Lewis Lake Road Network Maintenance Review Project

October, 2013

Consulting Project for

Maritime Parklands Homeowners Association

(MPHA)

Final Report

Submitted to:

Bill Collins, President
Board of Directors

By:

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Table of Contents

List of Appendices

List of Tables / Figures / Maps / Plans

1.0 - Introduction

Mr Bill Collins, a long time neighbour, and knowing something of my experience, approached me concerned about the condition of the roads in the development where he had recently built a new cottage. It was agreed I would make a site visit to view the current condition and write a report on the findings and any suggestions to maintain the roads going forward. A site visit was completed on Friday, 16 August, 2013. Over the course of a few hours, the road was driven, with incidental walking inspections of various aspects of the road, and approximately 140 pictures taken (refer to Appendix "B"). Various issues were discussed and notes taken. As President of the Maritime Parklands Homeowners Association (MPHA), the report is to be submitted to Mr Collins.

1.1 - Terms of Reference

The "expectations" or basic "terms of reference" identified with analysis or information incorporated in a report were expressed as:

General description of the road condition now.
What should (or needs to) be done now (this year)?
What should be done in the next few years?
What could constitute an annual road maintenance program?

1.2 - Background

Some background insight was gained on review of the MPHA web site. The Maritime Parklands development exists around Lewis Lake in Lunenburg County off the Windsor-New Ross Road, approximately ten kilometres northeast of New Ross which is on highway Trunk 12.

Lake Lewis is the top lake in the drainage basin of the east branch of the Gold River. The outfall of the lake is into Nova Scotia Lake and then Long Lake on its way to join the north branch of the Gold River. The lake lies on Devonian granite which is light grey in colour due to large white crystals of plagioclase feldspar mixed in with smaller crystals of clear quartz and black mica. Evidence of the last glaciation is visible with many granite boulders (known as erratics) resting randomly in the lake, along the lake shore and within the forest, and gouges on the exposed bedrock.

The MPHA maintains legal instruments to protect the interests of the community of homeowners including covenants and an association charter. One of the Objects of the Society is to maintain the access to the Development. Current annual dues are $350.00 due at the beginning of each fiscal year (which runs from 1 April to 31 Mar). The annual dues fund the following:

Road maintenance - grading, gravel and snow ploughing
Security
Garbage Shed
Gate Maintenance
Signs
Vegetation management

The MPHA holds a speed limit for all motorized vehicles on its roads at 30 km/hr.

The road network is comprised of the following road segments:

Parklands Road, Parklands Point Road, Sunset Lane, and Cliff Road

2.0 – Methodology

The normal approach to a road network assessment includes a number of different activities to help get as complete a picture of the situation as possible, including, but not limited to:

= Various map, plan, and field survey data compilation on the roads, land boundaries (rights-of-way and easements), terrain analysis for environmental impact on the physical nature of the network.

= Collection of operational data of the network including traffic control (signs, et al), volumes, speeds, driver behaviour, etc.

= Review of construction projects and maintenance activities (routine maintenance, upgrades).

= Comparison of what currently exists (including structures) against various design, operational, and maintenance standards and best practice.

= A cost analysis addressing capital cost amortization, maintenance costs, life cycle, and benefit / cost to help establish a cost effective work schedule into the future (usually at least a twenty year window).

2.1 - Paper Research

Due to the nature of this review, focusing on the existing condition of the roads and maintenance considerations, no documentation was provided and no effort was made to obtain any.

2.2 - Standards, Policy, Guideline, Best Practice

With no indication of the existence of any documented authority to follow in the design, construction, or maintenance of the road network, it is not possible to assess the quality of the product being reviewed, nor is it possible to hold contractors or individuals accountable for how well or poorly they perform in their activities on the roads.

In response to specific requests raised during discussions, reference was made to the Standard Specification Highway Construction and Maintenance, updated to 1 Feb, 2011, by Nova Scotia Transportation and Infrastructure Renewal (PNS TIR); and Geometric Design Guide for Canadian Roads (GDG), 1999 Edition, by Transportation Association of Canada (TAC). Excerpts are presented in Appendices “C” and “D”.

2.3 - Existing Condition and Maintenance Assessment

Significant information may be gleaned from a simple visual inspection. Evidence of construction and maintenance methods as well as traffic operation may tell a useful story as a basis of determining if and what improvements may be necessary. Some deficiencies may be obvious while a number of clues may lead to other conclusions. These findings should be helpful in developing suggestions for a reasonably effective maintenance plan for the next number of years, leading to a sustainable road network.

3.0 – Findings

The road system appears to be in generally good condition for the basic purpose of local traffic service between the provincial highway network and personal dwellings or cottages. With a few exceptions of washboard on hills and a small number of potholes or bumps, the road surface is smooth, especially taken at the desired speed limit of 30km/hr. More surface issues likely would become evident at higher speeds. Refer to Appendices "C" and "D" for any unfamiliar terminology, and the maps and air photo for small scale overviews of the study area and road network.

3.1 - Natural Environment

With a few exceptions, the topography or the area where the roads have been build has permitted an acceptable curvilineal alignment horizontally with limited long straight stretches and undulating profile with limited long grades or flat stretches. There are very few what might be considered "sharp" curves or steep hills.

3.1.1 - Vegetation

Significant vegetation, of different type, height, and density seems to abound on the roadway just outside the travelway as well as within the right-of-way.

This poses a problem as unabated vegetation can be very destructive to roads and a safety risk to vehicle operators. The root system can destroy compaction and facilitate greater frost issues, limit drainage and clog drainage structures (culverts). Vegetation on the road surface may hamper snow and ice control in winter. Vegetation may restrict sight views and create safety issues and hazards for wildlife and people perhaps partially hidden till the last moment, especially at night when visibility is limited and headlights may not penetrate effectively.

3.1.2 - Soils

At a number of locations, it was observed that boulders were already protruding from the road surface.

