Appendix B

Geologic Assessment

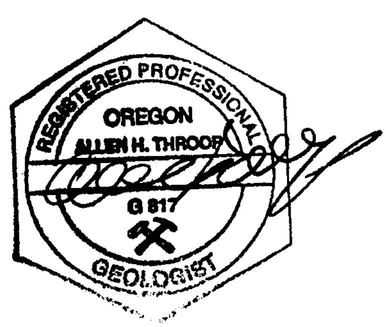
Throop Report (May 31, 2002)

Schlicker Report (January 9, 1989)

Addendum to Schlicker Report (March 29, 1989)

A Geologic Assessment of the Rock Resources of the western portion of Interstate Rock's Howard Canyon Quarry Multnomah County, Oregon

By: Allen H. Throop RG 817
2340 NW Arthur Ave.
Corvallis, OR 97330
541 753-1804
throopa@peak.org
May 31, 2002



Summary

This report was prepared at the request of Multnomah County to determine the location, quality, and quantity of any rock resource in the western portion of the Howard Canyon Quarry property, which is currently being mined by Interstate Rock Products, Inc. The aggregate resource site is located in eastern Multnomah County, approximately 2 miles southeast of Corbett school as shown on figure 1. Specifically, the study is focused on the westerly 1,000 feet of the N1/2, Sec.1, T1S, R4E (figure 2). The basalt in the study area is an extension of the rock to the east but the shape of the resource in the two areas are distinctly different.

The rock underlying the prominent ridge through the study are is expected to be of a quality similar to that of the area to the east. Due to changes in the shape of basalt resource, mining in the study are is expected to yield for each yard that the quarry face is advanced approximately $1/8^{th}$ of the material that will be produced per yard of advance of the quarry east of the study area.

The conceptual mine plan reviewed for this report contains numerous environmental concerns.

Scope of work and background

The purpose of this study is to evaluate the location, quality and quantity of the aggregate resources and to review the potential environmental impacts of the proposed mining in the western 1,000 feet of the designated aggregate resource area.

In 1989, H. G. Schlicker and Associates completed a geological assessment of the Howard Canyon Quarry (Appendix 1). The Schlicker report was used as a basis for a finding by Multnomah County that the site should be designated as a significant aggregate resource under Oregon's Statewide Planning Goal 5. The Schlicker report did not define the extent of the resource but test pits were dug on a grassy flat-topped ridge that is mostly east of the 1000-foot study area (figure 2). The focus of this assessment is the prominent tree-covered sharp, steep-sided hogback ridge shown in figure 2 and figure 5. The transition from the bog-backed ridge to the flat-topped ridge is about 840 feet east of the western boundary of the property.

Multnomah County has accepted the entire site, including the area covered by the Schlicker report and the present study area, as a significant aggregate resource. Multnomah County's acknowledged comprehensive plan references Oregon Administrative Rule (OAR) 660-016 for determining the significance of an aggregate site. This rule contains no set standards for the quality or quantity of rock needed to make a determination of site significance. The Oregon Department of Land Conservation and Development (DLCD) has adopted more stringent requirements for significance (OAR 660-023-180 (3)) but they are not applicable in Multnomah County.

Methodology and background data available

The estimated extent, quantity and quality of the basalt resource shown in this report was determined after:

- a site visit on January 18, 2002,
- a review of the Schlicker report (Appendix 1),
- examination of stereo-pair aerial photos of the site taken by Spencer B Gross Inc. taken in 1999 and by WAC Corp taken in 2000 (Appendix 2),
- review of two rock quality test results run by ODOT (Appendix 3) on samples collected during the site visit,
- examination of the 1983 Multnomah County soil survey by the US Soil Conservation Service (SCS),
- evaluation of a petrographic study by Dick M.Glasheen on samples collected during the site visit. (Appendix 4) and
- review of a 2001 letter from Landslide Technologies to Interstate Rock Products, Inc. (appendix 5).
- Review of sheets 1 through 8 of a quarry development plan drawn by Olson Land Surveyors and Engineers for Interstate Rock Products and dated April 9, 2002.

A portion of sheet 3 of 8 of the 2002 Olson plan is used as a base map for figures 2 and 3 to make clear the relationship between the areas referred to in this report and those used by Interstate Rock Products. The areas of phases 6 and 7, which are referred to throughout this report, are the last two areas scheduled for mining on the Olson sheets. The area of phase 7 approximates the outline of the rock resource within the study area

According to the Schlicker report, the basalt is approximately 40 feet thick in the area of the two existing quarries, which are about 1,500 to 2,000 feet east of the study area. Additional information about rock thickness under the flat-topped ridge may have been collected during exploratory drilling done after completion of the Schlicker report. The drilling program is mentioned in the Schlicker report and was mentioned by a landowner during the visit but no information from that drilling program has been made available for this report.

According to the Schlicker report, the rock that is the focus of this study is a basalt flow that filled a valley cut into unconsolidated or semi-consolidated sediments. Since the basalt filled the valley, erosion has removed the hills of sediments that once existed to the north and south of the now buried canyon. Now, Knieriem Creek flows to the north of the ridge and Howard Creek to the south (figure 1). According to the Schlicker report, the basalt is Boring Lava and the underlying sediments are in the Troutdale formation.

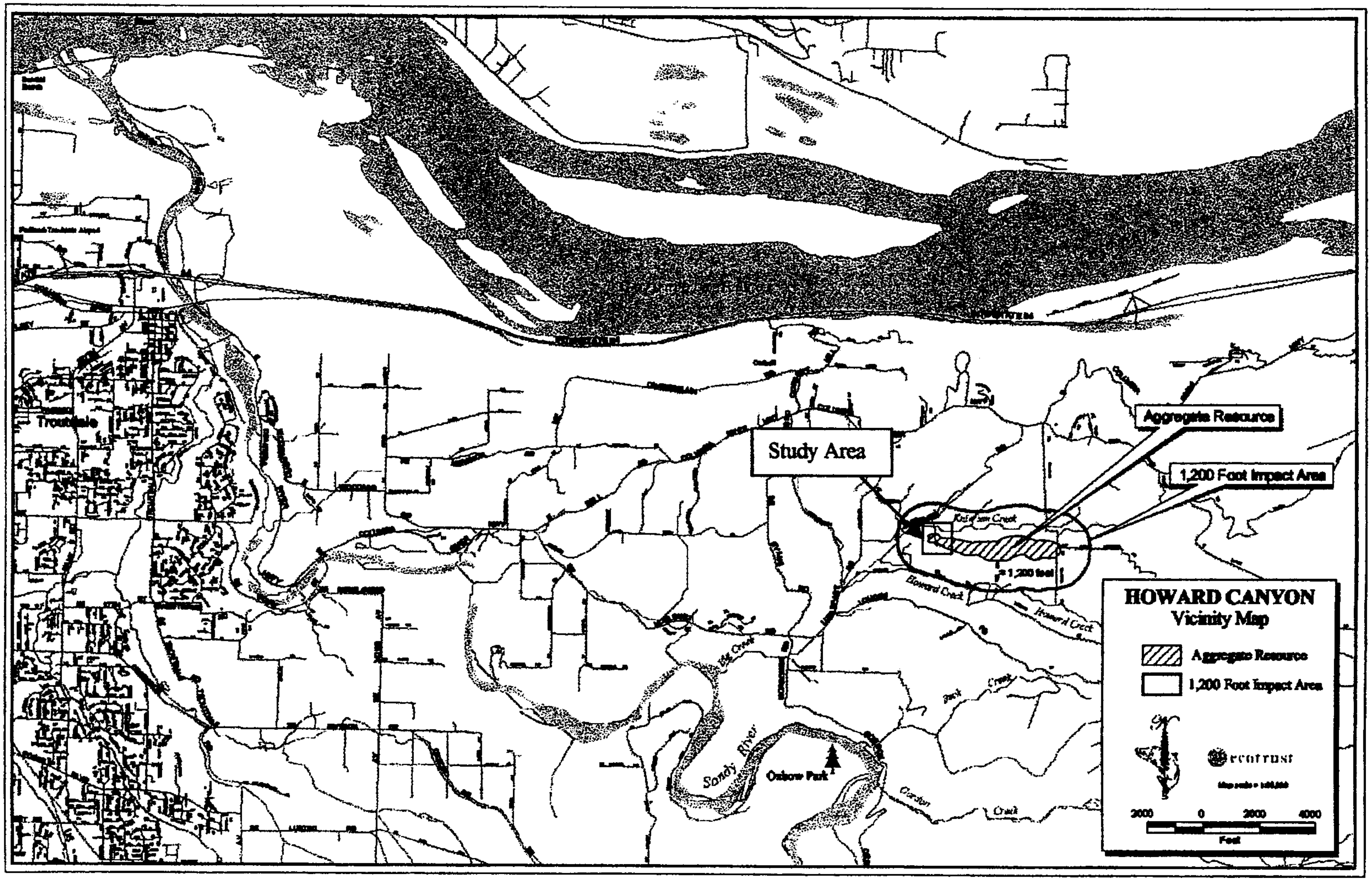

Study Area
Aggregate Resource
1,200 Foot Impact Area
HOWARD CANYON
Vicinity Map
Aggregate Resource
1,200 Foot Impact Area
ecotrust
2000
0
2000
4000
Feet
Troutdale
Sandy River
Oxbow Park
Howard Creek
Gordon Creek
1,200 feet

Figure 1

Site Investigations

A site visit was conducted on January 18, 2002. I was accompanied on the visit by Glennda McLucas, a geologist representing Interstate Rock Products, Inc.; Leroy Smith and Raymond Smith (in part), landowners; Kim Peoples and Adam Barber, Multnomah County Planning Department; and two laborers from Interstate Rock.

During the visit, we inspected the existing quarries and walked or drove over most of the flat-topped ridge east of the study area, walked down the farm road that goes down the south side of the ridge in the phase 6 area and walked along the top of the hog-backed ridge of phase 7. One bulk sample for rock quality testing was collected from the two existing quarries. A second sample was collected from the unweathered rocks mixed in the soil along the hog-backed ridge and along the farm road south of phase 6. The sample collection traverses are shown on figure 2. McLucas collected the four samples that are described in the petrographic analysis by Glasheen
(Appendix 4). Sample 1 west and Sample 2 west were collected during the traverse.

The nearest place to phase 7 where the thickness of the basalt could be determined was in the cutbank of the farm road south of phase 6. The road was cut across the side of the slope south of the phase 6 to allow the landowner easy access from the grazing areas above and below the slope. The road cut is approximately 5 feet high. Large basalt boulders, mixed with soil, are abundant in the cutbank near the top of the ridge. There is no evidence that solid rock was encountered as the road was constructed. McLucas, Barber and I agreed upon the location that seemed to be lowest elevation where basalt boulders were abundant in the road cut. This elevation was assumed to represent the bottom of the basalt. I saw no definite outcrop but the concentration of basalt below that point was distinctly lower.

Using a hand level, Barber and I determined that the bottom of the basalt was approximately 40 feet below the highest basalt exposed at the upper end of the farm road. The Schlicker report states that the basalt is also about 40 feet thick in the existing quarries to the east.

After walking over the flat upland portion of the site, I have little doubt that basalt underlies the fields of phase 6. A layer of silt (loess according to Schlicker report) underlies the fields of phase 6 and therefore overlies the basalt. In a few areas of phase 6, basalt outcrops along the break in slope at the edge of the field. A few basalt boulders are on the surface near the edges of the field. The Schlicker report contains results of backhoe tests over the entire flat-topped area, which confirm the existence basalt under the silt. Schlicker's backhoe test holes 7 and 8, which were in the western-most pits hit "medium hard rock" at 4 and 5.5 feet below ground level, respectively. The approximate locations of these two holes, which are within the study area, are shown in figure 2.

