Craig Holland, P.E.
Principal Engineer

Reid, Middleton & Associates, Inc.
Engineers • Surveyors • Planners
121 5th Ave. N. Suite 200 Edmonds WA 98020 206/775-3434

d, Middleton & Associates, Inc.
Engineers • Surveyors • Planners

File No. 01-83-033-006-01

4/1/84. Went over eng. report with [illegible] for first time. BS

PORT OF PORT ANGELES

JOHN WAYNE MARINA

ENGINEERING REPORT

RECEIVED
MAY 8 1984
CLALLAM COUNTY
DEPARTMENT OF HEALTH

WATER USE

Water is supplied by the John Wayne Estate.

Water use at the marina will be at three locations:

1. On the floats
2. Restroom
3. Administration building

1. Float Water Consumption

Number of berths	548
Amount water/berth/day	15
Total gallons/day	8,220

Background:

Port of Everett	- peak 2 months (May - June 1983)	14.15 gallon/berth/day
	- average (Nov. 1981 - Oct. 1983)	13.68 gallon/berth/day

The water is used to service boats and does not get into the sewer system.

2. Restrooms

Use 500 gallons/day

Background:

The Port of Everett has two restrooms for the 1200+ ship marina. The two restrooms averaged 370 gallons/day each during May - June 1982 and 1983.

3. Administration Building

The John Wayne Marina Administration Building will consist of showers, restrooms, two washing machines, office, two bedroom apartment and a 200 person assembly hall (75 person dining room).

Use	2,850 gallons/day for showers/laundry, etc.
	2,000 gallons/day for dining room
	300 gallons/day for two bedroom apartment

Background:

The Port of Everett has similar facilities for showers/laundry/restroom/office. The water use is fairly uniform in the Everett facility throughout the year; 2,850 represents the peak two month average (May-June 1982). The Everett facility services 1,200 slips.

Background:

The assembly room has been leased by the yacht club. The usage is intended to be meetings, pot luck dinners, picnic cooking, etc. The facility is not being designed as a restaurant or other food service establishment other than for group use.

Assume Restaurant
Use 35 gallons/seat/day @ 75 seats = 2,625
(Source: Metcalf & Eddy - "Wastewater Engineering")

Assume Assembly Hall
Use 2 gallons/seat/day @ 200 = 400
(Source: Parker - "Wastewater Systems Engineering")

Background:

Two bedroom apartment = 300 gallons
(Source: "Design and Management Guidelines for Larger On-Site Sewage Systems," December 1979)

SUMMARY OF WATER USE

Floats		8,220 gallons/day
Restrooms		500 "
Administration Building		5,150 "
Showers, et al	2,850	
Apartment	300	
Assembly Hall	2,000	
Subtotal	5,150	
Total		13,870 gallons/day

Maximum Instantaneous Demands

Figures projected above are the average daily demands on an average day in the peak two month period. To get the peak:

Assume water is used in 12-hour period.
Assume peak day of the peak month ratio of 3 to 1.
Also assume maximum instantaneous demand to peak day ratio of 3 to 1.
Therefore, with an average flow of 13,870 gallons/day (page 2), the maximum instantaneous demand is:

13,870 gallons/day ÷ 1,440 minutes/day x 3 x 3 x 2 = 173.4 gpm
Say 175.0 gpm

Piping must be sized to carry 175± gpm to the site.

SEWER USE

Sewage will be disposed through a septic tank and drainfield system. The original design in 1980 called for a 3,300 gallon per day design flow. The increased flow at the marina causes a larger design flow. It is proposed that the entire parcel of property be used for the drainfield. Reserve area will be on the Wayne Properties.

Sewage flow comes from the following sources:

1. Restroom
2. Administration Building
3. Boat Pump-Out Facilities

1. Restroom

500 gallons/day
Background: From water use figures.

2. Administration Building

5,150 gallons/day
Background: From water use figures.

3. Boat Pump-Out Facilities

200 gallons/day
Background: Assume 3 boats/hour peak day
20 gallons/boat
Normal dumping hours - 6 hours (2-8 p.m.)
Average day/peak day = 0.5
3 boats/hour x 6 hours x 20 gallons/boat x 0.5 =
180 gallons/day

SUMMARY OF SEWER USE

Restroom	500 gallons
Administration Building	5,150 "
Boat Pump-Out Facilities	200 "
	5,850 gallons

The figure 5,850 gallons represents the design flows for the drainfield system, siphon chamber, force main, pump and pump chamber. The restroom will have its own septic tank (based upon 500 gallons), and the Administration Building/ Boat Pump-Out Facility will have a septic tank design flow based upon 5,350 gallons.

PUMP CHAMBER SIZING

Dosing Rate - 4 doses/day
Pump Cycle -

$$\frac{6500 \text{ gallons/day}}{4 \text{ doses/day}} = 1625 \text{ gallons/dose}$$

Pump Chamber must be sized for pumping dose plus 6 hours storage (one pumping cycle). Clallam County PUD was called 2/4/84 concerning downtime- 1 to 4 hours depending on the problem. The water supply is alos dependent on the PUD - the Wayne Properties Water System has a booster pump downstream of the storage tank.

Therefore, pumping volume + storage

  1625 gallons/dose
+ 1625 gallons storage
  3250 gallons

Using 2 - 6 foot diameter manholes connected with an 48-inch pipe the effective pumping depth is

Area = 28.27 ft.^{2} (6-foot dia.)
= 56.55 ft.^{2} for two
= 423 gallons/foot depth

Therefore,

$$\frac{3250}{423} = 7.68 \text{ feet} = \text{pumping depth}$$

say 7.7

Elevations

Ground Elevation at siphon chamber	67.5
Top elevation of pump chamber	20.0 $\pm$
Water level at septic tank	11.0
Invert elevation at pump chamber	10.5

Water level at septic tank will be used to set the top elevation for storage. Approximately 150 gallons will be stored in the pipe.