Building a road in an area of minimal soil (low depth to bedrock) and boulders is quite challenging and may pose problems. One of the major concerns in building a road bed, is to have any large boulders well buried under preferably a foot or two of subgrade material to avoid frost heavals. This facilitates application of gravels and grading without risk of hitting such an obstruction. Such protruding boulders also create problems for snow and ice control (plowing).

3.2 - The Roadway

A typical roadway consists of the travelway, in this case intended for two-way traffic, shoulders, side slopes; and in cut situations, ditches and back slopes. Refer to Appendix "C". The roadway usually contains various "hardware" such as structures, under drainage, signage, guide posts, barriers (guardrail), etc. The old standard for subdivision roads or streets allowed a total roadway width of about thirty feet (two twelve foot lanes and a three foot offset to a curb or shoulder on each side. This allowed for snow storage from plowing. Any parking would encroach on vehicular travel along the road.

3.2.1 - Road Surface and Structural Adequacy

The road network appears to contain roads of differing design / construction standards. From the start near the gate on Parklands Road to Sunset Lane, the road has a travelway of perhaps twelve to sixteen feet with some usable shoulders, allowing opposing traffic to pass safely. From Sunset Lane to the bridge, the road is somewhat narrower with a travelway of perhaps ten to twelve feet and less useable shoulders. From the bridge to the cul-de-sac at the end, Cliff Road for most part is more like a private driveway with a travelway of perhaps eight feet made up of two wheel tracks with grass growing in the middle for much of it, and no useable shoulders. With each decrease in width there is increasingly less gravel evident in the travelway and on the shoulders.

For the most part, the roads appear to have minimal, if any crown (the cross slope from the centreline to allow for drainage). The norm for gravel roads is a crown of 4% (2% on paved roads), with possibly some superelevation on curves. The gravel used seems to be good quality quarry crushed stone with some fines to help as binder. The size of gravel varies from what looks like “B” class (1" and less) to “A” class (3/4" and less).

The gravel spread on the road surface appear to be of minimal depth with it not being spread over the total width of the road surface, but primarily just on the travelway. This has contributed to a better environment for vegetation to grow on the shoulders and side slopes. It has also allowed the travelway to be compacted, heaving the shoulder to the same grade and in some cases higher (ruts were observed in a couple of areas). Normally when the subgrade loses appropriate shape, it becomes problematic as water seeping through the granulars can be trapped in the dish plate shape of the soil underneath. The intent of a properly shaped subgrade is to be a barrier (being less pervious) to water seeping through the granulars and directing the water into the ditches. It is uncertain to what degree the problem might exist due to the nature of the soil, the higher than normal boulder volume, the proximity of bedrock, and the fact so much of the road is built on side hill.

The size and depth of granulars contribute to the water wicking process, increase load carrying capacity of the road, and minimize deformation (wheel ruts, failures). Normally a local road might have two to four inches of “C” class (2" and less) gravel with possibly two inches of “B” and one inch or so of “A” as a smooth course and riding surface. It is critical the “A” have sufficient fines to act as binder and hold the road shape. This would provide sufficient strength for delivery vehicles such as construction materials trucks & oil trucks, NS Power trucks, school buses, and the like. Today, more roads are being are being constructed using geotextile or geogrid to separate the shaped subgrade from the granulars to increase the water wicking process by separating subgrade fines from the granulars, and increase strength to avoid deformation, and possibly reduce granulars.

3.2.2 - Ditches

It was observed that for the most part, there are ditches, and in some cases it appears there was relatively recent ditch work to deepen and widen the ditches. However in a few areas the ditches are indiscernible. In this development, the majority of the roads have been built on the side slope of a hill. This makes it imperative that there is an adequate upper ditch system to keep ground water and runoff from traveling over (possibly a winter phenomenon) or through or under the road. Depending on the terrain, simple “V” ditches are usually adequate for local roads, at a depth of at least one foot below the subgrade, and provided there is adequate under drainage (culverts) and sufficient off take ditches to avoid standing water and ensure water is directed away from the road. There is no need for a ditch in “fill” sections or on the down side of a side slope as the water will follow its natural path down hill (unless there is a specific need to redirect the runoff).

3.2.3 - Back Slopes

It appears no special attention was paid to dressing the back slopes (landscaping). For the most part they seem relatively natural and smooth. However, there are a few sections along Cliff Road in particular, especially where recently ditched, that the back slopes are quite rough and inconsistent. Also, a few larger trees have been left growing somewhat close to the travelway, creating a maintenance issue and possibly a safety (vision site) issue. Preferably there is an area of the back slope which is maintained in shape to facilitate drainage and ditch maintenance, free from larger vegetation to improve vison, and facilitate sunlight to help dry the roadway or melt snow or ice in winter.

3.3 - Water Structures

Water structures come in different sizes and styles depending on the intended purpose. Those found on this road network are limited to one small bridge, cross culverts (corrugated galvanized steel and plastic pipe), and possibly driveway culverts.

3.3.1 - Culverts

Only cross culverts were inspected. It appears the original road construction used steel culverts, but as upgrades were required, apparently due to service failure (plugged, crushed, or rusted out in the bottom) or as the result of poor location or being missed entirely, the more recently installed ones are plastic culverts. Although no actual measurements were taken, it appeared the steel culverts are eighteen inches in diameter or larger (such as twenty-four inches). The plastic culverts tended to be smaller (perhaps twelve inches and up). Most of the plastic culverts seemed too small. Crushing damage was noted in a couple of culverts and it was observed that cover over the culverts may average only one foot (a few greater, many appeared less).

Although use of the plastic culverts is desirable from both an environmental and long term sustainability perspectives, there are at least two concerns. Whereas it is highly undesirable to have to dig up a road bed to install a cross culvert, it is critical that they be located and sized properly initially. Culverts generally are susceptible to siltation and clogging with vegetation and other debris. The larger diameter a culvert, the easier to perform maintenance to remove clogs.

With few exceptions, the minimum standard for cross culverts on roads is twenty-four inches in diameter, with a minimum of twenty-four inches of cover over them (to avoid crushing from heavy vehicles passing over them). To ensure larger culverts are sufficiently buried in the roadbed, the approaching ditches need to be excavated deeper, to drain. In some cases, the road bed may need to be raised to ensure adequate cover.

