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Appendix B

Active Transportation Assessment

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DATE : January 31, 2023

SUBJECT: Burleigh Hill Drive MCEA – Active Transportation Assessment

This technical memorandum details the Active Transportation (AT) Assessment conducted in support of the Burleigh Hill Drive Municipal Class Environmental Assessment Study, undertaken by the Regional Municipality of Niagara (Niagara Region).

The study limits for the Burleigh Hill Drive (Regional Road 56) EA extend from Glendale Avenue to St. David's Road, and the study will be assessing the transportation and reconstruction needs of this segment of regional road. Within the study area, Burleigh Hill Drive currently has a three-lane cross-section, with one traffic lane in each direction, and an additional lane that varies as a turning lane or a passing lane in different sections.

Existing and potential future active transportation facilities are detailed further in this assessment; however, in summary, the existing active transportation facilities are inadequate, and the steep grading and exposed rock facing on either side of the road at the escarpment is considered cost-prohibitive to widening the road platform and presents limitations with regards to building active transportation facilities outside of it. The inherent steep slope of the road presents a challenge to promoting active transportation use, particularly cycling, and so also included in this assessment is the consideration of the wider active transportation network and alternative planning solutions, including whether any nearby roads may be well suited to active transportation facilities/connections in addition to or in lieu of those that are being considered for Burleigh Hill Drive.

1. Background Review

The background review considered relevant background documents that will help to determine the justifications and feasibility of providing active transportation (AT) facilities along the study area for the Burleigh Hill Drive MCEA being conducted by the Region of Niagara. The review will also be useful to determine the type of walking and cycling facilities or other AT-supportive road improvements that are most appropriate, and how Burleigh Hill Drive fits into the AT network in the surrounding areas of St. Catharines.

The relevant background documents reviewed include.

- Niagara Region Transportation Master Plan (2017), including relevant background reports:
 - Complete Streets Vision and Direction for a Changing Region
 - Complete Streets Design Guidelines
 - Strategic Cycling Network
- City of St. Catharines Transportation Master Plan (2021)
 - *Note: The City of St. Catharines will be commencing work on an Active Transportation Masterplan in 2023, and thus some existing transport recommendations are subject to change.*
- Thorold Transportation Master Plan (2020)

1.1 Niagara Region Transportation Master Plan 2017

The Niagara Transportation Master Plan (TMP) focuses on seven high level goals, including to:

- enhance multi-modal connectivity
- improve options for sustainable modes of transportation
- Promote the development of healthy communities

The TMP notes some key trends that will shape transportation in Niagara Region, such as:

- The region's population and employment base will grow substantially by 2041, mostly in urban areas
- Age-related issues and lifestyle preferences among seniors and young adults will boost demands for non-car travel options
- A shift in employment will increase the market for transit and active travel modes

The Niagara TMP recognizes that “*the purpose of a street should be more than just a route for automobiles. Streets are the defining elements of Niagara's towns and cities and showcase the character of a place.*” With that in mind, the TMP recommends that

the Region plan and design all Regional Road projects using a Complete Streets approach, designing roads to be universally accessible, safe, and comfortable for all users. To do this, the Region has developed a supplementary Complete Streets Vision document and design guidelines, which are described in the subsequent sections.

Recommended actions in the Niagara TMP related to active transportation include:

- Implement the Niagara Bikeways Master Plan network, giving priority to projects with the greatest cycling impact, balance complexity of work to be undertaken, and taking advantage of opportunities to work jointly with local area municipalities
- Develop and support cycling education and safety, cycle wayfinding implementation and improve the overall cycling experience for all users
- Invest in cycling facilities and supporting infrastructure to promote active lifestyles and healthy communities
- Promote safe walking, cycling, and driving through education, engineering, engagement, evaluation, and enforcement.
- Implement Complete Street design guidelines as part of road rehabilitation and reconstruction projects, including assessing the opportunities for improved community living (pedestrian, cycling, urban design treatments, and accessibility)

1.1.1 Complete Streets Vision and Direction for a Changing Region 2017

Note: The Region is currently updating their Complete Streets Design Manual anticipated completed later in 2023. The following sections are primarily extracted from the 2017 guidance which provides the base of the 2023 manual; however, some statements have been updated to conform with the anticipated changes.

This report establishes the vision for complete streets in the Niagara Region and provides a decision-making framework to ensure successful implementation. Guiding Principles for Niagara’s Complete Streets will form the strategic basis for decision-making, including:

- All roads and streets in Niagara, will be designed using a “**complete corridor**” approach.
- Roads and streets will consider **public space** opportunities.
- Niagara’s roads and streets will **integrate** adjacent land uses.
- Corridors will be **multi-modal**, to move the largest numbers of people in the widest variety of modes.
- Corridors will be **universally accessible** to users of all abilities.
- Corridors will be **safe and comfortable** for all users, with an emphasis on vulnerable road users (children, older adults, people with disabilities), and protection of pedestrians and cyclists from motor vehicles.
- Corridors will provide space to accommodate a range of **services and utilities**.

- Regional roads are **economic engines**, with corridors working as a catalyst for private sector investment on adjacent lands.
- Corridors will be **green and sustainable** in their design, and include low-impact technologies and methods.
- Corridors will be **cost effective**.

Niagara Region has developed six road corridor types based on land use contexts:

- **Main Street** - Have historically narrow rights-of-ways (20m – 26m) and are found in urban areas and hamlets, often with a mix of at-grade retail and residential uses.
- **Urban General** - Have historically narrow rights-of-ways (20m – 26m) and are found in urban areas often serving commercial retail and service businesses and/or residential uses.
- **Urban Thoroughfare** - These roads generally have wide rights-of-ways (26m – 36m+) often with four or more vehicle lanes and in-corridor cycling facilities. These corridors often serve commercial retail and service businesses and connect residential neighbourhoods within communities.
- **Rural Scenic / Rural Thoroughfare** - These roads have varying rights-of-ways (20m to 36m+) depending on the number of travel lanes. They serve rural areas and connect communities across the Region.
- **Hamlet** - These roads have historically narrow rights-of-ways (20m – 26m) and are found in hamlets serving commercial retail and service businesses and/or residential uses.