Therefore, bottom of pumping cycle

```
  11.0
-  7.7
   3.3
```

Pump will be submerged for explosion-proof atmoshere. Pump will also sit on a 0.3 foot block. Therefore, floor elevation of basin.

```
 3.3 Bottom pump cycle
-1.0 Submerge Pump
-0.3 Elevate Pump
 2.0
```

PUMP HYDRAULICS

Static head =	Ground Elevation @ drainfield	67.5
-	Bottom Pump Cycle	3.3
	Static Head	64.2

Friction head = losses in fittings and pipe

Distance to siphon chamber = 400'
Fitting loss in piping = 50'

Use 2" piping for wet well @ 50'
Use 3" piping to drainfield @ 400'

(See Sheet C-10 for details of pumping chamber and 9000 gal. septic tank design).

SEPTIC TANK SIZING

Restroom Septic Tank

Design Flow 500 gallons/day

Use 1000 gallon two compartment precast septic tank

Administration Building/Boat Pump-Out

Design Flow 5,350 gallons/day

Use 6,000 gallons for sizing flow

Volume = 6,000 x 1.5 = 9,000 gallons with 1/3 vol. for liquid storage 2/3 vol. for solids storage.

(Page 5, "Design and Management Guidelines for Larger On-Site Sewage Systems," 1979).

SIZING OF SIPHON CHAMBER

Pumping cycle = 1625 gal./dose
Rate of flow from pumps - 40 gpm pump
Length of pumping cycle = 41 min ±

If size of siphon champer = 1300 gal.

Using 4" alternating siphon average rate of discharge from siphon = 165 gpm at 165 gpm it will take siphon 8 min. ± to discharge the 1300 gallons of effluent once the siphon begins to cycle. The pumping cycle not being completed when the siphon begins it's cycle will continue for 8 more minutes and will therefore end the pumping cycle at the same time as the siphon.

(See Sheet C-9 for details of siphon chamber).

SIZING OF DRAINFIELD SYSTEM

Per the new DSHS Standards for Sewage application rate for medium sand soils (Type 2) of 1.2 gal./sq.ft./day will be used.

Using the design flow of 6500 gal./day from summary of sewer use the required sq.ft of drainfield = 6500/1.2 = 5417 sq.ft.

Per DSHS standards 150% shall be installed with the system devided into 3 equal parts.

Utilizing 3' wide trenches 100% system = 5417/3 = 1806 l.f.

Addition 1/2 = 903 l.f. Provide 2709 l.f. x 3' = 8127 sq.ft. = 150%.

February 13, 1984
File No. 01-83-033-006-01

APPENDIX A

SEWER USE FIGURES BASED UPON

THE EQUIVALENT FIXTURE UNIT METHOD

	Number	EFU/Units	Total
Administration Building			
Basement			
Washing Machine	2	4	8
Drink Fountain	1	1	1
Hand Sink	8	2	16
Mop Sink	1	2	2
Water Closets	6	5	30
Urinals	2	5	10
Shower Heads	8	4	32
			99
Main Floor			
Kitchen Sink	3	2	6
Dishwasher	1	4	4
Hand Sink	4	2	8
Water Closet	3	5	15
Urinal	1	5	5
			38
Apartment			
Wash Machine	1	2	2
Kitchen Sink	1	0	0
Dishwasher	1	2	2
Bathtub/Shower	1	2	2
Water Closet	1	3	3
Hand Sink	1	1	1
			10
Total Building			147
Restroom			
Water Closet	3	5	15
Urinal	1	5	5
Hand Sink	2	2	4
Drink Fountain	1	1	1
Total			25

Duration Pumping	Rate (gpm)	hL One Pump 2" Pipe hL/100'	hL	3" Pipe hL/100'	hL	Total Head Loss One Pump	hL Two Pump 2"Pipe hL/100'	hL	3" Pipe hL/100'	hL	Total Head Loss Two Pump
10	165	48	24	6	24	48	12	6	1.6	7	13
15	110	20	10	3	12	22	5.5	3	0.8	3	6
20	82.5	12	6	1.6	5	11	3.1	2	0.5	2	4
30	55	5.5	2	0.8	3	5	1.8	1	---	--	1
60	27.5	1.8	1	--	--	1	--	--	---	--	--

Total Head

One Pump Total Flow SKH 150 (3Ø) - 40 gpm max.

