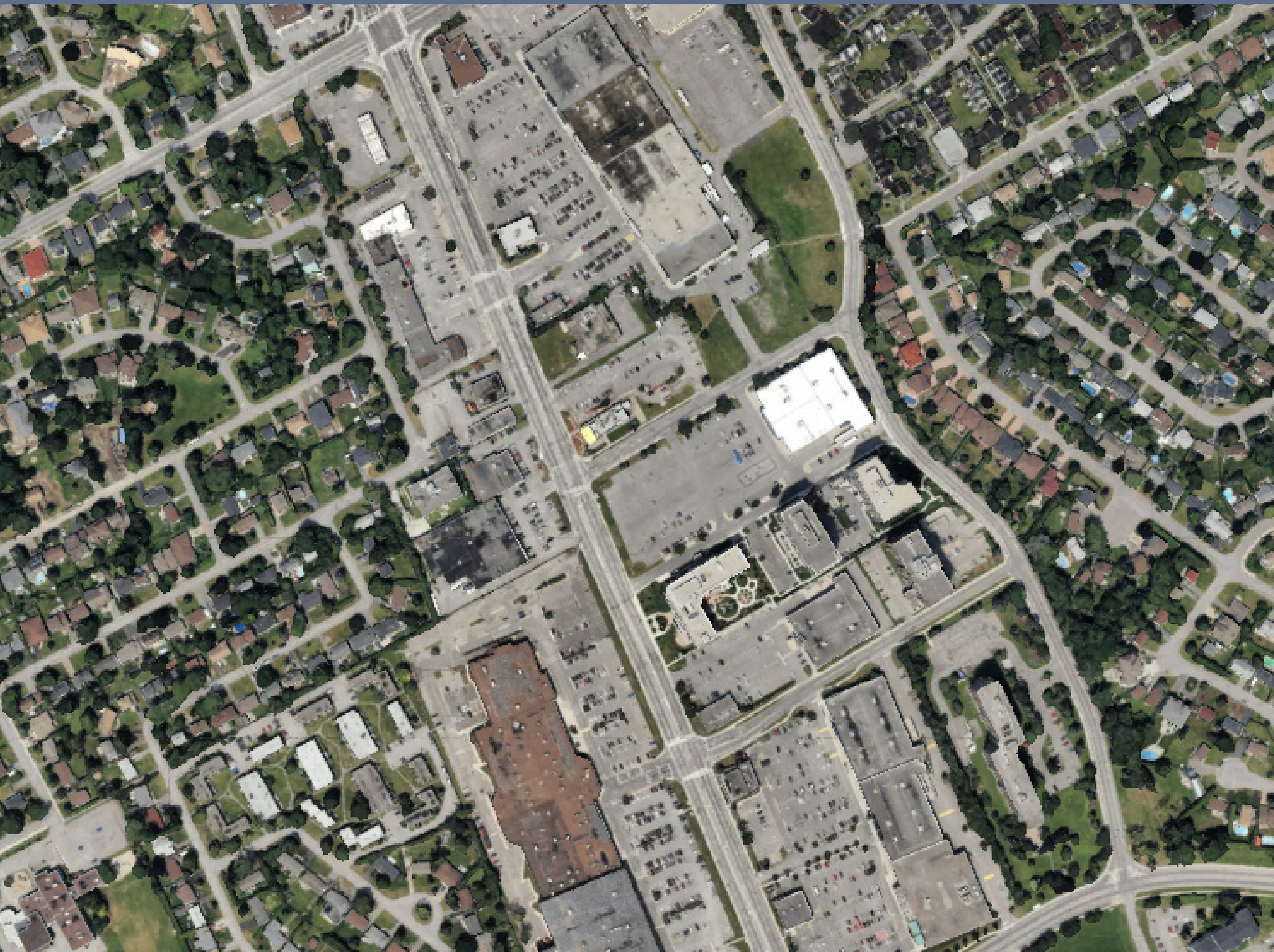
Transportation Association of Canada

Access Management: Synthesis of Practice

March 2024



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<tr><td colspan="2">Abstract
This report presents the findings of a literature review of technical and local resources from across Canada, a case study review, a series of interviews with agencies and municipalities, and a survey of practitioners. While the foundations of many locally used resources are rooted in the Transportation Association of Canada (TAC) Geometric Design Guide for Canadian Roads (GDG) Chapter 8 principles, adaptations are commonly made to align access management practices to local contexts. Several emerging access management practices warranting further review were identified regarding safety, multimodal integration, on-site strategies, functional area, and context considerations. The practices detailed in this report are recommended to be considered in a future update of Chapter 8 of the TAC GDG.</td><td>Keywords
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<tr><td colspan="2">Résumé
Le présent rapport présente les résultats d'une revue de la littérature sur les ressources techniques et locales des différentes régions du Canada, d'un examen d'études de cas, d'une série d'entrevues avec des organismes et des municipalités et d'une enquête menée auprès des spécialistes. Bien que les fondements de nombreuses ressources utilisées localement soient enracinés dans les principes du chapitre 8 du Guide canadien de conception géométrique des routes (GCCG) de l'Association des transports du Canada (ATC), des adaptations sont couramment apportées pour harmoniser les pratiques de gestion des accès aux contextes locaux. Plusieurs pratiques émergentes de gestion des accès qui méritent un examen plus approfondi ont été définies en ce qui concerne la sécurité, l'intégration multimodale, les stratégies sur place, le domaine fonctionnel et les considérations contextuelles. Il est recommandé de tenir compte des pratiques décrites dans le présent rapport dans une future mise à jour du chapitre 8 du GCCG de l'ATC.</td><td>Mots-clés
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Executive summary

This report includes the findings of an in-depth literature review of technical and local resources from across Canada, a case study review, a series of interviews with agencies and municipalities, and a survey of practitioners. While the foundations of many locally used resources are rooted in the Transportation Association of Canada (TAC) *Geometric Design Guide for Canadian Roads* (GDG) Chapter 8 principles, adaptations are commonly made to align access management practices to local contexts. While the review confirmed that the guidance in Chapter 8 was generally comprehensive, there were several emerging practices that warrant further consideration in a future update to Chapter 8. These practices include the following topics, discussed in more detail in this report:

- Intersection functional area (interchanges and roundabouts)
- Access spacing by classification and context
- Strategies to reduce or consolidate accesses
- Multimodal integration
- Safety evaluation of access management strategies

In addition, the results of the surveys and interviews identified several additional areas of potential updates to Chapter 8, including a number of overlapping areas:

- Safety considerations
- Type of context and locational attributes
- Multimodal integration
- Operational requirements
- Navigation
- Rationale

It was noted Chapter 8 would also benefit from greater clarification on application differences in urban, suburban and rural contexts, adjacent land uses and a broader range of roadway classifications within these contexts. Based on this review and its findings, it is recommended that a future update to Chapter 8 should be considered to incorporate and guide current industry practices. Included in this summary is a section-by-section review of the current Chapter 8 with recommendations on future updates.

Résumé

Le présent rapport comprend les conclusions d'une revue approfondie de la littérature sur les ressources techniques et locales des différentes régions du Canada, d'un examen d'études de cas, d'une série d'entrevues avec des organismes et des municipalités et d'une enquête menée auprès des spécialistes. Bien que les fondements de nombreuses ressources utilisées localement soient enracinés dans les principes du chapitre 8 du Guide canadien de conception géométrique des routes (GCCG) de l'Association des transports du Canada (ATC), des adaptations sont couramment apportées pour harmoniser les pratiques de gestion des accès aux contextes locaux. Bien que l'examen ait confirmé que les lignes directrices du chapitre 8 étaient généralement exhaustives, plusieurs pratiques émergentes méritent d'être davantage prises en considération dans une future mise à jour du chapitre 8. Ces pratiques comprennent les sujets suivants, abordés plus en détail dans le présent rapport :

- Zone fonctionnelle des intersections (échangeurs et carrefours giratoires)
- Espacement des accès par classification et contexte
- Stratégies de réduction ou de consolidation des accès
- Intégration multimodale
- Évaluation de la sécurité des stratégies de gestion des accès

De plus, les résultats des enquêtes et des entrevues ont permis de cerner plusieurs autres domaines du chapitre 8 dans lesquels des mises à jour pourraient être apportées, y compris un certain nombre de domaines qui se chevauchent :

- Considérations relatives à la sécurité
- Type de contexte et attributs liés à l'emplacement
- Intégration multimodale
- Exigences opérationnelles
- Navigation
- Justification

Il a été noté que plus de clarifications devraient aussi être apportées au chapitre 8 en ce qui concerne les différences d'application dans les contextes urbains, suburbains et ruraux, les utilisations des terres adjacentes et un éventail plus large de classifications routières dans ces contextes. À la lumière de cet examen et de ses conclusions, il est recommandé d'envisager une future mise à jour du chapitre 8 afin d'intégrer et d'orienter les pratiques actuelles de l'industrie. Ce résumé comprend un examen section par section du chapitre 8 actuel ainsi que des recommandations sur les mises à jour futures.

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1. Introduction

The Transportation Association of Canada (TAC) Geometric Design Guide for Canadian Roads (GDG), Chapter 8, provides Canadian practitioners guidelines to support the consistent application of access management practices in a variety of contexts. These include consideration for different roadway classifications and geometric conditions, balancing the needs of providing connectivity to adjacent land uses while maintaining roadway safety.

Transportation is undergoing a number of transformational changes with the introduction of new forms of mobility such as micromobility, greater awareness of climate change and healthy lifestyles that are increasing active transportation use, ride-hailing applications, food and grocery deliveries, and complete streets principles. Over the years, local agencies have adopted their own access management practices and policies to accommodate these changes and to align access management practices with their respective local contexts. Chapter 8 could require updates to adapt TAC guidelines to these changes. In preparation, TAC has commissioned a national review of access management guidelines and practices to compile a synthesis of practice and provide recommendations for changes. This national review considered local guidelines, policies and standards from across Canada, case studies, interviews with various policy makers and agencies, and an online survey of practitioners. Outlined in this document is a compilation of key findings and gaps for potential consideration in the future Chapter 8 update.

2. Context review

2.1 Cross-country practice review

An in-depth literature review of 34 resources from Canada and the United States was completed to analyze and compare the current state of standards and guidelines on access management practice with Chapter 8 of the TAC GDG. The available sources address rural, suburban, and urban contexts on topics including geometric design, safety, operations, and utility and street furniture impacts.

While the review confirmed that the guidance in Chapter 8 was generally comprehensive, there were several emerging practices that warrant further consideration in a future update to Chapter 8. These practices include the following topics, discussed in more detail below:

- Intersection functional area (interchanges and roundabouts)
- Access spacing by classification and context
- Strategies to reduce or consolidate accesses
- Multimodal integration
- Safety evaluation of access management strategies

2.1.1 Intersection/interchange functional area

Access restrictions are recommended within the intersection/interchange functional area to reduce traffic and safety related issues. Chapter 4 of the Ministry of Transportation Ontario's (MTO) *Highway Corridor Management Manual* (2022) defines the intersection functional area as the area where motorists are decelerating, accelerating, and maneuvering into the appropriate lane to stop, merge or complete a turn. The Manual further acknowledges that access points that are too close to intersections or interchange ramps can cause serious traffic and safety problems.

FHWA's *Access Management in the Vicinity of Intersections* (2020) similarly acknowledges that limiting or, where possible, eliminating driveways within the functional area of an intersection can help to reduce the number of decisions motorist must make. The report cites a study completed by the Utah Department of Transportation in the vicinity of signalized intersections in suburban areas that found an increase in collisions and collision severity when accesses were located within the upstream functional area. The study further found a more pronounced increase in total collisions, collision rates, and rear-end collisions as commercial access density increased.

Section 5 of British Columbia Ministry of Transportation and Infrastructure's (BC MOTI) *Planning and Designing Access to Developments* (2010) also describes similar findings; in order to preserve the functional area of an intersection, no access points are permitted within the intersection functional area of any intersection, including access points to adjacent property.

