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Oak Park Road Extension

Feasibility Study

Final Report

July 2019

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Executive Summary

The City of Brantford has retained Parsons to complete a feasibility study for the proposed Oak Park Road extension from Kraemer's Way / Hardy Road southerly to Colborne Street West. The purpose of the feasibility study is to determine roadway cross-section requirements, alignment options and to identify key constraints or challenges and provide alternative solutions. This study will build upon the previous 'Brantford Corridor Study' prepared by McCormick Rankin in March 1981 that examined ten potential roadway alignments and identified a preferred route. Based on the preferred alignment, the City began acquiring and designating lands along the route for long-term protection.

The November 2014 Brantford Transportation Master Plan Update lists the extension of Oak Park Road as a medium term (2020-2024) recommendation to improve overall traffic operations and support localized commercial and residential developments. Implementation of the extension with a four-lane cross-section is identified within 6 to 10 years (2020-2030).

A traffic impact assessment for the 2031 and 2041 horizon years was undertaken as part of the Feasibility Study to evaluate how the proposed extension may alleviate the traffic demand on the existing Paris Road/Brant Avenue and Rest Acres Road corridors and other routes through downtown Brantford. The assessment considered the impact of proposed land uses adjacent to the Oak Park Road extension and other planned developments in the vicinity. Based on the 2041 capacity analysis, it was found that Rest Acres Road and Paris Road/Brant Avenue would be over capacity if the Oak Park Road extension is not constructed. With the extension in place, these roadways would be below capacity in the vicinity of Hardy Road and approaching capacity at Colborne Street West.

In addition to the traffic impact assessment, the Feasibility Study included an examination of structural alternatives for the new Grand River crossing, potential environmental impacts, stormwater drainage considerations and the potential for roundabouts at the key intersections.

When developing roadway alignment alternatives, Parsons referenced the City of Brantford Design and Construction Manual for Roads and Transportation in addition to the Transportation Association of Canada (TAC) Geometric Design Guide for Canadian Roads, 2017. Utilizing these standards, a corridor-specific design criterion was developed to guide the development of horizontal and vertical alignment alternatives.

Initially, five horizontal roadway alignments were developed for the proposed extension of Oak Park Road using a 'first-principles' approach that only relied on a cursory screening of potential conflicts. These alignments were not limited solely to the corridor designated by the City for long-term protection. It was found that limited options were available to the south of the Oak Hill Cemetery property due to existing residential developments and existing topography constraints therefore, the horizontal alignment in this area is identical amongst all alternatives. A high-level screening found little justification for considering an alignment outside of the protected corridor except for attempting to cross the Grand River at its narrowest point. A total of three horizontal alignments were advanced for detailed analysis and evaluation:

Alternative 1 *– Straight extension of Oak Park Road from the north; remove Gordon Glaves Crossing Pedestrian Structure. (Approximate recommended alignment from McCormick Rankin Corridor Study, March 1981)*

Alternative 2 *– Shift to east side of 60m right-of-way; option to maintain Gordon Glaves Crossing Structure.*

Alternative 3 *– Crossing of the Grand River at its narrowest point (based on available aerial imagery).*

Due to a significant grade differential between Colborne Street West and Oakhill Drive (approx. 27 metres), Alternative 1 and Alternative 2 were further subdivided into options 'A' and 'B' for evaluation. The 'A' alternatives utilize a maximum downgrade travelling north from Colborne Street West which results in access across Oak Park Road being severed at Oakhill Drive and the Oak Hill Cemetery. This was found to severely restrict emergency access to the residential neighbourhood to the east of the proposed Oak Park Road extension and south of the Grand River and had significant impacts to the operations of the Oak Hill Cemetery. Alternatives 1B and 2B provide a flatter downgrade heading north from Colborne Street West and allow for grade separations at Oakhill Drive and the Cemetery lands. This configuration would preserve the existing roadway network in the area at the expense of additional structures and is consistent with previous Cemetery development plans.

Although Alternative 3 was selected to cross the Grand River at its narrowest point (based on available aerial imagery), a review of the existing topography found that the area to the north of the river at this location is a floodplain. This results in a structure that would be significantly longer than those considered in Alternative 1 and Alternative 2. Additionally, this alignment would significantly impact the planned Telephone City Aggregates (TCA) development currently planned on the north side of the Grand River.

Each alternative was evaluated against criteria set out in six major categories (Transportation, Technical Requirements, Socio-Economic Environment, Cultural Heritage, Natural Environment and Cost). A 'do-nothing' option was also considered alongside the five alignment alternatives. Following the evaluation, it was found that Alternative 3 was not preferred due to the extensive structural component, impact to the planned TCA development and impacts to the natural environment. Alternatives 1A, 1B, 2A, and 2B generally scored within a few points of each other with Alternative 2B selected as the most preferred option. The 'do nothing' option was found to not satisfy the objectives of the assignment.

Alternative 2B was selected as the preferred option based on the following factors:

- Access across Oakhill Drive and the Oak Hill Cemetery lands would be maintained using grade separations at these locations. Doing so will maintain emergency access to the existing residential neighbourhoods.
- Aside from impacts due to slope grading, the future layout of the Oak Hill Cemetery will remain unchanged from the 1990 Master Plan and maintenance operations are unaffected.
- This option provides flexibility to maintain the existing Gordon Glaves Crossing pedestrian structure and associated watermain/sanitary sewer services along with connections to the new multi-use trails adjacent to the roadway. The forthcoming environmental assessment will determine the long-term need for the structure with input from the public consultation stage.

A cost estimate was undertaken for each of the proposed alignment alternatives. It was estimated that the preferred alignment would cost as follows (figures have been rounded for clarity):

DESCRIPTION	ESTIMATED COSTS
Capital Construction (including roadway, electrical, structures (3), retaining wall, servicing, and landscaping)	$54,940,000
Engineering (including environmental assessment, design, geotechnical investigations, environmental permits, archaeological investigations, and contract administration)	$14,240,000
Contingency Funds (25% of total construction and engineering costs)	$17,300,000

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1 Introduction

The City of Brantford has retained Parsons to complete a feasibility study for the proposed Oak Park Road extension from Kraemer's Way / Hardy Road southerly to Colborne Street West. The purpose of the feasibility study is to determine roadway cross-section requirements and alternative road alignment options including required intersection improvements in order to identify key constraints and challenges and provide alternative solutions. The findings of this study will guide the scoping of a formal Municipal Class Environmental Assessment (EA) study which will then feed into the detailed design.

1.1 BACKGROUND

The City of Brantford's 2007 Transportation Master Plan (TMP), and subsequent 2014 update, has recommended that Oak Park Road be extended from Kraemer's Way / Hardy Road to Colborne Street West, a need first identified and confirmed in the 1981 Brantford Corridor Study and again in the 1997 City of Brantford Transportation Study. None of these studies developed formal alignments however, property has been acquired by the City to potentially accommodate the new corridor. The City of Brantford is now moving forward with technical alternatives for the extension of Oak Park Road, one that will feature a 4-lane arterial urban cross-section, including a structure spanning the Grand River, as well as widening from Kraemer's Way / Hardy Road northerly to the Oak Park Road and Highway 403 Interchange, with the ultimate goal of a continuous 4-lane urban roadway from Highway 403 southerly to Colborne Street.

1.2 PREVIOUS STUDIES

In March 1981, McCormick Rankin completed the 'Brantford Corridor Study' to recommend a preferred alignment for a future roadway connection in the west end of the City of Brantford. As per their report, the need for this corridor was identified in early 1980 when representatives of the County of Brant, the Township of Brantford and the City of Brantford negotiated the annexation of lands from the Township to the City. The Brantford-Brant Annexation Act, 1980 was passed in June 1980 and identified amongst other items:

- Annexation of approximately 1,600 acres to the southwest of the City, for primarily residential purposes;
- Annexation of approximately 1,700 acres to the northwest of the City, for primarily industrial purposes (to be extended by a further 600 acres in the future); and
- Agreement that a service and road corridor would be required between the future residential area and the future industrial area.

McCormick Rankin developed a total of ten potential alignment alternatives for the corridor identified in the Brantford-Brant Annexation Act, 1980. These alignments covered the area from the Brantford Municipal Airport in the west to the Grand River in the east. Based on the evaluation criteria outlined in the report, it was recommended that Alternative E3A (shown in Figure 1) be adopted as the preferred route.

The proposed route would be a straight extension of the existing Oak Park Road from Hardy Road to the Grand River. After crossing the river, the alignment would turn south and generally follow the boundary between the City of Brantford and the County of Brant until Colborne Street W. Following the recommendation of the Brantford Corridor Study, the City of Brantford began to designate lands along the preferred alignment for long-term protection.

The City of Brantford Official Plan notes a proposed right-of-way width of 60m for the southerly extension of Oak Park Road. The November 2014 City of Brantford Transportation Master Plan Update lists the extension of Oak Park Road from Hardy Road to Colborne Street as a Medium-Term (2020-2024) recommendation and assigns a capital cost of $37,000,000. Implementation was identified within a 6 to 10-year timeframe (2020-2030) with a four-lane cross-section.

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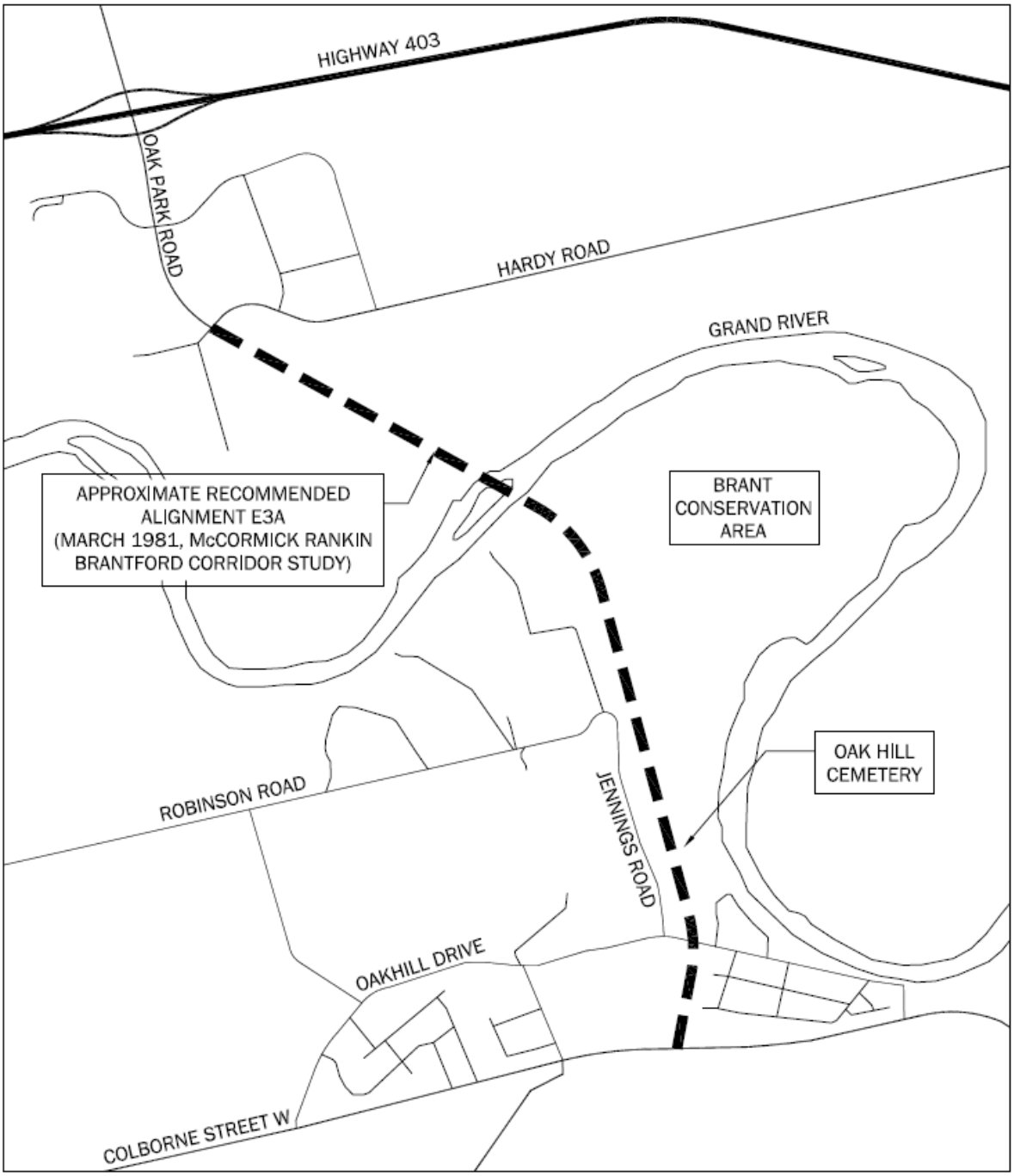
2 Existing Conditions

2.1 STUDY AREA

The study area extends from the existing intersection of Oak Park Road and Hardy Road/Kraemer's Way in the north to Colborne Street in the south. The City has protected a corridor of land for a future roadway through this area although this study generally considered the land between the western City boundary and the Grand River in addition to new development lands south of Hardy Road. The study area is illustrated below in Figure 1. It should be noted that the traffic report considered a much broader study area than the roadway alignment analysis which is detailed in Section 3.

Figure 1 – Study Area



2.2 ROADWAYS

The following provides a brief summary of the roadways that will be impacted by the proposed extension of Oak Park Road:

Oak Park Road travels in a north-south orientation from Paris Road southerly to Hardy Road where it currently terminates. It generally has a two-lane cross-section except in the vicinity of the interchange with Highway 403 where it widens to four lanes.

Hardy Road / Kraemer's Way is a two-lane roadway providing access to industrial properties in the vicinity of Oak Park Road. Kraemer's Way terminates just west of Oak Park Road while Hardy Road continues east across the City of Brantford under various road names.

Brant Conservation Area Access is currently located off Jennings Road where it meets Robinson Road. Any extension of Oak Park Road will need to investigate the impacts to this entrance.

Jennings Road is a minor two-lane roadway that generally travels along the western edge of the Oak Hill Cemetery property From Oakhill Drive north to Robinson Road.

Oak Hill Cemetery Access is currently provided from both Oakhill Drive and Jennings Road.

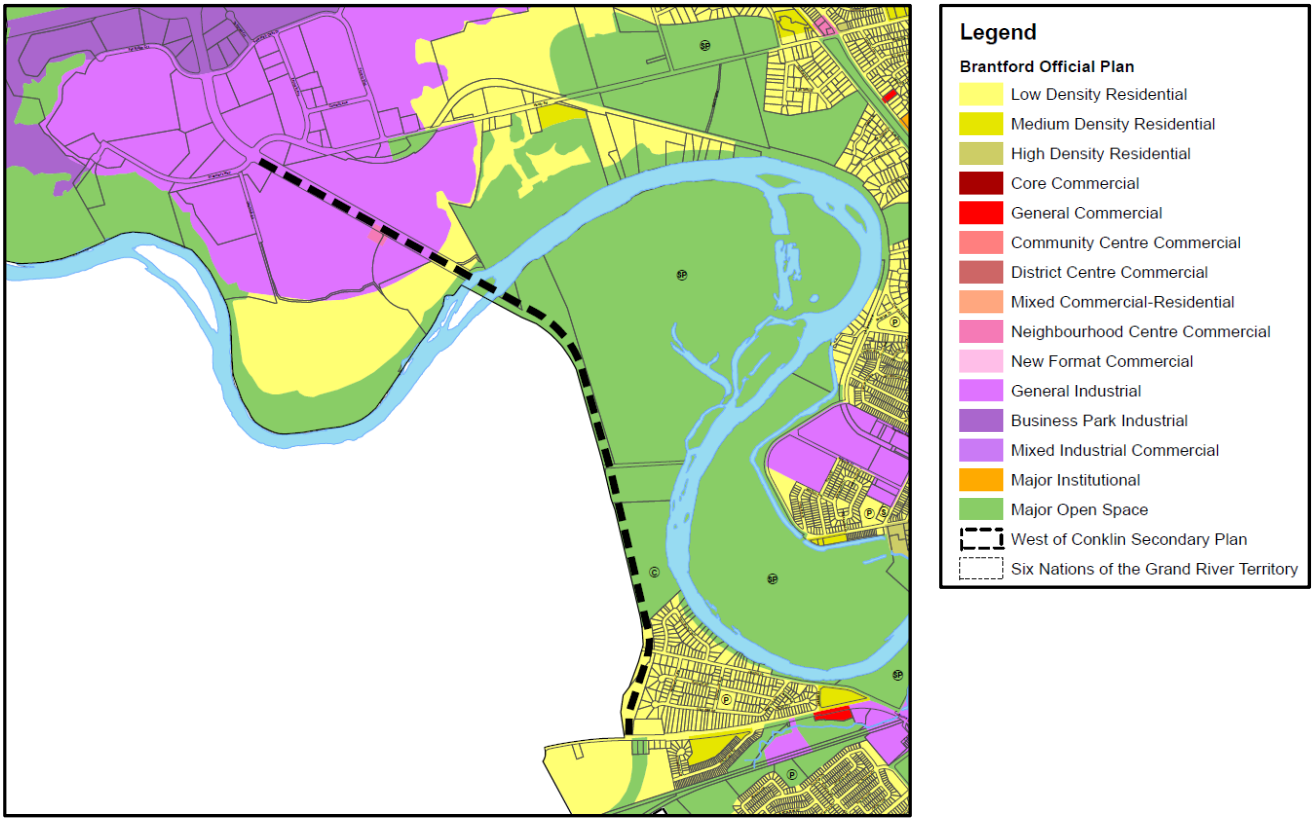
Oakhill Drive is a two-lane roadway that provides access to the residential properties to the north of Colborne Street West.

Colborne Street West is an arterial road that travels in a general east-west orientation across the City of Brantford.

2.3 LAND USES

Figure 2 is an excerpt from a land use plan provided to Parsons by City of Brantford planning staff that illustrates the land uses surrounding the proposed Oak Park Road extension.

Figure 2 – Study Area Land Uses



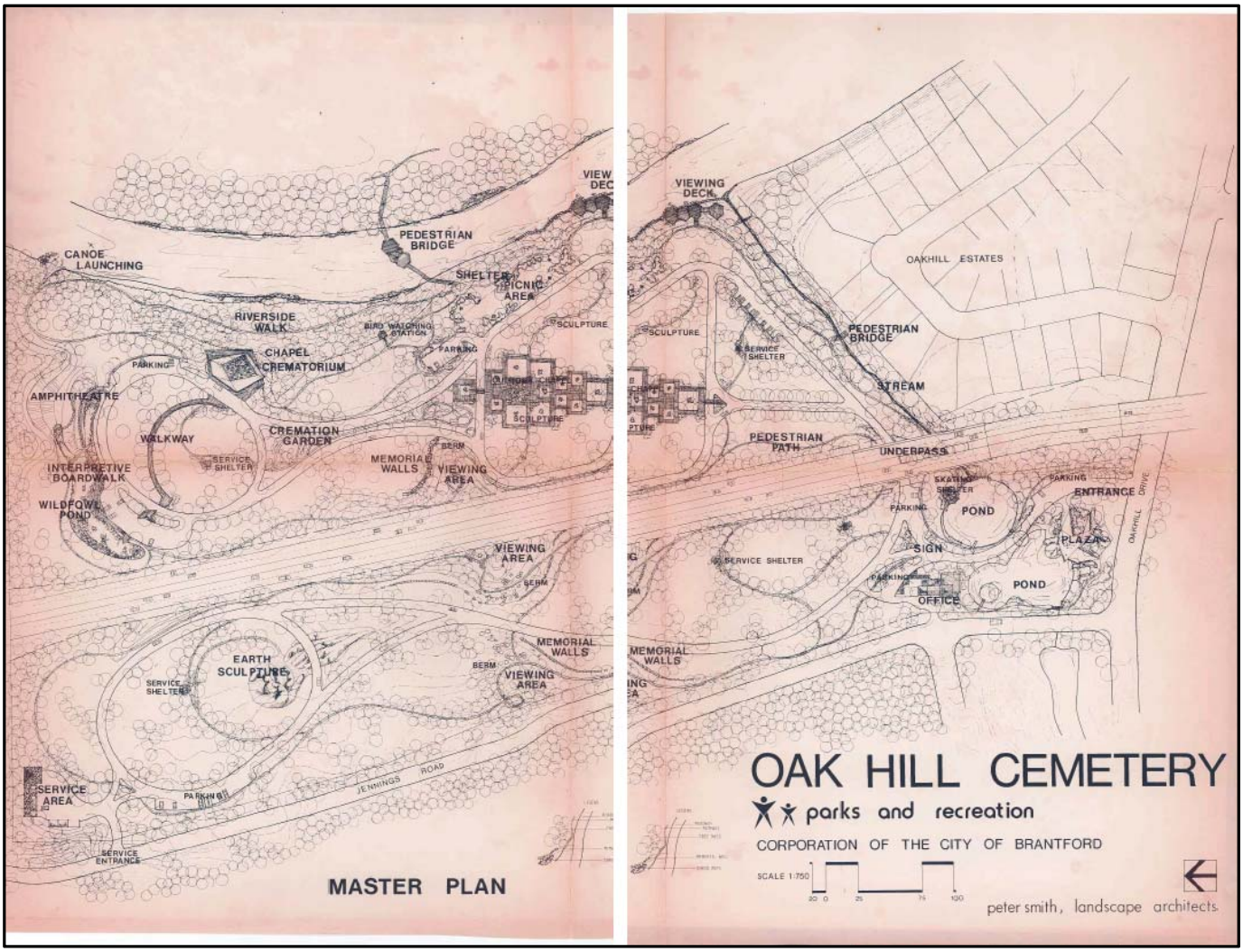
In general, the study area is comprised of three major land uses; Low Density Residential, Major Open Space and General Industrial.

2.3.1 OAK HILL CEMETERY

The Oak Hill Cemetery was opened in 1993 and is owned and operated by the City of Brantford. It is located on the northeast corner of Oakhill Drive and Jennings Road with access to and from both roadways. A large entrance feature is currently in place at the intersection with gardens and a reflection pond.

In 1990, the Oak Hill Cemetery Master Plan was developed which identified a future roadway corridor that would bisect the property. On-site circulation would be maintained via an underpass at the new roadway. This configuration is shown below in Figure 3.

Figure 3 – Oak Hill Cemetery Master Plan



2.4 PLANNED DEVELOPMENTS

Telephone City Aggregates Inc. has received approval to develop the industrial and residential lands south of Hardy Road and north of the Grand River. Two sites have been identified which will be separated by the protected 60m wide roadway corridor for the proposed Oak Park Road extension. The developments are known as TCA West and TCA East.

The TCA West development is located at 395 Hardy Road and consists of residential and industrial land uses. Based on report CD2014-098, TCA is proposing to construct 345-522 residential units and 9 industrial units. Access to these properties would be via two roadway connections to the future Oak Park Road extension.

The TCA East development is located at 375 Hardy Road and is planned to consist of 26 industrial units. Access to these properties will be via two roadway connections to the future Oak Park Road extension and would line up with the accesses to the TCA West development

Attachment A contains the proposed site plans for each of these developments.

2.5 CULTURAL HERITAGE

Much of the proposed Oak Park Road corridor is comprised of previously undisturbed soil that would require a full archaeological assessment. It is assumed that a minimum of Stage II assessment will be required. Lands to be developed as part of the Telephone City Aggregates sites would have undergone archaeological assessment as part of the development process.

The September 1999 Draft Plan & Environmental Protection Plan for the Northwest Industrial Area identified a previous Stage II assessment that was undertaken as part of the Secondary Plan. This assessment identified 25 prehistoric sites and 7 prehistoric find spots. It found that no further archaeological investigation was required at 12 of the prehistoric sites and the 7 prehistoric find spots. The remaining prehistoric sites should be supplemented with Stage III assessments in the event of conflicts with proposed development.

2.6 NATURAL ENVIRONMENT

The study area is located within the Norfolk Sand Plain physiographic region which joins the Grand River watershed near Brantford and drains Whiteman's Creek. The plain is composed of coarsely textured glaciolacustrine sand and silt deposits.

The new proposed crossing extends over the Grand River, a designated World Heritage River. The surrounding landscape has several informal and formal trails (SC Johnson and Blue CIR Trails) extending parallel to the river and one footbridge (Gordon Glaves Crossing) which extends across the river, directly over a small island. Within the study area, the bank to bank width of the river is approximately 192 m.

The landscape within the general study area is comprised of residential areas, forests, and wetlands. Natural land cover primarily consists of woody riparian vegetation located along the banks of the river and on the river island. The Grand River provides habitat for thousands of species of birds, fish and other wildlife including approximately 80 Species at Risk (SAR). More than 90 species of fish are found in the river system, about half of all species in Canada.

The Grand River and its floodplain fall under the jurisdiction of the Grand River Conservation Authority (GRCA). The proposed bridge alignments extend through slope valleys, wetlands, and floodplains with varying degrees of slope erosion mostly along the banks of the Grand River. The GRCA was contacted via email and confirmed that a Development, Interference with Wetlands and Alterations to Shorelines and Watercourses Permit (O. Reg. 150/06) would be required for any work within these areas. All proposed alignments extend through two small unevaluated wetlands which may require field investigations and Ministry of Natural Resources and Forestry (MNRF) consultation.

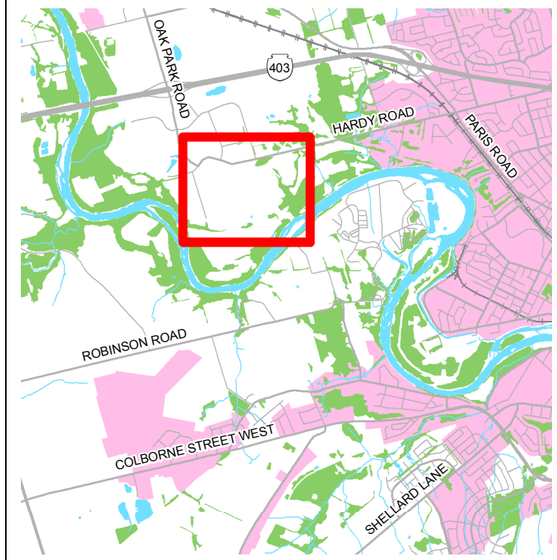
Figure 4 illustrates the environmental constraints within the study area.

Map 1a

Environmental Constraints and Features
Oak Park Road, Potential Future Extension

Location Map:

Scale: 1:150,000



Legend:

- Trail
- Watercourse
- Waterbody
- Wetland (Unevaluated or Non-significant)

Grand River Conservation Authority

- Protected Areas
- O.Reg. 150/06 Regulation Limit
- Regulatory Floodplain
- Steep Slopes and Erosion Hazards

MNRF Designated areas

- Provincially Significant Wetland
- Area of Natural and Scientific Interest (ANSI)

City of Brantford Environmental Policy Areas

- Environmental Protection Policy Area
- Environmental Control Policy Area

Scale:

1:5,000 1 centimetre = 50 metres

0 50 100 200 300 400 Metres

Parsons Job No:	Date:	Draft By:
476754	9/7/2018	W.V.

