

**95% Draft**

**Technical Memorandum 1**

**Assessment of the Existing Wastewater Disposal System  
(Septic Tank/Drainfield)**

**For**

**Tununak, Alaska**

**August 8, 2018**

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To:	Native Village of Tununak IRA Council Tununak, Alaska	From:	Bob Gilfilian, PE Stantec Consulting Services, Inc.
File:	<b>Technical Memorandum 1 – Assessment of the Existing Wastewater Disposal System (Septic Tank/Drainfield)</b>	Date:	August 6, 2018

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## Section 1.0 Introduction

The Native Village of Tununak a.k.a. Tununak IRA Council (herein referred to as Tununak), in cooperation with the Alaska Department of Environmental Conservation (ADEC) Village Safe Water (VSW) has retained Stantec Consulting Services, Inc. (Stantec) to prepare this Technical Memorandum (Tech Memo) with funding from the U.S. Department of Agriculture Rural Development (USDA-RD).

The purpose of this Tech Memo is to provide a summary of the assessment of the existing septic tank and drainfield system serving the Tununak Washeteria/Water Treatment Plant (WTP). Also, this Tech Memo provides recommendations for future use and/or corrective action for the septic tank system, if determined to be needed based on the findings of the field assessment (adequacy flow test).

## Section 2.0 Methodology

The assessment of the existing septic tank system was based on conducting an adequacy flow test in accordance with the standards and procedures outlined in the Anchorage Municipality Code, Chapter 15.65 (Attachment 1). The Alaska Department of Environmental Conservation (ADEC) uses the same methodology for testing septic systems as that required by the Anchorage Municipality. The adequacy test, initially referred to as *In-Situ Testing of On-Site Sewer Systems*, was developed by the Anchorage Municipality in the 1970s and has been successfully used since that time to test an existing septic tank and drainfield system to determine if it was adequate for a specific use building or facility that discharges sewage to a septic system.

An adequacy test involves the dose of a predetermined amount of water into the septic tank system and monitoring the hydraulic heads (liquid levels) in the septic tank and drainfield as the water flows through the system. Basically, the adequacy test is used to determine if a typical daily hydraulic load on the septic system is adequately absorbed by the drainfield without resulting in a backup of liquid into the incoming sewer line from the building to the septic tank. A measured quantity of water, based on the number of water use fixtures in the structure, is introduced into the septic tank system for monitoring the fluid levels in the septic tank and drainfield before, during, and after the addition of water. Based on these measurements, the engineer can make a determination as to whether the system is capable of absorbing the required minimum amount of daily flow.

The following describes the procedures used to conduct an adequacy test:

- Step 1 – All liquid levels in the septic tank system pump-out/clean-out pipes are probed to establish the elevations of the liquid levels in the septic tank prior to starting the adequacy test.
- Step 2 – To start the test, flow is initiated in the structure by running a spigot/faucet fully open. The rate of flow is measured frequently during the adequacy test.
- Step 3 – The liquid levels in the septic tank are measured, typically on a quarterly-hour basis, to determine the hydraulic impact of the flow into the septic system.
- Step 4 – The adequacy test is terminated (flow turned off) if it becomes obvious that the liquid levels in the septic tank and drainfield are rising appreciably above the inlet to the septic tank and/or daylights on the ground surface, both of which are an indication of a failed septic system. However, in cases where the liquid levels rise very slowly (less than 1 inch per measurement), the flow into the tank system continues until the daily total hydraulic load is reached; these observations/measurements are an indication the septic system is functioning adequately.
- Step 5 – The adequacy test is completed when the predetermined amount of total flow enters the septic tank.
- Step 6 – Depending on site conditions observed during the adequacy test, a 24-hour rebound test is conducted. The rebound test typically restricts the volume of water entering the septic system upon completion of the adequacy test and involves measurement of all liquid levels in the septic tank system at 24 hours after the adequacy test is completed. The 24-hour rebound test provides a means to make a final determination on the adequacy of the septic system. As a rule, if liquid levels are found to be near the pretest elevations, then the test results designate a passing septic system.

An adequacy test was conducted on the existing septic tank system serving the Tununak Washeteria/WTP on June 6 and 7, 2018, by Bob Gilfilian, P.E., Senior Principal Civil Engineer with Stantec. Mr. Gilfilian was assisted in the field by the Tununak WTP operators, Vincent Billy and Joseph (Joe) James. Field notes are provided in Attachment 1 and a photo log is provided in Attachment 3 – showing the site conditions of the washeteria and the existing septic tank manholes, sewage lift station, and observation pipes in the drainfield system.

Prior to the start of the adequacy test, Mr. Gilfilian inspected the operation of the WTP and the use of the washeteria. It was noted that water was not being produced at this time in the WTP, but the washeteria was in constant use during all hours of operation – which typically ran from 9 AM to 5 PM daily. Also, he observed there was only one washer in operation, because the other washers were broken. Because of the high demand for the use of the single washing machine, the washeteria users were observed inserting a water hose directly into the washing machine (see Photo 4) to add more water, since the users were over-packing the washer with clothes.

Joe James set up a discharge water hose in the laundry room that allowed for frequent measurement of flow going into the septic system. A calibrated 5-gallon bucket was used to

measure the flow rate at a frequent basis throughout the duration of the adequacy test. (Photo 5). Before the water was discharged to the septic system, Mr. Gilfilian inspected the condition of the existing septic tank and drainfield used by the washeteria/WTP. The manholes on the 4,000- and 2,000-gallon septic tanks (arranged in series flow) were uncovered and inspected. Their locations and configuration matched the 1980s as-built/record drawings prepared by the U.S. Public Health Service.

However, Mr. Gilfilian noted that there were eight new 4-inch diameter polyvinyl chloride (PVC) observation pipes installed in the drainfield area (Photo 7). Four of the pipes were on the north end of the drainfield area and the remaining four pipes were aligned on the south end. These new observation pipes indicated there were four parallel laterals with an observation pipe on each end. According to Joe James, a couple of years ago the Lower Kuskokwim School District constructed a new replacement drainfield system that consisted of several buried Infiltrators™. Also, a sewage lift station was connected to the outlet of the 2,000-gallon septic tank (Photo 10). The lift station pumps effluent into the buried header pipe on the south end of the drainfield system. Mr. Gilfilian observed a pipe in the lift station that appeared to be connected to the school's new wastewater treatment plant located to the west of the septic system. Apparently, the sewer line connection could be used as a backup system in the event the school district's wastewater treatment plant had operational problems.

The covers/caps on the observation pipes were removed and the depths to liquid in the drainfield (four Infiltrator™ lines) were measured with a staff. The length of the Infiltrator™ lines were measured to be approximately 125 feet long. The depth to the liquid level in each Infiltrator™ line was measured with respect to the top of the observation pipe. In addition, the depth of the liquid in the Infiltrator™ was measured.

At 3:08 PM on June 6, the adequacy test was started. The flow entering the septic tank system from the washeteria was measured at 7.6 gallons per minute (gpm). It was noted that the one washer in the washeteria was in constant use during the adequacy test. Prior to starting the test, Mr. Gilfilian calculated the discharge load for the proposed new replacement washeteria and WTP to be approximately 900 gallons per day. The adequacy test was conducted for a 3-hour period (180 minutes), with an average discharge flow rate of 6.6 gpm. During the 3-hour adequacy test, the liquid levels in the two septic tanks and eight observation pipes in the drainfield were measured and observed multiple times. At the completion of the test at 6:08 PM, the total flow that was discharged to the septic system was estimated to be 1,400 gallons. The total flow included an estimate of the wastewater discharged from the constant use of the washeteria's single operating washing machine.

On the following day (June 7) at 9 AM, Mr. Gilfilian met with Joe James to measure the liquid levels in the septic tanks and drainfield observation pipes. Mr. James informed Mr. Gilfilian that the washeteria had been open for the past hour and at least two loads of laundry wash water was discharged to the septic tank system. Shortly thereafter, Vincent Billy arrived and assisted Mr. Gilfilian in conducting a vertical control survey of all the drainfield's observation pipes to establish elevations of liquid level in each Infiltrator™ trench and the septic tanks.

On June 7 at 6:08 PM, the 24-hour rebound test was conducted. The liquid levels were remeasured in the observation pipes on the drainfield system, including the septic tanks. It was noted that the washeteria had been in continuous use for the entire day. The drainfield liquid levels measured at the completion of the 24-hour rebound period were found to be within ½ inch of the original liquid levels recorded prior to the start of the adequacy test.

### Section 3.0 Discussion of Findings

Table 1 shows the depth to the liquid level in the septic tank and drainfield observation pipes with respect to time and amount of flow entering the septic system.

**Table 1 Adequacy Test Field Measurements**

Time <sup>1</sup>	Flow Rate <sup>2</sup> (gpm)	Cumulative Volume (gallons)	ST CO	Observation Pipe <sup>3</sup>						NW CO
				S-2	S-3	S-4	N-2	N-3	N-4	
June 6, 2018										
14:30	7.6	0	99.5"	55.75"	51.5"	36.0"	99.5"	48.0"	54.0"	NM
15:23	7.6	175	100.0"	55.0"	52.0"	45.5"	99.5"	48.5"	Damp	NM
16:10	7.0	504	99.5"	54.25"	52.0"	Damp	99.5"	48.0"	Damp	72.5"
17:00	5.8	854	99.5"	54.5"	52.0"	Damp	99.5"	47.5"	Damp	72.5"
18:15	6.0	1,289	99.5"	54.75"	52.0"	Damp	99.75"	47.25"	Dry	72.5"
June 7, 2018										
09:15	NM	Recovery	99.5"	55.5"	52.25	Dry	99.5"	48.5"	Dry	73.0"
18:00	NM	Rebound	NC	NC	NC	NC	NC	NC	NC	NC

**Key:**

- 1 – Adequacy flow test started at 15:08 on June 6 and ended at 18:08 on June 6 (180 minutes).
- 2 – Average flow rate entering the septic tank system estimated at 7.7 gpm (includes washing).
- 3 – Represents an observation pipe on designated lateral on Infiltrator.
- " – inch(es)
- NW CO – Clean out pipe found on the north west corner of drainfield system
- ST CO –Septic Tank Clean Out (8" diameter pipe on 4,000-gallon septic tank).
- NM – not measured
- NC – no change (less than 0.5" from measurements at the start of the adequacy test)

In review of the test data in Table 1, it is apparent that the liquid levels during the 3-hour adequacy test that were monitored during the introduction of flow of approximately 1,400 gallons from the washeteria did not change appreciably. In fact, the measurements taken at the 24-hour rebound flow test were nearly the same as those collected prior to the start of the adequacy test. It is important to note that the liquid level measurements taken at the conclusion of the 24-hour rebound flow test had experienced the additional flow to the septic system from constant use of the washing machine in the washeteria on June 7 from the hours of 8 AM until 6 PM.

#### **Section 4.0 Conclusion and Recommendations**

Based on the findings of the adequacy test reported herein, the existing septic tank and drainfield system serving the Tununak Washeteria/WTP appeared to be functioning properly and is determined to be adequate to serve the facility for many years. With the understanding that the existing 4,000- and 2,000-gallon septic tanks are properly maintained (periodically cleaned out to remove septage by vacuum tanker at least once every 3 years), the existing drainfield system consisting of the four 125-foot long laterals of Infiltrators™ should be capable of handling the discharge of at least 1,400 gallons of wastewater effluent per day.

#### **Section 5.0 Limitations**

This Tech Memo was prepared by Stantec for the account of Native Village of Tununak IRA Council at the request of ADEC VSW Program. The findings and recommendations presented herein reflects Stantec's professional judgment in light of the scope, schedule, and other limitations stated in this document and in the contract between Stantec and the Client. The opinions in this document are based on conditions and information existing at the time the document was prepared and do not take into account any subsequent changes. In preparing the document, Stantec did not verify information supplied to it by others. Any use which a third party makes of this document is the responsibility of such third party.

**Stantec Consulting Services, Inc.**

**Robert (Bob) Gilfilian, PE**  
Principal, Civil Engineer

Cell Phone: 907-227-9883  
Email: bob.gilfilian@stantec.com

Attachments: Attachment 1 – Anchorage Municipality Code, Chapter 15.65  
Attachment 2 – Bob Gilfilian Tununak Field Notes for June 5-8, 2018  
Attachment 3 – Photo Log of Tununak Washeteria and Septic Tank/Drainfield

ATTACHMENT 1

ANCHORAGE MUNICIPALITY CODE

CHAPTER 15.65

“ADEQUACY TEST”

- 1  
2  
3  
4  
5  
6  
7
- b. Drainfield monitoring tubes are set to a depth which allows for an accurate determination of the liquid depth in the disposal field. If monitoring tube is not set to designed depth stated on the inspection report, engineer shall note actual depth.

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5. **Disposal field adequacy test.** A wastewater disposal field shall pass an adequacy test. The operating liquid level in the disposal field shall not be at or above the distribution pipe invert prior to commencing the adequacy test. The adequacy test shall be conducted in accordance with the following procedure:

- 15  
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- a. **Presoaking.** Disposal fields not in use for thirty days or longer shall be presoaked with clean water prior to commencement of the adequacy test. The adequacy test shall be conducted within forty-eight hours of completing the presoak. The volume of clear water required for presoaking the disposal field shall be the lesser of the following:

- 23  
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- i. 2,000 gallons.
  - ii. The gallons of water equal to the volume of the drainfield below the distribution pipe invert multiplied by 0.4.
  - iii. The maximum gallons of water the disposal field accepted without the liquid level raising above the top of the distribution pipe during the presoak.

- 34  
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- b. **Adequacy test.** A measured quantity of water, consisting of 150 gallons per bedroom, shall be introduced into the disposal field while monitoring fluid levels in the septic tank and disposal field monitor tubes before, during, and after the addition of water. The quantity of water introduced shall be sufficient to cause the fluid depth in the monitor tubes to increase enough to allow accurate measurement of the subsequent re-absorption. At no time during the course of the adequacy test shall the system be surcharged with a fluid depth greater than the top of the distribution pipe. Based on these measurements the engineer shall make a determination as to whether or not the system is capable of absorbing 150 gallons of water per bedroom per day. Systems that fail an adequacy test shall be reported to the department.

1                   **Exception:** A disposal field installed or adequacy tested  
2                   within twenty-four months of the COSA issuance date does  
3                   not require an adequacy test.  
4

5           C.    **Waivers for horizontal separation distances.** If a horizontal  
6           separation distance noted on the COSA form does not comply with  
7           this code or the code in force when the final inspection report and  
8           record drawings were approved, a waiver shall be obtained prior to  
9           issuance of the COSA.

10           D.   **Engineer's certification.** The engineer shall certify on department  
11           provided COSA forms that the wastewater disposal system appears  
12           to comply with the system's approved final inspection report and  
13           record drawings.  
14

15           E.   **COSA issuance.** Upon request, and subject to the provisions of  
16           this section, the department may issue or deny the issuance of a  
17           COSA.  
18

19           1.    **Unconditional approval.** The department shall issue a  
20           COSA if the department finds information provided by the  
21           engineer demonstrates the system for which the certificate is  
22           sought is in compliance with this section, the system's  
23           approved final inspection report and record drawings, and  
24           does not presently create a health hazard.  
25

26           2.    **Conditional approval.** When an on-site wastewater  
27           disposal system is not in compliance with the applicable  
28           codes, but no health hazard is posed by temporarily  
29           postponing correction of the wastewater disposal system's  
30           defects, the department may issue a conditional COSA to  
31           extend the period of time for corrective action. The COSA  
32           may be approved with conditions necessary to ensure that  
33           the public health and safety are not endangered. The  
34           specific requirements for a conditional COSA approval shall  
35           be:  
36

- 37           a.    The conditional COSA fee has been paid.  
38  
39           b.    If required, an approved design and permit for the  
40           required upgrades and/or repairs has been issued.  
41  
42           c.    Three estimates for the related construction shall be  
43           submitted to the department.  
44  
45           d.    A letter from an established escrow agency, stating  
46           1.5 times the highest construction estimate is being  
47           held in escrow for the specific purpose of funding the  
48           proposed construction, shall be submitted to the  
49           department.  
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51

ATTACHMENT 2

BOB GILFILIAN FIELD NOTES

TUNUNAK SITE VISIT

JUNE 5-8, 2018

(107) June 5, 2018  
Tues

Tunmall, AK  
Tech Memo Field Trip

@ 0500 arrived at ANC Airport - Rain. Arr  
for flight to Tunmall (via Bethel, Nightmute, Toolik  
(Bay))

@ 1000 left ANC for Bethel

@ 1130 arrived Bethel

@ 1250 left Bethel on Massland Air/Boon

@ 1330 arrived in Tunmall

met Ira at Airport/Airfield & Teddy

@ 1340 went to school to check in. Today

@ 1400 met Xavers at his house

Joseph James, operator H2O plant

Vincent Billings " " (652-2630)  
IRA # 6152 - 202 (not

@ Called Brandi for school internet password  
Amy 5493 - 4827

- Ira took me in H-Wheeler to Village  
office - everything in Village was  
shut down due to no power except school.

@ 3 pm took walking tour of Village to  
check out layout of photos.

Chook Masketkin JSTP to set up for test  
- Elizabeth secretary at School

Bob Gilfillan - Tunmall AK  
Field Trip Notes, June 5-8, 2018 (6 pages)

Tunmall, AK

6/5/18  
Tues

(128)

western Clear Sun

@ 4 pm walked along beach to the north

end where bluff (56' high) meets the beach.

Took photos to show exposed rock formation  
and brown sandstone/siltstone  
Collected sample of gray sandstone/siltstone  
horizontally fractured

✓ Walked south on beach to School's sewer  
outfall daylighted on upper beach

✓ Took photos of School's exterior water  
treatment plant and W/P plant.

✓ Went to Warehouse - closed due to power  
out. Took exterior photos and pipeline  
to Clinic

✓ Checked west leg of waterline to Wash  
WTP - noted repairs work on arctic pipe

@ 6 pm contacted Vincent Billie who  
agreed to meet me tomorrow at 10 am  
to start adequacy test on ST/SA.

- Returned to school to organize files  
and field gear for tomorrow's projects.

- Reviewed project files until 8 pm

Bob Gilfillan - Tunmall AK  
6/5/18

(109) TUESDAY, AK

June 6, 2018 (Wed)

~70°F

Part Sun

~5 mph Wind

~8 AM prepared draft proposal letter to USW for deep well Geophysical Survey

~9 AM called Collin Mackel on survey dates

Prepared field maps/docs to meet w/ Vincent Billie, Unumak WPA, to go over items needed to complete the following tasks:

- 1- Inspect WST (need folder to CK tank)
- 2- Inspect Well House on Unumak Creel
- 3- Inspect water transmission line
- 4- Conduct Adequacy Test on ST/SAs.

Also prepared form RM5-2 and other standard safety forms to review w/ Vincent

@1050 met Vincent Lilly at School, Check WTP but it was locked. Went to Village Office

@1030 hold mtg. w/ James James, James, Joe James, and Vincent Lilly

- Discussed purpose of my visit and scope of work (tasks)

- Went over well drill sites, noted Village owned corner of site south of Unumak

Creel along Muskok Co water transmission line

- Decided to walk sites tomorrow

Note: Near cold water discharge in Washegan  
Saghl = 375 sec

~45°F

Cloudy

~15 mph Wind

@1100 Went to Mackel's / WTP w/ Vincent Billie and Joe James

✓ Checked over Mack (in use) w/ my washer and 2 dryers (Vincent est 4 gal/wash)

✓ Made arrangements for discharge water in to Mack sewer drain for Adequacy Test

Mean flow at E.3 Spun

✓ Checked over empty nest conditions in WTP - took photos - barely operating

✓ Noted WST had ~14" water level

✓ Found one shower & one toilet working!

✓ Went to WST w/ ladder, climbed on top to check tank condition. Took photos and videos. Opened top access cover

Observed rust debris floating in tank plus an empty soda can floating

✓ Went to sewer system to check manholes and then opened access to 4 End 2 E ST

Found monitor tubes (8) that were installed by LKSD a couple of years ago when they

installed several new infiltrator lines in the area of the former WPA Sat-1

Absopth System (SAs) - Need Record Drawing.

@1230 I informed Vincent & Joe that I would complete Adequacy Test and we will meet tomorrow at 9 AM to inspect Well House & Unumak CK.

Thursak (110)

June 6 '18

(111) Timmuck  
June 6, 2018

530F  
Cloudy, Windy  
25 mph

@ 12:45 returned to school to prepare forms for adequacy test. Organized notes & equipment  
Lay out map of ST/SAS for Adequacy Test

@ 2 PM went to ST/SAS to take starting meas.

@ 2:30 meas liquid level in ST/SAS meas.

STCO 99.5" btop (6" Ø HDPE) (W/ST)

S-1 60.0" btop (4" Ø OW)

S-2 55.5" " (4" Ø OW)

S-3 57 1/2" " (headers) (4" Ø) wet

S-4 36" " (header pipe) (wet)

N-1 (8" Ø) (filled w rocks) (4" Ø) drains

N-2 99.5" btop (8" Ø OW)

N-3 48" " (4" Ø OW)

N-4 54" " damp bottom frame (4" Ø)

@ 15:08 started flow into Wash Area drain

meas flow in 5 gal bucket in 40 seconds

calc flow = 7.6 gpm plus 1 bad washer

@ 15:23 (15 min) meas SAS 1/2 ST

STCO 100.0" btop

S-1 59.5" btop (feels like header pipe)

S-2 55.0" "

S-3 52.0" "

S-4 45 1/2" " able to clear header wet bottom soil

Sunny 55°F  
25 mph Wind

Timmuck (112)  
6/6/2018

N-2 99 1/2" btop

N-3 48 3/4" btop

N-4 damp soil

@ 16:45 pm meas flow in Wash Area = 7 gpm

@ 16:10 meas ST/SAS Obs. Wen (OW)

STCO 99.5" btop

S-1 59.5" btop (This is header pipe w 4" Ø coming from 2K ST)

S-2 54 1/4" "

S-3 52" "

S-4 damp "

N-2 99 1/2" "

N-3 48" "

N-4 damp "

Found 4" Ø AGS ob pipe in NW corner of SAS

meas liquid = 72 1/2" btop (flush w SS)

~15' SW of N-2

@ 16:50 meas flow = 5.75 gpm of Wash Area

4 loads of washer used during test

@ 17:00 meas levels in ST/SAS

STCO 99 1/2" btop (stickup = 22" AGS)

S-1 57" btop (stickup = 7" ags)

S-2 54 1/2" btop " = 12"

(113) Timmerlake  
6/6/2018

Continue near ST/S

S3 52" btop

S4 damp "

N1 NA

N2 99 1/2" btop

N3 47 1/2" btop

N4 damp

NW corner OW = 72 1/2" btop, No stickup flash GS

@ 1752 meas flow = 60 gpm in Washeteria

@ 1808 Shut off flow for Adequan Test

Ave flow 616 gpm, Total flow = 1,195 gal

Plus 4 Wash load yields 1,300 gal in 180 min

Note: laundry being used all day - 1 washer

@ 1815 meas SWLs in ST/S/S OWs:

ST CU 99 1/2" btop

S1 55 1/2" (very difficult to measure headed)

S2 54 3/4" "

S3 52" "

S4 damp "

N2 99 3/4" "

N3 47 1/4" "

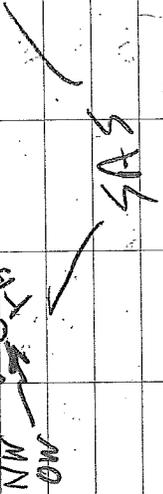
N4 dry 30 1/2" "

NW OW 72 1/2" "

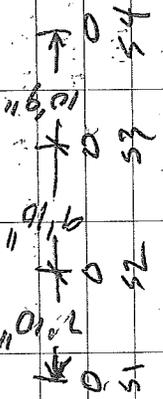
55°F Wind  
Sunny/20mph

Timmerlake (114)  
6/6/2018

Layout of ST/S/S measured at 18



GAS



4" ST to S1 = 44 1/4"

6" CU to S1 = 57 1/4"

N1 to S1 = 135"

MH →  
(ply wood  
5' x 6' box)

@ 7:10 pm returned to school to retrieve notes

Seat requested for Geophysical Survey to Susan

via email

BL/Justification 6/6/18

END Day 2

(116)

Thompson  
6/7/18

Cloudy, 25 mph wind  
40°F

7" HI above N2 to 2.3' NW-CO TOP  
7" HI " to 1.9' N3 TOP  
7" HI " to 1.8' N4 TOP  
- Check at Barb Miller, LKSP Butler

@ 10:20 went to WTP of Joe Vincent  
@ 11:00 inspected unnamed Creek  
Pump House

1.5 AP pump - 2 of them  
H2O level in well was 18" below floor  
H2O depth in well was 24"  
Creeper floor - 6" deep x 3' wide  
Channel 2' wide x 9" deep  
Velocity = 5 sec/ft in channel 30x6

✓ Walked along water transline

@ 12:00 drove in ATV of Vincent to work  
over proposed drill sites. Took photos & videos  
@ 12:30 drove up to gravel pit on top  
maintain in cloud layer a couple miles up  
hard road - filled w/ snow - developed by GAP

@ 1:300 went to TRA office to meet w/ staff  
Met w/ James James & Laura Post

@ 14:00 rode back to school w/ Vincent, stopped  
to photo base site south of BA school & horse bucket

@ 15:00 helped in tele conf w/ Susan Flannery  
Went to rest of day on notes & reports  
Note: 24 hr STSes Reboard  
CA 1815-5TCO = All done 15  
Day 3  
24 June 18

Cloudy 42°F  
15 mph wind

@ 0800 organized notes for field work  
to day schedule to complete Adequacy  
Text and inspect unnamed Creek well.

@ 0915 pet Joe Jones went to STSAS  
Joe informed me that ~ 2 loads wash so  
for this morning at Washoburn

Meas SWL in STSAS at 0930  
ST-CO 99 1/2" btop

S1 59" "  
S2 55 1/2" "  
S3 52 1/4" "  
S4 dry "  
N1 NA "

N2 99 1/2" "  
N3 48 1/2" "  
N4 98 1/2" dry "  
NW-CO 73" "  
Note: lift Sta  
discharge 2" @ HOVE  
is ~ 480 gpg

TOP (11)  
N 27" HI above S1 to ST-CO top ring  
30" HI " to 1.7' to 5.2 top  
30" HI " to 2.4' to 5.3 top  
30" HI " to 2.9' to 5.4 top  
2.5" HI " to N1 TOP  
7" HI " to N1 TOP

Timonah, AK  
June 8, 2018  
(Friday)

45° F Cloudy  
Calm

- ✓ @ 0800 organized field notes and photos on laptop
- ✓ @ 0930 walked to Tribol office (No Vincent!) Approx 1.25 miles school to office
- ✓ @ 1000 held teleconf w/ Susan Randlett, James James and Xavier Fast. Discussed approach to drilling exploratory deep wells. Need SHIPPO and wetland & maybe GEN
- ✓ Best Practices waiver
- ✓ Need cost est. for drilling wells
- ✓ Possible funding from RD by July 15
- ✓ Possible sale source
- ✓ Grant period up to 5 years
- ✓ Discussed maintenance
- ✓ Susan recommended include water line w/ well
- ✓ @ 1000 met w/ sides
- Xavier said most folks take steam baths & took several photos of steam huts
- Meas distance from ST Lift Sta to S1 or 25'
- ✓ @ 1130 returned to school for packing met Vincent belly ad Today on flight study
- Found out Hazelwood Air could not fly from Suxhel due to weather delay

Timonah  
June 8, 18

50° F Partly Sun  
-10 mph wind

- Next several hours kept calling Hazelwood in Timonah & Buxhel with negative response
- ✓ @ 1600 friend met Grant Air was coming to Timonah so Today rushed me out to the air port as the plane was landing - able to get a seat!
- Flaw to Tokleak Bay and then to Buxhel.
- Arrived at 1735 as my plane flight was departing Buxhel
- Went to AK Air and able to get a seat for 9 pm flight to ANC
- ✓ @ 2015<sup>PM</sup> boarded Alaska Air Flt #46 for ANC for ANC
- ✓ @ 2100 arrived at ANC Airport
- ✓ @ 2200 arrived at Greg Meyer's for the night
- End Day 4  
Buxhel Airport 6/8/18

ATTACHMENT 3

PHOTO LOG

TUNUNAK SEPTIC SYSTEM



*Photo 1 - Looking West from Tununak School Towards Septic Tank and Drainfield System in foreground with the septic tanks on the left side and drainfield on the right side of the open field.*



*Photo 2 - Manholes and Clean-Out on 4,000-gallon Septic Tank. Photo 1 was taken from the hill in the background.*



*Photo 3 - Interior of Washeteria. Laundry user sitting on folding table and Joe James to the left setting up discharge hose for adequacy test.*



*Photo 4 – Water hose inserted into washer to provide additional wash water for overloaded washer.*



*Photo 5 – Discharge hose in 5-gallon bucket used during adequacy test to measure rate of flow.*



*Photo 6 – Looking north from Washeteria towards the septic tank and drainfield system located in the open field. The septic tanks are on the left side and the drainfield on the right side of field.*



*Photo 7 – Looking southwest towards observation pipes on the south end of the drainfield with septic tank covers in the background.*



*Photo 8 – Looking west toward observation pipe on north end of drainfield.*



*Photo 9 – Looking north towards septic tanks manholes and clean-outs with observation pipes on south end of drainfield in the background.*



*Photo 10 – Lift station located at outlet end on the 2,000-gallon septic tank*

**95% Draft**

**Technical Memorandum 2**

**Assessment of Existing Water Transmission Line**

**For**

**Tununak, Alaska**

**August 8, 2018**

---

To:	95% Draft Tech Memo #2 Tununak Water Line Assessment Tununak, Alaska	From:	Bob Gilfilian, PE Principal Civil Engineer Stantec Consulting Services, Inc.
File:	<b>Technical Memorandum 2 – Assessment of Existing Water Transmission Line</b>	Date:	August 6, 2018

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## Section 1.0 Introduction

The Native Village of Tununak a.k.a. Tununak IRA Council (herein referred to as Tununak), in cooperation with the Alaska Department of Environmental Conservation (ADEC) Village Safe Water (VSW) has retained Stantec Consulting Service, Inc. (Stantec) to prepare this Technical Memorandum (Tech Memo) with funding from the U.S. Department of Agriculture Rural Development (USDA-RD).

The purpose of this Tech Memo is to provide a summary of the findings of a field investigation to assess the condition of the existing water transmission line (WTL). This Tech Memo provides recommendations for future use and/or corrective action for the WTL, if determined to be needed based on the findings of the field assessment.

The original WTL was installed approximately 40 years ago by the U.S. Public Health Service (USPHS) for the purpose of supplying raw water from the water source (infiltration gallery on Unnamed Creek) to the water treatment plant (WTP) and Washeteria. Approximately 23 years ago (1995) the WTL was replaced as part of a VSW sanitation improvement project that was designed and constructed under the direction of Phukan Consulting Engineers & Associates, Inc. (PCA). The water line replacement from Unnamed Creek to the Washeteria/WTP was part of a larger project that extended the water line approximately 3,000 feet to connect to a new infiltration gallery located at Muskox Creek. The Muskox Creek water source failed over 10 years ago and has been abandoned ever since, Unnamed Creek is the current water source.

The original WTL installed by USPHS was approximately 1,153 feet in length and consisted of a 2-inch diameter PE pipe with a heat trace line that was located within a 4-inch diameter insulated Arctic pipe. This WTL ran from the Unnamed Creek infiltration gallery pump house to the Washeteria/WTP building. The 1995 replacement WTL installed by PCA is the current water line that was assessed for the preparation of this Tech Memo. A copy of the engineering plans for the PCA water line is provided in Attachment 1.

The 1995 WTL consists of two 2-inch diameter high density polyethylene (HDPE) water lines and a ¾-inch copper tubing heat trace line enclosed in an Arctic pipe that consists of a 6-inch diameter polyvinyl chloride (PVC) pipe (carrier) located within a high density insulated outer wall, 15-inch diameter aluminum jacket. Except for a short section of buried water line between Access Box #1 and the Washeteria/WTP, the WTL traverses above the ground surface supported by two types of

**Reference:** Tech Memo 2 – Assessment of Existing Water Transmission Line

foundation system. Most of the WTL is supported on a timber foundation system and a small portion near the Unnamed Creek pump house is held on a wire rope suspension that is connected to steel screw-piles. The WTL has three insulated wooden access boxes for maintenance access to the water line which are located on 90 degree turns in the alignment of the pipeline.

## **Section 2.0 Methodology**

The structural integrity and usability/functionality of the WTL and the foundation support system, including the water line turn boxes, was assessed during a field trip conducted on June 5 through 8, 2018, by Bob Gilfilian, P.E., Senior Principal Civil Engineer with Stantec. The assessment involved a physical inspection of the visible components of the WTL. The purpose of the assessment is to determine the usefulness of the WTL for serving the long-term needs of the Tununak's water supply system. During the site investigation, Mr. Gilfilian interviewed the Tununak water system operators and key administrative staff to obtain information on the operation of the WTL during all seasons of the year.

As an additional task, VSW requested Stantec to include an inspection of the existing infiltration gallery pump house on Unnamed Creek as part of the scope of work for the WTL assessment. The inspection of the pump house, conducted by Mr. Gilfilian, focused on: assessing the structural integrity of the 40-year old building, checking the control systems for the operation of the water system's submersible pump, and evaluating the overall sanitary conditions of the pump house.

### **Inspection of the Water Transmission Line**

Shortly after arriving in the village of Tununak on June 5, 2018, Mr. Gilfilian took a walking tour of the west end of the WTL located between the Washeteria/WTP and Access Box #2 that is shown on the PCA design plans (Attachment 1). This section of the WTL is in a north/south alignment located to the east of the Tununak School and the Tununak Washeteria/WTP.

Field inspection notes prepared by Mr. Gilfilian are provided in Attachment 2. Photographs were taken to document the condition of the WTL, water line access boxes, and timber foundation system for the Arctic carrier pipe. These photographs, with brief captions, are provided in the Photo Log (Attachment 3).

The photographs described in the following sections provide a pictorial perspective and documentation of the deteriorated condition of the WTL and the Unnamed Creek infiltration gallery pump house (discussed below). These photos, with the descriptive narratives, are provided to give a comprehensive understanding and appreciation of the condition of the existing infrastructures. The following provides a detailed description of Mr. Gilfilian's inspection findings as related to each photo:

**Reference: Tech Memo 2 – Assessment of Existing Water Transmission Line**

- Photo 1: WTL (Arctic pipe) entering the east side of the Washeteria/ WTP. The second Arctic pipe shown in the photo located below the WTL is the water service line to the nearby clinic.
- Photo 2: WTL looking south towards Access Box #1 located near the left corner of the clinic building. The timber foundation system, originally spaced on 10-foot centers for the Arctic pipe, has moved/shifted over the years due to unstable ground conditions and was found not to be level at many crossings. At many locations, the timber foundation system has failed and currently provides little to no structural support for the WTL.
- Photo 3: WTL looking north towards Access Box #2 located at the far end of the water line before making the 90-degree turn to the right. Tununak School is located to the left (west) of the WTL. Note the variation in the alignment of the WTL and poor structural support from the timber foundation system for the Arctic pipe.
- Photo 4: WTL Access Box #1 was found exposed/open with the cover partially removed. It appeared maintenance work was being made on repairs to the water line. Subsequent discussions with the WTP operator confirmed they were working on repairs to the WTL, which occurs on an annual basis due to multiple operational problems with the water line freezing.
- Photo 5: Uncovered section of Arctic pipe that provided access for the operators to repair the WTL.
- Photo 6: This photo shows the same section of the WTL that was discussed in Photo 5 and shows the deteriorated foundation system.
- Photo 7: A section of Arctic pipe that was previously repaired, the exterior of the pipe was wrapped with plastic sheeting held together with rope.
- Photo 8: Another section of repaired WTL wrapped in plastic and pieces of loose fiberglass insulation.
- Photo 9: A typical section of the Arctic pipe that has a significant sag due to the deteriorating structural conditions of the timber foundation system.
- Photo 10: WTL Access Box #2 that is not level due to significant deterioration of the box foundation. Note the Arctic pipe to the right of the turn box is pulling the box to the right due to the failing structural support system under the Arctic pipe. It is expected that, over time, the Arctic pipe would probably separate from the access box.
- Photo 11: Timber foundation system that was separated from its base. This failure of support may, over time, lead to a significant sag in the Arctic pipe. Likewise, the timber support on the left side is failing with a downhill slope that may result in a failed section of the WTL.

**Reference: Tech Memo 2 – Assessment of Existing Water Transmission Line**

- **Photo 12:** Elevated section of the WTL built many feet above the ground surface that causes major issues for the operators to repair the water line. Several of the timber supports have moved due to unstable ground conditions and are not providing structural support to the Arctic pipe.
- **Photo 13:** Exposed section of Arctic pipe shows recent attempts to repair the WTL. The line has been retrofitted with recirculating glycol heat trace lines that barely squeeze through the 6-inch diameter carrier pipe. This photo shows two repaired connections to the 2-inch HDPE water line with a cut section on the parallel line that requires additional repair work. It was later learned from the operator that this type of repair work is done on a routine annual basis.

On June 7, 2018, Mr. Gilfilian met with Mr. Vincent Billy, Tununak WTP Operator, and discussed the operational problems the IRA Council have encountered over the years in maintaining the WTL. Following the interview, Mr. Billy provided valuable assistance to Mr. Gilfilian during the site visit that included a thorough inspection of the Unnamed Creek pump house. They took a walking tour of the WTL from the pump house to the northern portion of the water line. The following photographs (Attachment 3) were taken by Mr. Gilfilian to document the condition of the WTL:

- **Photo 14:** WTL from the Unnamed Creek pump house to the Access Box #3, located just below the house in the background. Note the sagging WTL to the left of the access box. This section of the WTL is suspended on the buried anchors (helical pile support system) that have apparently moved due to unstable ground conditions.
- **Photo 15:** Shows Access Box #3 that has a slightly sagging Arctic pipe exiting the access box.
- **Photo 16:** The Arctic pipe from Access Box #3 that was apparently re-leveled with a helical pile support system. In the far background of the photo is the abandoned section of the Arctic pipe coming from the former Muskox Creek infiltration gallery.
- **Photo 17:** Northern section of the WTL that is elevated on a very unstable timber support system which has shifted significantly due to unstable ground conditions. As shown in the photo, the Arctic pipe is several feet above the ground surface and has several sections that have sagged. It was clear that the height of the Arctic pipe above the ground surface poses a significant danger for the workers to provide repair services on the WTL.
- **Photo 18:** Shows uneven sections along the northern portion of the WTL that result in difficulty for the operators to extract or blow out the trapped water held between the sagged sections of pipe.

**Inspection of the Unnamed Creek Infiltration Gallery**

The findings of Mr. Gilfilian's inspection of the existing pump house on Unnamed Creek is described in this section. Attachment #4 provides an as-built drawing of the infiltration gallery that was

**Reference: Tech Memo 2 – Assessment of Existing Water Transmission Line**

prepared by the USPHS. Mr. Billy assisted in this inspection and explained the operational issues associated with the pumping of the infiltration gallery. The following photographs, with detailed photo explanations (see Photo Log, Attachment #3), were taken by Mr. Gilfilian when he was accompanied by Mr. Billy during the inspection of the infiltration gallery pump house:

- **Photo 19:** WTL exiting the Unnamed Creek pump house. The pump house straddles a narrow shallow section of Unnamed Creek.
- **Photo 20:** This photo was taken on the downstream section of Unnamed Creek looking east towards the pump house. The Arctic pipe to the right of the pump house shows the abandoned section of WTL coming from the former Muskox Creek infiltration gallery. The Arctic pipe to the left of the pump house is the current WTL flowing towards the Washeteria/WTP. Note the litter and debris in the surface water source of Unnamed Creek.
- **Photo 21:** This photo shows the entrance to the Unnamed Creek pump house. This doorway is often blocked by high drifts of dense snowpack that prevents the operators from entering the pump house in the winter; therefore, they have to enter the pump house through an opening in the roof. The 24-inch diameter corrugated metal pipe (CMP) infiltration gallery is visible just inside the pump house.
- **Photo 22:** Interior of the Unnamed Creek pump house showing the debris of clutter and unsanitary condition surrounding the open top/exposed infiltration gallery. The 6-inch diameter stainless steel screen pipe leaning against the back corner had been used in the past to protect the submersible pump when it was placed inside the infiltration gallery. Due to the deteriorated condition of the infiltration gallery, the slotted screen is no longer used during the operation of the submersible pump.
- **Photo 23:** Photo taken above the open infiltration gallery that shows the pipe line hook up to the submersible pump that is on the ground surface in the upper right corner of the photo. Also, the photo shows the WTL (two 2-inch diameter HDPE pipes) exiting the pump house. During the inspection, a field mouse exited from the Arctic pipe into the pump house.
- **Photo 24:** Dangerously exposed electrical wiring and open/damaged electrical control boxes and pump relay switch for the submersible pump used to pump raw water from the infiltration gallery.
- **Photo 25:** Photo taken looking down the interior of the 24-inch diameter CMP used for the Unnamed Creek infiltration gallery. It was observed that the raw water in the infiltration gallery had floating scum and that there were several open sections in the wall of the pipe. Also, the unsafe condition of the exposed electrical wiring for the submersible pump was noted. According to the operator, the original 10-foot-deep infiltration gallery has, over the years, filled in with mud and debris from seasonal flooding and is currently only about 2 feet deep. The operators reported they have attempted in vain to remove the mud, but it has continued to fill in – resulting in reduced flow of raw water available for pumping, especially during the winter months when the water level in the creek is very low.

**Reference: Tech Memo 2 – Assessment of Existing Water Transmission Line**

- **Photo 26:** Deteriorated horizontal support beam used to suspend the pump house above Unnamed Creek. During certain high-water flow conditions in the creek, particularly during spring break up, the entire floor of the pump house is covered with water and mud – which also inundates the infiltration gallery.
- **Photo 27:** The rear (south facing) section of the Unnamed Creek pump house. The Arctic pipe on the left side of the pump house is from the former Muskox Creek infiltration gallery. The Arctic pipe to the right of the pump house is the existing WTL to the Washeteria\WTP. The pump house is structurally unsound and is leaning to the rear of the building due to deteriorating support beams beneath the building. The roof of the pump house has a covered opening that is used during the winter for access to the pump house when the door is blocked with drifted snow. The operators must enter the pump house through the roof in order to operate the submersible pump in the infiltration gallery to refill their 50,000-gallon water storage tank.

**Section 3.0 Discussion of Findings**

Section 2 presented the findings of the field inspection associated with the assessment of the WTL and the Unnamed Creek infiltration gallery. The photographs taken during the site visit clearly show the deteriorated condition of both the WTL and the infiltration gallery. Valuable information on the operation and maintenance (O&M) of these infrastructures was obtained during the interview with Tununak's WTP operator including subsequent discussions with the IRA Council administrators.

The following provides a summary of the findings of the site assessment conducted by Mr. Gilfilian:

1. The WTL was found to be barely functional as reported by the operator. Because of operational problems with the circulating glycol heat trace system, the water line often will freeze up and requires considerable effort to get the water line thawed. On many past occasions, the operators had to wait over a week or two until they could receive assistance from Alaska's remote maintenance workers. Consequently, the community is often unable to use the Washeteria due to the lack of available water.
2. The operators typically attempt to treat and fill the community 50,000-gallon water storage tank prior to the onset of winter. Most winters, the Washeteria runs out of water which requires the operators to refill the tank with the WTL from the infiltration gallery. During the winter months, Tununak experiences severe windstorms that cause very dense and deep snowdrifts around the pump house and block the entrance. The operators often have to gain entry into the pump house via the opening in the building's roof.
3. Hooking up the submersible pump to pump raw water from the infiltration gallery is dangerous due to the exposed electrical wiring and the deteriorated pump control.
4. The water level available for pumping in the infiltration gallery is nearly depleted in spite of the efforts of the operators to remove debris and mud accumulated from seasonal flooding.

**Reference: Tech Memo 2 – Assessment of Existing Water Transmission Line**

5. As shown in the photographs, there are many sections on the WTL that have been repaired in the past due to line blockage or freeze up. Attempts have been made to squeeze additional glycol heat trace lines inside the Arctic pipe, which has required a considerable amount of work on the part of the operators.
6. Due to the failing condition of the timber foundation system on many sections of the WTL, the water line has developed sags in the profile where water can be trapped – resulting in difficulty for the operators to extract the trapped water. Normally, the flushing of the lines can only occur during the times of the year when temperatures are above freezing. It is understood, based on operator testimony, that this effort requires a lot of time and work.
7. The infiltration gallery pump house building is in a deteriorated condition that appears to have a very limited life remaining. This building and its foundation needs to be replaced. Also, the infiltration gallery is in very bad condition and likewise needs to be replaced in order to continue using the surface water from Unnamed Creek.

**Section 4.0 Conclusion and Recommendations**

Based on the findings of the assessment reported herein, it is recommended the following course of action be taken to correct the deficiencies noted on the WTL and the Unnamed Creek infiltration gallery pump house:

1. Although the site assessment was not intended to be a comprehensive, detailed inspection of the entire WTL, it appears justified based on the limited site observations and discussions with the operator that the entire WTL should be replaced. In addition, the WTL access boxes also should be replaced with new boxes that are more functional for use by the operators. The foundation system for the replacement Arctic pipe should consist of the same type used on the abandoned section of the former Muskox Creek infiltration gallery. The elevated WTL along the northern section of the current alignment from Access Box #2 to Access Box #3, should follow the contour of the ground surface and include another access box to provide a means at the lowest point for flushing the WTL. However, the length and alignment of the WTL may be altered if it proves that a deep water well could be installed to serve as the future water source for the community.
2. The infiltration gallery pump house on Unnamed Creek should be replaced in its entirety. The pump house and infiltration gallery have deteriorated to such a condition that they are barely functional. In addition, the existing building poses risk to the operators with the use of the current electrical wiring for the operation of the submersible pump, as well as getting access to the pump house during the winter months when the building entrance is blocked by dense snowdrifts. This recommendation may not be necessary if a deep water well could be installed to serve as the future water source for the community.

Reference: Tech Memo 2 – Assessment of Existing Water Transmission Line

Table 1 provides an estimated cost to construct a replacement WTL and access boxes along the same alignment currently used from the Unnamed Creek infiltration gallery to the existing Washeteria/WTP.

