Mr. James Toteff

Proposed Harmony Ridge Subdivision
Old Pacific Highway
Kalama, Washington

March 1998
Project No: L98-0118

GeoStandards

Engineers raising the quality of consulting service in geosciences

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Project No. L97-0118

March 30, 1998

Mr. James Toteff
231 Ring Road
Kalama, Washington 98625

Dear Mr. Toteff:

Re: Geotechnical Evaluation for the Harmony Ridge Subdivision, Old Pacific Hwy, Kalama, Washington

We have completed the geotechnical evaluation you authorized in May 1997. Results of our evaluation are summarized below.

Subsurface Exploration Results

We encountered following specific subsurface soil and groundwater conditions during our subsurface exploration which included two SPT borings/rock cores (B-1 and B-2), thirteen test pits (TP-1 to TP-13), and two hand-augured borings (HA-1 to HA-3).

Topsoil/Organic Debris – Roughly 12 to 24 inches of organic-rich silt loam is present throughout the site. Organic debris consisting of cleared vegetation is also present at a few random locations within upper 24 inches.

Fill – Fill consisting of mixture of crushed rock, silt, and sand is present in upper 2 to 4 feet in the existing two entrance driveways near the eastern site boundaries. Fill soils consisting of organic debris and domestic debris is present in upper 5 feet in the eastern-southeastern portion around Test pit location TP-7.

Weathered Rock - Saprolite - The near surface topsoil and fill is underlain by highly to completely weathered basaltic rock formations consisting of volcanic flows. These highly to completely weathered rock formations are called saprolite. The saprolite stratum at the site generally extends to a depth of up to 9 feet. It is generally medium dense near surface and becomes very dense with depth. Rock outcrops at the site mainly consist of saprolite. Based on our experience, we believe the saprolite can be easily excavated using a heavy trackhoe.

Partially Weathered Rock – Saprolite is underlain by partially weathered rock formations consisting of mudflows and pyroclastic and volcanoclastic deposits that were placed between the andesite volcanic flows extending to depths of tens of feet. Some of these flow boundaries are present as rock outcrops at the site. These rock outcrops and upper volcanic flows have weathered into saprolite as discussed in above paragraph.

Based on our experience, we believe, partially weathered rock at the site can be excavated using a heavy trackhoe in upper 9 to 10 feet from existing grades. Below 9 to 10 feet, rock weathering appears to diminish and rock quality appears to gradually improve. Our evaluation of rock cores obtained during drilling indicate a Rock Quality Designation (RQD) value of roughly 0.4 to 0.5 for partially weathered gray basaltic rock present below 9 to 10 feet at the site. RQD is an index or measure of the quality of a rock mass used by a geotechnical engineer in design purposes.

Rock discontinuities mainly consist of extensive fractures or joints. There are no distinct bedding planes or faults. Presence of gouge or infill containing clayey materials between discontinuities is evident in upper layers. Frequency of discontinuity is extensive with evidence of extensive weathering.

Groundwater - We did not encounter groundwater seepage in our explorations. We did not notice any surficial drainage features on the site. It appears that the rainfall over the site drains surficially into a small pond present near the toe of the site slopes along the western site boundary. Our evaluation of the western toe slopes of the site did not indicate the presence of subsurface streams or seepage through the face of the slopes.

Site Stability Evaluation

During our site visits, we did not notice scarps, crevices and depressions, tension cracks in the ground surface, irregular toes, exposed surfaces of ruptures without vegetation, presence of distinct fast growing vegetation, undrained depressions, etc. that are generally indicative of active and/or inactive

landslides or slope instability.

At the time of our site visit, we did not notice evidence of severe erosion at the site. In general, we did not notice unusual surface water features such as filled depressions, deep creeks, disarranged drainage systems, etc which are sometimes indicative of previous landslide activities or slope instability. A small creek runs west-east near the southern property line. A pond is situated beyond and along the western site boundary. Besides these surface features, there are no groundwater or drainage features present on the site or around the site boundaries.

In addition, we specifically noted surface conditions for rock slope instability. During our site reconnaissance, we did not notice big rock block slumps, or debris, or talus. We did not notice three dimensional wedge discontinuities, evidence of past "block glides", tension cracks in the ground surface, severely bent tree bottoms, head scarps, irregular toes, undrained depressions, etc. that are generally indicative of rock slope instability.

Our reconnaissance of site vicinity area did not indicate visual evidence of slope instability or landslide hazards in areas adjacent to all site boundaries at the time of our site visits. Our literature research and interview with the Public Works Director of the City of Kalama did not reveal any information indicative of slope instability in the immediate site vicinity area.

We modeled on-site rock slopes using XSTABL computer software and analyzed rock slope stability using Janbu's slice method for a block failure. Results of our analyses indicated factor of safety against slope instability in excess of 3.0. In addition, we evaluated on-site rock slopes for stability using a probability approach based on extensive field observations, literature review, and local information.

Considering the results of our analyses, existing site surface conditions, and geologic characteristics of on-site rock slopes, in our opinion, on-site rock slopes are stable at this time. The probability of rock slope failure at the site is minimal at this time.

Design Recommendations

Based on the results of our study, we believe the site is suitable for the proposed development, provided following recommendations are followed.

Foundations

Proposed new buildings can be supported on properly prepared uniform native subgrade or on structural fill using continuous and individual shallow spread footings designed for following net maximum allowable bearing capacity of **2,000 psf.** The given allowable bearing capacity is intended for dead loads and sustained live loads and can be increased by one-third for the total of all loads, including short-term wind or seismic loads.

Slab-on-grade

We anticipate the use of framed slab with crawl space. If concrete slab-on-grade is used, then it should be supported on native subgrade or on structural fills after the topsoil is removed and after the subgrade is proof-rolled.

Individual Lot Development

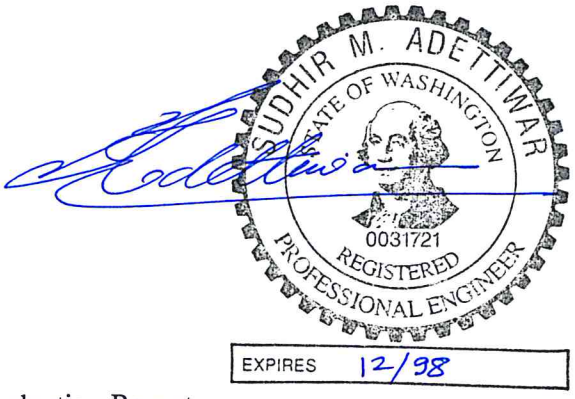
Based on the results of our study, we believe the site is suitable for individual lot development including building construction. Specifically, for moderately sloping lots in the western portion of the site, following additional studies may be required in addition to our recommendations described in all previous paragraphs.

- Stability of any proposed access road embankments or cuts;
- Stability of any cut slopes and fill slopes to achieve proposed finished floor grade;
- Specific retaining wall requirements and design for proposed grade changes; and
- Drainage requirements.

However, the requirement for additional studies will depend upon the proposed lot grades and the proposed building layout.

We appreciate the opportunity to be of service to you on this project. Please refer to the attached report for a detailed description of our analyses and recommendations. If we can provide additional assistance or observation and testing services during design and construction phases, please call us at 360-575-1101 in Longview.

Sincerely,



Sam Adettiwar, M.S., P.E.
Principal

Attachment: Geotechnical Evaluation Report
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Geotechnical Evaluation Report
Proposed Harmony Ridge Subdivision
Old Pacific Hwy, Kalama, Washington

1.0 Purpose and Scope

The purpose and scope of this study was to explore surface and subsurface site conditions, perform slope stability analyses, and provide foundation design, pavement design, site preparation, and general construction recommendations for the proposed construction. Specifically, our scope of services included following work items. Environmental and seismic assessments of any kind were beyond our scope of services.

1.1 Surface Evaluation and Research

We visited the site to observe surface conditions at the site and in the site vicinity. We reviewed available city records and interviewed city officials to obtain historical information on past landslide or slope instability problems at the site or in site vicinity area. In addition, we reviewed available geologic literature to evaluate subsurface conditions and geologic hazards.

1.2 Subsurface Exploration

We evaluated surface conditions at the site and reviewed available geological literature to develop our subsurface exploration program. In order to ascertain subsurface soil conditions at the site, we excavated 13 test pits using a trackhoe, hand-augured three soil borings, and performed SPT drilling (rock coring) at two locations shown in Figure 2.

We collected soil samples at random intervals during test-pit excavation and hand-auguring. In addition, we collected continuous rock core samples by coring with a rock barrel using a CME 75 drill rig. We used a 140-pound pin-guided hammer falling 30 inches to measure soil consistency. Number of blows required to drive the sampler a given distance was considered a measure of soil consistency.

Samples were identified in the field, placed in sealed containers, and transported to the laboratory for further classification and testing. Logs of all borings and test pits showing details of subsurface soil conditions encountered at the site are included in an Appendix.

1.3 Laboratory Evaluation

Selected samples of soils were transported to our laboratory for further evaluation, to aid in classification of the materials, and to help assess their strength and compressibility characteristics. Laboratory evaluation consisted of visual and textural examinations. Laboratory index soil testing was not deemed necessary for this project.

1.4 Engineering Analyses

Using the results of subsurface exploration and laboratory evaluation, we analyzed existing site stability. We performed bearing capacity and settlement analyses to develop recommendations for foundation and floor slab design. We performed lateral earth pressure analyses to develop recommendations for retaining wall design. In addition, we designed asphalt and concrete pavement sections for assumed traffic loading. We also developed recommendations for general site preparation including placement and the compaction of fill materials, foundation excavations, and construction dewatering/drainage.

1.5 Limitations

We have completed this study in general accordance with generally accepted geotechnical engineering principles and practices as discussed in attached ASFE document included in an Appendix. This warranty is in lieu of all other warranties expressed or implied. GeoStandards is not responsible for the independent conclusions, opinions or recommendations made by others based on the information presented in this report.

Results of our study are discussed below.

2.0 Project Description

The site is located roughly 1/2 a mile south of the City of Kalama on Old Pacific Hwy, as shown in an attached Site Location Map, Figure 1. Interstate I-5 is situated adjacent and parallel to the western site boundary.

The site is named as 'Harmony Ridge Subdivision.' We understand that present plans are to develop the site into several individual lots and/or subdivision as shown in Figure 2.

At this time, complete details on proposed construction are not available. We anticipate the new residential buildings will be constructed of wood with finished concrete or wood floor elevations at or near existing surface elevations or on structural fill. The project will also involve some cuts and fills to achieve proper grades for streets and building lots. We have estimated maximum point load of 80 kips, maximum strip footing load of 1,500 psf, and floor loads of 150 psf for proposed structures.

3.0 Surface Conditions

The site is an irregularly-shaped, undeveloped, 20-acre parcel of land. At present, the site is cleared of all the vegetation. Site topography and specific site conditions related to site stability are discussed below.

3.1 Topography

The site topography generally consists of a westerly sloping ground with a downward gradient of around 3(H):1(V) to 4(H):1(V). The site topography steepens (2H:1V) near the western site boundary. Our review of Site Plan provided by James Engineering indicate site grades at elevations ranging from EL. 110 near the eastern property line to El. 20 near the western property line. Beyond the western site boundary, the ground surface is relatively flat to gently sloping. A few rock outcrops are evident throughout the site. Attached Figures 3 to 7 show surface features and generalized cross-sectional profiles of the site at critical locations.

