city of CINCINNATI
TRANSPORTATION & ENGINEERING

2019 COLUMBIA PARKWAY

Landslide Evaluation and Report

Bains Street to Torrence Parkway

This report provides the City of Cincinnati's Department of Transportation and Engineering's (DOTE) evaluation of the current status of the slope stability issues on the uphill side of Columbia Parkway between Bains Street and Torrence Parkway. Recent landslide activity in January through March of 2019 has prompted demands that the City address the problem of hillside slippage on Columbia Parkway and prevent such reoccurrences. The report presents conceptual solutions, prioritized locations, preliminary estimates and recommendations to substantially reduce the hazards associated with the stability of the hillside.

The stretch of the Columbia Parkway between Bains Street and Torrence Parkway contain the most active landslide activity. With the exception of one location addressed in this report, landslides between Torrence Parkway and Delta Avenue have not been an issue since 1981. The recent landslide and retaining wall failure east of Beechmont Avenue is a separate issue and is not addressed in this report.

COLUMBIA PARKWAY *(Background)*

Columbia Parkway (the Parkway), U.S. Route 50 is a limited access roadway connecting eastern Cincinnati, its suburbs, and eastern Hamilton County with downtown Cincinnati. The western terminus of Columbia Parkway is located on the edge of the central business district of downtown Cincinnati. The Parkway extends 6.4 miles to the east, becoming Wooster Road at the Cincinnati-Fairfax corporation line.

Columbia Parkway was constructed in 1937 and 1938 and followed the alignment of pre-1937 Columbia Avenue. The latter was a two-lane roadway with a total width of 35 to 40 feet, measured from the ditch line on the uphill side to the top of the downhill slope.

Columbia Parkway was created by widening Columbia Avenue, which was accomplished by cutting into the hillside on the northern, uphill side and constructing retaining walls. The cut section was about 20 feet wide, and the temporary retaining-wall cuts were on a slope of approximately 1:1. The wall was constructed, and then backfilled at a slope of 1.5:1 to the intersection with the existing grade. The height of the wall ranged from 6 to 12 feet. ***Figure 1 (below)*** is a typical wall section that shows the configuration of the pre-1937 ground line, the temporary cut for construction of the retaining wall, the retaining wall itself, and the ground slope behind the retaining wall.

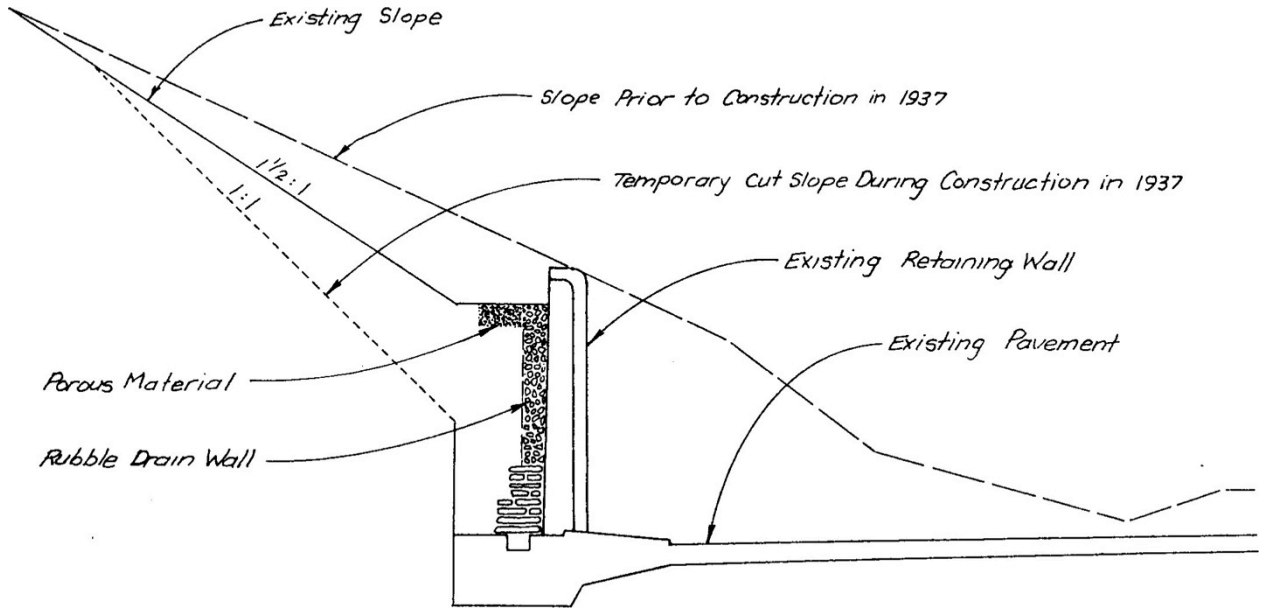

Figure 1: Typical section retaining wall.

The rebuilt roadway had a total width of 57 feet from the face of the retaining wall to the top of the downhill slope. Construction included a 44-foot-wide roadway, a 4-foot sidewalk along the north side, and a 9-foot berm along the south side, which included a second 4-foot-wide sidewalk.

In 1976, the Ohio Department of Transportation (ODOT) City widened the section of Columbia Parkway between Torrence Parkway and Delta by adding approximately 8 feet onto the south side of the roadway. Retaining walls consisting of 36-inch-diameter concrete piers, socketed into bedrock, were required in several places. The City improved the walls on the downhill side of the roadway along this section in the fall of 1992 by installing additional pier walls and underpinning sections of existing barrier walls.

