



*BUILT ON REPUTATION*

CONSULTING  
GEOTECHNICAL / FORENSIC / ENVIRONMENTAL  
ENGINEERS

May 23, 2019

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The Borough of Economy  
c/o Shoup Engineering, Inc.  
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Attn: Scott A. Shoup, P.E., P.L.S.  
President

Subject: Geotechnical Engineering Review of Stability Analyses and Report  
Section of Amsler Ridge Road  
Economy Borough, Beaver County, Pennsylvania  
Garvin Boward Beitko File 19024

Pursuant to your request, with respect to slope stability considerations, we reviewed the: April 22, 2019, Public Access Roads Geotechnical Analysis and Recommendations report (Report), by Stahl Sheaffer Engineering (SSE), submitted to Penn Energy Resources, LLC; April 18, 2019, Drawings for Construction, (from Sta. 29+80.6 to Sta. 65+04.00), by SSE; and, April 18, 2019, Drawings for Construction, (from Sta. 35+25.00 to Sta. 37+50.00) (Wall Drawings), by SSE. This letter report summarizes the results of our review.

As part of our review, on May 8, 2019, we visited the approximately 0.6-mile-long section of Amsler Ridge Road investigated by the SSE Report. The photos herein, taken by us on that date, are referenced via the marked-up copy of the SSE Amsler Ridge Road – Boring Locations (BL) drawing, herein included as Figure 1. We superimposed Zones 1 thru 8 on the BL to assist with site condition conditions herein discussed.

Photos 1 thru 4 show Zone 1, as indicated on the marked-up BL drawing, where SSE had Borings B-5, B-6, and B-7 drilled. This is the area where SSE recommends that the roadway low-side slope, northeast of the road, should be stabilized via a conventional soldier beam and lagging (SBL) retaining wall, as illustrated on the SSE Wall Drawings. We concur with this SSE recommendation.



**FIGURE 1 – MARKED-UP EXCERPT FROM SSE REPORT**



**PHOTO 1 – LOOKING NORTHWEST AT ZONE 1 AREA**





**PHOTO 2 – LOOKING SOUTHEAST AT ZONE 1 AREA (ASPHALT PATCH AT APPARENT FORMER LANDSLIDE AREA ENCROACHMENT INTO ROADWAY)**



**PHOTO 3 – CLOSE-UP OF AREA ON PHOTO 1 (APPARENT SSE BORING LOCATION)**





**PHOTO 4 – AREA LEFT OF PHOTO 2**

Photos 5, 6, and 7 show Zone 2, where the roadway is patched nearby the top of the slope along the low-side of the roadway.



**PHOTO 5 – LOOKING SOUTHEAST AT ZONE 2 AREA**





**PHOTO 6 – LOOKING NORTHWEST AT ZONE 2 AREA**



**PHOTO 7 – AREA RIGHT OF PHOTO 6**

The distressed and cracked asphalt pavement at the Zone 2 area appears to be related to the same hillside instability discussed for the Zone 1 area. It is unclear to us whether the SSE-recommended SBL retaining



wall will extend to this area. In our opinion, it would be prudent to include this roadway zone within the stabilization plan.

Zone 3, shown on Photos 8 and 9, exhibits pavement cracks on the low-side of Amsler Ridge Road, as well. However, based on the adjacent hillside condition, we suspect that these pavement distresses are related to pavement subgrade failure. Thus, we are concerned that the roadway pavement subgrade, likely including the subbase, may be inadequate. Regardless, as of our visit, this zone does not appear to visually exhibit obvious slope instability.



**PHOTO 8 – LOOKING  
NORTHWEST AT ZONE 3**

**PHOTO 9 – LOOKING SOUTHEAST  
AT ZONE 3 AREA**



Zone 4, shown on Photos 10 thru 16, displays cracked asphalt pavement at the roadway low side. Below, and northeast of Amsler Ridge Road, we found an apparent aged cut area. Its purpose is unclear.

Although at this juncture, we discerned no common signs of slope instability at this area, such a cut area, which reduces forces that tend to resist slope movements/failure, possesses the potential to eventually result in problematic slope conditions. Hence, it would be prudent to monitor this hillside area with respect to movements, as required to understand its status and react to it should the monitoring system reveal apparent problematic performance.

