



Submittal Review Response

Project Name: Hilo WWTP Rehabilitation and Replacement Project Phase 1
Submittal No.: 01756-001.0
Date: 8/14/2025

Client: County of Hawai'i Carollo Project No.: 203975
Contractor: Nan, Inc.
Submittal Name: TSC Qualifications For Review
Reviewed By: Gavin Goo

SUBMITTAL REVIEW

Review is for general compliance with contract documents. No responsibility is assumed by Carollo for correctness of quantities, dimensions, and details. No deviation or variation is approved unless specifically addressed in these review comments. Refer to Section 01330 for additional requirements. The Contractor shall assume full responsibility for coordination with all other trades and deviations from contract requirements.

Approved	<input type="checkbox"/>	No Exceptions
	<input type="checkbox"/>	Make Corrections Noted - See Comments
	<input type="checkbox"/>	Make Corrections Noted - Confirm
Not Approved	<input checked="" type="checkbox"/>	Correct and Resubmit
	<input type="checkbox"/>	Rejected - See Remarks
Receipt Acknowledged	<input type="checkbox"/>	Filed for Record
	<input type="checkbox"/>	With Comments - Resubmit

Review Comments:

1. Although the proposed personnel have operations experience, there is very little start-up and testing experience that would qualify the individuals to perform as the Equipment and Systems Testing and Start-up Coordinator (TSC) for this project.
2. A list of references and phone numbers were not included as part the submittal package.

CONTRACTOR SUBMITTAL TRANSMITTAL FORM

Owner:	County of Hawaii	Date:	5/27/2025
Contractor:	Nan, Inc.	Project No.:	WW-4705R
Project Name:	Hilo WWTP Phase 1	Submittal Number:	01756-001.0
Submittal Title:	TSC Qualifications		
To:	Owner		
From:	Nan Inc.		

Specification No. and Subject of Submittal / Equipment Supplier			
Spec #:	01756	Subject:	TSC Qualifications
Authored By:	Matthew Chun	Date Submitted:	5/27/2025

Submittal Certification	
Check Either (A) or (B):	
<input checked="" type="checkbox"/> (A)	We have verified that the equipment or material contained in this submittal meets all the requirements specified in the project manual or shown on the contract drawings with no exceptions.
<input type="checkbox"/> (B)	We have verified that the equipment or material contained in this submittal meets all the requirements specified in the project manual or shown on the contract drawings except for the deviations listed.
Certification Statement: By this submittal, I hereby represent that I have determined and verified all field measurements, field construction criteria, materials, dimensions, catalog numbers and similar data, and I have checked and coordinated each item with other applicable approved shop drawings and all Contract requirements.	
General Contractor's Reviewer's Signature:	<i>Matthew Chun</i>
Printed Name and Title:	M. Chun , QC
In the event, Contractor believes the Submittal response does or will cause a change to the requirements of the Contract, Contractor shall immediately give written notice stating that Contractor considers the response to be a Change Order.	
Firm:	Signature: Date Returned:

PM/CM Office Use
Date Received GC to PM/CM:
Date Received PM/CM to Reviewer:
Date Received Reviewer to PM/CM:
Date Sent PM/CM to GC:

Nan, Inc

PROJECT: HILO WWTP REHABILITATION
AND REPLACEMENT PROJECT - PHASE 1

JOB NO. WW-4705R

THIS SUBMITTAL HAS BEEN CHECKED BY
THIS CONTRACTOR. IT IS CERTIFIED
CORRECT, COMPLETE, AND IN
COMPLIANCE WITH CONTRACT
DRAWINGS AND SPECIFICATIONS. ALL
AFFECTED CONTRACTORS AND
SUPPLIERS ARE AWARE OF, AND WILL
INTEGRATE THIS SUBMITTAL (UPON
APPROVAL) INTO THEIR OWN WORK.

DATE RECEIVED 5/27/25
SPECIFICATION SECTION # 01756
SPECIFICATION Commissioning
PARAGRAPH 1.04
DRAWING N/A
SUBCONTRACTOR Wastewater Solutions, Inc.
SUPPLIER N/A
MANUFACTURER N/A

CERTIFIED BY: M. Chun , QC

SECTION 01756

COMMISSIONING

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Requirements for equipment and system testing and facility start-up and commissioning, including the following:
 - 1. Testing and Start-Up Plan.
 - 2. Testing and Start-Up Coordinator (TSC).
 - 3. Performance Testing.
 - 4. General Start-Up and Testing Requirements.
 - 5. Pre-Start-Up Tests and Checks.
 - 6. Operational Readiness Tests (ORTs).
 - 7. Functional Tests (FTs).
 - 8. Reliability Acceptance Tests (RATs).
 - 9. Operation Acceptance Testing.
 - 10. Certificate of Proper Installation.
 - 11. Services of manufacturer's representatives.
 - 12. Training of Owner's personnel.
- B. Apply the requirements of this Section to the various work restrictions and completion milestones defined in Section 01140 - Work Restrictions.

1.02 DEFINITIONS

- A. System: A system means the collection of devices, equipment, pipes, tanks, channels, instruments, electrical systems, control systems, and other items that perform a specific function.
- B. Pre-Start-Up Tests: Pre-start-up tests are preliminary checks and tests, prior to starting Operational Readiness Tests (ORTs), as described in Article 3.08.
- C. Start-Up Tests: Start-up tests include all ORTs, Functional Tests (FTs), and Reliability Acceptance Tests (RATs).
- D. Functional Tests: Also referred to as Performance Tests (field).
- E. Factory Acceptance Testing: Also referred to as Factory Testing and Source Testing.

1.03 GENERAL TESTING, TRAINING, AND START-UP REQUIREMENTS

- A. Contract Requirements: Testing, training, and start-up are requisite to the satisfactory completion of the Contract.
- B. Complete testing, training, and start-up within the Contract Times.

- C. Allow realistic durations in the Progress Schedule for testing, training, and start-up activities.
- D. Furnish labor, power, chemicals, tools, equipment, instruments, and services required for and incidental to completing FTs, performance tests, and RATs.
- E. Provide competent, experienced technical representatives of equipment manufacturers for assembly, installation and testing guidance, and operator training.
- F. General Training Requirements:
 - 1. Training is requisite to the satisfactory completion of the Contract.
 - 2. Complete training within the time of completion set forth in the Contract.
 - 3. Allow realistic durations in the project schedule for training activities.
 - 4. Furnish all training materials (books, handouts, visual aids) and services required for and incidental to completing training.
 - 5. Owner will provide location for training at or near project site.

✓ 1.04 TESTING AND START-UP COORDINATOR

- ✓ A. The Contractor shall designate and provide an Equipment and Systems Testing and Start-up Coordinator (TSC) for this project.
 - ✓ 1. The TSC must be regularly engaged and experienced in all aspects of pre-start-up, start-up, and testing of wastewater pumping and treatment facilities, electrical switchgear, and treatment plant controls of similar size, type, and capacity as this project. This must be demonstrated with reference project descriptions and reference contact information.
 - ✓ 2. The TSC shall provide technical instruction for the start-up and start-up testing, and shall direct the actual facility operation during pre-start-up testing, start-up, start-up testing, and performance testing.
 - ✓ 3. The TSC shall lead all of the Contractor's efforts relating to testing and start-up of project facilities and shall be the primary interface with the Engineer and Owner for these activities.
 - ✓ 4. The specified testing and start-up activities will require a variety of expertise and the effort of several individuals working under the TSC. The TSC shall be supplemented by similarly experienced assistants as required.
- B. All facility operation and tests shall be performed in the presence of the Engineer unless such presence is expressly waived in writing.
- ✓ C. Submit qualification of the TSC for review and Owner approval.
- D. The TSC shall carefully review the additional testing requirements in other specification sections.

1.05 SUBMITTALS

- A. General:
 - 1. Organization chart for conducting start-up and testing.
 - 2. Description of previous experience on similar projects for the designated TSC. Include list of references complete with phone numbers.