When implementing and making decisions about Complete Streets in Niagara, the Vision document notes that Complete Streets are not always about accommodating all modes of transportation, but to pursue incremental improvements to a street to make it as complete as possible. The priority is to be on pursuing completeness in roads/streets that:

- Are located within existing and planned high density and mixed use area such as downtowns, hamlets, mobility hubs, schools, colleges and universities, employment nodes, retail districts, and other areas where there is high propensity to attract pedestrians, cyclists and transit users;
- Serve as designated cycling routes, public transit routes, or tourist routes;
- Are within special precincts such as Community Improvement Areas, Heritage Conservation Districts, or waterfronts;
- Have excess vehicle capacity for current and anticipated traffic; and/or
- Are experiencing safety concerns for street users.

1.1.2 Complete Streets Design Guidelines 2017

Note: The Region is currently updating their Complete Streets Design Manual anticipated completed later in 2023. The following sections are primarily extracted from the 2017 guidance which provides the base of the 2023 manual; however, some statements have been updated to conform with the anticipated changes.

The Regional Official Plan defines all regional roads as arterial, but to address the various mobility needs, land use contexts and built form conditions, six new road typologies have been created, as detailed above.

It is our understanding that Burleigh Hill Drive is designated “Urban General” however note that this roadway segment does not fit neatly into this single typology but has elements of both the ‘Urban General’ and ‘Urban Thoroughfare’ street types. Although it is in the urban area of St. Catharines, its location in the lower-density suburban periphery could also be appropriate for the Urban Thoroughfare type. Both street types are consistent in recommending space be provided for pedestrians on both sides of the road, some type of cycling facility, and a planting zone to allow for trees and other vegetation.

The **Urban General** street type is described as:

- Having historically narrow rights-of-ways (20m – 26m) and are found in urban areas often serving commercial retail and service businesses and/or residential uses.
- The streets are to be active transportation supportive as these streets often connect neighbourhoods within communities and can form part of the Region’s cycling network.
- Breaking up the rights-of-way may create impacts that can diminish the potential for completing streets.
- Having a goal to influence the future land use and built form and change existing land use and built form overtime.

The **Urban Thoroughfare** street type could be described as the following (to be confirmed by the Region’s Complete Street Design Manual (2023)):

- Generally located in commercial or residential areas that are transitioning to a more urbanized and mixed-use context, such as from large format retail to medium or high density residential.
- Playing important roles in connecting communities, cross-region travel and goods movement.
- Supporting regional cycling through a range of in-corridor cycling facilities, which are ideally separated.

1.1.3 Strategic Cycling Network 2017

This report summarizes the development of the Strategic Cycling Network and recommended projects to be implemented over the next ten years. There are three main components to the cycling network:

- **Existing Network** - The existing region-wide cycling network forms the foundation of the strategic network. It includes network links that were constructed previously but are no part of the current regional network, however they play an important part in feeding to the larger regional network. The existing network draws on opportunities to connect existing facilities even if they lie outside the current regional network.
- **Planned capital investment** - Planned capital investment is defined as an opportunity to provide cycling facilities as and when roads are reconstructed.
- **Infill corridors**- Infill links are the primary new components of the strategic network which is intended to connect the missing network links between capital investment, existing network, and key destinations.

The Regional Strategic Cycling Network identified Burleigh Hill Drive as ‘a Regional Road Capital Project’. The most recent cycling network plan for the Region of Niagara, the Bikeways Master Plan Study (BMPS), was approved by Council in 2005, and the Region has been implementing the BMPS network through their road capital program. This EA constitutes a part of that process as it will be reviewing the potential improvements/reconstruction of the roadway, and thus potential to include an active transportation facility.

A roughly parallel north-south connection to traverse the escarpment is identified along Mountain St. (bike lane) between Glendale Ave. and Leeson St., and Leeson St. (bicycle boulevard) to connect to St. David’s Road, as an Infill link (as noted above).

Other relevant existing and planned cycling network connections include:

- Existing bike lanes on Glendale Ave., west of Mountain Street
- Existing Merritt Trail and associated on-road links, just east of Burleigh Hill Drive
- Existing (recently constructed) multi-use trail on the south side of St. David’s Road, east of Burleigh Hill Drive, continuing over Highway 406 to Brock University, and proposed route to extend to Leeson St.
- Proposed route to Chestnut Street, including extending the street to address current gap between Mountain St. and Hastings St.

The report, however, notes that the review conducted for the network is a high-level review of feasibility and should be viewed as a network concept that is meant to evolve over time as new opportunities become available.

1.2 City of St. Catharine’s Transportation Master Plan 2021

The City’s Master Plan, like the Regional plan, also supports a Complete Streets approach to transportation planning and design, which prioritizes the most vulnerable road users, particularly pedestrians.

The City’s Master Plan mostly confirms the Regional cycling network, while providing some important refinements and additional detail, particularly regarding facility types. A detailed analysis is done of Chestnut Street, for instance, recommending bike lanes as the cycling facility type. Notably, Mountain Street was a previously identified route (identified in the 2019 TMP) however in the 2021 update, the street does not include a cycling route or specific facility type along Mountain St. among its proposed AT routes (Map 6 of TMP). The TMP also notes “no issues were identified with the existing and previously proposed facilities. No revisions are recommended to these routes / facilities” and so it is unclear why the recommendation was not retained.

It is highlighted that the City will be commencing with an Active Transportation Masterplan later this year. The above recommendations are then subject to change.

1.3 Thorold Transportation Master Plan 2020

While the study area is within the City of St. Catharine’s, St. David’s Rd. forms the boundary between St. Catharine’s and Thorold. Thorold’s TMP proposes painted bike lanes along Collier Rd. N. (the southerly continuation of Burleigh Hill Dr.) and Tupper Dr. south of Saint David’s Rd. as part of its proposed cycling network.

2. Planning and Network Assessment

The study area is located on a Niagara Regional Road, within St. Catharines and at the edge of Thorold, and so is influenced by several transportation plans, policies, and other documents. These do not provide a prescriptive approach for considering active transportation facilities along Burleigh Hill Drive but do provide important general guidance. The topography, constrained conditions, and multiple potential routes also make for a convoluted assessment.