**Table 1 Estimated Cost for a Replacement WTL and Access Boxes**

Item Description	Unit	Estimated Quantity	Unit Cost	Total Cost
WTL	Linear Feet	1,153	\$350	\$403,550
<b>Total Estimated Cost</b>				\$403,550
15% Construction Contingency				\$60,532
Subtotal with Contingency				\$464,083
Design & Construction Administration Services (20%)				\$92,816
Agency Administration (8%)				\$37,127
<b>Estimated Total Capital Cost</b>				<b>\$594,026</b>

Key:  
 % – percent  
 WTL – Water Transmission Line

Table 2 provides an estimated cost to construct a replacement infiltration gallery with pump house on Unnamed Creek

**Table 2 Estimated Cost for a Replacement Infiltration Gallery/Pump House**

Item Description	Unit	Estimated Quantity	Unit Cost	Total Cost
Infiltration Gallery with Pump House	LS	1	LS	\$300,000
<b>Total Estimated Cost</b>				\$300,000
15% Construction Contingency				\$45,000
Subtotal with Contingency				\$345,000
Design & Construction Administration Services (20%)				\$69,000
Agency Administration (8%)				\$27,600
<b>Estimated Total Capital Cost</b>				<b>\$441,600</b>

Key:  
 % – percent

## Section 5.0 Limitations

This Tech Memo was prepared by Stantec Consulting Services, Inc. (Stantec) for the account of Native Village of Tununak IRA Council at the request of ADEC VSW Program. The findings and

**Reference: Tech Memo 2 – Assessment of Existing Water Transmission Line**

recommendations presented herein reflects Stantec's professional judgment in light of the scope, schedule and other limitations stated in this document and in the contract between Stantec and the Client. The opinions in this document are based on conditions and information existing at the time the document was prepared and do not take into account any subsequent changes. In preparing the document, Stantec did not verify information supplied to it by others. Any use which a third party makes of this document is the responsibility of such third party.

**Stantec Consulting Services, Inc.**

**Robert (Bob) Gilfilian, PE**

Principal, Civil Engineer

Cell Phone: 907-227-9883

Email: bob.gilfilian@stantec.com

Attachment: Attachment 1 – Phukan Consulting Engineers & Associates, Inc. (PCA) Plan Sheets for the Tununak Water Transmission Line, dated 1995

Attachment 2 – Bob Gilfilian's Tununak Field Notes for June 5-8, 2018

Attachment 3 – Photo Log

Attachment 4 – USPHS As-Built of Unnamed Creek Infiltration Gallery

c. Susan Randlett, PE

ADEC Village Safe Water Program

**Attachment 1**

**Phukan Consulting Engineers & Associates, Inc. parenthesis(PCA)**

**Plan Sheets for the**

**Tununak Water Transmission Line**

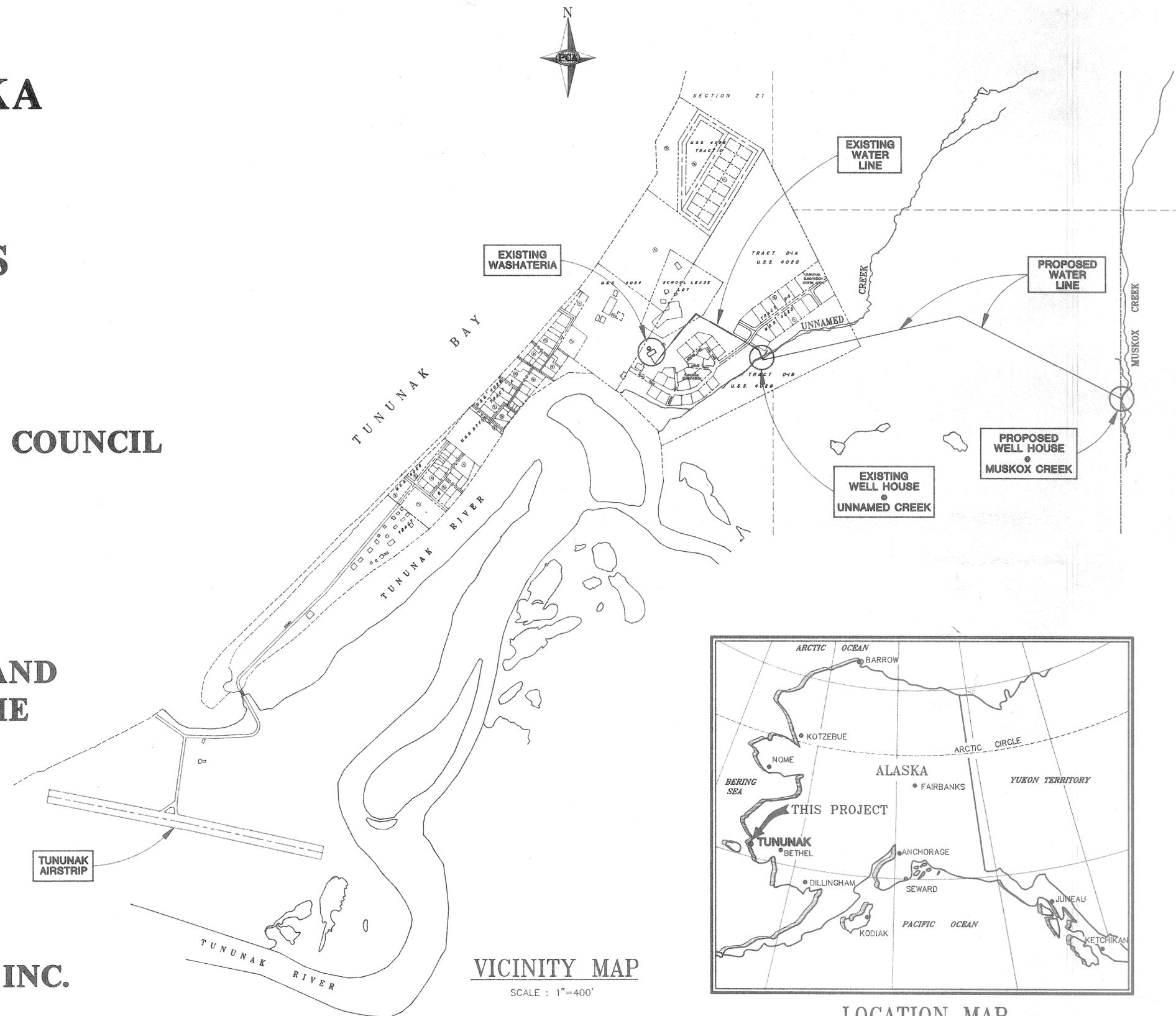
**1995**

# VILLAGE OF TUNUNAK, ALASKA PHASE III SANITATION IMPROVEMENTS 1995

Prepared for:  
**TUNUNAK TRADITION ELDERS COUNCIL**  
P.O. BOX 50  
TUNUNAK, ALASKA

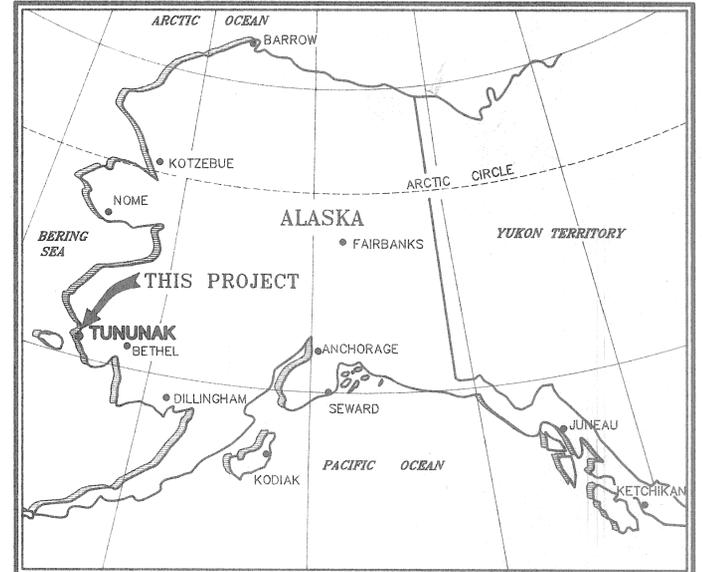
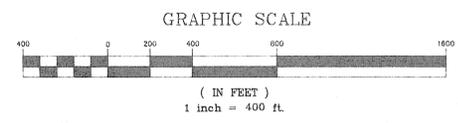
Grants thru:  
**STATE OF ALASKA,  
VILLAGE SAFE WATER AND  
U.S.D.A. FARMERS HOME  
ADMINISTRATION**

Prepared by:  
**PHUKAN CONSULTING  
ENGINEERS & ASSOCIATES, INC.**



**VICINITY MAP**

SCALE : 1"=400'



**LOCATION MAP**

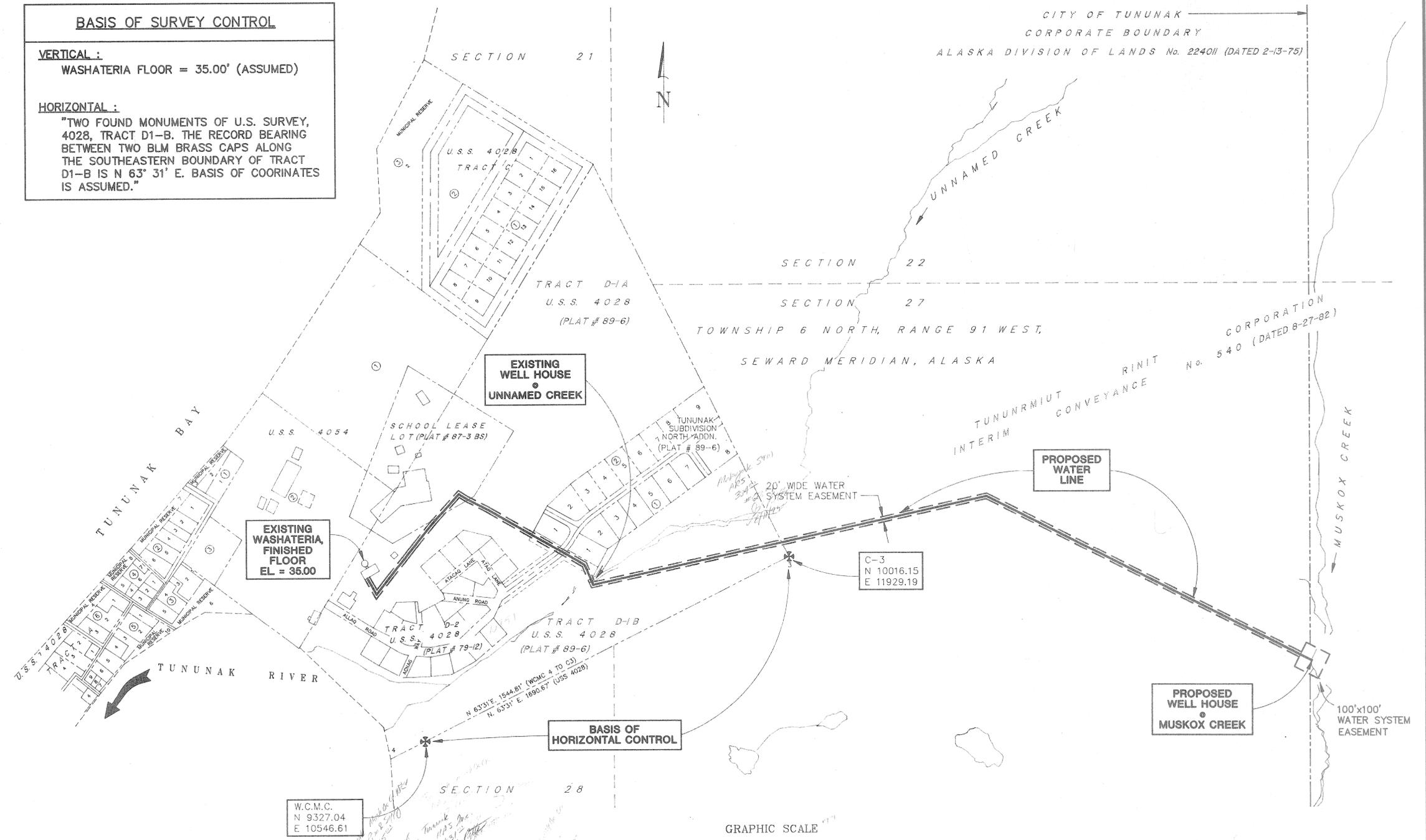
**INDEX TO SHEETS**

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**BASIS OF SURVEY CONTROL**

**VERTICAL :**  
WASHATERIA FLOOR = 35.00' (ASSUMED)

**HORIZONTAL :**  
"TWO FOUND MONUMENTS OF U.S. SURVEY, 4028, TRACT D1-B. THE RECORD BEARING BETWEEN TWO BLM BRASS CAPS ALONG THE SOUTHEASTERN BOUNDARY OF TRACT D1-B IS N 63° 31' E. BASIS OF COORINATES IS ASSUMED."



**SCHEDULE OF PROJECT PHASES**

- PHASE I**  
WASTEWATER DISPOSAL IMPROVEMENTS AND DEMONSTRATION FLUSH/HAUL UNITS
- PHASE II**  
ADDITIONAL FLUSH/HAUL UNITS
- PHASE III**  
ADDITIONAL FLUSH/HAUL UNITS, MUSKOX CREEK WATER LINE AND HONEY BUCKET BUNKER DECOMMISSIONING
- PHASE IV (FUTURE)**  
ADDITIONAL FLUSH/HAUL UNITS AND WASTEWATER DISPOSAL IMPROVEMENTS HONEY BUCKET BUNKER DECOMMISSIONING

**DESIGN CRITERIA**

DESIGN MUSKOX CREEK MINIMUM STREAMFLOW:	0.5 CFS = 224 GPM ±
DESIGN FLOW RATE, MUSKOX CREEK WELL PUMP:	26 GPM @ 76' TDH
DESIGN MINIMUM OPERATING TEMPERATURE:	-20°F
DESIGN WIND LOADING CRITERIA: BASIC WIND SPEED: EXPOSURE:	110 MPH "C"
DESIGN SNOW LOAD:	30 PSF
DESIGN LIVE LOAD, MUSKOX CREEK WELL HOUSE:	125 PSF

DATE	BY	DATA	BY	DATE	REVISIONS	BY
Designed	SMM	Sanitary Sewer Storm Sewer				
Drawn	JA	Water Gas				
Checked	SMM	Telephone Electric Cable TV				
Approved	AP	Easement Footing Elev.				

**PHUKAN CONSULTING ENGINEERS & ASSOCIATES, INC.**  
Civil • Geotechnical • Surveying • Environmental

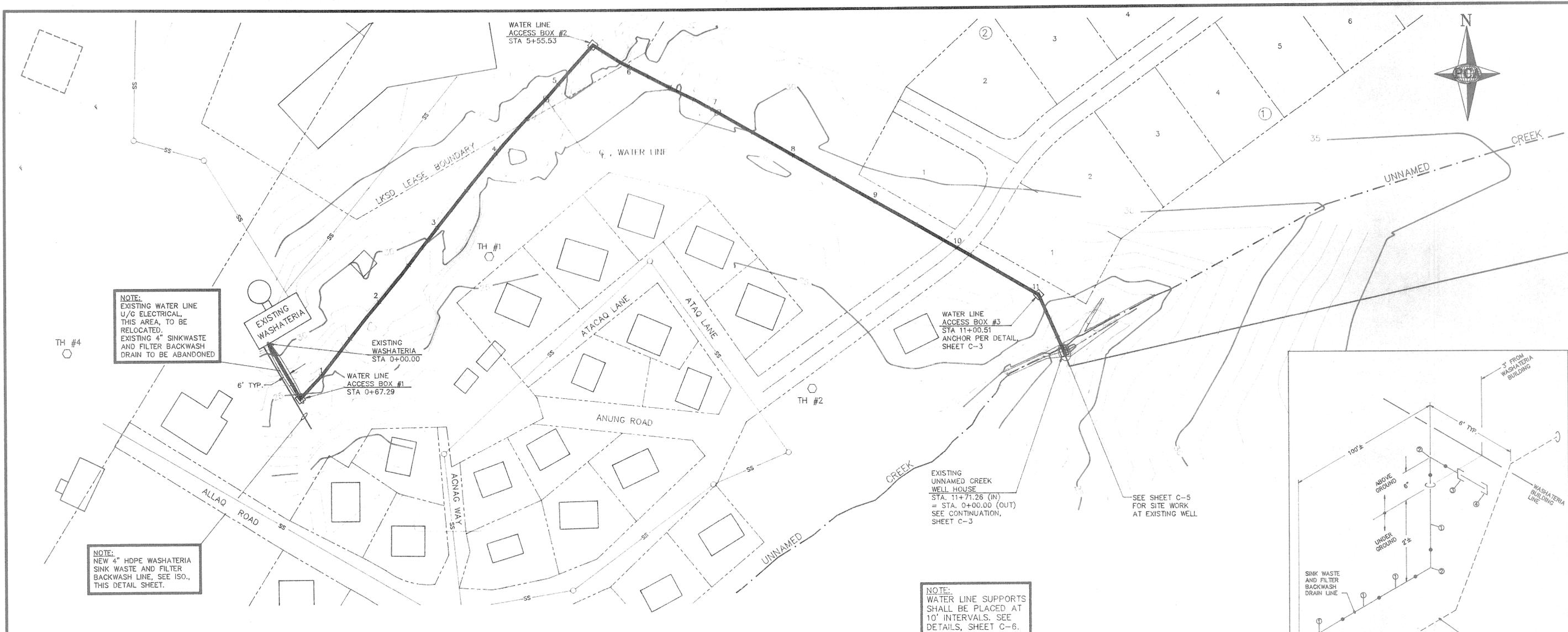
2702 Gambell St., Suite 201, Anchorage, AK, 99503  
Tele: (907) 272-7111 Fax: (907) 277-3177

VILLAGE OF  
TUNUNAK, ALASKA  
PHASE III  
SANITATION IMPROVEMENTS  
1995



**INDEX TO SHEETS, SCHEDULE OF PROJECT PHASES, DESIGN CRITERIA, AND BASIS OF SURVEY CONTROL**

SCALE HORZ. 1" = 200'	GRID DATE 5/23/95	COMP. FILE NO. 730-C1.DWG	SHEET C-1 OF
DRAWN JA	W.C. 94730.1	FILE DRAWER NO.	

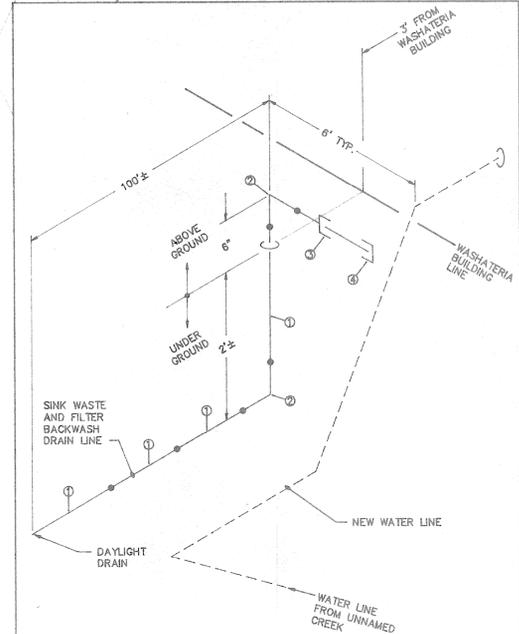
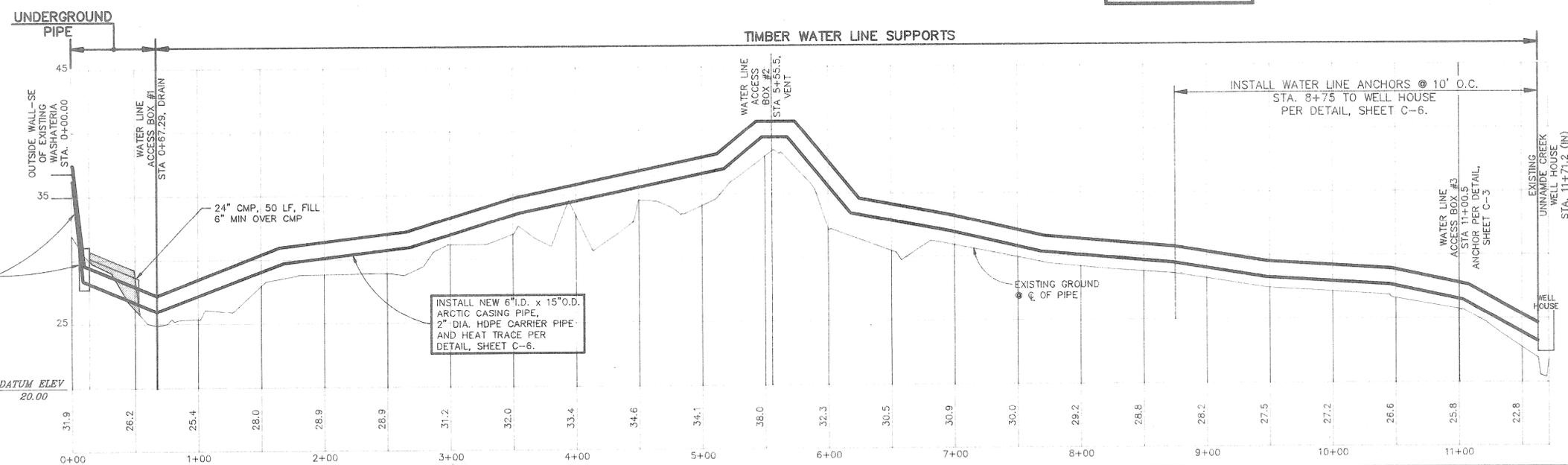


NOTE:  
EXISTING WATER LINE  
U/G ELECTRICAL,  
THIS AREA, TO BE  
RELOCATED.  
EXISTING 4" SINKWASTE  
AND FILTER BACKWASH  
DRAIN TO BE ABANDONED

NOTE:  
NEW 4" HDPE WASHATERIA  
SINK WASTE AND FILTER  
BACKWASH LINE, SEE ISO,  
THIS DETAIL SHEET.

NOTE:  
WATER LINE SUPPORTS  
SHALL BE PLACED AT  
10' INTERVALS. SEE  
DETAILS, SHEET C-6.

SEE SHEET C-5  
FOR SITE WORK  
AT EXISTING WELL



**BILL OF MATERIALS**

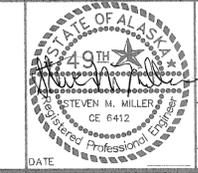
ITEM	DESCRIPTION	QUANTITY
①	4" PIPE, HDPE, INSULATED	1 LOT
②	4"-90° ELBOW, HDPE, SDR 11	2 EA.
③	4" TRANSITION FITTING, HDPE SDR 11 x 304 SS MNPT	1 EA.
④	4" CAP, GALV. STEEL, FNPT	1 EA.
*	USE EXISTING ON-SITE PIPE	

**ISOMETRIC, NEW 4" HDPE WASHATERIA SINK WASTE AND FILTER BACKWASH DRAIN**  
A  
NOT TO SCALE

DATE	BY	DATA	BY	DATE	REVISIONS	BY
Designed 12/94	SMM	Sanitary Sewer				
		Storm Sewer				
Drawn 12/94	J.A.	Water				
		Gas				
Checked		Telephone				
		Electric				
		Cable TV				
Approved		Easement				
		Footing Elev.				

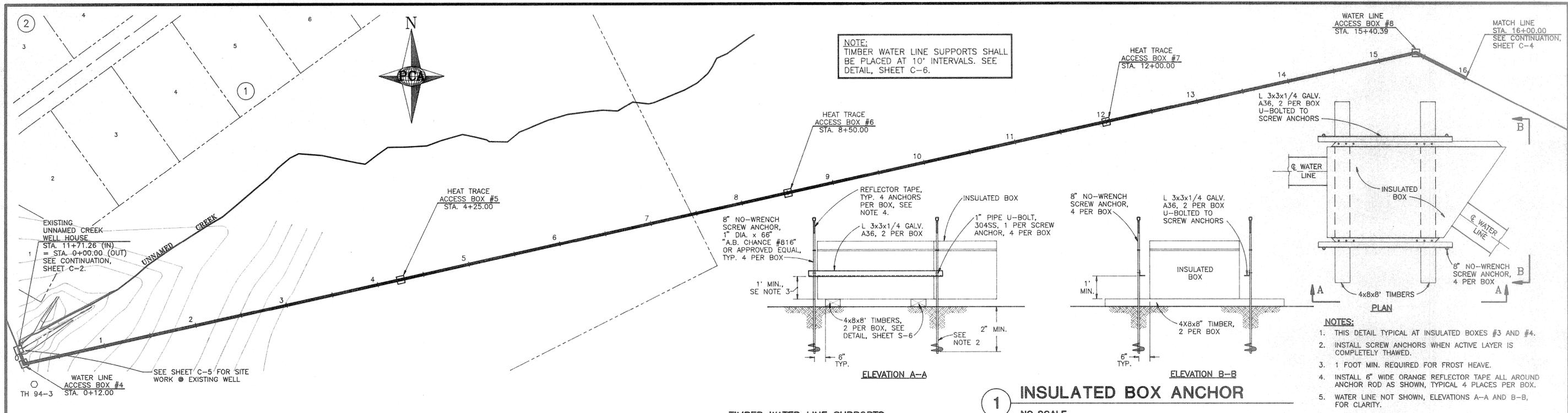
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Tele: (907) 272-7111 Fax: (907) 277-3177

**VILLAGE OF TUNUNAK, ALASKA  
PHASE III  
SANITATION IMPROVEMENTS  
1995**



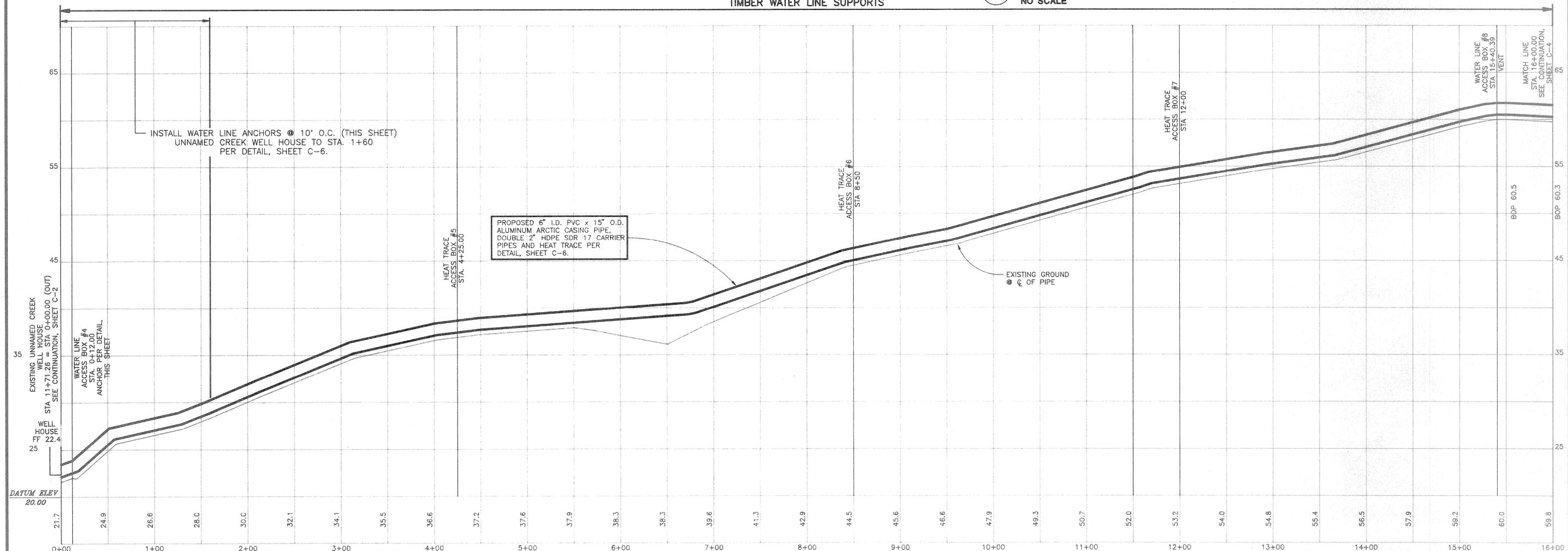
**WATER LINE IMPROVEMENTS  
WASHATERIA TO  
UNNAMED CREEK WELLHOUSE**

SCALE HORZ. 1"=50' VERT. 1"=5'	GRID DATE 5/23/95	COMP FILE NO. 730-C2.DWG	SHEET C-2 OF
DRAWN JA/DKS	W.C. 94730.1	FILE DRAWER NO.	

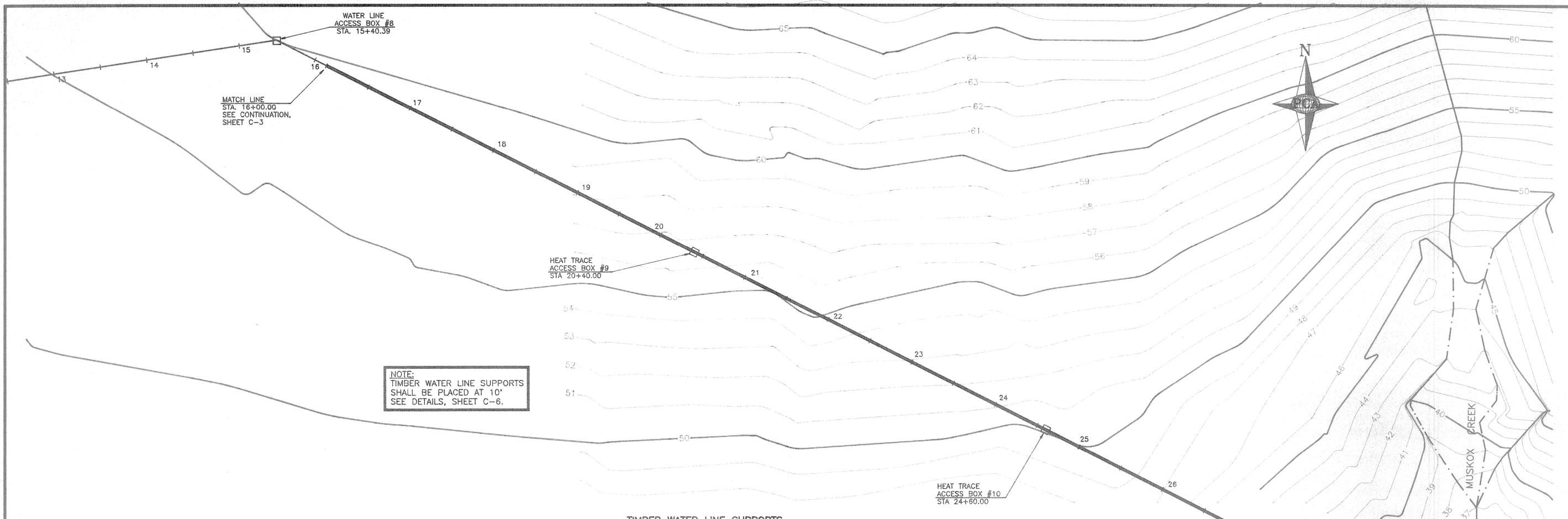


**TIMBER WATER LINE SUPPORTS**

**1 INSULATED BOX ANCHOR**  
NO SCALE

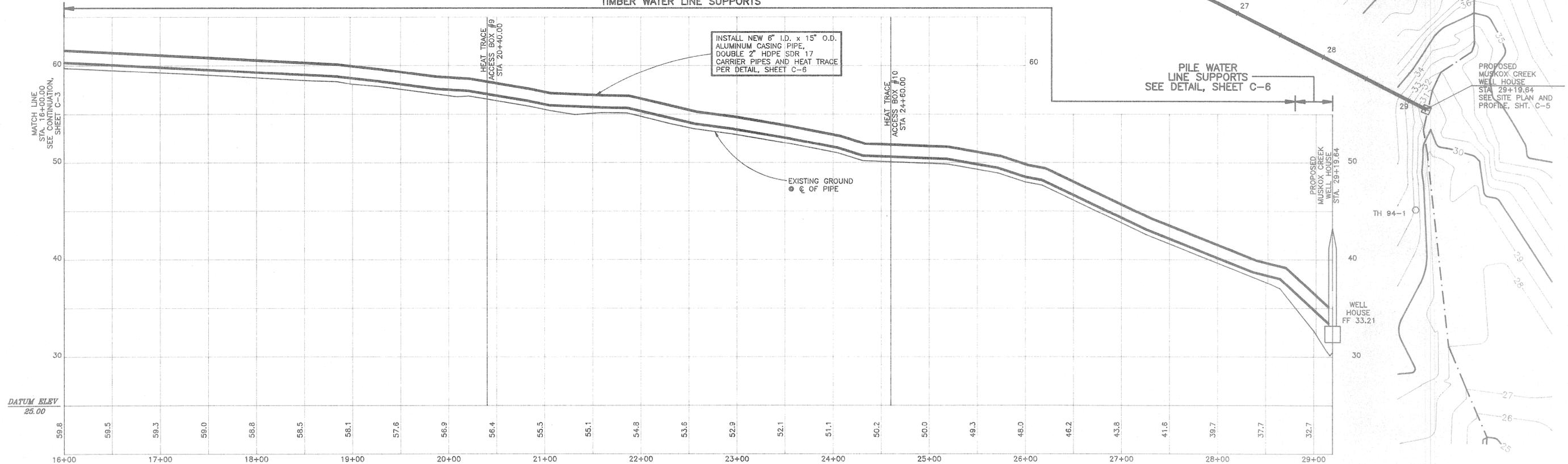


<p><b>PHUKAN CONSULTING ENGINEERS &amp; ASSOCIATES, INC.</b> Civil • Geotechnical • Surveying • Environmental</p> <p>2702 Gambell St., Suite 201, Anchorage, AK, 99503 Tele: (907) 272-7111 Fax: (907) 277-3177</p>		<p><b>VILLAGE OF TUNUNAK, ALASKA</b> PHASE III SANITATION IMPROVEMENTS 1995</p>		<p><b>STATE OF ALASKA</b> 49th STEVEN M. MILLER CE 6412 Professional Engineer</p>		<p><b>WATER LINE IMPROVEMENTS</b> UNNAMED CREEK WELL HOUSE TO STA. 16+00.00</p>		<p>SCALE HORZ. 1"=50' VERT. 1"=5'</p> <p>GRID DATE 5/23/95</p> <p>COMP. FILE NO. 730-C3.DWG</p> <p>SHEET C-3</p> <p>FILE DRAWER NO.</p> <p>DRAWN J.A./DKS W.O. 94730.1</p>	
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NOTE:  
 TIMBER WATER LINE SUPPORTS  
 SHALL BE PLACED AT 10'  
 SEE DETAILS, SHEET C-6.

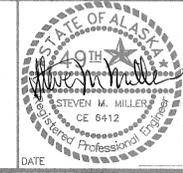
TIMBER WATER LINE SUPPORTS



DATE	BY	DATA	BY	DATE	REVISIONS	BY
Designed 12/94	SMM	Sanitary Sewer Storm Sewer				
Drawn 12/94	JA	Water Gas				
Checked		Telephone				
Approved		Electric Cable TV Easement Footing Elev.				

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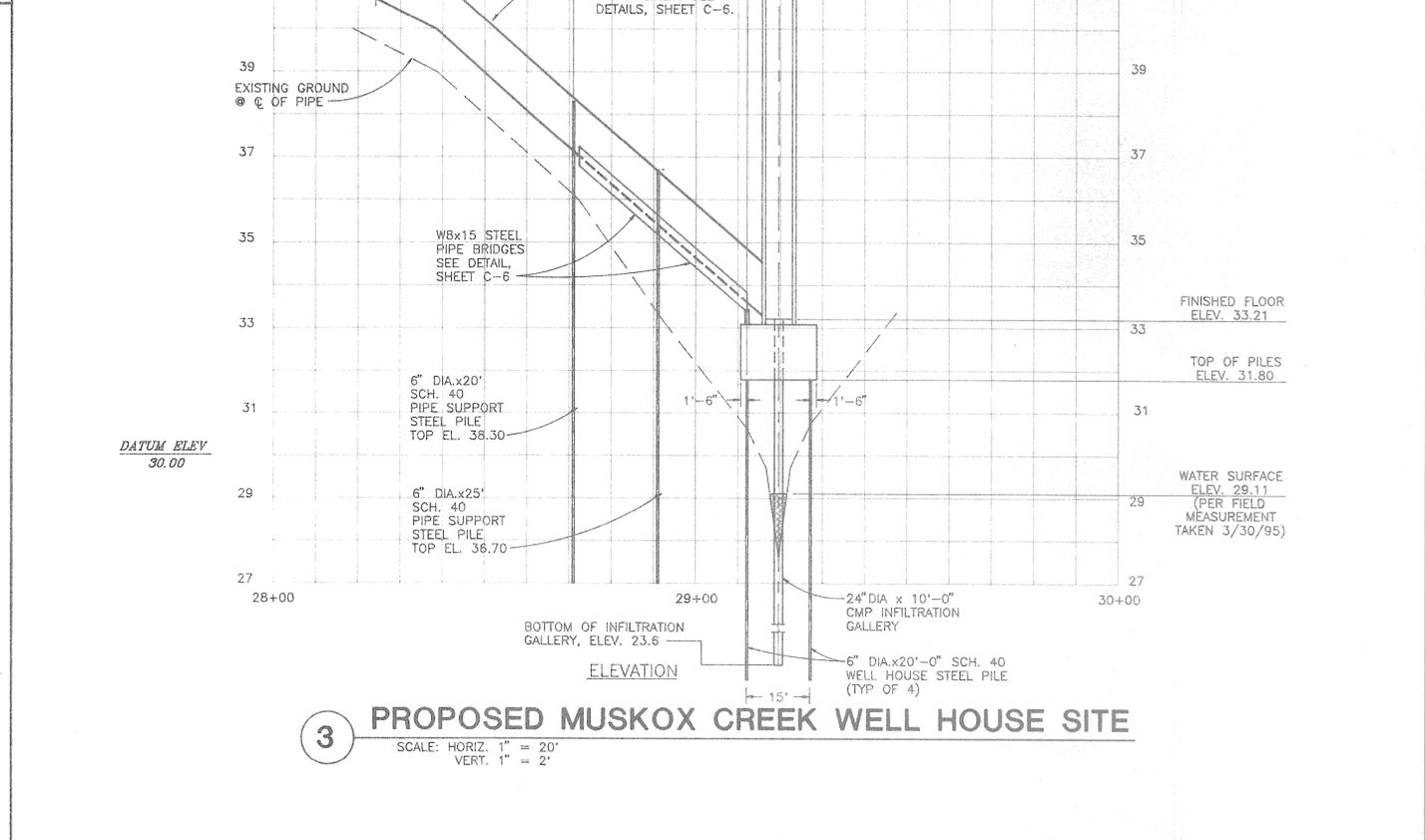
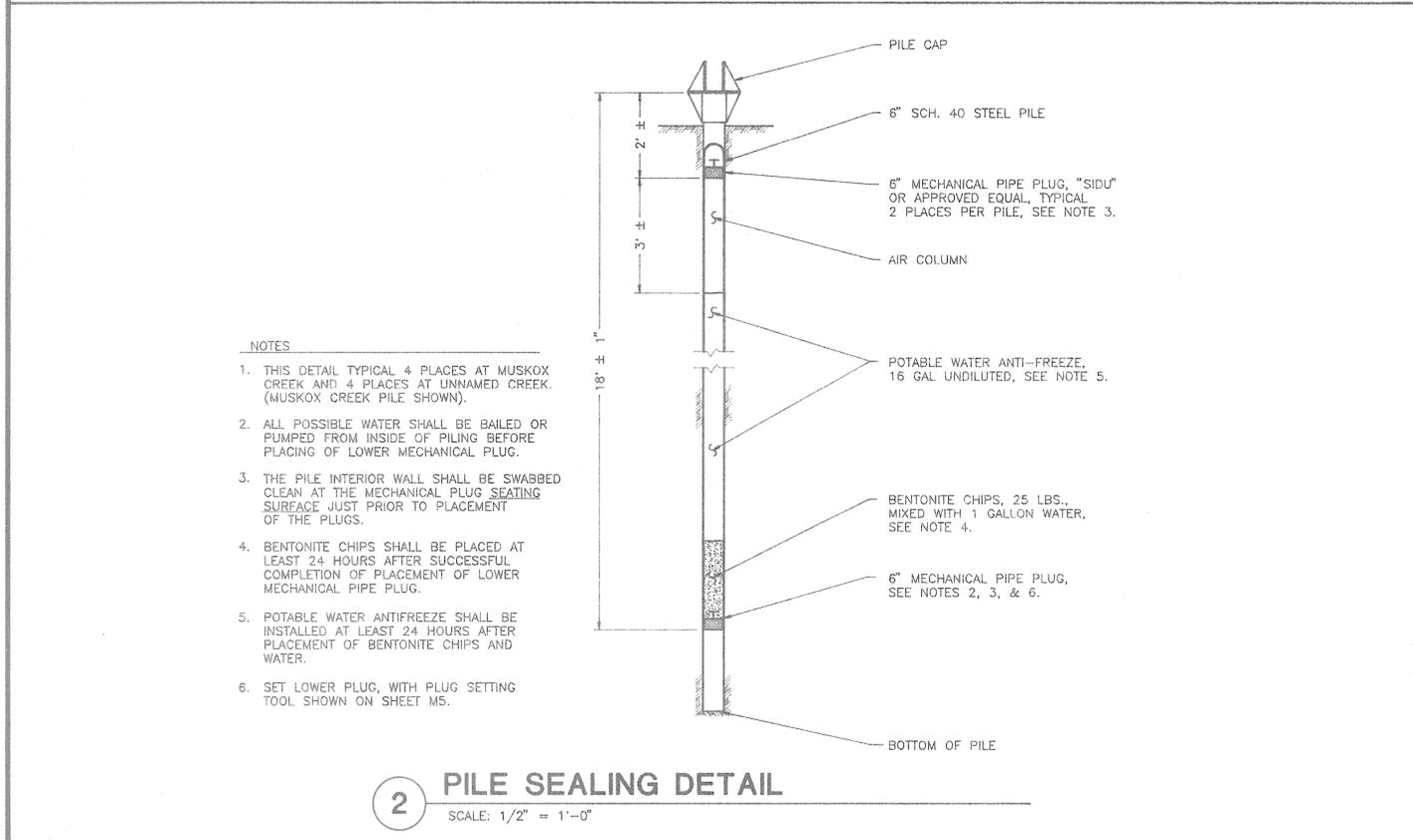
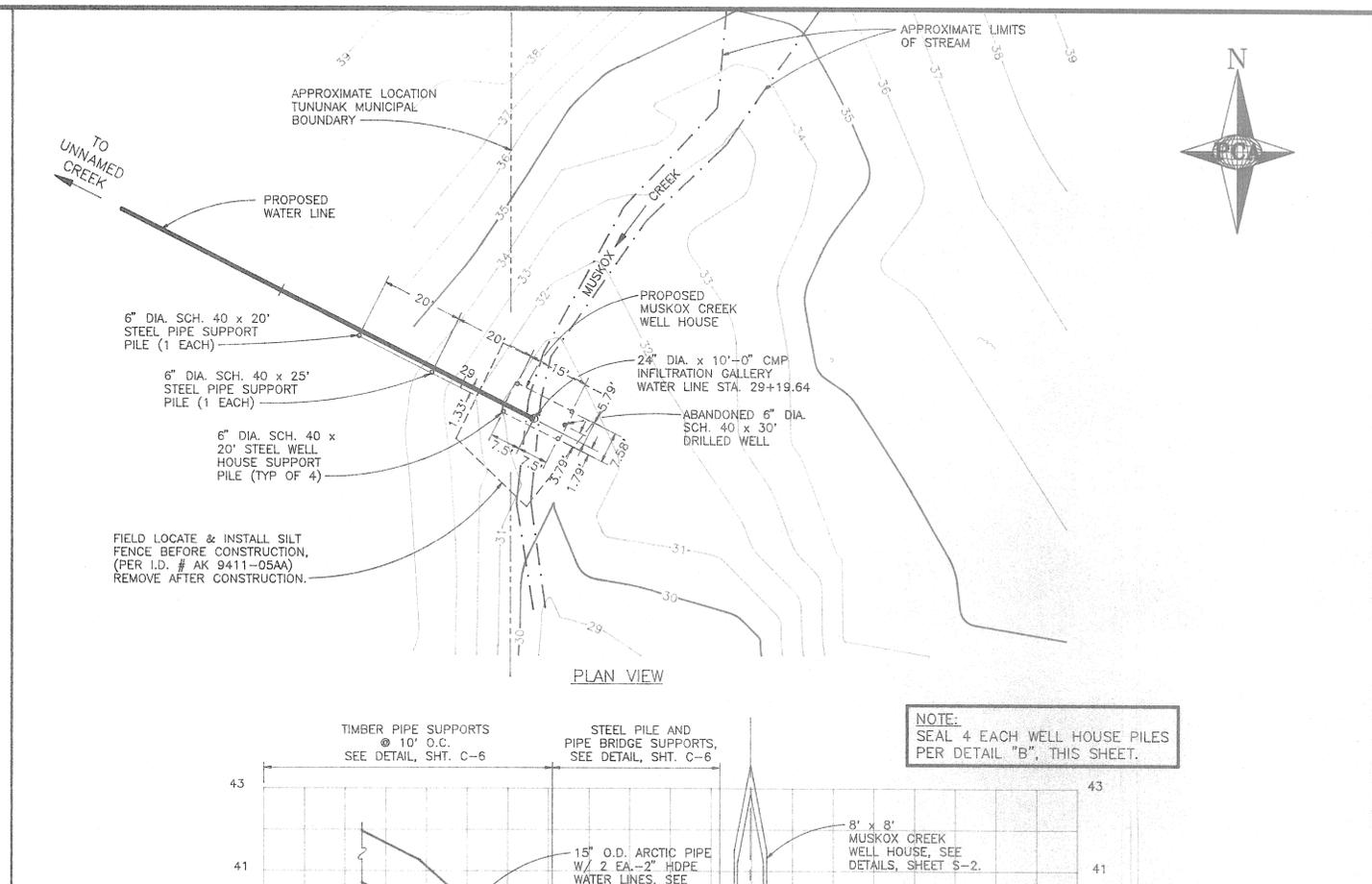
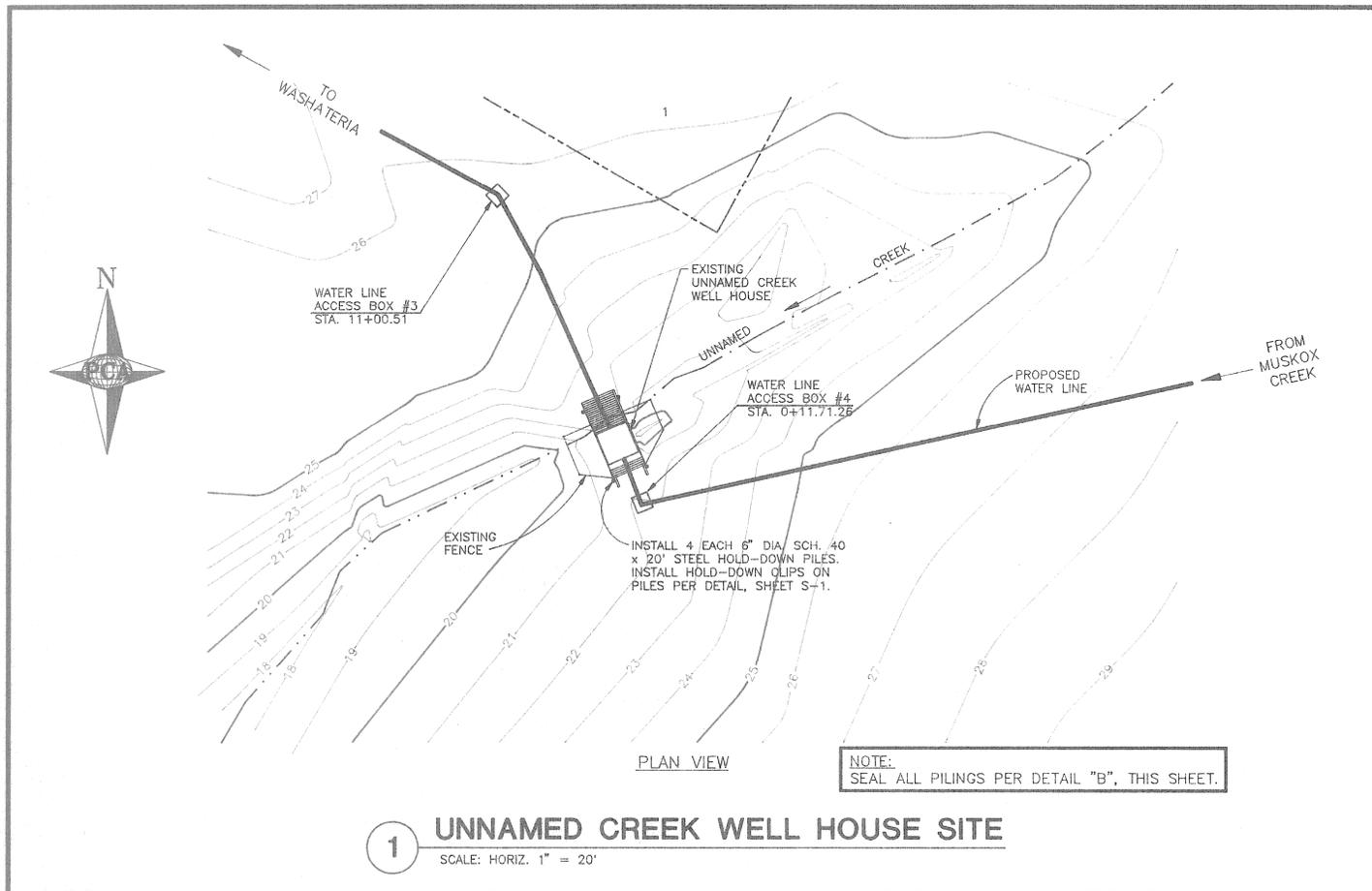
**VILLAGE OF  
 TUNUNAK, ALASKA  
 PHASE III  
 SANITATION IMPROVEMENTS  
 1995**



**WATER LINE IMPROVEMENTS  
 STA. 16+00.00 TO  
 MUSKOKX CREEK WELL HOUSE**

SCALE HORIZ. 1" = 50' VERT. 1" = 5'	GRID DATE 5/23/95	COMP FILE NO. 730-C4.DWG	SHEET C-4 OF
DRAWN J.A./DKS		FILE DRAWER NO.	

