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TERRA ASSOCIATES, Inc.

Consultants in Geotechnical Engineering, Geology
and
Environmental Earth Sciences

112604 9121

January 29, 1994
Project No. T-2129

Mr. Al Herring
North Coast Enterprises, Inc.
P.O. Box 25850
Seattle, Washington 98125

Subject: Plan Review
North Coast Contractors Office and Storage Yard
17423 - 68th Avenue NE
Kenmore, Washington

Reference: Geotechnical Report, North Coast Office Building, dated December 3, 1992 by Terra Associates, Inc.

Dear Mr. Herring:

As requested, we have completed a cursory review of the drawings for the above subject project. These plans were prepared by Noboru Hara Architect and included Sheets 1 through 11 dated December 30, 1992 with revisions dated April 21, 1993. The plan sheets also included civil drawings, Sheets C1 through C4 prepared by ABA, Inc. dated October 23, 1992.

In general, examination of the drawings notes that they conform to recommendations presented in the referenced geotechnical report. However, as County reviewers noted, storm sewer utilities depicted on Sheet C3 of the ABA drawings are not shown to be pile supported. As described in our referenced report, excessive settlements can be expected in this area due to the required amount of fill necessary to achieve grades and the compressible peat layer which underlies the site. These utilities should be structurally supported. We have discussed this with you, and as we understand, modifications to the storm utility design which may include attaching the storm sewer utility to the pile supported structure will be completed.

12525 Willows Road, Suite 101, Kirkland, Washington 98034 • Phone (206) 821-7777

We also noted that there is no specific detail regarding the reinforcing of the fill material required to raise grade along the south property line. Sheet C4 of the ABA drawings depicts a rockery section and references geogrid facing as required in the referenced report. Discussion with a County representative indicated that the County would prefer to see a reinforced structural fill used in conjunction with a precast concrete modular unit wall such as Keystone.

Given the anticipated settlements, we would advise against using a system where the geogrid reinforcing is rigidly connected to the facing units. With the potential for differential movement, high stresses could develop resulting in tensal or pull-out failures. Therefore, we recommend that the geogrid reinforcing only be incorporated in the structural fill. To eliminate the concern for potential rockery failure as described in the geotechnical report, precast concrete units such as Keystone or ecology blocks that provide a consistent and uniform interlocking system can be used to independently face the reinforced structural fill zone.

We appreciate the opportunity to examine the project drawings. We trust the information presented is sufficient to meet your current needs. If you have any questions or require additional information, please call.

Sincerely yours,

TERRA ASSOCIATES, INC.

1-29-94

Theodore J. Schepper, P.E.
Principal Engineer

EXPIRES 6/18/95

TJS:tm

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GEOTECHNICAL REPORT

North Coast Office Building
17423 68th Avenue NE
Kenmore, Washington

Project No. T-2129

Terra Associates, Inc.

Prepared for:

North Coast Enterprises, Inc.
Seattle, Washington

December 3, 1992

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Geotechnical Report
North Coast Office Building
17423 68th Avenue NE
Kenmore, Washington

1.0 PROJECT DESCRIPTION

The Vicinity Map, Figure 1, indicates the project location. The proposed building is shown on the Boring Location Plan, Figure 2. The project site presently is nearly level and about ten feet lower than 68th Avenue NE. We understand that a two-story office building will be constructed near the center of the lot. The main floor will be the upper story. The floor will be at Elev. 34.5 feet, which is slightly above the street. A future third story is being considered. Parking at the main floor level will be provided east of the building. The main entrance to the building and the parking stalls north of the driveway will be supported on a concrete deck. The driveway and the southernmost two parking stalls will be supported on ten to twelve feet of new fill. Additional fill will be placed in order to ramp the driveway down to present grades on the south and west sides of the building. We understand that no new fill will be placed in the landscaped area east of the deck.

The lower floor will be at Elev. 20.5, slightly below present grades. An enclosed storage area will be provided beneath the deck at the east side of the building.

Once the project plans have been completed, Terra Associates, Inc. should be provided an opportunity to review the drawings and specifications for foundations and other earthwork. At that time we can provide supplementary recommendations, if needed.