Updated design practice that includes guidance on defining the intersection functional area and restricting access may be warranted in an update to Chapter 8.

2.1.2 Access management practices near roundabouts

Roundabouts have become increasingly common across Canada within municipalities of all sizes, in both newly constructed communities and as retrofits. In both contexts, roundabouts can improve access and traffic management along corridors as well as improve safety compared to three or four-legged intersections by reducing crossing conflict points. Access management can be challenging particularly for corner parcels of a roundabout due to the splitter islands that are typically present. Roundabouts also provide an opportunity for vehicles to turn around, eliminating the need for left-turn lanes and median openings along corridors. Additionally, the roundabout can function as a direct connection to a parcel with one leg of the roundabout dedicated as the access driveway if justified by traffic demand. This potentially creates two avenues for future consideration within Chapter 8 as it relates to roundabouts: design practice relative to appropriate access management including spacing relative to roundabouts within new build environments, and access management practices in retrofit contexts, such as appropriate spacing and geometric design changes.

2.1.3 Number of accesses and spacing by road classification and context

Chapter 8 provides some general rules associated with spacing between accesses for each road classification including Freeway, Expressway, Arterial, Collector and Local. Other sources provide greater nuance in terms of access spacing for road classifications that may include major and minor arterial or collector roadways and other classifications specific to a municipality. For example, York Region's *Access Guidelines* (2020) include City Centre Street, Avenue, Main Street, Connector, Rural Road and Rural Hamlet Road. Halton's *Access Management Guidelines* (2015) includes Rural/Natural Heritage System, Corridors (urban growth along arterials), Node (compact, TOD, intensive urban use, multimodal). Ontario's *Highway Corridor Management Manual* (2022) includes general guidance that limits total private access density d/km/side to four for Arterials, six for Collectors, and eight for Major Locals. It is important to note that some jurisdictions have mandates regulating access management, thus access management practices must align with jurisdiction specific regulations.

Access spacing guidance is also further described based on spacing from signalized/unsignalized intersections and interchanges. Halton's *Access Management Guidelines* (2015) includes guidance on right-in/right-out, full movement, partial movement, mutually shared driveway, emergency, construction and temporary, and rural driveway. Similarly, the City of Edmonton's *Access Management Guidelines* (2022) includes access spacing requirements based on traffic signals, non-signalized, right-in/right out, alleys, local roads, collector roads. A review of access restrictions based on both roadway classification, context and type of access is recommended with a future update to Chapter 8. Context should consider both urban/suburban/rural classifications and land use context (e.g. commercial, residential, industrial).

2.1.4 On-site strategies to reduce number of accesses

On-site strategies refer to treatment located off the roadway and typically on a property (e.g. parking lot or driveway areas). The literature review identified strategies to reduce the number of accesses through the regulation of the number of accesses per property or development, encouraging shared driveways, internal cross connectivity of properties and frontage or backage roads. There was no guidance about the closure of existing accesses but rather the evaluation of proposed accesses through permitting. Nova Scotia's *Draft Access Management Guidelines* (2022) Section 5.2.6 generally limit accesses to one per property or development subject to the development size and road classification that the access will be added to. Shared driveways and interconnection within and between commercial properties under common ownership is strongly encouraged in the Guidelines as described in Section 5.2.8.

Similarly, Section 5.2.7 of BC MOTI's *Planning and Designing Access to Developments* (2010) requires the evaluation of a range of feasible access alternatives and options (existing and proposed). Some access alternatives that must be considered include the consolidation or relocation of existing or proposed accesses, provision of access roads, frontage roads or rear service roads and the provision of separate one-way entrance and exit accesses.

The Federal Highway Administration of the United States of America's (FHWA) *Safety Evaluation of Access Management Policies and Techniques* (2018) reiterates the benefits of frontage/backage roads and shared driveways, and internal cross-connectivity strategies discussed in Nova Scotia's *Draft Access Management Guidelines* (2022) and BC MOTI's *Planning and Designing Access to Developments* (2010). The report describes frontage/backage roads as an access roadway that is generally parallel to a main roadway and is used to provide direct access to properties and from local access-related traffic. Frontage/backage roads reduce the frequency and severity of conflicts along the main roadway as well as traffic delays. A description of factors and benefits of these strategies may be beneficial for incorporating in Chapter 8.

2.1.5 Multimodal integration

There is limited guidance on specific strategies that address the integration with active transportation users, micromobility or transit. The FHWA's *Intersection Proven Safety Countermeasure – Technical Summary: Corridor Access Management* (2020) describes the general benefits of reducing conflict points involving pedestrians and bicyclists by reducing accesses. The report identifies the following four techniques for reducing conflict points or pedestrian and cyclist exposure:

- Reduce the number of driveways, particularly commercial driveways, within a given distance (per block or kilometre).
- Reduce the number of conflict points at driveways (e.g. converting driveways to right-in/right-out, installing a median that restricts left turns in and out of driveways).
- Provide more distance between driveways.
- Provide a safe refuge for pedestrian crossings with raised medians.

Nova Scotia's *Draft Access Management Guidelines* (2022) suggest selecting the minimum practical width for a driveway to provide the shortest possible path for pedestrians to cross. Further, where a driveway is four or more lanes across it should be designed with pedestrian refuge between entering and exiting traffic.

For suburban areas, the FHWA's *Access Management in the Vicinity of Intersections* (2020) report recommends placing pedestrian driveway crossings that are visible to the drivers, and ensuring that drivers are visible to pedestrians by limiting landscaping or signage that might block pedestrian-driver sightlines. Bike facilities that cross driveways should have appropriate signage to alert bicycles that motorists may be entering or exiting a driveway, and vice versa. In urban areas, several design treatments such as coloured pavement across driveways, crosswalk markings, and auditory signals can be considered for the safety of pedestrians and cyclists. On the driver side, reducing driveway radii can slow turning vehicles, thus also contributing to the safety of pedestrians and cyclists.

The Transportation Research Board's (TRB) National Cooperative Highway Research Program's (NCHRP) *Report 900: Guide for the Analysis of Multimodal Corridor Access Management* (2018) provides a comprehensive overview of the impact of different access management strategies on the safety and operation of different modes. The following strategies were found to have a positive impact on operations or safety for either pedestrians, cyclists or transit:

- *Frontage and service roads* – Increase distances from service roads to arterials along crossroads; construct service roads behind properties abutting the arterial; construct bypass roads to remove through traffic from arterials.
- *Unsignalized median openings* **–** Increase median widths to store left-turn egress vehicles; channelize left turns across wide medians to improve offsets.
- *Traffic signal spacing* – Locate new high-volume driveways where signal spacing criteria can be met.
- *Number and spacing of unsignalized access points* **–** Increase corner clearances; consolidate driveways; increase the spacing between adjacent access points; require access on collectors (if available) in lieu of arterials; relocate or reorient accesses.
- *Interchange areas* **–** Increase access separation distance in interchange areas.
- *Left-turn lanes* – Install left-turn deceleration lanes; install alternating left-turn lanes; install isolated medians.
- *Driveway channelization* **–** Move sidewalk-driveway crossings laterally away from roadways while maintaining sightlines for pedestrian visibility; install two one-way driveways with limited turns in lieu of two full-access, two-way driveways.
- *Driveway sight distance* **–** Regulate minimum sight distances to improve driveway sight distances; restrict on-street parking next to driveways; install visual cues for driveways and optimize sight distances in the permit authorization stages.
- *Driveway width* – Regulate maximum driveway widths; install guidance to prevent uncontrolled access along property frontages.
- *Driveway vertical geometry* – Improve driveway vertical geometry to achieve "flatter" grades and allow vehicles to enter the roadway at the intended design speed; implement safety measures to ensure vehicles exit safely and reduce conflict with vulnerable users, reducing the speed differentials between vehicles; improve conformance to accessibility standards and sight distance between egressing vehicles and approaching vulnerable users.
- *Driveway throat length* – Increase driveway throat length to provide adequate distance from on-site intersections and parking areas to the driveway connection; minimize potential queuing on the driveway access that impacts the adjacent roadway.

Based on the literature review, there are several strategies that could be elaborated on in Chapter 8 to address multimodal considerations for access management. Beyond the themes mentioned above, several sources indicated the importance of minimum corner clearance distances, sightlines and application of medians to reduce conflicts and improve safety. Traffic impact studies were also required with the assessment of proposed accesses based on the development size. Chapter 8 does currently touch on these elements but there may be new research to be incorporated with a future update.

2.1.6 Safety evaluation of access management strategies

An evaluation of the safety of the different access management strategies will encourage the implementation of access management controls. The literature review has identified studies that developed collision prediction models for evaluating the safety effects of various access management policies and strategies on urban and suburban arterials. These models help to assess the safety impacts of decisions related to access management. Quantifying the safety of various access design elements can result in cost savings through collision prevention and support the project implementation process. The FHWA's *Safety Evaluation of Access Management Policies and Techniques* (2018) document provides the methodology for developing collision prediction models along with guidance for the practical application of the models to assess various access management strategies. TRB's *NCHRP Web-Only Document 256: Assessing Interactions Between Access Management Treatments and Multimodal Users* (2018) identifies the relationship between access management techniques and their impacts on safety of various users or travel modes along multimodal corridors. It may be beneficial to add a section within Chapter 8 that describes methodologies for assessing the safety impact of access management.

2.2 Case study review

Several case studies in rural, suburban and urban contexts across Canada were reviewed to understand the impact of access management practices on safety, operations and different modes of transportation.

2.2.1 Commercial site – Quebec

The City of Laval had safety concerns regarding a temporary access for an under-construction warehouse and commercial store (**Figure 2.1**) in a suburban area accessed a 70 km/h service road. The City plans to finalize the reconfiguration of the road network in the area in order to solve safety issues along this service road related to the proximity of multiple access points within approximately 600 metres (one highway ramp, two private accesses, one street, and one weaving zone between freeway exit and entrance ramps). However, this reconfiguration will not take place before the opening of the warehouse for which a temporary access is required. Three different access options were studied along the service road before a preferred option was selected and further optimized. The options included:

- Use an existing access of a commercial mall downstream of the weaving zone.
- Use a temporary access built for construction of the warehouse.
- Use the projected and permanent access as planned by the City before the other measures also planned by the City are in place.

The preferred option was selected based on various criteria and considerations:

- Number of conflicts, including potential conflicts with pedestrians in the parking lot area of the commercial mall
- Traffic volumes
- Truck movements
- Travel time

- The no-access zone based on MTQ standard within the weaving zone
- Risk of collision especially within weaving zones
- Driver behaviors entering the service road from the street

Chapter 10 of the TAC GDG was applied in the analysis of option 2 to demonstrate the short distance for changing lanes between the exit ramp of the freeway and the temporary access. An update to Chapter 8 may require further discussion on the proximity of access and necessity of auxiliary deceleration and acceleration lanes.

Figure 2.1: Commercial site, Quebec (Source: Google Earth, 2019)

2.2.2 Queensway Complete Street – Ontario

The Queensway Complete Street project (**Figure 2.2**) in Toronto, ON included the 30% design of the street with the addition of cycle tracks and the intent to improve safety for all modes by reducing collision rates along the corridor. Construction is expected around 2025. The corridor is an arterial roadway that intersects with collector and local roadways in a suburban context.