Static + dynamic

63.7 + 1.8 = 65.5 ⟶ 40 gpm ⟶ 1 hour pump

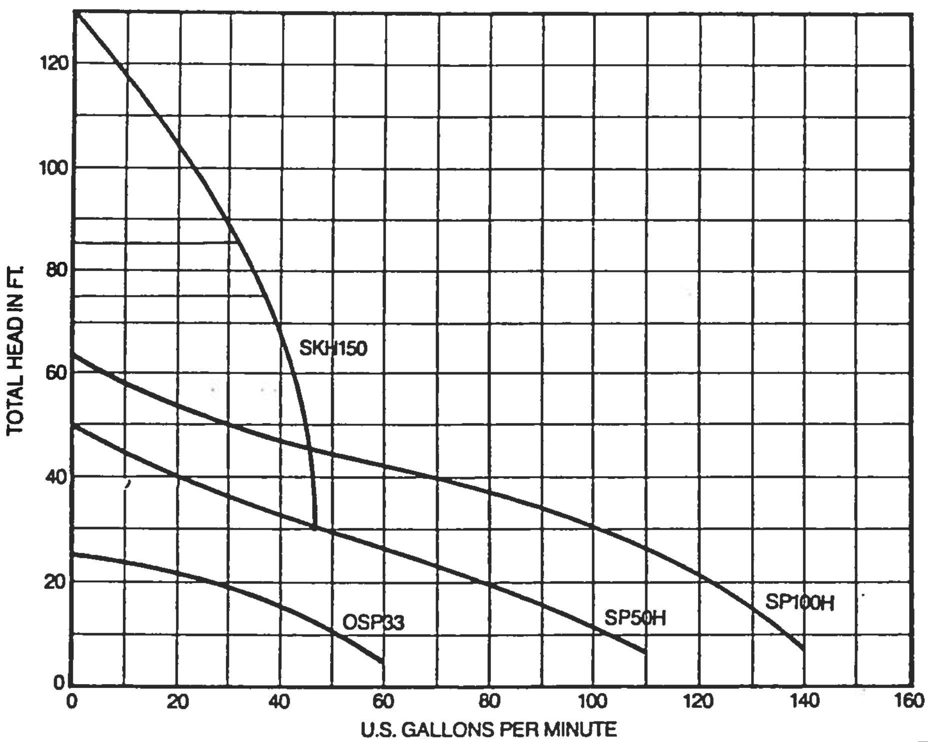
Two Pump SKH 150 (3Ø)

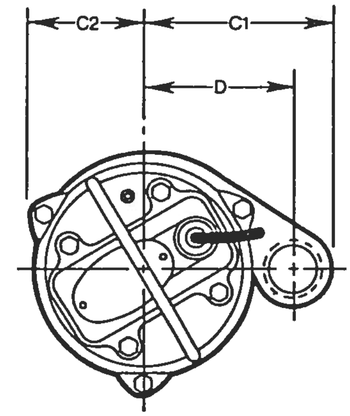
Static + dynamic

20 mins. 64.2 + 4 = 68.2
30 mins. 64.2 + 1 = 65.2
60 mins. 64.2 + - = 64.2

Stainless Steel

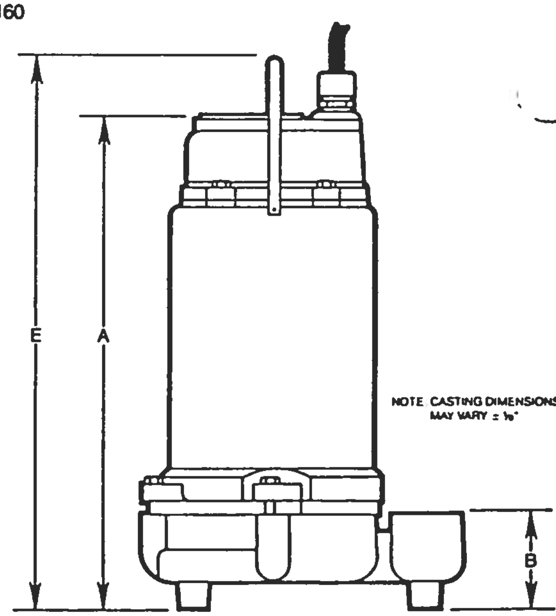
Dimensions and performance data models: OSP33, SP50H, SP100H, SKH150





MODEL	TYPE	DISCH. (in.)	hp	CAPACITIES		SOLIDS PASSED (inches)
				GPM to (feet)	HEADS to (feet)	
OSP33	Automatic and manual	1¼	⅓	60	25	⅜
*SP50H	Automatic and manual	2-3	½	110	50	¾
*SP100H	Automatic and manual	2-3	1	140	60	¾
*SKH150	Manual	1½	1½	45	130	¾

*available in three phase with magnetic starter with ambient compensated overload located in control panel.
OSP33, SP50H, SP100H available in all bronze construction.



MODEL	A	B	C1	C2	D	E
OSP33	9¼	2⁵⁄₁₆	4⅛	6¼	4¾	NA
SP50H	12³⁄₁₆	6	4⅜	8⅛	5⅞	NA
SP100H	12³⁄₁₆	6	4⅜	8⅛	5⅞	NA
SKH150 1Ø	16⁷⁄₁₆	3³⁄₃₂	3¹⁹⁄₃₂	6³⁄₁₆	5	19
SKH150 3Ø	11³⁄₁₆	3³⁄₃₂	3¹⁹⁄₃₂	6³⁄₁₆	5	13¹⁵⁄₁₆

Dimensions are in inches.

hydromatic PUMPS A Marley Company

Box 327, 419/289 3042, Ashland, Ohio 44805
Canada—Wylain Canada Ltd. Ltee., 126 East Dr., Brampton, Ontario L6T 1C2
International Sales—Ashland, Ohio Telex 987432

ORIGINAL SOILS AND DRAINFIELD ANALYSIS
FROM ENVIRONMENTAL IMPACT STATEMENT

RITTENHOUSE-ZEMAN & ASSOCIATES, INC.
GEOLOGY & SOILS ENGINEERING

13837 N.E. 8th Street, Bellevue, Washington 98005 (206) 746-8020
8050 S.W. Cirrus Drive, Beaverton, Oregon 97005 (503) 644-9141

September 29, 1980 W-3453

Port of Port Angeles
P.O. Box 791
Port Angeles, Washington 98362

Attention: Mr. Jerry Hendricks
Executive Director

Subject: Soils Evaluation
Sequim Bay Boat Basin
Drainfield Area

Gentlemen:

At your request, we have excavated a series of soil log test holes at the proposed drainfield site. This report summarizes our findings.