2.0 SCOPE OF WORK

Our preliminary scope of services was outlined in detail in our proposal to you, dated July 24, 1992. Our proposal was accepted, and we received authorization to proceed with our preliminary study on July 27, 1992. Accordingly, on July 29, 1992, we advanced one test boring to a depth of 50 feet below existing surface grades. Using this soil information, we provided preliminary information regarding geotechnical recommendations for design and construction. Subsequently, we were requested to provide specific recommendations. Accordingly, this report addresses the following:

- o Soil and groundwater conditions;
- o Suitability of native soils for use as fill, with recommendations for import fill material;

- o Site grading and preparation;
- o Foundation support alternatives;
- o Earth pressure parameters for lower level or retaining wall design;
- o Slab-on-grade support;
- o Subsurface drainage;
- o Excavations;
- o Pavements.

3.0 SITE CONDITIONS

3.1 Surface

The property measures 150 feet north to south and 145 feet east to west. It is bounded on the east by 68th Avenue NE and on the west by a gravel driveway and parking area leading to Custom Industries, a light industrial business immediately south of the project site. A two-story office building over a daylight basement occupies the site to the north. The south wall of this building extends to or beyond the property line.

The site lies nearly level eight to ten feet below the street to the east and level with the driveway to the west. The vegetation is weeds and blackberries. Construction materials are stored in a small shed near the southwest corner. Chain link fence encloses the property on the west and the south sides.

3.2 Subsurface

Subsurface conditions on the site were explored by drilling one test boring at the location shown on the Boring Location Plan, Figure 2. A log of the boring and a description of the drilling methods used are presented in Appendix A. This section of the report summarizes the subsurface conditions encountered. For a more detailed description of subsurface conditions at the location explored, refer to the boring log in Appendix A.

The test boring encountered ten feet of loose sandy fills overlying 23 feet of peat and other organic soils with occasional wood and sand seams. The peat overlies water-bearing sand with gravelly seams. There is a layer of stiff silty clay about six feet thick interbedded with the sand at depth 40 feet. The boring was completed at depth 49 feet in gravelly sand.

3.3 Groundwater

Groundwater under slight pressure was encountered in the sands immediately beneath the peat. When the drilling was completed, water stood in the borehole at a depth about 9.5 feet below the ground surface.

4.0 DISCUSSION AND RECOMMENDATIONS

4.1 General

Based on our study, it is our opinion that the site can be developed as planned. The recommendations in this report should be incorporated into the design and construction of the project.

The test boring indicates that over twenty feet of peat is present on the site beneath about ten feet of fill. Because the peat is highly compressible, the office building, if supported on conventional shallow foundations, would experience excessive settlements. Consequently, we recommend supporting the building, including the ground floor, on pile foundations that bear in sands and stiff silts that underlie the peat.

We understand that new fills up to about twelve feet thick will be placed at the southeast corner of the building. The peat underlying this area will compress, probably a foot or more over a period of a few years. Pavement supported on the fill will subside. Frequent regrading and pavement repair should be expected.

Piles installed near areas where new fills are placed will be subjected to downdrag loads as the ground surface subsides. These unwanted loads could be large and must be added to the normal building loads carried by the piles.

For this application, we recommend using pipe piles driven into the firm soils beneath the peat, then filled with concrete. The driving will cause minor ground vibrations. The low intensity of these vibrations should not damage nearby property, but may annoy occupants of the buildings. Augercast piles, which are installed without driving, would avoid this disadvantage. However, the wet grout, which is under pressure while the piles are being installed, could balloon into the soft peat. The additional grout consumption in such cases often is an expensive contract extra. In addition, the downdrag acting on the grout balloon is difficult to estimate and is potentially very large. Consequently, we feel that augercast piles are not a good choice in areas where new fills will be placed.

It is feasible to drive the recommended pipe pile adjacent filled areas and use augercast piles elsewhere. However, two pile rigs would have to be mobilized, which would increase costs. Alternatively, the new fill could be eliminated. This would avoid the downdrag problem and allow augercast piles to be recommended everywhere. The concrete deck east of the building would have to be extended southward to support the driveway. Other alternatives, such as special lightweight fills, are also feasible. All these alternatives involve cost tradeoffs that we have not completely evaluated. You may wish to consider in more detail these or other alternatives before reaching a final decision to drive the recommended pile.

