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**Preliminary Report of Subsurface Exploration and Geotechnical Engineering Studies,
Proposed Tavis Property Development, West side of Pacific Highway South at Roughly
South 280th Street, King County, Washington** Project Number: 8030-001

This report presents the results of our preliminary subsurface exploration and geotechnical engineering studies at the referenced site. The purpose and scope of these studies was outlined in our proposal to you dated March 27, 1997. Written agreement to proceed with our studies was completed on April 28, 1997, and the fieldwork was started on May 1, 1997.

The property under consideration is located on the west side of Pacific Highway South (State Route 99) and extends westward approximately 830+/- feet, terminating at the rear of the properties fronting on the east side of 13th Avenue South. The northern edge of the property terminates at the rear of properties fronting on the south side of South 279th Street. The south property line is defined by adjacent properties fronting on South 282nd Place and 15th Avenue South. The parcel covers an area of approximately 12+ acres in size and, to varying degrees, has been previously developed. We understand that it is your desire to re-develop the property for multiple residential usage with associated street improvements. The presence of a pond-type area and areas of known fill are key considerations in the final development plan for the property. Although development plans are only conceptual at this time, it is anticipated that a moderate amount of regrading may be associated with site development, including road development and site drainage.

Subsurface Exploration Program

We explored site subsurface conditions by excavating and logging soils exposed in a series of 21 exploration pits across the site, viewing soils exposed in slopes and road cuts in the site area, and reviewing information in our files. The exploration pit locations are shown on the attached Site Sketch, Figure 1 of this report.

The exploration pits were excavated using a rubber-tired backhoe and extended to a maximum depth of 21 feet. Soils exposed in the exploration pits were examined and logged by an engineering geologist subcontracted to this office. The exposed soils were examined and the difficulty of excavation evaluated as an indication of the relative soil density. The soil strata encountered are shown on the attached Exploration Pit Logs, Figures 3 through 9. The soil strata shown on the logs were observed at spot locations across the site. Actual subsoil conditions may vary between pits and/or as exposed in excavations.

At the time of our site work no topographic map of the property was available. Slope angles, heights and distance measurements used in this report were established using hand held equipment, ie, tape measure, Brunton compass, inclinometer, and optical range finder, and should be considered approximations. Figures 1 and 2 were developed based on hand held equipment and limited data and should be considered as being an approximate representation of the site and indicated features.

Site and Subsurface Conditions

From the guard rail along Pacific Highway South the property drops fairly steeply (roughly 2H to 1V) downward for a distance of about twenty to forty feet, at which point, on the south two-thirds of the property, the slope flattens to gradients of moderate steepness which continue to flatten to the west for a total distance of about two to three hundred feet. In the northern third of the site adjacent to Pacific Highway South, a portion of the property has been filled with soil and concrete and asphalt rubble to develop driveway access into the property. This fill is variably sloped for a distance of about 150 to 180 feet from the highway, at which point, the face of the fill takes on a steep slope downward to the west. From the toe of the west facing slopes, down from the highway, to the west property line the ground surface is fairly flat to slightly rolling.

As shown on Figure 1, a pond-like feature occupies the north central portion of the property. From our field observations, it is suspected that the size of the pond fluctuates greatly both seasonally and during periods wetter and dryer weather. These observations tend to support information from you that this feature was excavated and reportedly vanishes or is greatly reduced in size later in the normally dry season. The boundaries shown on Figure 1 are as estimated at the time of our fieldwork.

To the south of the "pond" area and extending to the south property line is a nearly level, extensively filled area. The fill in this area appears to be on the order of six to seven feet thick and comprised of a variable mixture of soil; concrete, brick and asphalt rubble; wood; logs and miscellaneous debris.

Vegetation on the east and west thirds of the property consists, for the most part, of an openly wooded, mixed age "forest" of evergreen and deciduous trees over an open to dense, mixed understory of brush, small trees, vines and weeds. The central third of the site, south of the "pond", is covered with grass and weeds, with a dense growth of berry vines along the east side of the fill and "pond".

Materials of both pre- and post-glacial age were identified on the property, their general locations are shown on Figure 2. All soil contacts shown on Figure 2 should be considered as approximate or estimated and subject to modification during additional field exploration or grading observation.

Ignoring the defined areas of fill, in general terms, it appears that the northeast portion of the property is underlain by recessional outwash (primarily sand and gravelly sand) while the southeast portion of the site, adjacent to the highway, is underlain by glacial till, an ice deposited, generally dense mixture of silt, sand and gravel. West and down slope of the area underlain by glacial till is what appears to be advance outwash, a pre-glacial mixture of sand and gravel having a variable silt content. Extending north-south through the central portion of the site is a large deposit of interbedded sand, gravel, and sand and gravel which appears to occupy an outwash channel. This material also forms the berm shown on Figures 1 and 2 and is suspected to be a combination of both advance and recessional outwash, with the recessional materials deposited in a channel carved into the advance materials. Under a two to five foot thick mantle of possible weathered fill and recessional outwash, the western third of the property appears to be underlain by glacial till interbedded with glacial drift-like materials. Glacial drift can be of similar composition to glacial till, which in this case it is, deposited in association with the glacier but not necessarily by glacial ice.

For purposes of future site grading, it should be noted that in both the advance and recessional outwash there scattered large cobbles and very large boulders.

On a gross scale it is our opinion that the site soils are generally similar that indicated on geologic and Soil Conservation Service (SCS) maps of the area. The geologic maps "Geology of the Poverty Bay Quadrangle, Washington" (USGS, 1961) and "Geology and Ground Water Resources of Southwestern King County, Washington" (Water Supply Bulletin No. 28, Washington State Department of Water Resources, 1969) indicate that glacial till is the primary material underlying the site with the "pond" and fill area in the south center of the site possibly being an extension of glaciolacustrine deposits (materials deposited in glacial lakes) which, on the maps, have an approximate contact indicated near the study site's south property line. Soil Conservation Service maps ("Soil Survey, King County Area, Washington", 1973) indicate that the major portion of the site is underlain by Alderwood type soils, which have a glacial till parent material, with soils in the "pond" area and along the pond outlet ditch, west of the "pond", identified as soils of the Norma series. The SCS indicates that Norma-type soils develop in alluvium and are generally found in basins on glaciated uplands and stream bottoms.

It is our opinion that differences between the reference maps and our field observations is more a result of mapping scale and not inconsistencies in mapping or site specific work.

No ground water was observed in the exploration pits adjacent to the highway or in pits 15 and 19. Across the rest of the property ground water was found generally between a depth of about 2.5 and 7 feet. A water well is located about 200 feet north of pit 6. This well has a diameter of approximately four feet and an apparent depth of 31 feet. The 12 foot depth to ground water at pit 6 appears similar to the measured 16 foot depth to water level in the well.

