541 | **$618,415** | | **$618,415** |
| | 3.5% Growth based on Actual Authorized Pumpage (@ 17¢/ 1,000 gallons) | 97,648,997 | $16,600 | | $16,600 |
| | 3.5% Growth based on Actual Authorized Pumpage (@ 44¢/1,000 gallons) | 11,420,071 | $5,253 | | $5,253 |
| | Pending Permit Increases (@ 17¢ per 1,000 gallons) | 188,400,000 | $32,028 | | $32,028 |
| | **Total Projected Permitting Revenue** | 3,413,728,170 | **$672,296** | | **$672,296** |
| | COA Water Use Fee Assessment | | 870,501 | | 870,501 |
| | | | **$1,542,797** | | **$1,542,797** |
| | Water Transport Fees ( $0.31/1,000 gallons ) | 400,000,000 | $124,000 | | $124,000 |
| | **Total Water Use Fees and Production Fees** | | **$1,666,797** | | **$1,666,797** |
| **B.** | **Other Fees:** | | | | |
| | Annual Permit Fees | | $5,700 | | $5,700 |
| | Administrative Fees - Permit Application and Development | | $12,950 | ($3,150) | $9,800 |
| | **Total Other Fees** | | **$18,650** | | **$15,500** |
| **C.** | **Other Income:** | | | | |
| | Interest Income | | $13,000 | $12,000 | $25,000 |
| | **Total Other Income** | | **$13,000** | | **$25,000** |
| **D.** | **Transfers In/Out:** | | | | |
| | General Account Funds Transferred into Contingency | Initial | -$16,000 | | -$16,000 |

| | | | | |
|---|---|---|---|---|
| TWDB Grant Reimbursement in the General Account Fund | Initial | $226,157 | | $226,157 |
| Travis County ILA Funds in the General Account Fund | Initial | $100,000 | | $100,000 |
| General Account Funds for Additional Legal Expenses | Revision 1 | $75,000 | | $75,000 |
| Contingency Account Funds Requested to Cover Legal Expenses | Revision 2 | $0 | $50,000 | $50,000 |
| **TOTAL PROJECTED INCOME** | | **$2,083,604** | $58,850 | **$2,142,454** |
| **II. EXPENDITURES** | | | | |
| **A. Operational Expenses** | | | | |
| Electricity & Water | | $7,000 | | $7,000 |
| Telecommunications Services | Phone, Internet, Telemetry, Smartphone | $20,100 | | $20,100 |
| Printing / Copying / Photo Processing | | $2,000 | | $2,000 |
| Postage / Freight / Shipping | | $3,500 | | $3,500 |
| Office Supplies / Canteen | | $10,500 | | $10,500 |
| Office Furniture | | $2,000 | | $2,000 |
| Computer Hardware / Supplies / AV Equipment | Non-Capital | $7,000 | $1,000 | $8,000 |
| Computer Software Maintenance/Upgrades/Acquisitions | | $6,200 | | $6,200 |
| Information Technology Monthly Maintenance | | $12,000 | | $12,000 |
| Board Meetings and Staff Meetings | | $7,600 | | $7,600 |
| External Meetings and Sponsorships | | $7,500 | | $7,500 |
| Subscriptions / Publications | | $4,200 | | $4,200 |
| Advertising and Notices | | $7,000 | | $7,000 |
| Accounting System Operation and Maintenance | QB/Journyx | $6,900 | | $6,900 |
| **Upgrades, and Repair and Maintenance:** | | | | |
| Fleet Maintenance / Repair | Vehicles | $7,000 | | $7,000 |
| Office Complex Maintenance / Offices / Lawn | | $11,000 | | $11,000 |
| Facilities General Repair & Maintenance | | $5,000 | | $5,000 |
| Facilities Upgrades / Remodeling Projects | | $5,000 | | $5,000 |
| **Leases:** | | | | |
| Postage Meter Lease | Quarterly Lease | $1,150 | | $1,150 |

| | | | | | |
|---|---|---|---|---|---|
| | Copier Lease and Maintenance | GE Capital / Dahill / CIT | $11,500 | | $11,500 |
| | Directors Conferences / Travel | | $5,000 | | $5,000 |
| | Organizational / Staff Professional Dues | | $6,500 | $375 | $6,875 |
| | Insurance (Auto, Liability, Property, E&O, Public Bonds) | | $5,700 | | $5,700 |
| | Senior Staff Discretionary Funds | | $15,000 | | $15,000 |
| | Conservation Credits | Revenue Deduction | $23,297 | | $23,297 |
| | **Total Operational Expenses** | | **$199,647** | $1,375 | **$201,022** |
| **B.** | **Salaries, Wages and Compensation** | | | | |
| | **Salaries and Wages** | | $905,000 | | $905,000 |
| | **Total Salaries and Wages** | | **$905,000** | | **$905,000** |
| | Cost of Living Increases | COLA | $18,000 | | $18,000 |
| | Salary and Wage Increases, and Merit Adjustments | | $18,000 | | $18,000 |
| | Goal-based Incentive Compensation | | $51,305 | $1,125 | $52,430 |
| | Interns/Temporary Employees | | $16,000 | | $16,000 |
| | Directors' Fees of Office | 9000 Legislative Cap | $45,000 | | $45,000 |
| | **Total Salaries, Wages and Compensation** | | **$1,053,305** | | **$1,054,430** |
| **C.** | **Employment Taxes, Insurance and Benefits** | | | | |
| | Payroll Taxes | 7.65% | $80,578 | $122 | $80,700 |
| | Texas Workforce Commission Taxes | 1.80% | $2,600 | | $2,600 |
| | Group Health Insurance (Employee only) | All Savers and SISlink | $103,500 | $7,500 | $111,000 |
| | Group Health Insurance (Dependent Coverage) | 25% of All Savers premium, District-paid | $12,447 | $2,553 | $15,000 |
| | Dental Insurance (Employee & Dependent Coverage) | MetLife | $16,400 | $1,600 | $18,000 |
| | Life Insurance (Employee Coverage) | Unum | $13,000 | | $13,000 |
| | Vision Insurance (Employee Coverage) | Ameritas | $1,600 | | $1,600 |
| | Workers Compensation Insurance | TML | $3,100 | $517 | $3,617 |
| | Employee Pension Plan Contribution | 7.50% | $65,000 | | $65,000 |
| | **Total Employment Taxes, Insurance and Benefits** | | **$298,225** | $12,292 | **$310,517** |

| | | | | | |
|---|---|---|---|---|---|
| D. | **Professional Services** | | | | |
| | Auditor (Annual) | Montemayor | $12,500 | | $12,500 |
| | Retirement Plan (Third Party Administration) | The Standard | $24,000 | $6,000 | $30,000 |
| | Database Management | | $5,000 | | $5,000 |
| | Legal - General Services, and Special Services | | $160,000 | | $160,000 |
| | Legislative Support | SledgeLaw | $36,000 | | $36,000 |
| | Election Services | Travis and Hays Counties | $22,000 | ($19,900) | $2,100 |
| | **Total Professional Services** | | **$259,500** | ($13,900) | **$245,600** |
| E. | **Team Expenditures** | | | | |
| | **Aquifer Science Team** | | | | |
| | Hydrogeologic Characterization | | $7,000 | | $7,000 |
| | Water Chemistry Studies | | $13,000 | | $13,000 |
| | Monitor Well, Equipment and Supplies | | $15,000 | | $15,000 |
| | Contracted Support | | $48,000 | | $48,000 |
| | Professional Development | | $7,000 | | $7,000 |
| | **Total Aquifer Science Team** | | **$90,000** | | **$90,000** |
| | **Education and Outreach Team** | | | | |
| | Publications | | $1,500 | | $1,500 |
| | Outreach | | $14,250 | | $14,250 |
| | General Support | | $5,000 | | $5,000 |
| | Equipment and Supplies | | $3,500 | | $3,500 |
| | Contracted Support | Zavala | $3,000 | | $3,000 |
| | Professional Development | | $4,000 | | $4,000 |
| | **Total Education and Outreach Team** | | **$31,250** | | **$31,250** |
| | **Regulatory Compliance Team** | | | | |
| | Special Projects and Investigations | | $5,000 | | $5,000 |
| | Well Sampling and Services | | $8,000 | | $8,000 |

| | | | | |
|---|---|---|---|---|
| Equipment and Supplies | | $4,200 | | $4,200 |
| Contracted Support | | $25,000 | | $25,000 |
| Professional Development | | $5,000 | | $5,000 |
| **Total Regulatory Compliance Team** | | **$47,200** | | **$47,200** |
| **General Management Team & Administrative Team** | | | | |
| Contracted Support | | $40,000 | | $40,000 |
| Professional Development | | $6,000 | | $6,000 |
| **Total General Management & Administrative Team** | | **$46,000** | | **$46,000** |
| **Total Team Expenditures** | | **$214,450** | | **$214,450** |
| **F. Special Projects Expenses** | | | | |
| Shared Territory Monitor Well | | $30,000 | | $30,000 |
| HCP Implementation | | $28,000 | | $28,000 |
| **Total Special Projects Expenses** | | **$58,000** | | **$58,000** |
| **TOTAL PROJECTED EXPENSES** | | **$2,083,127** | | **$2,084,019** |
| **III. NON-CASH DISBURSEMENTS** | | | | |
| Depreciation Expense | | $50,000 | | $50,000 |
| Accrued Benefits Payable (Earned Vacation) | | $50,000 | | $50,000 |
| **Total Non-Cash Disbursements** | | **$100,000** | | **$100,000** |
| **IV. PROJECTED POSITION** | | | | |
| Total District Expenditures | | $2,083,127 | $892 | $2,084,019 |
| Total District Revenue | | $2,083,604 | $58,850 | $2,142,454 |
| Current Net Gain / (Loss) | | **$477** | | **$58,435** |
| Contingency Fund (Legal Defense is 25% of Contingency) | As of 3/14/2019 | **$817,167** | | **$822,155** |

6/21/201911:05 AM

**Item 4**

**Board Discussions and Possible Actions**

**b. Discussion and possible action on proposed amendments to the fee schedule and setting a Public Hearing for July 11, 2019.**

Barton Springs
Edwards Aquifer
CONSERVATION DISTRICT

# Memorandum

Date: June 21, 2019

To: Board of Directors

From: Alicia Reinmund-Martinez, General Manager
Shannon DeLong, Senior Accounting Specialist

RE: Proposed changes to the Excess Pumpage Fees

The Barton Springs/Edwards Aquifer Conservation District (the "District") has the authority under Chapter 36, Texas Water Code to establish reasonable fees. Every year, District staff reviews its Fee Schedule and recommends changes as appropriate to the Board of Directors. After their review, the Board of Directors officially adopts the annual Fee Schedule so that it becomes effective at the beginning of each new fiscal year - September 1.

This memorandum provides the background and staff recommendation to change those fees charged to permittees that withdraw more than their annual permitted amount – the "Excess Pumpage Fees". If approved, these changes will go into effect on September 1, 2019 for the Fiscal Year 2020.

**Background**

The District assesses "Excess Pumpage Fees" to those permittees who withdraw more than their annual permitted amount a fee in accordance with the following schedule:

| | |
|---|---|
| An excess of **500,000 gallons or less:** | $0.17 per 1,000 gallons for a Historical Permit, a Conditional Permit not authorized by material amendment, or a Temporary Production Permit. |
| | $0.44 per 1,000 gallons for new Conditional Permits and Conditional Permits authorized by material amendment. |
| An excess of **more than 500,000 gallons:** | |
| Up to 25% of permitted pumpage - | $0.50 per 1,000 gallons plus the applicable production fee* |
| 25% - 100% of permitted pumpage - | $1.00 per 1,000 gallons plus the applicable production fee* |
| Over 100% of permitted pumpage - | $2.00 per 1,000 gallons plus the applicable production fee* |

* Applicable production fee means the higher rate associated with any authorized pumpage.

**For Consideration**

For over twenty-five years, the District has used this excess fee schedule structure, which allows a permittee to overpump their annual permit up to 500,000 gallons annually and only pay their applicable production fees. They do not have to pay an increased fee structure until after they have overpumped by 500,000 gallons. Currently, over half of the permittees in the District are permitted for 2,000,000 gallons or less, so this 500,000-gallon threshold is quite a sizeable threshold for them to overpump their permit with no consequence.

The five proposals of excess pumpage fees outlined below have eliminated this 500,000-gallon threshold. The excess pumpage fees plus applicable production fees will be applied beginning with the first gallon of excess pumpage of their annual production permit. The attached Excess Pumpage Fee Analysis spreadsheet illustrates these five proposals using permittees who overpumped in Fiscal Year (FY) 2018 and other noteworthy scenarios.