A key focus in this study was road safety and, in particular, the application of a centre median between Stephen Drive and Park Lawn Road to improve safety. Along this 500-metre undivided section of the Queensway, approximately 25 accesses and intersections to residential properties, local streets and commercial uses exist. A road safety review was completed, which referenced the Chapter 8 data comparing relative safety performance of centre median divided roadways compared to undivided two-way left-turn lanes (Table 8.1.2 in TAC GDG). The review resulted in the following outcomes:

- Introduction of a centre median to reduce mid-block collisions in a high-collision stretch (between Stephen Drive and Park Lawn Road), resulting in the closure or restriction of movements at about 25 accesses
- Substantially reduced lane widths to reduce operating speeds
- Expected improvements in delay for through traffic due to left-turning traffic no longer blocking through lanes

The new centre median will restrict vehicles traveling eastbound on the Queensway from making left turns into the properties on the north side of the street and restrict vehicles exiting the properties on the north side from making left turns to travel eastbound on the Queensway. The results of the study could lead to increasing application of centre medians on major arterial roads in Toronto instead of current two-way left-turn lane (TWLTL) designs. The raised median consumed less of the overall roadway cross section, allowing more space for complete streets features like landscaped boulevards, cycle tracks, and wider sidewalks. If a 5-metre TWLTL were used instead of a 1-metre raised median, the boulevard would be much more constrained. Therefore, raised medians offer improved safety and more flexibility for design compared to TWLTLs. Section 8.1.2 of Chapter 8 may benefit from a review to reinforce this treatment and consider encouraging continuous narrow medians on mature corridors or ones that are urbanizing with complete street features.

Figure 2.2: Queensway Complete Street, Ontario (Source: City of Toronto)

2.2.3 PTH 12 & PTH 52 Access Management Plan – Manitoba

Rapid growth in Steinbach and the Rural Municipality of Hanover (a small suburban community) resulted in the need for an access management plan to guide development along two highway corridors, Provincial Trunk Highway (PTH) 12 and PTH 52 (**Figure 2.3**). The objective of the study was to create a functional plan for access management improvements to provide upgraded, safe access to adjacent facilities, while minimizing delays to through traffic along each corridor. As well, a key goal of the functional plans was to provide a relatively consistent treatment along the two corridors. The PTH 12 and PTH 52 highway corridors are classified as expressway and secondary arterial, respectively.

The Access Management Plan applied the guidance included in Manitoba Transportation and Infrastructure's (MTI) *Geometric Design Guide Supplement Sheets* (2002) and TAC's *Geometric Design Guide for Canadian Roads* (1999 and 2017). The study followed the overall principles in Section 8.3 Access Management by Design Classification and Section 8.4 Access Configuration of Chapter 8 in the TAC GDG. Slotted left-turn lanes were a key feature of the plan, and were the first to be implemented in the province. The plan also emphasized minimizing the number of accesses, proper intersection spacing, closing median openings, applying right-in and -out accesses, use of 90-degree intersection angles, encouraging joint use approaches where possible, using internal roadway connections between developments, and identifying criteria for traffic control and roadway design. The guidance in Chapter 8 on these items should be reviewed.

Figure 2.3: PTH 12 in Steinbach, Manitoba (Source: Google Earth, 2022 Airbus)

2.2.4 South Perimeter Highway Design Study – Manitoba

The South Perimeter Highway Design Study in the Winnipeg capital region was completed to address increased traffic volumes on the South Perimeter Highway (**Figure 2.4**). Subsequently, operational issues and safety concerns led to a need for a functional design for a full access-controlled facility. The South Perimeter Highway is considered an expressway in a rural context (highway infrastructure) but is planned to be upgraded to a freeway classification.

The study applied several guidelines including the MTI's *Geometric Design Guide Supplement Sheets* (2002), TAC *Geometric Design Guide for Canadian Roads* (1999 and 2017), American Association of State Highway and Transportation Officials' (AASHTO) *A Policy on Geometric Design of Highways and Streets* (2018), design guides from other Provincial Transportation Departments, TAC's *Canadian Roundabout Design Guide* (2017), TAC's *Manual of Uniform Traffic Control Devices for Canada* (2021), MTI's *Draft Roadside Design Guide* (2021), AASHTO's *Roadside Design Guide* (2011), AASHTO's *Highway Safety Manual* (2014) and TAC's *Canadian Road Safety Audit Guide* (2001). The overall principles in Section 8.3 Access Management by Design Classification and Section 8.4 Access Configuration of Chapter 8 of the TAC GDG were applied in the study.

The access management plan included strategies developed using a context-sensitive approach. Based on adjacent land uses and other unique local conditions, access management strategies were developed for three land use categories (Rural Agricultural, Agricultural/Industrial and Highway Commercial, and Urban Residential) as well as three special vehicle categories (Emergency and Service Vehicle Access, Agricultural Equipment Crossings and Over-Height Vehicles). It is important to consider local conditions, and work with local governments and stakeholders to ensure reasonable access is maintained while improving safety and efficiency on similar corridors.

Figure 2.4: South Perimeter Highway, Manitoba (Source: Google Earth, 2014)

2.2.5 Centre Street North – Alberta

The Centre Street North corridor functional planning study in Calgary was initiated to integrate new greenfield development and a future roadway network associated with the Livingston Outline Plan (OP) with the future Green Line Light Rail Transit (LRT) and anticipated at-grade transit stations along the Centre Street North corridor (**Figure 2.5**). Based on the proposed land use densities along the Centre Street North corridor, a couplet roadway system along 1st Street SE and 1st Street SW was proposed to direct the majority of vehicular traffic away from Centre Street North. An access management strategy was required for the east-west grid network of roadways proposed between the two 1st Streets that considered the various functional designs of the surrounding roadways, and to account for the impacts associated with the future Green Line LRT platforms and challenging roadway grades. Throughout the Livingston OP, the proposed roadway cross-sections were designed with a complete streets approach that integrates pedestrian and cycling infrastructure in the future transit system and vehicular roadway network.

Future parcel accesses were governed by the City of Calgary's Major Activity Centre (MAC) and Urban Corridor (UC) design criteria, which primarily directed vehicular accesses to be accommodated on the longer frontage of parcels rather than the shorter frontage and designed to minimize impacts to pedestrians and cyclists. High-level principles from Section 8.3 Access Management by Design Classification and Section 8.4 Access Configuration of Chapter 8 of the TAC GDG were applied in the study through the application of the MAC and UC design criteria and balanced with the design requirements for the LRT station requirements. Additional guidance from Section 8.1.2 of Chapter 8 for access management strategies in heavily urban environments would have been beneficial to the strategy where integration with competing complete streets principles and practices are critically important as part of a complete multimodal transportation system.

Figure 2.5: Centre Street North (proposed), Alberta (Source: City of Calgary)

2.2.6 Esquimalt Graving Dock – British Columbia

The study included a functional design for accesses to a proposed industrial use in a suburban context, addressing operational issues and safety concerns at the Esquimalt Graving Dock (**Figure 2.6**) in the Town of Esquimalt. The functional design applied to 50 km/h arterial and local roadway classifications.

The study applied the TAC's *Geometric Design Guide for Canadian Roads* (2017), BC MOTI's *Active Transportation Design Guideline* (2019), BC MOTI's *Planning and Designing Access to Developments* (2010) and Institute Transportation of Engineers' (ITE) *Traffic Engineering Handbook* (2016). Sections 8.4, 8.8 and 8.9 within Chapter 8 of the TAC GDG were used. Chapter 8 did not address the access configuration near multi-use pathways and railways, or also queueing considerations for the developments with a security kiosk. As a result, the BC MOTI's *Active Transportation Design Guideline* (2019) and ITE's *Traffic Engineering Handbook* (2016) were used as the main technical sources. Additional guidance with respect to access treatments to support integration of active transportation facilities and storage requirements for accesses with security kiosks would be beneficial in Chapter 8.

Figure 2.6: Esquimalt Graving Dock, British Columbia (Source: Google Earth, 2023)

2.2.7 King George Boulevard – British Columbia

King George Boulevard (**Figure 2.7**) located in Surrey, BC, underwent a traffic safety and operational review in 2021. That study reviewed the safety performance of intersections and collision prone areas along the King George Boulevard corridor. Aside from intersections, areas identified with several conflict points and potential for collision included entries to frontage roads and several parking lot accesses. The areas identified were not associated with a high frequency of injury collisions, and thus did not require short-term intervention. These accesses experienced issues due to users travelling at high speeds into parking lots, lack of sufficient pedestrian infrastructure, sharp entry angles, and lack of offset between sidewalk and parking stalls. The following long-term measures were suggested for these accesses to resolve conflict issues:

- Close, restrict, or relocate accesses to lower speed roads.
- Minimize pedestrian crossing distance at access with curb extension.
- Improve pedestrian markings and signage at accesses.
- Reduce access entry angles.

Technical reference sources were not available regarding the safety improvement measures recommended.

Figure 2.7: King George Boulevard corridor, Surrey, British Columbia (Source: Google Earth, 2014)

3. Cross-country practitioner survey and interviews

3.1 Key findings

The access management state of practice was assessed by conducting a national survey – with ten respondents comprising individual volunteer members of TAC's Geometric Design Committee – and completing twelve interviews with professionals across Canada. The survey and interview questions were focused on assessing usage of the current Chapter 8 – Access in the TAC GDG, determining additional reference sources used by organizations in Canada, and identifying areas of possible improvement.

3.1.1 Chapter 8 section usage

A majority of respondents stated that Chapter 8 in the TAC GDG is not their first reference for access management, but with differences between urban and rural jurisdictions. It was found that urban jurisdictions and provincial agencies tend to use local guidance created by their respective organizations, though the TAC GDG often informs these municipal and province specific guidelines. However, Chapter 8 in the TAC GDG is usually the first reference source for smaller rural jurisdictions that had not developed local standards.

The sections within Chapter 8 of the TAC GDG vary in usage as shown in **Figure 3.1**. Respondents stated that certain sections were not applicable to urban contexts, while others were not applicable to rural contexts.

Figure 3.1: Survey responses – Chapter 8 section usage

3.1.2 Access management issues

The survey asked respondents to describe 'the biggest access management issues or complaints' faced at their respective organizations. Issues related to accesses near high-speed facilities were brought up several times, while active mode infrastructure and other issues were also mentioned and summarized below.

Accesses near high-speed facilities such as highways and arterials are an issue in several jurisdictions. It is difficult to meet sightline requirements for accesses along high-speed roadways. Issues are faced with attempting to provide appropriate accesses to commercial locations (e.g. shopping centres) near highway entrances and exits. As well, jurisdictions are experiencing complaints with landowners requesting direct access to highways and requiring justification to allow or deny appropriate access. Organizations are experiencing safety issues with turning movements across major roadways, especially left turns on arterials.

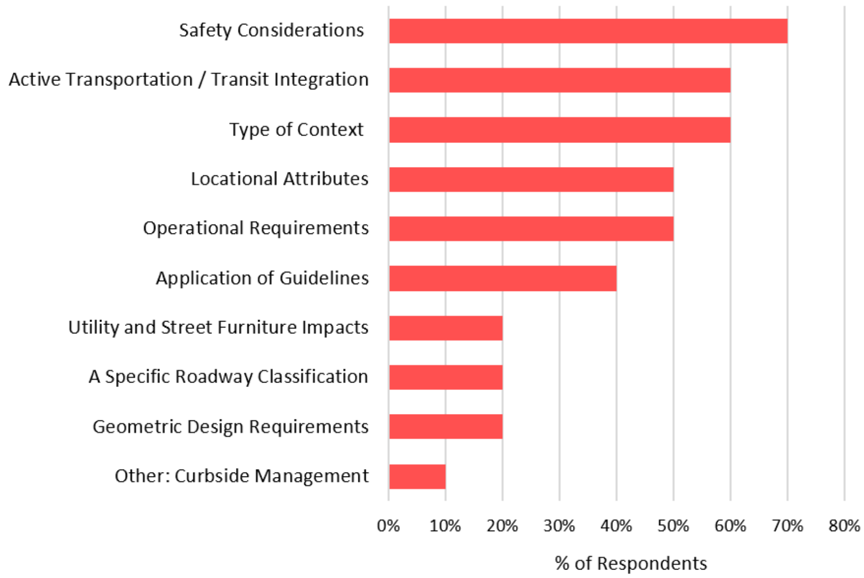
Active transportation modes are lacking design guidance for accesses that conflict with pedestrian and cyclist routes, especially where laneway access is not possible for vehicles. This includes sidewalks, uni-directional bike lanes, bi-directional bike lanes, and multi-use paths that intersect vehicle accesses. This issue directly relates to the topic of 'integration with active transportation or transit' which has been identified as important information to add to Chapter 8 of the TAC GDG.