3. Detailed start-up and testing plan with schedule signed by the TSC, for each equipment item and system. Submit schedules showing testing work not less than 120 days in advance of first scheduled tests. Schedules shall list each piece of equipment or component to be tested. Schedules shall include sequence and duration for all testing required including pre-start-up testing, ORTs, FTs, 7-day RATs, and Operation Acceptance Testing.
 4. An overall schedule and subsequent updates, presenting the Contractor's plan for testing the equipment and systems installed under this contract.
 5. A detailed schedule establishing the expected time period (calendar dates) when the Contractor plans to commence testing of the completed systems, along with a description of the temporary systems and installations planned to allow testing to take place.
 6. A summary of the Quality Assurance Manager's qualifications.
 7. The original and 3 copies of all records produced during the testing program.
 8. Acceptance criteria required to release equipment and systems for start-up.
 9. Manufacturer's certification of proper installation of equipment before testing begins.
 10. Operation and maintenance instruction manual for each equipment item and system to be tested as specified in Section 01782 - Operation and Maintenance Manuals.
 11. Refer to Article 1.06, Manufacturer's Field Services, for additional requirements.
 12. Refer to other specification sections for additional requirements.
- B. Test Procedures and Forms:
1. The Contractor, through the services of the TSC, shall prepare and submit for review:
 - a. All testing procedures.
 - b. All testing forms.
 - c. Required information on all testing equipment.
 2. Written testing procedures shall be submitted for initial review at least 90 days prior to the test for which the procedures have been prepared. Failure to submit complete test forms and procedures at least 90 days prior to the subject test shall result in rescheduling of the test, and any resulting delay shall be solely the responsibility of the Contractor.
 3. Detailed testing procedures setting forth step-by-step descriptions of the procedures proposed by the Contractor for the systematic testing of all equipment and systems installed under this contract.
 - a. Procedures shall include statement indicating test objective, test descriptions, forms, and checklists to be used to control and document the required tests.
 - b. Once the detailed Test Procedures Submittals have been reviewed by the Engineer and returned stamped either "no exceptions noted" or "make corrections noted," the tests may be scheduled.
 - c. Upon completion of each required test, a copy of the signed-off test procedures shall be submitted as test documentation.
 4. The Contractor shall develop test plans detailing the coordinated, sequential testing of each item of equipment and system installed under this contract. Each test procedure shall be specific to the item of equipment or system to be tested. Generic or general test forms and procedures shall not be acceptable. Test procedures shall identify by specific equipment of tag number each

device or control station to be manipulated or observed during the test procedures and the specific results to be observed or obtained. Test procedures shall also be specific as to support systems required to complete the test work, temporary systems required during the test work, Subcontractors' and Manufacturers' Representatives to be present, and expected test duration.

5. Test forms shall include, among other items, tag and name of equipment or device to be tested, date, names of persons conducting and witnessing (where applicable) the tests, blanks for entry of test data, description of each data item, check offs for each completed test or test step, and place for signature of person conducting tests and for the witnessing person (as applicable).
 6. Test procedures and forms shall be subject to Engineer's approval.
 7. Once the Engineer has reviewed and taken no exception to the Contractor's test plans, the Contractor shall reproduce the plans in sufficient number for the Contractor's purposes and an additional 6 copies for delivery to the Engineer. No test work shall begin until the Contractor has delivered the specified number of final test plans to the Engineer.
- C. Test Reports:
1. Submit preliminary copies of test data in field report form within 2 days after completion of each test.
 2. Submit 5 bound copies of field test reports of checkout and testing of all equipment within 30 days after completion of testing.
 3. Test Reports for each phase of testing for each equipment system, shall be submitted and approved prior to start of next test or start-up phase.
- D. Operation and Maintenance (O&M) Manuals:
1. In accordance with Section 01782 - Operation and Maintenance Manuals.
 2. The O&M manual shall be submitted by the Contractor and reviewed/accepted by the Owner prior to RAT testing and required training. The Owner reserves the right to delay the RAT test for a particular equipment item if the manuals for that equipment submitted by the Contractor are incomplete, inaccurate, or otherwise unsuitable for use by Owner's O&M staff. No contract extensions or extra costs will be allowed for delays due to O&M Manual submittal delays.

1.06 MANUFACTURER'S FIELD SERVICES

- A. General:
1. Where manufacturer's services are specified, Contractor shall furnish a qualified Manufacturer's Representative to provide these services.
- B. Definitions:
1. For purposes of furnishing Manufacturers' Representative services, the following definitions shall apply:
 - a. Manufacturer's Representative: Authorized employee of manufacturer who is factory trained and knowledgeable in technical aspects of their products and systems.

- b. Workday or Instructor-Day: Eight hours straight time on the jobsite between 6:00 a.m. and 6:00 p.m., exclusive of Saturdays, Sundays, or holidays; does not include travel time. Size of manufacturer's field services team shall not be used to reduce the specified number of days on the jobsite.

C. Field Services:

- 1. Contractor shall coordinate all field services with the manufacturer, the Manufacturer's Representative, and Owner. Coordination shall begin during the preparation of equipment bids so that manufacturer can adequately determine the number of trips and Workdays that Contractor will require based on Contractor's sequence for testing, start-up, and training. Contractor's sequence will require staged testing and start-up for some equipment and systems as required in this Section and Section 01140 - Work Restrictions.
- 2. Manufacturer's Representative shall perform the following services in separate trips to the project site. Number of trips and level of effort is the minimum requirement and applies to each type of equipment furnished by manufacturer. Also, the Contractor and manufacturer shall provide additional trips and effort as needed to meet required quality of Work:
 - a. Installation Assistance: As required.
 - b. Installation Inspection: One trip after installation for a duration as needed but not less than 1 Workday, unless specified otherwise.
 - c. Start-Up/Testing Assistance: One trip at start-up for a duration as needed but not less than 2 Workdays, unless specified otherwise. The equipment shall be ready for testing prior to manufacturer representative's arrival on the job site for testing.
 - d. Training: As specified in this Section and in the equipment specification sections.
 - e. Final Acceptance Checkout: One trip for 1 Workday, unless specified otherwise.

D. Submittals:

- 1. Contractor shall submit the following in accordance with General Requirements, Section 01330 - Submittal Procedures:
 - a. Qualifications and experience records of each proposed Manufacturer's Representative who will provide field services.
 - b. After installation inspection, each Manufacturer's Representative shall submit to Engineer a written report (using the form prepared by the TSC) certifying that the equipment is installed properly, in accordance with the manufacturer's installation instructions.
 - c. After start-up/testing, each Manufacturer's Representative shall submit to Engineer a written report (using the form prepared by the TSC) verifying that the equipment has been properly installed and lubricated and that it operated satisfactorily.
 - d. After final checkout, each Manufacturer's Representative shall submit to Engineer a written report (using the form prepared by the TSC) verifying that the equipment is in proper condition for regular continuous operation.
 - e. After post-start-up, each Manufacturer's Representative shall submit to Engineer a written report (using the form prepared by the TSC) verifying that this service has been performed and that the equipment Manufacturer's Representative and the Contractor have inspected all

equipment under this contract as installed, the appropriate adjustments have been made, and the complete system is operating in conformance with the design, specifications, and manufacturer's requirements. Notation of improper operation shall be detailed, and recommendations made and attached to the report.

- f. In addition to the requirements indicated in the TSC form, each Manufacturer's Representative report shall include purpose of visit, work performed, findings, and corrective actions required. Reports shall be on the manufacturer's letterhead and shall be signed by the representative. Submit each report within 10 days of visit.

E. Scheduling of Manufacturer's Field Services:

1. The scheduling of all visits to the site by the Manufacturer's Representative shall be determined by Contractor and approved by Engineer. The Manufacturers' Representatives' visits specified herein are for the purpose of making equipment inspections and normal adjustments.
2. After complete installation but prior to operating or testing equipment, Manufacturer's Representative of each item of equipment for which field services are indicated in the individual sections of the Technical Specifications shall visit the site of the Work and inspect, check, adjust if necessary, and approve the equipment installation.
3. The Manufacturer's Representative shall be present when the equipment is being tested and placed in operation to verify that the equipment has been properly installed and lubricated, is in accurate alignment, is free from any undue stress imposed by connecting piping or anchor bolts, and has been operated under full load conditions and that it operated satisfactorily. During the testing, the Manufacturer's Representative shall assist the Contractor, as applicable for the type of equipment, with equipment and system adjustments and calibrations.
4. The Manufacturer's Representative shall revisit the jobsite as often as necessary until any and all problems are corrected and the equipment installation and operation are satisfactory to Owner.
5. Manufacturer's Representatives shall resolve assembly or installation problems attributable to or associated with, their products and equipment.
6. After all acceptance tests have been completed, but prior to final acceptance, Contractor shall recheck all equipment for proper alignment and adjustment, check oil levels, re-lubricate all bearing and wearing points, and, in general, assure that all equipment is in proper condition for regular continuous operation. Manufacturer's Representative shall re-inspect the installation and operation to verify this condition.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 GENERAL