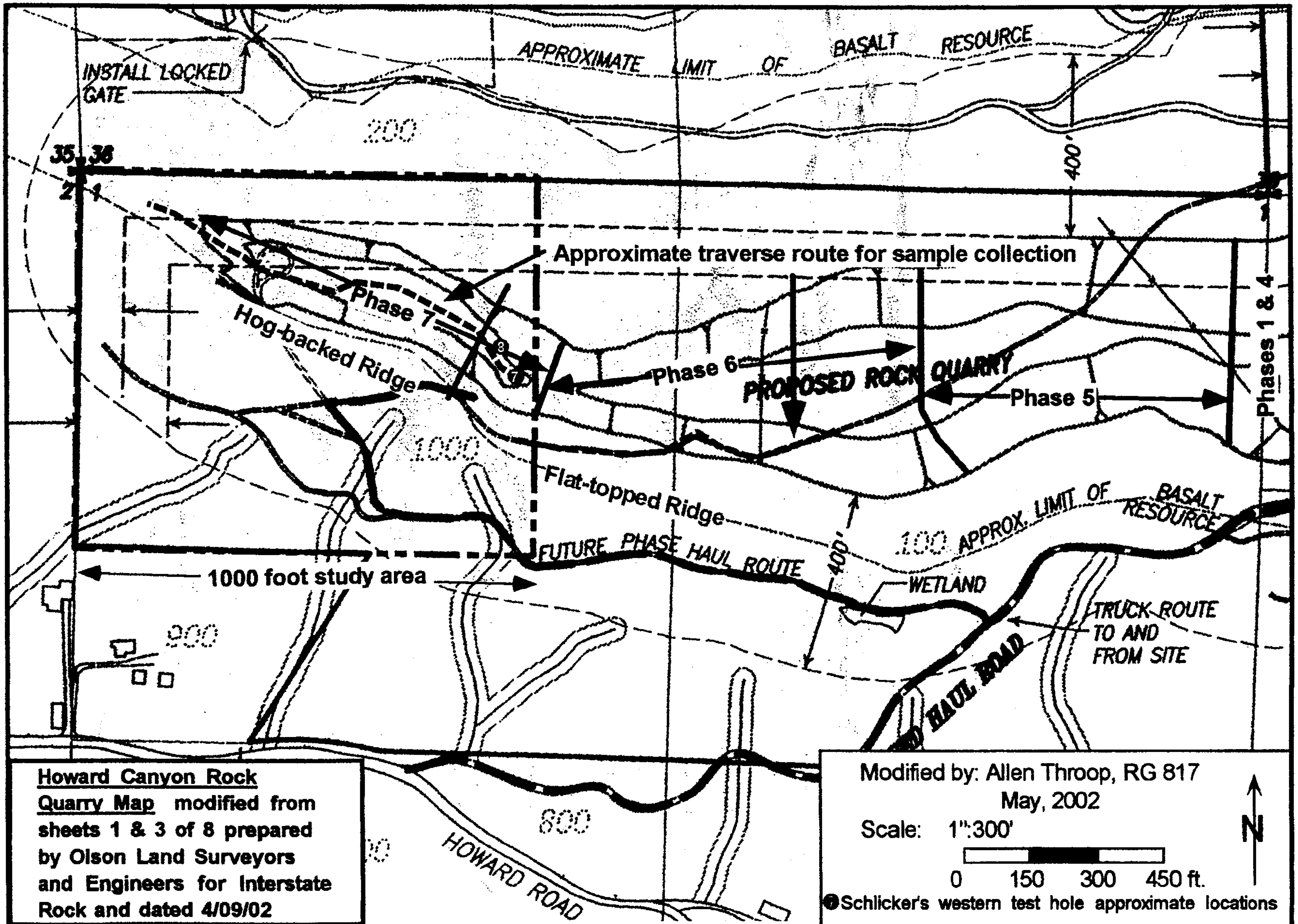


Figure 2 Study Area Detail Map

26-0065 Howard Canyon - Olson site map

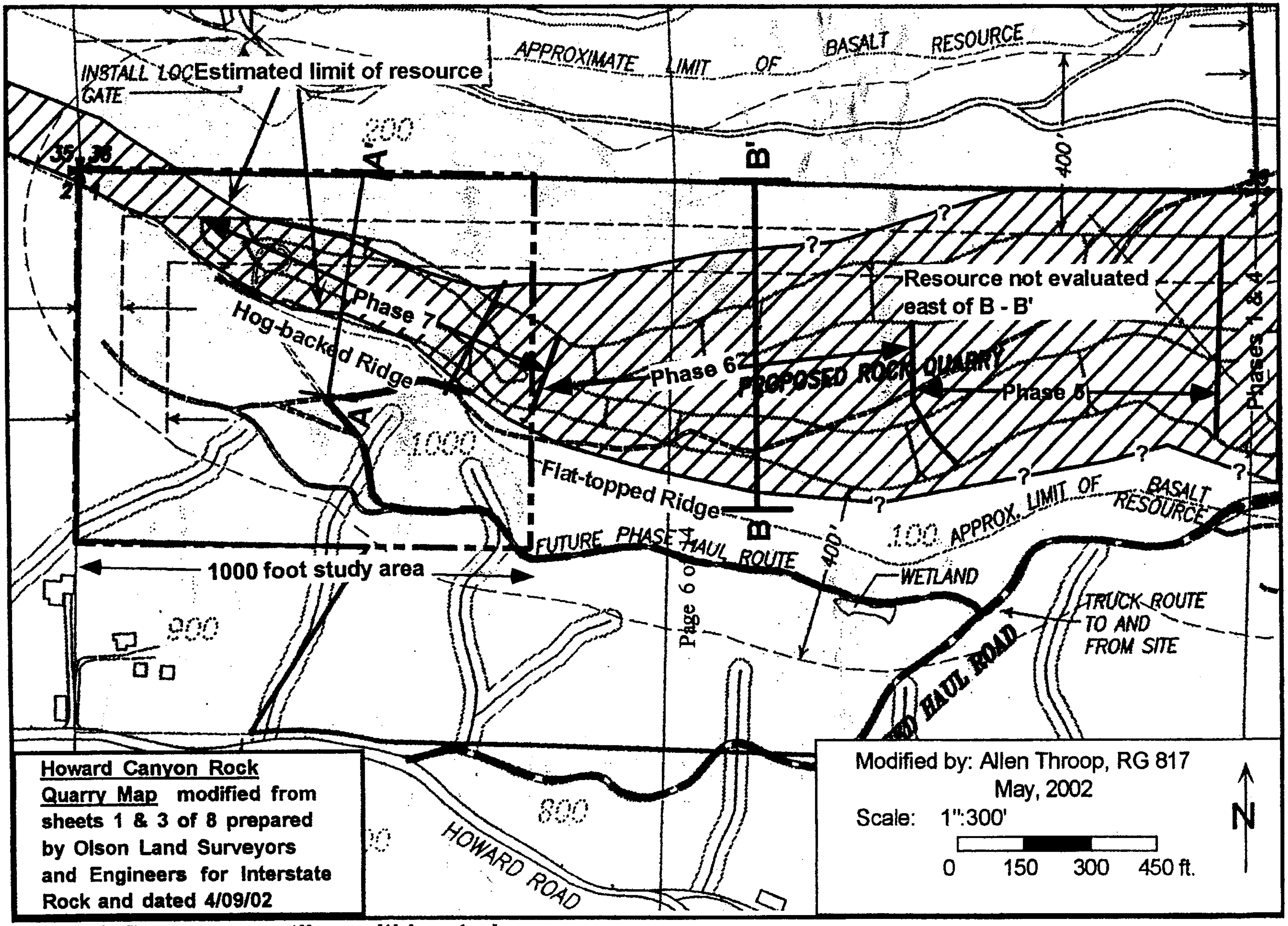


Figure 3 Resource outline within study area

26-0065 Howard Canyon - Olson site map - geology layer

Aerial photography and the existing soil survey of the area were also used to attempt to define the bottom of the basalt flow. Stereo pair photos by Spencer B. Gross taken in 1999 and by WAC Corp. taken in 2000 (Appendix 2) both show very well the break in slope between the flat-topped ridge and the slopes to the north and south and break in slope at the bottom of the ridges. I have seen no evidence to suggest that the change in rock type can be identified, to the accuracy required for rock reserve delineation, via aerial photo interpretation.

A petrographic analysis by Dick M.Glasheen (appendix 5) compares two rock samples from the study area with another two from the active quarries. The petrographer's conclusion is that the rocks are from the same unit. This conclusion strengthens the argument that a good quality basalt unit underlies the phase 7 area.

A review of the Multnomah County Soil Survey (1983) produced by the Soil Conservation Service (now the Natural Resources Conservation Service) shows that the soil units in the area are defined by slope steepness. Therefore the soil survey is not useful in defining the extent of the basalt.

As mentioned previously, Multnomah County does not require the rock from significant sites to meet any specific quality or quantity standards. The basalt at this site does meet DLCD's quality and quantity standards as defined in OAR 660-023. To meet DLCD's current standards for a significant aggregate site the rock must be meet ODOT's degradation and abrasion standards for base rock and the site must contain at least 2 million tons of rock. The figures in Table 1 indicate that the rock quality of this site meets the quality standards. The Schlicker calculation of more than 2 million yards of basalt on the entire property means that the rock resource defined in that report could qualify as a significant resource under OAR 660-023.

Based on the field review, the petrographic comparisons, the ODOT analytical work and the Olson topographic map (sheet 3), I conclude that the phase 7 area contains a geologic resource of approximately 140,000 cubic yards or more of basalt. The geologic reserve goes to the property line; the mineable resource will be smaller. My estimate of the aerial extent of the basalt is shown on figure 3. The resource volume is based on the conservative assumptions that the basalt was 40 feet thick in the phase 7 area as it is to the east and that the top 10 feet have weathered into the mixture of basalt boulders and soil that now overlies the solid rock (figure 4). The 10 feet of overburden that forms the top and sides of the phase 7 area would need to be stripped and stockpiled. Volume calculations are shown in table 2. For comparison purposes, I have made a similar calculation of the geologic resource of the Olson phase 6 area. The important item to note from the comparison is that for each average yard along the length of phase 6, about 2000 cubic yards of resource would be found. In the phase 7 area, each yard along the axis of the deposit contains only about 210 cubic yards of resource. Therefore each yard of advance in the phase 6 area yields at least 8 times as much rock as would a similar advance in the phase 7 area.

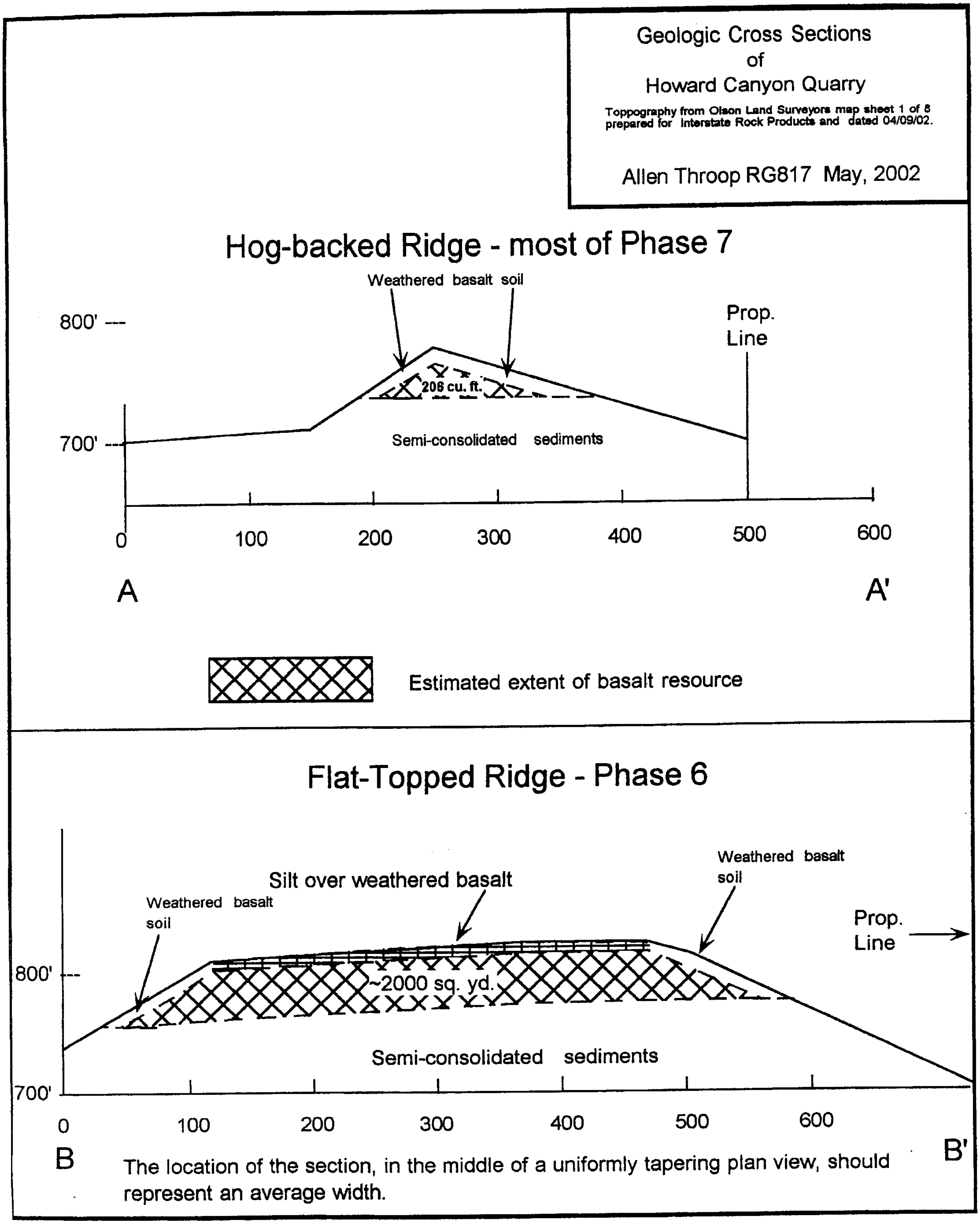


Figure 4 - Cross sections

TABLE 1 ODOT Rock Quality test results

Lab No. & source	Test date	Coarse degradation		Abrasion	Apparent gravity
		850 sieve	Sediment height		
	Standards:	30.0% max.	75 mm max.	Maximum: 35.0%	No standard
02-000145 Study area	01-29-02	21.9%	15 mm	30.2%	2.857
02-000188 Existing quarries	01-31-02	19.4%	12 mm	30.4%	2.832

Mine Plan Review

The Olson mining plans show that the hogback ridge (phase 7) will be mined using a completely separate infrastructure of roads and stormwater control systems from that used in phases 1 through 6 to the east. This is appropriate considering the differences between the topography, overburden, and vegetation in the two areas. The mining plans in the Olson report for phase 7 raise numerous environmental issues that will be discussed next and are summarize in table 3.