DATE \_\_\_\_\_ W.D. 94730.1



DATE	BY	DATA	BY	DATE	REVISIONS	BY
Designed	—	Sanitary Sewer				
	—	Storm Sewer				
Drawn	—	Water				
	—	Gas				
Checked	—	Telephone				
	—	Electric				
Approved	—	Cable TV				
	—	Easement				
	—	Footing Elev.				

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VILLAGE OF  
TUNUNAK, ALASKA  
PHASE III  
SANITATION IMPROVEMENTS  
1995



**UNNAMED CREEK WELL HOUSE SITE**  
**MUSKOX CREEK WELL HOUSE SITE**

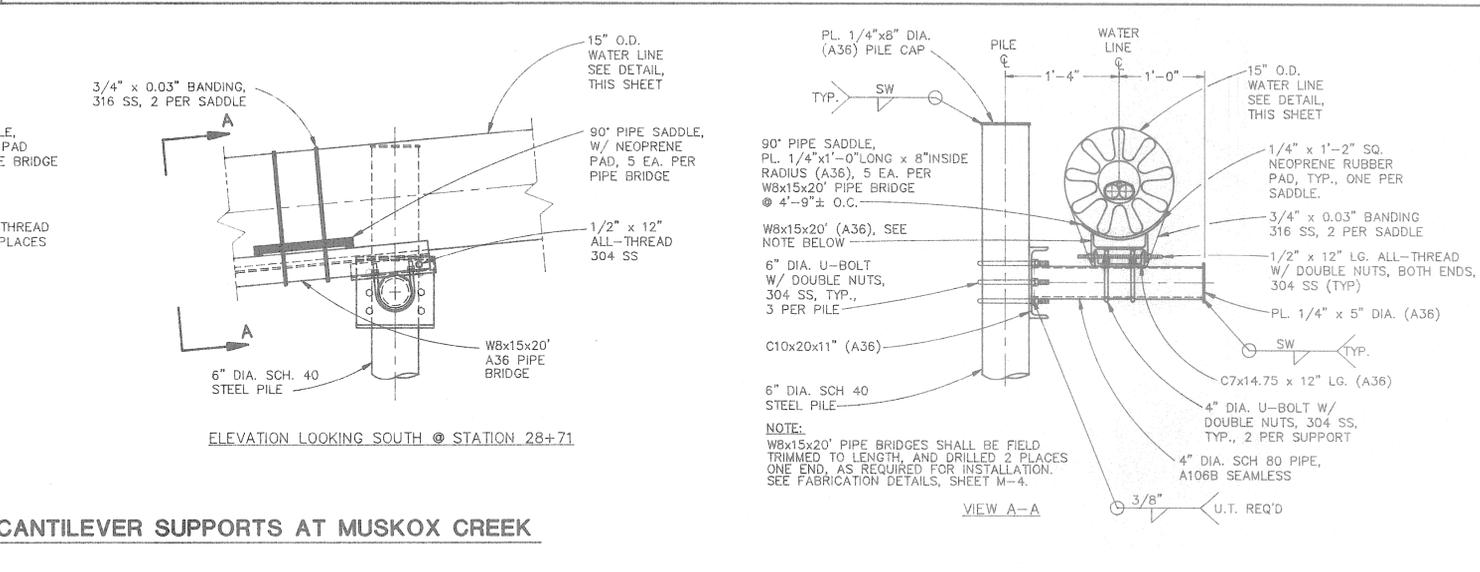
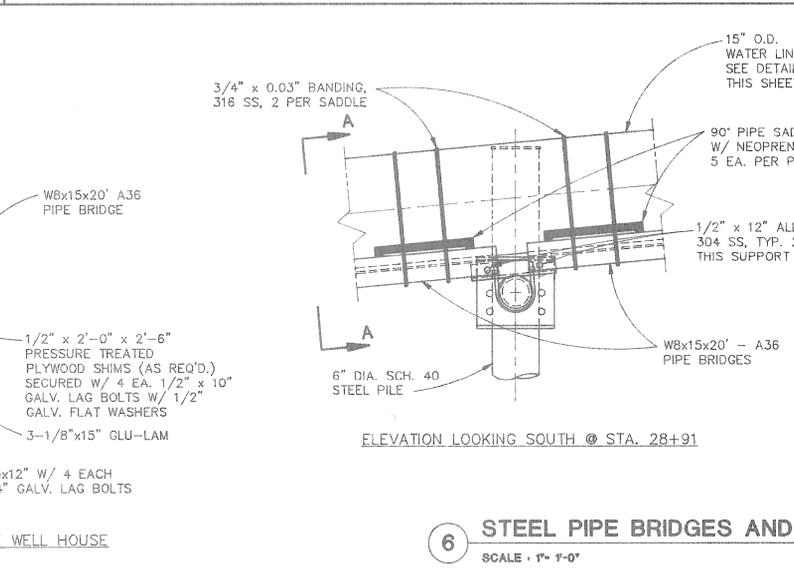
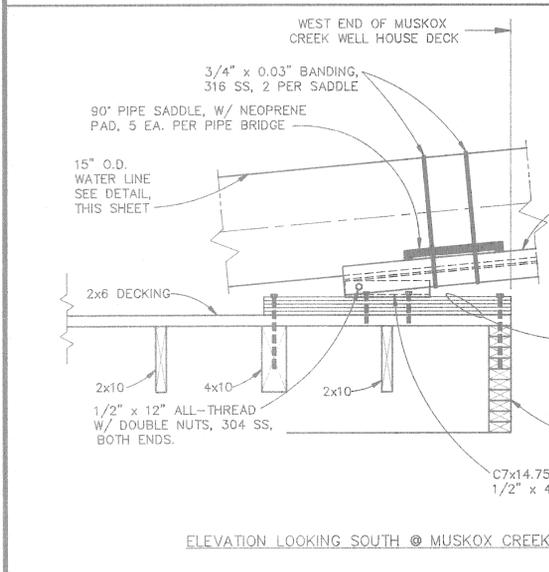
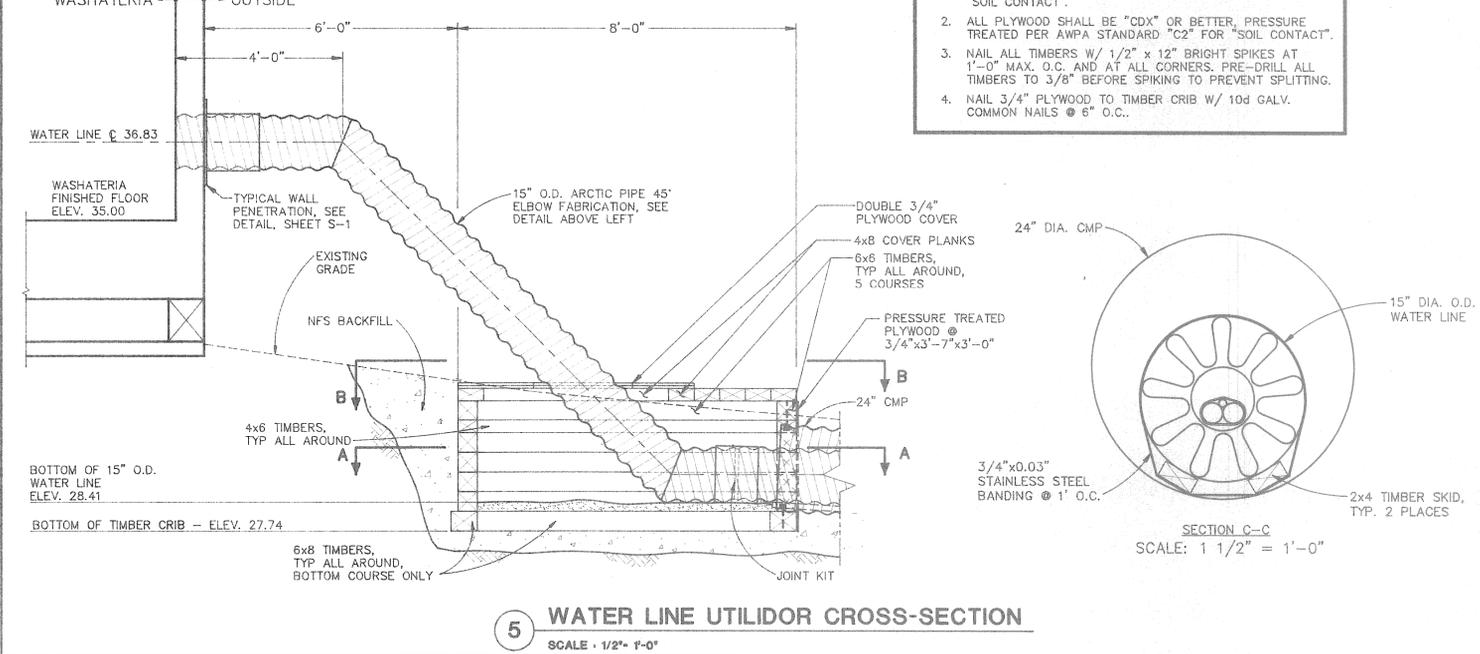
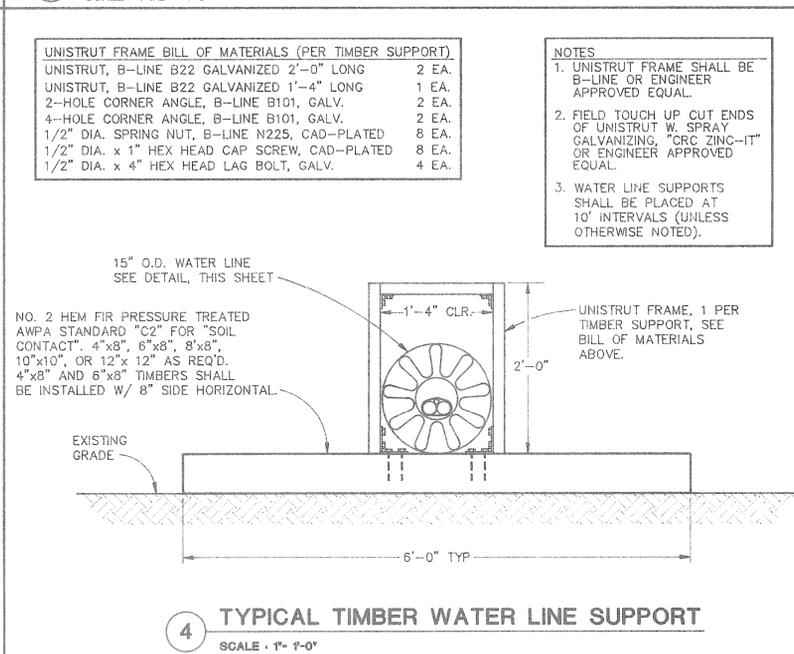
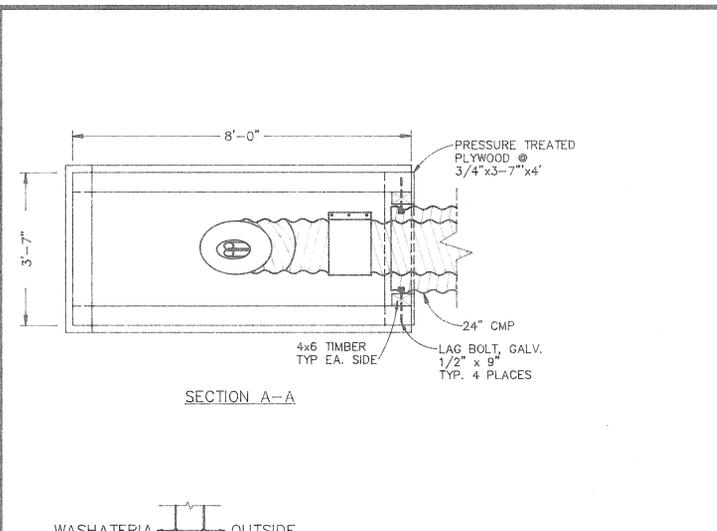
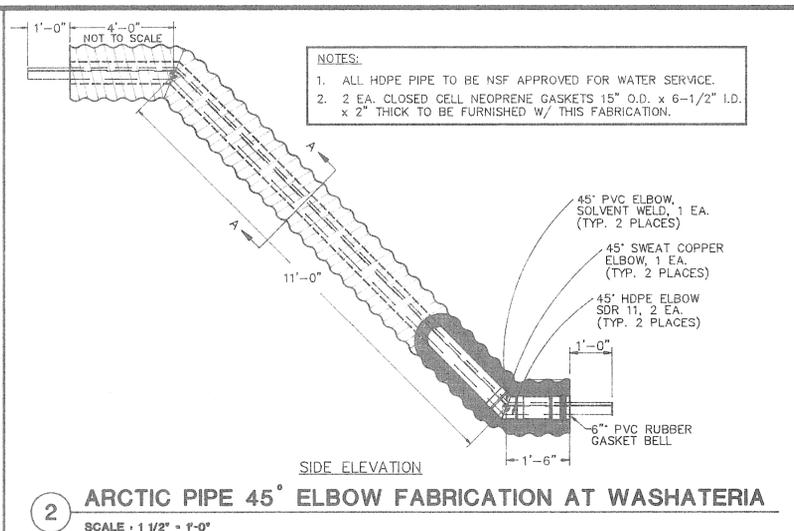
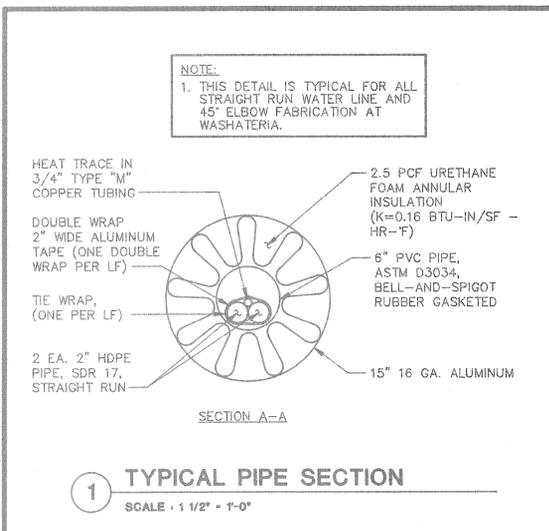
SCALE: HORIZ. 1" = 20'  
VERT. 1" = 2'

GRID: DATE 5/23/95

COMP. FILE NO. 730-C5.DWG  
FILE DRAWER NO.

SHEET C-5 OF

DRAWN J.A. DATE 5/23/95



DATE	BY	DATA	BY	DATE	REVISIONS	BY
Designed	---	Sanitary Sewer	---			
Drawn	---	Storm Sewer	---			
Checked	---	Water	---			
Approved	---	Gas	---			
		Telephone				
		Electric				
		Cable TV				
		Easement				
		Footing Elev.				

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**VILLAGE OF TUNUNAK, ALASKA**  
PHASE III  
SANITATION IMPROVEMENTS  
1995



**WATER LINE IMPROVEMENTS**  
WATER SYSTEM DETAILS

SCALE AS SHOWN  
GRID ---  
DATE 5/23/95  
W.O. 94730.1

COMP FILE NO. 730-C6.DWG  
FILE DRAWER NO. ---  
SHEET C-6 OF ---

**Attachment 2**  
**Bob Gilfilian's Tununak Field Notes**  
**For**  
**June 5-8, 2018**

(107) June 5, 2018  
Tues

Tunmall, AK  
Tech Memo Field Trip

@ 0500 arrived at ANC Airport - Rain. Air for flight to Tunmall (via Bethel, Nightmute, Toolik Bay)

@ 1000 left ANC for Bethel

@ 1130 arrived Bethel

@ 1250 left Bethel on Massland Air/Boon

@ 1330 arrived in Tunmall

met Ira at Airport/Airfield & Teddy

@ 1340 went to school to check in. Today

@ 1400 met Xavers at his house

Joseph James, operator H2O plant

Vincent Billings " (652-2630)

IRA # 6152 - 202 (not

@ Called Brandi for school internet password

Amy 5493 - 4827

- Ira took me in H-Wheeler to Village office - everything in Village was shut down due to no power except school.

@ 3 pm took walking tour of Village to check out layout of photos.

Chook Masketkin JSTP to set up for test

- Elizabeth secretary at School

Bob Gilfillan - Tunmall AK  
Field Trip Notes, June 5-8, 2018 (6 pages)

Tunmall, AK

6/5/18

(128)

Tues  
~50°F, Clear Sun  
western

@ 4 pm walked along beach to the north end where bluff (56' high) meets the beach. Took photos to show exposed rock formation and brown sandstone/siltstone. Collected sample of gray sandstone/siltstone horizontally fractured.

✓ Walked south on beach to School's sewer outfall daylighted on upper beach.

✓ Took photos of School's exterior water treatment plant and W/P plant.

✓ Went to Warehouse - closed due to power out. Took exterior photos and pipeline to Clinic.

✓ Checked west leg of waterline to Wash WTP - noted repairs work on arctic pipe.

@ 6 pm contacted Vincent Billie who agreed to meet me tomorrow at 10 am to start adequacy test on ST/SA.

- Returned to school to organize files and field gear for tomorrow's projects.

- Reviewed project files until 8 pm

Bob Gilfillan - Tunmall AK  
6/5/18

(109) TUESDAY, AK

June 6, 2018 (Wed)

~70°F

Part Sun

~5 mph Wind

~8 AM prepared draft proposal letter to USW for deep well Geophysical Survey

~9 AM called Collin Mackel on survey dates

Prepared field maps/docs to meet w/ Vincent Billie, Unumak WPA, to go over items needed to complete the following tasks:

- 1- Inspect WST (need folder to CK tank)
- 2- Inspect Well House on Unumak Creel
- 3- Inspect water transmission line
- 4- Conduct Adequacy Test on ST/SAs.

Also prepared form RM5-2 and other standard safety forms to review w/ Vincent

@1050 met Vincent Lilly at School, check WTP but it was locked. Went to Village Office

@1030 hold mtg. w/ James James, James, Joe James, and Vincent Lilly

- Discussed purpose of my visit and scope of work (tasks)

- Went over well drill sites, noted Village owned corner of site south of Unumak

Creel along Muskok Co water transmission line

- Decided to walk sites tomorrow

Note: Near cold water discharge in Washegan

Sqft = 375 sq

~45°F

Cloudy

~15 mph Wind

@1100 Went to Mackel's / WTP w/ Vincent Billie and Joe James

✓ Checked over Mack (in use) w/ my washer and 2 dryers (Vincent est 4 gal/wash)

✓ Made arrangements for discharge water in to Mack sewer drain for Adequacy Test

Mean flow at 8.3 gpm

✓ Checked over empty nest conditions in WTP - took photos - barely operating

✓ Noted WST had ~14" water level

✓ Found one shower & one toilet working!

✓ Went to WST w/ ladder, climbed on top to check tank condition. Took photos and videos. Opened top access cover

Observed rust debris floating in tank plus an empty soda can floating

✓ Went to sewer system to check manholes and then opened access to 4 End 2.5 ST

Found monitor tubes (8) that were installed by LKSD a couple of years ago when they

installed several new infiltrator lines in the area of the former WPA Sat

Absorption System (SAs) - Need Record Drawing.

@1230 I informed Vincent & Joe that I would complete Adequacy Test and we will meet tomorrow at 9 AM to inspect Well House & Unumak CK.

Thursak (110)

June 6 '18

(111) Timmuck  
June 6, 2018

530F  
Cloudy, Windy  
25 mph

@ 12:45 returned to school to prepare forms for adequacy test. Organized notes & equipment  
Lay out map of ST/SAS for Adequacy Test

@ 2 PM went to ST/SAS to take starting meas.

@ 2:30 meas liquid level in ST/SAS meas.

STCO 99.5" btop (6" Ø HDPE) (W/ST)

S-1 60.0" btop (4" Ø OW)

S-2 55.5" " (4" Ø OW)

S-3 57 1/2" " (headers) (4" Ø) wet

S-4 36" " (header pipe) (wet)

N-1 (8" Ø) (filled w rocks) (4" Ø) drains

N-2 99.5" btop (8" Ø OW)

N-3 48" " (4" Ø OW)

N-4 54" " damp bottom frame (4" Ø)

@ 15:08 started flow into Wash Area drain

meas flow in 5 gal bucket in 40 seconds

calc flow = 7.6 gpm plus 1 bad washer

@ 15:23 (15 min) meas SAS 1/2 ST

STCO 100.0" btop

S-1 59.5" btop (feels like header pipe)

S-2 55.0" "

S-3 52.0" "

S-4 45 1/2" " able to clear header wet bottom soil

Sunny 55°F  
25 mph Wind

Timmuck (112)  
6/6/2018

N-2 99 1/2" btop

N-3 48 1/2" btop

N-4 damp soil

@ 16:45 pm meas flow in Wash Area = 7 gpm

@ 16:10 meas ST/SAS Obs. Wen (OW)

STCO 99.5" btop

S-1 59.5" btop (This is header pipe w 4" Ø coming from 2K ST)

S-2 54 1/4" "

S-3 52" "

S-4 damp "

N-2 99 1/2" "

N-3 48" "

N-4 damp "

Found 4" Ø AGS ob pipe in NW corner of SAS

meas liquid = 72 1/2" btop (flush w SS)

~15' SW of N-2

@ 16:50 meas flow = 5.75 gpm of Wash Area

4 loads of washer used during test

@ 17:00 meas levels in ST/SAS

STCO 99 1/2" btop (stickup = 22" AGS)

S-1 57" btop (stickup = 7" ags)

S-2 54 1/2" btop " = 12"

(113) Timmerlake  
6/6/2018

Continue near STAS

S3 52" btop

S4 damp "

N1 NA

N2 99 1/2" btop

N3 47 1/2" btop

N4 damp

NW corner OW = 72 1/2" btop, No stickup flash GS

@ 1752 meas flow = 60 gpm in Washeteria

@ 1808 Shut off flow for Adequan Test

Ave flow 616 gpm, Total flow = 1,195 gal

Plus 4 Wash load yields 1300g in 180 min

Note: laundry being used all day - 1 washer

@ 1815 meas SWLs in ST/SAS DNS:

ST CU 99 1/2" btop

S1 ~~55 1/2"~~ (very difficult to measure headed)

S2 54 3/4" "

S3 52" "

S4 damp "

N2 99 3/4" "

N3 47 1/4" "

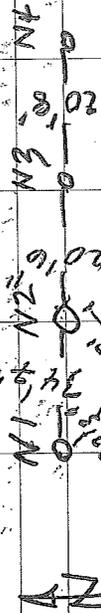
N4 dry 30 1/2" "

NW OW 72 1/2" "

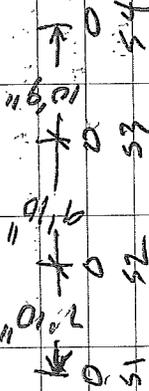
55°F Wind  
Sunny/20mph

Timmerlake (114)  
6/6/2018

Layout of ST/SAS measured at 18



GAS



2" ST 27"

4" ST 27" ST 6" CO to S1 = 44 1/4"

6" CO 27" S4 = 57 1/4"

N1 to S1 = 135'

MH 27" (ply wood box)

@ 7:10 pm returned to school to retrieve notes

Seat reserved for Geophysical Survey to Sweden

via email B/V justification 6/6/18

END Day 2

(116)

Thompson  
6/7/18

Cloudy, 25 mph wind  
40°F

7" HI above N2 to 2.3' NW-CO TOP  
7" HI " to 1.9' N3 TOP  
7" HI " to 1.8' N4 TOP  
- Check at Barb Miller, LKSP Butler

@ 10:20 went to WTP of Joe Vincent  
@ 11:00 inspected unnamed Creek  
Pump House

1.5 AP pump - 2 of them  
H2O level in well was 18" below floor  
H2O depth in well was 24"  
Creeper floor - 6" deep x 3' wide  
Channel 2' wide x 9" deep  
Velocity = 5 sec/ft in channel 30x6

✓ Walked along water transline

@ 12:00 drove in ATV of Vincent to work  
over proposed drill sites. Took photos & videos  
@ 12:30 drove up to gravel pit on top  
maintain in cloud layer a couple miles up  
hard road - filled w/ snow - developed by GAP

@ 1:300 went to TRA office to meet w/ staff  
Met w/ James James & Laura Post

@ 14:00 rode back to school w/ Vincent, stopped  
to photo base site south of BA school & horizon bucket

@ 15:00 helped in tele conf w/ Susan Flank & back  
Worked rest of day on notes & reports  
13th June Day 3  
Note: 24 hr STS As board  
CA 1815-5TCO = All done 15

Cloudy 42°F  
15 mph wind

@ 0800 organized notes for field work  
to day schedule to complete Adequacy  
Text and inspect unnamed Creek well.

@ 0915 pet Joe Jones went to STSAS  
Joe informed me that ~ 2 loads wash so  
for their morning at Washoburn

Meas SWL in STSAS at 0930  
ST-CO 99 1/2" btop

S1 59" "  
S2 55 1/2" "  
S3 52 1/4" "  
S4 dry "  
N1 NA "

N2 99 1/2" "  
N3 48 1/2" "  
N4 98 1/2" dry "  
NW-CO 73" "  
Note: lift Sta  
discharge 2" @ HOVE  
is ~ 480 gpg

TOP  
(11)

N 27" HI above S1 to ST-CO top ring  
30" HI " to 1.7' to 5.2 top  
30" HI " to 2.4' to 5.3 top  
30" HI " to 2.9' to 5.4 top  
2.5" HI " to N1 TOP  
7" HI " to N1 TOP

Timonah, AK  
June 8, 2018  
(Friday)

45° F Cloudy  
Calm

- ✓ @ 0800 organized field notes and photos on laptop
- ✓ @ 0930 walked to Tribol office (No Vincent!) Approx 1.25 miles school to office
- ✓ @ 1000 held telecont w/ Susan Randlett, James James and Xavier fast. Discussed approach to drilling exploratory deep wells. Need SHIPPO and wetland & maybe GEN
- ✓ Best Practices waiver
- ✓ Need cost est. for drilling wells
- ✓ Possible funding from RD by July 15
- ✓ Possible sale source
- ✓ Grant period up to 5 years
- ✓ Discussed maintenance
- ✓ Susan recommended include water line w/ well
- ✓ @ 1000 met w/ sides
- Xavier said most folks take steam baths & took several photos of steam huts
- Meas distance from ST Lift Sta to S1 or 25
- ✓ @ 1130 returned to school for packing met Vincent belly ad Today on flight study
- Found out Hazelwood Air could not fly from Suxhel due to weather delay

Timonah  
June 8, 18

50° F Partly Sun  
-10 mph wind

- Next several hours kept calling Hazelwood in Timonah & Bechtel with negative response
- ✓ @ 1600 friend met Grant Air was coming to Timonah so Today rushed me out to the airport as the plane was landing - able to get a seat!
- Flown to Toklean Bay and then to Suxhel.
- Arrived at 1735 as my plane flight was departing Bechtel
- Went to AK Air and able to get a seat for 9 pm flight to ANC
- ✓ @ 2015<sup>PM</sup> boarded Alaska Air Flt #46 for ANC for ANC
- ✓ @ 2100 arrived at ANC Airport
- ✓ @ 2200 arrived at Greg Meyer's for the night
- End Day 4  
Bechtel report 6/8/18

**Attachment 3**

**Photo Log**



*Photo 1 – Water transmission line entering the east side of Washeteria/WTP*



*Photo 2 - Looking south along water transmission line towards the turn box #1 at clinic. Note the condition of the Arctic pipe foundation system.*



*Photo 3 - Looking north along west portion of the water transmission line with Tununak School shown in the upper left corner.*



*Photo 4 – Uncovered water line turn box #1 located next to clinic.*



*Photo 5 – Exposed section of Arctic Pipe on water transmission line.*



*Photo 6 – Looking southeast at exposed section of Arctic Pipe shown in Photo 5.*



*Photo 7 – Temporary repair of an exposed section on the Arctic pipe.*



*Photo 8 – Looking east towards temporary repair on another section of the Arctic pipe.*



*Photo 9 – Looking east along west portion of the water transmission line with timber supports.*



*Photo 10 – Looking east towards water line turn box #2.*



*Photo 11 – Looking east on western portion of the water transmission line with foundation issues.*



*Photo 12 – Looking east along the northern portion of the water transmission line.*



*Photo 13 - Uncovered section of water transmission line showing repair work.*



*Photo 14 – Looking north from the Unnamed Creek pump house along eastern portion of the water transmission towards the waterline turn box #3 shown just below house in background.*



*Photo 15 - Looking east towards the waterline turn box #3.*



*Photo 16 – Looking east towards the water line turn box#3 and Unnamed Creek pump house with water transmission line in background from former Muskox infiltration gallery.*



*Photo 17 - Looking north towards northern portion of the water transmission line set on elevated foundation system.*



*Photo 18 - Looking north towards the northern portion of the water transmission line.*



*Photo 19 - Looking south at water transmission line exiting the Unnamed Creek pump house. In the background is the water transmission line from the former Muskox Creek infiltration gallery.*



***Photo 20 - Looking east from the down gradient side of Unknown Creek towards the Unknown Creek pump house. Arctic pipe on right side is the water transmission line from the former Muskox Creek infiltration gallery. The Arctic pipe to the left of the Unnamed Creek pump house is the existing water transmission line to the Tununak washeteria/WTP.***



***Photo 21 - Looking into the Unnamed Creek pump house with the infiltration gallery consisting of the 24 inch diameter corrugated pipe shown in the center of the door opening.***



***Photo 22 - Looking inside the Unnamed Creek pump house with the infiltration gallery in foreground.***



***Photo 23 - Looking down on the infiltration gallery consisting of the 24 inch diameter corrugated pipe. Electrical wiring hooked up for temporary use of the submersible pump that is plumbed into the water transmission line shown to the right of the well.***



***Photo 24 - Electrical control boxes and pump relay for the submersible pump.***



*Photo 25 - Looking down inside 24 inch diameter corrugated pipe used for the infiltration gallery.*



*Photo 26 - Foundation support beam for the Unknown Creek pump house suspended over Unnamed Creek.*



*Photo 27 - looking north at the rear side of the Unnamed Creek pump house suspended over Unnamed Creek. The Arctic pipe on the left side of the building is the water transmission line from the former Muskox Creek infiltration gallery. The Arctic pipe on the right side is the existing water transmission line from Unnamed Creek infiltration gallery to the Tununak Washeteria/WTP. On the roof of the pump house is an entrance use during the winter time when snowdrifts prevent access to the pump house where the operator must climb on the roof and enter the pump house through the roof opening.*

**Attachment 4**  
**USPHS As-Built**  
**of**  
**Unnamed Creek Infiltration Gallery**



**95% Draft**

**Technical Memorandum 3**

**Structural Assessment of the Existing 50,000-Gallon  
Water Storage Tank**

**For**

**Tununak, Alaska**

**August 8, 2018**

To:	Native Village of Tununak IRA Council Tununak, Alaska	From:	Bob Gilfilian, PE Principal Civil Engineer Stantec Consulting Services, Inc.
File:	<b>Technical Memorandum 3 – Structural Assessment of the Existing 50,000-Gallon Water Storage Tank</b>	Date:	August 1, 2018

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## Section 1.0 Introduction

The Native Village of Tununak a.k.a. Tununak IRA Council (herein referred to as Tununak) in cooperation with the Alaska Department of Environmental Conservation (ADEC) Village Safe Water (VSW) has retained Stantec Consulting Services Inc. (Stantec) to prepare this Technical Memorandum (Tech Memo) with funding from the U.S. Department of Agriculture Rural Development (USDA-RD).

The purpose of this Tech Memo is to provide a summary of the findings of an assessment of the structural condition and usability of the existing 50,000-gallon water storage tank (WST). This Tech Memo provides recommendations for future use if the tank is found to be in satisfactory condition, or corrective action if it is determined that the tank needs to be repaired or upgraded.

The WST is located adjacent to the Water Treatment Plant (WTP)/Washeteria building with an attached corridor between the tank and the WTP. The corridor houses the treated water inlet line to the tank and the outlet service line from the tank. The WST was constructed approximately 40 years ago by the U.S. Public Health Service (USPHS). Attachment 1 provides an as-built plan sheet titled "50,000 Gallon AWWA Water Tank & Details" prepared by USPHS for the Construction Plans for Sanitation Facilities, Tununak, Alaska, dated February 1980.

Based on a 2007 sanitary survey inspection, the interior of WST has noticeable corrosion with a poor interior coating condition and the survey recommended the interior of the tank should be inspected. The purpose of the inspection is to determine if the WST is structurally sound and assess the interior coating to determine if it needs to be recoated to prevent further corrosion. It is also understood, per discussion with the WTP operators, that the interior of the tank has never been cleaned.

According to the findings of a Sanitary Survey of the Tununak WTP that was completed for ADEC on August 17, 2010, there were several deficiencies noted with the WST. The tank's water overflow line and air vent at the top of the tank were not properly screened. Also, the air vent needed to be turned downward a minimum distance of 2.5 times the line diameter above the tank surface.

**Reference: 95% Draft Tech Memo #3 – Structural Assessment of the Existing 50,000-Gallon Water Storage Tank**

## **Section 2.0 Methodology**

The structural integrity and usability/functionality of the WST and its foundation system was inspected during a field trip conducted on June 5 through 8, 2018, by Bob Gilfilian, P.E., Senior Principal Civil Engineer with Stantec. During the site investigation, Mr. Gilfilian interviewed the Tununak WTP operators and key administrative staff to obtain information on the operation of the WST during all seasons of the year. According to the operators, the tank is filled on an as needed basis dependent on the water usage in the Washeteria and supply to the nearby clinic. The operators typically pump raw water from the Unnamed Creek infiltration gallery and treat the water prior to filling the tank. It is understood the tank is normally filled approximately four times a year.

The field assessment for the preparation of this Tech Memo involved a field trip to visually inspect the exterior condition of the WST roof, walls, bottom, and foundation. In addition, the interior of the tank was checked from the roof hatch to assess the tank's interior condition above the tank's water level. The observable portion of the tank foundation was assessed to the greatest extent possible. The inspection of the WST did not involve intrusive measurements of the tank material nor the foundation.

Shortly after arriving in Tununak on June 5, 2018, Mr. Gilfilian inspected the exterior condition of the WST from the ground surface. On the following day (June 6), Mr. Gilfilian met with the two water systems operators, Mr. Joe James and Mr. Vincent Billy. The operators accompanied Mr. Gilfilian during a brief inspection of the WTP. Mr. James provided a ladder that allowed access to the exterior ladder on the WST. Mr. Billy assisted Mr. Gilfilian during the inspection of the top of the tank. Access to the interior of the tank was provided via the tank's roof hatch. Upon opening the hatch, it was noted that there was considerable amount of floating debris on the water surface which was at a level near its maximum height.

The field inspection notes prepared by Mr. Gilfilian are provided in Attachment 2. Several photographs were taken to document the condition of the WST. These photographs, with brief captions, are provided in the Photo Log (Attachment 3).

## **Section 3.0 Discussion of Findings**

The photographs taken during the site visit conducted on June 5 through 8, 2018, show the exterior and interior condition of the WST and its foundation system. Information on the operation and maintenance (O&M) of this infrastructure was obtained from interviews with Tununak's WTP operators, including subsequent discussions with the IRA Council administrators.

A summary of the findings of the site assessment conducted by Mr. Gilfilian is provided below.

Reference: 95% Draft Tech Memo #3 – Structural Assessment of the Existing 50,000-Gallon Water Storage Tank

### **Tank Exterior Walls**

As shown in Photos 1 and 2, the exterior of the WST appears to be in reasonable condition considering the tank is 40 years old and had experienced adverse weather conditions from being located along the coast of the Bering Sea. Photo 1 shows the northwest side of the tank with apparent typical rust stains on the aluminum siding. Photo 2 shows the ladder access to the tank and a missing section of siding located just below the top of the tank. Photo 6 shows a torn portion of the exterior beneath the tank ladder which was probably damaged in the past when operators tried to use the ladder. A close-up view of the missing panel of the aluminum siding that exposed the foam installation near the top of the tank is shown in Photo 7. This is the only area that had missing siding, the remainder of the exterior appeared to still be intact and completely covered the underlying foam insulation. Photos 9 and 10 show the tank's overflow line that appears to be in satisfactory condition with the weather beaten exterior siding. The overflow drain needs to be screened.

### **Tank Timber Foundation**

Photo 3 shows the southwest corner of the WST's foundation. Overall, the timber and high density-foam insulation board appeared to be in fair condition. The condition of the timber foundation beneath the tank, between vertical sections of floor joists/supports, is shown in Photos 4 and 5. The lumber members appeared to be in good condition with no signs of deterioration; however, some minor weather-worn sections of the exterior side panels on the lumber foundation were noted as shown in Photos 3, 10, 12, and 20.

### **Exterior Tank Cover**

The exterior of WST cover was checked for deficiencies and was found to be in fair condition, with small sections of foam insulation missing. Photos 1 and 20 show the insulated edge of the tank cover, which appeared to be in good condition with no apparent damaged sections. Photos 13 and 14 show the overall condition of the exterior surface of the foam insulation on the tank cover. The photos show a missing section of insulation over the roof hatch. Photo 13 shows the condition of the ladder cage at the tank top, which appeared to be intact and functional. Photo 14 shows the tank vent pipe that needs to have a 90-degree extension installed on the pipe.

### **Tank Interior**

The interior of the WST was visually checked via access through the roof hatch. Several photographs were taken of the water surface and the tank's interior wall and roof section above the water surface. Photos 15 and 16 show the water surface in the tank, with a considerable amount of floating debris that included an empty soda pop can, fragments of foam insulation, and rust particles. Photos 17 and 18 show sections of the tank side wall panels. Photo 17 shows the tank's north side interior wall that appeared to be in good condition above the water surface; however, the

**Reference:** 95% Draft Tech Memo #3 – Structural Assessment of the Existing 50,000-Gallon Water Storage Tank

adjacent wall shown in Photo 18 shows obvious signs of surficial deterioration. Also, Photo #18 shows the underside of the WST cover that appeared to be in fair to good condition.

#### **Section 4.0 Conclusions and Recommendations**

Overall, the exterior of the WST appeared to be in fairly good condition considering the age of the structure. As shown in many of the photographs provided in the Photo Log (Attachment 3), the tank appears to be vertical and the foundation system is still functional and provides a stable base for the tank. It is recommended that a small amount of minor improvements and cosmetic repair work should be done. These improvements include: replacing small sections of the tank's aluminum siding; extending the tank vent line with a 90-degree bend so it is placed downward a minimum distance of 2.5 times the line diameter above the tank roof surface, and screening the tank overflow line. It is estimated that the cost for this repair work would be less than \$25,000.

However, there are some noteworthy issues and concerns about the interior of the WST. Based on conversations with the WTP operators, it is understood the tank has not been cleaned since it was originally placed in operation nearly 40 years ago. In addition, the photographs described in Section 3 clearly show a portion of the tank interior walls has experienced deteriorating surficial damage. It is recommended the WST be emptied and cleaned thoroughly. In addition, the interior tank lining/coating should be tested and determined if recoating the tank is needed. Attachment 4 provides a cost estimate for cleaning and recoating the tank interior. This cost estimate was prepared by Estimation and provides the estimated cost with contingencies for this work for a total of \$534,898.

As an alternative cost saving approach considering the old age of the tank and its expectant limited remaining useful life, the tank could continue to be used as is for a few more years provided the tank is thoroughly cleaned and its interior coating tested by a professional quality testing firm. Also, the recommended repairs/modifications to the tank's overflow pipe and vent should be made. This interim corrective action would probably cost less than \$100,000 dependent on the resources available to the community and assistance provided by the State's Rural Maintenance Worker Program.

#### **Section 5.0 Limitations**

This Tech Memo was prepared by Stantec for the account of Native Village of Tununak IRA Council at the request of ADEC VSW Program. The findings and recommendations presented herein reflects Stantec's professional judgment in light of the scope, schedule and other limitations stated in this document and in the contract between Stantec and the Client. The opinions in this document are based on conditions and information existing at the time the document was prepared and do not take into account any subsequent changes. In preparing the document, Stantec did not verify



August 1, 2018  
Native Village of Tununak IRA Council  
Page 5 of 5

**Reference: 95% Draft Tech Memo #3 – Structural Assessment of the Existing 50,000-Gallon Water Storage Tank**

information supplied to it by others. Any use which a third party makes of this document is the responsibility of such third party.