- A. General testing requirements are specified in this Section. The Contractor shall develop a specific test plan and sequence based on requirements in this Section, requirements in Section 01140 - Work Restrictions requirements in the detailed equipment control strategies (Section 17100 - Control Strategies and Sections 17101A through 17101W) and requirements in other Contract Documents. This shall be incorporated into the Contractor's construction schedule specified in Section 01321 - Schedules and Reports.
- B. In general, testing of electrical equipment and building support systems must be completed prior to start-up and testing of the main process equipment. Refer to Section 01140 - Work Restrictions for additional specific requirements. Complete testing as described below is required for all equipment and systems, including electrical equipment, ventilation systems, and building utility systems.
- C. All testing and related activities shall be the sole responsibility of the Contractor, except where explicitly specified otherwise. As specified below, the Owner will assist with some test activities, and shall have the right to direct or perform additional testing where deemed necessary to completely test an item or system of equipment, instrumentation, or other work.
- D. Written notification of scheduled tests must be delivered to the Engineer at least 21 days prior to the start of each test. Witnessed tests and tests requiring Owner assistance shall be scheduled and performed in accordance with applicable Owner staff working days and hours. Testing shall be performed during normal working hours, which shall be from 7:30 a.m. to 3:00 p.m., with a 45-minute lunch break and two 15-minute breaks each day.
- E. Completion of all test activities shall be documented by a certified report, including all test forms with test data entered, delivered to the Engineer with a clear and unequivocal statement that all test requirements have been satisfied.
- F. Contractor shall participate in, and cooperate with, a Start-Up Team consisting of Owner operations staff, Owner Engineering staff, Owner maintenance staff, consulting design engineer, Owner construction management staff, Contractor staff, TSC, and Training Coordinator. This team will meet regularly, generally weekly prior to and whenever testing and start-up activities are being performed. The meetings will be used to coordinate start-up and testing activities; schedule and plan training activities; familiarize and inform Owner staff on construction, start-up and testing activities and to plan and discuss testing activities. Contractor, through the TSC, shall prepare addenda and meeting minutes.
- G. The Owner reserves the right to waive or terminate any test, in whole or in part, for its convenience, at its sole discretion.

3.02 WORKSHOP

- A. The Contractor shall plan and arrange for an 8-hour workshop and a follow-up 4-hour workshop. The purpose of the workshop shall be to work with appropriate Owner staff and to receive their input on a project-specific testing plan and testing schedule. The Owner will provide a meeting room to be coordinated by the Contractor and the Engineer. The workshop will be attended by 8 to 10 Owner staff. The following from the Contractor's team shall attend: Project Manager, On-Site Superintendent, TSC, Project Manager for the Instrumentation Subcontractor, the Contractor's Quality Assurance Manager, and appropriate tradesmen, subcontractors, vendors, and others, as deemed appropriate by the Contractor. The workshop is intended to provide brainstorming and discussion of the development of the test plan and test schedule. However, it is the Contractor's sole responsibility to develop the products defined in the Specifications, and as required by other Contract Documents. The Contractor shall provide all computers, projection, or other equipment that may be required to assist progress in the workshop. The equipment used within Owner meeting rooms should be coordinated with Owner through the Engineer. Hold the workshop within 550 days of Notice to Proceed.

3.03 SEQUENCING OF START-UP AND TESTING

- A. The Summary of Field Testing Steps table summarizes the general test sequence and steps to be followed.

3.04 COORDINATION WITH OWNER OPERATIONS

- A. In addition to other notification requirements, Contractor shall notify Owner's operations staff not less than 72 hours in advance of the planned start of each equipment or system testing in order to coordinate project test with plant operations.
- B. Testing and start-up activities shall be designed and conducted to minimize impacts to ongoing treatment plant operations. No Contractor activity shall interfere with the Owner's ability to properly and safely treat wastewater.

3.05 MATERIALS AND EQUIPMENT

- A. Provide all testing and recording devices required for specified tests. The TSC shall determine or approve the type, number, and quality of all such devices. Obtain Engineer's acceptance of such equipment including oscillograph and test equipment calibration certification.
- B. Provide all lubricating oil, hydraulic oil, grease, packing, and insulating and lubricating fluids and filters required to clean, blow out, flush, and initially charge equipment and systems.

Summary of Field Testing Steps					
Test Step	Lead Responsible Entity	Owner Witnessing Required	Owner Assistance Required	Sewage and/or Sludge Available	Typical Test Summary
Pre-Start-Up Tests and Checks	Contractor	Some Tests	No	No	Mechanical: Leak test, equipment powered, clean and lubricate, ready to start, etc. Electrical: Wire tests, circuit tests, termination, power systems ready, etc. I&C: Calibration, initial checkout, etc.
Operational Readiness Tests 1	Contractor	No	No	No	Loop checks. Test hardwired logic. Test equipment in Local Manual mode.
Operational Readiness Tests 2	Contractor	Yes	No	No	Repeat ORT-1, witnessed.
Operational Readiness Tests 3	Contractor	Yes	Yes	No	PLC software loaded and available. End-to-end tests of signal from field to PLCs. Test equipment in Remote Manual. Test simple software logic.
Functional Tests	Contractor	Yes	Yes	Yes	Equipment wet tests, performance tests. Operate equipment for continuous periods through full range of operation. Test all Automatic logic; tune feedback loops. Test functionality of equipment systems.
Reliability Acceptance Tests (7-day)	Contractor	Yes	No	Yes	Continuous operation of collections of equipment systems for minimum of 7 days. Test reliability of Contractor-provided work.
Operation Acceptance Test	Owner	n/a	n/a	Yes	Continuous operation of collections of equipment systems by Owner staff for 30 days. Test reliability of Contractor-provided work.

3.06 TESTING AND START-UP RESPONSIBILITIES

A. Owner's Responsibilities:

1. Observe tests for compliance with the contract requirements.

B. Contractor's Responsibilities:

1. Furnish labor and materials, tools, instruments, process control software, and services for checking, testing, and pre-start-up for each equipment item, except as specified. This includes such services as Manufacturers' Representatives, subcontractors, electricians, instrumentation technicians, and pipe fitters.
2. Be responsible for and prepare testing schedule and incorporate testing and start-up activities in the progress schedule for the work, in accordance with Section 01321 - Schedules and Reports.
3. Obtain and furnish qualified Manufacturer's Representative to assist with testing of equipment.
4. No required test shall be performed without prior written notice to the Engineer, which has the right to witness any test. Notify Engineer and all respective equipment manufacturers, in writing, at least 21 days prior to the date when each equipment system is scheduled to be tested or initially started.
5. Submit testing plan, including schedule and quantity and source of utilities and other materials needed.
6. Perform all testing specified herein.
7. Review and become thoroughly familiar with the Process Control Strategies, Sections 17101A through 17101V.
8. Prepare the submittals required for the work of this Section.
9. Develop and implement test procedures.
10. Develop a standard testing log to be used as a record of testing of each equipment item. This log shall:
 - a. Be subject to approval of Owner.
 - b. Include equipment name.
 - c. Have provisions for recording dates of completion for checking, inspection by manufacturer, verification of instrumentation and controls, and completion of tests.
 - d. Provide space for problems remaining with equipment and for signature of Engineer, TSC, Instrumentation Subcontractor (where applicable), and Manufacturer's Representatives (where applicable) indicating acceptance.
11. Perform the actual pre-start-up tests and/or supervise the performance of pre-start-up tests for various pieces of equipment.
12. Operate equipment during start-up and testing.
13. Perform the ORTs.
14. Perform the FTs.
15. Perform the 7-Day RATs.
16. Assist plant staff with the Operation Acceptance Test.
17. Provide technical instruction during training.
18. Prepare the test reports.

3.07 PERFORMANCE TESTING

- A. Test equipment for proper performance at point of manufacture or assembly when specified.
- B. When source quality control testing is specified:
 - 1. Demonstrate equipment meets specified performance requirements.
 - 2. Provide certified copies of test results.
 - 3. Do not ship equipment until certified copies have received written acceptance from Engineer. Written acceptance does not constitute final acceptance.
 - 4. Perform testing as specified in the equipment specification sections.
- C. Include costs associated with witnessing performance tests as specified in Section 01450 - Quality Control.

