



Engineering Report

*Wastewater Treatment Plant Expansion
City of Arlington, Washington*

Prepared for:
City of Arlington
238 North Olympic Avenue
Arlington, WA 98223

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DESIGN MEMO

To: Jeff Howard, Jim Lutz
Fr: Robert Pride
Re: Arlington WWTP

FES.
Date: ~~Jan~~ 12, 1996
Proj. No. 95-169.

This design memorandum summarizes the results of the field exploration program conducted at the site of the proposed wastewater treatment plant additions in Arlington, and provides geotechnical recommendations for design of structure foundations. Exploratory drilling was performed on February 7th, and included the drilling of five test borings to depths ranging from 8 to 24 feet. Standard penetration drive samples were obtained at roughly five foot intervals, and groundwater measurements were made at the time of drilling. Subsurface conditions were continuously recorded by our field geologist, and summary logs of each test boring are attached to this design memo. Refer to Drawing No. 1 for the approximate location of the test borings.

Subsurface conditions consisted of dense deposits of Older Alluvium overlain by a variable thickness of fill material. A majority of the alluvial soils consist of silty sand and gravel containing cobbles and boulders. Refusal on large rock was encountered during the drilling of B-1, although the remaining borings were completed to their planned depths. Gravel and cobbles contributed to the generally high blow counts measured in the borings, but overall the alluvial soils were classified as dense to very dense.

Intermediate layers of finer-grained deposits of sandy silt were encountered in B-3 and B-5 at depths of 21 and 15 feet. SPT blow counts indicate that these soils are stiff, but they do not appear to represent continuous lenses or layers throughout the site. Groundwater exists below a depth of about 8 to 10 feet within the granular alluvial soils at elevations ranging from 60 to 66 feet. This water is probably not a perched water table, but appears to be recharged from higher elevations to the south and east. A relatively steep groundwater gradient extends from the wastewater treatment site to the river located approximately ¼ mile to the north.

Recommendations

From a foundation bearing viewpoint, the existing Older Alluvium is considered excellent for support of shallow or deep structures. Existing fill soils should not be utilized for foundation or slab support, unless they are removed and replaced as controlled compacted fill. Deeper structures (in excess of 6 feet deep) must be designed for the hydrostatic uplift forces, and the higher lateral earth pressures caused by elevated groundwater levels. Consideration should be given to installing a subdrain system around affected structures to minimize the effects of groundwater, and to provide a gravity (or pumped) drainage system for structure protection. If these deeper structures are designed for permanent uplift conditions, a warning system must be installed to alert plant operators prior to the onset of cleaning operations.