**Stantec Consulting Services, Inc.**

**Robert (Bob) Gilfilian, PE**  
Principal, Civil Engineer

Cell Phone: 907-227-9883  
Email: bob.gilfilian@stantec.com

Attachment: Attachment 1 – USPHS As-Built Plan Sheet titled “50,000 Gallon AWWA Water Tank & Details” for Tununak  
Attachment 2 – Bob Gilfilian’s Tununak Field Notes for June 5-8, 2018  
Attachment 3 – Photo Log  
Attachment 4 – Cost Estimate for Tank Cleaning and Recoating by Estimations

c. Susan Randlett, PE  
ADEC Village Safe Water Program

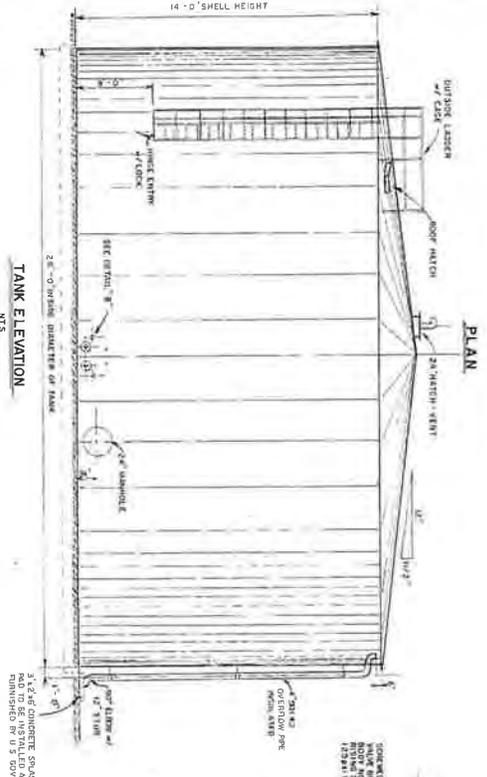
# **ATTACHMENT 1**

## **USPHS As-Built Plan Sheet**

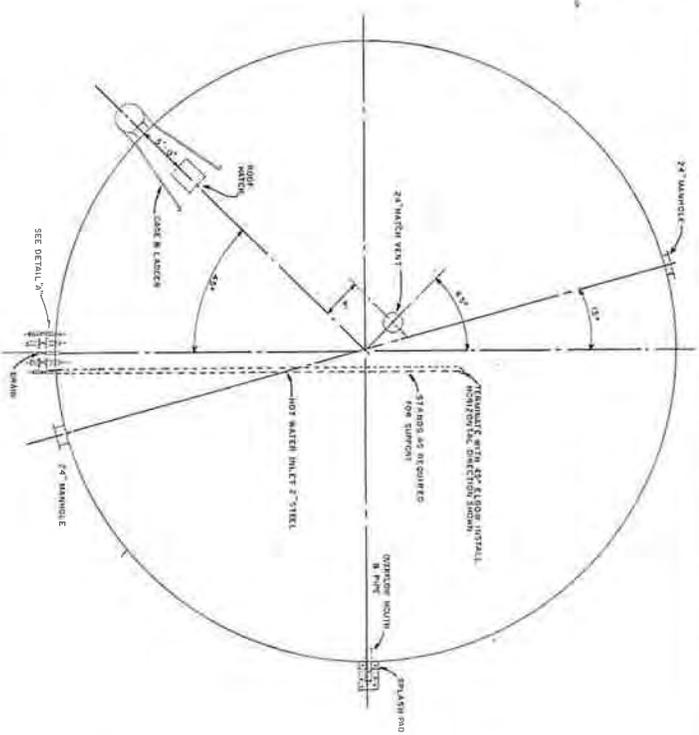
### **“50,000 Gallon AWWA Water Tank and Details”**

14'-0" SHELL HEIGHT

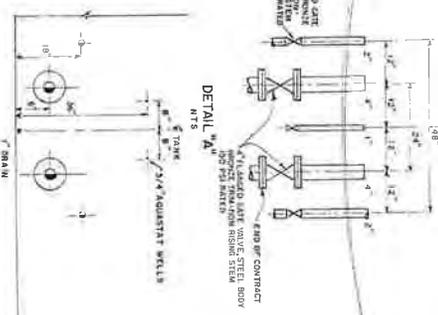
TANK ELEVATION  
N15



PLAN  
N15



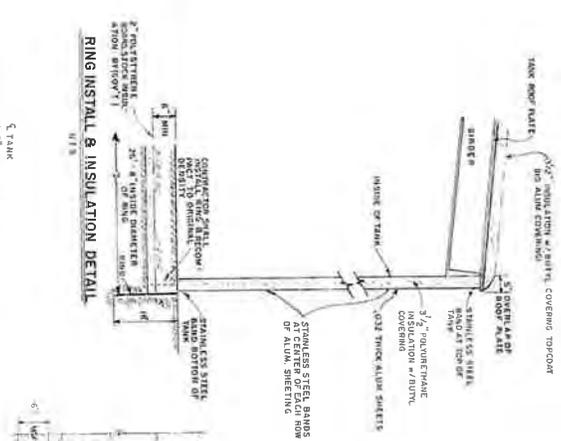
DETAIL 'A'  
N15



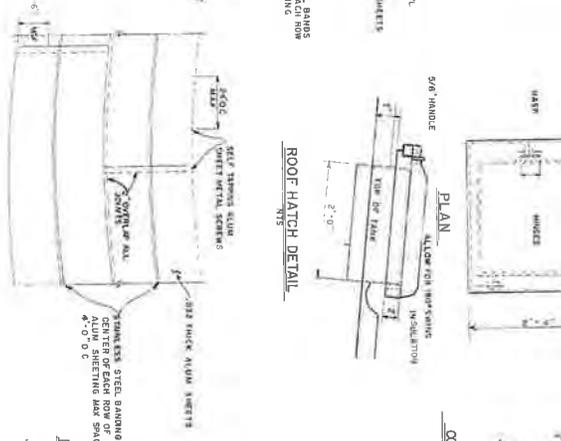
DETAIL 'B'  
N15



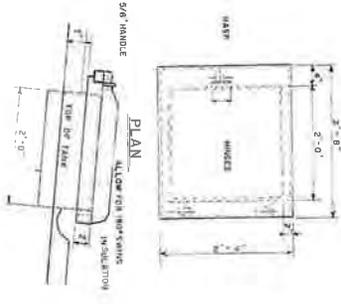
RING INSTALL & INSULATION DETAIL  
N15



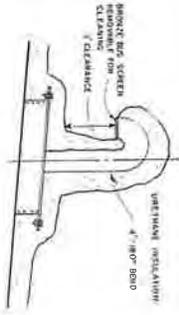
ALUMINUM COVERING DETAIL  
N15



ROOF HATCH DETAIL  
N15



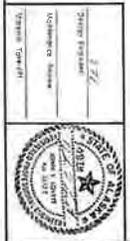
COMBINATION ROOF HATCH & VENT DETAIL  
N15



NOTES:

1. ROOF SHELL, 8 BOTTOM PLATES A-36 STEEL.
2. ALL 4" PIPES TO BE SCHEDULE 40 STEEL PIPE.
3. ALL 2" PIPES TO BE SCHEDULE 40 STEEL PIPE.
4. ALL BOLTS & NUTS TO BE A-307.
5. SHELL COUPLERS A-36 STEEL.
6. ALL COUPLERS SHALL BE INSULATED.
7. 1/2" POLYURETHANE SPRAYFOAM INSULATION.
8. VAPOR BARRIER, FIBERGLASS & CAST IRON INSULATION.
9. INSULATOR TO PROVIDE ALL VALVES.
10. TANK CONSTRUCTION TO LATEST ANAWA STANDARDS OR DRAWING SHALL BE ONLY STEEL PIPE.
11. DRAWN PIPE SHALL BE GALV STEEL PIPE.
12. RING SHALL BE ROUND WITHIN 1/8" SHALL BE PLACED SO THAT TOP IS AT SAME ELEVATION ALONG RING PER TANK DIMENSIONS, SHALL BE COMPASS INDICATION.
13. TANK DIMENSIONS SHALL BE COMPASS INDICATION.
14. OVERLAP AT EACH JOINT AS SHOWN IN DETAILS.

**AS BUILT**



REF. NO.	REV.	DATE	REVISIONS	INITIALS

U.S. Department of Health, Education & Welfare  
Indian Health Service

**TUNUNAK, ALASKA**  
50,000 GALLON AWKA WATER TANK  
Tribic AW 64-121 PROJECT  
PROJECT NO. AN 77-631

DESIGNED BY: [Signature]  
CHECKED BY: [Signature]  
DATE: 12-8-71

SHEET NO. 18 OF 23  
TOTAL SHEETS

SANITATION FACILITIES CONSTRUCTION BRANCH  
ALASKA INDIAN HEALTH SERVICE

## **ATTACHMENT 2**

**Bob Gilfilian's Tununak Field Notes**

**For June 5-8, 2018**

(107) June 5, 2018  
Tues

Tunmall, AK  
Tech Memo Field Trip

@ 0500 arrived at ANC Airport - Rain. Air for flight to Tunmall (via Bethel, Nightmute, Toolik Bay)

@ 1000 left ANC for Bethel

@ 1130 arrived Bethel

@ 1250 left Bethel on Massland Air/Boon

@ 1330 arrived in Tunmall

met Ira at Airport/Airfield & Teddy

@ 1340 went to school to check in. Today

@ 1400 met Xavers at his house

Joseph James, operator H2O plant

Vincent Billings " (652-2630)

IRA # 6152 - 202 (not

@ Called Brandi for school internet password

Amy 5493 - 4827

- Ira took me in H-Wheeler to Village office - everything in Village was shut down due to no power except school.

@ 3 pm took walking tour of Village to check out layout of photos.

Chook Masketkin JSTP to set up for test

- Elizabeth secretary at School

Bob Gilfillan - Tunmall AK  
Field Trip Notes, June 5-8, 2018 (6 pages)

Tunmall, AK

6/5/18

(128)

Tues  
~50°F, Clear Sun

@ 4 pm walked along beach to the north end where bluff (56' high) meets the beach. Took photos to show exposed rock formation and brown sandstone/siltstone. Collected sample of gray sandstone/siltstone horizontally fractured.

✓ Walked south on beach to School's sewer outfall daylighted on upper beach.

✓ Took photos of School's exterior water treatment plant and W/P plant.

✓ Went to Warehouse - closed due to power out. Took exterior photos and pipeline to Clinic.

✓ Checked west leg of waterline to Wash WTP - noted repairs work on arctic pipe.

@ 6 pm contacted Vincent Billie who agreed to meet me tomorrow at 10 am to start adequacy test on ST/SA.

- Returned to school to organize files and field gear for tomorrow's projects.

- Reviewed project files until 8 pm

Bob Gilfillan - Tunmall AK  
6/5/18

(109) TUESDAY, AK

June 6, 2018 (Wed)

~70°F

Part Sun

~5 mph Wind

e 8 AM prepared draft proposal letter to USW for deep well Geophysical Survey

e 9 AM called Gailin Mackel on survey dates

Prepared field maps/docs to meet w/ Vincent Billie, Unumak WPA, to go over items needed to complete the following tasks:

- 1- Inspect WST (need folder to CK tank)
- 2- Inspect Well House on Unumak Creel
- 3- Inspect water transmission line
- 4- Conduct Adequacy Test on ST/SAs.

Also prepared form RM5-2 and other standard safety forms to review w/ Vincent

@ 10:50 met Vincent Lilly at School, Check WTP but it was locked. Went to Village Office

@ 10:30 hold mtg. w/ James James, James, Joe James, and Vincent Lilly

- Discussed purpose of my visit and scope of work (tasks)

- Went over well drill sites, noted Village owned corner of site south of Unumak

Creel along Muskok Co water transmission line

- Decided to walk sites tomorrow

Note: Near cold water discharge in Washegan  
Saghd = 375 sec

~45°F

Cloudy

~15 mph Wind

@ 11:00 Went to Mackel's / WTP w/ Vincent Billie and Joe James

✓ Checked over Mack (in use) w/ my washer and 2 dryers (Vincent est 4 gal/wash)

✓ Made arrangements for discharge water in to Mack sewer drain for Adequacy Test

Mean flow at E.3 Spun

✓ Checked over empty nest conditions in WTP - took photos - barely operating

✓ Noted WST had ~14" water level

✓ Found one shower & one toilet working!

✓ Went to WST w/ ladder, climbed on top

to check tank condition. Took photos and videos. Opened top access cover

Observed rust debris floating in tank plus an empty soda can floating

✓ Went to sewer system to check manholes and then opened access to 4 End 2 E ST

Found monitor tubes (8) that were installed by LKSD a couple of years ago when they

installed several new infiltrator lines in the area of the former WPA Sat-1

Absorption System (SAs) - Need Record Drawing.

@ 12:30 I informed Vincent & Joe that I would complete Adequacy Test and we will meet tomorrow a.d. 9 AM to inspect Well House & Unumak CK.

Thursak (110)

June 6 '18

(111) Timmuck  
June 6, 2018

530F  
Cloudy, Windy  
25 mph

@ 12:45 returned to school to prepare forms for adequacy test. Organized notes & equipment layout map of ST/SAS for Adequacy Test

@ 2 PM went to ST/SAS to take starting meas.

@ 2:30 meas liquid level in ST/SAS meas.

STCO 99.5" btop (6" Ø HDPE) (W/ST)

S-1 60.0" btop (4" Ø OW)

S-2 55.5" " (4" Ø OW)

S-3 57 1/2" " (headers) (4" Ø) wet

S-4 36" " (header pipe) (wet)

N-1 (8" Ø) (filled w rocks) (4" Ø) drains

N-2 99.5" btop (8" Ø OW)

N-3 48" " (4" Ø OW)

N-4 54" " damp bottom frame (4" Ø)

@ 15:08 started flow into Wash Area drain

meas flow in 5 gal bucket in 40 seconds

calc flow = 7.6 gpm plus 1 bad washer

@ 15:23 (15 min) meas SAS 1/2 ST

STCO 100.0" btop

S-1 59.5" btop (feels like header pipe)

S-2 55.0" "

S-3 52.0" "

S-4 45 1/2" " able to clear header wet bottom soil

Sunny 55°F  
25 mph Wind

Timmuck (112)  
6/6/2018

N-2 99 1/2" btop

N-3 48 1/2" btop

N-4 damp soil

@ 16:45 pm meas flow in Wash Area = 7 gpm

@ 16:10 meas ST/SAS Obs. Wen (OW)

STCO 99.5" btop

S-1 59.5" btop (This is header pipe w 4" Ø coming from 2K ST)

S-2 54 1/4" "

S-3 52" "

S-4 damp "

N-2 99 1/2" "

N-3 48" "

N-4 damp "

Found 4" Ø AGS ob pipe in NW corner of SAS

meas liquid = 72 1/2" btop (flush w SS)

~15' SW of N-2

@ 16:50 meas flow = 5.75 gpm of Wash Area

4 loads of washer used during test

@ 17:00 meas levels in ST/SAS

STCO 99 1/2" btop (stickup = 22" AGS)

S-1 57" btop (stickup = 7" ags)

S-2 54 1/2" btop " = 12"

(113) Timmerlake  
6/6/2018

Continue near ST/S

S3 52" btop  
S4 damp  
N1 NA  
N2 99 1/2" btop  
N3 47 1/2" btop  
N4 damp  
NW corner OW = 72 1/2 btop, No stickup flash GS

@ 1752 meas flow = 60 gpm in Washeteria

@ 1808 Shut off flow for Adequan Test

Ave flow 616 gpm, Total flow = 1,195 gal  
Plus 4 Wash load yields 1,300 gal in 180 min  
Note: laundry being used all day - 1 washer

@ 1815 meas SWLs in ST/S/S OWs:

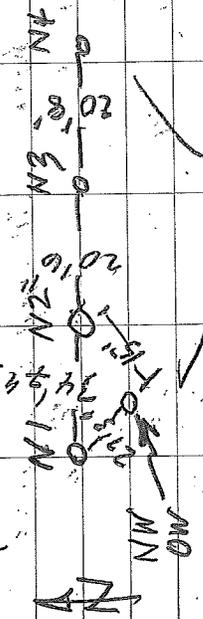
ST CU 99 1/2" btop  
S1 55 1/2"  
S2 54 3/4"  
S3 52"  
S4 damp  
N2 99 3/4"  
N3 47 1/4"  
N4 dry 30 1/2"  
NW OW 72 1/2"

(very difficult to measure headed)

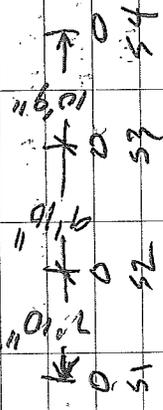
55°F Wind  
Sunny/20 mph

Timmerlake (114)  
6/6/2018

Layout of ST/S/S measured at 18



GAS



2" ST 27"

4" ST 27"  
6" CO to S1 = 44 1/4"  
S4 = 57 1/4"  
N1 to S1 = 135'

@ 7:10 pm returned to school to retrieve notes  
Seat reserved for Geophysical Survey to Sweden  
via email  
B/V justification 6/6/18  
END Day 2

Thompson  
6/7/18

Cloudy, 25 mph wind  
40°F

7" HI above N2 to 2.3' NW-CO TOP  
7" HI " to 1.9' N3 TOP  
7" HI " to 1.8' N4 TOP  
- Check at Barb Miller, LKSP Butler

@ 10:20 went to WTP of Joe Vincent  
@ 11:00 inspected unnamed Creek  
Pump House

1.5 AP pump - 2 of them  
H2O level in well was 18" below floor  
H2O depth in well was 24"  
Creeper floor - 6" deep x 3' wide  
Channel 2' wide x 9" deep  
Velocity = 5 sec/ft in channel 30x6

✓ Walked along water transline

@ 12:00 drove in ATV of Vincent to work  
over proposed drill sites. Took photos & videos  
@ 12:30 drove up to gravel pit on top  
maintain in cloud layer a couple miles up  
hard road - filled w/ snow - developed by GAP

@ 1:300 went to TRA office to meet w/ staff  
Met w/ James James & Laura Post

@ 14:00 rode back to school w/ Vincent, stopped  
to photo base site south of BA school & horse bucket

@ 15:00 helped in tele conf w/ Susan Flank & back  
Worked rest of day on notes & reports  
13th June Day 3  
Note: 24 hr STS As board  
CA 1815-5TCO = All done 15

Cloudy 42°F  
15 mph wind

@ 0800 organized notes for field work  
to day schedule to complete Adequacy  
Text and inspect unnamed Creek well.

@ 0915 pet Joe Jones went to STSAS  
Joe informed me that ~ 2 loads wash so  
for this morning at Washobeni

Meas SWL in STSAS at 0930  
ST-CO 99 1/2" btop

S1 59" "  
S2 55 1/2" "  
S3 52 1/4" "  
S4 dry "  
N1 NA "

N2 99 1/2" "  
N3 48 1/2" "  
N4 98 1/2" dry "  
NW-CO 73" "  
Note: lift Sta  
discharge 2" @ HOVE  
is ~ 480 gpg

TOP (11)  
N 27" HI above S1 to ST-CO top ring  
30" HI " to 1.7' to S2 top  
30" HI " to 2.4' to S3 top  
30" HI " to 2.9' to S4 top  
2.5" HI " to N1 TOP  
7" HI " to N1 TOP

Timonah, AK  
June 8, 2018  
(Friday)

45° F Cloudy  
Calm

- ✓ @ 0800 organized field notes and photos on laptop
- ✓ @ 0930 walked to Tribol office (No Vincent!) Approx 1.25 miles school to office
- ✓ @ 1000 held telecont w/ Susan Randlett, James James and Xavier Fast. Discussed approach to drilling exploratory deep wells. Need SHIPPO and wetland & maybe GEN
- ✓ Best Practices waiver
- ✓ Need cost est. for drilling wells
- ✓ Possible funding from RD by July 15
- ✓ Possible sale source
- ✓ Grant period up to 5 years
- ✓ Discussed maintenance
- ✓ Susan recommended include water line w/ well
- ✓ @ 1000 met w/ sides
- Xavier said most folks take steam baths & took several photos of steam huts
- Meas distance from ST Lift Sta to S1 or 25
- ✓ @ 1130 returned to school for packing met Vincent belly ad Today on flight study
- Found out Hazelwood Air could not fly from Suxhel due to weather delay

Timonah  
June 8, 18

50° F Partly Sun  
-10 mph wind

- Next several hours kept calling Hazelwood in Timonah & Bethel with negative response
- ✓ @ 1600 friend met Grant Air was coming to Timonah so Today rushed me out to the air port as the plane was landing - able to get a seat!
- Flaw to Tokleak Bay and then to Suxhel.
- Arrived at 1735 as my plane flight was departing Bethel
- Went to AK Air and able to get a seat for 9 pm flight to ANC
- ✓ @ 2015<sup>PM</sup> boarded Alaska Air Flt #46 for ANC for ANC
- ✓ @ 2100 arrived at ANC Airport
- ✓ @ 2200 arrived at Greg Meyer's for the night
- ✓ End Day 4  
Bethel Airport 6/8/18

# **ATTACHMENT 3**

## **Photo Log**



*Photo 1- Looking south at the northwest side of the 50,000 gallon WST with Washeteria/WTP in background to the right.*



*Photo 2 - West side of the WST and roof access ladder with the Washeteria/WTP to the right.*



*Photo 3 - Foundation at the southwest side of the WST*



*Photo 4 - Looking east through spacing of WST timber foundation.*



*Photo 5 – Looking West through spacing in W ST foundation.*



*Photo 6 - Horn aluminum exterior skin covering on Southwest side of WST beneath the roof access ladder.*



*Photo 7 - Missing aluminum skin on WST surface exposing foam insulation on South side of tank.*



*Photo 8 - Looking north at WST with Washeteria/WTP on the right and Tununak school to the left.*



*Photo 9 - North side of WST looking at tank overflow pipe.*



*Photo 10 - Tank overflow drain with deteriorated section on exterior of tank timber foundation*



*Photo 11` - Looking at East side of building connecting the WST and the water treatment plant.*



*Photo 12 - Manway to access the bottom of WST and foundation at the Northwest corner of tank*



*Photo 13 - Looking southeast at roof hatch and ladder cage at the top of the WST.*



*Photo 14 - looking north at WST hatch vent and insulated roof.*



*Photo 15 - Looking down inside the WST, observed floating debris including flakes of insulation, rust and an empty soda pop can.*



*Photo 16 - Looking down inside the WST, observe floating chunks of insulation and rust.*



*Photo 17 – Looking down inside the WST towards the north side of tank.*



*Photo 18 – Looking inside the WST towards the east side of tank – note deteriorated side wall.*



*Photo 19 – Looking east at west side of WST and back of washeteria/WTP building.*



*Photo 20 – Looking at the northeast corner of the WST that shows the tank foundation.*

# **ATTACHMENT 4**

## **Cost Estimate for Tank Cleaning And Recoating For Tununak Water Storage Tank**

**Prepared by Estimations**

**Dated July 31, 2018**

**Tununak Water Storage Tank  
Clean and Recoat  
Tununak, Alaska**

**Construction Cost Estimate  
Concept Design Submittal  
July 31, 2018**



1225 E. International Airport Road, Suite 205  
Anchorage, Alaska 99518  
907.561.0790

**Prepared for:**

**Stantec**

725 E Fireweek Lane #200  
Anchorage, AK 99503  
888-706-8754

**Documents**

Damage Assessment and Schmatic Design Narrat	21-Sep-16
Drawings	21-Sep-16

**Notes and Assumptions**

- 1 Based on 2017 procurement/2017 construction.
- 2 Labor rates based on Davis Bacon, 50 hours/week.
- 3 Assumes open competitive bid procurement.
- 4 Materials storage area will be designated near the building.
- 5 Local contractor.

**Tununak Water Storage Tank**  
**Clean and Recoat**  
**Prepared for Stantec by Estimations**

**Construction Cost Estimate**  
**Concept Design Submittal**  
**July 31, 2018**

Description	Estimated Cost	Estimated Cost Plus Contingency & Escalation	Div.
<b>Basic Bid</b>			
01 - GENERAL REQUIREMENTS	\$358,161	\$426,301	1
33 - UTILITIES	\$91,239	\$108,597	33
<b>Total Estimated Cost - Basic Bid:</b>		<b>\$449,400</b>	<b>\$534,898 &lt;&lt;&lt;&lt;&lt;</b>

Estimating Contingency: 15.0%  
Escalation For Inflation: 12 Mths @ 3.5% 3.5%

**Tununak Water Storage Tank**  
**Clean and Recoat**  
**Prepared for Stantec by Estimations**

**Construction Cost Estimate**  
**Concept Design Submittal**  
**July 31, 2018**

Line No.	Description	Qty	UNITS	Material Costs		Labor Hours		Labor Cost	Equip Cost	Total Cost	Total Cost w/ OH & P
				Unit	Total	Units	Totals				
1	<b>01 - GENERAL REQUIREMENTS</b>										
2											
3	<b>Project Management</b>										
4	Project Manager, 8 Hour/Week	8	WEEKS			8.000	64.0	\$6,240		\$6,240	\$6,240
5	Supervisor, 60 Hour/Week	6	WEEKS			60.000	360.0	\$30,240		\$30,240	\$30,240
6											
7	<b>Subsistence</b>										
8	Room & Board	183	MANDAY	\$250.00	\$45,824					\$45,824	\$45,824
9											
10	<b>Travel</b>										
11	Air Fare - Anchorage - Site	10	EA	\$700.00	\$7,000					\$7,000	\$7,000
12											
13	<b>Small Tools &amp; Consumables</b>										
14	Consumables	1	LS	\$300.00	\$300					\$300	\$300
15	Small Tools	1	LS	\$900.00	\$900					\$900	\$900
16											
17	<b>Mobilization</b>										
18	Mobilization/Demobilization, Misc Labor	1	LS			160.000	160.0	\$14,935		\$14,935	\$14,935
19	Equipment	51	TONS	\$1,500.00	\$77,100					\$77,100	\$77,100
20	Freight										
21	Materials	1	TONS	\$520.00	\$602	2.857	3.3	\$308		\$910	\$910
22	Temp Materials	5	TONS	\$520.00	\$2,600	2.857	14.3	\$1,335		\$3,935	\$3,935
23	Scaffolding	2	TONS	\$520.00	\$1,040	2.857	5.7	\$532		\$1,572	\$1,572
24	Connex Storage, Tools	10	TONS	\$520.00	\$5,200	2.857	28.6	\$2,670		\$7,870	\$7,870
25	Air Freight Anchorage - Job Site	1,300	LBS	\$1.20	\$1,560					\$1,560	\$1,560
26											
27	<b>Equipment (for Duration + 2 months)</b>										
28	Fourwheeler	15	WEEKS						\$3,750	\$3,750	\$3,750
29	Forklift (1 Ea)	15	WEEKS						\$12,750	\$12,750	\$12,750
30	Manlift (1 Ea)	15	WEEKS						\$4,500	\$4,500	\$4,500
31	Boom Truck (1 Ea)	15	WEEKS						\$32,500	\$32,500	\$32,500
32	Vacuum Pump	15	WEEKS						\$3,000	\$3,000	\$3,000
33	H.Pressure Pumps	15	WEEKS						\$2,250	\$2,250	\$2,250
34											
35											
36											

**Tununak Water Storage Tank**  
**Clean and Recoat**  
**Prepared for Stantec by Estimations**

**Construction Cost Estimate**  
**Concept Design Submittal**  
**July 31, 2018**

Line No.	Description	Qty	UNITS	Material Costs		Labor Hours		Labor Cost	Equip Cost	Total Cost	Total Cost w/ OH & P
				Unit	Total	Units	Totals				
37	<b>Other Requirements</b>										
38	Project Meetings, Safety, Misc meetings	6	EA			4.000	24.0	\$1,440		\$1,440	\$1,440
39	Test Lab Services	1	LS	\$5,000.00	\$5,000					\$5,000	\$5,000
40	Temporary Facilities										
41	Project Office - Rental House	2	MTHS						\$3,750	\$3,750	\$3,750
42	Office Equipment/Supplies	2	MTHS	\$500.00	\$750					\$750	\$750
43	Project Tool Sheds	2	MTHS						\$300	\$300	\$300
44	Project Safety Equipment	1	LS	\$450.00	\$450					\$450	\$450
45											
46	Temporary Services										
47	Chemical Toilets	2	MTHS	\$690.00	\$1,035					\$1,035	\$1,035
48	Electrical	2	MTHS						\$2,550	\$2,550	\$2,550
49	Lighting	1	LS	\$1,000.00	\$1,000					\$1,000	\$1,000
50	Heat Temporary	2	MTHS	\$12,000.00	\$24,000					\$24,000	\$24,000
51	Cleaning	1	LS			60.000	60.0	\$5,082		\$5,082	\$5,082
52											
53	Record Documents	1	LS	\$1,000.00	\$1,000					\$1,000	\$1,000
54	Contract Closeout and Training	1	LS	\$2,500.00	\$2,500					\$2,500	\$2,500
55	Certified Payroll Fee	1	LS	\$1,348.82	\$1,349					\$1,349	\$1,349
56											
57											
58											
59											
60											
61											
62											
63											
64											
65											
66	<b>General Contractor Profit (Fee)</b>	10.0%									\$39,858
67	<b>General Contractor Bond &amp; Insurance</b>	2.5%									\$10,961
68											
69	<b>Subtotal: 01 - GENERAL REQUIREMENTS</b>				\$179,210		719.9	\$62,782	\$65,350	\$307,342	<b>\$358,161</b>
70											
71											
72											

**Tununak Water Storage Tank**  
**Clean and Recoat**  
**Prepared for Stantec by Estimations**

**Construction Cost Estimate**  
**Concept Design Submittal**  
**July 31, 2018**

Line No.	Description	Qty	UNITS	Material Costs		Labor Hours		Labor Cost	Equip Cost	Total Cost	Total Cost w/ OH & P
				Unit	Total	Units	Totals				
73	<b>33 - UTILITIES</b>										
74	<b>33 16 13.13 Steel Aboveground Water Utility Storage Tanks</b>										
75	<b>Ventilation</b>										
76	Setup Ventilation System	1	EA			20.000	20.0	\$1,694		\$1,694	\$1,694
77	Operate Ventilation System	20	DAYS						\$4,000	\$4,000	\$4,000
78											
79	<b>Temp Storage</b>										
80											
81	<b>Drain Tank</b>										
82	6 Man Crew	4	DAYS			60.000	240.0	\$20,329		\$20,329	\$20,329
83											
84	<b>Cleaning</b>										
85	Area	2,621	SF								
86	Top	531	SF								
87	Framing	416	SF								
88	Bottom	531	SF								
89	Walls	1,144	SF								
90	6 Man Crew	4	DAYS			60.000	240.0	\$20,329		\$20,329	\$20,329
91	Vac Pump	4	DAYS						\$800	\$800	\$800
92	Boom Truck	4	DAYS						\$1,400	\$1,400	\$1,400
93	Manlift	4	DAYS						\$800	\$800	\$800
94	Scaffolding	1,143	SF	\$2.00	\$2,286	0.071	81.2	\$6,878		\$9,164	\$9,164
95											
96	<b>Coatings (3 Coat System)</b>										
97	Paint	2,621	SF	\$1.50	\$3,932	0.103	270.0	\$22,870	\$2,621	\$29,423	\$29,423
98	Top	531	SF								
99	Framing	416	SF								
100	Bottom	531	SF								
101	Walls	1,144	SF								
102	Boom Truck	6	DAYS						\$2,100	\$2,100	\$2,100
103	Manlift	6	DAYS						\$1,200	\$1,200	\$1,200
104											
105											
106	<b>Subtotal: 33 - UTILITIES</b>				\$6,218		851.2	\$72,100	\$12,921	\$91,239	<b>\$91,239</b>
107											
108											

**95% Draft**

**Technical Memorandum 4**

**Task 1**

**Water Source Assessment  
Desktop Study to Assess the Capacity of the Unnamed Creek  
Infiltration Gallery**

**For**

**Tununak, Alaska**

**August 8, 2018**

---

To:	Native Village of Tununak IRA Council Tununak, Alaska	From:	Collin Macheel CPG Bob Gilfilian PE Stantec Consulting Services Inc.
File:	<b>Technical Memorandum 4 – Water Source Assessment, Task 1 – Desktop Study to Assess the Capacity of the Unnamed Creek Infiltration Gallery</b>	Date:	August 6, 2018

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## Section 1.0 Purpose and Scope

The Native Village of Tununak a.k.a. Tununak IRA Council (herein referred to as Tununak), in cooperation with the Alaska Department of Environmental Conservation (ADEC) Village Safe Water (VSW) has retained Stantec Consulting Services Inc. (Stantec) to prepare this Technical Memorandum (Tech Memo) with funding from the U.S. Department of Agriculture Rural Development (USDA-RD). The purpose of this Tech Memo is to provide a summary of the results of a desktop study to estimate the hydraulic capacity of the existing infiltration gallery on Unnamed Creek that serves the Tununak washeteria and water treatment plant (WTP).

## Section 2.0 Description of Existing Infiltration Gallery on Unnamed Creek

The water source for the existing washeteria/WTP uses a shallow water well that consists of an infiltration gallery located in Unnamed Creek that was constructed in 1978 by the U.S. Public Health Service (USPHS). The well structure would normally be called an infiltration gallery. The well (infiltration gallery) remains in the same configuration as it did when it was installed in Unnamed Creek nearly 40 years ago. The infiltration gallery consists of a 9-foot deep, 24-inch diameter, perforated (slotted) corrugated metal pipe, that was installed vertically in the middle of the Unnamed Creek. The top of the well's culvert pipe is approximately 3.5 feet above the surface of the creek.

Unnamed Creek flows through a tundra area and has a width that varies from 1 foot to a few feet and has a shallow depth of approximately 1 to 2 feet, as shown in attached photos of the creek (Attachment 1). The flow of the creek varies throughout the year, depending on precipitation and snow accumulation. During the winter, the creek freezes and often develops aufeis (overflow ice conditions), as shown in the photo of the flooded well house (Attachment 1).

The drainage basin for Unnamed Creek is on the south side of Ugchirnak Mountains and has a drainage area of approximately 1 to 1.5 square miles. The infiltration gallery is located inside an 8-by 8-foot wooden well house structure. The well house is located approximately 900 feet east and downhill of the existing washeteria/WTP. The raw water from the well house is pumped via a 2-inch diameter high density polyethylene (HDPE) pipe inside a 4-inch diameter Arctic pipe in an aboveground utilidor to the washeteria/WTP.

**Reference: Technical Memo 4**  
**Task 1 – Desktop Study to Assess the Capacity of the Unnamed Creek Infiltration Gallery**

On June 7, 2018, Bob Gilfilian, PE, inspected the Unnamed Creek Infiltration Gallery pump house. He observed the water in the infiltration gallery had floating scum and that there were several open sections in the wall of the 24-inch corrugated metal pipe. He was informed by the WTP operator that the original 9-foot-deep infiltration gallery has, over the years, filled in with mud and debris from seasonal flooding and is currently only about 2 feet deep. The operators reported they have attempted, in vain, to remove the mud, but it has continued to fill in – resulting in reduced flow of raw water available for pumping, especially during the winter months when the water level in the creek is very low.

### **Section 3 Methodology**

The scope of this desktop study was to provide an approximation of water supply capacity of the Unnamed Creek Infiltration Gallery that is used to supply raw water for the washeteria/WTP located in Tununak, Alaska. Since little to no data has been published on the nature of the water shed or channel flow, a regression model developed by the U.S. Geologic Survey (USGS) for approximating flow for ungaged stream sites was employed<sup>1</sup>. After estimated flows were derived, assumptions were made to further approximate the amount of flow accessible by the infiltration gallery in its current condition. Existing pump specifications are also provided.

### **Section 4 Unnamed Creek Flow Estimate**

The USGS has developed a methodology for approximating monthly low-flow statistics for ungaged streams in Alaska. This method was used to prepare estimations for surface water flow through the Unnamed Creek in consideration of the physical properties of the watershed located upgradient of the existing infiltration gallery.

The surface water source properties of the Unnamed Creek watershed were inferred based on spatial precipitation estimates and regional air temperatures published by the USGS<sup>2</sup>. Additionally, watershed drainage area was approximated based on ADEC's Source Water Assessment for the Tununak Public Water System 270231.001 Zone C Watershed Boundary (Attachment 2). Characteristics of the channel slope and length were approximated by 1:63,360 scale digitized topographic maps and 2015 Lidar elevation dataset.

Table 1 summarizes estimated parameters for the watershed of the Unnamed Creek derived from the above sources.

---

<sup>1</sup> Wiley, J.B., and Curran, J.H., 2003, Estimating annual high-flow statistics and monthly and seasonal low-flow statistics for ungaged sites on streams in Alaska and conterminous basins in Canada: U.S. Geological Survey Water-Resources Investigations Report 03-4114, 61p.

<sup>2</sup> Jones, S.H., and Fahl, C.B., 1994, Magnitude and frequency of floods in Alaska and conterminous basins of Canada: U.S. Geological Survey Water-Resources Investigations Report 93-4197, 122p.

Reference: **Technical Memo 4**  
**Task 1 – Desktop Study to Assess the Capacity of the Unnamed Creek Infiltration Gallery**

**Table 1 Watershed Basin Characteristics Regression Model Inputs**

Basin Characteristics	Approximated Value
Drainage area, in square miles	1.1
Main channel length, in miles	1
Main channel slope, in feet per mile	200
Mean basin elevation, in feet	200
Area of lakes and ponds, in percent	0
Area of forests, in percent	0
Area of glaciers, in percent	0
Mean annual precipitation, in inches	15
Mean minimum January temperature, in degrees Fahrenheit	4

Estimated flows by reoccurrence interval for the months of July, August, and September are provided in Table 2. These months are expected to comprise typical summer conditions.

**Table 2 Estimated Developable Flow Based on Model Results**

Month – Reoccurrence Interval	Modeled Output Flow (gpm)	Estimated Actual Developable Flow (gpm)
<b>July</b>		<b>12</b>
90 <sup>th</sup> Percentile	45	
50 <sup>th</sup> Percentile	180	
<b>August</b>		<b>12</b>
90 <sup>th</sup> Percentile	45	
50 <sup>th</sup> Percentile	180	
<b>September</b>		<b>23</b>
90 <sup>th</sup> Percentile	90	
50 <sup>th</sup> Percentile	180	

Key: gpm – gallons per minute

Results indicate that low flows for the stream could range between 0.1 to 0.4 cubic feet per second (equivalent to 45 to 180 gallons per minute [gpm]) during these summer months. As a conservable measure for long term planning purposes, it is recommended the 90<sup>th</sup> percentile value (representing the flow conditions that would be available to the infiltration gallery the majority of the time based on modelling assumptions) be used for estimating water resource quantities. The 90<sup>th</sup> percentile

**Reference:** **Technical Memo 4**  
**Task 1 – Desktop Study to Assess the Capacity of the Unnamed Creek Infiltration Gallery**

reoccurrence interval represents the flow condition that would be probable during very dry conditions and exceeded more often than not based on modelling assumptions and limitations.

Actual developable flow from the infiltration gallery would be restricted/reduced by several factors, including flow through the hyporheic zone around Unnamed Creek and inefficiency in the rip rap zone placed around the 24-inch diameter perforated corrugated metal pipe infiltration gallery. A schematic as-built drawing (prepared by the USPHS) of the infiltration gallery is presented in Attachment 3. These physical constraint factors likely account for a significant decrease in flow compared to modeled values.

The hyporheic zone along the Unnamed Creek likely includes highly porous organic mat and fractured bedrock cobbles allowing flow to move freely outside of the main stream channel. This zone, from photographs of the watershed (in Attachment 1) could be substantial in allowing flow bypass the main channel where the infiltration gallery intake is constructed. Secondly, organic material and oxidized iron and/or manganese deposits in the riprap surrounding the culvert could additionally reduce efficiency of the infiltration gallery, resulting in limited recoverable flow. The recoverable flows from the infiltration gallery, estimated at approximately 25 percent of the model flow in the Unnamed Creek drainage, are also provided in Table 2.

The current infiltration gallery is equipped with a submersible pump that is used to pump surface water to the WTP. The pump is a 1.5-horsepower Goulds 5GS15<sup>3</sup> with a 1.2 to 7.5 gpm designed flow capacity (see pump curves in Attachment 4). To potentially increase the flow rate, a larger pump would be required or some application of a raw water storage tank could be considered.

## **Section 5      Conclusions and Recommendations**

As shown in Table 2, the model results for the surface water flow of Unnamed Creek indicate that 12 gpm would be probable during the summer months. The model does not provide a means of estimating typical winter flow conditions, which may be more variable and likely lower through much of the season. However, based on historical use of the infiltration gallery it appears that the well can provide a flow rate of at least 5 gpm based on the size of the submersible pump used to pump water to the WTP. There have been no reported incidents of the community running out of water from the infiltration gallery, including times during the winter when the WTP operators are refilling the 50,000-gallon water storage tank. In summary, the estimated probable developable flow for the infiltration gallery on Unnamed Creek is 12 gpm for July through September.

Another important point to consider is the recent discovery made during the site visit by Mr. Gilfilian on June 7, 2018, when he noted the reduced effective pumping depth in the well caused by decades of mud accumulation during annual flooding events. The available pumping depth in the well has decreased nearly 76% over the past 40 years.

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<sup>3</sup> Alaska Native Tribal Health Consortium. 2017. Trip Report, Tununak – Rural Alaska Village Grant Assessment. William Hickey. March 20-21, 2017.

**Reference:** Technical Memo 4  
Task 1 – Desktop Study to Assess the Capacity of the Unnamed Creek Infiltration Gallery

It is recommended a well flow test be performed during the winter months to measure the efficiency of the infiltration gallery, including measurements of the water level in the 24-inch diameter well. The pump test would provide very valuable data on assessing the actual hydraulic capacity of the water source during the winter when upland recharge is expected to be at its minimum.

## **Section 6 Limitations**

This Tech Memo was prepared by Stantec for the Native Village of Tununak IRA Council at the request of ADEC VSW Program. The findings and recommendations presented herein reflects Stantec's professional judgment in light of the scope, schedule and other limitations stated in this document and in the contract between Stantec and the Client. The opinions in this document are based on conditions and information existing at the time the document was prepared and do not take into account any subsequent changes. In preparing the document, Stantec did not verify information supplied to it by others. Any use which a third party makes of this document is the responsibility of such third party.

### **STANTEC CONSULTING SERVICES INC.**

**Collin Macheel, CPG**

Senior Hydrogeologist

Phone: (907) 266-1104  
collin.macheel@stantec.com

**Bob Gilfilian, PE**

Principal Engineer

Phone: (907) 227-9883  
bob.gilfilian@stantec.com

Attachments: Attachment 1 – Site Photographs

Attachment 2 – Alaska Department of Environmental Conservation Drinking Water Protection Program. April 2004. Source Water Assessment – A Hydrogeologic Susceptibility and Vulnerability Assessment for Tununak Water System, Tununak Alaska. Report 1081. PWSID 270231.001

Attachment 3 – U.S. Public Health Service. July 1978. Tununak, Alaska Infiltration Gallery and Pumping Facility. Project AN-77-631

Attachment 4 – Goulds Water Technology. March 2015. GS 60HZ Standard Capacity 4" Submersible Pumps. Specification Sheet

c. Susan Randlett, PE  
ADEC VSW

# **ATTACHMENT 1 – SITE PHOTOGRAPHS**

**Technical Memorandum 4 – Water Source Assessment**  
**Task 1 – Desktop Study to Assess the Capacity of the Unnamed Creek Infiltration Gallery**  
**Attachment 1 – Site Photographs**



**Photograph 1 - Open stream channel upstream of the Unnamed Creek infiltration gallery at approximately 100 feet above sea level.**



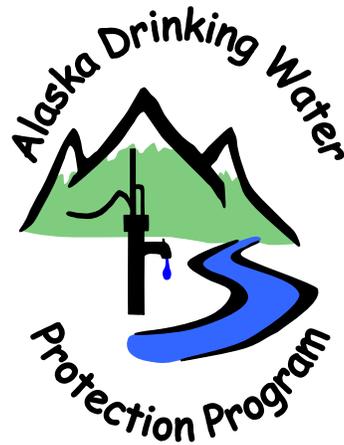
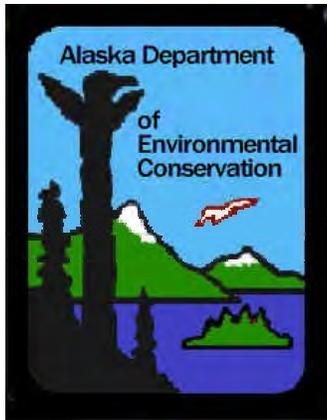
**Photograph 2 - Open stream channel upstream of the Unnamed Creek infiltration gallery at approximately 150 feet above sea level.**

**Technical Memorandum 4 – Water Source Assessment**  
**Task 1 – Desktop Study to Assess the Capacity of the Unnamed Creek Infiltration Gallery**  
**Attachment 1 – Site Photographs**



**Photograph 3 - Infiltration gallery house on Unnamed Creek at approximately 60 feet above sea level.**

**ATTACHMENT 2 – ALASKA DEPARTMENT  
OF ENVIRONMENTAL CONSERVATION  
DRINKING WATER PROTECTION  
PROGRAM  
SOURCE WATER ASSESSMENT FOR PWSID  
270231.001**



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# Source Water Assessment

## A Hydrogeologic Susceptibility and Vulnerability Assessment for Tunanak Water System

Tunanak, Alaska

PWSID #270231.001

April 2004

Drinking Water Protection Program Report #1081

Alaska Department of Environmental Conservation

# Source Water Assessment for Tunanak Water System

## Tunanak, Alaska

### PWSID# 270231.001

April 2004

Drinking Water Protection Program Report #1081

The Drinking Water Protection Program (DWPP) is producing Source Water Assessments in compliance with the Safe Drinking Water Act Amendments of 1996. Each assessment includes a delineation of the source water area, an inventory of potential and existing contaminant sources that may impact the water, a risk ranking for each of these contaminants, and an evaluation of the potential vulnerability of these drinking water sources.

These assessments are intended to provide public water systems owners/operators, communities, and local governments with the best available information that may be used to protect the quality of their drinking water. The assessments combine information obtained from various sources, including the U.S. Environmental Protection Agency (EPA), the Alaska Department of Environmental Conservation (ADEC), public water system owners/operators, and other public information sources. The results of this assessment are subject to change if additional data becomes available. It is anticipated that this assessment will be updated every five years to reflect any changes in the vulnerability and/or susceptibility of public drinking water source. If you have any additional information that may affect the results of this assessment, please contact the Program Coordinator of DWPP, (907) 269-7521.

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Tunanak Drinking Water Protection Area	2
Inventory of Potential and Existing Contaminant Sources	2
Ranking of Contaminant Risks	2
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## APPENDICES

APPENDIX	A.	Tunanak Drinking Water Protection Area (Map 1)	
	B.	Contaminant Source Inventory and Risk Rankings (Tables 1-7)	
	C.	Tunanak Drinking Water Protection Area and Potential and Existing Contaminant Sources (Map 2)	
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# Source Water Assessment for the Tunanak Water System, Tunanak, Alaska

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## Drinking Water Protection Program Alaska Department of Environmental Conservation

### EXECUTIVE SUMMARY

The public water system for the City of Tunanak, Alaska, is a Class A surface water system that obtains water from First Creek and Muskox Creek, the primary and secondary water sources respectively. The creeks flow southwest from Ugchirnak Mountain towards the community. Water from the creek is filtered, chlorinated, fluorinated, and piped to the school and a 50,000-gallon storage tank located at the Tunanak pumphouse / washeteria.

The Tunanak protection area is approximately 1.5 square miles in size and has received a susceptibility rating of **High**. *A rating of High to Very High is typical for all systems with surface water intakes.* Potential and existing sources of the following contaminants were evaluated for the Source Water Assessment: bacteria and viruses, nitrates and/or nitrites, heavy metals, cyanide, and other inorganic chemicals, synthetic organic chemicals, volatile organic chemicals, and other organic chemicals.

Known potential contaminant sources are located within the surface water protection area and include roads and a landfill. These sources may affect drinking water at the source and could potentially influence sampling results. Samples were collected from post-treated water. Contaminant sources identified within the surface water protection area for this public water system have been considered in order to provide the most conservative evaluation.

This evaluation included all available water sampling data submitted to the Alaska Department of Environmental Conservation (ADEC) by the system operator. As stated previously, the samples were collected from post-treated water. Vulnerability ratings for the water system have been determined by combining the susceptibility of the surface water source with the contaminant risks. The system received a vulnerability rating of **Medium** for bacteria and viruses and volatile organic compounds. Nitrates and nitrites received a vulnerability rating of **Very High** and heavy metals, cyanide, other inorganic compounds, synthetic organic compounds, other organic compounds received a vulnerability rating of **High**.

This assessment can be used as a foundation for local voluntary protection efforts as well as a basis for the continuous efforts on the part of the community of Tunanak to protect public health.

### DRINKING WATER SYSTEM AND AREA OVERVIEW

Tunanak (Sec. 28, T006N, R091W, Seward Meridian) is located in a small bay on the northeast coast of Nelson Island. The Yup'ik Eskimo community lies about 519 miles northwest of Anchorage. Tunanak has a current population of 323 (ADCED, 2003). Average annual precipitation in Tunanak is 17 inches, including approximately 28 inches of snowfall. Tunanak has a maritime climate with average summer temperatures ranging from 42 to 59°F and winter temperatures averaging 2 to 19°F. However, temperatures have been as extreme as -35 to 80°F.