The Ohio Department of Transportation performed two improvement projects to the Parkway in the early 1990's; Tusculum to Beechmont Avenue 1990-1992 (project cost $9,933,336 which included $7,618,091 for walls) and Bains to Torrence 1991-1993 (project cost S10,409,058 which included $5,934,306 for walls). Both projects involved widening the existing traffic lanes. Because of continuing sliding beneath the Parkway and the need to further widen the roadway the improvements required the installation of a total of 3.2 miles of pier walls on the downhill side of the roadway. The existing walls on the uphill side of the Parkway were resurfaced with concrete and a safety barrier was incorporated into the wall. Many of the walls were strengthened using tiebacks grouted into the bedrock. The height of the existing walls was not raised significantly in the two ODOT improvements.

There are currently only two private driveways that have access onto Columbia Parkway between Bains and Torrence Parkway. The western most serves two residences at 1850 and 1852 Columbia Parkway and is located approximately 1,500 feet east of Kemper Lane. The second driveway is located approximately 3,600 feet East of Kemper Lane and serves the residences of 2106 and 2110 Columbia Parkway. The City purchased the property immediately west of this drive in order to eliminate its access onto the Parkway.

GEOLOGY

The hillside above Columbia Parkway rises as much as 200 feet in a horizontal distance of 400 feet, which is a slope of 2:1 (about 27 degrees). Natural slopes beneath the Parkway are generally about 3:1 (about 19 degrees). The hillside is underlain by Upper Ordovician shales and limestones of the Kope and Fairview Formations. The contact between the Kope and Fairview occurs at an elevation of

about 670 feet above sea level, which is 60 to 100 feet above the Parkway. The bedrock is covered with a clayey residual soil known as colluvium. Each of these is described below.

The Kope Formation is primarily shale, but thin limestone layers, typically 2 to 6 inches thick, constitute 20 to 30 percent of the Kope. Shale in the Kope Formation is not tightly cemented and is therefore susceptible to physical disintegration. The large amount of easily disintegrated shale results in accumulations of colluvium, which range from 3 to 50 feet thick, atop the Kope. Within the uppermost 50 feet of the Kope Formation is the eleven-foot-thick Grand Avenue Member, which contains a higher percentage of limestone than does most of the Kope. Shale beds in the Grand Avenue Member are less than 2 feet thick, and limestone layers are as thick as 1 foot.

The Fairview Formation lies above the Kope Formation and has an average limestone-to-shale ratio ranging from 1:1 to 3:1. The limestone layers are typically thickly bedded and tabular. Many of the limestone layers are more than 4 inches thick, and some are 7 to 10 inches thick. Because of the higher percentage of limestone, the Fairview Formation supports steeper slopes and thinner soils than does the Kope Formation. Natural slopes developed on the Kope Formation can be as gentle as 6:1 (about 10 degrees), whereas slopes developed on the Fairview Formation can be steeper than 2.5:1 (about 22 degrees). Hence, there is in many cases a noticeable change in topography at the Kope-Fairview contact. Colluvium thickness above the Fairview Formation ranges from zero to 6 feet.

Foundations for some of Cincinnati's early buildings were constructed with local limestone. Practically all the commercial quarrying was done in the Fairview Formation, mostly in the upper Fairmont Member (also known as the Hill Quarry Beds). Steep slopes, terraces, and exposed bedrock suggest that limestone was quarried from the top of the hillside above Columbia Parkway. During quarrying, shale was often dumped over the slope across from the exposed quarry wall. In 1975, waste from 19th-century quarrying operations slid onto Columbia Parkway west of Audubon Avenue.

Colluvium in the Cincinnati area is weathered shale and limestone that has been transported downslope by soil creep. Colluvium derived from the Kope and Fairview Formations is typically a very stiff to hard, medium-plastic clay containing pieces of embedded shale and limestone. During dry periods, colluvium near the ground surface is dry and hard; however, it is softened and becomes plastic during rainy periods. Colluvium occurs along the entire length of Columbia Parkway and can be as much as 50 feet thick on the downhill side of the Parkway and can have a thickness of 5 feet or

less on the uphill side of the Parkway. When wet, Cincinnati colluvium is highly susceptible to landslides.

The stretch of the Ohio River Valley from the Little Miami River to Anderson Ferry is a young, immature valley having formed after the Illinoisan Glaciation. The section of the valley on the Ohio side of the river is also on the outside of a meander in the river. The river has been eroding into the hillside ever since it came into existence.

LANDSLIDES ABOVE COLUMBIA PARKWAY

Movement of colluvium on the hillside above Columbia Parkway has been a continuous problem since its construction. The landslides involve a thin mantle of clay soil, typically less than 5 feet thick, that moves over the steepened slope when it becomes saturated due to prolonged periods of rainfall. The failure or slip surface of the landslides is located along the soil-bedrock interface. The landslides are classified as rapid earthflows commonly referred to as “mudslides”. The areas in which soil encroaches upon the retaining wall are slide blocks that have separated from the lower portions of much larger landslides, which extend much higher up the slope.

