Alaska Department of Environmental Conservation
Village Safe Water Program
Proposal Form

THIS FORM MUST BE THE FIRST PAGE OF THE PROPOSAL.

PROJECT

Proj No.: VSW-MTM-2019-37
Project Title: Design Services
City.: Metlakatla, Alaska

OFFEROR (CONTRACTOR)

Contractor:

Street:
P.O. Box:
City, State, Zip:
Alaska Business License Number:
Federal Tax Identification No.:
DUNS Number:
MBE / WBE Certification No. (if any):
Individual(s) to sign contract:
Title(s):
Type of business enterprise (check one): [ ] Corporation in the state of:
[ ] Individual [ ] Partnership [ ] Other(specify):

PROPOSED SUBCONTRACTOR(S)

Service, Equipment, etc.	Subcontractor & Office Location	AK Business License No.	MBE / WBE Certification No.

CERTIFICATIONS

I certify: that I am a duly authorized representative of the Contractor; that this Submittal accurately represents capabilities of the Contractor and Subcontractors identified herein for providing the services indicated; and that the requirements of the Certifications on page 2 and 3 of this form for 1) Alaska Licenses/Registrations, 2) Trade Restrictions/Suspension/Debarment, 3) Foreign Contracting, 4) MBE / WBE Commitment, 5) Former Public Officer 6) Human Trafficking – will be complied with in full. These Certifications are material representations of fact upon which reliance will be placed if the proposed contract is awarded. Failure to comply with these Certifications is a fraudulent act. The Department of Environmental Conservation is hereby authorized to request any entity identified in this proposal to furnish information deemed necessary to verify the reputation and capabilities of the Contractor and Subcontractors. This proposal is valid for at least ninety days.

Signature: ______________________________
Name: Date:
Title: Telephone (voice):
(fax):
Email Address:

CERTIFICATION FOR ALASKA BUSINESS LICENSES AND REGISTRATIONS

1. **Alaska Business License** (Form 08-070 issued under AS 43.70) at the time contract is awarded as required by AS 36.30.210(e) for Contractor and all Subcontractors. In accordance with Administrative Manual, Section 81.120, proof of application for an Alaska Business license will satisfy this requirement. Per AAM 81.120, acceptable evidence that the offeror possesses a valid Alaska business license consists of any one of the following:
   a. Copy of the Alaska business license.
   b. A canceled check that demonstrates payment for the Alaska business license fee.
   c. A copy of the Alaska business license application with a receipt stamp from the State's business license office.
   d. A sworn notarized affidavit that the bidder/offeror applied and paid for the Alaska business license.
   e. Other forms of evidence acceptable to the Department of Law.

2. **Certificate of Registration** for each individual to be in "responsible charge" (AS 08.48.341(11-14)) for Architecture, Engineering, Land Surveying, or Landscape Architecture (Form 08-2407 issued under AS 08.48.211) issued prior to submittal of proposal. Associates, consultants, or specialists under the supervision of a registered individual in "responsible charge" are exempt from registration requirements (AS 08.48.331).

3. **Certificate of Authorization for Corporations, Limited Liability Companies, and Limited Liability Partnerships** for Contractors and Subcontractors for Architecture, Engineering, Land Surveying, or Landscape Architecture (Form 08-2407 issued under AS 08.48.241). Entities offering to provide Architectural, Engineering or Land Surveying services do not need to be registered for such disciplines at the time proposal is submitted provided they obtain registration prior to contract award (AS 08.48.241).

4. **Certificate of Incorporation** (Alaska firms) or **Certificate of Authorization for Foreign Firm** ("Out-of-State" firms). All corporations, regardless of type of services provided, must have one of the certificates (AS 10.06.218 and other sections of Title 10.06 - Alaska Corporations Code).

5. **Current Board of Director's Resolution** for incorporated Contractors and incorporated Subcontractors for Architecture, Engineering, Land Surveying or Landscape Architecture (reference AS 08.48.241) that names the person(s) designated in "responsible charge" for each discipline. Such persons shall be licensed in Alaska and shall participate as project staff in the Contract/Subcontracts.

6. **All partners** in a Partnership to provide Architectural, Engineering, Land Surveying, or Landscape Architecture **must be legally registered in Alaska** prior to submittal of proposal for at least one of those disciplines (AS 08.48.251) which the Partnership offers.

7. **Joint Ventures**, regardless of type of services provided, must be licensed/registered in the legal name of the Joint Venture as used in this proposal (AS 43.70.020 and 43.70.110(4)).

8. **Contracts for Architecture, Engineering, Land Surveying, or Landscape Architecture** may not be awarded to individuals, corporations or partnerships not in compliance, respectively, with the provisions of paragraph 2, 3, and 6, above (AS 36.90.100).

For information about licensing, Offerors may contact the Alaska Department of Commerce, Community, and Economic Development, Division of Corporations, Business and Professional Licensing at P.O. Box 110806, Juneau, AK 99811-0806, or at Telephone (907) 465-2550, or at Internet address:
https://www.commerce.alaska.gov/web/cbpl

CERTIFICATION – TRADE RESTRICTIONS AND SUSPENSION AND DEBARMENT

The individual signing this proposal certifies to the best of his or her knowledge that the Contractor and any subcontractors are in compliance with DOT&PF 25A262 Appendix A, General Conditions, Article A25 and Article A26.

CERTIFICATION - FOREIGN CONTRACTING

By signature on this solicitation, the offeror certifies that all services provided under this contract by the contractor and all subcontractors shall be performed in the United States. If the offeror cannot certify that all work is being performed in the

United States, the offeror must contact the Contracts Officer to request a waiver at least 10 days prior to proposal deadline. The offeror must provide with their submission a detailed description of the portion of work being performed outside the United States, where, by whom, and the reason the waiver is necessary. Failure to comply with this requirement may cause the state to reject the bid or proposal as non-responsive, or cancel the contract.

MBE / WBE COMMITMENT

This procurement is funded in part or fully through federal grants or cooperative agreements. It is a national policy to award a fair share of contracts to Minority Firms and Women's Business Enterprises through affirmative action. The negotiated Federal "Fair Share" percentage for **fiscal years 2018 through 2019** is 3.67% MBE and 1.54% WBE. This solicitation incorporates a five point preference for all qualified minority firms and women's business enterprises.

In order to be deemed a bona fide Minority Business Enterprise (MBE) or Women's Business Enterprise (WBE) a firm must be an independent business concern which is a least fifty-one percent (51%) owned and controlled by minority group members or women.

It is the responsibility of the offeror to include in the proposal their qualifications and/or of the qualifications of their subcontractors for this preference. It is also the responsibility of the offeror claiming eligibility for this preference to pledge in the proposal that the eligible subcontractor will be **guaranteed** at least 5.21% of the proposed work.

CERTIFICATION – FORMER PUBLIC OFFICER

Any proposer listing as a member of the proposer's team a current public officer or a former public officer who has left state service within the past two years must submit a sworn statement from that individual that the Alaska Executive Branch Ethics Act does not prohibit his or her participation in this project. If a proposer fails to submit a required statement, the proposal may be deemed nonresponsive or nonresponsible, and rejected, depending upon the materiality of the individual's proposed position.

The Ethics Act bars a public officer who leaves State service from representing, advising or assisting a person for compensation regarding a matter – that was under consideration by the administrative unit in which the officer served, and in which the officer participated personally and substantially through the exercise of official action, for two years after leaving state service. See AS 39.52.180(a). "Public officer" includes a state employee, a member of a state board and commission, and a trustee of the Exxon Valdez Oil Spill Trust. "Official action" means a recommendation, decision, approval, disapproval, vote, or other similar action or inaction. Possible remedies for violating the bar include penalties against the former public officer and voiding the state grant, contract or lease in which the former public officer is involved.

Additionally, former public officers may not disclose or use information acquired in the course of their official duties that could in any way result in a benefit to the former public officers or their families, if the information has not been disseminated to the public or is confidential by law, without appropriate authorization. *See* AS 39.52.140.

Each current or former public officer is responsible for determining whether he or she may serve in the listed capacity on this project without violating the Ethics Act. A form that a former public officer may use to certify their eligibility is attached. Current public officers may seek advice from their designated ethics supervisors concerning the scope and application of the Ethics Act. Former public officers may, in writing, request advice from the Office of the Attorney General, Ethics Attorney concerning the application of the Ethics Act to their participation in this project. It is the responsibility of the individual and the proposer to seek resolution in a timely manner of any question concerning the individual's eligibility.

HUMAN TRAFFICKING

By signature on their proposal, the offeror certifies that the offeror is not established and headquartered or incorporated and headquartered in a country recognized as Tier 3 in the most recent United States Department of State's Trafficking in Persons Report.

The most recent United States Department of State's Trafficking in Persons Report can be found at the following website: http://www.state.gov/j/tip/

Failure to comply with this requirement will cause the state to reject the proposal as non-responsive, or cancel the contract.

Former Employee's Certification of Eligibility
Under the Alaska Executive Branch Ethics Act
(AS 39.52.140, AS 39.52.180)

I am a former employee of the State of Alaska and left state service within the last two years. My last position with the state was [*job title*] with the [*name of state agency and administrative unit*]. I propose to work on [*describe state contract or other matter*] on behalf of [*name of current employer*]. This work will not involve any matter (a) that was under consideration by the state administrative unit that I served, and (b) in which I participated personally and substantially during my state service through the exercise of official action ("official action" means a recommendation, decision, approval, disapproval, vote, or other similar action or inaction). I am therefore eligible to participate in this [*contract or matter*] under the Alaska Executive Branch Ethics Act. I also understand that as a former public officer I may not disclose or use information acquired in the course of my official duties that could in any way result in a benefit to me or my family, if the information has not been disseminated to the public, or that is confidential by law, without appropriate authorization.

I certify under penalty of perjury that the foregoing is true.

Dated: _________________________, 20__, at __________, Alaska.

____
[*name of former state employee*]

STATE OF ALASKA)
) ss.
_______ JUDICIAL DISTRICT)

On this ______ day of ____________, 20__, [*name of former state employee*], whom I know to be the individual described in and who executed this certification, personally appeared before me and acknowledged that [s]he signed the certification as [her or his] free and voluntary act.

IN WITNESS WHEREOF, I have placed my signature and affixed my official seal.

____
Notary Public in and for Alaska
My commission expires: ___________

If no notary or other official (judge, magistrate, U.S. postmaster or municipal clerk) is available, omit the notary certificate and include the following statement in the text: A notary or other official empowered to administer oaths is unavailable.

STATE OF ALASKA
Department of Environmental Conservation
Village Safe Water Program

Request for Statement of Qualifications
VSW-MTM-2019-37

City of Metlakatla, Alaska
Design Services

Date of Issue: June 17, 2019

Proposal Due Date & Time: July 8, 2019, 3:00PM AKST

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SECTION

On behalf of the City of Metlakatla, Alaska, the Department of Environmental Conservation (DEC), Village Safe Water (VSW) Program is requesting Statement of Qualifications (SOQ) for design services.

The Procurement Officer for this SOQ is:

Pearley M. Bingham, Procurement Officer
Department of Environmental Conservation
Village Safe Water Program
555 Cordova Street, 4th Floor
Anchorage, Alaska 99501
Telephone: 907-334-2638
Email: **DECDASPROCUREMENT@alaska.gov**

1.0 BACKGROUND

The City of Metlakatla is a community of approximately 1,405 people, located on Annette Island about 15 air miles from Ketchikan. One can access Metlakatla by float plane or by a short ferry ride. It is a significant drive from the ferry terminal to the Metlakatla community.

The June 16, 2017 City of Metlakatla Water Treatment Facility Disinfection Byproduct Reduction and Pipe Corrosion Preliminary Engineering Report (PER), by GV Jones and Associates, Inc. describes recommended community Water Treatment Plant Upgrades, replacement of the Trailer Court Water Distribution Piping and, the Calvin Street Distribution Main Extension.

The Water Plant is a direct filtration plant with four each 8-feet diameter multi-media filters. Operation and backwash are automated, which is controlled from an Allen Bradley PLC control panel. Chester Lake is the water source, and the pressure is stepped down twice to get it to the plant operational pressure of 115 psi.

PER Drinking Water Treatment Recommendations

The City of Metlakatla drinking water supply is Chester Lake, located about a mile east of the community Water Plant, and 920 feet above sea level. Chester Lake is a dammed impound. Historically the penstock from the dam has provided turbine power and raw drinking water, though over the last several summers, water shortages have precluded using the water for hydro-power.

The 2017 PER was drafted in response to Disinfection by-product (DBP) regulatory violations in the Metlakatla drinking water system. The PER found that a change in the filter coagulant will improve removal of dissolved organics (the DBP precursor) and eliminate the DBP problem. The reduction in dissolved organics will increase the drinking water corrosivity, which is already a problem, though not rising to the level of triggering lead and copper violations. In summary, in order to better remove organics by implementing a new coagulant, it will be necessary to introduce corrosion inhibitor.

Increasing the coagulant dose and adding soda-ash and disodium phosphate, for corrosion control, creates a need to increase the building foot print. The PER findings includes a building addition. Preliminary sizing of the building addition foot print is 975 square feet.

PER Distribution System Findings

To reduce aged water, which intensifies the buildup of some types of disinfection by-products in the water distribution mains, the PER recommended elimination of distribution pipe dead ends. PER findings include construction of a pipeline connecting Milne and Haines Street to Hillcrest Street. See "Calvin Street Conceptual Water Main Construction Map" in the 2017 PER.

PER Trailer Court Water Main Findings

For some years, the City of Metlakatla maintenance crew has spent a disproportionate amount of its time repairing water distribution main leaks in the Trailer Court water distribution branch. The 2017 PER performed corrosion and geotechnical investigation of this water main branch and found that it needed to be replaced. See the "Trailer Court Conceptual Water Main Replacement Map" in the 2017 PER.

2.0 SCOPE OF SERVICES

The Contractor shall provide the following design services for the City of Metlakatla, Alaska.

1. Develop and draft bid-ready plans and specifications for upgrading the City of Metlakatla water treatment plant and required permitting;

2. Develop and draft Force Account ready plans for constructing the Calvin Street water main and replacing the Trailer Court water main.

Any contract resulting from this SOQ and Request for Proposals (RFP) may be amended to provide contract administration services of the Water Plant work and construction support services of the water main construction work. Work may include some or all of the following:

- Approval of submittals for procurement of materials;
- Review and response to Request for Information (RFI) and Design Clarification/Variation Request (DCVR);
- Construction inspections;
- Approval of pay requests.

The selected firm will not be eligible to compete for the force account construction management services of this scope of work.

<u>Project Tasks, Deliverables and Schedule:</u>

Water Plant Design Deliverables

- Design Analysis Report (DAR) and 35% for the Water Plant process improvements and building addition. This is conceptual design phase. It will included:
    - DAR outline submittal requiring VSW approval;
    - 35% Plan Set Submittal meeting Basic Plan Set Requirements;

- Plan Sheet Outline Submittal requiring VSW approval;
- Narrative Specification in the DAR including identification of Divisions to be used;
- 35% Cost Estimate.

- Develop 65% design
  - 65% Basic Plan Set Requirements;
  - Outline level of Specifications;
  - 3rd Party 65% Cost Estimate.

- Develop 95% design or draft procurement/construction document level design
  - 95% Plan Set. This shall be substantially complete. Corrections and coordination that is not yet complete at 65% shall be complete by this stage;
  - Draft full length specification according to CSI format;
  - Final 3rd Party Cost Estimate.

- Develop Procurement documents
  - VSW Procurement Group will manage General Contractor procurement;
  - Consultant shall draft change, and substitution procedures, and handle questions during General Contractor procurement process.
  - Consultant shall draft schedule of values to use during procurement process.

Trailer Court and Calvin Street Water Main Deliverables

- Develop and draft DAR and 35% water main improvement design. This includes:
  - DAR outline submittal requiring VSW approval;
  - 35% submittal meeting Basic Plan Set Requirements (attached);
  - Sheet Specifications – Outline specification on the 35% plans;
  - The City of Metlakatla and VSW are responsible for site control.

- Develop 65% water main design. This includes
  - 65% plan set shall be relatively complete because there is no electrical or control design;
  - Sheet specifications shall be mostly complete.

- Develop 95% water main design. 95% includes
  - Drafting procurement package specifications for long lead items;
  - Permitting;
  - 95% cost estimate.

Plan Review and Submittal

- VSW and the City of Metlakatla shall review the plans, specifications, and cost estimates at the DAR, 35%, 65% and 95%;
- EPA Region 10 has regulatory authority both for water treatment and distribution;
- Fire Marshall review is not required as State of Alaska is not authority having jurisdiction.

3.0 MINIMUM QUALIFICATIONS AND RELEVANT PROJECT EXPERIENCE

The design team shall hold the following License and Certifications issued by the State of Alaska.

- Civil Engineering;
- Architect;
- Structural Engineering;
- Electrical Engineering.

The team, or a significant portion of it, shall have provided Water Plant process design services, and new building or building addition design services in the State of Alaska during the last five years.

The proposing firm shall be in the business of providing engineering design services for rural community projects.

The project manager shall be a current licensed Professional Engineer (P.E.) in the State of Alaska, and have at least five years of design experience as a P.E. in the State of Alaska.

Proposals that do not meet the minimum qualifications shall be deemed non-responsive and disqualified from consideration.

Please include projects that are related to the scope of work in Section 2.0 with your submission. The offeror's statement of qualifications shall expand on the relevant qualifications and experience of the firm's team by the category scoring breakdown below.

4.0 PROPOSAL FORMAT GUIDELINES AND EVALUATION SCORING

The SOQ shall follow the format and content requirements described below. The SOQ shall be typed on standard 8.5" X 11" paper, the font shall be no smaller than 12 point and margins shall be at least 1" all the way around the page. The evaluation scores will be on a 100 point scale as defined in this section. All SOQ's will be evaluated and scored using the following criteria and total points basis.

Proposals that do not meet the format and content requirements may be deemed non-responsive and disqualified from consideration.

5.0 PROPOSAL CONTENTS

The following information must be included in all proposals.

(a) AUTHORIZED SIGNATURE
All proposals must be signed by an individual authorized to bind the offeror to the provisions of the RFP. Proposals must remain open and valid for at least 90-days from the date set as the deadline for receipt of proposals.

(b) OFFEROR'S CERTIFICATION
By signature on the proposal, offerors certify that they comply with the following:

a. the laws of the State of Alaska;

b. the applicable portion of the Federal Civil Rights Act of 1964;

c. the Equal Employment Opportunity Act and the regulations issued thereunder by the federal government;

d. the Americans with Disabilities Act of 1990 and the regulations issued thereunder by the federal government;

e. all terms and conditions set out in this SOQ;

f. a condition that the proposal submitted was independently arrived at, without collusion, under penalty of perjury;

g. that the offers will remain open and valid for at least 90 days; and

h. that programs, services, and activities provided to the general public under the resulting contract conform with the Americans with Disabilities Act of 1990, and the regulations issued thereunder by the federal government.

If any offeror fails to comply with [a] through [h] of this paragraph, the state reserves the right to disregard the proposal, terminate the contract, or consider the contractor in default.

(c) VENDOR TAX ID

A valid Vendor Tax ID must be submitted to the issuing office with the proposal or within five days of the state's request.

(d) CONFLICT OF INTEREST

Each proposal shall include a statement indicating whether or not the firm or any individuals working on the contract has a possible conflict of interest (e.g., currently employed by the State of Alaska or formerly employed by the State of Alaska within the past two years) and, if so, the nature of that conflict. DEC reserves the right to **consider a proposal non-responsive and reject it or** cancel the award if any interest disclosed from any source could either give the appearance of a conflict or cause speculation as to the objectivity of the program to be developed by the offeror. DEC's determination regarding any questions of conflict of interest shall be final.

6.0 PROPOSAL EVALUATION CRITERIA

Cover Letter =10 points

Provide a brief cover letter introducing your firm, the project manager and any sub consultants that will be used. Describe the organizational structure and lines of authority of the team. Include statements that the team meets minimal qualifications and has the experience to perform the project scope of work and has current Alaska business and professional licenses.

Limit two pages.

Qualifications of the Team = 55 points

Introduce the firm's overall services and resources and list the names of the members on the project team, including all sub consultants. The scoring committee shall be looking for team members in the following areas:

- Civil and Geotechnical design;
- Water treatment plant process design;
- Electrical and Control design;
- Structural and Architectural design;
- Cost estimating.

Identify recent project work by the project manager and team members with:

- Project Title;
- Project Description;
- Project start and end dates;
- Client name, telephone number and email address.

Limit four pages.

Qualifications of the Project Manager = 10 points

Identify the proposed project manager and briefly explain why the person is a good fit for this project. The project manager shall be a member of the design team and shall have participated in project(s) listed above.

Limit one page.

Availability of Principal Staff = 10 points

Describe the availability of principal staff or sub consultants during the course of this project.
Limit (1) one page.

References = 10 points

Provide at least three references for the firm and at least three references for the proposed Project Manager. Information shall include the name, phone numbers, email address and project(s) name for work similar to the project described herein. In addition to these references, VSW reserves the right to check any other available references for evaluating and scoring.

MBE/WBE Preference = Five points

To receive the points, the qualified Minority Business Enterprise (MBE) or Women's Business Enterprise (WBE) offeror or subcontractor will provide evidence of certification and the work that they will perform. Please refer to Section 8 for additional information on the MBE/WBE preference.

The SOQ evaluation phase will establish the three highest ranking offerors based on the evaluation criteria and points identified in this section. The three highest ranking offerors will be short-listed and receive a RFP. Only the three short-listed offerors will receive the RFP.

7.0 SOQ QUESTIONS

Questions regarding this SOQ shall be addressed in writing (email preferred) to the Procurement Officer.

The deadline for submission of questions is June 27, 2019 at 3:00 PM Alaska Time. This will allow time for an amendment to be issued if one is required.

8.0 MBE/WBE PREFERENCE - Minority Business Enterprise (MBE) and Women's Business Enterprise (WBE)

To receive the points, the qualified Minority Business Enterprise (MBE) or Women's Business Enterprise (WBE) Contractor or subcontractor must provide evidence of certification and the work that they shall perform.

This procurement is funded in part or fully through federal grants or cooperative agreements. It is a national policy to award a fair share of contracts to Minority Firms and Women's Business Enterprises through affirmative action. The negotiated Federal "Fair Share" percentage for **fiscal years 2018 through 2019** is 3.67% MBE and 1.54% WBE. This solicitation incorporates a five point preference for all qualified minority firms and women's business enterprises.

In order to be deemed a bona fide Minority Business Enterprise (MBE) or Women's Business Enterprise (WBE) a firm must be an independent business concern which is a least fifty-one percent (51%) owned and controlled by minority group members or women.

It is the responsibility of the offeror to include in their proposal their qualifications and/or of the qualifications of their subcontractors for this preference. It is also the responsibility of the offeror claiming eligibility for this preference to pledge in their proposal that the eligible subcontractor will be **guaranteed** at least 5.21% of the proposed work.

Following is an example of how the preference points will be calculated for qualifying businesses:

MBE/WBE Offeror's Preference
[STEP 1]
Determine the number of points available to MBE/WBE eligible offerors under this preference.

Total number of points available in this example situation = 100 Point

100x	5%	=	5
Total Points	MBE/WBE Offeror's Percentage Preference		Number of Points Available to Eligible Offerors Under MBE/WBE Preference

[STEP 2]

Add the preference points to the qualified MBE/WBE SOQ's. In a hypothetical situation, there are three (3) offerors. After being evaluated, each received the following points:

Offeror #1	95 points
Offeror #2	90 points
Offeror #3	92 points

Before preference points are calculated, offeror #1 is the apparent winner. However, in this hypothetical situation, offeror #2 and offeror #3 are eligible for the MBE/WBE preference. After adding five points to their scores, offeror #3 is the new apparent winner, with 97 points.

9.0 ASSISTANCE TO OFFERORS WITH A DISABILITY

Offerors with a disability may receive accommodation regarding the means of communicating this SOQ or participating in the procurement process. For more information, contact the Procurement Officer no later than five calendar days prior to the deadline for receipt of SOQ's.

10.0 SUBMITTAL INFORMATION AND SCHEDULE

Offerors shall submit an original signature paper version of the completed SOQ with three paper copies and one electronic version on CD.

SOQ's shall be received on July 8, 2019, by no later than 3:00 PM Alaska time. Faxed, oral or emailed SOQ's are not acceptable. SOQ's submitted after the deadline established for submitting SOQ's shall be deemed non-responsive and disqualified from consideration.

SOQ's shall be submitted to the address below:

Department of Environmental Conservation
Village Safe Water Program
Attn: Pearley M. Bingham, Procurement Officer
SOQ # VSW-MTM-2019-37
555 Cordova Street, 4th floor
Anchorage, Alaska 99501

SOQ/RFP Schedule:

Below is the schedule for this solicitation. If any of the dates are changed, the other dates will change accordingly:

Issue Request for SOQ's	June 17, 2019
SOQ question submission deadline	June 27, 2019/3:00PM AKST
SOQ submission deadline	July 8, 2019/3:00PM AKST
Short-list three offerors approximately	Week of July 22, 2019
Issue RFP approximately	Week of July 29, 2019

<u>Required Documentation from Offerors:</u>

- Proposal Form
- Minimum Qualifications and Experience – **in accordance with Section 3;**
- Proposal – **in accordance with Section 4;**

Offerors that fail to submit the required documentation, as identified above, before the deadline set for receipt of proposals shall be deemed non-responsive.

11.0 PROTEST PROCEDURE Similar to AS 36.30.550 provides that an interested party may protest the content of the solicitation.

An interested party is defined in 2 AAC 12.990(a) (7) as "an actual or prospective bidder or offeror whose economic interest might be affected substantially and directly by the issuance of a contract solicitation, the award of a contract, or the failure to award a contract."

An interested party must first attempt to informally resolve the dispute with the procurement officer. If that attempt is unsuccessful, the interested party may submit a written protest. Written protest must include the following information:

- The name, address, and telephone number of the protester;
- The signature of the protester or the protester's representative;
- Identification of the contracting agency and the solicitation or contract at issue;
- A detailed statement of the legal and factual grounds of the protest including copies of relevant documents; and the form of relief requested.

All protests will be submitted to and responded to by the Procurement Officer IV as the protest decision authority. The appeal of a protest decision will be submitted to and responded to by the Procurement Officer IV and VSW Program Manager as the appeal decision authority. The appeal decision authority is the final decision and cannot be protested further. If protesting a solicitation document including the content of a specification, the protest must be filed with the Procurement Officer no later than **four** business days before quotations, bids, or proposals are due. Within **one** business day of receiving the protest, the Procurement Officer shall provide notice of the protest to all firms or persons that received the solicitation.

If protesting a decision to cancel a solicitation or the award of a purchase or contract, the protest shall be filed with the Procurement Officer within 10 calendar days of the date of the written Notice of Cancellation or Notice of Award. The deadline date cannot end on a weekend or state holiday. Within **one** business day of receiving the protest, the Procurement Officer shall provide notice of the protest to all firms or persons that received the solicitation and will acknowledge receipt of the protest. After protest receipt, the Procurement Officer shall take one of the following actions within 15 calendar days:

a) Issue a written decision denying the protest including the specific reasons for the denial;

b) Issue a written decision sustaining the protest in whole or in part and implementing an appropriate remedy.

If the protester is not satisfied with the protest decision, they may appeal the protest decision to the VSW Program Manager. The written appeal must be filed within 10 calendar days of the date of the protest decision. The deadline date cannot end on a weekend or state holiday. The appeal shall not raise any new issues that were not included in the written protest. An informal hearing on the protest appeal may be conducted by the VSW Program Manager to attempt to resolve the dispute. A written appeal decision on the appeal will be issued as follows:

a) Issue a written decision denying the appeal; citing the specific reasons for the denial;
b) Issue a written decision sustaining the appeal in whole or in part and implementing an appropriate remedy.

12.0 FEDERAL DEBARMENT CERTIFICATION AND BYRD ANTI-LOBBYING AMENDMENT

Expenditures from a contract resulting from this solicitation may involve federal funds. The U.S. Department of Labor requires all state agencies that are expending federal funds to have a certification filed in the proposal (by the offeror) that they have not been debarred or suspended from doing business with the federal government. Certification regarding debarment, suspension, ineligibility and voluntary exclusion lower tier covered transactions must be completed and submitted by the contractor to the Procurement Officer prior to being "short listed" and advancing to the RFP process (Appendix B: Federal Debarment Certification Form).

The Contractor agrees to comply with all requirements of the Byrd Anti-Lobbying Amendment (31 U.S.C 1352). A certification must be completed and submitted to the Procurement Officer prior to being "short listed" and advancing to the RFP process (Appendix C: Certification and Disclosure Regarding Payments to Influence Certain Federal Transactions).

<u>APPENDICES:</u>

- Appendix A: General Provisions (10 pages);
- Appendix B: Federal Debarment Certification Form (two pages);
- Appendix C: Certification and Disclosure Regarding Payments to Influence Certain Federal Transactions (three pages);
- Appendix D: Proposal Form.

<u>ATTACHMENTS</u>

Attachment 1: Metlakatla Preliminary Engineering Report, Final Draft, Metlakatla, Alaska, June 2017, GV Jones and Associates, Inc. (105 pages);

Attachment 2: VSW Basic Plan Set Requirements (11 pages).