Each end of a culvert should have adequate rip rap (stone piled to make a rock wall) to protect the pipe entrance, and minimize scour, erosion, and side slope failure.

3.3.2 - Bridge

Although structural engineering is not a strength, a few observations are noted for consideration. The cribwork has moss growing on parts of it, trees starting to grow out of the top of it, and there is encroachment by other vegetation. The logs / timbers may have been treated initially. The cribs should be free from any growth and have clearance to allow good air circulation and drying.

From the underside, the structural timbers and planking appeared to have been treated initially. All appeared in good shape although the exposed side is now weathered.

The steel girders and frame appear to have been for another purpose and have been reused as the bridge structural steel. Although not measured, the girders seem substantial and adequate for their current use. They were once painted but are now showing signs of rusting.

3.4- Guidance System

A roadway usually contains various features intended to help a driver operate his vehicle within the travelway, in a prudent fashion, consistent with desired operational characteristics (such as speed). These features include "hardware" such as signage (also lane marking on paved roads), guide posts, barriers (guardrail), etc.

3.4.1 - Signage

Signage is intended to advise the driver of what to expect ahead, and to clarify situations to avoid any confusion and possible conflicts or crashes. A critical feature at intersections are "Stop" signs, advising a driver of the first right of passage. No stop signs were observed at intersections. The picture taken does not show and there is no recollection of a stop sign at the intersection with the paved provincial highway. Speed limit signs were lacking, if the intent is to hold travel speed to 30km/hr. It was noted there were road name signs for Parklands Point Road and Sunset Lane but others appeared to be missing. No "No Exit" sign was observed on entering the road network. Nor were there any sharp curve signs, bridge load sign, or any other signs noted.

3.4.2 - Barriers, et al

No location was identified where any type of barrier (guide posts, guardrail, etc) may be required.

3.5- Operation

Although operation is intended to address how the road network is used and maintained, the site visit was quite short and virtually no traffic was encountered (perhaps one other vehicle on the road).

3.5.1 - Traffic

Usually traffic composition is analyzed such as percentage make up of passenger vehicles, different types of trucks, tractor trailer combinations, buses, routes (such as school bus, postal, newspaper, oil delivery, etc), and weights. Also traffic volume (counts converted to ADT and AADT) is estimated. Operating speeds are also captured.

It is doubtful most traffic observes the 30km/hr speed limit as the road condition and roadway parameters are such that drivers are encouraged to drive faster. This is evident by the washboard on the hill, usually caused at higher speeds by vehicle drive wheel slippage while trying to grip the surface creating a vibration which deforms the surface. With increasing traffic volumes, the washboard effect worsens as the washboard sensation increases in amplitude. The creation of “tire tracks”, well worn paths from tire wear on the surface often indicate higher speed cars spraying away stone, leaving fines, which in dry weather make the road dusty.

3.5.2 - Maintenance

The road was found to be in quite good condition considering little evidence of routine maintenance. From the lack of crown and inconsistent application of riding surface gravel, it did not appear the road was recently graded. However, there were a number of gravel wind rows, and areas of fairly substantial gravel sprays onto the side slopes, into the ditch, and even onto the back slope. This indicates the snow plowing operation was likely performed at too high a speed, and perhaps the plow blade was allowed to be set too low, into the road surface. Possibly the guides or wear shoes on the bottom of the blade, behind the moldboard, were not properly set for a gravel surface road.

4.0 – Recommendations

In response to the findings and issues identified, a number of recommendations may be offered for consideration to address the issues both today and going forward. As a caveat to the recommendations, it needs to be realized they are offered based on a limited, short term, site visit. What is suggested as should or needs to be done is within such limitations, not considering what might have been missed or misinterpreted.

4.1 - Standards, Policy, Guideline, Best Practice

Without a framework to base comparisons or judgements, it is difficult to manage expectations of homeowners or hold contractors to be accountable to achieve the desired goal(s) - end results. It would be beneficial if a section might be added to the appropriate legal instrument (presumably the association charter) more completely detailing standards, policy, guideline, and best practice intended to maintain the road network. Many of the points made here might be considered to be included in the new documentation.

A set of design / construction standards needs to be developed for the road network. Consideration should be made if all roads in the network need to be to the same standard, or a number of different standards developed. For example, the desired finished top width of the main road may be twenty-four feet, while other roads my be narrower at sixteen feet (this being taken as a minimum). Gravel is intended to be evenly applied over the entire finished top (thereby its name). Side slopes of old roads are often quite steep (2:1), but newer ones are usually more gentle (3:1 and 4:1). Other jurisdictions, to be more environment friendly and more forgiving to the driver, have higher standards with side slopes of 5:1 and 6:1. Setting a minimum ditch depth will have an impact on the side slope based on available right-of-way. Due to the nature of Nova Scotia's glacial tills (frequently containing clay lenses, subject to circular slip failures), the back slopes for newly constructed roads tend to be at least 3:1 flat. Refer to Appendix C, Cross Section Elements - RLU (Rural Local Undivided) Road.

Consideration should also be given by MPHA to the creation of a road authority, an individual or group of three, with a mandate to make recommendations to the Board for an annual work program and make operational decisions as needed within their mandate to effect the plan, including negotiations with the contractor(s).

4.2 - Vegetation

Vegetation growth within the right-of-way, especially the finished top and side slopes, needs to be controlled. Annuals such as grass and flowers should be mown at least once a year, preferably twice, but particularly in the fall to ensure not a hindrance to snow and ice control. Perennials such as shrubs, bushes, and trees should be removed before reaching three feet in height. As a higher priority, it is highly desirable to conduct brush clearing and mowing along the road network this fall.

4.3 - Grading and Graveling

Once a desired end result cross-section standard is established, a competent grader operator should be retained to reshape the roadway to match the standard as best possible (maintenance operation versus new construction). This operation would include shaping the ditch and side slopes. During this operation, any boulders encountered in the roadway need to be removed and holes filled with compacted material.