Data Sources: Parsons; City of Brantford; Grand River Conservation Authority; Ontario Ministry of Natural Resources and Forestry; Ontario Ministry of Transportation; ESRI

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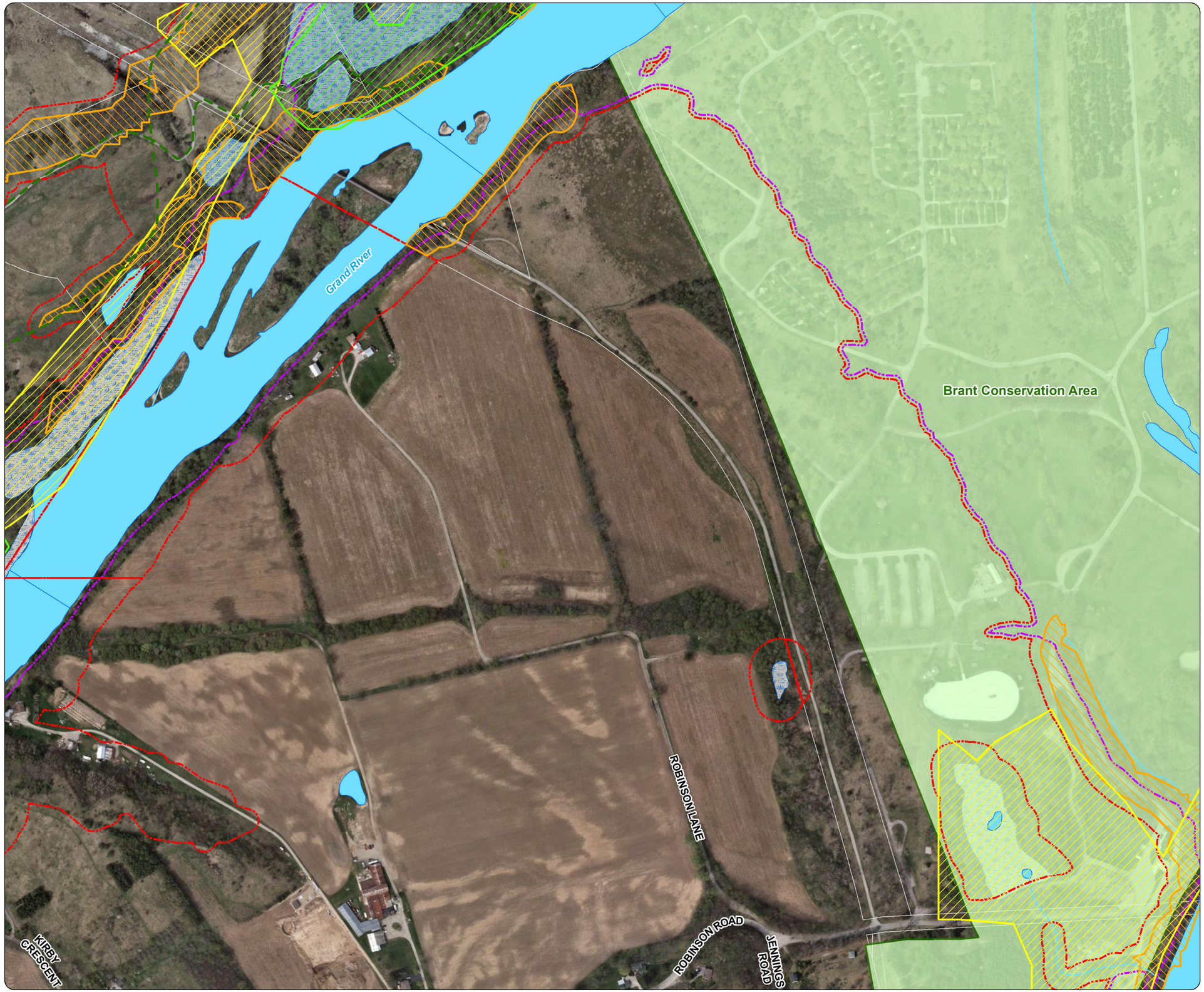
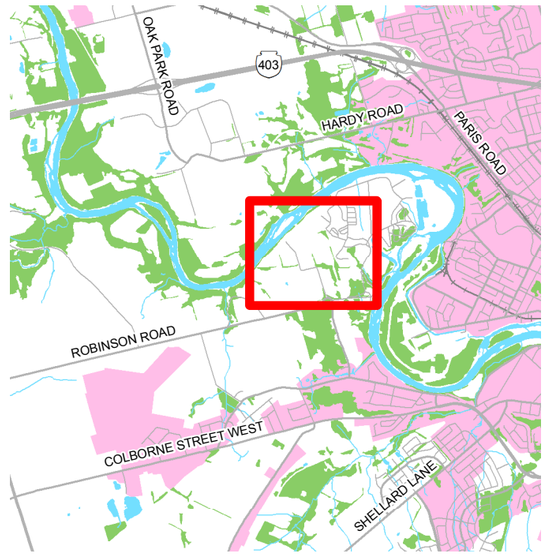


Map 1b

Environmental Constraints and Features
Oak Park Road, Potential Future Extension

Location Map:

Scale: 1:150,000



Legend:

- Trail
- Watercourse
- Waterbody
- Wetland (Unevaluated or Non-significant)

Grand River Conservation Authority

- Protected Areas
- O.Reg. 150/06 Regulation Limit
- Regulatory Floodplain
- Steep Slopes and Erosion Hazards

MNRF Designated areas

- Provincially Significant Wetland
- Area of Natural and Scientific Interest (ANSI)

City of Brantford Environmental Policy Areas

- Environmental Protection Policy Area
- Environmental Control Policy Area

Scale:

1:5,000 1 centimetre = 50 metres

0 50 100 200 300 400 Metres

Parsons Job No:	Date:	Draft By:
476754	9/7/2018	W.V.

Data Sources: Parsons; City of Brantford; Grand River Conservation Authority; Ontario Ministry of Natural Resources and Forestry; Ontario Ministry of Transportation; ESRI

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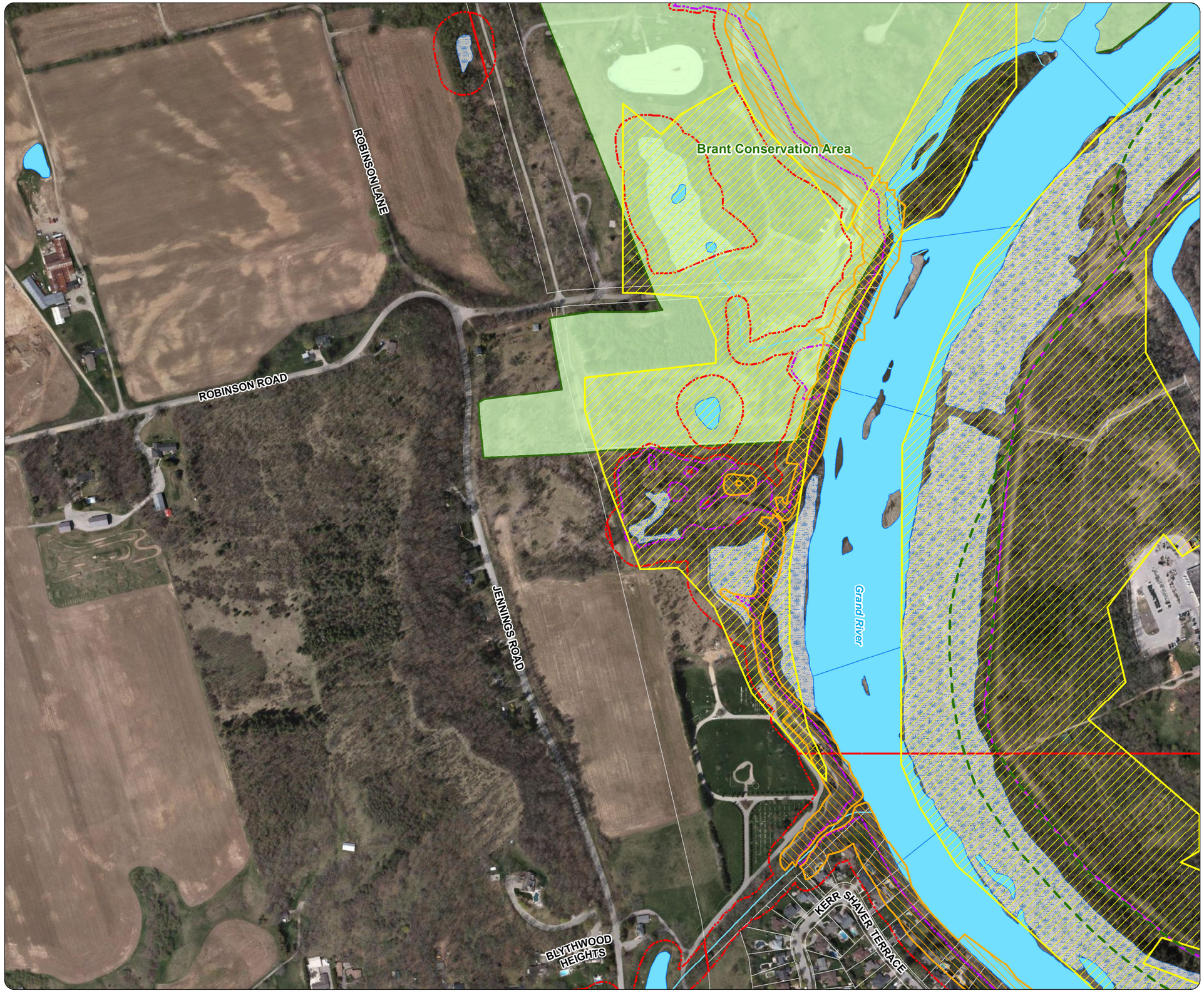
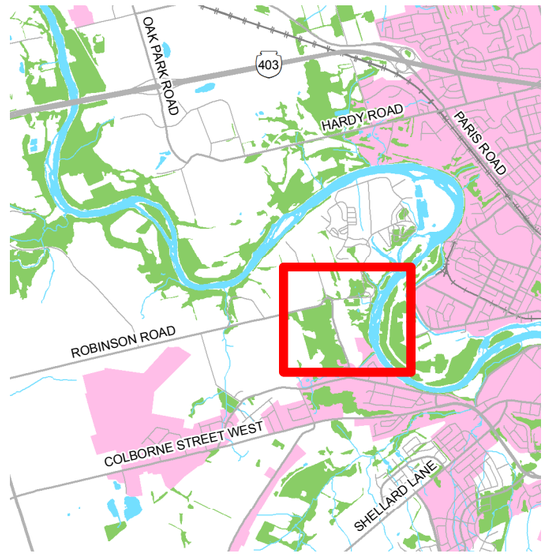


Map 1c

Environmental Constraints and Features
Oak Park Road, Potential Future Extension

Location Map:

Scale: 1:150,000



Legend:

- Trail
- Watercourse
- Waterbody
- Wetland (Unevaluated or Non-significant)

Grand River Conservation Authority

- Protected Areas
- O.Reg. 150/06 Regulation Limit
- Regulatory Floodplain
- Steep Slopes and Erosion Hazards

MNRF Designated areas

- Provincially Significant Wetland
- Area of Natural and Scientific Interest (ANSI)

City of Brantford Environmental Policy Areas

- Environmental Protection Policy Area
- Environmental Control Policy Area

Scale:

1:5,000 1 centimetre = 50 metres

0 50 100 200 300 400 Metres

Parsons Job No:	Date:	Draft By:
476754	9/7/2018	W.V.

Data Sources: Parsons; City of Brantford; Grand River Conservation Authority; Ontario Ministry of Natural Resources and Forestry; Ontario Ministry of Transportation; ESRI

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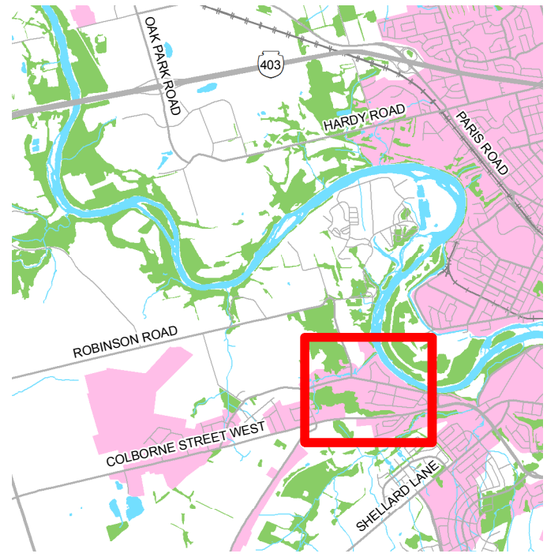
Map 1d

Environmental Constraints and Features
Oak Park Road, Potential Future Extension

Location Map:

Scale: 1:150,000



Legend:

- Trail
- Watercourse
- Waterbody
- Wetland (Unevaluated or Non-significant)

Grand River Conservation Authority

- Protected Areas
- O.Reg. 150/06 Regulation Limit
- Regulatory Floodplain
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- Provincially Significant Wetland
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Scale:

1:5,000 1 centimetre = 50 metres

0 50 100 200 300 400 Metres

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Data Sources: Parsons; City of Brantford; Grand River Conservation Authority; Ontario Ministry of Natural Resources and Forestry; Ontario Ministry of Transportation; ESRI

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2.6.1 SPECIES AT RISK

The Grand River and surrounding woodlots and wetlands have the potential for several aquatic and terrestrial SAR. All proposed crossings are expected to have piers within the Grand River. Fisheries and Oceans Canada (DFO) mapping indicated Critical Habitat for Eastern Sand Darter (*Ammocrypta pellucida*) and therefore, the project will likely need further DFO review, *Species at Risk Act* (SARA) permitting, and subsequent offsetting plans. Additionally, background screening identified the potential for several other species (Table 1). Field investigations and consultation with MNRF will be needed to confirm the presence of these species and/or their habitats, and consultation with the Ministry of the Environment, Conservation and Parks (MECP) to determine potential permitting requirements for this project under the *Endangered Species Act* (ESA).

Table 1 – Potential Species at Risk

COMMON NAME	SCIENTIFIC NAME	FEDERAL (SARA)	PROVINCIAL (ESA)	DISCUSSION
Fish				
Eastern Sand Darter	*Ammocrypta pellucida*	THR	END	Prefers sand bottom areas of lakes and streams, in which it burrows.
Black Redhorse	*Moxostoma duquesnei*	THR	THR	Usually lives in moderately sized rivers and streams and with generally moderate to fast currents. It is rarely found associated with aquatic vegetation. Substrates include rubble, gravel, sand, boulders and silt.
Silver Shiner	*Notropis photogenis*	THR	THR	Prefer moderate to large size streams with swift currents that are free of weeds and have clean gravel or boulder bottoms
Mussels				
Wavy-rayed Lampmussel	*Lampsilis fasciola*	SC	THR	Prefers gravel or sand bottoms of riffle areas in clear, medium-sized streams. It usually burrows into the substrate and may be particularly sensitive to siltation.
Rainbow Mussel	*Villosa iris*	END	THR	Often found in shallow, well-oxygenated reaches of small- to medium-sized rivers, and sometimes lakes, on substrates (bottoms) of cobble, gravel, sand and occasionally mud.
Vegetation				
Bird's-foot Violet	*Viola pedata*	END	END	Prefers dry, open sites such as savannahs, prairies and slopes with sandy soils. Common associates include oaks and/or pine species (Bickerton, 2013b).
Smooth Yellow False Foxglove	*Aureolaria flava*		THR	Distribution restricted in Canada to southwestern Ontario. There are few individuals remaining in a small number of locations within oak savannas and woodlands.
Birds				
Cerulean warbler	*Setophaga cerulea*	END	THR	Prefers deciduous forests, especially in river valleys. Breeds in mature hardwoods either in uplands or along streams. Prefers elm, soft maple, oak, birch, hickory, beech, basswood, linden, sycamore, or black ash.
Eastern Meadowlark	*Sturnella magna*	THR	THR	Tall grasslands, such as pastures and hayfields or shrubby overgrown fields or other open areas.
Insects				
Rapids Clubtail	*Phanogomphus quadricolor*	END	END	The Rapids Clubtail is typically found in clear, cool medium-to-large rivers with gravel shallows and muddy pools.

2.7 TRAILS

Numerous off-road trails are currently in place along the proposed corridor for the Oak Park Road extension. The Oak Hill Trail begins at the south end of the Oak Hill Cemetery and extends to north of the Grand River where it meets the S.C. Johnson Trail. The S.C. Johnson Trail is part of the Trans Canada Trail system and provides connections to Hardy Road. Figure 5 illustrates the existing trail network within the study area.

Figure 5 – Study Area Trail Network

2.8 STRUCTURAL

A steel truss pedestrian structure is in place where the Oak Hill Trail crosses the Grand River named the Gordon Glaves Crossing. The structure was designed in 1998 by Marshall Macklin Monaghan and constructed in 1999. It provides a 4.5m wide wooden deck suitable for use by both pedestrians and cyclists. The structure also carries municipal watermain and sanitary sewer pipes across the Grand River below the deck.

A structural evaluation completed in June 2017 determined that the crossing is in good condition overall and recommended some minor maintenance items. Based on a typical structure lifecycle of 75 years, the pedestrian structure is less than a third through its useful life.

2.9 SERVICING

Existing sanitary sewer and watermain utilities can be found within the existing protected roadway corridor. These utilities travel southerly from Hardy Road with the watermain turning east at the Brant Conservation Area and the sanitary sewer turning east at Oakhill Drive. Both utilities use the Gordon Glaves Crossing pedestrian structure to cross the Grand River.

2.10 DRAINAGE

Under existing conditions, the external catchments areas flow from west to easterly direction toward Grand River within the proposed Oak Park Road extension. The drainage from the west portion of the proposed Oak Park Road corridor, i.e. north of Oakhill Drive including offsite areas to the west, currently flows to a Stormwater Management Facility (SWMF) and is conveyed under Oakhill Cemetery access road through a CSP culvert, which is located about 150m north of Oakhill Drive and Oak Park Road interchange. This area drains directly to Grand River through ditch system.

The rest of the external catchment areas generally drains through overland flow. The existing topography shows a natural low point area just north of Brant Conservation Area entrance between Robinson Lane and Oak Hill Trail which appears to be receiving the drainage from a catchment area of over 40ha. This area requires further study with detail topographic information.

Telephone City Aggregates Inc. has received approval to develop the industrial and residential lands south of Hardy Road and north of the Grand River. Two sites have been identified which will be separated by the protected 60m wide roadway corridor for the proposed Oak Park Road extension. The developments are known as TCA West and TCA East. The Stormwater Management Facility (SWMF) as part of this development must account for the proposed Oak Park Road within this area.

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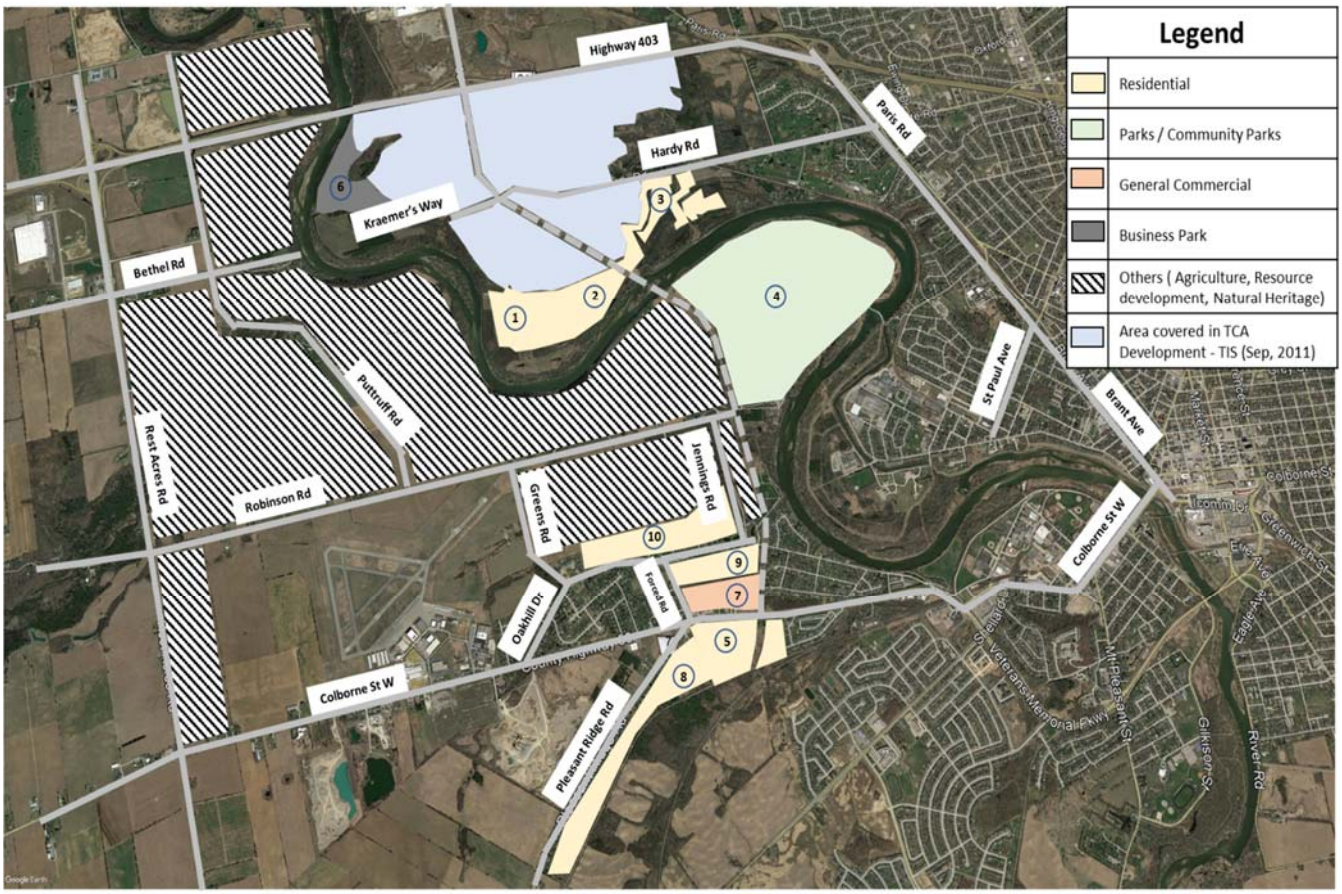
3 Traffic assessment

A traffic impact assessment for horizon years 2031 and 2041 was undertaken as part of the Feasibility Study to evaluate the potential of the proposed extension in reducing the traffic demand on existing north-south Paris Road/Brant Avenue and Rest Acres Road corridors. The assessment also considered the impact of proposed land uses adjacent to Oak Park Road extension as well as the impact of other developments planned in the vicinity and transportation demand from such developments will likely use the proposed Oak Park Road extension. Full impact assessment report is included as Attachment B.

3.1 PROPOSED LAND USES AND TRAFFIC DEMAND

The traffic assessment assumed proposed land uses and already planned Telephone City Aggregates (TCA) Development. The proposed development approximate locations are illustrated in Figure 6. The proposed land uses (Site 1 -10) information is based on **Schedule 1-1** of the Official Land Use Plan of the City of Brantford and **Schedule A** of the Official Land Use Plan of County of Brant.

Figure 6 - Proposed Land uses and Planned Developments Included in Traffic Assessment



The site traffic demand during weekday AM and PM peak hours was estimated using the Institute of Transportation Engineers' (ITE) Trip Generation Manual, 9th Edition. It is estimated that the proposed land uses will generate approximately 2,104 total trips (1,164 inbound and 940 outbound) during the AM peak hour and 2,879 total trips (1,409 inbound and 1,470 outbound) during the PM peak hour. Site trips forecast for each site is presented in Table 2.

Table 2 - Weekday AM and PM Hour – Proposed Land Use Estimated Traffic Demand

Site #	Trip Generation	Area (m2) / Unit		Trips - AM Peak Hour			Trips - PM Peak Hour		
				In	Out	Total	In	Out	Total
1	ITE 210 (Single Family Home)	253	Unit	47	142	190	159	94	253
2		151	Unit	28	85	113	95	56	151
3		182	Unit	34	102	137	115	67	182
5		164	Unit	31	92	123	103	61	164
8		143	Unit	27	81	108	90	53	143
9		105	Unit	20	59	78	66	39	105
10		109	Unit	20	61	82	69	40	109
4	ITE 411 (City Park)	234,277	-	146	115	261	115	87	203
6	ITE 770 (Business Park)	52,556	-	673	119	792	185	528	713
7	ITE 820 (Shopping Centre)	21,442	-	137	84	222	411	445	856
	TOTAL TRIPS			**1,164**	**940**	**2104**	**1,409**	**1470**	**2,879**

3.2 CORRIDOR CAPACITY ANALYSIS

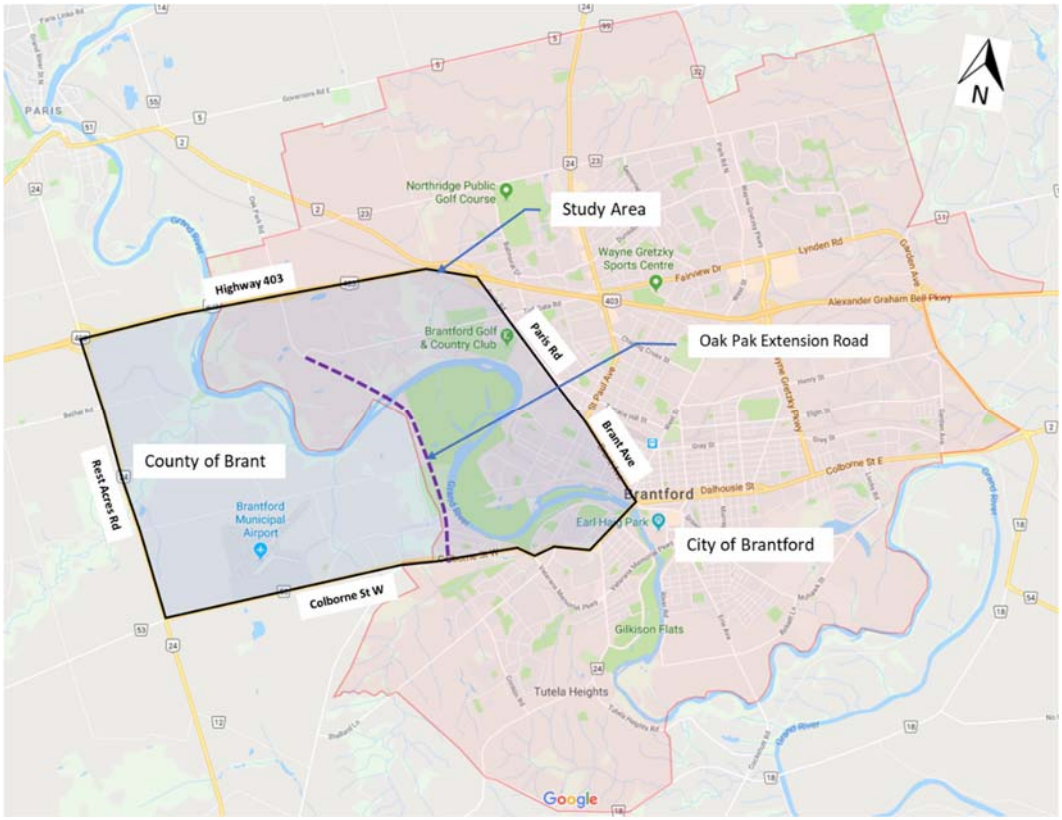
The City's Transportation Master Plan (TMP) 2007 and subsequently 2014 TMP update identified the need of Oak Park Road extension from the existing Kramer's Way / Hardy Road intersection to Colborne Street West to accommodate long term population and employment growth within the north-west and south-west quadrants of the City. Presently, trips originating from the south-west quadrant of the City do not have direct access to Highway 403 as well as to the north-west quadrant of the City and vice versa. As discussed further below, the indirect routes to be adopted by traffic volumes generated by developments located in these quadrants will cause an increase in traffic congestion not only at the downtown core but also at other roads in the City. The proposed Oak Park Road extension will provide a direct connection to Highway 403 for traffic originating from south-west quadrant of the City, and thus relieving congestion on Brant Avenue/Paris Road.