CONCLUSIONS AND PRELIMINARY RECOMMENDATIONS

General

Based on the results of our subsurface exploration program and review of associated materials, it is our opinion that, from a geotechnical view, the property is generally suitable for the type of development proposed. The existence of the large fills in the northeast and south central portions of the site and the presence of the "pond" and associated wet and occasionally organic laden soils, and apparent elevated ground water levels (although perhaps seasonally elevated) complicates the development considerations from a foundation support, earthwork and site drainage perspective. The response of the existing fill and loose/soft soils to loadings imposed by placement of any additional fill and building foundations must be considered. As site development and building design plans become more defined, we anticipate that it may be beneficial to more

closely explore the subsurface conditions in the fill areas and in areas adjacent to and south of the "pond". If such additional explorations are timed for the normally dry season they could be particularly useful in evaluation of foundation construction options in the areas of softer soil and in those areas presently showing elevated ground water levels.

We caution that, although not strictly a geotechnical consideration, an additional consideration for site grading is the presence of AT&T and U S West fiber-optic telephone cables laid parallel with Pacific Highway South between our exploration pits 1 through 5 and the highway. Care should be taken to assure that site work does not destabilize up slope areas that could damage the fiber-optic cable or highway.

Additional considerations for site development design are what appear to be small, vegetation covered piles of soil, trees or debris in the southwestern portion of the site, vegetation in this area may cover undesirable materials. Consideration will also be required in the "pond" area with regard to the water source and disposal, and, if the "pond" is to be maintained as part of the development, control of potential water level fluctuations.

With regard to the existing water well on the property, if this well is to be abandoned it should be backfilled and sealed in full accordance with Washington State Department of Ecology standards and regulations and the abandonment reported to the Department of Ecology.

Our studies did not include the testing for possible methane gas generation from the existing site fills. If structures are built over the existing fill areas, without removing the existing fill, as a safety consideration, we recommend that provisions be made to assure that all crawl spaces and enclosed areas are well ventilated to prevent the possible build-up of methane gas.

The following preliminary recommendations are provided to aid in addressing preliminary design considerations for the development of the site and should be incorporated into the site planning, design and construction considerations.

Site Preparation and Grading

Water Related Concerns

Only minor storm water related problems are anticipated if site grading and preparation are undertaken during the normally drier portions of the year. If site work is undertaken during wet

weather the near surface sands and silty soils may become over-saturated and temporarily unworkable. If the site work is undertaken during wet weather, the contractor should be fully prepared to deal with soil and water problems normally encountered in these materials during wet weather work including the filtering of runoff, as needed, to prevent the siltation of down slope areas. Additionally, we recommend that the contractor be fully prepared to deal with potentially large amounts of runoff from the roadway and parking areas until these areas are paved and the storm drains are operational. It should be anticipated that silt fences and other erosion control devices could be used to control sediment transport from leaving the site.

A significant water source is a storm drain pipe that discharges onto the slope from under Pacific Highway South. This pipe is located in the vicinity of pit 4. A small gully has formed from the uncontrolled discharge from this pipe.

Depending upon the final site grades and weather conditions it is possible that springs or seeps may develop in some areas and in excavations, particularly on the western two-thirds of the site. In that we are unable to predict where or when this might occur we recommend that any development of springs or seeps be treated as a construction/maintenance problem and addressed at that time. Due to the initially apparent randomness of ground water depths, for planning purposes it should be anticipated that ground water may be encountered in any excavations made for foundations, basements, utility trenches or other similar subsurface excavations. Additionally, water seepage can cause failure of the excavation walls and the contractor should be observant for possible cave-in or other hazardous conditions and provide shoring for all cuts and excavations in accordance with local, state, and federal regulations. All contractors working on the project should be advised of the potential for and be prepared to deal with any water related problems during construction.

To preclude the possible build-up of ground water or storm runoff in the soils adjacent to the structures, it is recommended that a four inch diameter perforated, rigid pipe be placed, perforations down, around the outside of the building foundations at or below the footing subgrade elevation. All of the drainage system should be bedded in a drainage sand and gravel and designed to carry any accumulated water away from the structure to the storm drainage system or other appropriate discharge area. Roof drainage should not be connected to the footing or other subsurface water drains.

All runoff from roofs, driveways, paved areas and other hard surfaced areas should be intercepted, collected and disposed of away from structures and site slopes, and discharged where the water will not effect down slope structures, walls or properties. Additional location specific recommendations may be required to address special considerations if the "pond" area is to be drained and maintained in a "dry" condition.

Preliminary Development Recommendations

Generally under all buildings, pavements and fill areas, it is recommended that all sod, organic soil, existing fill and debris be removed. However, we understand that due to apparent fill thicknesses this may not be practical in all areas and alternative design considerations may be needed depending on the final development plan. Over most of the site it is anticipated that stripping depths of six inches to a foot will be generally adequate to remove topsoil and similar materials. Grubbing to depths of three to four feet may be required to remove larger root balls. If the existing fill in the south central portion of the site is to be removed, stripping to depths on the order of six to eight feet should be expected to remove the fill with an additional one to two feet of depth anticipated to remove any possible underlying topsoil or organic laden layers.

Stripped soils, contaminated with organics or debris, should be wasted off site or used in landscape areas. Stripped granular soils free of organics and debris, or other deleterious materials, may be used as structural fill subject to the following considerations.

Following stripping of the site, and prior to the placement of any fill, the exposed subgrade should be proof rolled and compacted using a vibratory roller developing a dynamic rating of at least 25,000 pounds. Compaction of the stripped subgrade should be continued until field density tests show that a minimum compaction of 95% of the maximum dry density, as determined by ASTM method D-1557, has been achieved in all building, driveway, and parking areas. Any soft or weaving areas disclosed during proof rolling should be excavated and replaced with compacted structural fill. Areas which are to be filled to bring the building or pavement grades up to the desired elevation should be filled with compacted granular material free from roots, trash or other deleterious materials. It is anticipated that site fill materials may be a mix of native and imported materials. During wet weather the siltier portion of the on site soils are not expected to be suitable for use as fill. These soils are sufficiently fined grained, such that with the addition of small quantities of water they become overly saturated and are difficult or impossible to compact to the desired density. As a result, we recommend that all site grading and preparation be undertaken

and completed during dry weather. If grading in building or pavement areas is necessary during wet weather, we recommend that all excavated soil be removed from the site and that materials used as structural fill (fill placed on slopes or under buildings or pavements) consist of free draining sand and gravel with not more than 5.0% fines, material passing a U.S. No. 200 sieve. (Note: As the site soils are better exposed for observation and evaluation during grading, it may be possible that some of the native sands and gravels containing variable amounts of silt can be modified for usage with approval of the geotechnical engineer.) All imported fill material should conform to the above recommendation regardless of the weather.