**PHOTO 10 – LOOKING  
NORTH AT ZONE 4 AREA**



**PHOTO 11 – LOOKING NORTHWEST AT  
ZONE 4**





**PHOTO 12 – AREA RIGHT OF PHOTO 11**



**PHOTO 13 – LOOKING SOUTH TOWARD ROADWAY AT ZONE 4**





**PHOTO 14 – AREA RIGHT OF PHOTO 13 (OLD CUT AREA ON HILLSIDE)**



**PHOTO 15 – AREA RIGHT OF PHOTO 14**





**PHOTO 16 – AREA RIGHT OF PHOTO 15  
(OLD CUT AREA ON HILLSIDE BELOW AMSLER RIDGE ROAD)**

Photos 17 thru 22 show Zone 5. A large and apparently non-engineered fill embankment is situated on the hillside below and northeast of Amsler Ridge Road at this zone. The fill embankment appears to include substantial organics, which are inherently unstable. The fill generally looks to have been end-dumped without proper subgrade preparations, drainage, bonding, placement, differentiation, and compaction. We did not attempt to comprehensively evaluate the fill embankment. Although we observed no obvious signs that the embankment has yet detrimentally impacted Amsler Ridge Road, such a condition – if it should move or fail – possesses the potential to result in distresses to the roadway. Thus, it would be prudent, in our professional opinion, to monitor the hillside on the low side of Amsler Ridge Road at this zone, as it may be only marginally stable in its current configuration.



**PHOTO 17 – LOOKING  
NORTHWEST AT ZONE 5  
AREA**





**PHOTO 18 – AREA RIGHT OF PHOTO 17  
(ENTRY ROAD TO FILL EMBANKMENT AREA)**



**PHOTO 19 – AREA RIGHT OF PHOTO 18**





**PHOTO 20 – CLOSE-UP OF AREA ON PHOTO 19  
(FILL EMBANKMENT AREA)**



**PHOTO 21 – AREA RIGHT OF PHOTO 20**





**PHOTO 22 – AREA RIGHT OF AND BELOW PHOTO 21**

Photos 23, 24, and 25 generally depict Zones 6, 7, and 8. We observed some pavement distresses. However, they appeared to be related to pavement subgrade failure and/or inadequate pavement structure section thickness. Although soil creep – a long-term condition wherein the hillside upper soil mantle creeps down-slope on a seasonal basis due to freeze-thaw effects common to a region at this latitude – was observed, no obvious landslide or unstable slope conditions were seen. Soil creep, which occurs on most hillsides to varying degrees in southwest Pennsylvania, is not necessarily a sign of instability. Typically, the affected upper soil mantle “heals” and regains its shear strength during drier seasons.



**PHOTO 23 – ZONE 6 AREA**





**PHOTO 24 – ZONE 7 AREA**



**PHOTO 25 – ZONE 8 AREA**

We consulted with references<sup>1, 2</sup> pertaining to slope stability for this region. Reference 1 indicates that the portion of Amsler Ridge Road under study is designated as “Soil and Rock Susceptible to Landsliding.” That reference defines this status as “Soil and rock similar to that involved in landslides elsewhere in map

