Development of Complete Street Guidelines – The Calgary Experience

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ABSTRACT

The City of Calgary is undertaking a multi-year development of a Complete Streets Guide. This initiative has a comprehensive guiding Project Charter and is governed by a City Steering Committee made up of senior managers. The main objective of the Guide is to provide a selection of multi-modal streets for both 'greenfield' and 'brownfield' development, and a process to implement them, with the goal of increasing the attractiveness, convenience and safety of all urban transportation modes. The Guide is intended for the use of both City staff and of the very active residential/industrial/commercial development industry in Calgary.

The basic notion of 'Complete Streets' (as compared to the traditional **auto**-centred design standards) involves a much higher degree of complexity in design and potential for stakeholder involvement, and may involve greater per-metre costs and cross-section widths for streets. The focus on encouraging 'Active' mode use and transit, combined with the soon-to-be-mandatory (in Calgary) incorporation of Low Impact Development (LID) measures into most street cross-sections, requires a delicate balance of the needs of the various users and facilities competing for space within the right-of-way. In addition, the Guide's intent to provide **flexibility** in application of the palette of new street standards is in contrast to the traditional 'prescriptive' approach.

The paper describes D.A. Watt's involvement, as the consulting extension of the City's technical team, in the Complete Streets process. It addresses key aspects of the 2011 work scope, such as the survey of Winter Cities' practice, development of recommended values for key (Critical) cross-section elements (e.g., driving lane, sidewalk and Multi-use Pathway, cycle lane widths), and development of the design documentation (text, road/intersection figures, spreadsheets) for Base and 'Alternate' cross-sections. A discussion of the key issues and 'trade-offs' (e.g., **reduced** driving lane width but **increased** minimum sidewalk width) is included. The impact and influence of shallow utility suppliers and developers is integrated into the process of design development. The paper also addresses the process, with internal City and 'external' stakeholders, by which the new standards and practice were developed. Finally, the paper touches on the 'lessons learned' and how other agencies may benefit from the Calgary experience.

INTRODUCTION

The Calgary 'Complete Streets' work stems from the September 2009 approval of the Municipal Development Plan (MDP) and the Calgary Transportation Plan (CTP) by the Calgary City Council. Those documents set out a vision and accompanying policies for sustainable growth, through a more compact city form that promotes walking, cycling and transit, amongst numerous other 'sustainable' objectives. This CTP objective is reflected in the following statement from the document:

> "Complete Streets" aims to increase the attractiveness, convenience and safety of all modes of transportation by creating a new selection of multi-modal streets that emphasize walking, cycling and transit, incorporate elements of green infrastructure and function in the context of surrounding land uses [1:2].

The intent of a Complete Street is to consider the needs of **all** users (ages, income levels, level of mobility, etc.) in its planning and design. It is recognized that there are many types of users, and they cannot all necessarily be accommodated to the highest possible

standard, given the practical constraints of cost and right-of-way. In Calgary, as in most other communities, streets within residential subdivisions are entirely funded by the development industry, and that industry also funds a significant portion of regional roads (arterials, skeletal roads) in the city. The City's per-acre development levies have risen substantially in recent years. The introduction of additional elements within the existing right-of-way, or within an **expanded** right-of-way, will necessitate extensive discussion with the development industry stakeholder.

In 2010, a Complete Streets Program Charter was developed and approved by the City's Transportation Leadership Team, which set out parameters for a multi-phase, three-year program to develop and deliver a Final Complete Streets Guideline. The Charter provided background and rationale for the program, priorities and resourcing for executing the work, identified stakeholders and protocol for engagement, and set out a timeline of deliverables.

Basic philosophies behind Calgary's Complete Streets Program were to:

- Avoid drastic format changes to the existing Design Guide for Subdivision Servicing (DGSS), which includes detailed geometric standards for roads, in order to limit the learning curve of users.
- Reorganize the DGSS information to make it more 'user-friendly'.
- Utilize existing/auxiliary design standards (TAC, Low Impact Development, Bike Guide and others) by cross-referencing to avoid repeating/republishing applicable standards.
- Update design sheets/cross sections with new criteria and standards.
- Include space/place holders and allocations in cross sections for other feature elements to be integrated (trees and LID elements, furnishings).
- Be less prescriptive with details so as to permit both innovation and flexibility in applications.

PROGRESSION OF CALGARY STREET STANDARDS

Historically, up until around 2000, Calgary's roadway hierarchy has included the traditional Freeway /Expressway, Major Street (or Arterial), Primary (divided) Collector, Collector (undivided) and Local Residential Street, with a couple of industrial road types. Leaving aside the Freeway /Expressway designation (not applicable to subdivisions), the City of Calgary's historical approach of these standards was essentially prescriptive – little or no deviation from the identified roadway cross-section and geometric standards was permitted. In addition, the City introduced the notion of an 'Environmental Capacity Guideline' (ECG) in the mid-1970s – this is in essence a statement of the maximum desirable daily (24-hour) traffic volume on a street with single-family residential frontage. If the projected daily volume on a proposed Local Residential Street, say, exceeded the ECG for that standard of road, then the next higher street in the hierarchy, a Collector, would have to be built instead.

In addition, the standards were based almost entirely on the comfort and safety of the **driver**, resulting in generous parking and driving lane widths. This in turn has resulted in high operating speeds in these traditional subdivisions. In contrast, the sidewalk provisions for pedestrians have been modest.

In 1996-97, the City and development industry teamed up to carry out a review [2] of the traditional standards. This resulted in recommendations for a more detailed and flexible set of standards, with more emphasis on the users of non-auto travel modes, and with narrower driving/parking lanes to encourage reduced driving speeds. Only a few of the recommended

new standards were adopted, in 1999, and the traditional standards were essentially retained. The ECG traffic numbers have been adjusted upward on one occasion, and are represented in formal City policy [3].

In recent years, themes of sustainability, planning for the comfort and safety of **all** users, and sensitivity of the road system to adjacent land uses and the environment have been reflected in the recommendations and policies of the MDP and CTP. The formal adoption of these documents by City Council has led to the multi-year Complete Streets Program.

PROCESS

In November 2010, D.A. Watt Consulting's team was selected (as the result of an RFP process) to complete work for a 2011 Interim Complete Streets Guide. The 2011 part of the program included conducting research for critical design elements and best practices (e.g. driving lane and sidewalk widths), developing technical details to integrate with existing design standards, consulting with internal and external stakeholders regarding new standards, and preparing an Interim Complete Streets Guide. The objective was to develop recommended streets cross-sections for general use (and alternatives for specific contexts) for 9 classes of street classifications under the 2009 [CTP] nomenclature. The street classification addressed in 2011 were:

- Skeletal Road (formerly Freeway/Expressway)
- Divided Arterial (Major Street)
- Local Arterial
- Industrial Arterial
- Primary (divided) Collector
- Collector (undivided)
- Industrial Street
- Residential Street (the previous Local Residential Street and Residential Entrance Street)
- Lane (Alleys) [Based on 4]

The approach to the work in 2011 was completed in five stages:

- **Project Initiation**: this work included meeting with internal stakeholders to review the 2011 work plan, assembling relevant supporting documents from various City of Calgary and other sources, linking with associated parallel projects in other City business units, and determining the 'look' of the final product.
- **Conduct Research**: this work included a comprehensive review of existing Complete Street/sustainable transportation documents compiled by the city and by the project team, a survey of design element practices from comparable Winter Cities in North America and Europe, and 'gap analysis' between current City standards and 'best practice' standards from other cities.
- **Draft Technical Details**: with the background work completed, the next step was the preparation and recommendation of design criteria, development of modified base cross-sections, and creation of **conceptual** base and alternate cross sections.
- **Final Technical Details:** after draft materials were reviewed, final base and conceptual cross sections were prepared, criteria for application of alternate cross sections were identified, intersection/transit stop/ mid-block plans were prepared, and the definitions and design element details were summarized in tables.