In areas of fill placement, fill slopes should not be steeper than 2H to 1V for fill placed in accordance with the requirements of appendix chapter 33 of the Uniform Building Code (1994). For uncontrolled fills of moderate quality material slopes should be flatter than 3 or 4H to 1V. In areas where steeper slopes are required retaining structures or soil reinforcement should be provided. In areas where fills are to be made on slopes steeper than 5H to 1V the subgrade should be benched and prepared in accordance with UBC (1994) requirements prior to fill placement. Benches should be cut at a maximum vertical height of two feet.

All structural fill should be placed in layers approximately 8 inches in loose thickness, conditioned to a moisture content suitable for compaction, and compacted to 95% of the maximum dry density as determined by ASTM D-1557. Field density tests should be made at a frequency adequate to assure that the required compaction is achieved.

A special case for fill is the concrete and asphalt rubble in the northeastern portion of the property. This material currently underlies an access roadway. If this material is re-distributed in the current general area as an embankment fill for an entrance roadway and is compacted to a generally void free configuration with a large vibratory roller, is expected to provide a suitable embankment material to support a roadway alignment. A surfacing layer of a debris free pit-run sand and gravel should be placed between the compacted rubble fill and the pavement section. This pit-run layer should be sufficiently thick to contain any utilities that extend through this area.

Preliminary Foundation Design

The proposed structures may be supported on spread footings bearing on the medium dense to dense native sandy soils or on properly placed and compacted structural fill bearing on the medium dense to dense native soils. Due to the loose condition and large amount of debris, the

existing fill material is considered unsuitable and will not provide adequate foundation support for structures where normally anticipated settlements of an inch or less are required.

All foundations should be designed in accordance with Uniform Building Code requirements, as modified by local codes and regulations, in effect at the time of construction, for structures within seismic zone 3 as defined by the Uniform Building Code (1994) or the UBC seismic zone in effect at the time of construction.

Spread footing foundations should have a minimum embedment of 18 inches below the lowest adjacent finished grade except where the footings are on or adjacent to a downward slope. Where foundations are constructed on or adjacent to slopes the foundations should be designed to bear a minimum of five feet horizontally back of the soil face of the slope and have a minimum vertical embedment of three feet below the finished soil grade. Continuous footings for multi-family structures should have a minimum width of no less than 18 inches and isolated footing should have a minimum width of no less than 24 inches regardless of the resulting bearing pressure. For single-family structures continuous footings should have a minimum width of no less than 16 inches and isolated footing should have a minimum width of no less than 20 inches regardless of the resulting bearing pressure.

It is recommended that all foundation excavations be inspected, prior to placing concrete, to verify that the bearing surface has been properly cleaned and prepared. Bearing surfaces should be firm and free of disturbed, sloughed or water-softened soil prior to concrete placement. We recommend that, following excavation of the foundation areas to the subgrade elevation, the exposed subgrade be recompacted to assure a firm bearing surface without pockets of loose material. For spread footing foundations designed and constructed as outlined above the following allowable soil bearing pressures may be used.

<u>Material</u>	<u>Allowable Soil Bearing Pressure, psf</u>
Existing fill	Unsuitable without extensive clean up and compaction
Loose, sandy soils-present condition	500
Loose, sandy soils-after preparation as outlined above	2000
Structural fill placed and compacted as outlined above	2000

Medium dense to dense in situ native sandy soil	2000
Dense to very dense glacial till or sandy soil	4000

We estimate that total settlement for foundations designed and constructed as outlined above and bearing on the medium dense to very dense in situ native soil or structural fill placed as previously recommended will be an inch or less, with differential settlement between similarly loaded foundations potentially approaching the total settlement. It is anticipated that most settlements in these mineral soils will occur as the foundations are loaded. Failure to properly place structural fill or prepare the subgrade areas may increase settlement resulting from loading and/or shaking resulting from an earthquake.

Drainage Considerations

With the variable depth to ground water, crawl spaces may experience wet conditions in the lower elevation areas unless attention is paid to drainage and excavation elevations. The attached Subdrain and Backfill Schemes are included to provide guidance for establishing drainage around residential structures. Overall site drainage must be maintained such that the subsurface drains around the structures have a gradient to drain accumulated waters.

Slabs-on-Grade

Slab-on-grade floors, may be supported on the medium dense to dense in situ native soils, or on properly placed and compacted structural fill bearing on these materials. Slab-on-grade floors cast on the existing fill without designed structural support may be subject to settlement damage. A capillary break/drainage layer consisting of four inches of pea gravel, or clean crushed rock should be placed below the floor slab. The capillary break material should contain less than 1.0% material passing a U.S. No. 200 sieve and less than 4.0% material passing a U.S. No. 10 sieve. A vapor barrier should be placed between the capillary break and the floor slab. If a sand cushion is placed between the capillary break material or vapor barrier and the slab, it should not contain free moisture when the slab is constructed. Excess moisture in the cushion could cause impervious floor coverings to bubble.

Preliminary Pavement Design

The following pavement designs are based on the completion of all site preparation and grading as previously recommended. Depending on the final site development plan and associated site grades additional specific recommendations, beyond those presented below, may be required in

the areas of existing fill. Following smoothing of the surface for drainage and proof rolling, the on site sands should provide a desirable sub-base for supporting the recommended base course and surface course layers. In the fill area at the northeast corner of the property, the near surface fill appears to have been fairly well compacted, however, due to variability of the fill material, we recommend that if the fill is not substantially altered, a sub-base course of six inches of compacted Class A gravel base or clean pit run sand and gravel be placed on the prepared subgrade in the fill areas prior to construction of the following tabulated pavement sections to provide similar pavement structural support to that provided by the denser native sands. Similarly, in the fill area south of the "pond" we recommend that a sub-base course of twelve inches of compacted Class A gravel base or clean pit run sand and gravel be placed on the prepared subgrade prior to construction of the recommended pavement section. Some settlement, with time, of the surface of the fill area should be expected, particularly south of the "pond". This will change the drainage characteristics of the paved area, but will have little affect on specific wheel load related performance.

<u>Use Area</u>	<u>Pavement Section</u>	
	<u>Crushed Base Course</u>	<u>Asphalt</u>
Auto parking, light use driveways	4"	2"
Access subject to several times daily truck or bus traffic or other heavy or repeated loads	5"	3"

The gravel base and crushed base course materials should conform to WSDOT Standard Specifications and be compacted to at least 95% of the maximum dry density as determined by ASTM standard method D-1557. The asphaltic concrete should conform to WSDOT Class B requirements.

NOTE: The above pavement recommendation is not intended for nor should it be expected to support construction traffic without apparent or future distress.