Once the road is properly shaped, an adequate course of granulars needs to be applied to the entire top width. It would be desirable to have a steel drum, vibratory roller compact the road and gravel. Considering the summer conditions observed, but not knowing the spring frost break up conditions, it may be feasible to get away by applying a course of mainly one inch gravel with a skim of finer gravel on top as a finish course.

This work may be phased over several years depending on the availability of funding, realizing this will most likely be more expensive due to mobilization and other costs included in the price. Once completed, with routine grading, the road should not need major work for many years. Routine grading means being done usually at least once a year in the spring (late May or June) to reshape (crown) the road to restore from winter plowing or any damage (rutting) from the frost break up. Preferably the road is graded a second time in the fall (late September) to prepare the road for snow plowing operations.

A regular application (every year or two) of calcium chloride should be considered to hold the shape of the road, reduce dust in summer, and assist in snow and ice control in winter.

4.4 - Snow and Ice Control

A guideline should be prepared to be shared with the contractor retained for snow and ice control. They need to be aware of expectations to have their equipment properly set up for plowing a gravel road to ensure minimal disturbance to the road surface. Also, they need to adhere to speed restrictions to avoid catching gravel and spraying it off the road. A worst case scenario would be plowing gravel into a wind row which could easily be drawn back into the roadway when reshaped through the grading operation in the spring. As a higher priority, it is desirable to have this in place for this winter's plowing season.

4.5 - Ditches

The ditches need to be cleaned of silt and debris as well as graded (sloped) to drain to the nearest culvert or off-take ditch or water course. This may be accomplished at least in part when the roadway is shaped. A separate ditching operation may be needed to address difficult areas. Standing water should be eliminated. Problem areas may be tackled on a priority order basis over time, provided an area is not creating other complications for the roadway. Ditch cleaning is an operation which should be performed at least once every five years.

4.6 - Back Slopes

Restoring or finish grading those areas of back slope needing work is a lower priority, but may be addressed when tackling problem ditch areas in close proximity. This should reduce erosion with its resultant siltation of ditches and culverts.

4.7 - Water Structures

Water structures by their nature are critical to the well being of the road bed and operation of the roadway. They need to be checked on a regular basis, annually, to ensure functioning as intended.

4.7.1 - Culverts

There are several issues with cross culverts which need to be addressed over time. Of highest priority is ensuring they are functioning and not clogged with silt or debris or ice. A backed up culvert could lead to the road being over topped and eroded making it impassable. Function is best checked during a period of heavy rain and runoff (fall and winter).

With reshaping the road, some issues with culverts may be reduced or eliminated. Otherwise an assessment is needed to determine the most critical and priorities set. Based on the grading of the ditches and lay of the land, some cross culverts may need to be relocated and/or resized. On installation, the culvert must be set deep enough to ensure adequate protective cover, or the road built up over it. The culvert also needs to have adequate slope (at least 2% to 4%) to ensure water flows and does not stagnate, even with some settlement in the pipe.

Some culverts are too small and should be replaced over time with a larger size (at least eighteen inches in diameter). Some culverts have insufficient protective cover and need to be reset lower or the road built up over it. These issues are a lower priority and may be deferred to be addressed in future years, or when a more critical problem develops.

4.7.2 - Bridge

As a critical piece of the roadway for safe vehicular operation, the bridge needs to be maintained in the best condition possible, less normal wear and tear. It should be inspected annually. All vegetation needs to be removed from, and in close proximity to, the cribwork. This should be accomplished this fall and repeated annually if it recurs.

Possibly next year, the cribwork should be treated with environment friendly wood preservative and the steelwork should be treated with environment friendly rust paint. At the same time, or perhaps deferred for the following year, the deck should be swept of all gravel and soil and the exposed surface and railings treated with environment friendly wood preservative. This treatment should be repeated every five years or so.

4.8 - Signage

Stop signs are critical traffic control devices and are particularly helpful for insurance purposes if ever a crash occurs at an intersection. Stop signs may be erected on road name sign posts, provided such signs are properly co-located in the correct position for a Stop sign. Stop signs should be installed as soon as feasible, preferably before next summer.

Road Name signs are particularly helpful in getting emergency services to the correct location, when needed, and helpful for others such as visitors, delivery services, and the like. New Road Name signs should be installed for all roads at intersections throughout the network. Although this is a lesser priority, it should be accomplished over the next few years.

Speed Zone signs, Curve signs, and others are less critical and may be deferred, dependent on budgetary constraints.

All road signs are expected to be retro-reflective such that they show up in the same colours and brightness with headlights at night as in the sunlight by day.

4.9 - Summary

The above recommendations address what should be (or needs to be) done in the short term as well as over the next few years. Most are summarized in bullet form below:

= Create a road authority, detail standards, policy, guideline, and best practice intended to maintain the road network.

= Add a section to the appropriate MPHA legal instrument (presumably the association charter) to incorporate the road authority along with detail standards.

= Create set of design / construction standards including cross section elements as per Appendix C

= Consider if all roads in the network need to be to the same standards, or a number of different standards developed.

= Apply gravel evenly over the entire finished top of the roadway.

= Remove vegetation growth from within the right-of-way, especially the finished top and side slopes, and control annually.

= Grade the roadway to reshape it to match the end result cross-section standard as established.

= Remove boulders encountered in the roadway and filled holes with compacted material.

= Apply an adequate course of granulars over the entire top width, once the road is properly shaped.

= Grade the roadway at least once a year, preferably twice, as routine maintenance.

= Prepare a guideline for snow and ice control to manage the contractor.

= Clean the ditches of silt and debris and grade (slope) them to drain to the nearest culvert or off-take ditch or water course.

= Eliminate standing water in ditches.

= Restore or finish grade those areas of back slope needing work.

= Inspect the culverts and bridge annually to ensure functioning as intended.

= Relocate and/or resize cross culverts as needed.