The drainfield will be located in the northeast corner of the property, north of the existing line of cabins and west of the Old Olympic Highway. The entire area will be used for the primary or reserve drainfield site. The area slopes downward to the southeast with about twelve feet of fall. Presently, the area is covered with brush and a few trees. A total of five test holes were dug on September 18 and 19, 1980. Holes Numbered 1 through 4 were within the planned drainfield site, while Hole Number 5 was situated on the slope above Johnson Creek. These holes ranged in depth from ten to fourteen feet. The soils encountered in the field were visually classified by an engineering geologist from our firm. Selected samples were returned to our office for further examination.

The test pit logs are included in Table "A" at the end of this report along with a Site Sketch showing the approximate location of the test pits.

In the upslope, main drainfield area, the test pits encountered ten to twleve feet of medium dense, moist, brown, gray and tan, clean to silty sand containing discontinuous lenses of iron-stained and slightly cemented, silty, gravelly sand. At greater depth are dense, mottled, wet sands or hard silts. These deepest strata are relatively impervious and appear to support a seasonal perched ground water condition.

Downslope in the reserve field area, surficial, medium dense, permeable, tan-brown and red-brown, silty to clean, fine to medium sands with some roots are present to depths of about four and one-half to five feet. Beneath these soils are medium dense to dense, mottled, gray, fine to medium sands. Based on the scarcity of roots, the mottling and the increased density, it appears that this horizon is only slightly permeable and may become saturated seasonally. At greater depths, generally below ten feet, are stiff to hard, impervious silts.

In summary, the surficial soils appear to be capable of safely receiving and handling septic tank waste water. The actual drainfield design will be developed by the Project Engineer in conjunction with the appropriate local and state health authorities.

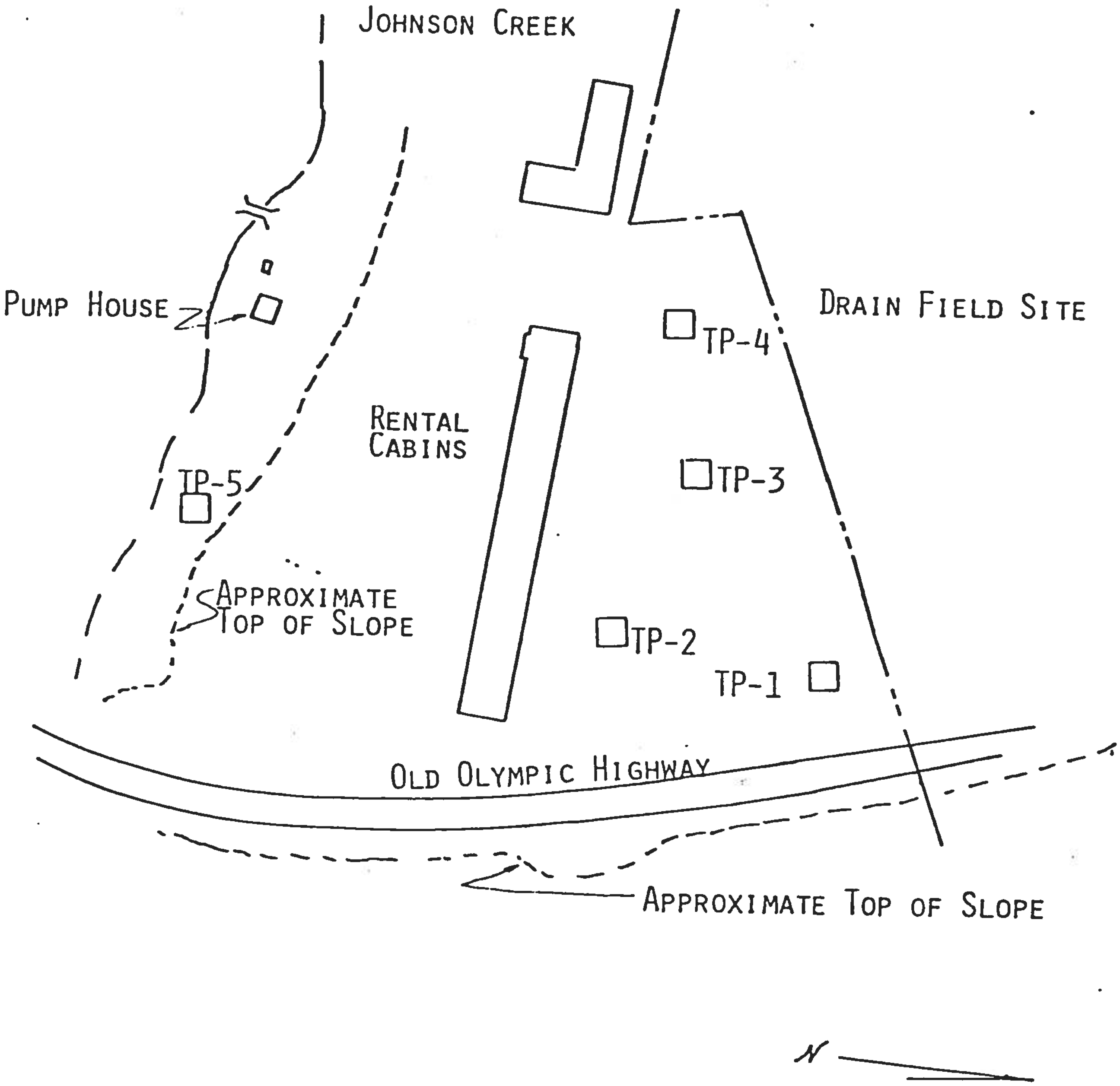
We appreciate having this opportunity to assist you. If you have any questions, please call.

Respectfully submitted,

RITTENHOUSE-ZEMAN & ASSOC., INC.

Tom Bekey, Chief Geologist

Alvin R. Zeman, P.E.