CITY OF METLAKATLA WATER TREATMENT FACILITY

DISINFECTION BYPRODUCT REDUCTION AND PIPE CORROSION

PRELIMINARY ENGINEERING REPORT

Prepared for

June 16, 2017

Prepared by

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List of Abbreviations

BMPs	best management practices
CIPP	Cured In Place Piping
DBPs	disinfection byproducts
DEC	Department of Environmental Conservation
DOC	dissolved organic carbon
EPA	U.S. Environmental Protection Agency
ER	Environmental Report
FPPA	Farmland Protection Policy Act
GAC	granular activated carbon
gpm	gallons per minute
GVJ&A	GV Jones & Associates, Inc.
HAA5	Haloacetic Acid
HDPE	high density polyethylene
HP	horsepower
HRT	hydraulic residence time
MCL	Maximum Contaminant Level
mg/L	milligrams per liter
MIC	Metlakatla Indian Community
mm	millimeter
NF	nanofilter
NPDWR	National Primary Drinking Water Regulations
O&M	operation and maintenance
PAC	Powdered Activated Carbon
PACls	polyaluminum chlorides
PER	Preliminary Engineering Report
PRVs	pressure reducing valves
psi	pounds per square inch
Rule	Stage 2 DBP Rule
RUS	Rural Utilities Service
SDS	Safety Data Sheet
SMCL	Secondary MCL
SWPPP	Storm Water Pollution Prevention Plan
System	MIC WTP and distribution system
TDS	total dissolved solids
TTHM	total trihalomethanes
USDA	United States Department of Agriculture
UV	ultraviolet
UVT	ultraviolet transmittance
VSW	Village Safe Water
WSE	water surface elevation
WTP	water treatment plant

EXECUTIVE SUMMARY

Village Safe Water (VSW), on behalf of the Metlakatla Indian Community (MIC), commissioned GV Jones & Associates, Inc. (GVJ&A) to prepare a Preliminary Engineering Report (PER) to address pipe corrosion and disinfection byproducts (DBPs) in the distribution system. DBPs are chemical substances formed from the reaction of a disinfectant with naturally present organic matter in the water. The MIC Public Water System has exceeded the regulatory limits for Haloacetic Acid (HAA5) DBPs, prompting the U.S. Environmental Protection Agency (EPA) to require an operational evaluation.

In addition to the ongoing DBP compliance issue, the potable water distribution system for MIC has experienced an excessive number of leaks due to corrosion of buried steel and ductile iron piping. Based on an analysis that found the corrosion to be primarily external, a proactive solution is necessary to avoid frequent and costly repairs.

Two categories of alternatives were developed: upgrades to the distribution system and upgrades to the water treatment plant (WTP). Upgrades to the distribution system included the following:

1. Upgrade to address Corrosion of Distribution System at New Trailer Park
2. Upgrade Connecting Dead End Pipelines to Reduce DBPs

Alternatives for addressing the corrosion in the distribution system included lining or removing and replacing the existing pipe. Removing and replacing the existing pipe with corrosion proof pipe was determined to be the most practical and cost effective option.

Connecting dead end pipes on Haines Street and Milne Street with the main that runs along Hillcrest Road is recommended to promote water flow and limit stagnant water in the system, a situation that can lead to DBP formation.

Alternatives for upgrades to the WTP included the following:

1. Flushing and Storage Tank Level Control
2. Alternative Coagulants
3. Nanofiltration
4. Granular Activated Carbon (GAC) Filtration
5. Alternative Disinfection Process

A combination water age/DBP study for the system found flushing to be an impractical method for reducing DBPs in the system. Three methods for removing organic material prior to disinfection, to prevent the formation of DBPs, were considered. These included use of an alternative coagulant, deployment of nanofiltration, or deployment of GAC filtration. Using a disinfectant that does not produce DBPs was considered, but literature showed non-regulated DBPs may be formed and this alternative is not recommended. Replacing the current coagulant was found to be the cheapest option in terms of capital and annual operation and maintenance (O&M) costs, and also introduces the least amount of operational change for the operators and treatment plant.

To prevent corrosion in the distribution system and potential increases in concentrations of lead and copper, soda ash and disodium phosphate are recommended as a corrosion inhibitor.

1 PROJECT PLANNING

The Village Safe Water (VSW) Program of the Department of Environmental Conservation (DEC), on behalf of the City of Metlakatla, Alaska, commissioned GV Jones & Associates, Inc. (GVJ&A) to prepare a Preliminary Engineering Report (PER) and an Environmental Report (ER) to address disinfection byproducts (DBPs) and pipe corrosion in the distribution system. The proposed project is described in this PER outlining alternatives for addressing the aforementioned issues listed for the Metlakatla Indian Community (MIC) water treatment plant (WTP) and distribution system. The MIC WTP and distribution system is herein referred to as the System.

1.1 LOCATION

Metlakatla is located on the northern portion of the Metlakatla Peninsula on Annette Island in Southeast Alaska, in Section 9 of T78S, R92E, in the Copper River Meridian. Annette Island is located approximately 900 miles southeast of Anchorage and 700 miles northwest of Seattle. The Island is accessible only by air and water. A location and vicinity map show the location of the community and the project in Figure 1.

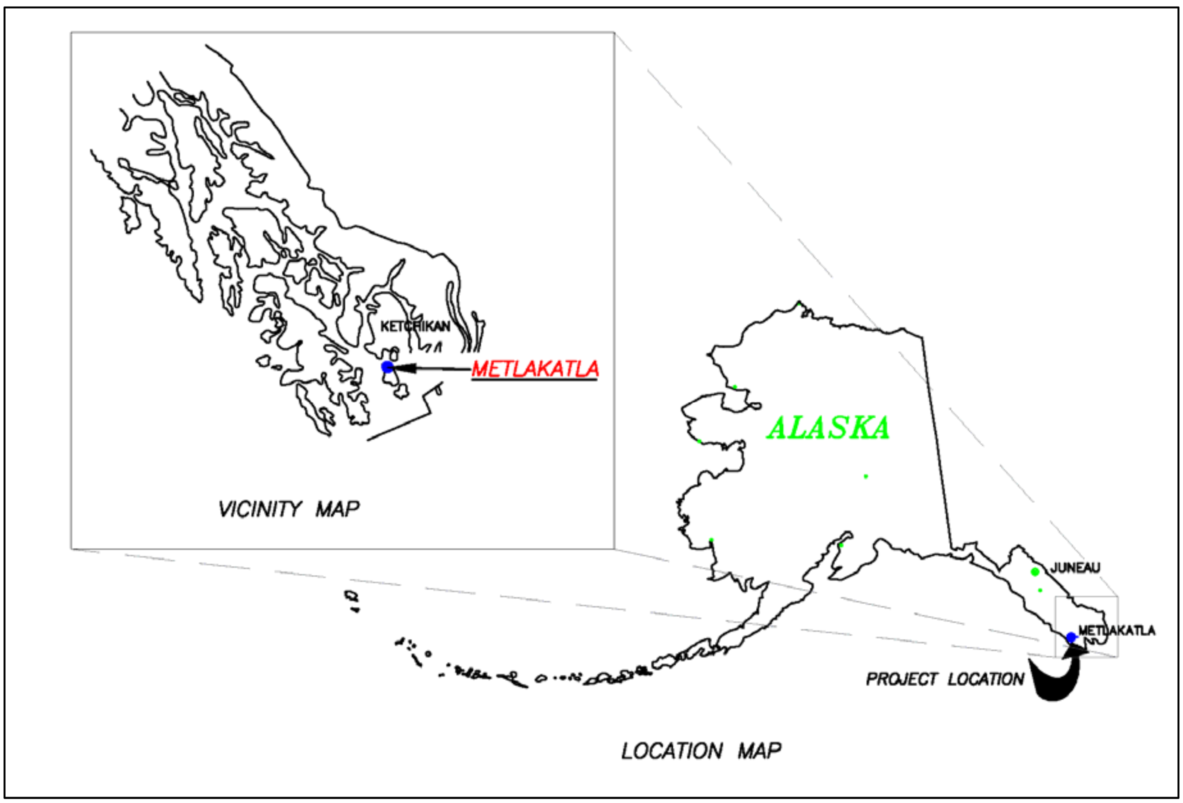

Figure 1. Project Site Location Map

The proposed project is to occur within the developed areas of the existing community. Within the community, three distinct locations require project work:

1. Trailer Court Water Line Upgrades: The distribution system corrosion is concentrated within the area of the trailer court. At this time, based on information from VSW and MIC, corrosion has not been significant in other areas of the distribution system.
2. Water Line Extension: The distribution water pipelines on Hillcrest Street, Lakeview Street and Milne Street are dead-end pipelines. A new water line is recommended to connect the existing pipelines into the line on Hillcrest to make a looped section and aid in reducing DBPs
3. WTP: Upgrades to the treatment process to address DBP formation will occur entirely within the existing boundary of the WTP (a fenced area delineates the WTP boundary.)

These three locations are noted on the satellite imagery map in Figure 2.

Figure 2. Google Earth Satellite Imagery showing the locations of the Proposed Project within the Metlakatla Indian Community

1.2 Environmental Resources Present

Annette Island is approximately 128 square miles, the majority of which is undeveloped. Outside of the community, the island is covered by a combination of wetlands, forests and mountains. A fish hatchery is operated in a southern cove of the island. Salmon fishing is a major source of income for the community, with logging also contributing to the economy. MIC is located on the tip of a peninsula on the west side of the island, as shown in the photo in Figure 3. For an in-depth analysis of environmental resources potentially affected and the proposed mitigation for the environmental consequences associated with each considered alternative, refer to the ER prepared in conjunction with this report.

Figure 3. Metlakatla Indian Community from Near the Chester Lake Reservoir Spill Way

1.2.1 Land Use/Important Farmland/Formerly Classified Lands

The proposed project location does not infringe on any farmland as protected by the United States Department of Agriculture (USDA) Farmland Protection Policy Act (FPPA). All land proposed for the project is owned by MIC and has already been developed.

1.2.2 Floodplains

A review of the Federal Emergency Management Agency's Flood Mapping Products database, the USDA Natural Resource Conservation Service's Web Soil Survey, and the US Army Corps of Engineers Alaska District's Alaska Flood Database did not result in identifiable floodplains near the proposed project site.

1.2.3 Wetlands

The U.S. Fish and Wildlife Service's National Wetlands Inventory database was accessed to identify wetlands in the area. Wetlands are present on Annette Island, but none are present within the proposed project area, as the proposed project area is contained entirely on previously developed land.

1.2.4 Historic Properties

No historic properties, archaeological sites, visually sensitive areas or traditional cultural sites were identified within the project area.

1.2.5 Biological Resources

No listed or proposed threatened or endangered species, or any designated or proposed critical habitat, under the Endangered Species Act of 1973 (87 Stat. 844) are expected to be affected during the project.

1.2.6 Water Quality

Improvement of the water quality of the community drinking water is the objective of the proposed project. Surface runoff could be exposed to disturbed ground temporarily during the construction phase of the distribution system upgrades, an issue that can be managed using Storm Water Pollution Prevention Plan (SWPPP) best management practices (BMPs) during construction. Currently, the only available option to address DBPs is flushing the distribution system, which entails opening fire hydrants to discharge onto the ground. Flushing of the water distribution system results in surface runoff, and the proposed project intends to eliminate the dependency on this practice.

Implementation of new unit processes at the WTP has the potential to increase the concentration of compounds in the water being discharged to the on-site water treatment process waste water settling pond. This will be discussed in detail in subsequent sections in this report. Clarified water from the settling pond at the MIC WTP is discharged to a stream, along with the discharge from the tailrace of the hydroelectric plant. The volume of water from the settling pond is small compared to the volume passing through the hydroelectric plant into the tailrace, and small increases in dissolved ions is not expected to have any significant impacts.

1.2.7 Coastal Resources

Coastal resources are not anticipated to be impacted by this project.

1.2.8 Socio-Economic Issues/Environmental Justice

Socio-economics and environmental justice are not expected to play a role in this project. If left unaddressed, the corrosion in the distribution system could impact all customers with potable water contamination resulting from failing pipes. Similarly, DBPs in the water have potential to affect any or all of the community members that have access to the water system. While replacement and/or upgrades to portions of the distribution system may cause interruptions of water service to some residents, any interruptions will only be temporary and accommodations to affected parties can be made during the construction timeframe.

1.3 Population Trends

As of the 2010 Census, the population of Metlakatla is 1,405 (Census, 2010). This is almost exactly the same as the 1990 population of 1,407 (Census, 1990), after a slight drop in 2000 down to 1,375 (Census, 2000). Based on these numbers, the population of the community is not expected to see significant changes in the near future.

1.4 Community Engagement

This project worked closely with MIC personnel involved with the System. Efforts were made to consider current operations and to minimize unnecessary changes at the request of the personnel directly responsible for operating and maintaining the System, while still addressing the problems identified by EPA regulatory oversight. The Tribal Council makes decisions for the community. Prior to finalization of the engineering report, a committee will review the project to verify that no negative impacts related to the environment, the community, or other culturally sensitive sites will result. Following review and approval by the committee, a proposed project can be submitted to the Tribal Council for review. Members will have a chance to review the proposed project and the ER prior to finalization.

2 EXISTING FACILITIES

The source of water for the System at MIC is rain and snowmelt runoff impounded in a reservoir behind the Chester Lake Dam. As is typical for Southeastern Alaska, the Chester Lake impounded source water quality is low in total dissolved solids (TDS), alkalinity, and pH, but has concentrations of dissolved organic material. Naturally occurring dissolved organic material that is not removed during the treatment processes can form elevated concentrations of DBPs upon exposure to chlorine in post treatment.

The residents of MIC are served by a conventional water pressure distribution system with direct filtration and chlorination water treatment, originally constructed in 1988. Water flows via gravity from the Chester Lake Dam Reservoir through a 20-inch penstock to supply the hydro-turbine generation station and the WTP. Water supply pressure is reduced through several pressure reducing valves (PRVs), in a valve vault and within the WTP, from 350 pounds per square inch (psi) to approximately 120 psi. Upgrades were done in 1995 to add a polymer feed system and surface wash water. The water is coagulated with Nalcolyte 8105, based on readings from a streaming current detector, and filtered through four dual-media (anthracite and sand) pressure filters. After filtration, the water is disinfected with sodium hypochlorite and flows to two 500,000-gallon water storage tanks for disinfection contact time and storage, with a total storage capacity of 1,000,000 gallons. Water from the storage tanks is distributed by gravity to the users through a buried pipe system. Photos of the WTP building and interior are shown in Figure 4 and Figure 5, respectively. A schematic of the treatment train is shown in Figure 6.

The existing facilities are in good condition and are adequate for existing treatment, aside from a connex used for onsite storage that personnel indicated is in poor condition. The treatment train of direct filtration, chlorination and contact time in the two 500,000-gallon tanks meets regulatory filtration and disinfection requirements. As discussed in detail in a subsequent section, the WTP has recently experienced excursions of the Haloacetic Acid (HAA5) DBP limits set by the Stage 2 DBP Rule. At the encouragement of the U.S. Environmental Protection Agency (EPA), MIC is flushing the distribution system on a quarterly basis to reduce DBP concentrations. Energy consumption at the WTP is limited, as water flow through the System is driven by gravity. Energy consumed is for the automated valves, instrumentation, coagulant dosing pumps and WTP lights.

Monthly revenue collected is between $31,000 and $33,000. User fees for customers are $62 for water and sewer service and $82 for water, sewer, and garbage service. The annual budget for the utility is $507,700, with $43,000 of that allocated to electricity costs.

Figure 4. Photos of MIC WTP, front and back of building

Filter gallery with four dual media pressure filters, piping and turbidimeters

PRVs reduce water pressure to around 150 psi in the plant

A dilution of coagulant and water is injected upstream of the pressure filters

Chlorine is injected upstream of the flow meter prior to the distribution system

Figure 5. Photos inside MIC WTP

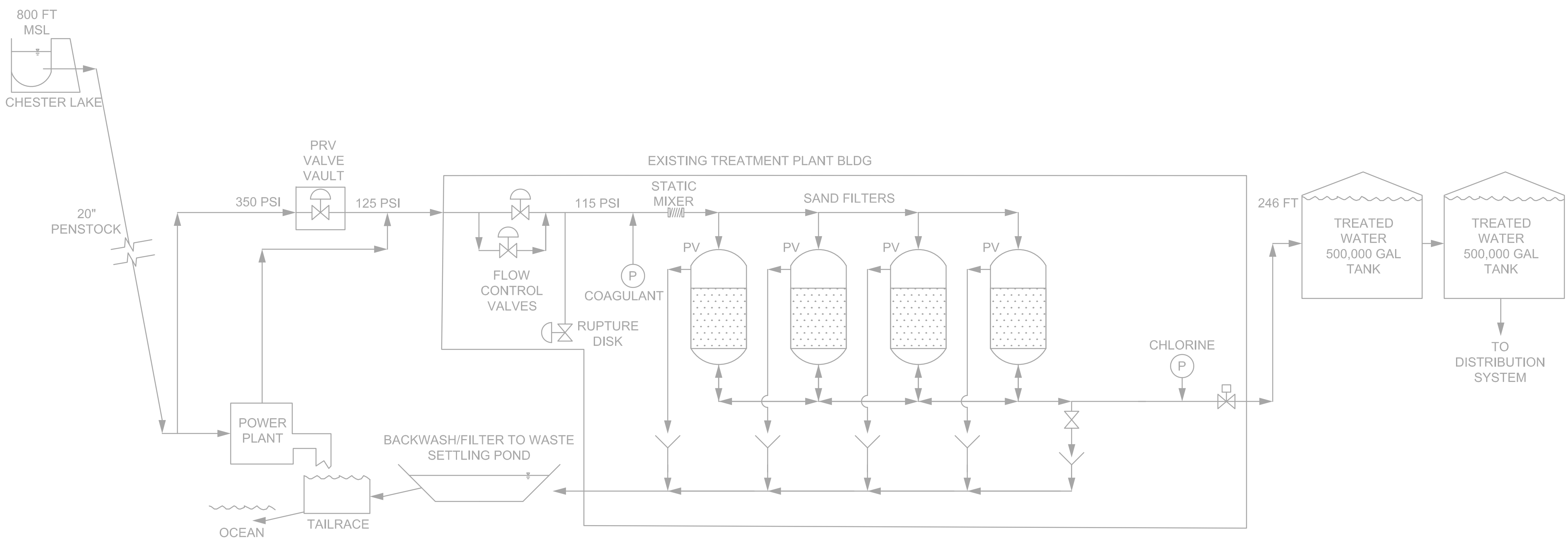

FIGURE 6. SYSTEM SCHEMATIC FOR THE METLAKATLA COMMUNITY SYSTEM TREATMENT TRAIN

3 NEED FOR PROJECT

The project is needed to meet health, sanitation and security concerns, as well as to address aging infrastructure problems. DBPs are chemical, organic and/or inorganic substances formed from the reaction of a disinfectant with naturally present organic matter in the water. In the spring of 2016, the System (ID# 100211202) exceeded the Operational Evaluation Level value of 60 parts per billion for HAA5 DBPs based on the local running annual average calculated using values from the previous three quarters. As a result, the EPA required MIC to complete an Operational Evaluation, as dictated by the Stage 2 DBP Rule (Rule), the requirements of which will be completed with the submission of this PER. The next quarterly DBP report (July 2016) included DBP concentrations which, when averaged with the prior three quarterly values, exceeded the Maximum Contaminant Level (MCL) for HAA5s and placed the System in violation of the Rule. EPA notified the System of the requirements to issue a public notification and take action to reduce DBPs (See Appendix X). MIC began more frequent flushing (once per quarter) to reduce the age of water within the System in an attempt to lower DBP concentrations. Testing since the violation has resulted in HAA5 concentrations close to the MCL, indicating that flushing has not significantly decreased HAA5 concentrations.

The MIC WTP needs to upgrade their current system and/or operation strategy to consistently meet HAA5 DBP regulations. Failure to address the issue could result in the System being out of compliance with the Safe Drinking Water Act and facing financial and legal penalties. Addition of corrosion inhibitor to the treatment train is recommended to prevent corrosion of lead and/or copper in the System based on the high corrosive potential of the water and the expected increase in corrosion associated with DBP precursor removal (explained in following sections).

In addition to the ongoing DBP compliance issue, the potable water distribution system for MIC has experienced an excessive number of leaks due to corrosion of buried steel and ductile iron piping. Repair of these leaks is frequent, costly, and interrupts potable water utility service to portions of the MIC. The problem requires a larger scale approach rather than isolated fixes to avoid frequent service interruptions and contamination of the community drinking water. Failure to address corrosion of the distribution pipe could result in contamination of the drinking water due to pipe failure.

4 ALTERNATIVES CONSIDERED

The project alternatives considered for upgrades to the System can be broken into two focus points: (1) Alternative upgrades to the MIC potable water distribution system, and (2) Alternative upgrades to the MIC WTP. Alternatives considered did not include alternative ownership or management, as the treatment plant and distribution system are owned by MIC and are located on an Indian reservation. Alternative ownership entities do not have a presence in the area and were not considered as a part of this project. VSW provides support to MIC to develop and maintain sustainable systems for water and wastewater, including support for development of this PER.

4.1 Alternatives Considered for Upgrades to the MIC Potable Water Distribution System

Two upgrades to the MIC potable water distribution system are being evaluated:

1. An upgrade to address the corrosion that has occurred within the area referred to as the New Trailer Court.
2. Connecting dead end pipelines to form a looped pipeline to prevent stagnant water in the System and aid in reducing DBPs.

4.1.1 Upgrade for Corrosion of Distribution System at New Trailer Park

Taku Engineering was contracted to perform a corrosion condition assessment on the section of distribution lines that services the trailer court. The *Metlakatla Water Distribution System Corrosion Condition Assessment* is included in Attachment B. Refer to the original report for a full explanation; the following is a summary of the report findings.

The Corrosion Condition Assessment reported the following results:

1. The corrosion that resulted in the previous failures of the New Trailer Court's water distribution piping was overwhelmingly due to external corrosion attack. All observable pipe segments (previously removed and replaced) exhibited significant external pitting and wall loss resulting in multiple through-hole penetrations. These observations coincide with the aggressive soil/water conditions found in each of the excavated examination sites.
2. Internal surfaces of the previously removed pipe segments were found to be in relatively good condition. Minor pitting and general surface corrosion was observed on the internal surfaces of the pipe. However, these were minor in nature (less than 12% wall loss) and were not associated with the extensive external corrosion-related failures.
3. The soil environment surrounding the 6-inch ductile iron water line was found to be very corrosive. Although individual test results for soil resistivity, chloride and sulfates, and corrosion-causing bacteria indicate moderate corrosivity, collectively, they produce a significantly more aggressive corrosion environment. This is further compounded by the presence of clay, heavy organic material, and flowing groundwater that can result in more concentrated corrosion cells.
4. Although the piping exposed in the three excavated examination locations was found to be in fair condition, random locations of corrosion staining and/or bacterial attack leaching through the deteriorating asphaltic coating were evident. Considering the aggressive nature of the soil environment, construction methods used in the original installation (i.e., wood cribbing left in contact with the pipe, etc.), and the aging factory coatings, ever increasing failures of the New Trailer Court water distribution line are expected.
5. Due to the presence of electrically discontinuous bell and spigot pipe joints, the application of cathodic protection as a corrosion control measure would be extremely difficult and costly to achieve. This would require excavation of each pipe joint to either install electrical bonds and anodes to protect the pipe collectively, or excavation of each pipe joint to install anodes to protect pipe sections individually.

Based on the Corrosion Condition Assessment, two alternatives were identified: (1) slip lining of the existing pipe, and (2) removal and replacement of the pipe within the Trailer Court.

4.1.1.1 Cured In Place Piping Lining

Cured In Place Piping (CIPP) lining is sometimes referred to as trenchless piping because the pipe only requires access at one or two points, depending on the method of slip lining used. Therefore, the excavation efforts are often only a fraction of the cost of pipe replacement. The end result is a resin cured, fiberglass cloth (or other material) pipe with a slightly smaller inner diameter that returns structural integrity to the pipe. Service connections can be restored with a robotic cutting device, but excavation is often required to reinstate the connection. There is approximately 2,000 feet of piping in the Trailer Court, with approximately 55 housing connections. Analysis of this system indicated that even if CIPP lining of the pipe were to occur, almost the entire 2,000 feet of 6-inch ductile iron pipe would have to be excavated to reinstate the 55 service connections. Because the trenchless benefit would not be realized by using a lining process, lining of the pipe was not further investigated as an alternative.

4.1.1.2 Removal and Replacement

Removal and replacement of the pipe was determined to be the only reasonable alternative for addressing the failing pipes in the Trailer Court. Removal and replacement of the corroding pipes would not only ensure that structurally sound pipes made of corrosion-resistant high density polyethylene (HDPE) are distributing water to the community, but would allow for bedding and backfill material to be installed around the new pipes, along with cathodic protection and engineer-approved coating for valves, as part of the design to ensure that the corrosion problem does not continue or reoccur. As such, removal and replacement was selected as the alternative to replace the portion of the distribution system where corrosion is occurring.

Figure 7, below, is a project map showing the area of the distribution system termed the New Trailer Court where the pipe will be replaced.

Environmental Impacts

The replacement of pipe for this alternative is to occur within the developed areas of the existing community. As the pipe already exists in this location, replacement is not anticipated to cause any environmental impacts. Surface runoff could be exposed to disturbed ground temporarily during the construction phase of the distribution system upgrades. However, this issue can be managed using SWPPP BMPs during construction.

Land Requirements

Neither new land nor easements will be needed for this alternative.

Potential Construction Problems

High groundwater is known to be present in the area. The contractor responsible for removing and replacing the pipe will need to be prepared with appropriate equipment to pump water out of the excavation during construction.

Sustainability Considerations

Replacement of the existing distribution lines in the New Trailer Court with HDPE pipe will incorporate corrosion resistance into the design, a long-term, sustainable solution. This alternative will potentially reduce the carbon footprint associated with shipping and capital costs by reducing future pipe replacement events.

Cost

The construction cost for the remove and replace alternative was estimated to be $645,265. The breakdown of costs are included in Attachment D.

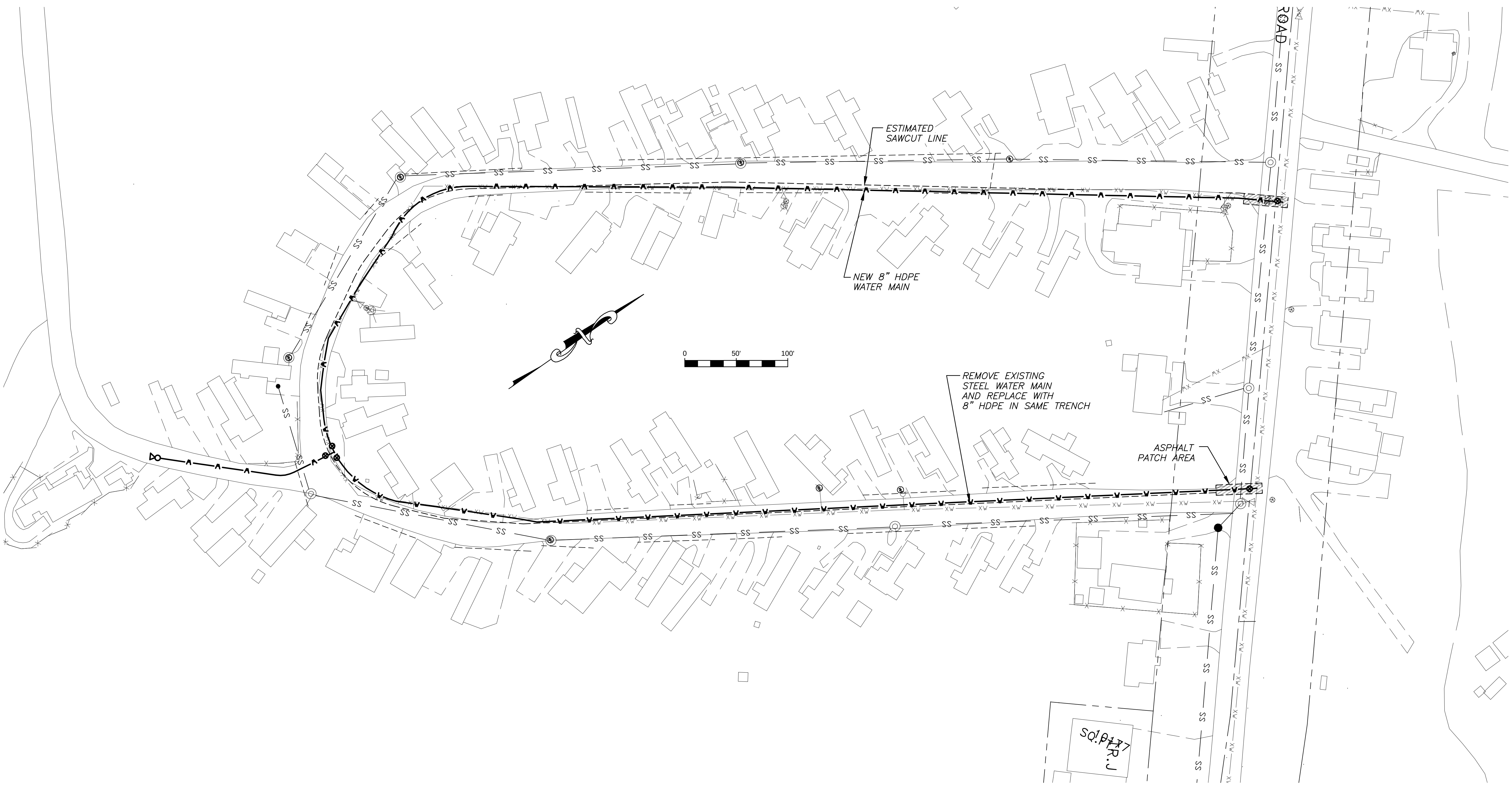

Figure 7. Distribution System Trailer Court Pipe Replacement Upgrades Site Map

Date	No.	Description	By	Designed: RKB	Approved: RKB	R&M ENGINEERING–KETCHIKAN, INC. 355 CARLANNA LAKE ROAD KETCHIKAN, ALASKA 99901	Client: G.V. JONES & ASSOCIATES 1200 EAST 76TH AVE UNIT 1207 ANCHORAGE, AK 99518	Project: METLAKATLA DBP REDUCTION AND PIPE CORROSION PROJECT	Sheet Description: TRAILER COURT CONCEPTUAL WATER MAIN REPLACEMENT MAP	Sheet No. EX1
REVISION				Drawn: JPT	Date: MARCH 2016					
				Checked: RKB	PROJECT #: 172301.01					

4.1.2 Upgrade of Connecting Dead End Pipelines to Reduce DBPs

Residual chlorine within the System will continue to react with the dissolved organic matter present in the plant discharge and the organic matter associated with biofilms on the pipe walls. The longer that water is in the distribution system, the higher the concentration of DBPs. Within dead end pipes, water can become stagnant and increase water age. Converting the dead end pipes into a looped system will aid in reducing the DBP concentrations within those pipes. In addition, eliminating dead end pipes increases redundancy and reduces susceptibility to loss of service for residents on those streets. Looping can also help ensure pressure and flow are maximized at each point for fire control.

