BUTLER | SNOW

September 10, 2024

VIA ELECTRONIC FILING

Electronically Filed in TPUC Docket Room on September 10, 2024 at 1:49 p.m..

David Foster, Director
Utilities Division
c/o Ectory Lawless, Docket Room Manager
Tennessee Public Utility Commission
502 Deaderick Street, 4th Floor
Nashville, TN 37243
TPUC.DocketRoom@tn.gov

RE: ***Application of Limestone Water Utility Operating Company, LLC to Expand Its Certificate of Convenience and Necessity to Serve the Adley Subdivision, TPUC Docket No. 24-00020***

Dear Mr. Foster:

We are in receipt of your data requests to Limestone Water Utility Operating Company ("Limestone"), dated August 27, 2024. Please find Limestone's responses below.

1. *Regarding Commission Rule 1220-04-13-.17(2)(a)(7): Please provide an updated map (plat) which shows the map number and parcel number(s) associated with the proposed Adley subdivision, as well as all residences and habitable structures to be served, and the preliminary designs of the proposed development.*

   Response: Please see attachment **DR 1 - Adley Subdivision Maps**.

2. *Regarding Commission Rule 1220-04-13-.17(2)(b)(3): If an agreement between the Developer and its designated contractor exists for this project, please provide a copy.*

   Response: Please see attachment **DR 2 – Developer Agreement**. It is Limestone's understanding that the developer and the contractor are awaiting regulatory approval prior to executing this agreement.

3. *Regarding Commission Rule 1220-04-13-.17(2)(b)(1): Provide a recently issued letter from the Williamson County government and public wastewater utilities in or near the proposed service area stating that they do not provide wastewater service to the proposed service area and that they are unable or unwilling to provide wastewater service to the proposed service area within the ensuing twelve (12) months.*

The Pinnacle at Symphony Place
150 3rd Avenue South, Suite 1600
Nashville, TN 37201

KATHERINE B. BARNES
615.651.6797
katherine.barnes@butlersnow.com

T 615.651.6700
F 615.651.6701
www.butlersnow.com

BUTLER SNOW LLP

Response: Please see attachment **DR 3 – HVUD No Service Letter**. Limestone has also contacted Williamson County regarding a similar statement and will file that statement as soon as it is available.

4. *Regarding Commission Rule 1220-04-13-.17(2)(d)(1): Provide any applications, engineering and/or design reports submitted to TDEC regarding the provision of service to the proposed Adley subdivision.*

   Response: Please see attachments **DR 4.1 – Basis of Design Report** and **DR 4.2 – Preliminary Engineering Report for Grassland STP Improvements**.

5. *Regarding Commission Rule 1220-04-13-.17(2)(e)(1): Provide the financial statements of CSWR.*

   Response: Please see attachment **PROPRIETARY** and **CONFIDENTIAL DR 5 – CSWR Consolidated Financial Statements** for 2022 and 2023 submitted **UNDER SEAL**.

6. *Regarding Commission Rule 1220-04-13-.17(2)(f)(5): The Direct Testimony of Todd Thomas should contain a statement that the applicant is aware of the requirement of Commission Rule 1220-04-13-.09(7) concerning the completion of the construction of the wastewater system within three years of the Commission's written approval of the CCN. Please amend the testimony to include this statement.*

   Response: Please see attachment **DR 6 – Supplemental Direct Testimony of Todd Thomas** that includes a statement that Limestone is aware of the requirement of Commission Rule 1220-04-13-.09(7).

7. *Please provide certification from an engineer that Limestone Water Utility Operating Company, LLC has sufficient capacity at the Grasslands wastewater treatment system to serve the existing customers of the Grasslands system, the planned customers to be added from the Nash Ridge development approved in Commission Docket No. 23-00036, and the planned customers to be added from the proposed Adley subdivision.*

   Response: Limestone has prepared the affidavit of Jacob Freeman, Director of Engineering for CSWR, LLC, Limestone's ultimate parent company. However, due to travel schedules, Mr. Freeman has been unable to sign the affidavit and have it notarized; therefore, Limestone will file the affidavit as **DR 7 – Affidavit of Jacob Freeman** separately and as soon as possible. As construction has not begun on the homes in Adley, it is reasonably possible that by the time the homes are ready to connect to Limestone Water's sewer system, the Grasslands replacement facility will be at or near completion. Limestone can provide an engineer certification of that replacement facility, as well.

8. *Has the Company had any communications to and/or from the Tennessee Department of Environment and Conservation (TDEC) regarding the Company's ability to utilize capacity at the Grasslands wastewater treatment system to serve the Nash Ridge development approved in Commission Docket No. 23-00036 and/or the Adley subdivision proposed in this docket?*

Please provide copies of all such communications. If such communications were verbal communications, please provide the name of such person(s) at TDEC, as well as the date(s) the communications were held.

Response: Yes. Limestone has had numerous conversations with TDEC regarding the Grasslands facility. The initial conversation was held in March 2022 and centered around the NPDES permit and the proposed facility expansion. From TDEC, Liz Campbell, Wade Murphy, Vojin Janjic, and Angela Jones participated. In September 2023, Limestone had a follow-up call with Tim Hill, Angela Jones, Wade Murphy, Bob O'Dette and Daniel Pleasant from TDEC. The group discussed the facility expansion, high flows, and mass loading. A copy of TDEC's meeting notes is attached as **DR 8 – TDEC/Limestone Meeting Notes September 2023**. Most recently, Limestone held a call with TDEC on September 3, 2024. Participants from TDEC included Vojin Janjic, Tim Hill, Angela Jones, and Patrick Parker. The group discussed the facility generally, the I&I issues, capacity, high flows, and the collection system application submitted by the developer of Nash Ridge (TPUC Docket No. 23-00036). Limestone will also provide the Commission with updates regarding the ongoing discussions with TDEC prior to connecting Adley.

Please feel free to reach out to me if you have any further questions.

Sincerely,

BUTLER SNOW LLP

Katherine Barnes

Katherine Barnes

Attachments
cc: Russ Mitten, Limestone Water Utility Operating Company, LLC
Shilina B. Brown, Consumer Advocate Division
Victoria B. Glover, Consumer Advocate Division

Attachment DR 1 – Adley Subdivision Maps

CONCEPT PLANS

ADLEY SUBDIVISION

DATE: November 30th, 2022

6740 MANLEY LANE
BRENTWOOD, TN 37027
Tax Map 27 / Parcel 38
Williamson County, Tennessee

OWNER:

TRUST PARTNERS, LLC
1163 GATEWAY DRIVE
NASHVILLE, TN 37220

DEVELOPER:

GROVE PARK CONSTRUCTION
1537 FRANKLIN ROAD SUITE 300
BRENTWOOD, TN 37027
Tel. 615.584.1615

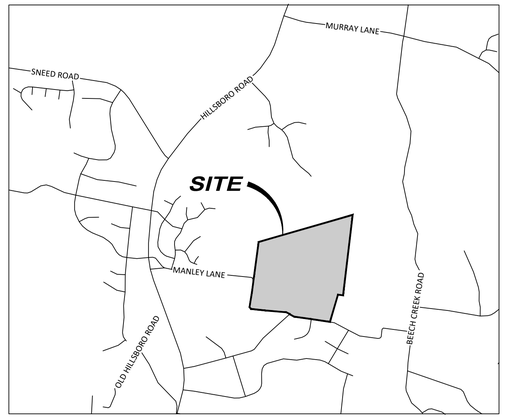
PROJECT ENGINEER:

MCNEELY CIVIL ENGINEERING, LLC
254 BELGIAN ROAD
NOLENSVILLE, TN 37135
Tel. 615.335.3172

PROJECT SURVEYOR:

TWM SURVEYING
504 AUTUMN SPRINGS COURT SUITE B14
FRANKLIN, TN 37067
Tel. 615.533.4885

WATER:	CITY OF FRANKLIN, TN WATER 109 3RD AVE SOUTH FRANKLIN, TN 37064
SEWER:	LIMESTONE WATER UTILITY OPERATING COMPANY, LLC
POWER:	MIDDLE TENNESSEE ELECTRIC 2156 EDWARD CURD LANE FRANKLIN, TN 37067
GAS:	DUKE ENERGY/PIEDMONT NATURAL GAS



NORTH

Vicinity Map
NTS

CURRENT ZONING: RP-5 (CONSERVATION SUBDIVISION)
FRONT SETBACK: 50 FEET UNLESS OTHERWISE NOTED ON PLAN
SIDE YARD SETBACK: 20 FEET
REAR SETBACK: 30 FEET

LOTS 5-18 AND 21-30 WILL BE DESIGNATED
AS CRITICAL LOTS DUE TO STEEP TOPOGRAPHY

SITE DATA		
USE	ACRES	% SITE
LOTS (30)	48.74 ACRES	32.42%
ROAD R.O.W.	4.16 ACRES	2.77 %
OPEN SPACE	97.46 ACRES	64.81%
TOTAL (NET WITH RIGHT OF WAY DEDICATION	150.36 ACRES	100 %

SET ASIDE OPEN SPACE REQUIRED RP-5 IS 60 % OR 90.22 AC
SET ASIDE OPEN SPACE PROVIDED: 97.46 AC

SHEET INDEX

N

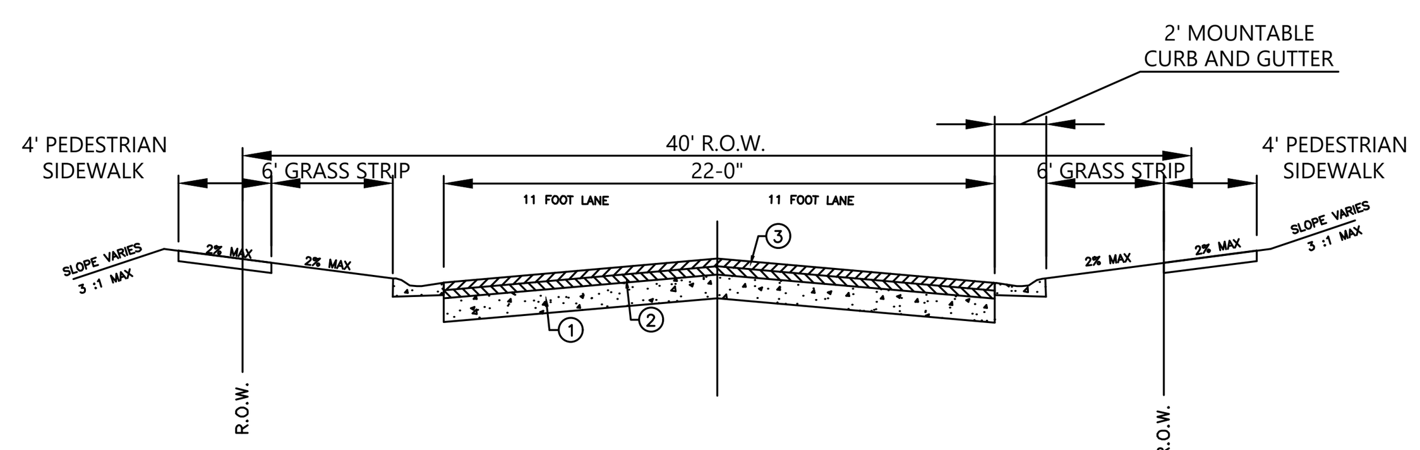
0 100 200 400 600
GRAPHIC SCALE

811
Know what's below.
Call before you dig.

ELLA SUBDIVISION CONCEPT PLANS COVER SHEET

C0.00

*LOTS DESIGNATED WITH AN ASTERISK * HAVE NATURAL SLOPES OF GREATER THAN 15%. PRIOR TO THE ISSUANCE OF A BUILDING PERMIT FOR A RESIDENTIAL LOT WITH A SLOPE OF 15% OR GREATER, A PLAN SHALL BE PREPARED BY A LICENSED PROFESSIONAL ENGINEER FOR APPROVAL BY THE COUNTY ENGINEER SHOWING EXISTING TOPOGRAPHIC INFORMATION FROM FIELD RUN SURVEY DATA, BOUNDARY AND SETBACK LINES, UTILITY AND DRAINAGE EASEMENTS, EXISTING AND PROPOSED DRAINAGE PIPES, DITCHES AND SWALES TO BE CONNECTED TO PUBLIC DRAINAGE LINES AND/OR TO DIRECT OR RE-DIRECT STORMWATER RUNOFF, THE PROPOSED BUILDING FOOTPRINT AND THE DRIVEWAY PLAN, INCLUDING THE FINISHED FLOOR ELEVATIONS AND FINISHED GRADES OF PAVEMENTS AND GROUND LINES, AND THE LOCATION AND TIMING OF INSTALLATION OF EROSION CONTROL FEATURES. NO CLEAR CUTTING OF TREES OR GRADING OF LOT WILL BE PERMITTED WITHOUT PRIOR APPROVAL FROM WILLIAMSON COUNTY ENGINEERING DEPARTMENT.



(1) 8" STONE (GRADING D PUG MILL MIX)

(2) 2" ASPHALTIC CONCRETE BASE (B–M2)
PRIME COAT (RS–2)

(3) 1.5" ASPHALTIC CONCRETE SURFACE (411E)
TACK COAT (SS–1)

NOTES:

a) SPECIFICATIONS ARE TAKEN FROM TENNESSEE DEPARTMENT OF TRANSPORTATION BUREAU OF HIGHWAYS, NASHVILLE STANDARD SPECIFICATIONS FOR ROAD AND BRIDGE CONSTRUCTION, ADOPTED MARCH 1, 1995 AND ALL SPECIFICATION PROVISIONS PERTAINING THERETO.

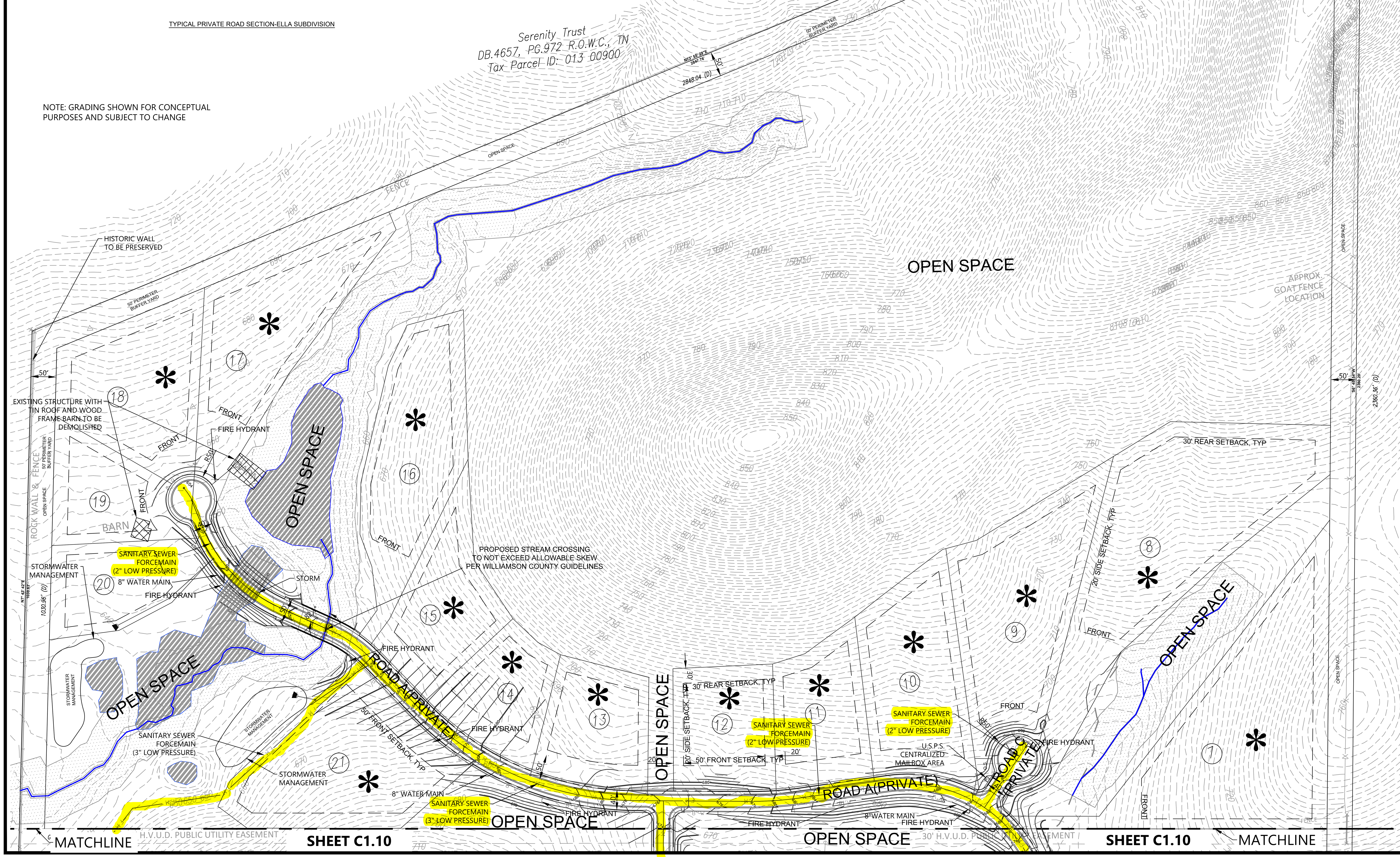
b) ALL STORM SEWERS SHALL BE CONCRETE PIPE AND CATCH BASINS SHALL MEET THE STANDARDS OF THIS REGULATION AND THE STATE OF TENNESSEE DEPARTMENT OF TRANSPORTATION BUREAU OF HIGHWAYS STANDARD SPECIFICATIONS AND STANDARD ROADWAY & STRUCTURE DRAWINGS.

TYPICAL PRIVATE ROAD SECTION-ELLA SUBDIVISION

LEGEND

- MANLEY LANE RIGHT OF WAY DEDICATION
- REMOVE EXISTING STRUCTURE
- WATERWAY NATURAL AREA (W.N.A.)
- WETLANDS

NOTE: GRADING SHOWN FOR CONCEPTUAL PURPOSES AND SUBJECT TO CHANGE



LOT TABLE		
LOT #	ACRES	SQ. FT.
1	1.84	80,338.93
2	1.34	58,387.19
3	1.36	59,046.04
4	1.37	59,567.52
5	1.30	56,799.72
6	1.80	78,445.04
7	3.40	147,918.69
8	3.52	153,447.99
9	2.33	103,847.99
10	1.80	78,449.62
11	1.17	50,755.51
12	1.14	49,500.63
13	1.13	49,067.77
14	1.01	43,934.07
15	1.29	56,166.47
16	1.97	85,701.10
17	2.04	89,014.31
18	1.76	76,791.70
19	1.01	44,120.66
20	1.05	45,965.51
21	2.21	96,278.98
22	1.14	49,868.40
23	1.17	51,011.05
24	1.60	69,550.28
25	2.04	89,052.56
26	2.20	95,775.20
27	1.07	46,817.34
28	1.25	54,262.67
29	1.12	48,849.95
30	1.25	54,538.88

OPEN SPACE/PUBLIC UTILITY DRAINAGE AND ACCESS EASEMENT TO BE MAINTAINED BY THE HOMEOWNER'S ASSOCIATION

GENERAL NOTES

1. THE PURPOSE OF THIS CONCEPT PLAN IS TO CREATE 30 SINGLE FAMILY UNITS, OPEN SPACE, AND PUBLIC ACCESS AND PUBLIC UTILITY AND DRAINAGE EASEMENTS.

2. THE PROPERTY SHOWN HEREON IS LOCATED WITHIN WILLIAMSON COUNTY, TN. ALL MATTERS PERTAINING TO CONSTRUCTION, USE, LOCATION OF IMPROVEMENTS, SETBACK PROVISIONS, ETC., ARE SUBJECT TO THE WILLIAMSON COUNTY, TN ZONING REGULATIONS AS INTERPRETED AND REGULATED BY WILLIAMSON COUNTY, TN.

3. THIS PROPERTY CURRENTLY IDENTIFIED AS TAX MAP 27, PARCEL 38 WILLIAMSON COUNTY, TN.

4. DEED REFERENCE: DEED BOOK 1856 PAGE 582 REGISTER'S OFFICE OF WILLIAMSON COUNTY, TENNESSEE.

5. THIS PROPERTY LIES WITH FLOOD ZONE "X" AREAS DETERMINED TO BE OUTSIDE THE 100-YEAR FLOODPLAIN, AS DESIGNATED ON CURRENT FEDERAL EMERGENCY MANAGEMENT AGENCY MAP NO. 47187C0069G WITH AN EFFECTIVE DATE OF 12-22-2016 AND 47187C0088F WITH AN EFFECTIVE DATE OF 9-29-2006.

6. ALL OPEN SPACE AREAS ARE TO BE DESIGNATED AS PUBLIC UTILITIES AND DRAINAGE EASEMENTS AND MAINTAINED BY A HOMEOWNER'S ASSOCATION.

7. PROPOSED SANITARY SEWER, PROPOSED WATERLINES, AND PROPOSED STROM DRAINAGE LOCATED OUTSIDE ROAD RIGHT OF WAY SHALL HAVE A PERMANENT 20' PUBLIC UTILITY AND DRAINAGE EASEMENT.

8. LIDAR INFORMATION WAS UTILIZED TO CONDUCT THE SLOPE ANALYSIS FOR THIS PROJECT.

9. CRITICAL LOTS ARE DENOTED WITH AN ASTERISK * AND ARE INDICATED AS CRITICAL DUE TO 15%-25% SLOPES INDICATED ON THE SLOPE ANALYSIS.

10. VARIANCES ARE NOT BEING REQUESTED FOR THIS DEVELOPMENT PROJECT.

11. OWNER: TRUST PARTNERS, LLC

Know what's below. Call before you dig.

GRAPHIC SCALE 0 50 100 200 300

McNeely Civil Engineering, LLC
254 Belgian Road
Nolensville, TN 37135

Permit-Seal:

11/30/2022

Client/Project:

GROVE PARK CONSTRUCTION

1537 FRANKLIN ROAD ST. 300
BRENTWOOD, TN 37027
615-584-1615

ADLEY SUBDIVISION CONCEPT PLANS

Revisions:

Item:	Date:
COUNTY COMMENTS	11-23-2022
COUNTY COMMENTS	11-30-2022

Project No.: MCE 220004

Designed By:
Drawn By:
Checked By: E. MCNEELY
Date: 11-30-2022

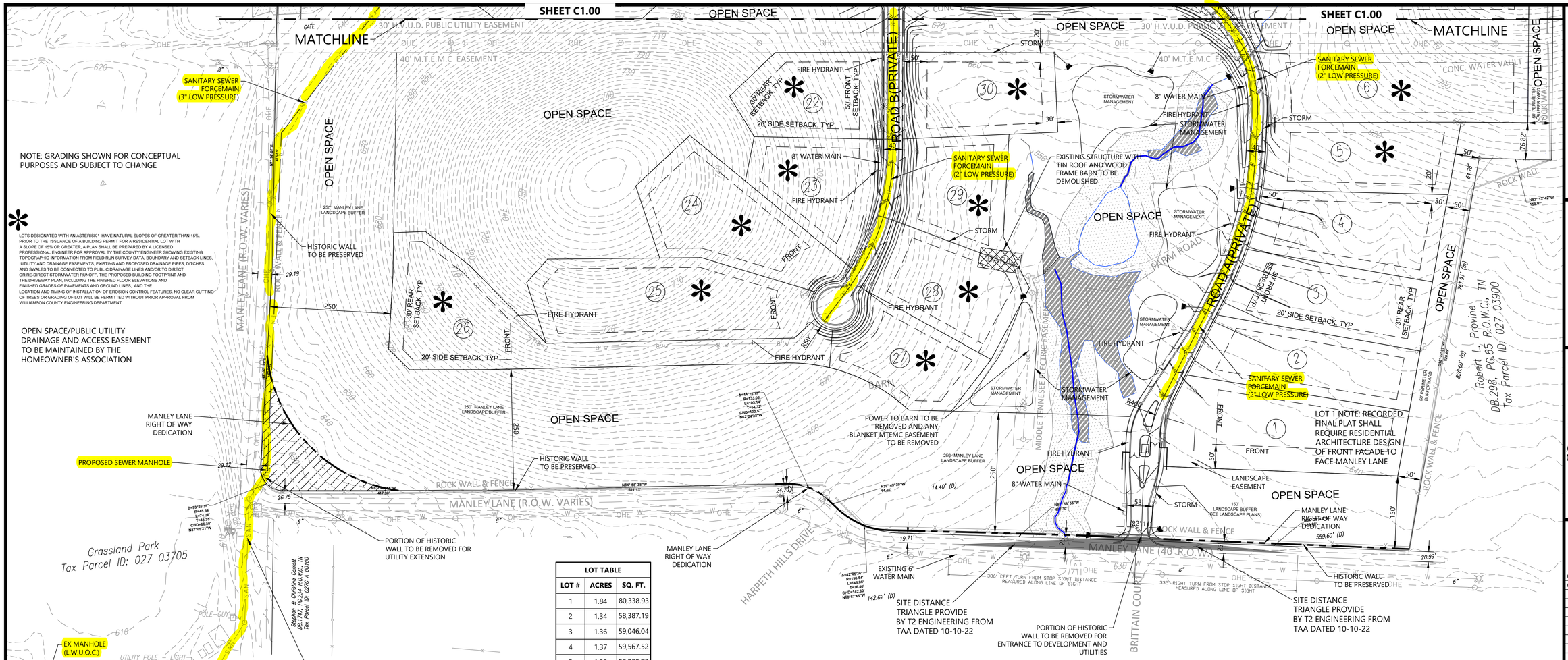
Scale:

Title:

ADLEY SUBDIVSION CONCEPT SITE PLANS GRADING, DRAINAGE AND UTILITY PLAN

Drawing No.

C1.00



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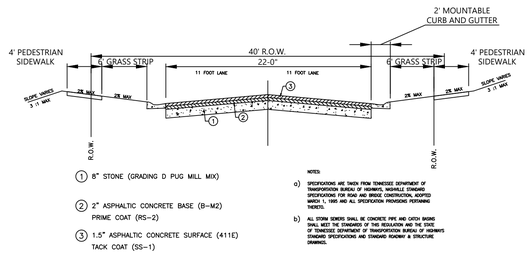

TYPICAL PRIVATE ROAD SECTION-ELLA SUBDIVISION

LEGEND

- MANLEY LANE RIGHT OF WAY DEDICATION
- REMOVE EXISTING STRUCTURE
- WATERWAY NATURAL AREA (W.W.N.A.)
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11. OWNER: TRUST PARTNERS, LLC

N

Know what's below. Call before you dig.

0 50 100 200 300
GRAPHIC SCALE

McNeely Civil Engineering, LLC
254 Belgian Road
Nolensville, TN 37135

Permit-Seal:

ERIC M. MCNEELY REGISTERED ENGINEER AGRICULTURE COMMERCE STATE OF TENNESSEE 11/4/2022

Client/Project:

GROVE PARK CONSTRUCTION

1537 FRANKLIN ROAD ST. 300
BRENTWOOD, TN 37027
615-584-1615

ADLEY SUBDIVISION
CONCEPT PLANS

Revisions:

Item:	Date:
COUNTY COMMENTS	11-23-2022
COUNTY COMMENTS	11-30-2022

Project No. : MCE 220004

Designed By:
Drawn By:
Checked By: E. MCNEELY
Date: 11-30-2022

Scale:

Title:
ADLEY SUBDIVSION CONCEPT SITE PLANS GRADING, DRAINAGE AND UTILITY PLAN

Drawing No.
C1.10

Attachment DR 2 – Developer Agreement

CONSTRUCTION CONTRACT

Contractor: Grove Park Commercial Builders, LLC
1537 Franklin Road, Suite 300
Brentwood, TN 37027

Owner: Manley Lane Holding Company, LLC
1537 Franklin Road, Suite 300
Brentwood, TN 37027

Property to be Improved: 6740 Manley Lane, Williamson County, Tennessee
151.01+/- acres

Contractor and Owner enter into the following Construction Contract ("Agreement") for the performance of the Work on the above-referenced property ("Property") as set forth below:

1. The Work. Contractor shall furnish all labor, material, and equipment for the performance of the work described on **Exhibit A** ("Work"). Owner shall not be entitled to self-perform any of the Work, or to have any of the Work performed by anyone other than Contractor. Owner shall not interfere with or give instructions to Contractor's subcontractors or suppliers, or otherwise interfere with the Work.