The following sections present more detailed discussions and recommendations regarding geotechnical aspects of the project.

4.2 Site Preparation and Grading

Based on preliminary site plans we have examined, we understand that shallow excavations will be required in order to construct the lower floor at Elev. 20.5, as proposed. In the paved areas west and north of the building, proposed final grades are slightly below present grades. Grades will be raised only on the paved area south of the concrete deck. We understand that grades will not be raised in the landscaped area between the deck and the sidewalk.

Building and pavement areas should be cleared of any trash and brush, then excavated to construction grades. Slopes higher than four feet should be inclined not steeper than 1 horizontal to 1 vertical.

On areas where finish grades will be more than two feet above present grades, sod may be mowed short and left in place. Elsewhere, sod and topsoil should be stripped.

Fills used under pavement should be granular materials free of excessive organics. Depending on the weather, suitable fill may be salvaged from site excavations, provided it is dry enough to be compacted. If the earthwork is performed during the wet winter season, it may be necessary to waste all the excavated materials and import suitable fill. We recommend that any imported fill be evaluated by Terra Associates, Inc. before it is brought to the site. For import fills, we recommend a maximum aggregate size of six inches and not more than five percent of the fraction passing the 3/4-inch screen should pass the No. 200 sieve. Structural fill should be placed in uniform loose lifts not exceeding twelve inches and compacted to a minimum of 95 percent of the soils maximum dry density per ASTM D-698 (Standard Proctor).

4.3 Pile Foundations

For this application, we recommend driving steel pipe piles into the sands that underlie the peat. We expect that allowable loads of 50 tons can be obtained with piles 10-3/4 inches in diameter. If higher allowable capacity is needed in areas of high downdrag, piles 12-3/4 inches in diameter could be used for loads as high as 70 tons. Pile tips will likely stop at Elev. -15 to -25. They should be driven with their ends closed by plates at least 0.75 inch thick. In order to avoid damage due to driving stresses, the wall thickness should exceed 0.30 inch.

Piles may be driven to a resistance in blows per foot estimated using the Engineering News formula. To verify that the piles can be expected to take up with reasonable penetrations, prior to purchasing the steel, we recommend driving a test pile of each diameter that will be used.

Piles may be used singly or in clusters of two or more. All the piles should be connected by grade beams. The grade beam design should account for possible eccentricity between column centers and pile centers. Contractors often have difficulty keeping pile butts within three inches of the intended locations.

4.4 Downdrag

Downdrag loads will act where new fills are placed against pile-supported perimeter walls. Each pile in these locations should be designed to support the downdrag load acting directly on the side of the pile, plus the downdrag load acting on the portion of wall supported by the pile.

For the downdrag load acting directly on the sides of the piles, we estimate 25 tons for piles 10-3/4 inches in diameter and 30 tons for piles 12-3/4 inches in diameter. These loads should be assumed to act in all areas where the depths of new fill exceed three feet. Where new fill depths are less than three feet, the downdrag loads may be scaled down proportionately.

Where new fills subside outside perimeter walls, downdrag will act directly on the walls. This load must be added to the loads on the piles supporting the wall. For a wall backfilled to Elev. 34, we estimate the wall downdrag at one kip per lineal foot of wall. This load may be scaled down in proportion to the square of the fill depth, measured above the ground floor elevation.

Where peat compression occurs, downdrag loads not accounted for in the above discussions may be picked up by wall footings and other parts of the structure that project horizontally beyond the line of perimeter walls. To minimize these loads, wall footings and grade beams should extend beyond the outside lines of perimeter walls the smallest amount feasible.

4.5 Ground Floors

The ground floor in the storage area under the concrete deck may be a slab-on-grade, provided some slab settling and cracking is tolerable. This slab should float on the subgrade and should not be dowelled to pile-supported structure. The south end of the floor in this area will be most subject to settlement due to the drag effect of settlement of the outside fills. If movement of the floor is not desirable, we recommend structurally supporting the south 15 feet of the floor in this area.