Two pipelines on Haines Street and Milne Street have been identified as dead end pipes. This upgrade would entail connecting the dead end water mains on Haines and Milne streets with a line running along Calvin Street, and connecting into a water main on Hillcrest Road.

As no other pipes are dead ends, there are no alternatives. Figure 8 is a project map showing the area of the distribution system to be connected with a new water line.

Environmental Impacts

Addition of pipe connecting the pipelines on Haines Street and Milne Street to Hillcrest Road would occur in a developed area of the community where the distribution system has been routed. Thus, connection of these pipelines is not anticipated to cause any environmental impacts. Surface runoff could be exposed to disturbed ground temporarily during the construction phase of the distribution system upgrades. However, this issue can be managed using SWPPP BMPs during construction.

Land Requirements

Neither new land nor easements will be needed for this alternative.

Potential Construction Problems

High groundwater is known to be present in the area. The contractor responsible for installing the pipe will need to be prepared with appropriate equipment to pump water out of the excavation during construction.

Sustainability Considerations

Extension of the dead end pipes to become looped lines will increase the sustainability of the distribution system, as it will increase redundancy of service to the residents served by these service lines and make the utility service more robust.

Cost

The construction cost for the remove and replace alternative was estimated to be $193,660. The breakdown of costs are included in Attachment E.

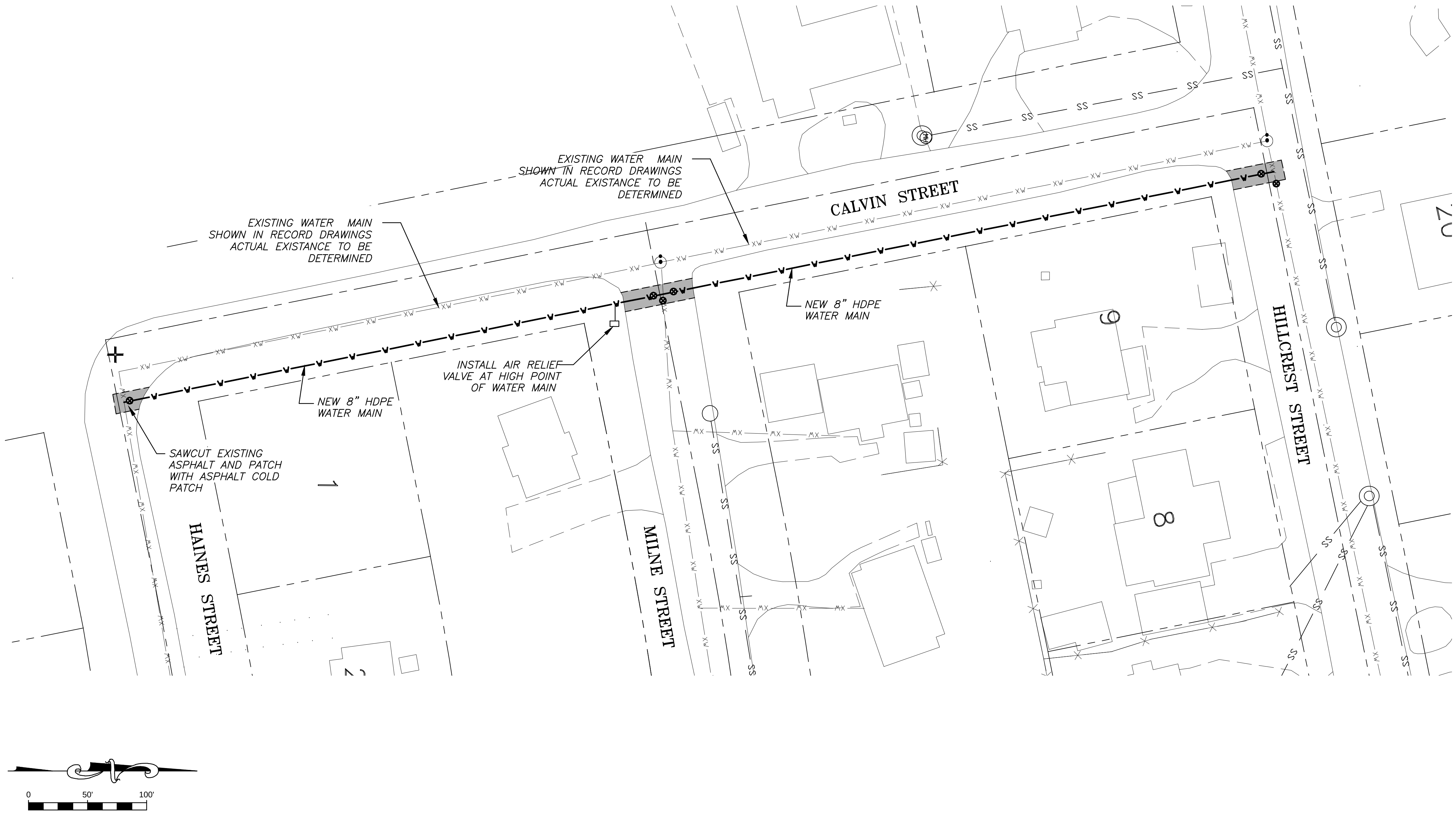

Figure 8. Calvin St. Water Line Upgrades Site Map

Date	No.	Description	By
		REVISION	

Designed: RKB | Approved: RKB
Drawn: JPT | Date: MARCH 2016
Checked: RKB | PROJECT #: 172301.01

R&M ENGINEERING–KETCHIKAN, INC.
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Client: G.V. JONES & ASSOCIATES
1200 EAST 76TH AVE UNIT 1207
ANCHORAGE, AK 99518

Project: METLAKATLA DBP REDUCTION AND PIPE CORROSION PROJECT

Sheet Description: CALVIN STREET CONCEPTUAL WATER MAIN CONSTRUCTION MAP

Sheet No. EX2

4.2 Alternatives Considered for Upgrades to the MIC Water Treatment Plant

The alternatives evaluated to reduce DBP formation included the following:

1. Management of distribution system water age through operations, including flushing and storage tank level control.
2. Replacing current coagulant with a coagulant that removes more dissolved organic carbon (DOC) from the water.
3. Modification of the potable water treatment train by adding membrane nanofiltration to remove DOC.
4. Modification of the potable water treatment train by adding GAC filtration to remove DOC.
5. Modification of the potable water treatment train by adding alternative disinfection processes.

The water quality characteristics of the finished water are generally corrosive to metal wetted surfaces and based on modeling with Water!Pro, corrosion of lead and copper should be occurring in the System. The Corrosion Condition Assessment Report did not identify any major internal corrosion in the previously removed pipe sections, nor has the System historically had problems with lead and copper concentrations. The lack of corrosion is attributed to the DOC in the water, which has been found in other systems to suppress corrosive properties of water. Water!Pro modelling is likely not taking into account the effect of organics in the water and not accurately predicting the corrosion.

Since all of the alternatives, with the exception of flushing and water level control, aim to reduce DOC (the believed corrosion suppressant) to prevent formation of DBPs, corrosive water is a concern after implementation of any of the three alternatives. If corrosion occurs in the System, lead and copper concentrations could be increased. To avoid replacing one compliance problem with another, alternatives that reduce the DBP formation potential by removing DOC also include upgrades to reduce the corrosivity of the water as part of the treatment process. Previous experience has shown that a combination of soda ash and disodium phosphate effectively prevents corrosion. While each compound has the potential to eliminate corrosion, experience has shown the combination of the two compounds to be a superior corrosion inhibitor. For each alternative, Water!Pro was used to estimate the necessary doses of the corrosion inhibitors Soda Ash and Disodium Phosphate to reduce the corrosion potential. After implementation of the alternative, testing will be required to fine tune the doses of the corrosion inhibitors. Soda ash (sodium carbonate) and disodium phosphate are both common additives for WTPs. The Safety Data Sheet (SDS) for Disodium Phosphate lists the product as a food additive with no adverse effects are expected, although the report does indicate that ingestion of large amounts may cause nausea and vomiting. The SDS for soda ash lists a low acute toxicity for oral, dermal and inhalation. Soda ash is NSF/ANSI 60 certified for concentrations up to 150 mg/L. As with almost any chemical, the dose determines the effect. The concentrations recommended for use at the WTP will have no negative side effects. If consumed in large quantities, negative side effects may be seen.

4.2.1 Flushing and Storage Tank Level Control

Flushing and storage tank level control have the potential to reduce DBP concentrations by reducing the water age or hydraulic residence time (HRT) of the water in the distribution system. To determine the efficacy of flushing and/or storage tank level control at controlling the HAA5 DBP concentrations, a tracer study was conducted to determine the water age at various points in the distribution system, and a DBP formation study was conducted to determine how DBP concentrations change over time.

A tracer study was conducted using fluoride to determine the water age in the distribution system. The tracer study determined that the mean HRT of water in the distribution system ranged from 5 to 7 days. Figure 9 shows the sampling points, while Table 1 shows the calculated mean HRT to each sampling location. Note that the tank outlet (MIC 7) has an HRT of 5.36 days indicating that the majority of the water age is attributed to time spent in the contact tanks.

Figure 9. Tracer Study Sample Point Locations

Table 1. Tracer Study Sample Point Location and Hydraulic Residence Time

Sampling Point ID	MIC 7	MIC 14	MIC 9	MIC 10	MIC 11	MIC 38	MIC 35	MIC 27	MIC 45
Sampling Point Location	Tank Outlet	Centennial	Council Chamber	Senior Cent	Senior Complex	Lagoon	Jerry's	Housing Auth.	Raven Tanks
HRT (Hours)	128.62	143.12	168.61	153.98	153.84	149.47	156.32	154.54	154.51
HRT (Days)	5.36	5.96	7.03	6.42	6.41	6.23	6.51	6.44	6.44

Concurrent to the tracer study, a study was conducted to determine the DBP formation rate as a function of water age under simulated distribution system conditions. Samples were collected of treated and disinfected water just prior to leaving the MIC WTP. The jars with the samples were placed in a tub and provided a continuous flow of plant water to maintain the temperature of the samples at the treated water temperature. A photo of the sample bottles during the study is shown in Figure 10. After 8 hours, a jar was removed and a sample was collected for total trihalomethanes (TTHM) and HAA5 analysis. Samples were collected after 8 hours, 16 hours, 24 hours, 48 hours, 96 hours, 192 hours, and 240 hours. Figure 11 shows the resulting concentrations of HAA5 DBPs that developed during the study over time. The area highlighted in orange on the graph demonstrates the range of mean HRT to each of the sample locations as determined by the tracer study, while the red horizontal line denotes the HAA5 maximum contaminant level (60 ug/L). As shown, at the calculated HRT for the water in the distribution system (128 to 168 hours), the concentration of HAA5 DBPs expected to develop is close to the limit of 60 ug/L. Additionally, the figure illustrates that HAA5 concentrations jump from 0 to around 40 ug/L within the first 8 hours. Based on these results, neither flushing nor storage tank level control would be an effective means to significantly reduce the HAA5 concentrations. Even if the HRT was significantly reduced (to 16 hours), the HAA5 concentration is expected to be within 67% of the 60 ug/L limit.

Figure 10. Photo of DBP study conducted onsite at the MIC WTP

Although storage tank level control does not appear to be a highly effective way of controlling HAA5 DBPs as a long term strategy, an evaluation of the contact time in the two 500,000-gallon tanks required to meet disinfection regulations was conducted to determine how low the water surface elevation (WSE) in the tanks could be maintained while still meeting contact time. Communication with plant staff relayed that the WSE in both of the storage tanks is maintained at a minimum of 19.6 feet. The evaluation of contact time determined that the WSE in the tanks could be reduced to 7 feet and still meet disinfection contact time requirements. While this management strategy is not identified as an effective way to ensure that DBP concentrations are below regulatory limits, operating with a lower tank level has the potential to slightly reduce the water age and DBP concentrations in the System.

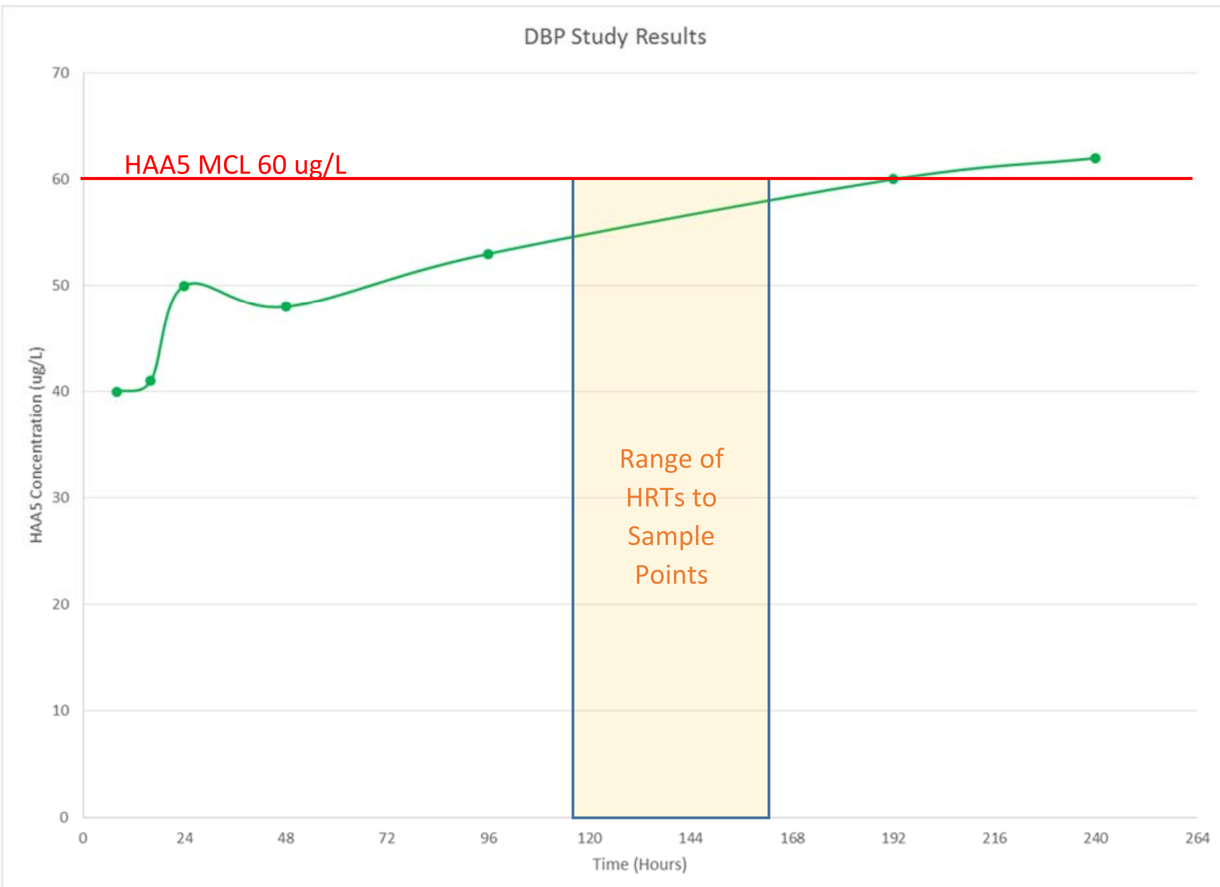


Figure 11. Results of DBP Study

Environmental Impacts

The strategy of flushing and/or storage tank level control does not require any construction and, subsequently, does not have any construction related environmental impacts. However, flushing of the water distribution system does result in surface runoff. As the water that is being discharged is potable drinking water, there are no substantial environmental impacts to this practice. However, flushing of the distribution system increases the volume of water being treated as water is discharged, thereby increasing the amount of chemical coagulant and disinfectant used.

Land Requirements

Neither new land nor easements will be needed for this alternative.

Potential Construction Problems

As this alternative does not require any construction, there are no potential construction problems.

Sustainability Considerations

Flushing is counterproductive to water efficiency, water conservation and energy efficiency, as potable water is generated only to be expended prior to use. Flushing increases the carbon footprint, as the amount of coagulant and disinfectants used increases, with no end user. Storage tank level control does not impact water conservation or water efficiency. Based on the onsite testing, flushing does not appear to be an effective way of controlling HAA5 DBPs and, subsequently, is not a sustainable practice to reduce DBPs. In addition, reducing the volume of water stored in the two storage reservoirs would reduce the resiliency of the utility.

Cost

This approach does not have a capital cost associated with the process. As this option was determined not to be an effective means to reduce DBPs, operation and maintenance (O&M) costs associated with flushing were not calculated.

4.2.2 Alternative Coagulants

Jar testing was used to assess the performance of coagulants other than the polyamine product (Nalcolyte 8105) currently in use, with the objective of reducing DBP precursors in the filtered water. Coagulants tested included polymeric inorganics [polyaluminum chlorides (PACls), aluminum chlorhydrates], iron-based coagulants [ferric sulfate and ferric chloride, and polymeric organic coagulants [polyDADMACS, polyacrylamides, blended PACl/polyamines]. Raw water was collected in Metlakatla and shipped to Anchorage for benchtop jar testing. Attachment C details the results for all coagulants tested.

Jar testing was conducted with conventional gang stirrer equipment using square beakers filled with source water and dosed with coagulant. The following protocol was followed immediately after coagulant dosing:

1. The jars were stirred at 300 rpm for 30 seconds.
2. The mixers were turned off and coagulated water was collected using a 60 cc syringe.
3. Collected water was filtered using a 5 mm filter disk.

Filtered samples were analyzed for turbidity, ultraviolet transmittance (UVT), and pH. UVT is the measure of ultraviolet energy at a particular wavelength that is transmitted through a sample. The amount of energy that is transmitted is impacted by the quantity of organics, colloidal solids and other material in the water. Subsequently, a higher UVT, usually expressed as a percentage, indicates fewer organics in the sample. Conversely, a lower UVT indicates a higher amount of organics in a sample.

A few PACls had higher performance than the polyamine coagulant, Nalcolyte 8105, that is currently used by the System. Filtered water treated with PACls had a similar turbidity, yet higher UVT than the water treated with Nalcolyte 8105, indicating that the PACls may be more effective at reducing dissolved organics. Results of the jar tests that provided the best results are displayed in Table 2. Table 3 shows that the PACls consumed alkalinity and reduced the pH slightly, while the Nalcolyte 8105 did not significantly decrease the pH.

Table 2. Jar Testing Results

Sample	Coagulant Dose (mg/L)	Turbidity (NTU)	UVT (% at 254 nm)	pH (pH units)
Raw	**--**	**0.43**	**83.8**	**5.81**
Nalcolyte 8105	3	0.15	94.9	5.65
PAX-XL8	13	0.11	98.2	4.9
PAX-18	13	0.15	98.1	4.75
DelPAC 2020	13	0.14	98.1	5.15

The filtered water from the top performing coagulant, PAX-XL8, and the coagulant currently used by the System, Nalcolyte 8105, were sent to a State-certified commercial water quality laboratory for metals, DOC, and alkalinity analysis. Table 3 shows the results of the water quality and metals analysis that was conducted on the raw water and filtered samples of water. Table 3 also lists each contaminant's MCL assigned by the EPA for comparison. Of those shown, copper and lead are regulated by the legally enforceable National Primary Drinking Water Regulations (NPDWR) and have action levels as limits. The action levels are based on the 90th percentile level of tap water samples, and an action level exceedance can trigger a treatment technique. The action levels are listed, yet they are not directly relatable to the concentrations measured in the samples. Aluminum does not fall under the legally enforceable NPDWR, but does have a Secondary MCL (SMCL) under the National Secondary Drinking Water Regulations, which are non-enforceable guidelines.

Table 3. Laboratory Results for Jar Testing

Sample	Coagulant Dose (mg/L)	Dissolved Organic Carbon (mg/L)	Aluminum (mg/L)
LIMIT		**--**	**0.05 to 0.2***
Raw		**1.5**	**0.1**
PAX-XL8	13	ND, <0.25	0.19
Nalcolyte 8105	3	0.719	0.04
*Aluminum is assigned a secondary MCL, a limit not enforceable by EPA, but provided for treatment plants as guidelines for analyzing treatment performance.			

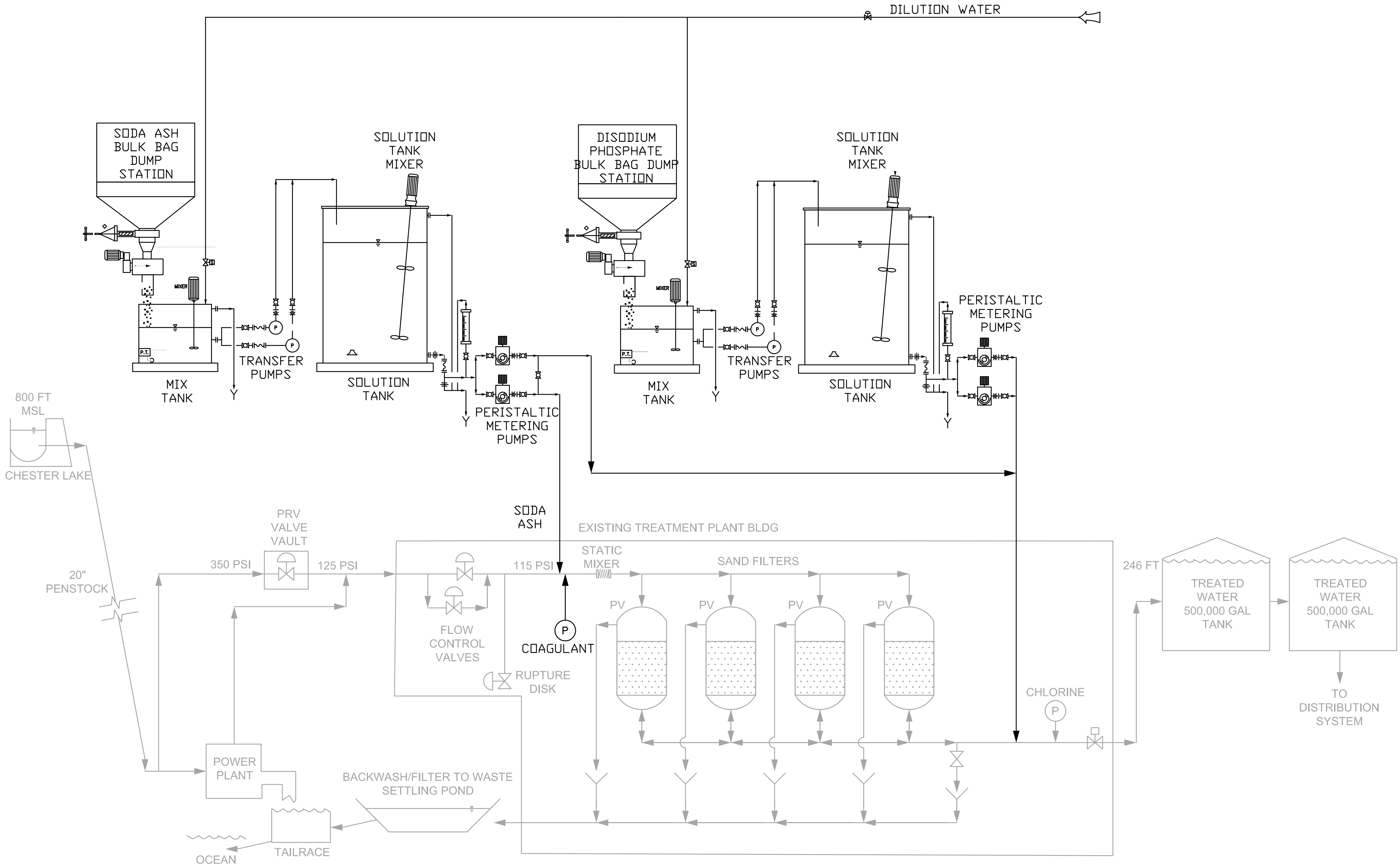
As shown in Table 3**,** the PAX-XL8 had a higher removal of DOC than the Nalcolyte 8105. The DOC in the filtered water treated with PAX-XL8 was non-detect and the detection limit is 0.25 milligrams per liter (mg/L), so the DOC concentration is either at or below 0.25 mg/L. PACls can contribute aluminum to treated water, and treatment with PAX-XL8 did increase the aluminum content in the water. However, the concentration in the filtered water sample was still below the SMCL limit. The copper and lead concentrations for both coagulants were well below the limits.

Note from Table 3 that the dosing concentration of PAX-XL08 is 13 mg/L, an increase of 10 mg/L from the 3 mg/L dose of polyamine currently used. The increased dosing requirement results in an annual increase in volume of coagulant used. MIC currently uses eleven 55-gallon drums of Nalcolyte 8105 per year. To accommodate a dose of 13 mg/L for the PACls, MIC would have to order forty-four 55-gallon drums of PACl per year. As such, this alternative will require additional chemical storage space. The design criteria for using PACl at the MIC WTP is summarized in Table 4.

Table 4. Design Criteria for PACl

Parameter	Quantity
Optimum New Coagulant Dose	13 mg/L
Total New Coagulant Usage Estimate	3,000 gallons per year
Total 55-gallon drums/year	44
Total 260-gallon totes/year	9

As mentioned previously, the lack of internal pipe corrosion in the distribution system is attributed to the protection provided by DOC in the water, which has been found to suppress corrosive properties of some water sources. As this alternative removes DOC, the assumed corrosion suppressant, addition of the corrosion inhibitors soda ash and disodium phosphate to the treatment train is necessary. For this alternative, the need for corrosion inhibitors is amplified as the PACls will consume alkalinity and depress the pH more than the currently used polyamine. As the System does not currently have soda ash or disodium phosphate dosing systems, or room in the existing facility to install new dosing systems, selection of this alternative would require new chemical dosing equipment and a new building to house the new equipment. The dry chemical dosing equipment for both soda ash and disodium phosphate includes a dry chemical bag dump station, dry chemical screw conveyor, mixing tank with mixer, transfer pumps, a stock solution tank and dosing pump system. Chemical storage is not only needed for the increased volume of coagulant required with PACls, but also for storage of soda ash and disodium phosphate. The new building would be designed to accommodate storage of all chemicals used within the WTP, as the onsite connex that is currently used is in poor condition. A flow diagram showing the additional processes is included in Figure 12, and a site layout is included in Figure 13.



LEGEND:
BLDG: BUILDING
DR: DRAIN
P: PUMP
PRV: PRESSURE REDUCING VALVE

FIGURE 12. SYSTEM SCHEMATIC FOR NEW COAGULANT WITH SODA ASH AND DISODIUM PHOSPHATE

SITE MAP
SCALE: 1"=30'

FIGURE 13. SITE MAP FOR NEW COAGULANT ALTERNATIVE

Table 5 displays the design criteria for soda ash and disodium phosphate systems for this alternative. The Water!Pro modeling software was used to estimate the doses of soda ash and disodium phosphate needed in order to meet the lead and copper limits. At a minimum, soda ash would have to be dosed at approximately 3 mg/L upstream of the coagulant and 2 mg/L downstream of the filters, and disodium phosphate would have to be dosed at 3 mg/L downstream of the filters.

Table 5. Design Criteria for Soda Ash and Disodium Phosphate

Soda Ash Dose Upstream of Coagulant	3 mg/L
Soda Ash Dose Downstream of Coagulant	2 mg/L
Disodium Phosphate Dose Downstream of Coagulant	3 mg/L
Estimated Annual Soda Ash Use	9800 lbs
Estimated Annual Disodium Phosphate Use	5900 lbs

Environmental Impacts

For this alternative, the WTP would have to be expanded to accommodate the storage of coagulant, soda ash and disodium phosphate, and new dry chemical feed equipment for soda ash and disodium phosphate. The expansion of the WTP would occur within the site boundary of the WTP. Construction of the facility expansion could temporarily expose surface runoff to disturbed ground. However, this issue can be managed using SWPPP BMPs during construction. Subsequently, this alternative would have no impacts on floodplains, wetlands, other important land resources, endangered species, historical, or archaeological properties.

PACl is a commonly used coagulant for drinking water treatment facilities and will comply with all federal and state agency regulations. As mentioned previously, PACls can contribute aluminum to treated water. In addition, an increase of the aluminum concentration may occur in the backwash water sent to the onsite settling pond at the WTP. The increase is not anticipated to cause downstream side effects. The EPA should be notified if a change is made to the coagulant used onsite as the NPDES permit for the WTP (AK0046876, currently pending) may require monitoring for aluminum. Updates should be added to the permit application currently on file at the EPA.