SEQUIM BAY MARINA

LEGEND

TP-5 TEST PIT NUMBER AND APPROXIMATE LOCATION

RITTENHOUSE - ZEMAN & ASSOC., INC.
FOUNDATION AND SOILS ENGINEERING, GEOLOGY

13837 N.E. 8th Street
Bellevue, Washington 98005
746-8020

8050 S.W. Citrus Drive
Beaverton, Oregon 97005
644-9141

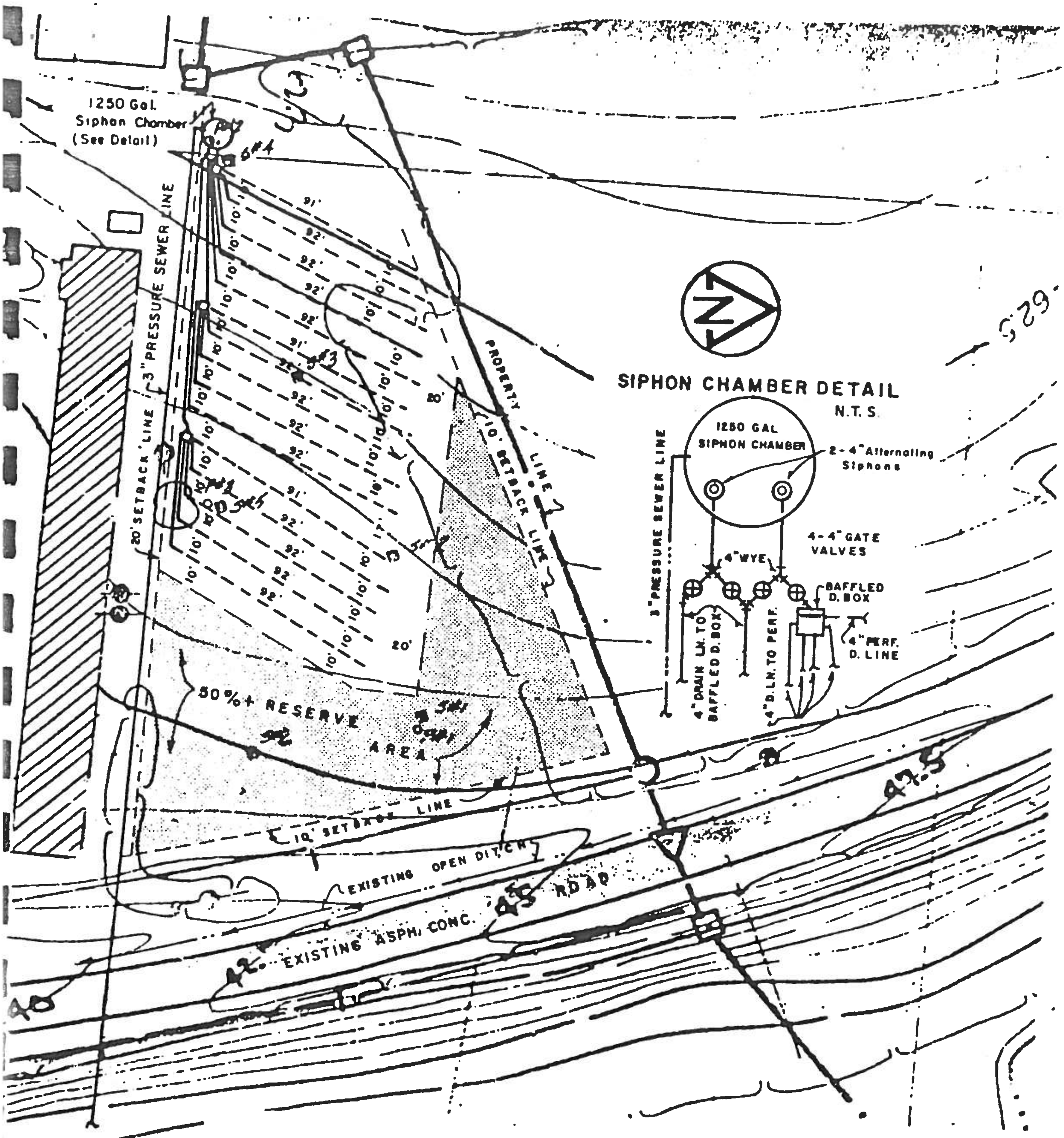
W.O. 3435 DATE 9/80
BY DH SCALE 1" = 100'

TEST PIT LOGS W-3453

Depth (feet)	Soil Classification
	Test Pit No. 1
0.0 - 0.8"	Loose, dry, black, silty, fine to medium sand with fine to coarse gravel
0 8" - 2' 6"	Medium dense, dry to moist, tan, silty, fine to medium sand with fine to coarse gravel and cobbles
2' 5" - 4' 3½"	Medium dense, dry, brown to red-brown, slightly silty, fine to medium sand with fine to coarse gravel and cobbles, and interbeds of gravelly sand
4' 3½" - 4' 7"	Medium dense, moist, black, silty, sandy, fine gravel with many fine roots
4' 7" - 5' 2"	Medium dense, moist, tan, slightly mottled, silty, clayey, fine sand with fine to medium gravel
5' 2" - 6' 9"	Dense, moist, gray, very silty, fine sand with thin mottled zones and some organic matter
6' 9" - 10' 4"	Dense, moist to wet, gray, slightly mottled, slightly silty, fine sand with occasional fine gravel
10' 4" - 11' 6"	Hard, moist, fractured, brown, fine, sandy, clayey silt with occasional fine to medium gravel and thin mottled lenses of fine sand
11' 6" - 11' 11"	Stiff, wet, gray, clayey silt with fine sand Slow seepage at 10 feet
	Test Pit No. 2
0 0 - 0 6"	Loose, dry, black, organic, fine to medium, sandy topsoil with gravel
0 6" - 2' 3"	Medium dense, dry, tan, silty, fine to medium sand with fine to medium gravel
2' 3" - 2' 10"	Medium dense, dry to moist, brown to red-brown, fine to medium sand with fine gravel