For the ground floor in the main building, we recommend a structural slab supported by piles. This slab may be cast on the ground surface without a bottom form.

To provide a capillary break, we recommend placing at least four inches of free-draining fill, such as pea gravel, beneath both slabs. In areas where moisture is undesirable, a plastic vapor barrier at least ten mils thick should be placed on the gravel. An inch or two of sand may be used to protect the membrane during construction and to aid curing the concrete.

4.6 Lower Level Retaining Walls

Walls that retain earth and are free to rotate about their base should be designed for an equivalent fluid weight of 30 pounds per cubic foot. Walls restrained at the top should be designed for the above load, plus a uniform load of 100 pounds per square foot.

To assure that the design pressures on retaining walls are not exceeded due to hydrostatic pressure build-up behind the walls, perforated drainpipe should be installed at the base of the wall footings. The drainpipe inverts should be at least six inches lower than the bottom of the adjacent ground slabs. The pipes should be surrounded by at least six inches of washed rock and wrapped in filter cloth. Free-draining backfill at least twelve inches wide should be placed above the drainpipes. The remainder of the backfill may be granular soil free of excessive organics and compacted to at least 90 percent of its ASTM D-698 maximum dry density. In order to reduce the amount of surface water that reaches the drain, the final foot of the backfill should be well-tamped silty sand.

Where additional fills will be placed adjacent walls to raise existing grades the foundation drains will be subject to distortional movement or possible crushing due to settlement of the overlying fill. To avoid this condition, the drainage medium should extend below the grade beams and the drain pipe and gravel envelope installed inside the building just below the grade beam invert.

4.7 Lateral Load Resistance

Lateral loads due to soil backfill stresses, seismic or wind loads may be resisted by passive stresses on the sides of walls, wall footings and grade beams. Lateral loads may also be carried on the sides of steel pipe piles.

The passive resistance on the sides of footings and grade beams may be estimated based on an equivalent fluid weight of 350 pounds per cubic foot, provided the concrete is placed in neat excavations or the backfill against the concrete is compacted to at least 95 percent of its ASTM D-698 maximum dry density. In areas less well compacted, the equivalent fluid weight should be reduced to 200 pounds per cubic foot.

For pipe piles pinned at the top, we recommend a maximum lateral load of ten kips on 10.75-inch piles and twelve kips on 12.75-inch pipes. Larger lateral loads could be carried by piles partially fixed at their tops.

4.8 Drainage

Foundation drains, area drains, and roof gutters should empty to the local storm water system. Rain from the roof gutters and the foundation drainage should be carried in separate tightlines. In areas adjacent to buildings, final site grades should prevent water from ponding against the building.

4.9 Utilities

Where utility lines will be installed under pavement, we recommend that all bedding and backfill be placed in accordance with APWA and all applicable local and state specifications. Excavated on-site soils may not be suitable for backfill in utility trenches. Due to excessive ongoing settlements, we do not recommend installing utilities in fill areas. If utility lines must be placed within new fill zones they should be pile supported.

4.10 Pavement

Pavement may be supported on the recompacted existing fills and on properly placed new fills free of excessive organics. The upper twelve inches of the subgrade should be compacted to at least 95 percent of its ASTM D-698 maximum dry density. Below the top foot, 90-percent compaction is adequate. Regardless of the compaction achieved, all subgrade areas should be stable and non-yielding prior to paving.

We recommend a pavement section including at least two inches of asphalt surfacing over either six inches of crushed rock base or four inches of asphalt-treated base. We recommend asphalt-treated base if construction occurs during the wet winter season.

Due to the long-term compression expected of the peat, the performance of pavement supported on new fill likely will be poor, even if the fills are well compacted and the pavement is properly constructed. Maintenance and repair of the pavement should be anticipated, especially where pavement supported on new fills must match grades on the pile-supported structure.

4.11 South Access Ramp Embankment

As noted earlier the fill placed to construct the south access ramp will be subject to excessive long term settlements. This fill will extend to within four feet of the south property line. Because of this site constraint, it is proposed to face the south embankment using rockery construction.