**Proposal #1 –**

| | |
|---|---|
| Up to 25% of permitted pumpage - | $0.50 per 1,000 gallons plus the applicable production fee* |
| 25% - 100% of permitted pumpage - | $1.00 per 1,000 gallons plus the applicable production fee* |
| Over 100% of permitted pumpage - | $2.00 per 1,000 gallons plus the applicable production fee* |

**Proposal #2 –**

| | |
|---|---|
| Up to 25% of permitted pumpage - | $1.00 per 1,000 gallons plus the applicable production fee* |
| 25% - 100% of permitted pumpage - | $2.00 per 1,000 gallons plus the applicable production fee* |
| Over 100% of permitted pumpage - | $3.00 per 1,000 gallons plus the applicable production fee* |

**Proposal #3 –**

| | |
|---|---|
| Up to 500,000 gallons of excess pumpage - | $0.50 per 1,000 gallons plus the applicable production fee* |
| An excess of 500,001 – 2,000,000 gallons - | $1.00 per 1,000 gallons plus the applicable production fee* |
| An excess more than 2,000,000 gallons - | $2.00 per 1,000 gallons plus the applicable production fee* |

**Proposal #4 –**

| | |
|---|---|
| Up to 100,000 gallons of excess pumpage - | $0.50 per 1,000 gallons plus the applicable production fee* |
| An excess of 100,001 – 200,000 gallons - | $1.00 per 1,000 gallons plus the applicable production fee* |
| An excess more than 200,000 gallons - | $2.00 per 1,000 gallons plus the applicable production fee* |

**Proposal #5 –**

| | |
|---|---|
| Up to 100,000 gallons of excess pumpage - | $1.00 per 1,000 gallons plus the applicable production fee* |
| An excess of 100,001 – 200,000 gallons - | $2.00 per 1,000 gallons plus the applicable production fee* |
| An excess more than 200,000 gallons - | $3.00 per 1,000 gallons plus the applicable production fee* |

**Proposal #6 –**

| | |
|---|---|
| Up to 300,000 gallons of excess pumpage - | $0.50 per 1,000 gallons plus the applicable production fee* |
| An excess of 300,001 – 1,000,000 gallons - | $1.00 per 1,000 gallons plus the applicable production fee* |
| An excess more than 1,000,000 gallons - | $2.00 per 1,000 gallons plus the applicable production fee* |

**Proposal #7 –**

| | |
|---|---|
| Up to 300,000 gallons of excess pumpage - | $1.00 per 1,000 gallons plus the applicable production fee* |
| An excess of 300,001 – 1,000,000 gallons - | $2.00 per 1,000 gallons plus the applicable production fee* |
| An excess more than 1,000,000,000 gallons - | $3.00 per 1,000 gallons plus the applicable production fee* |

**Proposal #8–**

Up to 300,000 gallons of excess pumpage - $1.00 per 1,000 gallons plus the applicable production fee*
An excess of 300,001 – 1,000,000 gallons - $2.00 per 1,000 gallons plus the applicable production fee*
An excess more than 1,000,000 gallons - $4.00 per 1,000 gallons plus the applicable production fee*

**Proposal #9 –**

Up to 25% of permitted pumpage - $1.00 per 1,000 gallons plus the applicable production fee*
25% - 100% of permitted pumpage - $2.00 per 1,000 gallons plus the applicable production fee*
Over 100% of permitted pumpage - $4.00 per 1,000 gallons plus the applicable production fee*

* Applicable production fee means the higher rate associated with any authorized pumpage.

As shown in the spreadsheets, eight out of nine of the permittees that overpumped in FY2018 were well below the 500,000-gallon threshold and only paid their applicable production fees of $0.17 or $0.44 per 1,000 gallons for the excess water used. The three largest overpumpers for FY2018 were Permittee 1, 2, and 3. A brief explanation of the reasons they over pumped are noted on the spreadsheet, and they were all attributed to leaks in their systems that were repaired.

Looking back over the past eleven years of excess pumpage, 89% (48 out of 54) of the permittees that overpumped were all below the 500,000-gallon threshold. Seven percent (4 out of 54) of the overpumpers fell into the 500,000-gallon to 2,000,000-gallon range and 4% (2 out of 54) were overpumped by more than 2,000,000 gallons and are listed on the top two lines of the Noteworthy Scenarios on the spreadsheet.

**Staff Recommendation**

Staff is recommending Proposal #3 as the recommended excess fee schedule based on the following:

- All permittees with excess pumpage over their annual permit should be assessed fees above their applicable production fees. Currently allowing all permittees to overpump their permits annually by 500,000 gallons with no consequences does not encourage conservation.
- Volume thresholds, as shown in proposals #3, #4 and #5, versus percentage thresholds, shown in proposals #1 and #2, allow for uniform and equitable fees for all permittees regardless of permitted volume. Volume thresholds also promote conservation since every gallon overpumped is the same.
- Using the 500,000 gallon initial threshold, as shown in proposal #3, versus the 100,000 gallon initial threshold in proposals #4 and #5, gives a more reasonable allowance for leaks or other extenuating circumstances that may cause excess pumpage for all permittees.
- Based on eleven years of historical excess pumpage, 89% (48 out of 54) of the overpumpers were under 500,000 gallons. Therefore, it is fair and reasonable to set 500,000 gallons as the first-tier threshold of the recommended proposal. Seven percent (4 out of 54) of the overpumpers fell into the 500,000 -2,000,000-gallon range, and 4% (2 out of 54) were overpumped by more than 2,000,000 gallons. The tiers set in proposal #3 are more than reasonable based on the historical excess pumpage.

# Excess Pumpage Fee Analysis

| Permittee | Primary Use | Permit Type | Annual Permit Fee | Annual Permitted Gallons | Pumpage | Difference | Percentage Over-pumped | Current Schedule Overpumpage Fee | Proposal #6 0-300k @ $.50 300,001-1mil @ $1 over 1mil @ $2 + production fees | Proposal #7 0-300k @ $1 300,001-1mil @ $2 over 1mil @ $3 + production fees | Proposal #8 0-300k @ $1 300,001-1mil @ $2 over 1mil @ $4 + production fees | Proposal #9 0-25% @ $1 26-100% @ $2 over 100% @ $4 + production fees |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Permittee 1* | Public Water Supply | Historical Edwards | $340.00 | 2,000,000 | 3,093,000 | 1,093,000 | 55% | $1,278.81 | $2,371.81 | $3,464.81 | $4,557.81 | $2,371.81 |
| Permittee 2** | Irrigation | Historical Trinity | $17.00 | 100,000 | 239,890 | 139,890 | 140% | $23.78 | $93.72 | $163.67 | $163.67 | $583.34 |
| Permittee 3*** | Irrigation | Historical Trinity | $30.60 | 180,000 | 275,710 | 95,710 | 53% | $16.27 | $64.12 | $111.98 | $111.98 | $207.69 |
| Permittee 4 | Public Water Supply | Conditional Edwards | $220.00 | 500,000 | 565,230 | 65,230 | 13% | $28.70 | $61.32 | $93.93 | $93.93 | $93.93 |
| Permittee 5 | Commercial | Historical Trinity | $17.00 | 100,000 | 159,700 | 59,700 | 60% | $10.15 | $40.00 | $69.85 | $69.85 | $129.55 |
| Permittee 6 | Irrigation | Historical Trinity | $166.60 | 980,000 | 1,038,000 | 58,000 | 6% | $9.86 | $38.86 | $67.86 | $67.86 | $67.86 |
| Permittee 7 | Irrigation | Historical Trinity | $74.14 | 436,117 | 492,970 | 56,853 | 13% | $9.67 | $38.09 | $66.52 | $66.52 | $66.52 |
| Permittee 8 | Public Water Supply | Historical Edwards | $87.98 | 517,500 | 526,220 | 8,720 | 2% | $1.48 | $5.84 | $10.20 | $10.20 | $10.20 |
| Permittee 9 | Commercial | Historical Edwards | $25.50 | 150,000 | 153,460 | 3,460 | 2% | $0.59 | $2.32 | $4.05 | $4.05 | $4.05 |
| Total | | | $978.82 | | | | | $1,379.31 | $2,716.08 | $4,052.87 | $5,145.87 | $3,534.95 |

**Noteworthy Scenarios**

| Permittee | Primary Use | Permit Type | Annual Permit Fee | Annual Permitted Gallons | Pumpage | Difference | Percentage Over-pumped | Current Schedule Overpumpage Fee | Proposal #6 | Proposal #7 | Proposal #8 | Proposal #9 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| FY2008 Permittee | Public Water Supply | Historical Edwards | $39,961.00 | 235,065,600 | 239,277,705 | 4,212,105 | 2% | $2,822.11 | $9,140.26 | $13,352.37 | $17,564.48 | $4,928.15 |
| FY2011 Permittee | Industrial | Historical Edwards | $36,429.00 | 214,291,000 | 226,162,500 | 11,871,500 | 6% | $7,953.75 | $25,761.15 | $37,632.66 | $49,504.16 | $13,889.65 |
| Permittee 5mil | Public Water Supply | Historical Edwards | $850.00 | 5,000,000 | 7,500,000 | 2,500,000 | 50% | $2,925.00 | $5,425.00 | $7,925.00 | $10,425.00 | $5,425.00 |
| Permittee 10mil | Public Water Supply | Historical Edwards | $1,700.00 | 10,000,000 | 13,000,000 | 3,000,000 | 30% | $3,510.00 | $6,510.00 | $9,510.00 | $12,510.00 | $6,510.00 |
| Permittee 50mil | Public Water Supply | Historical Edwards | $8,500.00 | 50,000,000 | 70,000,000 | 20,000,000 | 40% | $23,400.00 | $43,400.00 | $63,400.00 | $83,400.00 | $43,400.00 |
| Permittee 100mil | Public Water Supply | Historical Edwards | $17,000.00 | 100,000,000 | 125,000,000 | 25,000,000 | 25% | $16,750.00 | $54,250.00 | $79,250.00 | $104,250.00 | $29,250.00 |
| Permittee 300mil | Public Water Supply | Historical Edwards | $51,000.00 | 300,000,000 | 335,000,000 | 35,000,000 | 12% | $23,450.00 | $75,950.00 | $110,950.00 | $145,950.00 | $40,950.00 |
| Total | | | | | | | | $80,810.86 | $220,436.41 | $322,020.03 | $423,603.64 | $144,352.80 |

* Permittee 1's excess pumpage was due to substantial leaks that occurred during April 2018. The leaks produced 1,236,700 gallons pumped for that month.

** Permittee 2's excess pumpage was due to a ruptured pipe from freezing temperatures that occurred during January 2018. The rupture produced 109,830 gallons pumped for that month.

*** Permittee 3's excess pumpage was due to an old leaking water line that they have since replaced and their current pumpage for FY2019 is much lower.

# Excess Pumpage Fee Analysis

| Permittee | Primary Use | Permit Type | Annual Permit Fee | Annual Permitted Gallons | Pumpage | Difference | Percentage Over-pumped | Current Schedule Overpumpage Fee | Proposal #1 0-25% @ $.50 26-100% @ $1 over 100% @ $2 + production fees | Proposal #2 0-25% @ $1 26-100% @ $2 over 100% @ $3 + production fees | Proposal #3 0-500k @ $.50 500,001-2mil @ $1 over 2mil @ $2 + production fees | Proposal #4 0-100k @ $.50 100,001-200k @ $1 over 200,001 @ $2 + production fees | Proposal #5 0-100k @ $1 100,001-200k @ $2 over 200,001 @ $3 + production fees |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Permittee 1* | Public Water Supply | Historical Edwards | $340.00 | 2,000,000 | 3,093,000 | 1,093,000 | 55% | $1,278.81 | $1,278.81 | $2,371.81 | $1,278.81 | $2,371.81 | $3,464.81 |
| Permittee 2** | Irrigation | Historical Trinity | $17.00 | 100,000 | 239,890 | 139,890 | 140% | $23.78 | $303.56 | $443.45 | $93.72 | $163.67 | $303.56 |
| Permittee 3*** | Irrigation | Historical Trinity | $30.60 | 180,000 | 275,710 | 95,710 | 53% | $16.27 | $111.98 | $207.69 | $64.12 | $64.12 | $111.98 |
| Permittee 4 | Public Water Supply | Conditional Edwards | $220.00 | 500,000 | 565,230 | 65,230 | 13% | $28.70 | $61.31 | $93.93 | $61.31 | $61.31 | $93.93 |
| Permittee 5 | Commercial | Historical Trinity | $17.00 | 100,000 | 159,700 | 59,700 | 60% | $10.15 | $69.85 | $129.55 | $40.00 | $40.00 | $69.85 |
| Permittee 6 | Irrigation | Historical Trinity | $166.60 | 980,000 | 1,038,000 | 58,000 | 6% | $9.86 | $38.86 | $67.86 | $38.86 | $38.86 | $67.86 |
| Permittee 7 | Irrigation | Historical Trinity | $74.14 | 436,117 | 492,970 | 56,853 | 13% | $9.67 | $38.09 | $66.52 | $38.09 | $38.09 | $66.52 |
| Permittee 8 | Public Water Supply | Historical Edwards | $87.98 | 517,500 | 526,220 | 8,720 | 2% | $1.48 | $5.84 | $10.20 | $5.84 | $5.84 | $10.20 |
| Permittee 9 | Commercial | Historical Edwards | $25.50 | 150,000 | 153,460 | 3,460 | 2% | $0.59 | $2.32 | $4.05 | $2.32 | $2.32 | $4.05 |
| Total | | | | | | | | $1,379.31 | $1,910.62 | $3,395.06 | $1,623.07 | $2,786.02 | $4,192.76 |