The study area is bounded by Highway 403 to the north, Paris Road/Brant Avenue to the east, Rest Acres Road to the west and Colborne Street West to the south. The study area and the boundaries of the City is illustrated in Figure 7.

To determine the potential change in traffic travel patterns in the future with the Oak Park Road extension in place, VISUM models for the future (2031) PM peak hour received from the City were used for both with and without the Oak Park Road extension scenarios. It was noted that VISUM models used in this analysis contained the Veterans Memorial Parkway corridor under existing lane configurations. By using the VISUM plots for both the scenarios, percentage change in volumes was estimated for southbound PM peak hour traffic volumes along Paris Road/Brant Avenue and Rest Acres Road corridors between Highway 403 and Colborne Street West. The percentage of traffic reduction was estimated at approximately 6% along Paris Road/Brant Avenue and 4% along Rest Acres Road. Estimated percentages were applied to projected future background traffic volumes (2031 & 2041) along Paris Road/Brant Avenue and Rest Acres Road to estimate the rerouted traffic volumes to Oak Park Road extension via Highway 403.

The future total traffic volumes (2031 & 2041) were calculated by adding future (2031 & 2041) background traffic, total site generated traffic (Table 2), total background TCA development volumes and rerouted traffic for 2031 & 2041 horizons.

Figure 7 - Traffic Assessment Study Area – Oak park Road Extension Feasibility Study



To assess the contribution of the proposed extension to help mitigate the future congestion conditions, a screenline capacity analysis using the projected future (2041) total volumes for the PM peak hour for the southbound direction were used assuming with and without Oak Park Road extension. A screenline is an imaginary line on a map, extending across two or more generally parallel road segments. Screenline analysis provides a means of comparing the total number of lanes available with the total traffic volume passing along the road segments of the screenline.

The corridor screenline capacity analysis includes, north-south corridors consisting of Rest Acres to the west and Paris Road/Brant Avenue to the east in addition to the existing Oak Park Road and proposed Oak Park Road extension corridors. Two east-west screenline locations, one at immediately south of Hardy Road and a second north of Colborne Street were selected. The analysis is based on road segment (link) traffic volume to capacity ratio (V/C). Generally, link level of service (LOS) is estimated based on the traffic volume to capacity ratio (V/C) as tabulated below.

Volume to Capacity Ratios (V/C)	LOS	General Conditions
< 0.75	A to C	Stable flows with acceptable delays
≥ 0.75 < 0.85	D	Approaching unstable flows and tolerable delays
≥ 0.85 < 1.00	E	Unstable flows and intolerable delays
≥ 1.00	F	Overcapacity, forced flows and significant delays

Results of screenline analysis are presented in Table 3. Without Oak Park Road Extension, the screenline immediately north of Colborne Street West is anticipated to have significant congestion with volume exceeding the capacity by 60%. The congestion will likely be experienced mostly on Paris Road/Brant Road passing through the City downtown area, as the forecasted volume along this corridor crossing the screenline immediately north of Colborne Street West shows volume more than 50% in excess of the available capacity. With the Oak park Road extension in place, the screenline volume to capacity ratio drops to 0.99 from 1.60. Therefore, Oak Park Road Extension is anticipated to provide an alternate direct route to Highway 403 especially for trips originating from and destined to the south-west quadrant of the City. Similar improvement is shown for the screenline immediately south of Hardy Road where the screenline volume to capacity ratio improves to 0.65 from 1.05, after addition of the Oak Park Road extension.

Table 3 - Screenline Capacity Analysis, Southbound Future (2041) Total Volumes PM Peak Hour

Without Oak Park Extension								
Streets	**Immediately South of Hardy Road**				**Immediately North of Colborne Street W**			
	No of Lanes	**Lane Capacity**	**Total Capacity**	**Link Volumes***	**No of Lanes**	**Lane Capacity**	**Total Capacity**	**Link Volumes***
Rest Acres Road	1	1,000	1,000	1,150	1	1,000	1,000	1,040
Paris Road / Brant Avenue	2	800	1,600	875	2	800	1,600	2,500
New Site Volume (*will be distributed to Rest Acres Road & Paris Road / Brant Avenue*)				710				630
Total	***3***	**--**	***2,600***	***2,735***	***3***	**--**	***2,600***	***4,170***
Volume to Capacity				**1.05**				**1.60**

With Oak Park Extension								
Streets	**Immediately South of Hardy Road**				**Immediately North of Colborne Street W**			
	No of Lanes	**Lane Capacity**	**Total Capacity**	**Link Volumes***	**No of Lanes**	**Lane Capacity**	**Total Capacity**	**Link Volumes***
Rest Acres Road	1	1,000	1,000	1,150	1	1,000	1,000	1,040
Paris Road / Brant Avenue	2	800	1,600	875	2	800	1,600	2,500
Oak Park Extension (New Site Volume)	2	800	1,600	710	2	800	1,600	630
Total	***5***	**--**	***4,200***	***2,735***	***5***	**--**	***4,200***	***4,170***
Volume to Capacity				**0.65**				**0.99**

*Volumes rounded to nearest 5

Opportunities were investigated if additional capacity can be added to mitigate the overcapacity issues in this area without Oak Park Road extension. It was noted that a traffic impact study report completed for the Brant 403 Business Park development investigated the widening of the Rest Acres Road corridor to 4 lanes south of Highway 403 between Bethel Road and Colborne Street by 2036. A sensitivity analysis showed that the Rest Acres Road improvements to 4 lanes up to Colborne Street will still not alleviate the capacity deficiencies without the Oak Park Road extension to Colborne Street and there will be some spare capacity with the Oak Park Road extension in place. However, Rest Acres Road widening to 4 lanes (2 lanes per direction) prior to 2041, may alleviate the need of initial 4 lanes construction of the Oak Park Road extension. With Rest Acres Road widened to 4 lanes, single lane construction of Oak Park Road extension will still provide 5 lanes capacity across the screenlines to meet the capacity needs.

3.3 INTERSECTION CAPACITY ANALYSIS (2031 & 2041)

A total of sixteen (16) intersections were included as part of the traffic analysis study area. Of the total intersections, nine (09) are currently under signalized control while the remaining seven (07) are unsignalized intersections. Operation analyses were completed for the study area intersections using the using the Synchro/SimTraffic 10.0 software. Under existing conditions all intersections are operating satisfactorily with no issues that would require the need for intersection improvements. The intersection capacity analyses concluded that the local network can accommodate long term (2031 & 2041) population and employment growth within the north-west and south-west quadrants of the City, with the Oak Park Road extension in place as well as following recommended improvements.

- Highway 403 South Ramp Terminal at Rest Acres Road – EB Off Ramp intersection control was changed as a signalized intersection along with separated EB left and right turn lanes. It is noted that as advised by the County of Brant, both the ramp terminals at Rest Acres Rd and Hwy 403 will have roundabouts built in the next couple years. This study has identified that existing traffic controls (unsignalized) will not be enough to meet the future traffic demand. The type of future control in terms of signals or roundabouts at ramp terminals at Rest Acres Road and Highway 403, will not affect the need for the Oak Park Road extension;
- Highway 403 North and South Ramp Terminals at Oak Park Road – EB and WB Off Ramps intersection controls were changed as a signalized intersection along with separated EB and WB left and right turn lanes respectively. It is noted that a separate EA is in progress to design PARCLO A4 interchange which typically has higher capacity than existing simple diamond type interchange;
- Colborne Street West at Veterans Memorial Parkway – Dual EB left turn lanes (Colborne Street West to Colborne Street West) and modification to NB/SB approaches such as free right turn from Colborne Street West to Colborne Street West;
- Brant Road/Paris Road Corridor between Highway 403 and Colborne Street West – Signal time improvements; and
- Signalized traffic control at following existing unsignalized intersections.
    - Hardy Road/Kramer's Way and Oak Park Road
    - Colborne Street and Oak Park Road Extension
    - Rest Acres Road and Robinson Road
    - Colborne Street and Pleasant Ridge Road/Forced Road

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4 Alignment Alternatives

When developing potential alignment options for the proposed extension of Oak Park Road, Parsons undertook a first-principles approach. Preliminary alignments were developed based on the existing land and topography without specific consideration for potential limiting factors such as property acquisition or developments. The most viable of these preliminary options were then further refined and turned into alternatives for analysis and evaluation.

4.1 DESIGN CRITERIA

The City of Brantford has developed a design and construction manual for Roads and Transportation. This manual provides guidance on the City's preferences for the design of new roads but is not considered a complete resource. For items not covered, the guide defers to the Geometric Design Guide for Canadian Roads prepared by the Transportation Association of Canada (TAC). Parsons has prepared a design criteria table for use on the proposed Oak Park Road extension that compares the recommendations against those found in the City design guide and TAC manual. These criteria are illustrated below in Table 4.

Table 4 – Oak Pak Road Design Criteria

Oak Park Road Design Criteria	City of Brantford Design Standards		TAC		Oak Park Road Recommended Design				Comments
					Colborne St. W. to Oakhill Cemetery		Oakhill Cemetery to Hardy Rd.		
Roadway Classification	Arterial		Arterial		Arterial		Arterial		
Design Speed	70-90 km/h		50-100 km/h		70 km/h		80 km/h		Lower at south end to allow smaller radius curves to mitigate property impacts
Posted Speed	60 (preferred) - 80 km/h				60 km/h		70 km/h		
Superelevation	2% Max		4-6% Max		2.6% Max		2.6% Max		Higher superelevation allows smaller radius curves to mitigate property impacts
Alignment									
	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	
Radius	-	-	250m		500m	2000m	700m	4000m	TAC minimum based on 6% superelevation at 80 km/h design speed
Grade	0.50%	6.00%	0.50%	6.00%	0.50%	6.00%	0.50%	2.29%	
Grade Approaching Intersection	3% Max		3% Max		2% Max		2% Max		An at-grade intersection at Oak Hill Drive will not meet design standards (~5.4% approach grade)
Cross-Section Widths									
	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	
Thru Lane (Incl. 0.3m Gutter)	3.70m	-	3.60m	4.00m	3.70m*	-	3.70m*	-	Final lane widths to consider truck traffic
Curb Lane (Incl. 0.3m Gutter)	3.70m	-	3.60m	4.00m	3.70m*	-	3.70m*	-	Final lane widths to consider truck traffic
Shoulder Clearance	1.30m	-			-	-	-	-	Omitted to mitigate property impacts
Right Turn Lane	-	-	Same or 0.2-0.25m less than adjacent thru lane		-	-	3.25m	-	
Left Turn Lane	-	-	Same or 0.2-0.25m less than adjacent thru lane		-	-	3.25m	-	
Median Width	4.00m	-	2.00m	6.00m	4.00m	-	4.00m	-	
Sidewalk Widths	1.80m	-	1.50m	2.30m	1.80m	-	1.80m	-	
Multi-Use Path	3.00m	-	-	-	3.00m	-	3.00m	-	
Boulevard	2.50m	3.50m	2.00m	3.00m	2.50m	3.50m	2.50m	3.50m	3.1m used for conceptual layouts

*Complete streets approach typically considers lane widths between 3.30 - 3.50m excluding gutter.

4.2 PRELIMINARY ALIGNMENT OPTIONS

Figure 8 illustrates the preliminary alignment options at a high-level. It was found that limited alignment options were available to the south of the Oak Hill Cemetery property due to existing residential developments and topography in the area. As such, all alignment options converge and follow the same route between Oak Hill Cemetery and Colborne Street West.

4.2.1 OPTION A

The first alignment was developed to approximately match the recommendation from the McCormick Rankin Corridor Study completed in March 1981. This would be a straight extension of the existing Oak Park Road that would curve south of the Grand River and bisect the Oak Hill Cemetery before connecting to Colborne Street West. It was expected that this option would necessitate the removal of the existing Gordon Glaves Crossing pedestrian bridge over the Grand River on the Oak Hill Trail.

4.2.2 OPTION B

Option B would follow a similar path to Option A but shift to the east side of the protected corridor to the north of Oak Hill Cemetery. The purpose of this shift is to maintain the existing Gordon Glaves Crossing pedestrian structure across the Grand River on the Oak Hill Trail.

4.2.3 OPTION C

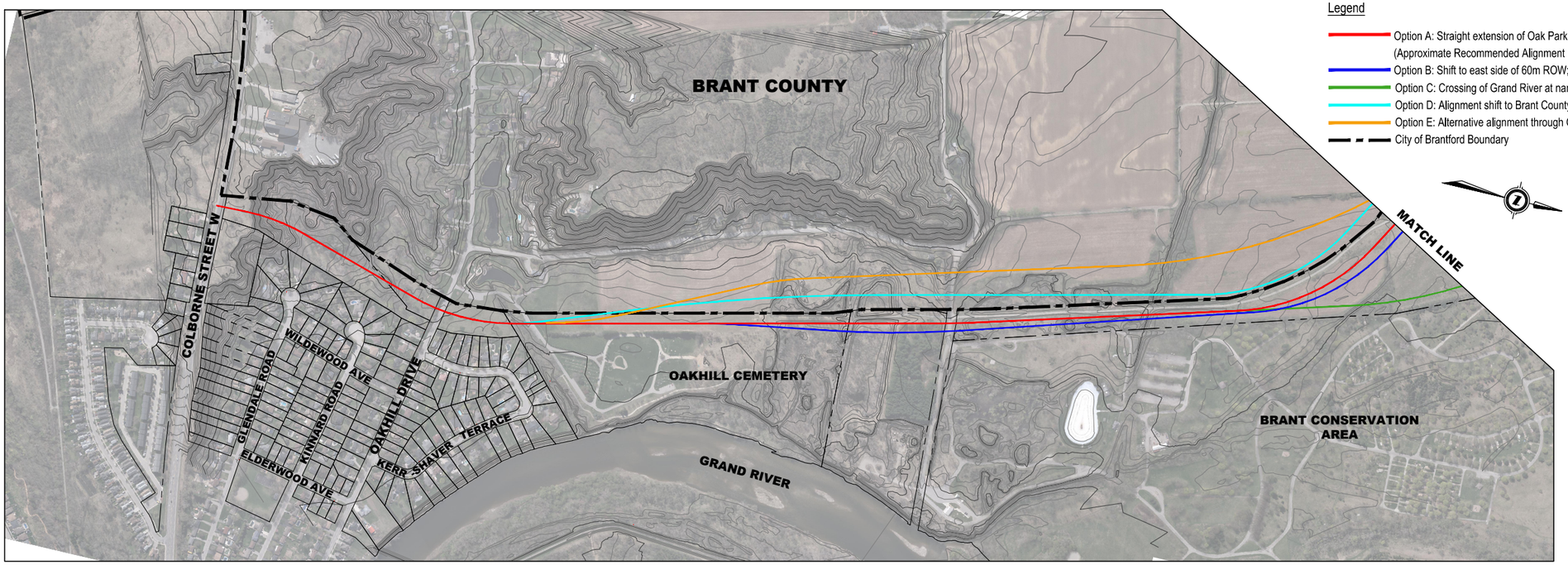
Option C was created to swing the alignment furthest to the east to cross the Grand River at what appears to be the narrowest point based on available aerial imagery. The goal of this is to minimize the impact to the Grand River of a new structure crossing by shortening the span to the greatest extent possible.

4.2.4 OPTION D

Lands designated by the City of Brantford for long-term protection for the future Oak Park Road extension generally follow the City boundary with the County of Brant to the south of the Grand River. Although the extension will be owned and operated by the City, Option D was developed to consider if any benefits existed to moving the alignment into the County.

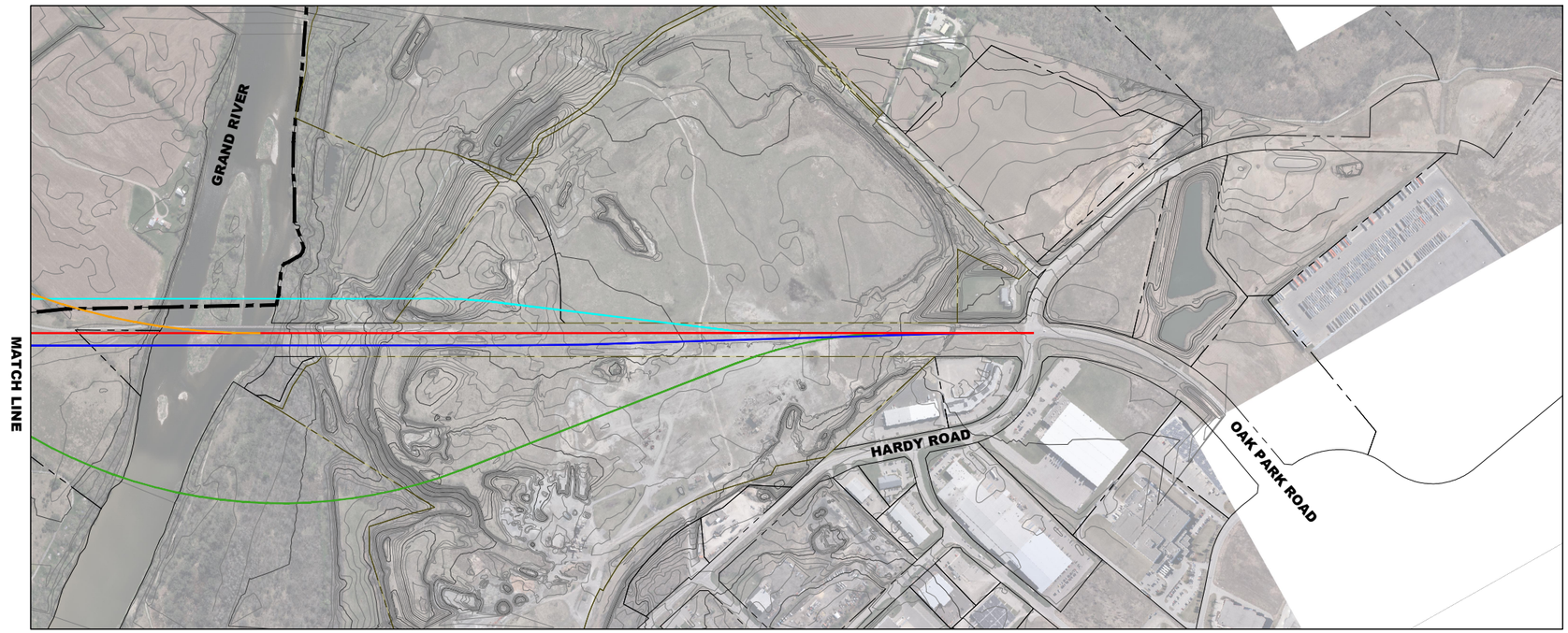
4.2.5 OPTION E

Option E also impacts lands owned by the County of Brant but to a lesser extent. The goal of this option is to provide an alternative alignment through the Oak Hill Cemetery grounds and minimize impacts to the Brant Conservation Area.



Legend

- Option A: Straight extension of Oak Park Road from the north; remove existing pedestrian bridge over Grand River (Approximate Recommended Alignment From McCormick Rankin Corridor Study, March 1981)
- Option B: Shift to east side of 60m ROW; option to maintain existing pedestrian bridge over Grand River
- Option C: Crossing of Grand River at narrowest point
- Option D: Alignment shift to Brant County
- Option E: Alternative alignment through Oak Hill Cemetery; minimize impact to Brant Conservation Area
- City of Brantford Boundary



THE CORPORATION OF THE CITY OF BRANTFORD

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50m 0 100m
HORIZONTAL 1:5000

Oak Park Road Extenstion
Preliminary Alignment Alternatives

FIGURE 8

4.3 SCREENING OF PRELIMINARY OPTIONS

Because a first-principles approach was taken in developing the preliminary alignment alternatives, each option was subjected to a high-level screening to identify any factors that would impact their viability as an alternative for evaluation.

Options A and B were found to be viable alternatives for alignments as they both fall within the protected corridor for the future Oak Park Road extension. The primary difference between these options is whether the existing pedestrian crossing structure over the Grand River is to remain or be removed.

Option C would bisect the proposed industrial development located at 375 Hardy Road, requiring significant alterations to the approved site plan. However, this option was considered viable for evaluation as the potential cost savings on a shortened structure may justify the additional site plan work.

Options D and E were eliminated from consideration as they provided no tangible benefit compared to the options that utilized all or a portion of the existing protected corridor. Option D would impact an existing structure near the entrance to the Brant Conservation Area and would require significant land transfers from the County to the City. Option E attempts to swing the alignment as far west as possible in order to avoid bisecting the cemetery property but this was not possible due to the horizontal alignment requirements. Additionally, doing so would effectively cut off the main office and entrance features completely from the remainder of the cemetery grounds.

4.4 ALTERNATIVES FOR EVALUATION

Alignment Options A, B and C were refined to ensure conformity to the proposed design criteria and mitigate some of the apparent conflicts with property and grading. The resulting alignments were redefined as Alternatives 1, 2 and 3 to make them distinct from the previous alignment options. It was found that multiple vertical profile options were available between Colborne Street W and Oak Hill Cemetery. These options were evaluated as sub-options to the alternatives.

It was found that few alignment options were available between Colborne Street W and the Oak Hill Cemetery due to property limitations, vertical fill requirements and the location of existing residences. Therefore, the horizontal alignment in this area is identical amongst all alternatives.

Attachment C contains detailed plan and profile drawings of each alignment alternative.

4.5 KEY FEATURES

The following sections highlight the key features and differences of each alignment alternative.

4.5.1 ALTERNATIVE 1A

Alternative 1A features a maximum allowable grade of 6% heading north from Colborne Street West to minimize the volume of fill required between Colborne Street and Oakhill Drive. This vertical alignment will match back to the existing ground to the north of Oakhill Drive. Due to the raised profile and grading requirements through this area, access across Oak Park Road at Oakhill Drive and the Oak Hill Cemetery will not be maintained. This will limit the residential neighbourhood to the east of Oak Park Road and south of the Grand River to a single access point from Colborne Street West.

A new intersection would be required to provide access from Oak Park Road to the Oak Hill Cemetery lands on the east side of the proposed roadway. Cemetery maintenance vehicles and visitors/patrons would be limited to vehicular access only for these lands and would be cut off from the main office located at Oakhill Drive and Jennings Road.

Another intersection will be required for access to Jennings Road and the Brant Conservation Area. This would be located where the existing Conservation access meets the new Oak Park Road alignment.

A new structure over the Grand River will be provided to provide pedestrian and vehicular access across the waterway. In this alternative, the existing Gordon Glaves Crossing pedestrian structure would be removed and all trails re-routed to the multi-use pathways that will be constructed within the roadway corridor.

4.5.2 ALTERNATIVE 1B

Alternative 1B follows the same horizontal alignment as Alternative 1A and features generally the same vertical profile to the north of Oak Hill Cemetery. The key difference is that Alternative 1B has a slope of 3.9% heading north from Colborne Street West. The gentler slope allows for grade separation where the alignment meets Oakhill Drive and the Oak Hill Cemetery. Introducing structures at these locations will allow emergency access to adjacent residential neighbourhoods and maintain connectivity to the Cemetery lands across Oak Park Road.

4.5.3 ALTERNATIVE 2A

Alternative 2A follows the same horizontal and vertical alignment as Alternative 1A from Colborne Street West to the Oak Hill Cemetery. North of the Cemetery, the alignment shifts to the east side of the protected corridor which allows for a longer radii curve to be provided south of the Grand River. The alignment shift also moves the new Grand River crossing structure enough to allow the existing Gordon Glaves Crossing pedestrian structure to remain in place. The proposed multi-use trail along Oak Park Road will be diverted to the existing off-road trail network allowing the cross-section of the new roadway bridge to be reduced (no pedestrian facilities on west side).

4.5.4 ALTERNATIVE 2B

Alternative 2B is identical to Alternative 2A except for the grade between Colborne Street West and the Oak Hill Cemetery. As with Alternative 1B, Alternative 2B provides for a 3.9% grade heading north from Colborne Street which allows for grade separation structures to be placed at Oakhill Drive and the Oak Hill Cemetery. This will allow emergency access to adjacent residential neighbourhoods and maintain connectivity to the Cemetery lands across Oak Park Road.

4.5.5 ALTERNATIVE 3

Alternative 3 follows the same horizontal and vertical alignment as Alternative 1A from Colborne Street West to the Oak Hill Cemetery. North of the Cemetery, the alignment is shifted easterly along the Grand River to attempt to place the crossing structure at the narrowest point of the River (based on available aerial imagery). As with Alternatives 2A and 2B, the existing pedestrian structure across the Grand River is to remain in place.