- **Final Deliverables:** to complete the work, we prepared accompanying text and figures for the 2011 Interim Complete Street Guide. Examples of the deliverables are provided later in the paper.

ENGAGEMENT PROCESS

The work program incorporated regular, scheduled involvement and engagement with a Technical Committee. The committee was made up of representatives from key City business units for Parks, Water Resources, Roads, Transportation Planning, Utility Line Assignments, and Urban Development. These individuals represented the technical interests from their area of expertise as the design details were developed. They also brought input from concurrent work in their units related to Residential Street Policy, Green Infrastructure, Bicycle Design Guide, and Low Impact Development.

The work was carried out under the overall direction of a Steering Committee made up of the City's Transportation Leaders. Meetings with this group were held at strategic times to provide progress updates, to seek approval of the key design elements, and to formally recommend adoption of the new documents and standards.

The process also included **external** involvement with the Urban Development Institute (UDI), the organization representing the interests of the development community. The 4 Party Shallow Utility Consortium was also actively engaged. This group represents the interests of the major utility providers in Calgary, including Enmax, Telus, Atco Gas and Shaw Cable.

REVIEW OF CRITICAL DESIGN ELEMENTS

Proposed changes for a number of basic design elements, to create Complete Streets, were the subject of debate within the City Administration. In order to assess how other cities were approaching this issue, the team undertook a survey of practices in comparable cities. The Winter Cities Practice Survey generated input from the following cities; Boston, Columbus, Waterloo, Seattle, Montreal, Edmonton, Toronto, Ottawa, Winnipeg, and Oulu (Finland). These jurisdictions volunteered data by a variety of street classifications on travel lane widths, curb and gutter standards, sidewalk and walkway widths and landscape boulevard dimensions and treatments. This data was compiled along with Calgary equivalent standards in a summary spreadsheet. From this array of inputs, our team reviewed and identified recommended standards that would support the future development of Complete Streets for both greenfield and brownfield applications. **Tables 1 – 3** illustrate many of these recommended standards, or Critical Design Elements, complete with comparative values, as follows:

- Table 1: Lane width dimensions for Skeletal, Arterial and Collector streets, including some variation between curb and median lanes.
- Table 2: Curb and gutter standards and dimensions.
- Table 3: Sidewalk style (mono or separate) and widths for various streets. Recommended multi-use pathway widths were also identified.

[Tables based on 4]

TABLE 1: LANE WIDTH

Road Type	Current Lane Width	Typical Survey Responses	Recommended
Skeletal (formerly Expressway)	3.7 m	3.0 – 3.7 m	3.7 m for all lanes
Arterials (form. Major Street, Local Major, Major Industrial)	3.5 – 3.7 m	3.25 – 3.5 m	Curb: 3.5 m (3.7 m industrial) when off-street bicycle facility provided Curb: With on-street bicycle operation, include 1.5 m bike lane with 3.5 m lane Remaining Lanes: 3.5 m (3.3 m for Local Arterial)
Collectors (form. Primary Collector, Collector Street, Connector Street)	3.5 m (3.35 m for Connector)	3.0 – 3.4 m	Curb Lane: 3.5 m Other Driving Lanes: 3.3 m Parking Lanes: 1.9 m with rolled curb Parking/Bike Lane: 4.2 m

TABLE 2: CURB AND GUTTER

Road Type	Current Gutter Pan	Typical Survey Responses	Recommended
Skeletal (formerly Expressway)	No curb / gutter*	0.21 – 0.46m (0.0m in some jurisdictions)	No curb / gutter
Arterials (form. Major Street, Local Major, Major Industrial)	0.5m median, 0.25m curb		0.25m for both median and curb side
Collectors (form. Primary Collector, Collector Street, Connector Street)	0.25m		0.25m

TABLE 3: SIDEWALK AND PATHWAY

Sidewalk Type	Current Width	Typical Survey Responses	Recommended
Monolithic Sidewalk	1.1 – 1.5m	1.7m – 2.0m	1.5m minimum for residential 2.0m minimum for all other
Separate Sidewalk	1.4m	1.7m – 2.0m	1.8m for single-family residential-type streets 2.0m minimum for all other road types, wider sidewalks on Primary Transit network and high volume pedestrian areas
Multi-use Pathway	2.5 – 2.8m	3.0 – 3.5m	3.0m (3.5m on River Valley Pathway)

The Critical Design Elements were presented to the Steering Committee and subsequently approved by the Committee for use in developing detailed base cross sections.

INCORPORATION OF NEW ELEMENTS IN THE APPROACH

As noted earlier in the paper, the Calgary Complete Streets process is reflecting the policies of the MDP and CTP, particularly with regard to the following:

- **Cyclists and Pedestrians**. The needs of these groups have been reflected in a number of ways, including:
    - provision of wider sidewalks, to comfortably accommodate **at least** two-way pedestrian movement as well as wheelchairs. Sidewalk width has also reflected the impact of a car door opening to the sidewalk.
    - provision of appropriate bicycle facilities. Depending on the projected daily traffic volume and on the roadway setting/standard, the bicycle facility ranges from a painted on-street dedicated lane (either unbuffered or buffered from adjacent traffic, depending on the road standard) to an off-street multi-use pathway (MUP) when the volume and/or make-up of adjacent traffic warrant it.
    - provision for continuity of on-street bike lanes and MUPs through intersections

  Figure 1 illustrates how cyclists, pedestrians and other modes are to be accommodated within the 'palette' of roadway standards being addressed in the Complete Streets work. The Figure shows that in most cases, cyclists and pedestrians will be accommodated with high standards. Some of the street types (e.g., Liveable) shown in the Figure were excluded in 2011, and are currently (2012) being addressed.
- **Transit**. As Figure 1 shows, transit also rates highly in the hierarchy of treatment of the travel modes, so the needs of transit were a primary consideration in the 2011 work. An over-riding principle is that **transit buses will load/unload within the curb driving lane of arterials**, except where the posted or design speed is 70 kilometres per hour (kph) or greater, or where there is a timing point (where the bus may be stopped for up to several minutes to provide 'timed transfer' service). The 2011 work provided bus bay designs for arterial roads, and also a layout at a mid-block pathway crossing on a collector street, with curb 'bump-outs'.
- **Emphasis on Driving Speed Reductions**. This has been referenced earlier in the paper, in the discussion of the Critical Elements. The policy emphasis on driving speed reduction refers primarily to streets in residential or mixed-use areas, where a significant amount of traffic interaction with pedestrians and cyclists (as well as transit vehicles and users) may be expected. The 'speed reduction' emphasis is intended to make it 'uncomfortable' for drivers to speed through these streets, and to increase driver awareness of (and therefore safe interaction with) other users of the road right-of-way. Exclusions to this policy are both industrial streets and arterial/skeletal roads that are more regional in nature.