3.2 Site-specific Stability Observations

During our site visits, we did not notice scarps, crevices and depressions, tension cracks in the ground surface, irregular toes, exposed surfaces of ruptures without vegetation, presence of distinct fast growing vegetation, undrained depressions, etc. that are generally indicative of active and/or inactive landslides or slope instability.

At the time of our site visit, we did not notice evidence of severe erosion. In general, we did not notice unusual surface water features such as filled depressions, deep creeks, disarranged drainage systems, etc which are sometimes indicative of previous landslide activities or slope instability. A small creek runs west-east near the southern property line. A pond is situated beyond and along the western site boundary. Besides these surface features, there are no groundwater or drainage features present on the site or around the site boundaries.

In addition, we specifically noted surface conditions for rock slope instability. During our site reconnaissance, we did not notice big rock block slumps, or debris, or talus. We did not notice three dimensional wedge discontinuities, evidence of past "block glides", tension cracks in the ground surface, severely bent tree bottoms, head scarps, irregular toes, undrained depressions, etc. that are generally indicative of rock slope instability.

3.3 Site-vicinity Stability Observations

Our reconnaissance of site vicinity area did not indicate visual evidence of slope instability or landslide hazards in areas adjacent to all site boundaries at the time of our site visits. Our literature research and interview with the Public Works Director of the City of Kalama did not reveal any information indicative of slope instability in the immediate site vicinity area.

4.0 Subsurface Conditions

We encountered following specific subsurface soil and groundwater conditions during our subsurface exploration. Detailed descriptions of subsurface soils are given in attached boring logs B-1 and B-2, test pit logs TP-1 to TP-13, and hand-augured boring logs HA-1 to HA-3 included in an Appendix.

4.1 Soils and Geology

Topsoil/Organic Debris – Roughly 12 to 24 inches of organic-rich silt loam is present throughout the site. Organic debris consisting of cleared vegetation is also present at a few random locations within upper 24 inches.

Fill – Fill consisting of mixture of crushed rock, silt, and sand is present in upper 2 to 4 feet in the existing two entrance driveways near the eastern site boundaries as described in boring logs B-1 and B-2. Fill soils consisting of organic debris and domestic debris is present in upper 5 feet in the eastern-southeastern portion around Test pit location TP-7 shown in Figure 2.

Weathered Rock - Saprolite - The near surface topsoil and fill is underlain by highly to completely weathered basaltic rock formations consisting of volcanic flows. Highly to completely weathered rock formations are called saprolite. The saprolite stratum at the site generally extends to a depth of up to 9 feet. It is generally medium dense near surface and becomes very dense with depth. Rock outcrops at the site mainly consist of saprolite. Based on our experience, we believe, the saprolite can be easily excavated using a heavy trackhoe.

Partially Weathered Rock – Saprolite is underlain by partially weathered rock formations consisting of mud flows and pyroclastic and volcanoclastic deposits that were placed between the andesite volcanic flows extending to depths of tens of feet. Some of these flow boundaries are present as rock outcrops at the site. These rock outcrops and upper volcanic flows have weathered into saprolite as discussed in above paragraph.

Based on our experience, we believe, partially weathered rock can be excavated using a heavy trackhoe in upper 9 to 10 feet from existing grades. Below 9 to 10 feet, rock weathering appears to diminish and rock quality appears to improve gradually. Our evaluation of rock cores obtained during drilling

indicate a Rock Quality Designation (RQD) value of roughly 0.4 to 0.5 for partially weathered gray basaltic rock present below 9 to 10 feet at the site. RQD is an index or measure of the quality of a rock mass used by geotechnical engineer in design purposes.

Rock discontinuities mainly consist of extensive fractures or joints. There are no distinct bedding planes or faults. Presence of gouge or infill containing clayey materials between discontinuities is evident in upper layers. Frequency of discontinuity is extensive with evidence of extensive weathering.

4.2 Groundwater

We did not notice any surficial drainage features on the site. It appears that the rainfall over the site drains surficially into a small pond present near the toe of the site slopes along the western site boundary. Our evaluation of the western toe slopes of the site did not indicate the presence of subsurface streams or seepage through the face of the slopes.

We did not encounter groundwater seepage in our explorations. Variations in groundwater levels should be expected seasonally, annually and from location to location. We anticipate that groundwater table will rise during months of peak runoff.

4.3 Seismic Considerations

The site falls within seismic Zone 3 having a seismic zone factor of 0.3 as classified by the Uniform Building Code of 1994. Based on site specific geology and subsurface soil conditions encountered during our exploration, we characterize the soil profile at the site as S1 with a site coefficient ('S' factor) of 1.0. It should be noted that a site-specific seismic evaluation was beyond the present scope of services. We can perform such an evaluation at your request at an addition cost.

5.0 Site Stability Evaluation

We modeled on-site rock slopes using XSTABL computer software and analyzed rock slope stability using Janbu's slice method for a block failure. Results of our analyses indicated factor of safety against slope instability in excess of 3. In addition, we evaluated on-site rock slopes for stability using a probability approach based on extensive field observations, literature review, and local information.

Considering the results of our analyses, existing site surface conditions as described in Section 3.0, and geologic characteristics of on-site rock slopes as described in Section 4.0, in our opinion, on-site rock slopes are stable at this time. The probability of rock slope failure at the site is minimal at this time.

In order to maintain site stability during and after construction, we make following general recommendations.

6.0 General Construction Recommendations

Based on the results of our field exploration, laboratory evaluation, and engineering analysis, we believe the site is suitable for proposed development provided following general construction recommendations are followed.

Following paragraphs provide only preliminary recommendations. We must be contacted to review our recommendations once final project plans including grading plans are available for our review.

Variations in soil conditions may be encountered during construction. In order to permit correlation between soil exploration data and actual soil conditions encountered during construction, we recommend that a geotechnical engineer be retained to perform inspections during construction and to provide specific recommendations for soils or foundation related phases of the project.

6.1 Subgrade Preparation

In general, we recommend that any surface water within construction areas be drained away by cutting drainage ditches or by pumping from a sump hole, if necessary. Surface vegetation including up to 24 inches of topsoil, fill, any saturated/inundated and disturbed soil, and any non-soil or incompetent materials encountered at the time of construction should be removed. Additional site preparation may include the removal of deeper fills or organic stockpiles and reworking of disturbed subgrade.

6.2 Fill Placement

Depending upon proposed road grades and proposed building features, additional structural fill may be placed on the site. In general, all required structural fill materials for new building and pavement areas should be placed in layers that, when compacted, do not exceed about 6 to 8 inches for fine grained soils (silts and clays) and about 10 to 12 inches for granular materials (sands and gravels). Structural fill materials should be moistened or dried to achieve near optimum moisture conditions and then compacted by mechanical means to a minimum of 95 percent of the maximum dry density determined from ASTM D1557 modified Proctor laboratory test. Landscape fill can be placed and compacted by mechanical means to a minimum of 90 percent of the maximum dry density determined from ASTM D1557 modified Proctor laboratory test.

As indicated earlier, these are general recommendations. Depending upon the type of fill material used during construction, a geotechnical engineer may revise the fill placement and compaction requirements. In any case, selected samples of fill materials should be submitted to our laboratory for evaluating the maximum dry density and optimum moisture content and for evaluating the suitability of chosen fill materials.

6.2.1 Dry Weather Conditions

During dry weather, prior to the placement of any fills, all exposed subgrades should be proof-rolled with a loaded dump truck having a static weight of at least 45,000 pounds. During a proof-roll test, areas found to be soft or otherwise unsuitable for supporting anticipated structural loads should be over-

excavated and replaced with compacted fill.

During dry weather, on-site native soils (saprolite) could be considered for use as fill materials for building pads, provided they are free from organics and non-soil debris. However, we anticipate that these materials will have moisture content in excess of optimum, except perhaps during the driest months of the year, and accordingly, may require drying to achieve adequate compaction. Should wet weather grading be anticipated, the use of on-site soils as fill will be difficult without stabilizing fill materials using lime, cement, kiln dust, etc.

6.2.2 Wet Weather Conditions

On-site native soils (saprolite) are highly moisture sensitive and thus will not be suitable for use as structural fill during wet weather unless they are stabilized. If on-site soils must be used as fill materials, then we should be contacted for specific recommendations for on-site soil stabilization using lime, cement, kiln-dust, etc. As an option, all-weather, clean granular fill materials such as sand, crushed rock, or sand and gravel containing less than 5 percent materials passing # 200 sieve can be used as fill during wet weather conditions.

6.2.3 Roadway Fill Embankments

Fill embankments over sloping ground should be constructed using a stepping method. Generally, an 8-foot wide and 2-foot deep step should be cut at the bottom of the slope and backfilled with granular fill. The next 8-foot X 2-foot step should be cut into the slopes as construction progresses from the bottom of the slope to the top of the embankment.

We anticipate the need for the placement of a drainage blanket on the original slope and at the bottom of the embankment. The on-site native soils (saprolite) may be considered for use as fill in embankment areas provided a fill sample is evaluated and the proposed embankment slope stability is analyzed by a qualified geotechnical engineer.

As an option, an all-weather, clean granular fill containing less than 5 percent material passing the No. 200 sieve, such as sand, crushed sound rock, or sand and gravel, is recommended in order to achieve adequate compaction during grading operations and slope stability. Maximum aggregate size for fill

should be generally 6 to 8 inches. Any large size rocks (up to 12 inches of maximum dimension)) should be placed at the bottom of embankment to a maximum height of one foot to provide a stable working subgrade.

6.3 Excavation and Dewatering

Following paragraphs provide general recommendations for utility trench excavations and cut slopes. Once the final project plans including grading plans are available, we should be contacted to review our recommendations.

6.3.1 Utility Trench Excavations

As indicated earlier, on-site saprolite and partially weathered rock formations can be excavated to depths of 9 to 10 feet using a heavy trackhoe. For utility trench excavations deeper than 10 feet, we recommend exploration trenching in which the depth of unrippable rock can be estimated using a heavy ripper (minimum static weight of 50 tons and 350 hp). Based on the results of test trenching, the need for blasting and the size of excavation equipment can be estimated.

Temporary earth slopes in dry season may be cut near vertical up to 5 feet deep. In general, dry weather excavations deeper than 5 feet should be performed in accordance with Department of Labor Occupational Safety and Health Administration (OSHA) guidelines for Type A soils. Deep excavations for any basements or deep utilities may be excavated at grades steeper than the recommended OSHA grades provided the excavations are monitored and certified by a registered geotechnical engineer. Please note that site safety is the sole responsibility of the project contractor.

Groundwater seepage in utility trench excavations should be anticipated during the wet season of the year. For most of the excavations for this project, pumping from sumps outside the limits of the excavation should control groundwater seepage and surface water ponding.

Soils exposed in excavated areas should be protected from rain, freezing, and excessive loading along edges. Surface water run-off should be intercepted and drained away from excavated areas.

6.3.2 Cut Slopes

Existing rock slopes at the site may be cut to achieve finished grades. Generally, on-site rock slopes may be cut at grades no steeper than 1.5(H):1(V) provided we review proposed grading plans in order to evaluate the effects of the depth of proposed cuts, any surcharge loading, etc.

In order to minimize erosion of the cut faces of rock slopes and potential weathering due to freeze and thaw (slope ravelling), surface water run-off from uphill areas should be intercepted by installing interceptor drain along the crestline of cut rock slopes. In addition to the installation of an interceptor drain, the installation of a toe drain along the toe of cut rock slopes may be required. If existing rock slopes are excavated and benched, then a collector drain may be required on the bench.

All drains should be discharged into suitable receptacle that is situated away from the toe area of rock slopes. All drains should have an allowable capacity and grade such that they do not overflow, and are durable such that they do not crack and leak soon after installation.