3.08 FIELD TESTS

- A. Pre-Start-Up Test and Checks.
 - 1. Cleaning and Checking: Prior to testing of all equipment:
 - a. Inspect and clean equipment, devices, and connected piping so they are free of foreign material.
 - b. Lubricate equipment in accordance with manufacturer's instructions.
 - c. Turn rotating equipment by hand and check motor-driven equipment for correct rotation.
 - d. Open and close valves by hand and operate other devices to check for binding, interference, or improper functioning.
 - e. Check power supply to electric-powered equipment for correct voltage.
 - f. Check for proper equipment alignment.
 - g. Obtain manufacturer's certification of proper installation.
 - h. Complete all conductor tests specified in Divisions 16 and 17, including meggar, continuity, and resistance tests.
 - 2. Mechanical Systems: As specified in the individual equipment specification sections and Section 15050 - Common Work Results for Mechanical Equipment, Section 15954 - Testing, Adjusting, and Balancing for HVAC, and Section 15958 - Mechanical Equipment Testing:
 - a. Remove rust preventatives and oils applied to protect equipment during construction.
 - b. Flush lubrication systems and dispose of flushing oils. Recharge lubrication system with lubricant recommended by manufacturer.
 - c. Flush fuel system and provide fuel for testing and start-up.
 - d. Install and adjust packing, mechanical seals, O-rings, and other seals. Replace defective seals.
 - e. Remove temporary supports, bracing, or other foreign objects installed to prevent damage during shipment, storage, and erection.
 - f. Check rotating machinery for correct direction of rotation and for freedom of moving parts before connecting driver.
 - g. Perform cold alignment and hot alignment to manufacturer's tolerances.
 - h. Adjust V-belt tension and variable pitch sheaves.
 - i. Inspect hand and motorized valves for proper adjustment. Tighten packing glands to ensure no leakage, but permit valve stems to rotate without galling. Verify valve seats are positioned for proper flow direction.

- j. Tighten leaking flanges or replace flange gasket. Inspect screwed joints for leakage.
 - k. Install gratings, safety chains, handrails, shaft guards, and sidewalks prior to testing.
3. Ready-To-Test Determination: All equipment shall be determined by the Engineer ready to test based on the following:
 - a. Notification in writing by the TSC of equipment and system readiness for testing.
 - b. Submittal and approval of detailed start-up and testing plan, including detailed procedures and test forms.
 - c. Receipt of approved O&M manuals as specified in Section 01782 - Operation and Maintenance Manuals.
 - d. Cleanliness of equipment, devices, and connected work.
 - e. Adequate completion of work adjacent to, or interfacing with, equipment to be tested.
 - f. Availability and acceptability of Manufacturer's Representative to assist testing of respective equipment and satisfactory fulfillment of other specified manufacturer's responsibilities.
 4. After Ready-To-Test Determination, perform pre-start-up tests and make adjustments as needed. Pre-start-up tests shall include, but not be limited to, the following:
 - a. Check for correct operation and perform calibration tests of position, pressure, level, flow, speed, temperature, and all other monitoring instruments in accordance with Division 17.
 - b. Perform pre-start-up testing and conduct operating tests for all electrical equipment systems and subsystems as specified in Division 17 and Division 16 technical specification sections.
 - c. Perform pre-start-up testing for all mechanical equipment, systems and accessories specified in Divisions 11, 14, 15, and 17 technical specification sections. Inspect, adjust, and operate the equipment and systems:
 - 1) Test gates and valves under dry conditions using local manual controls. Repeat operation and adjust as necessary until proper operation is obtained. Place gates and valves in their normal position.
 - 2) Operate pump and motor auxiliary systems (e.g., motor cooling, seal water, lubrication, etc.) to verify proper operation.
 - 3) Operate all mechanical building systems to verify proper operation:
 - a) Plumbing and drainage systems.
 - b) Ventilation systems.
 - c) W1, W2, W3, potable water, and plant air systems.
 - d. Check and operate pipeline accessories such as air valves and blowoffs.
 - e. Inspect and verify proper anchorage and grounding of equipment.
 - f. Perform leak tests of pipe, fittings, gaskets, and seals.
 5. Perform all pre-start-up tests specified in other sections of the technical specifications.
 6. Perform tests recommended by the manufacturer's field service representatives and/or as required by manufacturer's catalogs or specifications.

7. A label shall be attached to all devices to indicate that pre-start-up testing has been performed, indicating the date that tests were completed and initialed by the person conducting the tests.
 8. Obtain approval from Engineer to proceed with ORTs.
- B. Operational Readiness Test 1 (ORT-1):
1. The purpose of each ORT-1 is to verify that the equipment or other item being tested is properly installed and adjusted, has been properly wired, is ready for the next phase of testing, and is ready for operation in the Local mode. The Contractor shall fully document all ORT-1 test results; the test will not be witnessed. The Contractor, without Owner's assistance, shall perform these tests.
 2. Perform ORTs with power applied to the equipment.
 3. Test each and every control circuit and signal circuit. Test each control loop from the primary element in the field, through all cabling and junction boxes, to the PLC registers. Verify each command signal, from PLC output registers to final control elements and equipment.
 4. Configure PLC software to support testing.
 5. Coordinate with the Owner staff before testing any equipment not supplied by the Contractor.
 6. Exercise equipment in Local-Manual mode:
 - a. Stroke all valves between ends of travel limits.
 - b. Bump all pumps and motors.
 - c. Prove all hardwired interlocks with equipment energized.
 7. Verify electrical operation of auxiliaries including:
 - a. Solenoids.
 - b. Limit switches.
 - c. Remote indicating devices.
 - d. Position, pressure, and level transmitters.
 8. Perform tests of on-off controls, limit switches, and indicating lamps.
 9. Perform tests of alarms, signals, and fail-safe or system shutdown controls.
 10. The proper operation of all final control element, control panels, and instrumentation furnished under this Contract shall be verified by tests. Final control elements, control panels, and ancillary equipment shall be tested to verify proper operation using motor control center and local field mounted control circuits. All control circuit interlocks and alarms shall be operational. The control of final control elements and ancillary equipment shall be tested using both manual and automatic (where provided external to the PLC) control circuits.
 11. Measured final control element variable position/speed setpoint settings shall be compared to measured final control element position/speed values at 0 percent, 25 percent, 50 percent, 75 percent, and 100 percent of span and the results checked against specified accuracy tolerances. Specified accuracy tolerances are defined as the root-mean-square-summation of individual component accuracy requirements. Individual component accuracy requirements shall be as specified in the Contract Documents or as specified by published manufacturer accuracy specification whenever Contract Documents accuracy requirements are not specified.

12. Demonstrate all Hardwired Control Logic: For each control schematic in the electrical drawings perform a test to verify all logic works are shown. Test, on a line-by-line basis, each logical input and logical state. Verify that when an input signal or switch position changes state, all required outputs (relays, lights, solenoids, PLC inputs, etc.) are properly activated or deactivated. Also perform these tests for vendor package equipment and all other equipment that has logic not detailed in the Contract Documents control schematics.
- C. Operational Readiness Test 2 (ORT-2):
1. Repeat ORT-1, witnessed.
- D. Operational Readiness Test 3 (ORT-3):
1. The purpose of ORT-3 shall be to demonstrate that equipment and other items under test are properly wired and that equipment is ready for operation in the Remote Manual mode.
 2. Software will be loaded into PLC, as applicable, and each signal shall be tested end-to-end.
 3. The Contractor shall be responsible for all aspects of conducting the test and resolving deficiencies. Contractor shall schedule and direct the tests. Contractor shall enter test data and results on test forms. Contractor shall be responsible for all equipment operation, field support, injection of signals to simulate instrument operation, measurement of PLC output signals at final control elements, test equipment, test fluids, etc.
 4. For each PLC input signal, the Contractor shall actuate the signal at the primary field device, either by causing the sensor to output signals throughout its output range, or by injecting signals into the field wires at the primary device. Each analog input shall be field generated at 0, 50, and 100 percent of span. Each discrete signal shall be generated both "off" and "on." Proper receipt of each signal shall be confirmed at a PLC .
 5. The Contractor shall verify proper receipt of each signal in the field by observing final control element (i.e., equipment) operation in the field.
 6. Any deficiencies in Contractor work discovered during the ORT shall be resolved and retested prior to completion of the test.
- E. Function Tests (FTs):
1. The Contractor shall not schedule or perform any FT testing until a complete test plan for the entire project has been submitted to Engineer and approved.
 2. Contractor shall not begin FT for a complete equipment system until after completion of the ORT Part 3 for the complete equipment system, and acceptance of the test results submittal.
 3. A complete equipment system is a collection of related equipment, such as a Raw Sewage Pump and auxiliaries, all equipment and instrument items in a bar screen channel, etc. The Contractor shall identify each equipment system to be FT tested collectively in the Testing Plan submittal, which shall be subject to Owner approval.
 4. Regardless of how equipment systems are grouped for testing, all equipment control interactions and dependencies must be completely and thoroughly demonstrated and tested.