2.1 Pedestrian network assessment

Currently, sidewalks are provided along both sides of Burleigh Hill Drive at the ends of the study area, however between Warkdale Drive and Dalecrest Avenue, there is only a sidewalk on the east side which is below the AODA minimum width of 1.5 m. This portion of road also features a combination of concrete barriers and guard rails to protect pedestrians from traffic, although overall the pedestrian environment in this section is not very comfortable or welcoming. Pedestrians are also provided crossing opportunities at the Glendale Avenue and St. David's Road intersections, as well as a PXO just north of Warkdale Drive and in front of the two schools on Burleigh Hill Dr. (Burleigh Hill Public School and Sainte-Marguerite-Bourgeoys). There are also very faded crosswalk markings at an uncontrolled crossing at Dalecrest Avenue intersection.

The design of the existing pedestrian facilities is further detailed in **Section 3**.

Both Niagara Region and City of St. Catharine's policies are clear that pedestrians should be a priority in road design, in the context of this MCEA. Anticipated to be recommended in the Region's Complete Streets Manual (2023), is that a pedestrian clearway should be 1.8 m (minimum width 1.5 m) and should be set-back 1.9 m to 2.8 m (minimum of 1.0 m) from travel lanes. The study area is close to meeting these standards north of Warkdale Drive and south of Dalecrest Avenue, although opportunities exist to widen sidewalks and enhance planting areas. The section between Warkdale Drive and Dalecrest Avenue, as mentioned, has the greatest need for pedestrian improvements. Providing sidewalks of sufficient width on both sides of the road in this section should be investigated, although if it is only feasible on one side, it may be justifiable as there are currently no destinations that front the western side of this road segment. As part of this study, configurations including multi-use paths should be considered and this ties with the 'Urban Thoroughfare' street typology.

At the Warkdale Drive and Burleigh Hill Drive intersection, it is noted the sidewalk on the west side of Burleigh Hill Drive ends abruptly at Warkdale Drive with no connections to the south or west. Regardless of the Burleigh Hill Drive cross-section improvements, improvements to complete the sidewalk at this location (be it connecting with new Burleigh Hill Drive facilities or a new crosswalk at the intersection) are recommended to be investigated by this study.

At Dalecrest Avenue, an analysis should be done to determine if the location is appropriate for a controlled crossing (i.e., IPS or PXO), which would add to the pedestrian connectivity in the area, especially if a sidewalk is only provided on one side south of Dalecrest Ave.

In consultation with the City of St. Catharines, there have been past concerns regarding the lighting for pedestrians along Burleigh Hill Drive as it has been considered too dim. Illumination improvements shall be considered in conjunction with any roadway improvements undertaken by this EA study.

2.1 Cycling network assessment

As detailed above, the Region's on-going practice is to seek opportunities to provide cycling facilities as part of capital projects and the Region's Strategic Cycling Network identified Burleigh Hill Drive as one such potential capital project. Mountain Street and Leeson Street are also identified as a high-priority infill links by the Region's Strategic Cycling Network. These infill links of the strategic network were identified to connect the missing links between capital investment, the existing network, and key destinations. These links are intended to be implemented under retrofit conditions.

Further, the Region will be working with the City of St. Catharines in confirming priority local/infill links, as part of the City's upcoming Active Transportation Master Plan study.

Therefore, with this EA study presenting the opportunity for considering active transportation facilities on Burleigh Hill Drive, a question emerges on whether the nearby of Mountain Street / Leeson Street is better suited to provide the active transportation connection across the escarpment in this area, given the steep grade of Burleigh Hill Drive. Additionally, there could also be a scenario where facilities are provided on Mountain Street / Leeson Street in addition to those on Burleigh Hill Drive.

The below chart provides a high-level assessment of an active transportation route on Burleigh Hill Drive compared to a route along Mountain Street and Leeson Street. This assessment could be further built on / reviewed as part of the City's Active Transportation Masterplan, and thus its findings could be further refined.

The routes were assessed on the following criteria:

- **Directness / Connectivity:** Consideration of its integration within the existing and planned active transportation network.
 - To the north: There are currently on-road, conventional bike lanes on Glendale Avenue, from the Mountain Street intersection easterly. The Glendale Avenue and Mountain Street intersection is also a crossing point of the historically significant Merritt Trail. There is currently an established bike route – The St. Catharines Loop – which runs on Glendale Avenue, through the Mountain Street intersection and on Bradley Street. Glendale Avenue to the west of Burleigh Hill Drive is noted as a Regional Capital

Road Project and thus will be considered for active transportation facilities in the future.

- To the south: St. David’s Road was recently constructed and there is now a multi-use path that runs west of the Burleigh Hill Drive intersection. St. David’s Road, east of the Burleigh Hill Drive intersection currently has no cycling facilities however it was also identified as a high-priority infill link (paved shoulders), from the intersection to St. David’s Road West.
- Planning / Policy: Extent of which the routes had previously been considered for active transportation facilities, and how they align with regional policy.
- Geometric constraints: Assessment of the vertical, horizontal, and built environment constraints along the routes that would impact the desirability of a new active transportation facility.

Table 1 details the high-level assessment undertaken, and each route was given a ranking of how well they met the above criteria. It is acknowledged that several schools are in the vicinity of Burleigh Hill Drive however through consultation, the project team identified that the Niagara Escarpment has acted as a school zone boundary and as such, any new facilities along Burleigh Hill Drive or the Mountain Street / Leeson Street route are not expected to be subjected to significant use by school children.

Table 1 Active Transportation Route Assessment

| | Burleigh Hill Drive | Mountain Street / Leeson Street |
|--|---|---|
| Directness / Connectivity to existing facilities* | High – ~1.0 km from Glendale Ave. to St. David’s Rd. No existing direct connections north however the existing AT node at Mountain Street is only ~175 m to the east, existing direct connections south. | Medium – ~1.0 km from Glendale Ave. to St. David’s Rd. Existing direct connections north, no existing direct connections south with the St. David’s MUP and continuation of RR56 being ~675 m to the west. |
| Planning / Policy | Medium – identified as part of the Region’s Strategic Cycling Network, to be considered as part of capital works | Medium – identified as part of the Region’s Strategic Cycling Network, as a high-priority infill link. |