If more detailed geological information was used in the formation of the Olson sheets than what is presented in the preceding section, that information was not submitted for this review. The geological information is adequate to determine if a resource is present or not but it is not adequate for detailed mining plans. On the other hand, phase 7 mining is not scheduled for 40 years. As mining approaches the phase 7 area, information gathered from the advancing quarry face will be greatly superior to what would be gathered now with a few drill holes or seismic lines. Furthermore, mining equipment and practices can be expected to change considerably in the intervening years. Neither detailed mining reserve calculations nor detailed mining plans are appropriate for phase 7 at this time.

The issues discussed are meant to address the concepts presented in the phase 7 mining plan rather than addressing details that surely will change. Therefore the design details of sediment collection basin and other data included in some of the Olson sheets are not included in this review.

All mine plan that affect steep slopes such as those of phase 7 are subject to the Department of Geology and Mineral Industries (DOGAMI) steep-slope review. Removal of a thick overburden from a long steep slope that consists of soil and large boulders mixed with tree stumps will be very difficult to complete without negative off-site environmental impacts such as rolling boulders and turbid stormwater. This should not be done without very detailed planning scheduling and execution.

While topsoil removal is difficult but possible, stockpiling the removed overburden on steep slopes as shown on figure 2. is an approach that should not be approved by DOGAMI A letter from Landslides Technology to Interstate Rock dated January 25, 2001 (Appendix 5) recommends no construction of such stockpiles on ground steeper than 2H:1V.

Table 2 Howard Canyon Rock Resource Calculations

		Phase 6 Geological reserve	Phase 7 Geological reserve
Cross section area	sq. ft.	17627	1859
Cross section area – rounded	sq. yd.	2000	210
Length of area	ft.	830	1000
Length of area	yd.	280	330
Vol. Formula		V= (X.Sec. Area)* length	V= (X.Sec. Area)* length
Vol. Calc.	Cu. Yd.	560,000	69,000
Weight of rock	Tons	1,312,416	161,708
Weight of rock – rounded	Tons	1,300,000	160,000
Ratio rock per yd along the axis -	phase 6:phase 7		8:1

Constants used:	
Specific Gravity	2.8 from ODOT test
Weight of a cubic yard of water	1674 pounds

More overburden will be removed from the phase 7 area than could be stored in the locations shown on the Olson plans (figure 2). The phase 7 mining area is roughly 800 feet long and roughly 180 feet wide. Assuming a flat surface and only 6 feet of overburden, phase 7 will have 860,000 cubic feet or 32,000 cubic yards of overburden, without applying any expansion factor. The two overburden storage areas shown for phase 7 on figure 5 total about 700 feet in length with a width of perhaps 35 feet. Such storage, if built on a flat area with the piles constructed with 1:1 slopes would have a height of 18 feet and therefore a volume of 220,000 cubic feet or 8,000 cubic yards. (Stockpile slopes of 3:1 are generally required by DOGAMI.) Obviously more stockpile room is necessary.

Access and stormwater control of phase 7 mining requires entirely different facilities from those of phases 1 through 6. The location of the road and a major retention pond are shown on Olson map 3 south of phase 6 and 7. The proposed dam for stormwater retention is located south of phase 7 at an elevation of approximately 650. The road is located between 650 and 700 feet. he letter from Landslide Technology (appendix 5) mentions that the benched south slopes between 625 and 725 feet are probably old landslide areas. Very specific geotechnical mapping should be done before construction of a road and especially a water retention structure south of the ridge.

Table 3 Comparisons of the physical settings of the flat-topped ridge and hog-backed ridge areas

Item	Flat-topped Ridge	Hog-backed Ridge
Over-burden	Mapped as clayey silt in the 1989 Slicker report. Material removal with scrapers should be routine. Material depth well documented in the Schlicker report.	Mixture of deeply weathered basalt soils (clay and silt) and large boulders (up to six feet in diameter) on a 1 ¼ (H):1 (v) slope. Material removal will be extremely difficult. Overburden depth unknown. The nearest analogous site (the farm road cuts south of phase 6) suggests a minimum of 10 feet.
Vegetation	The flat surface is in pasture. Soil layers can easily be segregated for optimum revegetation.	The steep hillsides are covered with trees and blackberries. Trees would need to be cut and removed. Stumps would need to be segregated from the soil and the large rocks for proper disposal. Again this is on a steep hillside.
Over-burden storage	Overburden can be easily stored, as shown, within the cell being currently mined or in a previous one.	Overburden cannot be accommodated in the areas shown on the 2002 Olson sheets since the hillsides are too steep and the volume of material produced could not be accommodated in the areas shown even if it was on flat ground.
Crusher location	One location for phases 1 through 6.	A new, unspecified location is required
Access	Phases 1 through 6 all use the same access.	An entirely new access road is needed. The route shown on the 2002 Olson sheets traverses unstable areas defined in the 2001 Landslide Technology letter.
Storm water control	Water from Phases 1 through 6 will exit via the one storm water control system.	An entirely new storm water control system for the access road and for the phase 7 quarry must be established. The retention pond location shown on the 2002 Olson sheets is within the unstable area defined in the 2001 Landslide Technology letter.
Rock resource	All indications point towards a resource of quality rock that should yield .2000 cubic yards or more of rock for each yard that the face progresses.	The same basalt unit underlies the hogback that underlies the flat-topped ridge. Indications are that a quarry in the phase 7 area would produce only about 210 cubic yards of rock for each yard the face progresses..

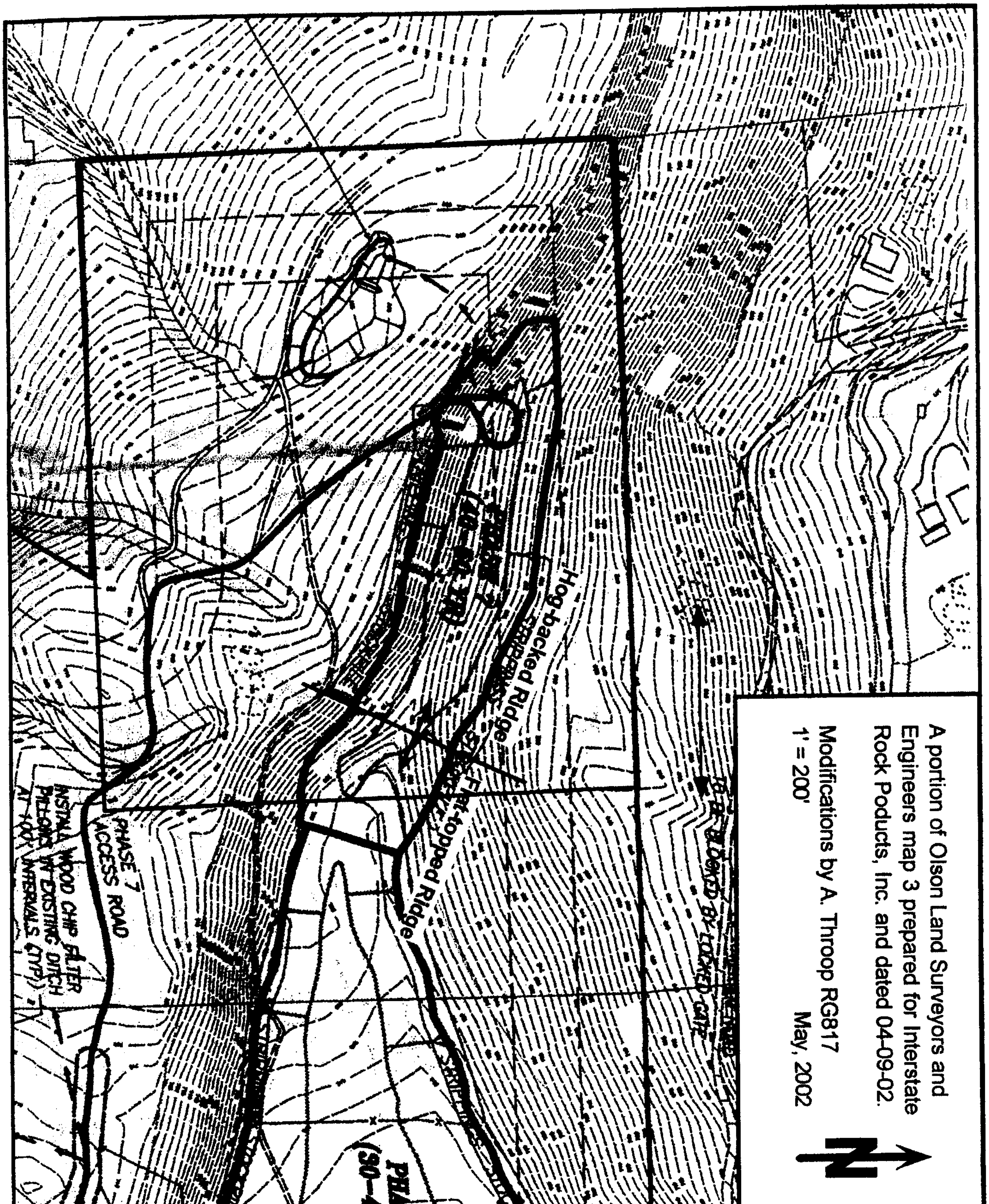

A portion of Olson Land Surveyors and Engineers map 3 prepared for Interstate Rock Poducts, Inc. and dated 04-09-02.
Modifications by A. Throop RG817
1' = 200'
May, 2002
Hog-backed Ridge
Flat-topped Ridge
PHASE 7
ACCESS ROAD

Figure 5

List of Appendixes:

1. H.G. Schlicker & Associates report of project #88-416 dated January 9, 1989
2. Aerial photograph references
3. Oregon Department of Transportation materials laboratory reports 02-000145 and 02-000188
4. Petrographic report by Dick Glasheen
5. Howard Canyon Quarry Geologic Hazard Assessment by Landslide Technology dated January 25, 2001.
6. Resume for Allen H. Throop, Geologist

GEOLOGIC RECONNAISSANCE
HOWARD CANYON QUARRY
EAST MULTNOMAH COUNTY, OREGON

for

Mr. Raymond Smith
P.O. Box 183
Corbett, OR 97019

Project #88-416

January 9, 1989

H.G. Schlicker & Associates, Inc.

H.G. Schlicker & Associates, Inc.
235 N.E. 122nd Avenue, Suite 315 • Portland, Oregon 97230
(503) 257-9666
Geologists • Engineers

Project #88-416

January 9, 1989

Mr. Raymond Smith
P.O. Box 183
Corbett, OR 97019

Dear Mr. Smith:

We are pleased to present this geologic reconnaissance of the Howard Canyon Quarry and a rock resource evaluation of East Multnomah County. Thank you for the opportunity of assisting you regarding the Howard Canyon quarry.

We will provide the additional drilling information as an addendum when it becomes available. Please contact us if you have any questions concerning this report.

Sincerely,

H.G. SCHLICKER AND ASSOCIATES, INC.

Herbert G. Schlicker

Herbert G. Schlicker, P.G., C.E.G.
President

HGS:kh

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H.G. Schlicker & Associates, Inc.
235 N.E. 122nd Avenue, Suite 315 • Portland, Oregon 97230
(503) 257-9666
Geologists • Engineers

Project #88-416

January 9, 1989

Mr. Raymond Smith
P.O. Box 183
Corbett, OR 97019

Subject: Expansion - Howard Canyon Quarry

Location: SE 1/4 Section 36, T. 1N., R.4E, WM &
N 1/2 Section 1, T. 1S., R.4E, WM

Dear Mr. Smith:

This report presents our geologic study of the rock resource at the location described above.

INTRODUCTION

The site was investigated using a backhoe to excavate 31 testpits to determine the thickness of the overburden. Fourteen testpits were done for this study and 17 were previously done by Mr. Raymond Smith. The overburden averaged 7.2 feet in the 14 recently dug test pits located west of the 1/4 section line. About 1 to 2 feet of weathered rock appeared to be present. East of the 1/4 section line 17 previously dug test pits indicated similar conditions.