5. The purpose of FT shall be to thoroughly test each item of equipment, equipment system, or process system under test, and demonstrate its proper operation under actual operating conditions. The purpose of the test is also to ensure that PLC software is working in conjunction with the hardware and plant as specified. Equipment and process systems shall be tested using the actual fluid or medium that it handles during normal operation, such as water, sewerage, and other fluids and solids to demonstrate and test operation under actual operating condition. The Contractor shall perform all tests, using the actual fluid, medium, or solids that the equipment handles during normal operation, including functionality of all aspects of the software.
6. Equipment shall be operated by qualified Contractor personnel under the supervision of a Contractor provided Grade 4 licensed wastewater treatment plant operator. At the sole discretion of the Owner, some or all equipment will be operated by, or under the direction of, Owner staff. ^{AD8}
- ~~6.7.~~ Perform a FT on each item of equipment and its related auxiliary systems and controls. Perform a FT on each process system and related controls. Test combined equipment and processes as systems, as required to thoroughly and completely test all Process Control Strategies in Sections 17101A through 17101V.
- ~~7.8.~~ Each FT test shall include tests to verify equipment operation and performance in the Manual mode (Local and Remote), and shall include tests to verify and demonstrate proper equipment and process system operation (manual and automatic) modes using the software and hardwired controls.
- ~~8.9.~~ For all equipment, perform equipment tests to verify proper operation under actual operating conditions with the use of the PLC software logic. Refer to Division 17 for additional requirements.
- ~~9.10.~~ Where specified in the equipment specifications, perform additional tests to demonstrate proper equipment performance, alignment, installation, or other operational characteristic.
- ~~10.11.~~ The stable steady-state operation of final control elements running under the control of field-mounted automatic analog controllers or software-based controllers shall be assured by adjusting the controllers, as required, to eliminate oscillatory final control element operation. Transient stability shall be verified by applying control signal disturbances, monitoring the amplitude and decay rate of control parameter oscillations (if any), and making necessary controller adjustments, as required, to eliminate excessive oscillatory amplitudes and decay rates. All electronic control stations incorporating proportional, integral, and/or differential control circuits shall be optimally tuned, experimentally, by applying control signal disturbances and adjusting the gain, reset, and/or rate setting as required to achieve a proper response.
- ~~11.12.~~ Pump and Motor Testing: Start-Up tests of pumps, motors, and VFDs shall be performed to verify pump performance and operation over the full operating range from minimum head/low flow up to maximum head/maximum capacity.
- ~~12.13.~~ Contractor shall perform complete and comprehensive testing of the PLC software. Contractor shall troubleshoot and confirm software errors and will fix same when practical.
- ~~13.14.~~ Contractor shall be responsible for all aspects of conducting the FT and resolving deficiencies. Contractor shall schedule and direct the tests. Contractor shall enter test data and results on test forms. Contractor shall be responsible for all equipment operation, test equipment, test fluids, etc.

~~14.~~15. The Process Control Strategies provided in the Contract Documents in Sections 17101A through 17101V shall be tested during the FT. The test shall demonstrate, on a sentence-by-sentence basis, that each and every function (both hardware and software specified in the Control Strategies operates as described. Each function shall be tested on each and every piece of equipment to which it applies, or a representative subset, at the Owner's sole discretion.

~~15.~~16. Any deficiencies in the work discovered during the test shall be resolved and retested prior to completion of the FT.

F. Seven-Day Start-Up Reliability Acceptance Tests (RATs):

1. Seven-Day RATs shall be performed by the Contractor after the FTs for each stage of construction are completed and accepted.
2. Each 7-Day RAT shall be considered complete when, in the opinion of the Owner, the portion of the project under test has operated properly for 7 continuous days without significant interruption.
3. ~~Equipment shall be operated by qualified Contractor personnel. At the sole discretion of the Owner, some or all equipment will be operated by, or under the direction of, Owner staff.~~Equipment shall be operated by qualified Contractor personnel under the supervision of a Contractor provided Grade 4 licensed wastewater treatment plant operator. At the sole discretion of the Owner, some or all equipment will be operated by, or under the direction of, Owner staff.^{AD8}
4. Subject to Owner approval, the 7-Day RAT for each stage of construction shall begin as soon as possible after completion of the FTs.
5. "Significant interruption" during a 7-Day RAT may include any of the following events:
 - a. Failure of a system (process, controls, etc.) that is not permanently corrected within 6 hours after such failure occurs.
 - b. Failure of a process equipment unit (mechanical, electrical, instruments, etc.) that is not permanently corrected within 8 hours after such failure occurs.
6. "Permanently corrected" means without a repeat failure during the remaining duration of start-up and shall consist of all of the following:
 - a. Work repaired and replaced to conform with specified requirements.
 - b. Parts and components replaced as recommended by original manufacturer, without impacting the warranty, and conforming with reviewed submittals.
 - c. Piping and valves properly installed and connected.
 - d. Wiring properly terminated.
 - e. Accessories, including spare parts and lubricants, furnished as specified.
 - f. The facility is back on line and operating within normal operating parameters.
7. Occurrence of a significant interruption shall require testing then in-progress to be stopped and restarted at time equals zero (begin at Day 1 again) after permanent corrections are made.
8. During a 7-Day RAT, any condition which affects the ability of the project equipment to operate as specified, or which would significantly increase operating or maintenance costs shall be considered unsatisfactory. It is the intent to confirm that each part of the project is capable of performing

satisfactorily. The performance of all other elements of the project necessary for this test shall also be considered.

9. Any malfunction of project equipment observed during the test shall be corrected when observed, unless otherwise directed by the Owner.
 - a. Where the malfunction is of a minor nature, as determined by the Owner, and any plant shutdown necessary for the repair can be scheduled and approved by the Owner, the test may be interrupted for a short period to correct the malfunction. The period of the test will then be increased by the duration of the actual period or periods of such shutdowns or for any shutdown requested by the Owner.
 - b. Where the malfunction is of a major nature and results in an unscheduled shutdown (of the process or equipment being tested), or a shutdown for an extended period or is considered unsatisfactory as defined above, all as determined by the Owner, the test will be deemed to have failed. After the malfunction has been corrected, the test shall be restarted and repeated until successfully performed.
10. Each RAT shall include a collection of equipment suitable to operate and demonstrate reliability of a related portion of the work.
 - a. Limited sewage flow rate will be available at the time of RAT testing. Therefore, multiple RAT tests will be required in order to test all facilities and equipment over the full range of operation. For process equipment, perform a minimum of two separate 7-day RATs for the Base Bid scope and one 7-day RAT for Additive Alternate No. 1 (if the County elects to include this additive alternate in the Contract). Equipment to be tested in each of these RATs are listed in the table below. Where more than one equipment is associated with a listed item in the table below (e.g. there are 2 return secondary sludge pumps are associated with each secondary clarifier), divide the RAT testing time equally between these equipment.
 - 1) Additional RAT tests (at no additional cost to the Owner) shall be conducted if partial use or occupancy is sought for a portion of the Work. Partial use or occupancy shall comply with the restrictions and requirements specified in Section 01110 - Summary of Work and the RAT testing for the associated portion of Work shall be in accordance with the table below. RAT testing shall be conducted for every portion of the Work for which partial use or occupancy is sought.