Other issues include managing the need for multiple accesses for individual parcels spaced closely together and developments located near intersections. There are also limited standards on appropriate levels of access for new developments in fully built-out urban areas. Furthermore, additional information is needed regarding proactive measures to reduce collisions and improve safety, especially in developed areas.

3.1.3 Information to add

The prevalent topics for consideration to add to Chapter 8 of the TAC GDG are in agreement with the cross-country practice review and interview feedback. The survey responses regarding information topics missing from Chapter 8 in the TAC GDG are summarized in **Figure 3.2**.

Figure 3.2: Survey responses – Information to add to Chapter 8



3.1.4 New and emerging practices

Interviewees and survey respondents were asked to provide new and emerging practices to include in Chapter 8 of the TAC GDG. Many refer to specific and unique access designs and access management for urban contexts that are becoming more common. The responses are listed below.

- Access management infrastructure
- Roundabout pairs
- U-turn facilities (e.g. bulb facilities)
- Internal connections
- Seagull access points (i.e. protected T)
- Right-turn bay warrants
- Median barrier guidelines
- Driveway guidelines for small-lot residential uses
- Additional contexts
- High streets (i.e. primary business and commercial activity)
- Flexible streets (i.e. adaptable to different modes and uses over time)
- Complete streets
- Multimodal considerations
- Transit considerations
- Safety
- Collision modification factors (CMF)
- Other considerations
- Topography in access design

- Access type based on pedestrian and cyclist volumes
- Pedestrian and cyclist route classification based on context and volumes
- Retrofitting existing accesses

3.2 Areas for improvement

The following subsections summarize the areas for potential improvement and missing information in Chapter 8 of the TAC GDG consolidated from survey responses and interview feedback. Further detail and sources supporting the following areas are provided in Section 4:

- Safety considerations (also see Section 4.1)
- Multimodal integration (also see Section 4.2)
- Context and locational attributes (also see Section 4.3)
- Operational requirements (also see Sections 4.4 and 4.5)
- Navigation
- Rationale

3.2.1 Safety considerations

The topic of safety is integral to all areas of access management and design. A larger emphasis on safety is needed, especially when considering all modes of transportation and potential conflicts at and around accesses. The impact on safety is extremely important and valuable to include for all areas of access management. This can be manifested as design rationale in the form of frontmatter or preface in reports, quantitative indicators, data and so on. As mentioned in the literature review summary in Section 2.1, it may be beneficial to add a section within Chapter 8 to describe methodologies assessing the impact on safety in access management.

3.2.2 Multimodal integration

Multimodal integration was discussed in survey and interview feedback. In particular, pedestrians and cyclists should be considered in access design and approval processes. This includes safety considerations and level of access or infrastructure allowed based on road classification and land use. Examples of infrastructure that should be regulated are trees, signage and bus shelters; these items should be regulated to ensure sufficient sightlines. As well, guidelines for safety and sightlines for driveways is needed, especially with pedestrian safety in mind. Curbside management (including appropriate regulation of parking and loading spaces) should also be considered in multimodal integration, as curbside space will often be situated near or conflict with access areas. It is evident that much guidance is needed in order to inform and safely integrate sidewalks, bike lanes, and multi-use paths intersecting new and existing accesses. Accessibility should also be considered when integrating pedestrian and cycling facilities with vehicle accesses and reducing conflicts.

3.2.3 Context and locational attributes

A common theme among interview and survey feedback from both urban and rural jurisdictions is that Chapter 8 of the TAC GDG does not provide sufficient context or specific guidance. For example, organizations serving rural areas – more so on a provincial level – feel that there is a lack of rural access management guidance. However, organizations serving urban areas feel that additional information is needed regarding fully developed areas, integration of active modes and transit, and back lane access guidance. On the other hand, more proactive planning (e.g. Transportation Master Plan) is needed to inform the design of accesses before development occurs. Several organizations requested a need to clearly indicate appropriate measures for each context (rural, suburban, urban).

Land use and locational attributes should also be considered in access management. For example, access management regulations on a segment of a high-speed arterial providing access to several commercial developments should differ from regulations on a segment of a high-speed arterial with the purpose of moving traffic. As well, subcontexts should be considered (e.g. complete streets or flexible streets in an urban context).

3.2.4 Operational requirements

Additional detail is needed in Chapter 8 of the TAC GDG regarding operational requirements for access management guidance. Respondents indicated a desire for information regarding median barrier design and median opening placement for public and private accesses. As well, more distinction between intersection types and road classification types may be beneficial as context and roadway operation can vary greatly depending on its purpose. In particular, it was requested that access guidance and considerations be provided for major arterials on which all movements are permitted. Additionally, a variety of design vehicles such as passenger vehicles, single-unit trucks, and articulated trucks should be considered in access management and design. Thus, a greater variety of access design dimensions should be provided based on anticipated vehicle usage. Larger infrequent vehicles can be managed either through design or through vehicle restrictions, depending on context.

3.2.5 Navigation

The topic of navigation refers to the ease of locating information within Chapter 8 of the TAC GDG. Issues mentioned include difficulty finding figures and tables as some are referenced in previous sections, while the figures and tables are located later in the chapter. As well, respondents stated that it is not always clear whether guidance is designed for urban contexts or rural contexts, thus improved labelling or notation may be helpful in identifying context specific sections. As well, further detail on sources referenced within the chapter was requested to assist users in locating referenced material.

3.2.6 Rationale

Sufficient rationale is required to defend design choices and the approval or refusal of development applications. Respondents have stated that Chapter 8 of the TAC GDG is used to defend municipal or provincial standards for unique challenges. Additional rationale and quantitative indicators would provide a stronger support for access management decisions. For example, quantitative indicators may include collision statistic comparisons before and after an access management measure was implemented. Similarly, visual data (e.g. conflict point diagrams) that support the rationale behind access management guidelines can be valuable in defending access decisions in political situations and for the general public. As well, quantitative data to support access management guidance would ensure Chapter 8 provides more of an engineering perspective, which is more valuable than simply compliance to standards and regulations.

In general, for all access management guidance more considerations are needed regarding when measures should and should not be applied, and factors to consider (e.g. speed, volume, sightlines, pedestrians, transit, land use, geometry, topography).

4. Summary of beneficial practices

The information gathered from the cross-country practice review, case study review, cross-country survey, and interviews has been summarized in a list of beneficial practices that are discussed in the following sections:

- Safety considerations
- Multimodal integration
- Context, land use and road classification
- Preserve intersection/interchange functional area
- On-site strategies to reduce number of accesses
- Additional practices

4.1 Safety considerations

In several areas of the TAC GDG, an increase in tangible safety considerations is needed to support access management designs and guidelines. These considerations may relate to not only vehicular safety and the reduction of number and severity of conflicts, but also pedestrian and cyclist safety. The topic of safety is foundational in access management and is incorporated in further sections including preserving intersection/interchange functional area and reducing the number of accesses. Methods to incorporate safety considerations can include supplementing access management strategies with visuals and quantitative indicators.

The following items can be used to further incorporate safety in access management strategies:

- Crash modification factors (CMFs)
- Collision rate correlations with access configurations with consideration of operating speeds
- Conflict point diagrams
- Collision history

4.1.1 Quantitative indicators

The Federal Highway Administration (FHWA) provides several collision rate models using variables including commercial, mixed-use and residential models (Gross et al., 2018). However, additional research is needed to determine equations for the purpose of predicting collision rates depending on the access density, access spacing, number of lanes, road classification, traffic volumes and so on. When dependable collision prediction models and research are available, they should be applied to analyze access management strategies.

Collision rates are presented in TRB's *Access Management Manual*, Second Edition (2014), based on several factors such as spacing, type of median, context (urban, suburban, rural) and movement. Several quantitative factors can be used from this source to rationalize access management infrastructure from the safety perspective. For example, **Table 4.1** provides collision rate percentage reductions after replacing a two-way left-turn lane with a non-traversable median. This form of rationale can be applied to several access strategies depending on available research.

Table 4.1: Change in crash rates after replacing a two-way left-turn lane with a non-traversable median (Williams et al., 2014)

Location	Total Crash Rate (%)	Injury Rate (%)
Midblock	–55	–59
Intersections	–24	–40
Total	–37	–48

4.1.2 Rationale

Supporting evidence is not only important from an engineering design perspective but is important when defending access management strategies and decision to stakeholders and the public. Rationale can be sourced, summarized, and provided in easy-to-understand forms such as diagrams and graphs.

The following series of diagrams, shown in **Figure 4.1**, illustrates the impact of offsetting driveways such that conflicts can be avoided. Similar progression diagrams may be useful when illustrating access management strategies such as median opening placement and access spacing from intersections or other accesses.

As well, conflict point diagrams, as shown in **Figure 4.2** and can be applied to analyze several access configurations and provide visual rationale.

There is a correlation between the presence of driveways in the functional area of intersections and an increase in safety risk (Allen, 2008). As well, an increase in total collisions, collision rates and rear-end collisions was found to correlate with an increase in commercial access density. Rationale and evidence such as this can be used to support the consolidation of accesses and minimum access spacing.

The Transportation Research Board (TRB) assessed and evaluated the correlation between various access management treatments and the operational impacts on multimodal users. For example, the impacts related to right-turn deceleration and several variables were assessed; improvements and additions to right-turn deceleration lanes were shown to improve the performance of cycling, transit, and trucks as shown in **Table** 4.2. It may be useful to present safety performance and factors in a table similar to Table 4.2.

Figure 4.1: Conflict potential for driveway alignments (Federal Highway Administration, 2020)

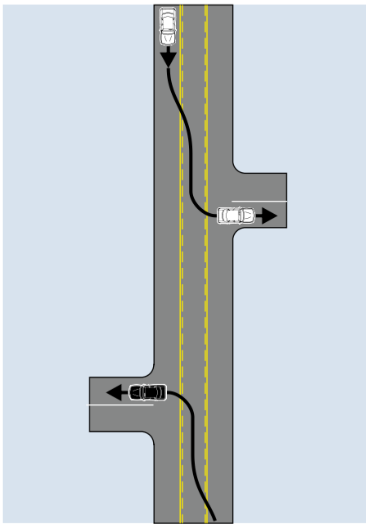


Figure 9: Locate Driveways on Opposite Sides of a Roadway to Achieve a Positive Offset

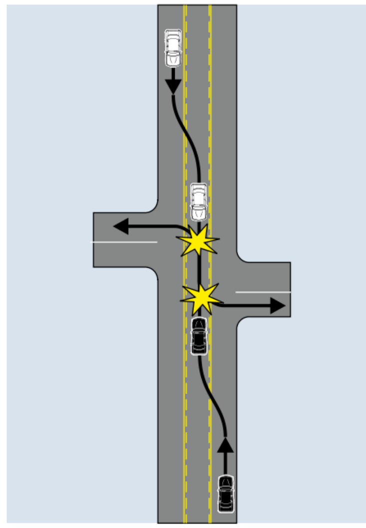


Figure 10: Avoid Locating Driveways on Opposite Sides of the Roadway that Create an Overlap for Left Turns Exiting the Major Roadway

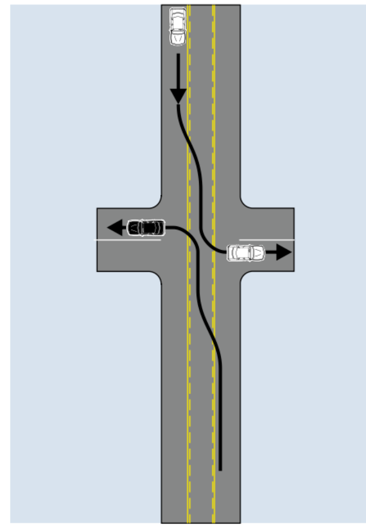


Figure 11: Align Driveways on Opposite Sides of the Roadway

Figure 4.2 Conflict points for access within right-turn lane (Allen, 2008)