Local commercial rock is scarce or not available. As a consequence the price of rock delivered to the local area is excessive due to the long haul costs. Mr. Smith desires to produce rock at the Howard Canyon site for the commercial sector.

SITE CONDITIONS

The site is located on a broad ridge which runs along the entire section line between section 36 and section 1. The ridge is more than 500 feet wide and is entirely underlain by basalt lava. The ground surface is nearly level with gentle rolling topography and ranges between 780 and 860 feet elevation.

Access is available from both Howard Canyon on the south and Big Creek Canyon on the north. The site is about 3 miles by road to Highway 30 and less than 5 miles to interstate 84.

Herbert G. Schlicker, P.G., C.E.G., President
John A. Talbott, P.E., Vice President
Mark E. Shaffer, P.E., P.G.
J. Douglas Gless, P.G., C.E.G.
Russell J. Ralls, P.G.

GEOLOGY

General

The site is located in the western foothills of the Cascade Range 18 miles east of Portland and less than 2 miles by direct line south of the Columbia River. The quarry produces rock from the Boring Lava Formation which caps the ridge between the canyon of Big Creek on the north and Howard Canyon on the south. The basalt overlies the Troutdale Formation which is exposed in the canyon walls beneath the Boring Lava.

Troutdale Formation

The Troutdale Formation is composed mainly of sandstone and conglomerate and was named for exposures in cliffs along the Sandy River near Troutdale. The Formation is wide spread in occurrence and was deposited as a great piedmont from the west flank of the Cascade mountains. The underlying Columbia River Basalt Formation which underlies the Troutdale elsewhere is not exposed locally.

Boring Lava Formation

Boring Lava overlies the Troutdale Formation. About 2 million years ago Boring vents in the Portland area erupted both basalt lava and pyroclastics. The Boring Lava typically flowed into existing stream valleys.

The occurrence of the Boring Lava along the ridge tops in this area was brought about by a sequence of geologic events. First, streams carved canyons in the existing Troutdale terrain. Secondly, the canyons were filled by basalt lava which erupted from the Boring vents. Thirdly, streams cut new channels in the softer Troutdale sediments that was left exposed between the lava filled canyons. This resulted in inverted topography with the former basalt filled canyons now the basalt crested ridge tops.

The Boring Lava is composed of a light gray olivine basalt with expanded texture. The pyroclastics known as the Boring Agglomerate consists of fragments and boulders of lava mixed with ash. The ash is often weathered to a red clay soil. The agglomerate is not used for rock sources. For this reason only select areas mapped as the Boring Formation can be used for crushed rock. The Howard Canyon quarry is the only site known to be available to produce rock in the area east of the Sandy River.

The Boring basalt is frequently massively jointed and oversize material can occur from blasting operations. Large rock has use for rip-rap and building stone described later under "Rock Resource".

Loess

The thin Loess, or sandy silt soil which caps the ridges south of the Columbia River in this region, is a deposit carried by the wind from the Columbia River floodplain sometime during final stages of the glacial period. It is composed of minor sand and glacial silt originally deposited over a broad Columbia River floodplain. Strong winds blowing south from the ice sheet somewhere south of the Tacoma Washington area carried the sediments south from the Columbia River. At the site these soils average about 6 feet thick.

ROCK RESOURCE

Quantity

The basalt occupies the upper 50 feet or more of the ridgecrest except for the thin Loess overburden. The ridge rock deposit is more than 4200 feet long and 350 feet wide and contains at least 33 acres of ground. The volume of rock in place is then (4200' x 350' x 40')/27 = 2,177,778 cu yards. When rock is crushed it expands about 25% therefore the deposit will produce more than 2.7 million tons of crushed basalt.

Because the lava is believed to occupy an old stream valley and the center of the valley should be much deeper, the deposit should be thicker than it appears and an estimate of an additional 30% of rock is not unreasonable. This additional rock would bring the total to 3.5 million tons. Drilling is underway to determine the actual thickness of the deposit and the results will be presented as an addendum to this report.

Quality

Exposures in the existing quarry face show the basalt to be columnar jointed and thinly weathered. Beneath the thin weathering scale the rock is hard and fresh. The top 2 feet of the basalt appears to be highly weathered and is considered as overburden in this report. Tests show the partially weathered rock to make satisfactory base rock. The harder fresh rock can be used for oil and topping.

The overburden is conservatively assumed to be about 10 feet thick and includes about 2 feet of weathered basalt. This overburden is easily mined and requires no processing and it is a marketable commodity.

Overburden can be used for fill and topsoil and both are in demand.

In addition to crushed rock, the site can produce high quality rip-rap. This material is scarce and after major floods is in short demand.

Mr. Smith has had preliminary conversation concerning possible use of the quarry rock for building stone. Many of the historic building in the area were built from Boring Basalt.

ROCK RESOURCES IN EAST MULTNOMAH COUNTY

East Multnomah County area includes all of Multnomah County east of Troutdale to the crest of the Cascade Range. Our records show that this area contains 22 quarries and/or gravel pits. At the present time none of these sites is available for commercial use. Four are owned by the Oregon Highway Division, fourteen by the United States Forest Service and four are privately owned. Eleven of the Forest Service quarries are located within the Bull Run watershed, four Highway Division sites and three of the four privately owned sites have been eliminated because they are within the Columbia River Scenic area. Only one site, the Howard Canyon quarry is available for use as a commercial rock source. No other sites which could produce commercial rock are known within the area.

ROAD CONDITIONS

We understand that the county has shown concern regarding the haul roads within Howard Canyon beginning at its junction with Littlepage Road. The concerns are restricted sight distance at 2 curves and ability of the road to hold up under truck traffic.

It is reported that the road contains 9 inches of rock and capped by 2 inches of built up asphalt. Logging trucks have been using this road without difficulty and with no apparent unusual road damage. Rock trucks are not likely to cause greater stress than logging trucks.

There are two areas along Littlepage Road that may have marginal sight distance. These two areas have roadcuts at the inside of the turn along the south side of the road.

The site distance could be improved by cutting away several feet of bank near the center of the curves, an estimated 5 feet or so. If necessary the speeds could be specified through the curve areas.

Troutdale sandstone is of sufficient strength to stand vertically and could be easily dressed back to provide more sight distance. The excavation will not cause any instability of the slopes.

CONCLUSIONS AND RECOMMENDATIONS

At the present time, there are no commercial quarries located in East Multnomah County. Unless rock from the Howard Canyon quarry is made commercially available there will be a continuing hardship to any potential users of rock, both government and private.

We recommend that the Howard Canyon Quarry owned by Mr. Raymond Smith be granted the privilege of selling rock commercially.

LIMITATIONS

Our investigation was based on geological reconnaissance and available published information. The data and recommendations presented in this report are believed to be representative. The conclusions and recommendations herein are professional opinions derived in accordance with current standards of professional practice and no warranty is expressed or implied. It has been our pleasure to serve you. If you have any questions concerning this report of the site, please contact us.

Respectfully submitted,

H.G. SCHLICKER AND ASSOCIATES, INC.

Herbert G. Schlicker, P.G., C.E.G.
President

HGS:kh

APPENDIX

ROCK MATERIALS OF MULTNOMAH COUNTY, OREGON
Plate 3, Special Paper 3, Oregon Dept. of Geology

Quarry No.	Ownership	Location	Past Prod.	Rock	Reserves Thousand cy
27	C.T. Howell	NW 1/4 Sec 31, 1N,4E	100	Boring Lava	150
28	Hershel McGriff	NW 1/4 Sec 22, 1N,5E	50	Columbia River Basalt	100
29	OSHD	SW 1/4 Sec 14, 1N,5E	500	Columbia River Basalt	3
30	Raymond Smith	NE 1/4 Sec 27, 1N,5E	75	Boring	25
31	OSHD	SE 1/4 Sec 7, 1N,5E	50	Columbia River	200
32	OSHD	NW 1/4 Sec 1, 1N,6E	0	Columbia River Basalt	5000
33	USFS	SW 1/4 Sec 33; 1N,6E	2	?	?
4a	OSHD	NE 1/4 Sec 3; 2N,7E	225	Columbia River Basalt	2000
34	USFS	SE 1/4 Sec 24; 1N,6E	5	?	?
35	USFS	Sec 20; 1N,7E	3	?	?
45	USFS	SE 1/4; 1S,5E	2	?	?
46	USFS	SW 1/4 Sec 1; 1S,6E	3	?	?
47	USFS	SE 1/4 Sec 10; 1S,6E	17	?	?
48	USFS	NE Sec 10; 1S,6E	6	?	?
49	USFS	SW Sec 11; 1S,6E	2	?	?
50	USFS	NW Sec 21; 1S,6E	8	?	?
51	USFS	Sec 3; 1S,7E	5	?	?

Rock Materials of Multnomah County, Oregon (continued)

Quarry No.	Ownership	Location	Past Prod.	Rock	Reserves Thousand cy
52	USFS	SW Sec 22; 1S,7E	1	?	?
53	USFS	NW Sec 24; 1S,7E	3	?	?
54	USFS	SE Sec 19; 1S,8E	2	?	?
55	USFS	SW Sec 20; 1S,8E	1	?	?

See map for locations.

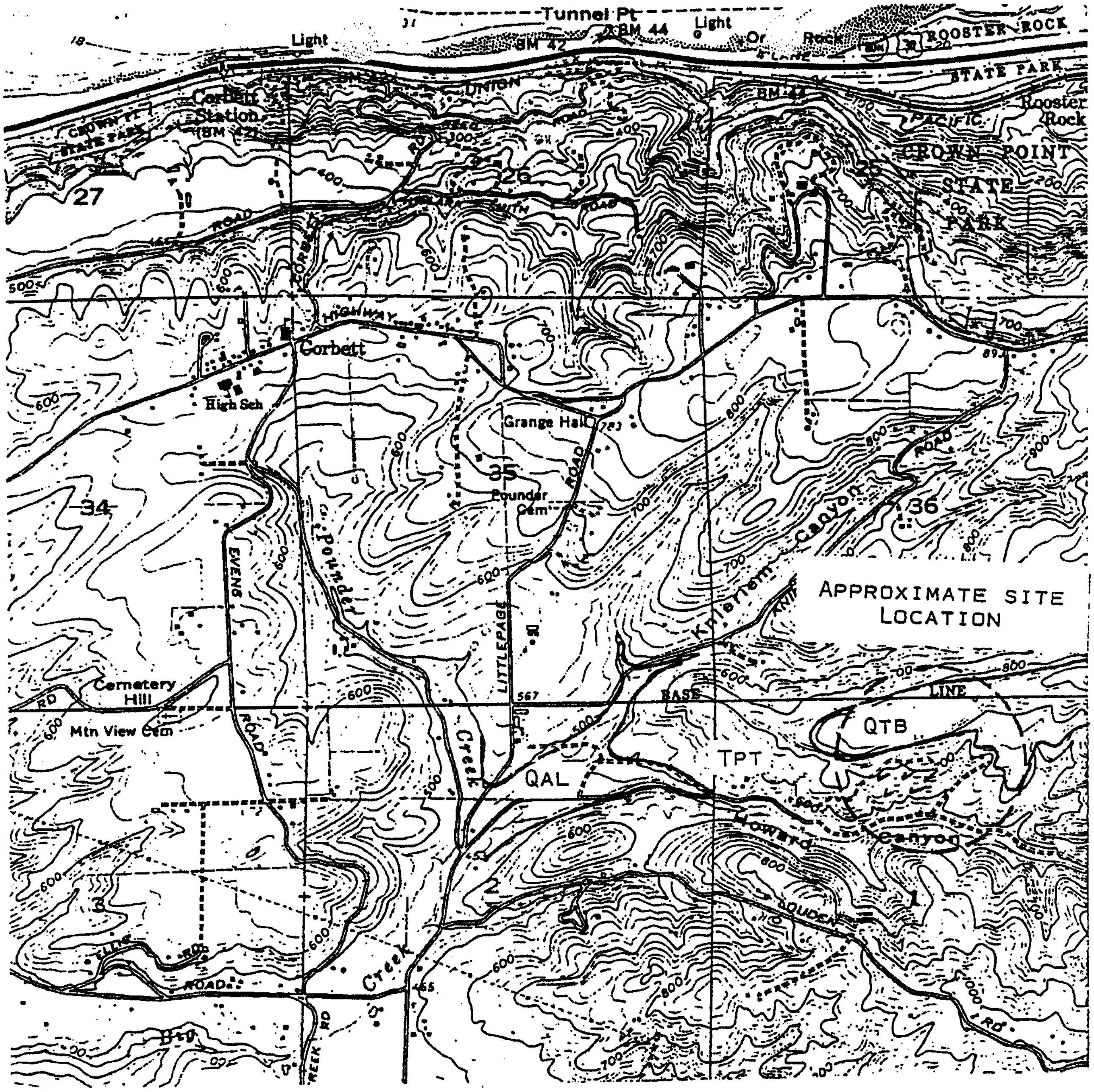
TEST PIT LOGS

TP-2	0 - 6"	Topsoil
	6"-10'	Clayey Silt
	10'-11'	Weathered Rock
TP-2	0 - 6"	Topsoil
	6"- 5'	Brown Silty Clay
	5'- 7'	Gray Clayey Silt
	7'-11'	Red Brown Clayey Silt
	11'-12'	Weathered Rock
TP-3	0 - 6"	Topsoil
	6"- 5'	Clayey Silt
	5'-6.5'	Weathered Rock
	6.5'-	Medium Hard Rock
TP-4	0 - 6"	Topsoil
	6"- 7'	Clayey Silt
	7'- 9'	Weathered Rock
	9'-10'	Medium Hard Rock
TP-5	0 - 6"	Topsoil
	6"-4.5'	Clayey Silt
	4.5'-	Medium Hard Rock
TP-6	0 - 6"	Topsoil
	6"- 7'	Clayey Silt
	7'-7.5	Weathered Rock
TP-7	0 - 6"	Topsoil
	6"-5.5'	Clayey Silt
	5.5'- 6'	Medium Hard Rock
TP-8	0 - 4'	Fill
	4'-	Medium Hard Rock
TP-9	0 - 6"	Topsoil
	6"-6.5'	Soft Rock
	6.5'-7'	Medium Hard Rock
TP-10	0 - 6"	Topsoil
	6"- 7'	Clayey Silt
	7'-7.5'	Soft Rock
TP-11	0 - 6"	Topsoil
	6"- 7'	Clayey Silt
	7'-8.5'	Soft Rock
TP-12	0 - 6"	Topsoil
	6"- 7'	Clayey Silt
	7'- 8'	Soft Rock

