AGEC
Applied GeoTech

October 10, 2019

Alta Planning and Design Inc.
8 East Broadway, Suite 203
Salt Lake City, Utah 84111

Attention: David Foster
EMAIL: davidfoster@atlasplanning.com

Subject: Retaining Wall and Slope Stability Assessment
Miller Park Path
900 South and Red Butte Creek
Salt Lake City, Utah
Project No. 1190653

Gentlemen:

Applied Geotechnical Engineering Consultants, Inc. was requested to conduct a geotechnical engineering assessment of retaining walls and slope stability concerns at the Miller Park Path at 900 South and Red Butte Creek in Salt Lake City, Utah.

Our services are provided in accordance with our proposal dated August 22, 2019.

BACKGROUND

Representatives of AGEC and Alta Planning and Design Inc. met at the site on August 13, 2019 to observe conditions at the Miller Park Path in preparation of a proposal for this study. An additional site visit was made on September 24, 2019 to observe conditions and meet with David Foster (Alta Planning), Lewis Kogan (Salt Lake City Parks) and McKay Parrish (ARW Engineers).

There are a number of stone retaining walls that we understand date back to the Works Projects Administration era. There are also a number of timber retaining walls and several areas of crib wall. There are relatively steep slopes above and below the retaining wall structures and it appears that improvements, including retaining structures, decks, fences, etc., have been constructed above some of the retaining walls. Some localized areas of erosion were observed. The ground level at the toe of the walls appears lower than it should be with respect to the base rock of the walls in some areas.

The purpose of the study is to provide a general assessment of stability concerns for retaining structures. We understand that some improvements are being considered where stability concerns have been observed.

SCOPE

The requested study includes a general assessment of retaining walls and conditions along the path to identify signs of instability as observed at the time of our site visits. No subsurface exploration, lab testing or stability analysis was conducted for this study.

This letter has been prepared to summarize the conditions observed including photographs of a few of the areas of interest observed at the time of our site visit. A discussion of considerations for improving stability and erosion protection is provided in the letter.

ANTICIPATED SUBSURFACE CONDITIONS

Based on our experience in the area, we anticipate that natural subsurface soils consist of clay, sand and gravel. Relatively shallow-depth groundwater is not anticipated in this area. There may be a potential for perched water and seepage during periods of the year in areas of moderate to steep slopes along Red Butte Creek. We did not observe seeps of springs at the time of our site visit, however, much of the site is not readily visible with the walls, fences and heavy vegetation.

GLOBAL SLOPE STABILITY

The rock retaining walls have been in place for many years (assumed to have been built in the 1930s) and appear to have performed relatively well. No signs of significant global stability failure were observed although the global stability of the walls and adjacent slopes may be marginal and was not evaluated as part of this study.

The timber walls were reportedly constructed in the 1980s and also appear to have performed relatively well with respect to global stability. There are localized areas of bulging where the top of the timber wall has rotated out resulting in a near vertical wall (where the wall would have originally been constructed with a batter into the slope). The rotation of the wall could be associated with global stability being marginal or near failure condition.

The crib walls are in relatively poor condition. This does not appear to be the result of global slope movement but erosion of soil from the crib walls.

While global stability failures such as rotational or sliding movement of the walls were not observed, it is likely that the global stability of many of the retaining systems and adjacent slopes is marginal under static conditions (likely to have a safety factor less than 1.5). The global stability has been reduced where soil has been removed at the toe of the walls, loads (soil, retaining walls and structures) have been added above the walls and where poor drainage or buildup of water develops behind the walls or in the overall slope.

OBSERVED CONDITIONS

At the time of our site visit, we walked the trails through the park to observe the conditions of the retaining walls. Some of the photographs taken at the time of our site visit are included in the appendix and we refer to them in the descriptions given below. The following notable conditions/concerns were observed:

North End (near 900 South Entrance)
Near the entrance to the park, where the stairs extend down from 900 South, there is an area where the rock wall has been undercut (see Photograph 1). There is a lower tier of rock wall in this area that has significant cracking in the mortar between the rocks (see Photograph 2).