| | | |
|---------------------------------------|--|---|
| <p>Geometric Constraints**</p> | <p>Low - very steep grade resulting in an uncomfortable ascent for cyclists. The winding roadway is also horizontally constrained by the required rock cut through the escarpment, and due to environmental protections, widening the roadway is likely not feasible. Potential facility type is to be confirmed however would have to be kept within the existing roadway platform.</p> | <p>Medium to Low – moderate to steep grade on a constrained, winding roadway. Nevertheless, the roadway will have a lesser AADT, and truck usage compared to the regional road, providing more flexibility for facility type. Strategic Cycling Network report identified painted bike lane facility on Mountain Street and in-boulevard facility along Leeson Road.</p> |
| <p>Assessment Conclusion</p> | <p>Overall, both routes are ranked similarly with a slight preference for Burleigh Hill due to its better connectiveness, even though it is at a steeper grade. The Mountain Street route would result in notable out-of-way travel (~675m) for routes south and west, if used as an alternative for those originally on Burleigh Hill Drive. Also, while at a lesser grade, the Mountain Street route is still at an incline for most of the length adversely impacting comfort levels and will be subject to geometric constraints.</p> <p>In this assessment, there is little that can provide a conclusive preference for a particular route. If provided both options, the route chosen by users will be that most suitable to their cycling capabilities and ultimate destination. As such, the project team is inclined to recommend both routes be implemented, with a note that a connecting link can be provided on Parkhill Road.</p> <p>It is highlighted that this is not the final decision, and that this EA study will ultimately evaluate various planning and design alternatives for Burleigh Hill Drive, based on a wide range of criteria covering many areas (e.g., transportation, environmental, drainage, socio-economic, constructability). However, this assessment will provide input into that process.</p> | |

*Connectivity to existing facilities was a focus as both routes would ultimately tie into and be links of the potential future cycling network.

Geometric conditions are further detailed in **Section 3.

3. Active Transportation Design

3.1 Sidewalks

Sidewalk assessment is included in **Section 2.1**. Sidewalk towards the southern limits of the study area is less than the minimum 1.5 m per AODA and 1.8 m per Regional Complete Streets Guidelines. As part of the proposed works of identified by this EA study, all sidewalks are recommended to be improved to a minimum 1.8 m width and if not achievable, as best achieving the 1.5 m minimum per AODA standards.

3.2 Cycling Facilities

Currently, Burleigh Hill Drive only has shared-route markings (“sharrows”) painted on the roadway between Glendale Avenue and Warkdale Drive. For the remaining segment of the study area to the south, no cycling facilities are provided. Burleigh Hill Drive has an average daily traffic volume count of approximately 9000 and has a posted speed limit of 50km/h, with the school zone at the northern portion of the study area having a 40 km/h limit during school hours. Given the traffic volumes along Burleigh Hill Drive, a physically separated cycling facility should be provided per OTM Book 18 (2021), such as separated bike lanes, cycle tracks, or a multi-use path. As above, the Region’s Complete Streets Guidelines has identified this segment to be Urban General Narrow typology, which includes buffer/barrier separated bike lanes (in the retrofit condition) and conforms to the recommendation of separated facilities per OTM Book 18. Cross-sections illustrating the Urban General typology, both ‘narrow’ and typical, are included in **Exhibit 3-1** and **Exhibit 3-2** .

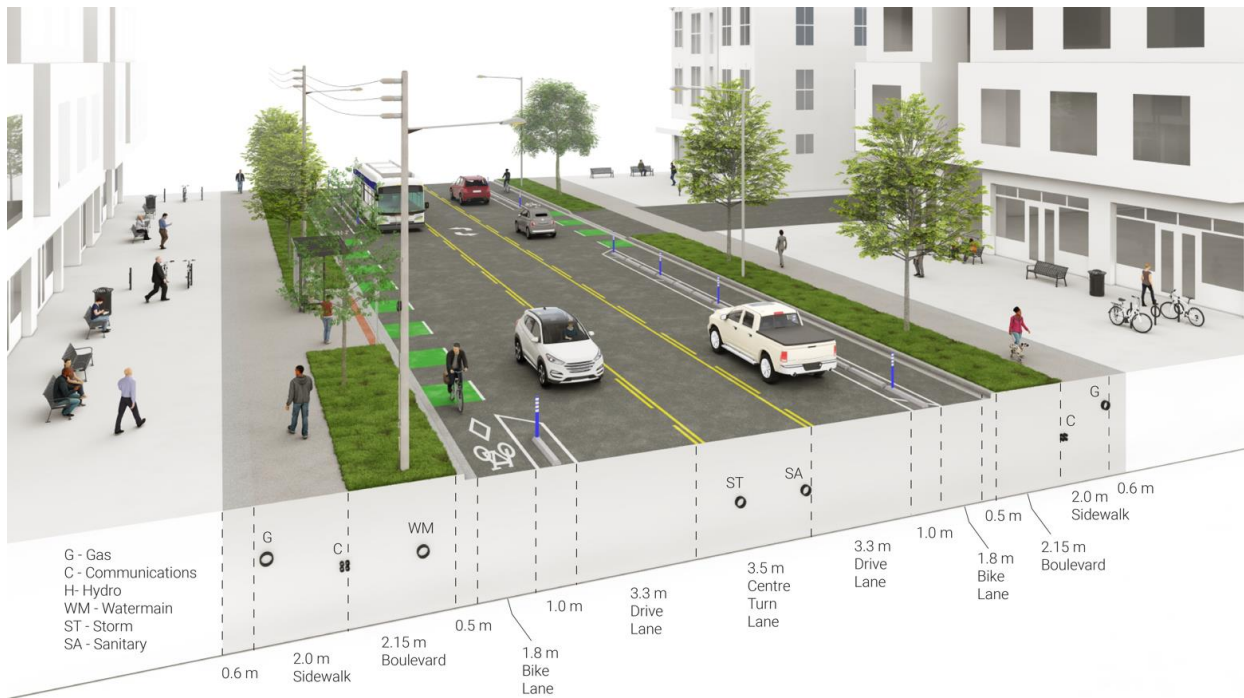


Exhibit 3-1 Urban General Narrow (Retrofit) - Niagara Region Complete Streets Guidelines