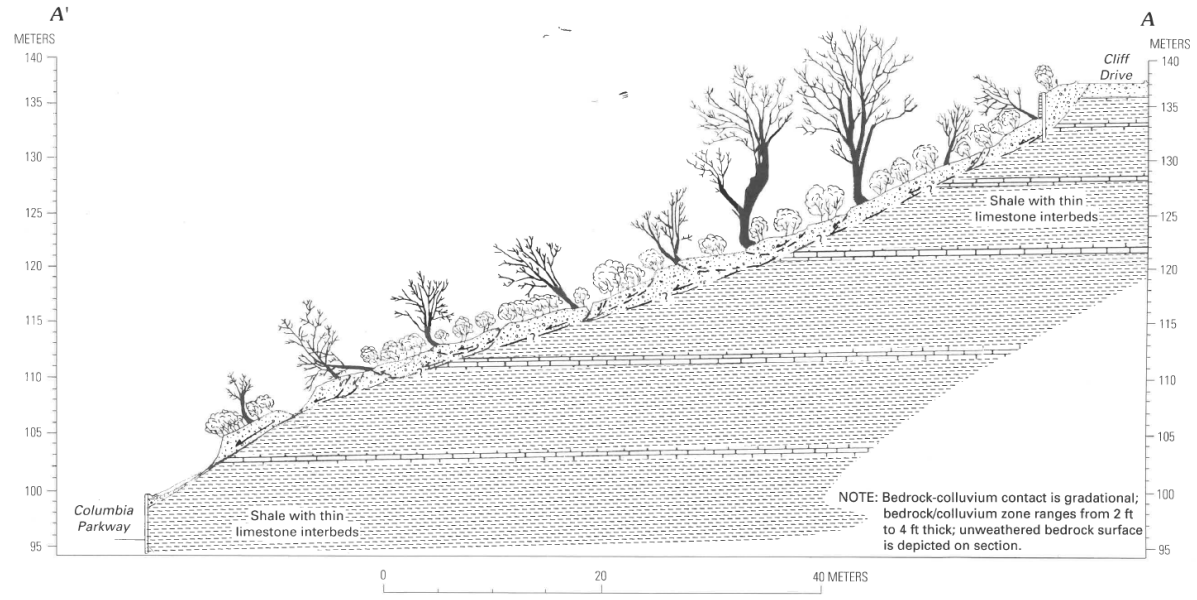

Figure 2: Cross section through landslide (Richards 1982)

Slide blocks that eventually reach the top of the wall are removed when they pose a hazard to the public. If movement onto the Parkway occurs prior to its removal, DOTE and Department of Public Services (DPS) personnel quickly respond to evaluate the

situation and if necessary take immediate action to close the road and mobilize crews to remove the debris from on top of the wall and on the roadway.

Removal of the slide block mass is possible if the complete slide block mass can be removed up to the point where it broke from the hillside. Once removed, the lower portion of the landslide remains dormant and marginally stable until another block separates, causing repeated landslides in the same location.

Major Landslides Above Columbia Parkway

Although this report specifically addresses the slope stability issues along the Parkway between Bains and Torrence Parkway, the largest landslide to occur on the uphill side of the Parkway occurred East of Torrence and west of Delta Avenue, approximately 775 feet west of the Parkway's intersection with Audubon St. The slide occurred on March 29, 1975. It had an average width of 150 feet and extended up the hillside approximately 150 feet in elevation. This large landslide reportedly involved as much as 10,000 cubic yards of soil. The weight and force of the moving slide mass caused about 160 feet of retaining wall to fail. It was concluded that most of the slide material was shale and clay dumped along the slope during 19th-century quarrying operations. The cost of the removal in 1975 was stated as $31,000. The occurrence of this landslide as stated in a June 30, 1975 City memorandum "precipitated much public concern regarding such occurrences not only above Columbia Parkway, but at other locations throughout the City as well, and gave rise to many demands the City prevent such reoccurrences."

Figure 3: 1975 landslide west of Audubon

Figure 4: 1975 Landslide clean- up. U.S.G.S. Website

Also noted from 1975 is the occurrence of six landslides along the hillside east of Kemper Lane. About 5,000 cubic yards of soil was removed from behind the retaining wall. The location of these landslides coincides with recent landslide locations that occurred in 2011 and 2019.

A second large landslide occurred above the Parkway on June 7 of 1996. The debris from this landslide rapidly overtopped the retaining wall immediately west of the driveway for 2110 Columbia Parkway. The landslide mass extended out into four of the five lanes of the Parkway. The major cause or trigger of this landslide was the extraordinary amount of rainfall that preceded the movement. Fill had been placed on the hillside in the upper reaches of the landslide. This landslide also occurred at the same location and most likely involved material that had previously slid in May of 1945.

City personnel first noticed movement of this landslide on May 27, 1996. At this time, soil was slowly moving on top and over the retaining wall with accumulation in the inbound traffic lane closest to the wall. Two of the three inbound lanes were closed to traffic and an employee was stationed at the site to monitor movement in case additional lane closure was necessary. Additional movement was not observed overnight. Soil was removed from the roadway and a minor amount of soil from on top of the wall on Thursday the 28th. Complete removal of the slide mass was not possible because of the magnitude and uphill extent of the landslide. All lanes were open to traffic on Friday May 29th 1996.