2. Completion of the Work. The Work shall commence upon the issuance of a notice to proceed from Owner to Contractor and is estimated to be Substantially Completed within a reasonable timeframe thereafter. Substantial Completion date will ultimately be driven by lead times, inspections, material availability and other factors. "Substantial Completion" or "Substantially Completed" means substantial completion of the Work as defined by T.C.A. 28-3-201(2). Contractor shall have no liability for any delay in the prosecution or completion of the Work resulting from the act, neglect, or default of Owner; damage by fire, earthquake, weather, or other casualty; strike, walkouts, or any other acts of employees or suppliers of labor or materials; governmental control, delays, regulations, permitting, or restrictions; allocations or shortages of labor, supplies and materials; and national or global pandemic (including COVID 19).

3. Contract Price. The Contract Price to be paid to Contractor by Owner for the performance of the Work is $835,590.00 ("Contract Price"). During the course of this Agreement, Contractor shall invoice Owner based on the percentage of completion of the Work. Each billing shall be based on Contractor's reasonable determination of the percentage of completion of the Work, multiplied by the total Contract Price, less payments made to date (each a "Payment Application"). Final payment shall be due upon Contractor's notice to Owner in writing that the Work is Substantially Completed. Within five (5) days after Owner's receipt of a Payment Application, Owner shall pay Contractor in full for the amounts billed on the Payment Application, without deduction or setoff.

4. Concealed or Unknown Physical Conditions. The Contract Price assumes that Contractor will not encounter rock, unsuitable soils, underground springs or streams, karst features or other concealed or unanticipated conditions in the construction of the Work (collectively "Concealed Conditions"). If Concealed Conditions are encountered as part of the Work, Contractor shall be entitled to a change order to address the Concealed Conditions equal to the cost of the work plus twenty percent (20%) of the cost of the work as a management fee.

5. Changes in the Work. Any changes in the Work, Contract Price, or any other aspect of the Agreement shall require a Change Order. A Change Order is a written order to Contractor, agreed to by Contractor and Owner, as evidenced by their signatures thereto, indicating Contractor's agreement to a change, with a corresponding adjustment to the Contract Price. Nothing herein shall be construed as requiring Contractor to agree to any Change Order submitted by Owner.

6. Default; Termination.

(a) In the event Owner fails to cure any default or breach of this Agreement within thirty (30) days' written notice from Contractor (with the exception that only five (5) days' written notice shall be required for

defaults in payment), Contractor may (in addition to any other rights and remedies afforded by law or equity) (i) stop all Work, and/or (ii) terminate this Agreement, and/or (iii) bring a claim for all consequential, incidental, actual and other damages, plus all collection costs, attorney's fees and expenses incurred.

(b) In the event of default by Contractor under this Agreement, Owner shall provide Contractor with written notice of the event of default and a thirty (30) day period to commence efforts to cure the same. In the event said thirty (30) day period is insufficient to reasonably enable Contractor to cure the default, then Contractor shall be afforded an additional reasonable period of time to cure the default.

(c) This Agreement shall automatically and immediately terminate in the event Owner elects not to proceed with the development of the contemplated residential subdivision on the Property.

7. **Dispute Resolution.** All disputes and claims between Contractor and Owner which arise from, or relate to, this Agreement or the Work, shall be submitted to binding arbitration in accordance with the Federal Arbitration Act, administered by the American Arbitration Association ("AAA"), pursuant to the Construction Industry Arbitration Rules ("AAA Rules") of the AAA in effect at the time a demand for arbitration is made. Any disputes as to the validity and enforceability of this arbitration agreement, including claims for fraud and fraudulent inducement, shall be resolved through binding arbitration as set forth herein. The parties acknowledge that this Agreement relates to and involves interstate commerce. The parties further agree that any claims or causes of action by Owner against Contractor's managers, owners, employees, officers, directors, members and shareholders shall be submitted to binding arbitration in accordance with this Agreement. The parties further waive any right they may have to a trial by jury related to any claims arising from, or related to, the Work or this Agreement. The arbitration shall take place in Davidson County, Tennessee before a single arbitrator, notwithstanding the amount in controversy.

8. **Miscellaneous.** (a) This Agreement shall be interpreted and construed in accordance with the laws of the State of Tennessee. (b) This Agreement is severable such that the invalidity or unenforceability of any provision hereof shall not affect the validity or enforceability of the remaining provisions. The invalid or unenforceable clause shall be severed. (c) This Agreement contains the entire agreement of the parties and may not be amended or modified except by an instrument in writing executed by all parties. (d) The section headings in this Agreement are inserted for convenience only and shall not limit or expand the scope or content of the provisions following such headings. (e) Contractor shall not be liable to Owner for any consequential, incidental, punitive or special damages, or for any lost profits. Owner waives all rights against Contractor for recovery of damages to the extent the damages are covered by insurance and waives the right to subrogation. (f) This Agreement shall not be construed more strongly for or against any party as the "drafter" of the document.

9. **Notice to Owner**. The above-captioned contractor hereby gives notice to the owner of the property to be improved, that the contractor is about to begin improving the property according to the terms and conditions of the contract and that under the provisions of the state law (§§ 66-11-101 - 66-11-141) there shall be a lien upon the real property and building for the improvements made in favor of the above-mentioned contractor who does the work or furnishes the materials for such improvements for a duration of one (1) year after the work is finished or materials furnished.

[signatures on following page(s)]

Grove Park Commercial Builders, LLC

By: _____
Its: _____
Date: _____

Manley Lane Holding Company, LLC

By: _____
Its: _____
Date: _____

EXHIBIT A

MCNEELY CIVIL ENGINEERING, LLC
ENGINEER'S OPINION OF PROBABLE COST

ADLEY SUBDIVISION — TOTAL LOTS 30

NO.	ITEM	QTY.	UNIT	UNIT PRICE	TOTAL PRICE
	SANITARY SEWER IMPROVEMENTS				
	CORE TO EXISTING MANHOLE	1	EA	$ 3,000.00	$ 3,000.00
	SANITARY SEWER, 8" PVC SDR 26, 5-8' (ROAD)	810	LF	$ 120.00	$ 97,200.00
	SANITARY MANHOLE, 4' DIA., 5-8' DEEP	4	EA	$ 5,000.00	$ 20,000.00
	SANITARY SEWER VIDEO AND TESTING	810	LF	$ 15.00	$ 12,150.00
	SANITARY SEWER FORCE MAIN, 1.5"-3" PVC SDR 21	5225	LF	$ 50.00	$ 261,250.00
	FORCE MAIN VALVE BOXES	30	EA	$ 1,200.00	$ 36,000.00
	GRINDER PUMP STATION AND MAINTENANCE AGREEMENT	30	EA	$ 10,000.00	$ 300,000.00
	SUBTOTAL FOR SANITARY SEWER IMPROVEMENTS				*$ 726,600.00*
	15 PERCENT CONTIGENCY				$ 108,990.00
	TOTAL FOR SANITARY SEWER IMPROVEMENTS				$ 835,590.00

Attachment DR 3 – HVUD No Service Letter

HARPETH VALLEY
UTILITIES DISTRICT

September 10, 2024

Mr. TJ Atwood
Regulatory Analyst
1630 Des Peres Rd., Ste. 140
Des Peres, Missouri 63131

Re: Water and Wastewater Service
Williamson County Map 27 Parcel 38
Proposed Adley Subdivision

Mr. Atwood:

Harpeth Valley Utilities District of Davidson and Williamson Counties, Tennessee (HVUD) does not provide nor has and desire to provide water or wastewater service to Williamson County Parcel 38 on Map 27, also known as the Adley Subdivision.

If you have any questions or comments, please feel free to contact me at your convenience.

Sincerely,

Sam Harrison
Senior Engineer

Attachment DR 4.1 – Basis of Design Report

BASIS OF DESIGN REPORT

TO:	CENTRAL STATES WATER RESOURCES (CSWR)
FROM:	EVAN GROOME, EIT, LOGAN DICKINSON, PE, AND TONY REID, PE, BCEE (GMC)
RE:	GRASSLAND STP IMPROVEMENTS
DATE:	MAY 2024

1. INTRODUCTION

Grassland Sewage Treatment Plant (STP) is currently owned by Limestone Water Utility Operating Company (LWUOC), LLC., which is part of Central States Water Resources (CSWR), and is operated by ClearWater Solutions (CWS). Designed for 0.25 Million Gallons per Day (MGD), the plant receives domestic sewage from residents of the Grassland community and a limited number of commercial facilities. Over time, however, unit processes have become hydraulically limited due to increasing amounts of inflow and infiltration (I&I). The current plant is unable to accommodate peak flows or consistently produce high-quality effluent, and it has repeatedly violated the National Pollution Discharge Elimination System (NPDES) permit. To address issues of the existing facility, CSWR retained Goodwyn Mills Cawood (GMC), LLC. to provide a Preliminary Engineering Report (PER) and Basis of Design (BoD) for improvements to Grassland STP.

1.1 Purpose

The purposes of this technical memorandum (TM) are to:

- Analyze the existing flows, facility, and historical wastewater quality,
- Discuss the plant capacity, equalization requirements, and projected permit limits, and
- Provide recommendation and design criteria for:
    - Influent Lift Station (ILS)
    - Headworks
    - Biological Treatment
    - Tertiary Filtration
    - Disinfection
    - Outfall

2. BACKGROUND

2.1 Existing Facility Flows

Due to I&I, influent flows have increased at Grassland STP over the years exceeding the treatment facility's design capacity of 0.25 MGD. With unit processes undersized, short-circuiting occurs, and the plant struggles to maintain compliance with its NPDES permit (TN0027278). To understand historical flows at Grassland STP, a flow analysis was performed using observed flow data from 2017 to 2024. A summary of the flow analysis is shown below in **Table 2.1.**

Table 2.1. Grassland STP Flow Analysis (2017 – 2024)

Flow Condition	Flow (MGD)	Peaking Factor
Minimum Daily Flow	0.07	0.20
Minimum Weekly Flow	0.10	0.30
Minimum Monthly Flow	0.11	0.33
Average Daily Flow	0.33	1.00
Maximum Monthly Flow	0.49	1.47
Maximum Weekly Flow	0.68	2.05
Maximum Daily Flow	1.66	5.01

From the analyzed flow data, the observed Average Daily Flow (ADF) was found to be 32% greater than the design flow of 0.25 MGD. Additionally, the maximum daily flow (1.66 MGD) is 6.6 times the plant's permitted flow. As a result, CSWR initiated an improvements project in 2019 for a 2.5-mile segment of the collection system, where I&I was a known issue. Completed in 2022, the rehab project resulted in a 26.5% reduction in Average Monthly Flow (AMF). Shown below, **Table 2.2** summarizes the significance of the 2019 project on observed influent flows.

Table 2.2. Impact of Collection Rehab Project on Observed Plant Flow

Parameter	Flow Rate Prior to Collection System Improvement	Flow Rate After Collection System Improvement
Flow Period	2017 – 2021	2022 - 2024
Minimum Daily Flow (MGD)	0.13	0.07
Average Daily Flow (MGD)	0.38	0.25
Maximum Monthly Flow (MGD)	1.04	0.49
Maximum Daily Flow (MGD)	1.66	0.90

Due to the observed impact of the 2019 project on flows to Grassland STP, CSWR plans to continue improving the collection system by performing various tests to identify and eliminate other sources of I&I.

2.2 Existing Facility Infrastructure

The Grassland STP receives domestic wastewater from the surrounding community, and its collection system extends out in a 1.5-mile radius from the facility, The current plant is generally comprised of an Influent Lift Station (ILS), Field-Erect Treatment Plant (FETP), and Chlorine Contact

Chamber (CCC). The treated effluent is discharged to the neighboring Harpeth River, which has strict permit limits.

The ILS is a dry-pit style pump station and poses a safety threat to operators due to the 40-foot descent that is required to enter it for servicing the pumps. In the past, the lift station has experienced failures, one of which resulted in approximately 250,000 gallons of untreated wastewater being released from a nearby manhole.

Designed as an extended aeration configuration, biological treatment is achieved in a 0.25 million gallon (MG) FETP. This structure incorporates multiple aspects of the biological process in a single tank including aeration zones, a secondary clarifier, and an aerobic digester. However, due to the age of the facility, the FETP is in disrepair. The steel wall that forms the designated digester zone has rusted through and is no longer able to handle solids, so a plastic digester tank has been brought in to temporarily treat solids generated from the biological process.

Disinfection currently takes place inside a decommissioned tertiary filtration tank which was converted to a CCC. Chlorine gas (Cl_2) is introduced to the treated wastewater to ensure sufficient pathogen kill. Prior to discharge, dechlorination occurs via sulfur dioxide (SO_2) in order to accomplish compliance with the NPDES-specified Total Residual Chlorine (TRC) limit.

2.3 Existing Wastewater Quality

Influent wastewater quality is consistent with standard domestic wastewater characteristics and is conveyed to the plant through a combination of gravity lines and force mains within the collection system. Influent flow, carbonaceous Biochemical Oxygen Demand (cBOD), Total Suspended Solids (TSS), Total Nitrogen (TN), and Total Phosphorus (TP) from the 2022 Grassland STP Discharge Monitoring Report (DMR) is shown below in **Table 2.3.**

Table 2.3. Monthly Influent Data from 2022 DMR

Parameter	Minimum	Average	Maximum
Flow (MGD)	0.11	0.25	0.48
cBOD (mg/L)	40	128	190
TSS (mg/L)	43	167	271
TN[1] (mg/L)	23	35	69
TP[1] (mg/L)	3.7	5.6	11

[1] Data not available, so values based on "medium-strength" values obtained in Metcalf and Eddy

Though influent TN and TP data was not available, the 2022 DMR does include effluent concentrations for all aforementioned parameters. However, values associated with TN and TP are more useful presented as mass loadings in pounds per day (ppd), due to total maximum daily load (TMDL) limits for Grassland STP. Therefore, the concentrations for TN and TP were multiplied by the monthly flow and a conversion factor, and the resulting effluent data from the 2022 DMR for flow, cBOD, TSS, TN, and TP is summarized on the following page in **Table 2.4**.

Table 2.4. Monthly Effluent Data from 2022 DMR

Parameter	Minimum	Average	Maximum
Flow (MGD)	0.11	0.25	0.49
cBOD (mg/L)	0.10	0.96	3.40
TSS (mg/L)	1.8	3.4	6.1
TN (lb/d)	5.6	16.4	27.3
TP (lb/d)	1.6	2.6	3.4

Previously mentioned, treated effluent discharged to the Harpeth River is subject to strict permit limits. This is accomplished through the implementation of a TMDL for certain wastewater constituents. Developed and approved in 2004, the TMDL was developed to protect aquatic life and dissolved oxygen levels in the Harpeth River. Grassland STP's NPDES permit requires effluent TN and TP to be below 15 and 5 ppd, respectively. Reflected in the monthly average value for TN, seen in **Table 2.4**, the inability of the existing plant to meet the specified TN limits results in permit violations.

3. DESIGN CRITERIA

A summary of design criteria for the Grassland STP is presented below. Additionally, a process flow diagram (PFD) for the improvements to Grassland STP can be found in **Appendix A**.

3.1 Design Flow

A flow analysis, using observed plant flows after the collection system rehabilitation project, was performed to recommend a design flow. Based on the available data, GMC recommended a design capacity of 0.60 MGD. However, after reviewing the information submitted by GMC, CSWR opted to select a *design capacity of 0.45 MGD*. With the design capacity determined, peaking factors (based on observed flow from 2022 to 2024 in **Table 2.2**) were used to establish design conditions for the proposed plant. The resulting design flows are summarized below in **Table 3.1**.

Table 3.1. Design Flow Conditions

Flow Condition	Flow (MGD)	Peaking Factor
Average Daily Flow	0.23	1.00
Design (Maximum Monthly Flow)	0.45	1.96
Peak Hourly Flow	1.35	5.87

3.2 Wastewater Characteristics

Data from Grassland's 2022 DMR was analyzed, and the 85th percentile was calculated for the purposes of developing design parameters. Where influent information was not available (NH_3, TKN, and TP), values for "medium-strength" untreated domestic wastewater were assumed from Table 3.15 in Metcalf and Eddy (4th Edition). The design parameters for improvements to Grassland STP are summarized on the next page, in **Table 3.2**.

Table 3.2. Design Parameters for Improvements at Grassland STP

Parameter	Influent	Effluent[2]
Max Month Flow (MGD)	0.45	-
Max Day Flow (MGD)	0.83	-
Peak Hour Flow (MGD)	1.35	-
cBOD (mg/L)	200	‹ 4
TSS (mg/L)	300	‹ 10
NH_3[1] (mg/L)	35	‹ 1.5
TKN[1] (mg/L)	52	-
TN (mg/L)	-	‹ 4
TP[1] (mg/L)	8	‹ 1.33
Min Temp (°C)	17	-
Max Temp (°C)	27	-

[1] Assumed, based on "medium-strength" values in Table 3.15, obtained in Metcalf and Eddy (Fourth Edition)
[2] The effluent design parameters) are subject to change based on the TDEC-issued NPDES permit.

3.3 Influent Lift Station

Inadequate pumping capacity and safety concerns at the current plant warrant an improvement to the existing ILS. The upgraded ILS shall include two (2) *submersible pumps* that operate in a duty – standby configuration. The plant must function with the largest (capacity) pump out of service; therefore, each pump will have a design capacity of 0.60 MGD and peak capacity of 1.80 MGD. **Table 3.3**, seen below, outlines the design summary for the ILS.

Table 3.3. Influent Lift Station Design Parameters

Parameter	Design
Type of Pumps	Submersible
Design Flow (MGD)	0.60
Peak Hourly Flow (MGD)	1.80
Number of Pumps	2
Duty	1
Standby	1
Design Pump Capacity (gpm)	420
Total Pump Capacity (gpm)	2,500

Additionally, the new ILS will be designed with operator safety in mind. Easy and safe access to pumps for routine operation and maintenance will be prioritized during construction.

3.4 Headworks

CSWR desired implementing static screens during the upgrades to Grassland STP. However, upstream requirements for AGS reactors specify a 6 mm perforated plate-style screening. Since static screens do not satisfy these conditions *rotary drum screens* will be utilized. For redundancy and added capacity, two (2) screens shall be provided, operating in duty – standby. Each screen has a design capacity of 0.60 MGD, with the ability to screen 1.80 MGD. **Table 3.4**, shown on the next page, outlines the design parameters for the rotary drum screens.

Table 3.4. Screening Design Parameters

Parameter	Design
Type of Screens	Rotary Drum
Design Flow (MGD)	0.60
Peak Hourly Flow (MGD)	1.80
Opening Size (mm)	6
Number of Screens	2
Duty	1
Standby	1
Total Screening Capacity (MGD)	3.60

Additionally, AGS requires a grit removal system where 95% is removed at a 140-mesh size upstream of the biological reactors. Therefore, two (2) *vortex grit chambers* will be provided, each designed for 0.60 MGD and the ability to accommodate flows up to 1.80 MGD. A summary of the grit removal design is seen below, in **Table 3.5.**

Table 3.5. Grit Removal Design Parameters

Parameter	Design
Type of Grit Removal	Vortex
Design Flow (MGD)	0.60
Peak Hourly Flow (MGD)	1.80
Number of Chambers	2
Duty	1
Standby	1
Total Capacity (MGD)	3.60

3.5 Equalization

With observed flows for ADF and Maximum Monthly Flow (MMF) being higher than the design flows for the new facility, CSWR plans to convert the existing FETP to an equalization (EQ) basin. An EQ analysis was performed to identify the minimum required EQ size and determine if the existing 0.25 MG steel tank provides sufficient EQ capacity for the proposed plant. Based on the design flow, two scenarios were analyzed: (1) a facility always operating at design flow (0.45 MGD) and (2) a facility that high-rates flow every fourth day (1.35 MGD). Results from the EQ analysis are shown below in **Table 3.6**.

Table 3.6. EQ Analysis

Flow Condition	Minimum EQ Required (MG)
Scenario 1	1.84
Scenario 2	0.66

The analysis indicates that, regardless of how the plant is operated, the existing FETP is inadequately sized to provide EQ on its own. At a minimum, if CSWR high-rates flow every fourth day, the plant will need 0.66 MG of equalization.

3.6 Biological Treatment

Selected by CSWR, *AGS* systems (similar to sequencing batch reactors) operate in cycles/batches. This requires equalization before and after the reactor, ensuring consistent flows and loads during operation. With a potential future design capacity of 0.60 MGD, CSWR desires the influent and effluent (AGS) EQ structures to be adequately sized to accommodate future expansion. Two (2) basins, operating in a duty – standby configuration, will be constructed, with room for a future third basin. Each AGS reactor shall have a design capacity of 0.45 MGD and peak capacity of 1.35 MGD. Further design details for biological treatment are listed below in **Table 3.7.**

Table 3.7. Design Parameters for Biological Treatment

Parameter	Design
Type of Biological Treatment	AGS
Design Flow (MGD)	0.45
Peak Hourly Flow (MGD)	1.35
Number of Basins	2
Basin Volume (MG)	0.15
HRT (d)	0.68
SRT (d)	28.9
MLSS Conc. (mg/L)	8,000
AOR (lb/d)	2,118
Total Capacity (MGD)	2.70

3.7 Tertiary Filtration

Pending the effluent limits for cBOD, a single tertiary filter shall be implemented. However, if TDEC requires a monthly cBOD concentration of 2 mg/L, tertiary filters in series would be required, per Aqua Aerobics.

As for the type of tertiary filtration, *disc filters* shall be utilized. Disc filters offer high treatment capacity (through the addition of more discs), require low amounts of energy, have a relatively small footprint, and can operate continuously during backwashes. While the number of filters is dependent on the revised NPDES permit, each filter will operate at a design flow of 0.45 MGD and have a max flow of 1.35 MGD. However, by adding discs, the filter has the ability to increase the design and max flow to 0.60 MGD and 1.80 MGD (respectively). **Table 3.8**, outlined below, details the design for tertiary filtration at Grassland STP.

Table 3.8. Tertiary Filtration Design Parameters

Parameter	Design
Type of Filtration	Disc
Design Flow (MGD)	0.45
Peak Hourly Flow (MGD)	1.35
Number of Filter(s) [1]	1
Number of Discs per Filter	4
Backwash Pump Horsepower (hp)	10
Total Capacity (MGD)	2.70

[1] Depends on effluent cBOD concentration in TDEC-issued NPDES permit.

3.8 Disinfection

To cut down on chemical costs and increase operator safety, *Ultraviolet (UV) disinfection* shall be implemented. In addition to savings and safety, UV technology provides a more consistent and efficient means to inactivate and destroy harmful pathogens and bacteria. Two (2) in-channel UV units (operating in duty – standby) will be provided, each with a design capacity of 0.45 MGD and a peak capacity of 1.35 MGD. Design parameters for disinfection are listed below in **Table 3.9.**

Table 3.9. Disinfection Design Parameters

Parameter	Design
Type of Disinfection	Ultraviolet (UV)
Design Flow (MGD)	0.45
Peak Hourly Flow (MGD)	1.35
Number of Units	2
UV Transmittance (%)	65
Total Capacity (MGD)	2.70

3.9 Outfall Line

Though the outfall line floods and becomes hydraulically limiting during wet weather events, hydraulics of the upgraded plant shall be designed to address this issue. During improvements, GMC will set elevations for all new structures and ensure the plant flows hydraulically, without being limited, during peak flows. Therefore, GMC shall *utilize the existing outfall line* (Mile 68.8 of the Harpeth River) and *Parshall flume* for the improvement project. **Table 3.10**, seen below, outlines the design parameters for the effluent.

Table 3.10. Outfall Line Design Parameters

Parameter	Design
Outfall Line Size (in)	8
Design Flow (MGD)	0.60
Effluent Flow Measurement	Parshall Flume
Flume Throat Width (in)	6
Total Capacity (MGD)	2.53

APPENDIX A: PFD for Proposed Grassland STP

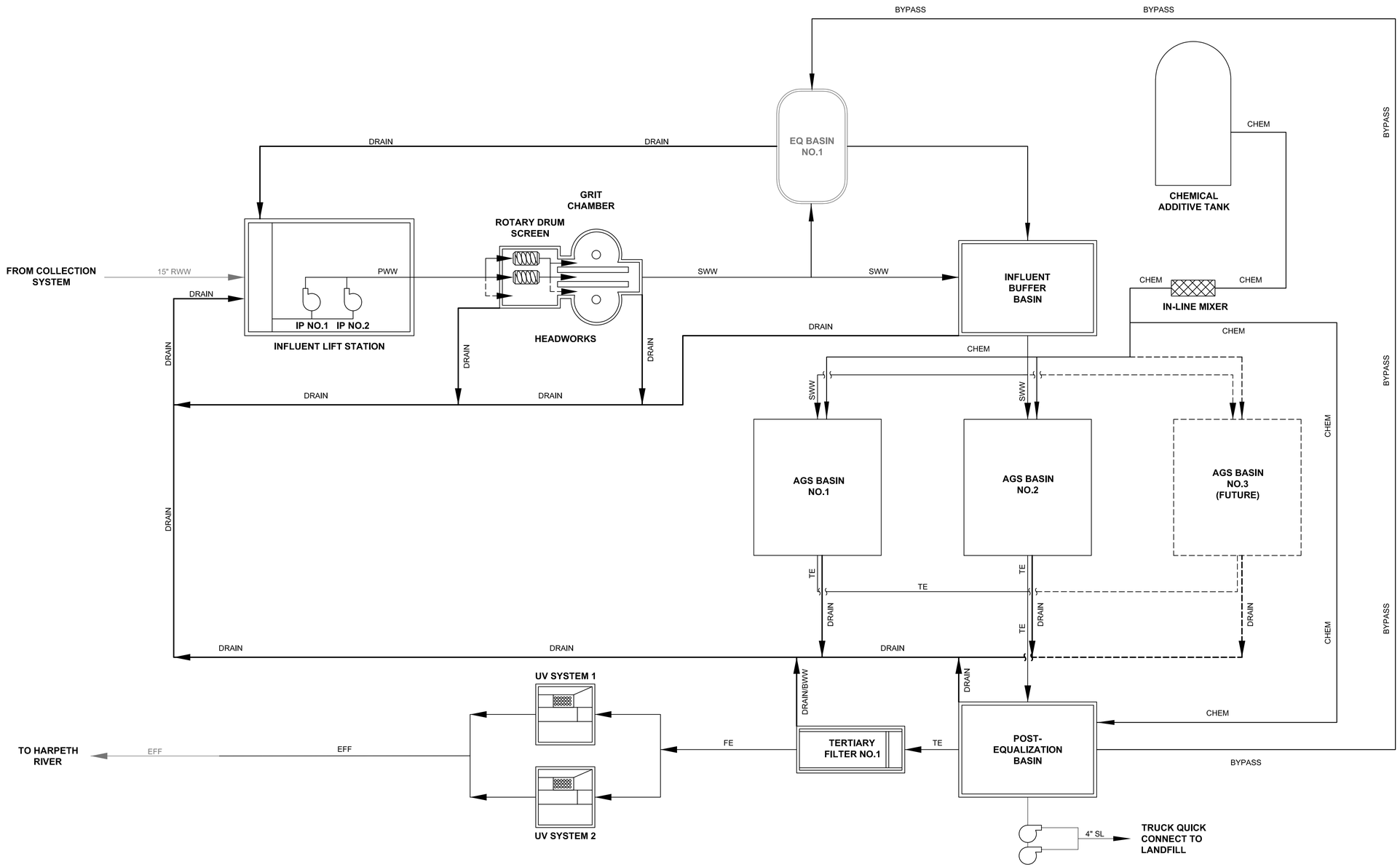
FLOWS									
	ROTARY DRUM SCREEN	GRIT CHAMBER	EQUALIZATION BASIN	INFLUENT BUFFER BASIN	AGS REACTOR	POST-EQUALIZATION BASIN	TERTIARY FILTRATION	UV SYSTEM	PARSHALL FLUME
AVERAGE DAILY FLOW (MGD)	0.60	0.60	0.25	0.30	0.23	0.30	0.45	0.45	0.30
MAXIMUM MONTHLY FLOW (MGD)	1.20	1.20		0.60	0.45	0.60	0.90	0.90	0.60
PEAK HOURLY FLOW (MGD)	3.60	3.60		1.80	1.35	1.80	2.70	2.70	2.53

FLOW LINES

- PRIMARY FLOW PATH
- BY-PASS FLOW PATH
- SECONDARY FLOW PATH
- DRAIN LINES
- EXISTING LINES

PROCESS FLOW DIAGRAM NOTES:

1. EQUIPMENT ARRANGEMENTS ARE BASED ON THE EQUIPMENT BASIS OF DESIGN IN THE SPECIFICATIONS. CHANGES TO THE LISTED BASIS OF DESIGN RESULTING IN DIFFERENCES OF THE SHOWN ARRANGEMENT SHALL BE THE CONTRACTORS RESPONSIBILITY. NO PAYMENT WILL BE ISSUED TO THE CONTRACTOR FOR MODIFICATIONS.
2. THE CONFIGURATION SHOWN ON THE PROCESS FLOW SCHEMATIC SHALL NOT BE USED FOR CONSTRUCTION BECAUSE THE LAYOUT IN THE PROCESS FLOW DIAGRAM IS NOT TO SCALE AND IS NOT REPRESENTATIVE OF THE ACTUAL FIELD LAYOUT.



