Engineering Report

Lawton Wastewater Treatment Plant Improvements

Lawton, OK

Prepared by:

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Garver Project No. 20W02400

Engineer's Certification

I hereby certify that this Engineering Report associated with the Lawton Wastewater Treatment Plant Improvements was prepared by GARVER under my direct supervision for the City of Lawton.

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Expires 06/30/2022

Executive Summary

The purpose of this Engineering Report (ER) is to evaluate the hydraulic and treatment capacities of the existing Lawton Wastewater Treatment Plant (WWTP) and develop design alternatives to meet treatment objectives under future flow and loading conditions. The Lawton WWTP is owned and operated by the City of Lawton, and currently receives flow from the City of Lawton. The existing WWTP has a preliminary and primary treatment capacity of 59.0 million gallons per day (MGD) and a secondary treatment design capacity of 18.0 MGD average day design capacity, with a peak day design capacity of 24.0 MGD.

The existing plant operates a number of facilities which have their initial elements commissioned in the early 1970's. Since that time, the plant has experienced several rounds of rehabilitation and upgrades. The facility has been mostly compliant over the facility's history, but a significant percentage of the operating facilities are nearing the end of their useful life and struggling to meet treatment goals.

This ER evaluates each facility on its ability to achieve and conform to the requirements set forth in the ODEQ 252:656 Water Pollution Control Facility Standards with the projected flow and loadings for a 20-year design period. Additional considerations for full build-out over a 50-year horizon have also been documented. Table ES-1 outlines the flow and loading conditions to be used for the 20-year design horizon, 2041.

Table ES-1 : 20-Year Design Flow and Loading Conditions Criteria for the Lawton WWTP

	Flow (MGD)	CBOD (mg/L)	CBOD (lb/d)	TSS (mg/L)	TSS (lb/d)	NH_3-N (mg/L)	NH_3-N (lb/d)
Annual Average Day	16.6	398	55,110	274	37,930	21.9	3,030
Max Month	21.9	-	82,670	-	53,100	-	3,820
Peak Day[1]	32.7	Hydraulic design flow through WWTP starting downstream of primary treatment					
Peak 2-Hour[1]	66.4	Hydraulic design flow from influent pump station through primary treatment					
[1]Excess peak day flow over 32.7 MGD will be diverted to FEB.							

Facility condition assessments, the open ODEQ consent order, discussions with plant and city staff, a review of historical data, and the development of flow and loading projections for this system yields a list of improvements that are recommended to be addressed immediately (Phase I), within 3 – 7 years (Phase II), and for the 20-year (2041) planning horizon (Phase III). It is anticipated that a significant portion of the existing plant cannot be cost effectively rehabilitated for continued use due to the age and condition of the facilities as well as documented hydraulic issues and flooding concerns. These hydraulic issues and flooding concerns have been areas of particular focus by the ODEQ consent order.

As such, Table ES-2 outlines the new common facilities for any of the alternatives that will be built, rehabilitated, or demolished as conceived in Section 6.0 of this ER. Facilities not shown in Table ES-2 will be addressed in Section 6.0 of this ER under the specific alternatives.

Table ES-2: WWTP Facilities Plan Summary (20-Year Horizon)

New Facilities	Rehabilitated Facilities	Demolished Facilities
• Influent Pump Station • Grit Removal Facility • Primary Clarifier(s) • Primary Clarifier Splitter Box • Aeration Basins • Secondary Clarifier Splitter Box • Tertiary Disk Filtration (Optional) • UV System • Parshall Flume • Non-Potable Water System • Anerobic Digestion • Solids Handling Facility • Office and Lab Building • Electrical Building • Site Electrical • Site Civil	• Screenings Building • Aeration Basin • Anerobic Digestion Tanks and Control Building • Sodium Hypochlorite Building • Supervisory Control and Data Acquisition (SCADA) System	• Influent Pump Station • Existing Grit Facility • FEB Diversion Structure • Primary Clarifier Diversion Structure • Trickling Filter Distribution Structure • Trickling Filter Clarifier Distribution Structure • Secondary Clarifier Flow Distribution Vaults • UV System • Tertiary Filtration

Several Biological treatment alternatives are considered in this report to meet the future wastewater treatment needs of the City of Lawton. The three alternatives that were selected for a more in-depth analysis are listed below.

1. Alternative 1 is conceived as a conventional activated sludge (CAS) process with anoxic-aerobic selector (AO) zones. The concept proposed is a series of new basins with an improved hydraulic profile that addresses the plant's hydraulic and flooding concerns.