**Noteworthy Scenarios**

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| FY2008 Permittee | Public Water Supply | Historical Edwards | $39,961.00 | 235,065,600 | 239,277,705 | 4,212,105 | 2% | $2,822.11 | $2,822.11 | $4,928.15 | $9,140.26 | $9,140.26 | $13,352.37 |
| FY2011 Permittee | Industrial | Historical Edwards | $36,429.00 | 214,291,000 | 226,162,500 | 11,871,500 | 6% | $7,953.75 | $7,953.75 | $13,889.65 | $25,761.15 | $25,761.15 | $37,632.65 |
| Permittee 5mil | Public Water Supply | Historical Edwards | $850.00 | 5,000,000 | 7,500,000 | 2,500,000 | 50% | $2,925.00 | $2,925.00 | $5,425.00 | $5,425.00 | $5,425.00 | $7,925.00 |
| Permittee 10mil | Public Water Supply | Historical Edwards | $1,700.00 | 10,000,000 | 13,000,000 | 3,000,000 | 30% | $3,510.00 | $3,510.00 | $6,510.00 | $6,510.00 | $6,510.00 | $9,510.00 |
| Permittee 50mil | Public Water Supply | Historical Edwards | $8,500.00 | 50,000,000 | 70,000,000 | 20,000,000 | 40% | $23,400.00 | $23,400.00 | $43,400.00 | $43,400.00 | $43,400.00 | $63,400.00 |
| Permittee 100mil | Public Water Supply | Historical Edwards | $17,000.00 | 100,000,000 | 125,000,000 | 25,000,000 | 25% | $16,750.00 | $16,750.00 | $29,250.00 | $54,250.00 | $54,250.00 | $79,250.00 |
| Permittee 300mil | Public Water Supply | Historical Edwards | $51,000.00 | 300,000,000 | 335,000,000 | 35,000,000 | 12% | $23,450.00 | $23,450.00 | $40,950.00 | $75,950.00 | $75,950.00 | $110,950.00 |
| Total | | | | | | | | $80,810.86 | $80,810.86 | $144,352.80 | $220,436.41 | $220,436.41 | $322,020.02 |

* Permittee 1's excess pumpage was due to substantial leaks that occurred during April 2018. The leaks produced 1,236,700 gallons pumped for that month.

** Permittee 2's excess pumpage was due to a ruptured pipe from freezing temperatures that occurred during January 2018. The rupture produced 109,830 gallons pumped for that month.

*** Permittee 3's excess pumpage was due to an old leaking water line that they have since replaced and their current pumpage for FY2019 is much lower.

## Item 4

## Board Discussions and Possible Actions

**c. Discussion and possible action related to the Sawyer-Cleveland Wastewater Treatment Plant.**

City of Austin
Founded by Congress, Republic of Texas, 1839
Watershed Protection Department
P.O. Box 1088, Austin, Texas 78767

May 20, 2019

Ms. Bridget C. Bohac *Via Electronic Filing*
Office of the Chief Clerk (MC-105)
Texas Commission on Environmental Quality (TCEQ)

RE: City of Austin Comments on Application No. WQ0015594001 (Sawyer-Cleveland)

Dear Ms. Bohac:

I write to provide supplementary comments on the Sawyer-Cleveland Partnership application for a Texas Pollutant Discharge Elimination System Permit (No. WQ0015594001). The application requests approval for a discharge up to 92,000 gallons per day to the Long Branch Tributary of Barton Creek. The City of Austin hopes that TCEQ staff will consider and utilize these comments during the technical review of the proposed permit application. The City reserves the right to amend and supplement these comments.

As it concerns this permit application, the City of Austin ("City") is an affected party. The City requests, as an affected party, notice of subsequent correspondence, proceedings, draft permits, or contested case hearings on this permit.

Barton Creek provides recharge to the Edwards Aquifer. Barton Creek currently exceeds fishable/swimmable quality. One of the City's interests is to prevent degradation of the water quality of Barton Creek and the Barton Springs Segment of the Edwards Aquifer. The City holds a 1,675.7 acre conservation easement in the Barton Creek Watershed downstream of the proposed discharge location, purchased in 1999 using $5,864,950 in voter-approved bond funding. This property has been preserved in perpetuity to protect the integrity of Barton Creek and regional groundwater resources. Additionally, the City is a participant in the Texas Clean Rivers Program and provides water quality monitoring data from Barton Creek to the TCEQ.

Attached please find water quality modeling performed by the City of the proposed discharge permit application. The City utilized a Water Quality Analysis Simulation Program (WASP) model to evaluate the water quality impacts of proposed discharge on the Long Branch Tributary to Barton Creek, including the detention ponds within the route of the proposed discharge in the Polo Club neighborhood northeast of the intersection of Polo Club Drive and Pemberton Way (Richter 2018). The WASP modeling predicts that total nitrogen and total phosphorus concentrations downstream of the detention ponds in the Long Branch Tributary will be similar to concentrations exiting the proposed wastewater treatment plant during the majority of the year, and phytoplankton chlorophyll *a* concentrations will be hypereutrophic during algal blooms.

City of Austin
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Watershed Protection Department
P.O. Box 1088, Austin, Texas 78767

The results from the WASP model were utilized in an analytic model to evaluate the potential water quality impacts of the proposed discharge on the mainstem of Barton Creek (Porras 2019). The analytic model predicts that, during low flow conditions, Barton Creek periphytic chlorophyll *a* concentrations would be degraded from oligotrophic to mesotrophic levels for a distance up to 15.6 miles downstream of the confluence of Barton Creek and the Long Branch Tributary. This change in trophic status would degrade water quality by more than a *de minimus* extent, would adversely impact existing recreational and aquatic life uses, and would degrade the quality of water recharging the Edwards Aquifer.

The City hopes that TCEQ staff will consider these comments during this process. Thank you for your consideration, and please contact me at chris.herrington@austintexas.gov or at 512-974-2840 if you have any questions.

Sincerely,

Christopher S. Herrington, P.E., Environmental Officer
City of Austin

cc: Patricia Link, Assistant City Attorney, City of Austin

City of Austin
# WATERSHED PROTECTION

## Analysis of a Proposed Wastewater Treatment Plant Discharge to the Long Branch Tributary of Barton Creek

DR-18-08; November 2018

Aaron Richter

City of Austin
Watershed Protection Department
Environmental Resource Management Division

### ABSTRACT

The Water Quality Analysis Simulation Program (WASP) is commonly used to model water quality responses to wasteloads. The City of Austin used the WASP model to create a continuous simulation of a proposed wastewater treatment plant (WWTP) discharge to the Long Branch Tributary of Barton Creek. The discharge would enter 5 detention ponds prior to entering the Long Branch Tributary. Results of the WASP model show that total nitrogen (TN) and total phosphorus (TP) concentrations downstream of the detention ponds will be similar to concentrations leaving the WWTP during the majority of the year and phytoplankton concentrations will be at hypereutrophic levels during blooms. Nutrients and chlorophyll *a* concentrations should be used as input into a parsimonious model to determine how far downstream the impacts will travel.

### INTRODUCTION

The Sawyer-Cleveland Partnership applied to the Texas Commission on Environmental Quality (TCEQ) for a new Texas Pollutant Discharge Elimination System (TPDES) permit to discharge treated wastewater effluent into the Barton Creek Watershed in the Contributing Zone of the Barton Springs Segment of the Edwards Aquifer (Proposed Permit No. WQ0015594001. EPA I.D. No. TX0137863). The proposed permit would authorize a discharge of treated wastewater not to exceed a daily average flow of 0.092 MGD (92,000 gallons per day). The location of the proposed wastewater treatment plant (WWTP) is approximately 220 m (720 ft) southwest of the intersection of US Highway 290 and Sawyer Ranch Rd. (Figure 1). The proposed discharge would travel through a series of detention ponds, approximately 9.771 km (32,057 ft; 6.1 miles) through the Long Branch Tributary to Barton Creek, and approximately 37.945 km (124,589 ft; 23.6 miles) through Barton Creek to the boundary of the Recharge Zone. The permit application requested treatment standards of 10 mg/L 5-day Biochemical Oxygen Demand (BOD5), 15 mg/L total suspended solids (TSS), 2 mg/L ammonia nitrogen ($NH_3$), and 6 mg/L dissolved oxygen (DO).

Figure 1: Location of the proposed WWTP and WASP segmentation for the water quality model. The location of the WWTP is southwest of the intersection of US Highway 290 and Sawyer Ranch Rd. on the southern border of the Barton Creek watershed (red line).

The City of Austin (COA) has an interest in maintaining the water quality of Barton Creek and the underlying Edwards Aquifer. Surface water in the contributing zone of the Edwards Aquifer, which includes Barton Creek, has previously been shown to be sensitive to nutrient enrichment (Herrington and Scoggins 2006; Mabe 2007; Herrington 2008a; Herrington 2008b; Richter 2010; Turner 2010). In aquatic systems, nutrients such as nitrogen and phosphorus support the growth of algae and aquatic plants. Nutrient enrichment can occur from the increase of either nitrogen or phosphorus to the aquatic system and can cause an increase in algal biomass to the extent that entire reaches of streams show aesthetic degradation (Wharfe et al. 1984; Biggs 1985; Biggs and Price 1987; Welch et al. 1988), loss of pollution-sensitive invertebrate taxa (Quinn and Hickey 1990), clogging of water intake structures (Biggs 1985), and degradation of dissolved oxygen and pH levels in the water column (Quinn and Gilliland 1989).

The COA Watershed Protection Department (WPD) constructed a Water Quality Analysis Simulation Program (WASP) model to examine impacts immediately downstream of the proposed WWTP effluent. Total nutrients and chlorophyll a predictions from this model can be used as input into a parsimonious model (Chapra et al. 2014) to determine how far downstream impacts might be seen.

## METHODS

The Water Quality Analysis Simulation Program (WASP) is a program maintained by the US Environmental Protection Agency (US EPA) and "general dynamic mass balance framework for modeling contaminant fate and transport in surface waters" (Ambrose and Wool 2017). WPD used an 'Advanced Eutrophication' model type in WASPv8.2 to simulate phytoplankton and benthic algae biomass in the unnamed tributary, detention ponds, and initial stretch of Long Branch tributary immediately downstream of the treated effluent in the proposed discharge permit.

The WASP model simulated from 01 January 1999 through 31 December 2014 using a Euler solution technique, which is a typical solution technique for hydrodynamic models (Ambrose and Wool 2017). The maximum allowable timestep was set to 0.042 days (1 hour) so that predicted dissolved oxygen (DO) could be examined at different times of the day rather than using a daily response value. In WASPv8.2, the user defines which state variables will be incorporated into a simulation. A list of the state variables simulated can be seen in Table 1.

Table 1: List of state variables used in the WASP model.

| WASP System Type | Description |
|---|---|
| WTEMP | Water Temperature |
| DISOX | Dissolved Oxygen |
| NH-34 | Ammonia |
| NO3O2 | Nitrate-nitrite |
| ORG-N | Organic Nitrogen |
| D-DIP | Inorganic Phosphorus |
| ORG-P | Organic Phosphorus |
| CBODU | Background CBOD |
| CBODU | WWTP CBOD |
| DET-C | Detritus Carbon |
| DET-N | Detritus Nitrogen |
| DET-P | Detritus Phosphorus |
| PHYTO | Phytoplankton biomass |
| MALGA | MacroAlgae (Benthic) Biomass |
| MALGN | MacroAlgae (Benthic) Nitrogen |
| MALGP | MacroAlgae (Benthic) Phosphorus |

Segmentation of the model was created with ArcGIS coupled with site visits to procure depths of ponded segments (Table 2). Slopes were calculated by taking the difference in elevation using 0.61 m (2 ft) contours at the beginning and end of the segment and dividing that value by the length of the segment. Roughness coefficients (manning's n) were estimated based on visual assessment of the channel (Chow 1959). The depth multiplier is the depth of the segment under average flow conditions and the depth exponent was taken from empirical hydraulic exponents that represent ephemeral streams in the semiarid US (Ambrose and Wool 2017).