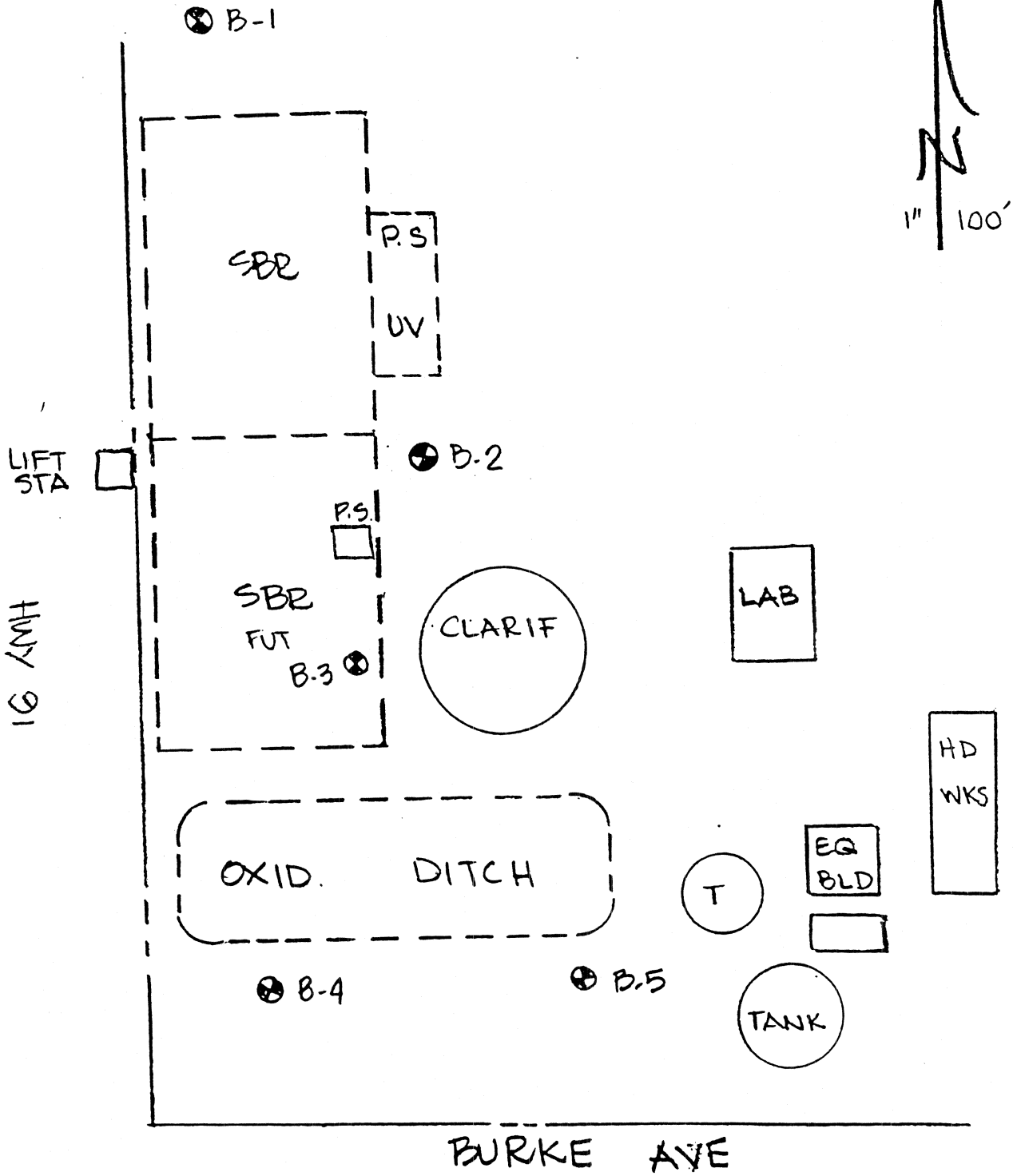
Geotechnical recommendations for structure design are based on the results of field testing and visual classification of the soil samples retrieved from the test borings. The subsoils are competent for foundation support with only minor post-construction settlements anticipated. The granular nature of the alluvial soils will require that the contractor use conservative temporary slopes during construction of the below-grade structures. Dewatering will be required for the duration of the open excavations to prevent failure of the excavated slopes, and to minimize disturbance of the foundation soils. Soils excavated below the water table will have to be dried out prior to reusing as compacted backfill. All excavated soils may be used as backfill providing the oversize rock (+ 6 inch) is removed. All backfill should be compacted to at least 90% of the maximum density based on the ASTM D1557 test method. Recommendations for foundation design are presented below:

- Allowable bearing value = 4000 psf (footings at least 2 feet deep)
- Estimated total settlement = ½ inch
- Lateral earth pressures = 55 pcf (braced walls – above water table)
= 90 pcf (braced walls – below water table)
Note: triangular pressures should be converted to rectangular or trapezoidal pressures.
- Seismic design = Use 1/3 increase for temporary seismic loading
- Backfill properties = Compacted density 125 pcf above water, 65 pcf below water table

A final review should be performed on the design drawings and specifications to confirm that the above recommendations have been interpreted appropriately, and that existing site conditions have been considered in developing the construction documents. Please call if there are any questions.

Robert M. Pride, P. E., G. E.

mp: eartharl



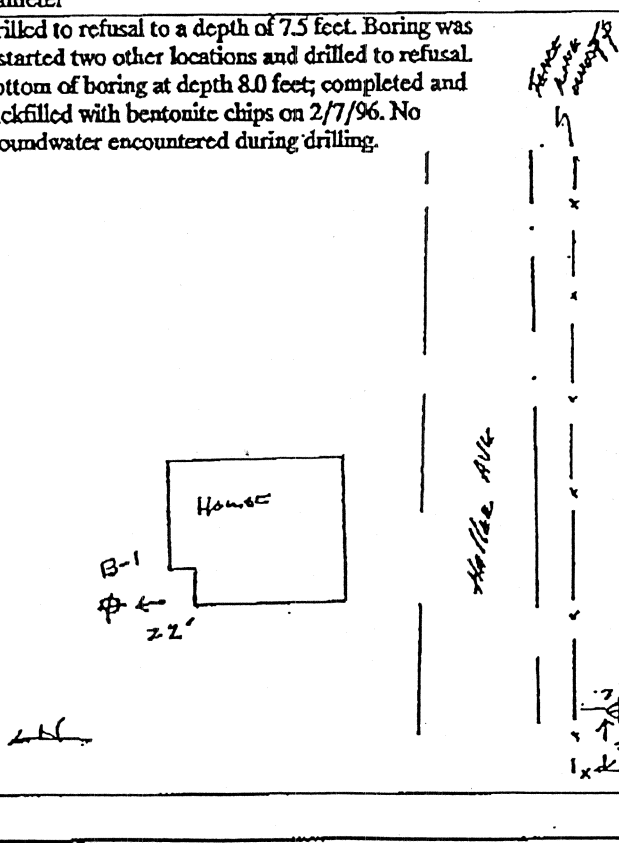
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LOG OF BORING NO. B-1