  This policy emphasis represents a significant departure from the 'traditional' Calgary street standards referenced earlier in the paper, and is present in several features of the 2011 work, such as:
    - reduced driving lane widths, except where high volumes of trucks are present
    - for all roads at or below a design speed of 60 kph, the direction that the **posted** and **design** speeds shall be one and the same.
- **Low-Impact Development (LID)/Green Infrastructure Considerations**. Stormwater retention has long been a feature of new Calgary subdivisions. However, the speed with which asphalt/concrete run-off from urban roads enters the stormwater system is a concern. City of Calgary experts indicate that the level of 'suspended solids' (from run-off) in the Bow River and other Calgary-area waterways is reaching critical levels. As a result, the City intends to implement a policy by which the provision of LID/Green

FIGURE 1: CALGARY TRANSPORTATION PLAN – STREET PALETTE [4]

CTP Classification		Transportation Modes				
		Walking	**Cycling**	**Transit**	**Goods**	**Autos***
SKELETAL ROAD						
ARTERIAL	Divided Arterial					
	Industrial Arterial					
	Local Arterial					
LIVEABLE (2012 WORK)	Urban Boulevard					
	Parkway					
	Neighbourhood Boulevard					
LOCAL	Primary Collector					
	Collector Street					
	Activity Centre Street (2012)					
	Industrial Street					
	Residential Street					
	Lanes (Alleys)					

* Includes Light Commercial Vehicles, Waste & Recycling Vehicles, etc.

EMS/Fire Trucks are to be accommodated on all Street Classifications

Accommodated with high standards (high quality facilities, low travel delay)

Accommodated with variable standards (average quality facilities, average travel delay)

Not required, or poor performance is acceptable (low quality or no facilities, high travel delay)

infrastructure within most, if not all, new urban streets will become **mandatory**. This specific policy direction is under discussion with the Calgary development industry, and design guidelines for the various LID options (e.g., bioswales, absorbent landscaping, bioretention areas, porous pavements, underground 'cells') are still under development. However, the direction to the 2011 Complete Streets work was that an appropriate and workable 'placeholder' area/width should be provided for in all street cross-sections[1]. An LID corridor of **at least 2.0 m** in width, and a minimum of 10% of the impervious area draining into the LID facility, was to be provided in each cross-section.

MAJOR POINTS OF DISCUSSION

The 2011 work involved lively discussion, both within the City's Technical Team and the supporting resource staff, and with the external stakeholders – the Urban Development Institute being the chief of these. The points of discussion or debate fell into two themes, the first being what we will term the '**ecology**' of the street and how to find balance, and the second being **cost/sustainability** as it relates to the developers who will have to fund and build and provide right-of-way for most of the streets identified in the 2011 Complete Streets work.

'Ecology' of the Street and finding 'Balance'

There are many elements that make up an urban small Street. These include:

- the volume and mix of non-vehicular and vehicular traffic that will be located on the street (e.g., cars, buses, trucks, bicycles, pedestrians);
- the width of the travelled surface of the street (i.e., between the curb on one side and the curb on the other side);
- whether on-street parking will be allowed, and in what form and frequency;
- the size and location of sidewalks [and pathways] adjacent to the street;
- whether or not trees and/or planting strips are to be located adjacent to the street;
- what speeds vehicles will travel along the street;
- whether adjacent properties are to be serviced directly from the street (driveways), or if lanes/alleys are to be provided;
- lot widths, driveway widths (where applicable) and driveway configurations;
- what types of utilities will be located along the street, both above and below ground, including side connections into the adjacent properties;
- …the adjacent building setbacks…with respect to the street; and
- Intersection [configurations and traffic control devices] [Based on 3:37]

This is a complex set of variables, as was recognized in the previous 1996-97 review of Calgary's road standards:

…As a very broad generalization, current subdivision street design in Calgary and elsewhere in North America has tended to focus on providing safe and comfortable movement for vehicles above the road surface, and

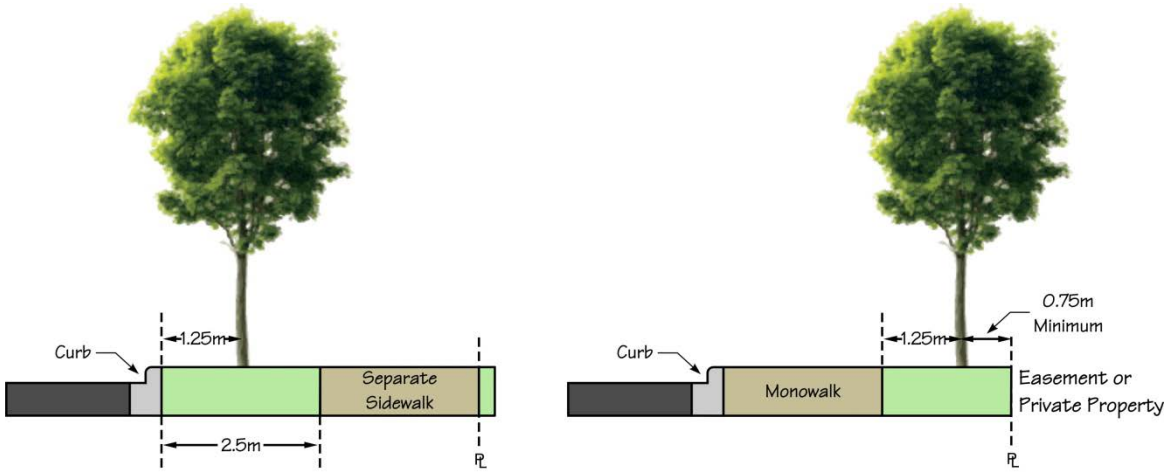
[1] Lanes (alleys) were an exception.

*on comfortable accommodation of utilities below the surface. The New street [sic] approach, on the other hand, requires recognition of **all the elements** and of their interdependence – in other words, the '**ecology**' of the street*. [3:37]

When one adds, to the list of elements noted above, the 'New Elements' such as bicycle lanes and LID facilities, one sees the challenges inherent in trying to find 'balance' within the street right-of-way. The following are main points of discussion that occurred during the 2011 process:

- **Bicycle facility and degree of protection**. The discussion here addressed both the daily traffic level above which an on-street dedicated bicycle facility should be required, and the traffic level above which an **off**-street facility should be provided because of the degree of hazard on-street. The discussion resulted in the recommended provision of an on-street facility at traffic levels between **5,500** vehicles per day (vpd), being the upper daily traffic limit for use of an **undivided** Collector street, and **20,000 vpd** (which would require a Divided Arterial standard). Above 20,000 vpd, the default standard would be a 3.0 m multi-use pathway (MUP) in both boulevards of the (Divided) Arterial.
- **Curb-and-Gutter widths**. The point of discussion was regarding the Divided Arterial – both the median lane and the curb lane curb-and-gutters. The primary Complete Streets motivation was to minimize the gutter width, both for speed management purposes and to minimize the 'ride' difficulties for cyclists (0.5 m gutters may cause cyclists to swerve or to go out of control). A 0.25 m gutter for the curb lane was therefore selected. In the **median** lane, the desire was to reduce the existing 0.5 m gutter to 0.25 m, both for speed reduction purposes and to provide a consistent standard for the industry's curb-forming construction equipment. Ultimately, the 0.25 m gutter was selected, with a slightly wider median driving lane (3.5 m) than the Team's initial choice for design speeds ≤ 60 kph (3.3 m).
- **Minimum Boulevard width to support viable trees**. Calgary's harsh freeze-thaw winter climate and typically very dry weather conditions are hard on trees, and the introduction of **more** trees in Calgary's subdivisions is a major policy initiative of the Calgary MDP. Substantial attention and discussion was given to the necessary tree offset from adjacent 'hard' edges. The approach shown in **Figure 2** was eventually selected, providing for at least 1.25 m to the nearest curb or sidewalk edge, and allowing for minor root spreading into the easement or private property adjacent to the right-of-way.