For fills of greater than four feet we recommend reinforcing the embankment behind the rockery facing with geogrid. For this application we recommend using Tensar SR2 geogrid or equivalent. The grid should extend horizontally behind the rockery a distance equal to the height of the fill. The first geogrid layer should be installed three inches up from the base of the fill and then at two foot intervals thereafter.

The rockery facing the embankment must be constructed by an experienced rockery contractor in accordance with ARC guidelines. The lower rock coarse should be embedded a minimum of two feet below the adjacent outside grade. In addition, the rockery should be laid back as flat as possible preferably no steeper then 1H:4V (Horizontal:Vertical).

In addition to maintaining roadway grade due to settlements you should be prepared to maintain the rockery construction. Excessive rockery movements can lead to failure if left uncorrected. If the owner is not willing to accept some degree of risk for rockery failure we recommend supporting the embankment with a pile supported retaining wall.

5.0 ADDITIONAL SERVICES

In order to verify that our recommendations have been properly interpreted and implemented in the project design, we recommend that Terra Associates, Inc. be retained to review the final earthwork and foundation drawings and specifications.

To observe compliance with the design concepts, specifications and recommendations, and to allow expedient design changes in the event subsurface conditions differ from those anticipated, we also recommend that Terra Associates, Inc. be retained to provide geotechnical services during construction. These services should include:

1) observing all earthwork operations and the placement and compaction of all structural fill;

2) monitoring the installation of test piles and all production piles;

3) observing all footing and slab areas prior to forming and concrete placement; and

4) observing and testing the subgrade under pavement.

6.0 LIMITATIONS

The analyses and recommendations submitted herein are based on data from a single test boring. Subsurface conditions at locations not explored may differ from those encountered at the test boring. The nature and extent of any such variations may not become evident until construction. If variations are observed during construction, prior to proceeding with construction Terra Associates, Inc. should be requested to evaluate the observed site conditions and review the recommendations in this report.

This report has been prepared specifically for this project. It is the property of Terra Associates, Inc. and is intended for the exclusive use of North Coast Enterprises, Inc. and its representatives. We do not guarantee project performance in any respect, only that our work meets normal standards of professional care. No other warranty, expressed or implied, is provided.