Sheet 1 of 1

Date drilled 2/7/96 Sampler / Driving Weight 140 lb 30" Drop Elevation (ft) 73

Depth, ft	Elevation	Samples	Blows/6"	Graphic Symbol	DESCRIPTION	Observation Well	Dry density pcf	Moisture Content, %	Other tests
					<p>This log is part of the report prepared by Yonemitsu Geological Services (YGS) for the named project and should be read together with that report for complete interpretation. This summary applies only at the location of this boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented are a simplification of actual conditions encountered.</p> <p style="text-align: center;">DESCRIPTION</p> <p style="text-align: center;">Fill</p> <p>2-inch layer of base course gravel SILTY SAND WITH GRAVEL; dark brown, fine to medium, trace organics; medium dense, moist</p> <p style="text-align: center;">Older Alluvium Deposits</p> <p>SILTY SAND WITH GRAVEL; gray-brown, fine to medium, trace cobbles up to 8" diameter, scattered boulders estimated by drill action 1-foot diameter; dense, moist</p> <p>Cobbles and Boulders; boulders estimated to be 2-foot diameter</p> <p>Drilled to refusal to a depth of 7.5 feet. Boring was restarted two other locations and drilled to refusal. Bottom of boring at depth 8.0 feet; completed and backfilled with bentonite chips on 2/7/96. No groundwater encountered during drilling.</p>				
70			3						
			4						
			5						
65			73/6"						
60									
55									
50									
45									



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Figure No.
 A-1

LOG OF BORING NO. B-2

Sheet 1 of 1

Date drilled 2/7/96 Sampler / Driving Weight 140 lb 30" Drop Elevation (ft) 70

Depth, ft	Elevation	Samples	Blows/6"	Graphic Symbol	DESCRIPTION	Observation Well	Dry density Pcf	Moisture Content, %	Other tests
70					<p>This log is part of the report prepared by Yonemitsu Geological Services (YGS) for the stated project and should be read together with that report for complete interpretation. This summary applies only at the location of this boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented are a simplification of actual conditions encountered.</p> <p>Fill</p> <p>SILTY SAND WITH GRAVEL; brown, fine to medium, fine to coarse gravel, trace roots; medium dense, moist</p>				
			6		(sampled on large gravel)				
5	65		50/4"		<p>Older Alluvium Deposits</p> <p>GRAVELLY SAND; gray-brown, fine to coarse sand and gravel, trace silt, scattered cobbles to 6" diameter; medium dense, moist becomes wet</p>				
			17						
			10						
-10	60		7		<p>SANDY GRAVEL; gray, fine to coarse sand and gravel, trace silt, scattered cobbles to 10" diameter; dense to very dense, wet</p>				
			8		(sampled on large gravel)				
			36						
15	55		40		<p>Bottom of boring at depth of 14 feet; completed and backfilled with bentonite chips on 2/7/96. Groundwater encountered during drilling operations at 10 feet.</p>				
20	50								
25	45								
40									

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Figure No.
 A-2

LOG OF BORING NO. B-3

Sheet 1 of 1

Date drilled 2/7/96 Sampler / Driving Weight 140 lb 30" Drop Elevation (ft) 75

Depth, ft	Elevation	Samples	Blows/B"	Graphic Symbol	DESCRIPTION	Observation	Dry density pcf	Moisture Content, %	Other tests
	75				<p>This log is part of the report prepared by Yonemitsu Geological Services (YGS) for the same project and should be read together with that report for complete interpretation. This summary applies only at the location of this boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented are a simplification of actual conditions encountered.</p> <p>DESCRIPTION</p> <p>Fill</p> <p>SANDY SILT; gray-brown, fine, very thinly laminated with silt and silty sand; firm, moist</p>				
	70		1 2 3		<p>Older Alluvium Deposits</p> <p>SANDY GRAVEL; gray, fine to coarse, trace silt, scattered cobbles to 6" diameter; very dense, moist</p>				
	65		12 50/ 6"		<p>large cobble 10" diameter</p> <p>Becomes wet</p> <p>SANDY GRAVEL; gray, fine to coarse sand and gravel, trace silt; very dense, wet</p>				
	60		16 48 30		<p>heaving sand (1-foot)</p>				
	55		11 50/ 4"		<p>SANDY SILT; gray, fine, very thinly laminated with silt and silty sand, scattered organic fragments; very stiff, wet</p>				
	50		5 12 12		<p>Bottom of boring at depth 24 feet; completed and backfilled with bentonite chips on 2/7/96. Groundwater encountered during drilling operations at depth 10 feet.</p>				