GMC
3310 West End Avenue Suite 420
Nashville, TN 37203
T 615.333.7200

STATE OF TENNESSEE
GOODWYN MILLS CAWOOD, LLC
No. 2007007858
Exp.06.30.2024
NOT VALID WITHOUT A CERTIFICATE OF AUTH

ISSUE	DATE
30% SUBMITTAL	TBD
60% SUBMITTAL	TBD
90% SUBMITTAL	TBD
100% SUBMITTAL	TBD
PROJECT MANAGER:	TBD
ENGINEER:	TBD
DESIGNER:	TBD
DRAWN BY:	TBD

GRASSLAND STP
CENTRAL STATES WATER RESOURCES
FRANKLIN, TENNESSEE

GMC Project # CNAS230028

PROPOSED PROCESS FLOW DIAGRAM

Attachment DR 4.2 – Preliminary Engineering Report for Grassland STP Improvements

PRELIMINARY ENGINEERING REPORT

GRASSLAND STP IMPROVEMENTS

FRANKLIN, TENNESSEE

for

CENTRAL STATES WATER RESOURCES

FEBRUARY 2024

Prepared By

Goodwyn Mills Cawood, LLC
3310 West End Avenue
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GMC PROJECT NUMBER: CNAS230028

EXECUTIVE SUMMARY

Goodwyn Mills Cawood (GMC) has been retained by Central States Water Resources (CSWR) to develop a Preliminary Engineering Report (PER) and Basis of Design (BoD) Report for improvements to the Grassland Sewage Treatment Plant (STP). Peak flows, caused by inflow and infiltration (I&I) throughout the collection system, have caused unit processes to become hydraulically limited. This results in short-circuiting and the plant's effluent exceeding state-regulated permit limits. Washouts, overflows, and other various plant upsets suggest that the current plant is inadequately sized, while the permit violations reflect the inadequacies of the existing biological treatment.

The effort to protect Harpeth River's water quality is reflected in the Total Maximum Daily Load (TMDL) limits set in the facility's National Pollution Discharge Elimination System (NPDES) permit. Grassland STP, regardless of its capacity, is restricted by the pounds of nitrogen and phosphorus discharged daily, with limits of 15 pounds per day (ppd) and 5 ppd, respectively. GMC evaluated various biological treatment options that would improve Grassland's ability to achieve current NPDES permit limits and potential future NPDES permit limits. The technologies of interest include aerobic granular sludge (AGS), membrane bioreactor (MBR), and membrane aerated biofilm reactor (MABR). Though all these treatment technologies meet the NPDES limits imposed by the permit, GMC recommends that CSWR implement **AGS** as the treatment technology for the improvement of Grassland STP. With a capital cost of $2.35 million and an annual operation and maintenance (O&M) cost of $34,500, AGS offers a cost advantage over the other two treatment technologies. While the costs listed in the proposals are quoted from a reputable vendor, they do not account for inflation, and are therefore subject to change.

While the primary purpose of the improvement project is to upgrade the biological treatment to consistently meet permit limits, consideration must be given for additional unit processes. Therefore, GMC recommends upgrading the existing influent lift station (ILS), installing a headworks (HW), incorporating an equalization (EQ) basin, introducing tertiary filtration, and upgrading the disinfection process. These improvements shall protect downstream equipment, dampen peak flows, and provide more consistent flows and loadings to the AGS reactors. Due to the observed benefits from the 2019 collection improvement project, GMC recommends CSWR continue addressing the collection system in tandem with upgrades to Grassland STP.

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TABLE OF CONTENTS

LIST OF TABLES

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SYMBOLS AND ABBREVIATIONS

Terms used throughout this report are defined as follows:

AGS	Aerobic Granular Sludge
AMF	Average Monthly Flow
BoD	Basis of Design
CAS	Conventional Activated Sludge
$cBOD_5$	5-Day Carbonaceous Biochemical Oxygen Demand
CCC	Chlorine Contact Chamber
CE	Cost Estimate
CEI	Compliance Evaluation Inspection
CSWR	Central States Water Resources
DMR	Discharge Monitoring Report
ENR	Enhanced Nutrient Removal
EPA	Environmental Protection Agency
EPS	Extracellular Polymers
ERT	Environmental Review Tool
EQ	Equalization
FEMA	Federal Emergency Management Agency
FETP	Field Erect Treatment Plant
FIRM	Flood Insurance Rate Map
FPPA	Farmland Protection Act
GMC	Goodwyn Mills Cawood, LLC
HW	Headworks
I&I	Inflow and Infiltration
ILS	Influent Lift Station
IPaC	Information for Planning and Consultation
KT	Kepner Tregoe
LCCA	Life Cycle Cost Analysis
LWUOC	Limestone Water Utility Operating Company, LLC
M&E	Metcalf and Eddy
MABR	Membrane Aerated Biofilm Reactor
MBR	Membrane Bioreactor
MGD	Million Gallons per Day
MMF	Maximum Monthly Flow
NOV	Notice of Violation
NPDES	National Pollution Discharge Elimination System
NRCS	Natural Resources Conservation Service
NRHP	National Register for Historic Places
NWI	National Wetlands Inventory
O&M	Operation and Maintenance
PER	Preliminary Engineering Report

PF	Peaking Factor
PFD	Process Flow Diagram
PHF	Peak Hourly Flow
PPD	Pounds Per Day
PV	Present Value
RAS	Return Activated Sludge
SBR	Sequencing Batch Reactor
SFHA	Special Flood Hazard Area
SND	Simultaneous Nitrification-Denitrification
STP	Sewage Treatment Plant
TDEC	Tennessee Department of Environment and Conservation
TMDL	Total Maximum Daily Load
TN	Total Nitrogen
TN-DNA	Tennessee Division of Natural Areas
TN-DOA	Tennessee Division of Archaeology
TN-NHP	Tennessee Natural Heritage Program
TP	Total Phosphorus
TRC	Total Residual Chlorine
TSS	Total Suspended Solids
UIC	Underground Injection Control
USACE	United States Army Corps of Engineers
USFWS	United States Fish and Wildlife Service
UV	Ultraviolet
WAS	Waste Activated Sludge
WOTUS	Waters of the United States

1 INTRODUCTION

1.1 Background

Grassland Sewage Treatment Plant (STP) is located at 1006 Treatment Plant Rd, Franklin, Tennessee and has an approximate one and a half (1.5) mile radius collection system, serving the surrounding area. The existing activated sludge treatment plant and majority of the collection system is estimated to be 50 years old and was recently acquired from Limestone Water Utility Operating Company (LWUOC), LLC. by Central States Water Resources (CSWR). The plant was originally designed for 0.25 Million Gallons per Day (MGD) and receives domestic sewage generated by residents of the community and a limited number of commercial facilities.

The treatment plant and collection system are in disrepair, having reached the end of their useful life. This is evident due to significant I&I as well as structural deterioration throughout the steel-fabricated facility. As a result, CSWR is beginning a project to expand the treatment plant capacity and to improve the overall collection system infrastructure, providing an improved treatment and collection system that complies with existing National Pollution Discharge Elimination System (NPDES) permit limits.

This Preliminary Engineering Report (PER) presents an assessment of potential wastewater treatment technologies for a new Grassland STP and provides a recommended treatment technology for implementation by CSWR.

1.2 Observed Flows

Influent flows to the facility from September 2017 to January 2024 indicates the average influent flow received by Grassland STP was 0.33 MGD or 32% greater than the permitted design capacity of 0.25 MGD. Further analysis of the data indicates a minimum single-day flow of 0.07 MGD and a maximum single-day flow of 1.66 MGD. This corresponds to a peaking factor of 6.6, when compared to the permitted flow. These historical flows are summarized below in **Table 1.1**.

Table 1.1. *Observed Plant Flows from September 2017 – January 2024*

Parameter	Influent Flow (MGD)
Minimum Daily Flow	0.07
Average Daily Flow	0.33
Maximum Daily Flow	1.66

In 2019, CSWR began an improvement project in the collection system to address a two and a half (2.5) mile segment of gravity sewer, which had been identified as a major contributor of I&I to Grassland STP (See **Appendix A**). To observe the improvements the project had on the system, flow data was isolated between January of 2022 and January 2024, as the project was completed in January 2022. The resulting flows are summarized below in **Table 1.2.**

Table 1.2. *Observed Plant Flows from January 2022 – January 2024*

Parameter	Influent Flow (MGD)
Minimum Daily Flow	0.07
Average Daily Flow	0.25
Maximum Daily Flow	0.90

The decrease in both average monthly and maximum daily flows indicate the success of the project.

1.3 Existing Collection System Infrastructure

CSWR has made great strides in improving portions of the sewage collection system, highlighted by the 2019 improvement project, which reduced the average monthly flow (AMF) conveyed to the treatment facility by 24.2% (**Table 1.2**). However, the system continues to experience treatment challenges associated with I&I, such as biomass washout. Due to the success of the aforementioned project, CSWR has plans in place to continue addressing and rehabbing the collection system.

1.4 Existing Treatment Facility

The current treatment plant consists of a 15-inch gravity main conveying wastewater to an influent dry-pit, lift station. Wastewater is then pumped through an in-line comminutor and a magnetic flow meter before entering the package plant. The configuration of the package plant is extended aeration, where the basins are aerated by diffused air, utilizing air blowers. After the wastewater is aerated, it is fed to the circular secondary clarifier, where solids settle to the bottom. A portion of the settled solids, called return activated sludge (RAS), are returned to the aeration basin, and the remaining solids, called waste activated sludge (WAS), are sent to the digester. The clarified effluent, which spills over the weir at the top of the tank, flows into a chlorine contact chamber (CCC) for disinfection prior to final discharge. A process flow diagram (PFD) of the existing facility can be viewed in **Appendix B**.

The existing lift station has a duplex pump configuration; however, it is assumed that the pumps operate in duty and stand-by. This means that one (1) pump is sized to accommodate the design flow of the facility, 0.25 MGD, and the second pump is only utilized during periods of peak flow. Assuming each pump has a maximum pumping rate three (3) times the setpoint of 0.25 MGD, each pump is believed to be able to drive 0.75 MGD or 1.50 MGD combined, thus the pumping capacity of the two (2) pumps falls short of the maximum daily flow observed in **Table 1.1**. Additionally, pump operation in parallel results in reduced flow rate for each pump as the discharge pressure elevates and the pump efficiency decreases, therefore the two (2) pumps have a combined pumping capacity less than the aforementioned 1.50 MGD. Observed overflows at the influent lift station (ILS) confirm that the existing unit process is undersized, requiring attention during the improvement project. Additionally, the dry-pit style poses a safety threat to operators as it is a forty (40) foot descent for the operator to enter the lift station and service the pumps. Further, the ILS is located in close proximity to the 100-year floodplain (585 feet), making it susceptible to

infiltration and flooding. CSWR is aware of the inadequacies associated with the existing lift station and has asked GMC to address the shortcomings of the ILS, while improvements are being made to the treatment plant.

Primary treatment at the existing facility consists of an in-line comminutor, reducing the size of the incoming wastewater solids. However, there is no equipment dedicated to remove debris, screenings, or grit. This lack of screening and solids removal results in solids accumulating throughout the aeration basin (thereby reducing treatment efficiency) and increasing the risk of damaged equipment. CSWR has indicated that trash accumulation is a recurring problem at the existing facility and has tasked GMC with also addressing this issue in the improvement project. The specific requirements of the screening and grit removal process will be determined by the selected biological treatment method.

Biological treatment at the current facility is achieved through a field-erect treatment plant (FETP). FETPs typically achieve biological treatment in a single reactor with multiple zones in the reactor, as is the case with this facility. The biological treatment configuration at the existing facility consists of an outer ring (with multiple zones) and a single-zone inner ring. The outer ring is comprised of aeration zones and a zone dedicated to digestion, while the inner ring is dedicated to secondary clarification. Diffused air is pumped throughout the aeration zones, supplementing the microbes that treat the incoming wastewater, prior to the wastewater entering the secondary clarifier. Secondary clarifiers allow the suspended biomass to settle to the bottom of the tank, where it is either returned to the aeration zone through a RAS line or wasted to the digester via a WAS line.

Disinfection occurs inside a decommissioned tertiary filtration tank, converted to a CCC. The plant uses chlorine gas (Cl_2) for disinfection, ensuring sufficient pathogen kill and virus inactivation, and sulfur dioxide (SO_2) for dechlorination, keeping the effluent total residual chlorine (TRC) below the permitted limit. The treated effluent is then discharged to an NPDES-permitted outfall (Outfall No. 001) at mile 68.8 of the Harpeth River, located just west of the Grassland STP.

Solids were originally stabilized in an aerobic digester, a zone in the outer ring of the FETP. Over time, however, the wall separating the digester from the aeration zones rusted through, rendering the digester inoperable. As a result, a plastic tank was installed as a means of temporarily holding and digesting generated solids. Currently, WAS is pumped from the secondary clarifier to the plastic tank, where it then is hauled offsite for disposal. CSWR retains a sewage hauling contractor to haul approximately three (3) tanker loads of WAS per week.

It should be noted that CSWR was unable to provide the original design for the Grassland STP, as a result of being an acquisition. With parts of the original plant design and unit process parameters unclear, assumptions were made using engineering judgement, where necessary.

1.5 Objectives

The objectives of this PER are to provide the following:

1. A biological treatment process for the proposed treatment plant;

2. Feasibility analysis and cost analysis of proposed biological treatment processes;
3. Identify supporting process equipment such as ILS, HWs, equalization, filtration, disinfection, and solids handling; and
4. Develop a process to consistently meet effluent permit limits, i.e. total maximum daily load (TMDL) nutrients.

2 NPDES PERMIT AND TMDL

2.1 Existing NPDES Permit

CSWR holds an NPDES permit issued by Tennessee Department of Environment and Conservation (TDEC) for the discharge of treated wastewater from Outfall 001 to the Harpeth River in accordance with Permit No. TN0027278. The permit, listed below in **Table 2.1**, was issued on January 1, 2022, and is set to expire on November 30, 2026.

Table 2.1. *Current Grassland STP NPDES Permit*

Parameter	Concentration Limits (mg/L)			Mass Limits (lb/d)		
	Monthly Avg	*Weekly Avg*	*Daily Max*	*Monthly Avg*	*Weekly Avg*	*Daily Max*
$cBOD_5$ (Summer)	5.0	7.5	10.0	10.0	15.0	N/A
NH_3-N (Summer)	2.0	3.0	4.0	4.0	6.0	N/A
$cBOD_5$ (Winter)	10.0	15.0	20.0	21.0	31.0	N/A
NH_3-N (Winter)	5.0	7.5	10.0	10.0	16.0	N/A
TSS	30.0	40.0	45.0	63.0	83.0	N/A
TN[1]		Report		15.0	Report	Report
TP[1]		Report		5.0	Report	Report

[1]TN and TP limits are calculated Annual Rolling Average values

It should be noted that the permit imposes limits on parameters and operational conditions other than what are shown above. For the purpose of the report, however, the parameters listed in **Table 2.1.** reflect the permit limits of interest, as it relates to the comparison of the various biological treatment technologies.

Over the span of twenty (20) years (2002 to 2022), LWUOC incurred several effluent limit violations at Grassland STP. On May 17, 2022, after an annual Compliance Evaluation Inspection (CEI) was conducted, TDEC issued a Notice of Violation (NOV) to LWUOC, citing effluent violations related to the parameters listed in **Table 2.1**. The inspection focused on two (2) major concerns that lead to permit violations and overflow/washout events: corrosion of equipment throughout the plant and lack of plant maintenance.

2.2 TMDL

In September 2004, a TMDL was developed and approved for this waterbody segment (Mile 68.8 of the Harpeth River) to protect ambient dissolved oxygen in the receiving stream. The TMDL was developed by Tennessee, with assistance from the Environmental Protection Agency (EPA) and the cooperation of permittees and local environmental groups. The EPA completed extensive computer modeling to develop the TMDL, which aimed at addressing organic enrichment and low dissolved oxygen levels within the receiving stream. The TMDL incorporated previously-established limits on five (5) – day carbonaceous biochemical oxygen demand ($cBOD_5$), ammonia,

and dissolved oxygen. In an effort to preserve the dissolved oxygen levels downstream of the discharge location, mass loadings for total nitrogen (TN) and total phosphorus (TP) were established on an annual average basis at 15 ppd and 5 ppd, respectively.

While the existing permit may be modified during its term (per public notice procedures) to include the parameters imposed by the TMDL, initial conversations with TDEC have indicated that the mass loadings for TN and TP will not be changed. Increasing the design flow (capacity) of the new Grassland STP is an important regulatory matter that requires CSWR to provide public notice and may require that an Antidegradation Analysis be performed and submitted to TDEC.

If required, the Antidegradation Analysis must have documentation demonstrating that the additional nutrient loading to the Harpeth River is necessary to accommodate important economic or social development in the surrounding area. A study must be conducted to ensure that the increase in capacity does not negatively impact the Harpeth River's downstream water quality, due to higher nutrient loading. Additionally, there must also be no other practicable alternatives to prevent or lessen degradation associated with the higher discharge [e.g., review a Land Application alternative treatment system that implements discharge via Land Application or Underground Injection Control (UIC).

2.3 Prospective Future Permit Limits

CSWR proposes increasing the design capacity to 0.45 MGD, which provides an additional 0.20 MGD to Grassland STP's current design flow. CSWR will submit an application to modify its NPDES permit according to the proposed treatment plant improvements.

After improvements and capacity upgrades have taken place at Grassland STP, TDEC shall issue a revised NPDES permit to reflect the increased capacity, based on stream modeling, using the aforementioned TMDL values for TN and TP. For the purposes of developing a preliminary basis of design and to compare alternate treatment technologies, GMC has estimated prospective permit limits, outlined in **Table 2.2**.

Table 2.2. *Prospective Grassland STP NPDES Permit*

Parameter	**Concentration Limits (mg/L)**			**Mass Limits (lb/d)**		
	Monthly Avg	*Weekly Avg*	*Daily Max*	*Monthly Avg*	*Weekly Avg*	*Daily Max*
$cBOD_5$ (Summer)	2.7	4.0	5.3	10.0	15.0	N/A
NH_3-N (Summer)	1.1	1.6	2.1	4.0	6.0	N/A
$cBOD_5$ (Winter)	5.6	8.3	10.9	21.0	31.0	N/A
NH_3-N (Winter)	2.7	4.0	5.3	10.0	15.0	N/A
TSS	16.8	22.4	25.3	63.1	84.1	N/A
TN[1]		Report		15.0	Report	Report
TP[1]		Report		5.0	Report	Report

[1]TN and TP limits are calculated Annual Rolling Average values

3 EVALUATION OF SERVICE AREA

3.1 Service Area

The existing facility currently serves a Grassland community, with 511 residential (92.1%) and 44 commercial (7.9%) connections. With no significant industrial users and no categorical industrial customers, the flow coming into Grassland STP is consistent with typical domestic wastewater characteristics. Based on the service area outlined in **Appendix C**, Grassland STP is expected to continue servicing domestic sewage customers for the foreseeable future.

4 HYDRAULIC DESIGN FLOW

4.1 Facility Design Flow

As a private utility, the main driver for CSWR to increase plant capacity is development throughout the service area. As a result, the design flow for the proposed facility was determined by the need to achieve the nutrient TMDL values and to accommodate a degree of I&I that currently exists in the collection system. However, as long as the plant effluent is discharged to the Harpeth River, the TN and TP limits set by the TMDL confines the maximum design flow for the facility to 0.60 MGD.

Using observed flows from January 2022 – January 2024, a flow analysis was performed to determine design flow conditions and the associated peaking factors for the proposed facility. Flows were restricted to the 2-year timeline since a significant amount of I&I was eliminated following the completion of the 2019 rehab project (2022). A summary of the flow analysis is shown below in **Table 4.1.**

Table 4.1. *Design Flows and Peaking Factors for the Proposed Facility*

Parameter	Design Flow (MGD)	Peaking Factor
Average Daily Flow	0.23	1.00
Maximum Monthly Flow	**0.45**	1.96
Peak Hourly Flow	1.35	5.87

When designing a new treatment facility, the design is based on the maximum monthly flow (MMF), which is 0.45 MGD. However, the unit processes and process piping should be able to handle the peak hourly flow (PHF), 1.35 MGD. Sizing plant processes to accommodate PHFs allows the facility to account for sudden fluctuations in flow due to storm events and diurnal patterns.

To further dampen the effects of peak flow events and help the facility maintain compliance, suitable EQ for downstream processes shall be incorporated in the recommended design. Providing an EQ basin at the plant will help regulate flows and loads to downstream unit processes, allowing Grassland STP to operate effectively and efficiently. These recommendations will substantially resolve long-term permit compliance concerns, as CSWR continues efforts to rehabilitate the collection system.

5 DESIGN CHARACTERISTICS OF INFLUENT WASTEWATER

5.1 Raw Wastewater Design Characteristics

Throughout the plant's history, no metals or other hazardous materials have been detected in the influent; instead, the influent wastewater has characteristics consistent with typical domestic wastewater. Based on observed raw wastewater characteristics from the 2022 DMR data, the design for Grassland STP is centered around the values listed below in **Table 5.1**.

Table 5.1. *Design Parameters for Improvements at Grassland STP*

Parameter	Influent	Effluent
Max Month Flow (MGD)	0.45	-
Max Day Flow (MGD)	0.83	-
Peak Hour Flow (MGD)	1.35	-
cBOD (mg/L)	200	‹ 4
TSS (mg/L)	300	‹ 10
NH_3[1] (mg/L)	35	‹ 1.5
TKN[1] (mg/L)	52	-
TN (mg/L)	-	‹ 4
TP[1] (mg/L)	8	‹ 1.33
Min Temp (°C)	17	-
Max Temp (°C)	27	-

[1] Assumed, based on "medium-strength" values in Table 3.15, obtained in Metcalf and Eddy (Fourth Edition)

The 90th percentile analysis was utilized to confirm adequate design for the parameters listed in **Table 5.1**. It is important to note, however, that the parameters above are key design points for treatment and not a comprehensive list.

5.2 Mass Balance

Based on Grassland STP's 2022 DMR data, a yearly average was collected for $cBOD_5$, total suspended solids (TSS), TN, and TP, shown below in **Table 5.2**.

Table 5.2 *Mass Balance for Grassland STP*

Parameter	Influent	Effluent	% Removal	Pounds Removed
$cBOD_5$ (lb/d)	204	2.7	98.7	201.3
TSS (lb/d)	247	7.3	97.0	239.7
TN (lb/d)	90	16.8	81.3	73.2
TP (lb/d)	14	2.6	81.4	11.4

As with **Table 5.1**, where information was lacking or questionable, wastewater characteristics associated with a M&E-defined "medium-strength" domestic wastewater were assumed. A detailed mass balance, broken down by month, can be found in **Appendix D**.

6 ALTERNATIVES

Upgrades to the existing Grassland STP include a new lift station, HW (screening and grit removal), EQ basin, biological treatment, tertiary filtration, and disinfection process. However, upstream and downstream requirements are dependent upon the selected biological alternative. To ensure the best fitting biological treatment method is selected, an analysis of several biological alternatives is presented below, as well as a final recommendation for implementation.

6.1 Proposed Biological Treatment Technology Alternatives

With the limits of TN and TP being set as a TMDL, the removal of nitrogen and phosphorus is crucial to the success of the plant. Due to the stringent effluent requirements, three (3) biological treatment methods were evaluated: 1) aerobic granular sludge (**AGS**), 2) membrane bioreactor (**MBR**), and 3) membrane aerated biofilm reactor (**MABR**). To select the most favorable biological treatment method, the advantages and disadvantages of each alternative were evaluated. Factors deemed important by CSWR such as price, expandability, and power requirements were utilized to assess each of the three (3) options.

6.1.1 Aerobic Granular Sludge

Combining the advantage of biofilm systems with activated sludge, AGS utilizes a batch cycle with three (3) main phases – fill/draw, react, and settle. However, the process relies on the high content of extracellular polymers (EPS) in the granule structures, so there is not a need for biofilm carriers. The granule is comprised of nitrifiers on the outer layer (aerobic zone), denitrifying bacteria in the inner layer (anoxic zone), and phosphorus release, as well as volatile fatty acid (VFA) uptake, in the innermost layer (anaerobic zone). The granule's different microbial layers allow for enhanced nutrient removal (ENR), including simultaneous nitrification-denitrification (SND) and phosphorus reduction.

AGS combines a flexible, compact footprint with an energy-efficient plant that significantly reduces operational requirements as the biological treatment occurs within two (2) main reactors: an aeration tank and settling tank. However, fine screens and grit removal are required upstream of the AGS reactor to protect equipment and ensure the formation of high-quality granules. While granules produced from the system are able to withstand fluctuations in loading, pH, and toxic shocks (showcasing the resilience of the process), the flow history of the existing plant warrants implementation of an equalization basin since AGS is a type of sequencing batch reactor (SBR). To further reduce the TN and TP levels in the effluent from the AGS system, tertiary filtration shall be utilized prior to disinfection. GMC also understands that CSWR desires to upgrade the disinfection process to ultraviolet (UV) disinfection. As UV disinfection is more sensitive to TSS than the existing CCC, the implementation of a tertiary filter upstream of the UV units shall ensure better pathogen kill and virus inactivation. While there are advantages to implementing an AGS process, it is important to note that this is a newer technology with a limited number of installations in the U.S.

6.1.2 Membrane Bioreactor

This process relies on biological and physical treatment within a single tank, as microbes break down organic matter in the wastewater and membranes filter out the remaining suspended solids and microorganisms from the treated water. This treatment technology has high removal efficiencies for nitrogen, phosphorus, bacteria, biochemical oxygen demand (BOD), and TSS. The high-quality effluent produced by MBRs, makes this system ideal for situations where extensive nutrient (nitrogen and phosphorus) removal is required. Being a membrane system, this technology inherently removes solids from the wastewater, but removing dissolved wastewater constituents requires chemical addition, precipitating solids. The integration of biological treatment with membrane filtration, eliminates the need for secondary clarification and tertiary filtration downstream of the MBR. A membrane upstream of the proposed UV disinfection process provides the UV units with adequate reduction of TSS, ensuring high UV transmittance and pathogen kill.

However, if an MBR is selected, protection of the membranes is paramount. Therefore, fine screening and grit removal (more stringent than that associated with AGS) are required upstream of the treatment technology. To operate at a high efficiency, consistently produce high-quality effluent, and extend the life of the membranes, the screens and membranes will require constant cleaning. Additional upstream requirements include an EQ basin, as MBRs are susceptible to shock loads. As industrial waste is not a contributing factor, shock loads come in the form of peak flow events. Therefore, equalization shall be incorporated upstream of the membranes and provide the system with consistent flows and loads.

Compared to conventional systems, MBRs have higher capital and operation costs for the same throughput. Energy requirements make up the largest operational cost as air scour is used to control bacterial growth. While MBRs work well for many applications, a key drawback is the heavy reliance on growing the right type of microorganisms and protecting them from shock/peaking events.

6.1.3 Membrane Aerated Biofilm Reactor

In MABRs, oxygen is constantly supplied, via passive aeration, to the fixed nitrifying biofilm allowing SND to occur in the anoxic bulk liquid. This treatment method produces low amounts of odor and noise, making it a favorable alternative for locations in close proximity to residential areas. Effluent from the MABR can either be sent to a secondary clarifier or membrane, dependent on-site conditions, effluent limits imposed by the NPDES permit, and the desires of the Owner. In this case, effluent limits warrant the implementation of a membrane on the back-end of the MABR process, keeping the effluent quality of this alternative competitive with the previous two (2) treatment technologies.

While MABRs introduce oxygen to microbes in the reactor through *passive* diffusion, the savings are offset by high energy demands associated with operating a membrane on the back-end of the process. Another factor to consider for the MABR system is that the technology is a proprietary design (under the Fluence company), which has a primarily international market. This raises

concerns on the availability of the product, lead time, support, and effectiveness due to the limited number of installations in the United States.