Table 2: WASP segment names, transport mode for flow, and channel geometry for each segment.

| Segment Name | Transport | Length | Width | Slope | Roughness | Depth Multiplier | Depth Exponent | Weir Height |
|---|---|---|---|---|---|---|---|---|
| DS Longbranch 2 | Kinematic Wave | 90.25 | 1.52 | 0.0068 | 0.05 | 0.6096 | 0.36 | |
| DS Longbranch 1 | Kinematic Wave | 153.97 | 1.52 | 0.0238 | 0.05 | 0.6096 | 0.36 | |
| pond5 | Ponded Weir | 71.54 | 11.7 | | | 0.3658 | 0.00 | 1.03 |
| pond4 | Ponded Weir | 99.67 | 28.93 | | | 0.7620 | 0.00 | 2.13 |
| pond3 | Ponded Weir | 130.45 | 20.38 | | | 1.3411 | 0.00 | 2.56 |
| Between Ponds 2 and 3 | Kinematic Wave | 89.36 | 0.82 | 0.0478 | 0.025 | 0.1524 | 0.36 | |
| pond2 | Ponded Weir | 125.84 | 42.37 | | | 1.6154 | 0.00 | 2.23 |
| pond1 | Ponded Weir | 202.69 | 54.10 | | | 1.7374 | 0.00 | 2.35 |
| US Longbranch 4 | Kinematic Wave | 115.13 | 0.82 | 0.0265 | 0.05 | 0.3048 | 0.36 | |
| US Longbranch 3 | Kinematic Wave | 233.01 | 0.67 | 0.0209 | 0.04 | 0.3048 | 0.36 | |
| US Longbranch 2 | Kinematic Wave | 90.84 | 0.61 | 0.0201 | 0.02 | 0.1524 | 0.36 | |
| US Longbranch 1 | Kinematic Wave | 156.86 | 0.61 | 0.0039 | 0.02 | 0.0762 | 0.36 | |
| DS Trib | Kinematic Wave | 274.84 | 0.64 | 0.0270 | 0.03 | 0.0762 | 0.36 | |
| US Trib | Kinematic Wave | 410.03 | 0.49 | 0.0178 | 0.015 | 0.0762 | 0.36 | |
| WWTP | Kinematic Wave | 64.01 | 0.61 | 0.0476 | 0.02 | 0.0762 | 0.36 | |

Time functions and parameters included in the model were solar radiation, air temperature, wind speed, light extinction, ammonia benthic flux, phosphorus benthic flux, and sediment oxygen demand. Solar radiation, air temperature (minimum and maximum), and wind speed were obtained from the National Climatic Data Center (NOAA Satellite and Information Service). Ammonia benthic flux, phosphorus benthic flux, and sediment oxygen demand were set to 0.015 mg/m$^2$-day, 0.015 mg/m$^2$-day, and 1.0 g/m$^2$-day, respectively, for each WASP segment based on previous WPD WASP modeling efforts. Light extinction was set to 0.813/meter for each WASP segment based on photosynthetic photon flux data collected using a quantum meter in Onion Creek. A full list of the constants used in the model can be seen in Appendix A. Constants were taken from previous WPD WASP modeling efforts (Richter 2010; Richter 2016) with the exception of the maximum nitrogen and phosphorus uptake constants for macro algae and algal stoichiometry. These constants were set to the default values. The maximum nitrogen and phosphorus uptake constants were set to the default values because they were impairing phytoplankton growth within the system. Stoichiometry was set to default values because WPD has not obtained any biologic data from the ponds in the current model for calibration.

Daily flows were input into WASP segments US Longbranch 1, US Longbranch 3, US Longbranch 4, Pond 1, Pond 2, Between Ponds 2 and 3, Pond 3, Pond 4, DS Longbranch 1, US Trib, and DS Trib. (Figure 1). Flows into US Longbranch 1, US Trib, and DS Trib were assumed to be headwater flows while flows into other segments were considered to be overland flow into the segment. Flow time series were constructed using the United States Geological Survey (USGS) gage 08155200 based on drainage area at the input location relative to the drainage area at the gage (Table 3). As this section of creek network is typically dry, only storm flows were input into the WASP model. If the daily flow at the gage was 50% higher than the previous days flow then input flows for that day were considered storm flow and WASP segment flows were entered into the separate model time series, otherwise the input flows were set to zero. Additionally, a daily evapotranspiration (ET) time series was constructed using the Hargreaves method and local climatological data in the Soil & Water Assessment Tool (SWAT) (Peacock 2016) and input into the WASP model to represent evapotranspiration from ponded segments.

Table 3: Percent of drainage area at each flow input for the WASP model compared to the drainage area at USGS gage 08155200.

| WASP Input | Drainage Area ($km^2$) | Percentage of gage |
|---|---|---|
| **US Longbranch 1** | 0.156 | 0.067% |
| **US Longbranch 3** | 0.232 | 0.100% |
| **US Longbranch 4** | 0.075 | 0.032% |
| **Pond 1** | 0.093 | 0.040% |
| **Pond 2** | 0.098 | 0.042% |
| **Between Ponds 2 and 3** | 0.059 | 0.025% |
| **Pond 3** | 0.048 | 0.021% |
| **Pond 4** | 0.039 | 0.017% |
| **DS Longbranch 1** | 0.159 | 0.068% |
| **US Trib** | 0.409 | 0.176% |
| **DS Trib** | 0.233 | 0.100% |
| **USGS gage 08155200** | 232.464 | 100% |

Storm loads for water quality parameters were input into WASP as boundary time series. For days in the time series when flows into a WASP segment were non-zero values, storm concentrations were set to the storm event mean concentration (EMC) for each parameter in Table 4 for that WASP segment. Otherwise, the value was set to zero. Storm concentrations were taken from other COA work where stormwater EMCs were developed from similar areas (Glick et al. 2009).

Table 4: Pollutant concentrations used as boundary time series in the WASP model.

| Parameter | Storm EMC (mg/L) |
|---|---|
| **Background CBOD** | 1.577 |
| **Ammonia** | 0.038 |
| **Nitrate-nitrite** | 0.233 |
| **Organic Nitrogen** | 0.594 |
| **Inorganic Phosphorus** | 0.022 |
| **Organic Phosphorus** | 0.022 |

To model the Sawyer-Cleveland WWTP discharge, flow and loads were input into the WASP segment labeled as WWTP in Figure 1. The flow was set to a continuous 0.004 $m^3/s$ (0.092 MGD) and loads were calculated by multiplying the WWTP pollutant concentrations by the discharge and converting the loads to kg/day. WWTP pollutant concentrations were taken as a combination of the requested permit concentrations in the application and adding nitrogen and phosphorus concentrations based on BioWin process modeling (Table 5). Coefficients within the BioWin process model were initiated to values used in previous modeling of the City of Dripping Springs WWTP with no nitrogen limitation in the effluent (Carollo 2015) while basins within the BioWin model were determined from the Sawyer-Cleveland permit application. BioWin results did not include an effluent concentration for inorganic phosphorus so a value of 0.5 mg/L was chosen based on the initial modeling efforts regarding the City of Dripping Springs WWTP effluent (Richter 2016).

Table 5: Pollutant concentrations used in the WWTP discharge load calculations for the WASP model based on BioWin process modeling. The application contained no information regarding nitrogen or phosphorus limits.

| Parameter | Effluent Limits Proposed in Application (mg/L) | WWTP Effluent Concentrations predicted by BioWin (mg/L) |
|---|---|---|
| **WWTP CBOD** | 10 | 4.84 |
| **Ammonia** | 2 | 1.21 |
| **Nitrate-nitrite** | | 17.31 |
| **Organic Nitrogen** | | 2.98 |
| **Inorganic Phosphorus** | | 0.5 |
| **Organic Phosphorus** | | 3.83 |

**RESULTS & DISCUSSION**

To determine the potential impacts of the proposed Sawyer-Cleveland WWTP discharge to the Long Branch Tributary and the receiving Barton Creek, results of the model from the first segment downstream of the detention ponds (WASP segment DS Longbranch 1) will be used as input into a more parsimonious model[1]. When the WWTP effluent is added to the WASP model, flow from the effluent slowly fills the ponded segments and eventually enters the DS Longbranch 1 segment. After such time, this segment is constantly flowing. Total nitrogen (TN) and total phosphorus (TP) concentrations are shown to be higher than the TN and TP concentrations in the WWTP effluent (Figure 2). Biologic and chemical reactions occurring within the first detention pond convert the organic phosphorus into inorganic phosphorus, a form available to be used by vegetation, which allows for even more phytoplankton or benthic algae to grow in the downstream segments. The conversion of nutrients from excess phytoplankton growth contributes to the WWTP effluent concentrations and the combination increases the TN and TP concentrations to above the WWTP effluent concentrations in the WASP segment downstream of the ponds. Benthic algae concentrations were never above 10 mg/m$^2$ during the simulation; however, phytoplankton concentrations ranged from 120 to 140 µg/L during blooms in this segment (Figure 3). Dissolved oxygen dropped below 5 mg/L once during the simulation period but was above 6 mg/L during the majority of the simulation (Figure 4).

[1] As additional stream length gets modeled, the number of inputs increases, thereby greatly increasing the complexity of the model. A more parsimonious model can aid in estimating the impacts without engendering the additional workload.

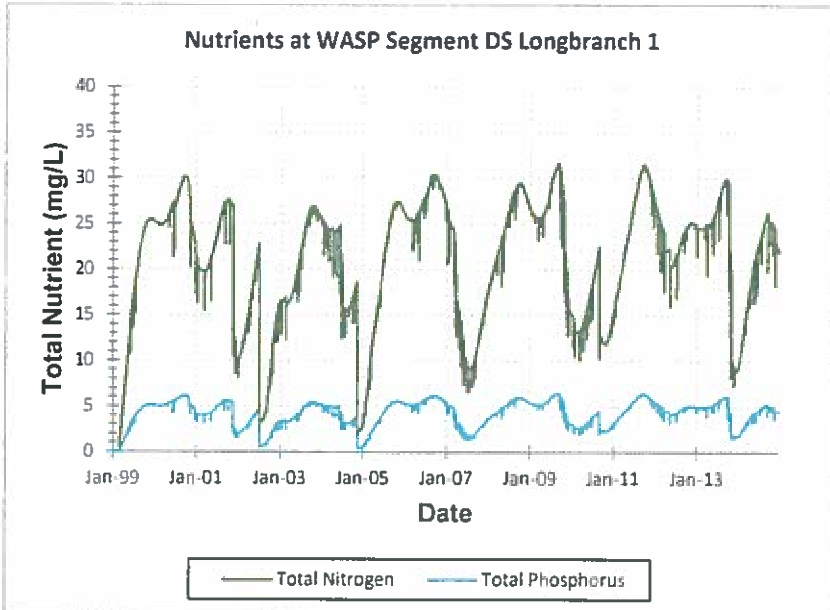


Figure 2: Total nitrogen (mg/L) and total phosphorus (mg/L) in WASP segment DS Longbranch 1, the first segment downstream of the 5 detention ponds immediately downstream of where the WWTP effluent enters Long Branch Tributary.

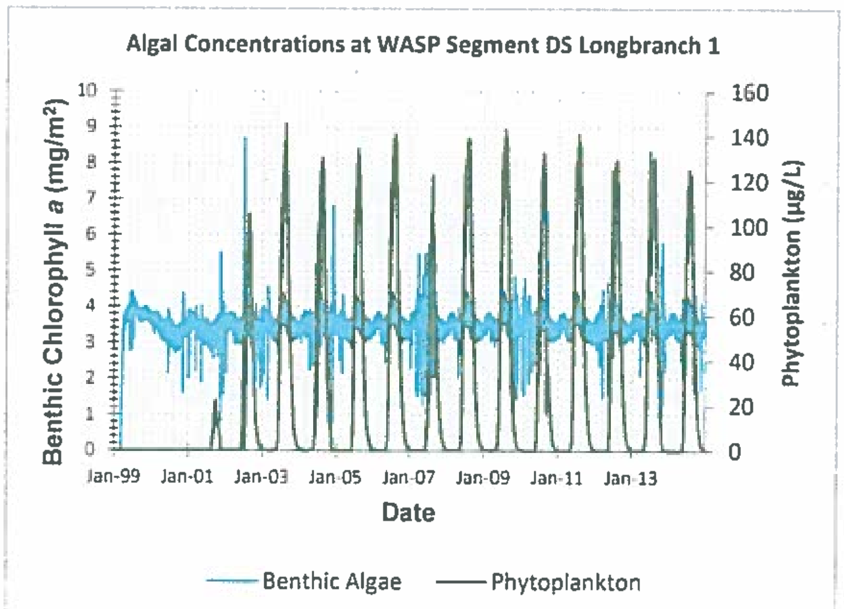


Figure 3: Benthic algae (mg/m$^2$) and phytoplankton (µg/L) concentrations in WASP segment DS Longbranch 1, the first segment downstream of the 5 detention ponds immediately downstream of where the WWTP effluent enters Long Branch Tributary.