Construction Considerations

Due to ground water flows and potential caving conditions we recommend that as a preliminary guideline for temporary cuts, temporary slopes be made no steeper than 2H to 1V in the loose to medium dense, sandy site soils or filled areas (new or existing). Temporary cuts made in the

dense to very dense glacial till or sands and gravels free from any water flow may be made at 1.5 or 1H to 1V. Temporary slopes or excavations should be benched as required by safety regulations in effect at the time of construction. These temporary slope recommendations are for native soils and engineered fill materials. It should be anticipated that flatter slopes and/or shoring may be required in wet weather or if ground water seepage is encountered or if soil conditions other than those previously described are encountered. The contractor should be aware that slope height, slope inclination, and excavation depths (including utility trench excavations) should in no case exceed those specified in local, state, or federal safety regulations; e.g., OSHA Health and Safety Standards for Excavations, 29 CFR Part 1926, or successor regulations. Such regulations are strictly enforced and, if not followed, the owner, the contractor, or the earthwork or utility subcontractors could be liable for substantial penalties. The contractor should be made responsible for the stability of all excavations and slopes during construction because he is continually on site and can observe the stability of the exposed soils. In addition, the contractor should be prepared to shore any unstable slope area and provide shoring as required by local, state, or federal laws or codes.

In no case should excavated soils be placed on the slope or stockpiled within one half the slope height of the top of any existing or excavated slope, trench, rock wall or retaining structure. Failure to comply with these guidelines may lead to destabilization of the slope.

The site soils may be easily eroded by channelized water or sheet flow storm runoff. Therefore, it is recommended that all site preparation and excavation work be completed during the normally drier portion of the year. During periods of heavy rainfall, ditching should be used to divert water away from stripped areas and visqueen should be used to cover the slopes and soil stock piles to aid in preventing excessive surface erosion. This covering also aids in preventing infiltration of water into the unprotected soils. All disturbed soil areas and slopes should be replanted with fast-growing, deep-rooted grass, shrubs and other ground cover as soon after final grading as possible. If the vegetation is not fully established prior to the onset of wet weather, the slopes should be covered with visqueen to aid in preventing excessive erosion and water infiltration.

It should be anticipated that there could be a number of additional site development or construction problems, particularly, if the earthwork has not been completed and the site properly protected at the onset of wet weather. It is recommended that the architect, structural engineer or

their representative make periodic inspections of all excavations and slopes to provide early recognition and recommendations to correct potential construction problems.

REPORT LIMITATIONS

This report has been prepared for the exclusive use of the Granville Southern Corporation and their agents for use in planning of the referenced development. The conclusions and recommendations in this report are based on our interpretation of site conditions as they presently exist, anticipated future construction activities, and the expectation that the exploratory efforts adequately define the subsurface conditions throughout the building site. The soil conditions described in this report and the conclusions and recommendations contained in this report are provided for this specific site only and should not be expanded for use on adjacent properties without additional exploration and review of those sites by our firm. The data and report should be provided to prospective contractors for their bidding or estimating purposes, but the report conclusions and interpretations should not be construed as a warranty of the subsurface conditions. There are possible variations in subsurface conditions. In the event that the scope or location of the project should change or subsurface conditions different from those encountered during this study be observed or suspected, we should be advised. At that time a review of the changed conditions will be made, and alternative or remedial recommendations given as required.

NOTE: Although we have explored subsurface conditions as part of this study, we have not conducted analytical laboratory testing of any samples obtained, have not evaluated the site for the potential presence of contaminated soil, and have not evaluated or addressed ground water conditions or concerns except as noted in this report. The evaluation of possible environmental or geo-environmental considerations is beyond the scope of this report.

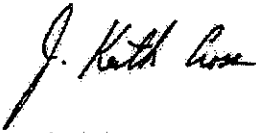
The owner and the contractor should make themselves aware of and become familiar with applicable local, state, and federal safety regulations, including current OSHA excavation and trench safety standards. Construction site safety generally is the sole responsibility of the contractor. The contractor shall also be solely responsible for the means, method, techniques, sequences, and operations of construction operations. The firm, J. Keith Cross, P.E., Geotechnical Engineering Consultant (including consultants) is providing the preceding information and recommendations solely as a service to the Granville Southern Corporation. Under no circumstances should the provision of this information or recommendations be construed to mean that the firm J. Keith Cross, P.E., Geotechnical Engineering Consultant (including consultants) is

assuming responsibility for construction site safety or the contractor's activities; such responsibility is not implied and should not be inferred.

Within the limitations of scope, schedule, and budget for this work, it is warranted that the work has been done in accordance with generally accepted practices followed in this area at the time this report was made. No other warranty, expressed or implied is made.

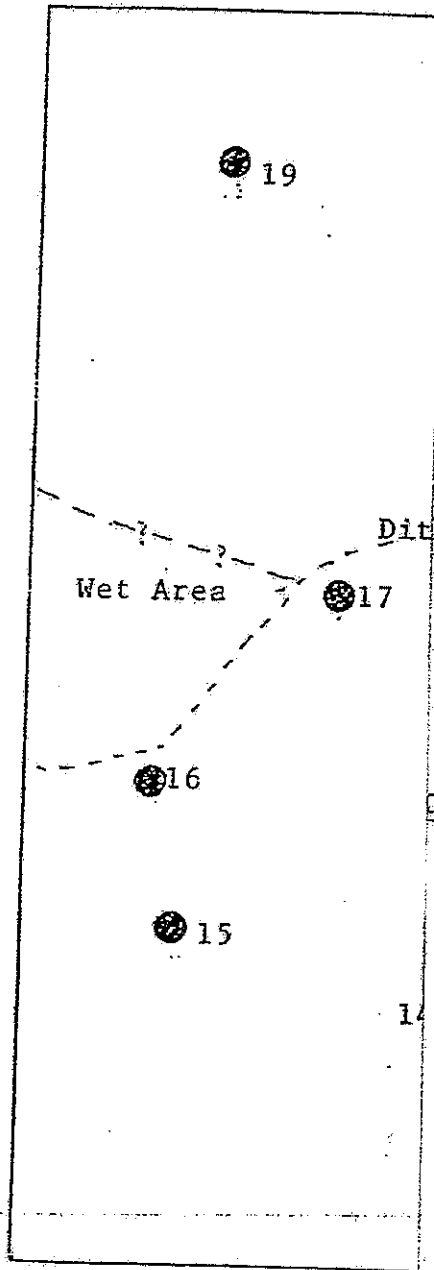
Should you have any questions or concerns which have not been addressed, or if we may be of additional assistance, please call.