Although the landslide had temporarily stabilized, additional movement was expected. Personnel from DOTE and PS visually monitored the slide. Traffic devices were left on site. Heavy rainfall was forecasted overnight for Thursday June 6 into Friday morning of June 7. Personnel from PS were stationed on site to monitor the location. Camera crews from WCPO were also on site overnight. Movement was not observed until approximately 4:00 am on Friday, June 7, 1996. Soil began slowly moving over the wall and accumulating in the inbound lane closest to the retaining wall. Personnel from PS closed the inbound lane adjacent to the wall. At approximately 6:00 am there was a surge in the rate of movement and the landslide mass rapidly came over the retaining wall.

Figure 5: 1996 landslide at 2110 Columbia Parkway

The landslide was captured on video, which shows the rapid movement and the magnitude of the slide. Traffic continued to travel in both directions as the slide mass was coming over the wall. It was fortunate that a vehicle was not directly impacted by the landslide or that a collision did not occur due to traffic crossing lanes to avoid the sliding mass.

Crews from PS worked essentially around the clock removing the slide debris. Traffic was opened on Monday June 10, 1996. The total cost of the cleanup was approximately $165,000.

Recent Landslide of 2019

The first significant landslide that occurred in 2019 was not on the Parkway but on Kemper Lane just north of its intersection with Columbia Parkway. A 60 ft. wide section of hillside slid down to the top of the retaining wall on the west side of Kemper Lane on January 23,2019. The walls on the west side of Kemper were constructed along with the original Columbia Parkway Wall. Trees within the slide mass that overhung the wall were cut back. Additional movement occurred on January 24th requiring the closure of Kemper Lane and the complete removal of trees from the slide mass. DPS removed the slide debris and opened Kemper Lane on January 25,1

Figure 6: Jan. 24th 2019 landslide on Kemper Lane

There were two locations where landslides on Columbia Parkway (between Bains and Torrence) that caused the closure of the Parkway in 2019 (see pages 26-27 for a third location). Sliding at the first location occurred on January 27, approximately 1,000 feet east of Kemper Lane. This landslide was the westward expansion of an area that slid in February and March of 2016, May of 2017 and again in February 25 of 2018. The most recent movement at this location was first noted by a DPS Emergency Service Response (ESR) person who notified DOTE personnel that the trees were leaning out onto the Parkway. DOTE and DPS personnel arrived on site and closed both lanes of the Parkway prior to any major movement. Slide debris came over the wall and onto the Parkway overnight while the Parkway was closed. Crews cleared trees and

removed the debris from the roadway on January 28 and January 29, 2019 and reopened the Parkway on the 29th.

Figure 7: Jan. 29th 2019 landslide on Columbia Parkway 1,000 ft. east of Kemper Lane

A small block of debris from higher up the slope broke loose at this location on February 11th, 2019. Although small, the removal of the debris required the temporary closure to remove it from the travel lane. Landslide activity was occurring at various locations on February 11, 2019. A significant landslide occurred on Hill Street in Mt. Adams approximately 200 feet west of Martin Drive and on Martin Drive 250 feet north of Hill Street. Hill Street was closed to through traffic.

Figure 8: Feb. 11th, 2019 debris coming over the wall 1,000 ft. east of Kemper Lane

The second landslide on the Parkway occurred overnight and prior to the morning rush hour on February 12, 2019. This landslide is located 300 feet west of Kemper Lane. Cincinnati Police Department (CPD) closed the Parkway in both directions. Soil did not actually come over the wall however trees in the slide mass were hanging over the wall. DPS crews removed the slide mass after Davey Tree who is under contract with the City for emergency tree removal services removed the trees. The landslide debris was cleared from above the wall. The Parkway was opened that evening. In addition to clearing the landslide at this location, a small block of soil mass was also removed from the previous slide location east of Kemper Lane.

Figure 9: 300 ft. west of Kemper morning of February 12th, 2019

Trees within slide blocks in the upper reaches of the slope broke loose from the slope prior to their scheduled removal. One of the blocks slid completely down the slope on the afternoon of February 14, 2019.

Figure 10: February 15, 2019 300 ft. west of Kemper

The Parkway again had to be closed at his location until the trees could be removed along with a minor amount of soil. The Parkway was reopened on February 15th.

Figure 11: February 15, 2019 300 ft. west of Kemper. FOX 19 drone coverage

Continued movement of soil left on the hillside at the landslide 1,000 ft. east of Kemper was observed on March 6th. The trees were removed from the slide mass in preparation for removal. Immediate removal of the slide mass could not be done because DPS was committed to winter operations. Movement of the slide mass occurred in the early morning of March 10th following a heavy rainstorm. The Heart Mini-Marathon took place on March 10th and the Parkway was closed to traffic for the marathon. DOTE personnel secured and remained on site to monitor the slope during the Marathon. The Parkway remained closed until DPS completed the removal of the debris mid-morning of March 12th.

CAUSES OF THE LANDSLIDES

Stating that the cause of the landslide was the over steepening of the slopes and that the height of the retaining walls were not constructed high enough during the original construction of the Parkway is an over simplification of the reasons for the landslides. The site geology and the sloping bedrock surface along the entire length of the Parkway are the primary reasons for the unstable conditions on the uphill and downhill sides of the Parkway.

Without question the hillside between the flat upland and the Ohio River has been sliding since this section of the Ohio River came into in existence following the melting of the Illinoisan Age Glaciation. As previously stated in the Geology section of this report the Ohio River Valley is geologically young and immature.

Deforestation clear cutting of the hillsides took place in the 1800's and early 1900's. Landslides both above and below Columbia Avenue prior to the construction of Columbia Parkway were also undoubtedly common occurrence.