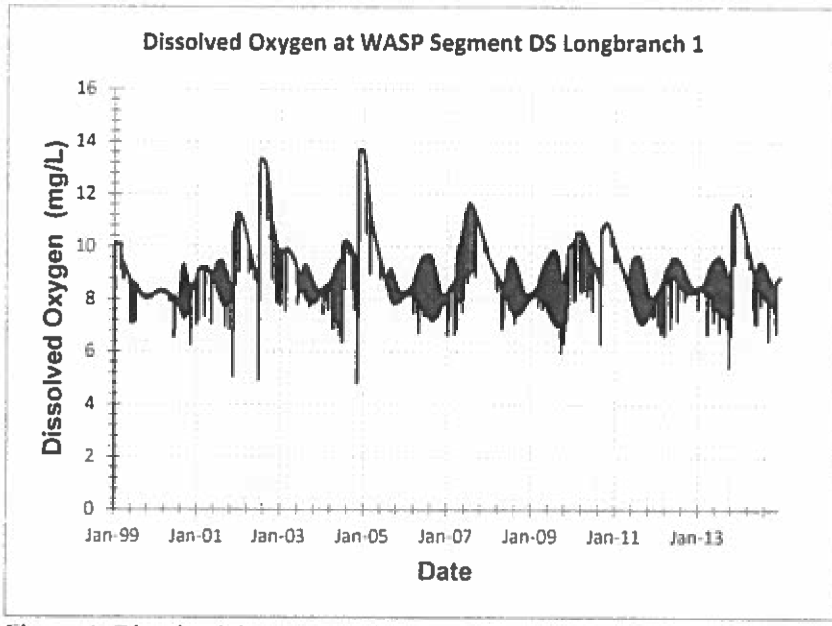


Figure 4: Dissolved Oxygen (mg/L) concentration in WASP segment DS Longbranch 1, the first segment downstream of the 5 detention ponds immediately downstream of where the WWTP effluent enters Long Branch Tributary.

## CONCLUSIONS

Simulations indicate that the portion of the Long Branch Tributary downstream of the impacted detention ponds will be transformed from an ephemeral stream to a perennial stream with high concentrations of TN, TP, and phytoplankton. Modeled concentrations of phytoplankton vary by season with blooms occurring during the warmer months at concentrations around 120 to 140 µg/L which is well above the hypereutrophic threshold of 56 µg/L (Carlson and Simpson 1996). The TN and TP concentrations in this portion of the Long Branch Tributary are predicted to be similar to the WWTP effluent concentrations. Results from this model should be incorporated into a parsimonious model to determine how far downstream the nutrients and chlorophyll *a* concentrations remain elevated.

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**APPENDIX A:** List of constants used within the WASP model by constant group.

| Constant Group | Value | Description |
|---|---|---|
| Global | 0 | Fresh water = 0- Marine Water = 1 |
| | 30.205 | Latitude- degrees |
| | -97.995 | Longitude- degrees |
| Inorganic Nutrient Kinetics | 0.13 | Nitrification Rate Constant @20 degree C (1/day) |
| | 1.08 | Nitrification Temperature Coefficient |
| | 2 | Half Saturation Constant for Nitrification Oxygen Limit (mg O2/L) |
| | 0 | Denitrification Rate Constant @20 degree C (1/day) |
| | 1.04 | Denitrification Temperature Coefficient |
| | 0.1 | Half Saturation Constant for Denitrification Oxygen Limit (mg O2/L) |
| Organic Nutrients | 0.075 | Dissolved Organic Nitrogen Mineralization Rate Constant @20 C (1/day) |
| | 0.22 | Dissolved Organic Phosphorus Mineralization Rate Constant @20 C (1/day) |
| | 1.08 | Dissolved Organic Nitrogen Mineralization Temperature Coefficient |
| | 1.08 | Dissolved Organic Phosphorus Mineralization Temperature Coefficient |
| CBOD | 0.4 | CBOD Decay Rate Constant @20 C (1/day) |
| | 0.4 | CBOD Decay Rate Constant @20 C (1/day) |
| | 1.05 | CBOD Decay Rate Temperature Correction Coefficient |
| | 1.05 | CBOD Decay Rate Temperature Correction Coefficient |
| | 0.4 | CBOD Half Saturation Oxygen Limit (mg O2/L) |
| | 0.4 | CBOD Half Saturation Oxygen Limit (mg O2/L) |
| Dissolved Oxygen | 7 | Global Reaeration Rate Constant @ 20 C (1/day) |
| | 2.667 | Oxygen to Carbon Stoichiometric Ratio |
| Phytoplankton | 1 | Phytoplankton Maximum Growth Rate Constant @20 C (1/day) |
| | 1.08 | Phytoplankton Growth Temperature Coefficient |
| | 50 | Phytoplankton Carbon to Chlorophyll Ratio (mg C/mg Chl) |
| | 20 | Optimal Temperature for Growth (C) |
| | 0.05 | Shape parameter for below optimal temperatures |
| | 0.05 | Shape parameter for above optimal temperatures |
| | 0.125 | Phytoplankton Respiration Rate Constant @20 C (1/day) |
| | 1.045 | Phytoplankton Respiration Temperature Coefficient |
| | 0.044 | Phytoplankton Death Rate Constant (Non-Zoo Predation) (1/day) |
| | 0 | Grazability (0 to 1) |
| | 0 | Nitrogen fixation option (0 no- 1=yes) |
| | 350 | Phytoplankton Optimal Light Saturation as PAR (watts/m2) |
| | 0.025 | Phytoplankton Half-Saturation Constant for N Uptake (mg N/L) |
| | 0.004 | Phytoplankton Half-Saturation Constant for P Uptake (mg P/L) |
| | 0.5 | Fraction of Phytoplankton Death Recycled to Detritus N |
| | 0.5 | Fraction of Phytoplankton Death Recycled to Detritus P |
| | 0.25 | Phytoplankton Nitrogen to Carbon Ratio (mg N/mg C) |
| | 0.025 | Phytoplankton Phosphorus to Carbon Ratio (mg P/mg C) |

| Constant Group | Value | Description |
|---|---|---|
| Light | 0 | Light Option (0 - light from lat-long: 1 - input diel light: 2 - input daily light-calculated diel light) |
| | 0 | Include Algal Self Shading Light Extinction in Steele (0=Yes- 1=No) |
| | 0.813 | Background Light Extinction Coefficient (1/m) |
| Macro Algae | 4 | Macro Algal Option: 1 = Floating forms (ave light) 2=Surface Algae (Top Light): 3 = submersed: 4 = benthic algae (not transported) |
| | 0.025 | MacroAlgae P:C Ratio (mg P/mg C) |
| | 0.025 | MacroAlgae Chl a:C Ratio (mg Chl/mg C) |
| | 1 | MacroAlgal Growth Model- 0 = Zero Order; 1 = First OrderMacroAlgal Growth Model- |
| | 0.4 | MacroAlgae Max Growth Rate (gD/m2-day- or 1/day) |
| | 1.05 | Temp Coefficient for Macro Algal Growth |
| | 500 | Macro Algal Carrying Capacity for First Order Model (g D/m2) |
| | 0.2 | Macro Algal Respiration Rate Constant (1/day) |
| | 1.06 | Temperature Coefficient for Macro Algal Respiration |
| | 0.1 | Internal Nutrient Excretion Rate Constant for Macro Algae (1/day) |
| | 1.05 | Temperature Coefficient for Macro Algal Nutrient Excretion |
| | 0.15 | Macro Algae Death Rate Constant (1/day) |
| | 1.05 | Temperature Coefficient for Macro Algal Death |
| | 0.1 | Macro Algal Half Saturation Uptake Constant for Extracellular Nitrogen (mg N/L) |
| | 0.02 | Macro Algal Half Saturation Uptake Constant for Extracellular Phosphorus (mg P/L) |
| | 135 | Macro Algal Light Constant for growth (langleys/day) |
| | 10 | Minimum Cell Quota of Internal Nitrogen for Macro Algal Growth (mgN/gDW) |
| | 0.5 | Minimum Cell Quota of Internal Phosphorus for Macro Algal Growth (mgP/gDW) |
| | 720 | Maximum Nitrogen Uptake Rate for Macro Algae (mgN/gDW-day) |
| | 50 | Maximum Phosphorus Uptake Rate for Macro Algae (mgP/gDW-day) |
| | 10 | Half Saturation Uptake Constant for Macro Algal Intracellular Nitrogen (mgN/gDW) |
| | 2 | Half Saturation Uptake Constant for Macro Algal Intracellular Phosphorus (mgP/gDW) |
| | 2.5 | MacroAlgae D:C Ratio (mg D/mg C) |
| | 0.18 | MacroAlgae N:C Ratio (mg N/mg C) |
| | 2.69 | MacroAlgae O2:C Production (mg O2/mg C) |
| | 0.1 | Fraction of Macro Algae Recycled to Organic N |
| | 0.1 | Fraction of Macro Algae Recycled to Organic P |

**Parsimonious Analysis of a Proposed Wastewater Treatment Plant Discharge to the Long Branch Tributary and Barton Creek**
SR-19-05; March 2019

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City of Austin
Watershed Protection Department
Environmental Resource Management Division

## ABSTRACT

The Sawyer-Cleveland Partnership is proposing to discharge treated wastewater effluent in Long Branch, a tributary of Barton Creek. In general, discharging treated wastewater in riverine systems provides an energy source for the growth of periphyton, which has the potential to change the aesthetics of the receiving stream and adversely impact aquatic species by consuming dissolved oxygen. For the special case of discharging treated wastewater in Barton Creek, the effluent has an additional harmful influence on the water quality of the underlying Edwards Aquifer. A water quality model predicting the impact of this discharge on the receiving water bodies was developed using a simplified approach. The parsimony of the model allows for quick assessment of the impact and incorporates the variability and uncertainty of the environment through different scenarios. Inputs into the model consisted of site-specific parameters, such as flow and solar radiation, as well as more general, default values, such as periphyton growth rates and periphyton death rates. These parameter values were input into the parsimonious model, including any variability and uncertainty. The result was that mesotrophic status of Barton Creek was predicted to be between 1.2 and 27.8 miles under high and low flow conditions, respectively.

## INTRODUCTION

Barton Creek is a significant waterway in Austin, which contributes flow to Barton Springs Pool, a popular destination spot approaching almost 1,000,000 visits a year, as well as home to two species of endangered salamanders, the Barton Springs Salamander (*Eurycea sosorum)* and the Austin Blind Salamander (*Eurycea waterlooensis)*. Furthermore, Barton Creek is located in the Barton Springs contributing and recharge zone that feeds the underlying Edwards Aquifer, a sole-source aquifer to 60,000 people. The importance of Barton Creek and other streams in the Barton Springs Zone has resulted in acquisition of open space by the City resulting in over 28,000 acres of Water Quality Protection Lands and in the promulgation of specific water quality ordinances for this area. To protect these assets, the City also actively monitors the Barton Creek watershed for potential water quality impacts to Barton Creek.

In 2018, the Sawyer-Cleveland Partnership applied to the Texas Commission on Environmental Quality (TCEQ) for a new Texas Pollutant Discharge Elimination System (TPDES) permit to discharge treated wastewater effluent into the Barton Creek Watershed in the Contributing Zone of the Barton Springs Segment of the Edwards Aquifer (Proposed Permit No. WQ0015594001, EPA I.D. No. TX0137863). The proposed permit would authorize a discharge of treated wastewater not to exceed a daily average flow of 0.092 MGD (92,000 gallons per day). The location of the proposed wastewater treatment plant is approximately 220 m (720 ft) southwest of the intersection of US Highway 290 and Sawyer Ranch Rd. (Figure 1). The proposed discharge would travel through a series of in-line detention ponds, approximately 9770 m (6.1 miles) through the Long Branch Tributary to Barton Creek, and approximately 37,945 m (23.6 miles) through Barton Creek to the boundary of the Recharge Zone. The permit application requested treatment standards of 10 mg/L 5-day Biochemical Oxygen Demand (BOD5), 15 mg/L total suspended solids (TSS), 2 mg/L ammonia nitrogen ($NH_3$), and 6 mg/L dissolved oxygen (DO). Richter (2018) analyzed the impact of the proposed effluent to just downstream of the series of ponds. The result from his model was effluent concentrations in Long Branch of 31.5 mg/L of Nitrogen, 6.0 mg/L of Phosphorus, and 3.5 mg/m$^2$ of chlorophyll-a.