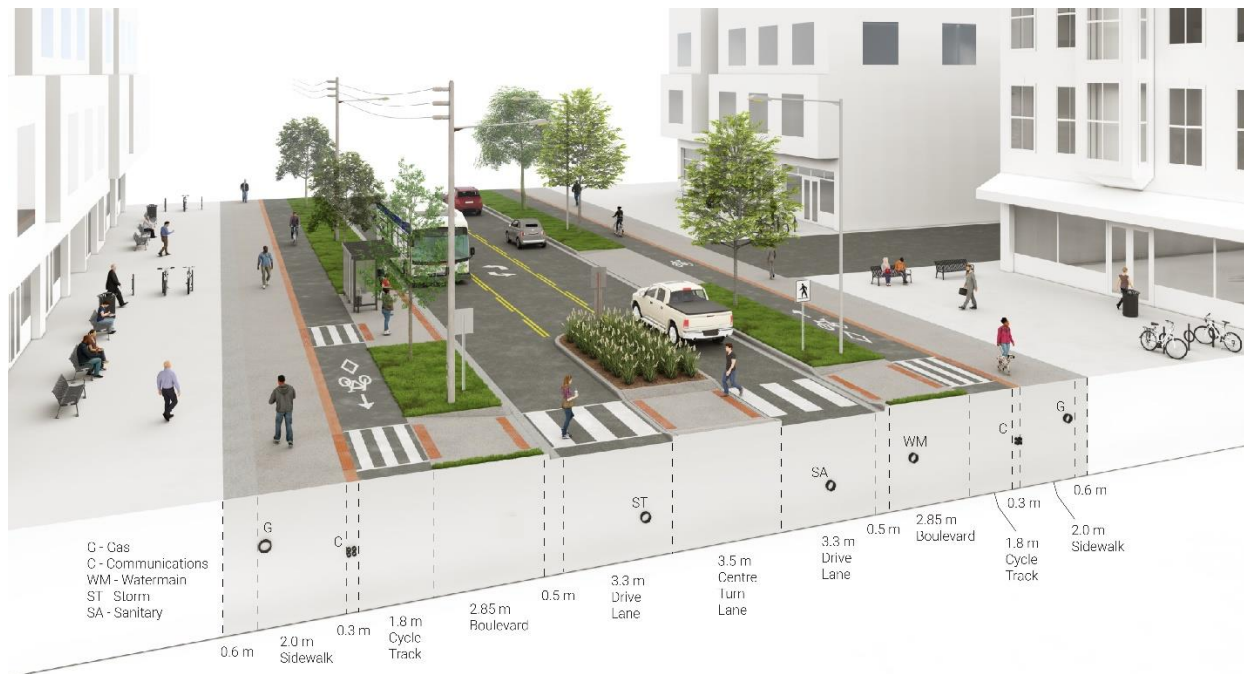


Exhibit 3-2 Urban General - Niagara Region Complete Streets Guidelines

3a: Collector Mixed-use Corridor

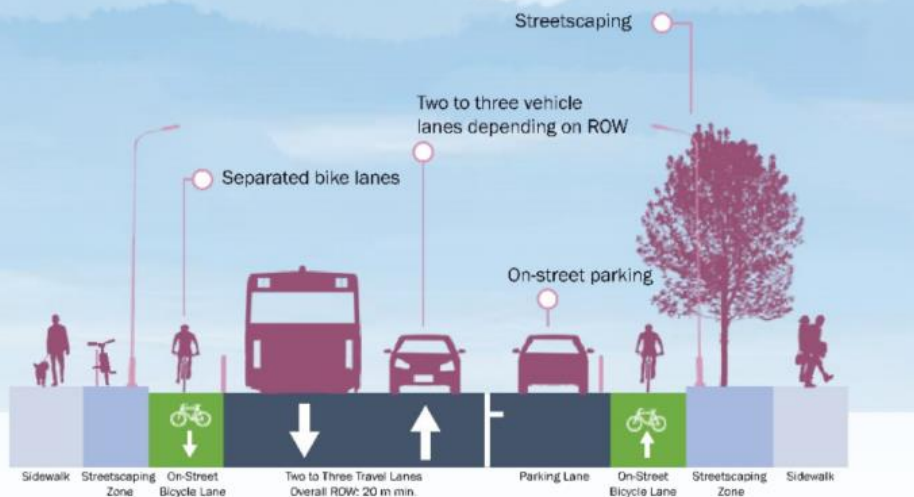


Exhibit 3-3 Proposed Cross-section for a Collector Mixed-use Classification Roadway, per the City of St. Catharines TMP

The Mountain Street route, with a current posted speed limit of 50 km/h and an average daily traffic volume of approximately 3400, appears suitable for a designated operating space (i.e., a bike lane or buffered bike lane) per OTM Book 18 guidance. The guidance also adds that physical separation can always be considered for roadways with such attributes. The City's TMP (2021) identifies Mountain Street as having a Mixed-use Collector Corridor and its recommended cross-section for this classification (illustrated in **Exhibit 3-3**) includes barrier-separated, on-road bike lanes, and thus conforms with the recommendations of OTM Book 18. The applicability of this facility type is further reviewed in **Section 3.3.2**.

The roadway is anticipated to be further reviewed by the City in their upcoming Active Transportation Master Plan study.

3.3 Implementation

3.3.1 Burleigh Hill Drive

The key constraint of implementing cycling facilities on Burleigh Hill Drive is the steep grade. Within the study area, the roadway has a maximum grade of approximately 8% and this maximum grade is used for approximately 380 m, as the road traverses the Niagara Escarpment. Per the OTM Book 18 (2021), the CROW Design Manual for Bicycle Traffic (2016) provides a formula for calculating the difficulty of a slope and

comfort target values are identified. With a height difference of approximately 40 m between either end, a facility along Burleigh Hill Drive would fall outside these the comfort target values, as illustrated in **Exhibit 3-4**. For ascents with a height difference of 10 m or more, only grades of 1-2% are considered comfortable.

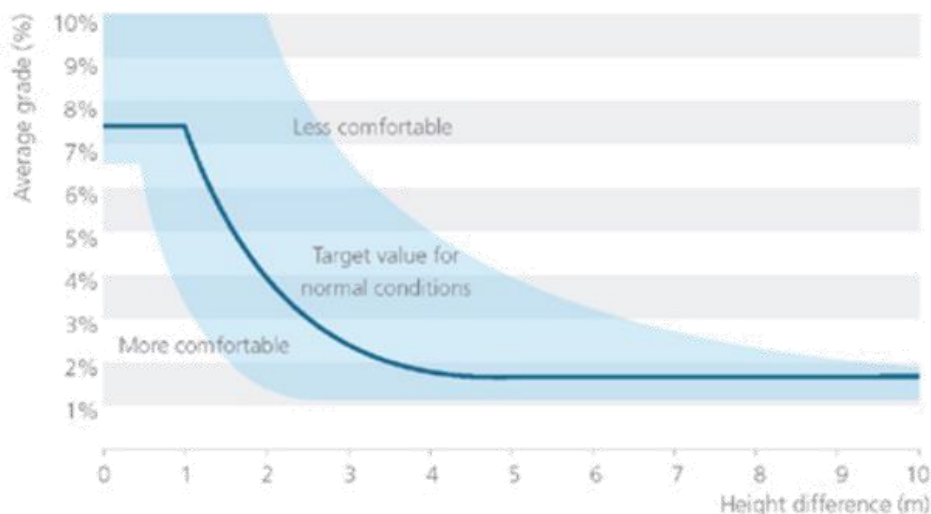


Exhibit 3-4 OTM Book 18 - Recommended Target Values for Grade Steepness

While it would be uncomfortable, a high-level literature review and site observations suggest that a cycling facility can still be implemented and represents an existing desire line for active transportation users.