6.2 Process Design Parameters

For budgetary purposes and to receive proposals from each of the three (3) aforementioned treatment technologies, yearly averages from the 2022 DMR data were provided with the prospective effluent limits in **Table 2.2**. Moving forward, however, the selected alternative shall update the design, proposal, and quote using values listed **Table 5.1** as the basis of design for the updated facility**.** Additionally, to ensure compliance, the selected alternative must guarantee treatment to the effluent limits contained in the updated NPDES permit (issued by TDEC).

7 ANALYSIS OF ALTERNATIVES

7.1 Evaluation of Alternatives

Each treatment technology was evaluated according to its life cycle cost analysis (LCCA), cost estimate (CE), operation and maintenance (O&M) requirements, and process footprint. Though quotes for the LCCA, CE, and O&M requirements were provided from reputable vendors in the project proposal, inflation/escalation in the economic market was not factored in the estimates. Estimates are relative to the treatment technology and are subject to change, according to the anticipated date of project construction. Based on the results from each of the analyses, as well as the goals deemed important to CSWR, the best fitting alternative shall be selected.

7.1.1 Life Cycle Cost Analysis

An LCCA was performed for each treatment option, where AGS was found to be the most cost-effective biological treatment option with a present value (PV) of $4,300,000 including the total capital and O&M cost. The MBR system is the second-most cost-effective treatment method with a PV of $5,600,000. Finally, the MABR had the highest PV totaling $8,980,000, making it the least cost-effective treatment option. Detailed results can be found in **Appendix E**.

7.1.2 Cost Estimate

To anticipate the total project cost for each alternative, a CE was put together. As with the LCCA and capital cost, AGS has the lowest estimated project cost at $12.4 million. Estimated at $12.9 million, MABR has the second lowest project cost. With an anticipated project cost of $13.9 million, MBR technology is estimated to be the most expensive alternative. Overhead, contractor mobilization, and various project disciplines (site/civil, structural, architecture, process, electrical, etc.) were evaluated to produce CEs for each treatment technology, seen in **Appendix F**.

7.1.3 Operation and Maintenance Cost

When it came to O&M associated with the treatment technology, three (3) categories remained constant in each proposal: power, equipment maintenance/replacement, and labor requirements. These costs are broken down by treatment method and displayed below in **Table 7.1**.

Table 7.1 *Annual O&M Cost for Biological Treatment*

	MBR	MABR	AGS
Power ($)[1]	49,930	96,580	8,850
Equipment ($)	7,000	25,000	5,300
Maintenance ($)[2]	4,200	12,480	20,280

[1] Power Rate = $0.08 per kWh

[2] Assuming $30 per hour

Focusing on the numbers provided by vendors in the proposals allows for the most uniform comparison between the various treatment methods. From the values shown in **Table 7.**1, AGS had

the lowest O&M cost ($34,500 per year), followed by MBR ($61,150 per year), and MABR with the highest O&M expense ($134,000 per year). These results, though estimates, are consistent with membranes having higher electrical demands.

Each process also utilizes chemicals, whether for coagulation, precipitation, and/or cleaning. However, due to the limited chemical requirements made available in each of the proposals, chemicals were omitted from **Table 7.1.** Nevertheless, estimated annual costs for chemicals were applied to the O&M portion of the LCCA, where AGS remained the most economic option.

7.1.4 Footprint

The MBR system offers the most compact footprint, and thus the greatest degree of flexibility for site layout, with a total of five (5) unit processes: HW, EQ, biological treatment, sludge storage, and disinfection. This results from a single treatment train that utilizes multiple zones being able to accomplish all biological treatment.

There are six (6) unit processes associated with AGS systems: HW, EQ, biological treatment, sludge storage, tertiary filtration, and disinfection. However, there are three (3) structures associated with biological treatment: an influent buffer basin, AGS reactor, and post-EQ basin. Additionally, AGS effluent requires tertiary filtration prior to disinfection. Requiring provisions for additional upstream and downstream structures increases the overall footprint and therefore reduces the number of site layout options.

With a total of six (6) unit processes: HW, EQ, biological treatment, membrane filtration, sludge storage, and disinfection. While the MABR system only requires one (1) additional structure than the MBR system, the required footprint is much larger than the other membrane option. As a result, MABR is considered to have a less favorable footprint for the site.

8 SELECTION OF ALTERNATIVE

8.1 Alternative Analysis

Each biological treatment alternative was analyzed using factors, deemed significant by CSWR and GMC, in a decision matrix to determine the most suitable technology for Grassland STP. A summary of the matrix can be found below, in **Table 8.1.**

Table 8.1 *Decision Matrix Summary*

Parameter	Score
AGS	2.8
MBR	2.1
MABR	1.4

Factors of interest for this analysis include capital cost, O&M costs, power cost, project cost, footprint, chemical requirements, and ease of operation. The aforementioned factors were scored from 1 to 3, based on the number of alternatives, with 3 representing the best option. To reflect a more accurate decision matrix, different weights (totaling 1.0) were assigned to each parameter. Where treatment methods were found to have similar results for the factor in question, they were awarded the same score. The treatment technology with the highest cumulative score is thought to be the most favorable and suitable option for Grassland STP.

With an average score of **2.8**, the **AGS** system is considered the most applicable treatment technology for Grassland STP. Therefore, GMC recommends CSWR implement **AGS** for biological treatment. A more detailed description of the decision matrix and the associated weights from the decision matrix can be found in **Appendix G**.

8.2 Plant Design

With the decision matrix indicating that AGS is the most suitable treatment technology for Grassland STP, the corresponding unit processes can be set. As shown in the PFD found in **Appendix H**, wastewater will enter the ILS and be pumped to the HW, which will be comprised of rotary drum screens and grit removal. From there, the flow shall either enter the equalization basin or the treatment train, depending on the influent flow. Due to strict effluent limits on treated wastewater discharging to the Harpeth River (TN and TP), GMC advises CSWR to implement a tertiary (disc) filter downstream of the AGS system. The tertiary filter further reduces TSS, ensuring adequate UV transmittance during disinfection, prior to discharging to the Harpeth River at the existing outfall location.

9 ENVIRONMENTAL EVALUATION

Whenever a water or wastewater plant experiences new construction, ample studies must be performed to ensure that no adverse effects will come to the surrounding environment, as a result of the project. On the other hand, consideration must be given to how the surrounding environment might impact the project, most notably the floodplain. The 100-year floodplain elevation is often used as the benchmark as the lowest point for the structural foundation to start, such that the unit processes do not become flooded during storm events. Land deemed to be agriculturally significant, wetlands, species in the affected area, and potential cultural implications are all important factors to evaluate when proposing a new water or wastewater plant project.

9.1 Flood Plains

The proposed project area is found on Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM) Panel 471870069G (effective December 22, 2016) within Williamson County jurisdiction (Community No. 470204). Portions of the property include a Special Flood Hazard Area (SFHA) associated with the Harpeth River. Specifically, the site includes a Zone AE floodplain with a 100-year floodplain and associated regulatory floodway. At this time, it is not anticipated that any proposed structure shall be placed within the SFHA.

In the event that any development takes place within the SFHA, coordination with the local floodplain administrator shall be necessary to secure a floodplain development permit. In addition, the local floodplain ordinance must be reviewed to determine the proper elevation (taking into account the required freeboard) and any floodproofing measures that may be required. It is likely that the proposed project may be regulated as a "critical facility", with respect to floodplains, and may be subject to special provisions within the local floodplain ordinance. The proximity of Grassland STP to the 100-year floodplain and Harpeth River can be seen in **Appendix I.**

9.2 Geologic Conditions

The New Madrid Seismic Zone is located in twenty (20) counties in Western Tennessee. Williamson County is not subject to the New Madrid Seismic Zone. All structures will comply with *ASCE 7-10* (Minimum Design Loads for Building and Other Structures) as identified in current state building code *IBC-10*. No significant impacts based on geologic conditions are anticipated.

The existing facility did not have a record of geotechnical exploration, so GMC tasked a licensed TN Geotechnical Engineer to perform borehole testing, prepare a written geotechnical report, and provide recommendations for excavation and backfill during construction, noted in **Appendix J**. Grassland STP is home to a region characterized by shallow rock formations, so to avoid rock blasting, the collected borehole data will be crucial in the placement of unit processes. Based on the findings, the process engineer will coordinate with the structural engineer and geotechnical engineer to ensure that the unit processes are proposed in locations without adverse subsurface conditions.

9.3 Important Farmland

According to the Natural Resources Conservation Service (NRCS) Web Soil Survey review, approximately 16% of the soils on the northern portion of the parcel are listed as prime farmland. The proposed project is located within the portion of the parcel where soil is not listed as prime farmland or farmland of statewide importance. The proposed project is not subject to the Farmland Protection Act (FPPA), and is not anticipated to result in significant impacts to important farmland in the area.

9.4 Wetlands

A preliminary review of wetlands and other Waters of the U.S. (WOTUS) within the proposed project area using the United States Fish and Wildlife Service (USFWS) National Wetlands Inventory (NWI) data was performed. The data indicated that there is one (1) mapped WOTUS watercourse, the Harpeth River, located along the western parcel boundary, outside of the proposed project area. No impacts to WOTUS are anticipated at this time, based on the NWI data.

A site visit was conducted on August 18, 2023, to identify water resources within the subject property, and a Hydrologic Determination Report is provided under separate cover. No areas with wetland characteristics were observed during the site visit. The location of the 'top of bank' of the Harpeth River was identified by GMC staff to identify the beginning for riparian buffer boundaries. The top of bank may be utilized to adhere to state, county, and city buffer requirements. Any impacts to potential wetlands and/or buffers onsite may be subject to permitting from the U.S. Army Corps of Engineers (USACE) or the TN Department of Environment and Conservation (TDEC).

9.5 Species

According to the USFWS's web-based Information for Planning and Consultation (IPaC), there are three (3) endangered, one (1) threatened, one (1) proposed endangered, one (1) non-essential experimental population, and one (1) candidate species within the proposed project area, with no critical habitats for these species within the area. The list of identified species that should be considered in an effects analysis for the project is provided in **Table 9.1** below.

Table 9.1. *Threatened/Endangered Species*

Group	Common Name	Scientific Name	Status
Mammals	Gray Bat	Myotis grisescens	Endangered
Mammals	Northern Long-eared Bat	Myotis septentrionalis	Endangered
Mammals	Tricolored Bat	Perimyotis subflavus	Proposed Endangered
Birds	Whooping Crane	Grus americana	Experimental Population, Non- Essential
Insects	Monarch Butterfly	Danaus plexippus	Candidate
Flowering Plants	Leafy Prairie-clover	Dalea foliosa	Endangered
Flowering Plants	Price's Potato-bean	Apios priceana	Threatened

In addition to obtaining the official species list, GMC utilized the TN Division of Natural Areas (TN-DNA) Natural Heritage Program (TN-NHP) Environmental Review Tool (ERT) to obtain a TN Environmental Review Report. This report provides information on species with documented occurrences within the proposed project footprint and within the 1- and 4-mile buffer of the project area. The report documents that there are no species within the project footprint or within a 1-mile radius of the project. Eight (8) species were reported as found within a 4-mile radius of the project footprint. Of the eight (8) unique species in the report, one is listed as federally protected and three (3) are listed as state endangered including: Harbison's Hawthorn, Leafy Prairie-clover, and Eastern Yampah. See **Table 9.2** below.

Table 9.2. *TN-DNA Species Report*

Common Name	Scientific Name	Federal Protection Status	State Protection Status	Habitat
Deam's Copperleaf	Acalypha deamii	n/a	Special Concern	Mesic Woods-Sandbars
Tennessee Milk-vetch	Astragalus tennesseensis	n/a	Special Concern	Glades
Harbison's Hawthorn	Crataegus harbisonii	n/a	Endangered	Dry Rocky Calcareous Woods
Leafy Prairie-clover	Dalea foliosa	LE	Endangered	Rocky Washes In Glades
Duck River Bladderpod	Paysonia densipila	n/a	Special Concern	Cultivated Fields
Eastern Yampah	Perideridia americana	n/a	Endangered	Cedar Barrens
Water Stitchwort	Stellaria fontinalis	n/a	Special Concern	Seeps And Limestone Creek Beds
Cerulean Warbler	Setophaga cerulea	n/a	Deemed in Need of Management	Mature deciduous forest, particularly in floodplains or mesic conditions.

1. LE = Listed Endangered

The project will include clearing of vegetation. Harbison's Hawthorn, Leafy Prairie-clover, and Eastern Yampah are unlikely to be found at the project site due to those plant species' particular habitat requirements. The proposed project is unlikely to result in adverse impacts to any of the listed species.

9.6 Wild/Scenic Rivers

The proposed project would be located at 1006 Treatment Plant Road. There are no Wild and Scenic Rivers within or adjacent to the proposed project area. The Obed Wild and Scenic River is the closest in proximity to the project area and is located over 100 miles to the east of the proposed project area. There would be no effect on Wild and Scenic Rivers due to the project's location within Williamson County.

9.7 Cultural Resources

A map check was requested from TN-Division of Archaeology (TN-DOA) and the National Register of Historic Places (NRHP), Tennessee Historical Commission (THC) data viewer, and the Tennessee Historic Cemeteries Viewer was accessed on July 25, 2023, to determine if cultural resources were mapped within the proposed project area. There were no historic structures or mapped areas located within the proposed project area. There were nine (9) historic structures listed within a 1-mile radius of the project site, with two (2) of these locations listed on the NRHP. The TN-DOA Map Check request showed no recorded archaeological sites on the project parcel, and eight (8) recorded sites within a 1-mile radius.

The closest historic structure is the William Leaton House, located 0.3 miles to the east at Hillsboro Road, Franklin, Tennessee, with state ID number WM-37 and NRHP number 88000357. The second historic structure is the John Motheral House, located 0.5 miles to the north at Moran Road, Franklin, Tennessee, with state ID number WM-41 and NRHP number 88000339. Based on this initial review and the distance from historic structures, no adverse impacts to historical or archaeological resources are anticipated to occur as a result of the proposed project. If federal funding or permitting is required, this may be subject to further review via Section 106 of the National Historic Preservation Act.

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10 REFERENCES

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APPENDICES

Appendix A – Collection System Rehab Project

Appendix B – Existing Facility Process Flow Diagram (PFD)

Appendix C – Current / Future Service Area

Appendix D – Mass Balance

Appendix E – Life Cycle Cost Analysis (LCCA)

Appendix F – Cost Estimate (CE)

Appendix G – Decision Matrix

Appendix H – Proposed Treatment Process Flow Diagram (PFD)

Appendix I – Flood Map

Appendix J – Geotech Report

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APPENDIX A – COLLECTION SYSTEM REHAB PROJECT

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Sneed Road West
Sneed Forest Estates
Foxhaven Drive
US 431
Sunnyside Estates
McIntyre Court
Moran Road
Harpeth River
River Rest
Grassland STP
Manley Lane
Grassland Field
Field 1
Field 4
Field 2
Field 3
Lion Sensory Garden for the blind
Harpeth Hills Drive
Grassland Estates
Bobby Drive
Hidden River Lane
Bethlehem Loop Road
Bethlehem
TN 46
Grassland
Battlewood Estates
Map data ©

	QTY	Unit Price	Units	Total Cost
Mobilization (3%)	1	--	LS	$18,100
Clean / CCTV 8 to 10-inch (includes root Removal)	13,500	$5	LF	$67,500
MACP Manhole Inspection	63	$125	EA	$7,875
Raise manhole rim elevation	10	$1,000	foot	$10,000
48-inch manhole Rehabilitation	275	$250	VF	$68,750
Manhole Ring and Cover Replacement	5	$2,500	EA	$12,500
CIPP install 8 to 10-inch	5,000	$65	LF	$325,000
Point Repair, 8 to 10 inch, up to 10 LF	10	$6,500	EA	$65,000
Additional open cut length, 8 to 10 inch	100	$250	LF	$25,000
Locate and inspect private property cleanouts	50	$25	EA	$1,250
Replace Cleanout Cap	25	$100	EA	$2,500
Surface Restoration - landscape	1,500	$5	LF	$7,500
Surface restoration - asphalt / concrete	100	$100	LF	$10,000
			Contingency 10%	$63,000
			Total Project Estimate	**$683,975**

N

0 500 1,000 2,000
Feet

GrasslandGravity
GrasslandForceMain
RehabFocusArea
GrasslandGravity selection

Grassland Sewer Rehabilitation Plan

Franklin, Tennessee

GMC#: CNAS220048
DATE: 2/3/2023
DRAWN BY: WWN

CSWR Central States Water Resources

GMC
3310 West End Avenue, Suite 420
Nashville, TN 37203
T: 615.333.7200
GMCNETWORK.COM

APPENDIX B – EXISTING FACILITY PFD

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FLOW LINES

- PRIMARY FLOW PATH
- SECONDARY FLOW PATH
- DRAIN LINES

FIELD ERECT TREATMENT PLANT

FROM COLLECTION SYSTEM

15" RWW

DRAIN

IP NO.1 IP NO.2

INFLUENT LIFT STATION

6" PWW

IN-LINE COMMINUTOR

6" SWW

AERATION BASIN 1

AERATION BASIN 2

SECONDARY CLARIFIER

SE

SCUM

AIR

RAS

WAS

TO DIGESTER

RAS/WAS PUMPS

BLOWERS

DRAIN

TO HARPETH RIVER

EFF

CHLORINATION / DECHLORINATION

GMC
3310 West End Avenue Suite 420
Nashville, TN 37203
T 615.333.7200

STATE OF TENNESSEE
NOT VALID WITHOUT A CERTIFICATE OF AUTHORITY
GOODWYN MILLS CAWOOD, LLC
No. PE2007018568
Exp.06.30.2024

ISSUE	DATE
30% SUBMITTAL	TBD
60% SUBMITTAL	TBD
90% SUBMITTAL	TBD
100% SUBMITTAL	TBD

PROJECT MANAGER:	TBD
ENGINEER:	TBD
DESIGNER:	TBD
DRAWN BY:	TBD

GRASSLAND STP
CENTRAL STATES WATER RESOURCES
FRANKLIN, TENNESSEE

GMC Project # CNAS230028

EXISTING PROCESS FLOW DIAGRAM

DRAWING FILE: T:\1 Projects\TN\Central States Water Resources\TN\CNAS230028 - Grassland STP Improvements\10 DWG\+CAD\Existing PFD.dwg
PLOTTED: Feb 08, 2024 - 9:30am

APPENDIX C – CURRENT / FUTURE SERVICE AREA

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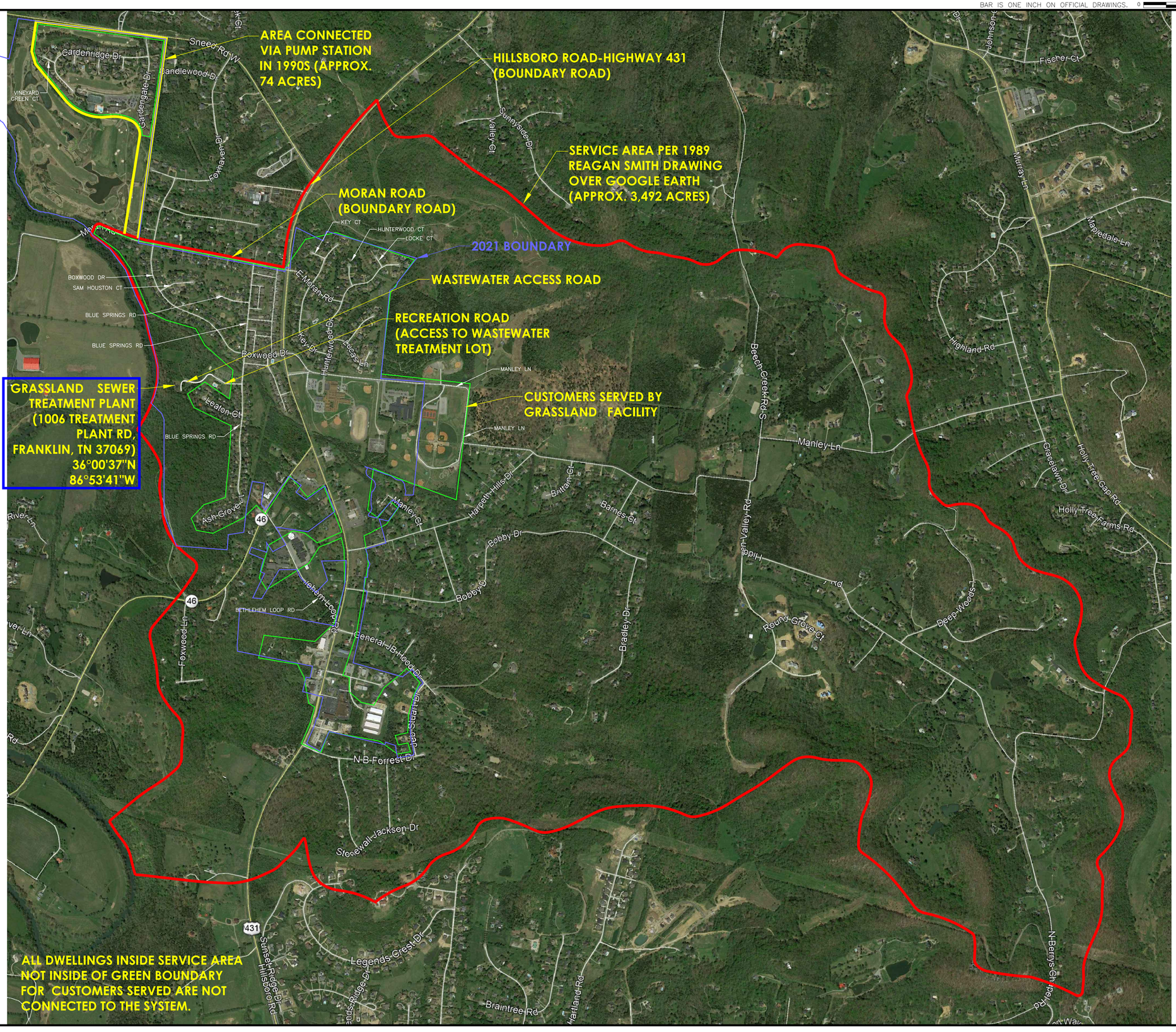
BAR IS ONE INCH ON OFFICIAL DRAWINGS. 0 1" IF NOT ONE INCH, ADJUST SCALE ACCORDINGLY



21 DESIGN GROUP INC.
1351 Jefferson, Suite 301
Washington, MO 63090
mail@21designgroup.net
P: 636-432-5029

BY | DATE | #

GRASSLANDS SERVICE AREA MAP

CARTWRIGHT CREEK UTILITY
WILLIAMSON COUNTY, TENNESSEE

PRELIMINARY NOT FOR CONSTRUCTION

SEAL DATE:	N/A
DRAWN BY:	BJK
PROJ NUMBER:	512-18
DATE:	04/26/2022
DRAWING NO:	v 1.2

APPENDIX D – MASS BALANCE

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Month	cBOD			TSS			Total N			Total P		
	Influent (lb/d)	Effluent (lb/d)	% Removed	Influent (lb/d)	Effluent (lb/d)	% TSS Removed	Influent (lb/d)	Effluent (lb/d)	% Removed	Influent (lb/d)	Effluent (lb/d)	% Removed
January	149	47.57	68.0	169	25	85.4	164	25	84.8	26	4	84.2
February	277	15.70	94.3	257	13	94.8	180	25	86.1	28	4	86.8
March	210	8.53	95.9	191	10	94.5	136	23	82.9	21	3	84.0
April	324	3.73	98.8	317	9	97.3	151	20	86.7	23	3	87.2
May	327	5.90	98.2	278	8	97.3	77	16	79.4	12	2	85.8
June	160	1.47	99.1	191	2	98.7	59	8	85.9	9	1	92.0
July	153	0.10	99.9	274	6	97.9	49	12	74.9	8	3	55.9
August	181	0.11	99.9	274	4	98.4	48	7	84.7	7	2	76.0
September	179	0.12	99.9	206	4	98.0	45	6	87.5	7	1	81.6
October	160	0.09	99.9	247	6	97.8	41	14	65.4	6	2	71.9
November	165	0.14	99.9	268	3	99.0	56	14	74.5	9	3	70.2
December	183	0.20	99.9	303	4	98.8	100	23	77.4	16	3	83.3

APPENDIX E – LCCA

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Life Cycle Cost Analysis (LCCA)

Client Central States Water Resources (CSWR)
Facility Grassland STP
Equipment AGS Biological Treatment

Date: February 23, 2024
Project No.: CNAS230028
Prepared by: EFG

Overview		
Initial Capital Cost	$	2,348,000.00
PV of Future O&M Cost	$	1,951,183.25
PV of Total Capital & O&M	$	4,299,190.00

First Year	Duration	O&M Cost Increase
2023	20	3.5%

Discount Rate (*i*)
2%

	Year	Period (n)		O&M Cost	Present Value Factor		Present Value (PV)
15 Years	2023	0	$	79,980.00	1.0000	$	79,980.00
	2024	1	$	82,779.30	0.9804	$	81,156.18
	2025	2	$	85,676.58	0.9612	$	82,349.65
	2026	3	$	88,675.26	0.9423	$	83,560.67
	2027	4	$	91,778.89	0.9238	$	84,789.51
	2028	5	$	94,991.15	0.9057	$	86,036.41
	2029	6	$	98,315.84	0.8880	$	87,301.65
	2030	7	$	101,756.90	0.8706	$	88,585.50
	2031	8	$	105,318.39	0.8535	$	89,888.23
	2032	9	$	109,004.53	0.8368	$	91,210.11
	2033	10	$	112,819.69	0.8203	$	92,551.44
	2034	11	$	116,768.38	0.8043	$	93,912.49
	2035	12	$	120,855.27	0.7885	$	95,293.56
	2036	13	$	125,085.21	0.7730	$	96,694.93
	2037	14	$	129,463.19	0.7579	$	98,116.92
	2038	15	$	133,994.40	0.7430	$	99,559.81
20 Years	2039	16	$	138,684.20	0.7284	$	101,023.93
	2040	17	$	143,538.15	0.7142	$	102,509.57
	2041	18	$	148,561.99	0.7002	$	104,017.07
	2042	19	$	153,761.66	0.6864	$	105,546.73
	2043	20	$	159,143.31	0.6730	$	107,098.89

GMC

Annual O&M Cost for AGS

O&M Item	Quantity Per Year		Unit Cost		Annual Cost
Electricity	Quote from Aqua				$ 8,850.00
Equipment Maintenance/Replacement	Quote from Aqua				$ 5,300.00
Labor Requirements	Quote from Aqua				$ 20,280.00
Chemicals	21,900.0	gal/yr	2.08	$/gal	$ 45,550.00
			Total Annual O&M Cost		$ 79,980.00

Life Cycle Cost Analysis (LCCA)

Client Central States Water Resources (CSWR)
Facility Grassland STP
Equipment MBR Biological Treatment

Date: February 23, 2024
Project No.: CNAS230028
Prepared by: EFG

Overview		
Initial Capital Cost	$	2,400,000.00
PV of Future O&M Cost	$	3,205,619.90
PV of Total Capital & O&M	$	5,605,620.00

First Year	Duration	O&M Cost Increase
2023	20	3.5%

Discount Rate (*i*)
2%

	Year	Period (n)		O&M Cost	Present Value Factor		Present Value (PV)
15 Years	2023	0	$	131,400.00	1.0000	$	131,400.00
	2024	1	$	135,999.00	0.9804	$	133,332.35
	2025	2	$	140,758.97	0.9612	$	135,293.12
	2026	3	$	145,685.53	0.9423	$	137,282.73
	2027	4	$	150,784.52	0.9238	$	139,301.59
	2028	5	$	156,061.98	0.9057	$	141,350.14
	2029	6	$	161,524.15	0.8880	$	143,428.82
	2030	7	$	167,177.50	0.8706	$	145,538.07
	2031	8	$	173,028.71	0.8535	$	147,678.34
	2032	9	$	179,084.71	0.8368	$	149,850.08
	2033	10	$	185,352.68	0.8203	$	152,053.75
	2034	11	$	191,840.02	0.8043	$	154,289.84
	2035	12	$	198,554.42	0.7885	$	156,558.81
	2036	13	$	205,503.83	0.7730	$	158,861.14
	2037	14	$	212,696.46	0.7579	$	161,197.34
	2038	15	$	220,140.84	0.7430	$	163,567.88
20 Years	2039	16	$	227,845.77	0.7284	$	165,973.29
	2040	17	$	235,820.37	0.7142	$	168,414.08
	2041	18	$	244,074.08	0.7002	$	170,890.76
	2042	19	$	252,616.67	0.6864	$	173,403.85
	2043	20	$	261,458.26	0.6730	$	175,953.91