Yours very truly,



J. Keith Cross, P.E.



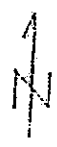
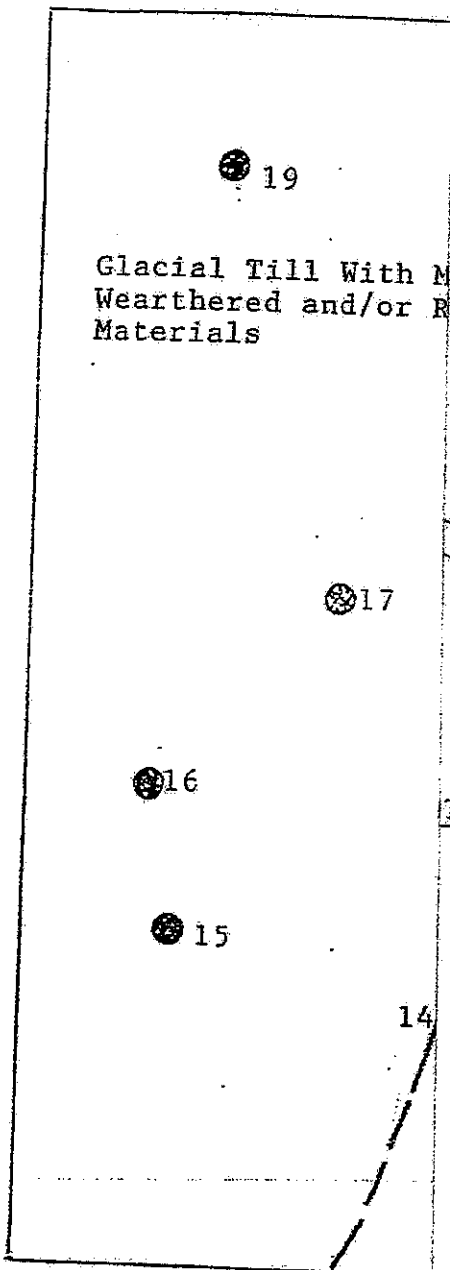


Approximate Scale 1"=100'

Feature boundary
Exploration pit number and approximate location

NOTE: All contacts and boundaries should be considered approximate or estimated.

SITE SKETCH FIGURE 1



Approximate Scale 1"=100'

- Geologic contact
- Feature boundary
- Exploration pit number and approximate location

NOTE: All contacts and boundaries should be considered approximate or estimated.

ETCH-GENERALIZED SITE GEOLOGY

FIGURE 2

EXPLORATION PIT LOGS

EXPLORATION PIT 1

Soil

<u>Depth-Feet</u>	
0.0 - 7.5	Dark brown to brown, loose, silty, gravelly SAND mixed with concrete and asphalt rubble to 18 inches, moist to very moist. (Fill)
7.5 - 8.0	Black to dark brown, loose, silty SAND, very moist. (Discontinuous across pit, possible old topsoil and/or fill.)
8.0 - 15.0	Gray-brown grading to tan, loose to medium dense, gravelly SAND with some silt to silty, very moist to wet.
15.0 - 18.0	Tan to rusty tan, medium dense to dense, silty, gravelly SAND, wet becoming very moist to moist.
7.5 - 11.0	Gray, dense, SAND, with occasional gravel, very moist to wet.

-No ground water observed.

EXPLORATION PIT 2

Soil

<u>Depth-Feet</u>	
0.0 - 0.5	SOD
0.5 - 6.0	Tan to gray-brown, loose to medium dense rapidly becoming dense to very dense with depth, gravelly SAND with trace to some silt, moist to very moist.
6.0 - 15.0	Gray-brown, dense to very dense, gravelly SAND with small cobbles to SAND and GRAVEL with small cobbles, scattered small boulders and trace to some silt, very moist.

-No ground water observed.

-Terminated at effective refusal, 15.0 feet.

EXPLORATION PIT 3

Soil

<u>Depth-Feet</u>	
0.0 - 0.8/1.0	FOREST DUFF and TOPSOIL.
0.8/1.0- 21.0	Tan grading to gray-brown, loose to medium dense rapidly becoming dense to very dense with depth, gravelly SAND with cobbles and scattered boulders, trace to some silt, moist.

-No ground water observed.

-Depth measured from upper end of pit.

FIGURE 3

EXPLORATION PIT 4

Soil

<u>Depth-Feet</u>			
0.0	-	0.5	FOREST DUFF and TOPSOIL.
0.5	-	1.5	Brown, loose to medium dense, silty, gravelly SAND, moist to very moist. (Possible weathered glacial till?)
1.5	-	3.5	Gray-brown, medium dense, silty, gravelly SAND, moist to very moist. (Possible weathered glacial till?)
3.5	-	17.0	Tan to gray-brown, dense to very dense, gravelly SAND with cobbles, trace to some silt, moist to very moist.

-No ground water observed.
-Depth measured from lower end of pit.

EXPLORATION PIT 5

Soil

<u>Depth-Feet</u>			
0.0	-	0.8/1.0	SOD, FOREST DUFF, TOPSOIL.
0.8/1.0-		3.0	Brown to gray-brown, loose to medium dense, silty, gravelly SAND, moist. (Weathered glacial fill)
3.0	-	11.0	Gray-brown to gray, dense to very dense, silty, gravelly SAND, moist. (Glacial till)
11.0	-	15.0	Gray with some iron staining, dense to very dense, gravelly SAND with varying silt, moist.

-No ground water observed.
-Depth measured from upper end of pit.

EXPLORATION PIT 6

Soil

<u>Depth-Feet</u>			
0.0	-	1.0	SOD, FOREST DUFF, TOPSOIL.
1.0	-	3.5	Brown grading to gray-brown, loose, silty SAND with gravel, moist.
3.5	-	19.0	Tan to rusty, dense to very dense, gravelly SAND with trace to some silt, scattered cobbles and boulders (including one, very large granitic boulder unmovable with the backhoe), moist to wet.

-Moderate ground water flow below 12.0 feet.

FIGURE 4

<u>Depth-Feet</u>		<u>EXPLORATION PIT 7</u> <u>Soil</u>
0.0	- 0.3	SOD
0.3	- 2.5	Tan to gray-brown, very loose to loose, silty SAND varying gravel, very moist to wet. (Fill)
2.5	- 6.0	Gray, very loose to loose, silty SAND with concrete rubble, brick, wood, logs and small, scattered pockets of unidentified, white, sugary to gritty material, wet. (Fill)
6.0	- 7.0	Black to dark brown, soft, organic SILT, wet.
7.0	- 14.0	Tan to gray-brown mottled, soft to medium stiff/loose to medium dense, interbedded SILT and fine SAND, wet grading to very moist.
14.0	- 16.0	Gray-brown to gray, medium dense to dense, gravelly SAND with trace to some silt, wet.

-Heavy ground water flow at 7.0 feet.
 -Moderate caving from surface.

<u>Depth-Feet</u>		<u>EXPLORATION PIT 8</u> <u>Soil</u>
0.0	- 0.2	SOD
0.2	- 2.5	Tan to gray-brown, very loose to loose, silty SAND varying gravel, very moist to wet. (Fill)
2.5	- 7.0	Gray, loose, silty SAND with clay pipe, concrete rubble, old rug, chair frame, duff and topsoil-like materials, very moist to wet. (Fill)
7.0	- 8.0	Dark brown, soft, organic SILT with roots, wet.
8.0	- 16.0	Gray, loose to medium dense, silty SAND grading to gravelly SAND, wet.

-Heavy water flow below 7.0 feet.
 -Moderate odor of decomposing organics.
 -Moderate caving from surface.

