GSA Data Repository item 2011163

Gray, R.E., Hamel, J.V., and Adams, W.R., Jr., 2011, Landslides in the vicinity of Pittsburgh, Pennsylvania, *in* Ruffolo, R.M., and Ciampaglio, C.N., eds., From the Shield to the Sea: Geological Field Trips from the 2011 Joint Meeting of the GSA Northeastern and North-Central Sections: Geological Society of America Field Guide 20, p. 61–85, doi: 10.1130/2011.0020(04).

ENGINEERING GEOLOGY AT TWO SITES ON INTERSTATE 279 AND INTERSTATE 79 NORTHWEST OF PITTSBURGH, PENNSYLVANIA

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Introduction

Recent construction of Interstate Route 279 (Legislative Route 1016, Section 12) near Glenfield, Pennsylvania (see index map Fig. 4-1) resulted in unexpected landsliding and costly remedial excavation. A detailed geologic study of the site shows that the recent landsliding occurred where ancient slide masses at the horizon of the Pittsburgh Redbeds (claystone) were undercut. A similar geologic setting exists on nearby Interstate Route 79 (Legislative Route 1021, Section 6), not yet constructed, where former landsliding in the redbeds is recognizable in the surface morphology.

The purpose of the field trip is to observe post-construction conditions on I-279 where extensive failures in the weak redbeds have occurred, and to discuss pre-construction conditions at that site. Then a study of similar, pre-construction conditions on I-79 will focus attention on the value of careful geologic studies in recognizing potential slope instability before the construction stage is reached. Detailed geologic mapping of the Pittsburgh Redbeds, and the identification of extensive ancient landsliding along the outcrop trace of this weak unit is the key to advance recognition of sites which may present slope stability problems during and after construction.

Geology of Field Trip Area

The field trip sites are in a highly dissected, hilly area having a relief of 300 to 400 feet. Both I-279 and I-79 in the study areas are located on steep, wooded valley slopes. Although the rock strata of the area appear to be flat-lying they are actually gently folded. Stratigraphic units range from a few inches to 30 or 40 feet thick. Beds are the cyclothemic, coal-measure type occurring in the Conemaugh Group (see Fig. 4-2). Figure 4-3, a generalized stratigraphic section of the area, shows that several different rock types occur within a

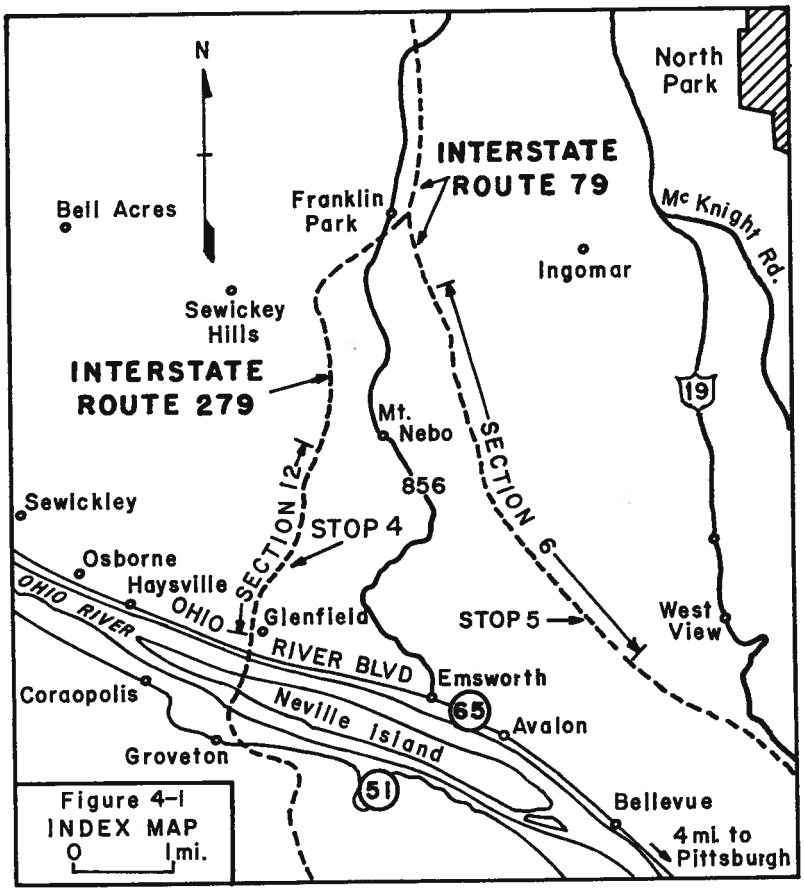

FIGURE 4-1. Index map.