FIGURE 2: TREE PLANTING OFFSETS



- **Mandatory LID facilities**? This was a central point of debate with the development industry stakeholders, who wish to see more flexibility in the use of Green and LID infrastructure. The City's intent is that LID infrastructure in streets rights-of-way be mandatory, but the issue is still under discussion. The Complete Streets approach was to provide for an LID 'placeholder' dimension within the right-of-way. While in most cases this would allow for surface LID facilities, certain cross-sections, for example, collector streets with front driveways, would require provision of **buried** LID infrastructure.
- **Shallow Utility Issues**. In Calgary's **laneless** residential subdivisions (i.e., those with only driveway access off the street), shallow utilities are provided in a 3.5 m easement adjacent to the right-of-way, on both sides of the street (residential, collector, primary collector). This easement sterilizes a substantial portion of the residential lot – the primary impact is that **trees** cannot be planted adjacent to the right-of-way to assist in a 'canopy' effect (in laneless subdivisions with the increasing preponderance of narrow lots, it is difficult to find a standard location in the right-of-way for a viable tree). The Calgary development industry has been pushing for a smaller (2.4 m) easement to replace the current one, based on trial installations that have been in place for several years. A smaller easement could also balance out increases in costs and right-of-way requirement due to the Complete Streets modifications. However, the Team was unable to find consensus on the narrower easement, given the concerns of the shallow utility providers (telephone, gas, cable, power). Part of the concern is that recent changes in utility regulation are resulting in **more providers** of these services, which may lead to the requirement to allow for additional shallow utility line assignments within the easements. Utility providers are also unwilling to take on the additional costs of placing utilities under roads or sidewalks.
- **One versus two sidewalks**. This point of discussion centred on (local) residential streets, and is part of a separate ongoing process around this particular class of street and what level of sidewalk/tree facilities the developer should be expected to provide. The existing City standards allow for only one sidewalk on a (local) residential street – the Complete Streets recommendation is for sidewalks both sides, both to provide accessibility for all users and to maximize the use of the walk trip to/from the bus.

Cost/Sustainability Discussion

The foregoing illustrates some of the technical challenges faced by the 2011 Complete Streets team in trying to fit the many elements into a 'reasonable' right-of-way. The other major challenge has been trying to find a suitable accommodation with the Calgary development industry in terms of **roadway costs and right-of-way**. The authors note that the Complete Streets work was occurring within the 'big picture' of recent major increases in City levies from the residential development industry, coupled with the aspirations of the MDP and CTP for more 'sustainable' roadways within and adjacent to residential subdivisions. The team had to consider the **costs to developers** – in terms both of increased right-of-way and of added/larger/wider elements in the roadway cross-section – with the MDP/CTP aspiration to apply **all** the desired elements within the right-of-way. The challenge was to find the 2011 Complete Streets 'place' within that cost/sustainability spectrum.

Several options were considered. These ranged from including all the desirable elements in an 'unconstrained' fashion, with little or no regard for cost/right-of-way implications, to respecting the **current** rights-of-way and the roadway construction costs associated with the current standards. We note that detailed analysis of costs, and the process of negotiating cost-

sharing with the development industry, was not part of the 2011 work program – this aspect will follow in 2012-13.

The approach chosen by the City's Team was to aim to accommodate the Complete Street cross-sections **within the current rights-of-way, ± 10%**. This approach was ratified by the Steering Committee, and underlies the 2011 standards.

THE 2011 'PRODUCT'

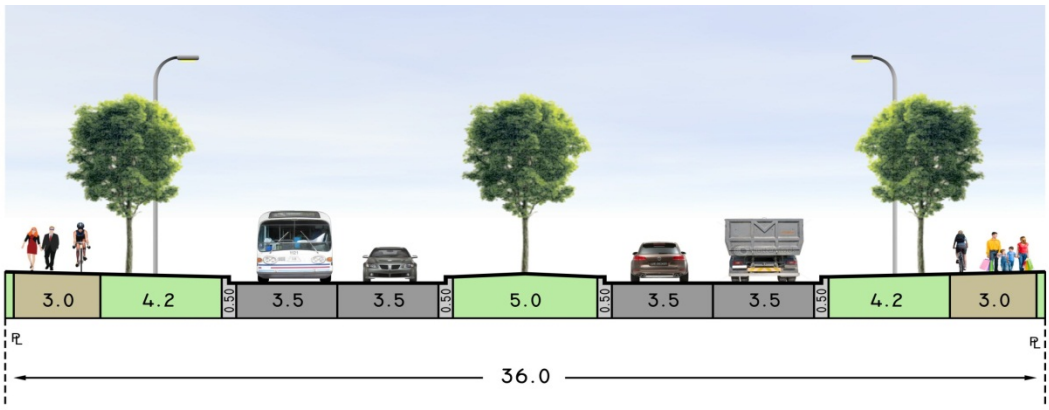
The current City of Calgary Design Guidelines for streets provide the design information for a particular type of street – the Roadway Definition, the Alignment Standards, and street cross-section, intersection designs associated with that street class – in different sections of the document. The user must therefore move from one section to another to apply the Design Guidelines. The approach chosen in the 2011 Complete Streets work was to group all this information **together**, by each class of street. The other primary basis of the approach, in terms of moving away from the traditional prescriptive standards towards a more flexible and context-responsive set of street standards, was the introduction of a **Base** standard and **Alternate** standards. The Base standard (for a Collector street, say) is the one that will likely be applied in the great majority (80-90%?) of 'greenfield' situations. There will, however, be contexts/ situations where an Alternate standard is called for or justifiable – this is best explained via this excerpt from the 2011 Guide:

> *[For] each classification of street, alternate cross sections have been prepared to take into account some of the more common contextual situations or constrained retrofit situations which may lead to designs that deviate from the base cross section. Some of these alternates would be required in specific contexts (for example, a Divided Arterial – High Speed alternate shows required changes if the street is designed to speeds above 60 km/h) while others are optional but appropriate in certain circumstances (such as the Collector – Parking One Side which may be used – but would not be required – if the street flanks a park or green space). These alternates have been developed at a conceptual level only, and detailed cross sections would be developed on a project-by-project basis. This guide provides widths and arrangements for key elements of the alternate cross section and the contextual criteria that govern their use.* [2:73]

With these principles in mind, the following Figures illustrate examples of the 2011 product, of which there are four (4) main components for each street classification:

- **Definition Sheet**. This sheet (shown in **Figure 3** for a Divided Arterial) provides an introduction to the street type, with a conceptual cross-section and notes on the basic function of the street, its driving lanes and right-of-way requirement, access management conditions and other operational notes specific to that type.
- **Design Elements**. The Design Elements table (**Table 4** represents the 'family' of Arterials) summarized the design parameters for that street type (e.g., design speed, grades, carrying capacity, bicycle treatment(s)).
- **Base Standard Cross-Section**. This cross-section drawing (**Figure 4** is for the Divided Arterial street) details the **Base** standard referred to above. It shows the horizontal location and spacing of all the cross-section elements, above and below ground, including LID infrastructure, bicycle/pedestrian facilities, trees and