There is a retained slope constructed with broken pieces of concrete slab above the rock wall in this area that appears to have added significant load near the top of the rock wall (see Photographs 3 and 4).

An amphitheater was constructed during recent improvements at the park utilizing timbers to retain the soil (see Photograph 5). The ground beyond the toe of the rock wall adjacent to the south side of the amphitheater has been lowered. This lowering of the ground reduces the stability of the rock wall.

West Side of Creek
Rock walls along the west side of the creek appear to generally be in good condition. There are localized areas where construction of retaining walls has encroached on the area above rock walls, potentially reducing the stability of the walls and the global stability of the slope.

There are areas where it appears that soil has been removed at the base of the rock wall (see Photograph 6).

There are several areas of crib wall on the downhill side of the trail along the west side of the creek. The crib wall is in relatively poor condition where soil appears to have eroded from the crib wall and undercut the wall (see Photograph 7).

East Side of Creek
There is a timber retaining wall that appears to have soil anchors. A portion of this wall appears to be bulging or the top has rotated out away from the slope (see Photograph 8 and 10). Soil is exposed below the lowest timber lagging.

An area of the timber wall was modified near the north end of the trail on the east side. Additional height was added to the timber wall and it does not appear that additional soil anchors were provided (see Photograph 9).

There are areas of crib wall on the downhill side of the trail along the east side of the creek. Like the crib walls on the west side, these walls appear to be in poor condition where soil has eroded from the crib wall units (see Photograph 10).

There are localized areas of significant erosion adjacent the rock wall on the east side of the creek (see Photograph 11). The rock wall in the area of this photograph can be seen near the top of the photograph, above the area of erosion. Photograph 12 is taken above this area and shows the rock wall with trees and structures near the top of the wall.

Structures have been placed near the top of the rock wall on the east side of the creek (see Photographs 13 to 15). Photograph 13 shows an area where the rock wall foundation has been exposed.

CONSIDERATIONS FOR IMPROVING STABILITY

We understand that consideration is being given to making improvements to the retaining walls and slopes in the park to improve stability. We understand that there are not currently any plans to conduct site-specific stability studies for the various slopes and retaining structures in and adjacent to the park. Such studies could be considered but would be a significant task, well beyond the scope of this study. We also understand that there is no current plan to improve the slopes and structures to conform with currently acceptable codes and requirements. Based on our observations, the following items are suggested to improve the general stability of the retaining systems and slopes in the park:

1. Erosion protection measures could be considered for areas that are experiencing erosion problems. Such measures could include regrading and/or providing additional retaining structures to flatten exposed slopes and control runoff, revegetation, eliminating access to slopes, providing erosion control mats or other measures.

2. Crib walls in poor condition could be replaced with new crib walls, gabions, mechanically stabilized retaining systems or other systems.

3. Consideration may be given to replacing the soil cover at the base of undercut rock walls. This would likely be in conjunction with improving the retaining systems (such as crib walls) on the downhill side of the trail.

4. The stability of retaining walls may have been reduced where structures have been placed or grade has been raised near the top of the retaining walls. Consideration may be given to evaluating the effect of the structures and increased grade for these walls.

5. We anticipate that when the timber wall was increased in height at the north end of the park, they may not have considered overall stability of the wall with the increased height (see Photograph 9). The stability of this wall should be reviewed and could be improved as needed. We anticipate that the area above this wall may be raised with additional fill to provide embedment of the rock wall above. Consideration could be given to reconstructing or improving the timber wall to facilitate the increased height.

6. Consideration should be given to further evaluation of the timber wall in the area where it appears to be rotating or bulging (see Photographs 8 and 10). Additional retaining systems on the toe side of this wall could be considered to buttress the wall and raise the grade of the trail below the wall. This is also an area where there are crib walls that should be considered for replacement on the creek-side of the trail.

7. The area at the north end of the park, adjacent the stairway from 900 South where the rock wall has been undercut (see Photograph 1) will be difficult to repair with the steep slope beyond the toe of the wall and the additional wall below. Soil nails or anchors with shotcrete may be a possible method of improving this area.