vertical distance of a few tens of feet. From the engineering geology standpoint the critical units are the Pittsburgh Redbeds, Ames Limestone, and an unnamed claystone unit immediately above the Ames. Together, these beds form a weak zone 50 to 60 feet thick that is prone to landsliding.

The Pittsburgh Redbeds are composed of claystone which is highly fractured in apparently random directions. Most of the fracture surfaces are slickensided.* Scattered small limestone nodules occur in the redbeds at some places. Although dull red is the dominant color of the unit, other colors such as pale green, gray, greenish gray, and purple are also present. Upon exposure, the

*This lithology is referred to as "indurated clay" by the Ohio River Division, U. S. Army Corps of Engineers and certain other organizations.

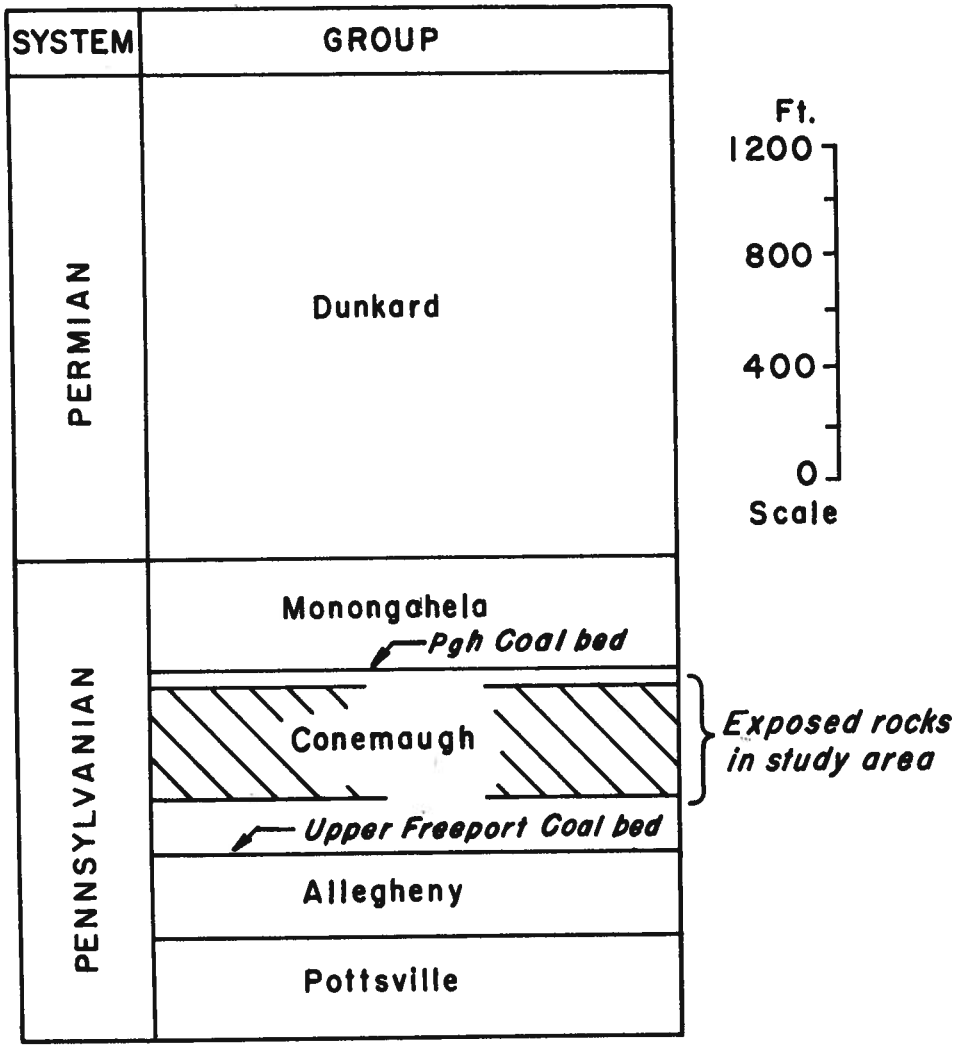

FIGURE 4-2. Stratigraphic Position of Exposed Rocks

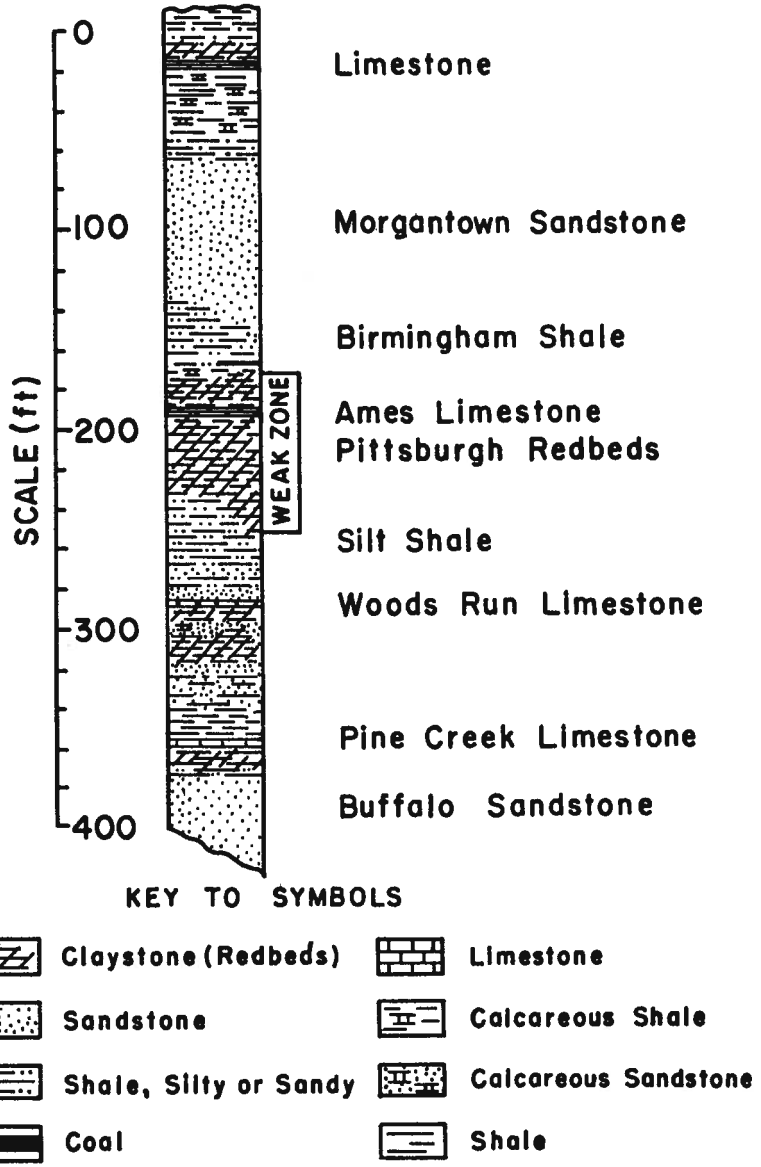

FIGURE 4-3. Stratigraphic Section

redbeds begin to disintegrate (ravel) within a few days to a few weeks. They ultimately weather to a silty clay soil of medium plasticity.

The Ames Limestone is an abundantly fossiliferous marine limestone that commonly occurs as a single hard bed about two feet thick. It is gray on fresh surfaces but weathers to various shades of gray, green and rusty brown. It is an excellent stratigraphic guide that is useful in geologic mapping and as a datum bed for plotting structure contours.

An unnamed gray claystone unit immediately above the Ames Limestone has a thickness of about 15 feet. It grades upward from nonbedded claystone in its lower part to poorly bedded claystone and shaly claystone in its upper part. This is a weak unit which, together with the Pittsburgh Redbeds and the Ames Limestone, represent a zone that has participated in numerous landslides, both ancient and recent.