RAT Testing		
RAT 1	RAT 2	RAT 3 (Additive Alternate No. 1)
Bar Screen 1	Bar Screen 2	
Screenings Conveyor	Screenings Conveyor	
Screenings Compactor 1	Screenings Compactor 2	
Influent Sampler	Influent Sampler	
Grit Basin 1, Grit Pump 1, Grit Washer 1	Grit Basin 2, Grit Pump 2, Grit Washer 2	
Primary Sedimentation Tanks 1 & 2	Primary Sedimentation Tanks 2 & 3	

RAT Testing		
RAT 1	RAT 2	RAT 3 (Additive Alternate No. 1)
Primary Scum Pump 1	Primary Scum Pump 2	
Headworks Odor Control Scrubbers	Headworks Odor Control Scrubbers	
Secondary Clarifiers 1 & 2	Secondary Clarifiers 2 & 3	
WSS Pump 1	WSS Pump 2	
Sodium Hypo Metering Pump 1	Sodium Hypo Metering Pump 2	
Blend Tank 1, BS Mixing Pump 1, Thickener Feed Pump 1	Blend Tank 2, BS Mixing Pump 2, Thickener Feed Pump 2	
Blend Tanks Odor Control Scrubber	Blend Tanks Odor Control Scrubber	
Rotary Drum Thickeners 1 & 2	Rotary Drum Thickeners 2 & 3	
Digesters 1 and 2	Digesters 1 and 2	Digester 3
Digester Gas Conditioning System	Digester Gas Conditioning System	Digester Gas Conditioning System
Digester Gas Flare	Digester Gas Flare	Digester Gas Flare
Centrifuge 1	Centrifuge 2	
Cake Conveyor 1	Cake Conveyor 2	
Cake Hopper 1	Cake Hopper 2	
Solids Odor Control System	Solids Odor Control System	
Return Flow Pump 1 (Lead)	Return Flow Pump 2 (Lead)	
2W Booster Pump 1 (Lead)	2W Booster Pump 2 (Lead)	
3W Pump 1 (Lead)	3W Pump 2 (Lead)	
All associated equipment, instrumentation, and accessories	All associated equipment, instrumentation, and accessories	All associated equipment, instrumentation, and accessories

- b. In addition, all facilities, including buildings and support systems shall undergo RAT testing.
 - c. TSC shall develop a RAT test plan to incorporate every item of equipment provided under this contract.
 - d. If any item of equipment fails during a RAT, the test shall be stopped, the equipment repaired, and the test restarted.
11. The Owner, at its sole discretion, may alter, suspend, or terminate all, or part of, a 7-day RAT test if needed to maintain continuous, safe, and proper

treatment and disposal of wastewater and byproducts. A suspended test shall be continued at Owner direction. If a portion of a test is terminated, in writing, the portion of equipment under test shall be considered to have completed its 7-day RAT, or at the Owner's discretion, shall be retested.

12. At its sole discretion, the Owner reserves the right to terminate any 7-day test and take beneficial occupancy of equipment, for its convenience.
- G. Operation Acceptance Testing: After satisfactory completion of all Reliability Acceptance Tests (RATs), the treatment plant (or portion thereof for which partial use or occupancy is sought) shall be placed into normal operation with wastewater for 30 calendar days to demonstrate fault-free operation while being operated by Owner staff, except that the sludge blending, digestion, and all solids handling facilities shall be placed into normal operation with sludge for 60 calendar days to demonstrate fault-free operation while being operated by Owner staff. Contractor staff shall be available to assist plant staff and to immediately address any failures and make corrections.
 1. Occurrence of a significant interruption shall require testing then in progress to be stopped and restarted at time equals zero (begin at Day 1 again) after permanent corrections are made.

3.09 RETESTING OF EQUIPMENT

- A. When testing or operation of the equipment demonstrates that the equipment does not meet the specified requirements, Contractor shall repeat or perform all additional tests as necessary and required by Owner.
- B. When the re-testing is caused by failure of Contractor to perform the Work satisfactorily, as a required procedure, or for minor changes to the equipment,
- C. Contractor will not be granted an increase in the Contract Price, nor an extension of Contract Time.

3.10 OWNER OPERATION

- A. After successful testing of a particular equipment type or system, Owner may elect to operate a portion of the equipment or system for continuous operation. Such operation will not interfere with testing of other equipment and systems that may still be underway, and shall not preclude the need to start up the portion operated in combination with the rest of the facility when all testing is completed.

3.11 TEST REPORTS

- A. TSC shall prepare the test reports.
- B. The report shall be comprehensive and contain all test data obtained during testing and shall include any data previously submitted in preliminary form, including but not limited to, the following:
 1. Manufacturer's Equipment Data:
 - a. Field-recorded dimensional measurements and clearances.
 - b. Pressure, pressure differential, level, flow, and other field settings.
 - c. All electrical devices field settings.

- d. Operational pressure tests, control system timing tests, settings, and other test data specified.
 - e. Field wiring changes made, including marked-up drawings.
- 2. Test results, including completed test forms, test logs, test equipment printouts, and other documentation of test results.
- 3. Test equipment calibration certifications and calibration reports.

3.12 SCHEDULING OF TESTS AND TIME ALLOWANCES

- A. All testing activities shall be clearly shown on the Contractor's CPM Schedule specified in Section 01321 - Schedules and Reports. Allow sufficient time periods for testing.

3.13 TRAINING OF OWNER'S PERSONNEL

- A. Provide site-specific operations and maintenance training for items of mechanical, electrical, and instrumentation equipment when specified in specifications for the equipment. Generally, all training will include a process overview component, operational process, maintenance, troubleshooting, and rebuilding. The Owner may provide a summary of training requirements.
- B. Contractor shall designate and provide a training coordinator responsible for coordinating, scheduling, and expediting training. The coordinator shall be present at all training coordination meetings with the Owner's staff, including representatives from the Owner's Operation and Maintenance Division.
- C. The Contractor and coordinator shall organize and coordinate the training periods with Owner's personnel and manufacturer's representatives and shall submit a training schedule for each piece of equipment or system for which training is to be provided. Training schedules shall be submitted not less than 60 calendar days prior to the time that the associated training is to be provided.
- D. The Contractor shall use only qualified manufacturer's representatives to conduct training sessions. Submit name and qualifications of trainer not less than 30 days before scheduled training. Approval of manufacturer's trainer by Owner is required.
- E. Training sessions shall not overlap. The Contractor shall schedule classes so that each individual operator and maintenance technician does not attend more than 16 hours of training per week and that the total amount of training in any 2-week period does not exceed 32 hours. Training hours in excess of these amounts are at the discretion of the Owner.
- F. Submit Operation and Maintenance Manual (in accordance with Section 01782 - Operation and Maintenance Manuals) for specific equipment or systems not less than 30 days prior to training session for that equipment or system.
- G. Training shall be satisfactorily completed after successful completion of FTs and before beginning the RAT for associated equipment.
 - 1. Training on some minor and incidental equipment and instruments may be allowed before FT or after RAT, but only if specifically accepted in writing by the Owner.

- H. Provide separate training sessions for plant operators, mechanical maintenance technicians, and electrical/instrumentation/controls maintenance technicians.
- I. Each training session for plant operators shall be repeated on 2 separate days to allow half the operators to attend the first session and the other half the second (repeat) session.
 - 1. Allowable training times for operations personnel: 7:30 a.m. - 2:30 p.m.
 - 2. Maximum number of training sessions (separate equipment) per day: 2.
- J. Each maintenance training topic will be no more than 3 hours in duration per training day.
 - 1. Allowable training times for maintenance personnel: 7:30 a.m. - 2:30 p.m.
 - 2. Maximum number of training sessions per week: 2 mechanical and 2 electrical/instrumentation.
- K. Training Sessions: Provide training sessions for equipment as specified in the individual equipment specification sections under Manufacturer's Field Services and in this Section.
- L. For systems with multiple components, the manufacturer that has primary responsibility for the overall system shall coordinate and schedule the training for the various components. The manufacturer that has primary responsibility for the system shall provide training on the overall system, as well as the component(s) manufactured by him. In addition, training shall be furnished for each component by the component's manufacturer.
- M. Training sessions shall be conducted according to the lesson plan approved by the Owner, and shall include hands-on activities, demonstration, and discussion. Simply reviewing the equipment manual does not fulfill the training requirements.
- N. Training Materials:
 - 1. All training requires specific, customized and itemized class plans. A draft of the training lesson plan and any books, handouts, etc. to be used for the training shall be submitted not less than 30 days before the training.
 - 2. A complete set of any books, handouts, etc. shall be provided for each person to be trained. Each training session may have up to 10 Owner personnel.
 - 3. Two additional copies of any books, handouts, etc. shall be provided.
- O. Record Keeping:
 - 1. Contractor shall videotape and transfer onto DVD-R, all training sessions and provide three copies to the Owner.
 - 2. Three electronic copies of any handouts, slides, pictures, or other visual aids (i.e., Microsoft PowerPoint®, etc.), shall be provided to the Owner.
 - 3. Electronic training data shall comply with the labeling, formats, file saving, and file naming conventions and requirements for electronic Operation and Maintenance data as specified in Section 01782 - Operation and Maintenance Manuals.

END OF SECTION

^{AD8} Addendum No. 8 - August 2024

TSC Qualifications

Jon (Brad) Musick (Operations Specialist)

Wastewater Solutions, Inc.