Test Pit Logs (continued)

TP-13	0 - 6"	Topsoil
	6"- 2'	Brown Clayey Silt
	2'-7.5'	Light Brown Clayey Silt
	7.5'-8'	Soft Rock

TP-14	0 - 6"	Topsoil
	6"- 9'	Clayey Silt
	9'-10'	Soft Rock

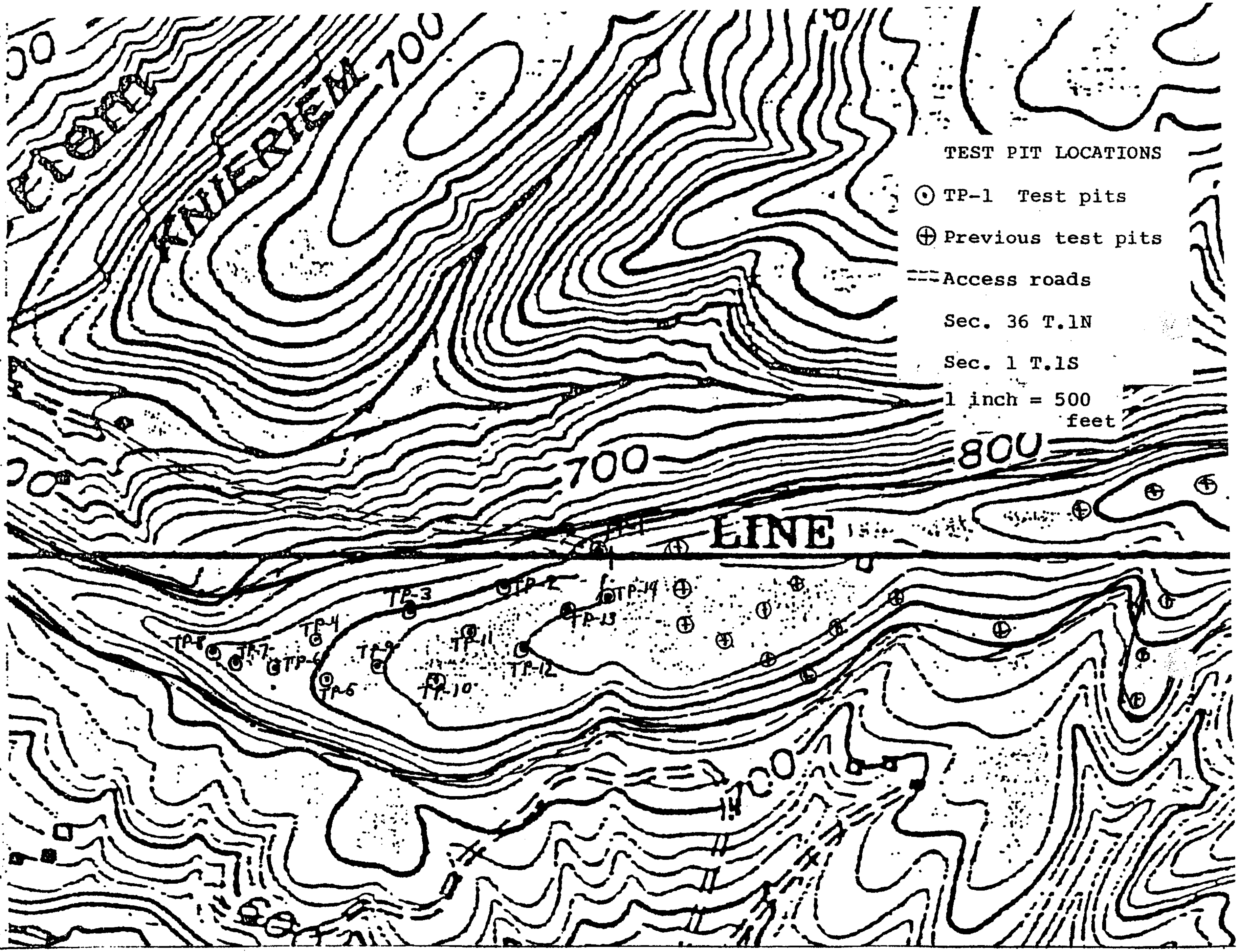


SITE GEOLOGIC MAP

PROPOSED HOWARD CANYON QUARRY SITE
MULTNOMAH COUNTY OREGON

QAL	QUATERNARY ALLUVIUM, RECENT STREAM SEDIMENTS
QTB	COLUMNAR BASALT, WITH BISCUIT WEATHERING ON OUTCROP
TPT	TROUTDALE FORMATION, SANDY GRAVEL AND SILTY SAND BEDS
✓✓	SLOPE MOVEMENT

BASE: A portion of Washougal, Wash.-Oreg.
U.S.G.S. 7½ min. Quad Sheet
Photo revised 1970 Scale 1"=2000'



TEST PIT LOCATIONS
TP-1 Test pits
Previous test pits
Access roads
Sec. 36 T.1N
Sec. 1 T.1S
1 inch = 500 feet
700
700
800
LINE
TP-1
TP-2
TP-3
TP-4
TP-5
TP-6
TP-7
TP-8
TP-9
TP-10
TP-11
TP-12
TP-13
TP-14

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235 N.E. 122nd Avenue, Suite 315 • Portland, Oregon 97230
(503) 257-9666
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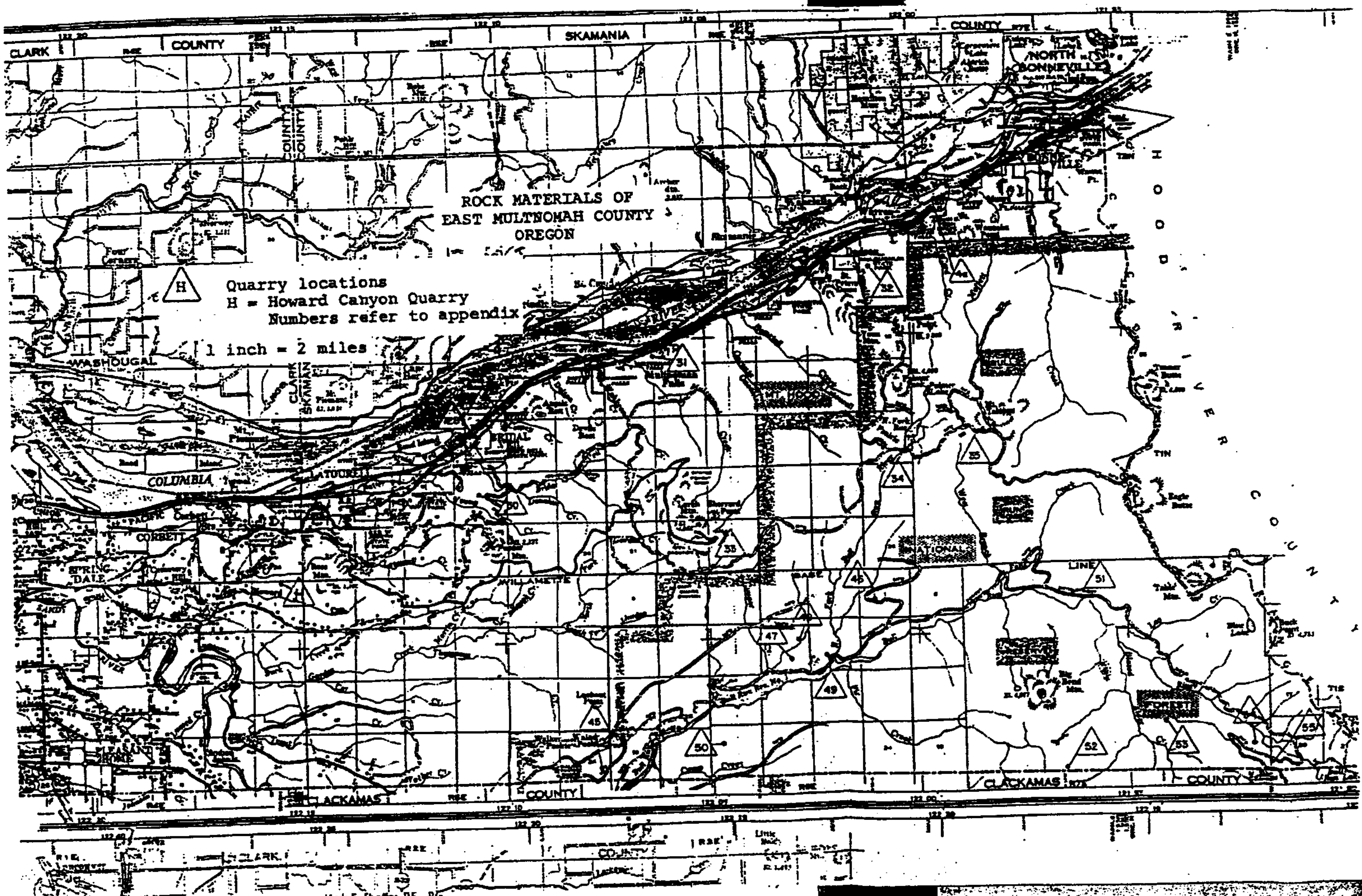

Mark E. Shaffer P.E., P.G.
J. Douglas Gless, P.G., C.E.G.
Russell J. Rolls, P.G.

H.G. Schlicker & Associates, Inc.
235 N.E. 122nd Avenue, Suite 315 • Portland, Oregon 97230
(503) 257-9666
Geologists • Engineers

HERBERT G. SCHLICKER
President, H. G. SCHLICKER & ASSOCIATES
Principal Geologist

EDUCATION

B.S. 1950. Geology, Oregon State University
M.S. 1953. Stratigraphy, Oregon State University

REGISTRATION

Engineering Geologist, Oregon, License No. E-1 and Idaho, No. 491
Certified Professional Geologist, American Institute of Professional Geologists, CPG-392

SUMMARY OF EXPERIENCE

Mr. Schlicker has more than 30 years of experience in Geology. He has worked as a subsurface geologist in Louisiana for a major oil company, and for 24 years as an engineering geologist for the Oregon Department of Geology and Mineral Industries. He is principal author of numerous geologic publications. Presently, he is a consulting geologist specializing in engineering geology, mineral and oil and gas and expert witness.

1980 - present	President, H. G. Schlicker & Associates, Consulting Geologists and Engineers
1955 - 1980	Geologist, State of Oregon, Department of Geology & Mineral Industries, Project Manager for geologic mapping projects and rock materials resource studies resulting in major publications. Engineering geologic consultant for state agencies.
(1974 - 1979)	Professor of Geology, Oregon State University, Corvallis, Oregon, courtesy appointment.
1953 - 1955	Subsurface Geologist, The Texas Company, New Orleans, Louisiana
1952 - 1953	Assistant Soils Engineer, Oregon Highway Department, Salem, Oregon

Herbert G. Schlicker, P.G., C.E.G., President
John A. Talbott, P.E., Vice President
Mark E. Shaffer, P.E., P.G.
J. Douglas Gless, P.G., C.E.G.
Russell J. Rolls, P.G.