2. Alternative 2 utilizes a similar process to Alternative 1, with the addition of a mobile ballasted biomedia to the aeration basin. The Nuvoda Mobile Organic Biofilm (MOB™) ballasted biomedia is proposed to circulate within the activated sludge and work as a substratum for biofilm growth to enhance treatment capacity and sludge settleability. The addition of the MOB™ reduces the volume of the aeration basins by approximately 1/3 of a similar traditional aeration basin. Note that Alternative 2 is not an ODEQ-approved process and would likely require a variance and pilot testing at the Lawton WWTP. As with the first proposed alternative this alternative will address the hydraulic and flooding issues that occur at the plant.

3. Alternative 3 rehabilitates and expands the existing plant processes to treat the future increased flow and constituent loadings to the plant. This alternative does not address the hydraulic and flooding issues that currently exist.

The evaluation of the three alternatives consider the ODEQ Consent Order, future wastewater flows and loading, improved plant hydraulics, the capability for future nutrient removal, operations and maintenance cost, initial capital cost to construct, and net present worth analysis. The net present worth analysis considers initial capital cost together with long term costs to operate and maintain. Based on the above presented criteria, Alternative 1 is proposed as the recommended alternative for the City of Lawton to pursue.

Table ES-3 presents a summary of the recommended alternative's estimated construction costs, and overall estimated project costs for the improvements to the Lawton WWTP for a 20-year (2041) design period. All budgetary costs that are developed for this ER include material procurement, construction, professional services, contractor overhead and profit, and contingency. For this level of planning, these costs should be considered as Rough Order of Magnitude (ROM) budgetary estimates, which should be utilized for budget authorization or control. The expected range of accuracy for this type of estimate is -30 to +50% of the actual project estimate. There is no guarantee that proposals, bids, or actual project costs will not vary from these cost estimates.

The costs presented are provided in 2021 U.S. dollars unless otherwise stated. It should be noted that future cost estimating efforts will be required to develop an Opinion of Probably Construction Cost (OPCC) for the proposed projects following detailed design.

Table ES-3: Proposed Recommended Alternative Estimated Project Cost

Element	Project Cost Estimate
Common Elements[1]	$88,851,000
Selected Alternative[1]	$96,255,000
Subtotal	**$185,106,000**
Professional Services	$42,069,000
Construction Subtotal	**$227,175,000**
Market Variation (30%)	$50,484,000
Total Project Estimate	**$227,175,000-$277,659,000**
[1]Costs are presented in 2021 dollars and include Facility totals, contractor overhead and profit, mobilization, and contingencies for technical items and construction allowances.	

As shown in Table ES-3, significant investment is required at the Lawton WWTP to meet 20-year treatment goals. To assist with project funding, a phased approach has been proposed for implementing the recommended improvements.

The project phasing is comprised of three (3) primary phases:

- Phase I – Phase I Improvements are recommended to be pursued immediately to address the facilities of greatest concern. These improvements are required to bring the plant back into consistent permit compliance, increased operator safety and efficiency, and greater process redundancy. The proposed new facility improvements in Phase I are sized to meet current needs as well as the needs identified for the 20-year planning horizon.

- Phase II – Phase II Improvements are recommended to be pursued as soon as possible but can be deferred for an interim period (for example, three to eight years) while additional funding sources are acquired. Phase II Improvements increase plant efficiency and process redundancy, as well as the capacity needs identified for the 20-year planning horizon.
- Phase III – Phase III Improvements are proposed to be pursued to increase the plant's capacity to meet the requirements of the 20-year (2041) planning horizon. These improvements are recommended to be started no later than 10-15 years from the start of Phase 1 or as soon as funding allows.

Phase I is proposed to include the following facility improvements. Note that Phase I is proposed to be constructed within the next three to four years, and as such costs have been escalated at 3% per year to the midpoint of estimated construction. Table ES-4 details the estimated cost for Phase I, and a proposed site layout of Phase I can be seen in Section 8.1 of the ER.

- New office building and lab
- Screening facility rehabilitation
    - Gates, HVAC, Screening Compactor
- Influent pump station replacement and relocation
- New grit removal facility
- Rehabilitation of the trickling filter mechanisms, structures, and media
- Existing FEB Flow Meter Replacement
- New WAS pump in existing mix sludge blending building
- Anerobic digestion heating equipment rehabilitation, waste gas handling, and decant piping replacement
- Rehabilitate existing non-potable plant water system.
- Associated site Civil, Electrical, and SCADA improvements

Table ES-4: Phase I Estimated OPCC

Element[1]	OPCC
Site Civil	$4,830,000
Office Building and Lab	$3,669,000
Screening Building Improvements	$2,173,000
Grit Removal Facility	$4,334,000
Influent Pump Station	$10,276,000
Trickling Filter Rehab	$2,933,000
Anaerobic Digestion Rehabilitation	$3,000,000
Solids Facility Rehabilitation	$1,953,000
Non-Potable Water System Rehab	$470,000
Site Electrical	$5,047,000
SCADA	$1,683,000
Subtotal for Project Elements	**$40,368,000**
Technical Items and Construction Allowance (10%)	$3,574,000
Professional Services (25%)	$8,931,000
Construction Subtotal	**$52,873,000**
Market Variation (30%)	$10,712,000
Total Project Estimate	**$ 52,873,000- $63,585,000**

[1] Facility line-item costs include facility totals, escalation, contractor overhead and profit, and mobilization costs.