The public water system is a Class A surface water system that operates year-round and obtains water from First Creek and Muskox Creek, which run near the village. Water from the intake is treated using filtration, chlorination, and fluorination before it is piped to the school and the 50,000-gallon storage tank in the village. Residents haul treated water from six watering points located around the village. Most residents use the honeybucket system for sewage disposal, although a few households are connected to a flush/haul system (ADCED, 2003).

Tunanak receives its electrical power from Alaska Village Electric Cooperative (AVEC) operated by the REA Co-op. The electric company is located near the center of the village. Power generating facilities are fueled by diesel. The Tunanak Traditional Council operates sewage and refuse collection services and the local landfill (ADCED, 2003).

Information acquired from a November 1999 sanitary survey for the public water system indicated that the surface water intake is adequately constructed. The average daily production of the system is unknown.

Tunanak is located on the Yukon-Kuskokwim (Y-K) Delta. The Y-K Delta is located on the southwest coast of Alaska and primarily consists of lowlands formed by the deposition of fluvial sediment from the Yukon and Kuskokwim Rivers.

The Y-K Delta topography is relatively flat and approximately 40% to 50% of the delta surface is wet (Alaska Geographic Society). The lower delta area generally receives about 20 inches of precipitation annually. Areas of both discontinuous and continuous permafrost are present on the Y-K Delta. Permafrost is often present within 10 feet of ground surface and varies in thickness from 15 feet to 600 feet thick (R&M, 1979b). Thaw bulbs generally persist around areas of standing and flowing water.

### TUNANAK DRINKING WATER PROTECTION AREA

Identifying the pathways most likely for surface contamination to reach water intake areas is the first step in determining the water system’s risk. These pathways are initially determined by looking at the drainage area contributing overland water flow to a surface water source intake. The entire drainage area is also known as the “drinking water protection area.” Please refer to pages 10-11 of the “Guidance Manual for Class A Public Water Systems” for additional information.

The protection area established for surface water sources by the ADEC is usually separated into three zones. These zones correspond to the overland-flow distance that water travels to get to the source. The ADEC Drinking Water Protection Program’s Technical Advisory Committee developed guidelines for derivation of these zones in 1998. The following is a summary of the three protection area zones:

**Table 1. Definition of Zones**

<b>Zone</b>	<b>Definition</b>
A	Areas within 1000-ft of lakes or streams
B	Areas within 1-mile of lakes or streams
C	The watershed boundary

The protection area for the Tunanak water intake includes each of these Zones (See Map 1 of Appendix A).

### INVENTORY OF POTENTIAL AND EXISTING CONTAMINANT SOURCES

The Drinking Water Protection Program has completed an inventory of potential and existing sources of

contamination within the Tunanak surface water protection area. This inventory was completed through a search of agency records and other publicly available information. There is a wide array of potential contamination sources to surface water. These contaminants are found within agricultural, residential, commercial, and industrial areas, but can also occur within areas that have little or no development.

For Class A public water system assessments, six categories of drinking water contaminants were inventoried. They include:

- Bacteria and viruses;
- Nitrates and/or nitrites;
- Volatile organic chemicals;
- Heavy metals, cyanide, and other inorganic chemicals;
- Synthetic Organic Chemicals; and
- Other Organic Chemicals.

Several contaminant sources were identified in the Tunanak protection area as displayed on Map 2 of Appendix C and in Table 1 of Appendix B.

### RANKING OF CONTAMINANT RISKS

Once potential and existing sources of contamination have been identified, they are assigned a ranking according to what category and level of risk they represent. Ranking of contaminant risks for “potential” or “existing” sources of contamination is a function of the toxicity and the volume of specific contaminants associated with that source. Rankings include:

- Low;
- Medium;
- High; and
- Very High.

The time-of-travel for contaminants within the water is dependent on the physical and chemical characteristics of each contaminant. Bacteria and Viruses are only inventoried in Zone A because of their short life span. Only “Very High” and “High” rankings are inventoried within Zones B and C due to the probability of contaminant dilution by the time the contaminants reach the water intake.

The remaining tables in Appendix B contain the ranking of potential and existing sources of contamination with respect to bacteria and viruses, nitrates and/or nitrites, volatile organic chemicals, heavy metals, cyanide, and other inorganic chemicals, synthetic organic chemicals, and other organic chemicals.

## VULNERABILITY OF THE DRINKING WATER SYSTEM

Vulnerability of a drinking water source to contamination is a combination of two factors:

- Surface Water Susceptibility and
- Contaminant risks.

Appendix D contains 13 charts, which together form the ‘Vulnerability Analysis’ for the public drinking water Source Water Assessment. Chart 1 analyzes the ‘Susceptibility of the Surface Water Source’ to contamination by looking at the climate, terrain, and intake location. Chart 2 analyzes ‘Contaminant Risks’ for the drinking water source with respect to bacteria and viruses. The ‘Contaminant Risks’ portion of the analysis considers potential sources of contaminants as well as a review of contamination that has or may have occurred, but has not arrived or been detected at the intake area. Chart 3 contains the ‘Vulnerability Analysis for Bacteria and Viruses,’ which is a composite score of the Vulnerability Analysis and the overall Susceptibility. Charts 4 through 13 repeat the Contaminant Risks and Vulnerability Analyses for nitrates and nitrites, volatile organic chemicals, heavy metals, cyanide, and other inorganic chemicals, synthetic organic chemicals, and other organic chemicals, respectively.

A score for the Surface Water Susceptibility of the source is reached by considering the properties of the water intake and the surrounding area. The derivation of this information is presented below and the data for this source is shown in Chart 1 of Appendix D.

Susceptibility of the Surface Water Source – always considered to be “high” (30 points)

+

Adequate Construction of the Intake (0 – 5 Points)

+

Runoff Potential Within Zone B (0 – 5 Points)

+

Dilution Capacity of the Surface Water (0 – 10 Points)

=

Natural Susceptibility  
(0 – 50 Points)

A ranking is assigned for the Surface Water Susceptibility according to the point score:

### Surface Water Source Susceptibility Ratings

40 to 50 pts	Very High
30 to < 40 pts	High

**Table 2. Susceptibility of the Water Source**

	<b>Score</b>	<b>Rating</b>
Minimum Allowable Susceptibility	30	
Intake Construction Adequate	0	
Runoff Potential	2	
Dilution Capacity	5	
<b>Overall Susceptibility</b>	<b>37</b>	<b>High</b>

For contaminants, risks to a drinking water source depend on the type, number or density, and distribution of the contaminant sources. The Contaminant Risk score has been derived from an examination of existing, and historical contamination sources that have been detected in the protection area through routine sampling. It also evaluates potential sources of contamination. Flow charts are used to assign a point score, and ratings are assigned in the same way as the susceptibility:

### Contaminant Risk Ratings

40 to 50 pts	Very High
30 to < 40 pts	High
20 to < 30 pts	Medium
< 20 pts	Low

Table 3 summarizes the Contaminant Risks for each category of drinking water contaminants.

**Table 3. Tunanak Contaminant Risks**

<b>Category</b>	<b>Score</b>	<b>Rating</b>
Bacteria and Viruses	12	Low
Nitrates and/or Nitrites	43	Very High
Volatile Organic Chemicals	12	Low
Heavy Metals, Cyanide, and Other Inorganic Chemicals	34	High
Synthetic Organic Chemicals	40	Very High
Other Organic Chemicals	42	Very High

Finally, an overall vulnerability score is assigned for each contaminant type by combining each of the contaminant risk scores with the susceptibility score:

$$\begin{array}{r}
 \text{Susceptibility of the Surface Water Source} \\
 \text{(0 – 50 points)} \\
 + \\
 \text{Contaminant Risks (0 – 50 points)} \\
 = \\
 \text{Vulnerability of the} \\
 \text{Drinking Water Source to Contamination (0 – 100).}
 \end{array}$$

Again, rankings are assigned according to a point score:

Overall Vulnerability Ratings	
80 to 100 pts	Very High
60 to < 80 pts	High
40 to < 60 pts	Medium
< 40 pts	Low

Table 4 contains the overall vulnerability scores and ratings for each of the six categories of drinking water contaminants. Note: scores are rounded off to the nearest five.

**Table 4. Tunanak Water System Overall Vulnerability**

Category	Score	Rating
Bacteria and Viruses	50	Medium
Nitrates and Nitrites	80	Very High
Volatile Organic Chemicals	50	Medium
Heavy Metals, Cyanide, and Other Inorganic Chemicals	70	High
Synthetic Organic Chemicals	75	High
Other Organic Chemicals	75	High

### Bacteria and Viruses

The contaminant risk for bacteria and viruses is **Low**. The contaminant risk for bacteria and viruses is primarily attributed to the presence of the landfill in Zone B and a partially attributed to roads in Zone A.

Coliforms (a bacteria) are found naturally in the environment and although they aren't necessarily a health threat, they are an indicator of other potentially harmful bacteria in the water, more specifically, fecal coliforms and E. coli, which only come from human and animal fecal waste. Harmful bacteria can cause diarrhea, cramps, nausea, headaches, or other symptoms (EPA, 2003). Positive samples increase the overall vulnerability of the drinking water source, indicating that the source is susceptible to bacteria and virus

contamination. Typically, coliform detection in raw water samples collected from surface water sources is normal. (See Chart 2 – Contaminant Risks for Bacteria and Viruses in Appendix D).

Two positive bacteria counts were reported in recent (previous 5 years) sampling events. The positive samples were recorded in 2002 and 2003, however, the confirmation sampling results were negative, therefore no risk points were retained.

After combining the contaminant risk for bacteria and viruses with the natural susceptibility of the source, the overall vulnerability of the source to bacteria and virus contamination is considered **Medium**.

### Nitrates and Nitrites

The contaminant risk for nitrates and nitrites is **Very High** (See Chart 4 - Contaminant Risks for Nitrates and/or Nitrites in Appendix D). Two potential contaminant risk sources for nitrates were identified in the protection area for this public water system. The contaminate risk is primary attributed to the presence of the landfill in Zone B and partially attributed to roads in Zone A. Nitrates are very mobile, moving at approximately the same rate as water.

The Maximum Contaminant Level (MCL) for nitrates is 10 milligrams per liter (mg/L). The MCL is the maximum level of contaminant that is allowed to exist in drinking water and still be consumed by humans without harmful health effects (EPA, 2003).

Although low concentrations of nitrates have been reported in recent sampling history, none of the concentrations exceed the MCL of 10 mg/L.

After combining the contaminant risk for nitrates and nitrites with the natural susceptibility of the source, the overall vulnerability of the source to contamination is **Very High**.

### Volatile Organic Chemicals

The contaminant risk for volatile organic chemicals is **Low** (See Chart 6 – Contaminant Risks for Volatile Organic Chemicals in Appendix D). One potential contaminant source for volatile organic chemicals was identified in the protection area for this public water system (See Table 4 – Appendix B). The contaminate risk is primary attributed to the presence of roads in Zone A.

Detectable concentrations of trihalomethane were reported in sampling events for this public water system. However, the detectable concentration of

trihalomethane reported in 2000 was well below the MCL of 0.08 mg/L. Trihalomethanes are considered byproducts of the water treatment process and are not from the source waters. Since the reported concentration of TTHM's in the most recent sampling did not exceed the applicable MCLs, risk points were not retained.

Aside from being byproducts of the drinking water treatment process, possible sources of volatile organic chemicals include facilities with automobiles, residential areas, fuel tanks, roads, and airports. See Table 4 in Appendix D for a complete listing.

After combining the contaminant risk for volatile organic chemicals with the natural susceptibility of the source, the overall vulnerability of the source to contamination is **Medium**.

### **Heavy Metals, Cyanide, and Other Inorganic Chemicals**

The contaminant risk for heavy metals is **High**. Two contaminant sources for heavy metals, cyanide, and other inorganic chemicals were identified in the protection area for this public water system. The contaminant risk is primary attributed to the presence of the landfill in Zone B and partially attributed to roads in Zone A.

Based on review of recent sampling records for this public water system, moderate levels of copper and lead have been detected. Copper and lead have been detected in recent sampling history, but have not exceeded their respective MCLs of 1.3 mg/L and 0.015 mg/L (see Chart 8 – Contaminant Risks for Heavy Metals, Cyanide, and Other Inorganic Chemicals in Appendix D).

The reported concentrations of copper and lead in recent sampling events are not likely to be representative of source water conditions. These two analytes are likely attributed to either the water treatment process or water distribution network; therefore, no risk points were assigned based on the presence of these analytes.

After combining the contaminant risk for heavy metals with the natural susceptibility of the source, the overall vulnerability of the well to contamination is **High**.

### **Synthetic Organic Chemicals**

The contaminant risk for synthetic organic chemicals is **Very High**. One contaminant source for synthetic organic chemicals was identified in the protection area for this public water system. The contaminant risk is primary attributed to the landfill in Zone B.

Review of historical sampling data found no recent sampling results for synthetic organic chemical contaminants.

After combining the contaminant risk with the natural susceptibility of the source, the overall vulnerability to synthetic organic chemicals of the source is **High** (See Chart 11 – Contaminant Risks for Synthetic Organic Chemicals in Appendix D).

### **Other Organic Chemicals**

The contaminant risk for other organic chemicals is **Very High**. Two contaminant risk sources for other organic chemicals were identified in Zones A and B of the protection area. The contaminant risk is primary attributed to the presence of the landfill in Zone B and partially attributed to roads in Zone A.

Review of the historical sampling data found no recent sampling results for other organic chemicals.

After combining the contaminant risk with the natural susceptibility of the source, the overall vulnerability to other organic chemicals of the source is **High** (See Chart 13 – Contaminant Risks for Other Organic Chemicals in Appendix D).

### **Using the Source Water Assessment**

This assessment of contaminant risks can be used as a foundation for local voluntary protection efforts as well as a basis for the continuous efforts on the part of the community of Tunanak to protect public health. It is anticipated that Source Water Assessments will be updated every five years to reflect any changes in the vulnerability and/or susceptibility of the drinking water source.

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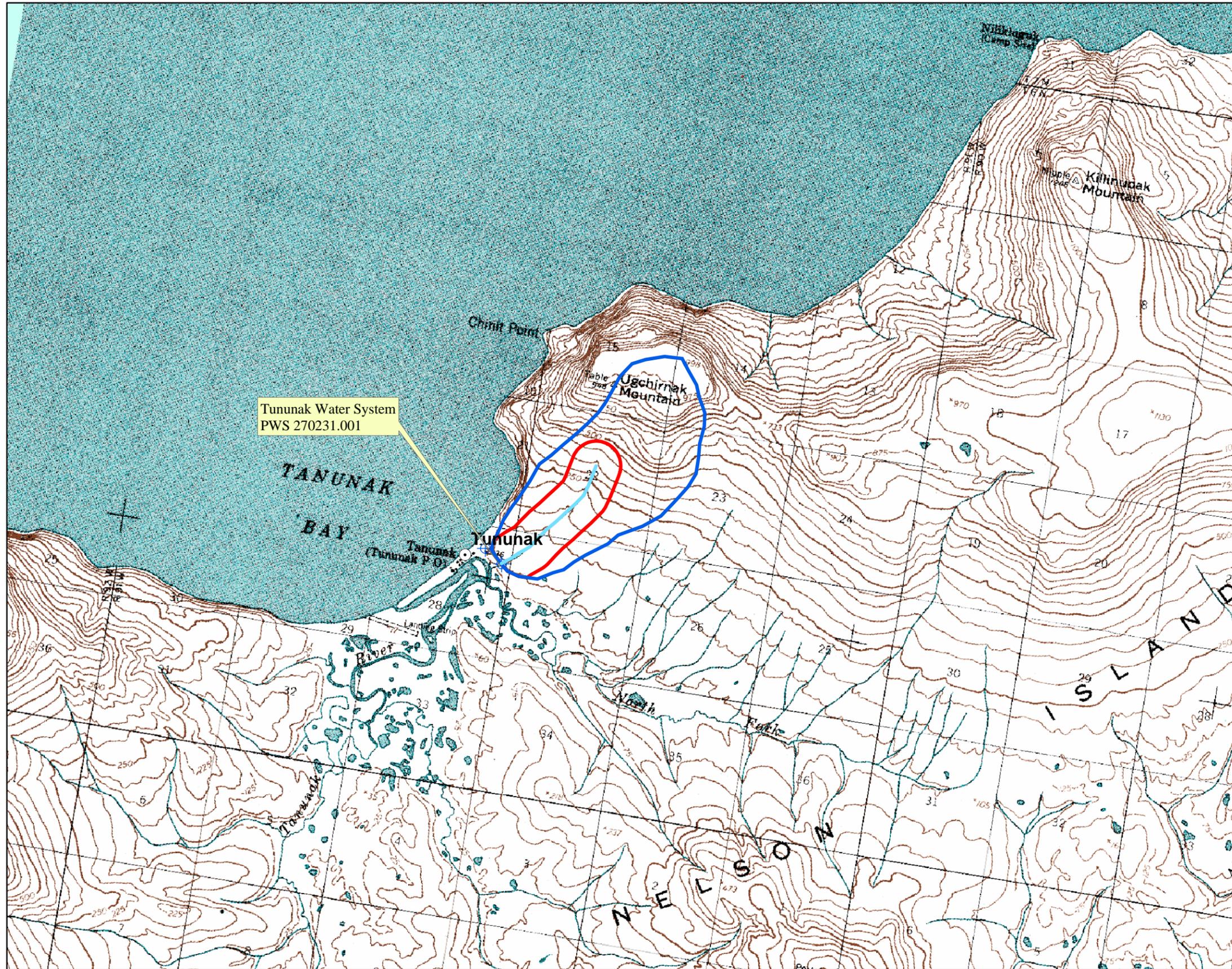
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## **APPENDIX A**

### **Tunanak Water System Drinking Water Protection Area Location Map (Map 1)**

Public Water System for PWS #270231.001 Tununak Water System



**LEGEND**

- Public Water System
- Surface Water Protection Zones**
  - Zone A – 1000 Feet from Surface Water
  - Zone C – 10 Miles from Surface Water or Watershed Boundary

- Hydrography/Physical**
  - Parcels
  - Stream
  - Lake or Pond
  - Contours (approx. 50 ft. or as indicated)

- Transportation**
  - Primary Route (Class 1)
  - Secondary Route (Class 2)
  - Road (Class 3)
  - Road (Class 4)
  - Road (Class 5, Four-wheel drive)
  - Road Ferry Crossing

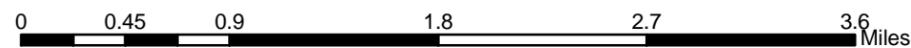
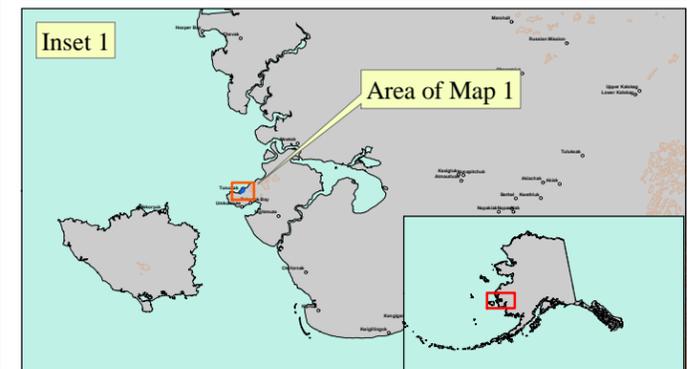
Data Sources:  
Contaminant Sources, Public Water System Wells, Contours  
Alaska Department of Environmental Conservation (ADEC)

Critical Facilities  
Federal Emergency Mangement Agency (FEMA)

All other data  
United States Geological Survey (USGS)

Drinking Water Protection Areas based on ADEC published document:  
"Alaska Drinking Water Protection Program - Guidance Manual for  
Class A Public Water Systems"

URS Corporation does not guarantee the accuracy or validity of the data provided.



## **APPENDIX B**

### **Contaminant Source Inventory and Risk Rankings (Tables 1-7)**

**Table 1**

**Contaminant Source Inventory for  
Tununak Water System**

**PWSID 270231.001**

<b>Contaminant Source Type</b>	<b>Contaminant Source ID</b>	<b>CS ID tag</b>	<b>Zone</b>	<b>Map Number</b>	<b>Comments</b>
Highways and roads, dirt/gravel	X24	X24-01	A	C	Assumed at least 1 unpaved road in Zone A to provide access to Water System intake
Landfills (municipal; Class III)	D51	D51-01	B	C	Tununak Class III Municipal Landfill
Highways and roads, dirt/gravel	X24	X24-02	B	C	Assumed at least 1 unpaved road in Zone B to provide access to landfill

**Table 2**

*Contaminant Source Inventory and Risk Ranking for  
Tununak Water System  
Sources of Bacteria and Viruses*

*PWSID 270231.001*

<i>Contaminant Source Type</i>	<i>Contaminant Source ID</i>	<i>CS ID tag</i>	<i>Zone</i>	<i>Risk Ranking for Analysis</i>	<i>Map Number</i>	<i>Comments</i>
Highways and roads, dirt/gravel	X24	X24-01	A	Low	C	Assumed at least 1 unpaved road in Zone A to provide access to Water System intake
Landfills (municipal; Class III)	D51	D51-01	B	High	C	Tununak Class III Municipal Landfill

**Table 3**

*Contaminant Source Inventory and Risk Ranking for  
Tununak Water System  
Sources of Nitrates/Nitrites*

*PWSID 270231.001*

<i>Contaminant Source Type</i>	<i>Contaminant Source ID</i>	<i>CS ID tag</i>	<i>Zone</i>	<i>Risk Ranking for Analysis</i>	<i>Map Number</i>	<i>Comments</i>
Highways and roads, dirt/gravel	X24	X24-01	A	Low	C	Assumed at least 1 unpaved road in Zone A to provide access to Water System intake
Landfills (municipal; Class III)	D51	D51-01	B	Very High	C	Tununak Class III Municipal Landfill

**Table 4**

*Contaminant Source Inventory and Risk Ranking for  
Tununak Water System  
Sources of Volatile Organic Chemicals*

*PWSID 270231.001*

<i>Contaminant Source Type</i>	<i>Contaminant Source ID</i>	<i>CS ID tag</i>	<i>Zone</i>	<i>Risk Ranking for Analysis</i>	<i>Map Number</i>	<i>Comments</i>
Highways and roads, dirt/gravel	X24	X24-01	A	Low	C	Assumed at least 1 unpaved road in Zone A to provide access to Water System intake

**Table 5**

*Contaminant Source Inventory and Risk Ranking for  
Tununak Water System*

*PWSID 270231.001*

*Sources of Heavy Metals, Cyanide and Other Inorganic Chemicals*

<i>Contaminant Source Type</i>	<i>Contaminant Source ID</i>	<i>CS ID tag</i>	<i>Zone</i>	<i>Risk Ranking for Analysis</i>	<i>Map Number</i>	<i>Comments</i>
Highways and roads, dirt/gravel	X24	X24-01	A	Low	C	Assumed at least 1 unpaved road in Zone A to provide access to Water System intake
Landfills (municipal; Class III)	D51	D51-01	B	High	C	Tununak Class III Municipal Landfill

**Table 6**

*Contaminant Source Inventory and Risk Ranking for  
Tununak Water System  
Sources of Synthetic Organic Chemicals*

*PWSID 270231.001*

<i>Contaminant Source Type</i>	<i>Contaminant Source ID</i>	<i>CS ID tag</i>	<i>Zone</i>	<i>Risk Ranking for Analysis</i>	<i>Map Number</i>	<i>Comments</i>
Landfills (municipal; Class III)	D51	D51-01	B	Very High	C	Tununak Class III Municipal Landfill

**Table 7**

*Contaminant Source Inventory and Risk Ranking for  
Tununak Water System  
Sources of Other Organic Chemicals*

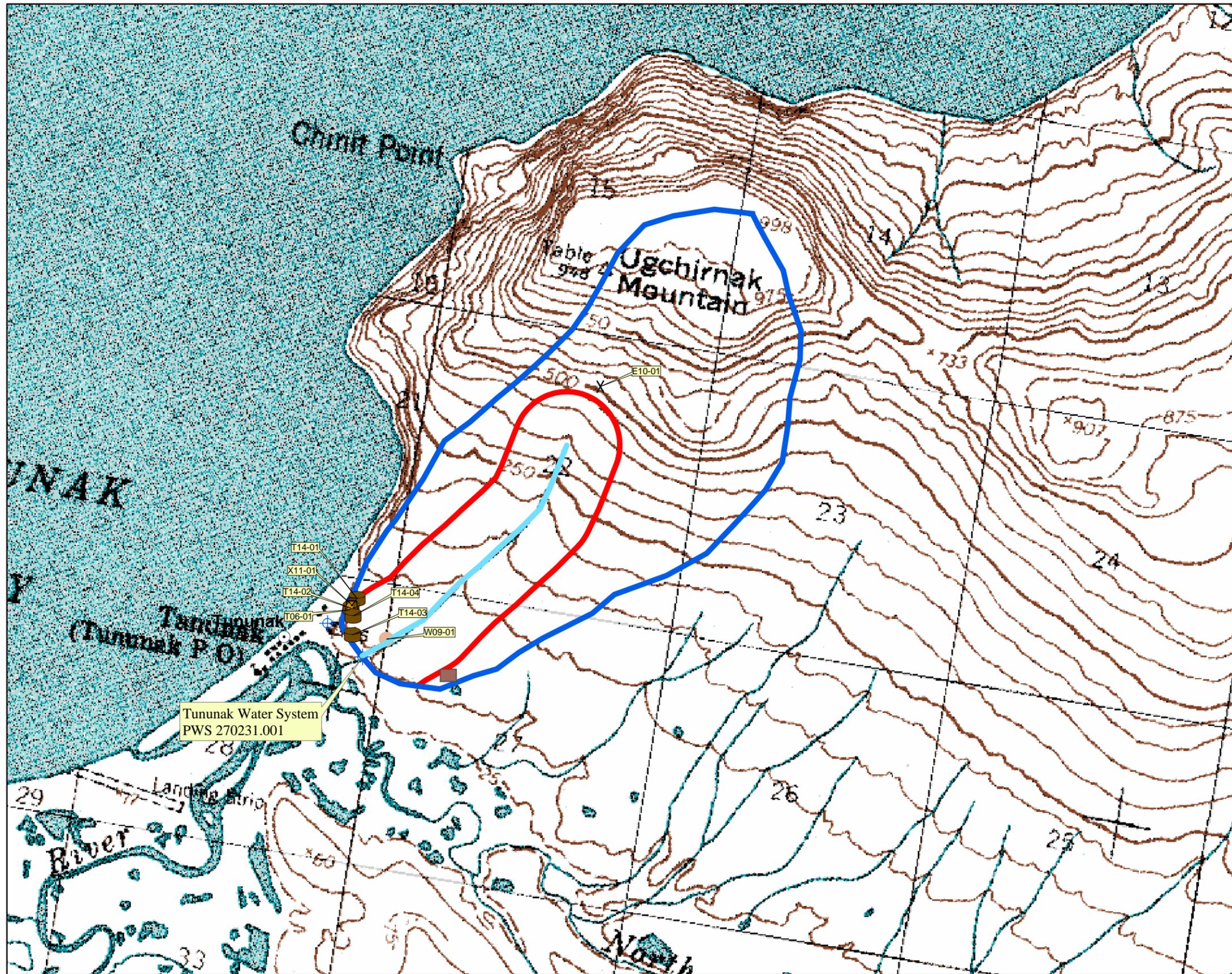
**PWSID 270231.001**

<i>Contaminant Source Type</i>	<i>Contaminant Source ID</i>	<i>CS ID tag</i>	<i>Zone</i>	<i>Risk Ranking for Analysis</i>	<i>Map Number</i>	<i>Comments</i>
Highways and roads, dirt/gravel	X24	X24-01	A	Low	C	Assumed at least 1 unpaved road in Zone A to provide access to Water System intake
Landfills (municipal; Class III)	D51	D51-01	B	Very High	C	Tununak Class III Municipal Landfill

## **APPENDIX C**

### **Tunanak Water System Drinking Water Protection Area and Potential and Existing Contaminant Sources (Map 2)**

**Public Water System for PWS #270231.001 Tununak Water System  
Showing Potential and Existing Sources of Contamination**



**LEGEND**

- Public Water System

**Hydrography/Physical**

- Parcels
- Stream
- Lake or Pond
- Contours (approx. 50 ft. or as indicated)

**Transportation**

- Primary Route (Class 1)
- Secondary Route (Class 2)
- Road (Class 3)
- Road (Class 4)
- Road (Class 5, Four-wheel drive)
- Road Ferry Crossing

**Surface Water Protection Zones**

- Zone A - 1000 Feet from Surface Water
- Zone C - 10 Miles from Surface Water or Watershed Boundary

**Existing or Potential Contaminant Sources**

- Propect mine (E10)
- Aboveground diesel storage tank (T06)
- Tanks, heating oil, nonresidential (aboveground) (T14)
- Fuel storage tank >500 gallon (non-residential) (X11)
- Landfills (Municipal, Class III) (D51)

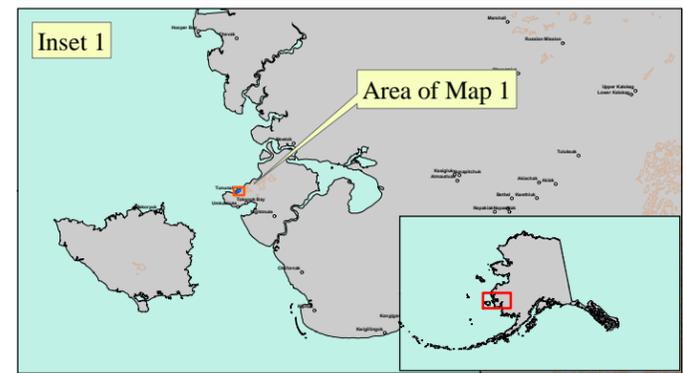
**Data Sources:**  
Contaminant Sources, Public Water System Wells, Contours  
Alaska Department of Environmental Conservation (ADEC)

**Critical Facilities**  
Federal Emergency Mangement Agency (FEMA)

**All other data**  
United States Geological Survey (USGS)

Drinking Water Protection Areas based on ADEC published document:  
"Alaska Drinking Water Protection Program - Guidance Manual for Class A Public Water Systems"

URS Corporation does not guarantee the accuracy or validity of the data provided.



## **APPENDIX D**

### **Vulnerability Analysis and Contaminant Risks (Charts 1-13)**

**Chart 1. Susceptibility of the Surface Water Source - Tununak Water System (PWS No. 270231.001)**

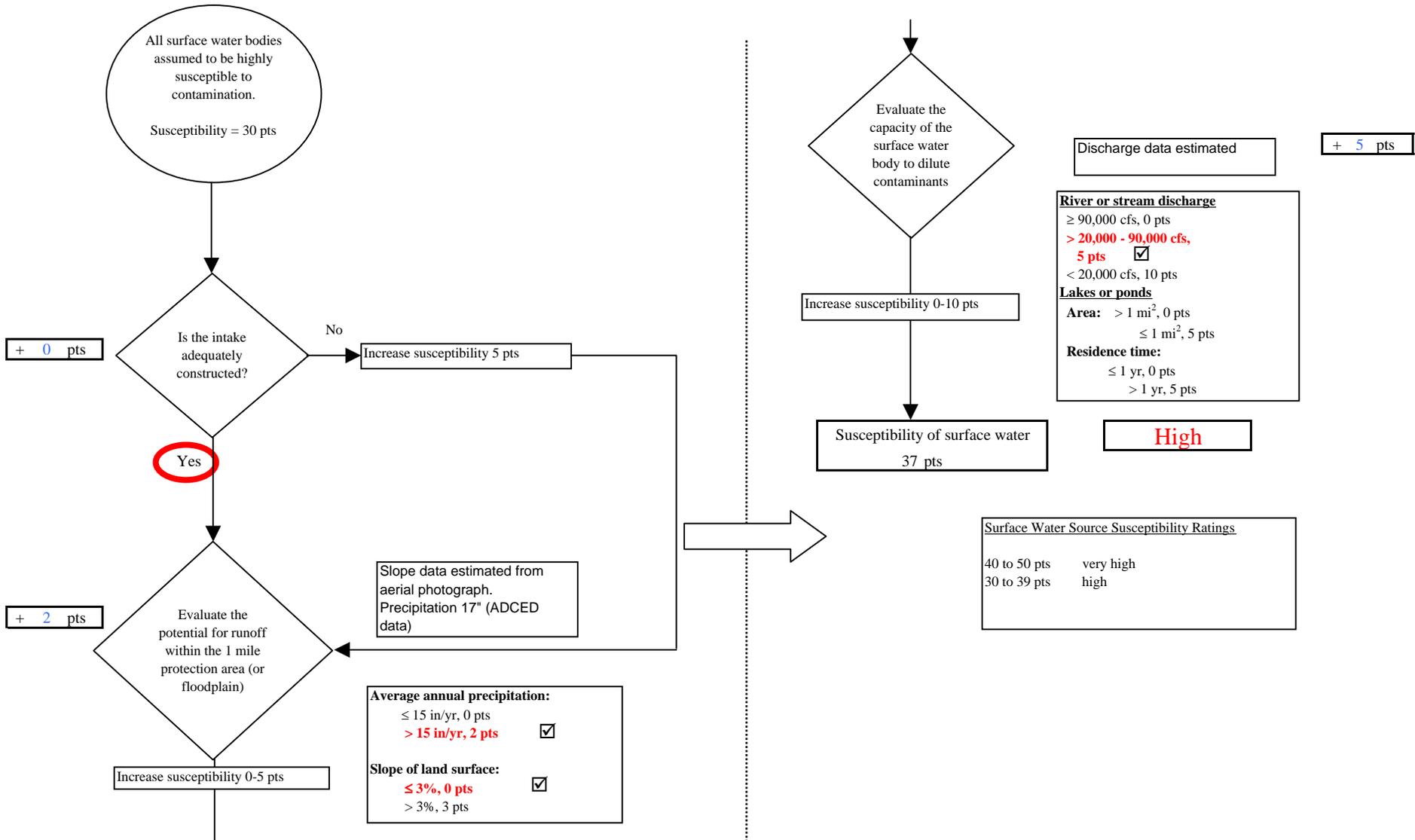
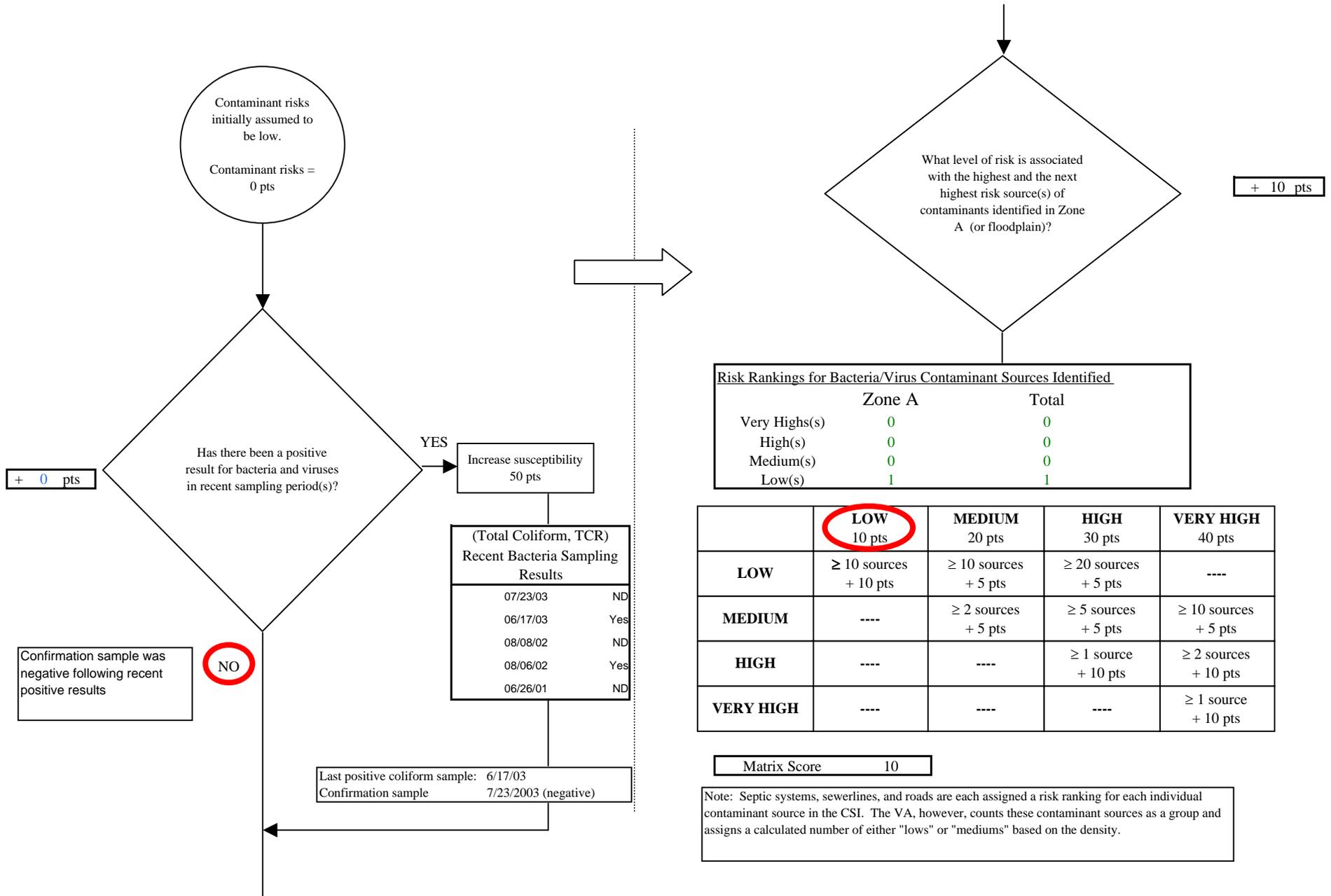
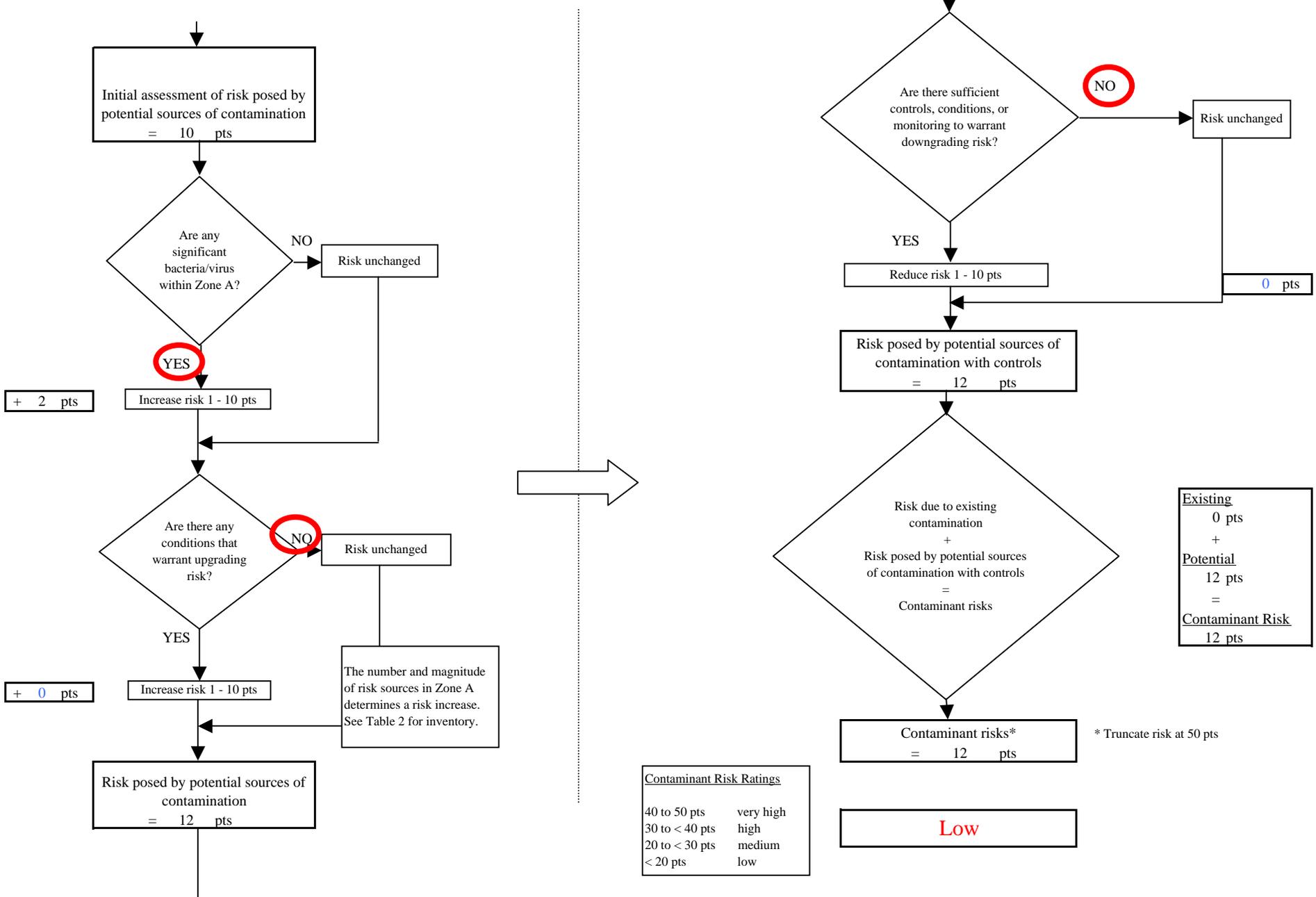


Chart 2. Contaminant risks for Tununak Water System (PWS No. 270231.001) - Bacteria & Viruses



**Chart 2. Contaminant risks for Tununak Water System (PWS No. 270231.001) - Bacteria & Viruses**



**Chart 3. Vulnerability analysis for Tununak Water System (PWS No. 270231.001) - Bacteria & Viruses**

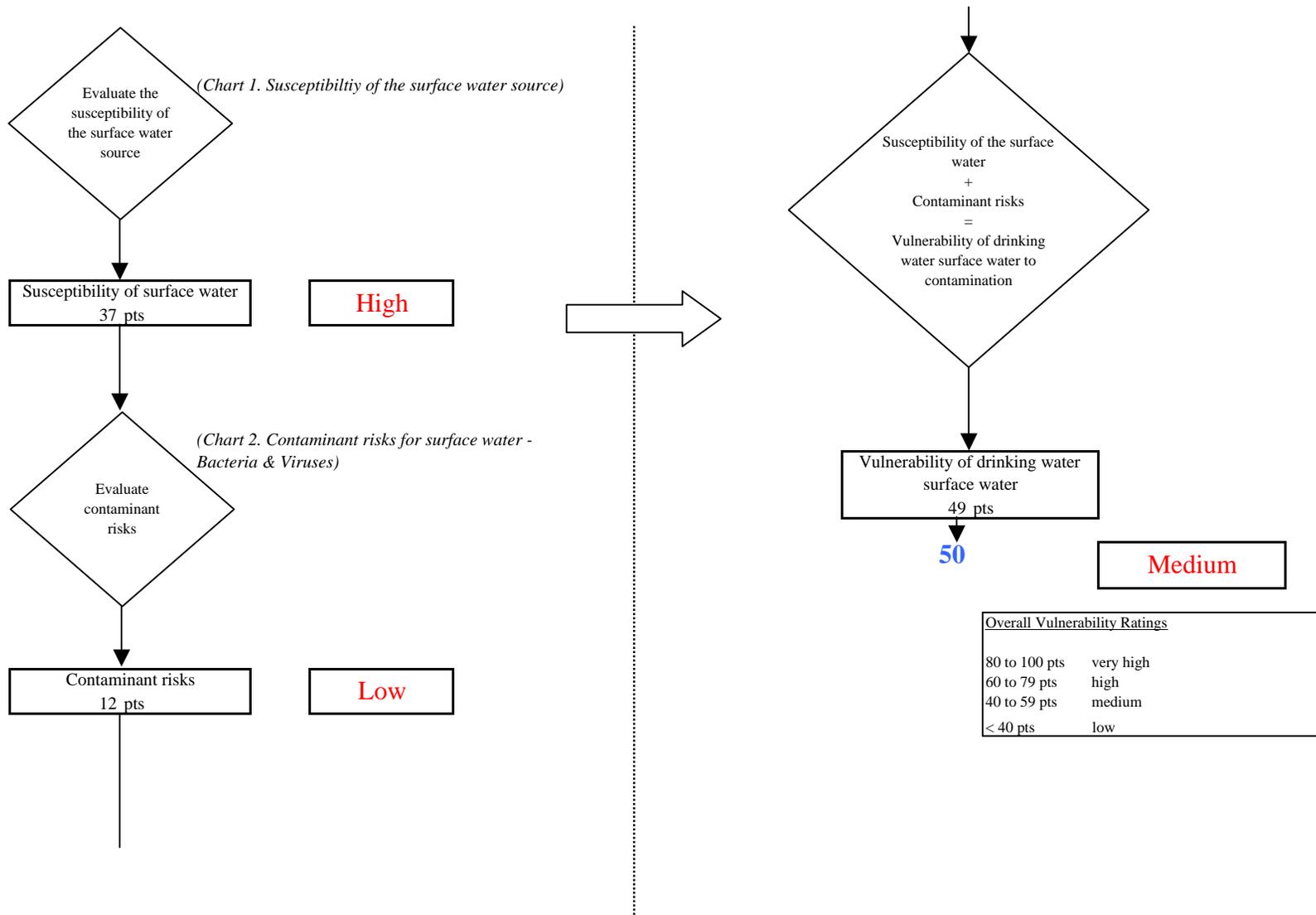
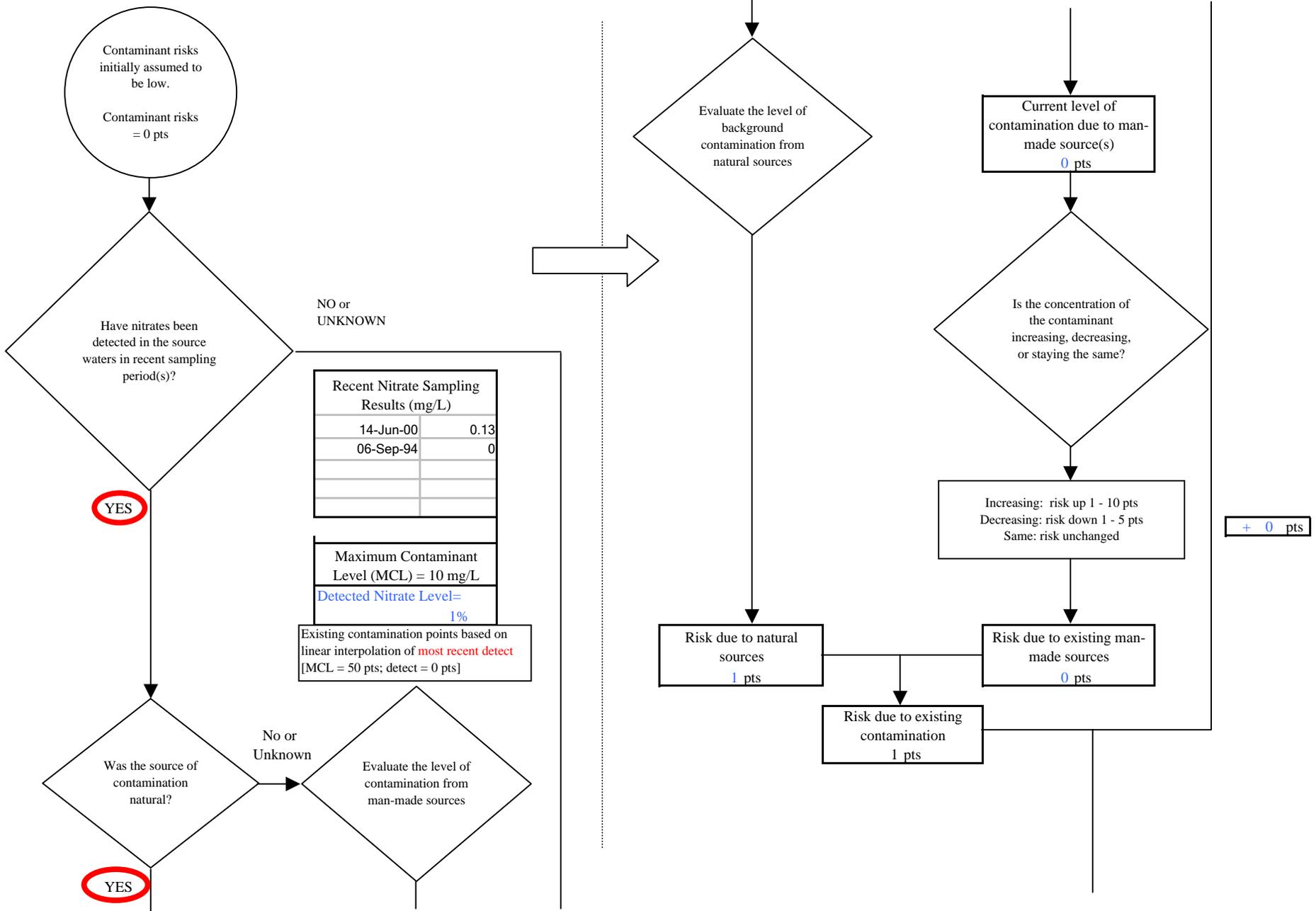