We recommend the planting of vegetation on exposed cut slope faces for minimizing erosion and weathering. In order to avoid a wash-out, vegetation should not be planted during heavy rainy season.

If proposed structures are placed close to the toe of cut rock slopes, the design of a catchment area (buffer zone) along the toe of cut slopes for collecting weathered or eroded rock pieces and groundwater seepage may be required.

6.3.3 Blasting and Vibration Monitoring

We do not anticipate excessively deep excavations or cuts for this project. In any case, if utility trench excavations or cuts deeper than 10 to 15 feet become necessary, blasting may be required for rock removal.

If blasting becomes necessary, we recommend that a blasting expert be consulted to estimate blast hole diameter, blast overburden, blast bench height, potential for flyrock, airblast, noise, vibrations, etc. For safety, small charges should be used initially to establish a site-specific relationship between charge weight, distance, and response.

We recommend that a pre-blasting survey of adjacent and nearby properties be conducted to monitor effects of blasting on adjacent structures. As a minimum, this survey should include photographic documentation of site and adjacent properties, and establishment of horizontal and vertical survey control points.

In addition, vibration monitoring should be considered to evaluate effects of blasting on adjacent structures. Vibration monitoring data is extremely useful in litigation processes and in protecting client's interests. At your request, we can provide vibration monitoring services at an additional cost.

7.0 Design Recommendations

We have developed following design recommendations using the results of our study and our knowledge of proposed construction. We should be contacted to revise our design recommendations once final project plans are available for review.

7.1 Foundations

Proposed new buildings can be supported on properly prepared uniform native subgrade or on structural fill using continuous and individual shallow spread footings designed for following net maximum allowable bearing capacity of **2,000 psf.** The given allowable bearing capacity is intended for dead loads and sustained live loads and can be increased by one-third for the total of all loads, including short-term wind or seismic loads.

All excavated footings must be inspected and approved by a geotechnical engineer prior to the placement of concrete. All residential footings should be at least 16 inches wide. All continuous exterior footings should extend to a minimum depth of 12 inches beneath the lowest adjacent exterior compacted grade to provide frost protection and to minimize punching shear failure. Interior footings in heated areas can be placed at any convenient depth.

We estimate that foundations supported on uniform native subgrade designed and constructed in accordance with the above recommendations will experience total settlements generally less than 1-inch and differential settlements between columns generally less than ½-inch.

Allowable lateral frictional resistance between the base of footings and the native or fill subgrade can be expressed as the applied vertical load multiplied by a coefficient of friction of 0.45. In addition, lateral loads may be resisted by passive earth pressures based on an equivalent fluid density of 450 pounds per cubic foot (pcf) on footings poured "neat" against in-situ soils or properly back-filled with structural fill. This recommended values include a factor of safety of approximately 1.5, which is appropriate due to the amount of movement required to develop full passive resistance.

7.2 Floor Slabs

We anticipate the use of framed slab with crawl space. If concrete slabs-on-grade is used, then it should be supported on uniform native subgrade or on structural fills after the topsoil is removed and after the subgrade is proof-rolled.

For concrete slab-on-grade, we recommend the placement of a minimum of 6 inches of free-draining (a maximum size of 3/4 inch with less than 5 percent passing the No. 200 sieve) well-graded gravel or crushed rock base course to provide uniform subgrade reaction or support for the slab. The base course material should be compacted to at least 95 percent of the maximum density determined by ASTM D 1557 laboratory test procedure.

The crushed rock beneath slab-on-grade should provide a capillary break for the migration of moisture through the slab. If additional protection against moisture vapor is desired, a vapor retarding membrane may also be incorporated into the design. Because of variables such as cost, special considerations for construction, and floor coverings, we suggest that the owner or the architect make decisions regarding the use of vapor retarding membranes beneath the slab.

7.3 Retaining Walls

We can provide specific recommendations for retaining wall design once final project plans are available. In general, lateral earth pressures on walls that are not restrained at the top, such as retaining walls, etc., may be calculated using an equivalent fluid pressure of 35 pcf for level backfill and 60 pcf for steeply sloping backfill. Walls that are restrained from yielding at the top (such as foundation walls) may be calculated using an equivalent fluid pressure of 55 pcf for level backfill and

90 pcf for steeply sloping backfill.

Lateral earth pressures on walls may be resisted by passive pressure resistance acting against footing base and by frictional resistance between footing elements and supporting soils. An equivalent fluid density of 450 pounds per cubic foot (pcf) and a friction factor of 0.45 may be used for retaining wall design. The recommended equivalent fluid density includes a factor of safety of 1.5, which is appropriate due to the amount of movement required to develop full passive resistance.

All backfill immediately behind retaining walls, foundation walls, etc., should be select granular material (sand and/or sandy gravel). We anticipate that on-site material will not be suitable for this purpose. All backfill behind walls should be placed in lifts not exceeding 6 inches in loose thickness and compacted to at least 90 percent of the maximum dry density obtainable by the ASTM D 1557 test procedure. While placing fill behind walls, care must be taken to minimize undue lateral loads on the wall.

7.4 General Drainage

Foundation drains should be installed at the base of all footings placed on native subgrade to prevent surface and shallow perched water from migrating beneath footings. In general, building areas placed below exterior site grades must be provided with a well-designed drainage system in order to control hydrostatic pressures against walls, seepage of groundwater through base walls, etc.

Under no circumstances should surface water run-off and roof drains be led into foundation drains. Surface run-off from roofs, parking areas, etc., should be tight-lined into storm sewer or other approved disposal areas. All pavement areas should be sloped away from the building to prevent ponding of water near buildings.

All drain systems must be discharged into suitable receptacles, but, not into the face of the slope or over the crest of the slope.

7.5 Pavements

In general, prior to placing the base or leveling course, the subgrade should be proof-rolled with a loaded dump truck having a minimum static weight of 45,000 pounds to detect areas or pockets of unusually soft material. These failed areas should be excavated and replaced with suitable compacted fill. Fill material should be selected according to our recommendations described in Section 5.2. A filter fabric should be placed over all fine-grained soils (silts-clays) prior to the placement of base rock.

Based on our experience, we have provided following preliminary pavement design recommendations for planning purposes only. Once the project traffic data is available, we will revise our preliminary recommendations and modify them if necessary.

7.5.1 Bituminous Pavements

We assumed a design California Bearing Ratio (CBR) of 10. We assumed 15,000 cumulative ESALs for parking area and < 100,000 cumulative ESALs for driveway areas for 20 years of design life. Based on these assumptions, we recommend following bituminous pavement sections:

Materials	Thickness	
	Entrance, Driveways, Service Roads	Car Parking
Bituminous Concrete (AC)	4 inches	2½ inches
Crushed Rock Base	8 inches	8 inches

Bituminous pavement crushed rock base course materials should consist of well-graded 1½-inch or ¾-inch minus crushed rock, having less than 5 percent material passing # No. 200 sieve. The base course and bituminous concrete materials should conform to the requirements given in the latest edition of the

State of Washington DOT, Standard Specifications for Road, Bridge, and Municipal Construction handbook. In general, the base course material should be compacted to at least 95 percent of the maximum dry density determined by the ASTM D-1557 laboratory test procedure. The bituminous concrete material (AC) should be compacted to at least 90 percent of the theoretical maximum density determined by ASTM D-2041 (Rice Specific Gravity) laboratory test procedure.

7.5.2 Concrete Pavement

We assumed a design modulus of subgrade reaction, k, of 200 pci. Based on our assumed k value and ESALs, we recommend following concrete pavement sections:

Materials	Thickness	
	Entrance Service Roads	Car Parking
Concrete (4,000 psi)	6 inches	4 inches
Leveling Coarse (Sand or All-Weather Base)	2 inches	2 inches

Once the project data is available, we can provide detailed pavement design recommendations that will discuss joints, reinforcement, etc.

7.6 Individual Lot Development

Based on the results of our study, we believe the site is suitable for individual lot development including building construction. Specifically, for moderately sloping lots in the western portion of the site, following additional studies may be required in addition to our recommendations described in all previous paragraphs.

- Stability of any proposed access road embankments or cuts;
- Stability of any cut slopes and fill slopes to achieve proposed finished floor grade;

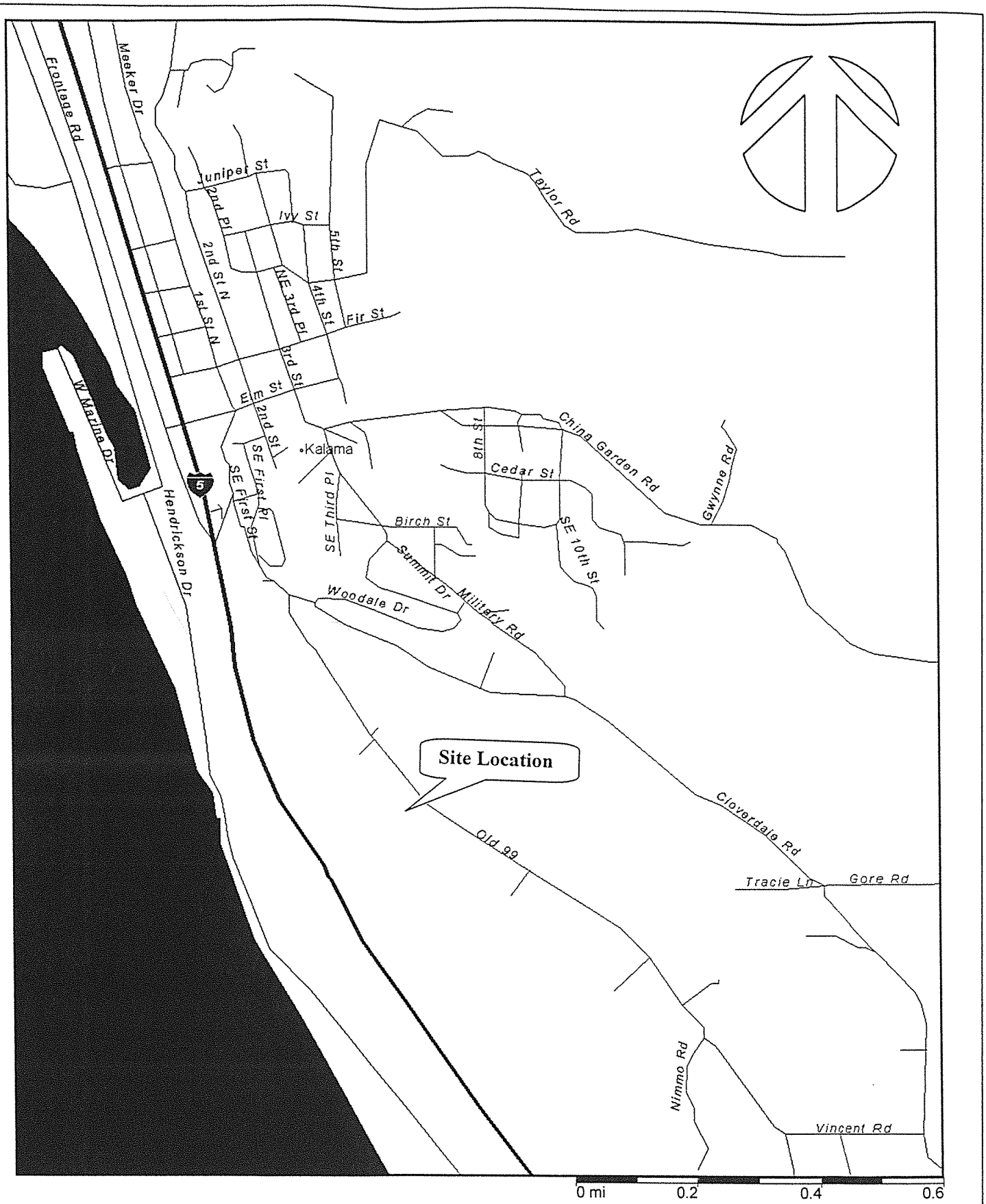
- Specific retaining wall requirements and design for proposed grade changes; and
- Drainage requirements.