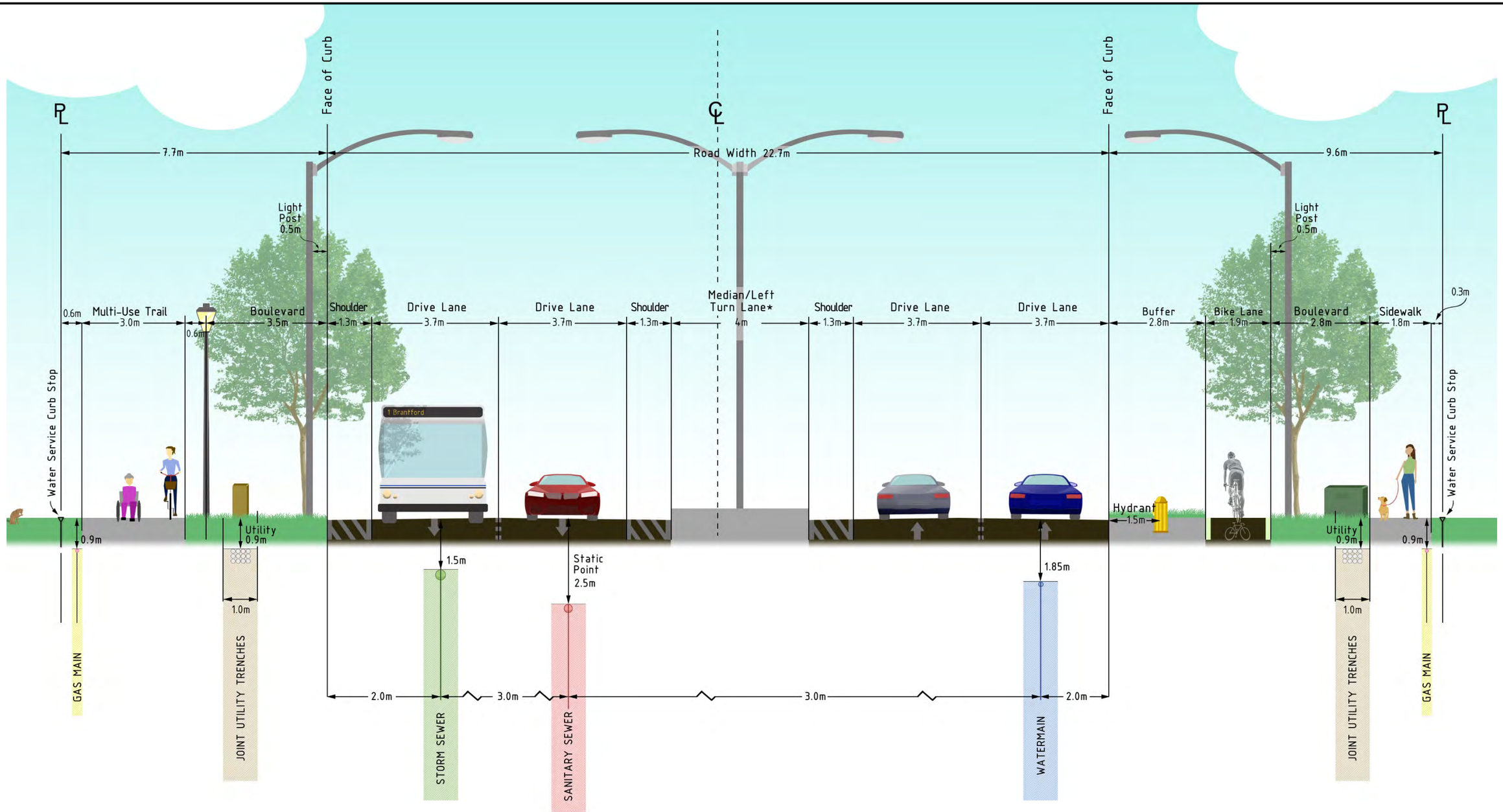
It should be noted that this alignment was moved forward in the evaluation process on the basis that the structure would be shorter compared to Alternatives 1 and 2. While developing the vertical profile for this alternative, it was found that the area north of the River at this location was subject to flooding based on the water level survey data available. Due to this, the structure would have to be substantially longer than those in Alternatives 1 and 2 in order to avoid the flooding area.

4.6 CROSS SECTIONS

When developing the proposed alignment alternatives, consideration was given to the final cross-section that could be accommodated based on the given design criteria and property available.

4.6.1 CITY OF BRANTFORD ARTERIAL SECTION

The City of Brantford design and construction manual for Roads and Transportation provides a typical cross-section for an Arterial roadway with a 40.0m right-of-way and a road width of 22.7m. This cross-section provides for both a multi-use trail and segregated sidewalks and bicycle paths. An allowance is made for shoulders on both sides of the travelled lanes or only the median side. It should be noted that although the section specifies a right-of-way width of 40.0m, it appears that no allowance was made within this distance for cut or fill slopes that may be required based on the horizontal and vertical alignments. Figure 9 illustrates the cross section.



CITY OF BRANTFORD Public Works Commission	Date:	Revised:	Scale:
	October 2017		N.T.S.
ARTERIAL 40.0 M ROW, 22.7 M ROAD WIDTH	Drawn by:	Checked by:	Approved by:
Drawing Number: G-108	A.L.	L.V.	L.V.

NOTES:

* This road width is reserved for medians, turning lanes, bike lanes and other elements and shall be utilized as desired and approved by the City.

1. Curbs not shown. See Roads Manual for curb, gutter and subdrain standards.
2. Pavement design details not shown. See Roads manual for pavement design standards.
3. Lane markings are shown for information only and do not represent marking requirements. See Roads Manual for pavement marking standards.
4. Road grade and crossfall shall be in accordance with the Roads and Transportation Manual.
5. Sidewalk Grade: minimum of 0.5% and maximum of 8%; Sidewalk Crossfall: minimum of 2% and maximum of 4%.
6. Water service curb stops shall be on the property line. Installation on hard surfaced area, such as driveways and walkways shall be avoided.
7. A minimum clearance of 0.3 m must be maintained between the gas line and the property line.
8. Hydro, telecommunications, gas and street lighting installation details provided in Utilities Manual. If utilities cannot be installed according to this standard, they are to be installed as close as possible to the prescribed location subject to the approval of the City.

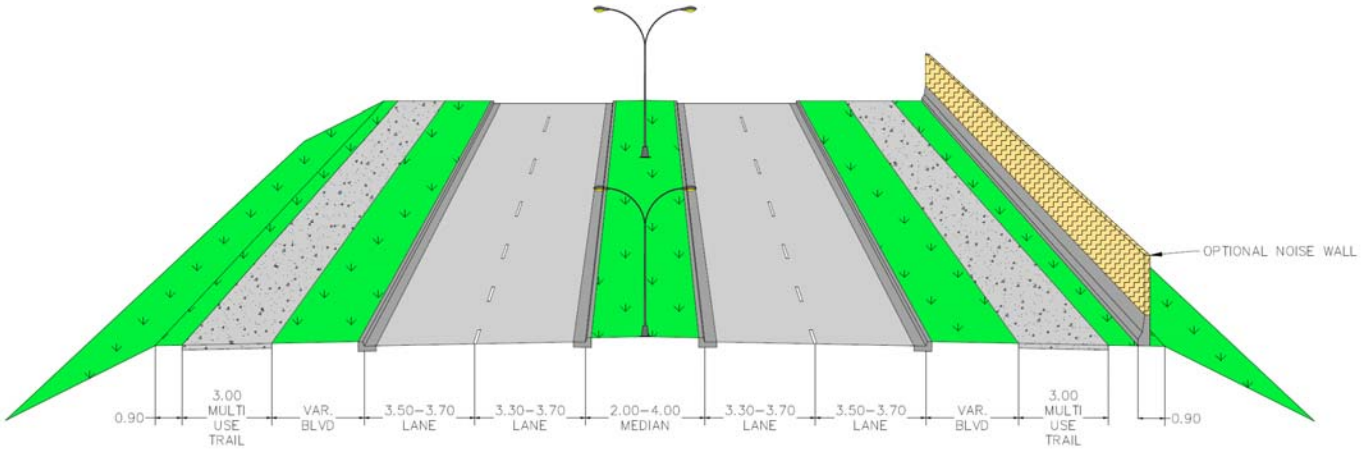
4.6.2 RECOMMENDED CROSS SECTIONS

When developing and refining the proposed alignment alternatives, it was found that it was not possible to accommodate the City of Brantford Arterial section without significant changes due to cut and fill slope requirements. Due to the number of connections to the existing trail network along the proposed route, it was decided that a multi-use trail would be provided on one or both sides of the roadway, eliminating the need for any segregated cycling facilities. Shoulders were eliminated as the proposed roadway will utilize curb and gutter on both sides. Boulevards could vary from 2.5m to 3.5m depending on requirements.

If further reductions are found to be required during the subsequent environmental assessment or detailed design phases, the median could be reduced from 4m to 2m or eliminated entirely if conditions warrant.

Figure 10 illustrates the proposed cross section for the new Oak Park Road corridor.

Figure 10 – Recommended Cross Section



4.7 STRUCTURAL ALTERNATIVES (GRAND RIVER CROSSING)

Parsons has developed a schedule of options for the new structural roadway crossing of the Grand River along the proposed Oak Park Road corridor. Multiple pier spacing and material options are available for use. Table 5 below summarizes the proposed structure options.

Table 5 - Bridge Structure Type Alternatives

PIER ARRANGEMENT	I	II	III	IV
Span lengths (m)	35-45-45-45-45-45-35	35-60-60-60-45-35	36-55-75-75-75-55	90-130-90-68-68-50
Total bridge length (m)	295	295	296	496
Alignment Alternatives	1A, 1B, 2A, 2B	1A, 1B, 2A, 2B	1A, 1B, 2A, 2B	3
Number of Piers	12 (6x2)	10 (5x2)	8 (4X2)	10 (5X2)
Structure Types	1. Precast NU Girders 2. Steel Plate Girders	1. Steel Box (Tub) Girders 2. Steel Plate Girders 3. Post-Tensioned Box Girders	1. Variable Depth Steel Plate Girders	1. Variable Depth Steel Plate Girders

Alignment alternatives 1A, 1B, 2A, and 2B have multiple variations of superstructure materials and pier spacings that could be implemented when selecting a preferred structure type. Alternative 3 is limited to one pier spacing and structure type due to the significant longer span that must be overcome.

In general, a preferred structure type is selected using cost and maintenance as the major factors. For the Oak Park Road structure, the total number of piers and the number of piers in the water will also be considered as fewer piers will minimize the environmental impacts to the Grand River.

Figure 11 illustrates the potential structure options for the new Grand River roadway crossing.

4.8 STORMWATER MANAGEMENT

The objective of drainage work as part of the proposed Oak Park Road feasibility study is to layout the drainage design criteria, identify the existing drainage conditions and provide preliminary high-level strategy for managing the proposed storm runoff.

The drainage design criteria are defined by the City of Brantford, Grand River Conservations Authority (GRCA), and Ministry of the Environment, Conservations and Parks (MECP) and Ministry of Transportation Ontario (MTO). The criteria for managing stormwater and hydraulic performance of the storm sewer systems, culverts, and proposed enhanced swales in the study area are described in the following sections.

4.8.1 STORMWATER MANAGEMENT

- Quantity Control – Control post-development peak flows to pre-development levels for all storms up to and including the 100-year storm
- Water Quality Control – Enhanced level of protection i.e. 80% Total Suspended Solids (TSS) on long-term basis on an annual loading basis;
- Water quality control prior to discharge to receiver will be provided through a combination of flat-bottom grassed swales and OGS units (where ditching is not feasible).
- Erosion Control – At minimum retain 5 mm runoff on site and for sites with SWM ponds, detain runoff generated from a 25 mm storm for 48 hours; and
- Water Balance – Best efforts to maintain groundwater recharge and hydrologic regimes.

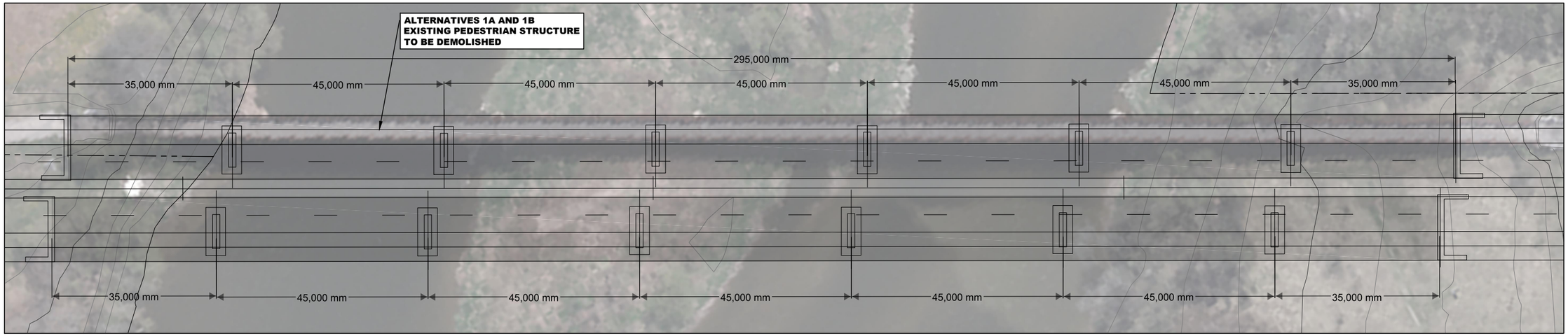
4.8.2 HYDRAULIC DESIGN

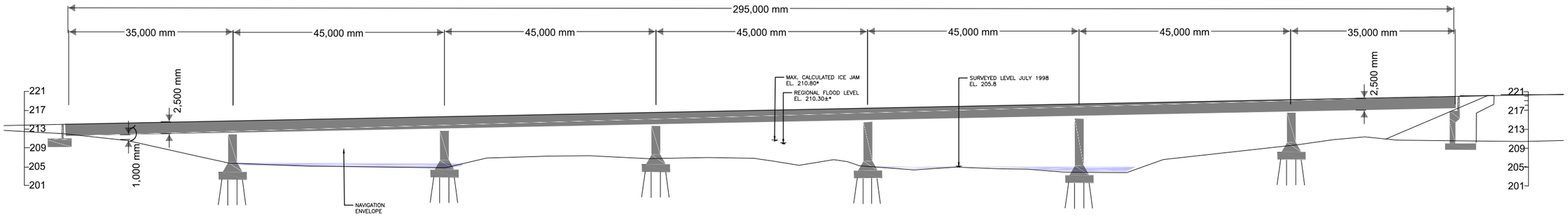
- Conveyance of the minor system (5-year storm) in storm sewers with an inlet entry time of 10 minutes, using Rational Method; and
- Safe overland conveyance of the major system flows, up to and including the 100-year storm;
- The City of Brantford Design and Construction Manual require that culverts and outfalls should be designed in accordance with the MTO Drainage Design Standards, OPSS and OPSD.

Table 6 - Design Flood Hazard Criteria for Bridges and Culverts on Watercourse

Road Classification	Bridges and Culverts[1]		Bridges[2]		Culverts[3]	
	Design Flood		Minimum Freeboard (m)	Minimum Clearance (m)	Minimum Freeboard (m)	Minimum Clearance[4] (m)
	Total span up to 6.0 m	Total span over 6.0 m				
Urban Arterial	50 year	100 year	1.0	1.0	1.0	0.3

Source: [1]: WC-1, [2]: WC-2, [3]: WC-7 - MTO Drainage Design Standards, January 2008;
[4]. Open-footing with erodible bottom only.





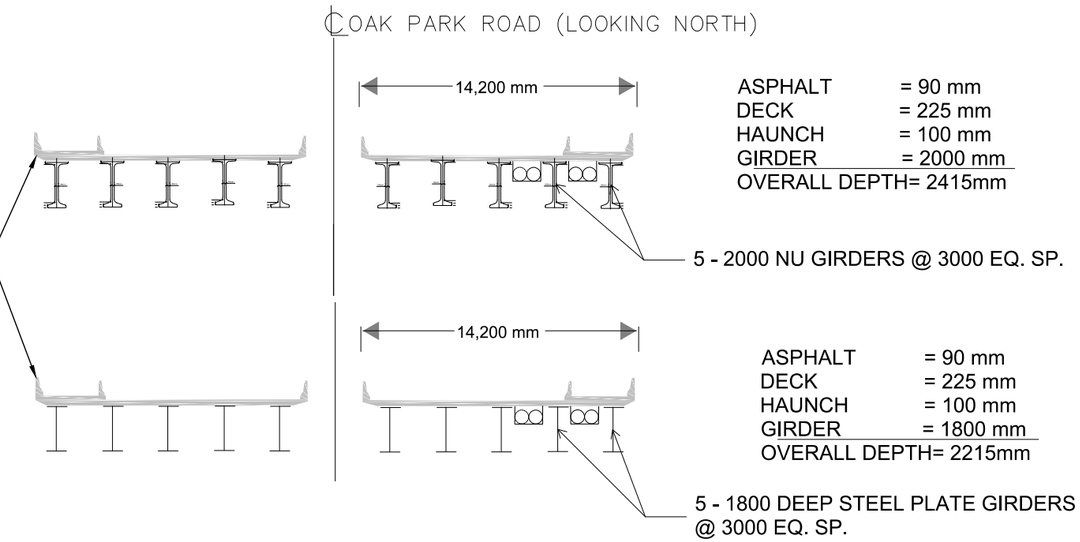
℄ PROFILE VIEW

℄OAK PARK ROAD (LOOKING NORTH)

OPTION
NU GIRDERS

ALTERNATIVES 2A AND 2B
WEST SIDE TRAIL TO NOT BE INSTALLED (DIVERTED TO EXISTING PEDESTRIAN STRUCTURE)

OPTION
STEEL PLATE GIRDERS



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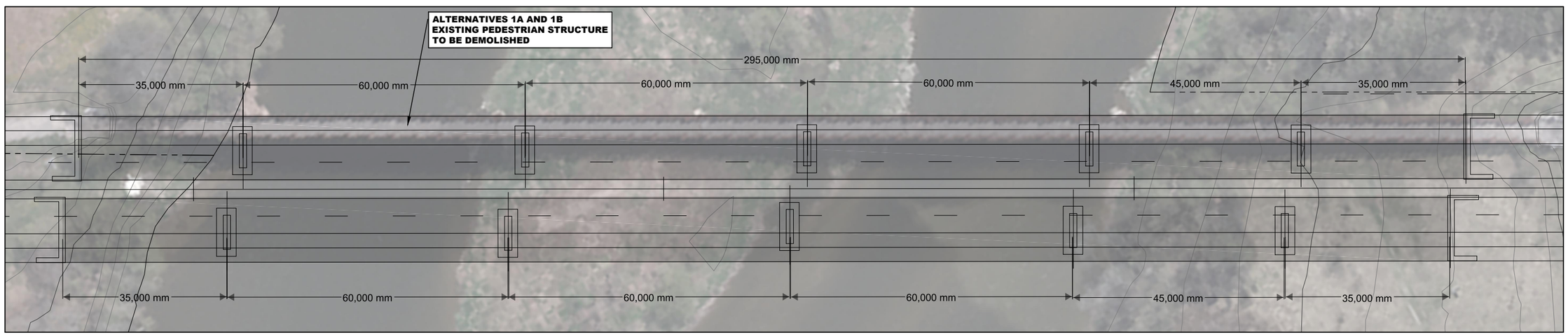
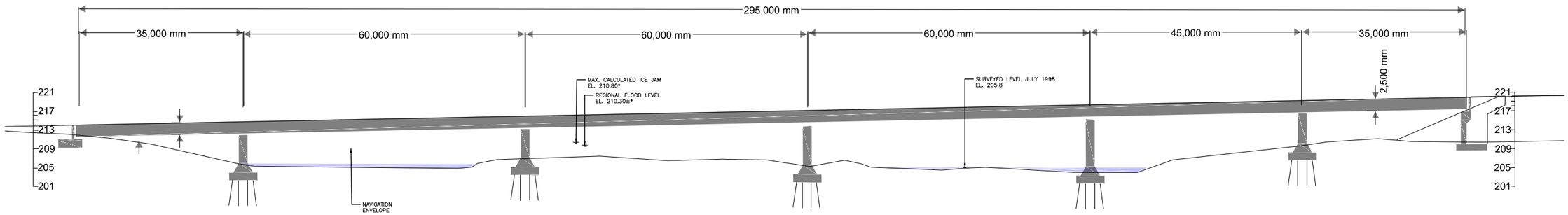
20m 0 40m
HORIZONTAL 1:35
4m 0 8m
VERTICAL 1:35

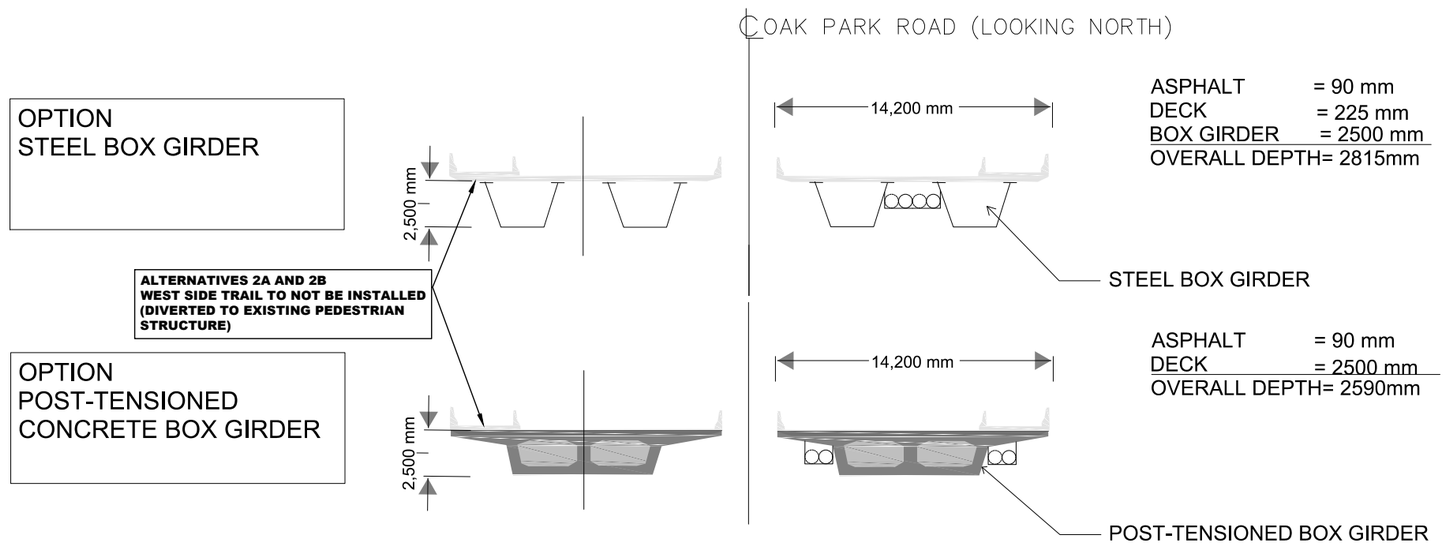
Oak Park Road Alignment
ALTERNATIVES 1A, 1B, 2A AND 2B

FIGURE
11





℄ PROFILE VIEW



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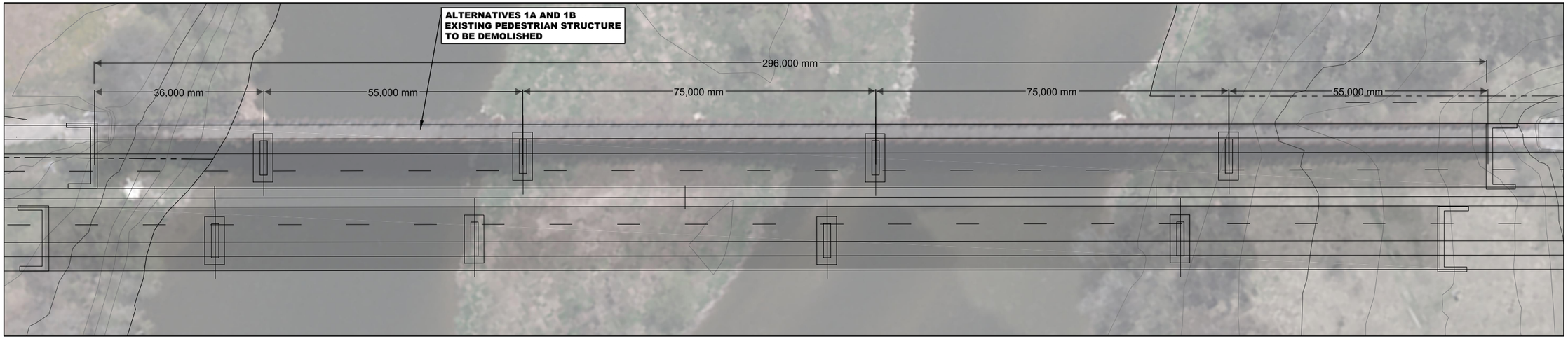
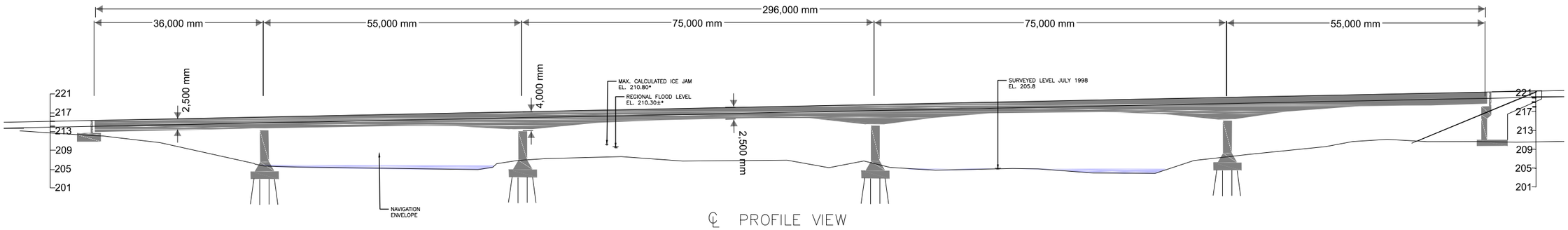
Oak Park Road Alignment
ALTERNATIVES 1A, 1B, 2A AND 2B

FIGURE
11



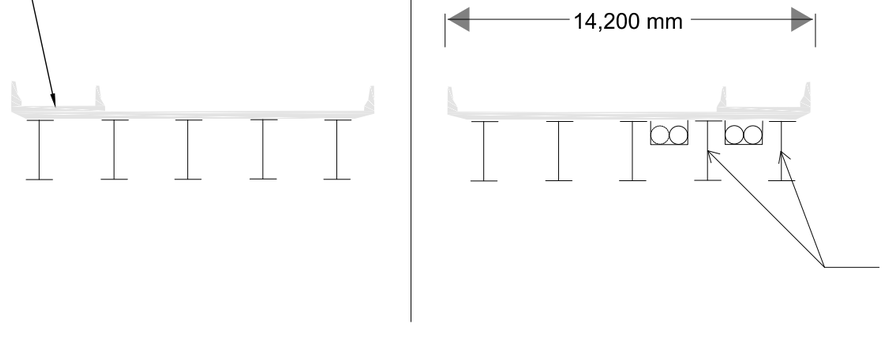


℄ PROFILE VIEW

ALTERNATIVES 2A AND 2B
WEST SIDE TRAIL TO NOT BE INSTALLED (DIVERTED TO EXISTING PEDESTRIAN STRUCTURE)