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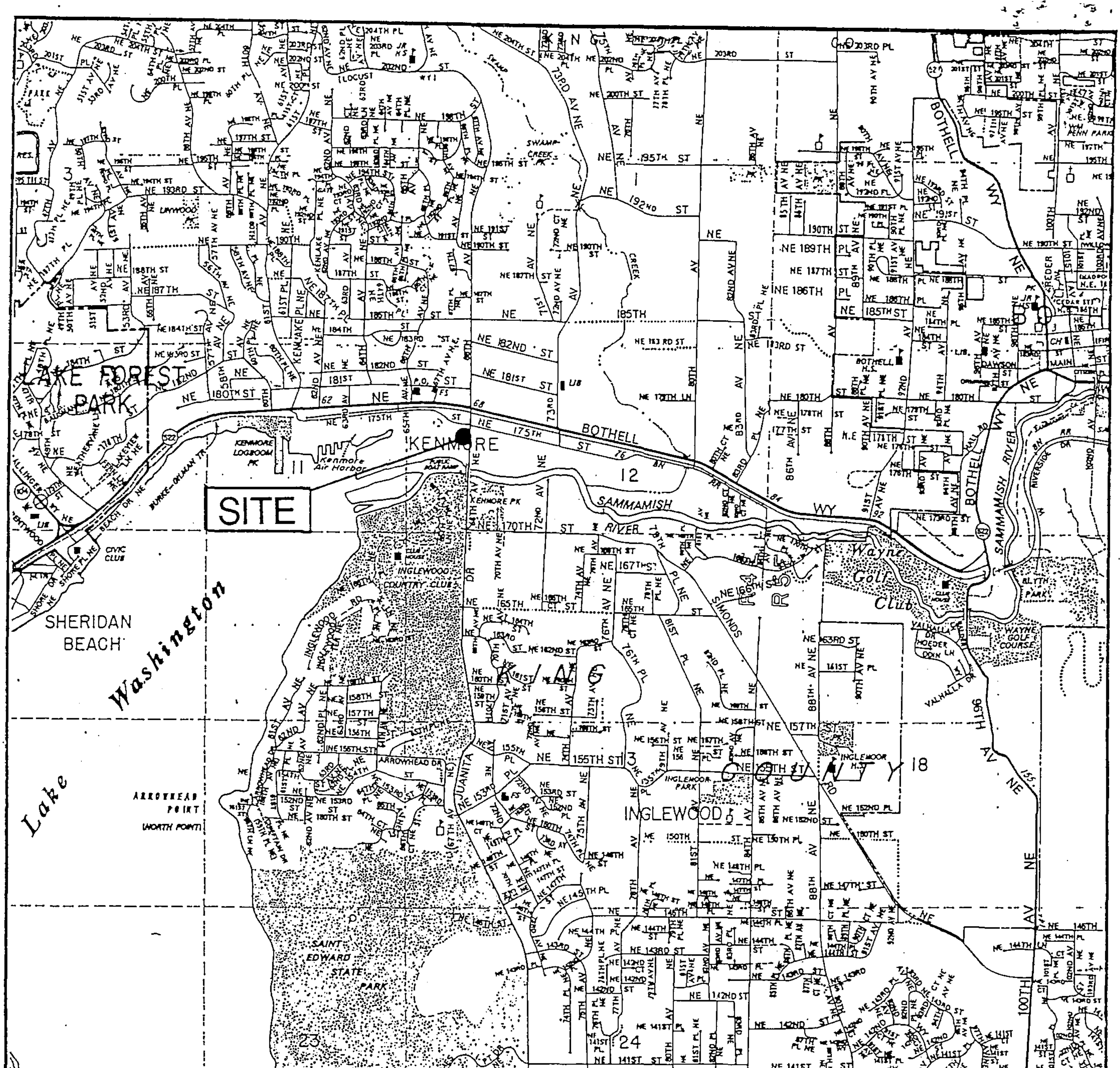
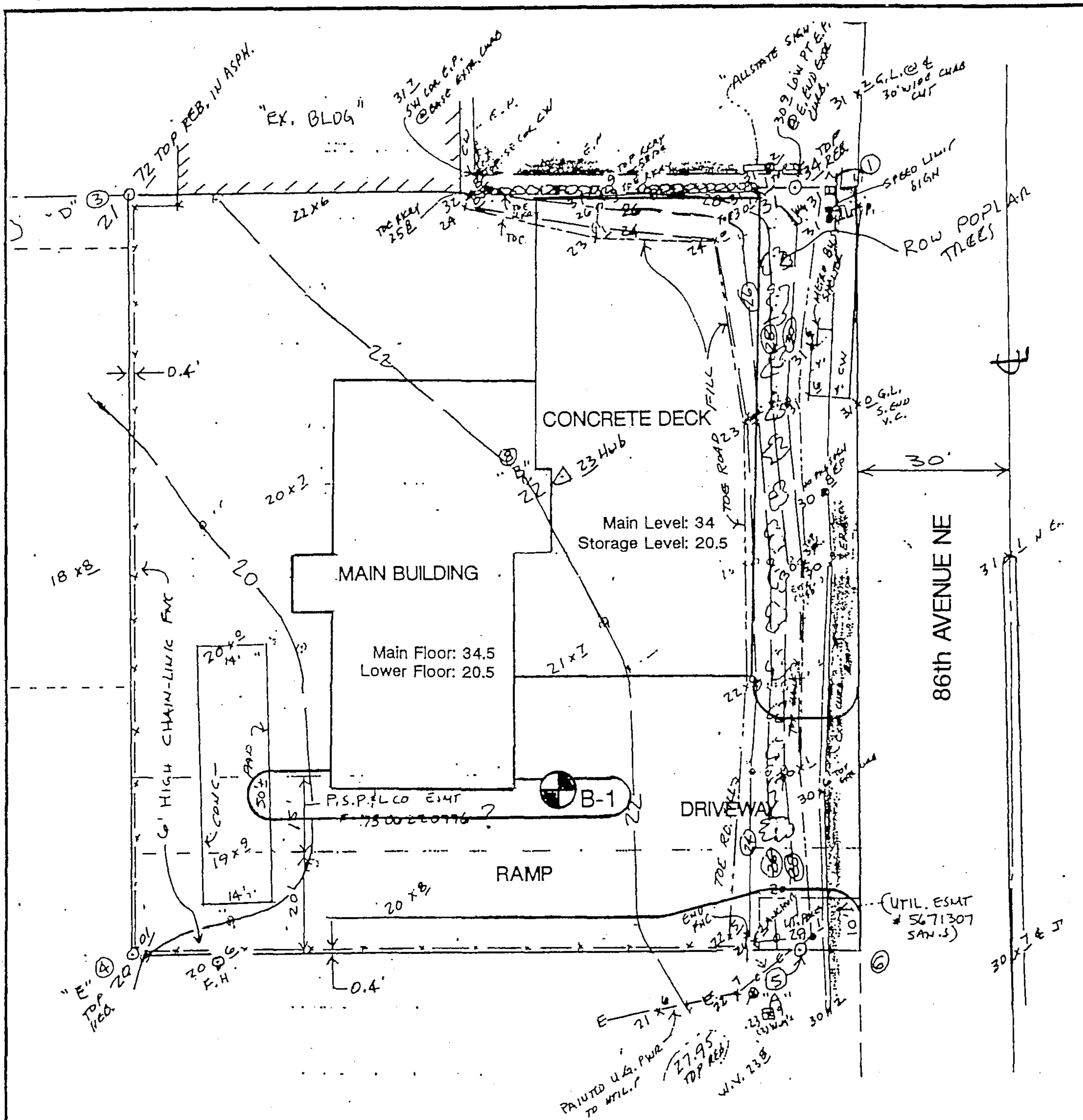