= Remove all vegetation from, and in close proximity to, the cribwork of the bridge and inlet and outfall of culverts.

= Treat the cribwork with environment friendly wood preservative and treat the steelwork with environment friendly rust paint now and on a regular basis going forward.

= Install Stop signs with Road Name signs co-located on the same post.

= Install other signs as funding is available.

= Consider a calcium chloride treatment to help with maintenance.

5.0 – Implementation

To develop an effective annual road maintenance program, implementation strategy and schedule, the MPHA road authority first needs to understand the portion of dues funds available to them as budget income. From the recommendations, a list of activities and priorities may be developed. Each one would need to be cost estimated and then based on priority a multi-year work plan may be developed. Some activities are needed on an annual basis as routine maintenance, while others are unique or sporadic and may be considered capital maintenance.

Inspections may be conducted by the road authority or a consultant hired to perform a more professional review. Some of the work (such as brush cutting, or even ditch cleaning) may be performed by homeowners, provided a clear guideline is developed and a good example is set for reference to ensure all done in a consistent manner.

Based on the funds available and cost demand of a particular year, if allowable, some years may be underspent so the funds might be carried forward to a year which otherwise would be overspent. Some amount of the annual dues needs to be held in a reserve fund (trust account) to ensure sufficient funds in place for a catastrophic event such as replacing the bridge or a major road washout or failure in future.

When negotiating with contractors to perform work, it is critical they are given something detailing the work and performance expectations so there are no surprises in the work performed. With this program system in place, MPHA should be successful in maintaining the road network sustainably.

Appendices

Appendix A - Author's Curriculum Vitae

David Rice Smith has completed his career as a Provincial civil servant, with in excess of thirty-five years as a Professional Engineer with the Department of Transportation and Infrastructure Renewal. He has experience and expertise in transportation planning, design, organization, geomatics, and project management, as well as establishing Provincial policy and standards for land-related information; developing the foundation and framework for integrated transportation information systems to support management decisions; and managing delivery of various regulatory traffic services both within government and to the private sector.

Working for a number of years with the Public Works branch of the department, David managed the Capital Program, Planning and Development for the provincial portfolio of buildings, including automation of processes and delivery of services via secure internet applications.

In addition to completing an MBA and MPM, David has completed his BEd and has experience teaching at C.P. Allen High School, Technical University of Nova Scotia (TUNS, now DalTech), Acadia University, and Nova Scotia Agricultural College.

Appendix B - Index to Pictures Taken

Parklands Road Project

Photographs taken Fri, 16 Aug/13

Orig Camera Image Code	Project Picture ID	Odometer Reading Forward	Reverse Reading	Description
DSC00282	PaRd-001	0.0	5.3	fwd / from turning circle at end of Cliff Road
DSC00283	PaRd-002	0.0	5.3	back / into turning circle at end of Cliff Road
DSC00284	PaRd-003	0.1	5.3	fwd / ditch RHS
DSC00285	PaRd-004	0.1	5.3	fwd / downhill, relatively straight with kink to L and curve ahead to the L
DSC00286	PaRd-005	0.1	5.3	fwd / ditch LHS full of vegetation
DSC00287	PaRd-006	0.1	5.2	plastic culvert half immersed in water L & R / some ditching / low vegetation both sides / top of hill pictures of rock - culverts both sides
DSC00288	PaRd-007	0.1	5.2	significant gravel sprayed off the road
DSC00289	PaRd-008	0.1	5.2	plastic culvert inlet partially immersed in water and vegetation
DSC00290	PaRd-009			back / up hill straight stretch kinking to the L
DSC00291	PaRd-010			back / curvilinear, undulating
DSC00292	PaRd-011			back / ditch RHS
DSC00293	PaRd-012			fwd / large boulder in road (sample or numerous occurrences)
DSC00294	PaRd-013			ditch with vegetation
DSC00295	PaRd-014			back / straight stretch with curve to the R ahead
DSC00296	PaRd-015	0.2	5.1	back / side of the road LHS with sprayed gravel & vegetation
DSC00297	PaRd-016	0.2	5.1	fwd / side of the road LHS with sprayed gravel & vegetation
DSC00298	PaRd-017			fwd / straight stretch with curve to the R ahead
DSC00299	PaRd-018			side of road with significant gravel sprayed
DSC00300	PaRd-019			side shot of roadway showing coarser gravel, approx 1" crushed stone
DSC00301	PaRd-020			fwd / curvilinear with curve to the L ahead
DSC00302	PaRd-021	0.3	5.0	galvanized 30" dia culvert without rip rap / failed - stagnant water
DSC00303	PaRd-022	0.3	5.0	looking thru the culvert / partially crushed / bottom rusted out
DSC00304	PaRd-023			back / from a curve to the L onto a straight stretch
DSC00305	PaRd-024			fwd / long flat curve to the L
DSC00306	PaRd-025			back / curvilinear with curve ahead to the L
DSC00307	PaRd-026			fwd / gravel sprayed into the ditch LHS
DSC00308	PaRd-027			fwd / gravel sprayed into the ditch LHS / boulders sticking out
DSC00309	PaRd-028			fwd / gravel sprayed into the ditch RHS
DSC00310	PaRd-029	0.5	4.8	back / straight stretch with curve to the R ahead
DSC00311	PaRd-030	0.5	4.8	fwd / curvilinear with curve ahead to the R