FIGURE 3: DIVIDED ARTERIAL – DEFINITION SHEET [4]

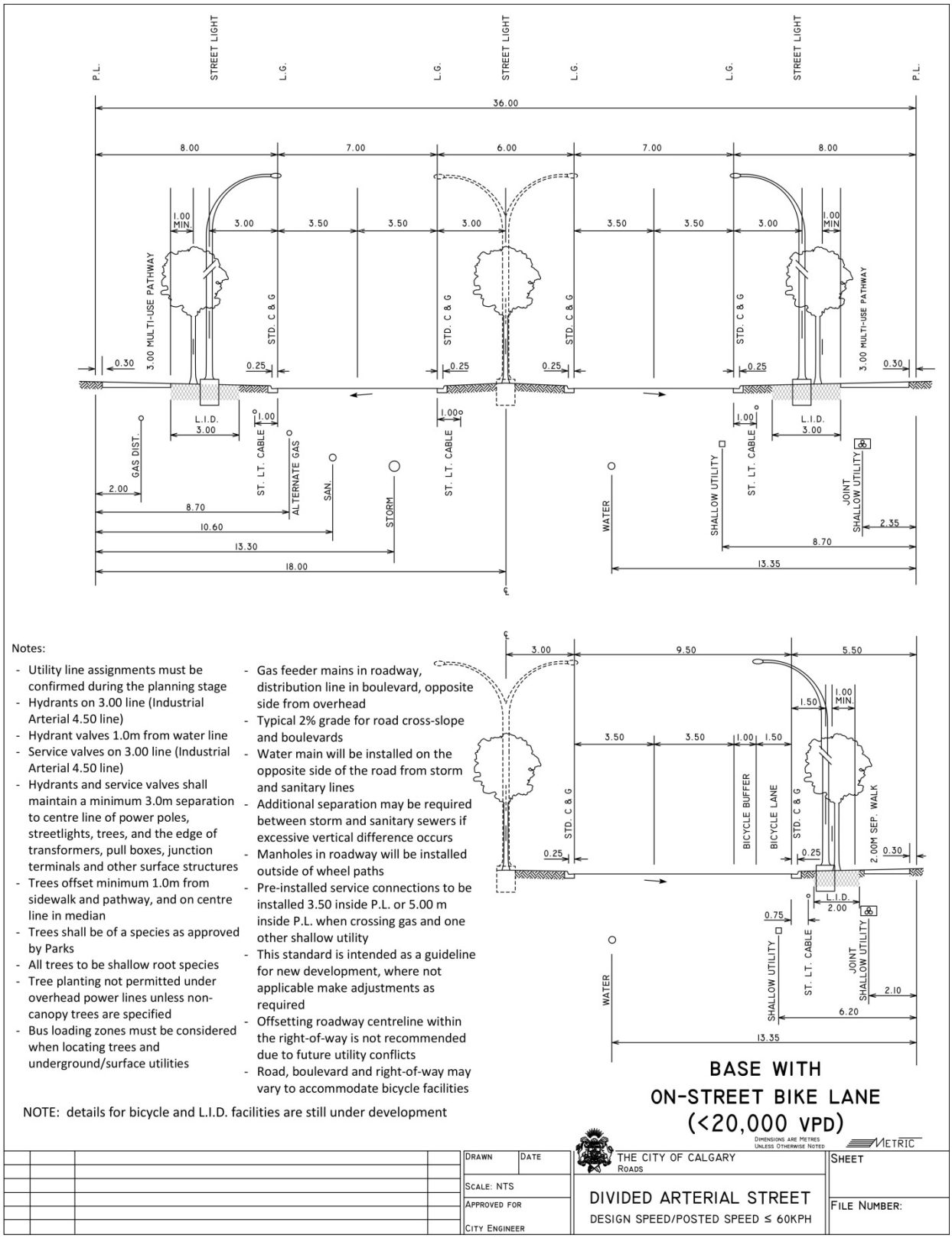


Arterial Street **Divided Arterial**		
Daily Traffic Volume (vehicles)	**Number of Lanes**	**Right-of-way Requirement**
10,000 - 30,000	**4**	**36.0 m (min)**
Function	• To expedite the movement of vehicles between multiple communities and major destinations. • To serve adjacent commercial lands and to collect and distribute traffic from Skeletal Roads to other street types or directly to traffic destinations. • Operate as a segment of Primary Transit, Goods Movement and Cycling Network. • High priority for autos, goods movement, transit and cycling modes.	
Access Conditions	• Direct access is only available to abutting commercial and industrial properties subject to traffic and design conditions and is generally restricted to right turns in and out. • No direct vehicular access is allowed to abutting residential properties. • Intersections may be grade separated when warranted. • Intersection spacing less than minimum 300 m is considered an exception and has to be located and designed to the satisfaction of the General Manager, Transportation. • The minimum acceptable spacing between the terminal of an interchange ramp and the centreline of the first Intersection on a Divided Arterial is 400 m. • At grade intersections should be channelized to provide proper control of the turning movements. • At-grade intersections should generally be signalized. • Left turn bays not permitted on curves with less than 400m centreline radius.	
Notes	• Bus bays are desirable when design/posted speed >60 km/h and at all transit timing stop locations. • No residential frontage is permitted along arterial streets. • Arterial Streets are designed to capacity level “D” or better. • The right-of-way width may need to be increased depending on number of lanes, sloping requirements, road grades, and noise attenuation requirements and special conditions such as accommodation of LRT, LID, pedestrian pathways. • Noise attenuation study is required for residential lots adjacent to Arterial streets to determine noise attenuation requirements. • Boulevard pathway is not desirable where there are more than 7 driveways or street crossings in a 1km stretch. • Low impact Development (LID) and bicycle accommodations are required within the right-of-way.	

TABLE 4: ARTERIAL STREETS DESIGN ELEMENTS [4]

Design Elements **Arterial Streets** Base Cross-Sections, Sheet # 1 of 1			
Base Cross-section	**Divided Arterial**	**Industrial Arterial**	**Local Arterial**
Right-of-way required	36.0 m (min.)	30.0 m (min.)	30.0 m (min.)
Number of travel lanes	4	4	4
Travel lane width	3.5 m	3.5/3.7 m	3.3/3.5 m
Basic width	2 x 7 m 2 x 9.5 m	14.4 m	2 x 8.3 m
Parking lane width	none	none	none
Curb and gutter (gutter)	0.75 m (0.5 m)	0.5 m (0.25 m)	0.5 m (0.25 m)
Median width	6 m	none	3.5 m
Sidewalk width			
mono	n.a.	n.a.	n.a.
separate	2.0 m separate walk on both sides OR	2.0 m separate walk on one side	2.0 m separate walk on both sides
Multi-use pathway	3.0 m multi-use pathway on both sides (for 2 x 7 m width) OR	3.0 m multi-use pathway on one side.	none
Bicycle lane width	1.5 m + 1.0 m buffer (for 2 x 9.5 width)	none	1.5 m
Alignment			
Posted speed	50 / 60 km/h	50 / 60 km/h	50 km/h
Minimum centreline radius (speed dependent)	90 / 120 m	90 / 120 m	90 m
Maximum super-elevation	6% / 8%	6% / 8%	4%
Maximum grade	7% / 6%	7% / 6%	8%
Minimum grade	0.6%	0.6%	0.6%
Minimum stopping sight distance (speed dependent)	65 / 85 m	65 / 85 m	65 m
Other			
Daily traffic volume	10,000 – 30,000 vpd	10,000 - 30,000 vpd	10,000 – 15,000 vpd
Minimum intersection spacing	300 m	300 m	150 m
Traffic signals	as warranted	as warranted	as warranted
Pedestrian crossing	at grade	at grade	at grade
Alternate on-street bike route	yes	no	no
Bus route	yes	yes	yes
Truck route	yes	yes	no
Sound attenuation	yes	No	yes