OPTION
VARIABLE DEPTH
STEEL PLATE GIRDERS

℄OAK PARK ROAD (LOOKING NORTH)



	SPAN	SUPPORT
ASPHALT	= 90 mm	90mm
DECK	= 225 mm	225mm
HAUNCH	= 100 mm	100mm
GIRDER	= 2000 mm	3500mm
OVERALL DEPTH	= 2415mm	3915mm

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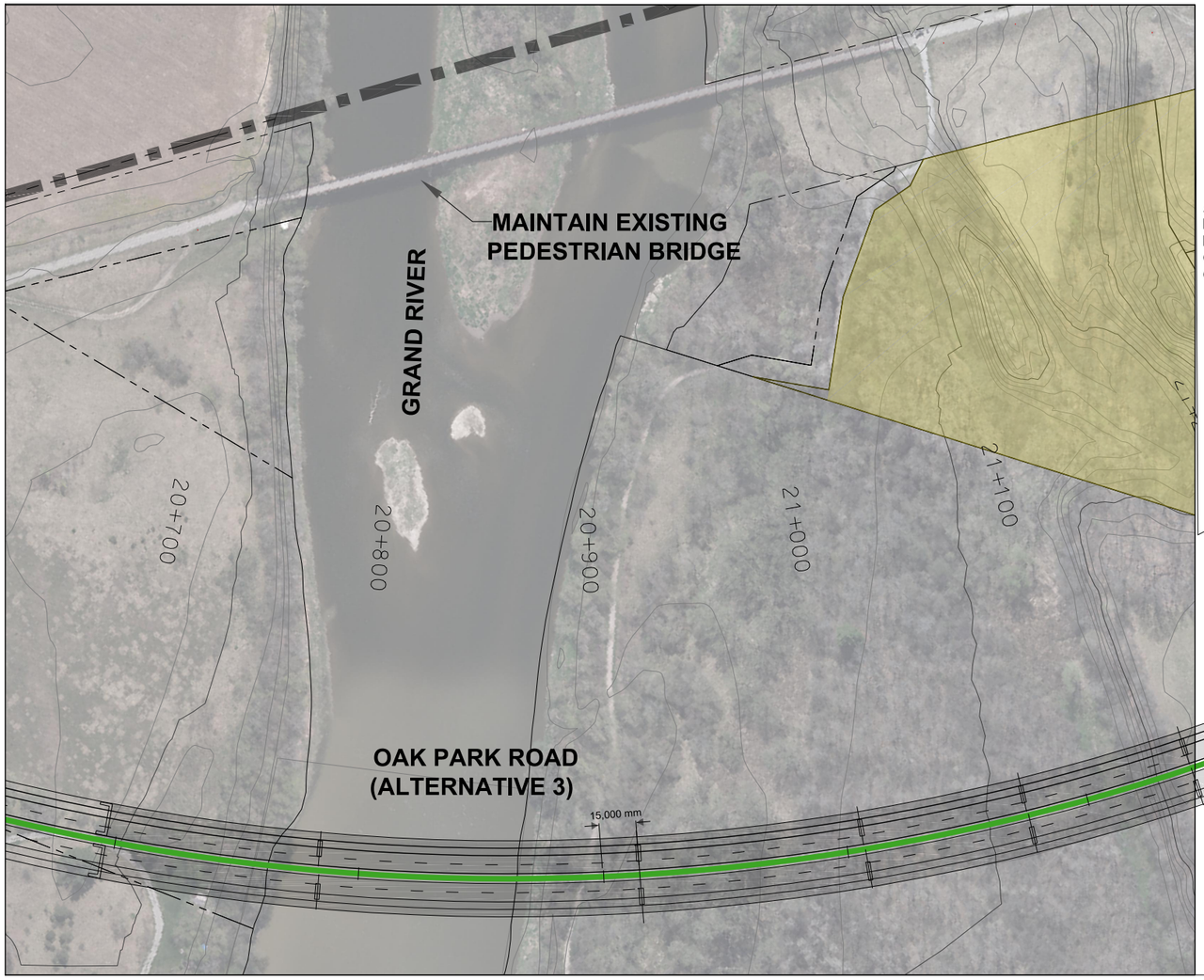
20m 0 40m
HORIZONTAL 1:35
4m 0 8m
VERTICAL 1:35

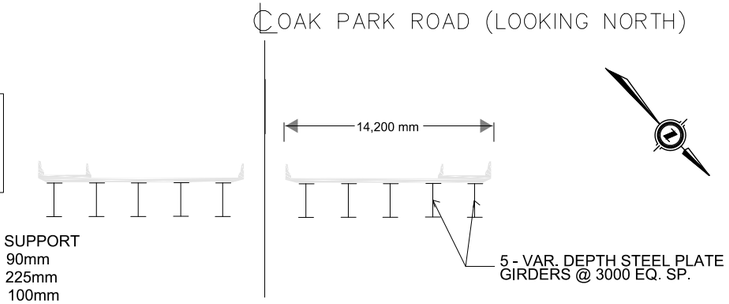
Oak Park Road Alignment
ALTERNATIVES 1A, 1B, 2A AND 2B

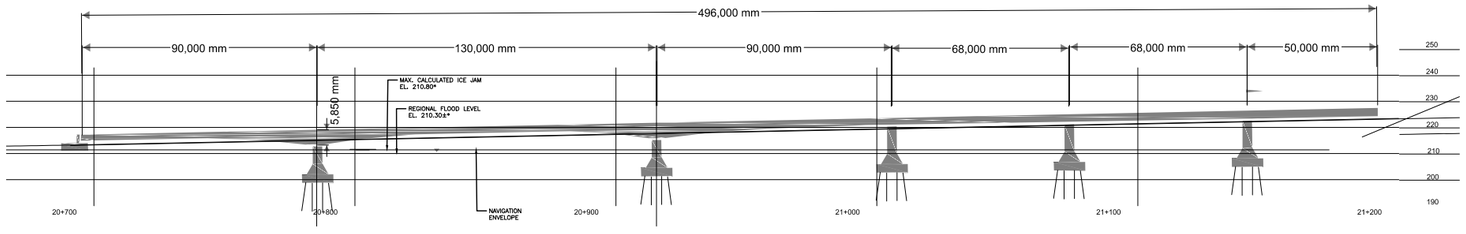
FIGURE
11



OPTION
VARIABLE DEPTH
STEEL PLATE GIRDERS

	SPAN	SUPPORT
ASPHALT	= 90 mm	90mm
DECK	= 225 mm	225mm
HAUNCH	= 100 mm	100mm
GIRDER	= 3000 mm	6000mm
OVERALL DEPTH	= 3415mm	6415mm





℄ PROFILE VIEW

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20m 0 40m
HORIZONTAL 1:45
4m 0 8m
VERTICAL 1:45

Oak Park Road Alignment
ALTERNATIVE 3

FIGURE
11

4.8.3 PROPOSED DRAINAGE CONDITIONS

As part of the proposed Oak Park Road extension, a high-level drainage and stormwater management (SWM) strategy has been prepared to support the proposed Oak Park Road alignment from Hardy Road to Colborne Street West and mitigate any potential negative impacts. **Refer to the Proposed Drainage Plans** for drainage details.

A significant component of the proposed drainage is to Convey flows from **external catchment** areas that naturally drain into the right-of-way. Where feasible, such flows are routed to their historical outlets through culverts with minimal contributions from drainage originating within the right-of-way. Where this cannot be achieved due to proposed road grades or other topographical constraints, the flows will be accommodated within the Oak Park Road drainage and stormwater management systems.

The **road drainage** will be collected through CBs and storm sewer system and conveyed to the outside ditches where it will be treated before discharging to the outlets. Existing outlets have been Identified and the proposed drainage will be directed to these outlets. Refer to the **Proposed Drainage Plans** for the proposed culverts, and outlet locations.

A summary of the proposed strategy includes the following:

- Culverts are proposed to allow the natural flow pattern,
- Storm sewers will capture roadway drainage and direct it to outside ditches,
- Option 1A and 2 (at grade) profile should be refined to allow the natural flow from west to east through culverts,
- The proposed alternatives (1A, 1B, and 2) goes through a natural low point area starting at approx. Station 1+600 to 1+900 which appears to be receiving the drainage from a catchment area of over 40ha. This area will require further study,
- Enhanced Swales are proposed for both quality and quantity control. Detail calculations/modeling will be completed in detail design for pre and post-conditions,
- The flow from the Oakhill Cemetery SWM Pond will be required to size the culvert crossing Oak Park Road,
- The drainage for a portion of the proposed Oak Park Road south of Hardy Road has been designed as part of the *Oak Park Road (B.S.A.R.) Extension South of Hardy Road* Project.

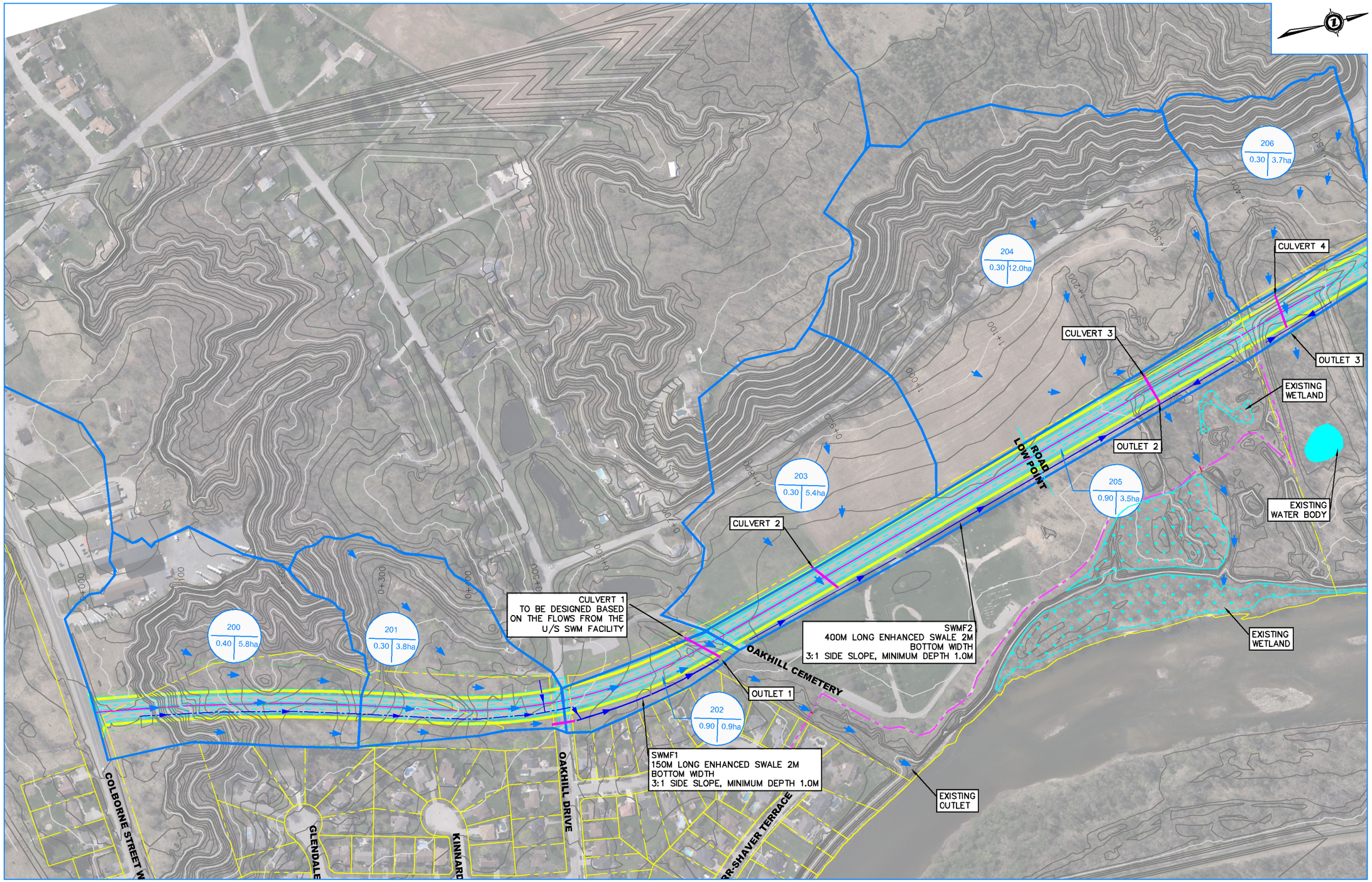
4.8.4 RECOMMENDATIONS

The main objective of the drainage work is to ensure that the proposed road construction project includes the necessary controls to preserve the hydrology and protect the water quality of the receiving systems with a design that is cost effective and practical to construct. The future work/design of stormwater management (SWM) plan shall focus on achieving the control targets outlined by the GRCA in the Grand River Watershed Plan, as this system will be the primary receivers.

All the storm sewers and appurtenance shall be designed in accordance with the City of Brantford Design and Construction Manual – Linear Municipal Infrastructure, as well as industry standards and best practices, including but not limited to:

- Ontario Provincial Standard Specifications (OPSS) and Ontario Provincial Standard Drawings (OPSD)
- Ministry of the Environment, Conservation and Parks (MECP) Design Guidelines for Sewage Works
- MECP Stormwater Management Planning and Design Manual
- Grand River Conservation Authority (GRCA) Stormwater Management Guidelines
- MTO Highway Drainage Design Standards

The drainage for the proposed catchment areas 209, 210 and 211 as shown in the drainage plan will be collected by storm sewer and treated by the proposed SWMF 3 and SWMF 4 before discharging to Grand River. The proposed plan shall be consulted with Grand River Conservation Authority to confirm the requirement of any approval as part of the future design. The proposed bridge alignments extend through slope valleys, wetlands, and floodplains with varying degrees of slope erosion mostly along the banks of the Grand River. The GRCA was contacted via email and confirmed that a Development, Interference with Wetlands and Alterations to Shorelines and Watercourses Permit (O. Reg. 150/06) would be required for any work within these areas. All proposed alignments extend through two small unevaluated wetlands which may require field investigations and Ministry of Natural Resources and Forestry (MNRF) consultation.



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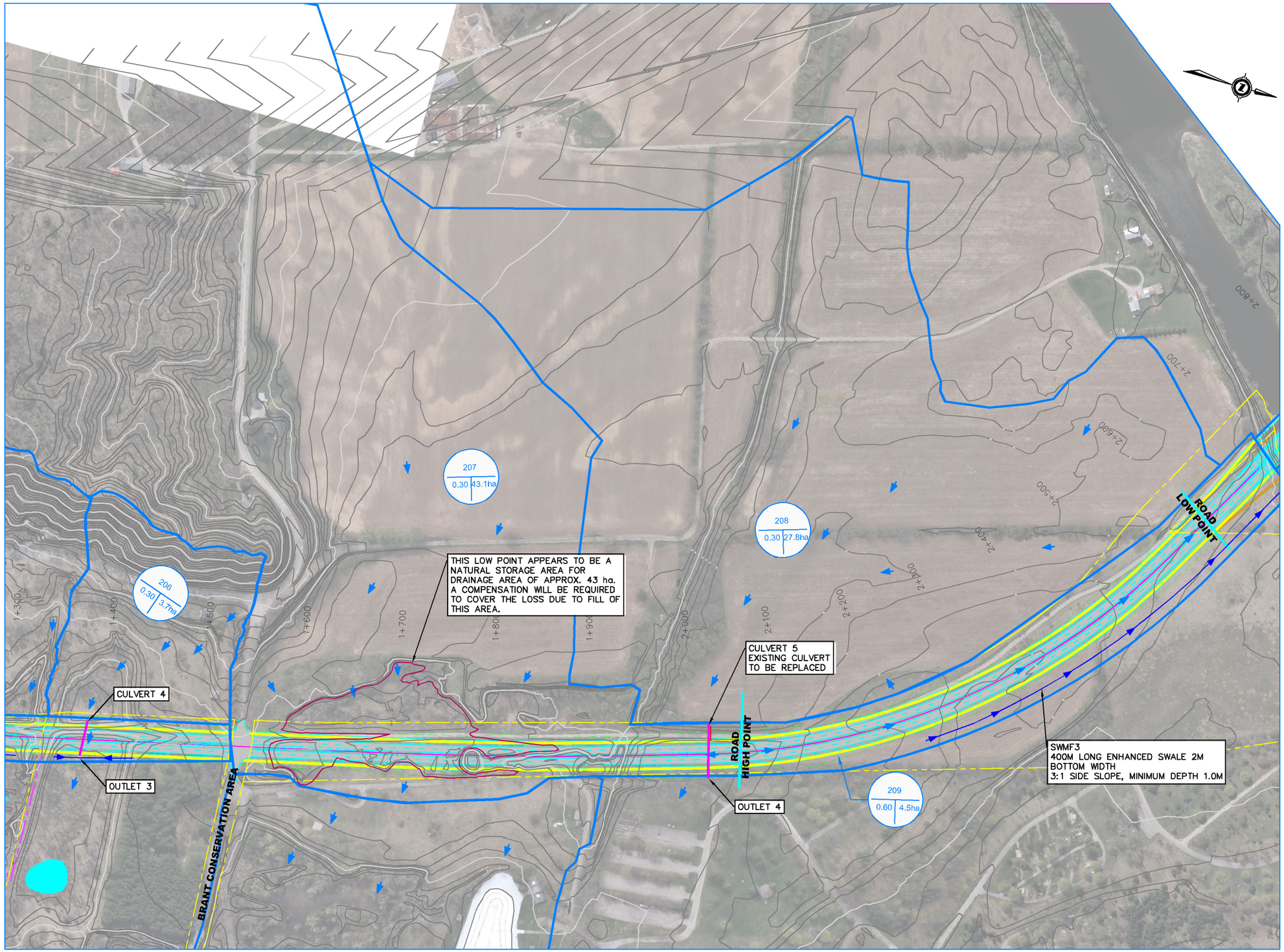
City of Brantford Boundary
STORM SEWER
DRAINAGE CATCHMENT
Draft Approved Development
FLOW DIRECTION
PROPOSED CULVERT

PROPOSED DRAINAGE PLAN

20m 0 40m
HORIZONTAL 1:2000
4m 0 8m
VERTICAL 1:400

Oak Park Road Alignment
PREFERRED ALIGNMENT

EXHIBIT
12



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City of Brantford Boundary
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HORIZONTAL 1:2000
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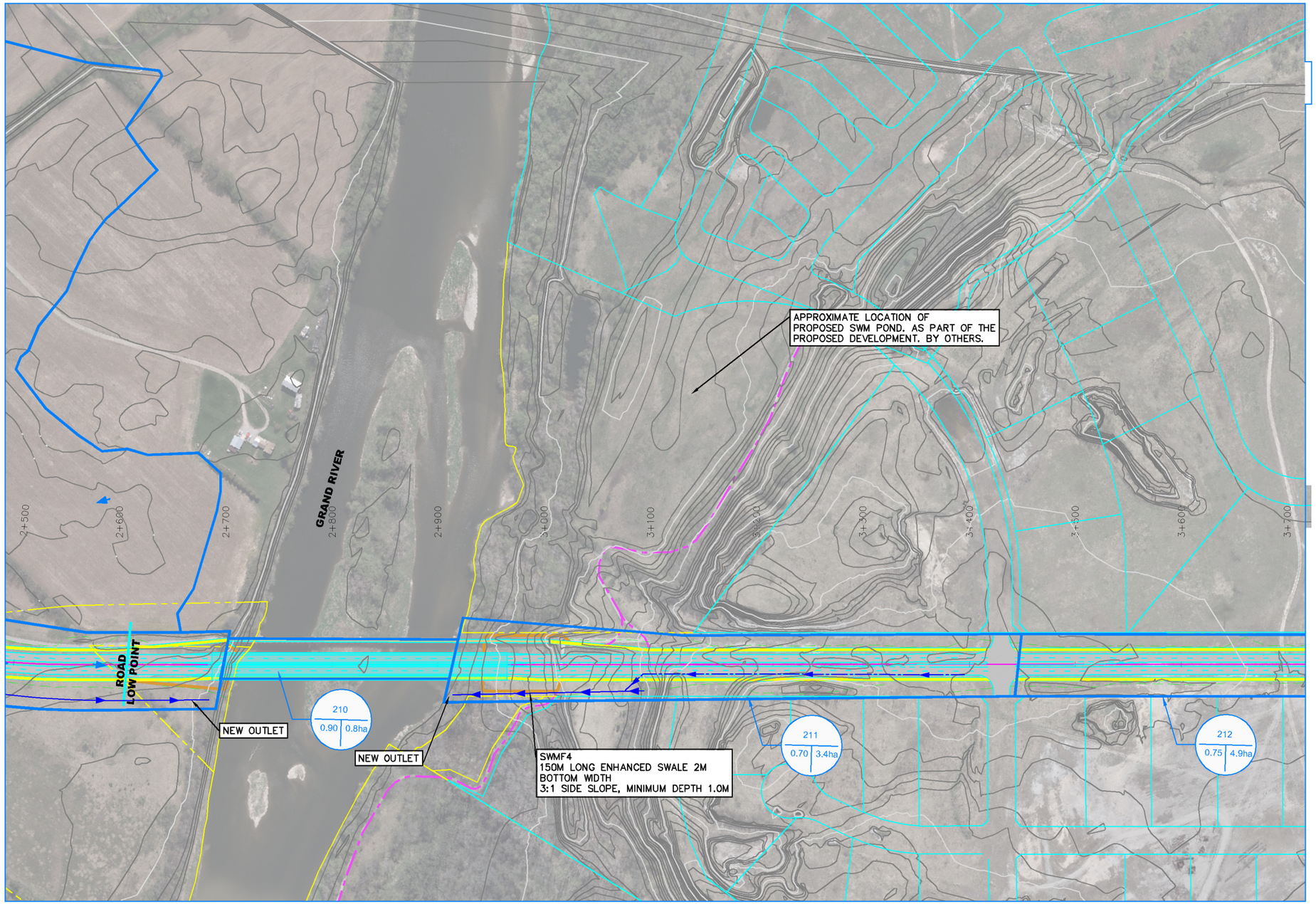
Oak Park Road Alignment
PREFERRED ALIGNMENT

EXHIBIT
12



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PROPOSED DRAINAGE PLAN

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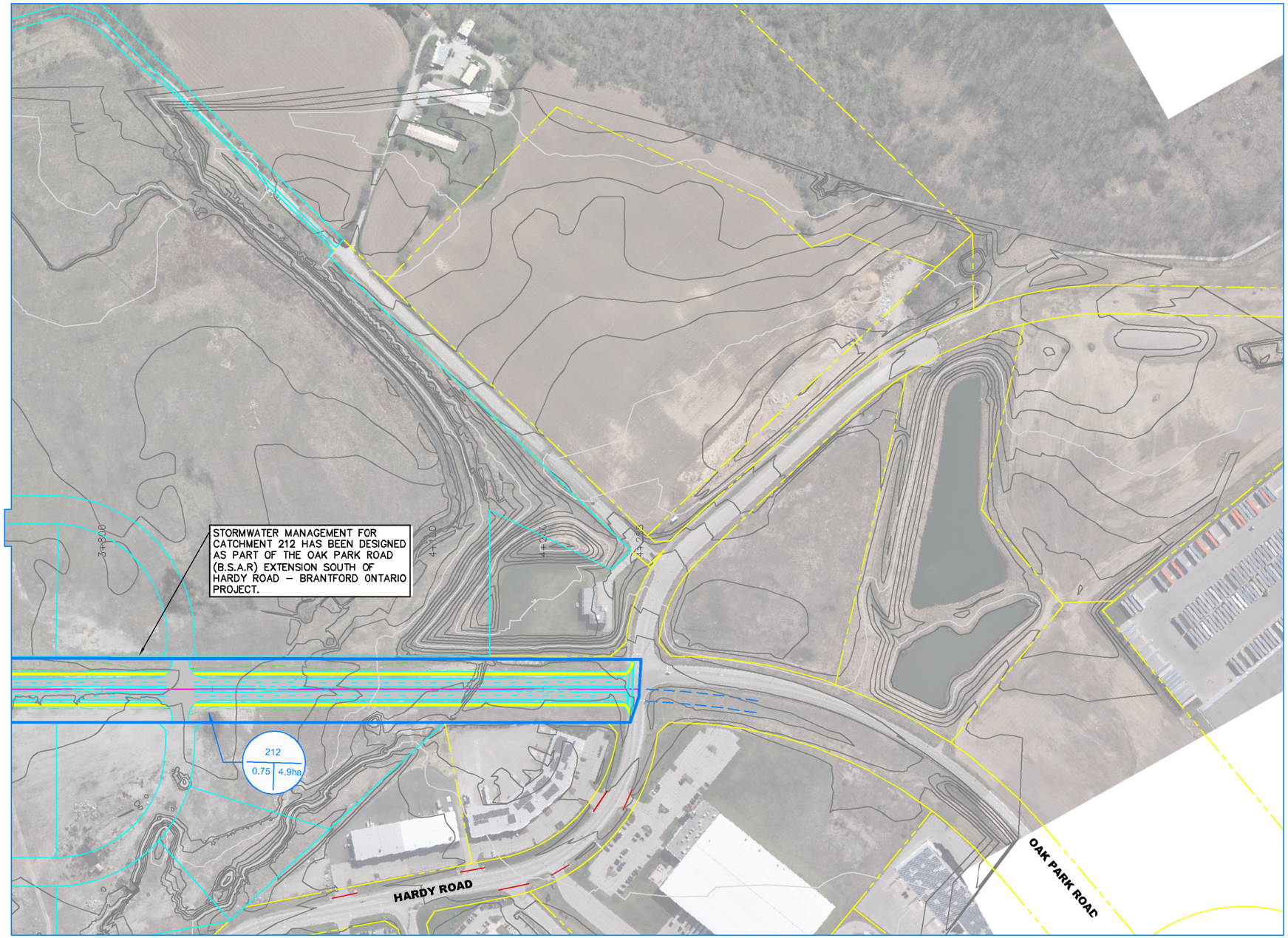
Oak Park Road Alignment
PREFERRED ALIGNMENT

EXHIBIT
12



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HORIZONTAL 1:2000
4m 0 8m
VERTICAL 1:400

Oak Park Road Alignment
PREFERRED ALIGNMENT

EXHIBIT
12

4.9 IMPACTS TO RECREATIONAL TRAILS

Between the Grand River and Oak Hill Cemetery, the existing Oak Hill Trail utilizes the corridor that was protected for the future extension of Oak Park Road. Due to this, any alignment that utilizes this property will have a significant impact on the off-road trail network. As shown on the alignment alternatives, a 3.0m wide multi-use trail has been included to facilitate the active transportation users that would otherwise have used the off-road trail. Connections are provided to the remaining portions of the Oak Hill Trail and the Trans-Canada Trail to the north of the Grand River.