Orig Camera Image Code	Project Picture ID	Odometer Reading Forward	Reverse Reading	Description
DSC00312	PaRd-031			fwd / curvilinear with curve ahead to the L
DSC00313	PaRd-032			back / straight stretch down hill with curve ahead to the L
DSC00314	PaRd-033	0.6	4.7	fwd / long flat curve to the L / entrance ahead on the RHS with blue sign
DSC00315	PaRd-034	0.6	4.7	back / straight stretch with curve to the R ahead
DSC00316	PaRd-035			fwd / curvilinear with curve tot he L ahead
DSC00317	PaRd-036			back / curvilinear with curve to the R ahead
DSC00318	PaRd-037	0.8	4.5	fwd / after a bit of a straight stretch a curve ahead to the L / entrance to civic #377 ahead on the RHS
DSC00319	PaRd-038	0.8	4.5	back / ditch RHS / gravel in ditch indicates snow plowing at speed
DSC00320	PaRd-039	0.8	4.5	fwd / ditch LHS / gravel in ditch indicates snow plowing at speed
DSC00321	PaRd-040	0.9	4.4	back / LHS, plastic 15" dia culvert outlet with no rip rap / off take ditch
DSC00322	PaRd-041	0.9	4.4	back / RHS, plastic culvert inlet partially rip rapped
DSC00323	PaRd-042	0.9	4.4	back / ditch RHS with plastic culvert inlet partially rip rapped
DSC00324	PaRd-043	0.9	4.4	fwd / ditch LHS
DSC00325	PaRd-044			back / long flat curve to the R
DSC00326	PaRd-045			fwd / long straight stretch with curve to the R ahead
DSC00327	PaRd-046	1.0	4.3	fwd / RHS looking thru galvanized pipe / partially crushed, rusting out, and apparently blocked
DSC00328	PaRd-047	1.0	4.3	fwd / RHS looking thru galvanized pipe / partially crushed, rusting out, and apparently blocked
DSC00329	PaRd-048	1.0	4.3	fwd / ditch LHS with culvert inlet partially blocked
DSC00330	PaRd-049			back / curve to the L followed by long relatively straight stretch
DSC00331	PaRd-050			fwd / uphill coming out of a curve to the R with road taking a curve to the L ahead
DSC00332	PaRd-051	1.1	4.2	fwd / strait stretch followed by curve to the R / for sale sign on RHS
DSC00333	PaRd-052	1.1	4.2	back / short strait followed by curve to the R
DSC00334	PaRd-053			fwd / curvilinear alignment among the forest trees / lot 37
DSC00335	PaRd-054			back / short strait followed by curve to the L
DSC00336	PaRd-055	1.2	4.1	back / short strait followed by curve to the L / lot 34
DSC00337	PaRd-056	1.2	4.1	fwd / coming out of a curve to the L / wind rows of gravel on shoulder
DSC00338	PaRd-057			back / ditch RHS / incomplete / getting silted from backslope excavation
DSC00339	PaRd-058			fwd / ditch LHS with sprayed gravel
DSC00340	PaRd-059	1.3	4.0	12" dia galvanized culvert entrance without rip rap
DSC00341	PaRd-060	1.3	4.0	12" dia galvanized culvert entrance with rip rap
DSC00342	PaRd-061			looking thru galvanized pipe / crushed
DSC00343	PaRd-062			looking thru galvanized pipe / clear
DSC00344	PaRd-063	1.5	3.8	fwd / driveway to civic #233
DSC00345	PaRd-064			fwd / curvilinear

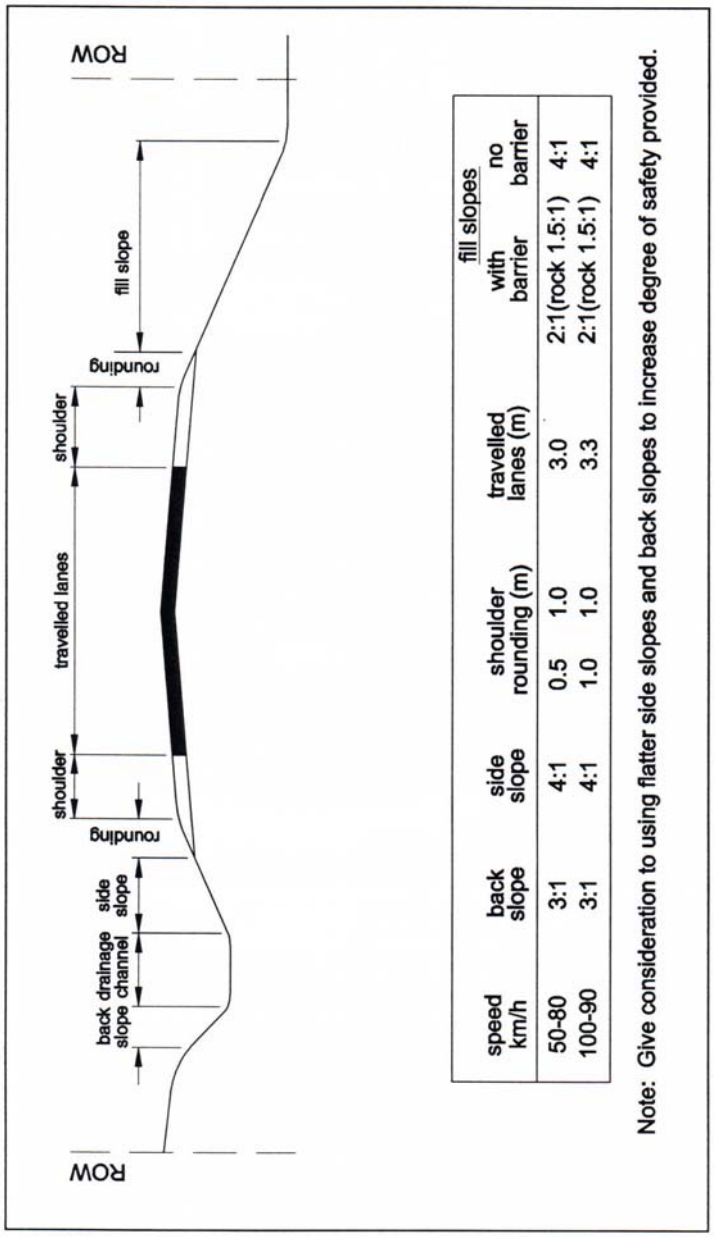
Orig Camera Image Code	Project Picture ID	Odometer Reading Forward	Reverse Reading	Description
DSC00346	PaRd-065			fwd / relatively straight with curve to the R in the distance
DSC00347	PaRd-066	1.6	3.7	fwd / large ant hill RHS shoulder
DSC00348	PaRd-067			back / curvilinear with intersection of road on LHS
DSC00349	PaRd-068			fwd / large galvanized culvert / outfall RHS
DSC00350	PaRd-069			fwd / large galvanized culvert / inlet LHS
DSC00351	PaRd-070	1.6	3.7	fwd / large frog in outfall to culvert RHS
DSC00352	PaRd-071			fwd / ditch RHS with deep laying water
DSC00353	PaRd-072			fwd / curve to the L after short straight section
DSC00354	PaRd-073	1.7	3.6	fwd / curvilinear with road curving to the R ahead / lot 30
DSC00355	PaRd-074	1.8	3.5	fwd / curve to the R
DSC00356	PaRd-075	1.9	3.4	fwd / curvilinear with road curving to the R in the distance
DSC00357	PaRd-076	2.0	3.3	back / very long stretch with curve to the L at the end
DSC00358	PaRd-077	2.1	3.2	back / culvert ? / straight stretch with curve to the L ahead
DSC00359	PaRd-078	2.2	3.1	fwd / downhill / #93 / no crown on road
DSC00360	PaRd-079			back / on long stretch with a curve to the L ahead
DSC00361	PaRd-080			fwd / with relatively long straight stretch ahead into a curve to the L
DSC00362	PaRd-081	2.5	2.8	back / on curve to the R with relatively long straight stretch ahead into a curve to the R
DSC00363	PaRd-082	2.5	2.8	fwd / on curve to the L / curve to the R ahead
DSC00364	PaRd-083			fwd / on curve to the R approaching bridge ahead
DSC00365	PaRd-084	2.6	2.7	pothole in travelway near bridge
DSC00366	PaRd-085	2.6	2.7	bridge / back LHS / some superstructure & corner of crib abutment
DSC00367	PaRd-086	2.6	2.7	bridge / fwd RHS / some superstructure & corner of crib abutment
DSC00368	PaRd-087	2.6	2.7	bridge / centre of structure showing separation of wood decking
DSC00369	PaRd-088	2.6	2.7	bridge / back RHS / superstructure with railing
DSC00370	PaRd-089	2.6	2.7	bridge / back RHS / some superstructure & corner of crib abutment
DSC00371	PaRd-090	2.6	2.7	bridge / fwd LHS / some superstructure & corner of crib abutment
DSC00372	PaRd-091	2.6	2.7	back / bridge crib abutment / steel girders / header / wood superstructure
DSC00373	PaRd-092	2.6	2.7	fwd / bridge crib abutment corner with some moss / steel girders / header / wood superstructure
DSC00374	PaRd-093	2.6	2.7	fwd / bridge crib abutment / steel girders / header / wood superstructure
DSC00375	PaRd-094	2.6	2.7	under bridge / back crib abutment / steel girders / wood decking showing treatment
DSC00376	PaRd-095	2.6	2.7	under bridge / back crib abutment / steel girders / header / wood decking
DSC00377	PaRd-096	2.6	2.7	back / bridge crib abutment / steel girders / wood superstructure