Although the beds of this weak zone are of prime interest, those units lying below and above have also played significant roles in the landsliding. Immediately below the Pittsburgh Redbeds lies a relatively strong silt shale unit that ranges from 30 to 50 feet in thickness. The shear surfaces of the I-279 slides were positioned at the contact between this silt shale and the Pittsburgh Redbeds. Above the weak zone lies the Birmingham Shale whose thickness is dependent on the stratigraphic position of the base of the disconformable Morgantown Sandstone. The latter is a channel sandstone that in some places channels downward in the section far enough to lie directly on the weak claystone, there being no Birmingham Shale present at such localities. These stratigraphic relations are significant from the engineering geology standpoint because contact type springs occur at the sandstone-claystone contact. The spring water which infiltrates colluvium of the Pittsburgh Redbeds below is probably a factor in facilitating further movement of this material.

STOP #4 (90 minutes)

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Interstate 279 Landslides

Several landslides that developed during construction of I-279 resulted from undercutting and reactivation of unrecognized ancient slide masses in the Pittsburgh Redbeds. Two of these have been described and analyzed in detail (Hamel and Flint, 1969). Figure 4-4 is a selected topographic map on which a portion of I-279 near Glenfield is plotted. Also plotted is the outcrop position of the weak zone that includes the Pittsburgh Redbeds. Extensive landsliding occurred at this locality during construction. Topographic benching within the weak stratigraphic zone is clearly evident on the map. A section (A-A') at Station 928+50 (Fig. 4-5) shows the highway design slope and its relation to the weak zone. Landsliding occurred there when a cut was made in the colluvium on a 1 1/4:1 slope (39°). Remedial excavation flattened the slope to 3:1 (18°) on the redbeds. Because landsliding continued even at that slope, a bench was cut at the base of the redbeds to collect the material which slumps onto it as a stable slope is being established.

Mileage

59.6	Proceed through Mt. Nebo on Mt. Nebo Rd. to intersection of Mt. Nebo Rd. and McAleer Rd. Stop for leader to point out contact. DO NOT LEAVE BUS. Continue southeast on Mt. Nebo-Lowries Run Rd.
61.3	Junction of Mt. Nebo-Lowries Run Rd. and Camp Horne Rd. Keep right.
61.5	Turn left on Bahl Hill Rd.
61.9	Turn left on Gass Rd.

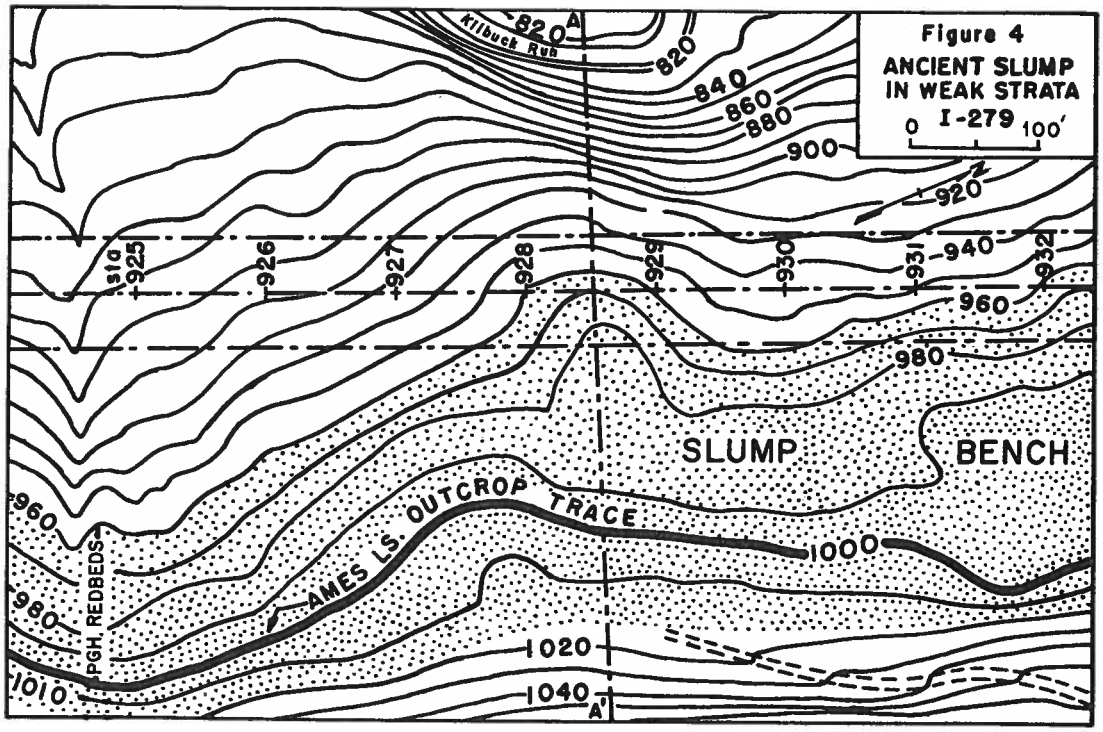

FIGURE 4-4.