However, the requirement for additional studies will depend upon the proposed lot grades and the proposed building layout.

8.0 Construction Monitoring

We recommend that a geotechnical engineer examine and identify all excavated footings to verify subgrade soil conditions. All structural subgrades should be proof-rolled in the presence of a geotechnical engineer. Structural fill placement and compaction should be continuously observed and tested by us. Fill samples should be submitted to our laboratory for evaluation prior to its placement. At your request, we can provide construction monitoring services at an additional cost.

FIGURES



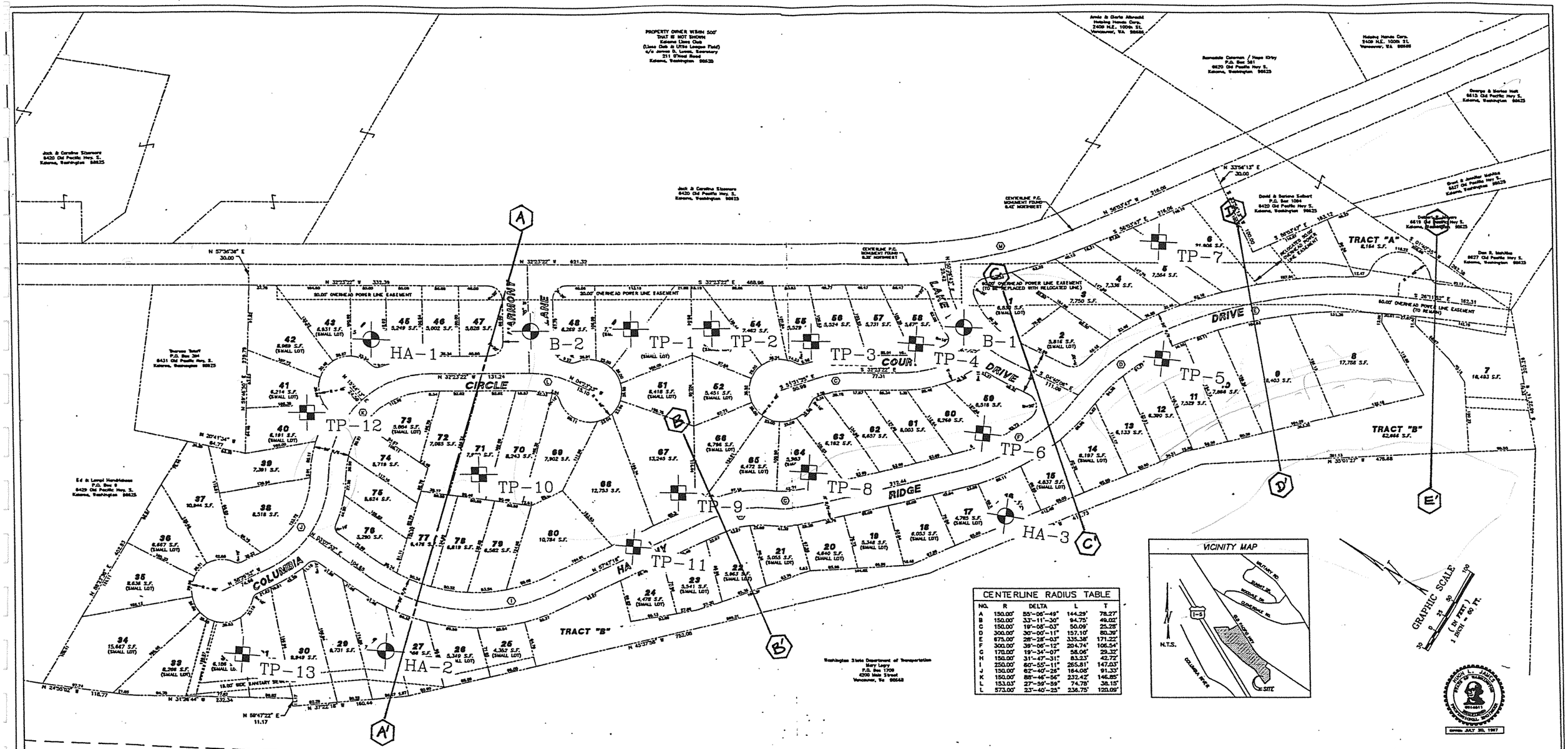
GeoStandards

Site Location Map

Harmony Ridge Subdivision
Old Pacific Highway – Kalama, WA

SCALE	FIGURE NO.	PROJECT NO.	DATE
As Shown	1	L97-0118	10/30/97

USER BR REVDATE FNAME 197-0118f1



CENTERLINE RADIUS TABLE				
NO.	R	DELTA	L	T
A	150.00'	55°-06'-49"	144.29'	78.27'
B	150.00'	33°-11'-30"	94.75'	49.02'
C	150.00'	19°-08'-03"	50.09'	25.25'
D	300.00'	30°-00'-11"	157.10'	80.39'
E	575.00'	28°-28'-03"	335.38'	171.22'
F	300.00'	39°-06'-12"	204.74'	106.54'
G	170.00'	19°-34'-07"	58.06'	29.32'
H	150.00'	31°-47'-31"	83.23'	42.72'
I	250.00'	60°-55'-11"	265.81'	147.03'
J	150.00'	62°-40'-26"	164.08'	91.33'
K	150.00'	88°-46'-56"	232.42'	146.85'
L	153.01'	27°-39'-59"	74.78'	38.15'
M	573.00'	23°-40'-25"	236.75'	120.09'

NO.	DATE	REVISION DESCRIPTION	DRAWN CALC. TSD	PROJECT I.D.	SCALE
			CHECK M. JAMES	NAME: HA PLAT13	HORIZ: 1" = 60'
			DESIGN A. JAMES	VIEW: PLOT	VERT: ——

JAMES ENGINEERING
6168 N.E. HIGHWAY 99 SUITE 101 A
VANCOUVER, WASHINGTON, 98665 (360) 696-1433

HARMONY RIDGE SUBDIVISION PRELIMINARY PLAT

DATE 4/1/97
SHEET 1 OF 7

Legend

- TP-1 to TP-13: Test pit excavated in 06/97
- B-1 and B-2: SPT borings drilled in 06/97
- HA-1 to HA-3: Hand-augured borings, 07/97

Reference: Site Plan by James Engineering, 4/97

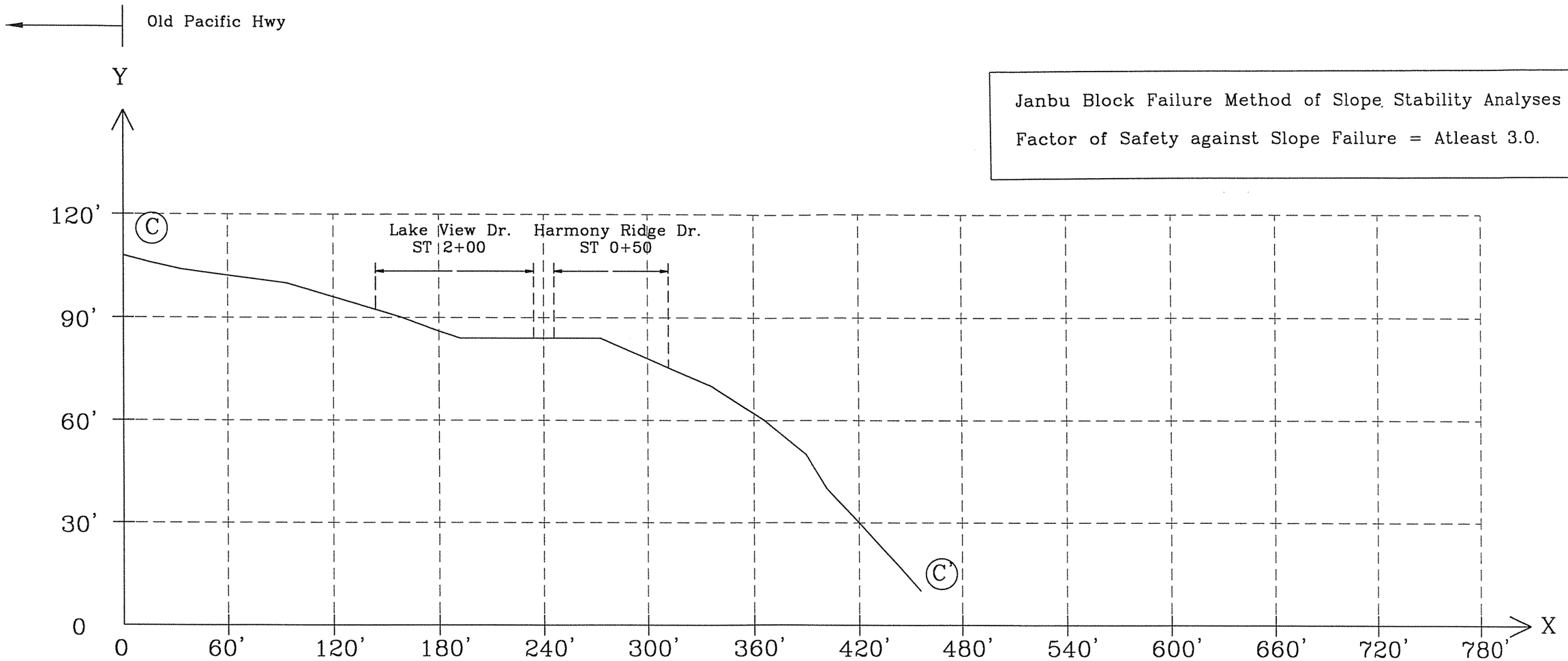
GeoStandards

Schematic Site Plan

Harmony Ridge Subdivision
Old Pacific Highway – Kalama, WA

SCALE	FIGURE NO.	PROJECT NO.	DATE
As Shown	2	L97-0118	10/30/97

USER BR REVDATE FNAME 197_0118f2



Janbu Block Failure Method of Slope Stability Analyses

Factor of Safety against Slope Failure = Atleast 3.0.

Cross-Section C-C'
Horizontal: 1 inch = 60 ft.
Vertical: 1 inch = 30 ft.