Figure 13: Plate 7 of 1848 "The Cincinnati Panorama" Fontayne & Porter

The lower portion of the hillside was over steepened during construction of the retaining walls for the Parkway. The over steepened slope decreased the height of the retaining wall. Most of the excavation behind the retaining walls and above the walls during construction was within bedrock. The over steepened bedrock cut slope was stable after construction of the wall.

Figure 14: 1938 looking west From Kemper Lane

This stable bedrock slope however quickly weathers into a clay rich soil. Soil derived from the weathering of the Kope Formation is well known for being prone to both shallow and deep-seated landslides. Sliding occurs when the soil becomes thick enough and when rainfall is heavy and frequent enough to saturate the soil and uplift (pore pressures) the soil along the soil-bedrock interface (the slip surface). The uplift pressures along the slip surface are due to seepage along this plane from sources higher in elevation and along joints within the limestone layers of the bedrock. Once the soil mass moves, open fissures occur in the soil and provide surface water direct access into the failure mass, and sometimes direct access to the failure surface.

Landslides have occurred prior to and after the construction of the Parkway. It has been close to ninety years since the Parkway's construction. Sufficient time for the shale bedrock to weather into thick or thicker deposits of soil. The weathering of the shale into soil in areas that have slide in the past is reoccurring for the second, third or fourth time.

An additional contributing factor is the recent clearing of trees on the hillside for views. Trees on the hillside also appear to have been hard hit by recent insect infestation.

Landslides above Columbia Parkway will continue to occur, and the rate of sliding at any given time will be related to rainfall. The conditions most conducive to landslides will be heavy rainstorms during mid to late winter and early spring before trees leaf out.

LANDSLIDE LOCATIONS

The locations of landslide areas are shown on Plates 1 through 4. Plates 1 and 2 show the location of the slide areas plotted on an Aerial Photographic background taken on February 22, 2019. Plates 3 and 4 show the location of the landslide areas along with parcel ownership designated as private ROW, Cincinnati Parks and other City Departments.

Landslide areas outlined in red are areas where there are active landslides. Areas outlined in green are areas where the City has removed slide debris from the hillside.

A cyan line on the plates shows the proposed length of areas that requires stabilization. The conceptual method of stabilization, Method A or Method B, is indicated on the plan for each area. A description of the two methods is given below.

Field Investigation was not performed specifically for this report. The locations of the landslides that are shown on Plates 1 through 4 were identified from previous hillside field inspections, aerial photographs, recent drone coverage and inspection from the Parkway. Additional field investigation and limited subsurface investigation needs to be performed prior to the implementation of any stabilization methods. Additional investigation is warranted and recommended for drainage improvements in the upper reaches of the slope.

Conceptual Stabilization Methods

The most likely methods that would be constructed to stabilize the landslide areas, Method A and Method B were used for estimating the cost of stabilizing the areas. The specific details of the two conceptual methods of stabilizing the landslides will need further development and engineering design. Alternative methods for stabilization other than the two methods described below are possible.

Method A

Method A consists of the construction of a conventional retaining wall upslope of the existing retaining wall. It is proposed in Slide Areas 7, 8 and 10. These areas are where there is active sliding but where the slide mass predominantly remains on the hillside. Wall construction would need to far enough away from the physical elements of the

existing wall but still within the reach of being able to construct from the Parkway to minimize excavation into the hillside. The type of wall constructed could range from an H-Pile wall with a concrete or modular facing to a soil nail wall with a mechanically stabilized facing. The most important aspect in the construction of Method A is that excavation into the slope will need to be limited in length, braced temporarily or with the temporary support incorporated into the permanent wall construction.

Method B

Method B is utilized in areas where past sliding has previously occurred and exposed much of the bedrock surface. It is used to stabilize slide areas 1 through 4 from Bains St. to Kemper Lane and the recent slide on Kemper Lane. The lower slide debris that broke away from the main body of the landslides and now rests on or directly above the retaining wall would be removed exposing the weathered bedrock surface. The lower portion of the slide mass uphill from the wall is then stabilized. The most likely method of stabilization is by the installation of soil nails with a wall facing. The exposed weathered bedrock surface between the upper soil nail wall and the existing parkway wall would be covered with a steel mesh over an erosion fabric that also promotes vegetative growth.

The lower portion of the landslide must be stabilized. Simply removing the soil that previously slid without stabilizing the lower extent of the slide will result in additional sliding in the future. Installation of the soil nail wall described above can be done by high reach drilling equipment and is considered the most economical. Conventional wall construction; drilled piers, modular blocks and reinforced concrete walls could be constructed instead of the soil nail wall but are likely more expensive and require benching of the slope below the proposed wall location.

Method B with the installation of a soil nail wall is probably the only alternative to stabilize the lower extent of the slides on and immediately east of Kemper Lane Slide Areas 4, 5 and 6 and the lower limits of the recent landslide in Slide Area 3 immediately west of Kemper. The lower limits of these slide areas, which is the previous scarp line, is high up the hillside and on an extremely steep slope.

Drainage Improvements

In addition to the stabilization methods, improving drainage on the hillside will help increase the stability of the hillside. This is especially true of the hillside between Bains and Kemper. Rills and gullies that channelize surface runoff over the existing retaining wall have developed or become increasingly active over the past decade. Intercepting surface and subsurface water by ditches and drains will lower the weight of the soil

improve the strength of the soil and reduce the hydrostatic pressure along the soil-bedrock interface.