FIGURE 5

EXPLORATION PIT 9

<u>Depth-Feet</u>	<u>Soil</u>
0.0 - 0.2	SOD
0.2 - 6.0	Gray-brown to brown, loose, silty SAND with varying gravel, and scattered small limbs with duff and topsoil-like materials mixed in lower portion, very moist to wet. (Fill with possible native materials mixed in lower foot to 18 inches.)
6.0 - 11.0	Gray, loose to medium dense, SAND to SAND and GRAVEL, wet.
11.0 - 13.0	Gray, medium dense, SAND interbedded with silt, clayey silt and silty sand, wet.

- Heavy water flow below 5.5 feet.
- Minor caving below 2.0 feet.
- Slight odor of decomposing organics.

EXPLORATION PIT 10

<u>Depth-Feet</u>	<u>Soil</u>
0.0 - 2.0	SOD and black, soft, silty TOPSOIL, very moist to wet.
2.0 - 3.5	Tan and rust mottled, loose, silty SAND, wet.
3.5 - 7.5	Gray-brown to gray, medium dense to dense, gravelly SAND to SAND with some gravel and varying silt, with occasional very large boulders, wet.

- Heavy water flow below 2.0 feet.
- Excavation terminated on very large boulder, unmovable with backhoe.

EXPLORATION PIT 11

<u>Depth-Feet</u>	<u>Soil</u>
0.0 - 1.0	SOD and black, soft, silty TOPSOIL, very moist to wet.
1.0 - 3.0	Gray to tan and rust mottled, loose/medium stiff, silty SAND to SILT and SAND, very moist.
3.0 - 11.0	Gray, medium dense to dense, gravelly, silty SAND, coarser and less silt with depth, wet.

- Light to moderate seepage below 3.0 feet.

FIGURE 6

EXPLORATION PIT 12

<u>Depth-Feet</u>	<u>Soil</u>
0.0 - 1.0	CONCRETE rubble on surface. (Fill)
1.0 - 5.0	Dark brown to gray, loose, silty, gravelly SAND mixed with concrete and asphalt debris, and brick, voids in layer, moist to very moist. (Fill)
5.0 - 6.5	Dark brown, soft, silty TOPSOIL, very moist.
6.5 - 9.0	Tan to gray-brown, loose becoming dense, gravelly SAND with trace to some silt, moist.
9.0 - 11.0	Gray, dense, silty, gravelly SAND, moist. (Glacial till)
11.0 - 17.0	Tan, dense to very dense, gravelly SAND to SAND and GRAVEL, very moist with wet zones.

-Light seepage at 9.0 feet.

-Measured from uphill side of pit, approximately five to six feet above adjacent ground.

EXPLORATION PIT 13

<u>Depth-Feet</u>	<u>Soil</u>
0.0 - 1.0	FOREST DUFF and TOPSOIL
1.0 - 3.0	Brown, loose silty SAND with varying gravel, moist.
3.0 - 5.8	Gray-brown with minor tan mottling, loose to medium dense, silty, gravelly SAND, moist. (Weathered glacial till)
5.8 - 7.0	Brown to gray-brown, medium dense to dense, silty, gravelly SAND, moist. (Glacial till)
7.0 - 12.0	Gray-brown to rusty brown, dense to very dense, gravelly SAND to SAND and GRAVEL, trace to some silt, moist.

-No ground water observed.

EXPLORATION PIT 14

<u>Depth-Feet</u>	<u>Soil</u>
0.0 - 0.5	SOD and TOPSOIL
0.5 - 2.5	Brown, loose, silty SAND with trace gravel, very moist.
2.5 - 5.0	Tan to gray, medium dense to dense, GRAVEL and SAND, wet.
5.0 - 11.0	Gray, dense to very dense, silty, gravelly SAND interbedded with gravelly SAND with some silt to silty, very moist to wet. (Glacial till interbedded with glacial drift materials.)
11.0 - 13.0	Gray, very dense, gravelly SAND with some silt to silty, wet.

-Light to moderate water flow between 2.5 and 5.0 feet.

FIGURE 7

Report to Grandville Southern Corporation
Project No. 8030-001
May 31, 1997

<u>Depth-Feet</u>	<u>EXPLORATION PIT 15</u> <u>Soil</u>
0.0 - 0.4	SOD and TOPSOIL
0.4 - 2.5	Brown, loose, silty SAND with trace gravel, very moist.
2.5 - 10.0	Gray, dense to very dense, silty, gravelly SAND interbedded with gravelly SAND with some silt to silty, very moist to wet. (Glacial till interbedded with glacial drift materials.)

-No ground water observed.

<u>Depth-Feet</u>	<u>EXPLORATION PIT 16</u> <u>Soil</u>
0.0 - 0.7	SOD and TOPSOIL
0.7 - 4.0	Brown, loose, silty SAND with trace gravel, very moist.
4.0 - 12.0	Gray, dense to very dense, silty, gravelly SAND interbedded with gravelly SAND with some silt to silty, very moist to wet. (Glacial till interbedded with glacial drift materials.)

-Light seepage between 4.0 and 5.0 feet.

<u>Depth-Feet</u>	<u>EXPLORATION PIT 17</u> <u>Soil</u>
0.0 - 0.8	SOD and TOPSOIL
0.8 - 3.5	Brown, loose, silty SAND with trace gravel, very moist.
3.5 - 13.0	Gray, dense to very dense, silty, gravelly SAND interbedded with gravelly SAND with some silt to silty, and scattered sand lenses and layers, very moist to wet. (Glacial till interbedded with glacial drift materials, less till-like in appearance with depth.)

-Light to moderate seepage below 7.0 feet.

FIGURE 8

J. Keith Cross, P.E. 9210 NE 134th Street, Kirkland, Washington 98034-1876

EXPLORATION PIT 18

Soil

<u>Depth-Feet</u>		
0.0 - 1.5		FOREST DUFF over black, soft, silty SAND and organic SILT, wet.
1.5 - 5.0		Brown to gray and tan mottled, loose to medium dense, silty, SAND with some gravel to gravelly, wet
5.0 - 14.0		Gray, dense to very dense, silty, gravelly SAND interbedded with gravelly SAND with some silt to silty, and scattered sand lenses and layers, very moist to wet. (Glacial till interbedded with glacial drift materials.)

-Light to moderate water flow between 1.5 to 3.0 feet.

EXPLORATION PIT 19

Soil

<u>Depth-Feet</u>		
0.0 - 0.3		FOREST DUFF
0.3 - 3.0		Brown to tan, loose, silty SAND with some gravel, moist.
3.0 - 12.0		Gray, dense to very dense, silty, gravelly SAND interbedded with gravelly SAND with some silt to silty, and scattered sand lenses and layers, very moist to wet. (Glacial till interbedded with glacial drift materials.)

-No ground water observed.

EXPLORATION PIT 20

Soil

<u>Depth-Feet</u>		
0.0 - 1.5		FOREST DUFF and TOPSOIL
1.5 - 5.0		Brown to tan, loose, silty SAND with some gravel, moist.
5.0 - 13.0		Gray, dense to very dense, silty, gravelly SAND interbedded with gravelly SAND with some silt to silty, and scattered sand lenses and layers, very moist to wet. (Glacial till interbedded with glacial drift materials.)