GeoStandards

Cross-Section C - C'

Harmony Ridge Subdivision
Old Pacific Highway - Kalama, WA

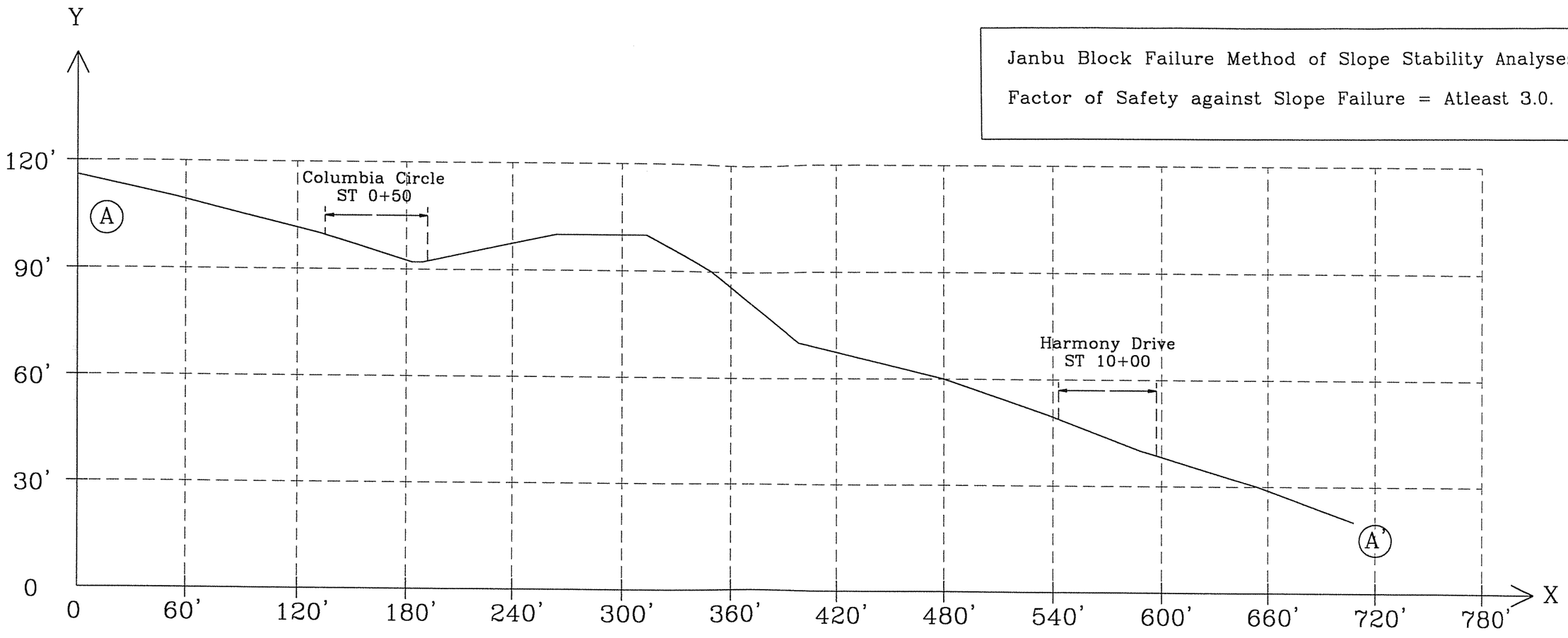
SCALE	FIGURE NO.	PROJECT NO.	DATE
As Shown	5	L97-0118	10/30/97

USER BR REVDATE FNAME 197_0118f5

Old Pacific Hwy

Janbu Block Failure Method of Slope Stability Analyses

Factor of Safety against Slope Failure = Atleast 3.0.



Cross–Section A–A'
Horizontal: 1 inch = 60 ft.
Vertical: 1 inch = 30 ft.

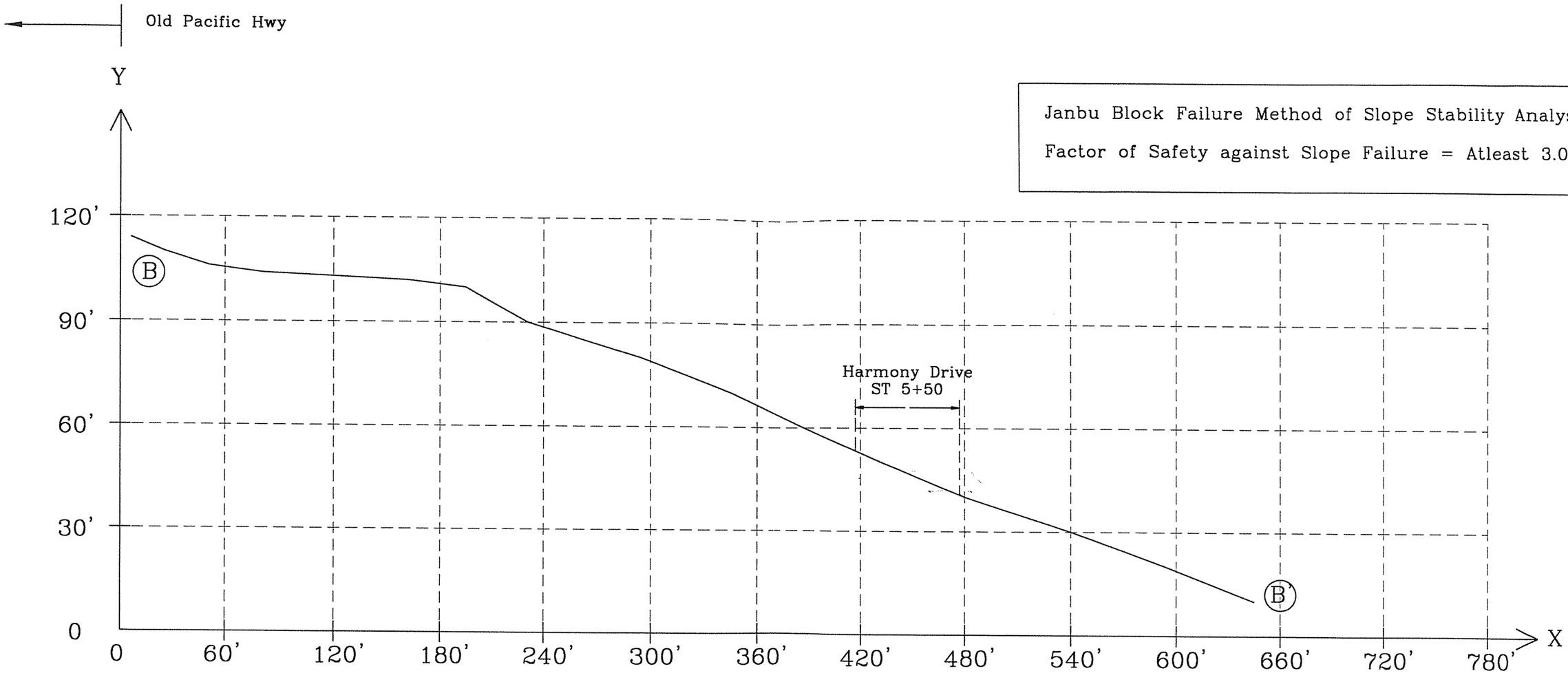
GeoStandards

Cross-Section A - A'

Harmony Ridge Subdivision
Old Pacific Highway – Kalama, WA

SCALE	FIGURE NO.	PROJECT NO.	DATE
As Shown	3	L97–0118	10/30/97

USER BR REVDATE FNAME 197_0118f3



Cross-Section B-B'
Horizontal: 1 inch = 60 ft.
Vertical: 1 inch = 30 ft.

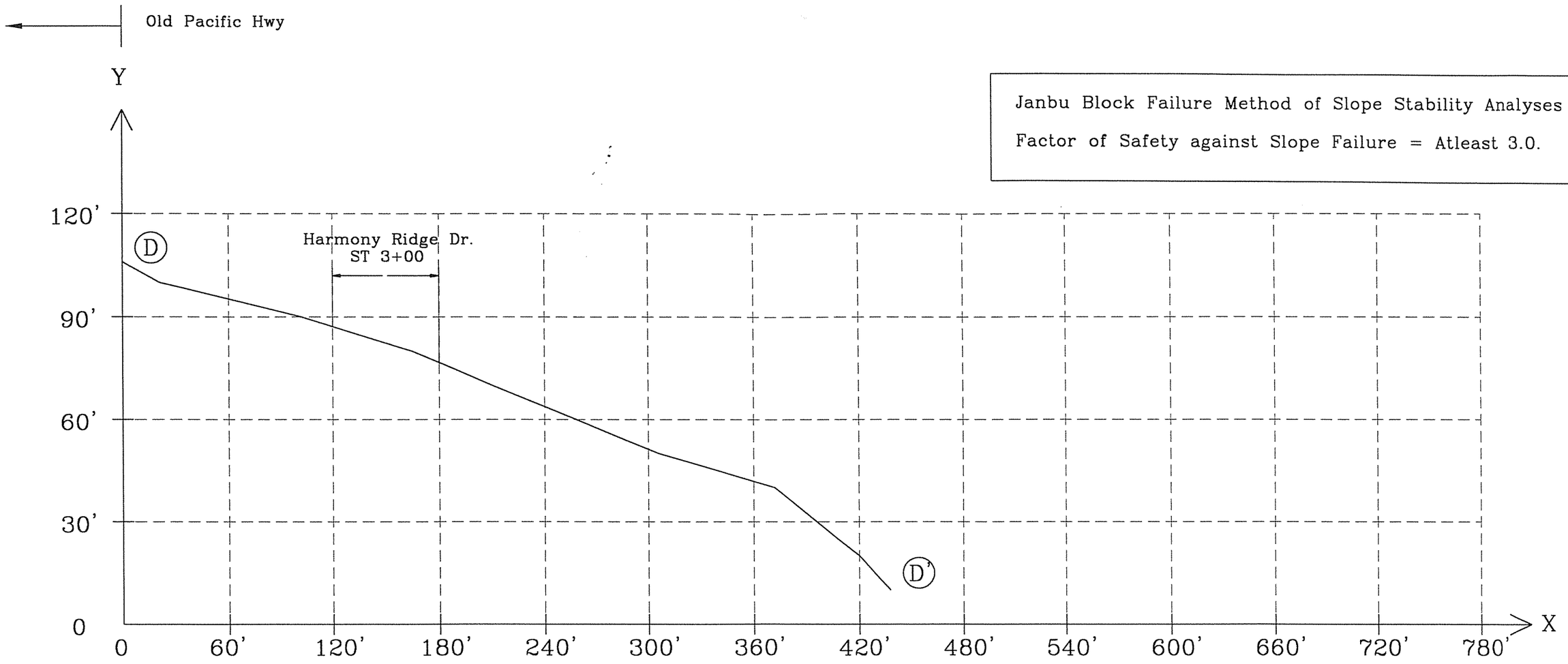
GeoStandards

Cross-Section B - B'

Harmony Ridge Subdivision
Old Pacific Highway - Kalama, WA

SCALE	FIGURE NO.	PROJECT NO.	DATE
As Shown	4	L97-0118	10/30/97

USER BR REVDATE FNAME 197_0118f4



Janbu Block Failure Method of Slope Stability Analyses

Factor of Safety against Slope Failure = Atleast 3.0.

Cross-Section D-D'
Horizontal: 1 inch = 60 ft.
Vertical: 1 inch = 30 ft.