A high-level literature review has been conducted on available active transportation guidance within the industry and from other authorities, and the review focused specifically on the consideration of grades (summarised in **Attachment A**). From that review, key guidance and policies that stood out regarding high-grade active transportation facilities included:

- Many people riding bikes will have difficulty sustaining a slope greater than 7.5% for more than a very short distance of 10 to 20 m. Additional widening of 0.5 to 1.0 m is recommended where the grade is greater than 3%. For grades > 6% or length > 75 m, facilities should be widened by an additional 1.0 m. (OTM Book 18)
- Multi-use paths should be designed with grades less than 10% where possible. Trails with steep grades should be widened to provide extra space for cyclists (Niagara Region).
- Where possible, on long steep grades it is desirable to introduce relatively flat rest areas approximately every 100 metres of horizontal distance (City of Windsor).

- The practical upper limit for an on-road bicycle facility is 8%. Where steep grades cannot be avoided, higher design speeds (e.g., 50 km/h to 60 km/h) should be used (Town of Orangeville).
- Grades up to 5% may be considered and above 5% for short distances, i.e., less than 500 m for grades between 5% and 7%. Consider mitigation measures for people riding uphill, such as flat landings at regular intervals (~every 100m). Consider mitigation measures for people riding downhill, including higher design speeds, improved sightlines, and other safety measures. Sign a flatter alternate route if possible. (City of Vancouver).

From this high-level literature review, it is apparent that a high-grade facility on Burleigh Hill Drive could still be implemented and conform to thresholds of applicable industry guidance. Additional mitigation measures will be recommended, and these will include items such as provision of wider facilities, provision of flat landings at intervals, and signing alternative routes, and these will be further investigated as part of this EA study. The last measure of signing an alternate route is directly related with the outcomes of the Burleigh Hill Drive vs. Mountain Street assessment (**Section 2.1**) and would further justify the implementation of active transportation facilities on both routes.

From an informal site visit to the study area in September 2022, several cyclists were observed ascending / descending Burleigh Hill Drive. As described above, there are currently no dedicated cycling facilities along the roadway however in a fairly short period of time (30~45 m), a total of three cyclists were observed using the road: one cycling downhill on the road and two cycling uphill on the sidewalk (one cycling and the other walking their bike). The observations lead the Project Team to believe that there will be interest in an AT facility on this roadway segment, even though it is uncomfortable, as it provides benefits in direct connectivity within the network (as described in **Section 2.1**). It is hoped this interest is confirmed through the public consultation that will be undertaken by this EA study.

Traffic Barriers

In addition to the grade, another element to be considered by the AT facility design are the roadside barriers. Currently guiderail is located south of Warkdale Drive, both sides of the road, and the eastern side connects with a jersey barrier that is used through the length of the escarpment rock-cut, separating the sidewalk from the travel lanes.

The new AT facility design will need to accommodate the placement of guiderail and it is recommended it consider the similar approach of barrier-separation between travel lanes and active transportation users (at the constrained locations at a minimum), even

though some alternatives (i.e., in-boulevard cycle tracks) could have a buffer between travel lanes and the AT facility. Through the escarpment, it is very constrained and there is limited space to move out the way in an emergency / limited protection for AT users. This condition confining AT facilities is like that of a structure, and TAC and OTM Book 18 guidance would recommend a barrier to separate AT users on bridges on roadways of posted speeds of 60 km/h or more. While this roadway is posted 50 km/h, 85th%ile speeds of 73-82 km/h were recorded downhill and 66-74 km/h uphill by the Traffic Safety Assessment (documented in a separate memo). While speed mitigation measures will likely be recommended by this study, there will always be the potential for drivers to speed. Also, the barriers provide some side benefits: 1) they provide some side friction to help mitigate speeds, 2) they provide some extent of rock-fall protection for vehicles, preventing any debris from rolling into the road.

3.3.2 Mountain Street and Leeson Road

As noted previously, the Region's Strategic Cycling Network report first identified an on-road (painted) bike lane facility on Mountain Street and in-boulevard facility along Leeson Road. The cross-section for the mixed-use collector classification of Mountain Street, per the St. Catharines TMP 2021, also identified on-road facilities however suggested they be barrier-separated.

Like Burleigh Hill Drive, a key constraint of implementing cycling facilities on Mountain Street is also grade. As noted in **Section 2.1**, while Mountain Street has a lesser grade than Burleigh Hill, it is still relatively steep at what appears to be >3% for approximately 500 m. Per OTM Book 18 and related guidance (**Attachment A**), any potential facility would also be considered to be widened an additional 1.0 m to help mitigate this length of grade (i.e., 2.5 m bike lanes). The roadway is further reviewed in terms of potential facility in the following paragraph, however it is noted that the final recommendation will be determined by another study, likely the City's upcoming Active Transportation Master Plan.

With an existing pavement width of approximately 7.5 m, neither 1.5 m nor the wider 2.5 m on-road bike lanes are feasible without pavement widening. Yet even with pavement widening, the existing ROW will constrain facilities. As shown in **Exhibit 3-** and in **Exhibit 3-5**, the roadway is in a heavily residential neighborhood and with a limited Right-of-Way (ROW). Initial review of the ROW along Mountain Road shows it varies between 20 m and a minimum point of approximately 13 m (just east of the Allanburg Road intersection, circled in yellow in **Exhibit 3-5**). Leeson Road has a continuous ROW of 20 m. The cross-section identified by the St. Catharines TMP (**Exhibit 3-3**) is for roadways of minimum 20 m ROW. Thus, to implement bike lanes,

roadway infrastructure works will be required (at a minimum) and there is potential for the property requirement, yet this would have to be confirmed in a future study (i.e., the City's upcoming Active Transportation Master Plan)..