SUMMARY OF EXPERIENCE, continued

1946 - 1952 Oregon State University, Bachelors and Masters programs

AFFILIATIONS

Oregon Academy of Science
American Institute of professional Geologists, CPG 392
Association of Engineering Geologists

OFFICES HELD

Chairman, Geology Section, Oregon Academy of Science
Chairman, Engineering Geologists of Oregon
Chairman and Treasurer, Oregon Section AIPG
Chairman, Board of Geologist Examiners, Oregon
Member of Advisory Committee AEG
Member of Hazards Committee AIPG

LIST OF PUBLICATIONS
Herbert G. Schlicker

PRINCIPAL AUTHORSHIP

1. Schlicker, H. G. and Finlayson, C. T. Engineering Geology and Hazards of Northwestern Clackamas County, Oregon: Oregon Department of Geol. and Mineral Indus., Bulletin 99, 1979.

2. Schlicker, H. G. Preliminary Geologic Hazards Report for Yoncalla, Sutherlin, Winston and Canyonville, Douglas County, Oregon, 1978.

3. Schlicker, H. G., Gray, J. J., and Bela, J. L. Rock Mineral Resources of Benton County, Oregon. Short Paper #27, Dept. of Geol. and Mineral Indus., 49 pp., maps, 1978.

4. Schlicker, H. G. Geologic Restraints to Development in Selected Areas of Marion County, Oregon. Open file report O-77-4, 59 pp., 27 maps, Dept. of Geol. and Mineral Indust., 1977.

5. Schlicker, H. G., Schmuck, R. A., and Gray, J. G. Rock Material Resources of Umatilla County, Oregon. Short paper #26, Dept. of Geol. and Mineral Indus., 57 pp., maps, 1976.

6. Schlicker, H. G., and Brooks, H. G. Engineering Geology of the John Day area, Oregon: Oregon Dept. of Geology and Mineral Indust. in cooperation with the City of John Day and Grant County, 43 pp., fig. and maps, 1975.

7. Schlicker, H. G., Schmuck, R. A. and Pescador, Pedro. Aggregate Resources of Josephine County, Oregon: Oregon Dept. of Geol. and Mineral Indus., 40 pp., 30 maps, 1975.

8. Schlicker, H. G., Deacon, R. J. Engineering geology of the La Grande Area, Union County, Oregon: Oregon Dept. Geol. and Mineral Indus., in cooperation with the City of La Grande and Union County, Oregon, 16 pp., geologic map, 1971.

9. Schlicker, H. G., Deacon, R. J., and Newcomb, R. C. Environmental geology of coastal Lane County, Oregon: Oregon Dept. Geol. and Mineral Indus., Bulletin 74, 1974.

10. Schlicker, H. G., Deacon, R. J., Olcott, G. W., and Beaulieu, J. D. Environmental geology of Lincoln County, Oregon: Oregon Department Geol. and Mineral Indus., Bulletin 81, 171 pp., 1973.

11. Schlicker, H. G., Deacon, R. J., Beaulieu, J. D., and Olcott, G. W. Environmental geology of the coastal region of Tillamook and Clatsop Counties, Oregon: Oregon Dept. Geol. and Mineral Indus., Bulletin 74, 164 pp., 1972.

12. Schlicker, H. G. and Deacon, Robert J. Gravel resources of the Applegate River area in Jackson County, Oregon: Oregon Dept. Geol. and Mineral Indus. in cooperation with Jackson County Board of Commissioners and Jackson County Planning Commission, 12 pp., 5 figs., illus., geologic maps, 1970.

13. Schlicker, H. G. and Deacon, Robert J. Sand and gravel, Bear Creek and Rogue River Valleys, Jackson County, Oregon Dept. Geol. and Mineral Indus. in cooperation with Jackson County Board of Commissioners and Jackson County Planning Commission, 12 pp., 5 figs., illus., geologic maps, 1970.

14. Schlicker, H. G. Sand and gravel, in Mineral and Water Resources of Oregon: Oregon Dept. Geol. and Mineral Indus., Bulletin 64, in cooperation with U.S. Geol. Survey, pp. 233-237, 3 figs., 1969.

15. Schlicker, H. G. and Deacon, Robert J. Preliminary engineering geology studies of Marion County, Oregon, in comprehensive water, sewerage, and resource development plan, Marion County, Oregon, 1969: Mid-Willamette Valley Council of Governments, Clark & Groff Eng., Oregon Dept. Geol. & Min. Indus., p. A (1-21), 2 figs., 1969.

16. Schlicker, H. G. and Deacon, Robert J. Preliminary engineering geology studies of Marion County, Oregon: Oregon Dept. Geol. and Mineral Indus., misc. study, 35 pp., 4 figs., geologic map, 1968.

17. Schlicker, H. G. and Deacon, Robert J. Engineering geology of the Tualatin Valley region, Oregon: Oregon Dept. Geol. and Mineral Indus., Bulletin 60, 103 pp., 45 figs., 5 tables, 4 plates, geologic map, 1967.

18. Schlicker, H. G. Engineering geology--a planning tool: American Inst. Planners, Pacific Northwest Chapter, The Long Ranger, pp. 3-6 illus., July-Aug., 1967.

19. Schlicker, H. G., Deacon, R. J., and Twelker, N. H. Earthquake geology of the Portland area, Oregon: Ore Bin, v. 26, no. 12, 0. 209-230 illus., geologic map, December 1964.

20. Schlicker, H. G. The occurrence of Spencer Sandstone in the Yamhill quadrangle, Oregon: Ore Bin, v. 24, no. 11, pp. 173-184, geologic map, Nov. 1962.

21. Schlicker, H. G., Corcoran, R. E., and Bowen, R. G. Geology of the Ecola State Park Landslide area, Oregon: Ore Bin, v. 23, no. 9, pp. 85-90, 6 figs., Sept. 1961.

22. Schlicker, H. G. Gravel resources in relation to urban development in the Salem area: Oregon Dept. of Geology and Mineral Indus. in cooperation with Mid-Willamette Valley Planning Council, 1 pl., 3 figs., 1 map, 9 pp., 1961.

23. Schlicker, H. G. Progress of geologic studies in Oregon: The Ore Bin, v. 22, no. 4, pp. 33-40, April 1960.

24. Schlicker, H. G. Bibliography of thesis on Oregon geology: Oregon Dept. Geology and Mineral Industries, Misc. Paper 7, 14 pp., illus., map, 1959.

25. Schlicker, H. G. and Dole, Hollis M. Reconnaissance of geology of the Marcola, Leaburg, and Lowell quadrangles, Oregon: The Ore Bin, v. 19, no. 7, pp. 57-62, July 1957.

26. Schlicker, H. G. Landslides: The Ore Bin, v. 18, no. 5, pp. 39043, May 1956.

27. Schlicker, H. G. Geology of proposed Portland mental institution sites in Clackamas and Washington Counties, Oregon: Oregon Dept. Geology and Min. Indus. Unpub. report, 9 pp., geol. maps, 1955.

28. Schlicker, H. G. Columbia River Basalt in relation to stratigraphy of northwest Oregon: Oregon State College master's thesis, 93 pp., geol. map, June 1954.

<u>CO-AUTHOR</u>

1. Wilkinson, W. D. and Schlicker, H. G. Corvallis to Prineville via Bend and Newberry Crater, Field Trip No. 3 <u>in</u> Wilkinson, W. D. (Ed.), Field guidebook, June 1959; Oregon Dept. of Geol. and Mineral Industries, Bulletin 50, pp. 32-72, illus. incl. geol. maps, 1959.

2. Peck, Dallas L., Griggs, A. B., Schlicker, H. G., Wells, F. G., and Dole, H. M. Geology of the central and northern parts of the Western Cascade Range in Oregon: U.S. Geol. Survey Prof. Paper 599, 56 pp., 36 figs., 9 tables, geologic map, 1964.

3. Ramp, Len, Schlicker, H. G., and Gray, J. G. Geology, mineral resources, and rock material and Curry County, Oregon: Oregon Department of Geology and Mineral Industries, Bulletin 93, 79 pp., incl. geol. mineral location and rock source map, 1977.

4. Brownfield, Michael E., and Schlicker, H. G. Preliminary Geologic Map of the Amity and Mission Bottom Quadrangles, Oregon: Oregon Dept. of Geology and Mineral Industries Map 0-81-5, 1981.

5. Brownfield, Michael E. and Schlicker, H. G. Preliminary Geologic Map of the McMinnville and Dayton Quadrangle, Oregon. Oregon Dept. of Geology and Mineral Industries, Map 0-81-6, 1981.

6. Rosenfeld, C. L. and Schlicker, H. G. Significance of Increased Fumorolic Activity at Mt. Baker, Washington. The Ore Bin, v. 38, no. 2, pp. 23-35, February 1976.

H.G. Schlicker & Associates, Inc.
235 N.E. 122nd Avenue, Suite 315 • Portland, Oregon 97230
(503) 257-9666
Geologists • Engineers

Project #88-416 March 29, 1989

Subject: Addendum to Report

To: Mr. Raymond Smith
P.O. Box 187
Corbett, OR 97019

Dear Mr. Smith:

This letter is an addendum to our report 88-416 dated January 9, 1989. We are presenting our analysis of your resource reserves based on additional subsurface information.

At the time of our report we recommended that you have the site drilled to determine the bottom elevation of the rock. In our opinion the rock could be thicker than it appeared to be from surface exposures. Our reason for thinking this was that a stream valley, which became filled with lavas could be a deep "V" shaped valley rather than a wide flat bottomed canyon.

Our report of January 9 assumed basalt to be 40 feet thick. An analysis of the drilling indicates a minimum thickness 51.5 feet of hard basalt. Many of the holes did not penetrate the total thickness of basalt and it could be more than 51.5 feet thick, however, we used the drilled thickness only to make our calculations.

CALCULATIONS

33 acres x 4,840 sq. yd./ac. x 17.2 yds. deep = 2,744,818 cu. yd.
2.74 million cy x crush swell 1.3 = 3.57 million cubic yards
3.57 million cy x 1.5 tons/cy = 5.35 million tons of crushed rock

The minimum quantity of rock available at the Howard Canyon quarry is 3.57 million cubic yards or 5.35 million tons of crushed rock.

There is no other known site in Multnomah County east of the Troutdale-Gresham area that can supply commercial rock. Sites are either depleted, in the Columbia River Gorge restricted area, or on government land that is remote or not available.

It should also be understood that even if a deposit might be found, its economics will depend on availability, access, minimal overburden, and subsurface exploration. All of these factors have been evaluated at the Howard Canyon Quarry.

Herbert G. Schlicker, R.G., C.E.G., President
John A. Talbott, P.E., Vice President
Mark E. Shaffer, P.E., P.G.
J. Douglas Glass, R.G., C.E.G.
Russell J. Rolls, P.G.

The drilling logs and reports from Boulder Creek Construction Co. are enclosed.

We trust that this report will be useful to you. If you have any questions concerning this report or the site, do not hesitate to contact us.

Respectfully submitted,

H.G. SCHLICKER AND ASSOCIATES, INC.

Herbert G. Schlicker, P.G., C.E.G.
President

HGS:kh

#1F

TEST PIT LOGS

TEST HOLE NO. 1:
Drilled 1/11/89 - 11:30 A.M.

0' - 11'	Overburden-low area collecting surface water-wet
11'- 68'	Rock-very consistent-gray basalt-hard
68'- ?	Troutdale formations-cobbles

TEST HOLE NO. 2:
Drilled 1/11/89 - 2:30 P.M.

0' - 16'	Overburden
16'- 33'	Rock-gray basalt-hard rock
33'- 51'	Rock-brown colored basalt-hard & consistent
51'- 68'	Rock-consistent
68'-	Troutdale Formation-cobbles

TEST HOLE NO. 3:
Drilled 1/11/89 - 3:35 P.M.

0' - 9'	Overburden
9' - 30'	Rock-soft gray basalt
30'- 70'	Rock-hard gray basalt-consistent- Stopped drilling at 70'

TEST HOLE NO. 4:
Drilled 1/11/89 - 4:30 P.M.

0' - 9'	Overburden
9' - 50'	Rock-gray basalt-hard-very consistent
50'- 56'	Rock-gray basalt-seamy or blocky Stopped drilling at 56'

TEST HOLE NO. 5:
Drilled 1/12/89 - 8:45 A.M.

0' - 7'	Overburden-very dry
7' - 62'	Rock-gray basalt-very consistent
62'- 65'	Rock-gravelly Stopped drilling at 65'

TEST HOLE NO. 6:
Drilled 1/12/89 - 9:40 A.M.

0' - 8'	Overburden-dry
8' - 65'	Rock-grey basalt-very hard-consistent Stopped drilling at 65'

Test Pit Logs Continued

TEST HOLE NO. 7:
Drilled 1/12/89 - 10:35 A.M.