-Light seepage between 3.5 and 5.5 feet.

EXPLORATION PIT 21

Soil

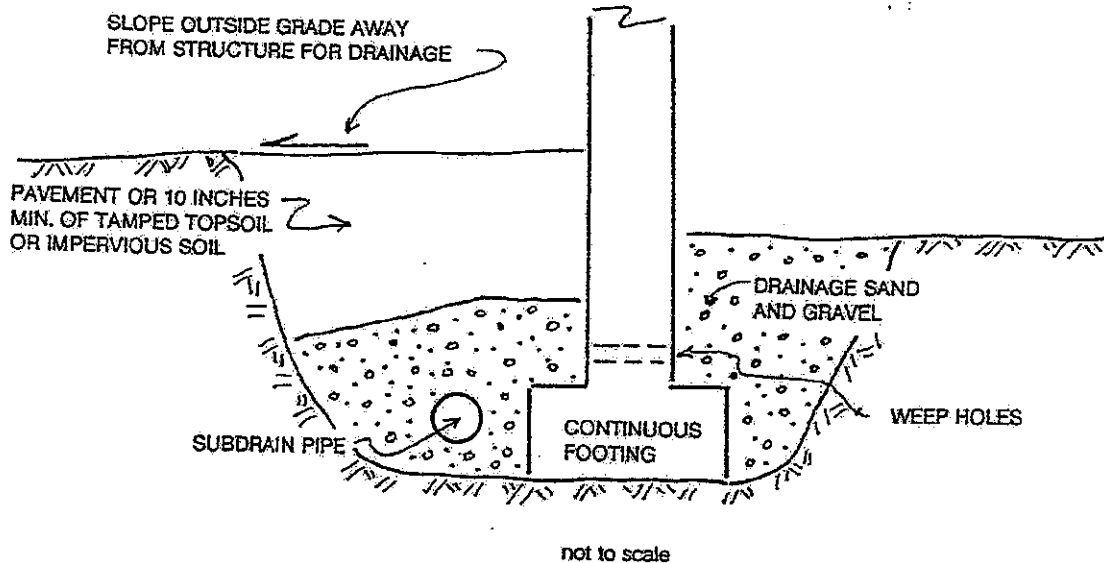
<u>Depth-Feet</u>		
0.0 - 0.3		SOD
0.3 - 13.0		Brown, loose to medium dense, stratified SAND and GRAVEL and gravelly SAND interbedded with gravel and clean sand to trace silt, moist to wet.

-Very heavy water flow below 10.0 feet.

-Massive caving from surface.

-Pit excavated into face of six foot high berm. Depth measured from top of berm.

FIGURE 9



MATERIALS

SUBDRAIN PIPE

4" Minimum Diameter Perforated Or Slotted, Rigid, Smooth Wall, Tight Jointed Pipe Sloped To Drain (4" / 100' min. slope) With Clean-Outs.
Pipe May Be Either Plastic (PVC or ABS), Metal, or Concrete.

ADS FLEXIBLE CORRUGATED PIPE IS SPECIFICALLY NOT RECOMMENDED FOR USE, EXCEPT FOR TEMPORARY INSTALLATIONS.

Slotted Pipe—1/8" max. Slot Width
Perforated Pipe—3/16" to 3/8" Holes
Slots or Perforations In Lower Half Of Pipe With Lower Quarter Segment Solid For Water Flow.

DRAINAGE SAND & GRAVEL

To Meet Washington State Specifications Or The Following Gradation.

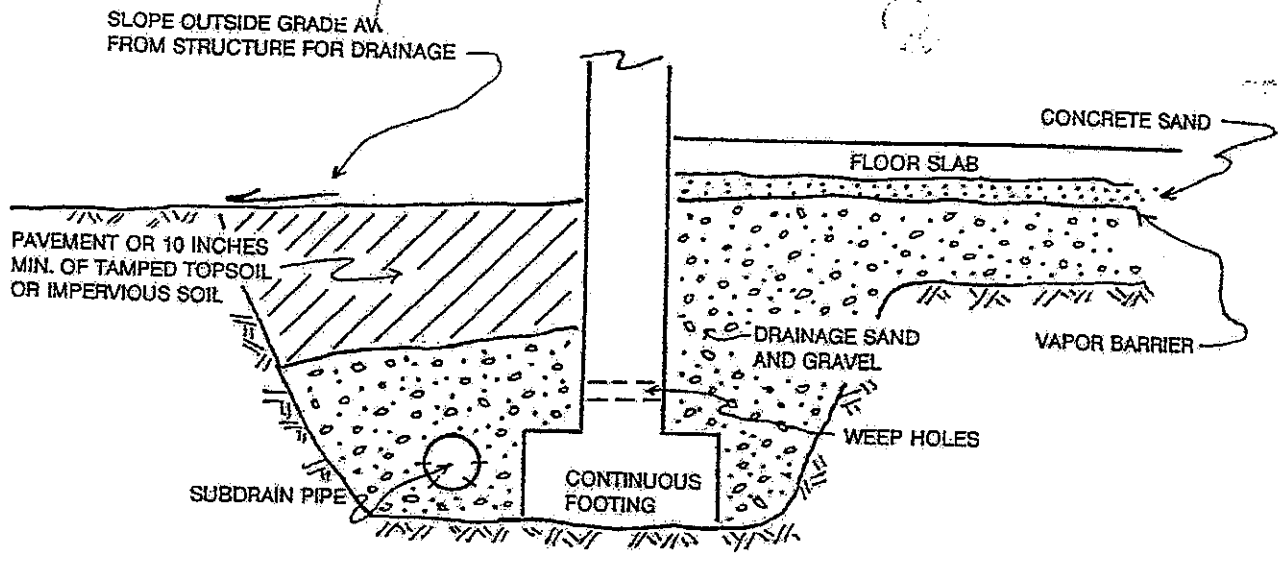
Sieve Size	% Passing By Weight
1 1/2"	100
3/4"	70-90
1/4"	30-60
No. 8	20-50
No. 30	8-30
No. 50	3-12
No. 200	0-1.2
(by wet sieving)	(non-plastic)

NOTES

- 1) Drainage Sand & Gravel Inside Stemwalls Should Be Connected Hydraulically To Subdrain Pipe. Use Of 1" to 2" Diameter Weep Holes Is One Applicable Method.
- 2) Subdrain Pipe Should Be Bedded With A Minimum Of 2" Of Drainage Sand & Gravel Beneath The Pipe And 6" Around The Sides And Above The Pipe.
- 3) Backfill Within 18" Of Wall Should Be Compacted With Hand-Operated Equipment. Heavy Equipment Should Not Be Used For Backfill, As Such Operation Could Increase Lateral Earth Pressures And Possibly Damage The Wall.
- 4) All Backfill Should Be Placed In Layers Not Exceeding 6" Loose Thickness And Be Nominally Compacted. Beneath Paved Or Sidewalk Areas, Compact To At Least 95% Modified Proctor Maximum Density (ASTM D1557).