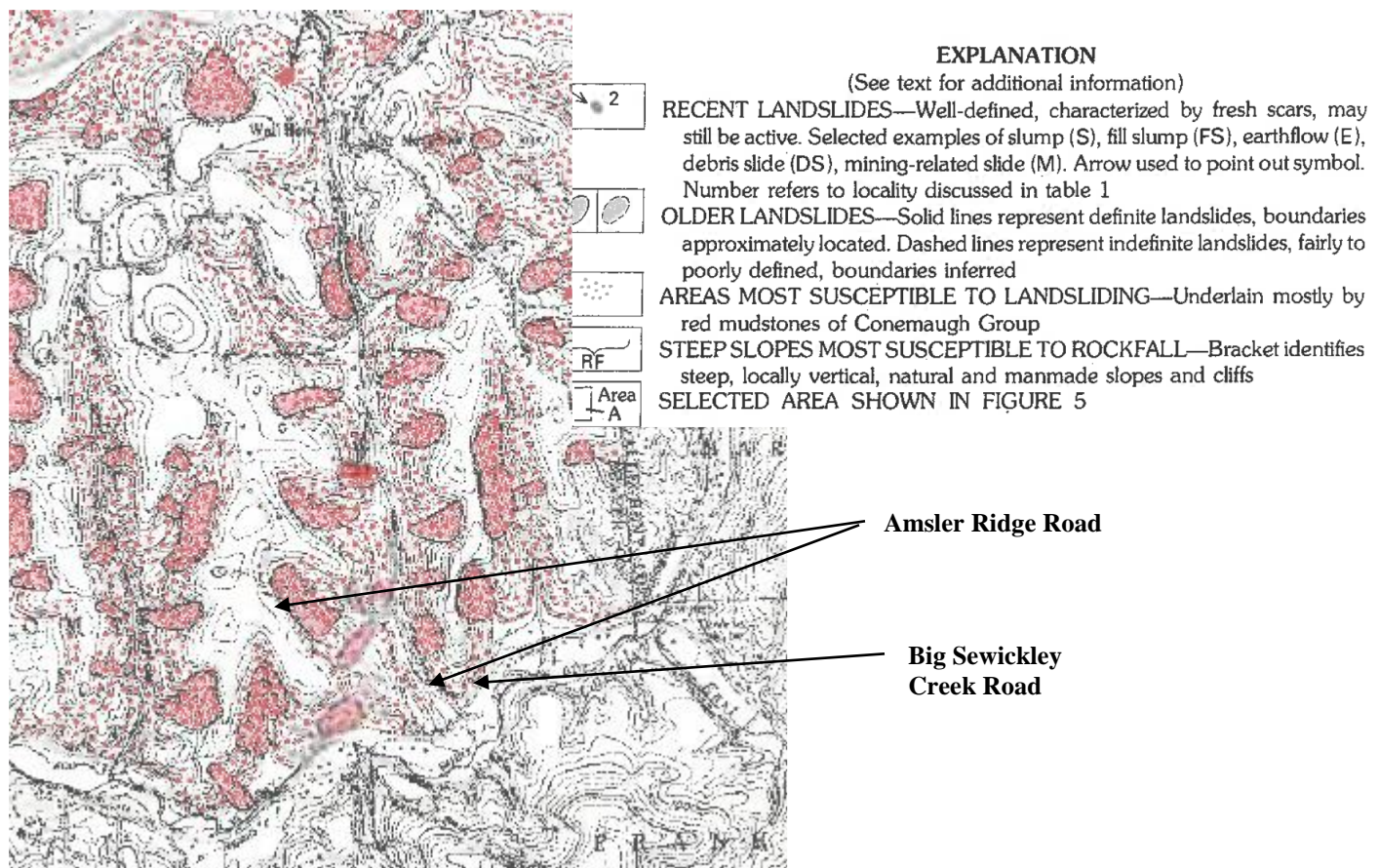
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<sup>1</sup> Pomeroy, John S., Landslide and Related Features of the Ambridge, PA. Quadrangle, U.S. Geological Survey Open File Map 78-1057 (E-15), 1978.

<sup>2</sup> Pomeroy, John S., Map Showing Landslides and Areas Most Susceptible to Sliding in Beaver County, Pennsylvania, United States Geological Survey, Miscellaneous Investigation Series, Map I-1160, 1979.



area; primarily areas underlain by claystone, mudstone and shale associated with other rock types. Rock weathers rapidly on exposure forming clayey soil highly susceptible to sliding.” The second reference, an excerpt of which is provided herein as Figure 2, shows the section of the roadway situated in an area deemed to be “Areas Most Susceptible To Landsliding,” therein defined as areas “Underlain mostly by red mudstones of Conemaugh Group.” Reference 2 also shows significant “Older Landslides” areas along the northeastern low-side of the roadway. This reference describes these areas via, “Solid lines represent definite landslides, boundaries approximately located. Dashed lines represent indefinite landslides, fairly to poorly defined, boundaries inferred.” The “Older Landslides” area appears to be generally situated in Zones 1 thru 5.



**FIGURE 2 – EXCERPT FROM AFOREMENTIONED REFERENCE 2**

The conditions revealed via our site reconnaissance and geologic research appear to be generally consistent with the SSE Report. SSE had seven test borings drilled along the roadway. Based on the boring data, SSE performed three slope stability analyses at isolated areas along the roadway showing



adequate stability, within standard-of-care provisions; however, those analyses do not represent the entire length of Amsler Ridge Road. Their fourth stability analysis revealed inadequate stability, at the Borings B-5 thru B-7 area (Zone 1). SSE recommended and prepared design drawings for a SBL retaining wall to address that condition.

SSE Borings B-3 and B-4 – located in Zones 6 and 3, respectively – encountered red clay materials, indicative of redbed strata, which are notoriously prone to sliding, especially once they become wet and lose essentially all shear strength. This is consistent with SSE Report Page 9 that relayed the site is geologically situated in the Glenshaw and Casselman Formations, which are known to contain redbed units.

We reviewed the SBL retaining Wall Drawings. They appear to have been developed in accordance with our interpretation of the generally-accepted local engineering standard of care.

However, we nonetheless have the following concerns that we recommend SSE, or other appropriate project design team member, address to our satisfaction.