The upper reaches of the slope immediately below Eden Park and along the edge of the upland need to be investigated not only for possible drainage improvements but stability issues.

LANDSLIDE AREAS AND PROPOSED IMPROVEMENTS

Table 1- Slide Areas, Stabilization Method and Estimated Costs located in Appendix B summarize the proposed improvement for each of the Landslide Areas identified on Plates 1 through 4. The estimated cost per linear ft. and the total cost for each landslide area is listed in the table. Each of the areas is ranked as to the priority of stabilization. The estimated cost to stabilize all the noted Landslide Areas is $13,287,000. Utility relocation, traffic control and drainage improve can increase the cost up to an estimated $17 million. The majority of the propose work will require the closure of two of the three inbound (westbound) lanes. Construction will take two construction seasons over a continuous time period of 18 months.

The following is a summary of landslide activity and conceptual stabilization methods proposed along segments of the Parkway.

Bains Street to Kemper Lane (Landslide Areas 1 through 4)

The Bains to Kemper Lane area is below Eden Park and contains the most active and most numerous landslides. Designated as only four areas, it does contain numerous individual landslides. Throughout almost its entire length the lower 60 feet of hillside immediately above the existing retaining wall has separated from the lower portions of larger landslides that extend further upslope. The slide blocks that separated from the upper slope block the drainage ditch and cause water to spill over the wall. Persistent areas of seepage freeze into icicles during the winter.

Figure 15: Landslide Areas 1 & 2, 2012

Figure 16: Landslide Areas 1 west, 2 & 3 2012

Figure 17: Landslide Area 3, 2017

The lower sliding is in the portion of the slope that was over steepened during construction. Weathered bedrock is exposed above the mass that slid and below the scarp where it broke from, now the lower portion of the landslide.

Soil has been removed from on top of the wall at seven locations (includes landslide on Kemper Lane) with the latest being the most recent landslide that occurred on February 12, 2019. Prior to the February 12th slide, the latest significant preemptive removal along this section was in 2014. Slid debris has remained relatively stable on top of the wall since at least 2010. Simply removing all the slid debris that sits on top of the wall would cost on the order of $700,000 of thousands in landfill fees alone. This may remove immediate threat but would not restore the slope or prevent future slide blocks from separating from the upper portion of the hill and over the wall. Removal of the lower portion of the slide can also destabilize the upper larger slide mass. The lower portion of a slide provides resistance to movement if it has not completely separated from the larger mass.

Property ownership is Right-of-Way (ROW) for the Parkway, unimproved ROW or Park Board. The existing retaining wall along this length is approximately 12 feet tall. The original wall was left in place and strengthened with tiebacks and a new facing in front of it as part of the ODOT 1991-93 improvement. The presence of the tiebacks does not prohibit the drilling of piers behind the wall but will require the determination of their locations and accounted for in design of stabilization methods. The retaining wall

on the west side of Kemper Lane was not included in the improvement and is the original retaining wall.

Kemper Lane to Torrence Parkway. (Kemper to 1850, 1852 Columbia Parkway) Landslide Areas 5, 6 and 6A.

Significant landslides occurred in Landslide Areas 5 and 6 in 1975. Recent landslide activity requiring the removal of the slide mass was done at Landslide Location 5 in 2011. Debris removal in Landslide Area 6 has been active from 2013 into 2019. The area between Landslide Areas 5 and 6 appears stable.