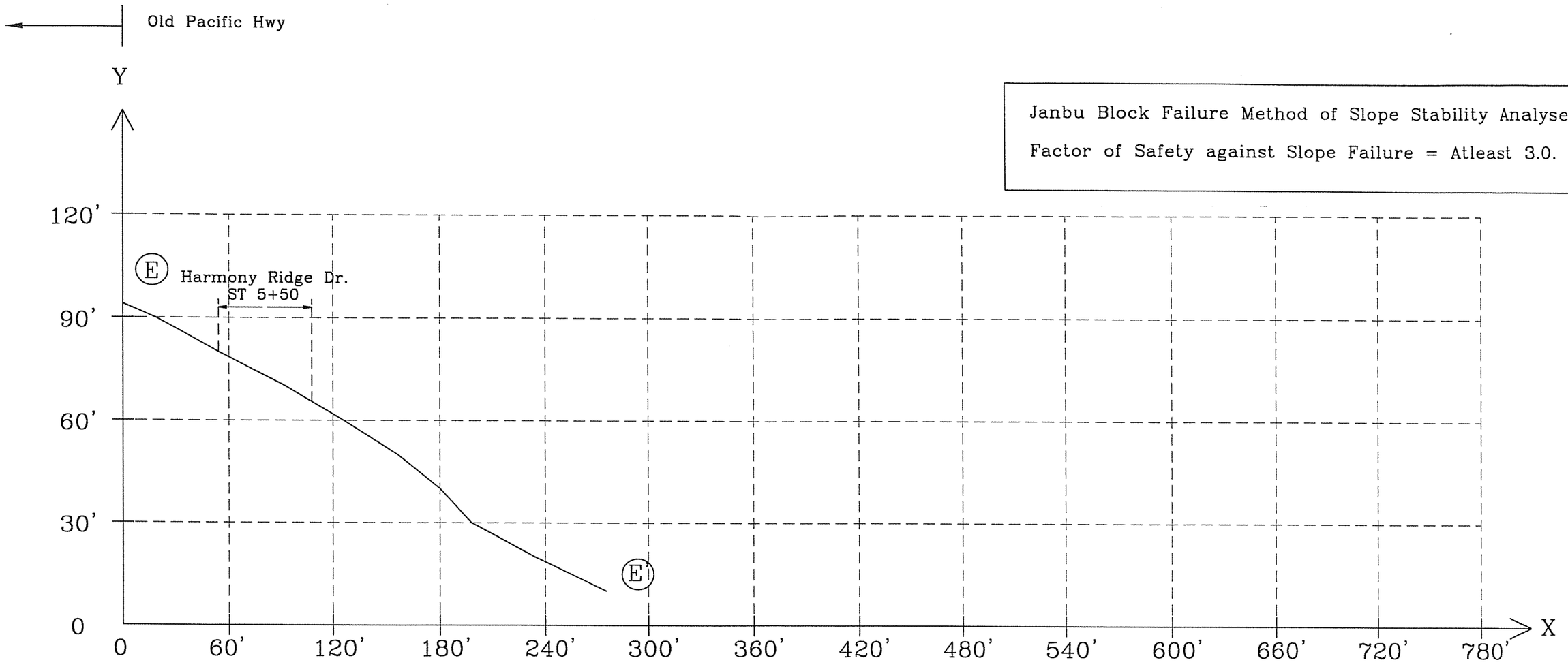
GeoStandards

Cross-Section D - D'

Harmony Ridge Subdivision
Old Pacific Highway - Kalama, WA

SCALE	FIGURE NO.	PROJECT NO.	DATE
As Shown	6	L97-0118	10/30/97

USER BR REVDATE FNAME 197_0118f6



Janbu Block Failure Method of Slope Stability Analyses

Factor of Safety against Slope Failure = Atleast 3.0.

Cross-Section E-E'
Horizontal: 1 inch = 60 ft.
Vertical: 1 inch = 30 ft.

GeoStandards

Cross-Section E - E'

Harmony Ridge Subdivision
Old Pacific Highway - Kalama, WA

SCALE	FIGURE NO.	PROJECT NO.	DATE
As Shown	7	L97-0118	10/30/97

USER BR REVDATE FNAME 197_0118f7

APPENDIX

GeoStandards

BORING NUMBER **B-1** SHEET **1** OF **1**

PROJECT NAME **Harmony Ridge Subdivision**

LOCATION **Old Pacific Highway - Kalamak, WA**

PROJECT NUMBER **L97-0118**

SURFACE ELEVATION DATUM **MSL** LOGGED BY **SMA**

SAMPLE INFORMATION					STRATA	DESCRIPTION	REMARKS	ELEVATION FEET
DEPTH FEET	SAMPLE TYPE	BLOW COUNTS	Recovery %	U.S.C.S. SYMBOL				
	CORE 1			GW-GC		FILL - Entrance roadway fill consisting of mixture of crushed rock, silt, and sand		
	CORE 2	5-6-30+		GP		SAPROLITE - Highly to completely weathered basaltic rock, gray-brown-orange mottled, medium dense to very dense		
5	CORE 3	60/4"		GP				
	CORE 4	50+/1"		GP-GM		Partially weathered gray basaltic rock, dense to very dense: Rock Quality Designation (RQD) = 0.4-0.5		
10								
15						Boring was terminated at 17 ft due to hard drilling	Groundwater was not encountered during drilling	

DRILLING CONTRACTOR

DRILLING METHOD **HSA/Rock Coring**

DRILLING EQUIPMENT **CME75**

DRILLING STARTED **6/5/97** ENDED **6/5/97**

SITE CONDITIONS **B-1 is located in the eastern portion of the site near the entrance from Old Pacific Hwy.**

GEOTECH_NO_WELL L970118.GPJ GEOSTAND.GDT 3/26/98

GeoStandards

BORING NUMBER **B-2** SHEET 1 OF 1

PROJECT NAME **Harmony Ridge Subdivision**

LOCATION **Old Pacific Highway - Kalamak, WA**

PROJECT NUMBER **L97-0118**

SURFACE ELEVATION DATUM **MSL**

LOGGED BY **SMA**

SAMPLE INFORMATION					STRATA	DESCRIPTION	REMARKS	ELEVATION FEET
DEPTH FEET	SAMPLE TYPE	BLOW COUNTS	Recovery %	U.S.C.S. SYMBOL				
	CORE 1			GW-GC		FILL - Entrance roadway fill consisting of mixture of crushed rock, silt, and sand		
5	CORE 2	60-46-47		GP		SAPROLITE - Highly to completely weathered basaltic rock, gray-brown-orange mottled, medium dense to very dense		
	CORE 3	65/4"		GP				
10	CORE 4	50+/1"		GP-GM		Partially weathered gray basaltic rock, dense to very dense: Rock Quality Designation (RQD) = 0.4-0.5 At 13 ft - 1"thk clay layer / discontinuity was noted		
15						Boring was terminated at 16 ft due to hard drilling	Groundwater was not encountered during drilling	

DRILLING CONTRACTOR

DRILLING METHOD **HSA/Rock Coring**

DRILLING EQUIPMENT **CME75**

DRILLING STARTED **6/5/97** ENDED **6/5/97**

SITE CONDITIONS **B-2 is located in the northern-eastern portion of the site near the entrance from Old Pacific Hwy.**

GEOTECH_NO_WELL L970118.GPJ GEOSTAND.GDT 3/26/98

GeoStandards

TEST PIT NUMBER **TP-1** SHEET **1** OF **1**

PROJECT NAME **Harmony Ridge Subdivision**

LOCATION **Old Pacific Highway - Kalamak, WA**

PROJECT NUMBER **L97-0118**

SURFACE ELEVATION DATUM **MSL** LOGGED BY **SMA**

SAMPLE INFORMATION					STRATA	DESCRIPTION	REMARKS	ELEVATION FEET
DEPTH FEET	SAMPLE TYPE	POCKET PENETR, tsf	MOIS-TURE, %	U.S.C.S. SYMBOL				
	GRAB 1			OL		TOPSOIL - Silty sandy loam with roots		
	GRAB 2			GP-GM		Partially weathered basaltic rock - Slow digging with a small trackhoe - Can possibly be excavated using a large trackhoe		
						Test pit excavation was terminated due to slow digging	Groundwater was not encountered during excavation	

DRILLING CONTRACTOR

DRILLING METHOD **Excavation**

DRILLING EQUIPMENT **Backhoe**

DRILLING STARTED **6/10/97** ENDED **6/10/97**

SITE CONDITIONS **TP-1 is located in the eastern portion of the site.**

TEST_PIT L970118.GPJ GEOSTAND.GDT 3/26/98

GeoStandards

TEST PIT NUMBER **TP-2** SHEET **1** OF **1**

PROJECT NAME **Harmony Ridge Subdivision**

LOCATION **Old Pacific Highway - Kalamak, WA**

PROJECT NUMBER **L97-0118**

SURFACE ELEVATION DATUM **MSL** LOGGED BY **SMA**

SAMPLE INFORMATION					STRATA	DESCRIPTION	REMARKS	ELEVATION FEET
DEPTH FEET	SAMPLE TYPE	POCKET PENETR, tsf	MOIS-TURE, %	U.S.C.S. SYMBOL				
	GRAB 1			OL		TOPSOIL - Silty sandy loam with roots		
						SAPROLITE - Highly to completely weathered basaltic rock - Gray-brown-orange mottled rock fragments - Easily ripped by a small trackhoe		
	GRAB 2			GP				
	GRAB 3			GP-GM		Partially weathered basaltic rock - Slow digging with a small trackhoe - Can possibly be excavated using a large trackhoe Test pit excavation was terminated due to slow digging	Groundwater was not encountered during excavation	

DRILLING CONTRACTOR

DRILLING METHOD **Excavation**

DRILLING EQUIPMENT **Backhoe**

DRILLING STARTED **6/10/97** ENDED **6/10/97**

SITE CONDITIONS **TP-2 is located in the eastern portion of the site.**

TEST_PIT L970118.GPJ GEOSTAND.GDT 3/26/98

GeoStandards

TEST PIT NUMBER **TP-3** SHEET **1** OF **1**

PROJECT NAME **Harmony Ridge Subdivision**

LOCATION **Old Pacific Highway - Kalamak, WA**

PROJECT NUMBER **L97-0118**

SURFACE ELEVATION DATUM **MSL** LOGGED BY **SMA**

SAMPLE INFORMATION					STRATA	DESCRIPTION	REMARKS	ELEVATION FEET
DEPTH FEET	SAMPLE TYPE	POCKET PENETR, tsf	MOIS-TURE, %	U.S.C.S. SYMBOL				
	GRAB 1			OL		TOPSOIL - Silty sandy loam with roots		
						SAPROLITE - Highly to completely weathered basaltic rock - Gray-brown-orange mottled rock fragments - Easily ripped by a small trackhoe		
	GRAB 2			GP				
5								
	GRAB 3			GP-GM		Partially weathered basaltic rock - Slow digging with a small trackhoe - Can possibly be excavated using a large trackhoe		
						Test pit excavation was terminated due to slow digging	Groundwater was not encountered during excavation	

DRILLING CONTRACTOR

DRILLING METHOD **Excavation**

DRILLING EQUIPMENT **Backhoe**

DRILLING STARTED **6/10/97** ENDED **6/10/97**

SITE CONDITIONS **TP-3 is located in the eastern portion of the site.**

TEST_PIT L970118.GPJ GEOSTAND.GDT 3/26/98

GeoStandards

TEST PIT NUMBER **TP-4** SHEET **1** OF **1**

PROJECT NAME **Harmony Ridge Subdivision**

LOCATION **Old Pacific Highway - Kalamak, WA**

PROJECT NUMBER **L97-0118**

SURFACE ELEVATION DATUM **MSL** LOGGED BY **SMA**

SAMPLE INFORMATION					STRATA	DESCRIPTION	REMARKS	ELEVATION FEET
DEPTH FEET	SAMPLE TYPE	POCKET PENETR, tsf	MOIS-TURE, %	U.S.C.S. SYMBOL				
	GRAB 1			OL		TOPSOIL/FILL - Upper 6 inches of loose rock-fragment fill followed by silty sandy loam with roots		
	GRAB 2			GP-GM		Partially weathered basaltic rock - Slow digging with a small trackhoe - Can possibly be excavated using a large trackhoe Test pit excavation was terminated due to slow digging	Groundwater was not encountered during excavation	