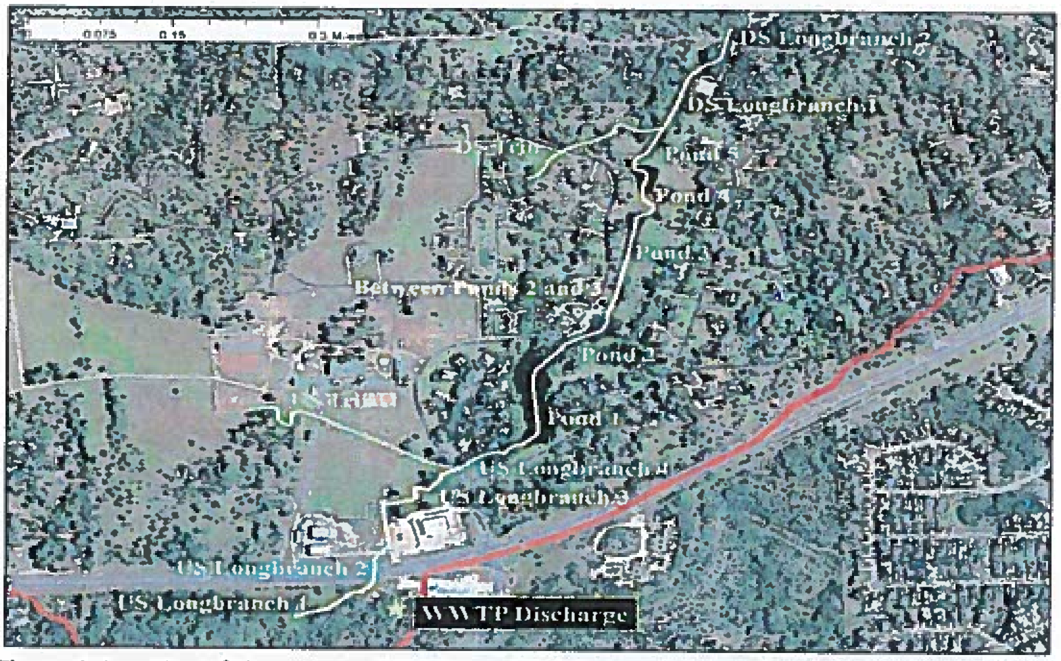


**Figure 1:** Location of the proposed WWTP and WASP segmentation for the water quality model. The location of the WWTP is southwest of the intersection of US Highway 290 and Sawyer Ranch Rd. on the southern border of the Barton Creek watershed (red line). Figure obtained from Richter (2018).

This report extends Richter's analysis to Barton Creek using Chapra's (2014) parsimonious model, which simplifies in-stream nutrient dynamics to a set of analytic equations without engendering the additional workload required by more complicated in-stream analyses. The trade-off is that some complexity in nutrient chemistry and stream heterogeneity is lost. Porras (2016) described and applied Chapra's model to simulate the impacts of effluent on Onion Creek from the Dripping Springs Wastewater Treatment plant. The analysis in this report takes the outputs from Richter's WASP model as inputs to Chapra's parsimonious model. Given these inputs and preliminary watershed characteristics, Chapra's parsimonious model estimates the impact of the proposed Sawyer effluent for the remainder of Long Branch and into Barton Creek. This report documents those results. A brief primer on the theory behind the parsimonious model will be described followed by the inputs to the model and then results.

## THEORY

The underlying theory behind the analysis in this report is that cycling of nutrients in a riverine system can be explained through four mass balances. Nitrogen and phosphorus provide a supply of food for the growth of periphyton. The periphyton then respires or excretes back the nitrogen and phosphorus to create a nutrient cycle. Additionally, the death of periphyton produces organic matter in the form of organic carbon, nitrogen, and phosphorus which is not readily available for periphyton uptake. Through hydrolysis and decomposition, the organic matter is converted back to available forms of nitrogen and phosphorus. Figure 2 below illustrates this through a schematic of the nutrient cycling.

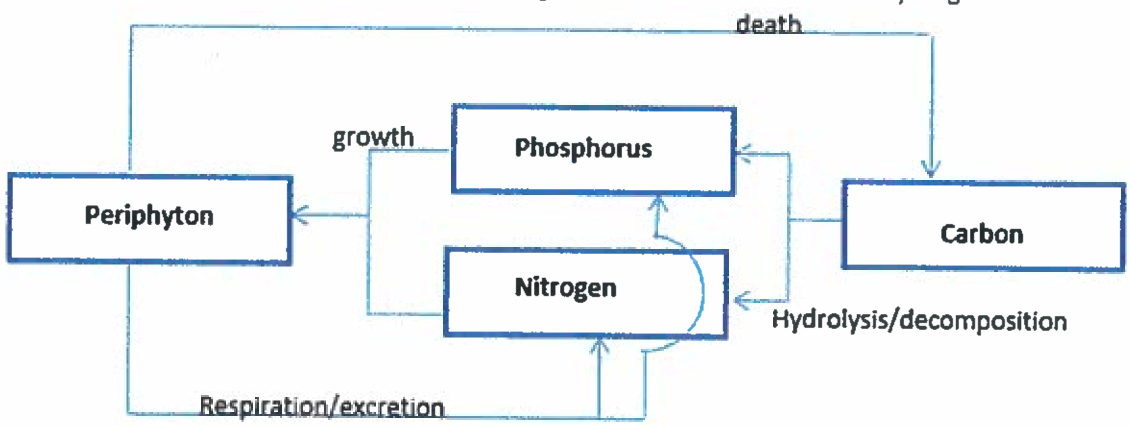


**Figure 2:** A schematic of the nutrient cycle in a riverine system.

The mass balances derived from the schematic can be expressed as differential equations (see Porras, 2016). The differential equations can then be solved to predict the concentrations of nitrogen, phosphorus, and periphyton (represented by chlorophyll *a*) along the length of the creek. The initial concentration of periphyton will consume the nitrogen and phosphorus, reducing the supply of food for downstream periphyton, which in turn limits further growth of the periphyton. After some length of creek, the supply of nutrients is exhausted constraining any more growth in periphyton. Denote this length the *critical* distance. The constrained concentration of periphyton is then transported downstream for as long as the wastewater effluent is being discharged. An average value of 36 mg/m$^2$ of periphyton is suggested as the threshold by which the riverine system goes from an oligotrophic to mesotrophic state (Dodds, 2006). Applying this simple model can be used to predict the trophic status of Barton Creek.

## MODEL INPUTS

### Physical Geography

Figure 3 below shows the extent of the watershed contributing to the model inputs. The end of the WASP model (and start of this model) is shown as a purple dot in the figure along with the model domain as a thick polyline. The light blue polyline represents Long Branch and the darker blue line signifies Barton Creek. Differentiating between Long Branch and Barton Creek is useful because the two water bodies operate under different hydrologic regimes. Long Branch is an intermittent stream with a 6.9 mi$^2$ (17.87 km$^2$) drainage area, whereas Barton Creek continuously has flow and a 51 mi$^2$ (132 mi$^2$) drainage at the confluence with Long Branch. Thus, the model was partitioned to take into account the low flow nature of Long Branch. Outputs from Long Branch then became input for Barton Creek using flow upstream of the confluence of Long Branch with Barton Creek.

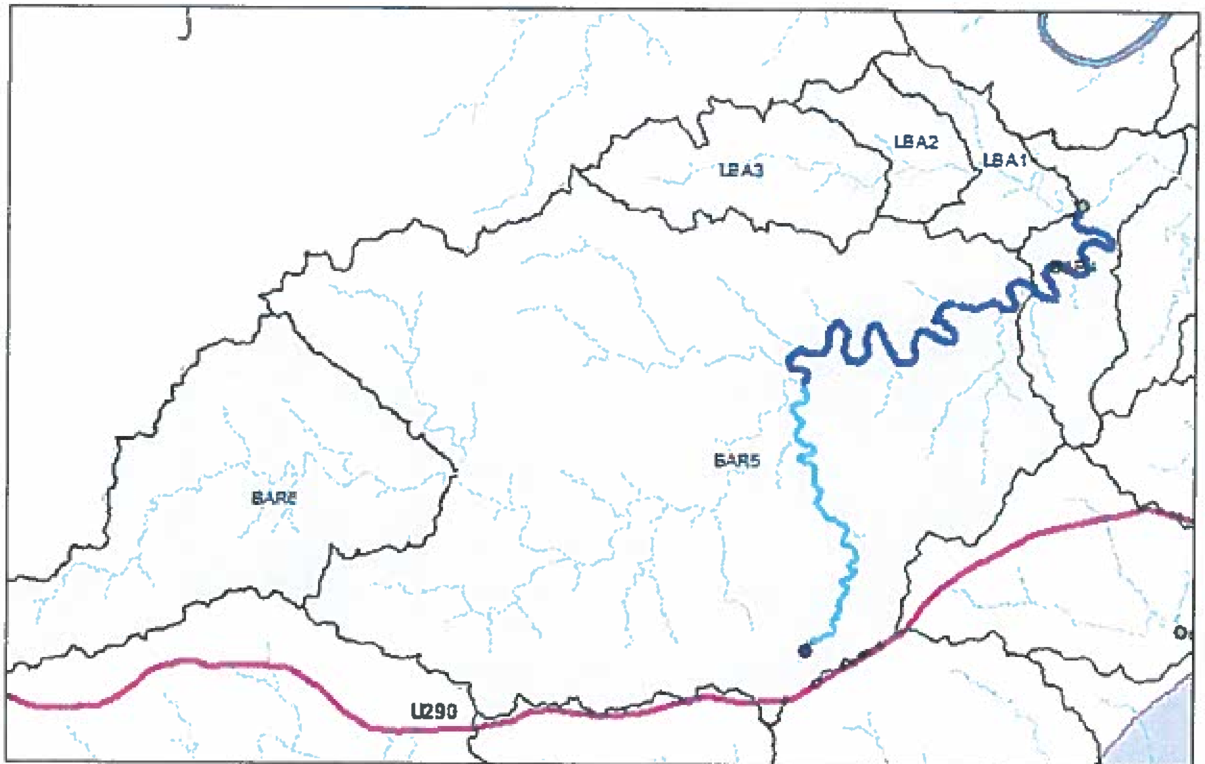


**Figure 3:** Areal view of the Barton Creek watershed showing the extents of the model domain as a thick polyline. The light blue polyline represents Long Branch and the darker blue line signifies Barton Creek. Dark green dot at the downstream point of Barton Creek represents USGS gage 08155200.

The dark green dot at the downstream point of Barton Creek shows the location of USGS gage 08155200, which was used to ground truth flows. The drainage areas and the corresponding flows under different conditions can be seen on Figure 4 and 5, respectively below.