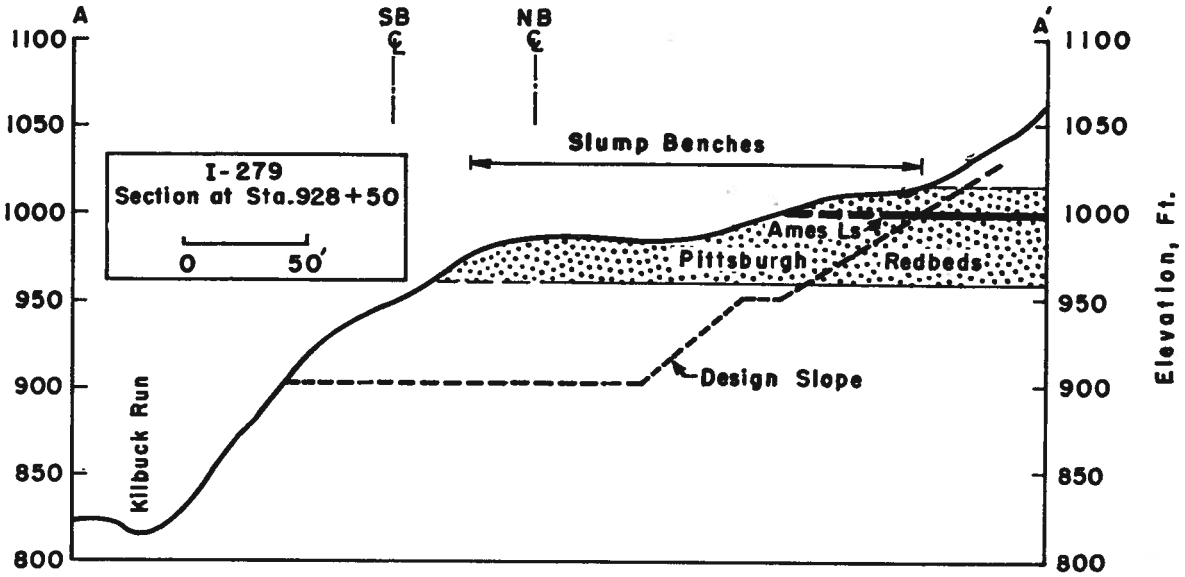

FIGURE 4-5. Ancient slump benches in weak strata that were undercut

STOP #5 (60 minutes)

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Potential Landslide Area on Interstate 79

On I-79 between Stations 341 and 344, pre-construction conditions similar to those on I-279 are present (see Figs. 5-1 and 5-2). There is a prominent topographic bench on the valley wall at the position of the Pittsburgh Redbeds. This bench is interpreted as the upper level of an ancient slump mass which is probably bounded by a shear zone at its base. Figure 6 also shows the alignment of I-79 in relation to the bench. A geologic section at Station 342 (Fig. 5-2) shows the relation between the highway grade, the weak Pittsburgh Redbeds and the inferred shear zone. All these features including exposures of the Ames Limestone, Pittsburgh Redbeds and the underlying silt shale will be seen and discussed in the field when the I-79 site is visited.