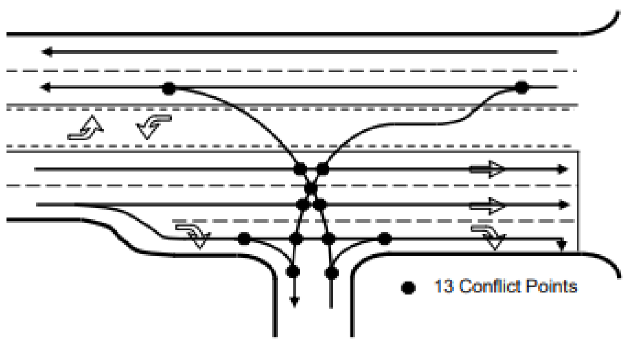


Table 4.2: Right-turn deceleration effects (National Academies, 2018)

Factor	Effect of a Change in Factor on Performance		
	Bicycle	Transit	Truck
Add right-turn deceleration lane	improve perf. ▲	improve perf. ▲	improve perf. ▲
Increase right-turn decel. lane length	—	improve perf. ▲	improve perf. ▲
Increase signal cycle length	decrease perf.↓	decrease perf.↓	decrease perf.↓
Allow right-turn-on-red operation	—	improve perf. ▲	improve perf. ▲
Increase approach traffic volume	—	decrease perf.↓	decrease perf.↓
Increase right-turn percentage	decrease perf.↓	decrease perf.↓	improve perf. ▲
Increase bicycle volume	—	—	—
Increase truck percentage	—	—	—
Increase bus stop frequency	—	—	decrease perf.↓
Increase bus dwell time	—	decrease perf.↓	—

Note:

1. "—" factor has no effect on operational performance.

4.2 Multimodal integration

The incorporation of multimodal integration in the TAC GDG would be extremely valuable as modal priorities shift and safety remains a high priority for all modes. Pedestrian, cyclist and transit activity should be considered when determining access type and access design. Modal priority should be reflected in the access design and in the road classification. As well, direct pedestrian and cyclist connections to sites should be considered. Barrier-free designs are recommended to be considered particularly for pedestrians at all potential conflict points; a variety of treatments can be considered such as tactile and auditory forms of treatment. Additional research regarding minimum corner clearance distances, sightlines and application of medians to reduce conflicts and improve safety is needed to supplement the multimodal considerations provided.

4.2.1 Access management strategies

Multimodal activity can impact accesses by conflicting with movements, requiring internal multimodal circulation routes, and especially requiring additional safety measures. TRB's *Access Management Manual*, Second Edition (2014) provides a comprehensive list of modal considerations and relationships to access management, as shown in **Table 4.3**.

Access management strategies for the purpose of improving safety for pedestrians and cyclists in suburban and urban contexts are summarized in **Table 4.4** and informed from several technical sources. The commonality and overlap across sources supports the need for multimodal consideration in access management.

Table 4.3: Modal considerations in access management (Williams et al., 2014)

Mode	Relationship to Access Management
Pedestrians and bicyclists	Nontraversable median or median design Spacing and design of median openings Spacing of vehicular access connections Location of bicycle and pedestrian-only connections Limitation of driveway volume and reduction of vehicular conflicts with pedestrians and bicyclists Facilitation of internal site circulation for bicycle and pedestrian access and minimization of conflicts with motor vehicle parking
Pedestrians	Spacing, frequency, and design of driveways Intersection of driveway and sidewalk Continuity of pedestrian (sidewalk) circulation Pedestrian crossings and, where possible, reduction of pedestrian midblock crossing distances (with particular attention to primary egress locations and transit stops)
Bicyclists	Bicycle lane crossings Reduction of roadway lane width to provide greater separation between bicyclists and vehicles
Bus transit	Location and design of bus stops and turnouts Interface with pedestrian circulation system
Light rail	Median design Spacing and design of median openings Right-in, right-out and U-turns Pedestrian circulation between transit stop and sidewalk system

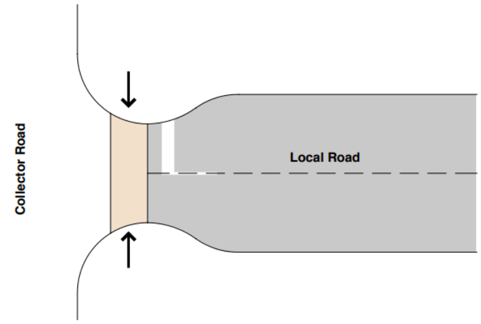
Table 4.4: Access management strategies to improve safety of pedestrians and cyclists

Source	Access management strategies
Access Management in the Vicinity of Intersections, Federal Highway Administration (2020)	**Medians:** • Provide raised medians on the major roadway to prohibit vehicles from turning left into driveways. This improves pedestrian safety by reducing the number of potential pedestrian-vehicle conflicts at a driveway. • Construct a channelized island between the inbound and outbound movements at right-turn-only driveways to provide a pedestrian refuge across the driveway. **Driveways:** • Minimize the width of the driveway as much as possible in order to reduce pedestrian crossing distances (e.g. reduce exposure). • Place sidewalks and pedestrian driveway crossings so that pedestrians are visible to the drivers, and drivers are visible to the pedestrians. Do not block pedestrian-driver sightlines with landscaping or signage. • Include bike lanes and signage, as appropriate, to alert bicyclists that motorists may be entering or exiting a driveway and to alert motorists that bicyclists may be crossing the driveway. • Use colored pavement across driveways in combination with crosswalk markings, and audio/visual treatments for exiting vehicles with limited sight distance. Such treatments include a signal and/or flashing sign that is activated to alert pedestrians a vehicle is about to cross the sidewalk from an adjacent parking area. • Restrict inbound vehicle speeds by designing the driveway access with appropriately designed radii. • Smaller driveway radii of 7.5 m to 10.5 m are more sensitive to pedestrian movements because motorists have to slow down to complete the turn. However, on-street parking and bike lanes can increase the effective driveway radius, so care should be taken to balance vehicle and pedestrian safety.
NCHRP Report 900: *Guide for the Analysis of Multimodal Corridor Access Management* (2018)	**Medians:** • Unsignalized median openings: Increase median width to store left-turn egress vehicles and channelize left turns across wide medians to improve offset. **Driveways:** • Driveway channelization: move sidewalk-driveway crossing laterally away from roadway, install two one-way driveways with limited turns in lieu of two full-access two-way driveways. • Driveway sight distance: regulate minimum sight distance, restrict on-street parking next to driveways, install visual cues for driveway and optimize sight distance in permit authorization stage. • Driveway width: regulate maximum driveway width and install barrier to prevent uncontrolled access along property frontage without impacting sightlines. • Driveway vertical geometry: improve driveway vertical geometry. • Driveway throat length: increase driveway throat length. **Other:** • Frontage and service roads: Increase distance from service road to arterial along crossroad, construct service road behind properties abutting the arterial and construct bypass road to remove through traffic from arterial. • Traffic signal spacing: locate new high-volume driveways where signal spacing criteria can be met and design driveways and median such that signals only affect one side of arterial at a time. • Number and spacing of unsignalized access points: increase corner clearance, consolidate driveways, increase the spacing between adjacent access points,

Source	Access management strategies
	require access on collector (if available) in lieu of arterial and relocate or reorient access. • Interchange areas: increase access separation distance in interchange areas. • Left-turn lanes: install left-turn deceleration lanes, install alternating left-turn lane and install isolated median and left-turn lane to shadow and store left-turning vehicles.
Intersection Proven Safety Countermeasure – Technical Summary: Corridor Access Management (2020)	**Medians:** • Providing a safe refuge for pedestrian crossings with raised medians. **Driveways:** • Reducing the number of driveways, particularly commercial driveways, within a given distance (per block or kilometre). • Reducing the number of conflict points at driveways (e.g. converting driveways to right-in, right-out or installing a median that restricts left turns in and out of driveways.) • Providing for greater distance between driveways.
Halifax Regional Municipality: *Municipal Design Guidelines* (2021)	**Driveways:** • When a bicycle lane crosses a driveway, it shall be made clear that the bicycle lane continues across the driveway and that a bicyclist has right-of-way over entering or exiting vehicles. For protected bicycle lanes, a break in the barrier is required.

Planning and Designing Access to Developments, British Columbia Ministry of Transportation and Infrastructure (2010)	• Pedestrian connections must consider the comfort and safety or pedestrians, and integrate the site's buildings with:
	  ○ Sidewalks and bicycle facilities on adjacent streets
	  ○ Transit stops
	  ○ Pick-up and drop-off points
	  ○ Adequate crosswalks
	  ○ Curb cuts and ramps for wheelchair access
	  ○ Designated walkways lighting and security

Road Corridor Planning & Design Guidelines, City of Ottawa (2008)	• Where a sidewalk along a Collector Road crosses an unsignalized private driveway, the Collector Road curb should be continuous but depressed along the crossing. The sidewalk should be depressed as little as possible. Grade transition should occur in the inner and outer boulevards where they exist. The sidewalk surface material should be continuous across the crossing. This design reinforces pedestrian priority and continuity of the road edge. • Where a sidewalk along a Collector Road crosses another public street, or signalized private driveway, the Collector Road curb should be returned to meet the curb of the intersecting street or driveway. The returning curb and crossing should be depressed to the elevation of the intersection. To announce the approaching safety risk to the pedestrian, the crossing surface material should be different from the sidewalk. This guideline also applies to other sidewalks that cross Collector Roads. • Where extra visual emphasis on pedestrian priority is desirable, or where traffic calming is being pursued, provide pedestrian crossing with distinct surfaces or markings. In such instances, the pedestrian crossing may retain a surface elevation that is continuous with the sidewalk. The crossing surface may differ from the roadway (or driveway) and the sidewalk surfaces. The use of such designs may be reviewed on a case-by-case basis, taking into account emergency service vehicle needs, pedestrian and vehicle traffic volumes, and accident history at the crossing." • Provide intersection narrowing or "neckdowns" at intersections with local streets to shorten crosswalk distances, reduce asphalt area, reduce the speed of vehicle turning movements; this can be considered at accesses.

Source	Access management strategies
	 *"Neckdowns" at intersections of Local Streets with Collectors are used to shorten crosswalk distances and to announce the entry to residential areas.*

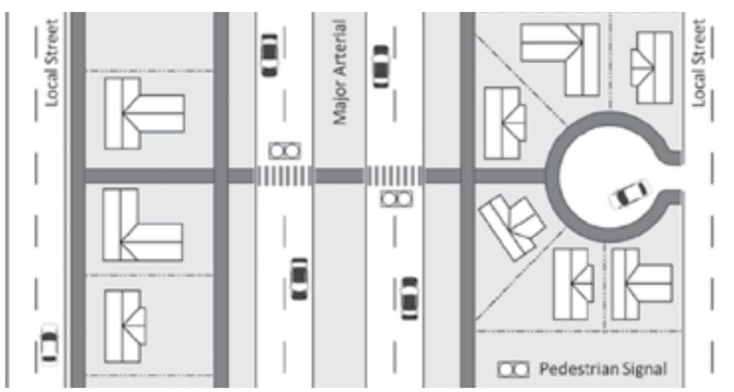
4.2.2 Transit considerations

Specific access measures can be applied to transit priority corridors to facilitate efficient transit and safety of passengers. For example, York Region (2021) restricts accesses located on rapid transit corridors to right-in/right-out only. Full movements are only permitted at signalized intersections. Additional information may be helpful in supplementing transit-specific guidance in a future TAC GDG update.

4.2.3 Pedestrian accesses

When providing pedestrian and cyclist access to developments, access designs should aim to reduce the distance between sidewalks and building frontage, or to provide a safe and accessible path between sidewalks and entries/exits (Williams et al., 2014). Continuity of a sidewalk between developments while limiting vehicular conflict and preserving sight distance is also important. **Figure 4.3** illustrates an example of sidewalk continuity between developments fronted by local streets and a major arterial.