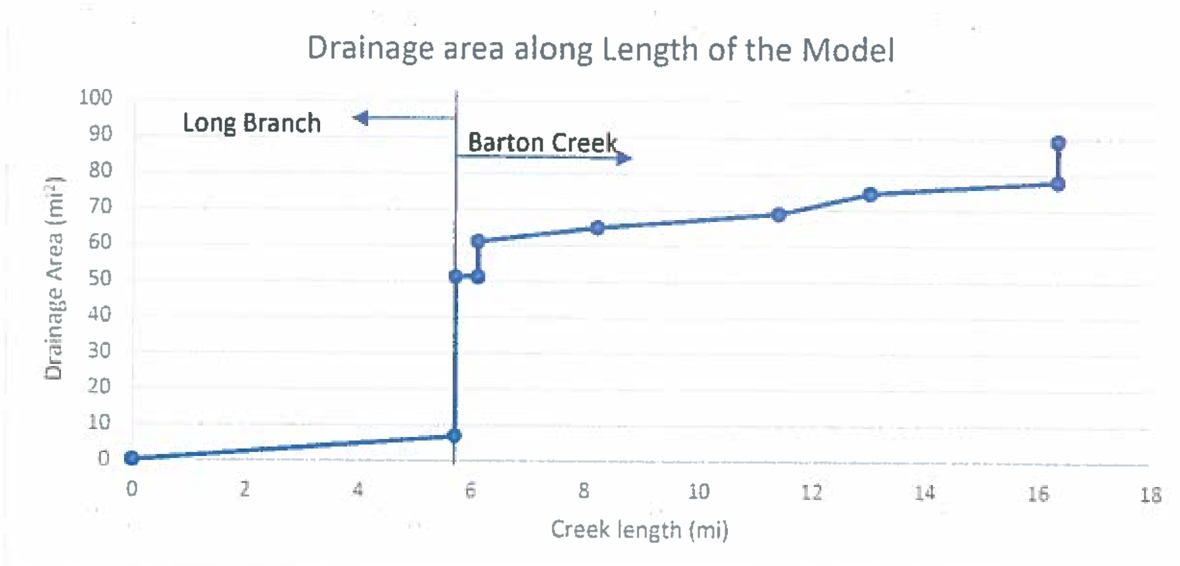


**Figure 4:** Drainage area of the model domain as a function of creek length

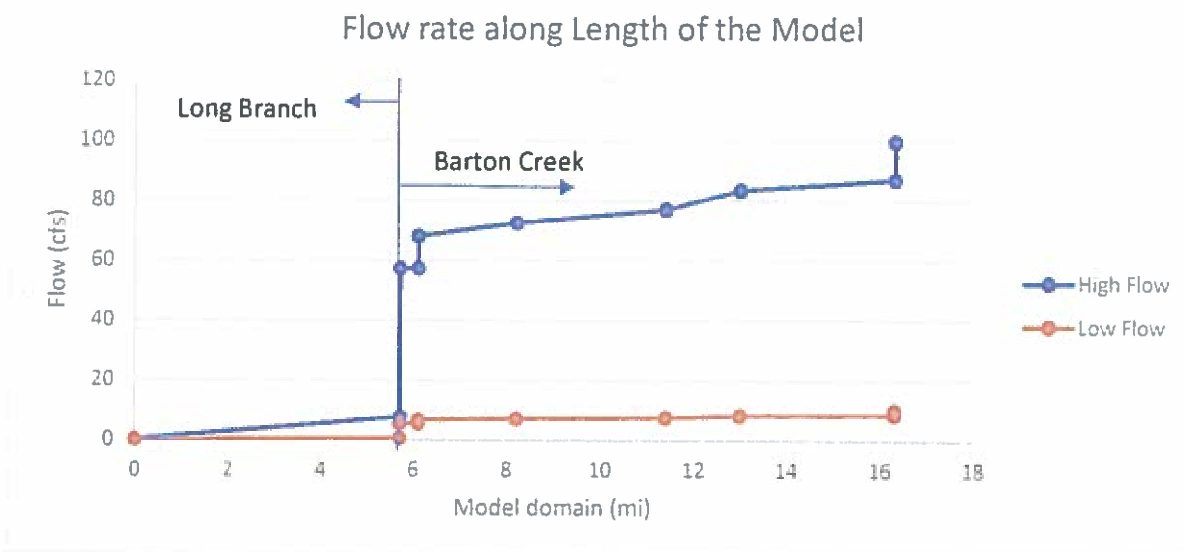


**Figure 5:** Stream flow inputs for the model as a function of creek length

The observations of stream flow at USGS gage station 8155200 show that flow will be at or less than 10 cfs roughly 40% of the time[1]. Denote this "low flow". Similarly, flow at the gage station greater than 100 cfs occurs about 10% of the time. This is designated as high flow. Values of flow upstream of the gage station (Figure 5) were assumed to be proportional to drainage area.

<u>Parameter Input Values</u>

The main inputs driving the model are the influent concentrations of nitrogen and phosphorus for a given rate. These values (taken from Richter, 2018) are approximately 31.5 mg/L and 6.0 mg/L, respectively, at a discharge rate of 92,000 gallons per day (0.14 cfs). The other parameter values are default values from Chapra (2012) and are displayed in the table below.

**Table 1:** Values for Parameter in Initial Periphyton Biomass

| Parameter | Parameter Name | Value | Units |
|---|---|---|---|
| $C_{g,T}$ | Growth rate of periphyton | 200 | mg/(m$^2$-day) |
| $k_r$ | Respiration and excretion rate of periphyton | 0.2 | 1/day |
| $k_d$ | Death rate of periphyton | 0.3 | 1/day |

Inputting the growth rate of periphyton, $C_{g,T}$, into Chapra's model for Austin, Texas (see Porras, 2016) results in initial values of 207 mg/m$^2$ of periphyton biomass in the summer, when periphyton is expected to be more abundant. From this, the model inputs given in Table 2 can be used to determine estimates of downstream phosphorus and nitrogen concentrations, as well as length of eutrophication from chlorophyll-*a* concentrations.

[1] Over a 5-year time period beginning in Dec 2013.

Table 2: Values for Parameter in Nutrient Concentrations

| Parameter | Parameter Name | Value | Units |
|---|---|---|---|
| $k_{sp}$ | Half saturation constant for available phosphorus | 5 | µg/L |
| $k_{sn}$ | Half saturation constant for available nitrogen | 20 | µg/L |
| $k_h$ | hydrolysis rate of periphyton | 0.05 | 1/day |
| $k_d$ | death rate of periphyton | 0.3 | 1/day |
| $r_{pa}$ | Stoichiometric coefficients for phosphorus to periphyton | 1.2 – 1.7 | mgP/mgA |
| $r_{na}$ | Stoichiometric coefficients for nitrogen to periphyton | 7.2 | mgN/mgA |
| $r_{ca}$ | Stoichiometric coefficients for carbon to periphyton | 0.04 | gC/mgA |
| $r_{pc}$ | Stoichiometric coefficients for phosphorus to carbon | 2.0 – 13.3 | mgP/gC |
| $r_{nc}$ | Stoichiometric coefficients for nitrogen to carbon | 50 – 100 | mgN/gC |

## RESULTS

Predictions from the parsimonious model are depicted in Figures 6 to 9 below. Figure 6 shows that under low flow conditions, nitrogen becomes the limiting nutrient. That is, the nitrogen concentration approaches its half saturation constant of 20 µg/L before the phosphorus concentration reaches its half saturation constant of 5 µg/L. The distance that the nitrogen concentration approaches its half saturation constant is denoted as the *critical distance*. Under low flow conditions, the critical distance is 21.26 miles (34.2 km) from the model origin or roughly 15.6 miles (25.1 km) downstream of the confluence of Barton Creek with Long Branch.

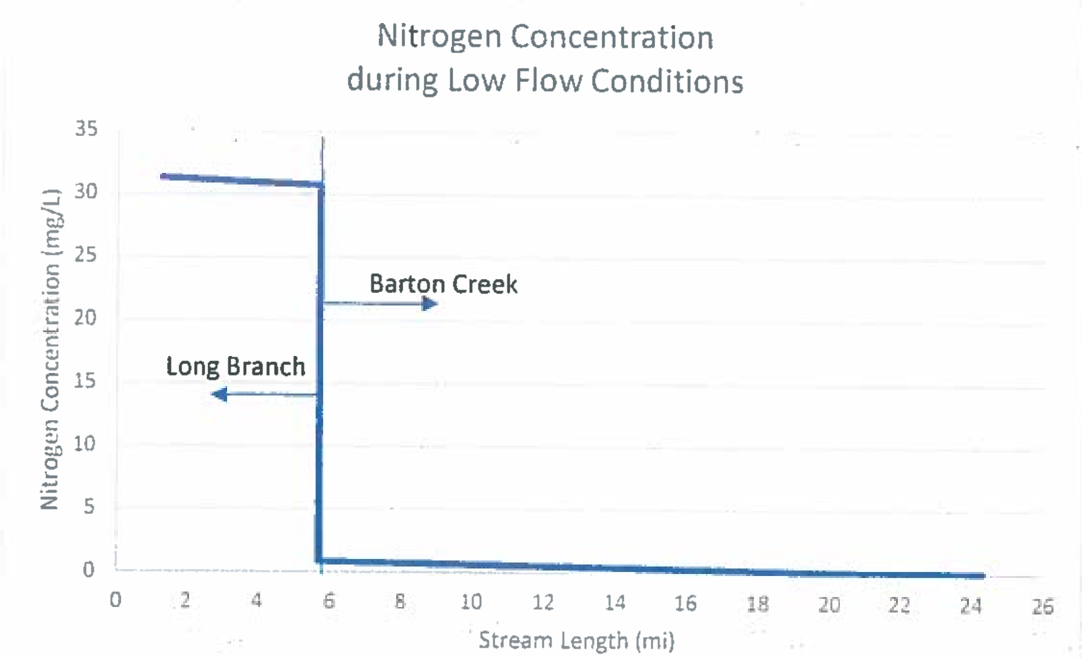


**Figure 6:** Nitrogen Concentrations along the length of the stream under Low Flow Conditions

This implies that the wastewater discharge provides available nutrients throughout the length of the critical distance. The impact on the stream can be more clearly seen in Figure 7, which shows the concentration of chlorophyll-*a* as a function of distance. This figure illustrates that the chlorophyll-*a* concentrations are estimated to be around 200 mg/m$^2$ at the wastewater discharge point and then, as nitrogen becomes less available along the length of the stream, its concentration is reduced to about 100 mg/m$^2$. Throughout the critical distance and even further, the creek can be classified as eutrophic (Dodds, 2006).

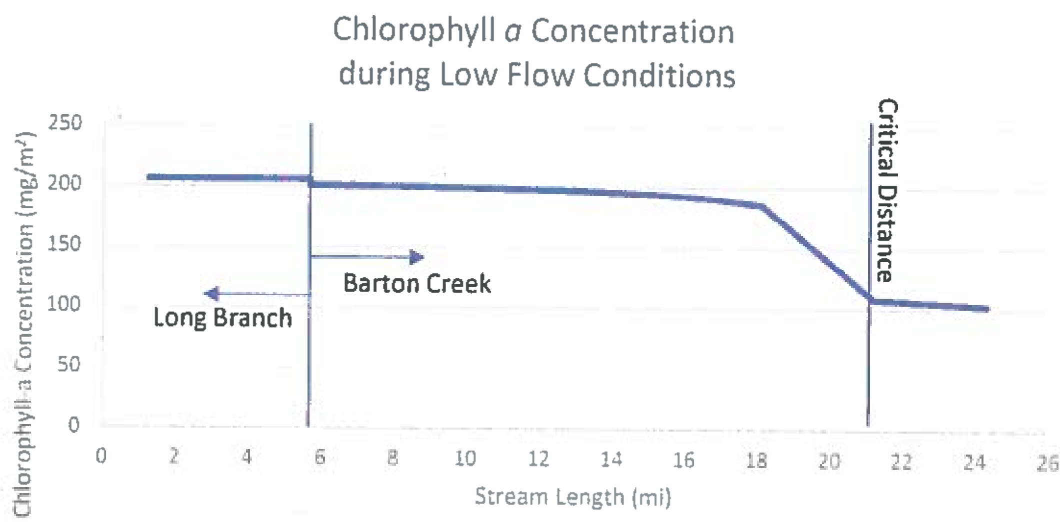


**Figure 7:** Chlorophyll-*a* Concentrations along the length of the stream under Low Flow Conditions

Under high flow conditions, phosphorus is the limiting nutrient, as it reaches it half saturation constant of 5 µg/L faster than nitrogen reaches its half saturation constant of 20 µg/L. The critical distance under high flow conditions is 8.57 mi (13.8 km) downstream from the model origin or about 2.9 miles (4.7 km) of Barton Creek will have these elevated concentrations of phosphorus.

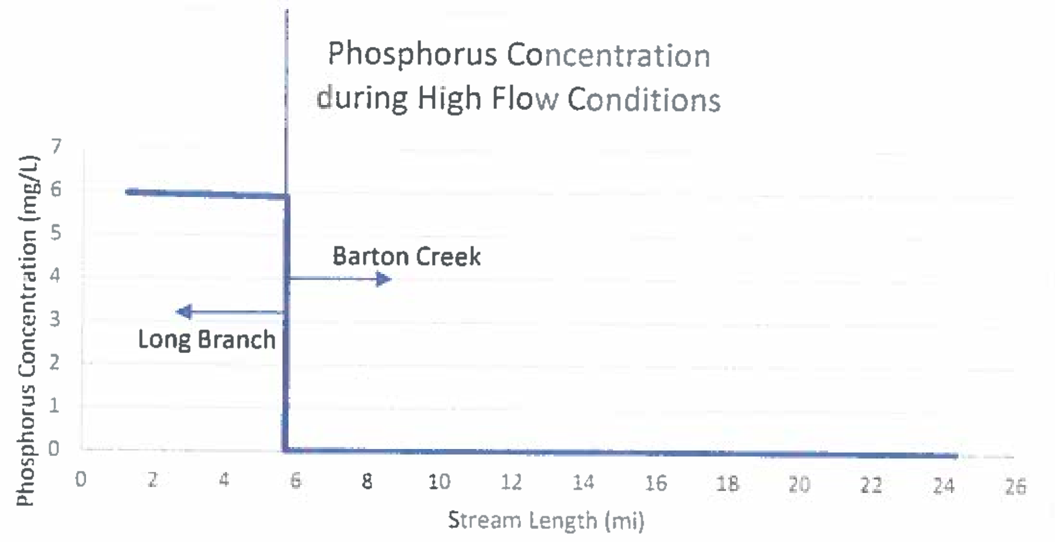


**Figure 8:** Phosphorus Concentrations along the length of the stream under High Flow Conditions

The result of elevated phosphorus during high conditions is chlorophyll-*a* concentrations starting at 200 mg/m$^2$ going down to about 100 mg/m$^2$ at the critical distance. Figure 9 shows the concentration of chlorophyll-*a* with respect to distance.