4.10 MUNICIPAL UTILITIES

If the existing Gordon Glaves Crossing pedestrian structure over the Grand River were to be removed as detailed in Alternatives 1A and 1B, the existing watermain and sanitary sewer attached to the bridge would need to be relocated. Since these utilities would still need to cross the River, provisions should be made in the design of the new vehicular structure to eventually allow these to be attached.

5 Cost Estimating

5.1 ROADWORKS

Parsons calculated a per metre cost for each of the roadway alignment alternatives that accounts for items such as asphalt, concrete, granulars, topsoil, lighting, storm sewers and landscaping. These costs were developed based on past contracts tendered by Parsons for local municipalities.

5.2 STRUCTURAL

Cost estimates for the various types of structures proposed for the new Grand River crossing were developed using data from the 2011 Ministry of Transportation Parametric Estimating Guide. Costs within this guide are derived from tendered capital contracts from 2002 to 2010 and reflects the average price of the three low bidders. All bid values are inflated to 2011 present day worth.

The costs presented in the guide reflect the average construction costs (total of all contract items) but do not include any right-of-way costs associated with property acquisition including purchasing, legal fees, costs of moving or altering utilities, or building removal unless part of the construction contract.

75-year lifecycle costs were calculated for each structure type based on the typical need for two minor and two major rehabilitations. Table 7 below summarizes the average 75-year structure lifecycle cost for each roadway alignment across all potential structure types.

Table 7 – 75-Year Lifecycle Costs

	ALTERNATIVE 1A/1B	ALTERNATIVE 2A/2B	ALTERNATIVE 3
75-Year Lifecycle Cost, Average of All Structure Types (2 Minor, 2 Major Rehabs)	$34,208,368	$30,113,000	$64,797,440
Gordon Glaves Crossing Pedestrian Structure	-	$5,007,600	$5,007,600
Total	$34,208,368	$35,120,600	$69,805,040

It should be noted that although lifecycle costs were calculated, the figures were not given weight in the determination of a preferred alternative due to the variability between the numerous structure types. The forthcoming Environmental Assessment will examine a preferred structure type and examine the associated costs in more detail.

5.3 OPERATING COSTS

Annual operating costs for each roadway alignment alternative were developed utilizing data from Ontario's Municipal Performance Measurement Program (MPMP). The program was introduced in 2000 by the Ontario government and required municipalities to report annually on 54 measures of effectiveness and efficiency across 12 key service areas. Included in these reports are operating costs for paved roads, winter maintenance, urban drainage and bridges and culverts. Generally, data collected from 2009 onwards is considered comparable from an analysis standpoint. The collection of MPMP data was discontinued in 2014.

5.4 COST ESTIMATE SUMMARY

Table 8 below summarizes the total capital, design, and operating costs for each of the proposed alignment alternatives. A detailed cost estimate is contained in Attachment D.

Table 8 – Cost Estimate Summary

	ALTERNATIVE 1A	ALTERNATIVE 1B	ALTERNATIVE 2A	ALTERNATIVE 2B	ALTERNATIVE 3
Roadway Costs[1]	$22,163,318	$27,401,403	$23,778,363	$29,010,385	$24,722,471
Structural Costs[2]	$24,545,098	$28,545,098	$21,606,600	$25,606,600	$35,497,728
Servicing Costs[3]	$1,120,000	$1,120,000	$320,000	$320,000	$320,000
Engineering Costs[4]	$12,457,104	$14,766,625	$11,926,241	$14,234,246	$15,635,050
Subtotal	$60,285,520	$71,833,126	$57,631,204	$69,171,231	$76,175,248
Contingency (25%)	$15,071,380	$17,958,281	$14,407,801	$17,292,808	$19,043,812
Grand Total	**$75,356,900**	**$89,791,407**	**$72,039,005**	**$86,464,039**	**$95,219,060**
Cost/m	$17,603	$20,975	$16,820	$20,188	$21,446
Total Annual Operating Costs[5]	$328,206	$334,691	$330,364	$336,695	$362,211
Total Annual Costs[6]	$834,119	$861,098	$843,027	$869,368	$962,738

Notes

[1]Roadway costs include granulars, asphalt, concrete, curb, storm sewer, earth cut/fill, topsoil, landscaping, traffic signals, lighting, noise walls and revisions to the Oak Hill Cemetery (if required).

[2]Structural costs include an average cost of the new Grand River roadway crossing and the Oakhill Drive/Oak Hill Cemetery grade separation structures (if applicable).

[3]Servicing includes culverts, stormwater management, and relocation of municipal services.

[4]Engineering includes cost of environmental assessment, design, geotechnical investigations, contract administration, environmental permits and archaeology.

[5]Annual operating costs are defined as the sum of salaries, wages, employee benefits, materials, contracted services, rents and financial expenses, external transfers, interfunctional adjustments and allocation of program support less the revenue from other municipalities.

[6]Total annual costs are defined as the sum of operating costs as defined by MPMP, amortization and interest on long term debt less the revenue from other municipalities for tangible capital assets.

6 Evaluation of Alignment Alternatives

6.1 EVALUATION CRITERIA

A comprehensive evaluation criterion was developed to evaluate each alignment alternative in six categories; transportation, technical requirements, socio-economic environment, cultural heritage, natural environment and cost. Table 9 describes the various components of each category.

Table 9 – Evaluation Criteria

Transportation	
Planning Policies and Objectives	Does the alternative meet the objectives of local policies and plans?
Traffic Operations/Performance	Will the projected traffic volumes be accommodated?
Connectivity	Does the alternative provide connectivity to the roadway network
Active Transportation / Trails	Are active transportation facilities provided? Do they meet current accessibility standards?
Transit	Will the alternative provide benefits to Brantford Transit?
Commercial and Residential Access	Will the alternative impact the access for commercial/residential properties adjacent to the corridor (including Oakhill Cemetery)?
Technical Requirements	
Structural	What type of structure will be required to cross the Grand River?
Geometric Design Standards	Does the alternative meet current geometric design standards?
Servicing	Will the alternative allow for the capture of water/waste water within the corridor?
Stormwater	What effect will the alternative have on stormwater and drainage?
Socio-Economic Environment	
Compatibility with proposed development projects	Does the alternative fit well with the planned residential developments north of the Grand River?
Property	Will the alternative require the purchase/acquisition of property?
Compatibility with adjacent residents and businesses	Does the alternative fit well with the existing adjacent land uses?
Cultural Heritage	
Archaeological Resources	Will the alternative have potential impact to existing archaeological resources?
Cultural and Built Heritage	Will the alternative have potential to impact existing cultural landscapes/built heritage resources?
Aboriginal/ First Nation Communities	Will the alternative impact Aboriginal or First Nation communities with an interest in the area?
Natural Environment	

Ministry of Natural Resources and Forestry (MNRF)	Does the alternative impact Provincially significant wetlands or areas of natural and scientific interest?
Environmental Protection/Control Policy Areas	Does the alternative impact City of Brantford Policy areas?
Vegetation	What impacts does the alternative have on surrounding vegetation?
Aquatic Species/Watercourses	What impacts does the alternative have on the existing fish community, their habitats and watercourses?
Wildlife and Wildlife Habitat	What impacts does the alternative have on the existing wildlife and their habitats?
Brant Conservation Area	What impacts will the alternative have on the Brant Conservation Area?
Grand River Conservation Authority (GRCA)	Will the alternative impact significant areas identified by the GRCA (includes floodplain, protected areas, steep slopes, etc.)?
Cost	
Capital Cost	What is the cost to construct the alternative?
Property Cost	What will be the cost to acquire the property needed for the alternative?
Utilities	What will be the cost to relocate utilities?
Operation and Maintenance Cost	What will be the cost to operate and maintain the alternative?

6.2 GENERAL EVALUATION

As this report is a high-level feasibility study with a future Environmental Assessment and Detailed Design yet to come, some of the evaluation criteria components cannot be examined in detail at this time. Generally, the criteria listed under Technical Requirements, Cultural Heritage and Natural Environment scored equally across all alignment alternatives. These sections are typically refined during the environmental assessment of a project when detailed archaeological and natural environment assessments would be undertaken.

6.3 EVALUTATION OF ALTERNATIVES

Using the evaluation criteria developed above, each alignment was evaluated against each other and a 'do nothing' option. Figure 13Figure 1 illustrates this comparison below. It should be noted that for the purpose of this study, all criteria were given an equal weighting in the final scoring. Given this, it is possible that the highest scoring alternative may not necessarily become the preferred alignment.

6.3.1 DO NOTHING

The purpose of this feasibility study is to assess if an extension of Oak Park Road from Hardy Road to Colborne Street West is possible to construct and if so, what it would look like and how it will impact the surrounding environment. A 'do nothing' option has been included in the evaluation to maintain consistency with any future environmental assessment for this corridor. Therefore, a 'do nothing' option will generally score higher than the proposed alignment alternatives on the environmental criteria since there will be no impact to the existing area including the Grand River. The 'do nothing' scenario will generally score lower on the technical criteria, as it does not provide a solution to the existing congestion issues in the City.

6.3.2 ALTERNATIVE 1A EVALUATION

Overall, Alternative 1A scored slightly lower than Alternatives 2A and 2B but close enough to still warrant consideration. Lower rankings were assigned for the requirement to relocate the watermain and sanitary sewer from the existing pedestrian structure to the new vehicle structure over the Grand River.

Additionally, Alternative 1A scored lower as access across Oak Park Road would be severed at Oak Hill Drive and the Oak Hill Cemetery. This will limit emergency access to the surrounding residential neighbourhoods and cut off the Cemetery lands from the existing entrance features and main offices. There is potential to install a new connection to Colborne Street W. from either Wildewood Avenue or Elderwood Avenue however; doing so would require the purchase of existing residential properties and could significantly alter the flow of traffic through the neighbourhood.

6.3.3 ALTERNATIVE 1B EVALUATION

Although Alternative 1B is similar to Alternative 2B, it scored a few points lower due to the removal of the existing pedestrian bridge over the Grand River and associated costs with relocating the watermain and storm sewer to the new structure.

6.3.4 ALTERNATIVE 2A EVALUATION

Based on the evaluation criteria outlined above, Alternative 2A scored the highest of the five alignment alternatives however; alternatives 2B and 1A were within a few points. Although functionally similar to Alternative 1A, the alternative scored slightly higher as it had the lowest capital cost and did not require utilities to be relocated from the existing pedestrian structure over the Grand River.

6.3.5 ALTERNATIVE 2B EVALUATION

Alternative 2B scored well, ranking only two points behind Alternative 2A. Key differences between the two alternatives were the additional property required to accommodate the grade separation at Oakhill Drive and the Oak Hill Cemetery and the overall higher costs associated with this.

6.3.6 ALTERNATIVE 3 EVALUATION

Of the five evaluated alignment alternatives for the proposed Oak Park Road extension, Alternative 3 scored the lowest overall. This can primarily be attributed to the location of the new structure over the Grand River. Although the structure location was selected to cross the river at the narrowest point (based on available aerial imagery), it was discovered that the lands to the north of the river are low-lying and have the potential to flood during high-water levels. Additionally, a review of available environmental data revealed that these lands are designated as a Provincially Significant Wetland by the Ministry of Natural Resources and Forestry (MNRF) and as an Environmental Protection Policy Area by the City of Brantford.

In order to place a structure in this area, the required span would approach 500m in length; approximately 200 metres longer than the other alignment alternatives. A structure of this length would require the placement of piers in the environmentally sensitive areas which significantly impacts the score of this Alternative. Another significant impact in the evaluation of this alternative is the increased costs that come with an extended structure. With a longer span, fewer structure materials are available for us. As noted previously, only variable depth steel plate girders were identified for use in this alternative.

6.4 OAK HILL CEMETERY

All five of the proposed alignment alternatives would bisect the Oak Hill Cemetery property, similar to what was shown in the 1990 Oak Hill Cemetery Master Plan. Alternatives 1A, 2A and 3 would sever all continuous access across Oak Park Road and isolate the existing built-out portion of the cemetery from the entrance features and offices located near the intersection of Oak Hill Drive and Jennings Road.

It would be preferable from an accessibility and maintenance perspective to maintain a private, continuous access across Oak Park Road. Therefore, either Alternative 1B or 2B would best serve the long-term needs of the Oak Hill Cemetery as they would provide a grade separation to allow traffic to cross under Oak Park Road.

6.5 BRANT CONSERVATION AREA

All alignments appear to have a similar footprint on the Brant Conservation Area. A new intersection would be provided at the location of the existing access road. Some minor alterations may be required to the internal roads of the Conservation Area.

Oak Park Road Extension
Evaluation of Alignment Options

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Evaluation Criteria	Description	Do Nothing		Alternative 1A		Alternative 1B		Alternative 2A		Alternative 2B		Alternative 3	
	ALIGNMENT DESCRIPTION	Baseline case alternative forms basis of comparison		Straight extension; centered on ROW; Removes pedestrian bridge; steep grade at Colborne; severs access to Oakhill area & Cemetery		Straight extension; centered on ROW; Removes pedestrian bridge; flatter grade at Colborne; maintains access to Oakhill area & Cemetery with tunnels		Shift to east; maintain pedestrian bridge;steep grade at Colborne; severs access to Oakhill area & Cemetery		Shift to east; maintain pedestrian bridge;flatter grade at Colborne; maintains access to Oakhill area & Cemetery with tunnels		Cross Grand River at narrowest point; splits draft approved developments; longest alignment; bridge crosses floodplain and wetland;	
Transportation													
Planning Policies and Objectives	Does the alternative meet the objectives of local policies and plans?	0	No new connection available	4	Meets the City's Planning Objectives of the Official Plan	4	Meets the City's Planning Objectives of the Official Plan	4	Meets the City's Planning Objectives of the Official Plan	4	Meets the City's Planning Objectives of the Official Plan	2	Meets the City's Planning Objectives of the Official Plan however; conflicts with pre-approved TCA development plans on east side
Traffic Operations/Performance	Will the projected traffic volumes be accommodated?	0	Will not serve increase in traffic; operations in other areas will continue to deteriorate	4	Equal - Same capacity in each option	4	Equal - Same capacity in each option	4	Equal - Same capacity in each option	4	Equal - Same capacity in each option	4	Equal - Same capacity in each option;
Connectivity	Does the alternative provide connectivity to the roadway network	0	No new connection available	2	New north-south connection in west end of City; no connection at Oakhill Drive, relocated access to Cemetery	4	New north-south connection in west end of City	2	New north-south connection in west end of City; no connection at Oakhill Drive, relocated access to Cemetery	4	New north-south connection in west end of City	2	New north-south connection in west end of City; no connection at Oakhill Drive, relocated access to Cemetery
Active Transportation / Trails	Are active transportation facilities provided? Do they meet current accessibility standards?	2	Existing off-road trail network to remain in place. Grades not believed to meet AODA standards; granular surface.	3	AODA compliant multi-use trails provided on both sides of Oak Park Road; connections provided to intersecting off-road trails. Steeper grade (6%) between Colborne St. W. and Oakhill Drive.	4	AODA compliant multi-use trails provided on both sides of Oak Park Road; connections provided to intersecting off-road trails. Flatter grade (<4%) between Colborne St. W. and Oakhill Drive.	3	AODA compliant multi-use trails provided on both sides of Oak Park Road; connections provided to intersecting off-road trails. Steeper grade (6%) between Colborne St. W. and Oakhill Drive.	4	AODA compliant multi-use trails provided on both sides of Oak Park Road; connections provided to intersecting off-road trails. Flatter grade (<4%) between Colborne St. W. and Oakhill Drive.	3	AODA compliant multi-use trails provided on both sides of Oak Park Road; connections provided to intersecting off-road trails. Steeper grade (6%) between Colborne St. W. and Oakhill Drive.
Transit	Will the alternative provide benefits to Brantford Transit?	0	No new connection available	4	Equal-New connection Hardy-Colborne	4	Equal-New connection Hardy-Colborne	4	Equal-New connection Hardy-Colborne	4	Equal-New connection Hardy-Colborne	4	Equal-New connection Hardy-Colborne
Commercial and Residential Access	Will the alternative impact the access for commercial/residential properties adjacent to the corridor (including Oakhill Cemetery)?	0	Access to developing industrial/residential areas not provided	1	Access across Oakhill Drive severed; Singular access to existing neighbourhood. Oak Hill Cemetery access via new intersection to Oak Park Road. Access to Brant Conservation Area and proposed developments maintained.	3	Access across Oakhill Drive and Oak Hill Cemetery to remain via grade seperation although no direct access to Oak Park Road. Access to Brant Conservation Area and proposed developments maintained.	1	Access across Oakhill Drive severed; Singular access to existing neighbourhood. Oak Hill Cemetery access via new intersection to Oak Park Road. Access to Brant Conservation Area and proposed developments maintained.	3	Access across Oakhill Drive and Oak Hill Cemetery to remain via grade seperation although no direct access to Oak Park Road. Access to Brant Conservation Area and proposed developments maintained.	1	Access across Oakhill Drive severed; Oak Hill Cemetery access via new intersection to Oak Park Road. Access to Brant Conservation Area maintained. Access to proposed developments will be impacted with alignment shift to east.
Technical Requirements													
Structural	What type of structure will be required to cross the Grand River?	1	Existing pedestrian structure over Grand River; no vehicular access available	3	Allows for multiple structure options including materials and pier spacing	3	Allows for multiple structure options including materials and pier spacing	3	Allows for multiple structure options including materials and pier spacing	3	Allows for multiple structure options including materials and pier spacing	0	Limited structure options available due to large span; high impact to environmental areas
Geometric Design Standards	Does the alternative meet current geometric design standards?	-	Existing geometry has not been reviewed.	4	Meets Geometric Design Standards	4	Meets Geometric Design Standards	4	Meets Geometric Design Standards	4	Meets Geometric Design Standards	4	Meets Geometric Design Standards
Servicing	Will the alternative allow for the capture of water/waste water within the corridor?	2	Servicing already exists	4	Accommodates servicing requirements	4	Accommodates servicing requirements	4	Accommodates servicing requirements	4	Accommodates servicing requirements	4	Accommodates servicing requirements
Stormwater	What effect will the alternative have on stormwater and drainage?	4	No stormwater impacts; No opportunity for enhancement	4	Stormwater and drainage impacts similar	4	Stormwater and drainage impacts similar	4	Stormwater and drainage impacts similar	4	Stormwater and drainage impacts similar	4	Stormwater and drainage impacts similar
Socio-Economic Environment													
Compatibility with proposed development projects	Does the alternative fit well with the planned residential developments north of the Grand River?	0	Proposed developments will not be served	4	Alignment consistent with proposed site plans	4	Alignment consistent with proposed site plans	4	Alignment consistent with proposed site plans	4	Alignment consistent with proposed site plans	1	Alternative will require full re-design of proposed site plan
Property	Will the alternative require the purchase/acquisition of property?	2	No property impacts; A corridor has been dedicated; Property could be required elsewhere in the City to improve other corridors	3	Property required for intersection at Colborne Street and minor grading along Cemetery and Brant Conservation Area (potential for mitigation measures)	2	Property required for intersection at Colborne Street. Property required to accommodate grade seperation at Oakhill Drive (unless other measures taken)	3	Property required for intersection at Colborne Street and minor grading along Cemetery and Brant Conservation Area (potential for mitigation measures)	2	Property required for intersection at Colborne Street. Property required to accommodate grade seperation at Oakhill Drive (unless other measures taken)	0	Property required for intersection at Colborne Street; Significant portion of proposed development would need to be acquired.
Compatibility with adjacent residents and businesses	Does the alternative fit well with the existing adjacent land uses?	2	Impacts can be mitigated	3	Impacts to existing lands similar	3	Impacts to existing lands similar	3	Impacts to existing lands similar	3	Impacts to existing lands similar	1	Impact to lands at north end and around Grand River significant
Cultural Heritage													
Archaeological Resources	Will the alternative have potential impact to existing archaeological resources?	4	No impacts	2	Potential impacts to archaeological resources similar	2	Potential impacts to archaeological resources similar	2	Potential impacts to archaeological resources similar	2	Potential impacts to archaeological resources similar	1	Potential impacts to archaeological resources greater due to length
Cultural and Built Heritage	Will the alternative have potential to impact existing cultural landscapes/built heritage resources?	4	No impacts	2	Potential impacts to cultural / heritage similar	2	Potential impacts to cultural / heritage similar	2	Potential impacts to cultural / heritage similar	2	Potential impacts to cultural / heritage similar	2	Potential impacts to cultural / heritage similar
Aboriginal/First Nation Communities	Will the alternative impact Aboriginal or First Nation communities with an interest in the area?	4	No impacts	2	Potential impacts to First Nations similar	2	Potential impacts to First Nations similar	2	Potential impacts to First Nations similar	2	Potential impacts to First Nations similar	2	Potential impacts to First Nations similar
Natural Environment													
Ministry of Natural Resources and Forestry (MNRF)	Does the alternative impact Provincially significant wetlands or areas of natural and scientific interest?	4	No impacts	3	Minor impact to Provincially Significant Wetland on north side of Grand River	3	Minor impact to Provincially Significant Wetland on north side of Grand River	3	Minor impact to Provincially Significant Wetland on north side of Grand River	3	Minor impact to Provincially Significant Wetland on north side of Grand River	1	Significant impact to Provincially Significant Wetland on north side of Grand River
Environmental Protection/Control Policy Areas	Does the alternative impact City of Brantford Policy areas?	4	No impacts	3	Minor impact to Environmental Control Policy Area	3	Minor impact to Environmental Control Policy Area	3	Minor impact to Environmental Control Policy Area	3	Minor impact to Environmental Control Policy Area	1	Significant impact to Environmental Protection and Control Policy Areas
Vegetation	What impacts does the alternative have on surrounding vegetation?	4	No impacts	2	Minor impacts to existing vegetation	2	Minor impacts to existing vegetation	2	Minor impacts to existing vegetation	2	Minor impacts to existing vegetation	1	Greater impact to to vegetation patch on north side of Grand River
Aquatic Species/Watercourses	What impacts does the alternative have on the existing fish community, their habitats and watercourses?	4	No impacts	3	Minor Impacts to fish community, their habitats and SAR.	3	Minor Impacts to fish community, their habitats and SAR.	3	Minor Impacts to fish community, their habitats and SAR.	3	Minor Impacts to fish community, their habitats and SAR.	1	Greater impacts to fish community, their habitats and SAR.
Wildlife and Wildlife Habitat	What impacts does the alternative have on the existing wildlife and their habitats?	3	No impacts. No opportunity for enhancement	2	Minor impacts to existing vegetation and habitat	2	Minor impacts to existing vegetation and habitat	2	Minor impacts to existing vegetation and habitat	2	Minor impacts to existing vegetation and habitat	2	Minor impacts to existing vegetation and habitat
Brant Conservation Area	What impacts will the alternative have on the Brant Conservation Area?	4	No impacts	2	Potential impacts to First Nations similar	2	Potential impacts to First Nations similar	2	Potential impacts to First Nations similar	2	Potential impacts to First Nations similar	2	Potential impacts to First Nations similar
Grand River Conservation Authority (GRCA)	Will the alternative impact significant areas identified by the GRCA (includes floodplain, protected areas, steep slopes, etc.)?	3	No impacts. No opportunity for enhancement	3	Minor impacts to steep slopes and protected areas/riverbed	3	Minor impacts to steep slopes and protected areas/riverbed	3	Minor impacts to steep slopes and protected areas/riverbed	3	Minor impacts to steep slopes and protected areas/riverbed	1	Impacts floodplain on north side of Grand River
Cost													
Capital Cost	What is the cost to construct the alternative?	2	Cost will be required to upgrade other routes	4	Lowest cost	2	Moderate cost	4	Lowest cost	2	Moderate cost	1	Highest cost
Property Cost	What will be the cost to acquire the property needed for the alternative?	2	Cost may be required to acquire property on other routes to improve traffic capacity	3	Property required for intersection at Colborne Street and minor grading along Cemetery and Brant Conservation Area (potential for mitigation measures)	2	Property required for intersection at Colborne Street. Property required to accommodate grade seperation at Oakhill Drive (unless other measures taken)	3	Property required for intersection at Colborne Street and minor grading along Cemetery and Brant Conservation Area (potential for mitigation measures)	2	Property required for intersection at Colborne Street. Property required to accommodate grade seperation at Oakhill Drive (unless other measures taken)	0	Property required for intersection at Colborne Street; Significant portion of proposed development would need to be acquired.
Utilities	What will be the cost to relocate utilities?	4	No cost	1	Relocate existing utilities from pedestrian bridge to new structure	1	Relocate existing utilities from pedestrian bridge to new structure	3	Potential local relocations at Colborne Street and Hardy Road	3	Potential local relocations at Colborne Street and Hardy Road	3	Potential local relocations at Colborne Street and Hardy Road
Operation and Maintenance Cost	What will be the cost to operate and maintain the alternative?	2	Increased cost to maintain other routes in the City due to increases in traffic use	3	Similar (+/- 5%) operating and maintenance costs	3	Similar (+/- 5%) operating and maintenance costs	3	Similar (+/- 5%) operating and maintenance costs	3	Similar (+/- 5%) operating and maintenance costs	1	Most expensive operating and maintenance costs due to longer route and structure
TOTAL		**61**		**78**		**79**		**80**		**81**		**49**	
0 → 4 Least to Most Preferred		NOT PREFERRED - DOES NOT MEET NEEDS OF ROADWAY NETWORK		FEASIBLE WITH CONSTRAINTS DUE TO ACCESS RESTRICTIONS AT CEMETERY AND OAKHILL AREA		FEASIBLE		FEASIBLE WITH CONSTRAINTS DUE TO ACCESS RESTRICTIONS AT CEMETERY AND OAKHILL AREA		MOST PREFERRED		FEASIBLE WITH MAJOR CONSTRAINT DUE TO LONG STRUCTURE AND PROPERTY REQUIREMENTS	

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7 Preferred Alignment

7.1 SELECTION OF PREFERRED ALIGNMENT

Overall, Alternatives 1A, 1B, 2A and 2B scored generally equal based on the given evaluation criteria. Due to this, a 'reasoned argument' approach was taken to selecting a preferred alignment alternative. The following factors were instrumental in selecting Alternative 2B as the preferred alternative:

a) Alternatives 1A and 2A would sever through access to Oakhill Drive and Oak Hill Cemetery. This would leave the residential area in the northeast quadrant of Colborne Street W and Oak Park Road with a singular access point, which is not ideal for network connectivity or emergency response to the area. Cemetery maintenance crews and visitors would be required to use a longer, indirect route to travel between the main buildings and grounds to the east of Oak Park Road. Alternatives 1B and 2B would require grade separation to be introduced at these locations but would preserve these critical access points. It should be noted that a grade separation was identified in the 1990 Oak Hill Cemetery Master Plan.

b) Although there would be impacts to the Oak Hill Cemetery in Alternatives 1B and 2B with slope grading, the interior network of the cemetery shown in the 1990 Master Plan can be maintained. Alternatives 1A and 2A would require significant redesign of the interior workings of the cemetery and would effectively cut off the main office from the rest of the lands.