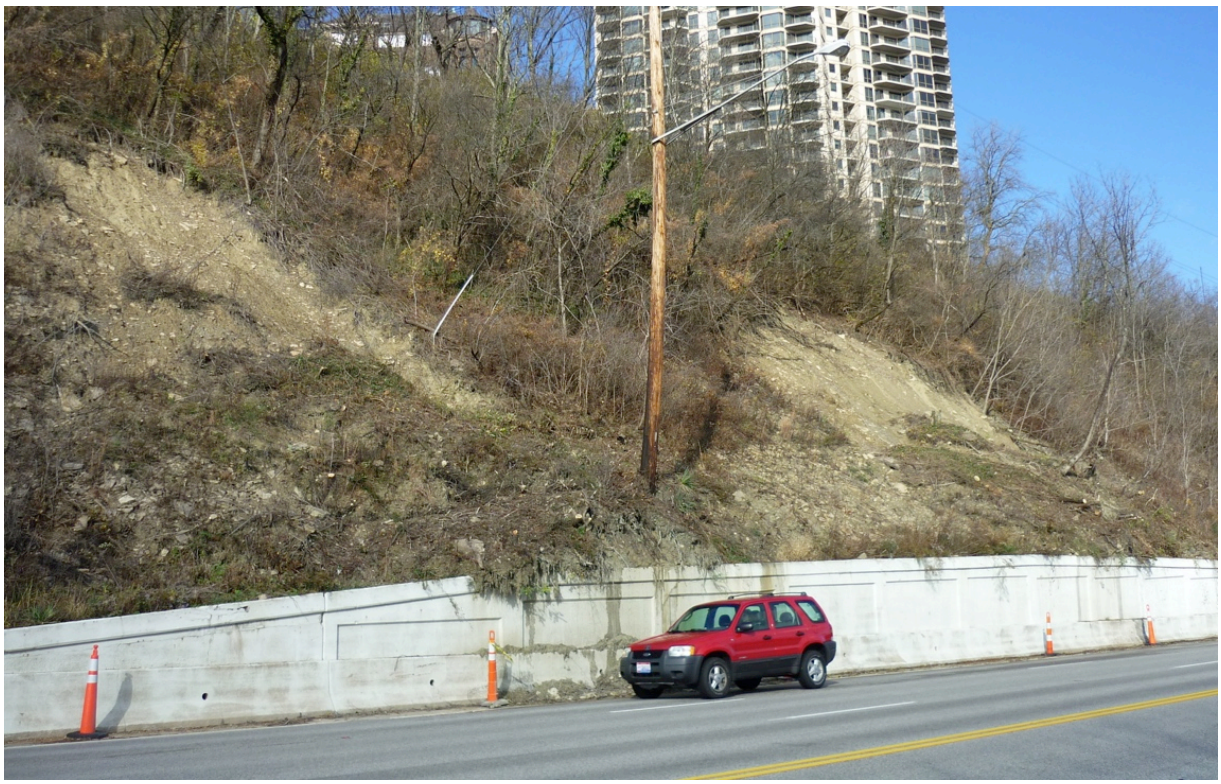

Figure 18: Landslide Area 5, 2011

Figure 19: Landslide Areas 5 & 6, 2017

The major portion of the slide masses in Areas 5 and 6 has already slid and been removed. The upper half of the slide mass still exists on the hillside. The portion of the slide, immediately above the scarp line of the previous slides, can continue to slide downhill as blocks or as a large mass. Trees on the slide blocks can slide into the travel lane. This threat will exist unless the lower reaches of the upper portion slide are secured. A possible solution is to remove the trees that are a major hazard when sliding occurs. Simply removing the trees will not prevent slide blocks from sliding down the slope.

The most likely method to secure the upper reaches of the slope is Method B. Method B is more than likely the only alternative method to secure the upper reaches of the slope because of the steepness and height of the slope.

Landslide Area 6A does not impose an immediate threat or possibly even a future threat but a scarp does exist mid-slope. The slope is not as steep as Areas 5 and 6. Trees on the slope have been cut and left on the slope, possibly for views or they may have been diseased.

Landslide Areas 5, 6 and 6A are on private property. Overhead utility lines are an obstruction to construction.

Kemper Lane to Torrence Parkway (1852 to 2110 Columbia Parkway) Landslide Areas 7, 8 and 9

A well-defined landslide toe occurs directly above the retaining wall along the entire length of Landslide Area 7. An approximate 20 ft. long portion of the toe extended out onto the wall where it remained relatively stable since it first appeared in 2010. A prominent linear scarp exists along the entire length of the landslide and coincides with the length toe. The scarp has a vertical offset on the order of three to four feet. The scarp is on the downhill side of what appears to be a bench cut into the hillside. Water pools on the bench. Removal of the toe that extends on top of the wall has not been done because of the possibility of causing additional movement. The soil that overhangs the wall weathers and drops to the base of the wall is periodically removed from the base of the wall. Removal of the soil that overhangs the wall is quickly replaced by additional overhanging soil that then drops to the base of the wall. The amount of time required between removals is decreasing even during dry periods. A second bulge of the toe onto the wall recently developed in February of 2019.

Figure 20: Toe of Landslide 7, 2019

Encroachment of the toe of a landslide onto and over the wall also occurs in Landslide Area 8. The toe of the western portion of Landslide 8 is within an abandoned driveway. This toe of this landslide started encroaching onto the wall since at least 2013. The size of the toe has increased significantly over the last six years. Minor removal of the

soil that overhangs the wall is quickly replaced. As in the case of Area 7 removal of the has not been done because of the possibility of causing additional movement. The eastern half of the landslide toe sits on top of the retaining wall. A light pole is located within the toe and has been leaning for at least the past decade.

Figure 21: Toe of Landslide 8, 2019

Landslide Areas 7 and 8 are extremely active in 2019. Both of the areas are large. The most economical method of stabilizing Landslide Areas 7 and 8 is by Method A which involves the construction of a retaining wall on the uphill side of the existing wall. Overhead utilities will need to be relocated or accounted for during construction. Landslide Area 7 is on private property. Landslide Area 8 is on City owned property.

The 1996 landslide at 2110 Columbia Parkway occurred just to the east of Landslide Area 8 and west of the driveway for 2110 Columbia Parkway Figure 22.

Kemper Lane (2110 Columbia Parkway) to Torrence Parkway (Landslide Areas 9 and 9a)

Landslide Area 9 includes a landslide that occurred in 1997 east of the driveway to 2110 Columbia Parkway. DPS removed the slide debris in 1997. The scar from the removal is shown below the switch back of the driveway of Figure 22.

Figure 22: 2110 Columbia Parkway 1997

The area east of the1997 landslide in this section of the Parkway is extremely active and recently started moving at an accelerated rate. This landslide Area started moving onto the wall in 2011. Soil did not start dropping onto the pavement until late February of 2019. Movement on March 20, 2019 resulted in the closure of two lanes. DPS began removal of the slide mass on March 21 and completed the removal on March 22, 2019.

On March 25, 2019 DOTE was notified by DPS personnel that a light pole was knocked over by a landslide. DPS was on the Parkway removing debris from the base of the wall in Landslide Area 7 when the pole fell. No one was injured. Westbound traffic lanes were closed and eastbound traffic was reduced to one lane.