0' - 17' Overburden-moist to dry
17'- 27' Rock-soft weathered basalt
27'- 72' Rock-gray basalt-semi-hard
Stopped drilling at 72'

TEST HOLE NO. 8:
Drilled 1/12/89 - 11:40 A.M.

0' - 12' Overburden-dry
12'- 20' Rock-soft weathered basalt
20'- 40' Dirt-inconsistent
Stopped drilling at 40'

TEST HOLE NO. 9:
Drilled 1/12/89 - 1:05 P.M.

0' - 8' Overburden-dry
8' - 80' Rock-gray basalt-very hard-consistent
Stopped drilling at 80'

TEST HOLE NO. 10:
Drilled 1/12/89 - 1:40 P.M.

0' - 7' Overburden-dry
7' - 49' Rock-gray basalt-very hard
Stopped drilling at 49'

Reference: Meagher, Terry W. November, 1983, Raymond Smith Quarry Site, Corbett, Oregon, Report, Drill logs and sketch map.

H.G. Schlicker & Associates, Inc.

BOULDER CREEK CONSTRUCTION, INC.

7606 N.E. 11th Portland, Oregon 97211 (503) 289-5265

RE: RAYMOND SMITH QUARRY SITE
CORBETT, OR

Test drilling took place on the Raymond Smith property located between Howard Rd. and Knieriem Rd. on January 11th and 12th, 1989. A total of ten holes were drilled using a Joy Air Trac equipped with a VCR 360 drill hammer. Hole diameter was 3 1/2". The drilling of these test holes was to determine the amount and/or depth of overburden and the amount and/or depth of rock in an area laid out by a geologist. In this report, a map has been included to show approximate area of where these test holes were drilled and are numbered to correspond with the following pages of drill results. I do not claim to to be a geologist. My experience covers twelve (12) years drilling in this area. It is my opinion, after drilling this area, that a quanity of at least 4.5 million yards of gray basalt lies within. Underneath this layer lies the Troutdale formation which consists of rock cobbles and that quanity would be endless for the purpose of producing pit rock, as is most prominent in most of all East County quarries.

Submitted By:

Terry W. Meagher
President
Boulder Creek Construction, Inc.

Appendix 2 - Aerial photograph references

From Spencer B. Gross, Inc. Portland, OR
Photographs taken on 2-03-99
SBG-M99_004 1-1
SBG-M99_004 1-2
SBG-M99_004 1-3

From WAC Corp., Eugene, OR
Photographs taken 6-27-00
WAC-OO-WV 8-98
WAC-OO-WV 8-99

** COPY ** OREGON DEPARTMENT OF TRANSPORTATION ** COPY **

MATERIALS LABORATORY
800 AIRPORT RD. SE SALEM, OR 97301-4798
(503)986-3100
FAX(503)986-3096

Contract No.: EA No.: MCLUCAS & ASSOC. Lab No.: 02-000188
Project: PRIVATE TESTING - MCLUCAS & ASSOC - CORBETT QUARRY

Highway:	County:	Data Sheet No.: None
Contractor:		FA No.:
Project Manager:	Org Unit:	Bid Item No.: NA
Submitted By: GLENDA MCLUCAS	Org Unit:	Sample No.: 2002-2
Material Source: CORBETT		Qty Represented: SOURCE QUALITY
Sampled At: EAST END OF QUARRY	Sampled By:	Witnessed By:
DATE-Sampled: Received: 02/ 1/24	Tested: 02/ 1/31	Date Reported:
Class/Type: COMPLIANCE	Use: QUARRY ROCK	

Q or G: QUARRY AGGREGATE LABORATORY REPORT - QUARAG Size: QUARRY CHUNK

Sieve	% Passing
100 mm	
90	
75	
63	
50	
37.5	
25.0	
19.0	
16.0	
12.5	
9.5	
6.3	
4.75	
2.00	
425 µm	
150	
75	

Test	Mfg.	As Rec'd
TM 101 Sand Equivalent		
TM 102 Liquid Limit		
TM 103 Plastic Index		
TM 202 Fine Bulk Gravity		
S.S.D.		
Apparent		
Absorption (%)		
TM 203 Coarse Bulk Gravity	2.632	
S.S.D.	2.703	
Apparent	2.832	
Absorption (%)	2.68 %	
TM 208a Coarse Degrade Ht	12 mm	
P20	19.4 %	
TM 208b Fine Degrade Ht		
P20		

TM 206 Sodium Sulfate Loss
37.5 - 19.0: 3.3 %
19.0 - 9.5: 2.9 %
9.5 - 4.75: 3.5 % CA: 3.0 %
4.75 - 2.36: 7.4 %
2.36 - 1.18: 8.5 %
1.18 - 600 µm: 9.4 %
600 - 300 µm: 9.7 % FA: 9.0 %

TM 221 Friables
Weighted Avg.:
37.5 - 19.0:
19.0 - 9.5:
9.5 - 4.75:
4.75 - 1.18:
TM 222 Lightweight Pcs
Coarse: Fine:

TM 211 Abrasion
Type A 30.4 %
TM 225 Woodwaste:
TM 226 Dust/Clay:
TM 227 Cleanness:
TM 229 Elong Pcs:

1 @ 203	=$ 45.00
7 @ 206	= 29.00
1 @ 208A	= 74.00
1 @ 211	= 97.00

NSM = Not Sufficient Material

TOTAL CHARGES: $ 419.00

REMARKS:
INFORMATIONAL

NOTE HIGH ABRASION LOSS.

C: FILES ; GLENDA MCLUCAS - MCLUCAS & ASSOCIATES ; SHMIR, CHEN, CORRIGAN & BACHBACH

OREGON DEPARTMENT OF TRANSPORTATION
MATERIALS LABORATORY
800 AIRPORT RD. SE SALEM, OR 97301-4798
(503)986-3100
FAX(503)986-3096

Contract No.:
EA No.: MCLUCAS & ASSOC. Lab No.: 02-000145
Project: PRIVATE TESTING - MCLUCAS & ASSOC - CORBETT QUARRY
Highway:
County:
Data Sheet No.: None
Contractor:
FA No.:
Project Manager:
Org Unit:
Bid Item No.: NA
Submitted By: GLENDA MCLUCAS
Org Unit:
Sample No.: 2002-1
Material Source: CORBETT
Qty Represented: SOURCE QUALITY
Sampled At: WESTERN 1000' OF QUARRY
Sampled By:
Witnessed By:
DATE-Sampled:
Received: 02/ 1/22
Tested: 02/ 1/29
Date Reported: JAN 30 2002
Class/Type: COMPLIANCE
Use: QUARRY ROCK

AGGREGATE LABORATORY REPORT - QUARAG

Q or G: QUARRY
Size: QUARRY CHUNK

Sieve	% Passing
100 mm	
90	
75	
63	
50	
37.5	
25.0	
19.0	
16.0	
12.5	
9.5	
6.3	
4.75	
2.00	
425 µm	
150	
75	

Test	Mfg.	As Rec'd
TM 101 Sand Equivalent		
TM 102 Liquid Limit		
TM 103 Plastic Index		
TM 202 Fine Bulk Gravity		
S.S.D.		
Apparent		
Absorption (%)		
TM 203 Coarse Bulk Gravity	2.624	
S.S.D.	2.705	
Apparent	2.857	
Absorption (%)	3.11 %	
TM 208a Coarse Degrade Ht	15 mm	
P20	21.9 %	
TM 208b Fine Degrade Ht		
P20		

TM 206 Sodium Sulfate Loss
37.5 - 19.0: 3.4 %
19.0 - 9.5: 3.5 %
9.5 - 4.75: 5.8 % CA: 4.0 %
4.75 - 2.36: 12.1 %
2.36 - 1.18: 18.3 %
1.18 - 600 µm: 19.8 %
600 - 300 µm: 19.5 % FA: 17.0 %

TM 221 Friables
Weighted Avg.:
37.5 - 19.0:
19.0 - 9.5:
9.5 - 4.75:
4.75 - 1.18:
TM 222 Lightweight Pcs
Coarse: Fine:

TM 211 Abrasion
Type A 30.2 %
TM 225 Woodwaste:
TM 226 Dust/Clay:
TM 227 Cleanness:
TM 229 Elong Pcs:

This lab report is not a billing. It is for your information only. An invoice will be mailed to you. If you are not already in the ODOT financial system, you will be called for your FID number so that an invoice can be created for you.

1 @ 203	=	$ 45.00
7 @ 206	=	29.00
1 @ 208A	=	74.00
1 @ 211	=	97.00

TOTAL CHARGES: $ 419.00

NSM = Not Sufficient Material
REMARKS:
INFORMATIONAL

NOTE HIGH LOSSES ON THE FINE SULFATES AND LAR ABRASION.

C: FILES ; GLENDA MCLUCAS - MCLUCAS & ASSOCIATES ; RAMIS, CREW, CORRIGAN & BACHRACH

February 7, 2002

Mr. Timothy V. Ramis
Ramis Crew Corrigan & Bachrach LLP
1727 N.W. Hoyt Street
Portland, OR 97209

Re: Petrographic Examination of Rocks - ASTM C295

Project: Corbett Quarry
Corbett, Oregon

Dear Mr. Ramis:

Enclosed is our Petrographic Services Report which contains results of our examination of the rock samples we received from McLucas and Associates on January 24, 2002.

All samples are saved for three months than discarded unless prior arrangements have been made. Prepared sections become a permanent part of our research library and are available for additional examination at any time.

Please call or E-mail us if you have any questions concerning this report.

Regards,

Dick M. Glasheen

Dick M. Glasheen, R.P.G.
Consulting Petrographer

DMG/ng
DL #681
Enclosure: Petrographic Services Report

Appendix 4

1104 Evergreen Drive, Newberg, OR 97132-1119 DominionLabs@aol.com Tel: 503-554-8925 Fax: 503-554-8958

PETROGRAPHIC SERVICES REPORT

Client: Ramis Crew Corrigan & Bachrach	**Date: February 7, 2002**
Client W.O. No.: 1/21/02 Letter	**Purpose: Classification/Characterization**
D.L. W.O. No.: 681	**Location: Corbett Quarry**
Petrographer: D. Glasheen	**Corbett, Oregon**

PETROGRAPHIC EXAMINATION OF ROCKS

Background

McLucas and Associates, Inc collected samples of rocks from a site in Howard Canyon southeast of Corbett, Oregon as part of a possible county permit extension request. Mrs. Glennda McLucas, R.P.G., requested the samples be classified based on mineralogy and texture (Tables 1 & 2). In addition, Mrs. McLucas also requested the rocks be characterized with respect to certain petrographical features affecting standard engineering tests (Table 3).

We understand that the pieces identified as "West 1000 feet" were collected from float (loose surface material) and the sample identified as "East 1000 feet" is shotrock. ODOT Materials Laboratory test results (summary in Table 4), sample photographs, and a copy of the Colorado School of Mines Classification System for igneous rocks are included in the Appendix.

Petrographic Methods

The rock samples were prepared and examined in general accordance with ASTM C295 (Standard Guide for Petrographic Examination of Aggregates for Concrete – Section 11 Ledge Rock). Longitudinal slabs were sawn and studied using a 10X hand-lens and stereo-zoom microscope (16-80X) to note overall rock fabric, weathering, and generally mineralogy. Thin-sections were prepared from representative parts of the slabs and used to perform point-counts and confirm mineralogy with a polarizing microscope at 100 magnification. Volume percentage of minerals obtained through point-counts (300 points) and rock texture were used to classify the samples following the Colorado School of Mines System (Appendix).

Summary of Rock Classification

Table No. 1

Location and Sample Type	Classification
#1 West 1000 feet (float)	Light-gray, fine-grained, pilotaxitic, olivine basalt porphyry
#2 West 1000 feet (float)	Gray, fine-grained, pilo-diktytaxitic olivine basalt porphyry
#1 East 1000 feet (shotrock)	Gray, fine-grained, diktytaxitic olivine basalt porphyry
#2 East 1000 feet (shotrock)	Light-gray, fine-grained, diktytaxitic olivine basalt porphyry

Description of Rocks Examined

West 1000 feet Samples

The two float pieces examined are light-gray to gray, fine-grained, olivine basalt porphyries with textures ranging from pilotaxitic to diktytaxitic. Phenocrysts consist of partially iddingsitized olivine typically ranging from 0.3mm to 0.5mm in length with a few reaching 1mm in dimension. The groundmass is predominantly plagioclase feldspar microlites ranging in composition from bytownite to labradorite. Intergranular pyroxene and iron ore grains are randomly distributed throughout the groundmass. Phenocrysts are generally euhedral and plagioclase microlites range from euhedral to subhedral.

East 1000 Feet Samples

The two shotrock pieces analyzed are light-gray to gray, fine-grained, olivine basalt porphyries with dominantly diktytaxitic texture. Phenocrysts consist of partially iddingsitized olivine typically 0.2mm to 0.3mm in length with a few reaching 0.5mm in dimension. The groundmass is predominantly plagioclase feldspar microlites ranging in composition from bytownite to labradorite. Pyroxene and iron ore grains are randomly distributed throughout the groundmass. Phenocrysts are generally euhedral and laths of plagioclase range from euhedral to subhedral.