Figure 4.3: Sidewalk system continuity (Williams et al., 2014)



4.3 Context, land use and road classification

Access management and appropriate infrastructure can be correlated with road classification, land use and context. Currently, the TAC GDG provides access management guidelines based on the following road classifications:

- Freeways
- Expressways
- Major and minor arterials
- Collectors
- Local roads

Additional road classifications and application of area context (urban, suburban, rural) can be considered. As well, access restrictions and guidelines can be based not only on road classification, but also considering characteristics including but not limited to land use, density, activity and transit availability. Applying access management principles to fully developed areas should also be addressed, and allowances permitted when appropriate.

4.3.1 Context

There is a desire for clear identification of appropriate measures for each context (rural, suburban, urban). However, sources did not identify access management measures based on context, but rather a variety of characteristics. It is recommended to develop a categorical system, similar to the existing road classification system, but expanded to include sub-classifications with commonly associated densities, land uses, activities, modes and speeds.

Similarly, access management in the context of proximity to new or retrofitted roundabouts or other alternative intersection treatments may warrant further evaluation and considerations, particularly due to the splitter islands typically found on most roundabout legs that may restrict access, but also due to the speed characteristics on the approach and departure lanes of roundabouts. Roundabouts may also provide an access management solution in and of itself, by having one roundabout leg serve as a driveway access to a development parcel.

4.3.2 Road classification

Road classification is divided for the purpose of defining function in the TAC GDG. The Transportation Research Board's *Access Management Manual* provides useful supporting theory and expands on the differences between road classifications based on trip stage purposes – termination, access, collection and distribution, and primary movement as shown in **Table 4.5** and **Figure 4.4** (Williams et al., 2014).

The following road classifications and definitions from various sources can be considered to supplement the current TAC GDG road classifications:

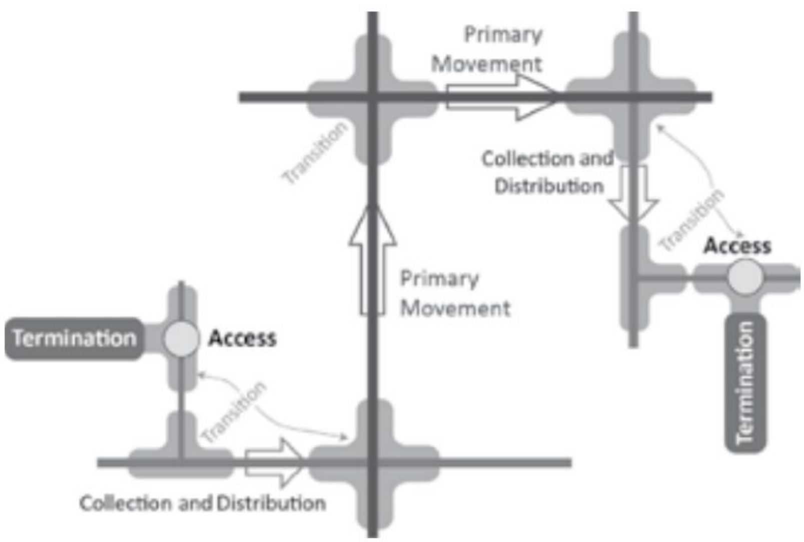
- *Inner ring loop and highway connectors* (City of Edmonton, 2022)
- *City centre street* – Urbanized and dense mixed-use areas, prioritize pedestrians and transit (York Region, 2020)

- *Corridors* – Higher-density mixed-use development and employment use consistent with planned transit service levels (Halton Region, 2015)
- *Avenue* – Support transit, active modes and goods movement (York Region, 2020)
- *Main street* – Active streets in smaller urban settings and stable residential neighbourhoods, often historical in context (York Region, 2020)
- *Rural hamlet road* – Rural roads that support commercial needs for the community (York Region, 2020)
- *Alleys* (e.g. laneways, back lanes) – Roads at the rear of properties with one travel lane and no parking (City of Edmonton, 2022)

Table 4.5: Expansion of basic roadway categories (Williams et al., 2014)

Trip Stage Served	Basic Category	Expanded Category for Planning and Design
Termination	Parking space	Not applicable
Access	Local	Alley Shared street, *woonerf* Court Cul-de-sac Loop Long block grid
Collection and distribution	Collector	Residential minor collector Residential major collector
Primary movement	Arterial	Minor arterial Principal arterial Expressway Freeway

Figure 4.4: Trip stages (Williams et al., 2014)



4.3.3 Land use

Land use and locational attributes should be considered in access management. For example, access management regulations on a segment of high-speed arterial providing access to several commercial developments should differ from regulations on a segment of high-speed arterial with the purpose of moving traffic. Sub-contexts should be considered:

- *Complete streets* – Designed to be safe, comfortable, and accessible for all ages and abilities, and all modes
- *High streets* – Designed to host primary business and commercial activity in an urban area
- *Flexible streets* – Designed to be adaptable to changing needs including variations in modal demand throughout the day, changing weather conditions, and so on
- *Nodes* – Compact, transit-oriented, pedestrian/cyclist-friendly, mixed-use/residential neighbourhood centres that are areas of more intensive urban uses within a community (Halton Region, 2015)
- *Rural/natural heritage system* – Areas for agriculture, protection of infrastructure that supports farming, and natural area conservation (Halton Region, 2015)

4.3.4 Road classification and context

The TAC GDG currently provides access and intersection spacing based on road classification and type of access. However, the type of information provided varies depending on the road classification and should consider not only classification, but also context and infrastructure (e.g. signalization, medians) . Information such as number of driveways per kilometre or types of access allowed based on road classification should be provided in an easily navigable manner.

The City of Regina (2022) provides driveway permissions based on road classification. For example, driveways are permitted on local roads and collector roads, not within 10 metres of an intersection. Commercial driveways, industrial driveways, and private road access may be permitted on arterials if the primary frontage is commercial and meets City requirements. As well, for collector roads with a traffic volume of ≥ 15,000 vehicles per day and driveways within 25 metres of an intersection, a raised centre median shall be constructed to limit turn maneuvers to and from the site. Similarly, York Region (2020) limits types of access based on road classification and context. For rapid transit corridors, right-in/right-out only accesses are permitted. Additional guidelines are provided for school accesses and high-occupancy vehicle (HOV) corridors.

Halton Region (2015) restricts minimum access spacing based on context (R = rural, C = corridor, and N = node) and type of access as shown in **Table 4.6**. The Ontario Ministry of Transportation (MTO) (2022) provides access spacing guidelines based on road classification, density, and signalization as shown in **Table 4.7**. The City of Edmonton (2022) provides minimum separation guidelines based on road classification, signalization, and number of lanes (see **Table 4.8**).

Table 4.6: Minimum access spacing (Halton Region, 2015)

TYPE*	Full Movement Access (m)	Right in/out Access (m)
R1	400	115
R2	400	115
C1	400	115
C2	300	115
C3	300	115
C4	300	115
C5	300	115
N1	250	115
N2	250	115

Table 4.7: Spacing and density of various access connection types (Ministry of Transportation, 2022)

Highway Access Management Classification System Category		Controlled-Access Highway (CAH) or King's Highway (KH)	Interchange Spacing [a]	Public Road Intersection Spacing Signalized / Unsignalized [b]	Commercial / Private Road Access Spacing Signalized / Unsignalized [c]	Total Private Access Density [d] / km / side	Minimum Total Pre-Severance Frontage Requirement for the Creation of a New Lot of Record [e]	
							New Access Connection	Mutual Access
1A -	Freeway	Fully CAH	3.0 - 8.0 km Desirable 2.0 km Minimum	N/A	N/A	N/A	N/A	N/A
1B -	Staged Freeway			3.0 - 8.0 km Desirable [f] 2.0 km Minimum [f]	N/A	N/A	N/A	N/A
2A -	Principal Arterial	Fully CAH	3.0 - 8.0 km Desirable 2.0 km Minimum	3.0 - 8.0 km Desirable [f] 2.0 km Minimum [f]	N/A	N/A	N/A	N/A
2B -	Arterial	CAH / KH	N/A	1600 m Desirable [g] 800 m Minimum [h]	1600 m Desirable [i] 800 m Minimum [j]	4	500 m	250 m
3 -	Collector	KH	N/A	800 m Minimum [h]	800 m Minimum [j]	6	300 m	150 m
4A -	Major Local	KH	N/A	400 m Minimum [h]	400 m Minimum [j]	8	250 m	125 m
4B -	Minor Local	KH	N/A	400 m Minimum [h]	N/A [k]	N/A [l]	N/A [l]	N/A [l]

Table 4.8: Separation distance guideline for a proposed access (City of Edmonton, 2022)

Classification of Road Being Accessed	Minimum Separation (metres) From Nearest Existing or Planned Traffic Signal
Freeway	Access not permitted
Inner Ring Loop and Highway Connectors	400
Divided Arterial	250 up to 4 lanes (2 travel lanes in each direction) 400 more than 4 lanes
Undivided Arterial, access signalized	250 up to 5 lanes (2 travel lanes in each direction and a centre left turn lane) 400 more than 5 lanes
Undivided Arterial, access non-signalized	100

4.4 Preserve intersection/interchange functional area

The idea of preserving the intersection/interchange functional area is foundational to access management and safety. The TAC GDG should perhaps incorporate the definition, guidance and strategies related to protecting the functional area of intersections.

4.4.1 Defining the area

The Ontario Ministry of Transportation (MTO) (2022) defines the functional area as "the area within the intersection or interchange where motorists are decelerating, accelerating, and maneuvering into the appropriate lane to stop, merge or complete a turn." In agreement, the Federal Highway Administration (2020) states that limiting or, where possible, eliminating driveways within the functional area of an intersection helps reduce the number of decisions motorists must make, thus improves safety in the vicinity of an intersection. Accesses are also not permitted within the functional area of any intersection by the BC Ministry of Transportation and Infrastructure (2010) and the Kentucky Transportation Cabinet (Kirk and Van Dyke, 2019).

Supplementing this, accesses that support transportation operations such as "transit stations, transit park-and-ride facilities and carpool parking lots" may have less restrictive guidelines than accesses to other uses (MTO, 2022). This guideline requires rationale and proof of safety before incorporating into the TAC GDG.

Figure 4.5 illustrates the functional and physical area of an intersection. Several technical sources (Gross et al., 2018; Williams et al. 2014; Kirk and Van Dyke, 2019) present similar figures when defining the functional area.

To determine the functional distance from the physical area of an intersection, a formula was found as illustrated in **Figure 4.6** and supported by the Transportation Research Board (2014).

Supplementing the functional distance formula, the British Columbia Ministry of Transportation and Infrastructure (2010) provides distances for each component of the formula based on context (urban, suburban, rural) in **Table 4.9**. The provided values do not include queue storage, which can be calculated using modelling when appropriate.