Orig Camera Image Code	Project Picture ID	Odometer Reading Forward	Reverse Reading	Description
DSC00378	PaRd-097	2.6	2.7	fwd / bridge cribwork corner RHS with moss and sprayed grave
DSC00379				missing
DSC00380	PaRd-098	2.6	2.7	fwd / on long straight stretch with curve to the R ahead
DSC00381	PaRd-099	2.6	2.7	back / on straight stretch with wood structure, curve to the L ahead
DSC00382	PaRd-100	2.7	2.6	fwd / on a straight stretch with a curve to the R ahead / Red Shirt Road steel gate to the left ahead
DSC00383	PaRd-101	2.8	2.5	fwd / long very flat curve to the R
DSC00384	PaRd-102	2.9	2.4	fwd / on a curve to the R with curve to the L ahead
DSC00385	PaRd-103			inadvertent picture of sunroof
DSC00386	PaRd-104	3.0	2.3	fwd / coming out of L curve - broken back - or very long flat curve
DSC00387	PaRd-105			looking thru galvanized pipe / clear
DSC00388	PaRd-106	3.1	2.2	ditch with laying water / culvert LHS plastic 24" dia / hill - washboard on the hill
DSC00389	PaRd-107			fwd / winding road to R
DSC00390	PaRd-108			fwd / on straight stretch, curve to the R ahead
DSC00391	PaRd-109			fwd / on straight stretch
DSC00392	PaRd-110			fed / Sunset Ln on RHS
DSC00393	PaRd-111			intersection / looking back sideways RHS - down Sunset Ln
DSC00394	PaRd-112			fwd / on long straight stretch / approaching entrance on RHS / undulating terrain
DSC00395	PaRd-113			fwd / on long straight stretch / undulating terrain
DSC00396	PaRd-114	3.9	1.4	fwd / straight stretch / edge of lot 21 (Collins)
DSC00397	PaRd-115	4.1	1.2	fwd / down hill on flat curve to the R, long straight stretch ahead
DSC00398	PaRd-116	4.2	1.1	fwd / approaching sharp curve at the L / Parklands Point Road straight ahead
DSC00399	PaRd-117			fwd / on a long flat curve to the L
DSC00400	PaRd-118			fwd / straight stretch ahead
DSC00401	PaRd-119	4.4	0.9	fwd / soil squeezed up in wind row LHS with gravel - 1" crushed stone
DSC00402	PaRd-120	4.4	0.9	fwd / soil squeezed up in wind row LHS with gravel - 1" crushed stone
DSC00403	PaRd-121	4.4	0.9	fwd / soil squeezed up in wind row LHS with gravel - 1" crushed stone
DSC00404	PaRd-122			back / gravel sprayed into ditch
DSC00405	PaRd-123			fwd / ditch LHS
DSC00406	PaRd-124			fwd / straight stretch ahead
DSC00407	PaRd-125			fwd / approaching curve to the R
DSC00408	PaRd-126			fwd / on a curve to the R
DSC00409	PaRd-127	4.7	0.6	fwd / into a straight stretch - curve to the L ahead / large 30-36" dia culvert / otter crossing
DSC00410	PaRd-128			fwd / long straight stretch ahead
DSC00411	PaRd-129			fwd / approaching entrance gate / on straight stretch
DSC00412	PaRd-130	5.3	0.0	fwd / approaching paved road at end / beginning