Exhibit 3-4 View from Mountain Street at Allanburg Road, looking North



Exhibit 3-5 ROW Boundaries along Mountain Street, between Parkhill Road and Allanburg Road

4. Conclusion

In summary:

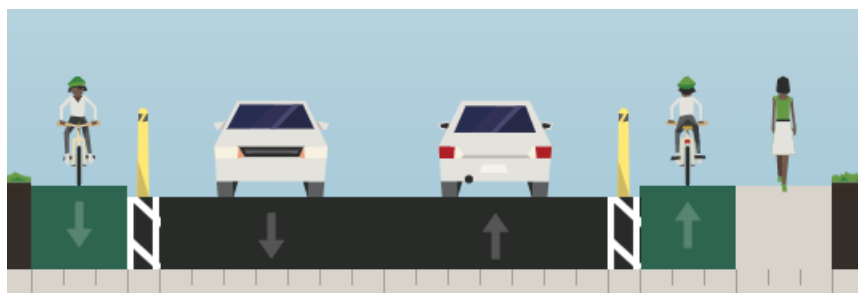
From a planning and network perspective, AT routes via Burleigh Hill or Mountain Street are ranked similarly, with a slight preference for Burleigh Hill. This is due to Burleigh Hill's better connectiveness, even though it is at a steeper grade. However, there is little that can provide a conclusive preference for a particular route as if provided both options, the route chosen by users will be that most suitable to their cycling capabilities and ultimate destination

- From a design perspective, both routes have geometrical constraints and challenges. Burleigh Hill Drive has a steep grade over a long distance however, there are design mechanisms to mitigate, including flat landings and seeing wider facilities. A route via Mountain Street will have a lesser grade, however, will likely still be in the zone of discomfort and will be subject to ROW constraints
- Given the two above perspectives, it is recommended an active transportation facility be pursued along Burleigh Hill Drive as part of this EA. It is also recommended the EA include a recommendation of Mountain Street to be investigated further for an additional active transportation route, to act as an alternate connection to Burleigh Hill Drive.

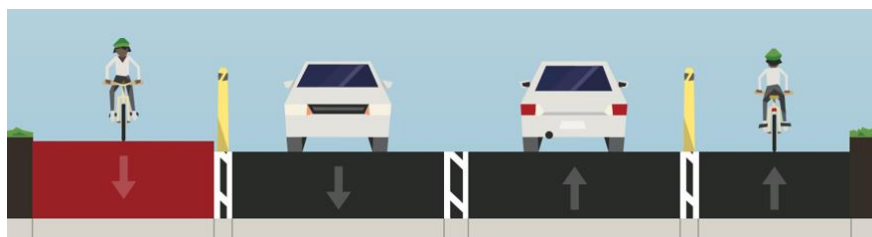
The facility design on Burleigh Hill will require to be developed as the EA progresses. The cross-section will be influenced by drainage requirements and dependent on the removal of an existing truck climbing lane. This EA study will ultimately evaluate various planning and design alternatives for Burleigh Hill Drive, based on a wide range of criteria covering many areas (e.g., transportation, environmental, drainage, socio-economic, constructability). However, this assessment will provide input into that process.

Therefore, dimensions and feasibility are to be confirmed however the alternatives can focus on three approaches as below. The following cross-sections are snapshots at the most-constrained conditions. At the limits of the study, the more conventional cross-sections (i.e., typical boulevards etc.) will be sought. Barriers indicated represent the roadside barriers as detailed in **Section 3.3.1**.

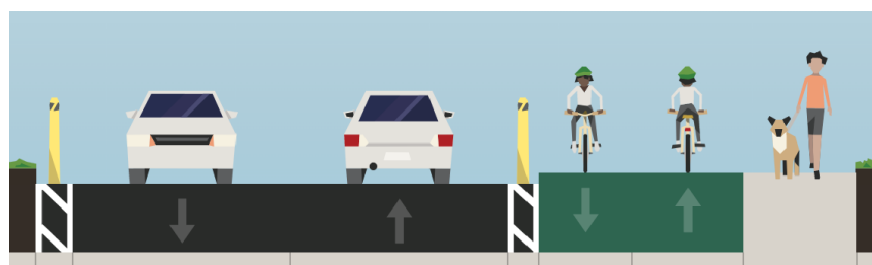
- Cycle Tracks: raised cycle tracks barrier-separated from traffic. While best aligning with the Urban Narrow Complete Streets typology, the approach may be limited in providing mitigation such as landings/rest areas.



- Multiuse Path and Bike Lane: the use of a barrier-separated multi-use path could enable the use of landings/rest areas at intervals. Having the MUP on the west side (southbound direction) will accommodate cycling heading uphill and can better integrate with the MUP on St. David's Road (that heads westerly). Barrier-separated bike lane or cycle track can be used for northbound cyclist.



- Two-way in-boulevard cycling and sidewalk: potentially most desirable for AT as would provide most opportunity for mitigation; however, would have the most requirement in terms of cross-section.



5. Next Steps

As noted, the facility design on Burleigh Hill will require to be developed as the EA progresses and the cross-section will be influenced by drainage requirements, and dependent on the removal of an existing truck climbing lane. This EA study will ultimately evaluate various planning and design alternatives for Burleigh Hill Drive, based on a wide range of criteria covering many areas (e.g., transportation,

environmental, drainage, socio-economic, constructability). However, this assessment will provide input into that process.

At the time of reporting, initial results from a truck climbing lane warrant analysis for both existing conditions and the future-year project horizon indicates that a truck climbing lane is not warranted in either condition. Also, consultation with key stakeholders (i.e., City and Regional transit authorities) identified no objection to the potential removal of the existing truck climbing lane.