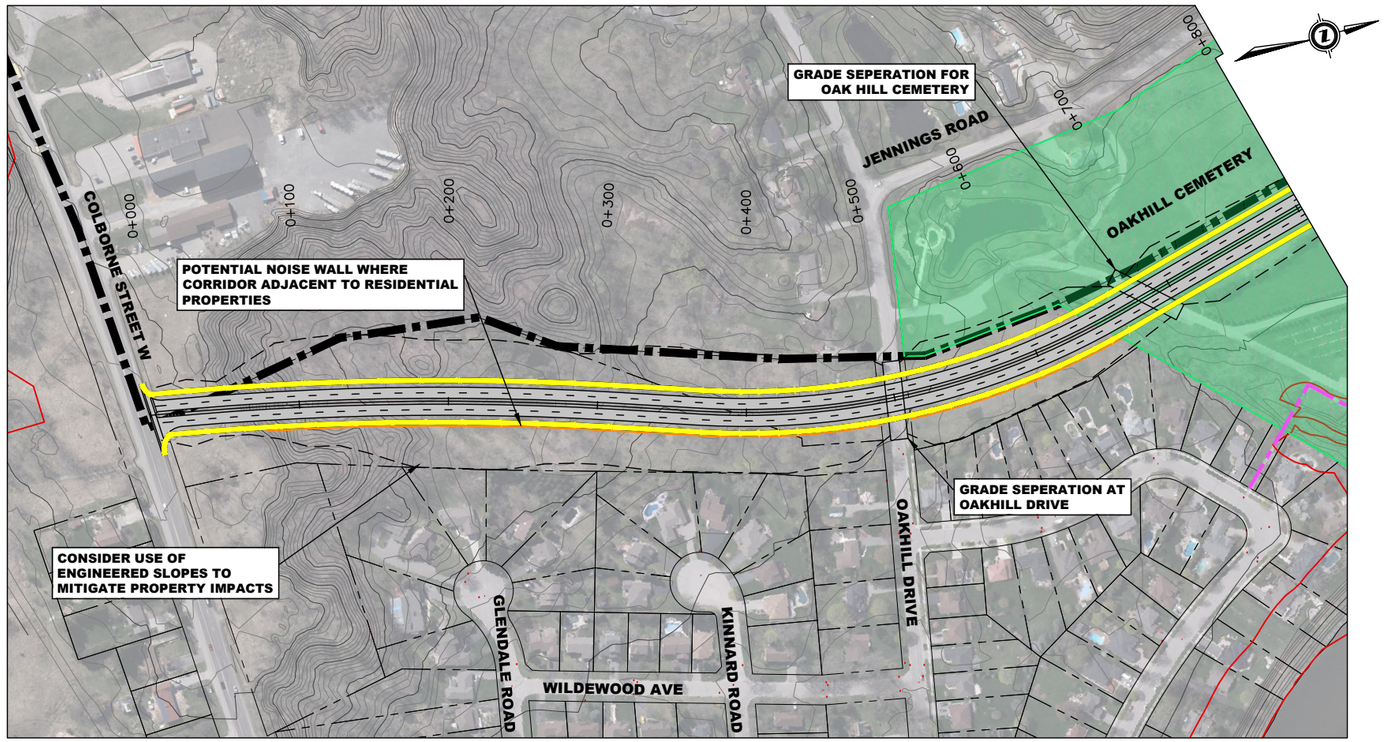
c) All horizontal curves presented in the plan/profile drawings meet current geometric design standards; however, the curve north of the Brant Conservation Area can use a larger radius with lower superelevation in Alternatives 2A and 2B. This would create a more comfortable alignment for motorists.

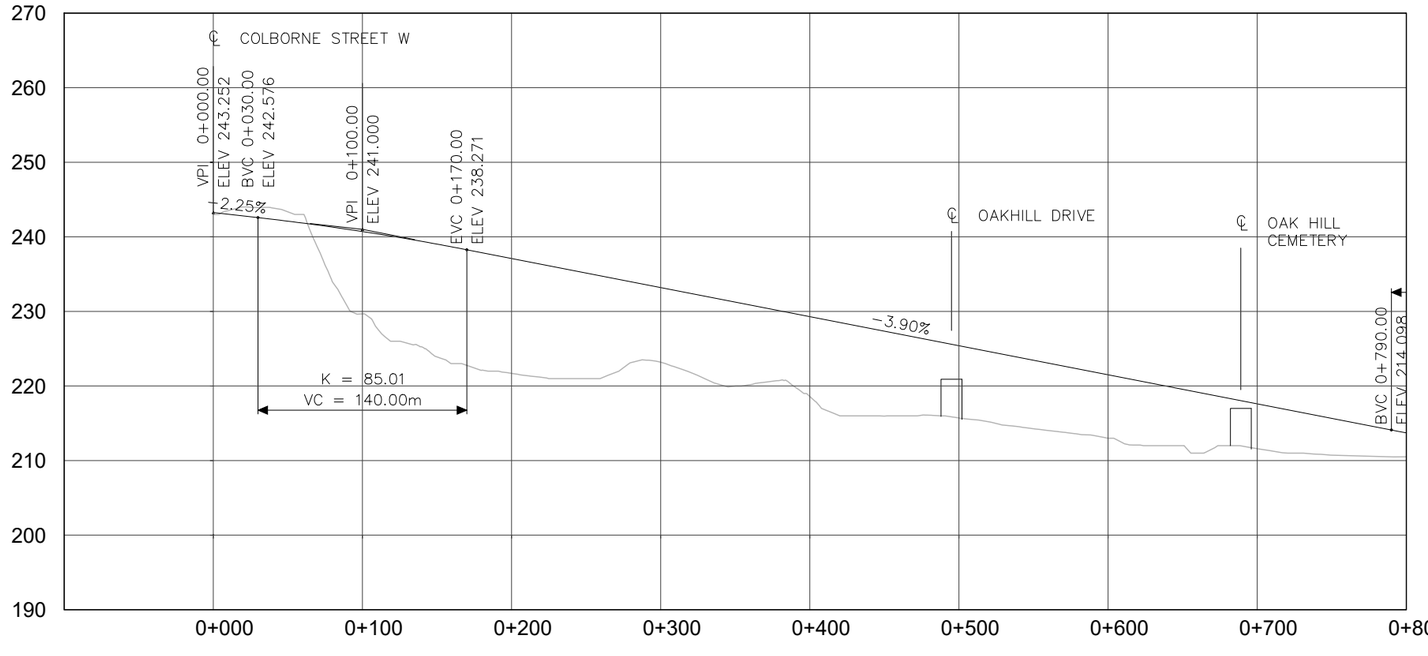
d) Alternatives 2A and 2B would provide flexibility to maintain the existing Gordon Glaves Crossing pedestrian structure over the Grand River. This structure currently services the off-road trail network in the area and a recent structural evaluation determined that it requires no major maintenance at this time. By keeping the structure, it is possible to reduce the cross-section of the new roadway structure over the Grand River and divert pedestrian and cyclist movements to the existing pedestrian bridge providing the existing pathways are upgraded to current AODA standards. It may be prudent to allow provisions in the design of the new structure to allow an additional pedestrian walkway to be added in the future in case the removal of the pedestrian bridge is ever required. Additionally, maintaining the structure will allow the existing watermain and sanitary sewer utilities to remain in place although provisions should also be made in the new structure design to allow these to be relocated in the future. The forthcoming Environmental Assessment and associated public consultation should investigate the costs of these provisions in greater detail.

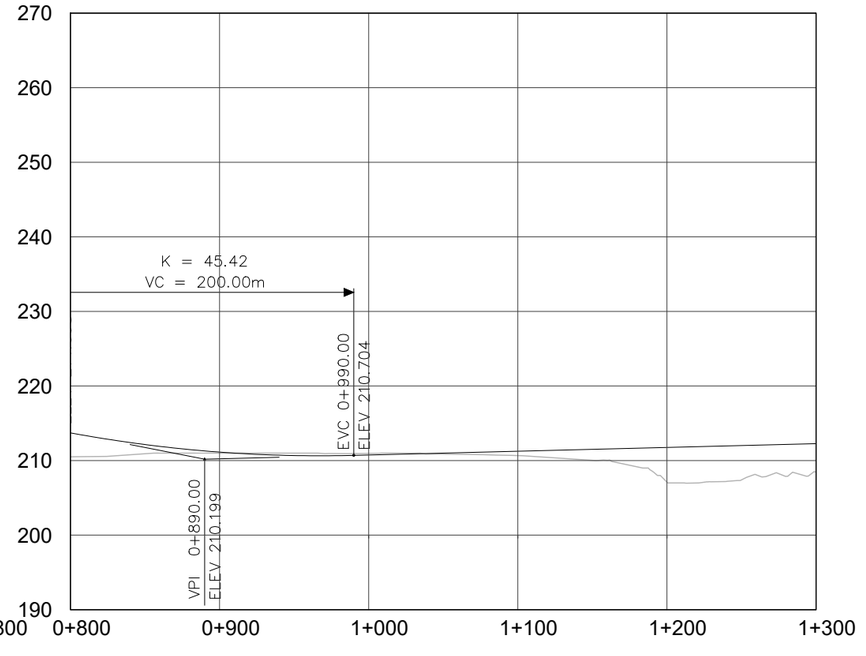
Overall, Alternative 2B costs approximately 20% more that Alternative 2A and 15% more than Alternative 1A but provides tangible benefits to the existing residents, roadway network, adjacent land uses, and active transportation users.

Figure 14 illustrates the preferred alignment alternative

It should be noted that the preferred alignment travels down the middle of the protected 60m corridor to the north of the Grand River whereas the alignment alternatives were placed towards the sides. This was done to match the design work already completed for this section of Oak Park Road to provide roadway connections to the proposed TCA developments.







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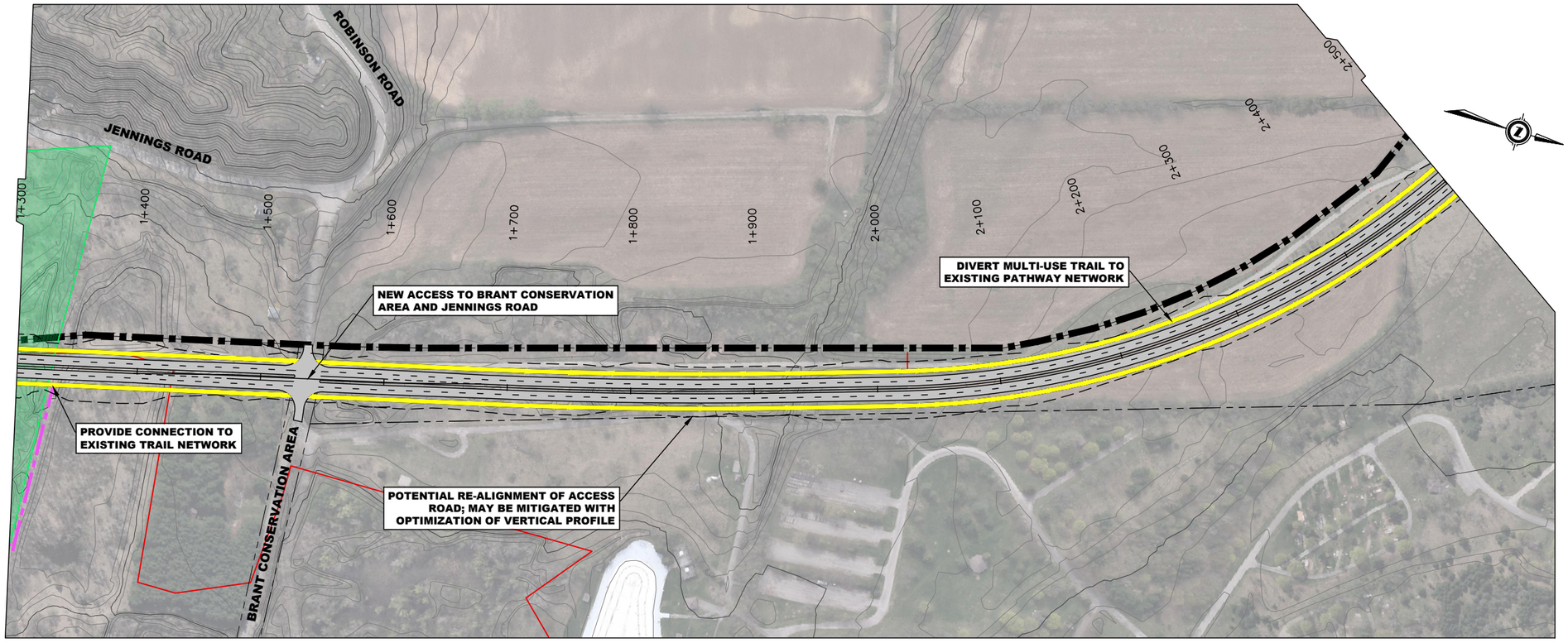
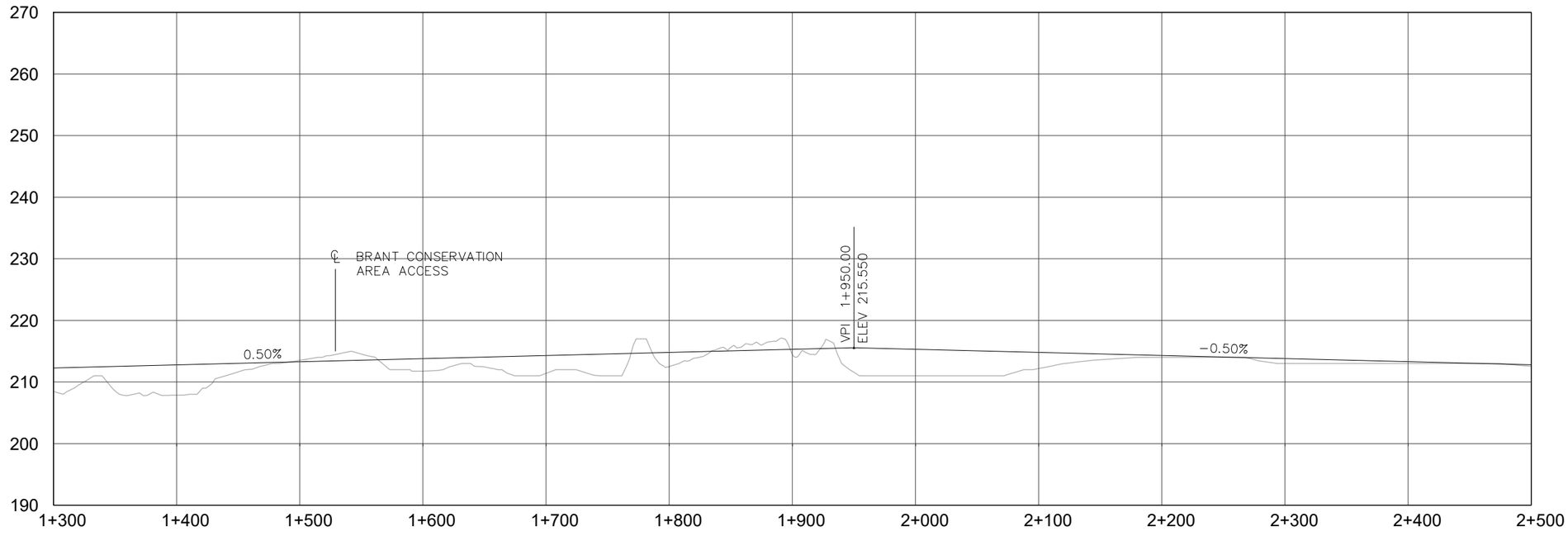
Proposed Multi-Use Trail / Sidewalk

HORIZONTAL 1:2000
VERTICAL 1:400

Oak Park Road
PREFERRED ALIGNMENT

FIGURE 14





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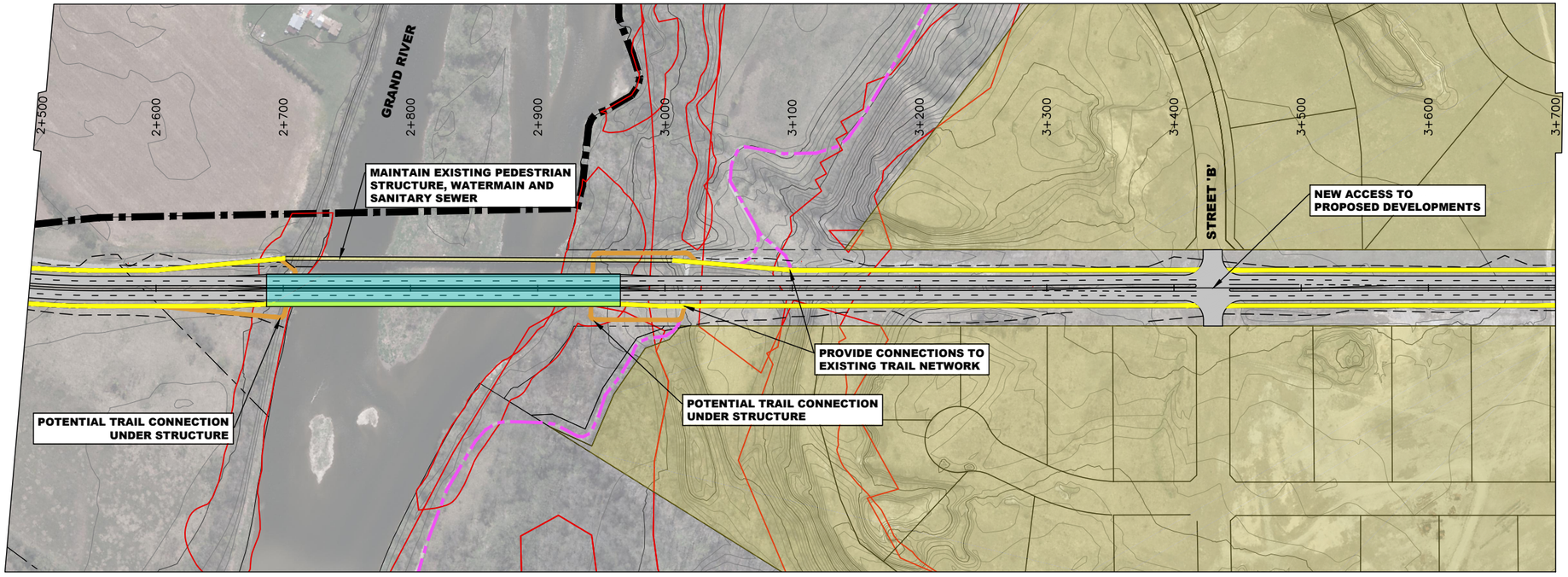
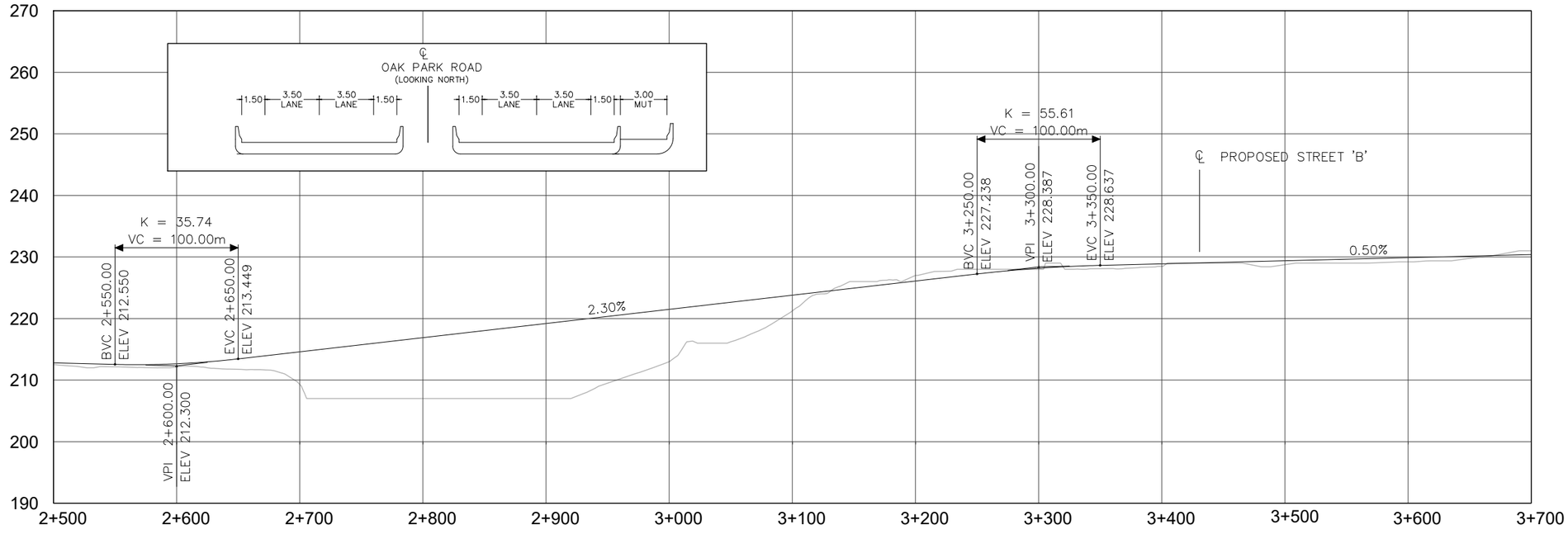
- City of Brantford Boundary
- Grading Limits
- Oak Hill Trail
- Draft Approved Development
- Oakhill Cemetery
- Grand River Structure
- Proposed Multi-Use Trail / Sidewalk

20m 0 40m
HORIZONTAL 1:2000
4m 0 8m
VERTICAL 1:400

Oak Park Road
PREFERRED ALIGNMENT

FIGURE
14





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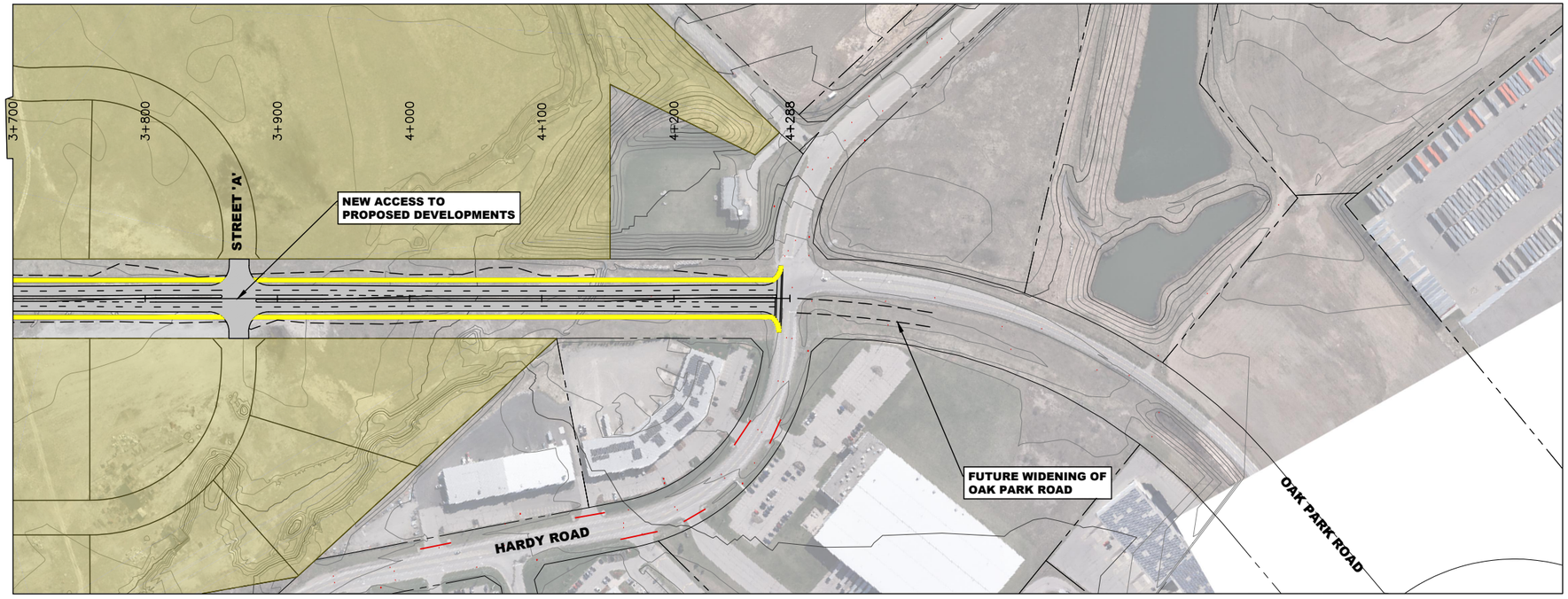
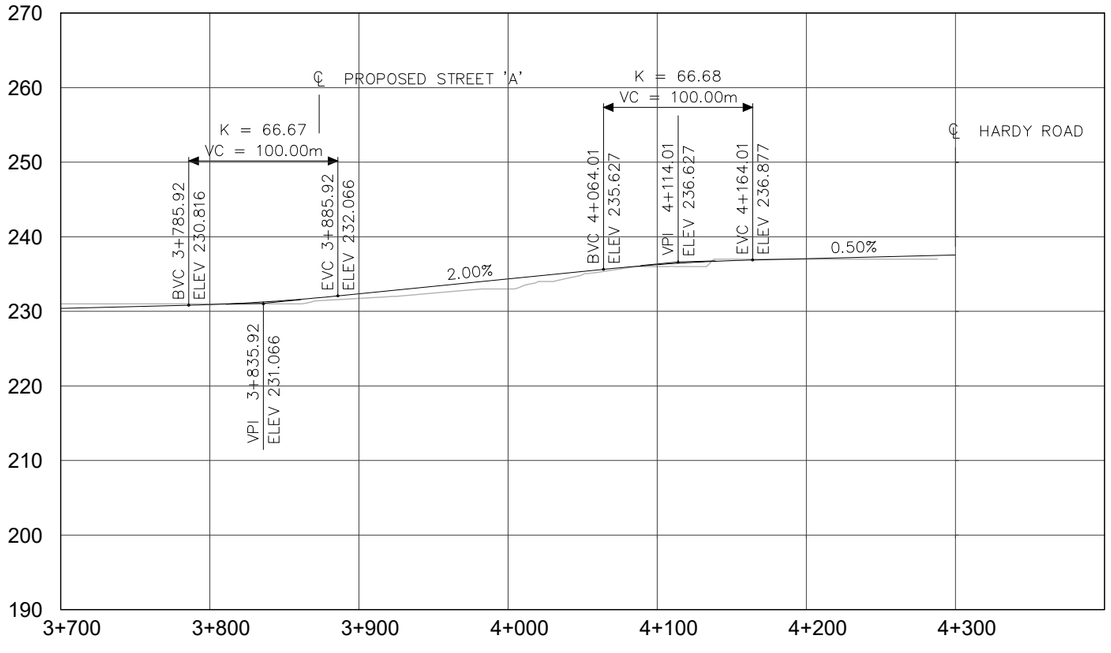
Oak Park Road
PREFERRED ALIGNMENT

FIGURE
14





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20m 0 40m
HORIZONTAL 1:2000
4m 0 8m
VERTICAL 1:400

Oak Park Road
PREFERRED ALIGNMENT

FIGURE
14

7.2 PROPERTY REQUIREMENTS

Property will be required along the proposed roadway corridor in order to accommodate the cut and fill slopes. Critically, land will be required from the Oak Hill Cemetery lands where the available right-of-way narrows to approximately 40m from the typical 60m. Retaining walls could be considered in strategic locations along the alignment to minimize the loss of revenue-generating land at the Cemetery and maintain the plan that was outlined in the 1990 Oak Hill Cemetery Master Plan.