GMC

Annual O&M Cost for MBR

O&M Item	Quantity Per Year	Unit Cost	Annual Cost
Electricity	Quote from OVIVO		$ 49,930.00
Equipment Maintenance/Replacement	Quote from OVIVO		$ 7,000.00
Labor Requirements	Quote from OVIVO		$ 4,200.00
Chemicals	Quote from OVIVO		$ 70,270.00
		Total Annual O&M Cost	$ 131,400.00

Life Cycle Cost Analysis (LCCA)

Client Central States Water Resources (CSWR)
Facility Grassland STP
Equipment MABR Biological Treatment

Date: February 23, 2024
Project No.: CNAS230028
Prepared by: EFG

Overview		
Initial Capital Cost	$	2,544,000.00
PV of Future O&M Cost	$	6,432,464.22
PV of Total Capital & O&M	$	8,976,464.22

First Year	Duration	O&M Cost Increase
2023	20	3.5%

Discount Rate (*i*)
2%

	Year	Period (n)		O&M Cost	Present Value Factor		Present Value (PV)
15 Years	2023	0	$	263,670.00	1.0000	$	263,670.00
	2024	1	$	272,898.45	0.9804	$	267,547.50
	2025	2	$	282,449.90	0.9612	$	271,482.02
	2026	3	$	292,335.64	0.9423	$	275,474.40
	2027	4	$	302,567.39	0.9238	$	279,525.50
	2028	5	$	313,157.25	0.9057	$	283,636.17
	2029	6	$	324,117.75	0.8880	$	287,807.29
	2030	7	$	335,461.87	0.8706	$	292,039.75
	2031	8	$	347,203.04	0.8535	$	296,334.45
	2032	9	$	359,355.15	0.8368	$	300,692.31
	2033	10	$	371,932.58	0.8203	$	305,114.26
	2034	11	$	384,950.22	0.8043	$	309,601.23
	2035	12	$	398,423.47	0.7885	$	314,154.19
	2036	13	$	412,368.29	0.7730	$	318,774.10
	2037	14	$	426,801.18	0.7579	$	323,461.96
	2038	15	$	441,739.23	0.7430	$	328,218.75
20 Years	2039	16	$	457,200.10	0.7284	$	333,045.50
	2040	17	$	473,202.10	0.7142	$	337,943.23
	2041	18	$	489,764.18	0.7002	$	342,912.98
	2042	19	$	506,905.92	0.6864	$	347,955.82
	2043	20	$	524,647.63	0.6730	$	353,072.81

GMC

Annual O&M Cost for MABR

O&M Item	Quantity Per Year		Unit Cost		Annual Cost	
Electricity	Quote from Fluence				$	96,580.00
Equipment Maintenance/Replacement	Estimated from Proposal				$	25,000.00
Labor Requirements	416	hr/yr	30	$/hr	$	12,480.00
Chemicals	55,720	gal/yr	2.33	$/gal	$	129,610.00
			Total Annual O&M Cost		$	263,670.00

APPENDIX F – COST ESTIMATE

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COST ESTIMATE: Pre Design

Grassland STP Improvements

Central States Water Resources

Grassland, Tennessee

Date: February 26, 2024

Project No.: CNAS230028

Prepared by: DMB/EFG

0.45 MGD - Aerobic Granular Sludge (AGS)

ITEM	DESCRIPTION	COST
1.00	**GENERAL REQUIREMENTS**	
1.01	Contractor mobilization, profit and field overhead, general conditions, bonds and insurance	$2,153,000
2.00	**SITE / CIVIL**	
2.01	Yard piping and valves	$539,000
2.02	Clearing, excavation, backfill, rough and final grading	$216,000
3.00	**STRUCTURAL**	
3.01	Concrete slabs	$315,000
3.02	Concrete walls	$352,000
3.03	Concrete suspended slabs	$12,000
4.00	**ARCHITECTURAL**	
4.01	Administration building	$350,000
5.00	**PROCESS**	
5.01	Influent pumps	$95,000
5.02	Static screens	$203,000
5.03	Grit chamber	$274,000
5.04	Equalization	$411,000
5.05	AGS system	$2,133,000
5.06	AGS tanks	$260,000
5.07	Sludge pumps	$41,000
5.08	Disc filters	$552,000
5.09	Effluent pumps	$95,000
5.10	Dewatering equipment	$130,000
5.11	Chemical system	$203,000
6.00	**ELECTRICAL / MECHANICAL / INSTRUMENTATION**	
6.01	Electrical gear, wire, and conduit	$1,292,000
6.02	SCADA	$108,000
7.00	**MISCELLANEOUS**	
7.01	Site cleanup	$25,000
7.02	Grassing	$15,000
7.03	Painting	$10,000
	Construction Sub-Total:	**$9,784,000**
	Contingency (10%):	$979,000
	Construction Total:	**$10,763,000**
	Design, Construction Administration, Inspection, Materials Testing	$1,615,000
	TOTAL PROJECT ESTIMATE:	**$12,378,000**

COST ESTIMATE CLASSIFICATION

Estimate Class:	Degree of Project Definition:	Purpose:	Expected Accuracy:
4	1% to 15%	Study/Feasability	Low: -15% to -30% | High: +20% to +50%

Notes:

1. Electrical cost assumes that the existing service entrance will handle proposed improvements.
2. Cost estimate does not account for inflation, so the Total Project Estimate will need to be adjusted according to the anticipated date of project construction.

COST ESTIMATE: Pre Design

Grassland STP Improvements

Central States Water Resources

Grassland, Tennessee

Date: February 26, 2024

Project No.: CNAS230028

Prepared by: DMB/EFG

0.45 MGD - Membrane Bioreactor (MBR)

ITEM	DESCRIPTION	COST
1.00	**GENERAL REQUIREMENTS**	
1.01	Contractor mobilization, profit and field overhead, general conditions, bonds and insurance	$2,419,000
2.00	**SITE / CIVIL**	
2.01	Yard piping and valves	$605,000
2.02	Clearing, excavation, backfill, rough and final grading	$242,000
3.00	**STRUCTURAL**	
3.01	Concrete slabs	$297,000
3.02	Concrete walls	$275,000
3.03	Concrete suspended slabs	$12,000
4.00	**ARCHITECTURAL**	
4.01	Administration building	$350,000
5.00	**PROCESS**	
5.01	Influent pumps	$95,000
5.02	Mechanical screens	$201,000
5.03	Static screens	$203,000
5.04	Grit chamber	$274,000
5.05	Equalization	$411,000
5.06	MBR system	$2,640,000
5.07	MBR Tanks	$262,000
5.08	MBR Install	$300,000
5.09	MBR Freight	$180,000
5.10	Sludge pumps	$41,000
5.11	Effluent pumps	$95,000
5.12	Sludge Treatment	$135,000
5.13	Dewatering equipment	$130,000
5.14	Chemical system	$203,000
6.00	**ELECTRICAL / MECHANICAL / INSTRUMENTATION**	
6.01	Electrical gear, wire, and conduit	$1,452,000
6.02	SCADA	$121,000
7.00	**MISCELLANEOUS**	
7.01	Site cleanup	$25,000
7.02	Grassing	$15,000
7.03	Painting	$10,000
	Construction Sub-Total:	**$10,993,000**
	Contingency (10%):	$1,100,000
	Construction Total:	**$12,093,000**
	Design, Construction Administration, Inspection, Materials Testing	$1,814,000
	TOTAL PROJECT ESTIMATE:	**$13,907,000**

COST ESTIMATE CLASSIFICATION

Estimate Class:	Degree of Project Definition:	Purpose:	Expected Accuracy:
4	1% to 15%	Study/Feasability	Low: -15% to -30% I High: +20% to +50%

Notes:

1. Electrical cost assumes that the existing service entrance will handle proposed improvements.
2. Cost estimate does not account for inflation, so the Total Project Estimate will need to be adjusted according to the anticipated date of project construction.

COST ESTIMATE: Pre Design

Grassland STP Improvements

Central States Water Resources

Grassland, Tennessee

Date: February 26, 2024

Project No.: CNAS230028

Prepared by: DMB/EFG

0.45 MGD - Membrane Aerated Biofilm Reactor (MABR)

ITEM	DESCRIPTION	COST
1.00	**GENERAL REQUIREMENTS**	
1.01	Contractor mobilization, profit and field overhead, general conditions, bonds and insurance	$2,243,000
2.00	**SITE / CIVIL**	
2.01	Yard piping and valves	$561,000
2.02	Clearing, excavation, backfill, rough and final grading	$225,000
3.00	**STRUCTURAL**	
3.01	Concrete slabs	$225,000
3.02	Concrete walls	$165,000
3.03	Concrete suspended slabs	$12,000
4.00	**ARCHITECTURAL**	
4.01	Administration building	$350,000
5.00	**PROCESS**	
5.01	Influent pumps	$95,000
5.02	Mechanical screens	$201,000
5.03	Static screens	$203,000
5.04	Grit chamber	$274,000
5.05	Equalization	$411,000
5.06	MABR system	$2,799,000
5.07	MABR Install	$318,000
5.08	Sludge pumps	$41,000
5.09	Effluent pumps	$95,000
5.10	Sludge Treatment	$135,000
5.11	Dewatering equipment	$130,000
5.12	Chemical system	$203,000
6.00	**ELECTRICAL / MECHANICAL / INSTRUMENTATION**	
6.01	Electrical gear, wire, and conduit	$1,346,000
6.02	SCADA	$113,000
7.00	**MISCELLANEOUS**	
7.01	Site cleanup	$25,000
7.02	Grassing	$15,000
7.03	Painting	$10,000
	Construction Sub-Total:	**$10,195,000**
	Contingency (10%):	$1,020,000
	Construction Total:	**$11,215,000**
	Design, Construction Administration, Inspection, Materials Testing	$1,683,000
	TOTAL PROJECT ESTIMATE:	**$12,898,000**

COST ESTIMATE CLASSIFICATION

Estimate Class:	Degree of Project Definition:	Purpose:	Expected Accuracy:
4	1% to 15%	Study/Feasability	Low: -15% to -30% | High: +20% to +50%

Notes:

1. Electrical cost assumes that the existing service entrance will handle proposed improvements.
2. Cost estimate does not account for inflation, so the Total Project Estimate will need to be adjusted according to the anticipated date of project construction.

APPENDIX G – DECISION MATRIX

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Detailed Breakdown of Decision Matrix				
Parameter	**Weight (%)**	**AGS**	**MBR**	**MABR**
Capital Cost	0.30	3	2	1
O&M Cost	0.15	3	2	1
Power Cost	0.10	3	2	1
Project Cost	0.15	3	1	2
Footprint	0.10	2	3	2
Chemical Requirements	0.10	3	2	1
Ease of Operation	0.10	2	3	2
Score		**2.8**	**2.1**	**1.4**

APPENDIX H – PROPOSED FACILITY PFD

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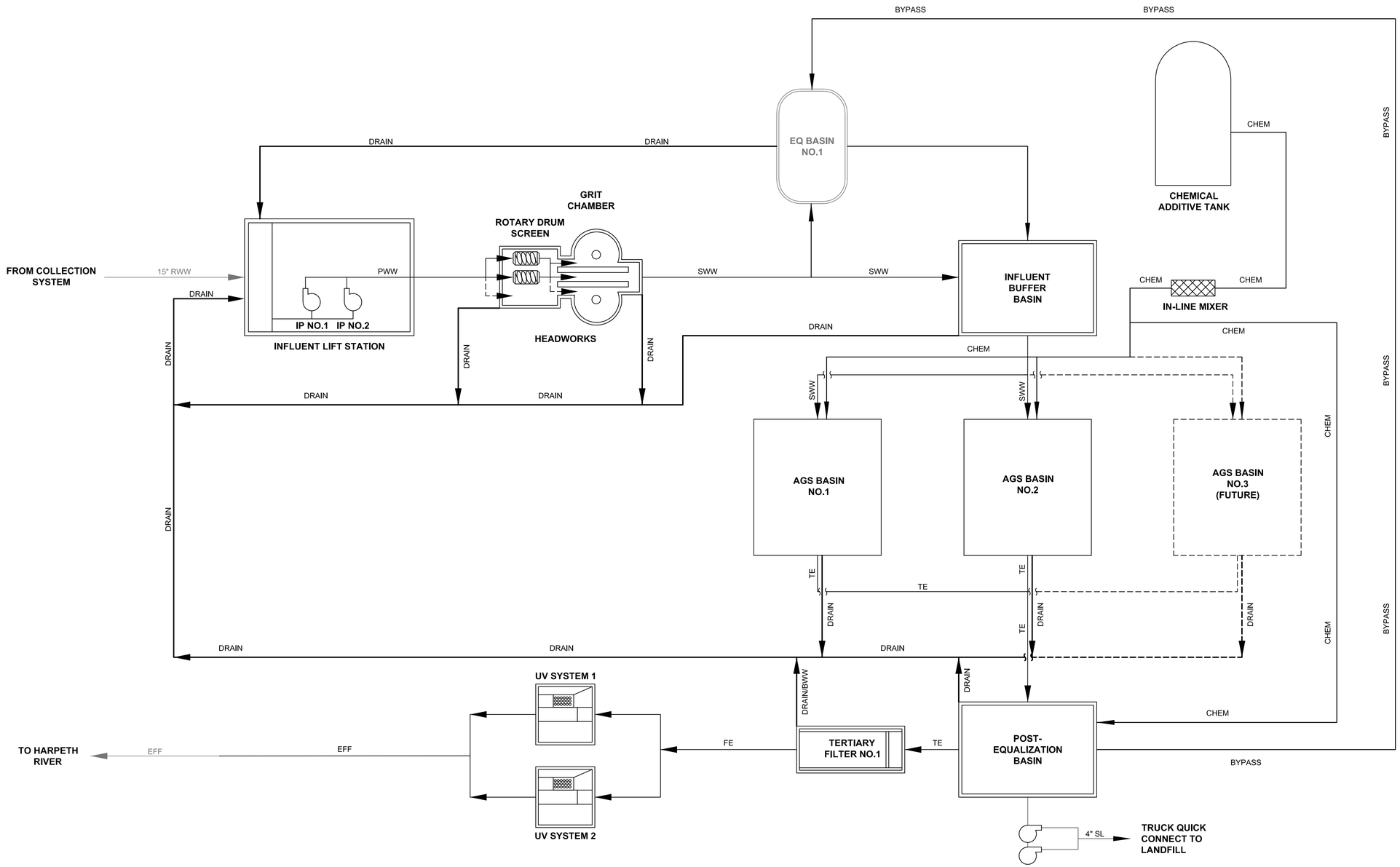
FLOWS									
	ROTARY DRUM SCREEN	GRIT CHAMBER	EQUALIZATION BASIN	INFLUENT BUFFER BASIN	AGS REACTOR	POST-EQUALIZATION BASIN	TERTIARY FILTRATION	UV SYSTEM	PARSHALL FLUME
AVERAGE DAILY FLOW (MGD)	0.60	0.60	0.25	0.30	0.23	0.30	0.45	0.45	0.30
MAXIMUM MONTHLY FLOW (MGD)	1.20	1.20		0.60	0.45	0.60	0.90	0.90	0.60
PEAK HOURLY FLOW (MGD)	3.60	3.60		1.80	1.35	1.80	2.70	2.70	2.53

FLOW LINES

- PRIMARY FLOW PATH
- BY-PASS FLOW PATH
- SECONDARY FLOW PATH
- DRAIN LINES
- EXISTING LINES

PROCESS FLOW DIAGRAM NOTES:

1. EQUIPMENT ARRANGEMENTS ARE BASED ON THE EQUIPMENT BASIS OF DESIGN IN THE SPECIFICATIONS. CHANGES TO THE LISTED BASIS OF DESIGN RESULTING IN DIFFERENCES OF THE SHOWN ARRANGEMENT SHALL BE THE CONTRACTORS RESPONSIBILITY. NO PAYMENT WILL BE ISSUED TO THE CONTRACTOR FOR MODIFICATIONS.
2. THE CONFIGURATION SHOWN ON THE PROCESS FLOW SCHEMATIC SHALL NOT BE USED FOR CONSTRUCTION BECAUSE THE LAYOUT IN THE PROCESS FLOW DIAGRAM IS NOT TO SCALE AND IS NOT REPRESENTATIVE OF THE ACTUAL FIELD LAYOUT.



GMC
3310 West End Avenue Suite 420
Nashville, TN 37203
T 615.333.7200

STATE OF TENNESSEE
GOODWYN MILLS CAWOOD, LLC
No. 2007007858
Exp.06.30.2024
NOT VALID WITHOUT A CERTIFICATE OF AUTH

ISSUE	DATE
30% SUBMITTAL	TBD
60% SUBMITTAL	TBD
90% SUBMITTAL	TBD
100% SUBMITTAL	TBD
PROJECT MANAGER:	TBD
ENGINEER:	TBD
DESIGNER:	TBD
DRAWN BY:	TBD

GRASSLAND STP
CENTRAL STATES WATER RESOURCES
FRANKLIN, TENNESSEE

GMC Project # CNAS230028

PROPOSED PROCESS FLOW DIAGRAM

APPENDIX I – FLOOD MAP

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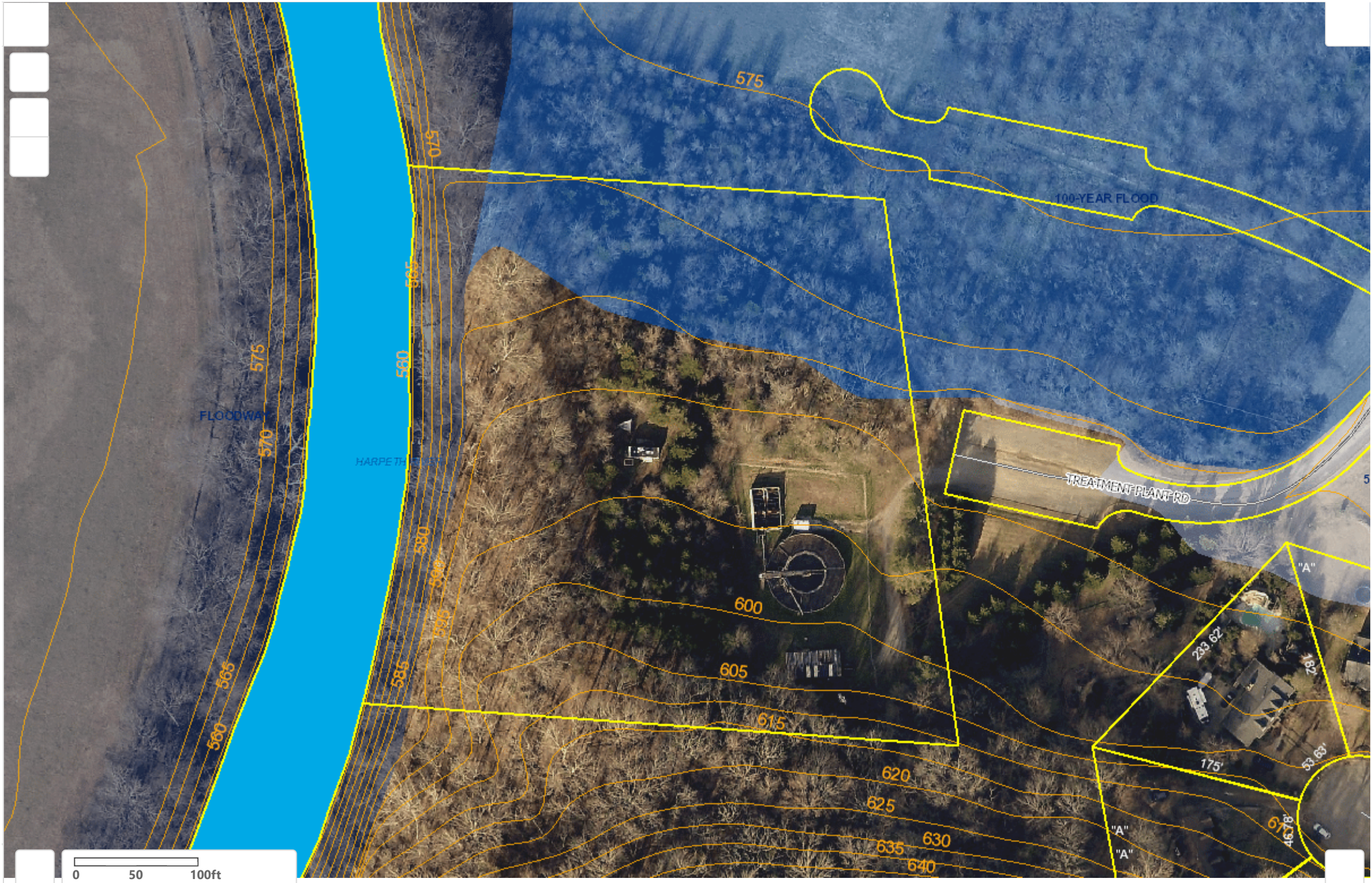
575
570
565
560
575
570
565
560
580
585
600
605
615
620
625
630
635
640
100-YEAR FLOOD
FLOODWAY
TREATMENT PLANT RD
"A"
"A"
"A"
233.62'
182'
175'
53.63'
46.08'
0
50
100ft

APPENDIX J – GEOTECH REPORT

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Grassland WWTF Improvements

Franklin, Williamson County, Tennessee

November 2, 2023

REPORT OF GEOTECHNICAL EXPLORATION

Prepared By

Goodwyn Mills Cawood, LLC
3310 West End Avenue, Suite 420
Nashville, TN 37203
T 615.333.7200
www.gmcnetwork.com

GMC PROJECT NUMBER: GNAS230064

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November 2, 2023

Logan Dickinson, P.E.
Goodwyn Mills Cawood, LLC
3310 West End Avenue, Suite 420
Nashville, Tennessee

RE: REPORT OF GEOTECHNICAL EXPLORATION
GRASSLAND WWTF IMPROVEMENTS
1006 TREATMENT PLANT ROAD
FRANKLIN, TENNESSEE
GMC PROJECT NO. GNAS230064

Mr. Dickinson,

Goodwyn Mills Cawood, LLC (Geotechnical & Construction Services Division) is pleased to provide this report of geotechnical exploration performed for the above referenced project. This report includes our understanding of the project, the subsurface conditions encountered and presents the results of field and laboratory testing, as well as recommendations for foundation design, pavement design, and general site preparation recommendations.

We appreciate the opportunity to perform this study and look forward to continued participation during the construction phase of the project. If you have any questions pertaining to this report, or if we may be of further service, please do not hesitate to call us.

Sincerely,

GOODWYN MILLS CAWOOD, LLC

Mark Van Aken, P.G.
Geotechnical Services Manager

Phillip J. Collins, P.E.
Senior Engineer
Licensed TN PE 104645

GMC

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1.0 PROJECT INFORMATION

1.1 Existing Site Conditions

A geotechnical exploration has been conducted for the proposed improvement project to the existing Grassland Waste Water Treatment Facility located in Franklin, Tennessee. Based on our site reconnaissance, the site is relatively flat. Based on available elevation information obtained from GMC Engineering, the site appears to be mildly-to-moderately sloped with approximately 30 feet of elevation change, ranging from about 582 to 612 feet above mean sea level. The existing site includes an existing waste water treatment facility. The proposed facility will be generally west of the existing facility in an area that is currently wooded.

1.2 Planned Construction

We understand the planned development will include improvements to the existing waste water treatment facility. GMC was provided with a site layout of the existing facility, with requested boring locations for the proposed development. However, a detailed layout of the proposed development is not currently available. We understand that a new pump station, a new biological treatment structure, and ancillary structures will be included in the development. We understand that the existing equalization will remain, but it may be upgraded.

Structural information for the proposed construction is not currently available. However, based on our experience with similar projects, we have assumed that biological treatment structures will consist of cast in place concrete with 2' to 2.5' thick footings, a 2' thick slab on grade, and 2' thick walls that are about 20 feet high. We expect there will be a combined structure, with two basins and the overall structure will have a footprint of about 91 feet x 93 feet. We expect the structure will be set about 7 feet into the ground. If such a structure is filled with water, we expect the area wide live load will be around 1,200 to 1,500 psf. We expect dead loads will add another 300 to 500 psf for a total area wide load of around 1,500 to 2,000 psf. We expect that wall footings will have loads of about 6 to 8 klf. For the pump station and ancillary structures, we expect that maximum column loads will be 150 kips of less and that maximum wall loads will be 5 klf or less.

Based on the existing site topography, we have assumed that minimal cut/fill operations will be required to reach planned grades (this does not include cuts required to install below grade structures). Depending on final building layout and grading design, some areas may require several feet of cut and/or fill. Except for the biological treatment structure, we are not aware of any below grade levels, significant retaining walls, or significant slopes associated with the site development.

Please note the project information and any assumptions listed herein should be reviewed by the appropriate team members. Modifications to our recommendations may be required if the actual conditions vary from our assumptions. We request the opportunity to review updated and final design information to determine if modifications are required.

1.3 Work Scope

The purpose of this exploration was to characterize the subsurface soil conditions at the site and to provide geotechnical recommendations for site preparation, foundations and pavements. The scope of the exploration and evaluation included field and laboratory testing and an engineering evaluation of this information.

The scope of services for the geotechnical exploration did not include environmental assessment for the presence or absence of wetlands or hazardous or toxic materials in the soil, surface water, groundwater, or air, on or below or around this site. Any statements in this report or on the exploration records regarding odors, colors, or unusual or suspicious items or conditions are strictly for the information of the client.

It is noted that design details such as layout of proposed structures, loads, and grading are not known at this time. As such, there are inherent limitations to the exploration results and recommendations. Once final design details are available, we should be given the opportunity to review the design and provide modified recommendations and/or a recommendation for additional exploration and assessment, as needed.

2.0 SUBSURFACE CONDITIONS

2.1 Site Geology

Published geologic information (Tennessee Division of Geology, *Geologic Map and Mineral Resources Summary of the Bellevue Quadrangle*, 1980) indicates the site is underlain by the Bigby-Cannon Limestone formation (Obc) to the north of the site and Leipers and Catheys Limestone formations (Olcy) to the south of the site. These formations generally consist of fine-to-coarse-grained limestone that are typically very thinly-to-medium bedded and ranging in color from dark-gray to pale yellowish-brown. Accessory features are commonly observed throughout these formations, such as interstratified shale, fossils, and mineral nodules or inclusions. These formations (especially the Bigby Cannon) can exhibit a variable top of rock profile.

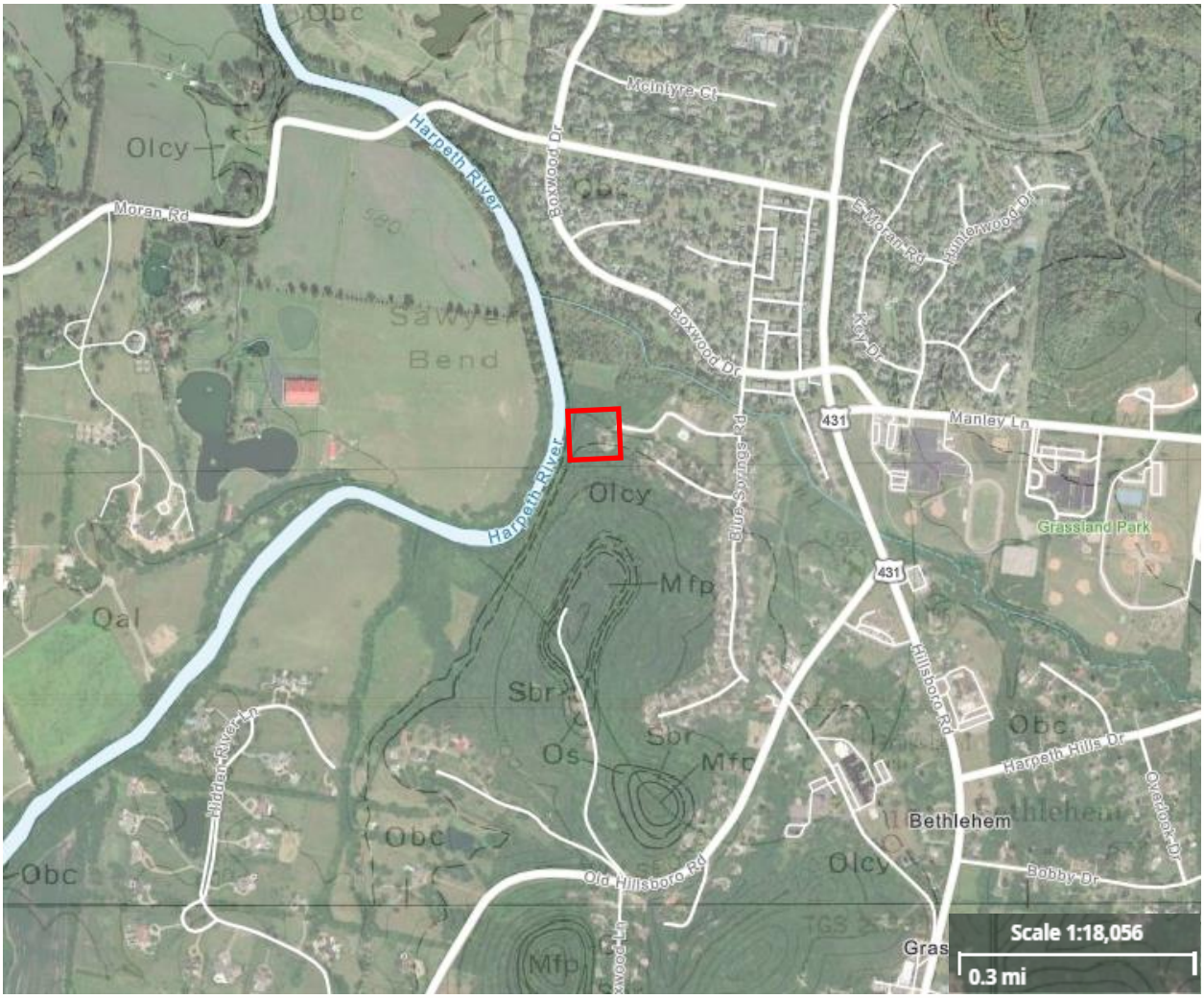

Figure 2.1 – Geologic Map and Mineral Resrouces Summary of the Bellevue Quadrangle, 1980
(approximate site location outlined in red)

This site is located in an area of elevated risk for karst-related features such as sinkholes. However, a review of online topographic information and a site reconnaissance did not indicate sinkhole activity at the project site. Even so, there is some risk that must be accepted when developing a site in this geologic area. Based on our experience, the presence of shallow bedrock can reduce some of the risks associated with potential sinkholes. In addition, implementing good drainage into the design usually is helpful in reducing risks related to karst geology. If karst features are encountered during construction, there are several remediation approaches available that have been successfully implemented in the middle Tennessee area. We recommend the Geotechnical Engineer provide evaluation of such features on an as-needed basis, during or following construction. If desired, GMC can perform additional exploration and evaluation to better assess the risk related to the karst geology.