Depth (feet)	Soil Classification
	Test Pit No. 2 (continued)
2' 10" - 4' 6"	Medium dense, moist, red-brown, slightly silty, fine to medium sand with fine to medium gravel and cobbles
4' 6" - 5' 3"	Medium dense, dry, brown, silty, fine to medium sand with roots
5' 3" - 5' 7"	Dense, moist, brown, silty, fine sand
5' 7" - 7' 0"	Dense, moist, gray, very silty, fine sand with mottling in fine sand lenses, small root tubes and occasional cobbles
7' 0" - 10' 0"	Dense, moist, gray, fine to medium sand
10' 0" - 11' 5"	Hard, moist to wet, fractured, brown, clayey, fine, sandy silt with thin mottled lenses of fine sand and minor organic matter
11' 5" - 12' 0"	Stiff, wet, fractured, gray, clayey, fine, sandy silt with thin lenses of saturated, fine sand and occasional gravel
	Slow seepage at 10 feet
	Test Pit No. 3
0 0 - 0' 6"	Loose, dry, black to brown, silty, fine to medium, sandy organic topsoil
0' 6" - 3' 0"	Medium dense, dry, tan, silty, fine to medium sand with gravel and cobbles
3' 0" - 10' 0"	Medium dense, moist, brown, fine to medium sand with occasional gravel and cobbles and some iron staining and cementation in a thin localized area, interfingering laterally into coarse, sandy cobbles
10' 0" - 11' 4"	Hard, moist, brown, fine, sandy, clayey silt with occasional gravel, localized organic matter, and thin, wet sand lenses
11' 4" - 12' 9"	Hard, gray, wet, fractured, fine, sandy, clayey silt
	Minor seepage from sand lenses below 10 feet

Depth (feet)	Soil Classification
	Test Pit No. 4
0 0 - 0' 6"	Loose, dry, brown, silty, fine to medium, sandy topsoil
0' 6" - 1' 10"	Medium dense, dry, brown, silty, fine to medium sand with fine to coarse gravel, cobbles and boulders
1' 10" - 2' 11"	Medium dense, dry, red-brown, silty, fine to medium sand with fine to coarse gravel, cobbles, and fine roots
2 11" - 4'6"	Medium dense, dry to moist, red-brown, fine to medium sand with fine to medium gravel
4' 6" - 6' 7"	Medium dense, moist, gray, brown, fine to coarse sand
6' 7" - 10' 6"	Medium dense, moist, gray, fine to coarse sand with occasional fine to medium gravel and some thin sand and silt beds
10' 6" - 11' 1"	Medium dense, moist, brown, silty, fine to medium sand with fine to medium gravel
11' 1" - 12' 0"	Medium dense, moist, gray, fine to coarse sand
12' 0" - 12' 11"	Medium dense, wet, gray-brown with some mottling, silty, fine to medium sand with organic material and gravel
12' 11" - 14' 0"	Dense, moist, fine to medium sand
	Slow seepage at 14 feet
	Test Pit No. 5
0.0 - 0' 6"	Loose, dry, black, silty, sandy, organic topsoil
0' 6" - 1' 0"	Medium dense, moist, brown, silty, fine to medium sand with gravel (slope wash)
1' 0" - 10' 0"	Hard, moist, mottled, brown, fine, sandy, clayey silt with minor gravel and containing organics
	No seepage



DES. A.R.M.	DATE Oct. 21, 80	FILE NO.
DR. A.R.M.	F.B. L.L.	6786 C-16
CH. J.O.	SCALE 1" = 50	SHEET OF

rma

REID, MIDDLETON & ASSOCIATES, INC.
Engineers • Surveyors • Planners

October 23, 1980
Sequim Bay
Estimate of Sewage Flow

METHOD NO. 1

548 total moorages @ 4.7 gal/day (which includes transient moorages)	=	2575.6 gal.
Boat Holding tanks are 5 to 50 gal.		
Say Average = 20 gal/Boat		
Est. 25% of Boat Trips will empty July - August Average Daily Boat Trips from Sequim Bay		
Study	=	108 trips
Therefore (108)(.25)(20)	=	540 gal/day
Total Sewage Flow	=	3115.6 gal/day

METHOD NO. 2

From Boat Traffic Study for this marina		
July - August Average Daily Trips from Sequim Bay		
Study	=	108 trips
Assume average of 3 persons per boat		
Trip = (108)(3)	=	324 person/day
From the Manual of Septic Tank practice a equivalent use of Picnic Parks with bathhouses, showers and flush toilets	=	10 gal/person/day
Therefore max. daily sewage flow	=	10 gpd (324)
	=	3240 gpd.

DRAINFIELD DESIGN DATA

Estimated Daily Sewage Flow per day - Use Method 2 for design purposes use 3300 gal	=	3240 gpd
Allowable application rate per PSHS Design Management Guidelines Dec. 1979	=	1.2 gal/sq. ft./day

Drainfield Area Req. = 3300 ga. ÷ 1.2 = 2750 sq. ft.

Utilizing 36" wide laterals, therefore install 917 L.F. 4" perforated drain line per the State Guidelines the system is divided into 2 equal half of 485.5 L.F.

Assuming a 16 hour Day flow provide a wet well storage for 4 hour flow @ 206.25 gal/hr. = 825 gal

Pump chamber min. size = 1250 gal.