FIGURE 4: DIVIDED ARTERIAL – BASE CROSS-SECTIONS [4]



Notes:

- Utility line assignments must be confirmed during the planning stage
- Hydrants on 3.00 line (Industrial Arterial 4.50 line)
- Hydrant valves 1.0m from water line
- Service valves on 3.00 line (Industrial Arterial 4.50 line)
- Hydrants and service valves shall maintain a minimum 3.0m separation to centre line of power poles, streetlights, trees, and the edge of transformers, pull boxes, junction terminals and other surface structures
- Trees offset minimum 1.0m from sidewalk and pathway, and on centre line in median
- Trees shall be of a species as approved by Parks
- All trees to be shallow root species
- Tree planting not permitted under overhead power lines unless non-canopy trees are specified
- Bus loading zones must be considered when locating trees and underground/surface utilities
- Gas feeder mains in roadway, distribution line in boulevard, opposite side from overhead
- Typical 2% grade for road cross-slope and boulevards
- Water main will be installed on the opposite side of the road from storm and sanitary lines
- Additional separation may be required between storm and sanitary sewers if excessive vertical difference occurs
- Manholes in roadway will be installed outside of wheel paths
- Pre-installed service connections to be installed 3.50 inside P.L. or 5.00 m inside P.L. when crossing gas and one other shallow utility
- This standard is intended as a guideline for new development, where not applicable make adjustments as required
- Offsetting roadway centreline within the right-of-way is not recommended due to future utility conflicts
- Road, boulevard and right-of-way may vary to accommodate bicycle facilities

NOTE: details for bicycle and L.I.D. facilities are still under development

BASE WITH ON-STREET BIKE LANE (<20,000 VPD)

DIMENSIONS ARE METRES UNLESS OTHERWISE NOTED

METRIC

				DRAWN / DATE	THE CITY OF CALGARY ROADS
				SCALE: NTS	DIVIDED ARTERIAL STREET
				APPROVED FOR CITY ENGINEER	DESIGN SPEED/POSTED SPEED ≤ 60KPH
					SHEET / FILE NUMBER:

shallow utilities. For some of the street types, and Figure 4 for the Divided Arterial is an example, the Base sheets includes an inset illustrating a second 'Base' design that has an equal status with the other cross-section. In this case, the main difference between the two cross-sections lies in the placement of the **bicycle** facility, and that placement depends on the anticipated daily traffic volume. The inset layout in Figure 4 is for situations where projected traffic is less than or equal to 20,000 vpd, and incorporates a protected (buffered) 1.5 m **on-street** bicycle lane. The other layout is for situations where the projected traffic is **greater than 20,000 vpd**, and incorporates dual Multi-Use Pathways (MUPs), which provide a shared facility for cyclists, pedestrians and other non-auto users.

- **Alternate Standards – Conceptual Cross-Section and Criteria for Use**. As noted earlier in the paper, Alternate standards were developed for virtually all street types, to provide for context-sensitive design. For each of these Alternates, the Team developed criteria for use (and **non**-use) of the cross-section. **Figure 5** illustrates one of the sheets from the 2011 Guide, showing two Divided Arterial Alternates cross-sections and their criteria for use. **Figure 6** shows two Alternates for a (undivided) Collector street in specific situations.
- **Intersection Designs**. The Guide provides a separate section/chapter for the more complex intersections, and **Figure 7** illustrates the intersection of two Divided Arterial streets, one with **off-street** bicycle facility and the other with an **on-street** bicycle lane.

The 2011 Guide is an **interim** one – further work is occurring in 2012 regarding important elements such as:

- Activity Centre streets and a new class of streets called Liveable Streets
- A review of Daily 'Carrying Capacity' guidelines for all classes of street
- A review of **corner radii** for all non-channelized intersections, with a view to reductions of existing radii wherever possible, so as to increase pedestrian comfort levels and reduce pedestrian crossing times.

Consensus support for the new approach to design, which Complete Streets warrants, was not fully received from the development industry and the Shallow Utility Consortium. The issues and concerns that remained unresolved in 2011 will be subject to further actions by the City during subsequent stages of the three-year program.

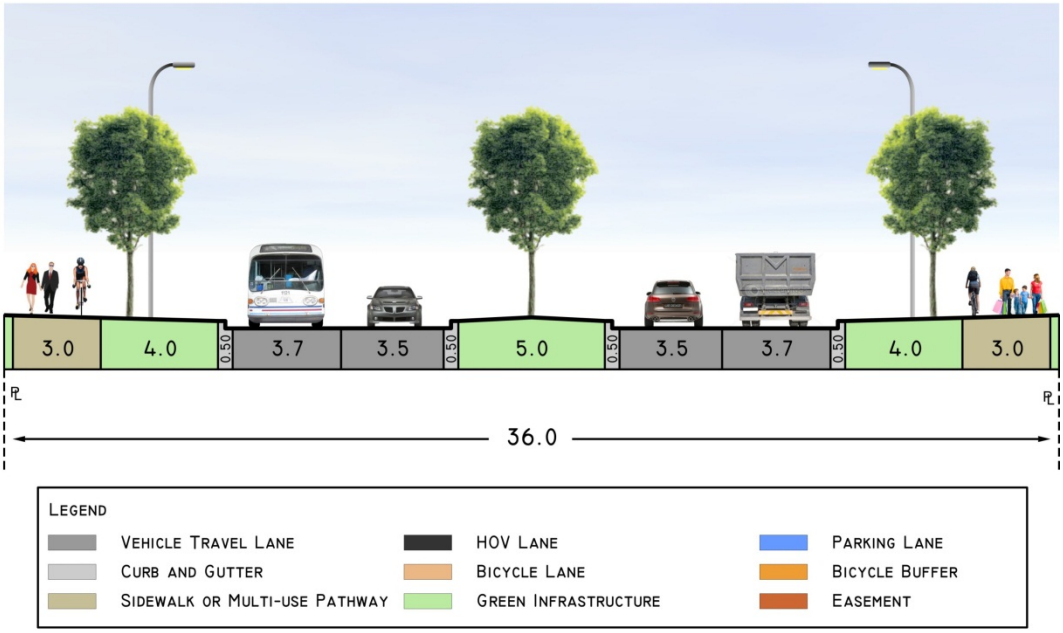
LESSONS LEARNED

Having successfully concluded this stage of the Complete Streets Project, and with the benefit of hindsight, we can reflect on these key learnings and 'take-aways' from the experience:

1. At key junctures during the project we scheduled meetings to present executive summaries of the work to date to Senior Department Managers. This group comprised our Steering Committee and was made up of the General Manager, Transportation and all the Transportation Directors. This group was presented with information and then asked to endorse the material. This endorsement enabled the team to move forward with full support and empowered department staff to work cooperatively and progressively, with minor risk of needing to backtrack on previous decisions.
   RECOMMENDATION: It is critical to have ongoing senior-level support and endorsement within the municipality during the project.