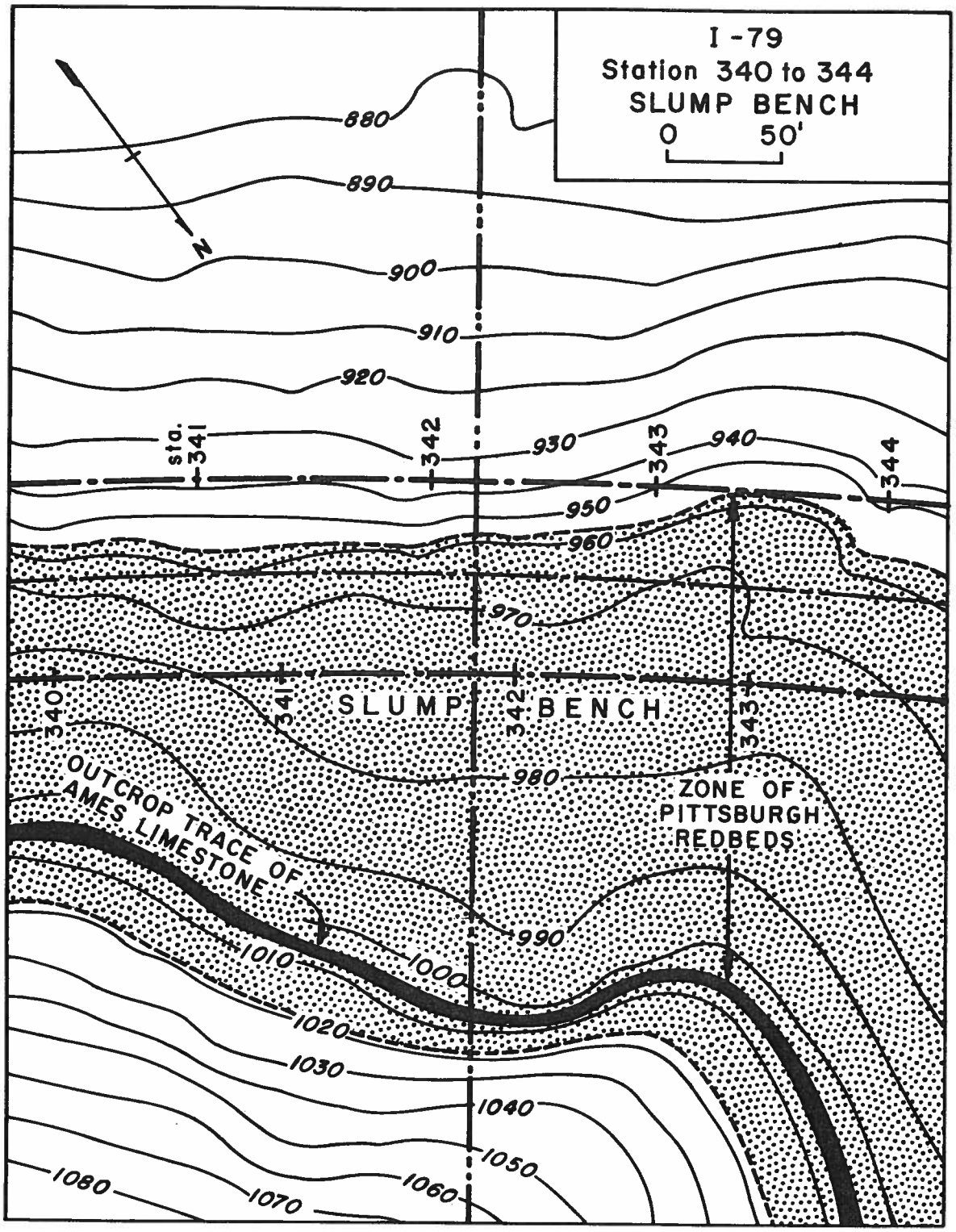

FIGURE 5-1. I -79 Station 340 to 344 slump bench

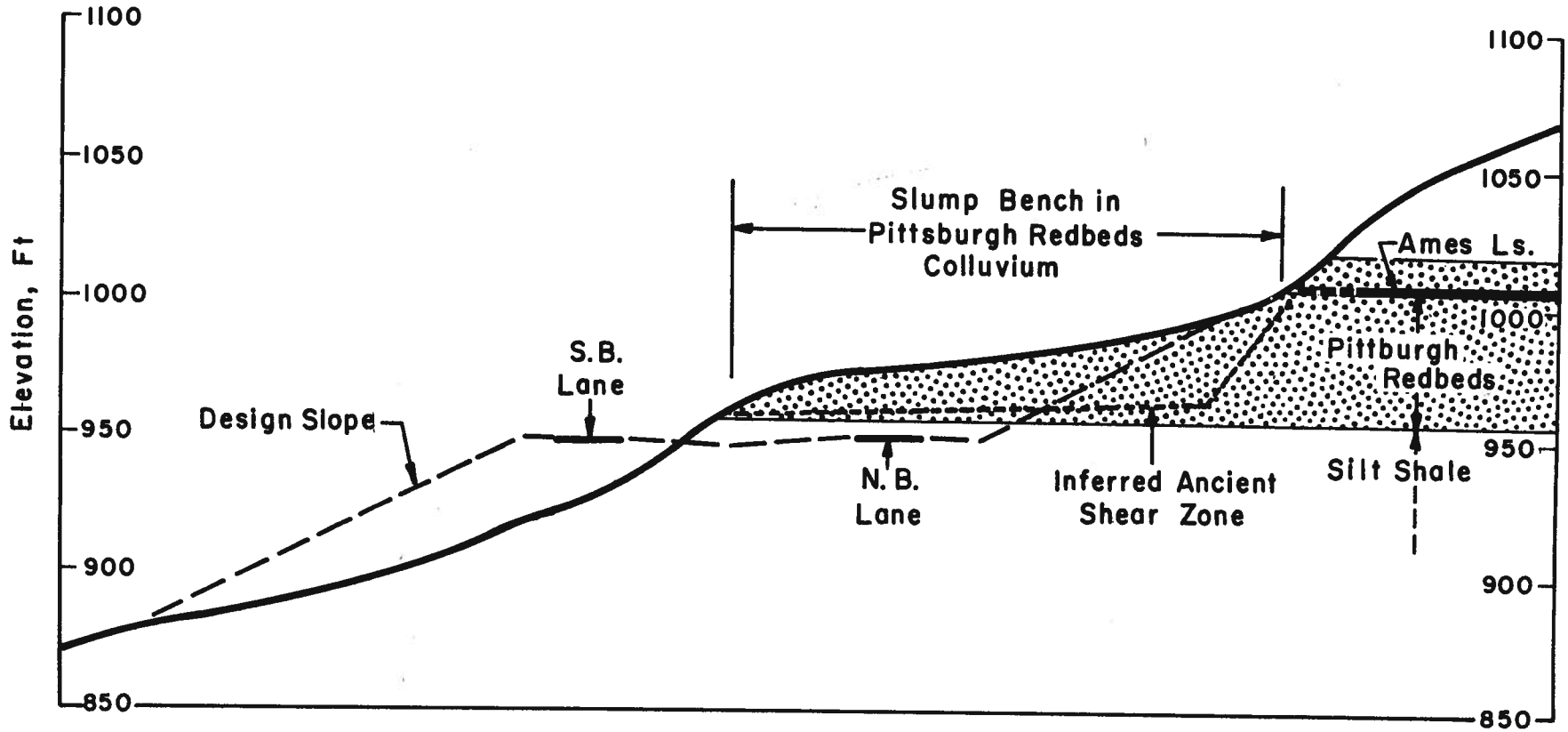

Figure 5-2
GEOLOGIC SECTION ON I-79 (L.R.1021, SEC.6)
AT STATION 342 + 00
0 50'

FIGURE 5-2. Geologic section on I-79 (L. R. 1021, sec. 6) at Station 342 + 00

61.9 Return to buses and prepare to return to hotel.

62.3 Retrace route on Gass Rd. Turn right onto Bahl Hill Rd.

62.8 Follow Bahl Hill Rd. to Camp Horne Rd.

74.1 Turn left on Camp Horne Rd. toward Emsworth to Pa. Rt. 65.

81.7 Turn left on Rt. 65 (Ohio River Blvd.) and return to hotel.

Reference

Hamel, J. V. and Flint, N. K. (1969). "Analysis and Design of Highway Cuts in Rock: A Slope Stability Study on Interstate Routes 279 and 79 near Pittsburgh, Pennsylvania," Research Report submitted to Pennsylvania Department of Highways, Bureau of Materials, Testing and Research, Harrisburg, 130 p.; 45 figs.; 6 tables.

ENVIRONMENTAL GEOLOGY IN THE PITTSBURGH AREA

Richard D. Thompson, Editor

A Guidebook Prepared for the 1971 Annual Meeting of the
Geological Society of America

Field Trip No. 6

Printed by the Annual Meeting Committee
Washington, D.C. November 1971