Phase II is proposed to include the following facility improvements. Note that Phase II is proposed to be constructed within the next five to eight years, and as such costs have been escalated at 3% per year to the midpoint of estimated construction. Table ES-5 details the estimated OPCC for Phase II, and a proposed site layout of Phase II can be seen in Section 8.2.

- New Electrical Building
- Replace existing screens with higher capacity fine screens
- Add extension to existing screening building for new screening compactor
- New screening conveyer to add redundancy to existing screenings conveyor
- Anaerobic digester storage and processing capacity increase.
- New solids handling facility
- Associated site Civil, Electrical, and SCADA improvements

Table ES-5: Phase II Estimated OPCC

Element[1]	OPCC
Site Civil	$7,166,000
Screening Building	$2,711,000
Anaerobic Digestion	$16,433,000
Solids Handling Building	$14,011,000
Site Electrical	$6,048,000
SCADA	$2,016,000
Subtotal for Project Elements	**$48,385,000**
Technical Items and Construction Allowance (10%)	$3,360,000
Professional Services (25%)	$8,399,000
Construction Subtotal	**$60,144,000**
Market Variation (30%)	$10,077,000
Total Project Estimate	**$ 60,144,000- $70,221,000**

[1] Facility line-item costs include facility totals, escalation costs, contractor overhead and profit costs, and mobilization costs.

Phase III is proposed to include the following facility improvements. Note that Phase III is proposed to be constructed within the next ten to twelve years, and as such costs have been escalated at 3% per year to the midpoint of estimated construction. Table ES-6 details the estimated OPCC for Phase III, and a proposed site layout of Phase III can be seen in Section 8.3.

- Demolition of abandoned structures
- New flow equalization basin (FEB) diversion structure
- New primary clarifiers
- New primary clarifier flow splitting structure
- New primary sludge/scum pump station
- New aeration basins
- New blower facility
- New secondary clarifiers
- New secondary clarifier flow splitting structure
- New RAS/WAS pump station
- UV disinfection system and channels
- New Parshall flume for plant effluent measurement
- New plant effluent flow splitting structure
- New non-potable water pump station
- New mixed sludge mixing system and storage pump station
- New WAS holding and sludge blending tanks
- Associated Site Civil, Electrical, and SCADA improvements

Table ES- 6: Phase 3 Estimate OPCC

Element[1]	OPCC
Site Civil	$24,266,000
Excavation and Demolition	$2,271,000
FEB Flow Diversion Structure	$467,000
Primary Clarifier Splitter Box	$841,000
Primary Sludge Pump Station	$4,368,000
Secondary Clarifier Splitter Box	$969,000
UV Disinfection and Parshall Flume	$6,356,000
Plant Effluent Diversion Structure	$556,000
Non-Potable Water System	$3,242,000
Primary Clarifiers	$19,263,000
Blower Facility	$17,199,000
Aeration Basin Alt. 1	$34,521,000
Secondary Clarifiers	$33,031,000
RAS/WAS Pumping	$12,992,000
Sludge Holding/Mixing Tanks and Pump Station	$4,404,000
Site Electrical	$24,714,000
SCADA	$8,240,000
Subtotal for Project Elements	**$197,700,000**
Technical Items and Construction Allowance (10%)	$9,898,000
Professional Services (25%)	$24,739,000
Construction Subtotal	**$232,337,000**
Market Variation (30%)	$29,679,000
Total Project Estimate	**$ 232,337,000- $262,016,000**

[1]Facility line-item costs include facility totals, escalation costs, contractor overhead and profit costs, and mobilization costs.

As shown in the previous three tables, significant investment is required at the Lawton WWTP to meet treatment goals over the 20-yea (2041) planning horizon. However, the proposed Alternative 1 improvements are anticipated to allow Lawton to meet or exceed items outlined in the Consent Order, address existing hydraulic capacity limitations, address existing flooding concerns, and process condition that currently hinder Lawton Staff's ability to meet treatment goals reliably and consistently. The proposed plant layout will allow for gravity flow through the entire facility after the influent pump station, as well as relocate or raise the plant's structures out of the 100-year floodplain, which is a source of ODEQ concern and significant historical plant damage and costs. Finally, the proposed Alternative 1 improvements leave space to readily expand the facility to serve the City of Lawton for the long-term 50-year (2071) planning horizon.