Therefore, it is recommended the Region consider the removal of the truck climbing lane for the benefit of the active transportation design and to align with Niagara Region's Complete Street Vision, due to the following rationale:

- As noted elsewhere in this memo, widening is not viable due to surrounding property and environmental constraints.
- The existing minimum pavement width is approximately 12 m. If the truck climbing lane were to remain, the three lanes and shoulders will comprise the entire 12 m pavement and improvement alternatives using dedicated cycling facilities will not be feasible.
- AT improvements will only be feasible for the existing sidewalk. There is potential to improve the sidewalk to an MUP however this will likely on be a reduced-width MUP, and as such will be little improvement on the existing facility and would act against industry recommendations for high-grade facilities (i.e., providing additional width on AT facilities, and providing resting areas). These will be required to ensure the roadway is multi-modal (to move the largest numbers of people in the widest variety of modes), universally accessible to users of all abilities, and safe and comfortable for all users (per the Region's Complete Streets Vision).

If the truck climbing lane is removed and active transportation alternative are further evaluated, it is highlighted that the City of St. Catharines shall also be consulted with and involved in the design process as, while the roadway is under the jurisdiction of the Region, the City are responsible for maintenance, including winter maintenance.

ATTACHMENT A

High-Level Literature Review; High Grades and Active Transportation Design Standards

AODA, Section 80.23

- The maximum running slope of the exterior path must be no more than 1:20 (5%), but where the exterior path is a sidewalk, it can have a slope of greater than 1:20 (5%), but it cannot be steeper than the slope of the adjacent roadway.

OTM Book 18, Grade Separated Crossings (2021)

- Additional widening of 0.5 to 1.0 m is recommended where the grade is greater than 3%. For grades of 3 to 6% and length < 75 m, facilities should be widened by an additional 0.5 m. For grades > 6% or length > 75 m, facilities should be widened by an additional 1.0 m.
- The CROW Design Manual for Bicycle Traffic (2016) provides a formula for calculating the difficulty of a slope and comfort target values are identified - Burleigh Hill Drive falls outside these the target values.
- Many people riding bikes will have difficulty sustaining a slope greater than 7.5% for more than a very short distance of 10 to 20 m. Slopes of less than 2% do not generally present difficulty. The prevalence of strong winds will also increase the difficulty of ascending a slope.
- Where the height difference exceeds 5 m, a flat landing may be provided to give people riding bikes an opportunity to regain momentum.
- Steep slopes also present challenges for downhill cyclists, who may build up significant speed. Sharp corners, intersections and other hazards should be avoided at the bottom of a steep decline. A minimum 20 m of flat surface should be provided between the bottom of the incline and any intersections, crossings, or other conflict points.

Niagara Region, Complete Streets Guidelines, 2017

- For cycle tracks, refer to OTM Book 18 –bike facilities for detailed design guidance
- Multi-use paths located within sensitive natural environments, such as the Niagara Escarpment should be constructed of low impact materials
- Multi-use paths should be designed with grades less than 10% where possible
- Trails with steep grades should be widened to provide extra space for cyclists

City of Windsor, Bicycle Use Master Plan Study, Design Toolbox (2001)

- Grades greater than 5% should normally be avoided, and desirable conditions, especially for long uphill grades, should not exceed 3%. Where possible, on long steep grades it is desirable to introduce relatively flat rest areas approximately every 100 metres of horizontal distance. The advent of the electric or electric assisted bicycle will require a future review of these standards.

Brief Dutch Design Manual for Bicycle and Pedestrian Bridges, English summary of the CROW design guide (2015)

- The difficulty of a ramp (Z) can be calculated as the square of the average grade multiplied by its length, or as the square of the height difference divided by its length: $Z = (H/L)^2 \times L = H^2/L$. Based on an average middle-aged cyclist under normal circumstances and with average wind conditions, the difficulty of a ramp should ideally be 0,075, with a maximum grade of 7,5 % and a minimum grade of 1,75 %.

Town of Orangeville, Cycling and Trails Master Plan, Appendix C: Cycling & Trails Design Guidelines, On-Road Bicycle Design (2019)

- Grades of 0-4% are optimal for cyclists. There is no absolute maximum grade for a bicycle facility. However, long steep grades are undesirable because the ascents are physically difficult for many cyclists to climb, and the descents cause some cyclists to exceed the speeds at which they are comfortable. The practical upper limit for an on-road bicycle facility is 8%. Where steep grades cannot be avoided, higher design speeds (e.g., 50 km/h to 60 km/h) should be used.

City of Vancouver, Transportation Design Guidelines, All Ages and Abilities Cycling Routes (2017)

- Since it is not always possible or practical to avoid a hill, routes with grades up to 5% may be considered 'All Ages and Abilities' and above 5% for short distances:
 - Less than 500m, for grades between 5% and 7%
 - Less than 150m (about a block), for grades between 7% and 8%
 - Less than 30m, for grades above 8%.
- For routes with grades of 5% or higher:
 - Consider mitigation measures for people riding uphill, such as flat landings at regular intervals (~every 100m) for resting and a wider bike path to accommodate weaving.
 - Consider mitigation measures for people riding downhill, including higher design speeds, improved sightlines, and other safety measures.
 - Sign a flatter alternate route if possible.
 - Identify hills on cycling route maps.

AASHTO, Guide to Bicycle Facilities (2012)

- Where a shared use path runs along a roadway with a grade that exceeds 5 percent, the side path grade may exceed 5 percent but must be less than or equal to the roadway grade. Grades steeper than 3 percent may not be practical for shared use paths with crushed stone or other unpaved surfaces for both bicycle handling and drainage erosion reasons. Typically, grades less than 0.5 percent should be avoided because they are not efficient in conveying surface drainage. Where paths are built in very flat terrain, proposed path grades can be increased to provide a gradually rolling vertical profile that helps convey surface drainage to outlet locations.

- Options to mitigate excessive grades on shared use pathways include the following:
 - Use higher design speeds for horizontal and vertical curvature, stopping sight distance, and other geometric features.
 - When using a longer grade, consider an additional 4 to 6 ft (1.2 to 1.8 m) of width to permit slower bicyclists to dismount and walk uphill, and to provide more maneuvering space for fast downhill bicyclists.
 - Install the hill warning sign for bicyclists (W7-5) and advisory speed plaque, if appropriate, per the MUTCD (7)
 - Provide signing that alert path users to the maximum percent of grade as shown in the MUTCD (7).
 - Exceed minimum horizontal clearances, recovery area, and/or protective railings.
 - If other designs are not practicable, use a series of short switchbacks to traverse the grade. If this is done, an extra 4 to 6 ft (1.2 to 1.8 m) of path width is recommended to provide maneuvering space.
 - Provide resting intervals with flatter grades, to permit users to stop periodically and rest.