Land Requirements

Neither new land nor easements will be needed for this alternative. A new building will be required to house the additional equipment, estimated at 975 square feet. This building would be constructed entirely inside the existing WTP site boundary.

Potential Construction Problems

A new building constructed adjacent to the existing WTP will likely require a new roof to be constructed on the existing building to accommodate the addition. A new roof for the existing WTP was included in the cost estimate for this alternative. Fire code will need to be adhered to during building design.

Sustainability Considerations

The elimination of flushing requirements makes this alternative more water efficient than current operations which include flushing. Switching to an alternative coagulant would not require any additional water use and would not create a waste stream. In comparison to nanofiltration and GAC, this alternative requires less energy intensive equipment and is subsequently more energy efficient. As the new coagulant will reduce the organics in the filtered water, chlorine demand to maintain residual requirements is expected to decrease.

Cost

Of the alternatives expected to produce noticeable results, this alternative is the least costly, both in terms of capital costs and O&M costs, which are summarized in Table 6. A breakdown of the cost analysis is included in Attachment D.

Table 6. Capital and Annual O&M Cost Estimate Summary for New Coagulant Alternative

Cost Description	Estimated Cost ($)
Capital Cost	$2,380,000
O&M Cost	$46,000

4.2.3 Nanofiltration

Nanofiltration refers to a membrane process which rejects particles in the size range of approximately 1 nanometer. Nanofilters (NFs) are capable of removing organic molecules with molecular weights greater than 200-400, certain percentages of dissolved salts, color, and total organic carbon. In addition, NFs provide an overall reduction of TDS. As such, nanofiltration would be a viable technology to remove DOC prior to chlorination and reduce the concentration of DBPs. There are two liquid streams discharged from a NF: (1) the purified water, termed permeate; and (2) reject water, termed concentrate. The concentrate contains all of the same dissolved constituents as the feed water, but at a higher concentration.

As it would be cost prohibitive to send all of the water through the NF, the design intent is to send approximately half of the plant flow through a NF to reduce the total DOC concentration by half and, subsequently, reduce the DBP concentration by half. During the peak summer season, the flow from the storage reservoirs to the Metlakatla distribution system is approximately 800 gallons per minute (gpm). For the remainder of the year, the flow from the storage reservoirs to the distribution system is approximately 300 gpm. The design intent for the nanofiltration system is to have two skids rated for 200 gpm each, where only one skid would be used for the low flow times of the year, and the second system would be brought on for the peak flow season. At 200 gpm, a single skid would treat approximately half of the flow during low flow times and, similarly, for the high season the two skids would treat approximately half the flow at 400 gpm.

A flow diagram of the existing treatment train incorporating the nanofiltration system is shown in Figure 14. A 15 horsepower (HP) pump would provide the additional pressure requirements for the water to traverse the NFs. The additional pump required to run the system would increase the electrical demand required for the treatment process. A site map showing the location of the system building with respect to the existing building is shown in Figure 15.

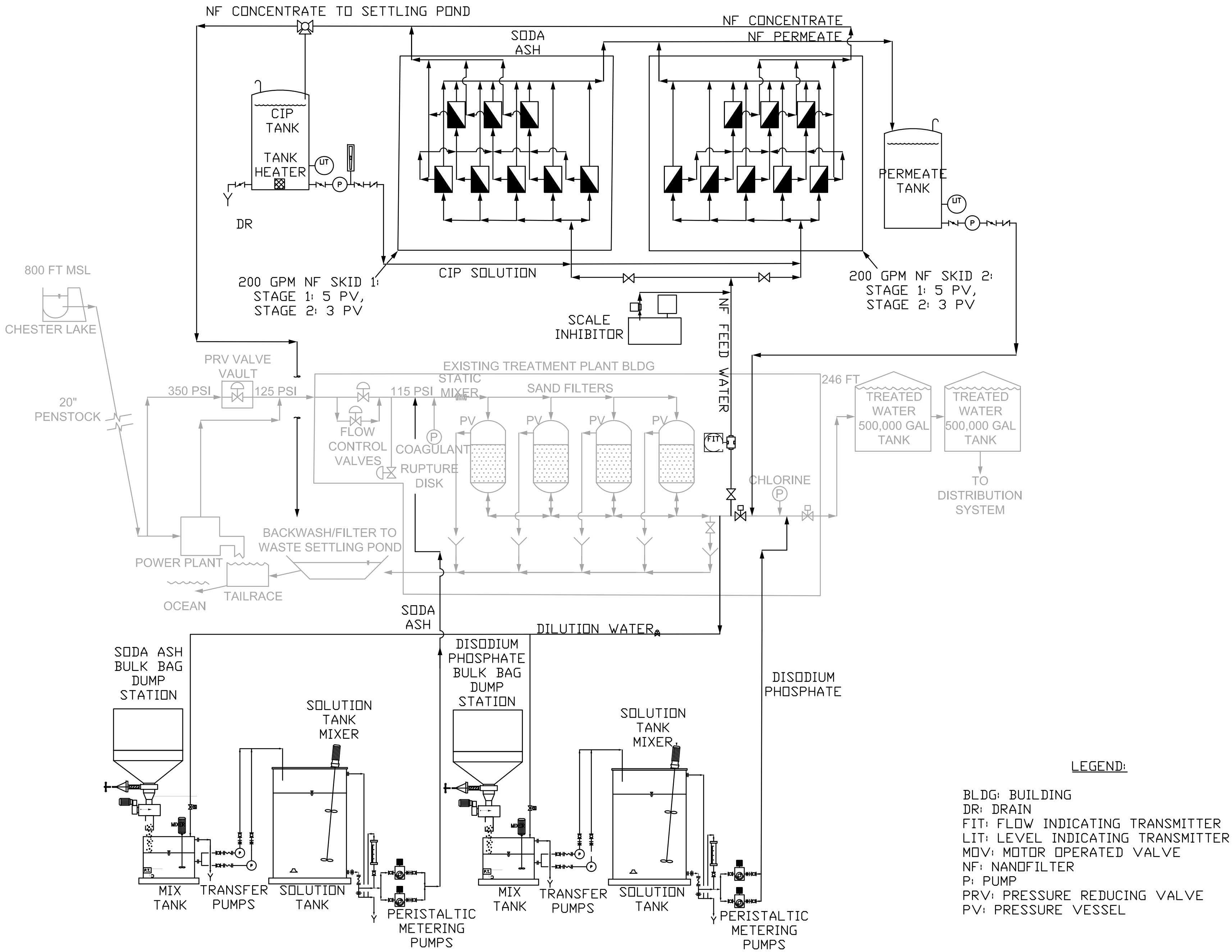
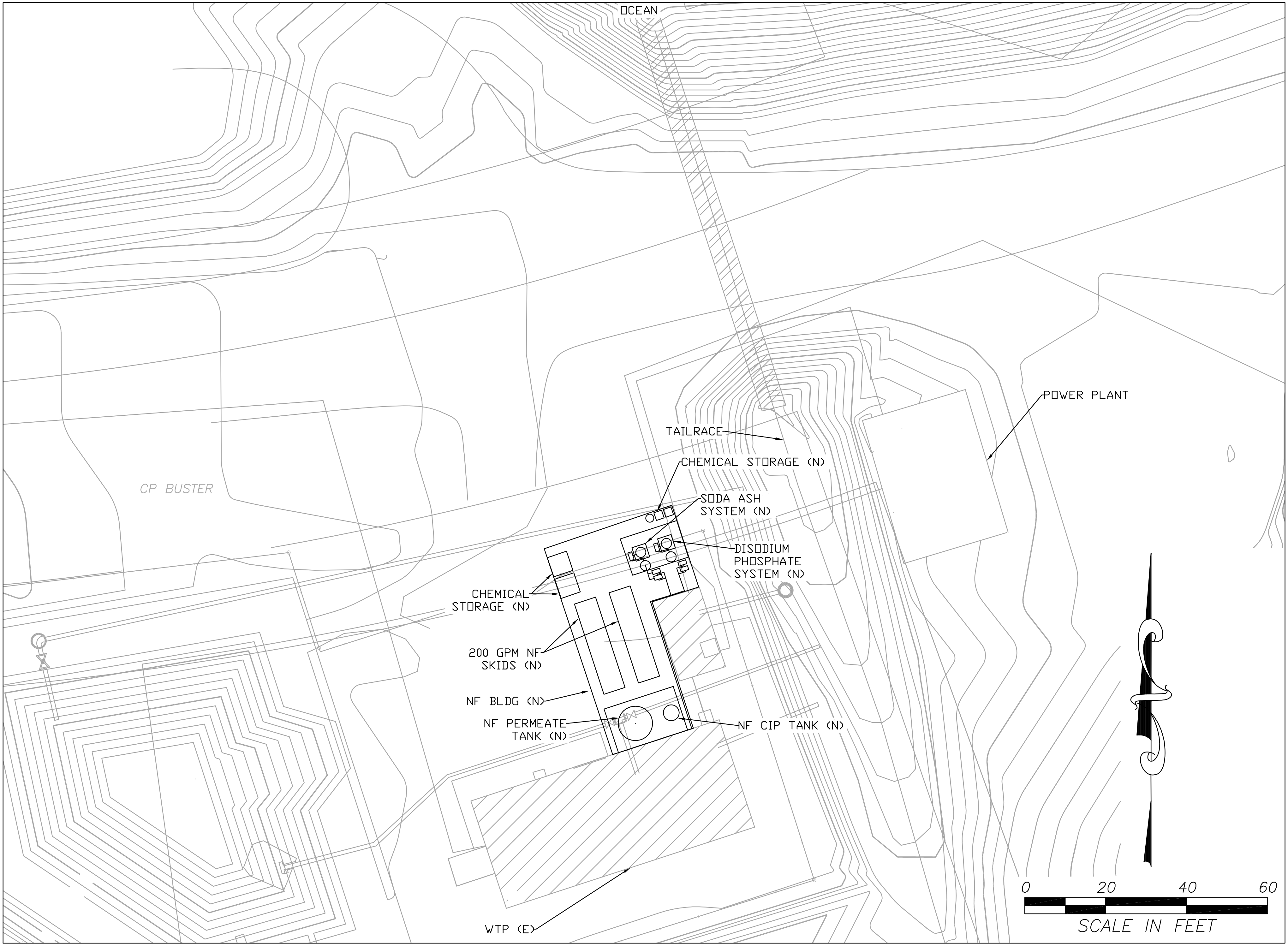


FIGURE 14. SYSTEM SCHEMATIC FOR NANOFILTRATION ALTERNATIVE WITH SODA ASH AND DISODIUM PHOSPHATE



SITE MAP
SCALE: 1"=30'

FIGURE 15. SITE MAP FOR NANOFILTRATION ALTERNATIVE

NF permeate typically has a lower pH and little buffering capacity due to reduced alkalinity. Subsequently, permeate can be corrosive and, in certain installations, steps need to be taken to avoid lead and copper from leaching into the water. Nanofiltration performance software was used to simulate the water quality of permeate. The water quality characteristics of the blended product (i.e., ½ NF Permeate+ ½ PF Discharge) were placed into the corrosion modeling software (Water!Pro) to estimate the soda ash and disodium phosphate concentrations needed to prevent lead and copper issues. The model predicted that nearly the same doses of soda ash and disodium phosphate would be required for this alternative and those presented above in the alternative coagulant section (refer to Table 5). As such, the size of the dry chemical feed systems for soda ash and disodium phosphate are the same for this alternative as for the aforementioned alternative coagulant option.

For each skid, 250 gpm of filtered water enters the nanofiltration skid and 200 gpm is returned to the treated water stream. The remaining water, containing the removed dissolved organic material and salts, is the concentrate stream. The concentrate stream would be discharged into the existing onsite settling pond. When both skids are in operation, the discharge stream would be 100 gpm. This volume of water is significantly larger than the current volume discharged from backwashing and filter to waste practices. This increase in volume and constant flow would need to be incorporated into the NPDES permit application for the MIC WTP, currently under review/development by the EPA.

Environmental Impacts

The NFs would remove dissolved organic material from the water, resulting in a concentrated stream of dissolved organics and dissolved salts. The concentrated stream would discharge into the settling pond, per current operating procedures at the project site, and combine with existing backwash and filter to waste water. From the settling pond, the clarified water would discharged into a mixing zone near the tailrace of the hydroelectric plant which discharges into the ocean in a short distance. The organics and salts present in the concentrate stream are not expected to have significant environmental side effects considering that the waste stream is diluted by the settling pond volume and the hydroelectric plant's tailrace. The settling pond discharges into the tailrace and, within a short distance, discharged to a marine outfall. Chemicals (acids and bases) used for cleaning the membranes would be neutralized prior to discharge into the settling pond and would only be used approximately four times per year.

For this alternative, the new building and all new equipment would be located within the fenced boundary of the current WTP. This alternative would have no anticipated impacts on floodplains, wetlands, other important land resources, endangered species, historical, or archaeological properties.

Land Requirements

Neither new land nor easements would be needed for this alternative. A new building would be required to house the additional equipment, estimated to be around 1,400 square feet.

Potential Construction Problems

A new building constructed adjacent to the existing WTP would likely require redesign of the existing WTP roof. Fire code would need to be adhered to during building design. The building design would need to be laid out such that access is maintained to the PRV vault. These are not fatal flaws and can be addressed during the design process.

Sustainability Considerations

The current practice of flushing lines is not part of the strategy following this upgrade alternative. Reducing the organics available in the water is expected to reduce the amount of chlorine used by the WTP to maintain the required residual. However, this alternative requires two 15 HP pumps for the nanofiltration skids and pumps for transferring permeate into the plant pipe system of filtrate. As such, this is likely the least energy efficient option of the available alternatives.

As mentioned previously, approximately 50 gpm of concentrate will be generated per skid (for a maximum of 100 gpm for two skids), which is wasted water. Thus, this alternative is less water efficient than the other alternatives.

Cost

A cost estimate summary including capital costs and annual O&M costs is included in Table 7.

Table 7. Capital and Annual O&M Cost Estimate Summary for Nanofiltration System Alternative

Cost Description	Estimated Cost ($)
Capital Cost	$4,740,000
O&M Cost	$99,000

4.2.4 Granular Activated Carbon

Granular Activated Carbon (GAC) is a media used to remove contaminants via the physical and chemical process of adsorption. GAC is a highly porous material that provides a high surface area onto which contaminants can adsorb. Common in water treatment facilities, GAC can remove organic material, turbidity, solids, chlorine, and chloramines, among other compounds.

GAC is made from a range of high carbon content organic materials, including wood, lignite, coal, and shells, such as coconut or walnut. The material comprising the GAC determines the properties, such as Iodine number (area available to adsorb low molecular weight organics), molasses number (the degree to which color is removed), abrasion number (degree of particle size reduction post tumbling with a harder material), and density.

The size of the granules is reported by the mesh size. A 20 x 40 carbon is comprised of particles that pass through a 20 Mesh Sieve (0.84 millimeter [mm]) but not through a 40 Mesh Sieve (0.42 mm). Drinking water treatment processes typically use 8 x 30 mesh (0.80-1.0 mm) or 12 x 40 mesh (0.5-0.7 mm).

Activated Carbon is also available as Powdered Activated Carbon (PAC); however, GAC is roughly three times more effective on a weight-basis than PAC. In addition, GAC requires less maintenance, produces less waste, and is better at removing organic material[1].

GAC filtration units are commonly installed in municipal water treatment facilities to remove organics after filtration and prior to disinfection. By removing organic material, a precursor to DBPs, prior to disinfection,

[1] www.wateronline.com/doc/the-real-cost-of-treating-drinking-water-with-0001

the requirement for chlorine is typically reduced as well as the formation of DBPs in the contact tanks and the distribution system. Iodine number is the most commonly reported parameter for GAC, with higher numbers indicating a higher degree of activation. For water treatment, carbons typically have iodine numbers between 600 and 1,100. The molasses number measures the macropore content, with a higher number indicating a higher adsorption of large molecules. The abrasion number (0-100) is important if backwashing is practiced. A higher number indicates the physical integrity of the carbon will be maintained when exposed to frictional forces.

Table 8. Typical Properties of GAC based on Media Type[2]

	Bituminous	Sub-Bituminous	Lignite	Nut Shell
Iodine Number	1,000-1,100	800-900	600	1,000
Molasses Number	235	230	300	0
Abrasion Number	80-90	75	60	97
Bulk Density (packed lb.cf)	26-28	25-26	23	29-30
Volume Activity	26,000	25,000	13,800	0

Organics in low pH water are less soluble than in high pH water. As solubility decreases, contaminants are easier to pull out of solution and removal is easier.

The activation process is important to ensure quality carbon. Manufacturing of high-performance GAC includes the following steps: raw material is pulverized, binder is added, product is reagglomerated, briquettes are crushed and then sized, carbon is baked and then carbon is thermally activated. Some offshore carbon has been produced that skips some of these steps to save costs, which results in lower adsorption rates and carbon that is exhausted quicker. In addition, carbon should be purchased from an ISO-certified facility to guarantee no addition of detrimental materials.

Flows through the treatment facility in Metlakatla vary diurnally and seasonally. The GAC system would be designed to handle a maximum of 400 gpm via a side-stream off of the main treatment flow train directing filtered water from downstream of the existing pressure filters. Although a range of layouts is possible, a GAC system using 100 gpm units running in parallel would allow the facility to ramp up or down the flow through the side-stream treatment to a maximum of 400 gpm. The flow could be adjusted to continuously treat half of the water with the GAC units during all flows up to 800 gpm, the expected maximum flows through the WTP.

The GAC system is capable of operating under the hydrostatic pressure available and will not require the addition of pumps. The water entering the plant can be a maximum of 150 psi. The headloss across the GAC units would be around 4 psi. Approximately 90 psi is needed to reach the water storage tanks. The PRVs into the plant may require slight adjustment, but the system is capable of operating without the addition of a pump. No additional energy would be required for daily operation of the system, other than that required to operate motor operated valves. New piping and two new modulating valves would be installed to direct filtered water to the GAC building for treatment, and then back into the existing treatment facility for disinfection and distribution. Additionally, each 100 gpm GAC unit would have an automated valve upstream

[2] http://www.watertreatmentguide.com/activated_carbon_filtration.htm

to control flow through the system, depending on the plant flow. A flow diagram of the treatment process, including the GAC system, is shown in Figure 16.

The GAC system is assumed to have similar DOC removal efficiency as the NF and the required soda ash and disodium phosphate doses are expected to be the same. Refer to Table 5 for the estimates of soda ash and disodium phosphate doses. Testing would be done after installation of the GAC system to verify the soda ash and disodium phosphate requirements.

Environmental Impacts

For this alternative, all new equipment would be located within the existing WTP site boundary. This alternative would have no impacts on floodplains, wetlands, other important land resources, endangered species, historical, or archaeological properties.

Backwashing is generally not required during normal operation as backwashing does not remove adsorbed material from the media and can actually result in stratification of the carbon, due to the adsorbed material, decreasing effectiveness of the filters. If a layer of organics forms on the top of the filter media, blinding can occur and backwashing may be required to break up the organic layer. For the given situation, any large debris will be removed be the existing filters upstream of the proposed GAC filters and therefore only small dissolved organics will be removed by the GAC system, not likely to result in a blinding layer. Backwashing will only occur when the carbon is replaced, the frequency of which is unknown without testing. Estimates from one manufacturer were once per year, but the lifespan of the carbon is completely dependent on the compounds to be removed from the water. This limited amount of backwashing is not expected to significantly impact the quality of the water in the settling pond or the water discharged from the pond. The daily water use for operations is not expected to increase since backwashing only occurs once, after carbon change out and prior to system start up. This alternative has the potential to save water by eliminating the current practice of flushing the system to address the DBP problems.

Land Requirements

A GAC system would require a new building to be constructed to contain the system. The new building would be approximately 1,225 square feet, constructed adjacent to the existing PRV vault within the existing treatment facility site and would provide sufficient storage to replace the existing onsite connex. A site layout showing the existing treatment facility with the new GAC building is shown in Figure 17.

Potential Construction Problems

A new building constructed adjacent to the existing WTP would likely require replacement of the existing WTP roof. Fire code will need to be adhered to during building design. The building design would need to be laid out such that access is maintained to the PRV vault. These are not fatal flaws and could be addressed during the design process.

Sustainability Considerations

The current practice of flushing lines is not part of the strategy following this upgrade alternative. Reducing the organics available in the water is expected to reduce the amount of chlorine used by the treatment plant to maintain the required residual.

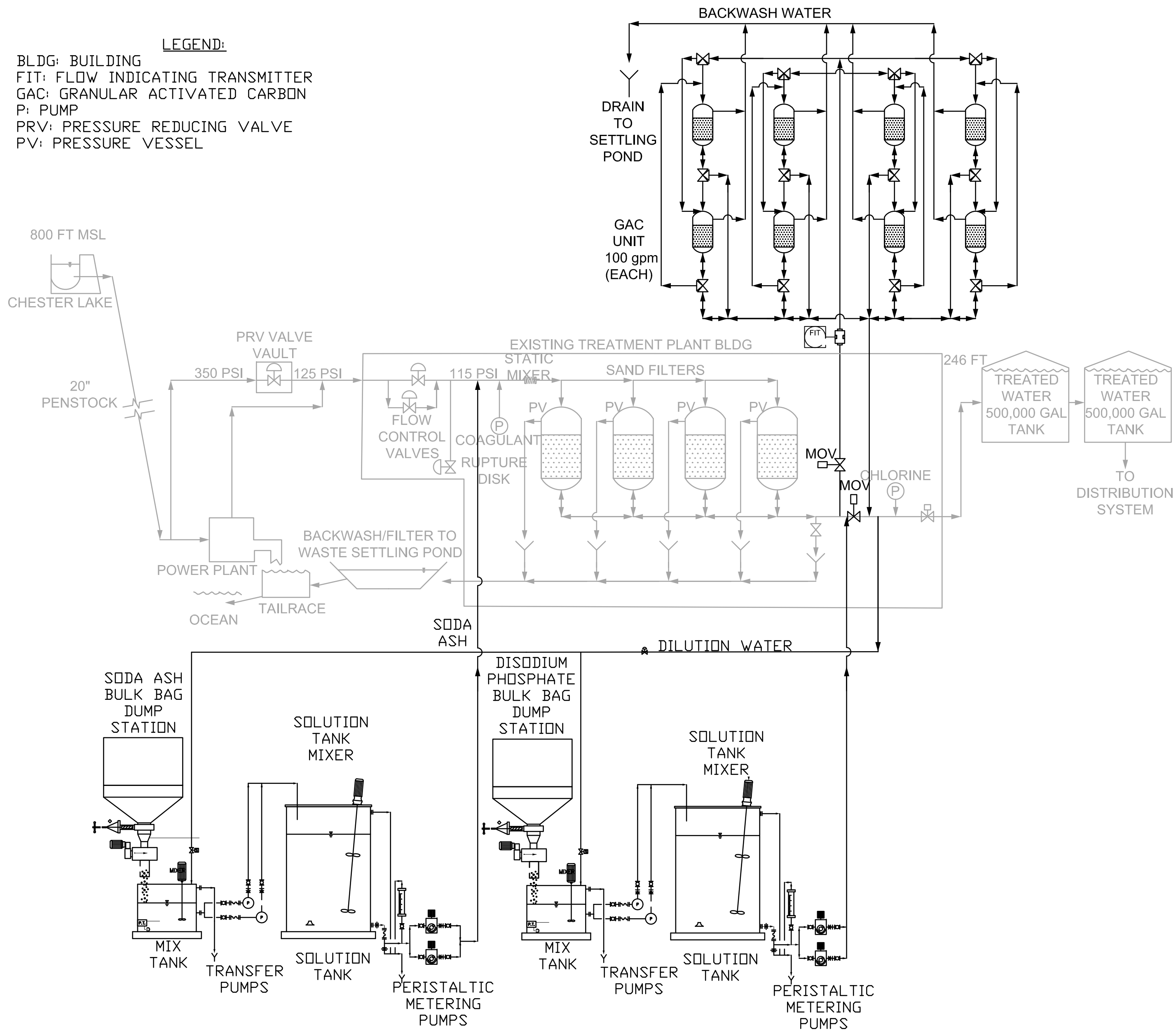
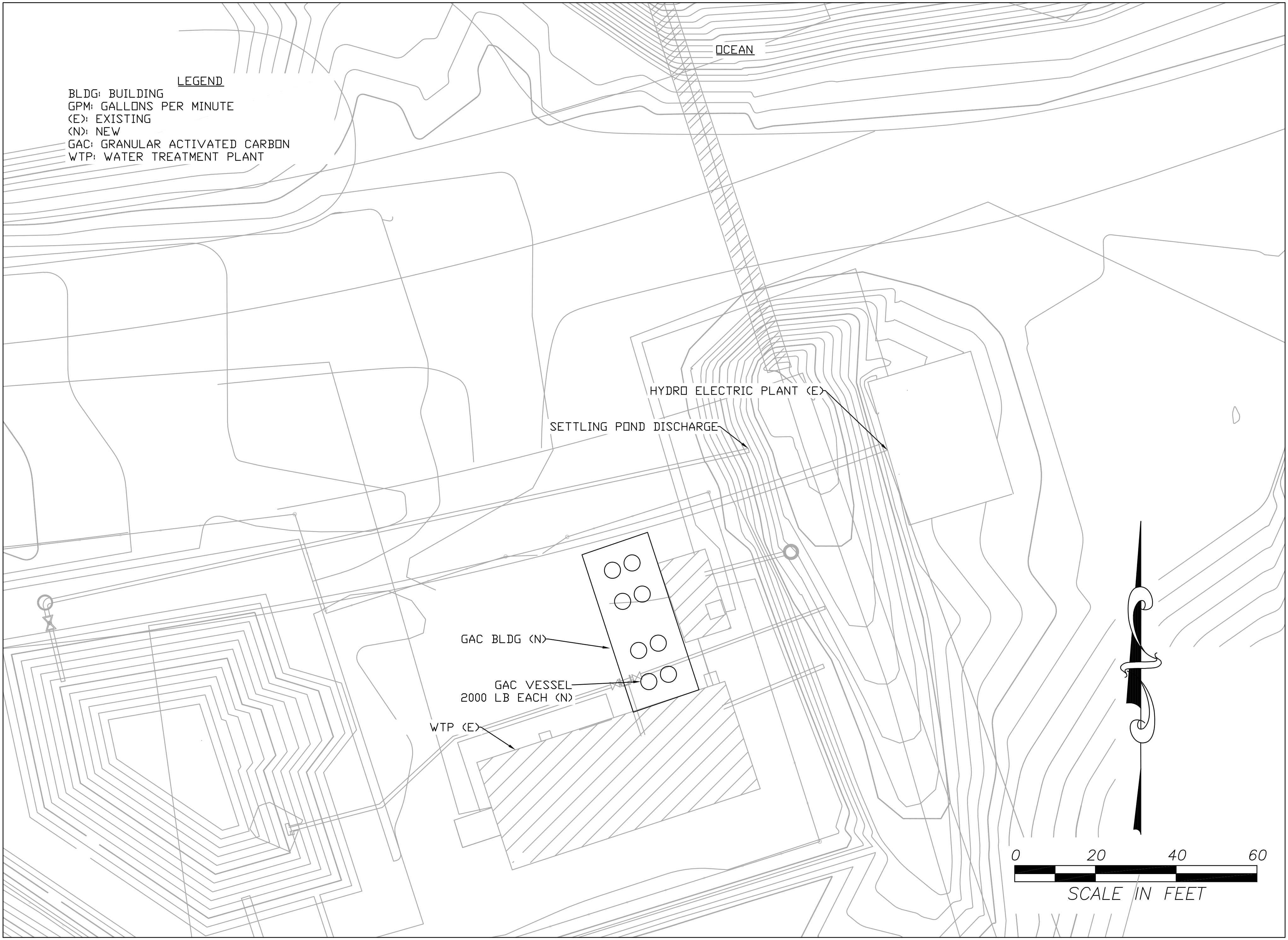


FIGURE 16. SYSTEM SCHEMATIC FOR GRANULAR ACTIVATED CARBON ALTERNATIVE WITH SODA ASH AND DISODIUM PHOSPHATE ADDITION



SITE MAP
SCALE: 1"=30'

FIGURE 17. SITE MAP FOR GRANULAR ACTIVATED CARBON ALTERNATIVE

The lifespan of GAC is dependent on the contaminant of concern. Since dissolved organic material can be represented by a range of material, life span is difficult to predict. During treatment, the point at which the contaminant of concern is detectable at concentrations above the designated maximum is called the breakthrough point. Once the breakthrough point is reached, the spent carbon needs to be replaced. This requires the use of a Vactor® truck to remove the material for transport off site. Spent carbon can be regenerated using several techniques; however, due to the remote location of Metlakatla, the likely approach would be disposal at the nearest landfill. MIC has indicated that the community is considering closing the local landfill. Acting under this assumption, spent carbon from a system installed at the Metlakatla Treatment Facility would likely be shipped to Ketchikan for disposal as "Construction and Demolition" material at the landfill. A Vactor® truck would be purchased to remove the GAC from the vessels once the breakthrough point is reached. The Vactor® truck could be driven directly onto the ferry to drive to Ketchikan for discharging at the landfill. Even after carbon has reached the breakthrough point for dissolved organic material, the carbon will still adsorb volatile organic compounds and may have some value at a landfill. Frequent disposal and replacement of the GAC would likely result in the highest carbon footprint of the available alternatives. Water efficiency is high as backwash is limited to once following media replacement.

A cost estimate, including capital and O&M costs, is outlined in Table 9. A breakdown of the cost analysis is included in Attachment D.