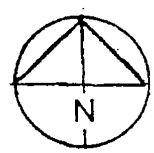
Approx Scale: 1 inch = 0.48 mile

Copied from Thomas Bros Maps, 1987

TERRA ASSOCIATES Geotechnical Consultants	VICINITY MAP NORTH COAST OFFICE BUILDING KENMORE, WASHINGTON

Proj. No. 2129	Date 11/92	Figure 1





Approx Scale: 1 in = 30 ft

References:

1. Preliminary Survey Plan provided by North Coast Enterprises, Inc
2. Site Plan by Noboru Hara, Architect

TERRA ASSOCIATES Geotechnical Consultants	BORING LOCATION PLAN NORTH COAST OFFICE BUILDING KENMORE, WASHINGTON

Proj. No. 2129	Date 11/92	Figure 2

MAJOR DIVISIONS				LETTER SYMBOL	GRAPH SYMBOL	TYPICAL DESCRIPTION
COARSE GRAINED SOILS	More than 50% material larger than No. 200 sieve size.	GRAVELS More than 50% of coarse fraction is larger than No. 4 sieve.	Clean Gravels (less than 5% fines)	GW		Well-graded gravels, gravel-sand mixtures, little or no fines.
				GP		Poorly-graded gravels, gravel-sand mixtures, little or no fines.
			Gravels with fines	GM		Silty gravels, gravel-sand-silt mixtures, non-plastic fines.
				GC		Clayey gravels, gravel-sand-clay mixtures, plastic fines.
		SANDS More than 50% of coarse fraction is smaller than No. 4 sieve.	Clean Sands (less than 5% fines)	SW		Well-graded sands, gravelly sands, little or no fines.
				SP		Poorly-graded sands or gravelly sands, little or no fines.
			Sands with fines	SM		Silty sands, sand-silt mixtures, non-plastic fines.
				SC		Clayey sands, sand-clay mixtures, plastic fines.
FINE GRAINED SOILS	More than 50% material smaller than No. 200 sieve size.	SILTS AND CLAYS Liquid limit is less than 50%		ML		Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity.
				CL		Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.
				OL		Organic silts and organic clays of low plasticity.
		SILTS AND CLAYS Liquid limit is greater than 50%		MH		Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic.
				CH		Inorganic clays of high plasticity, fat clays.
				OH		Organic clays of medium to high plasticity, organic silts.
HIGHLY ORGANIC SOILS				PT		Peat and other highly organic soils.