Petrographic Comparison of Samples

All the samples are relatively similar in mineralogy, texture, and observed physical properties. Olivine phenocrysts in the West 1000 feet rock may be slightly more weathered overall than in the East 1000 feet rock. This difference in degree of weathering may be due to the type of available sample: float rock versus shotrock. The East 1000 feet rock generally shows more of an open-grained texture (diktytaxitic) than the westerly samples.

Petrographic Observations and ODOT Test Results

Scratch testing using minerals from Mohs Scale showed relative hardness (4½-5) to be similar in all the rock samples. This appears to correlate well with the narrow range of LAR and OAD test results (Table 4). A diktytaxitic texture of plagioclase microlites around irregular-shaped gas voids looks like a microscopic "log jam" (Fig. 8). Abrasion, impact, and grinding during testing might "collapse" some of the "bridged" crystals into the gas voids producing overall smaller pieces without true attrition. It should be noted that fresh plagioclase feldspar and olivine have a hardness of 6-6½ and 6½-7, respectively (Mohs Scale).

The sodium sulfate test attempts to simulate freeze/thaw action. High losses in the fine aggregate size might be due in part to the relatively abundant microscopic voids (diktytaxitic texture) that could hasten ingress of fluids. Capillary testing showed some areas within the rocks to be highly absorptive of water drops and most fresh surfaces to be at least moderately absorptive. In addition, slight to moderately weathered crystals in these rocks provide less resistance to tensile stresses than rocks containing fresh crystals.

Table No. 2 – Rock Classification (after Colorado School of Mines)

	Primary Minerals			Secondary Minerals	
		Accessory Minerals		Altered Primary &	
Rock Name (Location)	**Essential Minerals** (%)	**Characterizing** (%)	**Minor** (%)	Post-solidification Minerals (%)	**Glass & Voids** (%)
Light Gray Olivine Basalt (#1 West 1000 ft)	Plagioclase (calcic) = 55 Feldspathoids = tr Plagioclase (sodic) = 4 Potash Feldspar = 2 Quartz = tr	Olivine = 15 Pyroxene = 5	Iron Ore = 3	Uralite = 1 Sericite = 1 Iddingsite = 4 Clay = 1	Glass = 0 Voids = 9
Light Gray Olivine Basalt (#2 West 1000 ft)	Plagioclase (calcic) = 57 Feldspathoids = tr Plagioclase (sodic) = 4 Potash Feldspar = 1 Quartz = tr	Olivine = 13 Pyroxene = 6	Iron Ore = 4	Uralite = tr Sericite = 1 Iddingsite = 5 Clay = 1	Glass = tr Voids = 8
Light Gray Olivine Basalt (#1 East 1000 ft)	Plagioclase (calcic) = 58 Feldspathoids = tr Plagioclase (sodic) = 3 Potash Feldspar = 1 Quartz = tr	Olivine = 14 Pyroxene = 4	Iron Ore = 5	Uralite = tr Sericite = 1 Iddingsite = 3 Clay = 1	Glass = 0 Voids = 10
Light Gray Olivine Basalt (#2 East 1000 ft)	Plagioclase (calcic)= 62 Feldspathoids=1 Plagioclase (sodic) = 4 Potash Feldspar = 1 Quartz = 0	Olivine = 10 Pyroxene = 4	Iron Ore = 4	Uralite = tr Sericite = tr Iddingsite = 2 Clay = tr	Glass = tr Voids = 12

Table No. 3 – Petrographic Characterization of Rocks

Sampling Location	Rock Name	Scratch Hardness	Relative Hardness	Capillarity (water drop)	Texture[1]	Shape[2]	Secondary Minerals[3]	Micro-cracks[4]	Grain Size	Porosity/ Packing
#1 West 1000 ft	Olivine Basalt	4½ -5 (Mohs)	R2-R3 (ODOT)	Rapid absorption	Rough	Angular	7%	Trace	Fine grained Small phenocrysts	Mostly Pilotaxitic
#2 West 1000 ft	Olivine Basalt	5 (Mohs)	R3 (ODOT)	Rapid-Mod. absorption	Rough	Angular	7%	Trace	Fine grained Small phenocrysts	Mixed Pilo-Diktytaxitic
#1 East 1000 ft	Olivine Basalt	5 (Mohs)	R3 (ODOT)	Moderate absorption	Rough	Angular	5%	Trace	Fine grained Small phenocrysts	Diktytaxitic
#2 East 1000 ft	Olivine Basalt	4½ -5 (Mohs)	R2-R3 (ODOT)	Moderate absorption	Rough	Angular	2%	Trace	Fine grained Small phenocrysts	Diktytaxitic

1-Texture refers to smoothness of a freshly broken surface. 2-Shape of a freshly broken piece. 3-Secondary Minerals include altered primary minerals and natural glass content. 4-Includes microcracks and joints. Some cracks may be due to hammer impact or blasting.

Table No. 4 – Summary of ODOT Soundness and Durability Testing

Sampling Location	Sample Size	Degradation[1] by abrasion, impact, grinding (LAR-TM 211)	Degradation[2] by abrasion (OAD-TM208a)	Porosity (Absorption-TM 203)	Soundness[3] by simulation of freeze/thaw action (Na_2SO_4-TM 206)
West 1000 ft	Quarry Chunk	30.2%	21.9% Ht = 15mm Coarse	3.11% Coarse	4.0% CA 17.0% FA
East 1000 ft	Quarry Chunk	30.4%	19.4% Ht = 12mm Coarse	2.68% Coarse	3.0% CA 9.0% FA

1-LAR maximum loss is 30.0%. 2-OAD maximum loss is 30.0% and maximum sediment height is 75mm. 3-Soundness maximum loss for CA is 12% and FA is 10%.

The above observations specifically apply to the samples as received for examination and analysis. This report may be copied only in its entirety without prior written approval from this office.

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COUNTY
PLANNING SECTION

LANDSLIDE
TECHNOLOGY

10250 S.W. Greenburg Road, Suite 111
Portland, Oregon 97223
Phone 503/452-1200 Fax 503/452-1528

1339

Interstate Rock Products, Inc.
10019 NE 72nd Avenue
Vancouver, WA 98686

January 25, 2001

Attn: Mr. Jerry Cates

Howard Canyon Quarry
Geologic Hazard Assessment
Corbett, Oregon

Dear Mr. Cates:

Following the request of Mike Pauletto, we have completed a geologic hazard assessment for the Howard Canyon Quarry. This letter-report is a summary of our assessment.

Background

The site is currently being operated as a quarry that produces decorative rock and building stone. The site is located on a broad ridge approximately three miles southeast of Corbett, Oregon. We understand that Interstate Rock Products, Inc., is considering expansion of the quarry operation.

Prior to the site visit, published topographic and geologic maps and available reports were reviewed for information on the project area. The available reports and maps included the following:

- Final Reclamation Map for Interstate Rock Corbett Quarry (Olson Engineering, sheets 1 through 5)
- Geologic Reconnaissance, Howard Canyon Quarry (H.G. Schlicker & Associates, January 9, 1989, letter to Raymond Smith)
- USGS Washougal, WA-OR and Bridal Vail, OR-WA 7.5 min. Quadrangle Maps
- Geologic and Engineering Slope-Hazard Studies, Unincorporated Multnomah County, Oregon (Shannon and Wilson, 1978)
- Landslide Locations and Zones of High Landslide Potential in the Portland

Appendix 5

Site Visit

An engineering geologist from our firm performed a brief site visit on January 24, 2001, accompanied by Mr. Michael Cates. The haul roads located on the north and south sides of the project site were traversed and the quarry operations area was observed. The top of the ridge, excluding the quarry operation area, is nearly flat with gentle rolling topography that is currently being utilized as pasture. The flanks of the ridge consist of steep slopes (approximately 25° to 45°) covered with deciduous trees, scattered fir trees and moderate to heavy undergrowth. Less steeply sloping benches are located approximately half way down the south side of the ridge. The two haul roads appear to have been constructed using cut and cast methods.

Geologic Conditions

The top of the ridge is capped by basalt rock from the Boring Lava Formation. This is the material that is being mined. A relatively thin layer of sandy silt with trace clay soil, or loess, overlies the Boring Lava. At the base of the Boring Lava is the Troutdale Formation. This unit consists of silty sand and gravelly sand. Clayey zones were observed in the upper portion of this unit. These clayey layers, similar to others found in the Troutdale Formation throughout the region, are susceptible to sliding. Where present, this material significantly reduces the strength and stability of the unit. The benched slopes, located between elevations 725 and 625 feet on the south side of the ridge, have a general appearance that, in our opinion, is due to ancient slope movement. These features are common throughout the surrounding area, which have similar slope steepness and subsurface geologic conditions. Also, a large landslide occurring in the same geologic material has previously been mapped about ½-mile to the east of the quarry on the north side of the ridge.

Geologic Hazards

No active slope movement was observed within the quarry or along the haul roads. Minor slumping was observed along the road running parallel to Howard Canyon Creek, south of the project site. Hummocky and irregular topography, observed at the project site, is indicative of ancient landslide activity. As stated above, these features are common throughout the surrounding area where slopes have similar steepness and subsurface geologic conditions.

Based on our reconnaissance, no slumping or sliding is anticipated in the quarry rock that is being mined. Fill, overburden and rock stockpiles should not be located on or near slopes that are steeper than 2H to 1V. We recommend that placement of these materials should be confined to the quarry rock floor as much as possible. When quarry operations are expanded, concentrated runoff is expected to increase. Increased concentration and quantity of water flowing onto the slopes below the quarry and natural drainage swales could cause erosion and possible saturation or undercutting of local slopes, and have a negative impact on local slope stability. Storm runoff retention ponds can locally increase groundwater levels, which would also have a negative impact on slope stability.

Conclusion

No active slope movement was observed within the Howard Canyon Quarry or along the haul roads. Suspect ancient landslide terrain that is associated with specific geologic conditions common throughout the region is present in the project area. Based on the occurrence of these geologic conditions, the development of stockpiles adjacent to steep slopes, and retention ponds and concentrated runoff on the slopes below the ridges basalt cap, should be evaluated for their impact on slope stability on a site-specific basis.

We trust this letter-report is sufficient for your requirements. Please call if you have any questions or concerns.

Sincerely,

LANDSLIDE TECHNOLOGY

By

Brent A. Black, C.E.G.
Project Geologist

CERTIFIED OREGON ENGINEERING GEOLOGIST

By

Charles M. Hammond, C.E.G.
Senior Associate Geologist

CERTIFIED OREGON CHARLES M. HAMMOND E-1056 ENGINEERING GEOLOGIST

Allen H. Throop
Geologist

Allen H. Throop
2340 NW Arthur Ave.
Corvallis, OR 97330

541 753-1804
e-mail: throopa@peak.org

Professional employment

1996 – Present	Adjunct Professor – Linfield College – various geology related subjects
1999 – Present	Consultant in mined land reclamation, storm water control and geology Clients include: US Forest Service, Mid-Valley Gravel, S2F Corporation and the Oregon Department of Geology and Mineral Industries
1980 – 1999	Oregon Department of Geology and Mineral Industries (DOGAMI), Mined Land Reclamation Program – reclamationist and geologist
1995 – Present	Linn Benton Community College – Benton Center – part-time instructor
1977 – 1979	Otisca Limited - manager of an experimental coal cleaning facility
1970 – 1976	Electrolytic Zinc Company of Australasia Ltd – exploration and mining geologist
1968 – 1970	Inspiration Consolidated Copper Company – mine and exploration geologist
1969 – 1970	Pinal Junior College, Miami, AZ – part-time instructor of geology

Education

1976	Diploma of Education – State College of Victoria at Hawthorn, Australia. This was a one-year graduate level program similar to the MAT programs in this country.
1970	Master of Science in geology – Arizona State University, Tempe, AZ
1966	Bachelor of Arts in geology – Colby College, Waterville, ME

Professional qualifications

Registered geologist in Oregon

Relevant publications

1991	Should the Pits be Filled? *Geotimes*, v. 38, no.11, pgs. 20-22.
1989	Cyanide in Mining, *Oregon Geology*, v.1, no. 1, pg. 9-11
1981	The Rock Material Resources of Polk, Yamhill, Marion, and Linn counties, Oregon, Dept. of Geology and Mineral Industries, open files report O-81-7.
	Numerous papers and talks to professional and non-professional groups on mining and reclamation.

During my years with DOGAMI, I helped write numerous revisions to the rules relating to mined land reclamation. My main assignment while with DOGAMI was implementation of those rules. One of my last assignments was overseeing DOGAMI's takeover of DEQ's storm water requirements at aggregate mine sites throughout Oregon.