Table 9. Capital and Annual O&M Cost Estimate Summary for a GAC System Alternatives

Cost Description	Estimated Cost ($)
Capital Cost	$3,190,000
O&M Cost	$111,000

4.2.5 Alternate Disinfection

Chlorine, either gaseous or sodium hypochlorite, will react with organic material in water to form TTHMs and HAA5s, both DBPs that are regulated by the EPA. Chloramines are sometimes used as a disinfectant because they do not react with organic material to form regulated chlorine DBPs; however, the contact time required for inactivation of viruses and Giardia cysts is significantly longer than the contact time required for chlorine and is often unattainable. Some treatment facilities use a combination of chlorine as a primary disinfectant and chloramines to provide a residual in the distribution system. While chloramine disinfection may not result in the formation of regulated DBPs, the disinfectant often forms non-regulated DBPs, including nitrogenous DBPs and iodinated DBPs. Many of these non-regulated DBPs are currently being researched to determine the potential health risks, with some findings showing health risks for certain compounds to be orders of magnitude more toxic than regulated DBPs. While the EPA does not yet regulate these compounds, some states have their own regulatory requirements. Although some treatment plants have implemented chloramination as an alternative disinfectant to limit the production of regulated DBPs, the uncertainty with how future regulations will develop along with the potential risk to public health make this option less than ideal.

5 SELECTION OF AN ALTERNATIVE

For this project, a "Do Nothing Alternative" would result in a failing water distribution system and a failure to comply with EPA regulations for DBPs in the community drinking water. Failure to address either of these problems could have harmful health impacts on the community. For this reason, a "Do Nothing Alternative" was not considered. For the failing pipe system, the only reasonable acceptable alternative was determined to be removal and replacement of the corroding pipe within the Trailer Court. Trenchless lining procedures, although cheaper in some situations, would lose the benefit of "trenchless" in this case due to the large number of service connections that would require excavation. The only alternative determined reasonable is removal and replacement with new pipe, with proper cathodic protection, and backfilled with material specifically intended to avoid a corrosive environment, rather than the existing material uncovered during the Corrosion Assessment conducted by Taku Engineering.

A life cycle present worth cost analysis was done to compare the three DBP treatment alternatives for the MIC WTP: Alternative Coagulants, Nanofiltration, and GAC. The cost for each aforementioned alternative includes treatment with soda ash and disodium phosphate for corrosion control. Flushing and storage tank level control is not expected to meet the objective of consistently reducing DBPs below regulatory limits. Alternate disinfection is expected to meet the objective of reducing regulated DBPs below the MCL, but is not recommended due to the uncertainty with how regulations will develop around currently unregulated DBPs, some of which have been found to be significantly more toxic than those currently regulated by the EPA. Alternatives not expected to meet the objective of improving the water quality of the community were not included in the cost analysis. A summary of the life cycle cost for each alternative is included in Table 10. The life cycle present worth cost analysis found that the most affordable alternative was the alternative coagulant option. The bottom two rows of the table calculate the Total Life Cycle Cost, with the second to last row showing the life cycle costs of each analyzed alternative, and the last row showing the total cost for each alternative including the distribution system upgrades.

Table 10. Life Cycle Present Worth Cost Analysis Comparing Alternatives With and Without the Distribution System Upgrades

	Nanofiltration	GAC	Alternative Coagulant
Project Capital Cost	$4,740,000	$3,190,000	$2,380,000
Annual O&M Costs	$146,421	$147,973	$66,001
Annual Interest Rate	2.5%	2.5%	2.5%
Design Life, years	20	20	20
Uniform Series Present Worth of Annual O&M Costs	$2,339,647	$2,364,450	$1,054,628
Single Payment Salvage Value	$10,000	$10,000	$0
Life Cycle Cost, Rounded	$7,100,000	$5,500,000	$3,400,000
Total Life Cycle Cost Including Distribution System Upgrades	$7,900,000	$6,300,000	$4,200,000

The alternative coagulant option is the most cost effective, the most energy efficient, and the most water efficient.

6 PROPOSED PROJECT (RECOMMENDED ALTERNATIVE)

Based on the analysis of alternatives for the WTP upgrade, the alternative coagulant option is the recommended alternative due to the lowest capital cost, O&M cost and life cycle cost. In addition, the alternative coagulant option is the most energy and water efficient option. This alternative is not expected to have significant environmental impacts and will be the easiest for the operator to incorporate into the existing plant operations because this alternative incorporates the fewest new treatment technologies.

6.1 Preliminary Project Design

The proposed project includes the following:

1. Remove and replace existing ductile iron pipe servicing the Trailer Court with HDPE pipe and new valves, including corrosion control and non-corrosive bedding material.
2. Loop the dead end water mains on Haines Street and Milne Street by installing a water main along Calvin Street, connecting both lines into the main on Hillcrest Road.
3. Switch the coagulant from the currently used polyamine to a PACl to increase removal of DOC prior to disinfection.

The distribution piping in the Trailer Court is to be dug up, removed and replaced with new 8” HDPE pipe. The replacement will include approximately 2,100 linear feet of piping, associated valves and connections, D-1 bedding, backfill material, cathodic protection, and a temporary water line to service the affected community during the project. The water main installation on Calvin Street will include approximately 600 linear feet of 8” HDPE water main to be installed with associated valves and connections. Both locations for distribution line upgrades will involve removing the existing asphalt and finishing the surface with an asphalt patching product (EZ Street Cold Patch). Refer to Figure 7 (Trailer Court Upgrades) and Figure 8 (Calvin Street Upgrades) for R&M Engineering-Ketchikan distribution system upgrade preliminary project drawings.

In the MIC WTP, the currently used polyamine coagulant, Nalco 8105, will be replaced with a PACl. Coagulant dosing will no longer require dilution prior to injection; the coagulant will be injected into the system undiluted, using the currently used injection point. The coagulant is available in 55-gallon drums or 270-gallon totes. Operator preference will determine the container size used, although costs are slightly higher per volume for the smaller containers. New coagulant dosing pumps are recommended to ensure that the pumps are properly sized for the flows required: 0.07 – 0.5 gallons per hour, based on plant flow.

A building extension would be constructed to house new equipment, including two new dry chemical feed systems for soda ash and disodium phosphate, and to provide storage for the new coagulant and corrosion control chemicals. The required PACl dose that was determined by jar testing is 13 mg/L, about 10 mg/L higher than the current coagulant dosing. Larger volumes of coagulant will be delivered during each shipment to maintain a sufficient stock on-site. In addition, there currently is no space available for storage of the new corrosion control chemicals of soda ash and disodium phosphate. The existing storage connex is in poor condition and does not have sufficient available space to accommodate the increased volume of chemicals. The additional building (layout in Figure 13) size requirements were estimated to be approximately 975 square feet to provide adequate room for the additional equipment and storage of all chemicals. Building codes will influence the building design, but, at a minimum, the roof on the existing building will need to be replaced or modified to accommodate the building addition on the southern wall of the existing building, the location preference expressed by on-site personnel.

Addition of soda ash and disodium phosphate is recommended upon switching to PAX-XL8 to prevent corrosion from the reduced DOC, to ensure that copper and lead concentrations do not increase in the distribution system. Modeling of the System using water quality data collected on-site in January 2017 and jar testing water quality data was done with Water!Pro modeling software. The modeling software calculated the following dosing requirements of soda ash and disodium phosphate to prevent corrosion related lead and copper issues: 3 mg/L of soda ash upstream of coagulant addition, 2 mg/L of soda ash downstream of coagulant addition, and 3 mg/L of disodium phosphate downstream of coagulant addition. Once the system is operational, water quality of water from the distribution system can provide insight for adjustments to optimize the chemical addition based on corrosion potential.

The soda ash and disodium phosphate will each involve a bagging system where the operator will load 50-pound bags of each chemical into a bag breaker unit (example shown in Figure 18). For each unit, a screw conveyor will transport the proper volume of chemical from the bag breaker unit to combine with a monitored flow of water into a mixing tank that will have a mixer. The solution in the mixing tank will be pumped to a stock solution tank, from which the stock solution, either soda ash or disodium phosphate, will be metered into the water. Further analysis will be required to determine the optimal injection point and dose for the soda ash. Alkalinity upstream of the coagulant may influence how the coagulant reacts with the dissolved organics to form floc. Further testing will be required to determine if the influence results in a higher removal of DOC without affecting the size of the floc such that filter run times are shortened. Depending on test results, soda ash can be injected entirely upstream of the filters or split between the two locations. Orthophosphate will be injected downstream of the filters, prior to chlorination and distribution.

Figure 18. An Example of the Bag Breaker System and Screw Conveyor Recommended for Soda Ash and Disodium Phosphate

Correspondence with MIC's EPA representative indicated that the WTP at Metlakatla is not currently classified according to the EPA Tribal Drinking Water Operator Certification Program. This classification would determine the certification level required by the operator to run the plant. Although MIC is currently not classified, an analysis was done to determine if the addition of two new chemicals (soda ash and disodium phosphate) would change the WTP's certification level. Analysis of the existing MIC WTP, using the point system outlined by the EPA, assigned 34 points based on the treatment processes, classifying the WTP as a Level II plant (see Table 11 for Classification of Water Treatment Plants based on the EPA point system). Addition of pH adjustment (soda ash) and stability or corrosion control (disodium phosphate) would add 14 points to the total score for the MIC WTP. This addition would bring the total score to 48, still within the range of a Level II – Intermediate classification. Pending acceptance by the EPA of this analysis, the certification requirements for the operator will not be affected by the proposed upgrade.

Table 11. EPA Water Treatment Facility Classification Levels Determined by the Point Rating System

Classification Level	Points Assigned by Rating System
Level I – Basic	30 points or less
Level II – Intermediate	31-55 points
Level III – Advanced Intermediate	56-75 points
Level IV – Advanced	76 points or greater

6.2 Project Schedule

The project will likely occur in the summer to avoid construction while the ground is frozen. A proposed project outline is delineated in Table 12 estimating a little over 4-1/2 months for the construction phase of the project. Aside from brief shutdowns to install the temporary water line during the upgrades to the distribution system and to connect piping in the treatment plant, the project does not require the water system to be taken offline for any extended time periods.

6.3 Permit Requirements

The following permits will be required to complete the project:

Construction General Permit

Administered by the EPA and required for construction activities that disturb one or more acres. Likely required for construction activities associated with distribution system upgrades.

Temporary Water System Permit

Administered by the EPA, required for the temporary water system that will provide water to the Trailer Court during the piping upgrades.

Building Permit

A building permit is expected to be required to construct the building addition at the MIC WTP.

Table 12. Preliminary Project Schedule for Task Duration and Start/Stop Days from Notice to Proceed

Work Task	Duration (days)	Start and Stop (Days from NTP)
Mobilization	21	0 to 21
Shop Drawing Submittals	21	14 to 35
Long Lead Equipment Fabrication and Shipping	126	35 to 95
Trailer Court DIP Replacement		
Coord with residents	7	90 to 97
Preconstruction Survey	2	90 to 92
Temporary Services Install	7	95 to 102
Excavation and remove old pipe	10	103 to 113
Pipe bedding placement	10	103 to 113
New DIP install	10	103 to 113
Service line reconnect	5	114 to 119
New installed pipe pressure testing	2	120 to 122
New pipe disinfection	2	123 to 125
Backfill placement, compaction	21	103 to 127
Restore roadway hard surfacing	12	127 to 139
Process Building		
Building foundation and slab	12	35 to 47
Building erection	20	48 to 68
Process equipment placement	3	69 to 72
Install mech, elect, automation sys	45	72 to 117
Pipe pressure test, disinfection	3	117 to 120
Confirm function of installed sys	5	117 to 122
Functional Performance Verification and Commissioning	7	123 to 130
Demobilization	5	131 to 136

6.4 SUSTAINABILITY CONSIDERATION

By removing DOC prior to filtration, the volume of chlorine necessary to maintain the regulatory required residual at the end of the system is expected to decrease. The organics available to react with the chlorine to form DBPs will be decreased and, thus, more chlorine will be retained in the System as a residual. The preventative action of removing organics prior to the formation of DBPs will eliminate the need for flushing, and reduce the amount of water wasted during each flushing event, saving on the volume of water treated by the plant. Although the amount may be minimal, water conservation will help to maintain the water level in the water storage reservoirs and increase the likelihood that water production can occur when hydroelectric power is available, the preferred generation option over costly diesel power generation. This is the most water efficient alternatives because waste streams are not generated. This option is the most energy efficient due to the addition of the least energy intensive equipment into the treatment train. Operationally, the proposed project incorporates the fewest additional treatment technologies into the existing plant, while meeting the project goals, and limits the new equipment that the operator must be trained to use.

6.5 TOTAL PROJECT COST ESTIMATE

A summary of project costs for the Trailer Court water main replacement is outlined in Table 13 and the Calvin Street water main extension to connect the dead ends is shown in Table 14. A summary of the estimated project costs for switching the coagulant to PACl is outlined in Table 15. Refer to Attachment D for the full cost analysis for all parts of the proposed project and alternatives.

Table 13. Trailer Court Area Water Main Replacement Preliminary Cost Estimate Summary

Item	Plan Amount
Mobilization / Bonding / Insurance	$52,273
Asphalt Cutting	$9,409
Asphalt Removal and disposal	$7,318
Asphalt Patching (Easy Street Cold Patch)	$15,682
Pipe Bedding Material (D-1)	$54,364
D-1 Road Surfacing (6" Thick)	$14,636
Backfill Material	$70,568
8" HDPE Water Main	$241,500
8" Gate Valves with valve boxes	$13,068
Connect to Existing Water Main	$3,136
Water Service Connections	$50,182
Reconnect Fire Hydrants	$3,764
Temporary Water System	$36,591
Air Release Valve	$3,659
Construction Staking	$10,455
Total Estimated Cost	$586,604
Contingency (10%)	$58,660
Total Estimated Construction Cost	**$645,265**

Table 14. Calvin Street Water Main Construction (Dead Ends) Preliminary Cost Estimate Summary

Item	Plan Amount
Mobilization / Bonding / Insurance	$16,727
Asphalt Cutting	$1,045
Asphalt Removal and disposal	$418
Asphalt Patching (Easy Street Cold Patch)	$28,227
Pipe Bedding Material (D-1)	$16,989
Backfill Material	$21,170
8 HDPE Water Main	$62,727
8" Gate Valves with valve boxes	$15,682
Connect to Existing Water Main	$4,705
Air Relief Valve	$3,659
Construction Staking	$4,705
Total Estimated Cost: $	$176,055
Contingency (10%);	$17,605
Total Estimated Construction Cost:	**$193,660**

Table 15. Breakdown of Preliminary Capital Cost Estimates for Switching Coagulant to PACl plus Corrosion Control

	Labor	Materials	Equip/Shipping	O&P	Total
Coag System					
Coag Pump (x2)	$900	$5,000	$318	$1,990	
Subtotal					**$8,208**
Soda Ash System					
Concrete housekeeping pad	$6,480	$2,000	$3,662	$3,886	
Dry Chemical Feed System	$16,200	$63,000	$16,145	$30,511	
Piping Systems	$7,200	$10,000	$5,507	$7,266	
Dosing pumps and tanks (x2)	$7,200	$20,000	$9,039	$11,597	
Electrical power to equipment	$13,680	$8,000	$2,231	$7,651	
SCADA Integration	$3,200			$1,369	
Equipment Commissioning	$8,550			$2,824	
Subtotal					**$268,554**
Disodium Phosphate					
Concrete housekeeping pad	$6,480	$2,000	$3,662	$3,886	
Dry Chemical Feed System	$16,200	$63,000	$16,145	$30,511	
Piping Systems	$7,200	$10,000	$5,507	$7,266	
Dosing pumps and tanks (x2)	$7,200	$20,000	$9,039	$11,597	
Electrical power to equipment	$13,680	$8,000	$2,231	$7,651	
SCADA Integration	$3,200			$1,369	
Equipment Commissioning	$8,550			$2,824	
Subtotal					**$268,554**
Building					
New Building (975 SF, 15' x 65')			$847,479		
New Roof on Existing Bldg			$93,607		
Subtotal					**$941,086**
Mob/Demob					
Travel/Room/Board					$117,009
10% of construction cost					$148,640
Additional					
Pre-Design Construction Estimate					$1,765,423
Contingency of 10%					$176,542
Engineering, 12%					$233,036
Project Permitting					$15,000
Construction Contract Admin 15%					$175,200
Facility Startup and Training					$13,372
Total Estimate, Rounded					**$2,380,000**

6.6 Annual Operating Budget

Cost estimates (included in Attachment D) for capital costs assumed construction of the building addition, including a new roof on the existing building, equipped with concrete housing pads, piping systems, dosing pumps and tanks, electrical power, controls integration, construction, engineering and contingency costs. Annual O&M cost estimates (also included in Attachment D) include chemical costs, operator time, general maintenance, energy of equipment, and additional building lighting.

6.6.1 Annual O&M Costs

Current annual budget and future annual budget incorporating the operating costs associated with the proposed project are compared in Table 16. The percent increase is shown. The annual O&M costs calculated for the project are intended to be conservative to ensure that no surprises result once the proposed upgrades are installed and operating. The Future Budget does not include the potential for money saved once the distribution system upgrades are complete and the frequent and costly repairs are no longer required.

Table 16. Annual Budget Adjustments for Project Upgrade Costs

Item	Current Budget	Future Budget	% Increase
Annual Budget	$507,700	$553,700	8.3%

6.6.2 Income

Annual revenue collected from rate payers is less than the current operating budget. The community of MIC subsidizes the utility operations from a General Fund, usually around 200 thousand dollars annually. To get the utility operating without subsidized funding from the community, VSW, the Public Works Director and the Tribal accountant have agreed to work with the Rural Utility Business Advisor (RUBA). RUBA offers several services free of charge to the community including the following:

- Budget Preparation
- Develop, amend and codify ordnances and resolutions
- Accounting system
- Financial reporting
- Organizational Management
- Payroll taxes and reporting
- Local elections assistance
- Interpreting Title 29 and state and federal statues
- Municipal laws and regulations
- Utility Management
- Trainings for council members and staff
- Grand compliance assistance
- Business Planning
- Community Planning Projects

RUBA is available to help MIC improve their Operations and Maintenance Best Practices Score, a value assigned by ADEC, RUBA and the Alaska Native Tribal Health Consortium (ANTHC) to assess the operation and maintenance capacity of rural utilities. MIC's most current score is 39, lower than ideal, but with assistance from RUBA, some adjustments can be made to improve managerial and financial operations for the utility and work towards reducing the utilities financial dependence on the community. RUBA has indicated they can provide assistance with rate structure development, including rates for residential and industrial users, to make sure that MIC can cover both their current and their increased budgeted expenses for the utility.

6.6.3 Debt Repayment

The proposed project is dependent on grant money to proceed. If MIC is unable to qualify for grant funding through the USDA Rural Utilities Service (RUS) to help with capital improvement costs, the project is unlikely to be advanced.

6.6.4 Reserves

Short lived asset reserve costs are included in the annual O&M costs calculated. Refer to Attachment D for a breakdown of calculations.

7 CONCLUSIONS AND RECOMMENDATIONS

Upgrades to the MIC water system are needed to address corrosion in the distribution system and limit excursions of HAA5 DBPs. For the corroded pipe in the distribution system at the Trailer Court, the only acceptable alternative was determined to be removal and replacement of the corroding pipe. A new water main is recommended along Calvin Street to connect the dead end pipes on Haines Street and Milne Street to aid in reducing DBPs in the distribution system and increase the sustainability and robustness of the utility. There are no alternatives to this recommended distribution system upgrade.

For the upgrade to the WTP to address DBP concentrations, the recommended alternative is to switch to a new coagulant and install soda ash and disodium phosphate for corrosion control. This alternative will require adding on to the existing WTP to accommodate new dry chemical dosing equipment for soda ash and disodium phosphate and storage of chemicals. This alternative was found to have the lowest capital, O&M, and life cycle cost of all of the WTP upgrade alternatives. In addition, this alternative had the lowest impact on the environment and was determined to be the most sustainable of all of the evaluated alternatives.

8 REFERENCES

Census. (1990). *US Census Bureau*. Retrieved from https://www.census.gov/

Census. (2000). *US Census Bureau*. Retrieved from https://www.census.gov/

Census. (2010). *US Census Bureau*. Retrieved from https://www.census.gov/

ATTACHMENT A

Regulatory Notices for the Metlakatla Indian Community Public Water System

ATTACHMENT 1

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 10
1200 Sixth Avenue, Suite 900
Seattle, WA 98101-3140

OFFICE OF
WATER AND WATERSHEDS

August 18, 2016

CERTIFIED MAIL-RETURN RECEIPT REQUESTED

Mr. Rick Anderson
Metlakatla Indian Community
P.O. Box 8
Metlakatla, Alaska 99926

Re: Violation of HAA5 Maximum Contaminant Level
Metlakatla Indian Community PWS ID# 100211202

Dear Mr. Anderson:

The Metlakatla Indian Community water system has recently violated the haloacetic acids (HAA5) maximum contaminant level (MCL) of 0.060 mg/L or 60 µg/L. As you are aware, compliance with the HAA5 MCL is determined every quarter by calculating a running annual average of HAA5 monitoring results at site Mic-35 from the four most recent quarters.

The results of the last four quarters of samples and the average of these results are as follows:

Date	Result - in µg/L
October, 2015	81
February, 2016	55
April, 2016	56
July, 2016	53
Average	**61.3**

Although this quarter's HAA5 concentration of 53 µg/L was below the MCL of 60 µg/L, your system's current running annual average is **61.3 µg/L.** This is an MCL violation and requires **Tier 2 public notification.**

A public water system that violates an MCL is required to notify the public of this MCL violation as soon as practical, but no later than 30 days after learning of the violation, so please make sure to notify your customers no later than 30 days after you receive this letter. The notice must be delivered by hand or by mail. It must also be made available to other persons served by the water system that have not been reached by the methods listed above, for example via newspaper, email or by posting in a public location. Please see the enclosure titled "Public Notification Delivery Instructions" which provides more details about public notification delivery. You must also send a copy of the notice that you deliver to your customers as well as a completed certification form (enclosed) to the Environmental Protection Agency no later than ten days after you notify your customers.

We have drafted a public notice which you can distribute to your customers (see enclosure with the heading "Important Information about Your Drinking Water"). If you would like to prepare your own public notice, please contact Ricardi at duvil.ricardi@epa.gov or (206) 553-2578 so that he can advise you as to which sections of this draft notice must be included in your notice exactly as written. If you would like to use the enclosed version of the notice but would like to change something in it, for example, the water system contact, please contact Ricardi. He can also make the change and send the revised notice to you, or he can send you an electronic copy of the notice and you can make changes yourself.

If you have any questions please contact me at the email address and phone number above.

Sincerely,

Ricardi Duvil, Ph.D.
Environmental Engineer

Enclosures

cc: Jerry Johnson – Lead Water Operator

Public Notification Delivery Instructions

If your system's running annual average for HAA5 exceeds the MCL of 0.060 mg/L (60 µg/L), you must provide Tier 2 notification to persons served as soon as practical but within 30 days after you learn of the violation. You must issue a repeat notice every three months for as long as the violation persists.

The notice must be delivered by one of the following methods:

- Hand or direct delivery
- Mail, as a separate notice or included with a water bill

In addition, you must use another method reasonably calculated to reach other persons if they would not be reached by the methods listed above. Such methods could include newspapers, e-mail, delivery to community organizations, or posting. If you mail, post, or hand deliver the notice, we suggest you print the notice on your letterhead, if available.

If you wish to modify this notice, please contact Ricardi Duvil at duvil.ricardi@epa.gov or 206-553-2578, as there are certain sections of the notice that cannot be modified.

For repeat notices, you should state how long the violation has been ongoing and remind consumers of when you sent out any previous notices. The notice should discuss any changes you have already made to lower TTHM levels and what more you plan to do. If there are delays to making any of the changes described in the previous notice, these should also be explained in the repeat notice.

After issuing the notice send EPA a copy of your notice and a completed certification form indicating that you have met the public notice requirements. These documents must be sent to EPA within ten days after you issue the notice.

IMPORTANT INFORMATION ABOUT YOUR DRINKING WATER

Haloacetic acids (HAA5) MCL Violation at The Metlakatla Community Water System

Our water system recently violated a drinking water standard. **Although this incident was not an emergency**, as our customers, you have a right to know what happened and what we are doing to correct this situation.

We routinely monitor for the presence of drinking water contaminants. Although this quarter's HAA5 concentration of 53 µg/L was below the MCL of 60 µg/L, testing results from October 2015 – July 2016 show that our system continues to exceed the drinking water standard, or maximum contaminant level (MCL), for HAA5. HAA5 are haloacetic acids which form when disinfectants react with natural organic matter in the water The MCL for HAA5 is 0.060 mg/L. It is determined by averaging all the HAA5 samples collected at a specific sampling location for the past 12 months. The average HAA5 level for October 2015 – July 2016 was 0.061 mg/L.

What should I do?

- **There is nothing you need to do**. You do not need to boil your water or take other corrective actions. If a situation arises where the water is no longer safe to drink, you will be notified within 24 hours.
- If you have a severely compromised immune system, have an infant, are pregnant, or are elderly, you may be at increased risk and should seek advice from your health care providers about drinking this water.

What does this mean?

This is not an emergency. If it had been an emergency, you would have been notified within 24 hours.

People who drink water containing trihalomethanes in excess of the MCL over many years may experience problems with their liver, kidneys, or central nervous system, and may have an increased risk of getting cancer.

What is being done?

We have collected additional investigative samples in order to see where the TTHMs are forming. We also plan to increase pipe flushing and reduce the age of the water in our distribution system by managing water levels in our storage tanks.

For more information, please contact Rick Anderson at 907-886-3356.

Please share this information with all the other people who drink this water, especially those who may not have received this notice directly (for example, people in apartments, nursing homes, schools, and businesses). You can do this by posting this notice in a public place or distributing copies by hand or mail.

This notice is being sent to you by Metlakatla Community Water System ID# 100211202
Date distributed: __________

PUBLIC NOTICE CERTIFICATION FORM

PUBLIC WATER SYSTEM NAME Metlakatla – Community Water System

PUBLIC WATER SYSTEM ID 100211202

DESCRIPTION OF VIOLATION(S) Exceedance HAA5 MCL

VIOLATION DATE(S) HAA5: October 2015 – July 2016

The public water system named above hereby affirms that public notice has been provided to consumers in accordance with the delivery, content, and format requirements and deadlines as required by 40 CFR Part 141 Subpart Q.

Consultation with EPA (if required) on the following date(s)________________________

Notice distributed by the following method(s) (for example, mail, posting, etc. __________

____

on the following date(s)____

Notice posted at the following location(s) ______________________________________

____

on the following date(s)____

____ ________________

Signature of owner or operator date

****

Send completed form and copy of public notice to EPA by

fax to (206) 553-1280 or

mail to Drinking Water Unit
Environmental Protection Agency
1200 Sixth Ave, Suite 900, OWW-193
Seattle, WA 98101

ATTACHMENT B

Metlakatla Water Distribution System Corrosion Condition Assessment

Prepared by Taku Engineering

METLAKATLA WATER DISTRIBUTION SYSTEM CORROSION CONDITION ASSESSMENT

FOR

ADEC Village Safe Water Program

AT

METLAKATLA, AK

PREPARED BY:

taku engineering, llc

205 E. Benson Blvd.
Anchorage, AK 99503
(907) 562-1204

February, 2017

TABLE OF CONTENTS

1.0 INTRODUCTION

The City of Metlakatla has experienced numerous corrosion related failures of its buried drinking water distribution piping over the past several years. These failures have required various shutdowns and costly repair/replacement of compromised piping segments in order to return the system to service. To address these and other concerns, the Alaska Department of Environmental Conservation's Village Safe Water (VSW) program awarded a contract to GV Jones & Associates to conduct an evaluation of the Metlakatla water system. Being part of the GV Jones' evaluation and assessment team, Taku Engineering was subsequently assigned the corrosion assessment and remediation recommendation aspects of the project.

Per the request of the VSW, corrosion related investigation and assessment focused on the New Trailer Court area of piping. This area features a single 6-inch diameter, "thin wall" ductile iron pipe (DIP) loop to distribute drinking water to the Trailer Court residents. Installed in the early to mid-1980's, this line has experienced the highest frequency of corrosion related failures in the village water system.

Corrosion evaluations performed included internal and external examination of previously removed piping segments, excavation and examination of active service piping, testing and evaluation of pipe soil conditions, testing of external groundwater and interview with Public Works Department personnel. Field investigation and sample collection was performed between January 25th through January 27th, 2017. The following report outlines the results, conclusions and recommendations associated with the pipe corrosion assessment.

2.0 CONCLUSIONS

1. The corrosion that resulted in the previous failures of the New Trailer Court's water distribution piping was overwhelmingly due to external corrosion attack. All observable pipe segments (previously removed and replaced) exhibited significant external pitting and wall loss resulting in multiple through-hole penetrations. These observations coincide with the aggressive soil/water conditions found in each of the excavated examination sites.

2. Internal surfaces of the previously removed pipe segments were found to be in relative good condition. Minor pitting and general surface corrosion was observed on the internal surfaces of the pipe. However, these were minor in nature (less than 12% wall loss) and were not associated with the extensive external corrosion related failures.

3. The soil environment surrounding the 6-inch ductile iron water line was found to be very corrosive. Although individual test results for soil resistivity, chloride and sulfates, and corrosion causing bacteria indicate moderate corrosivity, collectively they make for a significantly more aggressive corrosion environment. This is further compounded by the presence of clay, heavy organic material, and flowing groundwater that can result in more concentrated corrosion cells.