DEFINITION OF TERMS AND SYMBOLS

SAND or GRAVEL

Density	Standard Penetration Resistance in Blows/Foot
Very loose	0-4
Loose	4-10
Medium dense	10-30
Dense	30-50
Very dense	>50

SILT or CLAY

Density	Standard Penetration Resistance in Blows/Foot
Very soft	0-2
Soft	2-4
Medium stiff	4-8
Stiff	8-16
Very stiff	16-32
Hard	>32

I	2" OUTSIDE DIAMETER SPLIT SPOON SAMPLER
I	2.4" INSIDE DIAMETER RING SAMPLER OR SHELBY TUBE SAMPLER
P	SAMPLER PUSHED
*	SAMPLE NOT RECOVERED
▽	WATER LEVEL (DATE)
⌂	WATER OBSERVATION STANDPIPE
C	TORVANE READINGS, tsf
q_u	PENETROMETER READING, tsf
W	MOISTURE, percent of dry weight
pcf	DRY DENSITY, pounds per cubic foot
LL	LIQUID LIMIT, percent
PI	PLASTIC INDEX
N	STANDARD PENETRATION, blows per foot

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SOIL CLASSIFICATION SYSTEM
NORTH COAST OFFICE BUILDING
KENMORE, WASHINGTON

Proj. No. T-2129	Date 11/92	Figure A1

Boring No. B-1

Logged by: DBG

Dated: 7-29-92

Ground Surface Elevation +22'

Graph/ USGS	Soil Description	Consistency	Depth (ft.)	Sample	(N) Blows (ft)	Water Content (%)		
SM	Brown, silty SAND with trace gravel, moist.	Medium dense		I	16	8		
			5	I	3	13		
	7-29-92 ▼			I	23	18		
PT	Brown, organic SILT and PEAT, wet.	Soft	10	I	4	177		
			15	I	push/12" 2/6"	345		
	PEAT.		20	I	4	206		
	PEAT, wood and sand.			I	13	329		
	PEAT with thin sand layers.		25	I	6	263		
SP	heave	Loose to very dense	30	I	push/18"	19		
	Gray SAND, medium to coarse grained, saturated; with gravelly zones.		35	I	86/11"			
ML/CL	Gray, silty CLAY with thin sand layers, wet.	Stiff	40	I	33	25		
SP	Gray, gravelly SAND, medium to coarse grained, saturated.	Dense	45	I	42	16		

Boring completed at 49 feet.

TERRA ASSOCIATES
Geotechnical Consultants

Boring Log
NORTH COAST OFFICE BUILDING
KENMORE, WASHINGTON

Proj. No. T-2129 | Date 8/92 | Figure A-2

APPENDIX A

FIELD EXPLORATION AND LABORATORY TESTING

Our field exploration was performed on July 29, 1992. A single boring was drilled at the location shown on the Boring Location Plan in the body of this report. The boring was located by measuring from site features shown on the survey plan referenced on the figure. Ground surface elevations reported at the borehole was estimated by interpolating contour lines shown on the survey plan. The field exploration was continuously monitored by personnel from our firm. They classified the soil conditions encountered, maintained a log of each test boring, obtained representative soil samples and observed pertinent site features. All soil samples were visually classified in accordance with the Unified Soil Classification system described on Figure B1 in this appendix.

In each boring, standard penetration tests were performed at selected intervals by driving a split-barrel sampler with an outside diameter of 2.0 inches using a 140-pound hammer falling 30 inches. The results of these tests are the N-values reported on the boring logs.

The log of the test boring is reported on Figure B2. This log is an interpretation of the field log and reflects the results of laboratory examination and testing of samples recovered from the borehole.

Representative soil samples were taken to our laboratory for additional examination and testing. The field moisture content of each sample was measured and reported on the log.