FIGURE 5: DIVIDED ARTERIAL – SAMPLE ALTERNATE CROSS-SECTIONS [4]

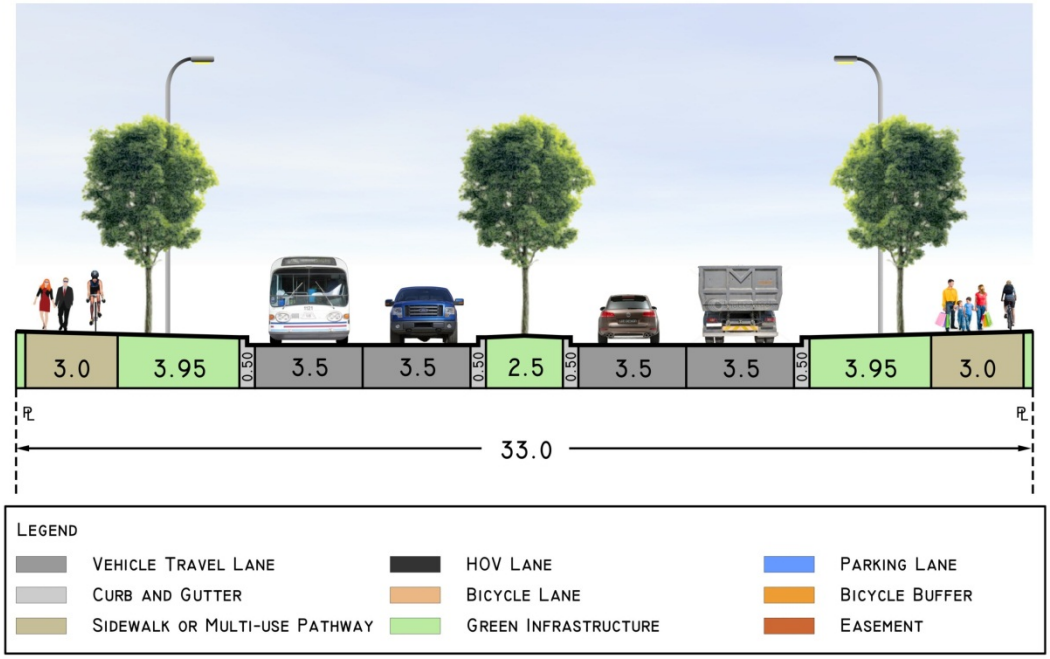
DIVIDED ARTERIAL - HIGH SPEED



MUST USE IF

- Design speed and / or posted speed ≥70 km/h AND
- Not on primary HOV network

DIVIDED ARTERIAL - ROUNDABOUT CORRIDOR

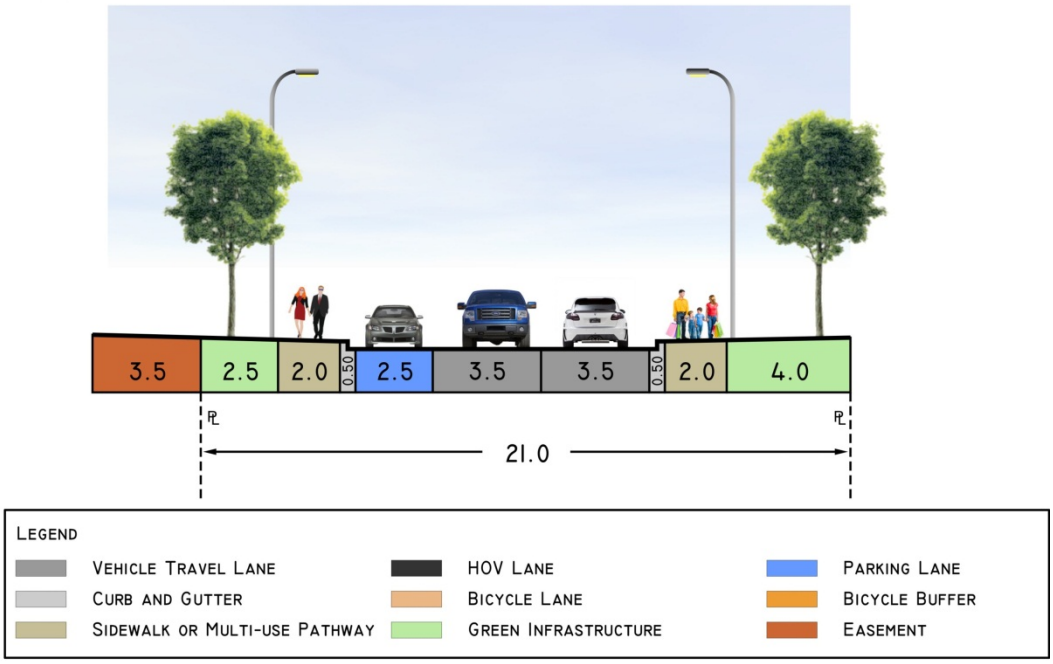


MAY USE IF

- Section of arterial road is bounded by roundabouts with no intervening all-turns intersections / accesses

FIGURE 6: COLLECTOR – SAMPLE ALTERNATE CROSS-SECTION [4]

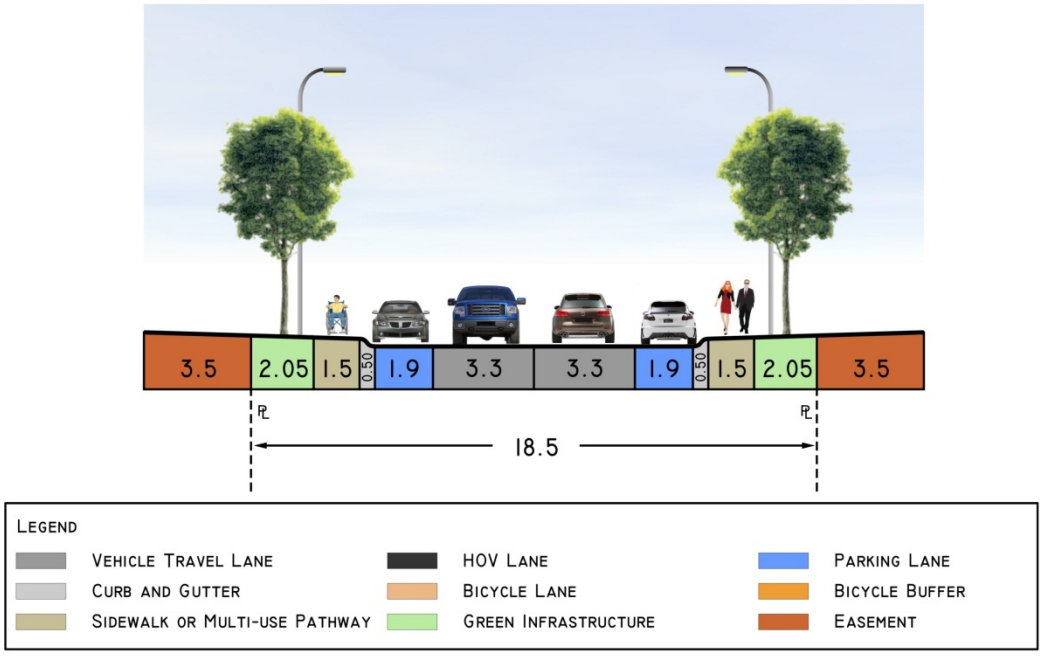
COLLECTOR - ENHANCED GREENSCAPE



MAY USE IF

- Development on side without parking is limited to park / green space
- Park / green space is not active recreational