Chart 4. Contaminant risks for Tununak Water System (PWS No. 270231.001) - Nitrates and Nitrites



**Chart 4. Contaminant risks for Tununak Water System (PWS No. 270231.001) - Nitrates and Nitrites**

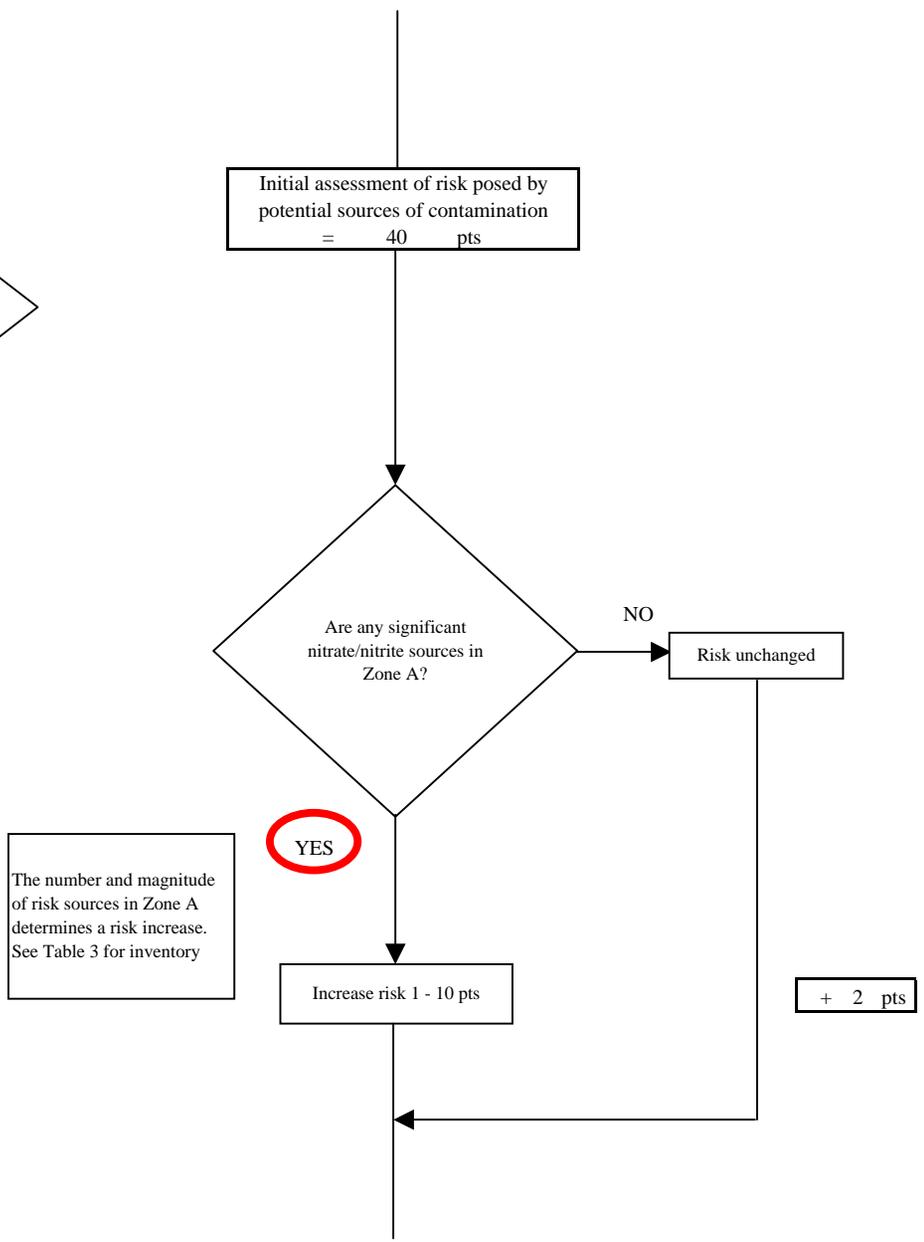
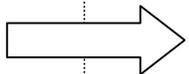
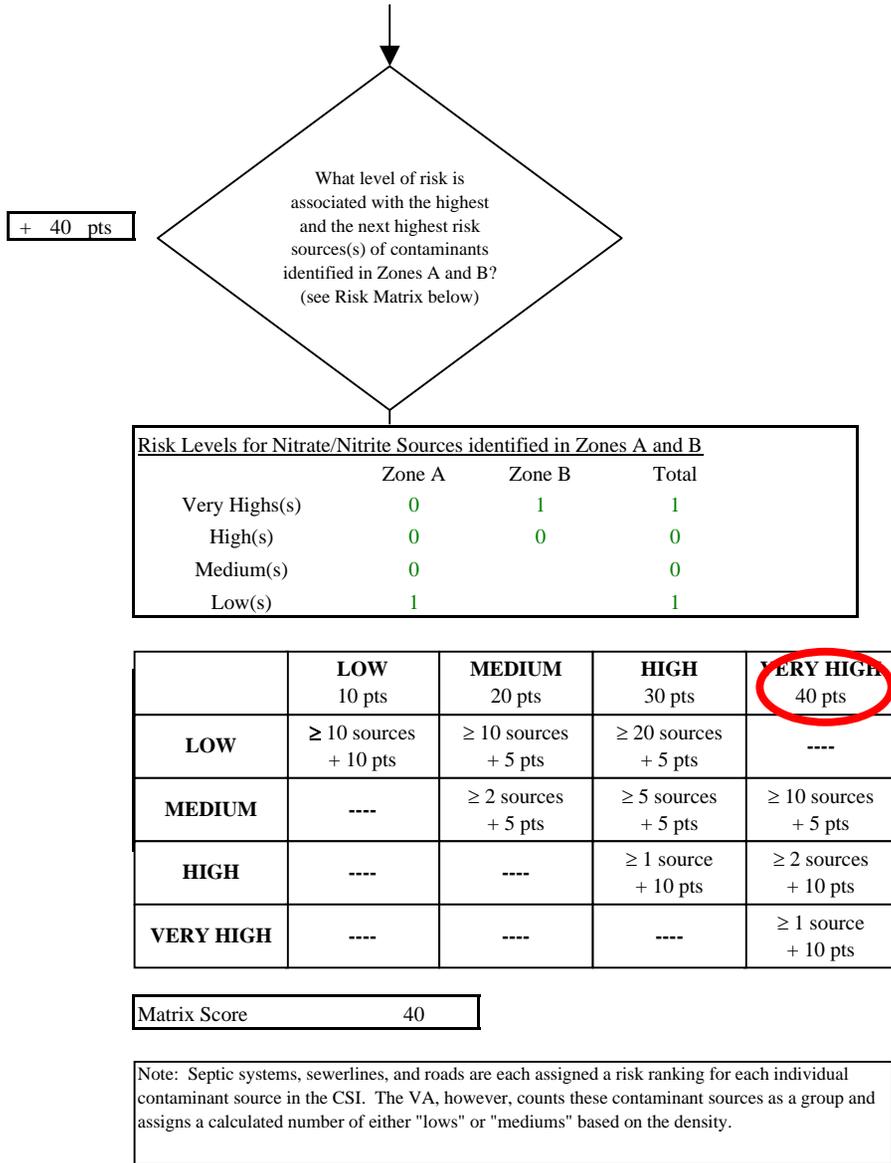
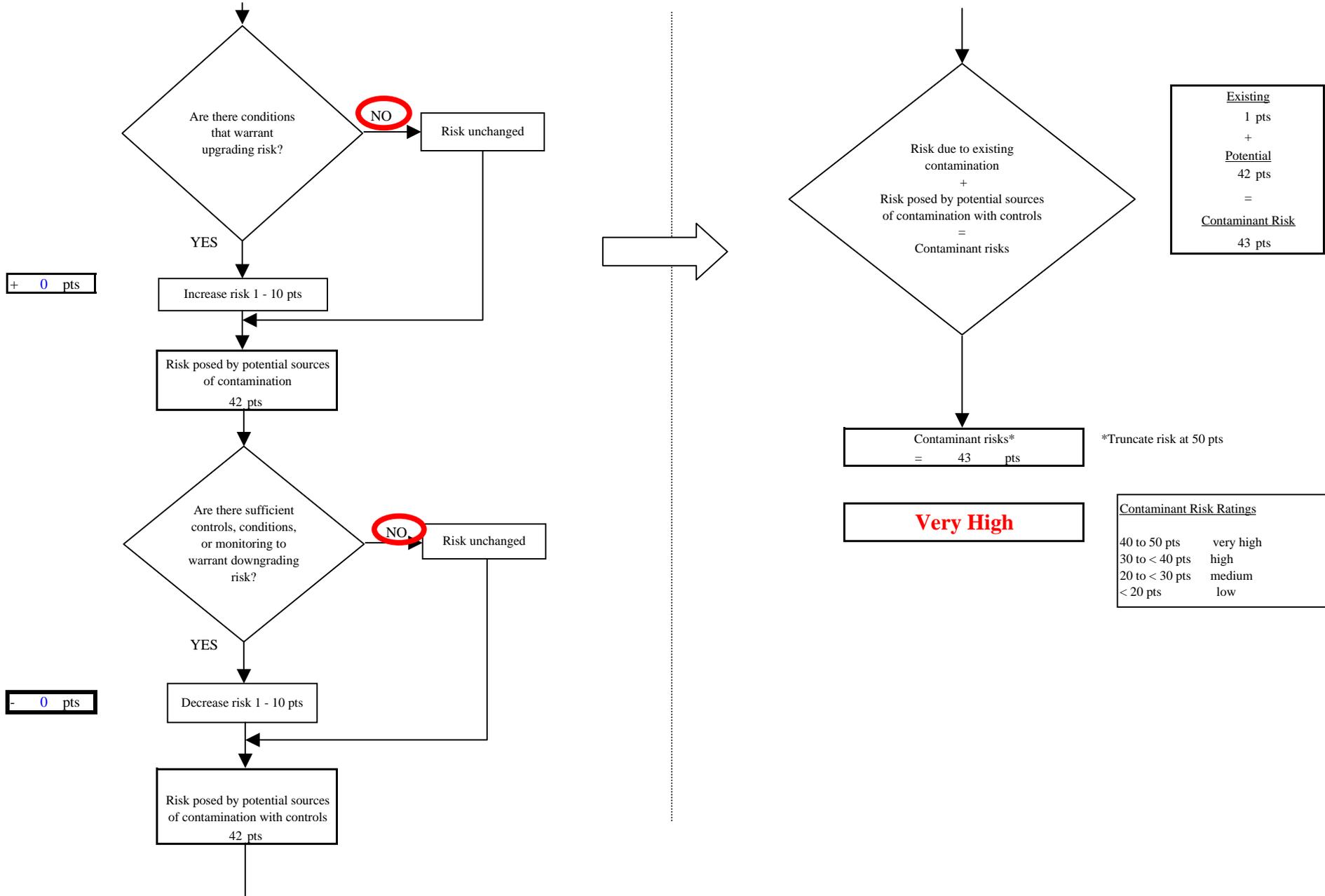
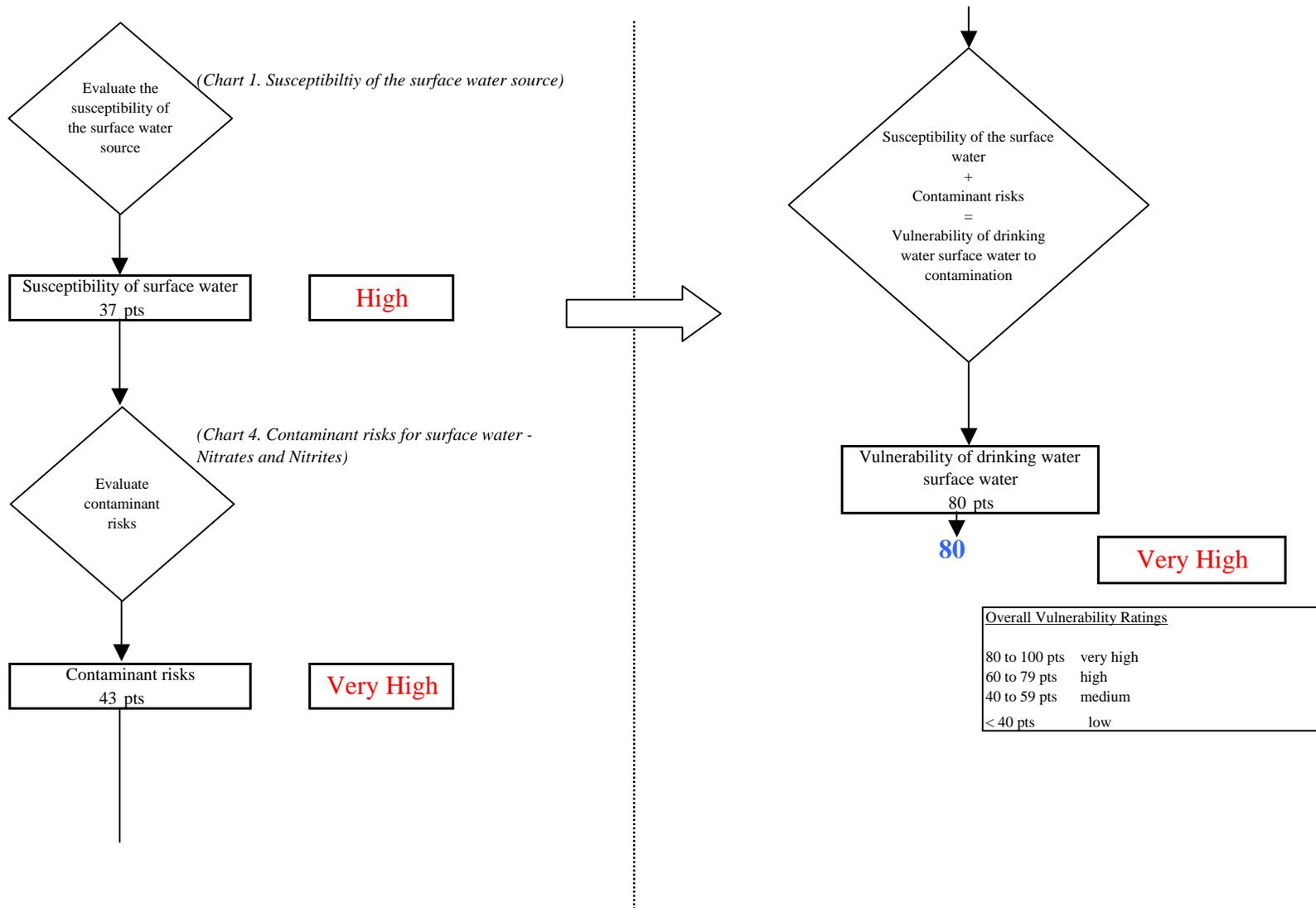


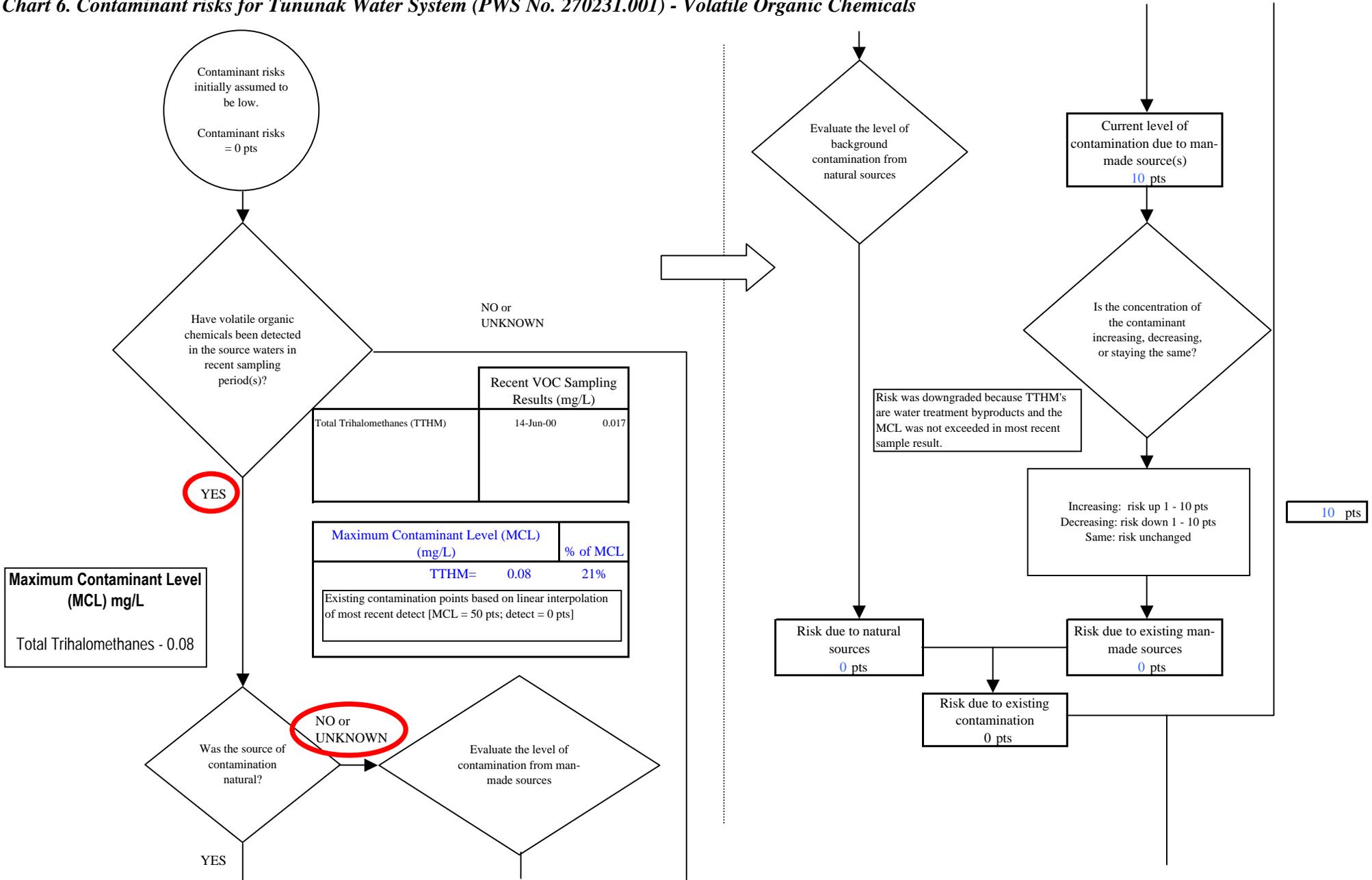
Chart 4. Contaminant risks for Tununak Water System (PWS No. 270231.001) - Nitrates and Nitrites



**Chart 5. Vulnerability analysis for Tununak Water System (PWS No. 270231.001) - Nitrates and Nitrites**



**Chart 6. Contaminant risks for Tununak Water System (PWS No. 270231.001) - Volatile Organic Chemicals**



**Chart 6. Contaminant risks for Tununak Water System (PWS No. 270231.001) - Volatile Organic Chemicals**

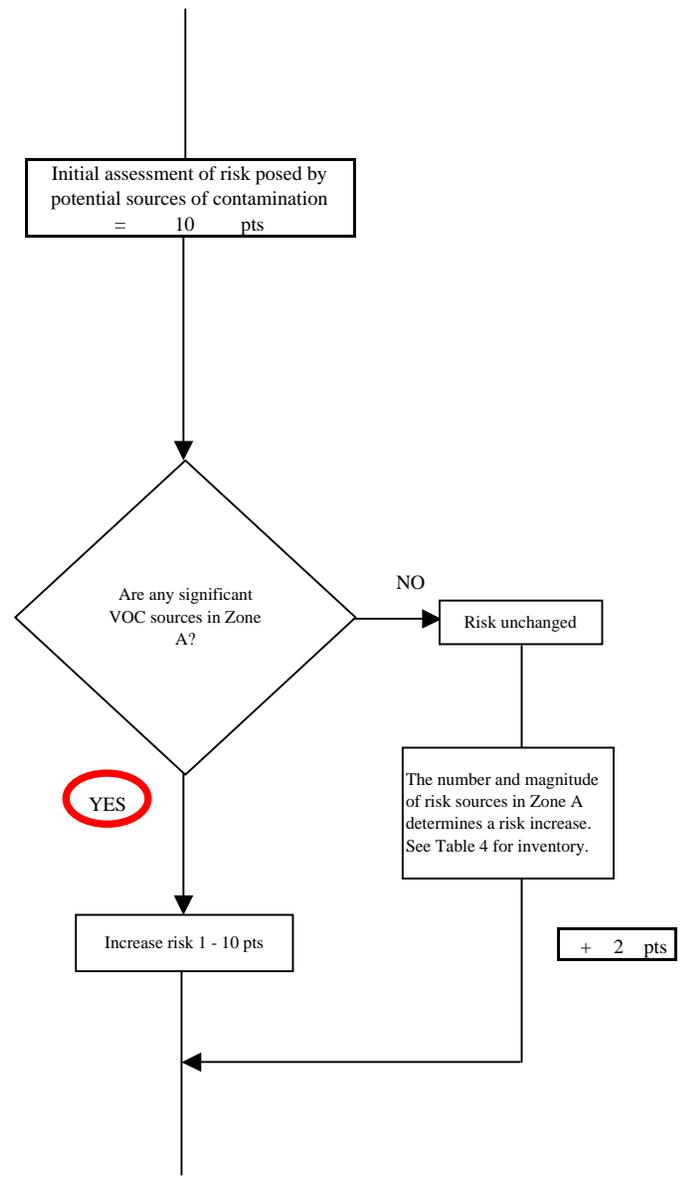
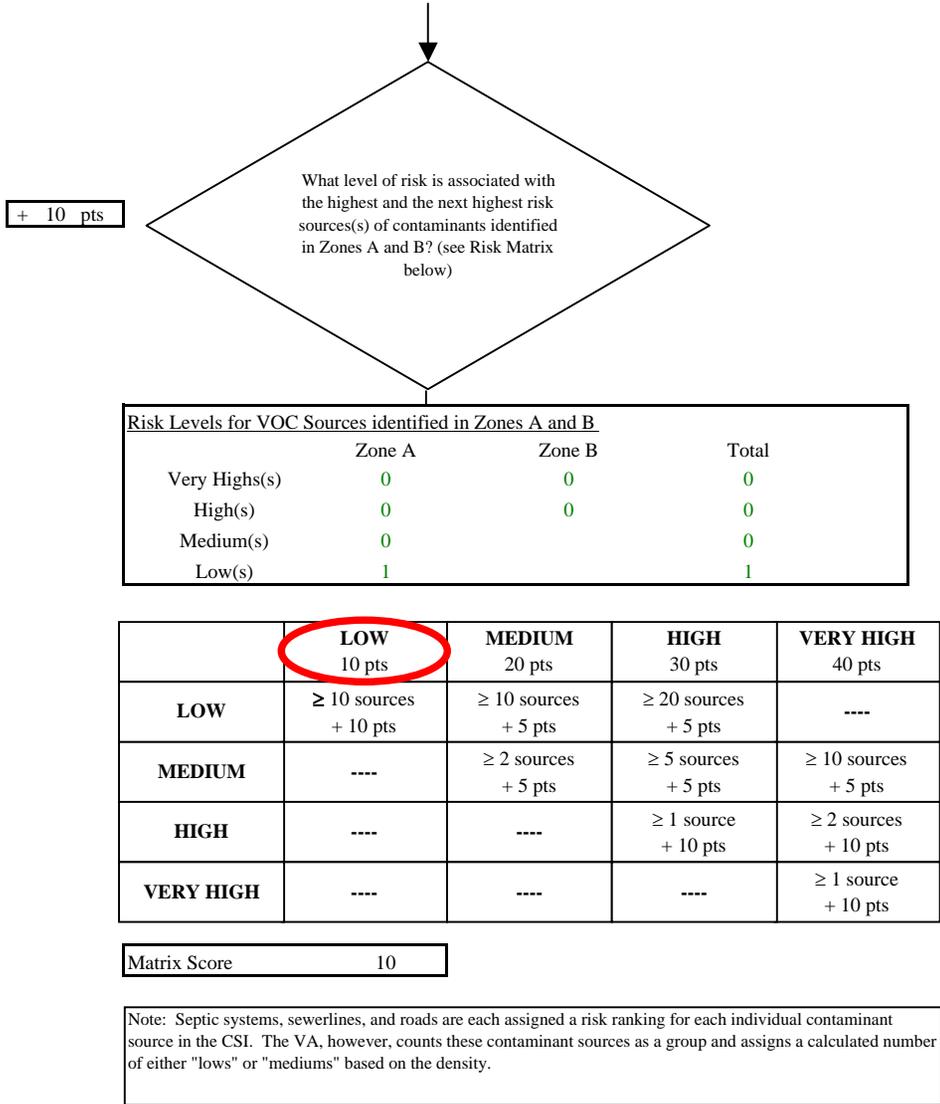
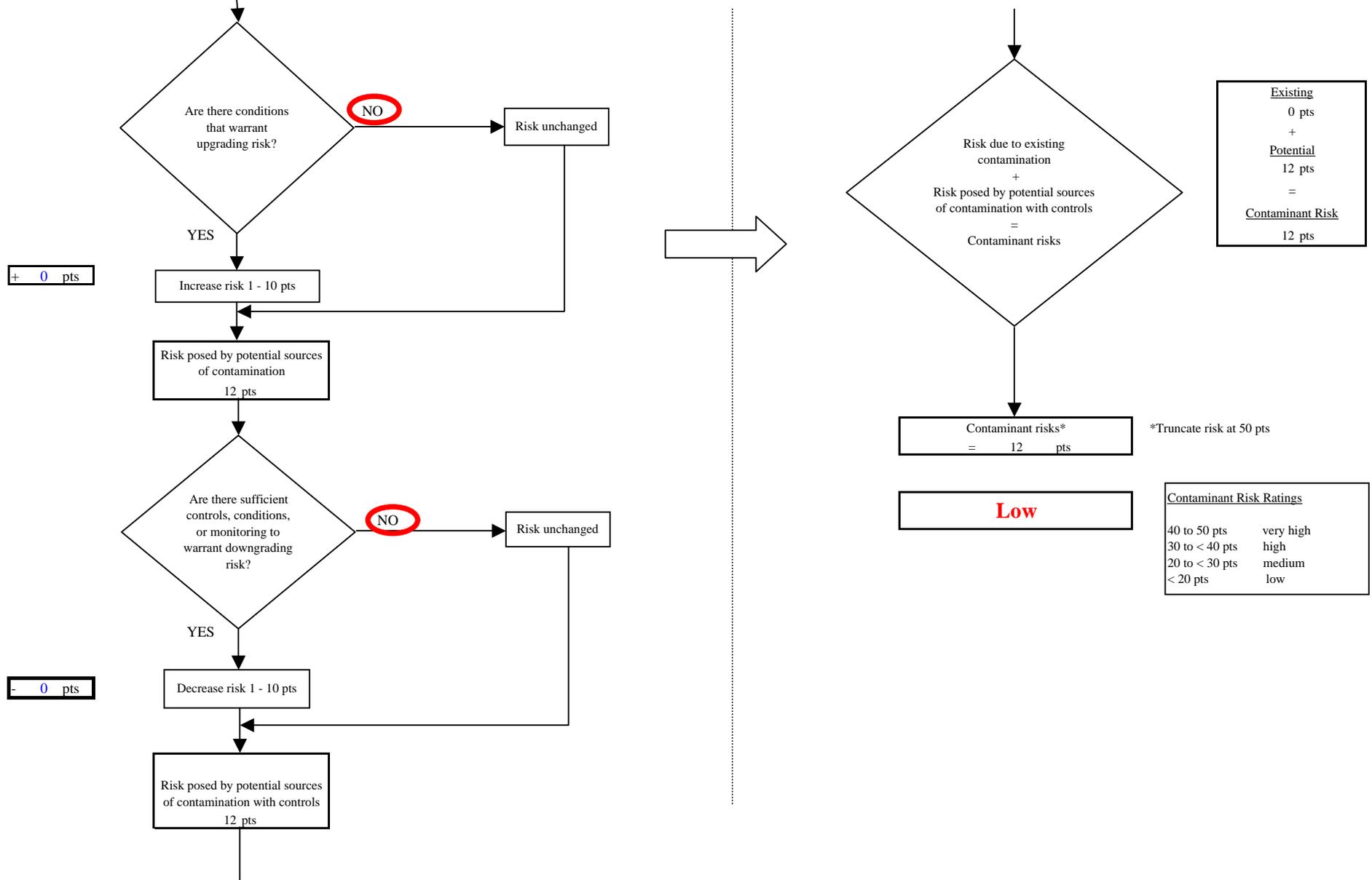
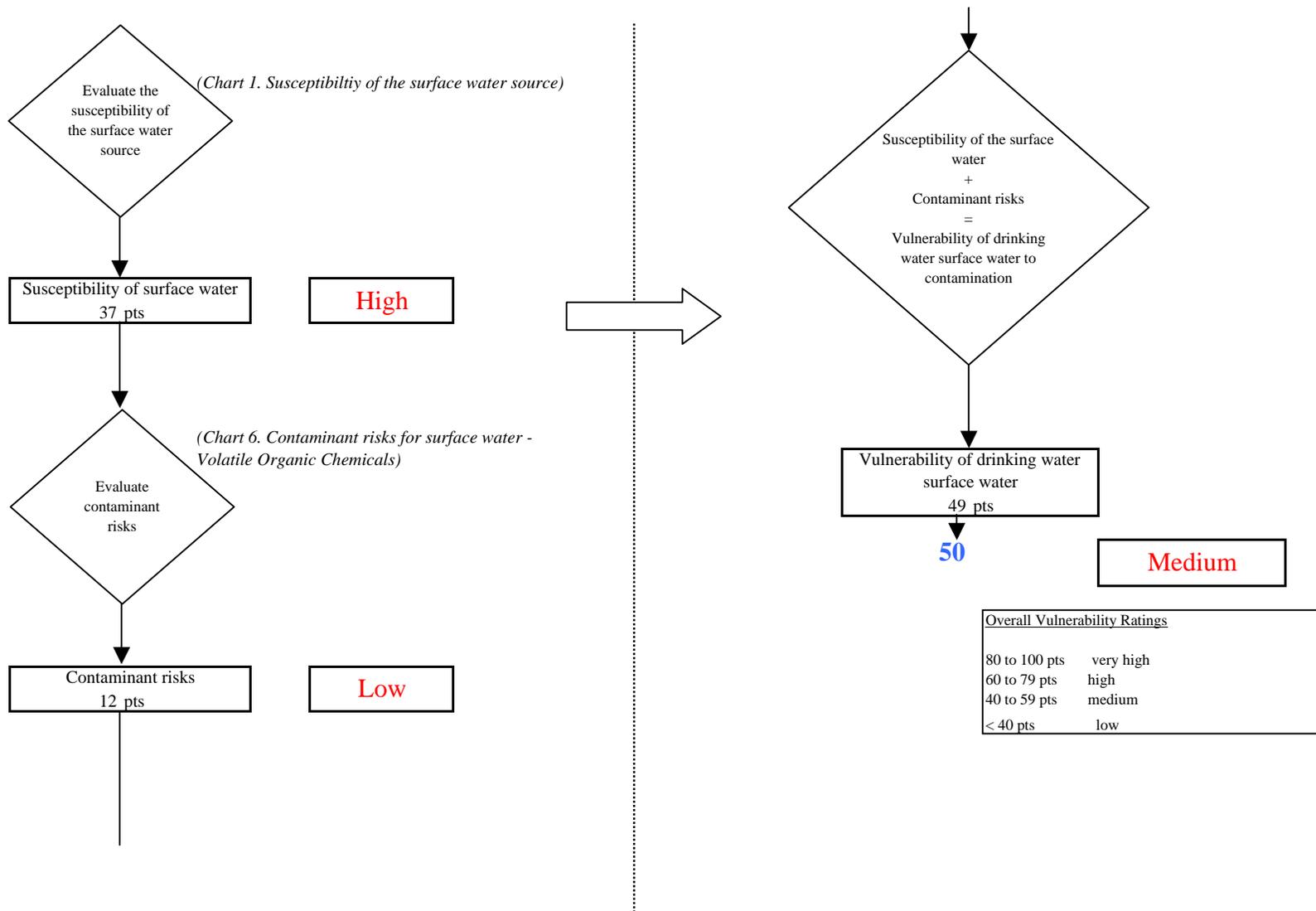


Chart 6. Contaminant risks for Tununak Water System (PWS No. 270231.001) - Volatile Organic Chemicals



**Chart 7. Vulnerability analysis for Tununak Water System (PWS No. 270231.001) - Volatile Organic Chemicals**



**Chart 8. Contaminant risks for Tununak Water System (PWS No. 270231.001) - Heavy Metals, Cyanide and Other Inorganic Chemicals**

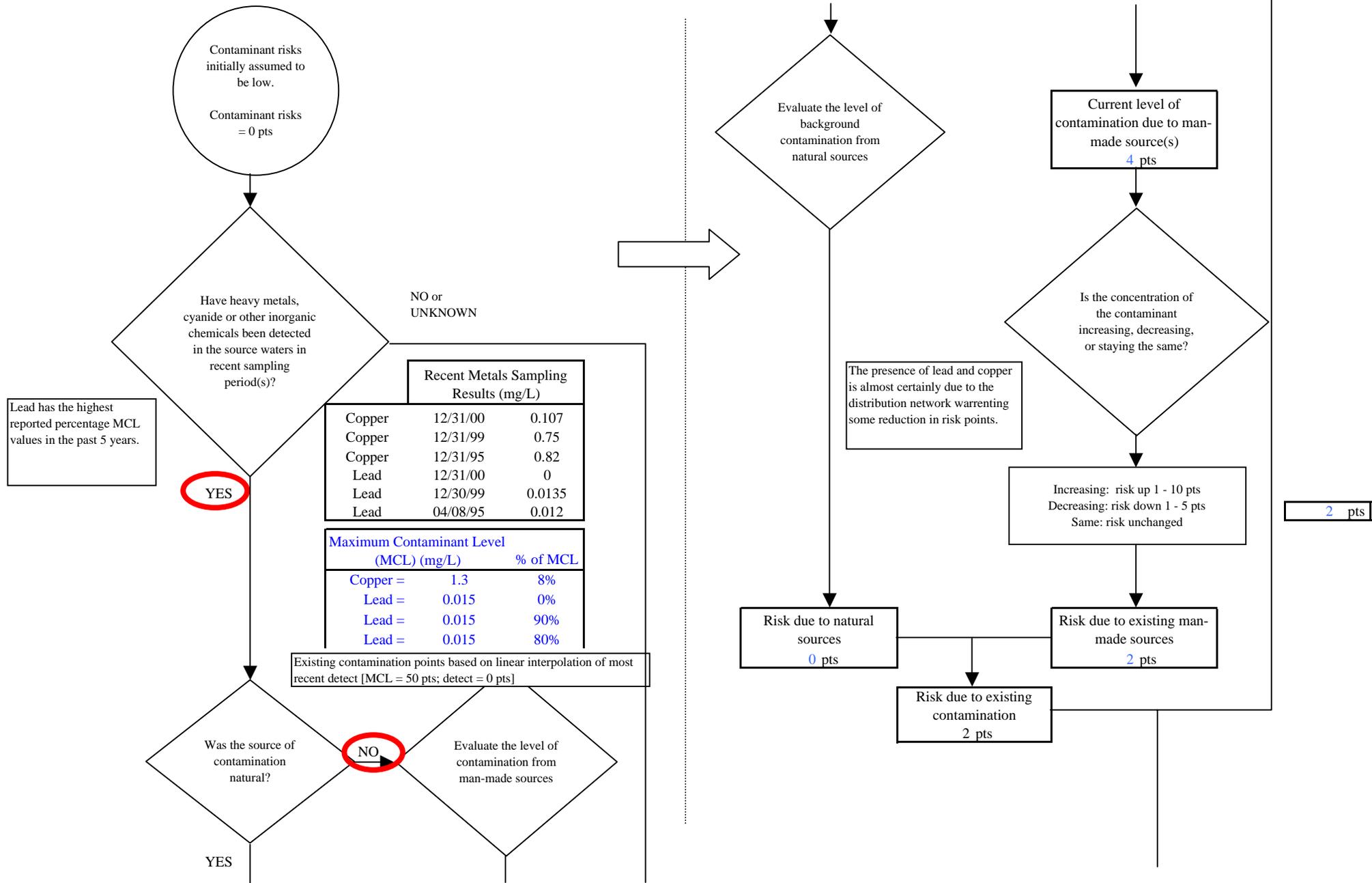
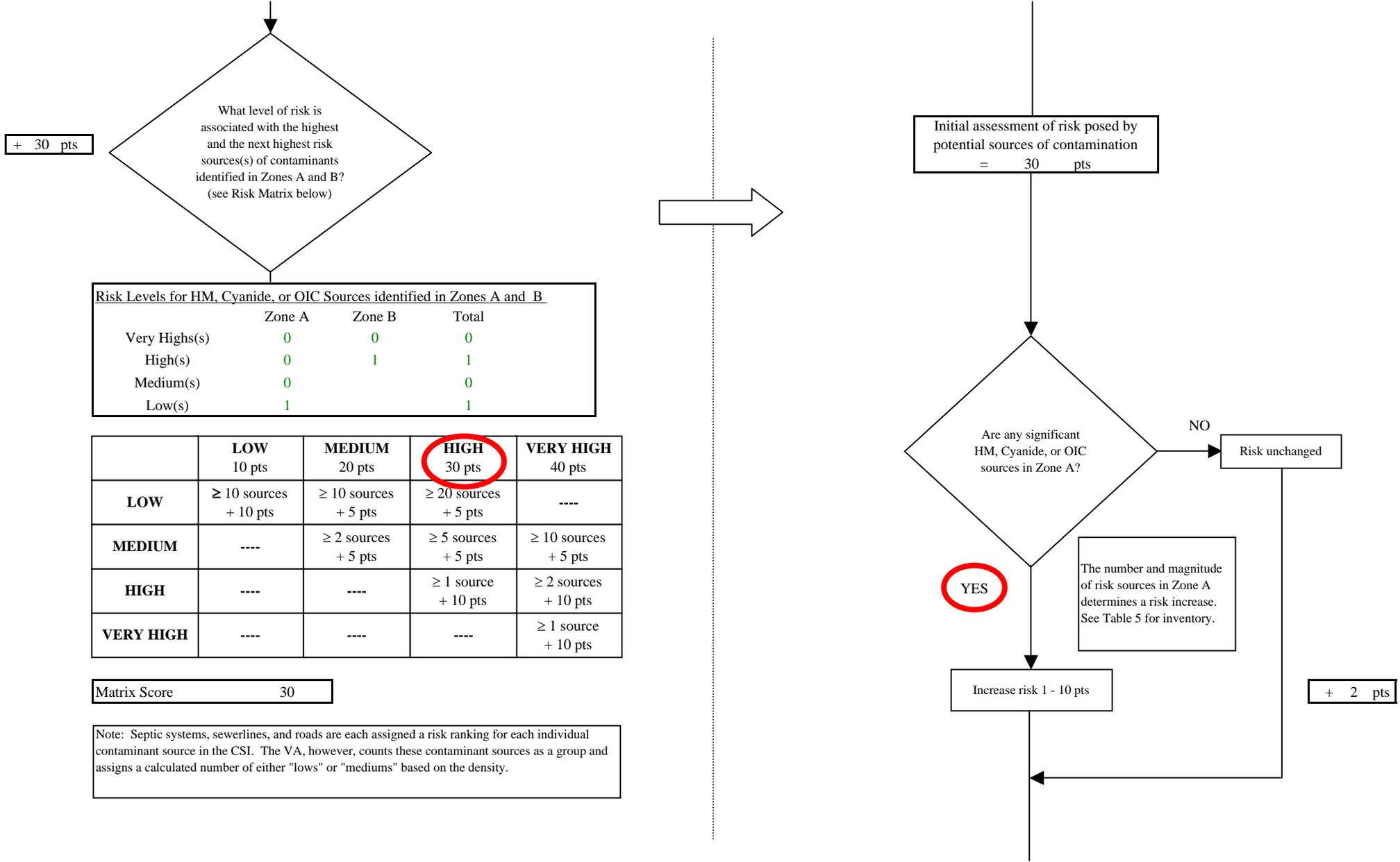
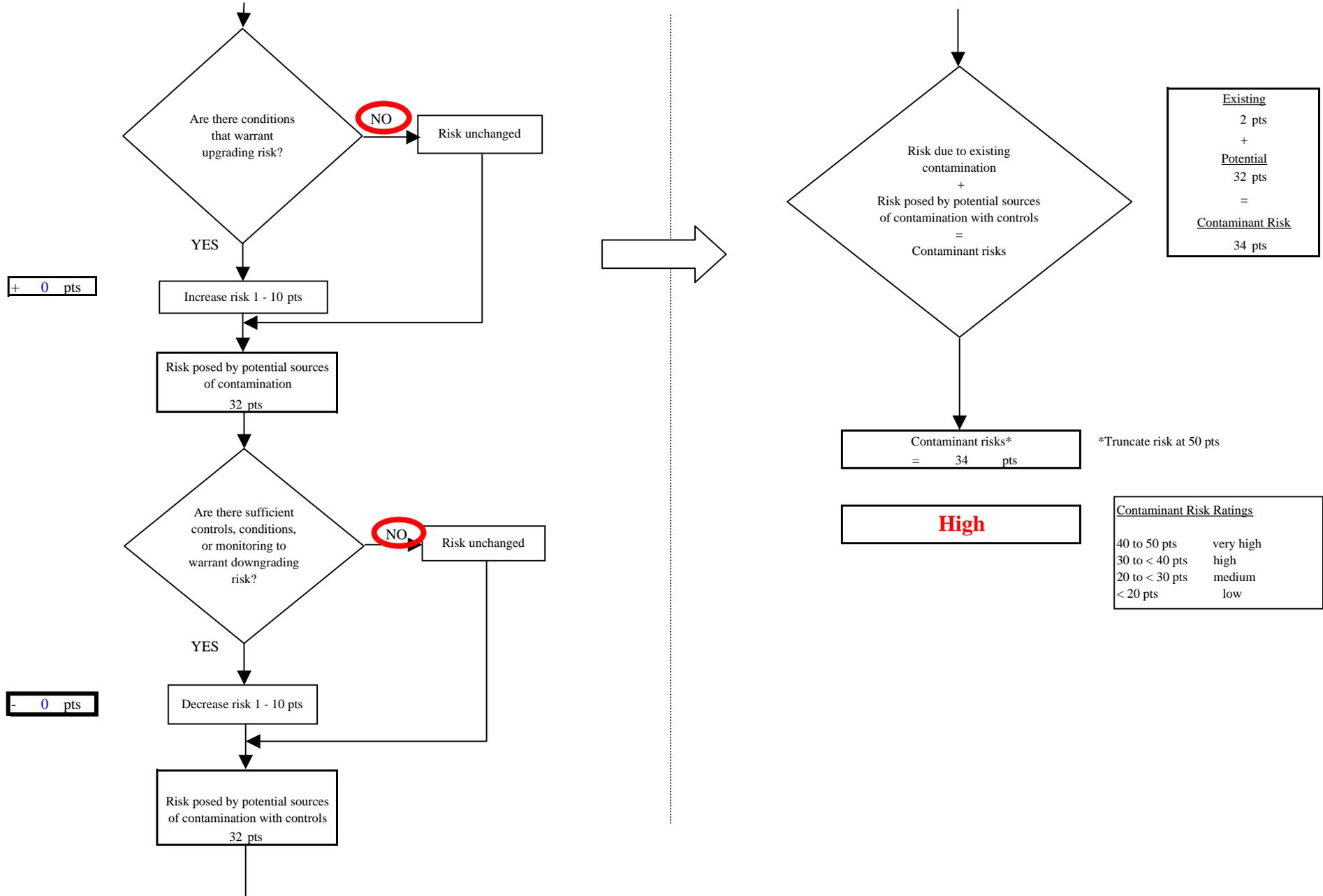


Chart 8. Contaminant risks for Tununak Water System (PWS No. 270231.001) - Heavy Metals, Cyanide and Other Inorganic Chemicals



**Chart 8. Contaminant risks for Tununak Water System (PWS No. 270231.001) - Heavy Metals, Cyanide and Other Inorganic Chemicals**