2.2 General

The borings were located in the field using simple pacing and taping techniques and/or a hand-held GPS device with pre-loaded coordinates. The field program consisted of performing fifteen (15) soil test borings, labeled BH-01 through BH-15. The borings were drilled using a subcontracted Diedrich D50 truck-mounted drill rig.

Elevations of the borings are based on information from Google Earth. Based on the methods used, locations and elevations of the borings should be considered approximate. Auger refusal was encountered in each boring, at depths ranging from about 4.9 to 21.3 feet below the existing ground surface.

Each of the drilled borings was advanced using hollow stem auger (HSA) drilling methods. Samples of the soils were obtained using split-barrel sampling procedures in general accordance with the procedures for *Standard Test Method for Standard Penetration Test (SPT) and Split-Barrel Sampling of Soils* (ASTM D1586). The split spoon samples were identified according to project number, boring number and depth, and were placed in polyethylene plastic wrapping to protect against moisture loss. The collected soil samples were observed in the laboratory to estimate material properties for our evaluation. In addition, laboratory testing was performed on select samples. Laboratory testing was performed in general accordance with ASTM procedures. Following drilling, boreholes were backfilled with the auger cuttings.

In borings BH-03 and BH-11, we advanced beyond auger refusal materials using a double barrel, wire-line diamond bit NQ (2-inch) coring technique generally following the procedures outlined in ASTM D2113. Rock core samples were stored in cardboard boxes and transported to our laboratory for visual classification by members of our engineering staff. The boring logs include percentages for core recovery (REC) and Rock Quality Designation (RQD). Rock core recovery, REC, is the total length of core sample recovered, expressed as a percentage of the total length cored. RQD is defined as the total length of NQ size rock core segments recovered, which are greater than 4 inches in length discounting drilling mechanical breaks and clay seams, expressed as a percentage of the total length cored. RQD is preferred over percent recovery as a measure of engineering characteristics of rock.

2.3 Subsurface Conditions

The descriptions below represent materials that were encountered by the borings during the course of the fieldwork. The subsurface descriptions contained herein are of a generalized nature to highlight the major soil stratification features and soil characteristics. The exploration records included in the Appendix should be reviewed for specific information as to individual locations. The stratification shown on the exploration records represents conditions only at the actual locations. Variations may occur and should be expected between exploration locations. In addition, the stratifications represent the approximate boundary between subsurface materials. Actual transitions may be gradual.

Clay/silt with varying amounts of sand and chert gravel was encountered at the surface and extended to the depth of auger refusal at each boring. The clay/silt material was generally stiff to hard in consistency (material with SPT N-values of 9 to 30+). However, there were some instances of firm material (material with SPT N-values of 5 to 8) between depths of about 5 feet to about 15 feet. Based on previous development in the immediate area of the site, we expect some of the subsurface material may included previously placed fill. Auger refusal was encountered between 4.9 and 21.3 feet beneath the existing ground surface. At borings BH-03 and BH-11, fairly continuous to continuous limestone bedrock was observed beyond auger refusal with rock quality ranging from good to excellent.

2.4 Groundwater Information

Groundwater was not observed during our exploration. However, groundwater levels may vary due to seasonal conditions and recent rainfall. It is common for water to migrate along the bedrock surface in this geology. It is also common to have perched or "trapped" water present within the soil overburden or near the interface of fill and natural materials.

2.5 Laboratory Analyses

The laboratory testing program included visual classification of all samples and laboratory testing on selected soil samples. The laboratory soil testing program was conducted in general accordance with applicable ASTM standards.

The moisture content of selected samples from the borings ranged from approximately 14 percent to 45 percent. Additional test results are summarized in the table below.

Table 2-1: Laboratory Test Results

Boring No.	Depth (feet)	Liquid Limit	Plastic Limit	Plasticity Index	Classification based on Plasticity	% Passing No. 200 Sieve	% Moisture
BH-05	1-2.5	37	21	16	Lean Clay (CL)	-	-
BH-07	1-2.5	42	27	15	Silt (ML)	-	-
BH-13	3.5-5	42	27	15	Silt (ML)	83	-

3.0 CONCLUSIONS AND RECOMMENDATIONS

3.1 Site Assessment

Based on the subsurface conditions encountered during this exploration, the subject site is adaptable for the planned construction. However, there are several considerations that will likely affect the project. Some of these considerations are included in the following subsections.

3.1.1 Shallow Refusal Conditions

The borings encountered refusal at depths ranging between 4.9 and 21.3 feet below the ground surface. In most of the borings, refusal was encountered at depths of around 12 to 13 feet. Therefore, if this condition is more prevalent over the whole site, we expect that significant rock excavation will not be required. However, it is noted that shallow rock may be present as well, as was encountered in Boring BH-02 at about 4.9 feet below the existing ground surface. In areas of shallow rock or where deeper excavation will be required to accommodate site grading operations or during the installation of foundations and utilities, there may be a need for rock excavation. The actual amount of rock excavation required will depend on final grading design and the variability in the top of rock profile.

3.1.2 Bearing Conditions and Settlement

It will be important to maintain consistent bearing conditions for foundations and even slabs on grade. Column footings, in particular, should bear on only one type of material. Additionally, separate column footings that are in close proximity to one another should bear on similar materials. The slabs on grade, and especially the slab on grade for the biological treatment structure should also bear on consistent materials. If rock is encountered at or above bearing elevation, we recommend the rock be over-excavated to a depth of at least 12 inches below bearing elevation and replaced with a compacted material that will provide similar stiffness as adjacent materials. If needed during construction, it may be possible to reduce some over-excavation of rock at continuous footings and/or slabs on grade by constructing a transition zone as directed by the Geotechnical Engineer, so as to avoid an abrupt transition in the stiffness of bearing materials. We expect such measures can be evaluated on an as-needed basis during construction. However, it is noted that in general, the bearing conditions should be relatively consistent in the biological treatment structure area to reduce the risk for differential settlement.

For most of the anticipated loads (i.e., at the pump station and ancillary structures), we expect that total settlement will be about 1 inch or less and differential settlement will be about one-half inch or less over distances of about 20 to 30 feet. However, based on an area wide load that is approaching 2,000 psf at the biological treatment structure, additional settlement may occur. We expect total settlement in this area will be on the order of 1 to 2 inches and possibly greater, depending on final design, final layout, and potential variations in subsurface conditions. It may be that more settlement is tolerable for the biological treatment structure as long as the settlement is consistent across the pad. Thus, it will be important to maintain consistency of bearing conditions in this area, in particular. We expect that much of the settlement will occur during construction.

We recommend that the design team provide input on the settlement tolerance of the biological treatment structure. If needed, additional evaluation and/or settlement monitoring can be performed during and/or following construction to better determine the amount and rate of settlement. One way to reduce some of the risk for settlement would be to over-excavate the biological treatment structure by about 3 to 4 feet and replace with compacted shot rock or surge stone fill. This approach may not be required, depending on the tolerance for settlement or the owner's tolerance for risk.

3.1.3 Time of Year Site Preparation Considerations

Surface drainage in areas underlain by clay/silt soils can sometimes be poor. During periods of heavy rain, the near surface soils can become saturated and swampy conditions can occur. The time of the year that the sitework begins can affect the project considerably. In this area, the "wet season" is generally between the months of November and April, and the "dry season" from May to October. There are many considerations that need to be addressed prior to bidding a project that could affect the budget based on the time of year a project starts earthwork activities. The time of the year that the geotechnical borings were performed can provide a false sense of actual near surface conditions depending on the time of year and weather conditions. Below are considerations that should be addressed based on the time of the year earthwork is started.

<u>"Wet Season"</u>

During the wet season, the amount of undercutting may be greater, therefore resulting in greater excavation costs. The soils are typically proofrolled to determine their suitability for the placement of new fill or subgrade support. During the wet season, the surface soils often have a higher moisture content and will tend to pump, thus hindering the placement of new fill. In addition, the drying time, time period between rain events, and temperature are often not conducive to scarifying soils, allowing to dry, and then recompacting. At this time, the decision should be made by the owner to try to either scarify/dry/compact the in-place soils, which could take time, or undercut and replace with suitable material, which could increase the sitework costs. Based on our experience, the amount of undercut could be an additional 1 to 2 feet (or greater in localized areas), whereas in drier weather, lesser amounts of undercutting may be necessary, if recompaction or stabilization of soils left in place can be achieved.

Some undercut soils are not always "unsuitable" soil and can be moisture conditioned and reused as fill, if drying conditions are favorable.

<u>"Dry Season"</u>

During the dry season, the surface soils often have a lower moisture content and will tend to "bridge" or "crust" softer underlying soils. They will generally allow the placement of new fill, but the crust can break down if repeated passes with heavily loaded equipment are persistent. In addition, new fill from cuts or other sources may need to be moisture conditioned prior to compaction. The soils can dry significantly, requiring the addition of water for proper compaction. Water trucks should be used, as necessary, by the contractor to condition the soils within the required specifications.

Contractor Responsibility

The grading contractors have the option of performing their own evaluation of the site conditions to assess the excavation considerations based on the time of year a project is bid. We strongly suggest that the grading contractors conduct their own exploration and evaluation of the site conditions and material management requirements to cost effectively develop the site.

Typically, due to the movement of heavy equipment and weather conditions, the subgrade becomes disturbed during construction. As a result, fine grained clayey/silty soils have a tendency to lose shear strength and support capability. Therefore, additional effort on the Contractor's part will be required to reduce traffic and limit disturbance of soils. It is essential that the subgrade be restored to a properly compacted condition based on optimum moisture and density requirements. Restoration of the subgrade should be addressed in the project specifications.

3.2 Sitework Recommendations

Sitework should begin initially with the stripping and removal of all gravel, vegetation, topsoil, and other deleterious materials. In addition, existing foundations, pavements, utilities, etc. should be removed, if applicable. The stripping, clearing, and grubbing should extend at least 10 horizontal feet beyond the construction limits, where possible.

Where applicable, after stripping of the site areas which are to receive fill, the subgrade should be thoroughly proofrolled to locate unsuitable materials that may require removal or remediation. Proofrolling consists of repeated passes with a fully loaded tandem-axle dump truck. Areas that rut or pump excessively will indicate soils that require remediation. Attempts can first be made to compact the problem soils if they are less than about one foot thick. If dry weather conditions exist prior to and at the time construction, re-compaction and densification may prove successful. The soils should be scarified and the soil moisture should be adjusted to within 3 percent of optimum moisture. Once these things have been accomplished then re-compaction of the soils can be attempted.

We recommend a GMC geotechnical engineer observe the proofrolling operations and provide recommendations based on materials encountered at the proposed subgrade in the cut areas. It should be noted that areas that pass a proofroll may still require re-working at a later date if the area is exposed to inclement weather.

3.3 Excavation

Refusal was encountered in the borings at depths ranging approximately from 4.9 to 21.3 feet below the existing ground surface. Based on the depth of refusal, it appears that rock may not be encountered during construction in many areas of the site. However, some areas of the site exhibited relatively shallow refusal. Therefore, it is possible that removal of rock will be required for the project during the construction of utility trenches, building foundations, or even during mass grading, depending on the final proposed grading plan and the variability in the depth of bedrock. If rock excavation techniques or blasting is anticipated, provisions for such should be included in the project documents.

Over-Blasting:

Irregularities in the base of foundations are common when rock materials are encountered. If blasting is required and the rock is overshot, it will typically excavate in a fairly platy structure. Although it may be possible to remove the larger broken plates with a backhoe, the fracture force may create sufficient voids in the rock plane to induce unacceptable settlement. Care should be taken so as not to over-blast and fracture the bedrock (heave) supporting foundations. Areas damaged by over-blasting should be evaluated by GMC to determine corrective measures. If over-blasting occurs, the loose or disturbed materials should be removed and replaced with controlled, compacted fill or dental concrete placed in accordance with the recommendations included in this report. Therefore, proper control of blasting operations is critical at the site, along with timing of blasting operations. The potential for over-blasting should be recognized during both the design and construction phases.

Condition Surveys:

Pre-blast condition surveys should be performed on existing structures located within 100 to 200 feet (farther if required) of portions of the project which will require blasting.

Blasting Prior to Concrete Placement:

We suggest the client consult with the design team and contractor regarding rock removal options to determine the most appropriate blasting procedures relative to the final project grading. In general, blasting on the site should be completed, to the extent practical, prior to the placement of concrete. In the event it is necessary to blast additional locations after concrete is placed, then the use of vibration monitoring equipment to monitor the performance of placed concrete will be necessary.

If blasting is performed during the construction phase, there is a potential risk of damage to "young concrete" within the blast radius. We recommend blasting not occur near fresh concrete less than 48 hours old and that blasting vibrations be withheld to suitable limits for "young concrete". The contractor is responsible for mass excavation at the site and must consider adjacent construction and the requirements of this report. The importance of maintaining the integrity of the rock below foundation bearing elevations cannot be over-emphasized.

Blasting should comply with applicable state and/or local ordinances. Excavations should comply with OSHA requirements. Safety is solely the responsibility of the contractor.

3.4 Compacted Fill

3.4.1 Soil Fill

All fill material should be placed in loose lifts not exceeding 8-inches in thickness if compacted by large equipment and 4 inches if compacted by manually-guided equipment. The following table summarizes the compacted fill requirements:

Location	Test Method	Compaction Required (minimum)	Moisture Content
Upper 12 inches in Structural Area (including beneath foundations, if applicable) and 10' beyond perimeter	ASTM D-698	98%	-/+3 percentage points of optimum moisture
Upper 12 inches below pavement base material	ASTM D-698	98%	-/+3 percentage points of optimum moisture
All other areas	ASTM D-698	95%	-/+3 percentage points of optimum moisture

Fill material should meet the following characteristics within 24 inches of slab and pavement subgrade elevations:

Property	Requirement
Liquid Limit (LL) and Plasticity Index (PI)	LL<55% and PI <35%
Maximum Dry Density (ASTM D-698)	≥ 95 pcf
Maximum Particle Size	3 inches or less
Organic Content (by weight)	<5%

Samples of the proposed fill materials should be provided to the geotechnical engineer for testing and evaluation prior to placement. Density tests should be performed to document compaction and moisture content of any earthwork involving soils and other applicable materials. Density tests should be performed frequently, with a recommended minimum of 1 test per 5,000 square feet per lift of fill placed in building areas and 10,000 square feet in other areas, but no less than two tests per lift of fill. Fill material must meet the specified density and moisture requirements to be considered acceptable.

3.4.2 Shot-Rock Fill

Shot-rock is a commonly used material for fill. Shot-rock fill can often be used in inclement weather, since it is more resistant than soil to degradation and rutting under construction traffic.

Suitable material for use as shot-rock fill includes rock fragments that are smaller than 12 inches in any one dimension or two-thirds the lift thickness, whichever is smaller (some quarries may call this material "surge

stone"). The rock fill should contain no more than 20 percent of soil particles (fines) by volume, which is generally enough fines to "choke" the shot-rock but still allow for point-to-point contact.

During placement, the larger rock pieces should lie flat and not overlap each other. Lift thickness should not exceed 18 inches, loose. The fill lifts should be placed and compacted by making multiple, perpendicular passes with a D-8 size or larger bulldozer and a smooth-drum vibratory roller. Smaller sized dozers will not provide the compactive effort required for the stiffness needed. The number of passes should be sufficient to demonstrate the material is densified and stable. We anticipate a minimum of four passes in each direction will be required. GMC personnel should observe the shot-rock fill placement to document the fill constituents, lift thickness, and compaction efforts and the performance of the material under load.

Please note that foundations and utilities excavated into shot-rock fill can be larger than similar excavations into clay soil. Greater quantities of concrete may be necessary to backfill these excavations into shot-rock fill, unless they are formed. In order to reduce the excavation sizes, it may be desirable to use shot-rock fill with rock fragments that are smaller than 6 inches in any one dimension.

3.5 Foundations

Based on maximum loads on the order of 150 kips or less for columns and 5 kips per foot for walls, the exploration findings indicate that the proposed buildings (pump station, ancillary buildings) can be supported by shallow spread footings and wall footings bearing on approved residual soil or engineered fill. We expect the biological treatment structure can be supported by a slab on grade, thickened at the edges and below walls. For the pump station and ancillary building structures, we recommend using a maximum allowable net bearing pressure of 3,000 pounds per square foot (psf) to size footings supported by approved materials. For the biological treatment structure (or any other structure with area wide loads), we recommend the area-wide bearing pressure be 2,000 psf or less (even at a 2,000 psf area wide load, there are potential settlement ramifications, as discussed previously). If soft areas are encountered during foundation construction, they should be thoroughly evaluated, and over-excavation or other remedial measures may be required. If needed, lean concrete with a compressive strength of at least 1,500 psi can be used to backfill footing excavations to the design foundation bearing elevation.

Minimum strip and individual spread footing widths should be at least 18 inches and 24 inches wide, respectively. This recommendation is made to help prevent a "localized" or "punching" shear failure condition that could exist with very narrow footings. Foundations can be constructed at a minimum of 18 inches below subgrade. Constructing the foundations at this depth provides confinement and protection against frost penetration.

Foundations should bear on consistent materials. Column footings, in particular, should bear on only one type of material. Additionally, separate column foundations that are in close proximity to one another should bear on similar materials. Please refer to Section 3.1.2 of this report for additional discussion related to bearing conditions and settlement.

Footings should be poured "neat" to the excavation such that water cannot collect behind forms before backfilling. If bearing conditions are not acceptable, over-excavation may be required until competent bearing material is reached, or other remedial measures may be required. Concrete should not be placed in standing water. Mud, water, loose materials, etc. should be removed from the bottom of foundation excavations prior to placement of reinforcing and concrete. Excavations for foundations should be observed by a member of our staff prior to placement of reinforcing steel and concrete. Mud mats can be used to help protect the bearing surface in the event there is a delay between the time the foundation is excavated and the concrete is placed.

Except as previously noted, for foundations constructed in accordance with the recommendations in this report, settlement should be within tolerable limits. Total settlement is anticipated to be less than 1 inch, and differential settlement is anticipated to be ½ inch or less over a distance of about 20 feet for foundations bearing on approved material. Please see Section 3.1.2 of this report for additional discussion on settlement.

3.5.1 Passive Resistance for Foundations

If needed, a passive resistance for soil of 240 pcf (equivalent fluid unit weight) can be used, except that we recommend that the top foot of the soil be neglected in passive resistance calculations. We recommend a coefficient of friction between the base of concrete footings and soil of 0.40. If additional passive resistance is needed, the geotechnical engineer can provide additional recommendations for parameters.

3.6 Slab-on-Grade

Provided that the recommendations in this report are followed, we recommend a modulus of subgrade reaction, k_s, of 150 pounds per cubic inch (pci) be utilized in the design. Ground supported slabs should be founded on a minimum of 4 inches of compacted, granular material such as a graded crushed stone with less than 10% passing the #200 sieve. The purpose of this layer is to provide uniform and immediate support for the slab and act as a capillary break; however, it should not be considered a part of the slab design. The design should consider use of a vapor retarder beneath the slab, dependent on the floor coverings and climate control of the building

Care should be taken so that fines are not allowed to contaminate the granular layer. If fines do contaminate this layer, capillary rise and subsequent damage to moisture sensitive floor coverings could occur.

On most projects, there is some time lag between initial grading and the time when the contractor is ready to place concrete for the slab-on-grade. Inclement weather just prior to placement of concrete for the slab-on-grade can result in trapped water in the crushed stone.

Prior to the construction of concrete slabs, a geotechnical engineer should evaluate the subgrade. This evaluation may include proofrolling with a pneumatic tired vehicle, such as a fully loaded dump truck. We suggest that provisions be included in the project specifications for the contractor to restore the subgrade soils to an acceptable condition (as outlined in this report) prior to the construction of floor slab. Such restoration may include moisture conditioning of the surficial soils and re-compaction to the project requirements. Based on the results of our exploration, we conclude that the floor slab is not likely to be

subjected to hydrostatic pressure from groundwater, especially if water is diverted away from the structure in the drainage design.

3.7 Below Grade Walls

We are not aware of site retaining walls or below grade levels associated with the project. However, small site walls and/or partial basement walls may be required. If required, we anticipate walls will be cast-in-place concrete retaining walls.

Below grade walls must be designed to resist the lateral earth pressures that will be induced by the weight of the backfill materials, hydrostatic pressures on the walls and any adjacent slab or pavement surcharge loads exerted on the walls. It is recommended that the walls be supported by footings and backfilled with a free draining material such as crushed stone or clean sand. A drainage system should be provided near or at the base of the walls to collect and remove groundwater and to prevent buildup of hydrostatic pressures.

Walls restrained at the top, supporting structures or otherwise movement sensitive, should be designed for "at rest" earth pressure conditions. Walls that are free to deflect should be designed for "active" earth pressure conditions. The "passive" earth pressure state should be used for soils supporting the retaining structure, such as toe backfill. Relatively free-draining crushed stone or sand should be used as backfill. The following table presents recommended values of earth pressure coefficients for the select backfill materials:

Soil Parameter	Backfill Type		
	SM / SC	GW, GP	SP, SW
Soil Unit Weight (moist)	120	130	128
Angle of Internal Friction, Φ, deg	31	39	37
At rest Pressure Coefficient, K_o	0.48	0.37	0.40
Active Pressure Coefficient, K_a	0.32	0.22	0.25
Passive Pressure Coefficient, K_p	2.0*	2.0*	2.0*

Samples of all proposed backfill material should be evaluated for use as backfill. The design values and recommendations presented above assume that the backfill behind the wall will be horizontal with no surcharge loads and that a permanent drainage system will be installed behind the retaining wall to prevent the development of hydrostatic pressures. The backfill should extend upward from the top of the footing on a line 35 degrees from the vertical. We recommend that the top foot of material be neglected when calculating passive resistance. In addition, we recommend a maximum passive pressure coefficient of 2.0 as noted in the table above.

An allowable bearing pressure of 3,000 psf should be used for the design of the retaining wall footings constructed on engineered fills or approved natural soils. For analysis of sliding resistance of the base of the retaining walls, the ultimate coefficient of friction may be taken as 0.4 between concrete and stiff soil.

The soils used behind the walls should be reviewed and approved by the Geotechnical Engineer prior to their placement. Using a select material can significantly reduce the horizontal loads on the wall as well as improve the effectiveness of the wall drainage system. Compaction of backfill behind walls should be performed by appropriate manual equipment. The wall should be properly braced, as needed, and heavy equipment should not be allowed behind the wall. No equipment or construction loads should be allowed within 10 feet of retaining walls of half the distance of the freestanding wall-height. This will help prevent any surcharge loads from adding lateral earth pressures above that previously recommended to the retaining wall.

Retaining walls should be braced, as needed, during any backfilling operations and monitored for movement. If the footing construction precedes the subgrade preparation, then the footings should either be embedded below the subgrade a sufficient distance to achieve the required horizontal component or the footing should include a shear key to prevent movement.

As previously noted, we are not aware of details associated with retaining walls that may be required for this site. The above values have been provided for a conventional cantilevered retaining wall. It should be noted that if other wall types are required or if significant slopes are planned, additional exploration, testing, and assessment, including global stability analysis, may be required.

3.8 IBC Seismic Site Class

Based on our exploration and knowledge of the site geology, we recommend a Seismic Site Class of C for this site. We do not anticipate that an improvement in site class will be appropriate, based on the subsurface conditions encountered and the available design details.

We have determined the design spectral response acceleration parameters via methodology established in ASCE7-16/IBC 2018. Online modeling applications available from the United States Geological Survey were utilized to determine the Mapped Responses, with adjustments as noted. The design responses for the short (0.2 sec, S_{DS}) and 1-second period (S_{D1}) are included in the following table. The responses are modeled for a site located at an approximate Latitude 36.010231 and an approximate Longitude -86.694775.

Table 3.8.1: Ground Motion Parameters "Site Class C"

Period (sec)	Mapped Spectral Response Accelerations (g)		Values of Site Coefficient for Site Class		Maximum Spectral Response Acceleration Adjusted for Site Class (g)		Design Spectral Response Acceleration (g)	
Reference	Figures 1613.3.1 (1) & (2)		Tables 1613.3.3 (1) & (2)		Eqs. 16-37 & 16-38		Eqs. 16-39 & 16-40	
0.2	S_S	0.304	F_a	1.3	$S_{MS}=F_aS_s$	0.395	$S_{DS}=2/3\ S_{MS}$	**0.264**
1.0	S_1	0.148	F_v	1.5	$S_{M1}=F_vS_1$	0.222	$S_{D1}=2/3\ S_{M1}$	**0.148**

The Site Class definition should not be confused with the Seismic Design Category designation, which the Structural Engineer typically assesses. Based on the conditions encountered and our knowledge of the site, we do not believe the risk of liquefaction is significant for this site.

3.9 Backfilling of Utility Trenches

Backfilling of drainage and utility trenches must be performed in a controlled manner to reduce settlement of the fill and cracking of overlying slabs and pavements. We recommend that utility trenches be backfilled with acceptable borrow or dense-graded crushed stone in 6-inch loose lifts and compacted with mechanical piston tampers to the requirements in Section 4.4 of this report. Should seepage occur in utility trenches, it may be necessary to "floor" the trench with dense-graded gravel to provide a working surface.

3.10 Drainage Considerations

Adequate drainage should be provided at the site to reduce the increase in moisture content of the foundation and/or slab subgrade soils. We recommend that the parking lots, walkways, and the ground surface be sloped away from the structure on all sides. Roof drainage should be collected by gutters and downspouts and transmitted by pipe to the storm water drainage system or discharge a minimum of 5 feet away from the building.

3.11 Pavements

This section has been prepared to provide recommendations for surface parking and drive areas that may be required at the site.

3.11.1 Subgrade

Prior to base course or fill placement, we recommend that the pavement subgrade be proofrolled with a loaded tandem axle dump truck. The proofrolling should be observed by the geotechnical engineer or his representative. Areas deemed to be unstable may be remediated as previously described in this report. Undisturbed firm soils or other materials that have performed satisfactorily during proofrolling can generally provide adequate support for a pavement.

3.11.2 Asphaltic Pavements

GMC was not provided with required traffic loading for this project. As such, we have assumed expected traffic loading will be on the order of magnitude of 75,000 18-kip ESALs over 20 years for heavy duty pavements and 25,000 18-kips ESALs over 20 years for light (standard) duty pavements. Since California Bearing Ratio (CBR) testing was not performed at this site, we have assumed a design CBR value of 3 for the existing fill/possible fill or newly placed fill soil subgrade materials.