LIMITATIONS

This letter has been prepared in accordance with generally acceptable engineering practices in the area for the use of the client for planning purposes. The information presented in the letter is based on conditions observed at the time of our site visits, our experience in the area and discussion with the other representatives at the site. Subsurface exploration, testing, geologic review and stability analysis were not performed in conjunction with this study. Additional study is recommended to evaluate specific slopes and retaining structures and to provide information for design of improvements.

If you have questions or if we can be of further service, please call.

Sincerely,

APPLIED GEOTECHNICAL ENGINEERING CONSULTANTS, INC.

Jay R. McQuivey, P.E.

JRM/bw

Reviewed by DRH, P.E., P.G.
Enclosures

APPENDIX

PHOTOGRAPHS

Photograph 1 - Undercut wall near the north park entrance at 900 South.

Photograph 2 - Cracks in lower-tier wall near north park entrance at 900 South.

Photograph 3 - Retained slope constructed above the top of the rock wall.

Photograph 4 - Retained slope constructed above the top of the rock wall.

Photograph 5 - Ground below the rock wall has been lowered.

Photograph 6 - Ground at toe of wall appears lower than base rock.

Photograph 7 - Crib wall on west side of creek has experienced erosion and undercutting.

Photograph 8 - Timber wall section appears to have rotated away from slope.

Photograph 9 - Newer timbers added to the top of the older timber retaining wall.

Photograph 10 - Crib wall on east side in poor condition. Timber wall above appears bulging or rotating.

Photograph 11 - Area of erosion above the trail on the east side of the creek. The rock wall is seen near the top of the photo, above the area of erosion.

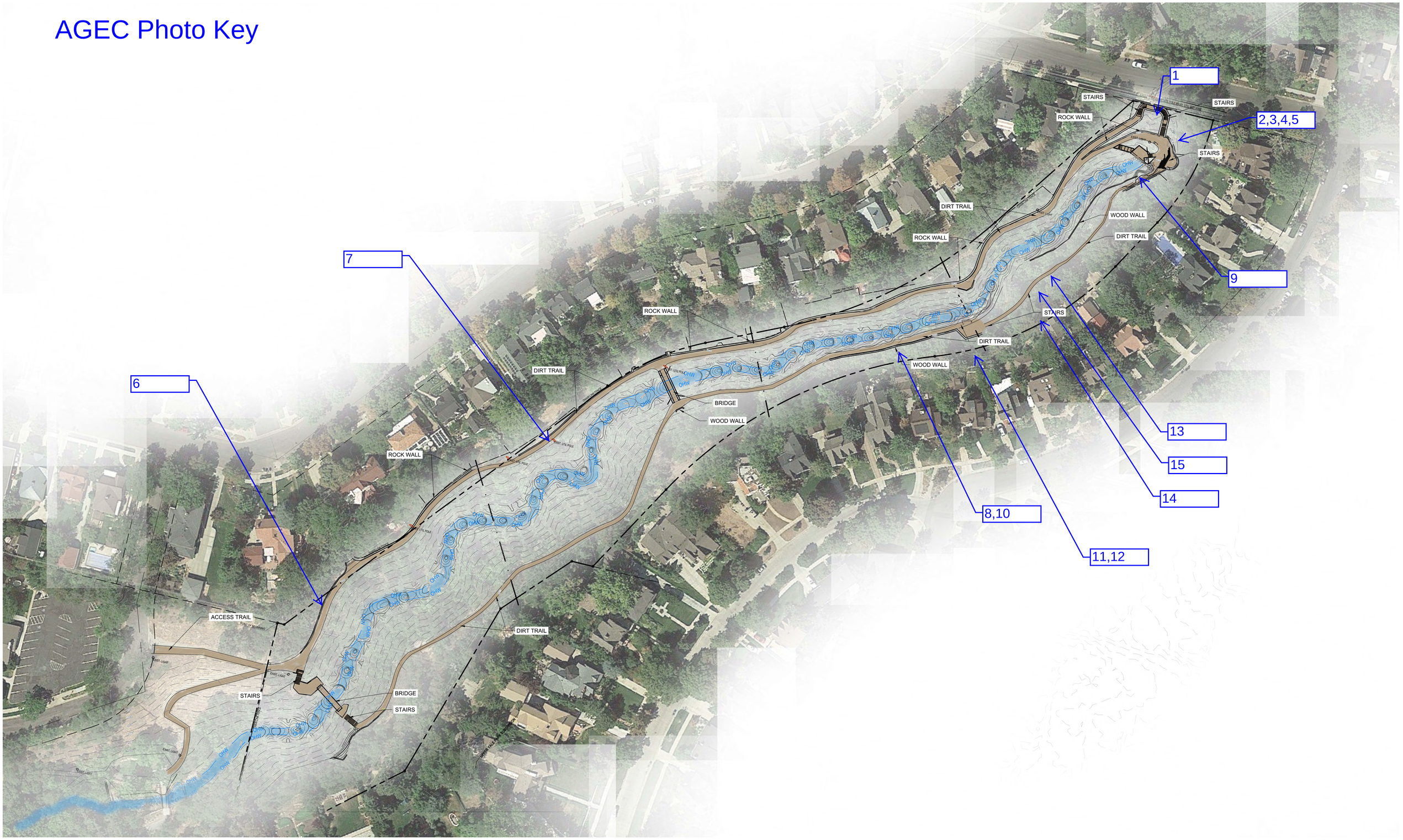
Photograph 12 - Rock wall above the area of erosion. Note trees and other loads near the top of the wall.