Figure 4.5: Functional and physical area of an intersection (Federal Highway Administration, 2020)

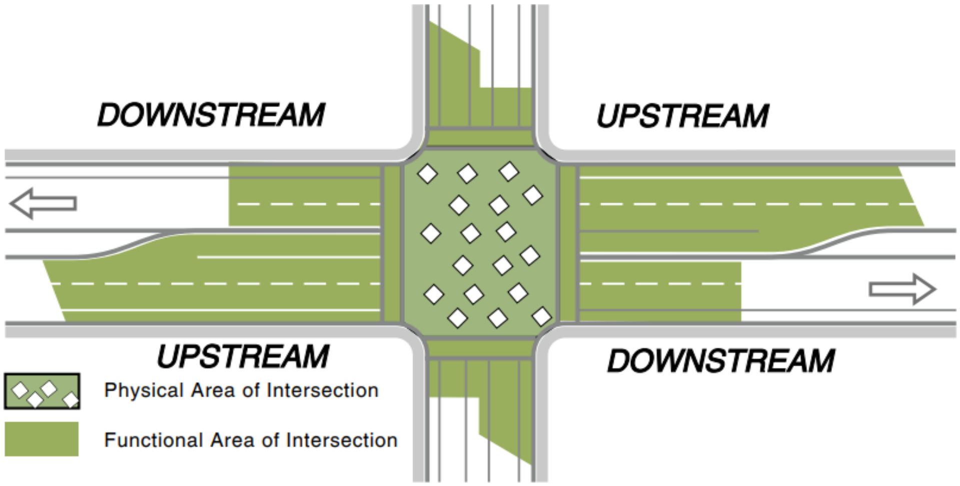


Figure 4.6: Functional distance (Allen, 2008)

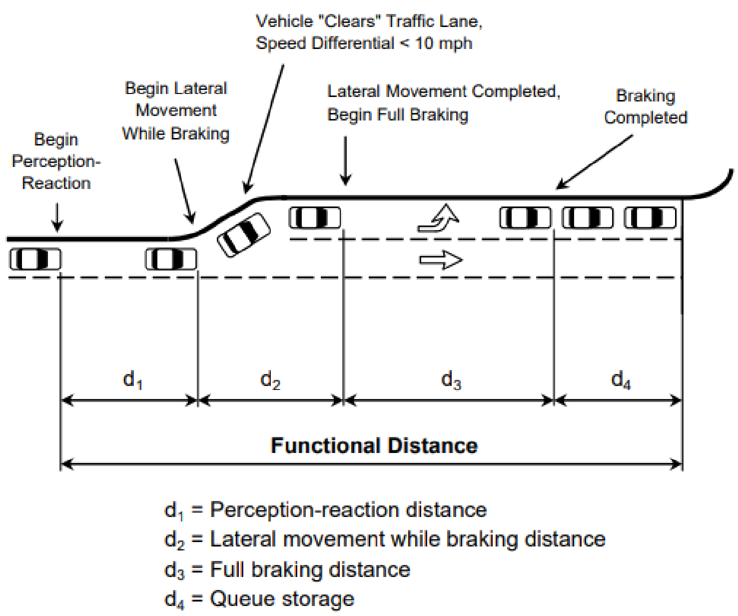


Table 4.9: Functional distance based on context (BC MoTI, 2010)

Location	Speed (kph)	Distance travelled in perception/ reaction time[a], d1 (m)	Maneuver distance, d2 (m)	Perception–reaction time, plus maneuver distances, d1 + d2 (m)	Queue storage length [b] d3 (m)	Upstream functional distance d1+d2+d3 (m)
Rural	80	55	130	185	15 [c]	200
	100	70	185	250	15	270
	110	80	250	320	15	335
Suburban	50	35	50	80	115 [d]	200
	65	45	85	120	75 [e]	205
	80	55	130	186	40 [e]	225
Urban	30	15	20	35	150 [g, h]	190
	50	20	50	69	150 [g, h]	220

Source: *Access Management Manual*. Table 8.4 converted to metric units

[a] Perception-reaction time is also known as Perception, identification, evaluation and volition time (PIEV)

[b] Queue storage needs to be determined for each approach to each intersection using methods such as those discussed in the *Access Management Manual*, Chapter 10.

[c] Minimum storage of two automobiles or one truck.

[d] Example of storage for 15 automobiles.

[e] Example of storage for 10 automobiles.

[f] Example of storage for 5 automobiles.

[g] Example of storage for 20 automobiles.

[h] Dual left-turn lanes can reduce the queue storage length.

4.4.2 Preserving the area

The British Columbia Ministry of Transportation and Infrastructure (2010) provides the following strategies and access alternatives for preserving the functional area of an intersection/interchange:

- Provide alternate access routes to the municipal road network instead of the highway.
- Amalgamate or relocate existing or proposed accesses.
- Provide access roads, frontage roads or rear service roads.
- Restrict turns at access points (must provide a physical barrier).
- Provide auxiliary lanes to accommodate acceleration, deceleration and turning movements without impacts to through-traffic.
- Provide separate one-way entrance and exit accesses.
- Ensure that all site access movements are unsignalized.

The City of Ottawa (2008) also presents specific strategies to support the preservation of the functional area and relate to reducing the general number of accesses:

- Consolidate access points along Collector Roads which serve higher density and mixed land uses, to reduce potential conflicts with turning movements and pedestrian routes.
- Align driveway accesses on either side of the road to create a more familiar intersection pattern and to coordinate the location of median breaks and potential future intersections.
- Consider the use of left-turn lanes in advance of only the busiest intersections, and evaluate their need on a case by case basis.

The *Access Management Manual*, *Second Edition* (2014) provides regulation strategies in the event that accesses must be located in the functional area:

- Require that the access connection be located as far from the intersection as possible.
- Limit driveway movements to right-in and right-out movements only and require construction of a nontraversable median or flexible pylons as a condition of the permit if necessary to limit the movements.
- Limit the maximum driveway volume (vehicles per hour and vehicles per day) as a condition of the permit.

4.5 On-site strategies to reduce number of accesses

Reducing the number of accesses is highly related to improving safety and reducing potential conflicts. Several sources provide strategies, visual aids, and written rationale that can be incorporated in the TAC GDG to support access reduction.

4.5.1 Rationale

The following excerpts can be used as a reference for rationale supporting the importance of reducing accesses:

Access Management Manual, Second Edition (2014)

> "When large areas of businesses (including multiple parcels and multiple ownerships) are grouped together, joint-use driveways, cross-access easements, and joint-parking circulation effectively serve as collectors and local streets. These private roadway systems, although not public streets in the traditional sense, operationally serve the same purpose of keeping short, local trips between businesses off the higher-volume and higher-speed arterials." (Williams et al., 2014)

Access Management Guidelines, City of London (2012)

> "Joint access and common internal driveways reduce the number of direct access points to the arterial road, and minimize the opportunity for turning conflicts to occur on the municipal road network. They are used to connect both minor and major developments and to improve driveway spacing, which allows intensive development of a corridor, while maintaining efficient traffic operations, and safe and convenient access to business." (Meksula, S., 2012)

4.5.2 Land use

During planning stages or redevelopment, land use planning can be integrated into on-site strategies to reduce the number of accesses. The *Access Management Manual, Second Edition* (2014), promotes joint access based on land use type as the following commercial developments are anticipated to have substantial interparcel traffic (Williams et al., 2014):

- High-turnover restaurants and gas stations, especially those serving travelers or located in tourist or recreational areas
- A discount store and a large shopping mall that are located in close proximity
- A specialty store and a shopping mall that are located in close proximity
- Shopping centres anchored by competitive supermarkets or that have complementary shops
- Neighborhood shopping centres and gas stations
- Neighborhood shopping centres and branch banks

On a larger scale, the City of Ottawa (2008) promotes locating "community serving uses such as schools, community and neighbourhood parks, minor commercial uses and places of worship" along collector streets such that they act as "focal points for community interaction." To promote multimodal access, parking shall not be located between the building frontage and the street. Similarly, land uses requiring larger lot sizes should be located along collector streets to allow the opportunity to consolidate accesses. As well, the Nova Scotia Department of Public Works (2022) encourages "shared driveways and interconnection within and between developments." Access reduction techniques including frontage and backage roads, shared driveways, and internal cross-connectivity are also supported by the Federal Highway Administration and are claimed to reduce the frequency and severity of conflicts along the main roadway (Gross et al., 2018).

4.5.3 Configurations

Several configurations are available from technical sources regarding joint accesses. The *Access Management Manual, Second Edition* illustrates a basic joint access configuration as shown in **Figure 4.7** and alternate cross-access configurations – rear cross-access drive, front cross-access drive, and zig-zag cross-access drive – in **Figure 4.8**.

The British Columbia Ministry of Transportation and Infrastructure (2010) provides comprehensive diagrams illustrating access management principles as well as a variety of on-site strategies and rationale as shown in **Figure 4.9** and **Figure 4.10**. These strategies include but are not limited to no parking on the main roadway, no direct parking connected to driveway, full connection of internal roads, adequate storage, and no dead-ends.

Figure 4.7: Joint-use driveways and parking lot cross access (Williams et al., 2014)

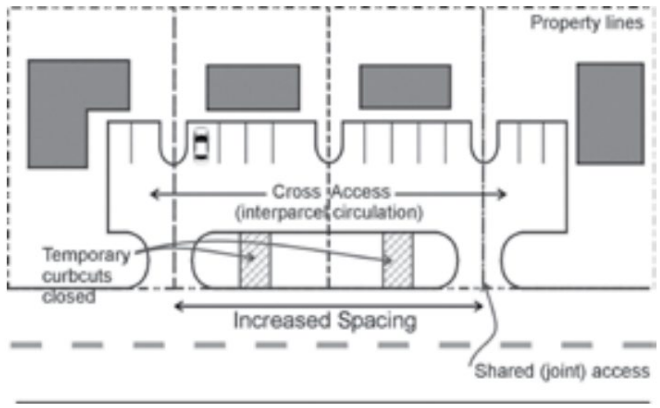


Figure 4.8: Cross-access configurations (Williams et al., 2014)

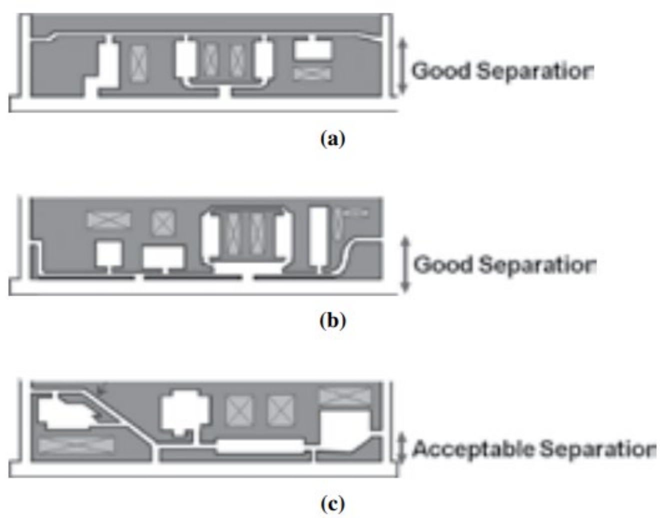


Figure 4.9: Access management principles (BC MoTI, 2010)