DRILLING CONTRACTOR

DRILLING METHOD **Excavation**

DRILLING EQUIPMENT **Backhoe**

DRILLING STARTED **6/10/97** ENDED **6/10/97**

SITE CONDITIONS **TP-4 is located in the eastern portion of the site.**

TEST_PIT L970118.GPJ GEOSTAND.GDT 3/26/98

GeoStandards

TEST PIT NUMBER **TP-5** SHEET 1 OF 1

PROJECT NAME **Harmony Ridge Subdivision**

LOCATION **Old Pacific Highway - Kalamak, WA**

PROJECT NUMBER **L97-0118**

SURFACE ELEVATION DATUM **MSL**

LOGGED BY **SMA**

SAMPLE INFORMATION					STRATA	DESCRIPTION	REMARKS	ELEVATION FEET
DEPTH FEET	SAMPLE TYPE	POCKET PENETR, tsf	MOIS-TURE, %	U.S.C.S. SYMBOL				
	GRAB 1			OL		TOPSOIL/FILL - Upper 6 inches of loose rock-fragment fill followed by silty sandy loam with roots		
	GRAB 2			GP		SAPROLITE - Highly to completely weathered basaltic rock - Gray-brown-orange mottled rock fragments - Easily ripped by a small trackhoe		
5	GRAB 3			GP				
	GRAB 4			GP-GM		Partially weathered basaltic rock - Slow digging with a small trackhoe - Can possibly be excavated using a large trackhoe		
						Test pit excavation was terminated due to slow digging	Groundwater was not encountered during excavation	

DRILLING CONTRACTOR

DRILLING METHOD **Excavation**

DRILLING EQUIPMENT **Backhoe**

DRILLING STARTED **6/10/97** ENDED **6/10/97**

SITE CONDITIONS **TP-5 is located in the southern portion of the site.**

TEST_PIT L970118.GPJ GEOSTAND.GDT 3/26/98

GeoStandards

TEST PIT NUMBER **TP-6** SHEET **1** OF **1**

PROJECT NAME **Harmony Ridge Subdivision**

LOCATION **Old Pacific Highway - Kalamak, WA**

PROJECT NUMBER **L97-0118**

SURFACE ELEVATION DATUM **MSL** LOGGED BY **SMA**

SAMPLE INFORMATION					STRATA	DESCRIPTION	REMARKS	ELEVATION FEET
DEPTH FEET	SAMPLE TYPE	POCKET PENETR, tsf	MOIS-TURE, %	U.S.C.S. SYMBOL				
	GRAB 1			OL		FILL - Loose rock-fragments with organics		
	GRAB 2			GP		SAPROLITE - Highly to completely weathered basaltic rock - Gray-brown-orange mottled rock fragments - Easily ripped by a small trackhoe		
5	GRAB 3			GP				
	GRAB 4			GP-GM		Partially weathered basaltic rock - Slow digging with a small trackhoe - Can possibly be excavated using a large trackhoe		
						Test pit excavation was terminated due to slow digging	Groundwater was not encountered during excavation	

DRILLING CONTRACTOR

DRILLING METHOD **Excavation**

DRILLING EQUIPMENT **Backhoe**

DRILLING STARTED **6/10/97** ENDED **6/10/97**

SITE CONDITIONS **TP-6 is located in the southern-central portion of the site.**

TEST_PIT L970118.GPJ GEOSTAND.GDT 3/26/98

GeoStandards

TEST PIT NUMBER **TP-7** SHEET **1** OF **1**

PROJECT NAME **Harmony Ridge Subdivision**

LOCATION **Old Pacific Highway - Kalamak, WA**

PROJECT NUMBER **L97-0118**

SURFACE ELEVATION DATUM **MSL** LOGGED BY **SMA**

SAMPLE INFORMATION					STRATA	DESCRIPTION	REMARKS	ELEVATION FEET
DEPTH FEET	SAMPLE TYPE	POCKET PENETR, tsf	MOIS-TURE, %	U.S.C.S. SYMBOL				
	GRAB 1			SP-SC		FILL - Organics, burnt stumps, tires, domestic debris, etc with rock fragments		
	GRAB 2			SP-SC				
5	GRAB 3			SP-SC				
	GRAB 4			GP-GM		Partially weathered basaltic rock - Slow digging with a small trackhoe - Can possibly be excavated using a large trackhoe		
						Test pit excavation was terminated due to slow digging	Groundwater was not encountered during excavation	

DRILLING CONTRACTOR

DRILLING METHOD **Excavation**

DRILLING EQUIPMENT **Backhoe**

DRILLING STARTED **6/10/97** ENDED **6/10/97**

SITE CONDITIONS **TP-7 is located in the eastern portion of the site.**

TEST_PIT L970118.GPJ GEOSTAND.GDT 3/26/98

GeoStandards

TEST PIT NUMBER **TP-8** SHEET **1** OF **1**

PROJECT NAME **Harmony Ridge Subdivision**

LOCATION **Old Pacific Highway - Kalamak, WA**

PROJECT NUMBER **L97-0118**

SURFACE ELEVATION DATUM **MSL** LOGGED BY **SMA**

SAMPLE INFORMATION					STRATA	DESCRIPTION	REMARKS	ELEVATION FEET
DEPTH FEET	SAMPLE TYPE	POCKET PENETR, tsf	MOIS-TURE, %	U.S.C.S. SYMBOL				
	GRAB 1 GRAB 2			OL GP-GM		TOPSOIL - Silty sandy loam with roots		
						Partially weathered basaltic rock - Slow digging with a small trackhoe - Can possibly be excavated using a large trackhoe		
						Test pit excavation was terminated due to slow digging	Groundwater was not encountered during excavation	

DRILLING CONTRACTOR

DRILLING METHOD **Excavation**

DRILLING EQUIPMENT **Backhoe**

DRILLING STARTED **6/10/97** ENDED **6/10/97**

SITE CONDITIONS **TP-8 is located in the eastern portion of the site.**

TEST_PIT L970118.GPJ GEOSTAND.GDT 3/26/98

GeoStandards

TEST PIT NUMBER **TP-9** SHEET **1** OF **1**

PROJECT NAME **Harmony Ridge Subdivision**

LOCATION **Old Pacific Highway - Kalamak, WA**

PROJECT NUMBER **L97-0118**

SURFACE ELEVATION DATUM **MSL** LOGGED BY **SMA**

SAMPLE INFORMATION					STRATA	DESCRIPTION	REMARKS	ELEVATION FEET
DEPTH FEET	SAMPLE TYPE	POCKET PENETR, tsf	MOIS-TURE, %	U.S.C.S. SYMBOL				
	GRAB 1 GRAB 2			OL GP-GM		TOPSOIL - Silty sandy loam with roots Partially weathered basaltic rock - Slow digging with a small trackhoe - Can possibly be excavated using a large trackhoe Test pit excavation was terminated due to slow digging	Groundwater was not encountered during excavation	

DRILLING CONTRACTOR

DRILLING METHOD **Excavation**

DRILLING EQUIPMENT **Backhoe**

DRILLING STARTED **6/10/97** ENDED **6/10/97**

SITE CONDITIONS **TP-9 is located in the central-western portion of the site.**

TEST_PIT L970118.GPJ GEOSTAND.GDT 3/26/98

GeoStandards

TEST PIT NUMBER **TP-12** SHEET 1 OF 1

PROJECT NAME **Harmony Ridge Subdivision**

LOCATION **Old Pacific Highway - Kalamak, WA**

PROJECT NUMBER **L97-0118**

SURFACE ELEVATION DATUM **MSL** LOGGED BY **SMA**

SAMPLE INFORMATION					STRATA	DESCRIPTION	REMARKS	ELEVATION FEET
DEPTH FEET	SAMPLE TYPE	POCKET PENETR, tsf	MOIS-TURE, %	U.S.C.S. SYMBOL				
	GRAB 1			OL		TOPSOIL - Silty sandy loam with roots		
	GRAB 2			GP		SAPROLITE - Highly to completely weathered basaltic rock - Gray-brown-orange mottled rock fragments - Easily ripped by a small trackhoe		
5	GRAB 3			GP				
	GRAB 4			GP-GM		Partially weathered basaltic rock - Slow digging with a small trackhoe - Can possibly be excavated using a large trackhoe Test pit excavation was terminated due to slow digging	Groundwater was not encountered during excavation	

DRILLING CONTRACTOR

DRILLING METHOD **Excavation**

DRILLING EQUIPMENT **Backhoe**

DRILLING STARTED **6/10/97** ENDED **6/10/97**

SITE CONDITIONS **TP-12 is located in the northern portion of the site.**

TEST_PIT L970118.GPJ GEOSTAND.GDT 3/26/98

GeoStandards

TEST PIT NUMBER **TP-13** SHEET **1** OF **1**

PROJECT NAME **Harmony Ridge Subdivision**

LOCATION **Old Pacific Highway - Kalamak, WA**

PROJECT NUMBER **L97-0118**

SURFACE ELEVATION DATUM **MSL** LOGGED BY **SMA**

SAMPLE INFORMATION					STRATA	DESCRIPTION	REMARKS	ELEVATION FEET
DEPTH FEET	SAMPLE TYPE	POCKET PENETR, tsf	MOIS-TURE, %	U.S.C.S. SYMBOL				
						TOPSOIL - Silty sandy loam with roots		
	GRAB 1			OL		SAPROLITE - Highly to completely weathered basaltic rock - Gray-brown-orange mottled rock fragments - Easily ripped by a small trackhoe		
	GRAB 1			GP				
5	GRAB 1			GP-GM		Partially weathered basaltic rock - Slow digging with a small trackhoe - Can possibly be excavated using a large trackhoe Test pit excavation was terminated due to slow digging	Groundwater was not encountered during excavation	

DRILLING CONTRACTOR

DRILLING METHOD **Excavation**

DRILLING EQUIPMENT **Backhoe**

DRILLING STARTED **6/10/97** ENDED **6/10/97**

SITE CONDITIONS **TP-13 is located in the north-western portion of the site.**

TEST_PIT L970118.GPJ GEOSTAND.GDT 3/26/98

GeoStandards

TEST PIT NUMBER **HA-1** SHEET **1** OF **1**

PROJECT NAME **Harmony Ridge Subdivision**

LOCATION **Old Pacific Highway - Kalamak, WA**

PROJECT NUMBER **L97-0118**

SURFACE ELEVATION DATUM **MSL** LOGGED BY **SMA**

SAMPLE INFORMATION					STRATA	DESCRIPTION	REMARKS	ELEVATION FEET
DEPTH FEET	SAMPLE TYPE	POCKET PENETR, tsf	MOIS-TURE, %	U.S.C.S. SYMBOL				
	GRAB 1			OL		TOPSOIL - Silty sandy loam with roots		
	GRAB 1			GP		SAPROLITE - Highly weathered basaltic rock - Auguring refusal Test pit excavation was terminated due to slow auguring	Groundwater was not encountered during auguring	

DRILLING CONTRACTOR

DRILLING METHOD **Excavation**

DRILLING EQUIPMENT **Backhoe**

DRILLING STARTED **6/10/97** ENDED **6/10/97**

SITE CONDITIONS **HA-1 is located in the northern portion of the site.**

TEST_PIT L970118.GPJ GEOSTAND.GDT 3/26/98

GeoStandards

TEST PIT NUMBER **HA-2** SHEET **1** OF **1**

PROJECT NAME **Harmony Ridge Subdivision**

LOCATION **Old Pacific Highway - Kalamak, WA**

PROJECT NUMBER **L97-0118**

SURFACE ELEVATION DATUM **MSL** LOGGED BY **SMA**

SAMPLE INFORMATION					STRATA	DESCRIPTION	REMARKS	ELEVATION FEET
DEPTH FEET	SAMPLE TYPE	POCKET PENETR, tsf	MOIS-TURE, %	U.S.C.S. SYMBOL				
	GRAB 1			OL		TOPSOIL - Silty sandy loam with roots		
	GRAB 1			GP		SAPROLITE - Highly weathered basaltic rock - Auguring refusal Test pit excavation was terminated due to slow auguring	Groundwater was not encountered during auguring	