**Chart 9. Vulnerability analysis for Tununak Water System (PWS No. 270231.001) - Heavy Metals, Cyanide and Other Inorganic Chemicals**

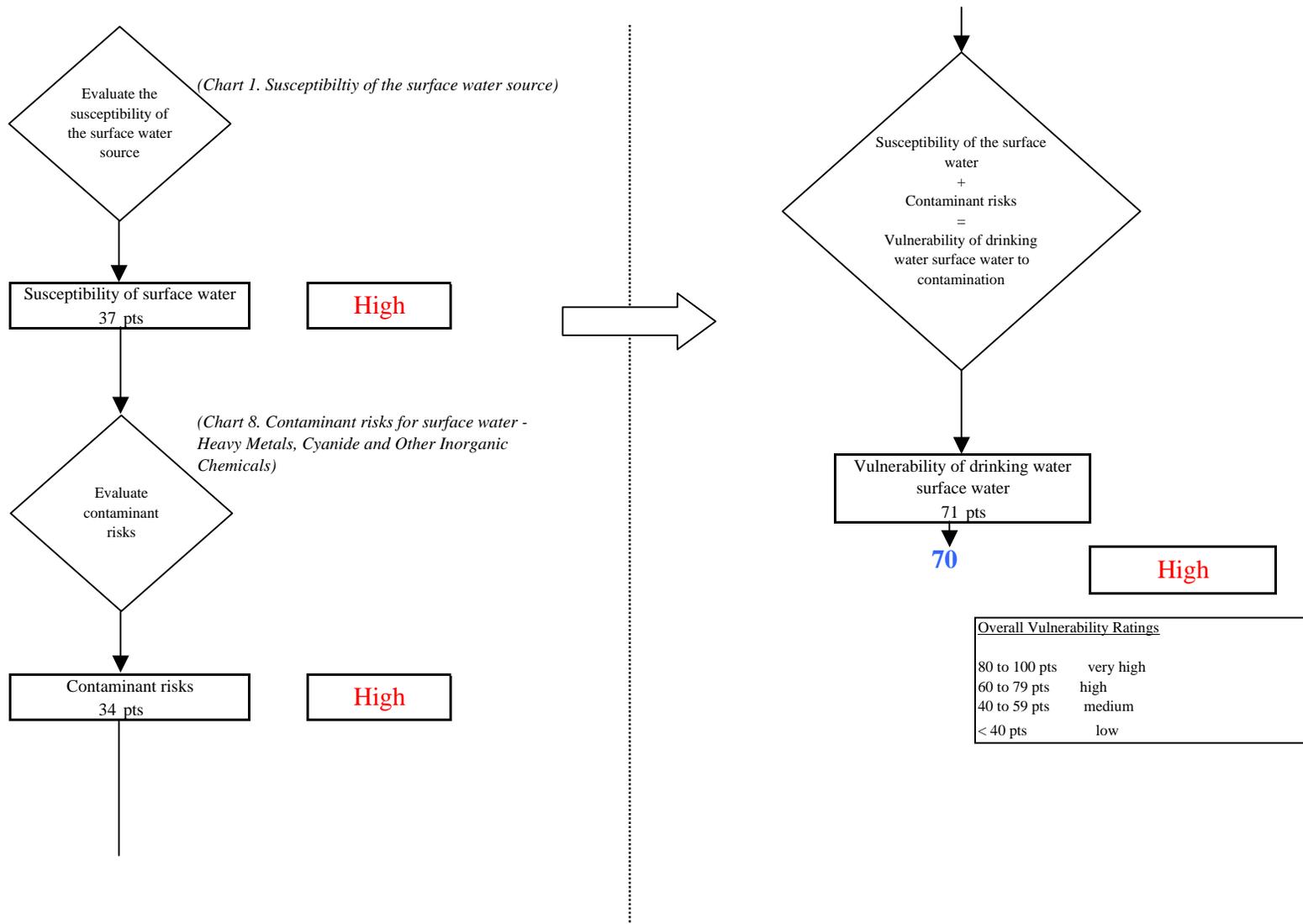
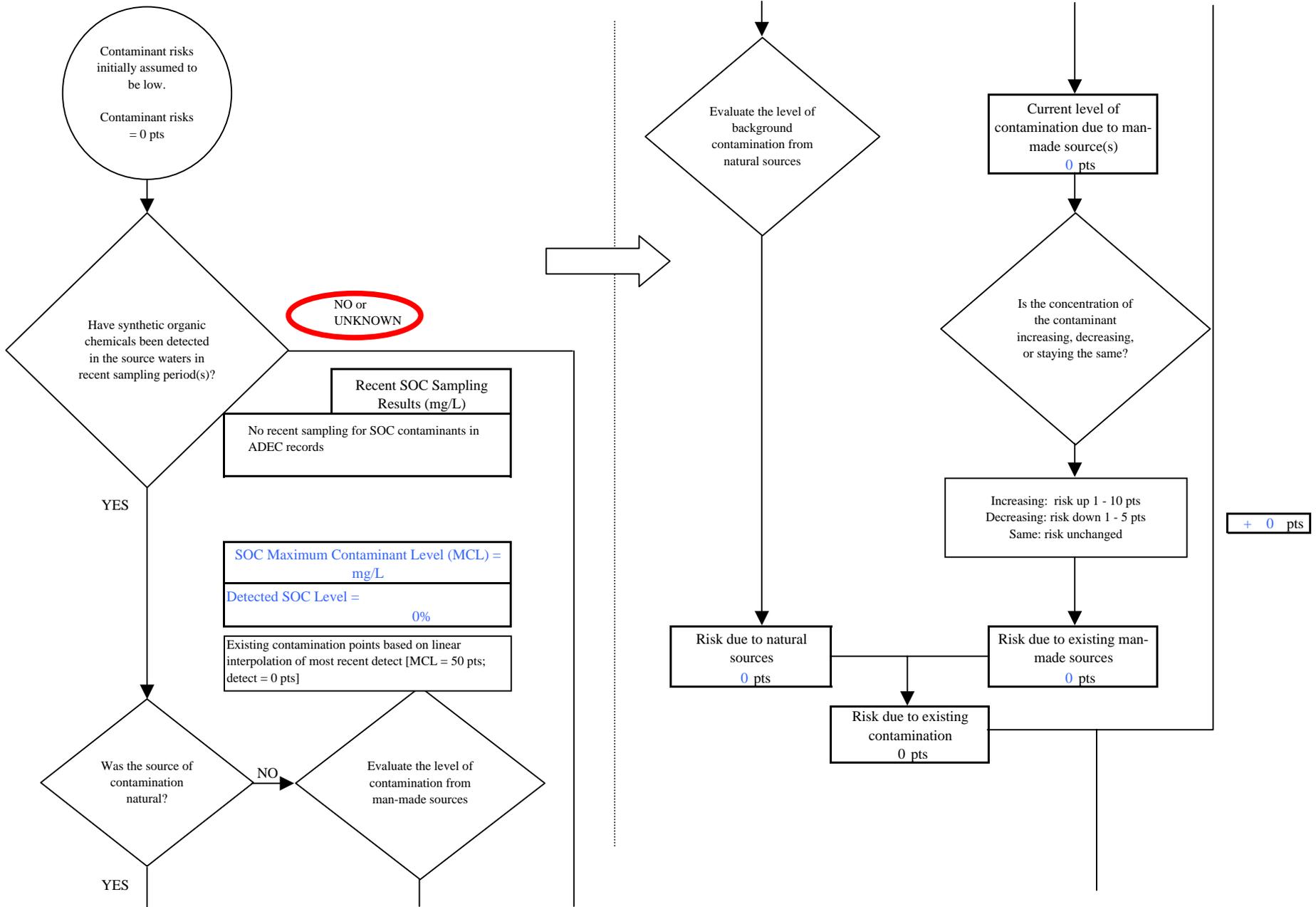
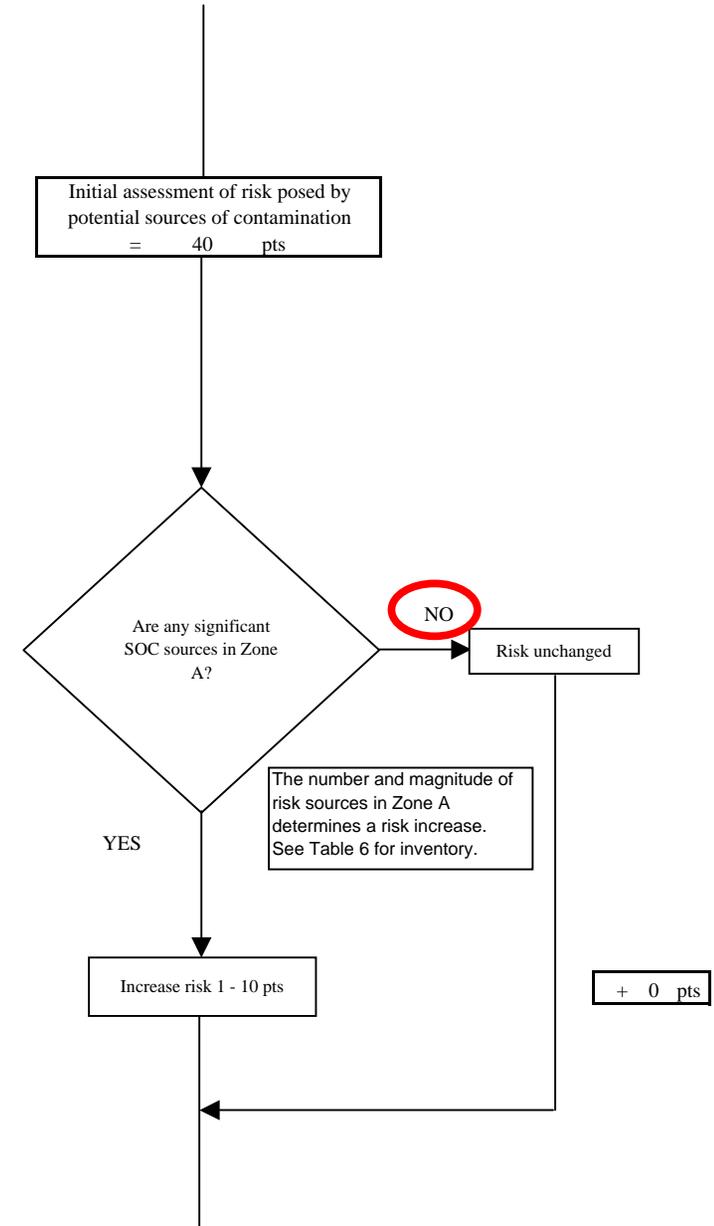
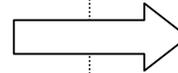
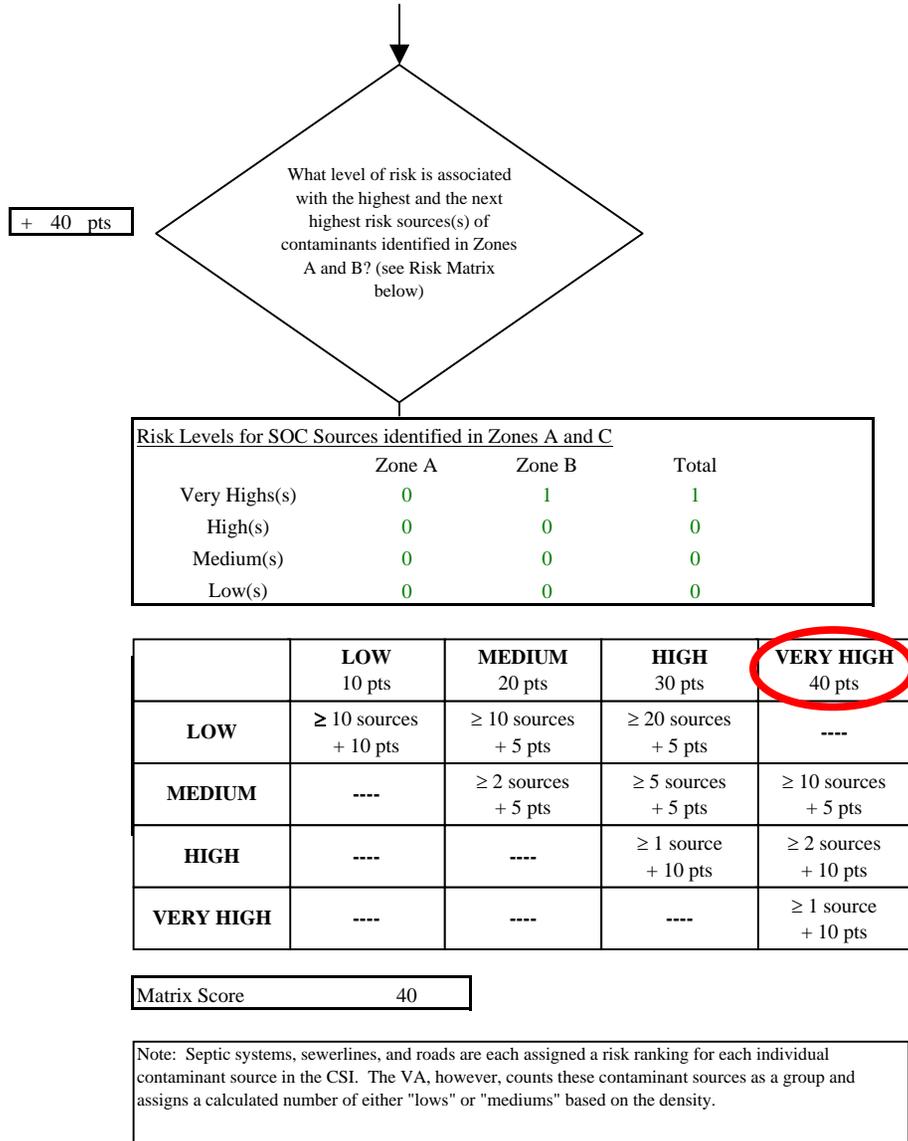


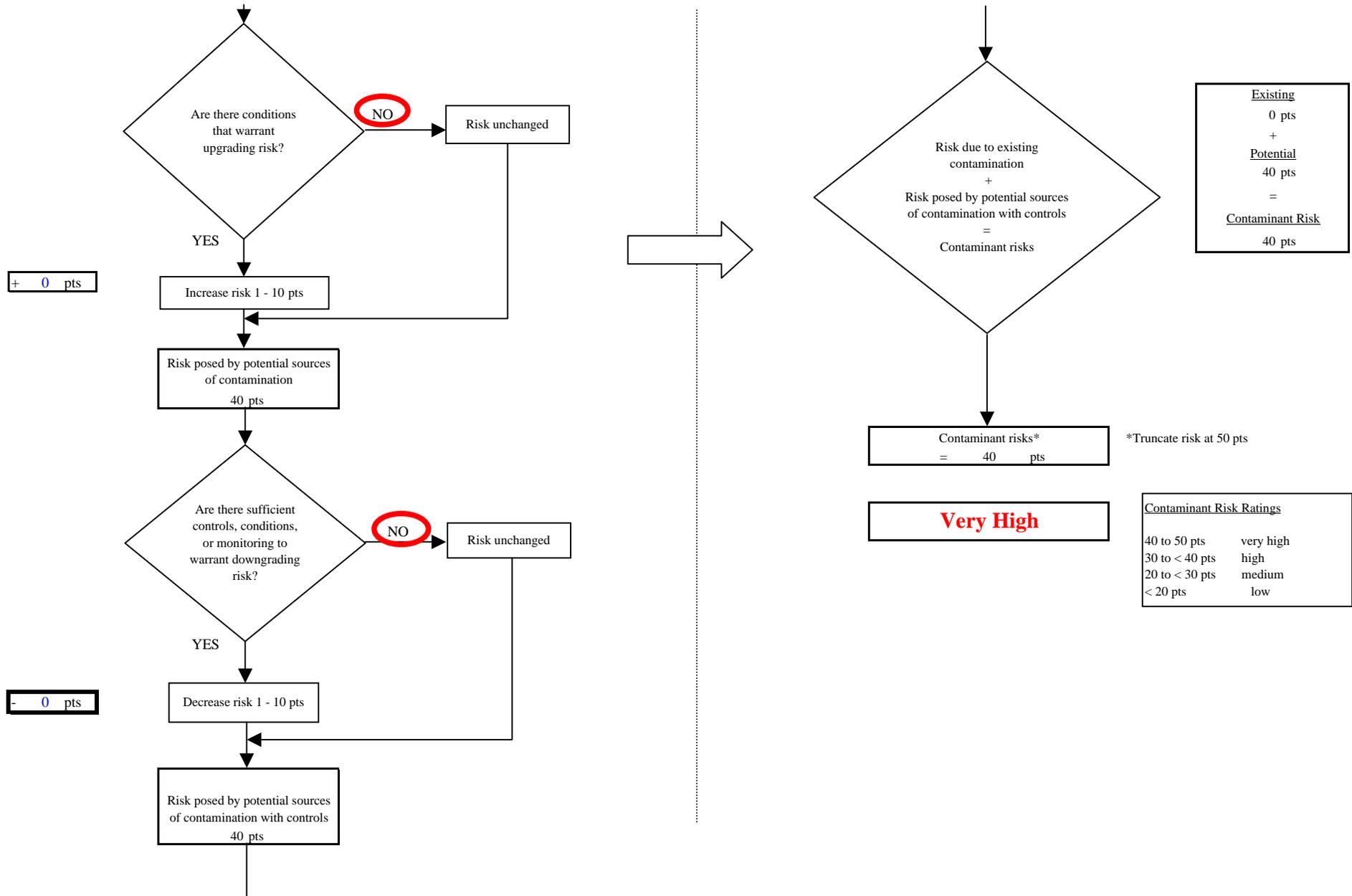
Chart 10. Contaminant risks for Tununak Water System (PWS No. 270231.001) - Synthetic Organic Chemicals



**Chart 10. Contaminant risks for Tununak Water System (PWS No. 270231.001) - Synthetic Organic Chemicals**



**Chart 10. Contaminant risks for Tununak Water System (PWS No. 270231.001) - Synthetic Organic Chemicals**



**Chart 11. Vulnerability analysis for Tununak Water System (PWS No. 270231.001) - Synthetic Organic Chemicals**

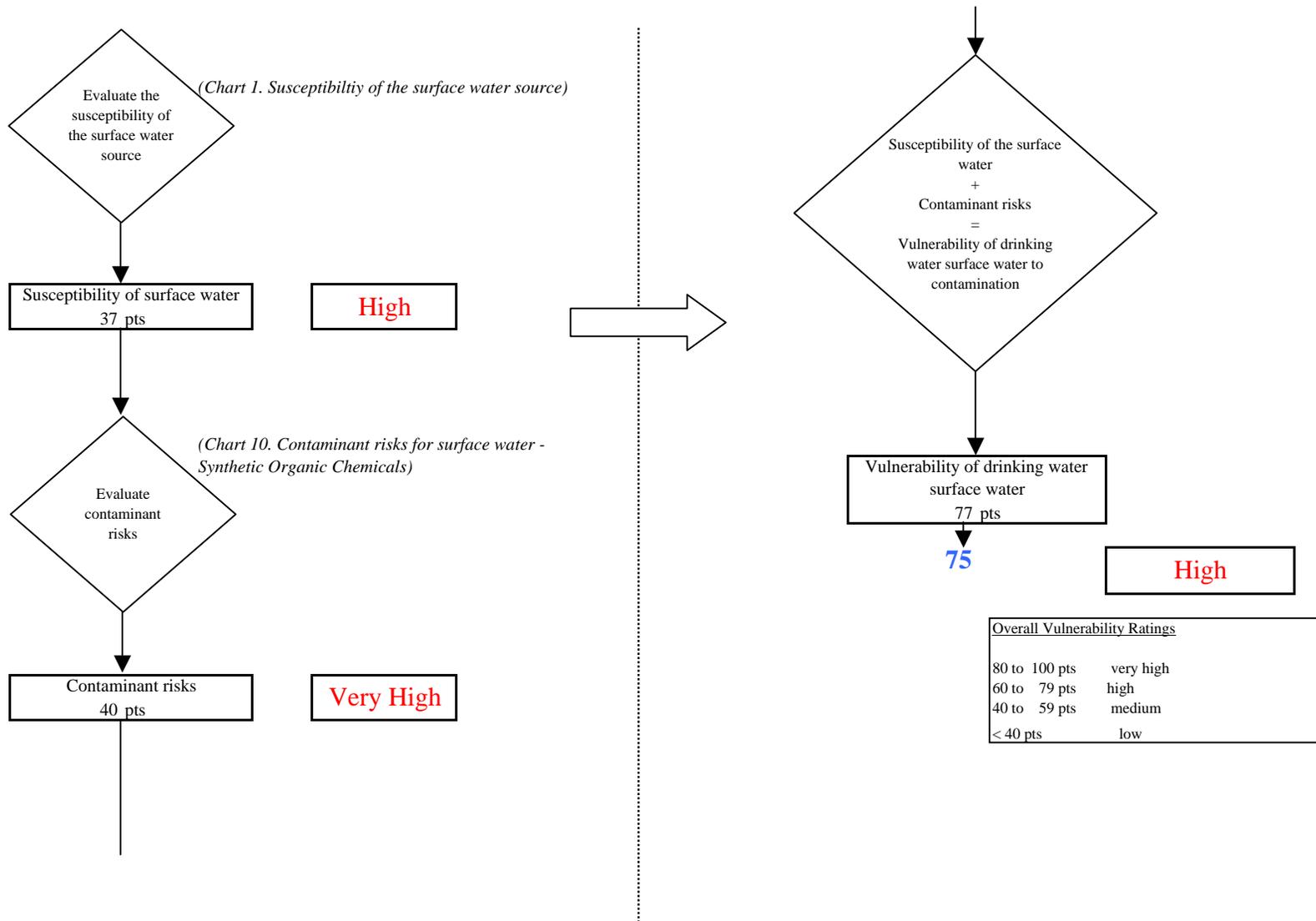


Chart 12. Contaminant risks for Tununak Water System (PWS No. 270231.001) - Other Organic Chemicals

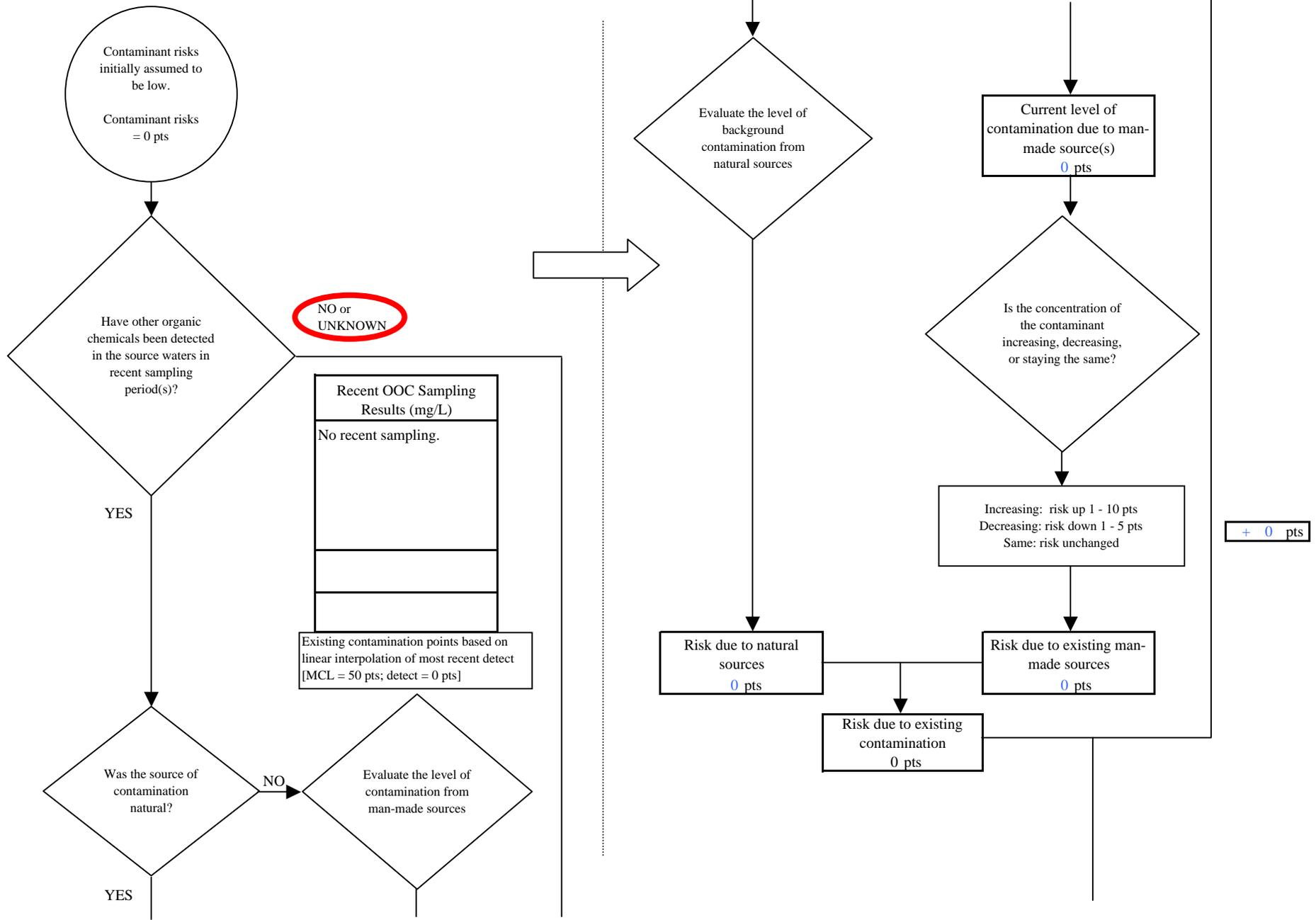
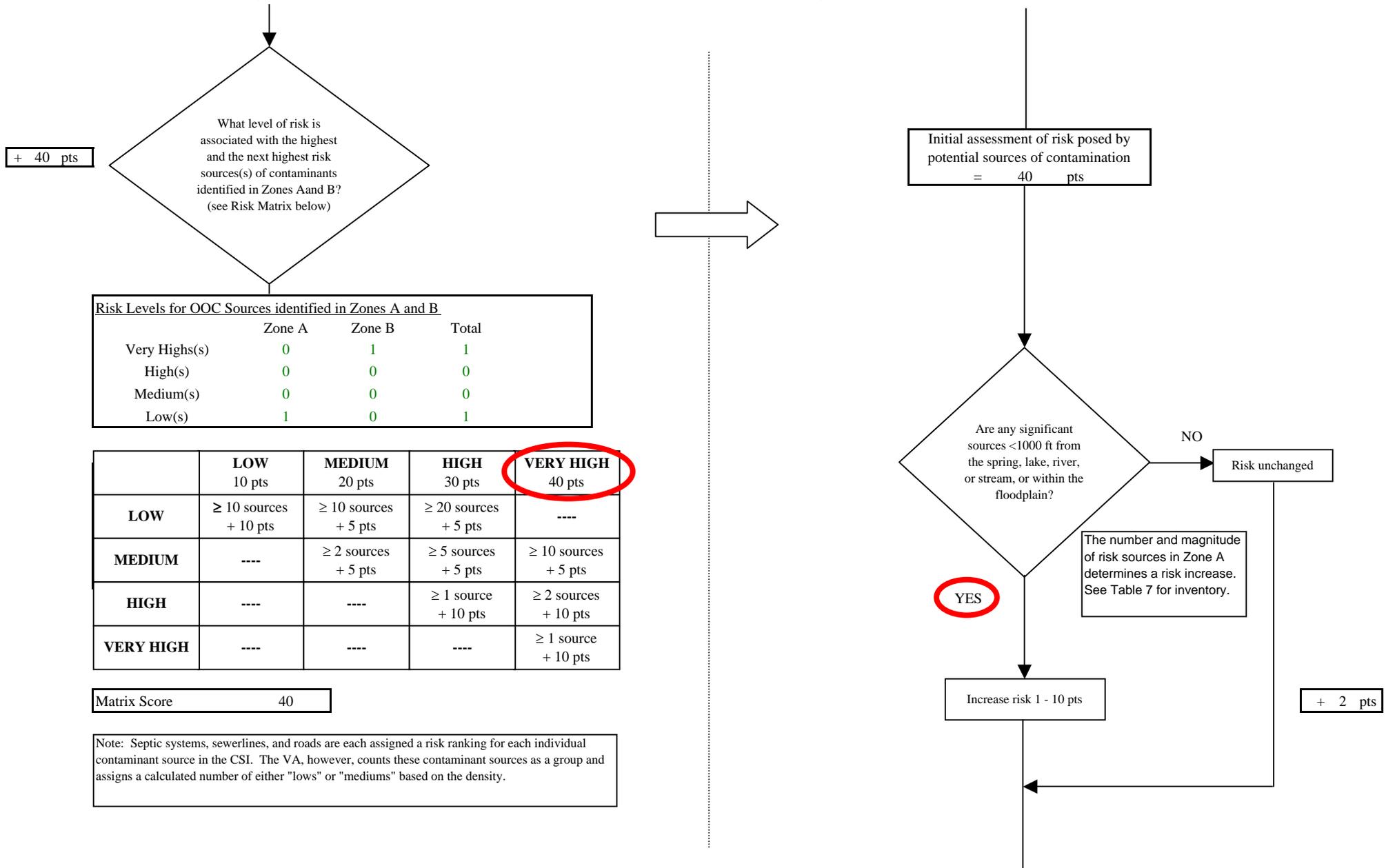
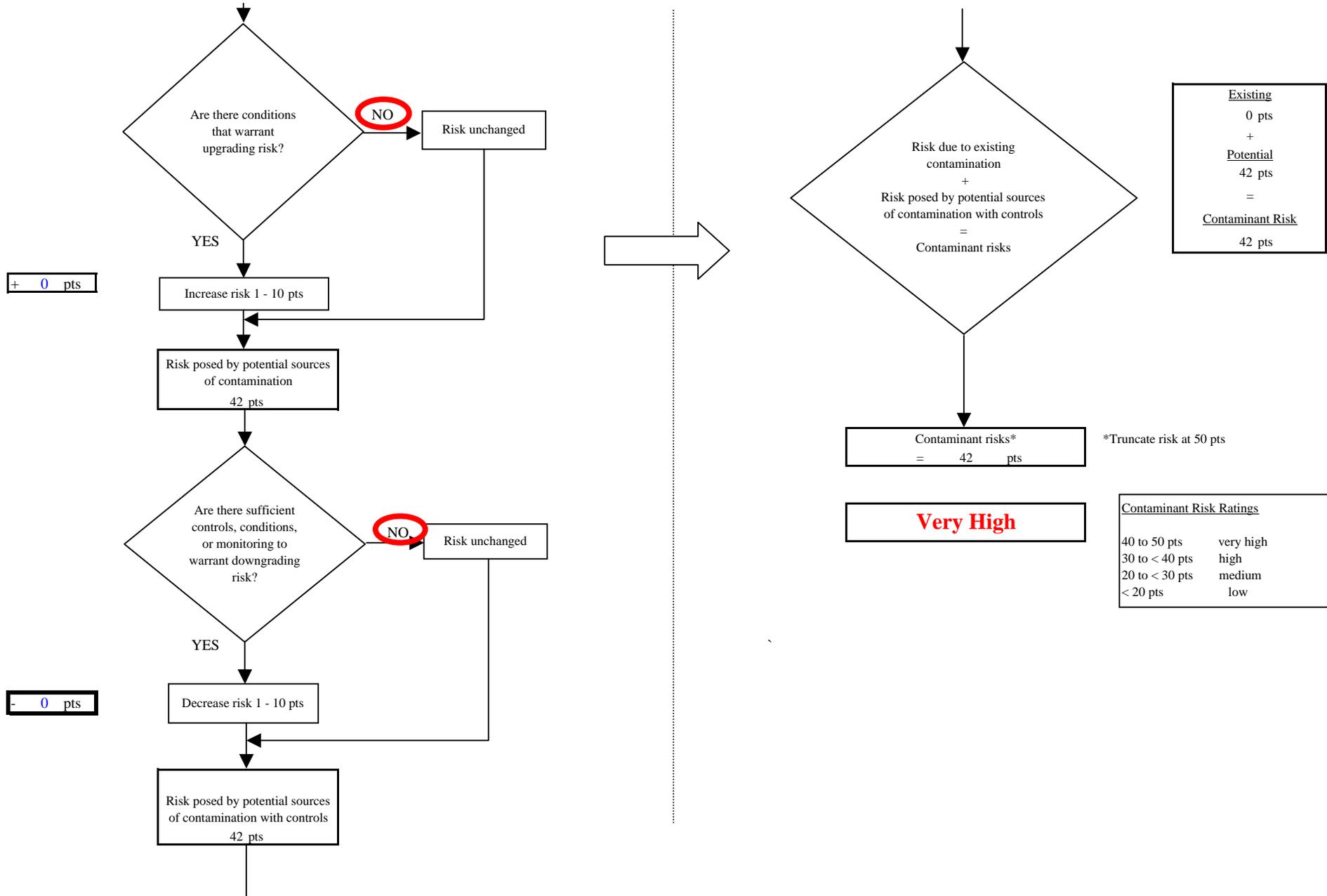


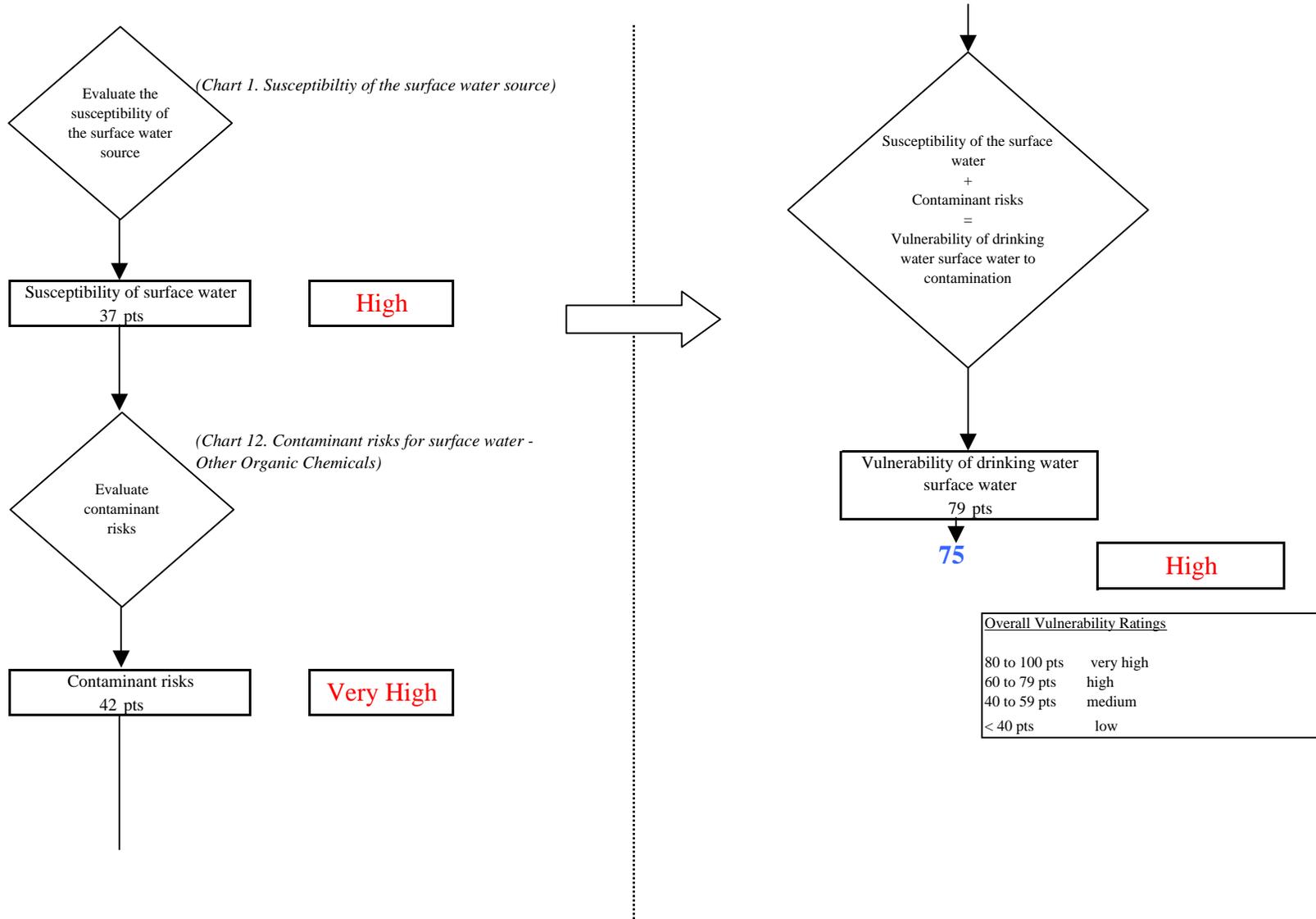
Chart 12. Contaminant risks for Tununak Water System (PWS No. 270231.001) - Other Organic Chemicals



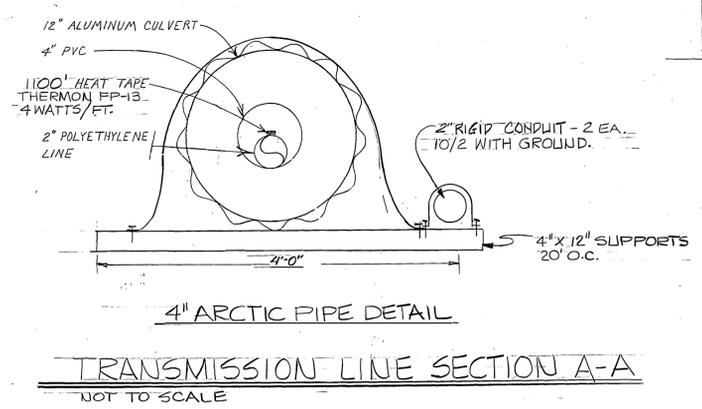
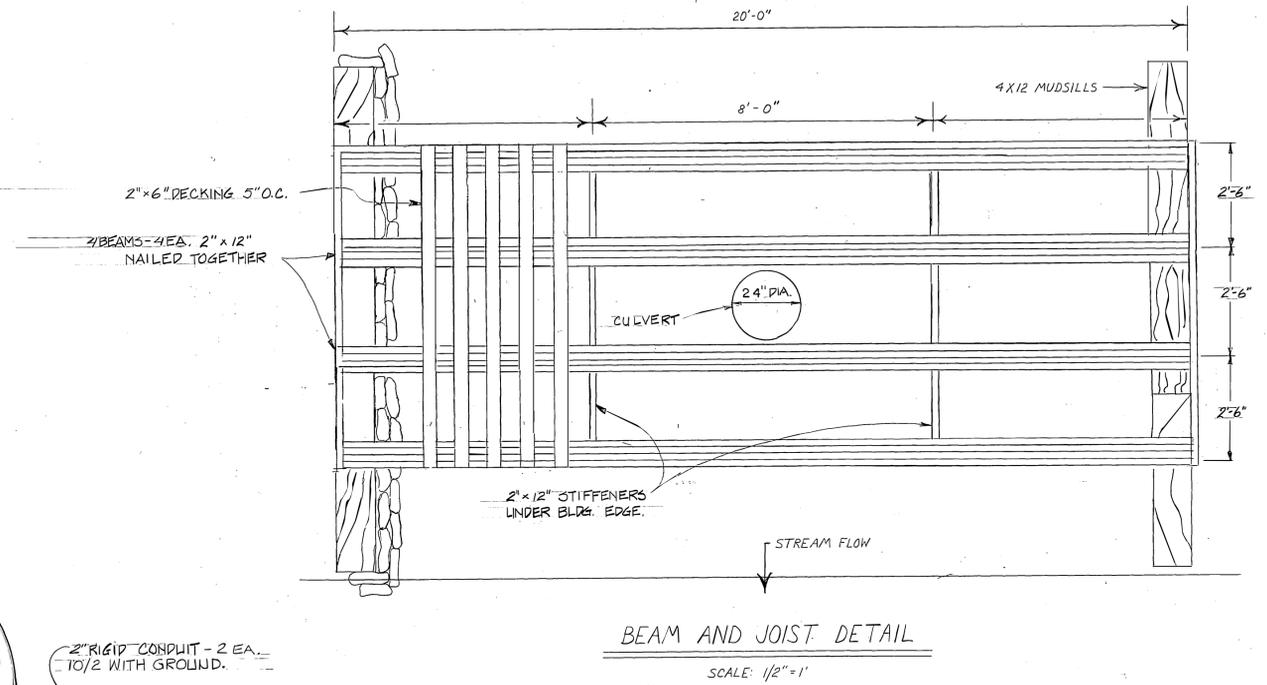
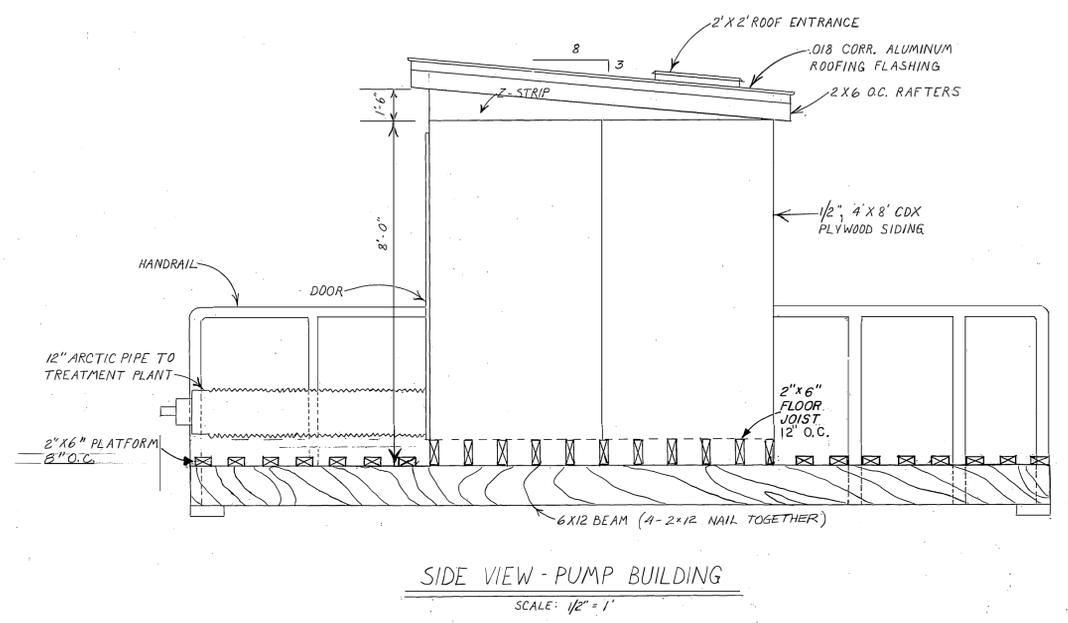
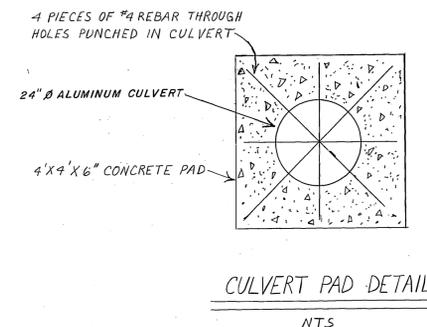
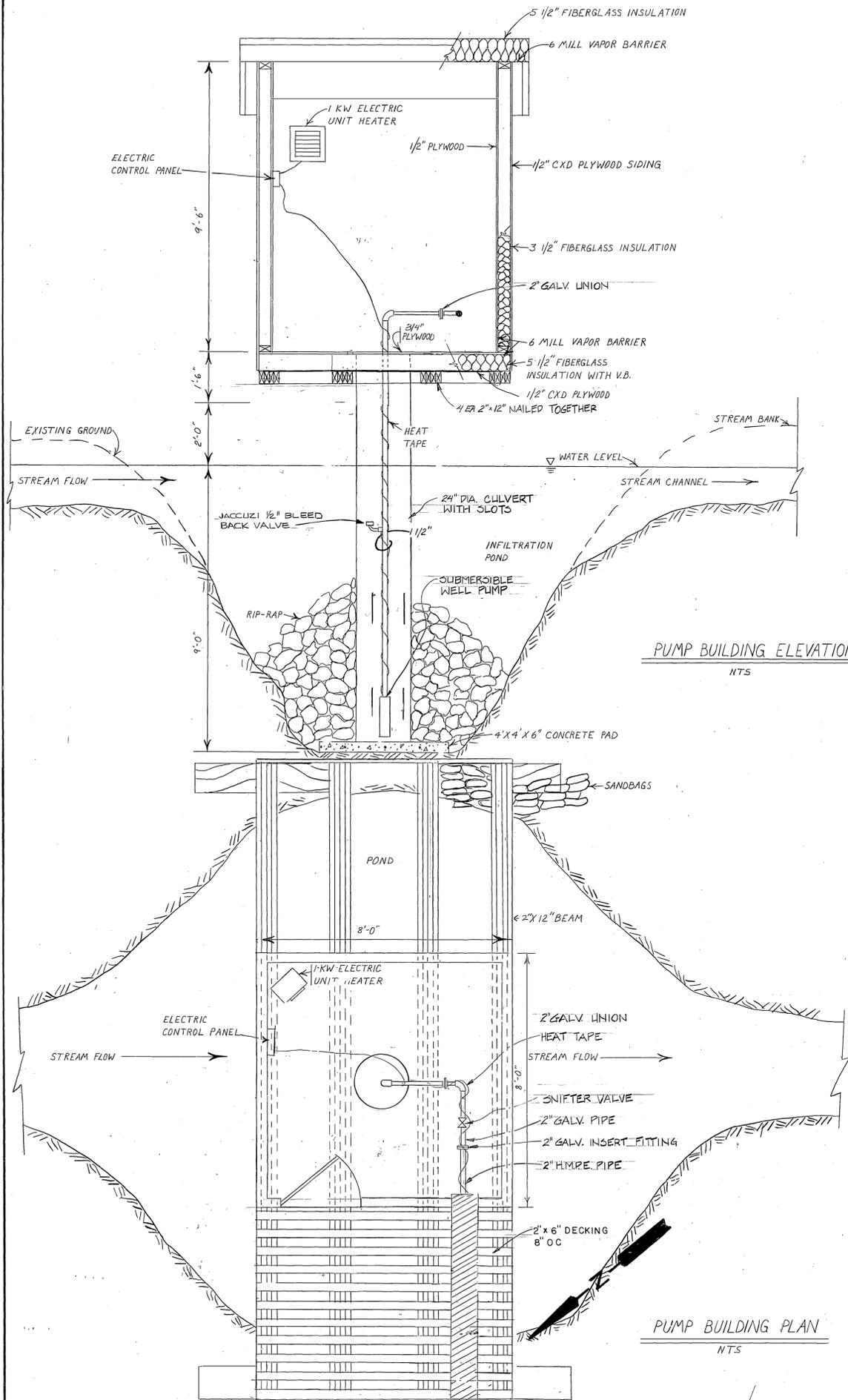
**Chart 12. Contaminant risks for Tununak Water System (PWS No. 270231.001) - Other Organic Chemicals**



**Chart 13. Vulnerability analysis for Tununak Water System (PWS No. 270231.001) - Other Organic Chemicals**



**ATTACHMENT 3 – U.S. DEPARTMENT OF  
HEALTH, EDUCATION & WELFARE PUBLIC  
HEALTH SERVICE  
TUNUNAK, ALASKA INFILTRATION  
GALLERY AND PUMPING FACILITY**



**AS BUILT**

Design Engineer  
Maintenance Review  
Material Take-off

FEBS 80	AS BUILT	CLC
MARCH 80	AS BUILT CHANGES	D.L.
SEPT 80	AS-BUILT CHANGES	P.M.L.
DATE	REVISIONS	INITIALS
U. S. Department of Health, Education & Welfare Public Health Service Indian Health Service		
TUNUNAK, ALASKA		SHEET NO.
INFILTRATION GALLERY & PUMPING FACILITY		19
PUBLIC LAW 86-121 PROJECT		OF
PROJECT NO. AN-77-631		TOTAL SHEETS
DRAWN BY: G.G.A.	CHECKED BY:	
DATE: JULY 1978	DATE:	
SANITATION FACILITIES CONSTRUCTION BRANCH ENVIRONMENTAL HEALTH BRANCH ALASKA AREA NATIVE HEALTH SERVICE ANCHORAGE, ALASKA		

**ATTACHMENT 4 – GOULDS WATER  
TECHNOLOGY  
SPECIFICATION SHEET FOR GS 60HZ  
STANDARD CAPACITY 4" SUBMERSIBLE  
PUMPS**

# GS

## 60 HZ STANDARD CAPACITY 4" SUBMERSIBLE PUMPS VFD COMPATIBLE - UP TO 80 HZ



### FEATURES

Powered by CentriPro 4" motors for dependable operation and long service life.