Dosing chamber at Drainfield site = 1250 gal.

Utilize 2 - 4" alternating siphons @ 10%± slope to drainfield = 0.65 c.f.s.

Maximum discharge from each siphon = 292 gpm if 1000 gallon dose per cycle is assumed for each half will be dosed for approximately 3 1/2 minutes. The rest period per half then would be 9.7 hours.

Per State Guidelines 3/2 (3 halves) arc to be installed. One of the halves is to be held in reserve, as 50% of the 100% reserve area requirement. After the drainfield system has been in use for period of 6 to 12 months one of the halves, which is in use, is to be rested and the reserve system is to be made active for a similar period so as to allow a larger period of rest for each system. This cycle is to be repeated every 6 to 12 months with 2 of the 50% drainfields in use at all times and with each being rested after 6 to 12 months or when saturated soil conditions are reached near the laterals, based on observation.

DRAINFIELD DISTRIBUTION

917 L.F. Required

Install 3/2 (three halves) of 458.5 ft each.
Each half will have equal distribution with 5 lines each. The first line being 91 feet long then all remaining lines being 92 feet long.

JAMES M. REID
[illegible] MIDDLETON
C. WAYNE JONES
LLOYD M. NELSON

Reid, Middleton & Associates, Inc. ENGINEERS • SURVEYORS • PLANNERS

324 Main Street • Edmonds, Washington 98020 • [illegible]

<u>Percolation data obtained on January 27, 1978</u>

Primary drainfield area - See attached drawing for location

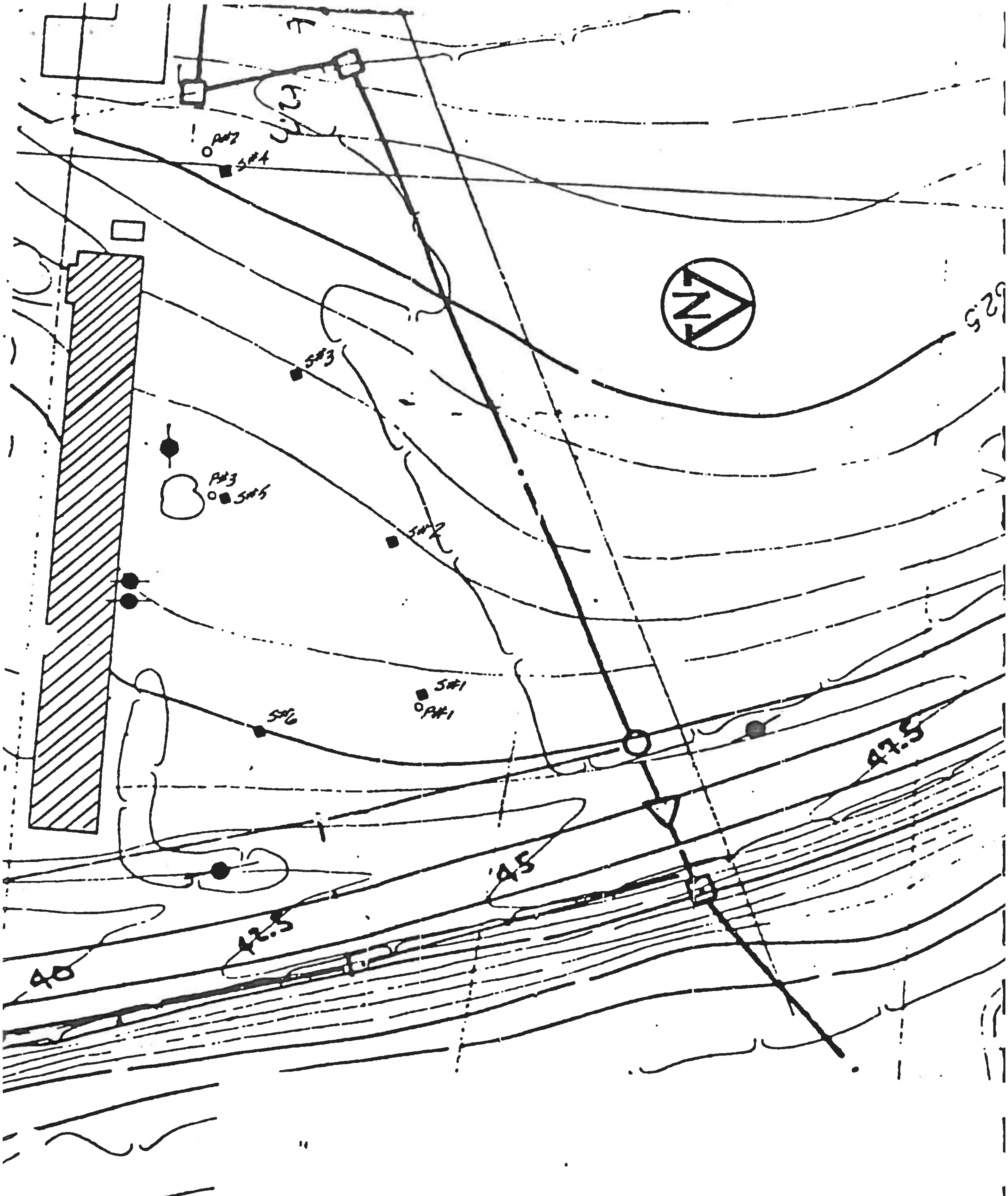
P-1 Adjacent to Soil Log #1 - 7.2 min/in @ 32" depth

P-2 Adjacent to Soil Log #4 3.5 min/in @ 36" depth

P-3 Adjacent to Soil Log #5 - 5 min/in @ 36" depth

Average - 5.2 min/in

Estimated application rate of proposed drainfield area 2.2 gallons per square foot per day



Reid, Middleton & Associates, Inc.
ENGINEERS • SURVEYORS • PLANNERS
324 Main Street • Edmonds, Washington 98020

DES.	DATE	FILE NO
DR.	F.B.	
CH.	SCALE	SHEET NO

UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SUBJECT Septic tank drain field for Sequim Bay Marina

DATE February 10, 1978

TO: Henry Hamm
Clallam County Health Department
903 Caroline
Port Angeles, Washington

FEB 1978
RECEIVED
REID, MIDDLETON & ASSOCIATES

Henry,

On January 27, 1978, an on-site investigation was made on land set aside for the Sequim Bay Marina project to determine the suitability of the soil for septic tank drain fields. The property was located in the SE¼ S27 T30N R3W, Clallam County, Washington.