4. Although the piping exposed in the three excavated examination locations were found to be in fair condition, random locations of corrosion staining and/or bacterial attack leaching through the deteriorating asphaltic coating were evident. Considering the aggressive nature of the soil environment, construction methods used in the original installation (wood cribbing left in contact

with the pipe, etc.), and the aging factory coatings, ever increasing failures of the New Trailer Court water distribution line are expected.

5. Due to the presence of electrically discontinuous bell and spigot pipe joints, the application of cathodic protection as a corrosion control measure would be extremely difficult and costly to achieve. This would require excavation of each pipe joint to either install electrical bonds and anodes to protect the pipe collectively, or excavation of each pipe joint to install anodes to protect pipe sections individually.

3.0 RECOMMENDATIONS

1. Evaluate the possibility of slip-lining the existing piping with a non-metallic (FRP or HDPE) material. This would effectively remove the threat of continued corrosion related failure while seeking to minimize excavation costs and home access restrictions.

   Slip-lining materials must be capable of maintaining structural integrity while meeting or exceeding operating pressure requirements. Factors to consider in the evaluation and feasibility of this option would include assessment of the water capacity to maintain the required volume necessary for Trailer Court use and excavation at each branch to accommodate connection points. Materials and vendors such as LightStream, LP, known to have problems with maintaining leak-free operation, should be avoided.

2. If slip-lining is not possible, consider wholesale replacement of the line with HDPE material. HDPE offers the benefit of corrosion-free operation without requiring extensive annual maintenance and repair.

4.0 TECHNICAL APPROACH

Visual Examinations & Personnel Interviews

Visual examinations of active service and previously removed pipe segments were utilized to ascertain both extent of corrosion, and the mechanisms associated with the various corrosion failures. These inspections examined all exposed surfaces for the presence of corrosion, noted as-found coating conditions and, documented surrounding soil and construction issues that may have enhanced corrosion activity.

With respect to active service piping, three individual excavations were performed to physically expose and examine the buried piping. Selected excavation sites attempted to target locations upstream or downstream of previously known corrosion failures. However, some relocation was required in an effort to minimize paved road damage, ensure individual trailer access, and accommodate parked obstructions (where present).

Examination of previously removed pipe segments assessed pipe surfaces for evidence of internally or externally oriented corrosion, possible corrosion mechanisms, and extent of metal loss. Interviews were then conducted with Public Works personnel to provide further information on modes of failure and extent of repairs performed over the course of operation.

SOIL CORROSIVITY EVALUATION:

Soil corrosivity evaluations utilized a combination of methods including direct soil resistivity measurements, soil chemistry evaluations, and exterior water testing. Wenner Four-pin resistivity measurements were also collected at other locations around the piping circuit to provide additional resistivity by layer information.

Direct soil resistivity measurements were performed by collecting soil samples directly above and below the pipe at each excavation site and testing them with an MC Miller soil box. The soil box utilizes a geometry that allows a 1:1 ratio of electrical resistance (ohms or Ω) to Ω-cm. Soil resistivity testing was performed by Taku Engineering in accordance with ASTM G57 test standards using a Nilsson Soil Resistance Meter.

The collected soil samples were also subjected to laboratory tests where the soil chemistry was analyzed for chlorides, sulfates, pH, and total solids. Laboratory testing was performed by SGS North America, Incorporated in accordance with EPA and AWWA Standards.

Werner 4-pin testing was performed at four additional locations along the pipe route, outside of the areas covered by the excavated direct measurements. Measurements were made using a calibrated NIST traceable AC resistance meter connected to four equally spaced steel spikes driven into the soil at surface grade. Pin spacing typically matched the estimated pipe depth to provide calculated resistance data at those depths but were also varied for cathodic protection design purposes to provide information over a range of depths and/or soil layers.

PIPELINE JOINT CONTINUITY TESTING:

Electrical continuity testing across an exposed pipe joint was performed to verify if pipe segments were electrical continuous from side to side. This information was critical in the evaluation of electrical continuity across the entire pipe run, essential to cathodic protection current distribution. Measurements were made by documenting the electrical resistance across exposed bell and spigot joints using a calibrated multimeter. Low resistance measurements (typically 10 ohms or less) would indicate that pipe segments were electrically continuous. Higher resistance measurements would indicate that the joints are electrically isolated.

Secondary measurements were also made by documenting the pipe-to-soil electrical potentials for each side of pipe using a calibrated multimeter and a copper-copper sulfate reference electrode. Measurements showing a significant potential differential (typically 10 millivolts or greater) would indicate that the piping segments were electrically isolated.

MICROBIOLOGICALLY INFLUENCED CORROSION EVALUATION:

Testing for corrosion causing bacteria (i.e. microbiologically influenced corrosion or “MIC”) was performed by collecting relevant water samples and subjecting them to Biological Activity Reaction Tests (BART). Relevant water samples were collected from the flowing groundwater present in each dig site to evaluate external bacteria influences. To evaluate internal water influence, a water sample was also collected from a trailer tap water source (cold), located in the New Trailer Court. All samples were then added to factory prepared test kits and allowed to incubate over time. Specific bacteria test for included sulfate-reducing bacteria (SRBs), iron related bacteria (IRBs), acid producing bacteria (ACBs) and slime producing bacteria (SLYM).

5.0 RESULTS AND DISCUSSION

PREVIOUSLY REMOVED PIPE EXAMINATIONS:

Pipe sections that had been previously cut and removed due to corrosion related failure had been stored at the Metlakatla Public works facility. These samples, collected from 2011 and 2012 pipe repair activities, were retrieved from the scrap pile and examined for internal and external corrosion activity.

All pipe segments were found to be 6-inch diameter ductile iron with 0.250-inch nominal wall thickness and varying degrees of failing external asphaltic coating (factory applied). One segment featured a bell and spigot joint (common for DIP water systems). This was confirmed by the Public Works personnel to be prevalent throughout the entire run of the New Trailer Court area water distribution piping along with several mechanical couples (used at the various pipe replacement locations).

Examination of internal surfaces found the piping to be in fair condition with either general surface corrosion or minor pitting (5 to 10 mils) present. Random instances of isolated tubercles were also observed but only exhibited 15 to 30 mil pitting. This equated to only 12% wall loss and was not associated with the readily evident through-hole penetrations prevalent from the exterior of the piping.

External examinations revealed significant and extensive corrosion along the bottom of pipe. While the top of pipe was always found to be in fair to good condition, the bottom of pipe was found to have isolated and large scale pitting prevalent throughout. In many instances this pitting was observed to be 6 inches to 12 inches in diameter with through-hole penetrations located in the deepest valleys. Discussion with the Publics Works crew indicated that the majority of through-hole penetrations were found to be were the pipe was in direct contact with muskeg or other organic material. This information, coupled with the overwhelming extent of the bottom side external corrosion was determined to be the primary corrosion mechanism resulting in the previous failures.

Figure 1 – Extensive metal loss and through-hole penetrations evident on the bottom exterior of a previously removed section of Trailer Court water distribution DIP.

Figure 2 – Typical internal pipe surface exhibiting only minor interior metal loss, light pitting and externally produced through-hole penetrations.

Please refer to Figures 1 and 2 (above), and to *Appendix B* for examples of the internal and external corrosion found.

DIG SITE EXAMINATIONS:

All piping segments exposed in the three dig excavations were found to be in fair condition with relatively good factory coating in place. The soil conditions, flowing groundwater, and presence of wood support cribbing in direct contact with the piping, however, pose a significant corrosion related risk to the continued operation of the DIP water distribution piping. A discussion of each individual excavation site is provided as follows:

DIG SITE #1: NEW TRAILER COURT SOUTH LOOP ROAD

The ductile iron water line was encountered at approximately 5.5-foot below grade and roughly eight (8) feet from the adjacent electrical meter post. As noted above, this piping was found to be in fair condition with the factory applied asphaltic coating still intact. Although significant corrosion was not observed around the circumference of the exposed pipe, a few small locations along the bottom quadrant did exhibit a small amount of localized corrosion staining and/or bacterial activity leaching through the coating.

Soil conditions surrounding the pipe were primarily course gravels with silt and topsoils mixed in. However, a moderate amount of clay and organic material was also observed to be interspersed throughout the strata. This tended to reinforce the observations made in the previously removed pipe segments as contact with clay or organic material can often lead to accelerated corrosion of metallic structures due to the creation of concentrated differential corrosion cells and/or associated bacterial development.

Groundwater was encountered approximately one foot above the pipe. This often serves to increase corrosivity by lowering soil electrical resistance, fostering bacterial growth or creating isolated corrosion cells when trapped under tape or coating.

The flow rate of the water also posed a problem with respect to attempting to examine the bottom of pipe as the rapid flow rates and presence of organic material tended to plug and clog pumping attempts. As such, bottom of pipe examination utilized touch-and-feel methods along with photo and video.

A final and potentially detrimental component observed in the dig site was that of wood cribbing installed as part of the original installation of the pipe. This cribbing was used to support the pipe during assembly and backfill. However, it was left in place posing a corrosion threats due to inadvertent pipe contact with a moisture and decay source that can also serve to damage pipe coatings. These were found to be prevalent in all dig locations and promptly removed as part of the investigation.

DIG SITE #2: NEW TRAILER COURT WEST LOOP ROAD

The piping in this location was encountered at approximately 4.8 feet below grade. As part of the excavation process, a previously unknown and/or undocumented shut-off valve was encountered. This valve was found to be functional and was subsequently returned to service upon completion of all investigation activities.

Although the piping and associated asphaltic coating was found to be in fair condition, evidence of heavier corrosion staining and SRB/IRB microbial by-product was found leaching through the coating at the valve and southern dig limits. Subsequent corrosion examination did not find any significant pitting or bare pipe surfaces, but this may be only a matter of time as corrosion begins to develop beneath the coating layer.

Significantly greater quantities of clay and organic material (see *Figure 3*) was found to be present in this dig location along with the typical flowing groundwater activity. The groundwater level was found to coincide with the top-of-pipe depth at approximately 4.8 feet below grade.

Wood cribbing was also encountered at this site (in direct contact with the pipe) and subsequently removed. Cursory examination of the wood-to-pipe contact point did not reveal any signs of significant corrosion or coating damage.

DIG SITE #3: NEW TRAILER COURT WEST LOOP ROAD

This location was significantly different than the previous excavation sites in that it was comprised primarily of wood and organic debris (see *Figure 4*) with some mixed gravel and clay. Piping in this location was also significantly shallower that others, being encountered at an approximate 3.5-foot depth.

As with the other locations examined, the piping and associated factory coating was found to be in fair condition with no significant corrosion observed. However, smaller isolated corrosion staining locations were observed to be leaching through the coating at the east and west dig limits.

Flowing groundwater and wood cribbing were also encountered at this location. Groundwater was encountered at the top-of-pipe depth (3.5 feet below grade). Wood cribbing was removed and the piping examined for possible corrosion at the contact point.

Figure 3 – Typical organic material collected from around the pipe at Dig Site #2.

Figure 4 – Typical backfill material collected from Dig Site #3 featuring heavy quantities of wood debris and organic material.

Please refer to *Appendix A* for specific location of each site and *Appendix B* for photo collected during the examination process.

SOIL RESISTIVITY:

Corrosion of a metal is electrochemical in nature and is always accompanied by the flow of electric current between the metal and its surrounding environment. Resistivity is a measure of the ability of an electrolytic medium (soil, water, etc.) to conduct an electric current and is therefore an important parameter in the evaluation of the soil corrosivity. Resistivity testing was performed on soil samples collected at each excavation location, as well as via Werner 4-Pin testing performed at four additional locations.

Corrosivity of soils increases as resistivity decreases. More aggressive corrosion will generally occur in the lowest resistivity areas. The following classification of soil corrosivity relating to resistivity values is frequently used for analysis of soil data. *Table 1* contains the classification of each value according to the system shown.

Table 1

CORROSIVE CLASSIFICATION OF SOIL RESISTIVITY

Corrosion Class[1]	Resistivity, ohm-cm	% of Soils in Class
Extremely Corrosive	0 – 1,000	0%
Highly Corrosive	1,000 - 3,000	0%
Corrosive	3,000 - 5,000	33%
Moderately Corrosive	5,000 - 10,000	66%
Mildly Corrosive	10,000 - 20,000	0%
Slightly Corrosive	Above 20,000	0%

[1]Corrosion/resistivity relationship from Handbook of Corrosion Engineering, Pierre R. Roberge, McGraw-Hill, 2000.

Based on the direct measurement resistivity data collected, the soil along the New Trailer Court water distribution line can be classified as corrosive to moderately corrosive. Measured soil resistivity ranged from to 3,050 Ω-cm to 9,400 Ω-cm. Resistivity measurements of the flowing groundwater within the excavations measured approximately 4,800 Ω-cm. By itself, this equates to a corrosive to moderately corrosive soil environment.

Werner 4-Pin measurements, performed in alternate locations along the pipe route, exhibited higher resistivity measurements than those of the direct measurements. These ranged from 5,641 Ω-cm to 24,393 Ω-cm. As these were subject to some possible error due to limitations in test site availability, they are generally discounted in lieu of the more precise direct measurements collected at pipe depth.

Please refer to *Appendix C* for specific measurements collected from the various excavation locations.

CHEMISTRY OF SOILS:

The chemistry of the soils along buried pipe routes is of major importance when classifying soil corrosivity. The majority of the soil along the pipe route is gravel mixed with decaying vegetation and clay. However, Dig Site #3, located on the North Loop road was primarily comprised of wood debris and organic material mixed with lesser amounts of topsoil and gravel.

Samples were collected from soil material around the exposed pipe within the three (3) pipe excavation locations. The samples were analyzed for chloride content, sulfate content, and pH by SGS North America, Inc. using EPA and AWWA standard methods. A summary of the laboratory results is shown in *Table 2* below. The full SGS report is available in *Appendix D*.

Table 2

SOIL CHEMISTRY

Dig Site Area	Chlorides (ppm)	Sulfates (ppm)	pH
1	4.45	172	6.42
2	4.80	541	6.64
3	10.80	43	6.26

CHLORIDE AND SULFATE CONCENTRATIONS

The aggressive nature of chloride and sulfate ions makes it imperative that their presence be quantified. Chloride concentrations exceeding 10 ppm[2] will cause an increase in the corrosion rate of iron and steel in soil. Dielectric coated pipelines can generally withstand higher concentrations.

The presence of sulfates in soil can pose a major risk towards buried metallic structures because sulfates can be converted into highly corrosive sulfides in anaerobic conditions by sulfate reducing bacteria (SRB). The sulfides are a byproduct of SRB life process and will typically accelerate corrosion rates for piping in soil. Sulfate concentrations exceeding 150 ppm[3] are considered aggressive and may pose a significant corrosion concern.

Sulfate concentrations for Dig Sites #1 and #2 were above the 150 ppm threshold indicating a higher potential for accelerated corrosion due to SRB and/or anaerobic bacteria related activity. With this in mind, Dig Site #2 appears to exhibit the highest corrosivity with the lowest soil resistivity (3,050 Ω-cm) and highest sulfate concentrations (541 ppm). Although Dig Site #3 demonstrated the highest chloride level (10.8 ppm), sulfate levels were found to be low and therefore poses only a moderate corrosion concern with respect to soil chemistry.

[2] Reference: API 651, *Cathodic Protection of Aboveground Storage Tanks,* 3rd Ed, 2007

[3] Reference: Peabody, A.W., *Control of Pipeline Corrosion,* 2nd Ed., 2001

SOIL PH

The concentration of hydrogen ions indicates the degree of acidity of the soil. The degree of acidity is expressed as pH which is the negative logarithm of the reciprocal of the hydrogen ion concentration.

Table 3 presents a correlation of descriptive soil reactivity terms published by the U.S. Department of Agriculture, Handbook No. 18. The handbook applies qualitative terms to the pH as follows:

Table 3

CHARACTERIZATION OF pH

Description	pH	Degree of Corrosivity
Strongly Acidic	Below 5.5	Severe
Mildly Acidic	5.5 to 6.5	Moderate
Neutral	6.5 to 7.5	Neutral
Alkaline	Greater than 7.5	None

Measured pH values within the three Trailer Court area excavations ranged from 6.26 to 6.64. As *Table 3* indicates, the soil samples range from mildly acidic to neutral. Generally, soil corrosivity increases as pH levels decrease (i.e. become more acidic). Neutral pH environments can support corrosion related bacterial growth. In alkaline (high pH) conditions, iron and steel typically develop protective passive films. As noted in *Table 2*, two of the three dig locations exhibited pH levels in the "mildly acidic" range. This garners a "moderate" soil corrosivity rating.

ELECTRICAL CONTINUITY TESTING OF PIPE JOINTS:

As is typical of most DIP installations of this type, the internal gaskets used to seal the joints typically renders each successive segment of pipe connection electrically discontinuous from one another. This appears to be the case for the New Trailer Court area piping as well. Electrical continuity testing across the exposed bell and spigot pipe joint produced a 158 kilohm (158,000 Ω) measurement. Supplemental testing using pipe-to-soil measurements produced a 30 millivolt differential. Collectively, this provides solid evidence that the piping is electrically isolated (i.e. discontinuous) from joint to joint.

MICROBIOLOGICALLY INFLUENCED CORROSION TESTING:

Corrosion related bacterial testing of the various water samples collected from each dig site (external testing) indicated the presence of aggressive to moderately aggressive activity in all locations. Each site tested positive for Sulfate reducing bacteria (SRBs), acid producing bacteria (APBs) and slime forming bacteria (SLYM). Iron related bacteria (IRBs), were found to be present in two (Dig Site #1 and #2) of the three test sites. Each poses a considerable threat to and risk of pipe related corrosion.

The single internal MIC related test was performed by means of collecting a water sample from one of the Trailer Court area trailer's drinking water sources. Although this evaluation tested positive for IRBs, APBs and SLYM, colony concentration levels were found to be relatively low. APBs and SLYM levels garnered a "non-aggressive" rating, while IRB concentrations were found to be in the "moderate" category. As such, the threat of internal related corrosion failure is considered to be relatively low with respect to bacterial influence.

Please refer to Appendix C for more quantitative information and results of the MIC testing.

SOIL CORROSIVITY ASSESSMENT:

Individually, the various soil related tests indicate the presence of corrosive to moderately corrosion soil conditions. However, when viewed collectively, the soil corrosivity poses a significantly higher corrosion threat. The presence of low resistivities, high sulfate levels, active MIC colonies, moderate to high concentrations of clay and organic material, flowing groundwater and decaying wood cribbing collectively combine to make for a considerably aggressive corrosion environment. This tends to explain the aggressive and excessive external metal loss observed on the previously removed segments of pipe. Any location along the New Trailer Court pipe route experiencing diminishing or failing coatings will be subject to rapid and aggressive metal loss.

--- END OF REPORT ---

τaku engineering, llc

APPENDIX A

Metlakatla & Investigation Area Site Plans

City of Metlakatla

Water Distribution System Corrosion Condition Assessment

Metlakatla Water System
Pipe Corrosion Assessment

AREA OVERVIEW
&
LEGEND

Metlakatla Water System
CORROSION INVESTIGATION SITE PLAN
(NEW TRAILER COURT AREA)

APPENDIX B

Corrosion Investigation & Testing Photos

City of Metlakatla

Water Distribution System Corrosion Condition Assessment

Appendix B

Metlakatla Water Service Piping
CORROSION INVESTIGATION & TESTING PHOTOS

PHOTO B1: 1/26/17 – Previously removed section of New Trailer Court Area piping (bell & spigot joint) exhibiting external bottom-of-pipe pitting and associated through-hole corrosion.

PHOTO B2: 1/26/17 – Previously removed bell & spigot pipe segment showing generally good top-of-pipe condition.

PHOTO B3: 1/26/17 – Typical internal condition of replaced piping segment exhibiting only minor wall loss and surface corrosion with random locations of light pitting (10 to 20 mils).

PHOTO B4: 9/13/15 – Another segment of previously removed Trailer Court piping from a separate repair area. Photo shows extensive bottom-side (external) wall loss and through-hole penetrations.

Appendix B

Metlakatla Water Service Piping
CORROSION INVESTIGATION & TESTING PHOTOS

PHOTO B5: Photo of insitu pipe segment prior to 2011 removal/replacement. Organic matter and debris evident around pipe. (Photo provided by Metlakatla Public Works Department.)

PHOTO B6: 1/26/17 – Same segment of pipe examined after previous removal (see Photo B5). Heavy external pitting and wall loss (bottom-of-pipe) noted prior to removing clamps.

PHOTO B7: 1/26/17 – Previously removed double-clamp segment after removal of clamps. Top-of-pipe in relative good condition.

PHOTO B8: 1/26/17 – Bottom-of-pipe view of previously removed double-clamp pipe segment. Extensive external corrosion and through-hole penetrations evident beneath former clamp area.

Appendix B

Metlakatla Water Service Piping
CORROSION INVESTIGATION & TESTING PHOTOS

PHOTO B9: 1/26/17 – Close-up of previously removed double-clamp segment showing extensive external corrosion and failed factory asphaltic coating.

PHOTO B10: 2/4/17 – Coupon cut-out of previously removed double-clamp pipe segment showing relative good condition of internal pipe surface with only minor wall loss noted.

PHOTO B11: 2/4/17 – End view of double-clamp pipe segment coupon cut-out showing heavy external wall loss with relatively little internal loss.

Appendix B

Metlakatla Water Service Piping
CORROSION INVESTIGATION & TESTING PHOTOS

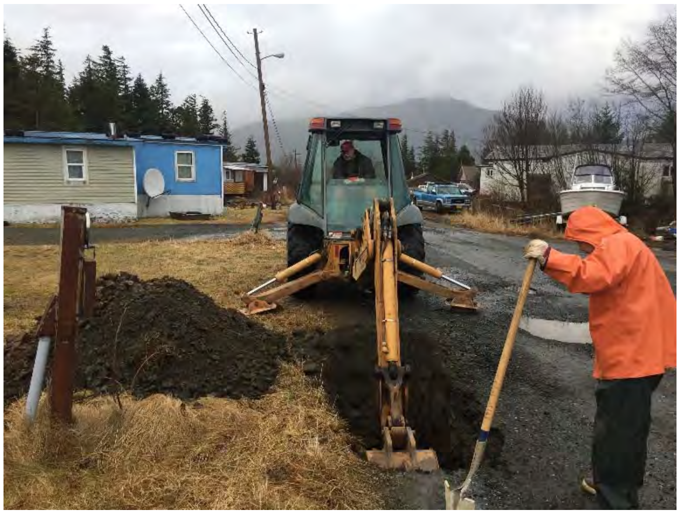


PHOTO B12: 1/26/17 – Dig Site #1 excavation area located on the north side of the New Trailer Court's South Loop Road. (Adjacent to Electric Meter Post #7).

PHOTO B13: 1/26/17 – Dig Site #1 flowing water encountered at the approximate 4' depth.

PHOTO B14: 1/26/17 – Dig Site #1 pipe exposure showing surrounding soil conditions with portions of clay and organic matter evident at pipe depth (~5.5' below grade).

Appendix B

Metlakatla Water Service Piping
CORROSION INVESTIGATION & TESTING PHOTOS

PHOTO B15: 1/26/17 – Dig Site #2 excavation area located on the west end of the New Trailer Court's Loop Road. (Near the southwest corner of the road).

PHOTO B16: 1/27/17 – Pipe exposure at Dig Site #2 showing wood support cribbing beneath pipe and corrosion staining leaching through asphaltic coating at dig limit.

PHOTO B17: 1/26/17 – Previously unknown shut-off valve (functional) encountered at the Dig Site #2 location. Corrosion staining, moderate organic material and possible MIC bacteria residue present around pipe.

PHOTO B18: 1/27/17 – Excavation of pipe trench commences in late morning (10:45 AM).

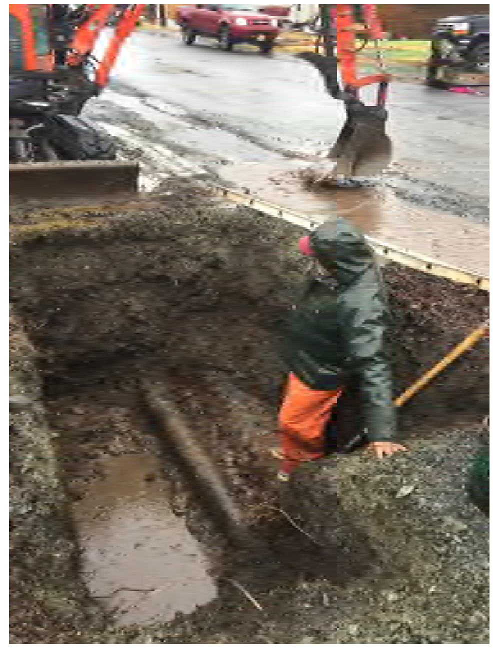


PHOTO B19: 1/27/17 – CP header cable installed in tank dike cable tray for future DC positive and negative connections between the Fuel Pump Building junction boxes and road crossing anode & pipe bonds.

PHOTO B20: 1/27/17 – Completed cable installation in tank dike cable tray (to Fuel Pump Building).

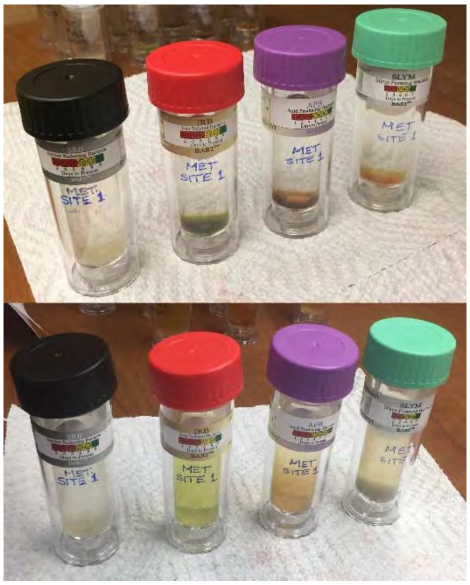


PHOTO B21: 2/21/17 – Dig Site #1 BART water sample comparison showing activation conditions (top) and 6-day incubation conditions (bottom). Sample test positive for corrosion causing iron reducing bacteria (IRB), acid producing bacteria (APB) and slime producing bacteria.

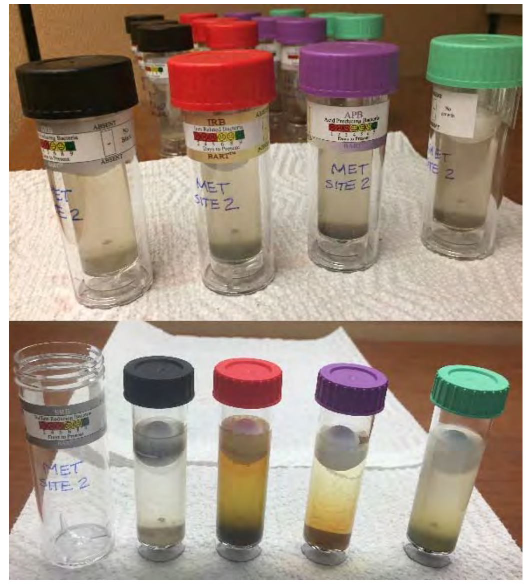


PHOTO B22: 2/21/17 – Dig Site #2 BART water sample comparison showing activation conditions (top) and 6-day incubation conditions (bottom). Sample tests positive for corrosion causing sulfate reducing bacteria (SRB), IRB, APB and slime producing bacteria.

PHOTO B22: 2/21/17 – Dig Site #3 BART water sample comparison showing activation conditions (top) and 6-day incubation conditions (bottom). Sample tests positive for corrosion causing SRB, IRB, APB and slime producing bacteria.

APPENDIX C

Corrosion Evaluation
Test Data

City of Metlakatla

Water Distribution System
Corrosion Condition
Assessment

Taku engineering, llc

CORROSION EVALUATION DATA

Client: Village Safe Water / GV Jones, Inc.
Project Title: Metlakatla Water System Pipe Corrosion Evaluation
Job Number: GVJ-001
Job Location: Metlakatla, Alaska
Date: February 1, 2017

Meter Type: Nilsson Model 400
Meter ID: 4-10314
Calibration Due: 3/3/2017
Technician(s): C. Farrar

Soil & Exterior Water Resistivity Measurements (Direct Samples):

Test Site	Test Location	Resistance Measurement			Soil Description and Other Encountered Conditions
		Pipe Depth	Sample Loc.	Resistivity	
1	Trailer Court S. Loop Road (Adjacent to Electrical Meter Stand #7)	5.5'	Top & Bottom of Pipe	**9,400 Ω-cm**	Coarse gravel with isolated spots of clay and organics (wood, roots, muskgeg). Flowing water encountered at approximate 3.5' depth. Wood support cribbing against pipe (removed.)
2	Trailer Court W. Loop Road (South End)	4.8'	Top & Bottom of Pipe	**3,050 Ω-cm**	Coarse gravel with mixed clay and heavier organics (muskgeg). Flowing water encountered at 4.5' depth. Wood support cribbing found against pipe. Undocumented valve and mechanical coupling (previous repair) encountered.
3	Trailer Court N. Loop Road (W. of Fenced Yard, Between First & Second Trailers)	3.5	Top & Bottom of Pipe	**9,150 Ω-cm**	Heavy organics (wood chips, roots, muskeg) with mixed gravel. Flowing water encountered at top-of-pipe depth (3.5'). Wood cribbing against pipe (removed.) Bell & spigot joint exposed & measured for electrical continuity (found to be discontinuous).
All	Combined Water Sample from All Dig Sites	Varies (See Above)	Top of Pipe Depth	**4,800 Ω-cm**	Water collected from flowing aquifer waters present in all pipe examination dig sites.

:he 6" line (estimated to be within 5' of the pipe centerline).