Stainless Steel Construction provides strength and corrosion resistance.

Noryl® impellers and Lexan® diffusers deliver excellent abrasion resistance.

Floating Impeller Stack has proven itself for over 50 years as a superior sand handling and durable pump design.

The proprietary engineering polymer bearing is strong and resistant to abrasion and wear.

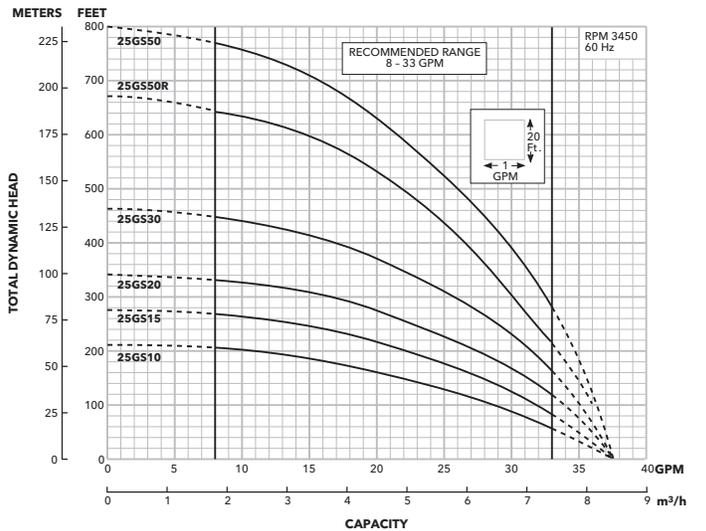
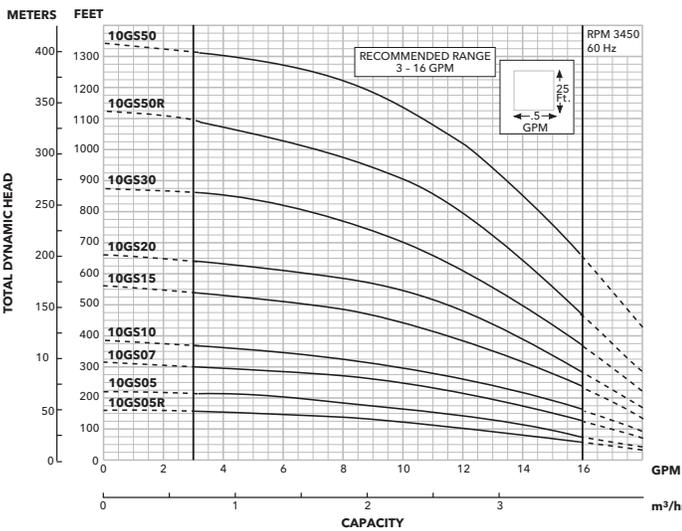
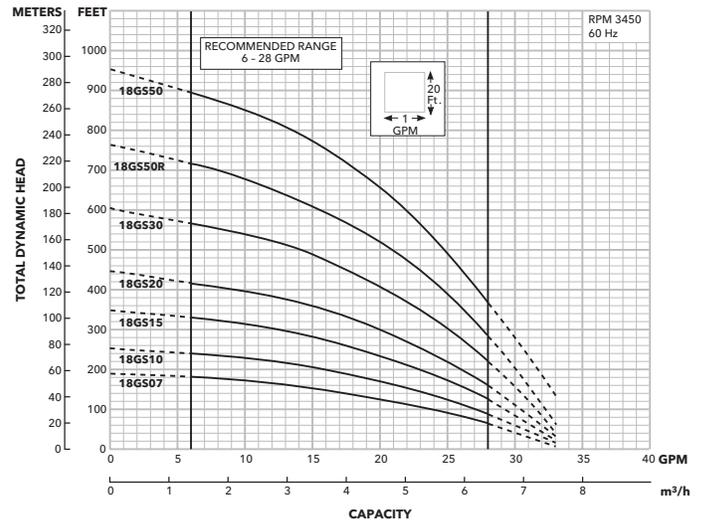
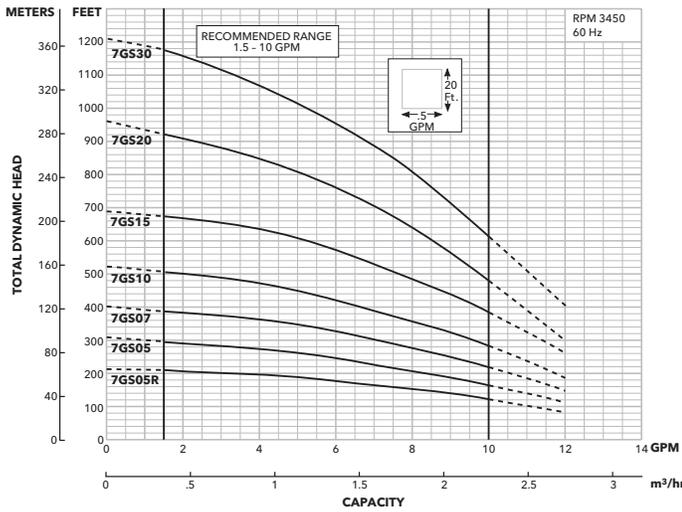
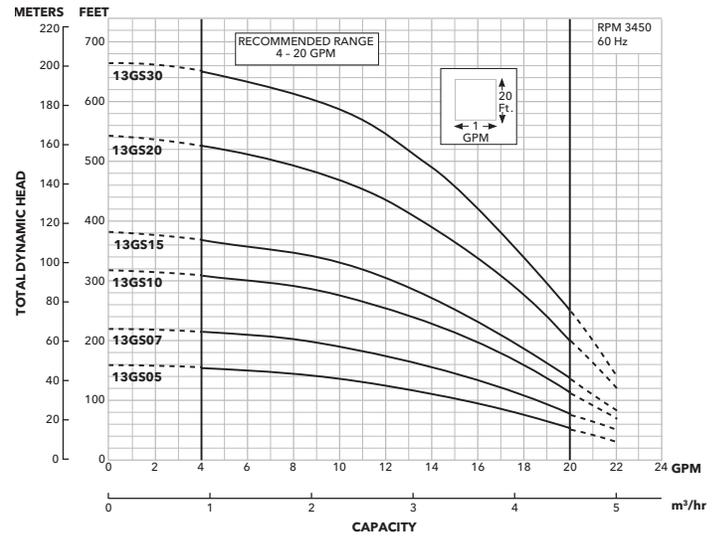
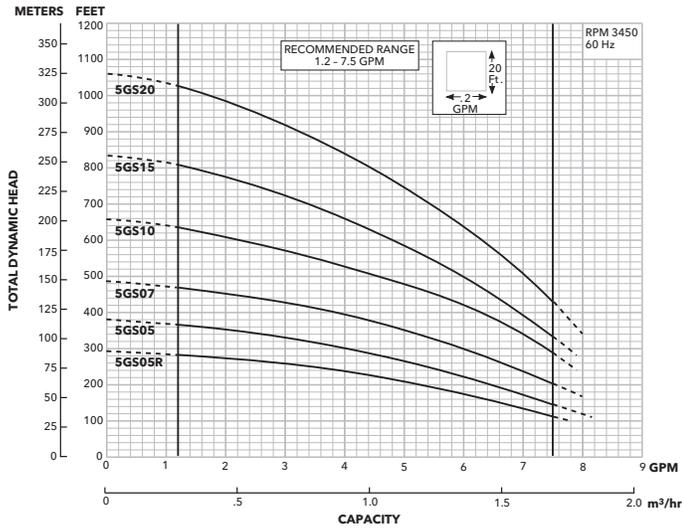
Cast stainless steel discharge head with built in stainless steel check valve. Two cast-in safety line loops for installer convenience.

### MATERIALS OF CONSTRUCTION

Part Name	Material
Discharge Head	AISI 303 SS
Check Valve Poppet	AISI 304 SS
Check Valve Seal	BUNA, FDA compliant
Check Valve Seat	AISI 304 SS
Check Valve Retaining Ring	AISI 302 SS
Bearing Spider - Upper	Noryl® GFN2
Bearing (s)	Proprietary Engineered Polymer
Klipring	AISI 301 SS
Diffuser	Lexan®
Impeller	Noryl®
Bowl	AISI 304 SS
Motor Adapter	AISI 303 SS
Casing	AISI 304 SS
Shaft	AISI 304 SS
Coupling	AISI 304 SS
Cable Guard / Screws	AISI 304 SS
Suction Screen	AISI 304 SS

### WATER END DATA

Series	Model	Req. HP	Stages	Length (in)	Weight (lbs)
5GS	5GS05R	0.5	9	12.9	8
	5GS05	0.5	12	15.0	9
	5GS07	0.75	15	17.0	11
	5GS10	1	20	21.7	13
	5GS15	1.5	26	25.8	15
7GS	5GS20	2	33	31.6	19
	7GS05R	0.5	7	11.7	6
	7GS05	0.5	10	13.8	7
	7GS07	0.75	13	16.0	8
	7GS10	1	17	18.8	9
	7GS15	1.5	22	23.6	12
10GS	7GS20	2	27	27.2	13
	7GS30	3	34	33.2	18
	10GS05R	0.5	5	10.1	6
	10GS05	0.5	7	11.5	7
	10GS07	0.75	10	13.6	8
	10GS10	1	12	15.0	9
	10GS15	1.5	17	18.4	12
	10GS20	2	20	21.7	13
13GS	10GS30	3	27	27.5	18
	10GS50R	5	35	33.0	21
	10GS50	5	42	40.2	24
	13GS05	0.5	5	10.1	6
	13GS07	0.75	7	11.5	7
	13GS10	1	10	13.6	8
18GS	13GS15	1.5	12	15.0	9
	13GS20	2	17	18.4	12
	13GS30	3	21	22.3	15
	18GS07	0.75	6	11.8	7
	18GS10	1	8	13.5	8
25GS	18GS15	1.5	11	16.1	10
	18GS20	2	14	18.6	11
	18GS30	3	19	24.1	15
	18GS50R	5	24	28.3	17
	18GS50	5	30	34.4	21
	25GS10	1	7	13.4	8
25GS	25GS15	1.5	9	15.3	9
	25GS20	2	11	17.2	10
	25GS30	3	15	20.9	14
	25GS50R	5	22	28.7	17
	25GS50	5	26	33.4	21



Xylem Inc.  
 2881 East Bayard Street Ext., Seneca Falls, NY 13148  
 Phone: (866) 325-4210 • Fax: (888) 322-5877  
[www.gouldswatertechnology.com](http://www.gouldswatertechnology.com)

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**95% Draft**  
**Technical Memorandum 4**  
**Task 2**

**Tununak Water Source Assessment**  
**Deep Water Supply Well**

**For**

**Tununak, Alaska**

**August 8, 2018**

---

To:	Native Village of Tununak IRA Council Tununak, Alaska	From:	Collin Macheel, CPG Victor Harris, CPG Bob Gilfilian, PE Stantec Consulting Services Inc.
File:	<b>Technical Memorandum 4, Task 2 – Tununak Water Source Assessment Deep Water Supply Well</b>	Date:	August 6, 2018

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## Section 1.0 Purpose

The Native Village of Tununak a.k.a. Tununak IRA Council (herein referred to as Tununak), in cooperation with the Alaska Department of Environmental Conservation (ADEC) Village Safe Water (VSW) has retained Stantec Consulting Services Inc. (Stantec) to prepare this Technical Memorandum (Tech Memo) with funding from the U.S. Department of Agriculture Rural Development (USDA-RD). The purpose of this Tech Memo is to provide a summary of the results of a desktop study to assess the feasibility of constructing a new deep (greater than 50 feet) groundwater well in Tununak. This Tech Memo provides a qualitative assessment which may or may not support further field investigation to evaluate the development of a deep groundwater source to serve as a production well that will meet the long-term water supply needs of Tununak, including a piped water system for the entire community, and provide a minimum yield of 50 gallons per day per resident.

## Section 2.0 Scope and Data Sources

The scope of this study included the compilation of published water resource and subsurface hydrogeologic data. Data sources included the following:

- Alaska Department of Natural Resources
- Alaska Department of Environmental Conservation
- Alaska Department of Transportation & Public Facilities
- VSW
- U.S. Geologic Survey
- Alaska Native Tribal Health Consortium, including consultants.

The data compiled from these sources are referenced throughout this document and summarized in Attachment 1.

To evaluate the possibility of a developing a deep-water supply well in the Tununak, several features were investigated as influencing the likelihood of a developable water well and are discussed in Sections 3 through 6. These features include:

- Local and regional geologic setting.
- Local and regional developed water sources and associated water quality.

**Reference:**           **Technical Memorandum 4,**  
                              **Task 2 – Tununak Water Source Assessment Deep Water Supply Well**

- Distribution of permafrost.
- Land accessibility including drill rig access, land ownership, and reasonable conveyance distances to Tununak.

### **Section 3.0   Local and Regional Geologic Setting of the Village of Tununak**

Tununak is located on Nelson Island in Southwestern Alaska along the coast of the Bering Sea. Tununak is one of two communities located on Nelson Island. Tununak is separated by approximately 6 miles from the City of Toksook Bay (Figure 1). Tununak lies partially over Quaternary unconsolidated surficial deposits and folded Cretaceous sandstone and shale sedimentary rock. The Cretaceous sandstone and shale sedimentary rock underlie both Tununak and Toksook Bay along the western extent of Nelson Island as shown on Figure 2. Young (Quaternary or Tertiary) basaltic flows cap the Cretaceous folded sedimentary rock on Nelson Island, found on several hill tops around Tununak (Wilson et al., 2015; Coonrad, 1957).

The distribution, occurrence, and nature of sedimentary rock units have been described by coastal outcrops and surficial geologic investigations in and around Tununak (Coonrad, 1957; AKDOT, 1995). Further relevant descriptions of the sedimentary rock were made in the City of Toksook Bay between 1993 and 1994, indicating the occurrence of Cretaceous sedimentary rock in orientation and nature described similar to that observed by surficial and coastal outcrop descriptions in Tununak (HDR, 2005).

The nature and distribution of the Quaternary unconsolidated surficial deposits has been widely investigated in geotechnical evaluations, including those conducted for the: Tununak High School Site; Tununak Airport relocation; Tununak Water Storage Tank Site Geotechnical Investigation; and, to a lesser degree, the Nelson Island Highway Geology Reconnaissance. Geotechnical investigations identified silt rich organic soil in most of the areas, with the occurrence of ice-rich soils. Drilling and geotechnical logs rarely describe bedrock or suspected bedrock assumed by refusal of the drilling rig.

The Tununak High School geotechnical investigation found bedrock at a depth of 16.5 feet below ground surface (bgs), described as siltstone in the location of the current school (RMC, 1979). The Tununak Airport Relocation Geophysical Investigation confirmed the occurrence of sandstone and siltstone in several borings, ranging in depth from 8 to 30 feet bgs in locations south of the Tununak River (AKDOT&PF, 2005a). The geotechnical investigation conducted at the Tununak Water Storage Tank Site found undescribed bedrock at 4.3 feet bgs near the 50,000-gallon water tank and no indication of bedrock in two other borings further to the southwest (USPHS, 1977). The Nelson Island Highway Geology Reconnaissance found sandstone and silt stone at variable depths along the proposed highway corridor between Tununak and Toksook Bay, ranging in depth from 4 feet bgs to greater than 12 feet bgs (AKDOT&PF, 2005b). Because of the relatively thin nature of the unconsolidated surficial deposits, in this context, a new “deep” well means a water supply well screened in the Cretaceous sedimentary rocks.

**Reference:** Technical Memorandum 4,  
Task 2 – Tununak Water Source Assessment Deep Water Supply Well

## **Section 4.0 Local and Regional Developed Water Sources and Associated Water Quality**

Water sources for Tununak have been primarily surface water and shallow groundwater wells. Tununak's washeteria and water treatment plant is served by an infiltration gallery as is recorded in the ADEC public water supply database (Palmer, 2018). Records were located for two shallow groundwater wells installed within the Quaternary unconsolidated surficial deposits. The Bureau of Indian Affairs (BIA) groundwater well adjacent to the Tununak School was installed to a depth of 36.5 feet bgs (ADNR, 1964). The well log identifies a limited production rate of 6 gallons per minute (gpm) during the initial well test. The well depth is shallow and vulnerable to contamination, including saltwater intrusion.

The second shallow well was installed approximately 30 feet southeast of the Alaska Village Electric Cooperative (AVEC) power generation building. The well was installed to a depth of 30 feet bgs (USGS, 1978). The AVEC well log indicates bedrock was present at bottom of the boring, and the well was pumped at 40 gpm for 6 hours, with a resultant drawdown of 16+ feet. U.S. Geologic Survey (USGS) documentation of the well indicates that the well was grouted with bentonite and constructed with a 6-foot of casing stickup. No other documentation was found regarding the AVEC well. The location of the well would indicate that it was likely installed near the Tununak River and, therefore, is likely under the influence of surface water.

Water produced from the Tununak School well has been reported to be of good quality; however, the shallow setting and vulnerability to contamination, and low production rates limit the water source. Total coliform results collected between 2002 and 2018 have all been negative (ADEC, 2018). In 1968, iron was detected at 0.05 milligrams per liter (mg/L), manganese at 0.05 mg/L, and nitrates at 0.3 mg/L (ADNR, 1964).

The water level elevation in the Tununak School well (reported at approximately 11.8 feet bgs during pumping) is near average sea level, indicating the salt water intrusion is a potential issue if a well at the location were installed with capability of producing higher flow rates. Conservatively, the Ghyben-Herzberg relates depth to the salt water interface at approximately 40 times greater below sea level for every foot of freshwater elevation head above sea level, by difference in density alone under static conditions (e.g., Freeze and Cherry 1979). The elevation of the ground surface at the Tununak School well is approximately 12 feet above sea level, based on 2015 Alaska Department of Transportation and Public Utilities (ADOT&PF) lidar elevation data. Water level in the well was measured at approximately 11.8 feet bgs during the original pump test for the well (ADNR, 1964). By the Ghyben-Herzberg relation, the salt water interface is a concern at the location. In this regard, it is interesting to note that a study of water quality in Toksook Bay indicated that, as a means to avoid seawater intrusion, a well site should be located at least 1,000 feet away from the coast (HDR, 2005).

The primary water source in Tununak is an infiltration gallery located on Unnamed Creek. Water sourced from the infiltration gallery of Unnamed Creek have been reported to have seasonal color variation (USPHS, 1977). Positive total coliform tests were recorded in August, September, and October 2009 (YKHC, 2010). No significant changes to the system have been made since the

**Reference:**           **Technical Memorandum 4,**  
                              **Task 2 – Tununak Water Source Assessment Deep Water Supply Well**

positive total coliform results. Analytical compliance testing of the Tununak water source has been inadequate and inconsistent.

Exploratory drilling at Toksook Bay, 6 miles to the southeast of Tununak, provides insight into the water-producing capabilities of the Cretaceous sedimentary rocks (sandstone units) which are expected to underlie Tununak. At least 13 groundwater wells were installed at Toksook Bay from 1976 to 1994. Toksook Bay's primary production wells used prior to 1994 were found to be effected by salt water intrusion or fuel contamination and spurred new efforts to develop a deep groundwater well source in 1993-1994. Geologic mapping of coastal outcrops and river cuts was conducted, along with surface geophysics (very-low-frequency electromagnetic survey methods), to site locations for new wells. In 1994, seven wells were installed by air rotary drilling methods. Of the seven wells installed, three provided adequate quantity and treatable quality water for supplying water to the city. The wells were screened in the Cretaceous sandstone and production rates of 20 to 50+ gpm were reported (HDR, 2005). A generalized conceptual model of the hydrogeology of the Cretaceous bedrock was provided in the City of Toksook Bay Sanitation Facilities Master Plan, as shown on Figure 3, indicating recharge in the folded Cretaceous sandstone is provided primarily by surface water.

Water quality in the three production wells currently used in Toksook Bay exceeded the secondary maximum contaminant levels (SMCLs) for iron and manganese in all three wells, with concentrations ranging from 0.69 to 1.4 mg/L iron and 0.067 to 0.13 mg/L manganese. The SMCLs for iron and manganese are 0.3 and 0.05 mg/L, respectively. No other constituents were detected above maximum contaminant levels (MCLs) or SMCLs in any of the wells. Total Organic Carbon analytical samples resulted in concentrations below laboratory detection limits (HDR 2005).

## **Section 5.0   Distribution of Permafrost**

The regions surrounding Tununak and Toksook Bay are characterized as having a sporadic distribution of permafrost (10 to 50 percent spatial coverage). Although specific permafrost depth and spatial occurrence data is not available for Nelson Island, permafrost thickness measurements from southwestern Alaska include depths ranging from 40 to 604 feet inland near Bethel. Permafrost thickness measurements from coastal communities of Quinhagak and Goodnews Bay have been published in the range of 20 to 75 feet (Jorgenson, T. et al. 2008). The deepest borings on Nelson Island occurred in 1994 during the water well installations in Toksook Bay. The consultant who performed the geologic logging of the wells did not document the presence of permafrost. It should be noted that permafrost or suspected permafrost, as well as ice-rich soils, in Tununak have been identified in the three geotechnical investigations referenced above but, as noted, have been limited in depth to the surficial Quaternary unconsolidated soil.

**Reference:**           **Technical Memorandum 4,  
Task 2 – Tununak Water Source Assessment Deep Water Supply Well**

## **Section 6.0 Land Accessibility Including Drill Rig Access, Land Ownership, and Conveyance Distance to the Community**

Land accessibility has greatly improved since the recent construction of the new, relocated Tununak Airport. The new airport facility included the construction of a new road, with road maintenance located along the east and north periphery of the village, that included new road access to an upland material borrow site. The road system in Tununak now allows for greater accessibility by a truck-mounted drilling rig (e.g., air rotary).

An updated aerial photography from 2015 is shown on Figure 4, along with general land ownership status and ADOT&PF right-of-way's. Land ownership data was obtained from the Alaska Department of Natural Resources (ADNR) Records Office, and needs to be evaluated by a formal title search prior to siting a new well location. Potential areas of further investigation for the drilling of deep water supply wells are depicted on Figure 4. These areas appear to be accessible for drilling a well with a truck-mounted drill rig, and are located within a reasonable conveyance distance to the washeteria and water treatment plant in Tununak, while also maintaining separation distance from surface water bodies.

## **Section 7.0 Conclusions**

Limited deep subsurface data are available in the Tununak community boundary. However, the following summarize pertinent observations of available information.

- Regional geologic mapping efforts between Tununak and Toksook Bay indicate similar folded Cretaceous sedimentary rock at both communities, including sandstone and shale.
- The sedimentary rock has been investigated in greater detail in Toksook Bay, where several deep wells were installed and produced adequate quantities of drinking water from Cretaceous sandstone units.
- The quality of groundwater developed in Toksook Bay from the Cretaceous sandstone was acceptable for the community, although iron and manganese were measured above the SMCL.
- Deep borings in Toksook Bay also described permafrost in shallow unconsolidated sediment, but no evidence of permafrost was found in deep well borings.
- Improved roads relating to the relocation of the Tununak Airport have resulted in greater accessibility for a truck-mounted drill rig capable of advancing deep soil borings (for example, depths of 160 to 170 feet bgs were obtained at Toksook Bay with a similar drill rig).

In regard to the observations and findings summarized above, we conclude the following:

**Reference:**       **Technical Memorandum 4,**  
                          **Task 2 – Tununak Water Source Assessment Deep Water Supply Well**

- Completion of a water production well in the shallow surficial deposits in Tununak is not recommended, because of anticipated poor production, susceptibility to surface water contamination, and potential for sea water intrusion.
- Based on exploratory drilling at Toksook Bay, completion of a deep well in the Cretaceous sandstone at Tununak has a reasonable probability of producing well flows greater than 20 gpm.
- A deep well in the Cretaceous bedrock has a probability of encountering a water production aquifer with naturally occurring levels of iron and manganese that may exceed the drinking water SMCLs associated with aesthetics (taste and appearance). Water treatment, in addition to disinfection, may be necessary subject to the water quality levels encountered.
- The location of exploratory drilling for a new production well in the Cretaceous bedrock should be based on the anticipated location and depth of relatively permeable sandstone layers (site-specific conceptual hydrogeologic model) similar to that shown on Figure 3, which would benefit from additional field studies of the geology at Tununak.

## **Section 8.0 Recommendations**

Based on the findings of this desktop study, it is recommended the following tasks be considered to further evaluate the possibility of developing a deep groundwater production well to serve the future water needs of Tununak:

- Title search to determine current landownership of potential drilling sites as shown on Figure 4. These drilling sites are shown on the figure in two shaded red areas labeled as “Proposed Deep Water Supply Investigation Areas”. The proposed drilling sites are located along the new airport road that was used to haul material for construction of the Tununak Airport. Although the two drill sites are shown on land owned by Tununmiut Rinit Corporation, the boundaries of the proposed sites are relatively general and could be adjusted to include the adjoining land that is owned by the Village of Tununak.
- Prepare geologic mapping of the Cretaceous sedimentary bedrock at outcrops along the coast, rivers, and areas of any road cuts or borrow pits. The purpose of this mapping would be to identify the location and orientation of permeable sandstone layers within the bedrock. Geologic mapping of these units could be aided by surface geophysical techniques similar to those used in Toksook Bay to determine favorable/recommended site(s) for drilling of a deep well(s).
- Evaluate the implementation of an exploratory well drilling program to determine the feasibility of drilling a large diameter (6-inch) water supply production well. The exploratory well drilling work would involve the mobilization of a small drilling rig to drill small diameter (2- to 3-inch) soil boring holes to obtain samples of the geologic formations and install a 2-inch diameter well that could be used for water quality sampling and flow measurements of the aquifer.

**Reference:**           **Technical Memorandum 4,  
Task 2 – Tununak Water Source Assessment Deep Water Supply Well**

## **Section 9.0   References**

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- Wilson, F.H. et al. 2015. Geologic Map of Alaska. Scientific Investigations Map 3340. U.S. Geologic Survey.
- Yukon-Kuskokwim Health Corporation (YJGC). 2010. Sanitary Survey of the Tununak Water System. September.

**Reference:**           **Technical Memorandum 4,  
Task 2 – Tununak Water Source Assessment Deep Water Supply Well**

## **Section 10.0 Limitations**

This Tech Memo was prepared by Stantec for the Native Village of Tununak IRA Council at the request of the VSW Program. The findings and recommendations presented herein reflects Stantec's professional judgment in light of the scope, schedule and other limitations stated in this document and in the contract between Stantec and the Client. The opinions in this document are based on conditions and information existing at the time the document was prepared and do not take into account any subsequent changes. In preparing the document, Stantec did not verify information supplied to it by others. Any use which a third party makes of this document is the responsibility of such third party.

### **STANTEC CONSULTING SERVICES INC.**

**Collin Macheel, CPG**

Senior Hydrogeologist

Phone: (907) 266-1104

collin.macheel@stantec.com

**Victor Harris, CPG**

Vice President/Principal Hydrogeologist

Phone: (626) 568-6024

victor.harris@stantec.com

**Bob Gilfilian, PE**

Principal Engineer

Phone: (907) 227-9883

bob.gilfilian@stantec.com

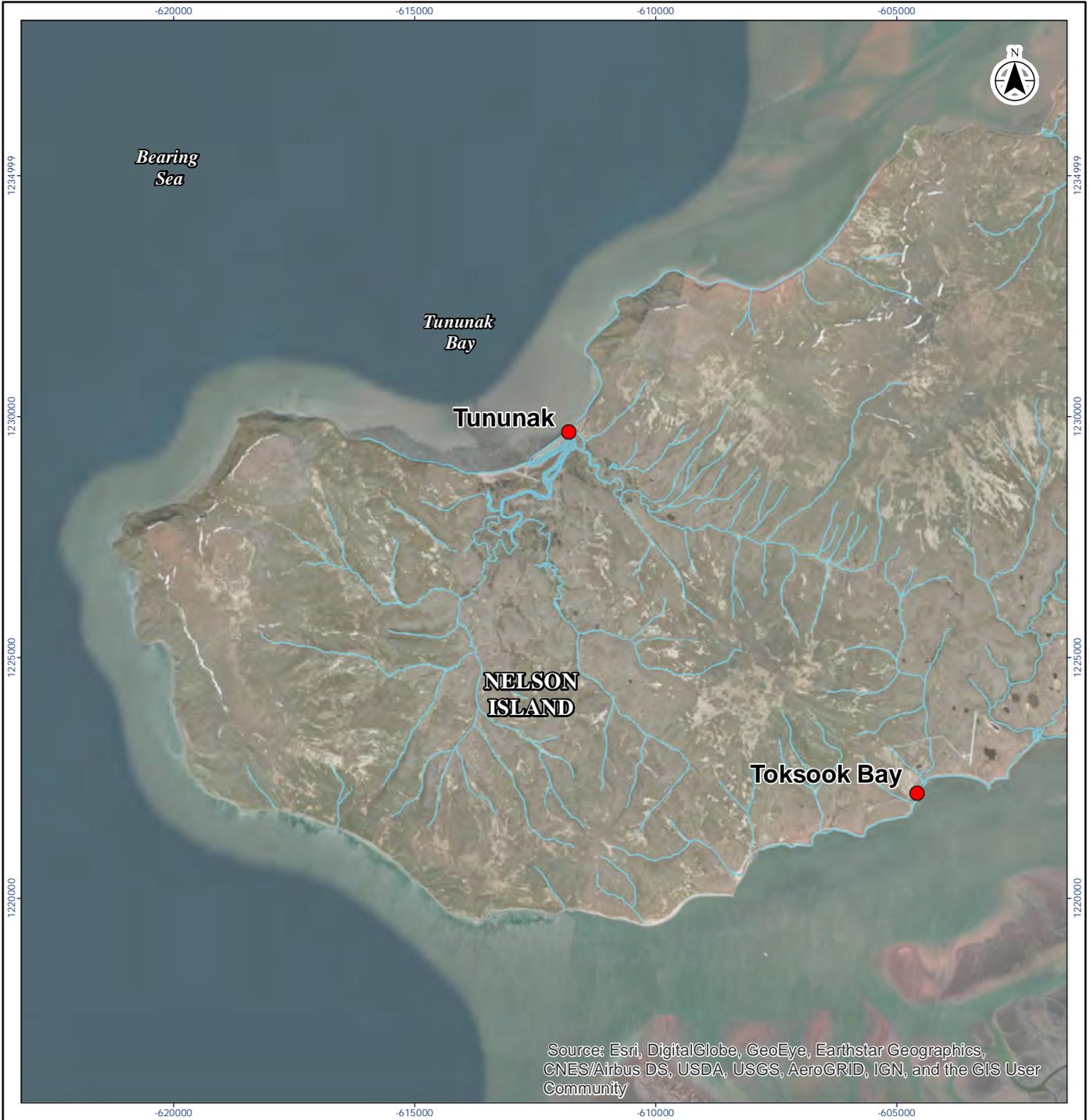
Attachments: Figure 1 – Village of Tununak Location and Vicinity Map

Figure 2 – Village of Tununak Regional Geologic Setting

Figure 3 – Conceptual Groundwater Model of Cretaceous Sandstone in Toksook Bay

Figure 4 – Village of Tununak Site Overview with Proposed Deep Water Supply Investigation Areas

Attachment 1 – Reference Table



Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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**Legend**  
 Hydrography 1:63360



Project Location: XXXXXXXX-XXXX REV A  
 T6N, R91W, S28 Prepared by CDP on 2018-03-13  
 Village of Tununak, AK Technical Review by ABC on 2018-XX-XX  
 Independent Review by ABC on 2018-XX-XX

Client/Project:  
 Technical Memorandum 4 - Water Source Assessment  
 Task 2 Hydrogeologic Desktop Study  
 Evaluation for Potential Deep Groundwater Supply Well

Figure No. 1

**Village of Tununak  
 Location & Vicinity Map**

Figure X-X.X

Notes  
 1. Coordinate System: NAD 1983 Alaska Albers  
 2. Hydrography and parcel features acquired from Alaska State Geo-Spatial Clearing House.  
 Originator: Alaska Department of Natural Resources - Information Resource Management  
 3. Orthoimagery Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



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**Legend**

Hydrography 1:63360

**Geologic Data**

- Water
- Qs - Quaternary Unconsolidated Surficial Deposits
- Ksd - Cretaceous Sandstone, Shale
- QTV - Young Volcanic Rocks, Undifferentiated



Project Location: XXXXXXXX-XXXX REV A  
 T6N, R91W, S28 Prepared by CDP on 2018-03-13  
 Village of Tununak, AK Technical Review by ABC on 2018-XX-XX  
 Independent Review by ABC on 2018-XX-XX

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Figure No. 2

Title

Regional Geologic Setting of  
 Tununak and Toksook Bay

Figure X-X.X

Notes  
 1. Coordinate System: NAD 1983 Alaska Albers  
 2. Hydrography and parcel features acquired from Alaska State Geo-Spatial Clearing House. Originator: Alaska Department of Natural Resources - Information Resource Management  
 3. Geologic Base Map Adapted From Wilson, F.H., Hults, C.P., Mull, C.G., and Karl, S.M., comps., 2015, Geologic map of Alaska: U.S. Geological Survey Scientific Investigations Map 3340.

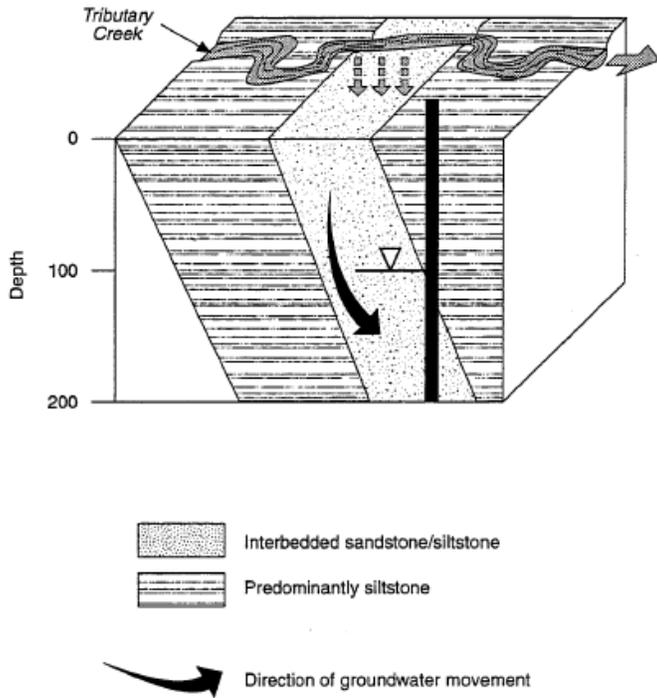
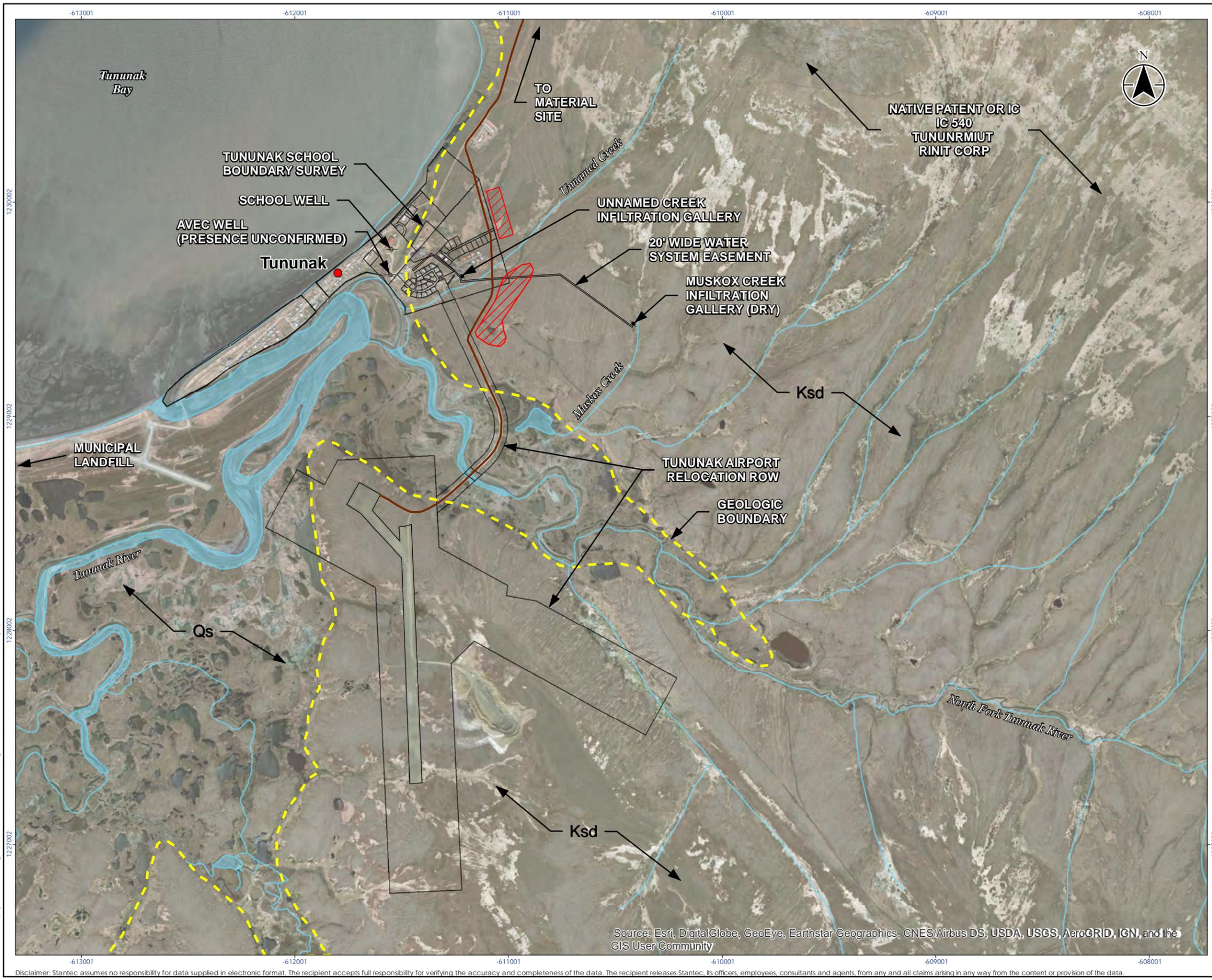
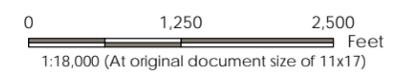


Figure 3- Conceptual groundwater model for deep water production wells in Toksook Bay (adapted from HDR Alaska Inc. 2005. City of Toksook Bay Sanitation Facilities Master Plan, Prepared for City of Toksook Bay.)



- Legend**
- Groundwater Well
  - Infiltration Gallery
  - Proposed Deep Water Supply Investigation Areas
  - Road
  - Hydrography 1:63360
  - Approximate Geologic Boundary
  - Qs - Quaternary Unconsolidated Surficial Deposits
  - Ksd - Cretaceous Sandstone, Shale



- Notes**
1. Coordinate System: NAD 1983 Alaska Albers
  2. Hydrography and parcel features acquired from Alaska State Geo-Spatial Clearing House, Originator: Alaska Department of Natural Resources - Information Resource Management;
  3. Orthoimagery Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
  4. Approximate Geologic Boundary Adapted from Wilson et al. (2015), Geologic map of Alaska, Sim 3340



Project Location: XXXXXXXX-XXXX REV A  
 T6N, R91W, S28 Prepared by CDP on 2018-03-13  
 Village of Tununak, AK Technical Review by ABC on 2018-XX-XX  
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 Technical Memorandum 4 - Water Source Assessment  
 Task 2 Hydrogeologic Desktop Study  
 Evaluation for Potential Deep Groundwater Supply Well

Figure No.  
**4**

Title  
**Village of Tununak  
 Site Overview**

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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Figure X-X.X

Attachment 1 - Reference Table

Source	Reference	Description	Importance
U.S. Geologic Survey	Coonrad, W.L., 1957. Geologic Reconnaissance in the Yukon-Kuskokwim Delta Region, Alaska. Miscellaneous Geologic Investigations MAP I-223. U.S. Geologic Survey.	Group conducted a 10-day reconnaissance of Nelson Island, including interpretation of aerial imagery and foot traverses along most of the coast along and also included helicopter aerial surveys. The publication described Cretaceous age sandstone-siltstone sequences which spanned the majority of the geographic extent of the island. In addition, he described the distribution of basaltic flow rock cap sequence with an aggregate thickness of 200 feet or more indicated by benches in numerous places. The bottom of the basaltic flow rock cap sequence is marked by an angular unconformity where the basaltic flow rock cap meets underlying folded Cretaceous sedimentary unit. Folded sedimentary bedrock is generally folded with a N70°W orientation	Describes the distribution, regional orientation, and character of sedimentary cretaceous bedrock of Nelson Island. Report indicates similar bedrock from the Village of Tununak to Toksook Bay.
	Wilson, F.H. et al., 2015. Geologic Map of Alaska. Scientific Investigations Map 3340. U.S. Geologic Survey.	Most recent review and update of geologic maps state-wide. Revised descriptions of lithology and geographic extents based on synthesizing regional information, new data sets, and updated imagery.	Reaffirms the findings of Coonrad, W.L., 1957 with minimal updates.
	U.S. Geological Survey. 1955. Tununak School Water Well Water Quality Field Sample. R.M. Waller. June 13. Site ID SB-6—91-28AACB1-1. Note, Page 1.	Water quality analyses and static water level measurements collected in 1955.	Provides additional record of water quality and history of construction at the BIA School Drinking Water Well.
	U.S. Geological Survey. 1978. Tununak Well Log. Anderson-Appleton. U.S. Public Health Service. May 1. Site ID SB-6-91-28AAC1-2.	Well log for water well installed and developed in 1978 south east of the AVEC power generation building.	Provides additional record of a drinking water well in Tununak, not present in the Department of Natural Resources database.
	U.S. Geological Survey. 1955. Groundwater Reconnaissance in Five Eskimo Villages in the Lower Kuskokwim-Yukon River Area, Alaska.	Described two wells installed at the time in Tununak, primarily a 14 foot well located in the School of the time. Provides general description of surficial geology and existing water sources. Provides general recommendations on avoiding permafrost and salt water intrusion in the town site in the unconsolidated sediment.	
Alaska Department of Natural Resources	AK DNR. 1964. Tununak Water Well PD&C. Ralph Donelson. Bureau of Indian Affairs. February 7.	Well log for the BIA School Well.	Provides most recent information on the construction of the BIA School Well including documented production rates.
Alaska Department of Transportation	Alaska DOT & PF, 2005. Geotechnical Data Report, Tununak Airport Improvements, AKSAS #51791.	Geotechnical data collected in several proposed locations for the new runway, as well as material mining sites.	Limited to quaternary unconsolidated soil south of the Tununak River. Limited information on the nature of permafrost distribution and bedrock encountered.
	Alaska DOT & PF, 2005. Reconnaissance Geology Report Nelson Island Roads, AKSAS #57176.	Geotechnical data collected along the proposed Nelson Highway corridor, between Villages of Tununak and Toksook Bay.	Describes depth to and types of bedrock encountered in the area between Tunuak and Toksook Bay.
Lower Kuskokwim School District	R&M Consultants, Inc. 1979. Geotechnical Investigation and Foundation Recommendations for High School Site Tununak, Alaska, Prepared for Lower Kuskokwim School District, Bethel, Alaska.	Geotechnical data collected at the Tununak School Site.	Describes shallow soils, permafrost distribution, and depth to bedrock.
City of Toksook Bay	HDR Alaska Inc. 2005. City of Toksook Bay Sanitation Facilities Master Plan, Prepared for City of Toksook Bay.	Sanitation Facilities Master Plan covers revisions to drinking and waste water systems in the nearby Village of Toksook Bay.	Describes groundwater well history, the finding of recent geologic mapping, geophysical investigations for the Village of Toksook Bay. The report also provides water quality data and production rates of the deep wells in the village.
Institute of Northern Engineering, University of Alaska Fairbanks	Jorgenson, Torre. 2008. Permafrost Characteristics of Alaska. Presented at the Ninth International Conference on Permafrost, Institute of Northern Engineering, Geophysical Institute.	Describes the updated understanding of permafrost distribution in Alaska, including all available depth information, and regional classifications.	Describes the general distribution of permafrost in southwest Alaska including all nearby thickness measurements.
Alaska Department of Environmental Conservation - Drinking Water Protection	Palmer, Charlie. 2018. Email communication March 02, 2018.	Provided current status of drinking water source classification for the Village of Tununak, well logs source from the Department of Natural Resources for Tununak and Toksook Bay.	