DRILLING CONTRACTOR

DRILLING METHOD **Excavation**

DRILLING EQUIPMENT **Backhoe**

DRILLING STARTED **6/10/97** ENDED **6/10/97**

SITE CONDITIONS **HA-2 is located in the north-western portion of the site.**

TEST_PIT L970118.GPJ GEOSTAND.GDT 3/26/98

GeoStandards

TEST PIT NUMBER **HA-3** SHEET **1** OF **1**

PROJECT NAME **Harmony Ridge Subdivision**

LOCATION **Old Pacific Highway - Kalamak, WA**

PROJECT NUMBER **L97-0118**

SURFACE ELEVATION DATUM **MSL** LOGGED BY **SMA**

SAMPLE INFORMATION					STRATA	DESCRIPTION	REMARKS	ELEVATION FEET
DEPTH FEET	SAMPLE TYPE	POCKET PENETR, tsf	MOIS-TURE, %	U.S.C.S. SYMBOL				
	GRAB 1			OL		TOPSOIL - Silty sandy loam with roots		
	GRAB 1			GP		SAPROLITE - Highly weathered basaltic rock - Auguring refusal Test pit excavation was terminated due to slow auguring	Groundwater was not encountered during auguring	

DRILLING CONTRACTOR

DRILLING METHOD **Excavation**

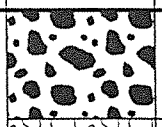
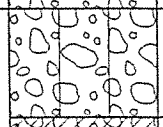
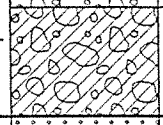
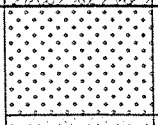
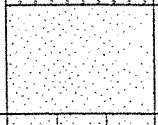
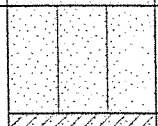
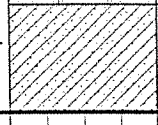
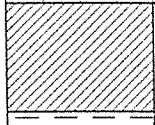
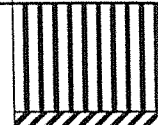
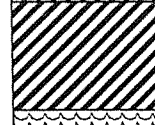
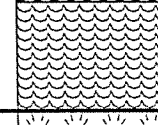
DRILLING EQUIPMENT **Backhoe**

DRILLING STARTED **6/10/97** ENDED **6/10/97**

SITE CONDITIONS **HA-3 is located in the western portion of the site.**

TEST_PIT L970118.GPJ GEOSTAND.GDT 3/26/98

SOIL CLASSIFICATION CHART

MAJOR DIVISIONS			SYMBOLS GRAPH	SYMBOLS LETTER	TYPICAL DESCRIPTIONS
COARSE GRAINED SOILS — MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	GRAVEL AND GRAVELLY SOILS — MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	CLEAN GRAVELS (LITTLE OR NO 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 (APPRECIABLE AMOUNT OF FINES)		GM	SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES
				GC	CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES
	SAND AND SANDY SOILS — MORE THAN 50% OF COARSE FRACTION PASSING ON NO. 4 SIEVE	CLEAN SANDS (LITTLE OR NO FINES)		SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
				SP	POORLY-GRADED SANDS, GRAVELLY SAND, LITTLE OR NO FINES
		SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SM	SILTY SANDS, SAND - SILT MIXTURES
				SC	CLAYEY SANDS, SAND - CLAY MIXTURES
FINE GRAINED SOILS — MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	SILTS AND CLAYS	LIQUID LIMIT 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 SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS	LIQUID LIMIT GREATER THAN 50		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS
				CH	INORGANIC CLAYS OF HIGH PLASTICITY
				OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS				PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS

IMPORTANT INFORMATION ABOUT YOUR GEOTECHNICAL ENGINEERING REPORT

As the client of a consulting geotechnical engineer, you should know that site subsurface conditions cause more construction problems than any other factor. ASFE/The Association of Engineering Firms Practicing in the Geosciences offers the following suggestions and observations to help you manage your risks.

A GEOTECHNICAL ENGINEERING REPORT IS BASED ON A UNIQUE SET OF PROJECT-SPECIFIC FACTORS

Your geotechnical engineering report is based on a subsurface exploration plan designed to consider a unique set of project-specific factors. These factors typically include: the general nature of the structure involved, its size, and configuration; the location of the structure on the site; other improvements, such as access roads, parking lots, and underground utilities; and the additional risk created by scope-of-service limitations imposed by the client. To help avoid costly problems, ask your geotechnical engineer to evaluate how factors that change subsequent to the date of the report may affect the report's recommendations.

Unless your geotechnical engineer indicates otherwise, do not use your geotechnical engineering report:

- when the nature of the proposed structure is changed, for example, if an office building will be erected instead of a parking garage, or a refrigerated warehouse will be built instead of an unrefrigerated one;
- when the size, elevation, or configuration of the proposed structure is altered;
- when the location or orientation of the proposed structure is modified;
- when there is a change of ownership; or
- for application to an adjacent site.

Geotechnical engineers cannot accept responsibility for problems that may occur if they are not consulted after factors considered in their report's development have changed.

SUBSURFACE CONDITIONS CAN CHANGE

A geotechnical engineering report is based on conditions that existed at the time of subsurface exploration. Do not base construction decisions on a geotechnical engineering report whose adequacy may have been affected by time. Speak with your geotechnical consultant to learn if additional tests are advisable before construction starts.Note, too, that additional tests may be required when subsurface conditions are affected by construction operations at or adjacent to the site, or by natural events such as floods, earthquakes, or ground water fluctuations. Keep your geotechnical consultant apprised of any such events.

MOST GEOTECHNICAL FINDINGS ARE PROFESSIONAL JUDGMENTS

Site exploration identifies actual subsurface conditions only at those points where samples are taken. The data were extrapolated by your geotechnical engineer who then applied judgment to render an opinion about overall subsurface conditions. The actual interface between materials may be far more gradual or abrupt than your report indicates. Actual conditions in areas not sampled may differ from those predicted in your report. While nothing can be done to prevent such situations, you and your geotechnical engineer can work together to help minimize their impact. Retaining your geotechnical engineer to observe construction can be particularly beneficial in this respect.

A REPORT'S RECOMMENDATIONS CAN ONLY BE PRELIMINARY

The construction recommendations included in your geotechnical engineer's report are preliminary, because they must be based on the assumption that conditions revealed through selective exploratory sampling are indicative of actual conditions throughout a site. Because actual subsurface conditions can be discerned only during earthwork, you should retain your geotechnical engineer to observe actual conditions and to finalize recommendations. Only the geotechnical engineer who prepared the report is fully familiar with the background information needed to determine whether or not the report's recommendations are valid and whether or not the contractor is abiding by applicable recommendations. The geotechnical engineer who developed your report cannot assume responsibility or liability for the adequacy of the report's recommendations if another party is retained to observe construction.

GEOTECHNICAL SERVICES ARE PERFORMED FOR SPECIFIC PURPOSES AND PERSONS

Consulting geotechnical engineers prepare reports to meet the specific needs of specific individuals. A report prepared for a civil engineer may not be adequate for a construction contractor or even another civil engineer. Unless indicated otherwise, your geotechnical engineer prepared your report expressly for you and expressly for purposes you indicated. No one other than you should apply this report for its intended purpose without first conferring with the geotechnical engineer. No party should apply this report for any purpose other than that originally contemplated without first conferring with the geotechnical engineer.

GEOENVIRONMENTAL CONCERNS ARE NOT AT ISSUE

Your geotechnical engineering report is not likely to relate any findings, conclusions, or recommendations

about the potential for hazardous materials existing at the site. The equipment, techniques, and personnel used to perform a geoenvironmental exploration differ substantially from those applied in geotechnical engineering. Contamination can create major risks. If you have no information about the potential for your site being contaminated, you are advised to speak with your geotechnical consultant for information relating to geoenvironmental issues.

A GEOTECHNICAL ENGINEERING REPORT IS SUBJECT TO MISINTERPRETATION

Costly problems can occur when other design professionals develop their plans based on misinterpretations of a geotechnical engineering report. To help avoid misinterpretations, retain your geotechnical engineer to work with other project design professionals who are affected by the geotechnical report. Have your geotechnical engineer explain report implications to design professionals affected by them, and then review those design professionals' plans and specifications to see how they have incorporated geotechnical factors. Although certain other design professionals may be familiar with geotechnical concerns, none knows as much about them as a competent geotechnical engineer.

BORING LOGS SHOULD NOT BE SEPARATED FROM THE REPORT

Geotechnical engineers develop final boring logs based upon their interpretation of the field logs (assembled by site personnel) and laboratory evaluation of field samples. Geotechnical engineers customarily include only final boring logs in their reports. Final boring logs should not under any circumstances be redrawn for inclusion in architectural or other design drawings, because drafters may commit errors or omissions in the transfer process. Although photographic reproduction eliminates this problem, it does nothing to minimize the possibility of contractors misinterpreting the logs during bid preparation. When this occurs, delays, disputes, and unanticipated costs are the all-too-frequent result.

To minimize the likelihood of boring log misinterpretation, give contractors ready access to the complete geotechnical engineering report prepared or authorized for their use. (If access is provided only to the report prepared for you, you should advise contractors of the report's limitations, assuming that a contractor was not one of the specific persons for whom the report was prepared and that developing construction cost estimates was not one of the specific purposes for which it was prepared. In other words, while a contractor may gain important knowledge from a report prepared for another party, the contractor would be well-advised to discuss the report with your geotechnical engineer and to perform the additional or alternative work that the contractor believes may be needed to obtain the data specifically appropriate for construction cost estimating purposes.) Some clients believe that it is unwise or unnecessary to give contractors access to their geotechnical engineering reports because they hold the mistaken impression that simply disclaiming responsibility for the accuracy of subsurface information always insulates them from attendant liability. Providing the best available information to contractors helps prevent costly construction problems. It also helps reduce the adversarial attitudes that can aggravate problems to disproportionate scale.

READ RESPONSIBILITY CLAUSES CLOSELY

Because geotechnical engineering is based extensively on judgment and opinion, it is far less exact than other design disciplines. This situation has resulted in wholly unwarranted claims being lodged against geotechnical engineers. To help prevent this problem, geotechnical engineers have developed a number of clauses for use in their contracts, reports, and other documents. Responsibility clauses are not exculpatory clauses designed to transfer geotechnical engineers' liabilities to other parties. Instead, they are definitive clauses that identify where geotechnical engineers' responsibilities begin and end. Their use helps all parties involved recognize their individual responsibilities and take appropriate action. Some of these definitive clauses are likely to appear in your geotechnical engineering report. Read them closely. Your geotechnical engineer will be pleased to give full and frank answers to any questions.

RELY ON THE GEOTECHNICAL ENGINEER FOR ADDITIONAL ASSISTANCE

Most ASFE-member consulting geotechnical engineering firms are familiar with a variety of techniques and approaches that can be used to help reduce risks for all parties to a construction project, from design through construction. Speak with your geotechnical engineer not only about geotechnical issues, but others as well, to learn about approaches that may be of genuine benefit. You may also wish to obtain certain ASFE publications. Contact a member of ASFE of ASFE for a complimentary directory of ASFE publications.

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