Electrical Continuity Verification (across pipe joint)*:

Test Site	Test Location	Pipe-to-Soil Potential		Electrical Continuity	Conclusion
		East Side	West Side		
3	Across Exposed Bell & Spigot Joint	-549 mV	-519 mV	158 kΩ	Piping is electrically discontinuous.

Note: Electrical continuity testing performed using Fluke 27 multimeter (continuity & potential testing) & copper-copper sulfate reference electrode (potential testing only).

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CORROSION EVALUATION DATA

Client: Village Safe Water / GV Jones, Inc.
Project Title: Metlakatla Water System Pipe Corrosion Evaluation
Job Number: GVJ-001
Job Location: Metlakatla, Alaska
Date: January 27, 2017

Meter Type: Megger DET4/CR2
Meter ID: 101304065
Calibration Due: 3/3/2017
Technician(s): C. Farrar

Soil Resistivity Measurements (4-Pin):

Test No.	Test Location	Meter Reading (Ω)			Total Resistivity (Ω-cm)			Calculated Layer Resistance (Ω)			Layer Resistivities (Ω-cm)		
		2.5 ft.	5.0 ft.	8.0 ft.	2.5 ft.	5.0 ft.	8.0 ft.	2.5 ft.	5.0 ft.	8.0 ft.	0 ft to 2.5 ft.	2.5 ft. to 5.0 ft.	5.0 ft. to 8.0 ft.
1.	N. Loop Road (S. Side), Next to Fence - Near Walden Pt. Rd.	52	12	5.4	g water e	11,490	8,273	52.0	15.6	9.8	24,895	7,469	**5,641**
2.	Corner of N. Loop Rd. & SW Loop Rd. (S. Side of Rd.)	68.4	29.2	12.99	ood supp	27,959	19,901	68.4	51.0	23.4	32,747	**24,393**	13,443
3.	S. Loop Road (N. Side), E. of Dig Site #1.	77.5	20	11	37,103	19,150	16,852	77.5	27.0	24.4	37,103	**12,905**	14,043
4.	S. Loop Road (N. Side), W. of Dig Site #1.	103	28	10	49,311	26,810	15,320	103.0	38.5	15.6	49,311	18,410	**8,937**

* Due to limited test site availability and paved road restrictions, all testing was performed paralleling pipe routes. Test locations were typically off set from the estimated pipe centerline by 10 to 15 feet. Test Site 4 was performed in presumed closer proximity to the 6" line (estimated to be within 5' of the pipe centerline).

Bold highlights equal estimated pipe depth range.

Taku engineering, llc

CORROSION EVALUATION DATA

Client: Village Safe Water / GV Jones, Inc.
Project Title: Metlakatla Water System Pipe Corrosion Evaluation
Job Number: GVJ-001
Job Location: Metlakatla, Alaska
Date: February 21, 2017

BART Kit Types: SRB, IRB, APB, SLYM
Manufacturer: DBI Inc.
Supplier: HACH Company
Tested By: C. Farrar

BART Testing for MIC Related Bacteria (External & Internal Water Samples):

Test No.	Water Sample Location Location	SRB				IRB				APB				SLYME			
		Result	Days	Population[1]	Rating[2]	Result	Days	Population[1]	Rating[2]	Result	Days	Population[1]	Rating[2]	Result	Days	Population[1]	Rating[2]
1.	Dig Site #1 - S. Loop Road Excavation (Flowing Groundwater)	Positive	4	27,000	Aggressive	Negative	N/A	N/A	N/A	Positive	4	4,500	Moderate	Positive	6	500	Moderate
2.	Dig Site #2 - W. Loop Road Excavation (Flowing Groundwater)	Positive	5	6,000	Aggressive	Positive	6	500	Moderate	Positive	4	4,500	Moderate	Positive	5	2,500	Moderate
3.	Dig Site #3 - N. Loop Road Excavation (Flowing Groundwater)	Positive	6	1,400	Moderate	Positive	6	500	Moderate	Positive	6	75	Moderate	Positive	7	100	Non-Aggressive
4.	Trailer Court Tap Water - Cold (Pipe Internal Water)	Negative	N/A	N/A	N/A	Positive	7	150	Moderate	Positive	7	10	Non-Aggressive	Positive	7	100	Non-Aggressive

LEGEND

SRB = Sulfate Reducing Bacteria - *Accelerates corrosion of iron and steel via the production of H_2S gas.*
IRB = Iron Related Bacteria - *Accelerates corrosion of iron and steel by consuming iron as part of their metabolic process.*
APB = Acid Producing Bacteria - *Accelerates corrosion of metallic structures by reducing pH to create acidic environments (often associated with SRBs)*
SLYM = Slime Forming Bacteria - *Affects corrosion via the production of biofilms that can stimulate bacterial growth and/or impact surface chemistry.*

Notes:

1. Bacteria colony population sizes are expressed in *cfu/mL* units.
2. Ratings of bacterial colony activity derrived from DBI, Inc. BART Test datasheets.

Taku engineering, llc

APPENDIX D

Metlakatla Soils Analysis Report

City of Metlakatla

Water Distribution System Corrosion Condition Assessment

Laboratory Analysis Report

Curt Farrar
Taku Engineering
PO Box 241386
Anchorage, AK 99524

Work Order:	1170499 Metlakatla Water
Client:	Taku Engineering
Report Date:	February 15, 2017

SGS maintains a formal Quality Assurance/Quality Control (QA/QC) program. A copy of our Quality Assurance Plan (QAP), which outlines this program, is available at your request. The laboratory certification numbers are AK00971 (DW Chemistry & Microbiology) for which SGS North America Inc. is Provisionally Certified as of 2/8/2017 & UST-005 (CS) for ADEC and 2944.01 for DOD ELAP/ISO 17025 (RCRA methods: 1020B, 1311, 3010A, 3050B, 3520C, 3550C, 5030B, 5035A, 6020A, 7470A, 7471B, 8015C, 8021B, 8082A, 8260C, 8270D, 8270D-SIM, 9040C, 9045D, 9056A, 9060A, AK101 and AK102/103). Except as specifically noted, all statements and data in this report are in conformance to the provisions set forth by the SGS QAP and, when applicable, other regulatory authorities.

*	The analyte has exceeded allowable regulatory or control limits.
!	Surrogate out of control limits.
B	Indicates the analyte is found in a blank associated with the sample.
CCV/CVA/CVB	Continuing Calibration Verification
CCCV/CVC/CVCA/CVCB	Closing Continuing Calibration Verification
CL	Control Limit
DF	Dilution Factor
DL	Detection Limit (i.e., maximum method detection limit)
E	The analyte result is above the calibrated range.
GT	Greater Than
ICV	Initial Calibration Verification
J	The quantitation is an estimation.
LCS(D)	Laboratory Control Spike (Duplicate)
LLQC/LLIQC	Low Level Quantitation Check
LOD	Limit of Detection (i.e., 1/2 of the LOQ)
LOQ	Limit of Quantitation (i.e., reporting or practical quantitation limit)
LT	Less Than
MB	Method Blank
MS(D)	Matrix Spike (Duplicate)
ND	Indicates the analyte is not detected.
RPD	Relative Percent Difference
U	Indicates the analyte was analyzed for but not detected.

Note: Sample summaries which include a result for "Total Solids" have already been adjusted for moisture content.
All DRO/RRO analyses are integrated per SOP.

SGS

SGS Ref.#	1170499001
Client Name	Taku Engineering
Project Name/#	Metlakatla Water
Client Sample ID	Dig Site 1
Matrix	Soil/Solid (dry weight)

Printed Date/Time	02/15/2017 13:12
Collected Date/Time	01/27/2017 9:00
Received Date/Time	02/06/2017 11:07
Technical Director	**Stephen C. Ede**

Sample Remarks:

Parameter	Results	LOQ	Units	Method	Container ID	Allowable Limits	Prep Date	Analysis Date	Init
Characterization									
pH	6.42	0.00100	pH units	SW9045D	A			02/10/17	EET
Waters Department									
Chloride	4.45	2.51	mg/Kg	SW9056A	A		02/13/17	02/14/17	NEG
Sulfate	172	2.51	mg/Kg	SW9056A	A		02/13/17	02/14/17	NEG
Solids									
Total Solids	77.9		%	SM21 2540G	A			02/08/17	ZCB

SGS Ref.#	1170499002
Client Name	Taku Engineering
Project Name/#	Metlakatla Water
Client Sample ID	Dig Site 2
Matrix	Soil/Solid (dry weight)

Printed Date/Time	02/15/2017 13:12
Collected Date/Time	01/27/2017 11:30
Received Date/Time	02/06/2017 11:07
Technical Director	**Stephen C. Ede**

Sample Remarks:

Parameter	Results	LOQ	Units	Method	Container ID	Allowable Limits	Prep Date	Analysis Date	Init
Characterization									
pH	6.64	0.00100	pH units	SW9045D	A			02/10/17	EET
Waters Department									
Chloride	4.80	2.48	mg/Kg	SW9056A	A		02/13/17	02/14/17	NEG
Sulfate	541	2.48	mg/Kg	SW9056A	A		02/13/17	02/14/17	NEG
Solids									
Total Solids	79.4		%	SM21 2540G	A			02/08/17	ZCB

SGS Ref.#	1170499003		
Client Name	Taku Engineering	**Printed Date/Time**	02/15/2017 13:12
Project Name/#	Metlakatla Water	**Collected Date/Time**	01/27/2017 15:00
Client Sample ID	Dig Site 3	**Received Date/Time**	02/06/2017 11:07
Matrix	Soil/Solid (dry weight)	**Technical Director**	**Stephen C. Ede**

Sample Remarks:

Parameter	Results	LOQ	Units	Method	Container ID	Allowable Limits	Prep Date	Analysis Date	Init
Characterization									
pH	6.26	0.00100	pH units	SW9045D	A			02/10/17	EET
Waters Department									
Chloride	10.8	3.31	mg/Kg	SW9056A	A		02/13/17	02/14/17	NEG
Sulfate	43.0	3.31	mg/Kg	SW9056A	A		02/13/17	02/14/17	NEG
Solids									
Total Solids	59.4		%	SM21 2540G	A			02/08/17	ZCB

ATTACHMENT C

Coagulant Jar Testing Results

Coagulant Name	Coagulant Type	Jar Number	Dose	Filtered Water		
				Turbidity	UVT	pH
PAX-XL9	PACL	1	1	0.25	84.3	6
PAX-XL9	PACL	2	7	0.33	95.4	5.6
PAX-XL9	PACL	3	13	0.44	86.4	5.21
PAX-XL9	PACL	4	20	0.36	84.4	5.05
PAX-18	PACL	1	1	0.2	88.5	5.73
PAX-18	PACL	2	7	0.14	95.8	4.93
PAX-18	PACL	3	13	0.15	98.1	4.75
PAX-18	PACL	4	20	0.41	95.8	4.65
PAX-XL8	PACL	1	1	0.14	89.5	5.44
PAX-XL8	PACL	2	7	0.12	98.2	4.9
PAX-XL8	PACL	3	13	0.11	98.2	4.9
PAX-XL8	PACL	4	20	0.2	97.3	4.83
DelPAC 2020	PACL	1	1	0.18	85.4	5.75
DelPAC 2020	PACL	2	7	0.31	85.4	5.48
DelPAC 2020	PACL	3	13	0.14	98.1	5.15
DelPAC 2020	PACL	4	20	0.16	98.2	5.06
Ultrion 8157	PACL	1	1	0.19	85.6	5.84
Ultrion 8157	PACL	2	7	0.39	87	5.49
Ultrion 8157	PACL	3	13	0.12	96.7	5.2
Ultrion 8157	PACL	4	20	0.22	97.2	4.78
Ultrion 8187	PACL	1	1	0.16	87	5.5
Ultrion 8187	PACL	2	7	0.14	97.2	5.57
Ultrion 8187	PACL	3	13	0.29	96.3	5.15
Ultrion 8187	PACL	4	20	0.29	87.8	5.12
CAT-FLOC 8102	DADMAC	1	1	0.12	85.3	5.47
CAT-FLOC 8102	DADMAC	2	3	0.23	85.1	5.65
CAT-FLOC 8102	DADMAC	3	5	0.25	84.7	5.58
CAT-FLOC 8102	DADMAC	4	10	0.31	88.8	5.48
CAT-FLOC 8103	DADMAC	1	1	0.15	86.6	5.75
CAT-FLOC 8103	DADMAC	2	3	0.22	92.2	5.58
CAT-FLOC 8103	DADMAC	3	5	0.28	86.8	5.59
CAT-FLOC 8103	DADMAC	4	10	0.54	88.8	5.9
CAT-FLOC 8108	DADMAC	1	1	0.15	82.6	5.67
CAT-FLOC 8108	DADMAC	2	3	0.21	82.2	5.66
CAT-FLOC 8108	DADMAC	3	5	0.25	82.4	5.62
CAT-FLOC 8108	DADMAC	4	10	0.34	87	5.58
Nalcolyte 8100	Polyamine	1	0.5	0.19	82	5.62
Nalcolyte 8100	Polyamine	2	2	0.32	86	5.54
Nalcolyte 8100	Polyamine	3	3	0.18	92.6	5.42
Nalcolyte 8100	Polyamine	4	5	0.36	90.5	5.36
PIX-311	Ferric Chloride	1	0.5	0.14	82.2	5.47
PIX-311	Ferric Chloride	2	1	0.14	80.9	5.46
PIX-311	Ferric Chloride	3	2	0.17	80	5.05
PIX-311	Ferric Chloride	4	5	0.52	78.5	4.51
PIX-312	Ferric Sulfate-Liquid	1	0.5	0.12	84.5	5.53
PIX-312	Ferric Sulfate-Liquid	2	1	0.13	83.7	5.49
PIX-312	Ferric Sulfate-Liquid	3	2	0.14	82.8	5.03
PIX-312	Ferric Sulfate-Liquid	4	5	0.38	80.7	4.5
Ferix-3	Ferric Sulfate- DRY	1	1	0.15	83	5.5
Ferix-3	Ferric Sulfate- DRY	2	2	0.17	81.7	4.94
Ferix-3	Ferric Sulfate- DRY	3	3	0.25	80.3	4.71
Ferix-3	Ferric Sulfate- DRY	4	5	1.13	77.4	2.93
Nalcolyte 8105	Polyamine	1	0.5	0.2	85.5	5.9

ATTACHMENT D

Cost Analysis for Water Treatment Plant Upgrade Alternatives

NF

Item Description	Materials: Unit Price	Estimated Quantity	Total Materials Cost	Labor: Number of Staff	Hours per day	Total Number of Hours	Base Hourly Pay $/hr	Number of Days Per year	Base Salary $/yr	Benefits package 70 % of base	Annual Labor Cost (base plus benefits)		Total: Annual Cost
							$ 20.00			70%			
Daily Operations													
Visual check of plant			$0	1	0.5	0.5	$ 20.00	365	$3,650	$2,555	$6,205		$6,205
Check chemical solutions			$0	1	0.5	0.5	$ 20.00	365	$3,650	$2,555	$6,205		$6,205
Weekly Operations													
Make Chemical Solutions	$ 50.00	1	$50	1	1	1	$ 20.00	52	$1,040	$728	$1,768		$1,818
Check Dosing Pump Calibration			$0	1	1	1	$ 20.00	52	$1,040	$728	$1,768		$1,768
Yearly Operations													
Complete CIP procedure (4 times per year)				2	8	16	$ 20.00	4	$1,280	$896	$2,176		$2,176
Replace dosing pump heads	$ 100.00	2	$200	1	2	2	$ 20.00	1	$40	$28	$68		$268
General Maintenance on Equipment	$ 100.00	1	$100	1	8	8	$ 20.00	24	$3,840	$2,688	$6,528		$6,628

Energy	Number of Units	Unit Hp	Percent Run Per Day	Hours Per Day	KWH per Month	Rate per $/KWH	Base Cost $/mo	Number of Months	Monthly Cost	Annual Cost
NF Pumps (1 runs in winter, 2 run in summer)	2	15	100	24	16107.12	$0.12	below	9	$1,852	$13,892.39
Dosing Pumps (50 W ea)	2	0.067	100	24	71.945136	$0.12	below	12	$8	$99
Building Lighting (160 W ea)	8	0.215	25	6	230.86872	$0.12	below	12	$27	$319
CIP Pump	1	5	100	24	2684.52	$0.12	below	0.1	$309	$30.87
CIP Heater (20kW)	1	2.7	100	24	1449.6408	$0.12	below	0.1	$167	$17
Electrical Power Base Rate							$12	$12	$12	$141

Process Chemicals	Annual Use gal/yr)	Annual Use (lbs/yr)	Unit Cost ($/lb or $/gal)	Monthly Cost	Annual Cost
STPP		500	$1.18		$591
15% HCl	30		$2.80	$7.00	$84
Citric Acid		500	$1.74		$870
Sodium Metabisulfite		50	$1.18	$4.92	$59

Short Lived Asset Maintenance/Replacement	Unit Price	Estimated Quantity	Total Materials Cost	Number of Staff	Hours per day	Total Number of Hours	Base Hourly Pay $/hr	Number of Days Per year	Base Salary $/yr	Benefits package 70 % of base	Annual Labor Cost (base plus benefits)	Annual Cost
Change out NF membrane modules (once every 4 years)	$ 500.00	48	$24,000	2	8	16	$ 20.00	2	$1,280	$896	$2,176	$8,176
Change Lightbulbs	$ 10.00	8	$80	1	1	1	$ 20.00	2	$40	$28	$68	$148

	Replace	Chemicals	Labor cost	Energy	Total
Annual Totals	$6,430	$1,605	$26,962	$14,498	$49,495

Soda Ash and Disodium Phosphate

Item Description	Materials: Unit Price	Estimated Quantity	Total Materials Cost	Labor: Number of Staff	Hours per day	Total Number of Hours	Base Hourly Pay $/hr	Number of Days Per year	Base Salary $/yr	Benefits package 70 % of base	Annual Labor Cost (base plus benefits)	Total: Annual Cost
Labor							$ 40.00			70%		
Daily Operations												
Visual check of plant	0	0	0	1	0.25	0.25	$20	365	$1,825	$1,278	$3,103	$3,103
Check chemical solutions	0	0	0	1	0.25	0.25	$20	365	$1,825	$1,278	$3,103	$3,103

Weekly Operations													
Replace Soda Ash	0	0	0	1	2	2	$20	52	$2,080	$1,456	$3,536		$3,536
Replace Disodium Phosphate	0	0	0	1	3.04348	3.043478261	$20	52	$3,165	$2,216	$5,381		$5,381
Check Dosing Pump Calibration	0	0	0	1	1	1	$20	52	$1,040	$728	$1,768		$1,768
MonthlyOperations													
Check Dry Feed Equipment	0	0	0	1	6	6	$20	12	$1,440	$1,008	$2,448		$2,448
Yearly Operations													
Replace dosing pump heads	100	3	300	2	1	6	$20	2	$240	$168	$408		$708
General Maintenance on Equipment	100	1	100	1	8	8	$20	1	$160	$112	$272		$372
Misc													
Energy				Number of Units	Unit Hp	Percent Run Per Day	Hours Per Day	KWH per Month	Rate per $/KWH	Base Cost $/mo	Number of Months	Monthly Cost	Annual Cost
Soda Ash Transfer Pump	0	0	0	1	0.5	100	24	268	$0.12	below	12	30.87198	370.46376
Disodium Phosphate Transfer Pump	0	0	0	1	0.5	100	24	268	$0.12	below	12	30.87198	370.46376
Soda Ash Dosing Pumps	0	0	0	1	0.067	100	24	36	$0.12	below	12	4.13684532	49.64214384
Disodium Phosphate Dosing Pumps	0	0	0	1	0.067	100	24	36	$0.12	below	12	4.13684532	49.64214384
Soda Ash Tank Mixer	0	0	0	1	1	100	24	537	$0.12	below	12	61.74396	740.92752
Disodium Phosphate Tank Mixer	0	0	0	1	1	100	24	537	$0.12	below	12	61.74396	740.92752
Building Lighting (160 W ea)	0	0	0	4	0.215	40	9.6	185	$0.12	below	12	21.23992224	254.8790669
Electrical Power Base Rate	0	0	0	0	0	0	0	0	$0.00	11.71	12	11.71	140.52
Process Chemicals										Annual Use (lbs/yr)	Unit Cost ($/lb)	Monthly Cost	Annual Cost
Soda Ash	0	0	0	0	0	0	0	0	0	9800	0.6058	494.7366667	5936.84
Disodium Phosphate	0	0	0	0	0	0	0	0	0	5900	3.538	1739.516667	20874.2
Professional Services													
									Replace	Chemicals	Labor cost	Energy	Total
Annual Totals			$400						$400	$26,811	$20,018	$2,577	$49,946
NF + Soda Ash and Disodium Phosphate Total													$99,441

Nanofiltration System with Soda Ash and Disodium Phosphate Addition

NF System Install Cost	Labor hours	Labor Rate	Per Diem mandays	Per Diem Rate	Materials	Const Eq	Shipping	Subs O&P 10	GC O&P 20	Total	Total
NF System											
Concrete housekeeping pad	20	$90	0	$200	$6,750	$3,091	$200	$1,184	$2,605	$15,631	
NF Skid and CIP system (2 200 gpm units @ 390K each)	200	$90	0	$200	$1,000,000	$29,610	$6,000	$105,361	$231,794	$1,390,766	
Piping Systems	210	$90	0	$200	$85,000	$4,521	$4,000	$11,242	$24,733	$148,395	
Electrical power and control systems for new equipment	210	$90	0	$200	$50,000	$7,219	$5,000	$8,112	$17,846	$107,077	
SCADA Integration	100	$160	0	$200		$1,049		$1,705	$3,751	$22,505	
Commission new equipment	80	$90	12	$1,200	$5,000	$1,073	$100	$2,777	$6,110	$36,660	
Subtotal											$1,721,033
Soda Ash System											
Concrete housekeeping pad	72	$90	0	$1,200	$2,000	$2,662	$1,000	$1,214	$2,671	$16,028	
Dry Chemical Feed System	180	$90	0	$1,200	$63,000	$7,545	$8,600	$9,535	$20,976	$125,856	
Piping Systems	80	$90	0	$1,200	$10,000	$4,507	$1,000	$2,271	$4,996	$29,973	
Dosing pumps and tanks (x2)	80	$90	0	$1,200	$20,000	$4,539	$4,500	$3,624	$7,973	$47,836	
Electrical power to equipment	72	$90	6	$1,200	$8,000	$2,000	$231	$2,391	$5,260	$31,562	
SCADA Integration	20	$160	0	$1,200	$0	$1,080	$0	$428	$942	$5,649	
Equipment Commissioning	15	$90	6	$1,200	$0	$276	$0	$883	$1,942	$11,650	
Subtotal											$268,554
Disodium Phosphate											
Concrete housekeeping pad	72	$90	0	$1,200	$2,000	$2,662	$1,000	$1,214	$2,671	$16,028	
Dry Chemical Feed System	180	$90	0	$1,200	$63,000	$7,545	$8,600	$9,535	$20,976	$125,856	
Piping Systems	80	$90	0	$1,200	$10,000	$4,507	$1,000	$2,271	$4,996	$29,973	
Dosing pumps and tanks (x2)	80	$90	0	$1,200	$20,000	$4,539	$4,500	$3,624	$7,973	$47,836	
Electrical power to equipment	72	$90	6	$1,200	$8,000	$2,000	$231	$2,391	$5,260	$31,562	
SCADA Integration	20	$160	0	$1,200	$0	$1,080	$0	$428	$942	$5,649	
Equipment Commissioning	15	$90	6	$1,200	$0	$276	$0	$883	$1,942	$11,650	
Subtotal											$268,554
Building											
New Building (1386 SF)						$900,900					
Subtotal											$900,900
Mob/Demob											
Travel/Room/Board (System)											$103,500
Travel/Room/Board (Building)											$43,750
10% of construction cost											$315,904
Facility Startup and Training											$10,000
Pre-Design Estimate of Construction Cost											$3,632,196
Contingency of 10%											$363,220
Engineering, 12%											$435,863
Project Permitting											$15,000
Agency Administration 8%											$290,576
Total Estimate, Rounded											**$4,740,000**

GAC

Item Description	Materials Unit Price	Estimated Quantity	Total Materials Cost	Labor Number of Staff	Hours per day	Total Number of Hours	Base Hourly Pay $/hr	Number of Days Per year	Base Salary $/yr	Benefits package 70 % of base	Annual Labor Cost (base plus benefits)		Total Annual Cost
							$ 20.00			70%			
Daily Operations													
Visual check of plant			$0	1	0.5	0.5	$ 20.00	365	$3,650	$2,555	$6,205		$6,205
			$0	0	0.5	0	$ 20.00	365	$0	$0	$0		$0
Weekly Operations													
			$0	0	0	0	$ 20.00	52	$0	$0	$0		$0
MonthlyOperations													
Check GAC			$0	1	4	4	$ 20.00	12	$960	$672	$1,632		$1,632
Yearly Operations													
Change out GAC			$0	2	8	16	$ 20.00	2	$640	$448	$1,088		$1,088
Dispose of GAC in Ketchikan Landfill	$ 145.00	8	$1,160	1	8	8	$ 20.00	2	$320	$224	$544		$1,704
Shipping Carbon to Ketchikan	$ 200.00	1	$200	1	8	8	$ 20.00	2	$320	$224	$544		$744
General Maintenance on Equipment	$ 100.00	1	$100	1	8	8	$ 20.00	24	$3,840	$2,688	$6,528		$6,628
Misc													
Vactor Truck Maint.	$ 4,000.00	1	$4,000	1	4	4	$ 60.00	4	$960	$672	$1,632		$5,632
Replacement Carbon	$ 2.00	16000	$32,000	2	8	16	$ 40.00	2	$1,280	$896	$2,176		$34,176
Carbon Shipping SEA to Met ($/2000lb)	$ 200.00	8	$1,600										$1,600
Carbon Shipping to SEA	$ 200.00	8	$1,600										$1,600
Energy				Number of Units	Unit Hp	Percent Run Per Day	Hours Per Day	KWH per Month	Rate per $/KWH	Base Cost $/mo	Number of Months	Monthly Cost	Annual Cost
Building Lighting (160 W ea)				8	0.215	25	6	230.86872	$0.12	below	12	$27	$319
Electrical Power Base Rate										$12	$12	$12	$141
Professional Services													
			Materials						Replace	Chemical	Labor cost	Energy	Total
Annual Totals			$40,660						$40,660		$20,349	$459	$61,468

Soda Ash and Disodium Phosphate

Item Description	Materials Unit Price	Estimated Quantity	Total Materials Cost	Labor Number of Staff	Hours per day	Total Number of Hours	Base Hourly Pay $/hr	Number of Days Per year	Base Salary $/yr	Benefits package 70 % of base	Annual Labor Cost (base plus benefits)	Total Annual Cost
Labor							$ 40.00			70%		
Daily Operations												
Visual check of plant	0	0	0	1	0.25	0.25	$20	365	$1,825	$1,278	$3,103	$3,103
Check chemical solutions	0	0	0	1	0.25	0.25	$20	365	$1,825	$1,278	$3,103	$3,103
Weekly Operations												
Replace Soda Ash	0	0	0	1	2	2	$20	52	$2,080	$1,456	$3,536	$3,536
Replace Disodium Phosphate	0	0	0	1	3.04348	3.043478261	$20	52	$3,165	$2,216	$5,381	$5,381
Check Dosing Pump Calibration	0	0	0	1	1	1	$20	52	$1,040	$728	$1,768	$1,768
MonthlyOperations												
Check Dry Feed Equipment	0	0	0	1	6	6	$20	12	$1,440	$1,008	$2,448	$2,448
Yearly Operations												
Replace dosing pump heads	100	3	300	2	1	6	$20	2	$240	$168	$408	$708
General Maintenance on Equipment	100	1	100	1	8	8	$20	1	$160	$112	$272	$372
Misc												

Energy				Number of Units	Unit Hp	Percent Run Per Day	Hours Per Day	KWH per Month	Rate per $/KWH	Base Cost $/mo	Number of Months	Monthly Cost	Annual Cost
Soda Ash Transfer Pump	0	0	0	1	0.5	100	24	268	$0.12	below	12	30.87198	370.46376
Disodium Phosphate Transfer Pump	0	0	0	1	0.5	100	24	268	$0.12	below	12	30.87198	370.46376
Soda Ash Dosing Pumps	0	0	0	1	0.067	100	24	36	$0.12	below	12	4.13684532	49.64214384
Disodium Phosphate Dosing Pumps	0	0	0	1	0.067	100	24	36	$0.12	below	12	4.13684532	49.64214384
Soda Ash Tank Mixer	0	0	0	1	1	100	24	537	$0.12	below	12	61.74396	740.92752
Disodium Phosphate Tank Mixer	0	0	0	1	1	100	24	537	$0.12	below	12	61.74396	740.92752
Building Lighting (160 W ea)	0	0	0	4	0.215	40	9.6	185	$0.12	below	12	21.23992224	254.8790669
Electrical Power Base Rate	0	0	0	0	0	0	0	0	$0.00	11.71	12	11.71	140.52
Process Chemicals										Annual Use (lbs/yr)	Unit Cost ($/lb)	Monthly Cost	Annual Cost
Soda Ash	0	0	0	0	0	0	0	0	0	9800	0.6058	494.7366667	5936.84
Disodium Phosphate	0	0	0	0	0	0	0	0	0	5900	3.538	1739.516667	20874.2
Professional Services													
			Materials						Replace	Chemical	Labor cost	Energy	Total
Annual Totals			$400						$400	$5,937	$20,018	$2,577	$49,946
GAC + Soda Ash and Disodium Phosphate Total													$111,414