The following information and observations are based on guidelines established by the U. S. Department of Agriculture, Soil Conservation Service.

The soils in 6 backhoe pits were analyzed and described (see attached map). Hole # 1 consisted of a gravelly loam surface layer which was underlain by stratified layers of cobbly sand, very gravelly sand, gravelly sand, and loam sand to 60 inches. The zone also contained thin bands of iron cemented reddish yellow sands. From 60 inches to the bottom of the pit, the soil consisted of stratified layers of compacted gravelly sand and very gravelly sand. These layers appeared to restrict root and water penetration to a minimum. Hole # 2 was composed of a gravelly sandy loam surface layer to a depth of 30 inches.

Thin lenses of loamy sand were also present in this layer. The subsoil consisted of a mottled silt loam to 38 inches underlain by very compact mottled and gleyed stratified layers of loamy sand, sandy loam, silty clay loam, and silty clay to 65 inches. This zone had few roots that occurred only in cracks and the horizon appeared to slow down water movement and penetration drastically. Drainage was poor and the soil had slow permeability within this zone. From 65 - 78 inches, at the bottom of the pit, the soil consisted of compacted stratified layers of gravelly sand and very gravelly sand. Hole # 3 consisted of stratified layers of cobbly sand, gravelly sand, sand, and loamy sand to 24 inches. This was underlain by more stratified layers of stony sand, cobbly sand, very gravelly sand, gravelly sand, and loamy sand to 70 inches at the bottom of the hole. Hole # 4 was composed of a faintly mottled cobbly and gravelly sandy loam surface layer 14 inches thick. This was underlain by stratified layers of stony sand, cobbly sand, very gravelly sand, gravelly sand, and loamy sand to 63 inches. Thin bands of iron cemented reddish yellow sands and loamy sands also occurred intermittently throughout these layers. In addition, between 34 - 36 inches and 51 - 53 inches, two thin layers of mottled clay loam and silty clay loam textures were present. From 63 - 69 inches, a compacted layer of faintly mottled, iron streaked gravelly loamy sand occurred. And from 69 - 79 inches (bottom of hole), stratified layers of very gravelly and gravelly sand with thin iron streaked lenses were present. Hole # 5 was composed of stratified layers of cobbly (loamy) sand, very gravelly (loamy) sand, and gravelly (loamy) sand to 24 inches. From 24 - 60 inches, the soil consisted of stratified layers of loamy sand and sand. Scattered gravels and iron streaked layers were also present. Underlying this to 65 inches, a compacted and hard layer of very gravelly sand and gravelly sand occurred. Beneath this to 70 inches, the soil consisted of a semi-compacted (very gravelly) sand. Hole # 6 had a disturbed, charred and burned surface layer to 16 inches. From 16 - 26 inches, the soil consisted of a faintly mottled semi-compacted gravelly sandy loam. Beneath this, the soil was composed of stratified layers of cobbly sand, very gravelly sand, and gravelly sand. Yellowish staining (i. e. mottling) occurred between 50 and 68 inches. There was an abrupt textural change at 68 inches to very fine textures. Root penetration also stopped abruptly at the mottling and water penetration appeared severely restricted. From 68 - 88 inches, the soil was composed of a dense layer of mottled and gleyed silty clay loam and silty clay. And from 88 - 98 inches (bottom of hole), the soil was a fine sand with thin iron cemented bands interspersed throughout it.

The soils in holes # 1, # 3, # 4 and # 5 had rapid permeability (ability of the soil to transmit water and air). Because most of the soil is excessively drained and rapidly permeable, it may not purify large volumes of septic tank effluent and there is a chance here of ground water contamination. The thin horizons of compacted or finer textured layers may help slow down water and/or effluent. In addition, there is a chance of contamination to the water in Sequim Bay. Water and/or effluent has a tendency to accumulate on cut bank faces such as those present just on the other side of the road in close proximity to the Bay. The soils in holes # 2 and # 6 had mottling present. The mottling is indicated by spots of color. The spots or variation in color indicate there is lack of aeration, poor drainage, and that there may be a seasonal and fluctuating water table present here. Large volumes of effluent may increase the possibility of water contamination or drain field failure. The reasons for the slow water penetration are due to the presence of very slowly permeable and compacted layers. The finer textured (more silt and clay) and compacted dense horizons greatly contrasted with overlying layers. Root and water penetration was slowed to a minimum. Because of capillary forces and the sharp contrast in texture, each zone or layer much become completely saturated before it is able to enter an underlying layer. Overloading the soil may cause subsurface lateral movement of water and/or effluent in the direction of Sequim Bay. The best places to locate a drain field are in the sandier coarser textured soils as far away from the Bay as is possible.

Sincerely,

Mark S. Amara

Mark S. Amara
Soil Scientist
USDA, Soil Conservation Service

cc: Allan R. Morgan, Reid, Middleton & Associates, Inc., 324 Main St. Edmonds, Washington 98020