1077 Greenleaf Blvd. #313 Elkhart, IN 46514 ☎ 503-701-2766 ✉ Brad@ActivatedSludge.com

Registrations and Certifications

- Class IV Wastewater Certification - Indiana
- Class IV - Hawaii
- Class D Industrial Wastewater Certification, Indiana

Professional Summary

Brad Musick's 43 years of experience in the wastewater field includes operations, management, and consulting. As a consultant, he specializes in activated sludge treatment, unique process energy and cost reduction audits, complete facility optimization, phosphorus removal, and process changes to reduce solids yield. His expertise in plant operations and facility management is utilized in projects throughout the United States and Canada. Brad is well known for his work on process and energy optimization projects. Brad is also proficient in both the development and delivery of training and has extensive experience in the writing of technical and operations and maintenance (O&M) manuals. Brad also brings the knowledge gleaned from work in 100's of treatment plants to bear on plant design operability reviews.

Relevant consulting experience includes:

Lafayette Wastewater Treatment Plant, Lafayette, Indiana. Performed process energy audit of the large activated sludge facility. The audit focused on both treatment performance enhancements as well as energy, and chemical cost reduction. The audit resulted in an annual reduction of \$536,000 in the O&M budget. Part of the savings included \$16,500 per month in electricity and \$8,000 in natural gas. The project resulted in a reduction of 6 million gallons per year in biosolids reduction.

Resume Proof: **Lafayette Optimization and Process Improvements**

Energy, Chemical and Labor Savings

Savings Area	Amount/yr.	Comments
Chemicals	tbd	Chemical saves have yet to be determined
Electric- Prim meter box	\$102,000	25% reduction in kwh used
Electric- Sec meter box	\$96,400	20% reduction in kwh used
Natural Gas	\$90,000	Winter natural gas savings valued at \$10-\$20K/month (55% reduc)
Biosolids Hauling	\$208,000	6.5 million gallons less biosolids hauled in 2008 vs. 2007.
Labor	\$40,150	11 hrs/d less GBT runtime at loaded rate of \$40/hr (15 min/hr gbt)
\$536,550		(per year)

Capacity Gains

Capacity Gain Process	Capacity Value	Comments
Digester	\$1,900,000	24% increase in digester DT=increase in avail. capacity
GBT	\$1,650,000	GBT extended life based on 4.5hrs/d vs. 15hrs/d
Secondary Clarifiers	tbd	Process changes resulted in approx. 8 mgd less flow to clarifiers
Aeration	\$282,000	Based on 9.4% increase in ammonia treatment capacity
\$3,832,000		(Value of added process capacity over 15-20 year life)

Treatment Performance Gains

Treatment Area	Performance Gains
Ammonia removal	10% reduction in effluent ammonia discharged 2007 vs. 2008
Effluent BOD removal	57% reduction in effluent BOD discharged 2007 vs. 2008
Effluent TSS removal	16.4 % reduction in effluent TSS discharged 2007 vs 2008
WAS sludge volume reduction to GBT	64% reduction in WAS to GBT (360K/d to 130K/d)
Aeration system capacity	9.4% secondary based on
Digester capacity	24% increase in detention time available
Primary sludge volume reduction	23,000 gallons less per day pumped to digesters (approx 50%)
Performance stability	Reduced risk of ammonia, BOD and solids violations

Waianae Wastewater Startup Commissioning. Performed startup and commissioning as a sub to the contractor (Hensel Phelps) on the headworks, primary clarifiers, odor control, and plant water systems. WSI developed the startup up plan and was responsible for onsite commissioning phases.



USS Arizona Memorial SBR Startup. Performed startup service on the unique stacked sequencing batch reactor (SBR) treatment plant. This work was performed through a contract with the US National Park Service (NPS). Also performed optimization at the Haleakala Visitor Center Waste Reuse Facility for the NPS.



Lakehaven Water District, Federal Way, Washington.. Developed plant-specific, detailed and complete plant operations manuals for District's two wastewater treatment plants. The Lakota Wastewater Treatment Plant is a 10 MGD, complete mix activated sludge facility, with anaerobic digestion. The Redondo Treatment Plant is a 4 MGD facility with primary treatment, biotowers for secondary treatment and chlorine disinfection.

Austin, Texas Wastewater Treatment Plants. Developed electronic O&M manuals for Austin's two liquid wastewater treatment plants. The Walnut Creek and South Austin Regional are large and complex facilities with a combined treatment capacity of up to 150 MGD.

Hills Canyon Treatment Plant, Thousand Oaks, CA. Performed an energy and process optimization audit of the activated sludge facility. The audit identified energy and chemical savings totaling over \$200,000 in annual savings. The audit findings helped staff reduce effluent nitrate. Aeration system design issues hindering operation were also identified. In a different project provided a review of the SCADA system and recommended changes that reduced manual information collection, improved energy monitoring, and improved information usefulness.

Camas Wastewater Treatment Plant, Camas, Washington. Provided troubleshooting and bench-top toxicity testing related to poor ammonia removal. While performing the testing, provided optimization suggestions that helped the facility regain ammonia permit compliance. Other projects for this utility include the optimization of the anoxic selector and plant-specific plant training.

West Lafayette Wastewater Plant, West Lafayette, Indiana. Performed an energy and process optimization audit that identified energy and labor annual potential savings totaling over \$450,000. Developed and delivered plant-specific operator training programs for the wastewater treatment facility. Some of the topics covered included activated sludge process control, anaerobic digestion, solids handling, chlorination and dechlorination, and safety. Brad has trained at this facility for twenty-five out of the last twenty-seven years. Brad wrote their O&M manual following their last plant upgrade.

Resume Proof: **Training**

When the training program was initiated, very few of the 12 operators were certified at the 10 mgd activated sludge facility. After a few years of training, the plant had 7 Class IV operators and all operators were certified. The facility's operational team placed 2nd in the state operator competition – winning the process and safety events.

Benefits seen from training included:

- Increased motivation and professionalism.
- Development of future leaders and managers
- Professional growth opportunities
- Improved operational performance/Reduced risk

Friday Harbor Wastewater Treatment Plant, Friday Harbor, Washington. Brad provided support services for the resort community's overloaded wastewater treatment plant. Services included management and operational assistance, training, design review, laboratory evaluation, and maintenance assistance. Developed and start-up training for the SBR activated sludge facility. Brad also manage the development of the plant O&M manual and wrote the secondary treatment process chapter.

Resume Proof: **Facility Optimization and Process Integrity**

Provided optimization at this wastewater facility. The optimization of the treatment plant was driven by regulatory pressure. Plant modifications were enacted to quickly reduce the SVI from 400 to below 150, allowing solids to be retained in the facility and permit compliance to be achieved.



Benefits:

- Optimization allowed the plant to meet summer permit limits for the first time in five years. The added 17% capacity also allowed the utility to delay design and upgrade for eight years resulting in an estimated savings of \$500,000.

Trinity River Authority, Dallas, Texas. Developed and delivered training for the large activated sludge facility (150⁺ mgd) servicing a large segment of Dallas. The training topics covered over multiple visits include activated sludge process control, biological selectors, and biological nutrient removal.

Hyperion Wastewater Treatment Plant Project, City of Los Angeles. Directed the development and delivery of training materials for the Power Restart and Digester Screening facilities at the 450-million gallons per day (mgd) plant. The training covered operations, mechanical maintenance, electrical, instrumentation, and HVAC, for each piece of equipment of each unit process.

Utoy Creek Wastewater Treatment Plant, Atlanta, Georgia. As part of a team, helped evaluate the training and staffing needs at the utility. Developed start-up training materials for the 44 mgd activated sludge plant. Provided QA/QC on training materials developed for other unit processes.

Greater Vancouver Regional District, Vancouver, British Columbia, Canada. Training and Commissioning Services. Responsible for development of start-up training materials for the secondary treatment process and provided QA/QC of other unit process training materials. Sites included Annacis Island (120⁺ mgd) and Lulu Island (20 mgd) WWTPs.

Paul Eisenhardt Group, Contract Operations Performance and Contract Review. Part of team that provided comprehensive performance reviews of various contracted wastewater plants in western US. Hired by the cities, the Eisenhardt Group evaluations were used to determine if contracts were being met and if renewal was warranted. The evaluations covered all areas of maintenance, operations, laboratory, finance, asset management, safety, SOPs, manuals, SCADA, and more. Contract revision input was provided and the Group. The Group also helped write RFP and evaluate and score submitted proposals.

City of Bend, Oregon, WWTP Process Evaluation. Instigated process changes that quickly resulted in a reduction of effluent total suspended solids from 60 mg/L to reliably below 10 mg/L (and dropping). The treatment plant performance had been poor and unstable for approximately 1 year prior to receiving operational input. This project was also reviewed during construction for potential improvements.