GAC System with Soda Ash and Disodium Phosphate Addition

NF System Install Cost		Labor		Per Diem		Materials	Const Eq	Shipping	Subs O&P	GC O&P	Total	Total
		hours	Rate	mandays	Rate				10	20		
GAC System												
Concrete housekeeping pad		40	$90	0	$200	$8,700	$1,939	$200	$1,444	$3,177	$19,059	
GAC Vessel (8 100 gpm units @ 20K each)		50	$90	0	$200	$200,000	$17,939	$4,000	$22,644	$49,817	$298,900	
Piping Systems		210	$90	0	$200	$88,020	$2,000	$3,500	$11,242	$24,732	$148,395	
Electrical power and control systems for new equipment (+MCC)		210	$90	0	$200	$87,447	$8,000	$5,000	$11,935	$26,256	$157,538	
SCADA Integration		100	$160	0	$200	$0	$1,049	$0	$1,705	$3,751	$22,505	
Commission new equipment		80	90	12	$1,200	$5,000	$1,072	$100	$2,777	$6,110	$36,659	
Vactor Truck for emptying GAC							$85,000	$4,000			$89,000	
Subtotal												$772,056
Soda Ash System												
Concrete housekeeping pad		72	$90	0	$1,200	$2,000	$2,662	$1,000	$1,214	$2,671	$16,028	
Dry Chemical Feed System		180	$90	0	$1,200	$63,000	$7,545	$8,600	$9,535	$20,976	$125,856	
Piping Systems		80	$90	0	$1,200	$10,000	$4,507	$1,000	$2,271	$4,996	$29,973	
Dosing pumps and tanks (x2)		80	$90	0	$1,200	$20,000	$4,539	$4,500	$3,624	$7,973	$47,836	
Electrical power to equipment		72	$90	6	$1,200	$8,000	$2,000	$231	$2,391	$5,260	$31,562	
SCADA Integration		20	$160	0	$1,200	$0	$1,080	$0	$428	$942	$5,649	
Equipment Commissioning		15	$90	6	$1,200	$0	$276	$0	$883	$1,942	$11,650	
Subtotal												$268,554
Disodium Phosphate												
Concrete housekeeping pad		72	$90	0	$1,200	$2,000	$2,662	$1,000	$1,214	$2,671	$16,028	
Dry Chemical Feed System		180	$90	0	$1,200	$63,000	$7,545	$8,600	$9,535	$20,976	$125,856	
Piping Systems		80	$90	0	$1,200	$10,000	$4,507	$1,000	$2,271	$4,996	$29,973	
Dosing pumps and tanks (x2)		80	$90	0	$1,200	$20,000	$4,539	$4,500	$3,624	$7,973	$47,836	
Electrical power to equipment		72	$90	6	$1,200	$8,000	$2,000	$231	$2,391	$5,260	$31,562	
SCADA Integration		20	$160	0	$1,200	$0	$1,080	$0	$428	$942	$5,649	
Equipment Commissioning		15	$90	6	$1,200	$0	$276	$0	$883	$1,942	$11,650	
Subtotal												$268,554
Building	**Building**											
New Building (1225 sq ft)	New Building (1386 SF)						$796,250					
Subtotal	Subtotal											$796,250
Mob/Demob	**Mob/Demob**											
Travel/Room/Board (System)	Travel/Room/Board (System)											$75,200
Travel/Room/Board (Building)	Travel/Room/Board (Building)											$43,750
10% of construction cost	10% of construction cost											$210,541
Facility Startup and Training	Facility Startup and Training											$10,000
Pre-Design Estimate of Construction Cost	Contingency of 10%											$2,444,906
Contingency of 10%	Pre-Design Estimate of Construction Cost											$244,491
Engineering, 12%	Engineering, 12%											$293,389
Project Permitting	Project Permitting											$15,000
Agency Administration 8%	Agency Administration 8%											$195,592
Total Estimate, Rounded												**$3,190,000**

Coagulant

Process Chemicals	Materials	Labor	Existing Annual Use (lbs/yr)	Existing Unit Cost ($/lb)	New Annual Use (lbs/yr)	New Unit Cost ($/lb)	Monthly Cost	Total Annual Cost
Coagulant Costs*			5917	$3.01	25643	$0.54	-$330.25	-$3,962.95
Annual Total								-$3,963

*(starting from existing cost base of $0. A positive value indicates increased costs from current operations, a negative value indicates savings from current operation

Soda Ash and Disodium Phosphate

Item Description	Materials: Unit Price	Estimated Quantity	Total Materials Cost	Labor: Number of Staff	Hours	Total Number of Hours	Base Hourly Pay $/hr	Number of Days Per year	Base Salary $/yr	Benefits package 70 % of base	Annual Labor Cost (base plus benefits)	Total: Annual Cost
Labor							$ 20.00			70%		
Daily Operations												
Visual check of plant			$0	1	0.25	0.25	$ 20.00	365	$1,825	$1,278	$3,103	$3,103
Check chemical solutions			$0	1	0.25	0.25	$ 20.00	365	$1,825	$1,278	$3,103	$3,103
Weekly Operations												
Replace Soda Ash			$0	1	2	2	$ 20.00	52	$2,080	$1,456	$3,536	$3,536
Replace Disodium Phosphate			$0	1	3.04	3.04	$ 20.00	52	$3,165	$2,216	$5,381	$5,381
Check Dosing Pump Calibration			$0	1	1	1	$ 20.00	52	$1,040	$728	$1,768	$1,768
MonthlyOperations												
Check Dry Feed Equipment			$0	1	6	6	$ 20.00	12	$1,440	$1,008	$2,448	$2,448
Yearly Operations												
Replace dosing pump heads	$ 100	3	$300	2	1	6	$ 20.00	2	$240	$168	$408	$708
General Maintenance on Equipment	$ 100	1	$100	1	8	8	$ 20.00	1	$160	$112	$272	$372
Misc												

Energy	Number of Units	Unit Hp	Percent Run Per Day	Hours Per Day	KWH per Month	Rate per $/KWH	Base Cost $/mo	Number of Months	Monthly Cost	Annual Cost
Soda Ash Transfer Pump	1	0.5	100	24	268	$0.12	below	12	$31	$370.46
Disodium Phosphate Transfer Pump	1	0.5	100	24	268	$0.12	below	12	$31	$370.46
Soda Ash Dosing Pumps	1	0.067	100	24	36	$0.12	below	12	$4	$49.64
Disodium Phosphate Dosing Pumps	1	0.067	100	24	36	$0.12	below	12	$4	$49.64
Soda Ash Tank Mixer	1	1	100	24	537	$0.12	below	12	$62	$740.93
Disodium Phosphate Tank Mixer	1	1	100	24	537	$0.12	below	12	$62	$740.93
Building Lighting (160 W ea)	4	0.215	40	9.6	185	$0.12	below	12	$21	$254.88
Electrical Power Base Rate							$12	$12	$12	$140.52

Process Chemicals	Annual Use (lbs/yr)	Unit Cost ($/lb)	Monthly Cost	Annual Cost
Soda Ash	9800	$0.61	$494.74	$5,936.84
Disodium Phosphate	5,900	$3.54	$1,739.52	$20,874.20

Professional Services

	Materials	Replace	Chemicals	Labor cost	Energy	Total
Annual Totals	$400	$400	$22,848	$20,018	$2,717	$49,946

Coagulant+ Soda Ash and Disodium Phosphate Total	$45,983

ALTERNATIVE COAGULANT WITH SODA ASH AND DISODIUM PHOSPHATE ADDITION

Coag+Soda Ash/DP System Install Cost	Labor		Per Diem		Materials	Const Eq	Shipping	Subs O&P	GC O&P	Total	Total
	hours	Rate	mandays	Rate				10	20		
Coag System											
Coag Pump (x2)	10	$90	0	$200	$5,000	$98	$220	$622	$1,368	$8,208	
Subtotal											$8,208
Soda Ash System											
Concrete housekeeping pad	72	$90	0	$1,200	$2,000	$2,662	$1,000	$1,214	$2,671	$16,028	
Dry Chemical Feed System	180	$90	0	$1,200	$63,000	$7,545	$8,600	$9,535	$20,976	$125,856	
Piping Systems	80	$90	0	$1,200	$10,000	$4,507	$1,000	$2,271	$4,996	$29,973	
Dosing pumps and tanks (x2)	80	$90	0	$1,200	$20,000	$4,539	$4,500	$3,624	$7,973	$47,836	
Electrical power to equipment	72	$90	6	$1,200	$8,000	$2,000	$231	$2,391	$5,260	$31,562	
SCADA Integration	20	$160	0	$1,200		$1,080		$428	$942	$5,649	
Equipment Commissioning	15	$90	6	$1,200		$276		$883	$1,942	$11,650	
Subtotal											$268,554
Disodium Phosphate											
Concrete housekeeping pad	72	$90	0	$1,200	$2,000	$2,662	$1,000	$1,214	$2,671	$16,028	
Dry Chemical Feed System	180	$90	0	$1,200	$63,000	$7,545	$8,600	$9,535	$20,976	$125,856	
Piping Systems	80	$90	0	$1,200	$10,000	$4,507	$1,000	$2,271	$4,996	$29,973	
Dosing pumps and tanks (x2)	80	$90	0	$1,200	$20,000	$4,539	$4,500	$3,624	$7,973	$47,836	
Electrical power to equipment	72	$90	6	$1,200	$8,000	$2,000	$231	$2,391	$5,260	$31,562	
SCADA Integration	20	$160	0	$1,200		$1,080		$428	$942	$5,649	
Equipment Commissioning	15	$90	6	$1,200		$276		$883	$1,942	$11,650	
Subtotal											$268,554
Building											
New Building (975 SF, 15' x 65')						$847,479					
New Roof on Existing Blg (+ Demo Old Roof)						$93,607					
Subtotal											$941,086
Mob/Demob											
Travel/Room/Board (System)											$74,844
Travel/Room/Board (Building)											$42,165
Mobilization and Demobilization											$148,640
Facility Startup and Training											$13,372
Pre-Design Estimate of Construction Cost											$1,765,423
Contingency of 10%											$176,542
Engineering, 12%											$233,036
Project Permitting											$15,000
Agency Administration Cost (8%)											$175,200
Total Estimate, Rounded											**$2,380,000**

ATTACHMENT E

Cost Analysis for Recommended Water Distribution Upgrades

R&M ENGINEERING-KETCHIKAN, INC.
ENGINEERS GEOLOGISTS SURVEYORS
355 CARLANNA LAKE ROAD, SUITE 200, KETCHIKAN, ALASKA 99901
PHONE (907) 225-7917 FAX (907) 225-3441 EMAIL: RNMMain@rmketchikan.com

Trailer Court Area Water Main Replacement
Preliminary Cost Estimate
Tongass Avenue Sewer

Item Number	Pay Item	Pay Unit	Unit Quantity	Utnit Price	Plan Amount
1	Mobilization / Bonding / Insurance	LS	1	$ 50,000.00	$ 50,000.00
2	Aspalt Cutting	LF	1,800	$ 5.00	$ 9,000.00
3	Asphalt Removal and disposal	CY	350	$ 20.00	$ 7,000.00
4	Asphalt Patching (Easy Street Cold Patch)	SF	500	$ 30.00	$ 15,000.00
5	Pipe Bedding Material (D-1)	CY	800	$ 65.00	$ 52,000.00
6	D-1 Road Surfacing (6" Thick)	CY	200	$ 70.00	$ 14,000.00
7	Backfill Material	CY	1,500	$ 45.00	$ 67,500.00
8	8" HDPE Water Main	LF	2,100	$ 110.00	$ 231,000.00
9	8" Gate Valves with valve boxes	EA	5	$ 2,500.00	$ 12,500.00
10	Connect to Existing Water Main	EA	2	$ 1,500.00	$ 3,000.00
11	Water Service Connections	EA	60	$ 800.00	$ 48,000.00
12	Reconnect Fire Hydrants	EA	3	$ 1,200.00	$ 3,600.00
13	Temporary Water System	LS	1	$ 35,000.00	$ 35,000.00
14	Air Release Valve	EA	1	$ 3,500.00	$ 3,500.00
15	Construction Staking	LS	1	$ 10,000.00	$ 10,000.00
				Total Estimated Cost:	**$ 561,100.00**
				Contingency (15%);	**84,165.00**
				Total Estimated Constrcution Cost:	**645,265.00**

Note:

1) The unit cost for 8" hdpe water main includes the cost associated with removing and disposing of the existing steel water main and the unsuitable pipe bedding material and fill within the trench.

2) This cost estimate assumes that the resurfacing of the road will be done by the Metlakatla Indian Community and the BIA under a separate contract.

3) Crushed aggregate unit prices assume the materials will have to be purchased In Ketchikan Alaksa and be brought to Metlakatla via barge.

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Calvin Street Water Main Construction (Dead Ends)
Preliminary Cost Estimate

Item Number	Pay Item	Pay Unit	Unit Quantity	Utnit Price	Plan Amount
1	Mobilization / Bonding / Insurance	LS	1	$ 16,000.00	$ 16,000.00
2	Aspalt Cutting	LF	200	$ 5.00	$ 1,000.00
3	Asphalt Removal and disposal	CY	20	$ 20.00	$ 400.00
4	Asphalt Patching (Easy Street Cold Patch)	SF	900	$ 30.00	$ 27,000.00
5	Pipe Bedding Material (D-1)	CY	250	$ 65.00	$ 16,250.00
7	Backfill Material	CY	450	$ 45.00	$ 20,250.00
8	8" HDPE Water Main	LF	600	$ 100.00	$ 60,000.00
9	8" Gate Valves with valve boxes	EA	6	$ 2,500.00	$ 15,000.00
10	Connect to Existing Water Main	EA	3	$ 1,500.00	$ 4,500.00
11	Air Relief Valve	EA	1	$ 3,500.00	$ 3,500.00
14	Construction Staking	LS	1	$ 4,500.00	$ 4,500.00
				Total Estimated Cost:	**$ 168,400.00**
				Contingency (15%);	**25,260.00**
				Total Estimated Constrcution Cost:	**193,660.00**

Note:

1) Crushed aggregate unit prices assume the materials will have to be purchased In Ketchikan Alaska barged to Metlakatla

Basic Plan Set Requirements

DRAWING CATEGORY & CONTENT	35%	65%, 95% and Stamped
GENERAL		
Cover Sheet & Sheet Index	x	x
General Legend & Vicinity Map	x	x
Abbreviations & General Notes	x	x
Scope of Work & Community/Climate Data	x	x
Overall Site Plan with Topography	x	x
System Schematic(s)	x	x
Soil Boring Data	x	x
SURVEY		
Easement Index Map	x	x
Basis of Bearing Map		x
Parcel Boundary Map		x
CIVIL		
Design Criteria	x	x
Legend & Abbreviations	x	x
General Material & Installation Notes	x	x
Individual Site Plans	x	x
Plan & Profile Index Map	x	x
Plan & Profiles	x	x
Standard Details	x	x
Project Specific Details		x
Grading Plan		x
Fencing Plan		x
PROCESS		
Design Criteria	x	x
Legend & Abbreviations	x	x
Piping Floor Plans	x	x
Piping & Instrumentation Diagram	x	x
Operation Description	x	x
General Material & Installation Notes	x	x
Standard Details	x	x
Equipment Schedule & Specifications		x
Equipment Floor Plans		x
Project Specific Details		x
MECHANICAL		
Design Criteria	x	x
Legend & Abbreviations	x	x
Equipment Floor Plan	x	x
Piping & Instrumentation Diagram		x
Operation Description		x

General Material & Installation Notes		x
Equipment Schedule & Specifications		x
Piping Floor Plans		x
Standard Details		x
Project Specific Details		x
ARCHITECTURAL		
Design Criteria	x	x
Legend & Abbreviations	x	x
Code Analysis	x	x
Floor Plans	x	x
General Material & Installation Notes	x	x
Elevations	x	x
Equipment Schedule & Specifications		x
Sections		x
Standard Details		x
Project Specific Details		x
STRUCTURAL		
Design Criteria & Loads	x	x
Legend & Abbreviations	x	x
Code Analysis	x	x
Foundation Plan	x	x
General Material & Installation Notes	x	x
Equipment Schedule & Specifications		x
Elevations		x
Sections		x
Standard Details		x
Project Specific Details		x
ELECTRICAL		
Design Criteria & Loads		x
Legend & Abbreviations	x	x
Code Analysis	x	x
Operation Description		x
General Material & Installation Notes	x	x
Power One Line & Panel List	x	x
Equipment Schedule & Specifications		x
Floor Plans		x
Elevations		x
Sections		x
Panel Faces		x
Panel Wiring Diagrams		x
Standard Details		x
Project Specific Details		x

GENERAL REQUIREMENTS FOR PLAN SHEETS

A typical set of drawings will contain many of the following sheets in the order in which they appear in the list.. The type of sheets contained in the plan set will vary depending on the scope of work for the project and the complexity of the proposed facility.

- Cover Sheet and Sheet Index
- General (G Sheets)
- Survey (V Sheets)
- Geotechnical (B Sheets)
- Civil (C Sheets)
- Structural (S Sheets)
- Architectural (A Sheets)
- Plumbing (P Sheets)
- Process (D Sheets)
- Mechanical (M Sheets)
- Electrical (E Sheets)
- Contractor/Shop Drawings (Z Sheets)

The following provides a detailed overview of the type of information that is normally included on drawings in the plan set:

I. Cover Sheet and Sheet Index

VSW's standard cover sheet will be used for all VSW projects.

II. General Legend and Vicinity Map (G Sheet)

VSW's standard General Legend and Vicinity Map format will be used for all VSW projects.

III. Scope of Work and Community/Climate Data (G Sheet)

The project scope of work, community data, climate data and project phasing plan is provided on this sheet.

IV. System Schematic and Project Specific Design Criteria (G Sheet)

Separate Schematic Sheets should be drawn for water and sewerage systems. The Schematic Sheet will serve as a line diagram of the overall systems. The schematic sheets should include the following:

A. Water

1. General perspective view of the entire water system with major features

2. Storage tanks with base and overflow elevations and capacities
3. Major points of use
4. Major elevation references
5. Operational pressures during both minimum and maximum flows

B. Well Data

1. Pump House/Washeteria location and note the source of power
2. Date of construction, contractor, well number, and surface elevation
3. Depth and size of bore hole
4. Static water level and the date of measurement

C. Sewerage

1. General

   a. General perspective view of the entire sewerage system designating direction of flow, major features, and force-mains
   b. Lagoon(s) with the number of cells, capacities of each cell, dimensions, floor elevations, overflow elevations, if applicable
   c. Community septic tanks with number of chambers, capacities of each chamber, dimensions, and inlet/outlet elevations, if applicable
   d. Community drainfield information with areas, materials, soil type, percolation rate, and elevations, if applicable
   e. Outfall lengths, materials, elevations, and diffuser type, if applicable
   f. Major points of use
   g. Major elevation references
   h. All manholes
   i. All lift stations

2. Lift Stations

   a. Type of lift station
   b. Make, model, horsepower, voltage, phasing and capacity of pump(s)
   c. Static, dynamic, and total discharge heads

V. Survey (V Sheets)

A. Survey Easement Index Map
B. Basis of Bearing and Vertical Control Map (including coordinates of monuments used)
C. Parcel Boundary Map
D. Project Right-of-Ways and Easements

VI. Geotechnical (B Sheets)

A. Site plan with test hole locations and legend
B. Test boring/hole logs with reference to boring/hole locations

VII. Civil Drawings (C Sheets)

A. Civil/Survey Legend
B. Civil General Material and Installation Notes
C. Civil System Layout and Sheet Locator Map(s)

The System Layout Sheet(s) will be a plan view of the water and/or sewer system(s) showing all (or a large portion) of the system on one sheet. For larger systems, the scale should be between 1" = 400' and 1" = 1,000', depending on the density of services provided. For smaller systems, the scale should be as needed in order to show sufficient detail on one sheet. If the system cannot be put on one sheet, an index sheet should be provided that shows the waterline locations (without valves), major features such as roads, rivers, etc. and a reference to the areas covered by each layout sheet. The system layout and sheet locator map will provide the following:

1. Highways, roads, streets, major drainage features, and major buildings. Aerial photographs can be used as a map base if the overlays are readable.
2. Sketch of the community sewer system(s) and wastewater treatment system location(s)
3. Reference areas designating which plan or plan and profile view sheet numbers apply to specific areas of the system
4. House numbers and names of homeowners in tabular form
5. Dwelling locations, with house numbers
6. Identity and approximate location of existing subsurface utilities
7. Main line gate valves (without markers and/or tie-ins)
8. North arrow and bar scale
9. Dimensional data for pipeline material used. (Example: ID., O.D., SDR, ASTM specification and pressure rating designation for each size of pipe used.) Pipeline distances between gate valves and appurtenances can be shown if desired but is not mandatory.
10. Topography existing & proposed contours. Proposed grade contours are shown on final stamped construction plans

D. Civil Plan and Profile Views

1. <u>General</u>

    a. North arrow with drawings oriented so that the north arrow is pointing more toward the top of the sheet than the bottom
    b. A bar scale
    c. Individual homes to be served and corresponding house numbers.

d. Adequate information (coordinates, distance to property lines, etc.) to stake the designed improvements in the field
e. Profile views are generally “left to right” but in certain instances to require them to go “right to left”.

2. <u>Water</u>

a. Fire hydrants
- Distance to the mainline and shut-off valve from the hydrant
- Size of the hydrant

b. Gate Valves, Air Release Valves, and Pressure Reducing Valves (PRV)
- Location of each valve with respect to at least two permanent points (i.e., buildings, hydrants, power poles, etc.) within 100 feet, if available
- Size of the valves
- Approximate depths of bury
- Size of PRV valve(s) including incoming and outgoing pressures, and ground elevations

c. Water main
- Proposed marker post locations on the plans, when appropriate. markers should be located at line of sight intervals or 1,500 feet apart (maximum)
- Nominal pipe size, material, type of joints, class, pressure rating, etc. (Example: 6”X 12” Aluminum Jacketed Arctic Pipe, HDPE, SDR 11, 160 psi, butt fused joints)
- Description and location of tees, elbows, crosses, bends, and reducers
- Profiles for 1) all road crossings, 2) any wash crossing which requires casing, 3) steep sections of water line where the slope exceeds 10%, 4) any area where the waterline is not at standard bury depth and 5) flow lines of deep ditch lines or drainages

d. Water Services
- Routing of service line with "dots" designating location of curb stop, meter, and corporation or domestic stop as applicable
- Use appropriate symbol from the “tool palette” and assign line type to the W/S layer

3. <u>Sewer</u>

a. Manholes and Cleanouts
- Ground, rim and invert (in and out) elevations
- Distances between manholes and/or cleanouts
- Number & type of each manhole and cleanout.

b. Sewer main

- Materials, type of joints, size, length, SDR, class, schedule, slope, etc.

c. Sewer Services

- Service/main connection location distances from a downstream manhole or stationing
- Routing of the sewer service line, indicating the cleanouts with "dots" use symbol from tool palette

d. Lift Stations

- Site map information similar to that of a well site
- Elevation and plan view with pump type, make, capacity, total discharge head (show both static and dynamic heads), voltage, phase, and horse power

e. Force mains

- Proposed pipeline marker locations on the plans (when appropriate)
- Nominal pipe size, material, type of joints, class, pressure rating, etc. (Example: 6" DI, Class 51, 350 psi, integral bell)
- Description and location of elbows, valves, reducers, and cleanouts
- Profiles for all road crossings, any wash crossing which requires casing, steep sections of force main where the slope exceeds 10% or any area where the force main is not at standard bury depth

E. Civil Site Plan and Elevation Views

1. Water Source

a. Site plan of the well and/or pump house/washeteria, proposed grading plan, drainage, access and power source
b. Date of construction, contractor, well number, and surface elevation
c. Depth and size of bore hole
e. Size, depth, type, and location of casing
f. Length, location, type, and slot size of screen, if applicable
g. Gradation of gravel pack, if applicable
h. Depth of grout envelope
i. Static water level and date of measurement
j. Make, model, horsepower, voltage, phasing, full load amperage of pump(s), and elevation of the pump probes. Actual or estimated pumping depth for the planned pumping rate.
k. Depth of setting of the water level indicator and type

l. Type and size of drop pipe and size of submersible cable
m. Type, size, etc., of a pitless unit, if applicable

2. Water Storage Tank

a. Size of the tank including the thickness of the floor, wall, and roof members
b. Tank manufacturer
c. Paint system and paint/primer brands used on the tank.
d. Map of operational valves, fencing, surface drainage plan, and maintenance access
e. Telemetry or controls if applicable
f. Elevations of floor, inlet, outlet, overflow, and probes, if used
g. Details of complex features such as controls, cathodic protection, if applicable
h. Details of the foundation
i. Overflow and drain locations and erosion protection

3. Pump House/Washeteria/Water Treatment Facility/Lift Station

a. Building footing drain and discharge location
b. Finish floor elevations
c. Site plan of the building site, road access with curve radius, buried utilities, surface drainage, ditching, fencing, danger trees/site clearing, etc.
d. Elevation view with classified fill, excavation limits, compaction, etc.

4. Wastewater Treatment System

a. Site plan showing drainage and horizontal dimensions
b. Side slopes, wave protection detail
c. Number of cells, surface area per cell, maximum liquid volume per cell, and depth of cells
d. Piping sizes and materials
e. Fence and gate location and sign detail
f. Location and lengths of inlet and outlet structures
g. Locations of liquid level control structures, over-flow lines and surface drainage ditches, and sewage flow routing
h. Elevations of top of berm, lagoon floor, overflow structure, and inlet(s)

5. Individual Site Plans

a. Site plan, drawn to visual scale, for each structure served including homeowner name, house number, if appropriate, and a north arrow.
b. Water Service
   - Service saddle location
   - Size, length, and type of service line materials used

- Appurtenances (curb stop, meter can, and domestic stop) tied to dwelling corners if within 100 feet

c. Sewer Service

- Cleanout locations
- Size, length, and type of pipe used

d. Septic tank and drainfield

- Size of the septic tank and the material it is made of
- Tie to the septic tank inspection manhole(s) and the corners of the drainfield to at least two permanent points (i.e., building corners, power poles, trees, etc.) within 100 feet, if available
- Configuration and depth of the drainfield, and the type of materials used (e.g., 4-inch D3034 PVC, slip-on joint)

VIII. Structural Drawings (S Sheets)

A. Structural Legend, Design Criteria and General Notes

B. Structural Plan Views

1. Foundation plan
2. Floor framing plan
3. Roof framing plan
4. Diaphragm schedule

C. Structural Elevations and Sections

1. Foundation sections
2. Wall sections
3. Shear wall schedule
4. Header elevations and schedule

D. Structural Details

1. Splice details
2. Wall intersections
3. Miscellaneous connections
4. Bracket details
5. Fastener details
6 Anchor details
7. Tie down details

IX. Architectural Drawings (A Sheets)

A. Architectural Legend and General Notes

1. Architectural Plan Views All building and room dimensions
2. Room name and numbering
3. Interior finish schedule
4. Exterior finish schedule
5. Wall Types
6. Door schedule
7. Window schedule
8. Roof plan

9. Code design data

B. Architectural Elevations and Sections
1. Front, rear, left side and right side views
2. Wall sections
3. Foundation sections
4. Bathroom/Laboratory/Treatment room/etc. elevations
5. Cabinet elevations

C. Architectural Details
1. Headers (internal and external)
2. Sills (internal and external)
3. Jams (internal and external)
4. Door frame schedule
5. Handrails and guard rails
6. Cabinet details
7. Stair and landing details
8. Ridge detail
9. Eave detail
10. Rake detail
11. Valley detail
12. Vent detail
13. Vapor barriers
14. Window seal
15. Insulation
16. Access hatch

X. Plumbing Drawings (P Sheets)

A. Plumbing Legend and General Notes

B. Plumbing Equipment Schedule

C. Plumbing Plan Views

D. Plumbing Elevation Views and Sections
1. Plumbing Isometrics

E. Plumbing Details
1. Equipment details
2. Equipment mounting
3. Equipment locations
4. Piping installation
5. Piping supports

XI. Process Drawings (D Sheets)

A. Process Diagram Legend

B. Treatment Process Diagram and Operational Narrative

C. Treatment Piping and Instrumentation Diagram

D. Heating and Ventilation Process Diagram and Operational Narrative

E. Heating and Ventilation Piping and Instrumentation Diagram

XII. Mechanical Drawings (M Sheets)

A. Mechanical Legend and General Notes
B. Mechanical Equipment Schedule and Operational Description
C. Mechanical Plan Views
  1. Piping plan
  2. Heating plan
  3. Ventilation plan
D. Mechanical Elevation Views and Sections
  1. Piping Isometrics
  2. Equipment elevations and sections
E. Mechanical Details
  1. Equipment details
  2. Equipment mounting
  3. Equipment locations
  4. Piping installation
  5. Piping supports
  6. Equipment control interface
  7. Fuel oil
  8. Ducting

XIII. Electrical Systems (E Sheets)

A. Electrical Legend, Design Criteria and Loads
B. Electrical Code Analysis and Operation Description
C. Electrical Equipment Schedule
D. Electrical Power One Line and Panel List
E. Electrical Plan View
  1. Exterior electrical site plan
  2. Power floor plan
  3. Electrical control device plan
  4. Electrical equipment plan
  5. Electrical signal plan
F. Electrical Elevation Views
  1. Electrical panel layout
  2. Electrical panel wiring diagram
  3. Panel schedule
  4. Ladder diagram for all control panels
G. Electrical Details
  1. Panel Faces

XIV. Contractor/Shop Drawings (Z Sheets)

A. Drawings of water storage tank construction, premanufactured buildings, foundation design, filter construction, or other fabricated equipment
B. Vendor cut sheets such as pumps, wall mounted instruments or other equipment