SUBDRAIN & BACKFILL SCHEME

SHALLOW FOOTINGS & STEMWALLS



not to scale

MATERIALS

SUBDRAIN PIPE

4" Minimum Diameter Perforated Or Slotted, Rigid, Smooth Wall, Tight Jointed Pipe Sloped To Drain (4" / 100' min. slope) With Clean-Outs. Pipe May Be Either Plastic (PVC or ABS), Metal, or Concrete.

ADS FLEXIBLE CORRUGATED PIPE IS SPECIFICALLY NOT RECOMMENDED FOR USE, EXCEPT FOR TEMPORARY INSTALLATIONS.

Slotted Pipe—1/8" max. Slot Width
 Perforated Pipe—3/16" to 3/8" Holes
 Slots or Perforations In Lower Half Of Pipe With Lower Quarter Segment Solid For Water Flow.

DRAINAGE SAND & GRAVEL

To Meet Washington State Specifications Or The Following Gradation.

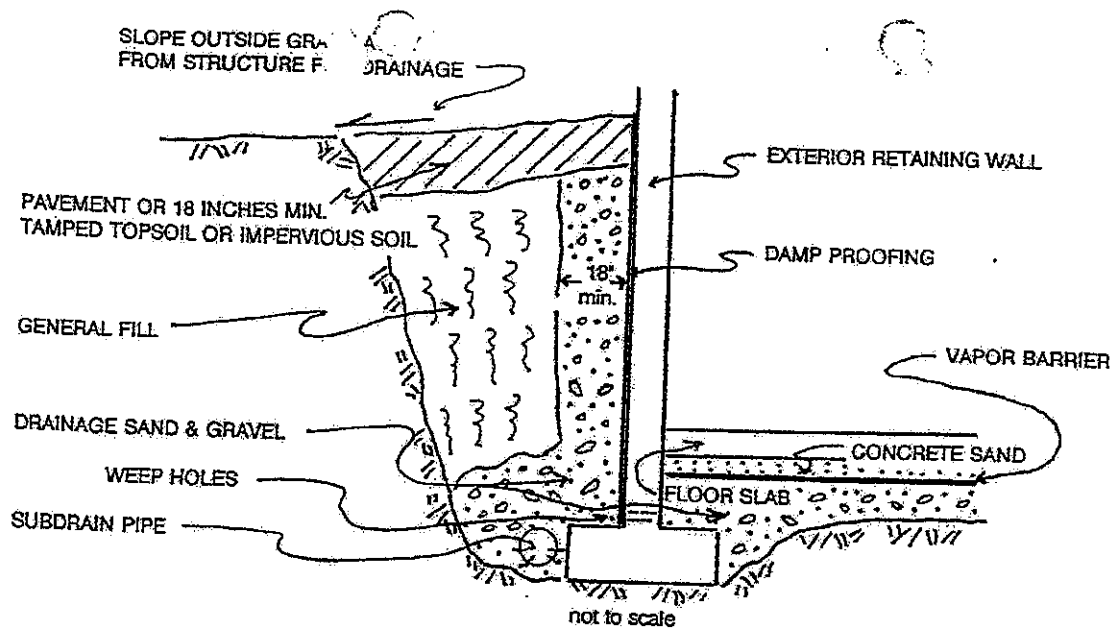
Sieve Size	% Passing By Weight
1 1/2"	100
3/4"	70-90
1/4"	30-60
No. 8	20-50
No. 30	8-30
No. 50	3-12
No. 200	0-1.2
(by wet sieving)	(non-plastic)

NOTES

- 1) Drainage Sand & Gravel Beneath Floor Slab Should Be Connected Hydraulically To Subdrain Pipe. Use Of 1" to 2" Diameter Weep Holes Is One Applicable Method.
- 2) Subdrain Pipe Should Be Bedded With A Minimum Of 2" Of Drainage Sand & Gravel Beneath The Pipe And 6" Around The Sides And Above The Pipe.
- 3) Backfill Within 18" Of Wall Should Be Compacted With Hand-Operated Equipment. Heavy Equipment Should Not Be Used For Backfill, As Such Operation Could Increase Lateral Earth Pressures And Possibly Damage The Wall.
- 4) All Backfill Should Be Placed In Layers Not Exceeding 6" Loose Thickness And Be Nominally Compacted. Beneath Paved Or Sidewalk Areas, Compact To At Least 95% Modified Proctor Maximum Density (ASTM D1557).

SUBDRAIN & BACKFILL SCHEME

SHALLOW FOOTINGS WITH INTERIOR SLAB ON GRADE



MATERIALS

SUBDRAIN PIPE

4" Minimum Diameter Perforated Or Slotted, Rigid, Smooth Wall, Tight Jointed Pipe Sloped To Drain (4" / 100' min. slope) With Clean-Outs. Pipe May Be Either Plastic (PVC or ABS), Metal, or Concrete.

ADS FLEXIBLE CORRUGATED PIPE IS SPECIFICALLY NOT RECOMMENDED FOR USE, EXCEPT FOR TEMPORARY INSTALLATIONS.

Slotted Pipe--1/8" max. Slot Width
 Perforated Pipe--3/16" to 3/8" Holes
 Slots or Perforations In Lower Half Of Pipe With Lower Quarter Segment Solid For Water Flow.

DRAINAGE SAND & GRAVEL

To Meet Washington State Specifications Or The Following Gradation.

Sieve Size	% Passing By Weight
1 1/2"	100
3/4"	70-90
1/4"	30-60
No. 8	20-50
No. 30	8-30
No. 50	3-12
No. 200	0-1.2
(by wet sieving)	(non-plastic)

NOTES

- 1) Drainage Sand & Gravel Beneath Floor Slab Should Be Connected Hydraulically To Subdrain Pipe. Use Of 1" to 2" Diameter Weep Holes Is One Applicable Method.
- 2) Subdrain Pipe Should Be Bedded With A Minimum Of 2" Of Drainage Sand & Gravel Beneath The Pipe And 6" Around The Sides And Above The Pipe.
- 3) Backfill Within 18" Of Wall Should Be Compacted With Hand-Operated Equipment. Heavy Equipment Should Not Be Used For Backfill, As Such Operation Could Increase Lateral Earth Pressures And Possibly Damage The Wall.
- 4) All Backfill Should Be Placed In Layers Not Exceeding 6" Loose Thickness And Be Nominally Compacted. Beneath Paved Or Sidewalk Areas, Compact To At Least 95% Modified Proctor Maximum Density (ASTM D1557).

SUBDRAIN & BACKFILL SCHEME

BASEMENT WALLS WITH INTERIOR SLAB-ON-GRADE