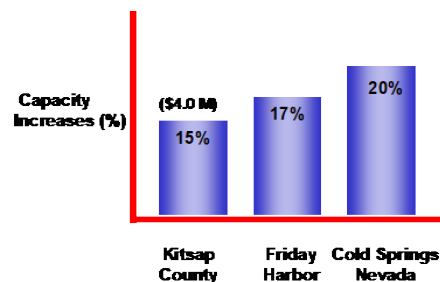
Central Kitsap Wastewater Treatment Plant (WWTP) Re-rating, Kitsap County, Washington. This re-rating/optimization project took a system-wide optimization approach to determine if the capacity of the WWTP could be re-rated.

Resume Proof: **Optimization**

Both Kitsap County, Washington (above) and Bend, Oregon (below) are among the list.

Benefits:

- Increased capacity
- Reduced capital costs



O&M Manual Development

Managed and/or performed technical writing, in the development of O&M manuals for clients including: Austin, Texas; Lakehaven Utility District, Reedsport, Oregon; Crescent City, CA; Tillamook, Oregon; Rainier, Oregon; West Lafayette WWTP, Indiana; Forest Grove WWTP, Clean Water Services, Oregon; Cave Junction WWTP, Oregon; Brookings WWTP, Oregon; Longview Fibre WWTP, Longview, Washington; MacMillan Bloedel WWTP (Harmac Division), Vancouver, BC; Elkhart WWTP, Indiana; Meridian, Idaho; Myrtle Creek, Oregon; Friday Harbor, Washington

Relevant Plant Management Experience

Anderson Water Pollution Control, Anderson, Indiana. Superintendent. Provided management and technical expertise in managing a 27-mgd advanced wastewater treatment plant, 19 lift stations, 450 miles of collection lines and 28 combined sewer overflow sites; actively participated in union contract negotiations and grievance proceedings; coordinated WWTP improvement projects

Muncie Wastewater Treatment Plant, Muncie, Indiana. Plant Superintendent. Administered and managed a 24-mgd advanced treatment plant, 11 lift stations, 28 combined sewer overflow sites; conducted final-step complaint procedures for the district and gave corrective discipline; coordinated and directed federal and state monetary grants and local revenue funds for present and future needs of the facility; prepared and managed the annual O&M budget.

Education

B.S., Natural Resources, Ball State University

Back up TSC -
Qualifications
note: Mr. Busch
will fill the role for
Mr. Musick if Mr.
Musick is sick or
on leave.

WASTEWATER OPERATIONS SPECIALIST, February 2023—Present

Wastewater Solutions, Inc., Elkhart, Indiana

As an independent sub-contractor to Wastewater Solutions, Inc. (WSI), responsible for the development, writing, and graphics of a facility-wide Operations manual for the City of Warsaw, Indiana's Wastewater Treatment Plant. With the objective of providing plant staff with a comprehensive and actionable understanding of the facility and its processes, coordinate with WSI, facility, and engineering stakeholders throughout the planning, curation, and composition of content. Apply wastewater operations and management experience to develop Operator-focused guidance, reference, and instruction materials. Work extensively with construction specifications, engineering plan sets, equipment manufacturer technical documentation, and regulatory materials.

From October 2023 until February 2025, supplied contract professional and technical support services during the Biological Process Startup and Process Operational Testing phases of the Honouliuli Wastewater Treatment Plant Phase 1C improvements project. Provided process control and operational oversight of the entire Secondary treatment system, establishing compliant, steady-state functionality of the activated sludge biological process. Coordinated closely with facility, design, construction, and equipment vendor teams, facilitating positive project outcomes and a successful hand-over of the new system to the City and County of Honolulu.

WASTEWATER OPERATIONS SUPERVISOR, October 2013—July 2022

Camas Wastewater Treatment Facility, Camas, Washington

In responsible charge of a Class IV, 6.1 million gallon per day (MGD) municipal wastewater treatment plant, including BNR activated sludge secondary treatment, anaerobic digesters, Class A, EQ biosolids production, septage receiving, and twenty-seven (27) lift stations. Reporting to the city's Public Works Director, oversaw all day-to-day facility activities, including regulatory compliance, treatment process control, maintenance, and laboratory functions. Participated in all aspects of facility management and played a key role in capital planning and improvement decision making. Set facility operational goals, maintenance standards, and staff schedules in service of compliance and organizational initiatives.

Leading a team of seven certified Operators, trained staff to improve analysis, optimization, troubleshooting, and self-sufficiency capabilities. Leveraged computerized tools to improve effectiveness, efficiency and stability of plant operations. Developed staff communication, documentation and coordination capabilities. Cultivated an environment of self-learning, problem solving, cooperation, and accountability. Worked with staff to overhaul day-to-day workflows, to promote productivity and duty prioritization.

Helped guide the facility from a period of prevalent process and compliance challenges, to sustainable permit adherence and operational stability. Developed the City's Class A, EQ biosolids program. Procured, and implemented the facility's first computerized maintenance management system (CMMS). Initiated a facility-wide lubrication program. Established a standard operating procedure (SOP) documentation program. Developed facility's first digital document storage and access framework.

Coordinated extensively with state and local regulatory agencies to remediate the facility's past non-compliance and to fulfill ongoing permit conditions and commitments. Acted as signatory and city's agent for all WWTP-related NPDES, Biosolids, and Air Discharge permit-related matters. Coordinated city's pretreatment monitoring activities and acted as the point of contact for commercial and industrial users of the city's sanitary sewer system.

Initiated and oversaw day-to-day public works contracting and purchasing for the facility, as well as the management of professional services and small-to-mid-sized capital projects. Maintained daily, productive coordination with engineering consultants, contractors, and equipment vendors throughout numerous procurement, professional services, and public works contracts. Played a key role in developing and maintaining engineering standards to facilitate consistency in future facility projects. Acted as facility liaison and spokesperson during major Public Works construction projects. Worked closely with city Finance and Engineering departments regarding contract solicitation and management, while staying abreast of procurement regulations.

Experience (Continued)

WASTEWATER OPERATIONS SUPERVISOR, August 2008—October 2013

West Lafayette Wastewater Treatment Utility, West Lafayette, Indiana

Managed a 24/7 Operations department of a Class IV, 10.5 MGD municipal wastewater treatment plant. Lead and mentored a team of eight, certified Plant Operators. Organized and analyzed treatment process data to evaluate, document and report treatment performance. Made procedural and process control decisions to ensure compliance with utility's NPDES permit, and applicable state and federal regulations. Developed department standard operating procedures and work schedules.

Acted as facility's Operations liaison throughout a multi-year utility improvement project. Project included the complete overhaul of anaerobic digestion system with the addition of a Combined Heat and Power (CHP) system and FOG/Food Waste receiving facilities. Coordinated closely with project engineers and contractors during construction to insure continuity-of-treatment and to overcome unforeseen obstacles.

Took a lead, ownership role in commissioning, operating, maintaining and optimizing new equipment. Trained and guided staff throughout start-up and steady-state operation. Optimized anaerobic digesters and CHP system for maximum energy recovery. Developed operating, monitoring and maintenance plans, as well as performance and energy savings tracking tools. Developed and managed waste receiving programs and procedures, in support of the utility's waste-to-energy initiatives. Innovated techniques and equipment in support of the system's unique needs. Performed extensive public outreach to publicize the Digester/CHP project and the energy savings it brought.

WASTEWATER PLANT OPERATOR, April 2005—August 2008

West Lafayette Wastewater Treatment Utility, West Lafayette, Indiana

Collected and analyzed data, monitored equipment, and performed field testing to ensure integrity of treatment processes and equipment. Respond to urgent, weather-related events, including on-call and after hours duty. Assisted staff Instrumentation Technician during numerous electrical, instrumentation, and controls projects and repairs.

Education

Purdue, University, West Lafayette, Indiana

B.A. in Philosophy with Law and Society Minor, 1999

Licenses and Certifications

Washington Group IV Wastewater Treatment Plant Operator

Hawaii Group IV Wastewater Treatment Plant Operator

Indiana Class IV Wastewater Treatment Plant Operator


Ohio Class III Wastewater Treatment Professional Operator

Awards and Memberships


Camas 2015 City Employee of the Year

Member of WEF, IWEA

Robert L. Busch

bob@robertlbusch.com 

www.robertlbusch.com 

(765) 479-2901 

Niles, MI 