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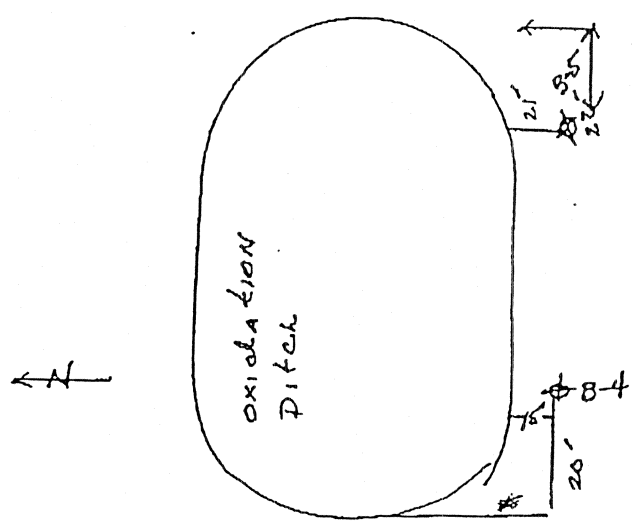
Figure No.
A-3

LOG OF BORING NO. B-4

Sheet 1 of 1

Date drilled 2/7/96 Sampler / Driving Weight 140 lb 30" Drop Elevation (ft) 72

Depth, ft	Elevation	Samples	Blows/B"	Graphic Symbol	DESCRIPTION	Observation Well	Dry density pcf	Moisture Content, %	Other tests
					<p>This log is part of the report prepared by Yonemitsu Geological Services (YGS) for the named project and should be read together with that report for complete interpretation. This summary applies only at the location of this boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented are a simplification of actual conditions encountered.</p> <p style="text-align: center;">DESCRIPTION</p> <p style="text-align: center;">Fill</p> <p>SILTY SAND; gray-brown, fine to medium, trace organics and roots; medium dense, very moist</p>				
70			2						
			3						
			5						
5					<p style="text-align: center;">Older Alluvium Deposits</p> <p>GRAVELLY SAND; gray-brown, fine to coarse sand and gravel, trace silt; very dense, wet</p>				
65			20						
			50/3"						
10									
60			30						
			50/4"		<p>Bottom of boring at depth 13.3; completed and backfilled with bentonite chips on 2/7/96. Groundwater encountered during drilling operations at depth 7.5 feet.</p>				
15									
55									
20									
50									
25									
45									



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Figure No.
 A-4

LOG OF BORING NO. B-5

Sheet 1 of 1

Date drilled 2/7/96

Sampler / Driving Weight 140 lb 30" Drop

Elevation (ft) 75

Depth, ft	Elevation	Samples	Blows/8"	Graphic Symbol	DESCRIPTION	Observation Well	Dry densitypcf	Moisture Content, %	Other tests
	75				<p>This log is part of the report prepared by Yonemitsu Geological Services (YGS) for the named project and should be read together with that report for complete interpretation. This summary applies only at the location of this boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented are a simplification of actual conditions encountered.</p> <p style="text-align: center;">DESCRIPTION</p> <p style="text-align: center;">Fill</p> <p>SILTY SAND; dark brown; fine to medium, little organics; loose, wet</p>				
5	70		2 3 3		<p style="text-align: center;">Older Alluvium Deposits</p> <p>CLAYEY SILT; gray, fine; firm, wet</p> <p>SAND; gray, fine to medium, trace silt, trace fine gravel; medium dense, wet</p>				
10	65		2 3 14		<p>becomes wet</p> <p>GRAVELLY SAND; gray, fine to coarse sand and gravel, trace silt; very dense, wet</p>				
15	60		8 10 11		<p>SANDY SILT; gray, fine, very thinly laminated with clayey silt, silt, and silty sand, scattered wood fragments; stiff, wet</p>				
20	55		8 8 8		<p>Bottom of boring at depth 19 feet; completed and backfilled with bentonite chips on 2/7/96. Groundwater encountered during drilling operations at 9 feet.</p>				
25	50								
45									

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Figure No.
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