Minimum pavement sections for this project site are as follows:

Pavement Layer	Standard Duty Pavements	Heavy Duty Pavements
Asphaltic Concrete Surface Course	1.5 inch	1.5 inches
Asphaltic Concrete Binder Course	2.0 inches	3.0 inches
Crushed Aggregate Base Stone	6.0 inches	6.0 inches

The pavement sections above represent minimum recommended thickness for a pavement section designed for a 20-year life, using a design terminal serviceability index of 2.0 and assuming loadings as previously described. Adjustments to these pavement recommendations will be required if the actual loads vary from our assumed loads. Periodic maintenance should be anticipated over the pavement design life. All pavement materials and construction procedures should conform to the Tennessee Department of Transportation's Standard Specifications for Road and Bridge Construction. The mineral aggregate base stone should be an aggregate as outlined in TDOT Standards and should be compacted to at least 98 percent of the modified Proctor (ASTM D1557) maximum dry density.

3.11.3 Concrete Rigid Paving

All Portland cement concrete (PCC) pavements should be placed over a compacted dense graded aggregate base. The concrete should have a minimum 28-day flexural strength of 650 psi and concrete compressive strength of at least 4,000 psi and contain 4 to 6 percent entrained air. We recommend that the rigid pavement be designed to include dowel bars at the pavement joints to aid in load transfer between the concrete pavement panels.

RIGID PAVEMENT MINIMUM THICKNESS (inches)		
Pavement Materials	**Light Duty**	**Heavy Duty**
Reinforced Portland Cement Concrete	5"	6"
Crushed Aggregate Base Course	4"	6"

Pavement joints, reinforcing, and details should be designed in accordance with the applicable American Concrete Institute (ACI) standards.

3.11.4 Additional Pavement Recommendations

We recommend the pavement surface and subgrade have a minimum slope of 1 percent to help promote positive drainage. We also recommend that the site be designed such that water entering the mineral aggregate base be drained into catch basins (through weep holes), out-slope areas, or drainage trenches. It may also be desirable to construct a concrete pad around catch basins to accommodate the problems associated with saturation of the pavement system in low areas. Maintenance is essential to good long-term pavement performance. Any distressed areas should be promptly repaired to prevent failures from spreading due to loading and water infiltration. Cracks and joints should be sealed annually.

4.0 REPORT LIMITATIONS

The recommendations submitted are based on the available soil information obtained by GMC and design details furnished for the proposed project. If there are any revisions to the plans for this project or if deviations from the subsurface conditions noted in this report are encountered during construction, we should be notified immediately to determine if changes in the foundation or other recommendations are required. If GMC is not retained to perform these functions, GMC cannot be responsible for the impact of those conditions on the performance of the project.

The findings, recommendations, specifications, and/or professional advice contained in this report have been made in accordance with generally accepted professional geotechnical engineering practices in the local area. No other warranties are implied or expressed.

After the plans and specifications are more complete, the geotechnical engineer should be provided the opportunity to review the final design plans and specifications to check that our engineering recommendations have been properly incorporated into the design documents. At that time, it may be necessary to submit revised and/or supplementary recommendations.

We emphasize that this report was prepared for design and informational purposes only and may not be sufficient to prepare an accurate construction budget. Contractors reviewing this report should acknowledge that the recommendations contained herein are for design and informational purposes only. A more comprehensive exploration and testing program would be required to assist the contractor in preparing the final building pad preparation, grading, and foundation construction budgets. In no case should this report be utilized as a substitute for development of specific earthwork specifications.

The information contained in this report is not intended, nor is sufficient, to aid in the design of segmental or mechanically stabilized earth (MSE) retaining walls. Segmental or MSE wall designers and builders should not rely on this report and should perform independent analysis to determine all necessary soil characteristics for use in their wall design, including but not limited to, soil shear strengths, bearing capacities, global stability, etc.

The recommendations in this report are only applicable to areas within the vicinity of our exploration and should not be used for other areas or for structures not specifically addressed in this report.

APPENDIX

Site Location Plan
Boring Location Plan
Soil Classification Chart
Boring Logs
Photograph Log
Laboratory Testing Summary

Site Location Plan	
Grassland WWTF Improvements	
GNAS230064	
M. Van Aken	October 16, 2023

Legend

Approximate Site Location

Exploration Location Plan	
Grassland WWTF	
GNAS230064	
M. Van Aken	October 16, 2023

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Legend

- 25' SPT Boring w Rock Core
- 25' SPT Boring

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Relative Density of Cohesionless Soils From Standard Penetration Test	
Very Loose	‹ 4 bpf
Loose	5 - 10 bpf
Medium	11 – 30 bpf
Dense	31 - 50 bpf
Very Dense	› 50 bpf
(bpf = blows per foot, ASTM D 1586)	

Consistency of Cohesive Soils	
Very Soft	‹ 2 bpf
Soft	3 - 4 bpf
Medium	5 - 8 bpf
Stiff	9 - 15 bpf
Very Stiff	16 - 30 bpf
Hard	› 30 bpf

Relative Hardness of Rock
Very Soft Rock disintegrates or easily compresses to touch; can be hard to very hard soil.
Soft Rock may be broken with fingers.
Moderately Soft Rock may be scratched with a nail, corners and edges may be broken with fingers.
Moderately Hard Rock a light blow of hammer is required to break samples.
Hard Rock a hard blow of hammer is required to break sample.

Particle Size Identification	
Boulders	Larger than 12"
Cobbles	3" - 12"
Gravel	
Coarse	3/4" - 3"
Fine	4.76mm - 3/4"
Sand	
Coarse	2.0 - 4.76 mm
Medium	0.42 - 2.00 mm
Fine	0.42 - 0.074 mm
Fines (Silt or Clay)	Smaller than 0.074 mm

Rock Continuity

RECOVERY = $\frac{\text{Total Length of Core}}{\text{Length of Core Run}}$ x 100 %

Description	Core Recovery %
Incompetent	Less than 40
Competent	40 - 70
Fairly Continuous	71 - 90
Continuous	91 - 100

Relative Quality of Rocks

RQD = $\frac{\text{Total core, counting only pieces › 4" long}}{\text{Length of Core Run}}$ x 100 %

Description	RQD %
Very Poor	0 - 25 %
Poor	25 - 50 %
Fair	50 - 75 %
Good	75 - 90 %
Excellent	90 - 100 %

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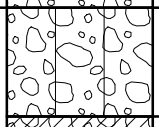
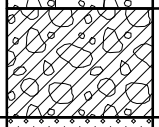
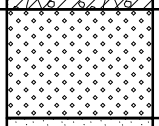
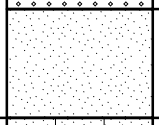
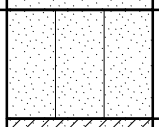
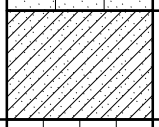
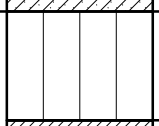
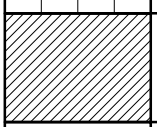
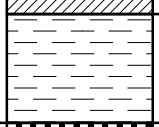
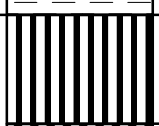
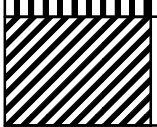
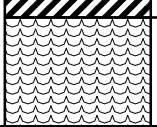
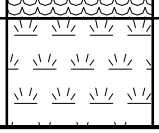
SOIL CLASSIFICATION CHART

MAJOR DIVISIONS			SYMBOLS		TYPICAL DESCRIPTIONS
			GRAPH	LETTER	
COARSE GRAINED SOILS MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	GRAVEL AND GRAVELLY SOILS MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	CLEAN GRAVELS (LITTLE OR NO FINES)		GW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
				GP	POORLY-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
		GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)		GM	SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES
				GC	CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES
	SAND AND SANDY SOILS MORE THAN 50% OF COARSE FRACTION PASSING ON NO. 4 SIEVE	CLEAN SANDS (LITTLE OR NO FINES)		SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
				SP	POORLY-GRADED SANDS, GRAVELLY SAND, LITTLE OR NO FINES
		SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SM	SILTY SANDS, SAND - SILT MIXTURES
				SC	CLAYEY SANDS, SAND - CLAY MIXTURES
FINE GRAINED SOILS MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	SILTS AND CLAYS	LIQUID LIMIT LESS THAN 50		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
				CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
				OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS	LIQUID LIMIT GREATER THAN 50		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS
				CH	INORGANIC CLAYS OF HIGH PLASTICITY
				OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS				PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS

BORING NUMBER BH-01

CLIENT GMC
PROJECT NAME Grassland WWTF Improvements
PROJECT NUMBER GNAS230064
PROJECT LOCATION Franklin, Tennessee
DATE STARTED 10/2/23 **COMPLETED** 10/2/23
GROUND ELEVATION 591 ft **HOLE SIZE** 3.25"
DRILLING CONTRACTOR Master Drillers
GROUND WATER LEVELS:
DRILLING METHOD Diedrich D-50, Auto-Hammer, HSA w/ SPT
AT TIME OF DRILLING -
LOGGED BY M. V. Aken **CHECKED BY** P. Collins
AT END OF DRILLING ---
NOTES
AFTER DRILLING -

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
590	0		LEAN CLAY with SAND (CL), brown, very stiff to hard, moist										
				SS		14-16-14 (30)			14				
			with chert gravel and oxides	SS		4-10-15 (25)			18				
585	5			SS		6-11-14 (25)			22				
	10			SS		5-11-15 (26)			26				
580			Auger refusal was encountered at 12.5 feet.										
	15												
575													
	20												
570													
	25												

BORING NUMBER BH-02

CLIENT GMC
PROJECT NAME Grassland WWTF Improvements
PROJECT NUMBER GNAS230064
PROJECT LOCATION Franklin, Tennessee
DATE STARTED 10/2/23 **COMPLETED** 10/2/23
GROUND ELEVATION 590 ft **HOLE SIZE** 3.25"
DRILLING CONTRACTOR Master Drillers
GROUND WATER LEVELS:
DRILLING METHOD Diedrich D-50, Auto-Hammer, HSA w/ SPT
AT TIME OF DRILLING -
LOGGED BY M. V. Aken **CHECKED BY** P. Collins
AT END OF DRILLING ---
NOTES
AFTER DRILLING -

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
590	0		LEAN CLAY with GRAVEL (CL), brown, hard, with sand, chert and limestone fragments, moist	SS		20-50			14				
585	5			SS		50/1"							
			Auger refusal was encountered at 4.9 feet.										
580	10												
575	15												
570	20												
565	25												

BORING NUMBER BH-03

GMC

CLIENT GMC
PROJECT NAME Grassland WWTF Improvements
PROJECT NUMBER GNAS230064
PROJECT LOCATION Franklin, Tennessee
DATE STARTED 10/5/23 **COMPLETED** 10/5/23
GROUND ELEVATION 593 ft **HOLE SIZE** 3.25"
DRILLING CONTRACTOR Master Drillers
GROUND WATER LEVELS:
DRILLING METHOD Diedrich D-50, Auto-Hammer, HSA w/ SPT
AT TIME OF DRILLING -
LOGGED BY M. V. Aken **CHECKED BY** P. Collins
AT END OF DRILLING ---
NOTES
AFTER DRILLING -

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
	0		SANDY LEAN CLAY (CL), brown, very stiff, with chert and limestone gravel, moist										
				SS		9-11-14 (25)			16				
590													
	5			SS		5-11-13 (24)			21				
				SS		5-10-13 (23)			29				
585													
	10			SS		4-8-11 (19)			30				
			Auger refusal was encountered at 11.5 feet										
580			LIMESTONE, gray moderately hard, slightly weathered, very thin to thin bedded	RC	87 (87)								
	15		LIMESTONE, gray moderately hard, slightly weathered, very thin to thin bedded	RC	94 (94)								
575													
	20		LIMESTONE, gray moderately hard, slightly weathered, very thin to thin bedded	RC	100 (100)								
570			Boring was terminated at 22.0 feet.										
	25												

BORING NUMBER BH-04

CLIENT GMC
PROJECT NAME Grassland WWTF Improvements
PROJECT NUMBER GNAS230064
PROJECT LOCATION Franklin, Tennessee
DATE STARTED 10/3/23 **COMPLETED** 10/3/23
GROUND ELEVATION 592 ft **HOLE SIZE** 3.25"
DRILLING CONTRACTOR Master Drillers
GROUND WATER LEVELS:
DRILLING METHOD Diedrich D-50, Auto-Hammer, HSA w/ SPT
AT TIME OF DRILLING -
LOGGED BY M. V. Aken **CHECKED BY** P. Collins
AT END OF DRILLING ---
NOTES
AFTER DRILLING -

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
	0		LEAN CLAY with SAND (CL), brown, stiff to very stiff, with chert gravel, moist										
590				SS		7-8-10 (18)			15				
	5			SS		5-8-10 (18)			15				
585				SS		4-7-10 (17)			33				
	10			SS		5-6-8 (14)			23				
580			Auger refusal was encountered at 12.5 feet.										
	15												
575													
	20												
570													
	25												

BORING NUMBER BH-05

GMC

CLIENT GMC
PROJECT NAME Grassland WWTF Improvements
PROJECT NUMBER GNAS230064
PROJECT LOCATION Franklin, Tennessee
DATE STARTED 10/3/23 **COMPLETED** 10/3/23
GROUND ELEVATION 593 ft **HOLE SIZE** 3.25"
DRILLING CONTRACTOR Master Drillers
GROUND WATER LEVELS:
DRILLING METHOD Diedrich D-50, Auto-Hammer, HSA w/ SPT
AT TIME OF DRILLING -
LOGGED BY M. V. Aken **CHECKED BY** P. Collins
AT END OF DRILLING ---
NOTES
AFTER DRILLING -

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
	0		SANDY LEAN CLAY (CL), brown, very stiff, trace chert gravel, moist										
				SS		9-13-10 (23)			14	37	21	16	
590													
	5			SS		7-13-14 (27)			15				
				SS		5-11-15 (26)			20				
585													
			LEAN CLAY with SAND (CL), brown, very stiff, trace chert gravel, moist	SS		4-8-11 (19)			24				
	10												
580			Auger refusal was encountered at 12.6 feet.										
	15												
575													
	20												
570													
	25												

BORING NUMBER BH-06

GMC

CLIENT GMC
PROJECT NAME Grassland WWTF Improvements
PROJECT NUMBER GNAS230064
PROJECT LOCATION Franklin, Tennessee
DATE STARTED 10/3/23 **COMPLETED** 10/3/23
GROUND ELEVATION 594 ft **HOLE SIZE** 3.25"
DRILLING CONTRACTOR Master Drillers
GROUND WATER LEVELS:
DRILLING METHOD Diedrich D-50, Auto-Hammer, HSA w/ SPT
AT TIME OF DRILLING -
LOGGED BY M. V. Aken **CHECKED BY** P. Collins
AT END OF DRILLING ---
NOTES
AFTER DRILLING -

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
	0		SANDY LEAN CLAY (CL), brown, hard, trace chert gravel, moist	SS		8-15-17 (32)			18				
590	5		LEAN CLAY (CL), brown, stiff to very stiff, trace sand, silt and chert, moist	SS		4-7-5 (12)			45				
				SS		4-6-10 (16)			33				
585	10			SS		3-5-8 (13)			35				
			Auger refusal was encountered at 11.5 feet.										
580	15												
575	20												
570	25												

BORING NUMBER BH-07

CLIENT GMC
PROJECT NAME Grassland WWTF Improvements
PROJECT NUMBER GNAS230064
PROJECT LOCATION Franklin, Tennessee
DATE STARTED 10/3/23 **COMPLETED** 10/3/23
GROUND ELEVATION 596 ft **HOLE SIZE** 3.25"
DRILLING CONTRACTOR Master Drillers
GROUND WATER LEVELS:
DRILLING METHOD Diedrich D-50, Auto-Hammer, HSA w/ SPT
AT TIME OF DRILLING -
LOGGED BY M. V. Aken **CHECKED BY** P. Collins
AT END OF DRILLING ---
NOTES
AFTER DRILLING -

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
595	0		SANDY SILT (ML), brown, very stiff to hard, trace chert gravel, moist										
				SS		7-15-18 (33)			19	42	27	15	
	5			SS		11-14-9 (23)			28				
590			LEAN CLAY with SAND (CL), brown, stiff, trace silt and chert gravel, moist										
				SS		3-4-6 (10)			35				
	10			SS		3-6-8 (14)			31				
585			Auger refusal was encountered at 11.7 feet.										
	15												
580													
	20												
575													
	25												

BORING NUMBER BH-08

GMC

CLIENT GMC
PROJECT NAME Grassland WWTF Improvements
PROJECT NUMBER GNAS230064
PROJECT LOCATION Franklin, Tennessee
DATE STARTED 10/4/23 **COMPLETED** 10/4/23
GROUND ELEVATION 595 ft **HOLE SIZE** 3.25"
DRILLING CONTRACTOR Master Drillers
GROUND WATER LEVELS:
DRILLING METHOD Diedrich D-50, Auto-Hammer, HSA w/ SPT
AT TIME OF DRILLING -
LOGGED BY M. V. Aken **CHECKED BY** P. Collins
AT END OF DRILLING ---
NOTES
AFTER DRILLING -

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
595	0		SANDY LEAN CLAY (CL), tan to brown, stiff to hard, trace chert gravel, moist										
				SS		11-13-16 (29)			21				
590	5			SS		11-14-21 (35)			18				
				SS		5-6-7 (13)			35				
585	10			SS		4-7-10 (17)			32				
580	15		Auger refusal was encountered at 13.0 feet.										
575	20												
570	25												

BORING NUMBER BH-09

GMC

CLIENT GMC
PROJECT NAME Grassland WWTF Improvements
PROJECT NUMBER GNAS230064
PROJECT LOCATION Franklin, Tennessee
DATE STARTED 10/3/23 **COMPLETED** 10/3/23
GROUND ELEVATION 597 ft **HOLE SIZE** 3.25"
DRILLING CONTRACTOR Master Drillers
GROUND WATER LEVELS:
DRILLING METHOD Diedrich D-50, Auto-Hammer, HSA w/ SPT
AT TIME OF DRILLING -
LOGGED BY M. V. Aken **CHECKED BY** P. Collins
AT END OF DRILLING ---
NOTES
AFTER DRILLING -

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
	0		SANDY LEAN CLAY (CL), tan to brown, very stiff to hard, trace chert gravel, moist										
595				SS		14-14-21 (35)			17				
	5			SS		11-14-16 (30)			17				
590				SS		5-9-10 (19)			20				
			LEAN CLAY with SAND (CL), brown, stiff, with chert gravel, moist	SS		3-6-6 (12)			36				
	10												
585													
			Auger refusal was encountered at 12.7 feet.										
	15												
580													
	20												
575													
	25												

BORING NUMBER BH-10

GMC

CLIENT GMC
PROJECT NAME Grassland WWTF Improvements
PROJECT NUMBER GNAS230064
PROJECT LOCATION Franklin, Tennessee
DATE STARTED 10/3/23 **COMPLETED** 10/3/23
GROUND ELEVATION 598 ft **HOLE SIZE** 3.25"
DRILLING CONTRACTOR Master Drillers
GROUND WATER LEVELS:
DRILLING METHOD Diedrich D-50, Auto-Hammer, HSA w/ SPT
AT TIME OF DRILLING -
LOGGED BY M. V. Aken **CHECKED BY** P. Collins
AT END OF DRILLING ---
NOTES
AFTER DRILLING -

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
	0		SANDY LEAN CLAY (CL), tan to brown, very stiff, with chert gravel, moist										
				SS		8-11-12 (23)			16				
595													
	5			SS		6-12-9 (21)			19				
			LEAN CLAY with SAND (CL), brown, firm to stiff, with chert gravel, moist										
				SS		3-3-5 (8)			33				
590													
				SS		2-4-6 (10)			33				
	10												
585			Auger refusal was encountered at 12.9 feet.										
	15												
580													
	20												
575													
	25												

BORING NUMBER BH-11

GMC

CLIENT GMC
PROJECT NAME Grassland WWTF Improvements
PROJECT NUMBER GNAS230064
PROJECT LOCATION Franklin, Tennessee
DATE STARTED 10/4/23 **COMPLETED** 10/4/23
GROUND ELEVATION 597 ft **HOLE SIZE** 3.25"
DRILLING CONTRACTOR Master Drillers
GROUND WATER LEVELS:
DRILLING METHOD Diedrich D-50, Auto-Hammer, HSA w/ SPT
AT TIME OF DRILLING -
LOGGED BY M. V. Aken **CHECKED BY** P. Collins
AT END OF DRILLING ---
NOTES
AFTER DRILLING -

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
	0		SANDY LEAN CLAY (CL)tan, very stiff to stiff, with chert gravel, moist										
595				SS		9-12-10 (22)			19				
	5			SS		5-8-7 (15)			19				
			LEAN CLAY with SAND (CL), brown, firm, with chert gravel, moist										
590				SS		3-3-4 (7)			30				
	10			SS		2-2-3 (5)			36				
585			Auger refusal was encountered at 12.7 feet										
			LIMESTONE, graymoderately hard, slightly weathered, very thin to thin bedded	RC	90 (75)								
	15		LIMESTONE, graymoderately hard, slightly weathered, very thin to thin bedded	RC	89 (89)								
580													
	20		LIMESTONE, graymoderately hard, slightly weathered, very thin to thin bedded	RC	100 (100)								
575													
			Auger refusal was encountered at 22.7 feet.										
	25												

BORING NUMBER BH-12

CLIENT GMC
PROJECT NAME Grassland WWTF Improvements
PROJECT NUMBER GNAS230064
PROJECT LOCATION Franklin, Tennessee
DATE STARTED 10/4/23 **COMPLETED** 10/4/23
GROUND ELEVATION 602 ft **HOLE SIZE** 3.25"
DRILLING CONTRACTOR Master Drillers
GROUND WATER LEVELS:
DRILLING METHOD Diedrich D-50, Auto-Hammer, HSA w/ SPT
AT TIME OF DRILLING -
LOGGED BY M. V. Aken **CHECKED BY** P. Collins
AT END OF DRILLING ---
NOTES
AFTER DRILLING -

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
	0		LEAN CLAY with SAND (CL), brown, very stiff to hard, with chert gravel, moist										
600				SS		7-12-18 (30)			20				
	5			SS		6-10-12 (22)			21				
			SANDY LEAN CLAY (CL), red brown to brown, firm to very stiff, with chert gravel, moist										
595				SS		4-9-11 (20)			19				
	10			SS		4-9-12 (21)			23				
590													
	15			SS		3-3-3 (6)			36				
585													
				SS		50/5"			29				
	20		Auger refusal was encountered at 19.0 feet.										
580													
	25												

BORING NUMBER BH-13

GMC

CLIENT GMC
PROJECT NAME Grassland WWTF Improvements
PROJECT NUMBER GNAS230064
PROJECT LOCATION Franklin, Tennessee
DATE STARTED 10/3/23 **COMPLETED** 10/3/23
GROUND ELEVATION 606 ft **HOLE SIZE** 3.25"
DRILLING CONTRACTOR Master Drillers
GROUND WATER LEVELS:
DRILLING METHOD Diedrich D-50, Auto-Hammer, HSA w/ SPT
AT TIME OF DRILLING -
LOGGED BY M. V. Aken **CHECKED BY** P. Collins
AT END OF DRILLING ---
NOTES
AFTER DRILLING -

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
605	0		SILT WITH SAND (ML), brown, stiff to hard, trace chert gravel and oxides, moist	SS		7-14-20 (34)			21				
	5			SS		5-12-20 (32)			22	42	27	15	83
600				SS		4-11-16 (27)			21				
	10			SS		5-11-16 (27)			20				
595				SS		4-9-10 (19)			17				
	15												
590				SS		4-6-6 (12)			28				
	20												
585			Auger refusal was encountered at 21.3 feet.										
	25												

BORING NUMBER BH-14

GMC

CLIENT GMC
PROJECT NAME Grassland WWTF Improvements
PROJECT NUMBER GNAS230064
PROJECT LOCATION Franklin, Tennessee
DATE STARTED 10/4/23 **COMPLETED** 10/4/23
GROUND ELEVATION 604 ft **HOLE SIZE** 3.25"
DRILLING CONTRACTOR Master Drillers
GROUND WATER LEVELS:
DRILLING METHOD Diedrich D-50, Auto-Hammer, HSA w/ SPT
AT TIME OF DRILLING -
LOGGED BY M. V. Aken **CHECKED BY** P. Collins
AT END OF DRILLING ---
NOTES
AFTER DRILLING -

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
	0		LEAN CLAY with SAND (CL)tan, stiff to hard, trace chert gravel and oxides, moist										
				SS		6-8-15 (23)			21				
600	5			SS		7-11-13 (24)			28				
				SS		5-10-21 (31)			24				
595	10			SS		7-11-13 (24)			22				
590	15			SS		3-5-5 (10)			20				
585	20			SS		2-2-50/4"			35				
			Auger refusal was encountered at 19.8 feet.										
580	25												

BORING NUMBER BH-15

GMC

CLIENT GMC
PROJECT NAME Grassland WWTF Improvements
PROJECT NUMBER GNAS230064
PROJECT LOCATION Franklin, Tennessee
DATE STARTED 10/4/23 **COMPLETED** 10/4/23
GROUND ELEVATION 593 ft **HOLE SIZE** 3.25"
DRILLING CONTRACTOR Master Drillers
GROUND WATER LEVELS:
DRILLING METHOD Diedrich D-50, Auto-Hammer, HSA w/ SPT
AT TIME OF DRILLING -
LOGGED BY M. V. Aken **CHECKED BY** P. Collins
AT END OF DRILLING ---
NOTES
AFTER DRILLING -

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
	0		SANDY LEAN CLAY (CL), brown to tan, very stiff, trace oxides, moist										
590				SS		7-7-10 (17)			40				
	5			SS		8-9-13 (22)			20				
585				SS		4-9-11 (20)			32				
	10			SS		5-7-9 (16)			41				
580			Auger refusal was encountered at 13.0 feet.										
	15												
575													
	20												
570													
	25												

Photo 1 – View of Rock Core BH-03

Photograph Log		GMC	
Grassland WWTF			
GNAS230064			
M. Van Aken	October 16, 2023		

Photo 2 – View of Rock Core BH-11

Photograph Log	
Grassland WWTF	
GNAS230064	
M. Van Aken	October 16, 2023

SUMMARY OF LABORATORY RESULTS

CLIENT GMC **PROJECT NAME** Grassland WWTF Improvements

PROJECT NUMBER GNAS230064 **PROJECT LOCATION** Franklin, Tennessee

Borehole	Depth	Liquid Limit	Plastic Limit	Plasticity Index	Max. Sieve Size Tested (mm)	%<#200 Sieve	Natural Moisture (%)	Class-ification	Opt. Moisture Content (%)	Max Dry Density (pcf)	Specific Gravity
BH-01	1-2.5						14.3				
BH-01	3.5-5						18.1				
BH-01	6-7.5						22.4				
BH-01	8.5-10						26.3				
BH-02	1-2.5						14.4				
BH-03	1-2.5						15.7				
BH-03	3.5-5						20.9				
BH-03	6-7.5						28.8				
BH-03	8.5-10						30.1				
BH-04	1-2.5						15.5				
BH-04	3.5-5						15.5				
BH-04	6-7.5						33.3				
BH-04	8.5-10						23.2				
BH-05	1-2.5	37	21	16			13.9				
BH-05	3.5-5						15.4				
BH-05	6-7.5						20.0				
BH-05	8.5-10						24.4				
BH-06	1-2.5						17.9				
BH-06	3.5-5						45.3				
BH-06	6-7.5						33.1				
BH-06	8.5-10						35.5				
BH-07	1-2.5	42	27	15			18.9				
BH-07	3.5-5						28.3				
BH-07	6-7.5						34.8				
BH-07	8.5-10						31.3				
BH-08	1-2.5						20.8				
BH-08	3.5-5.0						18.5				
BH-08	6-7.5						35.4				
BH-08	8.5-10						32.3				
BH-09	1-2.5						16.7				
BH-09	3.5-5						17.3				
BH-09	6-7.5						19.8				
BH-09	8.5-10						35.9				
BH-10	1-2.5						15.5				
BH-10	3.5-6						19.5				
BH-10	6-7.5						33.0				
BH-10	8.5-10						33.1				
BH-11	1-2.5						18.6				
BH-11	3.5-6						18.9				
BH-11	6-7.5						29.9				
BH-11	8.5-10						35.7				
BH-12	1-2.5						19.8				
BH-12	3.5-5						21.1				

SUMMARY OF LABORATORY RESULTS

CLIENT GMC **PROJECT NAME** Grassland WWTF Improvements

PROJECT NUMBER GNAS230064 **PROJECT LOCATION** Franklin, Tennessee

Borehole	Depth	Liquid Limit	Plastic Limit	Plasticity Index	Max. Sieve Size Tested (mm)	%<#200 Sieve	Natural Moisture (%)	Class-ification	Opt. Moisture Content (%)	Max Dry Density (pcf)	Specific Gravity
BH-12	6-7.5						18.9				
BH-12	8.5-10						22.7				
BH-12	13.5-15						36.5				
BH-12	18.5-19						28.8				
BH-13	1-2.5						21.2				
BH-13	3.5-5	42	27	15		83	22.1	ML			
BH-13	6-7.5						21.3				
BH-13	8.5-10						20.0				
BH-13	13.5-15						16.8				
BH-13	18.5-20						28.4				
BH-14	1-2.5						21.5				
BH-14	3.5-5						27.7				
BH-14	6-7.5						23.5				
BH-14	8.5-10						22.1				
BH-14	13.5-15						20.1				
BH-14	18.5-20						35.3				
BH-15	1-2.5						40.2				
BH-15	3.5-5						19.9				
BH-15	6-7.5						32.5				
BH-15	8.5-10						40.5				

Goodwyn Mills Cawood, LLC
3310 West End Avenue
Suite 420
Nashville, TN 37203
T 615.333.7200

www.gmcnetwork.com

PUBLIC

Attachment DR 5 – CSWR Consolidated Financial Statements

Attachment DR 6 – Supplemental Direct Testimony of Todd Thomas

DIRECT TESTIMONY

OF TODD THOMAS

LIMESTONE WATER UTILITY OPERATING COMPANY, LLC

WITNESS INTRODUCTION

Q. PLEASE STATE YOUR NAME AND BUSINESS ADDRESS.

A. My name is Todd Thomas. My business address is 1630 Des Peres Road, Suite 140, St. Louis Missouri, 63131.

Q. PLEASE DESCRIBE CSWR, LLC AND LIMESTONE WATER UTILITY OPERATING COMPANY.

A. CSWR, LLC ("CSWR") is a holding company that currently indirectly owns utility operating companies in 11 states. Limestone Water Utility Operating Company, LLC ("Limestone Water" or "Company") is the CSWR-affiliated utility operating company in Tennessee.