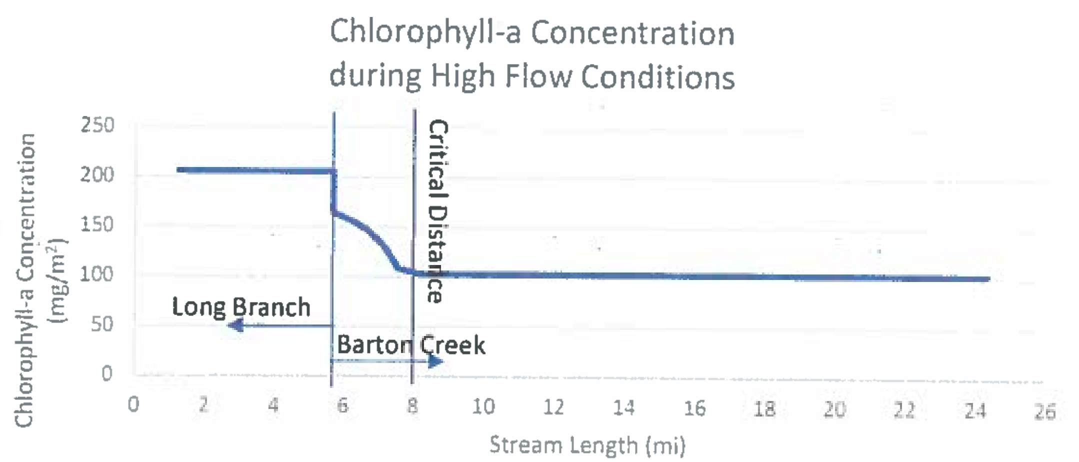


**Figure 9:** Chlorophyll-*a* Concentrations along the length of the stream under High Flow Conditions

During high flow conditions, the effluent concentrations from Long Branch are diluted by Barton Creek upstream of the confluence. This serves to reduce the length of the critical distance in Barton Creek to about 2 miles (3.2 km) of eutrophic conditions or about 7.5 miles (12.1 km) downstream of the model origin.

## SENSITIVITY and UNCERTAINTY

In addition to looking at different flow events, a sensitivity and uncertainty analysis was performed on the model. For the sensitivity analysis, the periphyton growth rate, $C_{g,T}$, was reduced by 50% from 200 mg/(m$^2$-day) to 100 mg/(m$^2$-day). The resulting chlorophyll *a* concentration under this reduction ranged from a high of 80 mg/m$^2$ at the origin of the model down to about 50 mg/m$^2$ at the critical distance. These lower chlorophyll *a* values are closer to modeled values in Richter (2018). However, under the low flow scenario, the model predicts that this reduction in periphyton growth rate increases the critical distance to over 40 miles (64 km). Under high flow scenario, the reduction in periphyton growth rate increases to 9.62 miles (15.5 km). Reducing the periphyton growth rate moderates the consumption rate of nutrients as well as their concentration, thus, keeping the nutrients in the water column longer and allowing for algae growth further downstream.

An uncertainty analysis was also performed where values of the different parameters in the model were selected at random from a normal probability distribution. Table 3 below depicts which parameters were changed and from what normal distribution the values were selected. The model was then run 500 times with each run using different randomly generated parameters sets.

**Table 3:** Values for Parameter in Uncertainty Analysis

| Parameter | Mean | Standard Dev | Units |
|---|---|---|---|
| $r_{pa}$ | 1.0 | 0.1 | ugP/ugA |
| $k_r$ | 0.2 | 0.02 | 1/day |
| $k_h$ | 0.05 | 0.01 | 1/day |
| $k_d$ | 0.3 | 0.06 | 1/day |
| $a_0$ | 208 | 17 | mg/m$^2$ |

The results from the uncertainty analysis are shown in Figures 10 and 11. Figure 10 shows the range of critical distances under low flow conditions. The figure indicates that about 98% of the model runs resulted in a critical distance between 17 miles (27 km) and 33.4 miles (53 km). This is equivalent to between 11.4 and 27.8 miles (18.3 and 44.7 km) of mesotrophic status in Barton Creek downstream of Long Branch.

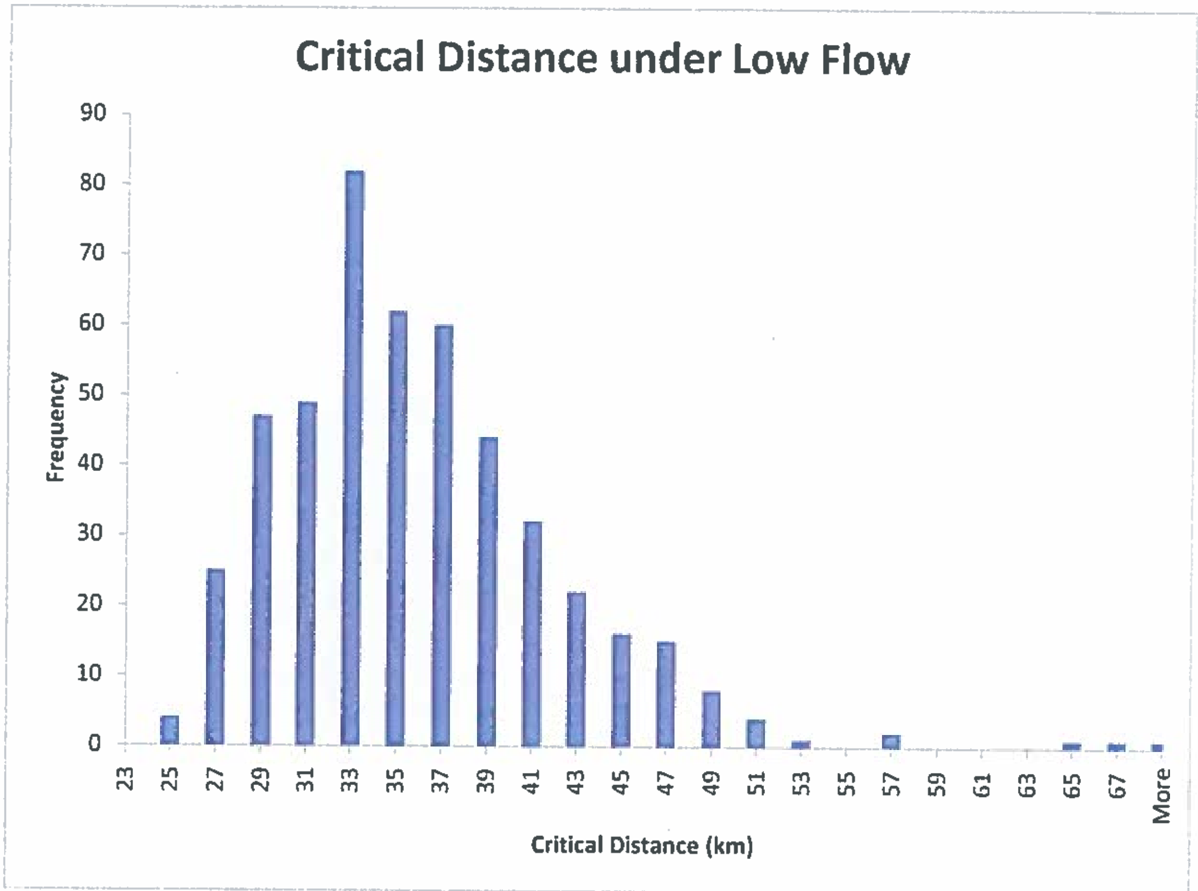


**Figure 10:** Histogram of critical distance for 500 model runs under low flow conditions

Figure 11 shows the range of critical distances under high flow conditions. Under this scenario, 98% of the model runs produced a critical distance of between 6.84 miles (11 km) and 9.32 miles (15 km) from the model origin. This translates to between 1.2 and 3.7 miles (1.9 and 6 km) of mesotrophic status in Barton Creek downstream of Long Branch

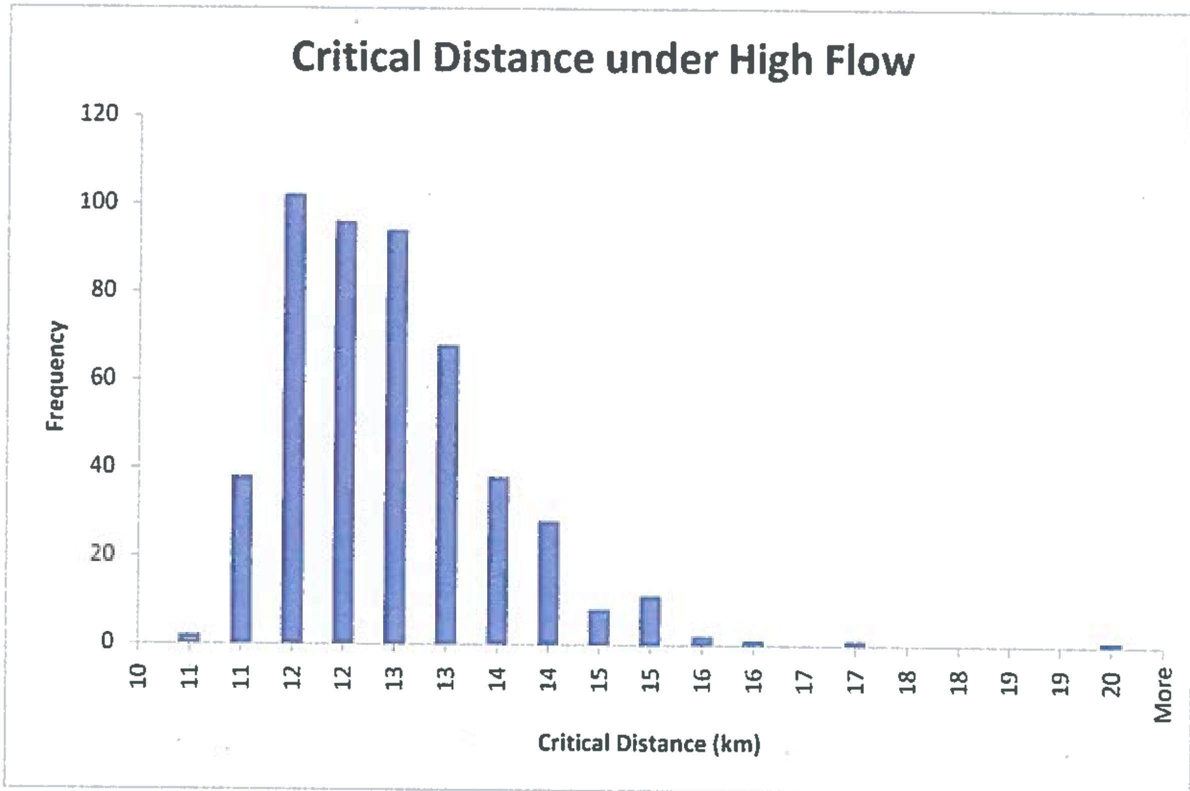


**Figure 11:** Histogram of critical distance for 500 model runs under high flow conditions

## CONCLUSION

A water quality model simulating in-stream nutrient dynamics was run for a proposed wastewater discharge in Long Branch, a tributary to Barton Creek. The parsimonious nature of the model allows for the variability of the environment to be assimilated through different scenarios. The main factor influencing the impact on the stream is stream flow. Flow in Barton Creek at a downstream USGS gage was found to vary between 10 cfs and 100 cfs. Both conditions were input into the model along with uncertainty in other parameter values. The result was that mesotrophic status of Barton Creek was predicted to be between 1.2 and 27.8 miles (1.9 and 44.7 km) under high and low flow conditions, respectively. Any flow between these two conditions can be expected to yield a deleterious change in trophic status along lengths between these two values. This change in trophic status adversely impacts the recreational and aesthetic value of Barton Creek, the habitat of the residing aquatic species, and the water quality of the underlying Edwards Aquifer.

## REFERENCES


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# Item 5

# Adjournment