1. We concur with the SSE retaining wall recommendation. However, we noted potential problematic slope stability issues southeast of the proposed wall terminus. Hence, this concern should be addressed. Possible solutions, in our opinion, entail extending the wall or, instead, providing adequate instrumentation to monitor the down-slope area southeast of the proposed retaining wall.
2. SSE Report Page 16 recommends that “The PennDOT District Geotechnical Engineer should approve the rock depth during the construction.” It is our understanding that Amsler Ridge Road is not a PA roadway. Thus, it does not appear appropriate to require that a Pennsylvania Department of Transportation (PennDOT) engineer should approve any aspect of work on this roadway. As such, SSE should reconsider this statement.
3. On Page 6 of their Report, SSE recommends monitoring slopes during heavy hauling and repairing any deterioration. In the SSE Report, Appendix B includes the Slide Field View Summary for Amsler Ridge Road in Beaver County, which states, “In conclusion, further monitoring would be recommended in order to make a more accurate assessment in slope stability. However, with the knowledge currently available, it is assumed that the area is stable, and no special course of action is required.” Two methods for monitoring the slope are suggested, including engaging a survey crew to check for slope movement and/or installing inclinometers on/at the slope. We concur that, at least some key slope areas – such as aforementioned areas at Zones 4 and 5 – should be provided with suitable and adequate instrumentation to monitor the low-side slopes. Further, due to the aforementioned historic landslide conditions, as well as redbed strata encountered in some of the SSE borings, it would be prudent to include monitoring instrumentation in Zones 2, 3, and 6, as well. Although SSE



has recommended monitoring slopes, we found no monitoring plan within the documentation submitted to us. We recommend that such a plan be developed by the project design professionals, and that plan be submitted to the Borough for our review. The plan should include the type and location of recommended instrumentation, the frequency of readings, trigger movement reading levels that would require action to address slope movements/instability, the entities that will be taking the readings, the process for submitting reading data to the Borough, and installation and protection measures to be implemented to assure that the instrumentation will remain viable over the long term (i.e., survey monument requirements to resist frost heave, etc.). All readings, accompanied by interpretations/conclusions regarding the data, should be submitted, on a timely basis, to the Borough for our review.

Based on our engineering review, as summarized above, **we do not recommend approval of the proposed roadway use until our above-listed concerns are addressed to our satisfaction.**

Our review is limited to verifying that the: submitted documents meet the Borough's geotechnically related Code requirements; proposed design appears to follow generally accepted geotechnical engineering practices; and planned project activities, based solely on the documents provided, do not appear to be detrimentally affecting the health, safety and condition of the public and/or public and private properties beyond the specific construction area or project owner's property(ies). No analyses, calculations or design and/or construction documents were checked by us for accuracy. It is our understanding that the project design professionals are responsible for the thoroughness, accuracy, and suitability of their documents. We further understand that the project contractor is solely responsible for the project element performance and all construction-related effects/disturbances/distresses. For this limited review, neither we nor the Borough assume any responsibility or professional and/or general liability related to this project.

This review only applies to the report(s), drawing(s) and information provided, and site visit(s) by us, as specifically herein outlined. Should earthwork/grading/excavating/filling/backfilling/cutting/construction, proposed structure foundation requirements, retaining wall construction, other geotechnical engineering related aspects, or equal/similar plans change, the herein-outlined conclusions/recommendations/requirements may no longer be valid. In that case, the revised plans/drawings/documents should be submitted to the Borough, and in turn, to us, for supplemental review with respect to geotechnical engineering considerations, both to our own concerns as practicing professional engineers and to those related to the Code. We reserve the right to present additional/supplemental comments/concerns as supplemental drawings/data/information/documentation is/are submitted. We further reserve the right to review any and all resubmitted and/or revised/modified geotechnical engineering investigation

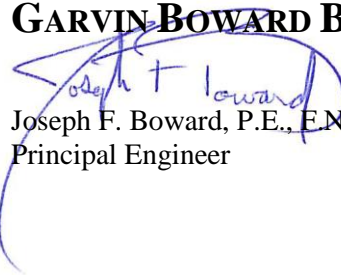


reports and site development plans to determine if they meet Borough Code requirements, as well as the generally understood local standard-of-care, for geotechnical engineering elements. Items not clearly shown on the plans/drawings and/or described in the submitted documents cannot be considered in our review. If such items become clear as the plans and investigatory programs evolve and are finalized, we may recommend that additional/supplemental geotechnical engineering investigation and/or analysis/evaluation be undertaken prior to the Borough granting approval.

Should you have any questions regarding our review, please feel free to contact us.

Respectfully submitted,

**GARVIN BOWARD BEITKO ENGINEERING, INC.**



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