Q. WHAT IS YOUR POSITION WITH CSWR?

A. I am Senior Vice President of CSWR, the affiliated company that has operational oversight over CSWR's utility operating companies including Limestone Water. At CSWR, my responsibilities include the acquisition, development, and operation of CSWR-affiliated utilities. Among other duties, and relevant to this testimony, I am responsible for engaging and overseeing management and maintenance service providers including those contractors responsible for day-to-day operations and maintenance ("O&M") of CSWR operating affiliates like Limestone Water. In addition, I am responsible for engaging and

overseeing customer service providers. At the present time, I oversee such activities for affiliated operating companies providing water or wastewater utility services to approximately 133,000 connections in Kentucky, Missouri, Arkansas, Tennessee, Louisiana, Texas, Mississippi, North Carolina, South Carolina, Arizona, and Florida. CSWR has additional applications pending in most of these states as well as in California seeking authorization to acquire even more systems and customers. If those applications are approved, my oversight responsibilities will extend to those additional systems and customers.

Q. PLEASE DESCRIBE YOUR EDUCATIONAL AND PROFESSIONAL EXPERIENCE.

A. My education includes a Bachelor of Science in Civil Engineering from the Missouri University of Science and Technology, and a Master of Business Administration from Washington University in St. Louis.

Before joining CSWR, I was President of Brotcke Well and Pump (the 2nd largest well driller and service provider in the Midwest); Vice President of Operations and Business Development of the Midwest for American Water Contract Operations; and General Manager of Midwest Operations for Environmental Management Corporation. I currently serve on the East Central Missouri Board of Directions and am an Advisory Board member for the Public Water Supply District 2 of St. Charles County, Missouri which is the largest water and sewer district in the State of Missouri serving approximately 60,000 connections.

Brotcke Well and Pump serves municipal potable, regulated potable, and industrial ground water suppliers in the states of Missouri, Illinois, Kansas, Tennessee, Kentucky, and Arkansas. Its total number of clients exceeds 200 and they range in size from the City of Bloomington, Illinois, with 31,000 water customers, to 230 customers in the City of Eminence, Missouri. Brotcke Well and Pump drills wells, cleans and treats wells, installs pumps, services pumps, rebuilds pumps, tests wells for regulatory compliance, and installs and services well controls. As President of Brotcke Well and Pump, I was involved in the design, maintenance, and repair of all client well systems. I have firsthand experience with how much damage can be done by lack of maintenance on a well system and how much money and effort is required to restore a well system after neglect.

As Vice President of Operations and Business Development of the Midwest for American Water Contract Operations, I was responsible for the water and wastewater operations and maintenance contracts for municipal and industrial clients. These clients included wastewater systems owned and operated by the City of St. Charles, in Missouri, and the cities of Godfrey, Mount Vernon, Quincy, Litchfield, Lincoln, Pittsfield, and Elwood in Illinois. These clients also included water and wastewater systems owned and operated by the City of Foristell, Missouri, and the Illinois cities of Brighton, and Monmouth. At one time I had responsibility for operating water and wastewater systems serving approximately 64,000 residential connections. My responsibilities included the direction and management of annual budgeting for each plant's operations and maintenance, design and planning of plant upgrades and maintenance projects, regulatory reporting, plant operations, and regulatory compliance of these systems.

My position as General Manager of Midwest Operations for Environmental Management Corporation was similar to my position with American Water Contract Operations with regard to the size and scope of the systems the company managed.

Q. WHAT IS THE PURPOSE OF YOUR DIRECT TESTIMONY IN THIS CASE?

A. The purpose of my testimony is to support the application filed in this case ("Application") through which Limestone asks that the Commission expand the company's Certificate of Convenience and Necessity ("CCN") to allow it to own and operate a wastewater system to serve the Adley subdivision in Williamson County. My testimony describes the proposed expansion and explains why Limestone believes the expansion is in the public interest. Specifically, I will discuss the development envisioned for the proposed service area, as well as the need for the CCN expansion so that Limestone can operate the wastewater treatment system to be constructed for the proposed development.

I also describe Limestone's relationship to CSWR, the role CSWR would play in Limestone's operation of the wastewater system at issue in this case, and the benefits Limestone's relationship with CSWR would bring to customers served by that system. Finally, to the extent applicable, I provide the Commission information required by TPUC Rule 1220-04-13-.17(2) and other rules applicable to the Application. In this testimony, I also adopt the Application and verify that all information included there is true and correct to the best of my information and belief.

BACKGROUND INFORMATION REGARDING LIMESTONE AND ITS AFFILIATES

Q. PLEASE PROVIDE SOME BACKGROUND INFORMATION ABOUT LIMESTONE AND CSWR.

A. Limestone is a Tennessee limited liability company formed to acquire water and wastewater assets in Tennessee and to operate those assets as a regulated public utility. In Docket No. 19-00062, involving Limestone's acquisition of Aqua Utilities Company, Inc., the Commission first authorized Limestone to operate in Tennessee. There the Commission held:

> Based on the evidentiary record, the Hearing Panel found that Limestone has the requisite managerial, technical, and financial capabilities to operate the water system and wastewater system in Hardin County serving Points of Pickwick, The Preserve, and Northshore (Phases 1, 2, and 3) now owned by Aqua.

The Commission subsequently reached similar conclusions regarding the managerial, technical and financial capabilities of Limestone when it approved the acquisition of Cartwright Creek and the expansion of Limestone's CCN:

> The Commission found that Limestone demonstrated that it has sufficient financial, managerial, and technical expertise to operate the Williamson County wastewater systems at issue.

As a result of these acquisitions, Limestone now serves approximately 580 water customers and 2,013 wastewater customers.

Limestone is a subsidiary of CSWR, a Missouri limited liability company formed to provide managerial, technical, and financial support to its utility operating affiliates. A corporate organization chart illustrating that relationship is included as **Exhibit 5** to the Application.

To date, CSWR-affiliated utility operating companies have acquired and are operating water or wastewater systems in Missouri, Arkansas, Kentucky, Louisiana, Texas, Mississippi, North Carolina, South Carolina, Arizona, Florida, and Tennessee. Furthermore, CSWR-affiliated entities have additional acquisitions pending in several of these states as well as in the state of California.

Q. WHAT IS CSWR'S BUSINESS PLAN WITH REGARD TO THE ACQUISITION AND OPERATION OF SMALL AND DISTRESSED WATER AND WASTEWATER SYSTEMS?

A. CSWR's business plan is to pursue the purchase and recapitalization of small water and wastewater systems and to operate those systems as investor-owned regulated utilities. Many of those systems are not currently regulated. Of those that are regulated, many, if not most, are out of compliance with utility commission rules and with federal or state pollution and safety laws and regulations. Indeed, many systems that CSWR acquires do not even have federal or state permits required to lawfully operate those systems. CSWR also has found that many regulated systems that it has acquired have not increased their rates for a decade or more and, as a result, lack the financial resources necessary to build, maintain, and replace assets used to provide service or bring operations into compliance with rapidly changing environmental and water quality regulations. Some systems that CSWR acquires are in receivership, and therefore lack the ability to raise capital necessary to improve their systems. In contrast, since CSWR has found investors willing to make investments and take risks necessary to bring small water and wastewater systems into compliance with current statutes, rules, and regulations, it has been able to acquire

distressed systems, upgrade or repair physical facilities, and operate those systems in a way that satisfies customers, regulators, and investors alike.

Q. PLEASE DESCRIBE CSWR-AFFILIATES' EXPERIENCE WITH WASTEWATER SYSTEMS.

A. If this application is approved, Limestone has the financial, technical, and managerial ability to serve the Adley subdivision in a manner that fully complies with applicable health, safety, and environmental protection laws and regulations and provides reliable, safe, and adequate service to customers. As of the end of 2022, CSWR was the twelfth largest investor-owned water and wastewater utility in the United States. We also are the largest single owner operator of individual wastewater systems in the United States, and we will be on track to singlehandedly bring into compliance the largest number of individual wastewater plants across our national footprint in recent United States history (potentially ever). The CSWR-affiliated group of companies is likely the most qualified utility in the United States to service customers based on the number of systems we own, the number of systems that we have purchased and kept in environmental compliance, and our personnel having the most relevant experience running small utilities. Our affiliate group current owns and operates more than 800 water and wastewater plants within our eleven-state operational footprint. On a daily basis we deliver, on average, more than 14.6 million gallons of water daily to our more than 42,000 water connections and treat almost 20 million gallons of wastewater to our more than 60,000 wastewater connections. In Louisiana, alone, our affiliate has removed fifty-nine (59) systems from Agreements on Consent with the Louisiana Department of Environmental Quality – the fastest timeframe ever for a large group of systems – and we are 100% compliant with environmental

compliance agreements entered into with state regulators. These agreements are necessary because of the extremely distressed nature of many systems our group acquires, and our record of compliance with and removal from these agreements is testament to our ability to own and operate such systems in a manner that complies with applicable laws and provides safe and reliable service to customers.

Specifically, on the wastewater side of the business, CSWR affiliates (including Limestone) have purchased wastewater treatment plants with associated sewer pumping stations, gravity force mains, and gravity conveyance lines. With the approval of state wastewater regulatory authorities, since March 2015, CSWR-affiliated companies have designed, permitted, and completed construction, of numerous sanitary sewer system improvements. These improvements include wastewater line repairs to remove infiltration and inflow, building sewer main extensions, the repair of multiple lift stations, the construction of lift stations, the closure of an existing regulatory impaired wastewater system, building fully activated sludge plants, constructing moving bed bio-reactor plants converting multiple failing wastewater systems into sludge storage/flow equalization and treatment basins, converting failed mechanical systems to I-Fast systems, and constructing various other wastewater supporting improvements.

Q. DOES CSWR HAVE PERSONNEL QUALIFIED TO PERFORM THE SERVICES YOU IDENTIFIED IN YOUR PRECEDING ANSWER?

A. Yes. This fact is evidenced by the fact that CSWR is already providing those and other similar services for wastewater systems in Tennessee, as well as 10 other states. While I have already described my background and experience in the water and wastewater utility industry, the resumes of the other key members of CSWR's senior team who would be

involved in Limestone's operations are included as **Exhibit 8**. The resumes of the CSWR senior team shows that Limestone is well-qualified to meet the demands of Limestone and its customers as well as any requirements of this Commission and other regulators charged with overseeing Limestone's operations. The types and quality of services that CSWR provides to Limestone are not typically available to small systems like that at issue in this case. However, CSWR's business model was developed specifically to provide that expertise and experience to affiliates and to do so while achieving economies of scale attributable to CSWR's centralized management structure.

Q. PLEASE DESCRIBE THE CUSTOMER SERVICES THAT CSWR PROVIDES TO ITS AFFILIATE CUSTOMERS.

A. In addition to these operational capabilities, CSWR also provides customer service to customers that meet or exceed regulatory commission rules. CSWR provides 24/7 access to customer service representatives via phone and email. Similarly, CSWR provides around the clock emergency response to operational problems. Furthermore, through its website, CSWR customers can access information regarding advisories, payment options and customer education items. If the Application is approved, Limestone would provide this same level of customer service to the Adley customers.

Q. DO LIMESTONE AND CSWR HAVE THE FINANCIAL CAPACITY TO PROVIDE WASTEWATER SERVICE TO THE ADLEY SUBDIVISION?

A. Yes, Limestone and CSWR have the financial capacity to provide wastewater services to the Adley subdivision. The CSWR-affiliated group, of which Limestone is a member, has been able to secure an ongoing commitment from a Wall Street private equity firm that enables CSWR utility affiliates to not only purchase small, oftentimes distressed, water

and wastewater systems, but to also make the investments necessary to bring those systems into compliance with applicable health, safety, and environmental protection laws and regulations. This investment commitment also includes working capital necessary to operate until an application for compensatory rates can be prepared and prosecuted.

Q. HOW DOES LIMESTONE PROPOSE TO PROVIDE OPERATIONAL SUPPORT TO THE ADLEY SUBDIVISION?

A. As it currently does for its other Tennessee service areas, Limestone would hire a local, non-affiliated third-party Operations and Maintenance ("O&M") firm that has knowledgeable and experienced personnel, possesses requisite state licenses, and carries insurance coverage necessary to operate the Adley system.

In addition to its service obligations during normal business hours, the O&M firm would also be required to have a 24-hour emergency service line to deal with customers experiencing service disruptions. CSWR has developed a centralized computerized maintenance management system that monitors the performance of both its drinking water and wastewater systems and allows it to track the ongoing maintenance and testing work performed by its O&M contractors. In addition, CSWR uses geographic information system ("GIS") survey information to accurately map all infrastructure assets, which allows the Company to specifically target ongoing infrastructure re-investment as part of the overall managerial and technical support CSWR provides each of its utility operating affiliates.

While day-to-day operational functions would be provided by non-employee contractors, all management, financial reporting, underground utility safety and location services, Commission regulatory reporting, environmental regulatory reporting and

management, operations oversight, utility asset planning, engineering planning, ongoing utility maintenance, utility record keeping, and final customer dispute management would be performed by personnel at CSWR's corporate office. CSWR personnel also would monitor the activities of the non-employee contractors to make sure the system is being operated and maintained properly and customers' needs are being met. As mentioned, the resumes of CSWR personnel who, in addition to me, would be responsible for providing services or oversight to Limestone's operation, are attached to the Application as **Exhibit 8**.

DESCRIPTION OF THE PROPOSED SERVICE AREA EXPANSION

Q. PLEASE DESCRIBE THE CERTIFICATE EXPANSION THAT LIMESTONE SEEKS IN THIS APPLICATION.

A. The proposed service area expansion is approximately 151 acres in Williamson County, which consists of a 30-lot residential subdivision. A maps showing the location of this system is provided as **Exhibit 1** to the Application. The subdivision is being developed by Manley Lane Holding Company, LLC.

Q. DOES THE PROPOSED SUBDIVISION FALL WITHIN THE SERVICE AREA OF ANY WATER / WASTEWATER PROVIDERS?

A. The subdivision does not fall within the service area of any water/wastewater providers to my knowledge. For this reason, Manley Lane Holding Company, LLC, developer of the Adley subdivision, proposes to construct its own wastewater collection system and send flows to the existing Grasslands Treatment Facility. The to-be constructed system will utilize precast concrete septic tanks for each home with E1 Grinder pumps and controls at each homesite. The sewer collection system will consist of low-pressure PVC force mains

and associated appurtenances and an extension of the gravity sewer with associated gravity sewer mains and manholes. This new collection system for the development will connect to the Grasslands collection system at an existing manhole with excess capacity for the increased flows. From there, flows will be sent to the Grasslands Treatment facility.

Q. WHAT IS LIMESTONE'S ROLE IN THIS PROJECT?

A. While Manley Lane Holding Company, LLC, plans to construct the wastewater treatment assets, it does not wish to be the ongoing operator of the treatment system. For this reason, Limestone was asked to accept ownership of the treatment system and accept ongoing responsibility for the operation of the system as well as providing wastewater services to the customers within this service area.

Q. IF THE COMMISSION APPROVES THE APPLICATION, IS LIMESTONE WILLING AND ABLE TO OPERATE THE WASTEWATER SYSTEM IN A MANNER THAT COMPLIES WITH APPLICABLE REGULATIONS?

A. Yes. If the Commission grants Limestone the authority it seeks in the Application, Limestone and CSWR are willing and able to operate the system in a manner that complies with applicable laws and regulations. As I described previously, the affiliate group of which Limestone and CSWR are part has access to capital adequate to operate that system in a manner that is in the public interest and complies with applicable statutes, rules, and regulations.

Q. WHAT RATES, RULES, AND REGULATIONS WOULD BE IN EFFECT FOR THE ADLEY SUBDIVISION?

A. Initially, Limestone proposes to utilize the rates, rules and regulations that are currently applicable to its Cartwright Creek service area. The existing tariff would be applicable at

least until Limestone files a Tennessee rate case. At that time, Limestone may seek to adjust the rates, rules or regulations for this service area. Limestone may also seek authority to consolidate the rates of this system with those of other systems it operates in Tennessee.

Q. ARE LIMESTONE AND CSWR FAMILIAR WITH THE COMMISSION'S RULES AND REGULATIONS GOVERNING WASTEWATER UTILITIES AND DO THOSE COMPANIES PLEDGE TO OPERATE THE SYSTEM AT ISSUE IN THIS CASE IN A MANNER THAT COMPLIES WITH THOSE RULES AND REGULATIONS?

A Yes, As indicated, Limestone currently operates in the state of Tennessee. Therefore, CSWR and Limestone are familiar with the Commission's rules and regulations and pledge to continue to operate the system in a manner that complies with all Commission requirements and all applicable state statutes and regulations.

Q. HOW DOES LIMESTONE PROPOSE TO SATISFY THE FINANCIAL SECURITY REQUIREMENTS IMPOSED BY TPUC RULES 122-04-13-.07 AND 1220-04-13-.08?

A. To demonstrate financial security as required by the Commission's rules, Limestone has already secured a corporate surety bond in the maximum required under the Commission's rule ($300,000) in a form that complies with TPUC Rule 1220-04-13-.08.

Q. DO YOU BELIEVE THE PROPOSED SERVICE AREA EXPANSION IS IN THE PUBLIC INTEREST?

A Yes. I believe Limestone's proposed expansion of its certificated service area, to include the Adley service area, would be consistent with and would promote the public interest.

Limestone and CSWR are fully qualified, in all respects, to own and operate that system and to otherwise provide safe and adequate service. Furthermore, as previously explained, this approximately 10-acre tract is currently undeveloped. Through the operation of the wastewater facility to be constructed by Manley Lane Holding Company, LLC, Limestone's service area expansion allows for the development of this land.

Q. WOULD YOU LIKE TO PROVIDE ANY OTHER INFORMATION IN YOUR DIRECT TESTIMONY?

A. Yes. The Adley homes may be built in time to connect to the Grasslands existing facility. However, as construction has not yet begun on the homes in Adley, it is reasonably possible that by the time the homes are ready to connect to Limestone's system, the Grasslands replacement facility will be at or near completion. If the homes are connected to the replacement facility, Limestone is aware of the requirement of Rule 1220-04-13-.09(7) concerning the completion of the construction of that wastewater system within three years of TPUC's written approval of the CCN, In accordance with Rule 1220-04-13-.17(2)(f)5.

DOES THIS CONCLUDE YOUR DIRECT TESTIMONY?

A. Yes, it does.

Attachment DR 8 – TDEC/Limestone Meeting Notes September 2023

STATE OF TENNESSEE
DEPARTMENT OF ENVIRONMENT AND CONSERVATION
DIVISION OF WATER RESOURCES
William R. Snodgrass - Tennessee Tower
312 Rosa L. Parks Avenue, 11th Floor
Nashville, TN 37243-1102

PROJECT NAME: Grasslands WWTP Improvements
DATE REQUESTED: 8/29/23
MEETING LOCATION: Microsoft Teams
PERMIT: TN0027278

COUNTY: Williamson
DATE HELD: 9/1/23
MEETING TIME: 200p central
WPN: 23.0470

PARTICIPANTS/REPRESENTING: (checklist ITEM I.A)

TDEC DWR: Tim Hill, PE (timothy.hill@tn.gov), Angela Jones, PE (angela.jones@tn.gov), Wade Murphy, EI (wade.murphy@tn.gov), Bob O'dette, PE, BCCE (Robert.Odette@tn.gov), Daniel Pleasant (Daniel.pleasant@tn.gov)

GMC: Logan Dickinson, PE (ldickinson@gmcnetwork.com)

Central States Water (Limestone): Jake Freeman (jfreeman@cswrgroup.com)

PROJECT BACKGROUND AND PURPOSE: (checklist ITEM B)

Limestone Water Utility Operating Company recently acquired (February 2022) Grasslands WWTP in Williamson County from Cartwright Creek. The WWTP is under Director's Order WPC22-0086 for various effluent violations and the condition of the treatment facility. Additionally, the facility experiences frequent washouts due to excessive I/I in the system (six reported events between March and July 2023). As a part of the CAP/ER, Limestone proposes to replace and potentially expand the existing WWTP.

SUMMARY OF PRELIMINARY ENGINEERING REPORT CONSIDERATIONS (checklist ITEMS C, D, E**):**

The existing WWTP is reported to be beyond repair and in need of replacement as soon as possible (including potential structural safety concerns). In the process of replacing the plant, the system would like to include an expansion of the design capacity. The new facility would be constructed adjacent to the existing plant, on land currently owned by the utility.

GMC is currently working on a Preliminary Engineering Report to evaluate various technology options for the new facility. The Division requests that although the PER is focused on the treatment plant, there should be attention paid to the collection system to reduce i/i at the plant. Influent characterization, particularly peak flow management, will be an important factor in the sizing and design of the new plant. Limestone reports to have had some successful i/i reduction efforts in the 2019-2020 timeframe and are working on another phase, however, there have still been several washouts reported in 2023 and work will need to continue and may have a big impact on the eventual design requirements of the plant.

Submission of a Preliminary Engineering Report (Alternatives Analysis) will be required as a basis for any permit modification. The evaluation should include an antidegradation statement, lifecycle cost analysis and operability/maintainability of the proposed system. If there is no expansion to the design capacity, then the next submission should be the Basis of Design/Preliminary Plans. Engineering Plans will be uploaded through the mytdec forms system (forms.tdec.tn.gov). Permit modifications and updates should be emailed to water.permits@tn.gov

The Compliance and Enforcement Unit and Nashville Field Office should be kept updated on progress as detailed within the Corrective Action Plan. Engineering and Permit document review must be correlated to Compliance documentation and milestones. Please include updates to dwrwater.compliance@tn.gov

The proposed project will be funded by the utility, with rates regulated by the Tennessee Public Utility Commission.

SUMMARY OF RECEIVING WATERS OR SITE SUITABILITY: (checklist ITEM F)

Harpeth River mile 68.8 (segment TN05130204009_3000) is listed as not supporting for total phosphorus and dissolved oxygen.

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DIVISION OF WATER RESOURCES
William R. Snodgrass - Tennessee Tower
312 Rosa L. Parks Avenue, 11th Floor
Nashville, TN 37243-1102

SUMMARY OF ANTICIPATED PERMITTING NEEDS: (checklist ITEM G, I, J, K):

There is a 2014 TMDL for the Harpeth River and therefore, the facility must operate within its existing waste load allocation.

Information for the TMDL can be found at https://tdec.tn.gov/document-viewer/#/search/tmdl

DWR ORGANIZER: TNH **MINUTES PREPARED BY:** TNH **DATE MINUTES PREPARED:** 10/3/23

STATE OF TENNESSEE
DEPARTMENT OF ENVIRONMENT AND CONSERVATION
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312 Rosa L. Parks Avenue, 11th Floor
Nashville, TN 37243-1102

Courtesy Information
Four-Step Planning Process

1. PRELIMINARY PROJECT DISCUSSION: Minutes provided above. Refer to Wastewater Project Number and Permit number in all correspondence.

2. SITE APPROVAL PHASE: Submit NPDES Permit application (see instructions at https://www.tn.gov/environment/permit-permits/water-permits1/npdes-permits1/national-pollutant-discharge-elimination-system--npdes--permit.html including:
    a. A preliminary engineering report (alternatives evaluation in terms of life cycle costs and permit implications) must be submitted before negotiations for the permit can be completed.

    b. Ensure treatment schematic on application matches engineering report and preliminary plans to be submitted in preliminary design phase (WW Design Criteria, Chapter 1, Appendices 1-D-2 and -3)

    c. Agreement stipulating transfer of property or permanent easements for utility access for maintenance and operation of collection system and treatment system.

    d. Plan review fee

3. PRELIMINARY DESIGN PHASE: After agreement on draft permit, submit preliminary design submittal consisting of:

    a. Engineering Report (or Basis of Design or Design Memorandum) in accordance with WW Design Criteria Chapter 1 Appendix 1-D-2; Review of the engineering report primarily focuses on due diligence taken in the characterization of the influent and the selection of an appropriate technology to meet the agreed upon discharge requirements given the influent characterization. Life cycle cost estimates should be upgraded; previously considered alternatives should be omitted or will be disregarded at this point. Treatment processes outside the Design Criteria parameters must be justified with preferably actual data on similar installations. Performance should be examined over the realistic range of influent values.

    b. Preliminary Plans in accordance with WW Design Criteria Chapter 1 Appendix 1-D-3. Review of the preliminary plans focuses on the process in accordance with the checklists. Preliminary plans may be attachments or figures in the engineering report.

    c. Engineering Report review fee

4. FINAL DESIGN PHASE: Upon completion successful completion of the public comment period of the permit and approval of the engineering report and the preliminary plans, the final design phase is authorized. The final CD's should consist of:

    a. Final Plans and Specifications in accordance with WW Design Criteria Chapter 1 Appendix 1-D-4. Note that the primary review emphasis is on those aspects not previously evaluated during the PRELIMINARY DESIGN PHASE: Maintainability, sustainability, operability and flexibility (including the visibility of process parameters to support operator optimization), expandability, and safety.

    b. Note procurement documentation in the project manual/specifications is generally reviewed for functionality and does not duplicate review procurement requirements, policies, or ordinances of funding agencies or owning public entities.

    c. Proof of ownership/permanent easements must be provided prior to transmission of wastewater or acceptance of wastewater at a new facility for treatment and disposal.

d. Note Rules authorize and require the Division to specify the format and content of the submittals. Current versions of the Rules and Design Criteria specify paper submittals. The Division is moving towards accepting and prefers digital submissions. Plans should be able to be legible if printed in 11x17 paper format; documents should be word/phrase searchable. PDF versions will be digitally stamped approved on cover sheets and indices and when reproduced will fulfill the requirements for on-site construction monitoring. A paper copy (red-lined plans) of the contract documents should also be on site to record field changes to ensure an accurate record drawing set can be provided.

e. Plan review fee

5. CONSTRUCTION PHASE

a. Notify location environmental field office (EFO) upon:

i. Start of construction

ii. Start up, final inspection, commissioning

b. Submit record or “as-built” drawings”

CERTIFICATE OF SERVICE

I hereby certify that a true and correct copy of the foregoing was served via U.S. Mail or electronic mail upon:

Shilina B. Brown, Esq.
Assistant Attorney General
Office of the Tennessee Attorney General
Consumer Advocate Division
P.O. Box 20207
Nashville, TN 37202-0207
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This the 10th day of September 2024.

Katherine Barnes

Katherine Barnes