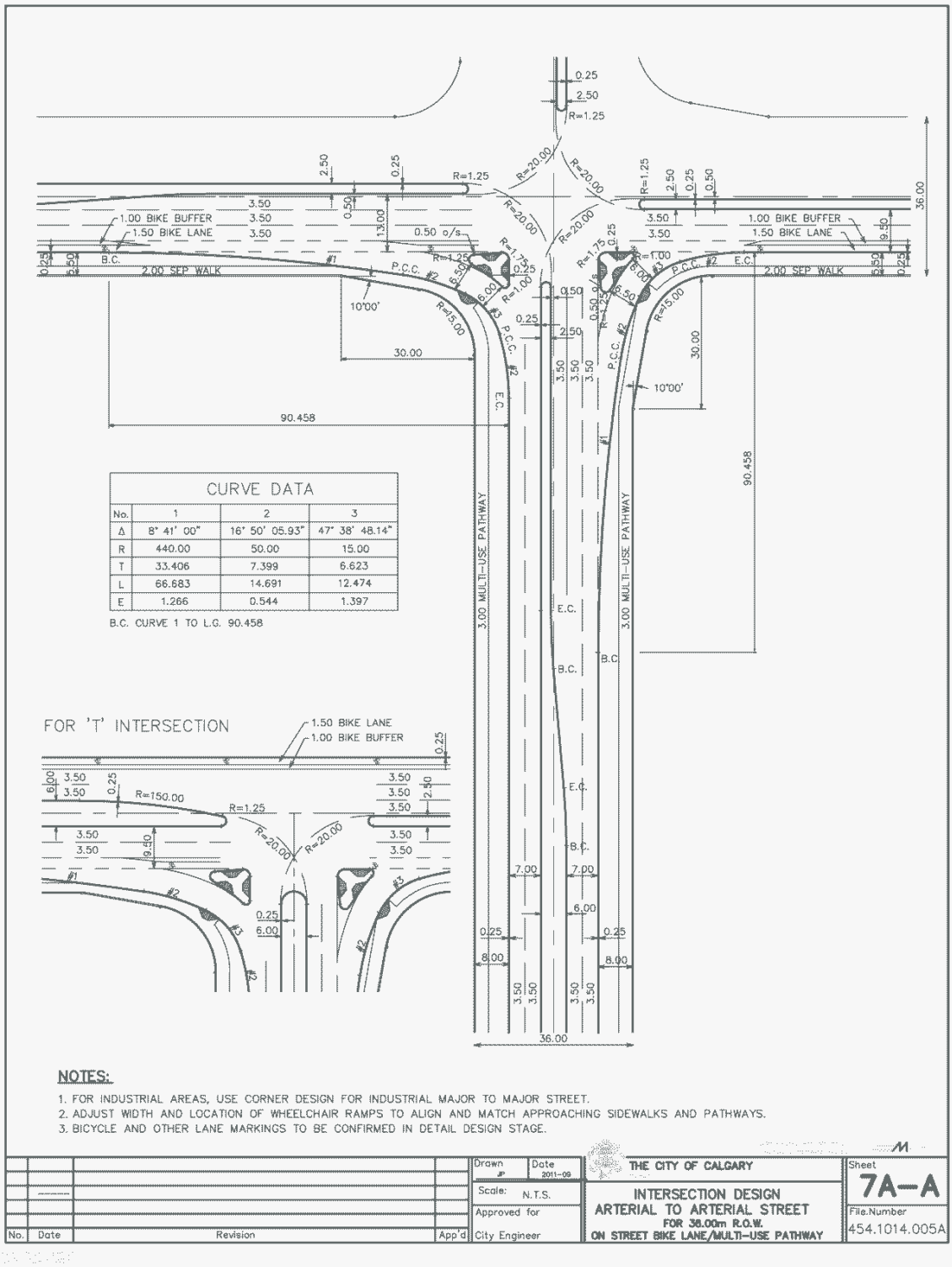
COLLECTOR - CONSTRAINED ROW



MAY USE IF

- ROW is restricted below 21.0 m by long-term existing development
- No bus routes are planned along roadway
- Rolled curb used adjacent to 1.9m parking lane

FIGURE 7: DIVIDED ARTERIAL/DIVIDED ARTERIAL INTERSECTION [4]



2. For the project carried out in Calgary, the research of current and best practices of other comparable cities proved to be extremely valuable for general learning and provided us with strong supporting evidence for introducing new ideas. This approach saved us time and has the potential for ongoing sharing of results as programs are implemented – for example, how operations and maintenance is affected by changes to the dimension of elements.
   RECOMMENDATION: Capitalize on the vast and growing opportunities to learn from the experience of other jurisdictions that have undertaken Complete Street policies and guideline programs.
3. When staff have not been exposed to alternative ideas or solutions and their effectiveness, there is little motivation to do things differently. What we found important was to firstly initiate staff involvement at an early stage in the project with representatives authorized to speak on behalf of their department. The second important step was to focus discussions on moving away from individual 'wants' and 'norms' within departments, towards identifying more specifically the 'needs' and 'acceptability' of new or modified standards of practice. This mindset was presented as an expectation of everyone involved, i.e., that collective concessions were to be pursued to enable the development of documents that meet operational requirements while accommodating other elements in the same general space. One example is bundling utility cables in common trenches, a practice not always done or preferred, but one that is feasible and enables more items to be placed in less space, creating opportunities to achieve Complete Street goals.
   RECOMMENDATION: Recognize the natural entrenchment of preferences and practices within city departments and reluctance of staff to change, and present the expectation of collective concessions.
4. As this project proceeded we received limited input from parallel, related initiatives in other City departments. Their timelines for delivering information were also not aligned with our timeline. While we attempted to accommodate the 'potential' aspects of features such as Low Impact Development, bike facilities, and tree planting within specified spaces, the lack of details made this very challenging. If these elements can be dimensioned and detailed sufficiently at an early stage in a Complete Streets project, it will allow a **complete** final product to be achieved in a more timely manner.
   RECOMMENDATION: Determine details of critical elements that are to be incorporated within the right-of-way at an early stage in the project. [Based on 5]

BENEFITS TO OTHER MUNICIPALITIES

The City of Calgary's 2011 Complete Streets work has been comprehensive, and has set the groundwork for delivery of the final Guide in 2013. It is the City's desire, and that of the authors, that this work benefit other cities and towns as well. We see a number of opportunities for that, including the following:

- The **process** that has been followed in moving from 'traditional' auto-centred standards to Complete Streets is something that other municipalities can use as a model.
- The Complete Streets work provides a wide array of street types for different contexts/settings, with a strong design grounding.
- Calgary is truly a 'winter city', and the Complete Streets process and results reflect that. Other 'winter cities' may wish to use the Calgary results as a base that they can then tailor for their specific needs.

REFERENCES

[1] The City of Calgary, "Calgary Transportation Plan," The City of Calgary, Calgary, AB, 2009.

[2] The City of Calgary, "New Street Design Standards," City of Calgary, Calgary, AB, 1997.

[3] The City of Calgary, "Policy TP009," City of Calgary, Calgary, AB, 2003.

[4] The City of Calgary, Transportation, "2011 Interim Complete Streets Guide," The City of Calgary, Calgary, AB, 2011.

[5] D.A. Watt Consulting Group, *Response to Request for Proposal No 922009, Development of Complete Streets Guidelines,* Edmonton: The City of Edmonton, 2012.