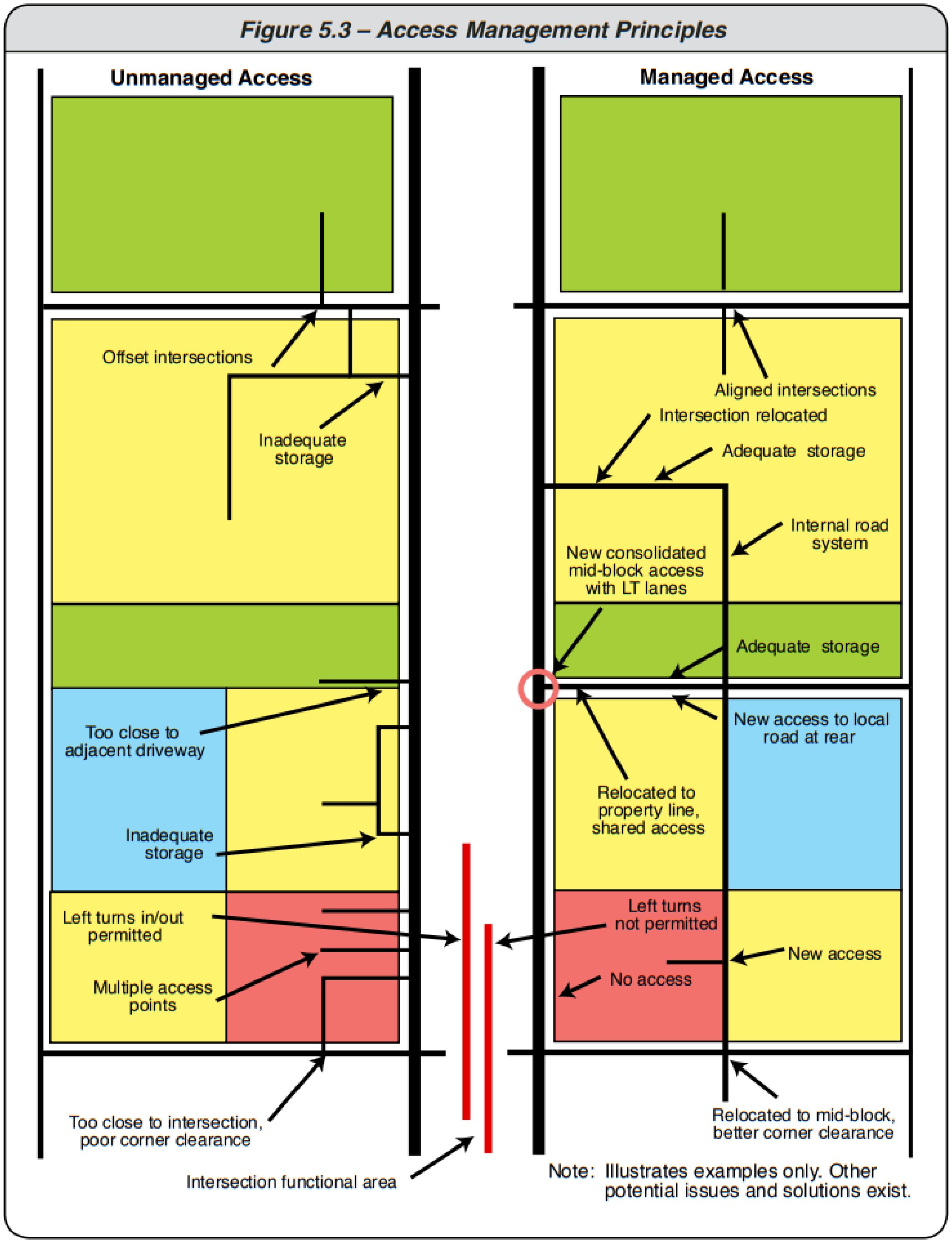
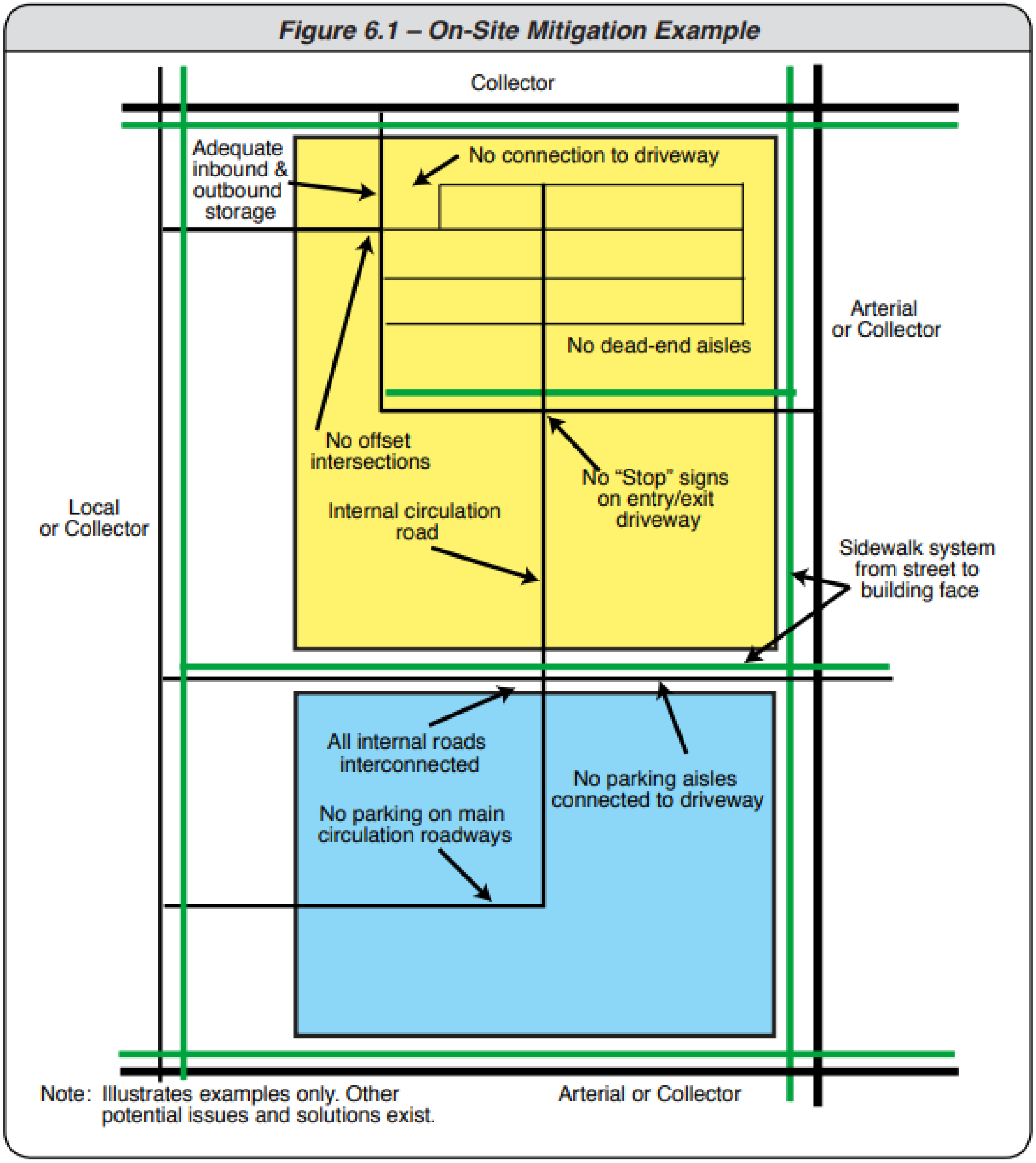


Figure 4.10: On-site mitigation example (BC MoTI, 2010)



4.6 Additional practices

Additional practice topics that appeared in the review of literature, case studies, survey feedback and interview feedback are listed below to guide future research:

- Utility and street furniture impacts
- Geometric design requirements
- Access management infrastructure
- Roundabout pairs
- U-turn facilities (e.g. bulb facilities)
- Internal connections
- Seagull access points (i.e. protected T)
- Right-turn bay warrants
- Median barrier guidelines
- Driveway guidelines for small-lot residential uses
- Topography in access design
- Ease of navigation

5. Recommendations

The results of the cross-country practice review, case study review and practitioner surveys were compared to the existing TAC GDG Chapter 8 to identify gaps. Overall, it was found that Chapter 8 was a comprehensive source for access management guidelines. The case studies confirmed that Chapter 8 is generally applied to inform approach to access management planning and that local context considerations often have a strong bearing on the assessment. Notwithstanding these observations, **Table 5.1** summarizes the areas identified as requiring update or review to reflect emerging practices and research. Refer to Chapter 4 for resources and additional detail on beneficial practices.

Table 5.1: Potential areas of updates to Chapter 8 TAC GDG

Section	Sub-section	Consider update?	Potential scope of update
8.1 Introduction	8.1.1 General 8.1.2 Access Management and Safety 8.1.3 Building Set-Back Guidelines 8.1.4 Pedestrian and Cyclists Considerations 8.1.5 Capacity Considerations	Yes	▪ Consider adding section on local context and adjacent land use implications to access management. ▪ Elaborate on capacity considerations section and requirements for traffic impact assessments. ▪ Consider adding a section to introduce safety as a priority for users of all modes.
8.2 Access Management and Functional Classification	8.2.1 Overview 8.2.2. Access Types 8.2.2.1 Public Road Access 8.2.2.2 Commercial Access 8.2.2.3 Industrial Access 8.2.2.4 Residential Access 8.2.2.5 Rural Recreational Access 8.2.2.6 Country Multi Residential Access 8.2.2.7 Farmstead Access 8.2.2.8 Field Access 8.2.2.9 Utility Access 8.2.2.10 Resource Access 8.2.3 Access Classification System	Yes	▪ 8.2.1 Overview may benefit from a general discussion of limiting the number of accesses by development type. This could include guidance by density or use. ▪ 8.2.3 Requires additional guidance. Access classification and recommended practice by access type, context (urban, suburban, rural and land use) and road classification would be valuable. This may require an update to 8.3 as well.
8.3 Access Management by Design Classification	8.3.1 Freeways 8.3.2 Expressways 8.3.3 Arterials 8.3.4 Collectors 8.3.5 Local Roads	Yes	▪ Consider introducing the purpose of classification with respect to trip stages. ▪ Major and minor designations are beginning to be defined for both arterial and collector roadways. The definitions of existing classifications may require more nuance by posted speed, volume of vehicles and median treatment. ▪ Subclassifications may be considered as land use and density can vary between the current design classifications.

Section	Sub-section	Consider update?	Potential scope of update
			▪ Consider including laneways as the lowest design classification as this is often the case in urban areas.
8.4 Access Configuration	8.4.1 Distance from curves 8.4.2 Distance from bridges 8.4.3 Distance from interchanges and intersections 8.4.4 Distance from Railways 8.4.5 Geometry 8.4.6 Intersection and Crossing Sight Distance 8.4.7 Gradients 8.4.8 Skew Angles 8.4.9 Turning Radii 8.4.10 Auxiliary Lanes 8.4.11 Signalized Access Spacing	Yes	▪ 8.4.3 should be expanded on to describe how to determine the intersection or interchange functional areas and the access requirements within that area. This includes guidance on access management spacing standards from roundabouts as either a specialized intersection treatment, or as a standalone new section that includes access management along an entire roundabout corridor (such as a "dumbbell concept" that manages or replaces all left-turn movements between the roundabouts. ▪ Consider moving 8.9.12 to this section and expand on the different strategies that may be applied to better support multimodal integration.
8.5 Continuous right-turn auxiliary lanes on divided arterials	8.5.1 General 8.5.2 Design Elements 8.5.2.1 Warrants 8.5.2.2 Width 8.5.2.3 Introduction and Termination 8.5.2.4 Driveway Location, Spacing and Design	No	n/a
8.6 Two-way left-turn lanes	8.6.1 General 8.6.2 Width 8.6.3 Application 8.6.3.1 Explicit evaluation of safety	Yes	▪ This section should be expanded to discuss medians more broadly and the different considerations regarding the selection of median treatment to reflect emerging practices and safety study findings.
8.7 Service (Frontage) Roads	8.7.1 General 8.7.2 One-way service (frontage) roads 8.7.3. Two-way service (frontage) roads	No	n/a
8.8 Corner Clearances at Major Intersections	8.8.1 General 8.8.2 Suggested Minimum Corner Clearance Dimensions	Potentially	▪ Minimum corner clearances seem to vary by source. This may warrant further review.
8.9 Driveways	8.9.1 General 8.9.2 Operational Considerations 8.9.3 Sight Distance	Yes	▪ Internal roadway connectivity, shared driveways and limiting number of accesses to property may be effective measures to add in this section.

Section	Sub-section	Consider update?	Potential scope of update
	8.9.4 Turning Characteristics 8.9.5 Width 8.9.6 Angle of Driveway 8.9.7 Corner Clearances at Minor Intersections 8.9.8 Spacing of Adjacent Driveways 8.9.9 Spacing Considerations for Driveways on Opposite Sides of the road 8.9.10 Clear Throat Lengths 8.9.11 Grades 8.9.12 Pedestrian and Bicycle Crossing Considerations		▪ Consider guidance related to improving safety, comfort, and accessibility for pedestrians and cyclists through driveway width, grade, material, and auditory or visual treatments.
8.10 Cul-de-sac	-	No	n/a
Various	-	Yes	▪ Add a section for multimodal integration in accesses, considering pedestrians, cyclists, transit users, and accessibility needs.

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