This landslide is an eastern extension of the landslide that occurred on March 21, 2019. The March 25, 2019 slide has a well defined scarp approximately 25 feet upslope of the wall. Additional scarps and tension cracks exist higher up slope. The ground was completely saturated on March 25. Water was standing in puddles and water was flowing from numerous seeps on the hillside.

Trees were removed from the slide mass on March 25, 2019. Soil fell over the wall and into the lane closest to the wall during late afternoon of March 25. All three inbound lanes remain closed as of March 26, 2019.

Removal of the lower portion of the hillside that broke away and remains on top of the wall will leave an approximate 175 ft. long cut above the wall at the toe of the slope. The immediate stability of the hillside is questionable at best and there is a strong potential for additional movement following or during a period of rainfall. This area needs immediate stabilization. Until the slide is secure, lane closures of westbound Columbia Parkway west of Torrence will be in place.

Figure 23: Landslide Area 9, 2019

Figure 24: Landslide removal Area 9, March 21, 2019

Landslide Area 9a is located approximately 650 east of Landslide Area 9. The toe bulge of the landslide has a length of 80 feet and is accumulating just behind the wall that is 6 feet tall. The scarp of the landslide occurs 70 feet uphill from the wall and has separated from the slope above by a foot.

Overhead utilities do not exist Landslide Ares 9 and 9a. The electricity for parkway lighting is in conduit attached to the back of the wall. The existing retaining wall is eight feet tall.

Figure 25: Landslide knocks over light pole, March 25, 2019

Five landslides have occurred east of Landslide Area 9, between the Collins Road overpass and Taft Road. The landslides occurred between early 1990 and 2017. The slide masses of the landslides were removed by DPS. The upper portion of the slide in the rear yard between 1875 and 1883 William H Taft Rd. although active, has not shown any landslide activity that threatens the Parkway since 2017.

Figure 26: Landslide scars west of Taft 2012

Torrence Parkway to 750 feet east of Torrence Parkway (Landslide Area 10)

An active landslide exists approximately 750 feet east of Torrence Parkway. The landslide is directly below and predominately on the property of 444 Whitman Court. The landslide has been in existence since at least 2001. A utility pole with a streetlight is in the slide mass. The landslide causes the pole to lean over time. The pole has been reset a least once since 2008. The existing wall along the length of the slide is only on the order of 2 ft. The toe bulge of the slide continually overtops the low wall. Debris accumulates at the base of the wall and requires constant removal by DPS. Duke has been notified in 2018 and 2019 about the leaning pole and recently straightened the pole on March 20, 2019.

The construction of a wall, most likely a pier wall is the probable method of stabilizing the area. Overhead utilities will need to be relocated or accounted for during construction.

Figure 27: Landslide Area 10, 2001

Figure 28: Landslide Area 10, 2019

RECOMMENDATIONS

1. Over the years the approach has been to close the roadway and clean up the debris and soil. These unscheduled shut downs and the potential that one of these slides can spill over the wall at any time in to active traffic makes it a priority to come up with a long-term permanent solution. The cost to DPS of immediate clean up alone, without any stabilization work to prevent future slides, has amounted to $607,000 including tree removal, since 2012.

2. Provide a comprehensive landslide solution that can be implemented in the near term to provide hillside stability for the known areas that are actively moving. The intent is to stabilize only the known active areas to minimize cost, which should also provide long-term stability to the rest of the hillside. The overall solution can be a combination of new retaining walls, soil stabilization methods such as “soil nails”, drainage improvements and possible other green solutions.
3. Implement these improvements using a modified two step competitive design-build delivery method. The first step would be to issue a Request for Information (RFI) like the city did for the emergency work for Phase II of the Riverside Wall project. The RFI will request design-build teams to submit their qualifications, overall stabilization plan, estimated cost, schedules and construction methods including impacts on traffic. Those proposals will be evaluated by a selection team and the firms that are short listed will be requested to provide a detailed follow up submittal through a modified Request for Proposal (RFP) process. The RFP will subsequently be awarded in accordance with CMC 321-89. DOTE is ready to release the RFI once this report is finalized. The entire process can take in minimum of 3 months to get a contract executed. The City Manager will approve the use of emergency procurement procedures.
4. The administration is working on funding scenarios that will be presented to Council soon. DOTE recommends, that if possible, the entire project be funded at one time. This will allow a comprehensive solution that can be implemented with the least disruption to traffic. DOTE estimates this work will take approximately 18 months, which will include two lanes of Columbia Parkway being shut down. Columbia Parkway handles approximately 30,0000 vehicle per day and is one of the main arteries leading in and out of the city from the east side. The impact of losing two lanes is high and should be minimized as much as possible. A phased solution rather than a comprehensive all at once approach will cost more and take longer. Phasing the work, depending on when funding is available can result in lengthy delays due to multiple mobilizations for specialized equipment that because of the high demand may not be available when needed. Furthermore, if the funding is phased, the work may not be able to be sequenced as economical as possible thus resulting in taking longer and costing more.

5. The Administration and DOTE will also aggressively pursue emergency grant funding sources to supplement city capital funds wherever possible. DOTE has already submitted a request to ODOT for FHWA Emergency Relief Funding for reimbursement for the failed retaining wall repair on Columbia Parkway below Richwood Circle. DOTE is also considering applying for a grant through the Ohio Emergency Management Agency (EMA), who has recently announced another round of funding available through the Hazard Mitigation Grant Program.