Land acquisition requirements are the greatest at the southern end of the study area between Colborne Street West and the Oak Hill Cemetery. This area requires extensive fill to construct the roadway and accommodate the grade separation structures at Oak Hill Drive and the Oak Hill Cemetery. These impacts may be minimized by further modifications to the proposed cross-section or through the use of retaining walls or engineered slopes.

Figure 15 illustrates the anticipated property requirements within the study area and summarizes the impact to the Oak Hill Cemetery lands.

7.3 ROUNDABOUTS

Parsons investigated the potential inclusion of roundabouts at the intersections of Colborne Street W and Hardy Road. Figure 16 illustrates, at a conceptual level, the additional property that would be required to accommodate them.

Chapter 2 of the Transportation Association of Canada (TAC) Canadian Roundabout Design Guide, 2017 provides advantages and disadvantages of roundabouts over other forms of traffic control. The Guide found that:

a) Roundabouts have been proven to reduce the frequency and severity of collisions when compared to stop controlled and signalized intersections due to fewer conflict points and lower operating speeds.
b) Roundabouts often operate with lower delays and shorter queues than other forms of intersection control.
c) Roundabouts require less maintenance that traffic control signals, offer time and fuel savings to users, and alleviate the need for auxiliary turn lanes.
d) A life-cycle cost analysis will often favour the construction of a roundabout over other intersection alternatives due to these benefits.
e) Roundabouts may require more property beyond the limits of a typical road allowance compared to a conventional intersection.
f) Roundabouts may be more challenging for pedestrians with vision impairment or mobility challenges.

Construction costs for a roundabout tend to be higher for retrofit construction due to the greater complexity involved, but more comparable for ‘greenfield’ installations, especially in an urban environment where lighting, curbing, drainage, etc. are required regardless. Due to the cost and safety benefits associated with roundabouts, they should be considered at all locations where signalization is recommended.

7.4 RENDERINGS

Graphical renderings were prepared to illustrate the preferred alignment and are shown below.

View 1: Looking north from Colborne Street West

View 2: Oakhill Drive and Oak Hill Cemetery looking west

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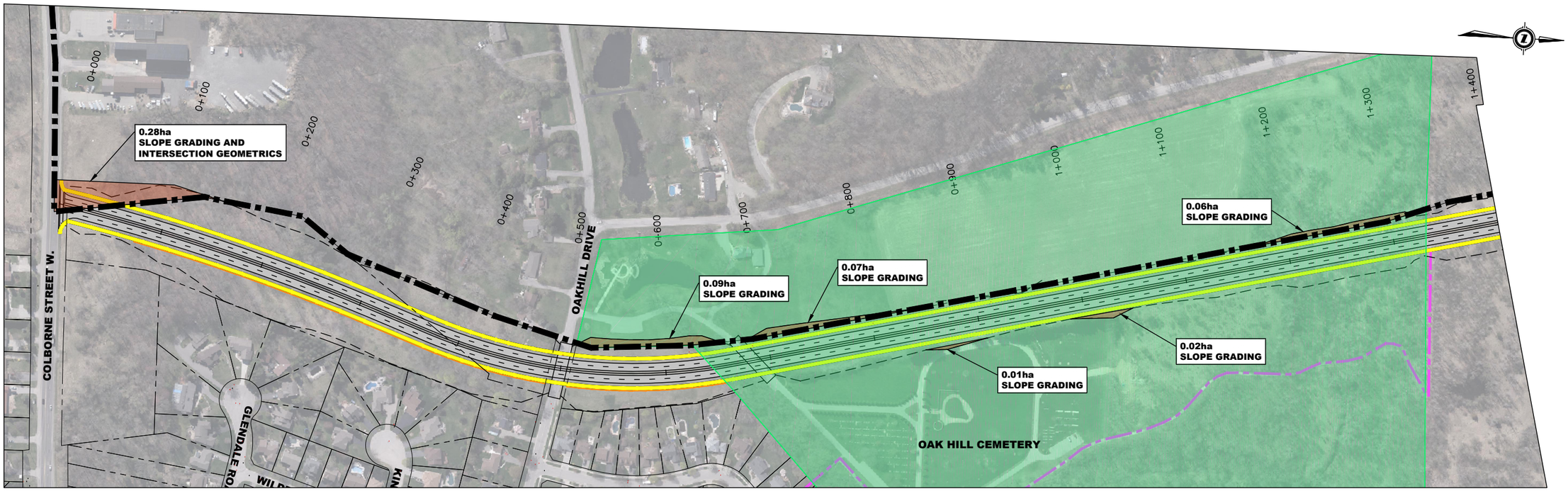
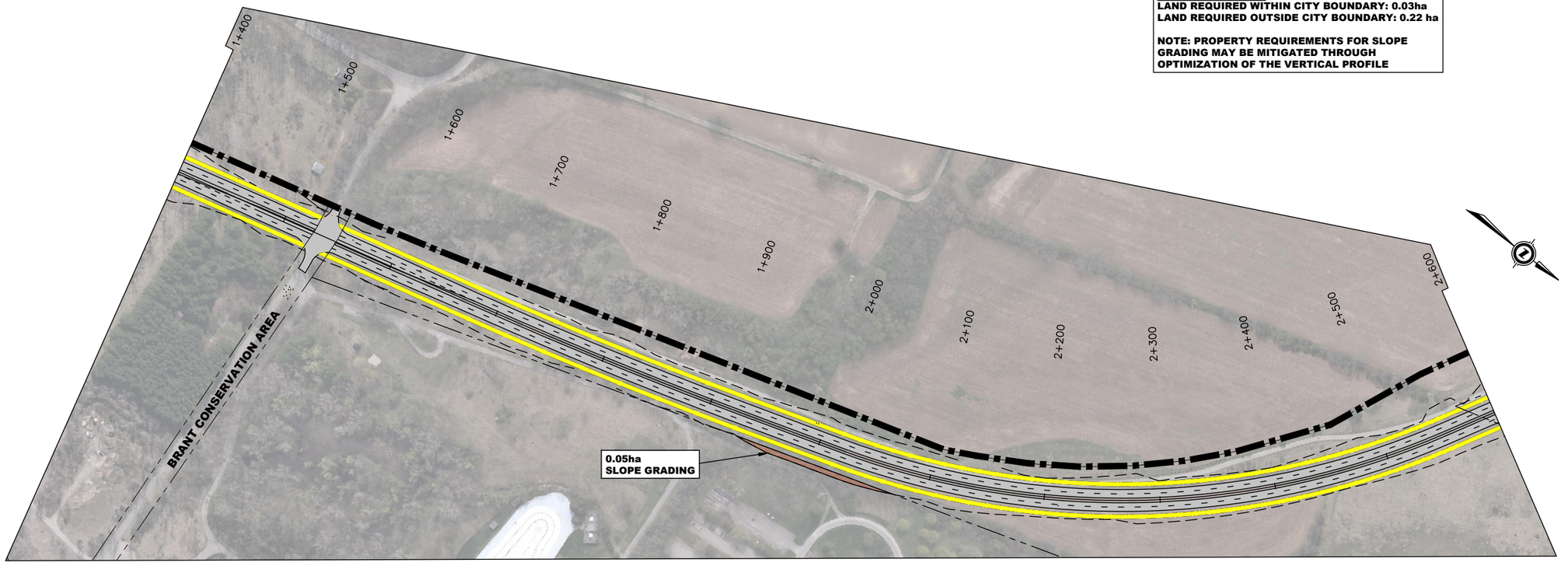
View 3: Grand River structure looking north



OAK HILL CEMTERY
LAND REQUIRED WITHIN CITY BOUNDARY: 0.03ha
LAND REQUIRED OUTSIDE CITY BOUNDARY: 0.22 ha

NOTE: PROPERTY REQUIREMENTS FOR SLOPE GRADING MAY BE MITIGATED THROUGH OPTIMIZATION OF THE VERTICAL PROFILE



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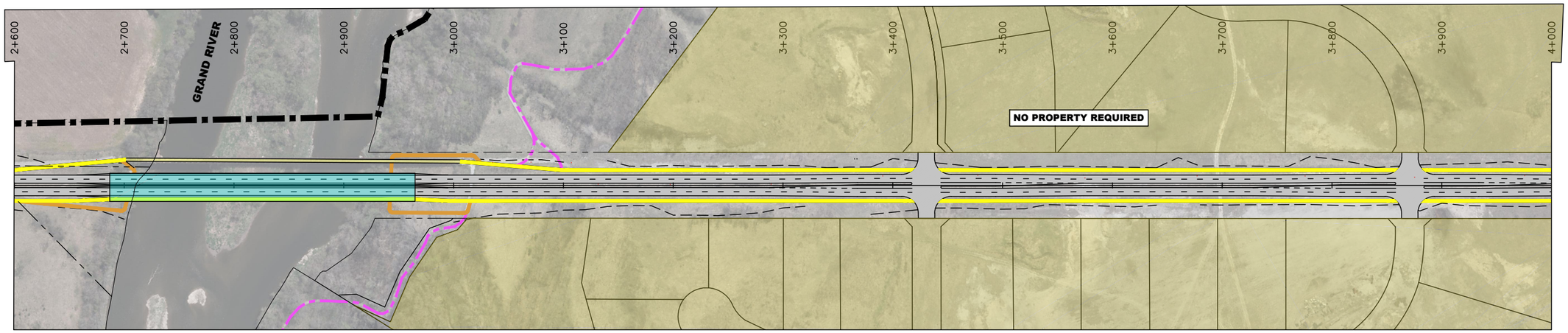
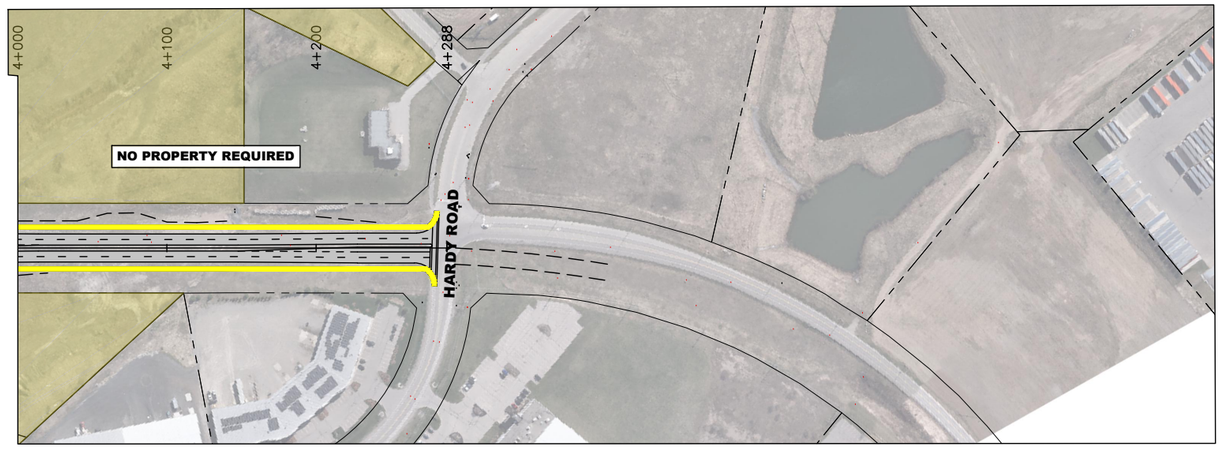
20m 0 40m
HORIZONTAL 1:2000
4m 0 8m
VERTICAL 1:400

Oak Park Road
PREFERRED ALIGNMENT - PROPERTY REQUIREMENTS

FIGURE 15





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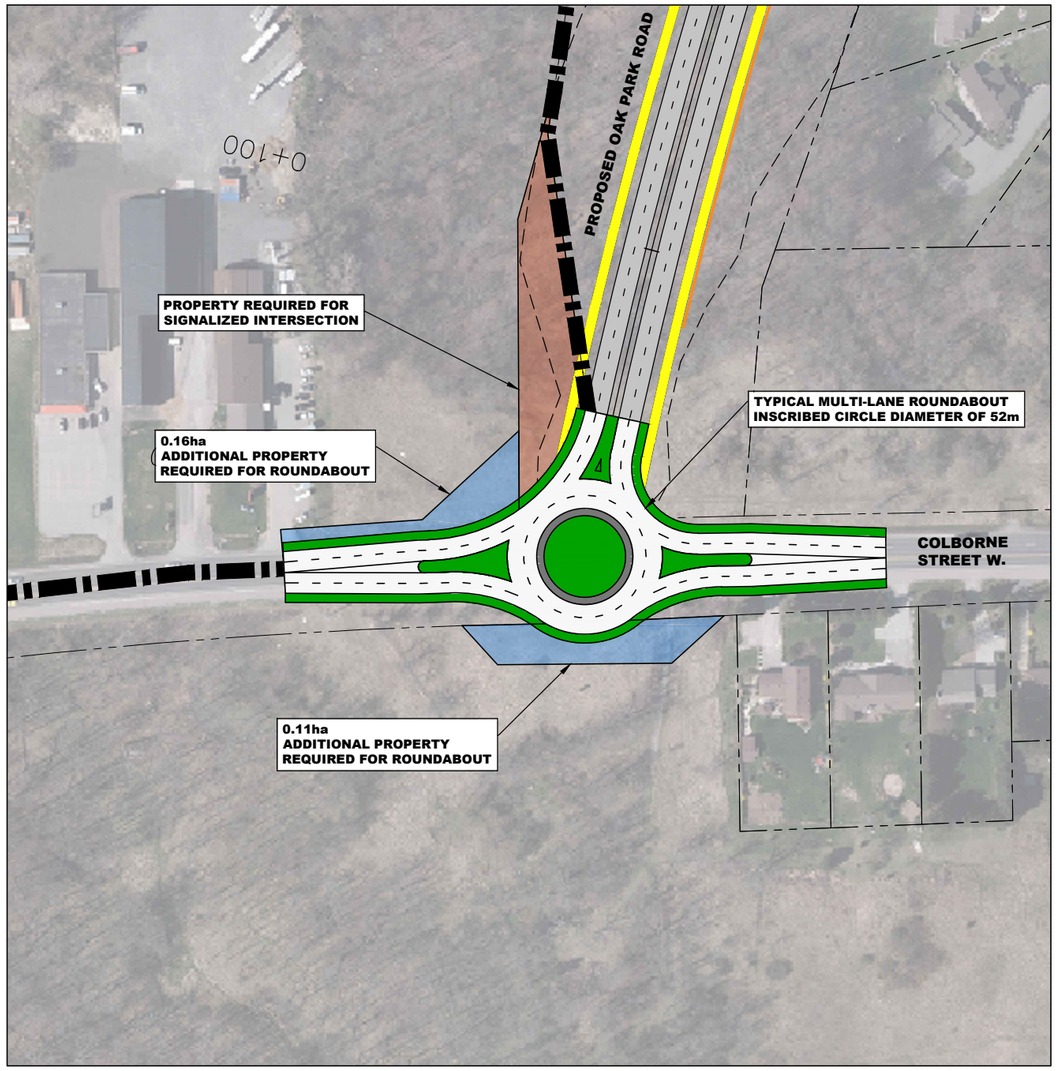
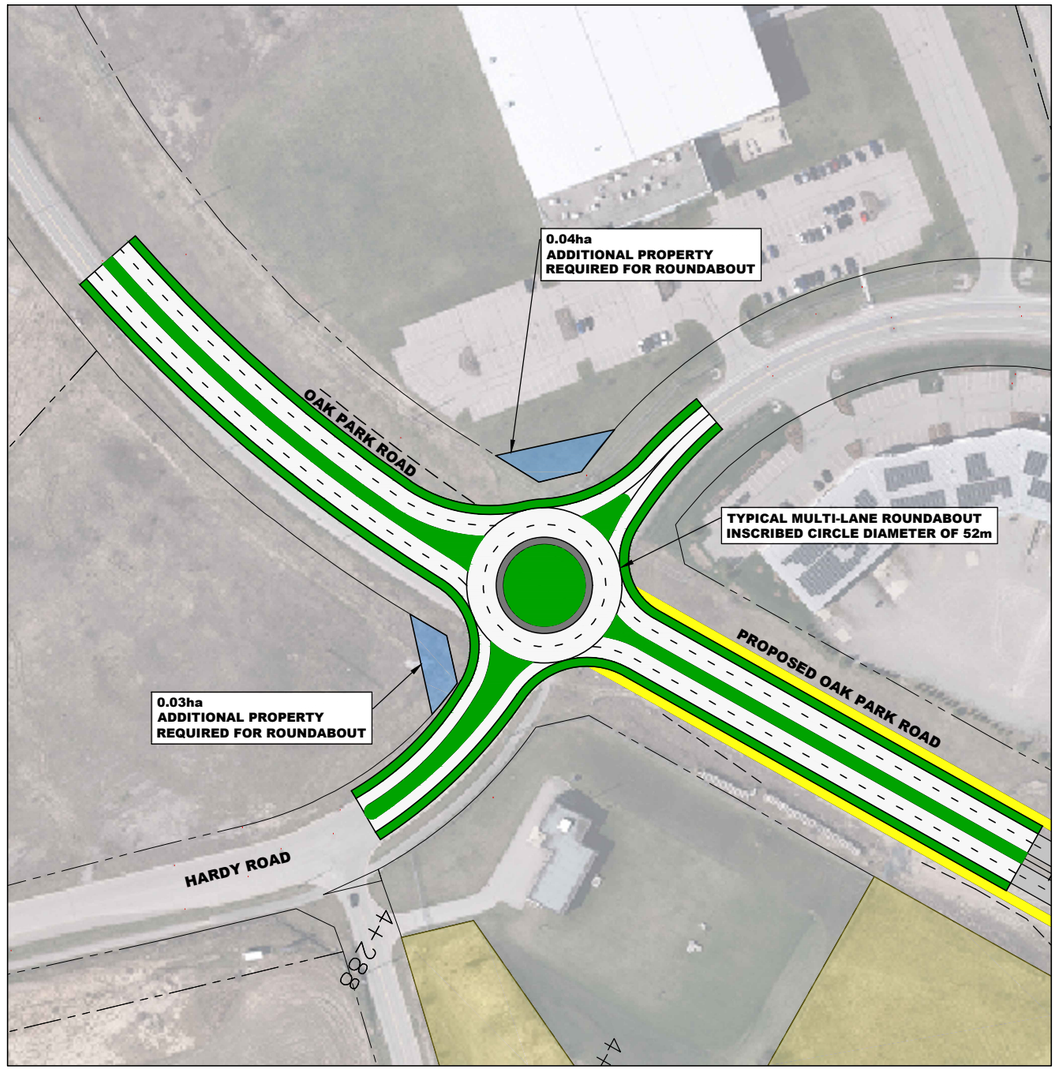
HORIZONTAL 1:2000
4m 0 8m
VERTICAL 1:400

Oak Park Road
PREFERRED ALIGNMENT - PROPERTY REQUIREMENTS

FIGURE
15





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4m 0 8m
VERTICAL 1:400

Oak Park Road
PREFERRED ALIGNMENT - PRELIMINARY ROUNDABOUT LAYOUT

FIGURE
16

7.5 STAGING AND IMPLEMENTATION

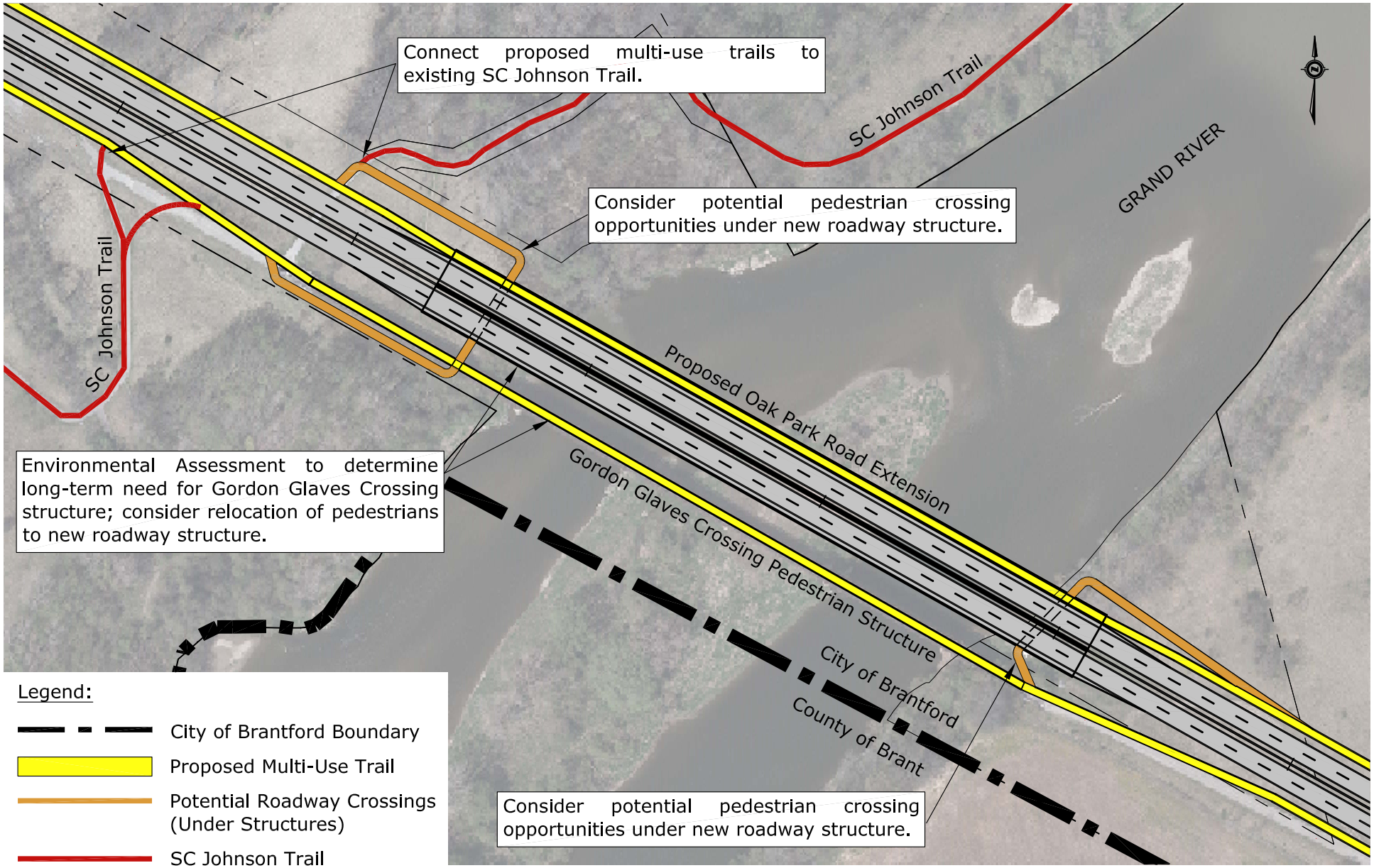
Because the proposed cross section for the Oak Park Road extension contains a median, it is possible to phase the project to initially construct a two-lane roadway with a widening to four-lanes in the future as necessary. This would be achieved by constructing one side of the roadway initially and marking it for two-way travel.

The grade separation structures at Oak Hill Drive and the Oak Hill Cemetery would be constructed in their entirety whereas the structure over the Grand River could be built in stages. It is likely that access across Oak Park Road would be severely limited during construction of the grade separations however, this will be temporary. It would be advisable to construct all piers for the Grand River structure at once in order to minimize disturbances to the existing waterway surrounding environment.

In order to accommodate two-way traffic on one side of the roadway, shoulders would be required on both sides to accommodate vehicles that need to stop and permit emergency vehicles to maneuver through traffic.

7.6 RECREATIONAL TRAIL CONNECTIONS

With the construction of the Oak Park Road extension, the existing SC Johnson Trail along the north side of the Grand River will be bisected. Connections to the existing trail will be provided from the new multi-use trails adjacent to the roadway with pathways potentially located under the structure to allow protected access across the roadway. Figure 17 illustrates these connections in detail.



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Oak Park Road Feasibility Study

Figure 17
Connections to Existing Trail Network

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8 Conclusions and Recommendations

Based on the above analysis and comparison of various alignment alternatives, Parsons determined that it would be possible to extend the existing Oak Park Road southerly from Kraemer's Way / Hardy Road to Colborne Street West utilizing the corridor that has been protected by the City of Brantford. The key considerations for the design of this roadway are:

- A significant grade difference exists between Colborne Street West and Oakhill Drive; large quantities of fill will be required in this area to construct the proposed roadway. The use of engineered slopes and/or retaining walls should be considered to mitigate impacts to the adjacent residential properties.
- It is not feasible to provide at-grade intersections at Oakhill Drive and the Oak Hill Cemetery. Structures should be placed at these locations to facilitate through movements under Oak Park Road.
- Refinements to the vertical profile should be considered to minimize the potential property impacts to the Oak Hill Cemetery.
- The new structure over the Grand River should be designed to minimize the environmental impact to the surrounding lands; consideration should be given to minimizing the potential for ice jamming between the adjacent structures.
- Consideration should be given to the potential long-term removal of the existing Gordon Glaves Crossing pedestrian structure.
- The proposed alignment should match into the existing design work already completed to the north of the Grand River.
- The existing off-road trail network should be maintained to the greatest extent possible with consideration given to providing opportunities to cross the Oak Park Road corridor (public consultation will be required and may impact these recommendations).

8.1 CONSIDERATIONS FOR FUTURE STUDIES

In developing the scope for a future environmental assessment, the following items should be considered:

Alignment
Optimize the vertical profile to minimize impacts to adjacent properties

Structure
Optimize the number of piers to minimize potential ice jamming in the Grand River with consideration given to pier placement on the existing pedestrian structure

Trails
Investigate the potential of trail crossings under the Grand River structure, adjacent to the abutments

Oak Park Road Extension - Feasibility Study

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