Photograph 13 - Area on the east side of creek where structures have been placed near the top of the wall. Also shown wall foundation exposed at the toe.

Photograph 14 - Structures encroaching near the top of the rock wall on the east side of the creek.

Photograph 15 - Structures encroaching near the tip of the rock wall on the east side of the creek.

AGEC Photo Key



Miller Park Trail Improvements: Base Map

Salt Lake City, UT

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April 6, 2023

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We were requested to provide a letter discussing various geotechnical issues affecting the stability of the walls. Specifically, we were requested to comment on whether relocating the trails would improve the stability of the walls.

BACKGROUND

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structures and it appears that improvements, including retaining structures, decks, fences, etc., have been constructed above some of the retaining walls. Some localized areas of erosion were observed. The ground level at the toe of the walls appears lower than it should be with respect to the base rock of the walls in some areas.

The purpose of our site visit was to provide a general assessment of stability concerns for retaining structures. We understand that some improvements are being considered where stability concerns have been observed.

We prepared a letter dated October 10, 2019 presenting our findings. Based on observations, it is anticipated that stability of many of the walls in the park may be marginal. Numerous issues that have negatively impacted the stability of the walls were described in the letter. Considerations for improving stability were discussed.

Site-specific studies of stability of various walls in the park could be considered. However, detailed stability analysis was beyond the scope of this study.

DISCUSSION

Some factors that can improve stability of retaining systems include the following:

- Erosion control above and below retaining walls.
- Repair of internal erosion problems.
- Embed the toe of retaining walls.
- Reduce the slopes that are down and away from the toe of walls.
- Reduce the slopes that are up and away from the top of walls.
- Reduced loads above walls.
- Reduced wall heights.
- Structural improvements such as anchors, tiebacks, bracing or other elements.
- Improved drainage away from walls.

In our professional opinion, stabilization measures such as those discussed above can be considered to improve stability of retaining systems in the park regardless of the trail location.

LIMITATIONS

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If you have questions or if we can be of further service, please call.

Sincerely,

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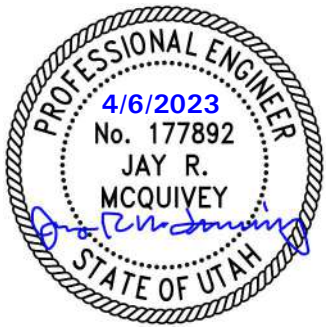

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