Orig Camera Image Code	Project Picture ID	Odometer Reading Forward	Reverse Reading	Description
DSC00413	PaRd-131	5.3	0.0	on return / at pavement heading uphill into the road / shed on the RHS
DSC00414	PaRd-132			on return
DSC00415	PaRd-133			on return / at entrance gate
DSC00416	PaRd-134			on return
DSC00417	PaRd-135			on return / large 30-36" dia culvert / otter crossing
DSC00418	PaRd-136			on return
DSC00419	PaRd-137			on return / approaching Parklands Point Road
DSC00420	PaRd-138			entrance to Collins driveway
DSC00421	PaRd-139			driving Collins driveway
DSC00422	PaRd-140			driving Collins driveway

Appendix C - Cross Section Elements - RLU Road

Figure 2.2.13.2 Typical Section - Rural Local Undivided Road



speed km/h	back slope	side slope	shoulder rounding (m)	travelled lanes (m)	fill slopes with barrier	fill slopes no barrier
50-80	3:1	4:1	0.5 1.0	3.0	2:1(rock 1.5:1)	4:1
100-90	3:1	4:1	1.0 1.0	3.3	2:1(rock 1.5:1)	4:1

Note: Give consideration to using flatter side slopes and back slopes to increase degree of safety provided.

Appendix D - Glossary of Terms

Back Slope - That portion of a road cross section, in a cut section, on a slope up from the bottom of the ditch bottom to blend with the undisturbed, natural terrain.

Bridge - A structure, usually over water, spanning at least ten feet (3m) between abutments, possibly with one or more piers if more than one span is required (shorter is considered a culvert).

Cribwork - Usually a wood structure (could be concrete) of logs or milled members, cross piled and filled with rock, often used as piers or abutments for water structures such as bridges or wharves or piers, but may also be used for retention of embankments, or other such purposes.

Cross Culvert - A water structure under a roadway to pass a ware course or water runoff from a ditch system on the higher side of the road to an offtake system on the lower side of the road.

Cross Section - The transverse profile of a roadway, a view taken along the centreline of the roadway of a slice perpendicular to the centreline.

Cross-Slope - The average grade between edges of a cross section element, perpendicular to the centreline.

Crown - The highest break point of the surface of a roadway in cross section, how the surface grades of each side of the road come together at the centreline.

Curvilinear Alignment - An alignment predominantly made up of circular and spiral curves, with limited or short straight sections.

Design Consistency - An indication of the quality of design offered by a roadway, whereby road features are the same all along the roadway with minimal deviation.

Design Speed - A speed selected for purposes of design and correlation of the geometric features of a road.

Geometric Design - The selection of the visible dimensions of the physical elements of a roadway.

Gradient - The rate of rise of fall with respect to the horizontal distance, the slope of the road along the centreline.

Granulars - Granulars consist of glacial or alluvial deposits, crushed rock or quarried material.

Gravel Class - Gravel is a type of granular, specifically composed of crushed and screened rock or deposit material of an approved hardness (petrographic number). Gravel is classified based on the largest size stone and gradation of fines passing thru a series of sieves to a recognized standard (such as ASTM). The volume and gradation of fines is necessary to allow proper compaction of the gravel to an acceptable standard. Gravels shall be free from flat, elongated or other objectionable pieces.

Guidelines - Outlines of acceptable practice, documentation which directs how something should be done in normal circumstances.

Normal Crown - A typical cross section in which adjacent surfaces slope in opposite directions from the centreline or a lane edge to effect drainage to the sides.

Retrofit - The reconstruction of an existing roadway with geometric improvements.

Reverse Crown - A surface cross section in which adjacent surfaces slope in the same direction at the normal crown, usually applied to assist vehicles travelling around curves or as required for problematic drainage situations.

Reverse Curve - Two curves, curving in opposite directions from a common point, may also be called a “switchback”.

Right-of-Way - The area of land acquired for or devoted to the provision of a road.

Rip Rap - Flat stone, at least one foot wide, piled at the entrance of a culvert pipe to make a rock wall to protect the pipe and minimize scour and erosion around the pipe.

Road - The entire right-of-way comprising a common or public throughfare, including a highway, street, lane, alley, bridge, and any other structure incidental thereto.

Roadside - The area adjoining the outer edge of the travelled way.

Roadside Barrier - A longitudinal structure, crash cushion, or other device used to shield roadside obstacles or non-traversable terrain features, which provides continuous protection to adjacent traffic, including Guardrail, Guiderail, and Guide Cable.

Roadway - That portion of a street or highway which is improved, designed, or ordinarily used for vehicular travel, inclusive of the shoulder.

Rounding - The introduction of a vertical curve between two transverse slopes to minimize the abrupt slope changes.

Shoulder - That part of a roadway contiguous with the travelled way intended for lateral support of the roadway structure, emergency stopping, and may be used for parking on local roads.

Side Slope - That portion of a road cross section, on a slope down from the edge of the shoulder to the ditch bottom in a cut section or the embankment bottom in a fill section.

Standard - A value for a specific design feature, which practice or theory has shown to be appropriate for a specific set of circumstances, where no unusual constraints influence the design.

Superelevation - The gradient measured at right angles to the centreline across the roadway from the inside to the outside edge of a curve, greater then Reverse Crown, applied to assist vehicles travelling around curves.

Swale - A shallow drainage channel.

Topography - The surface features of the earth, including water, landscape relief, unique occurrences, etc.

Travelway - That part of a roadway intended for vehicular uses or the path worn by passing vehicles, excluding shoulders, may also be called Carriageway (old term) or more recently referred to as the Travelled Way.

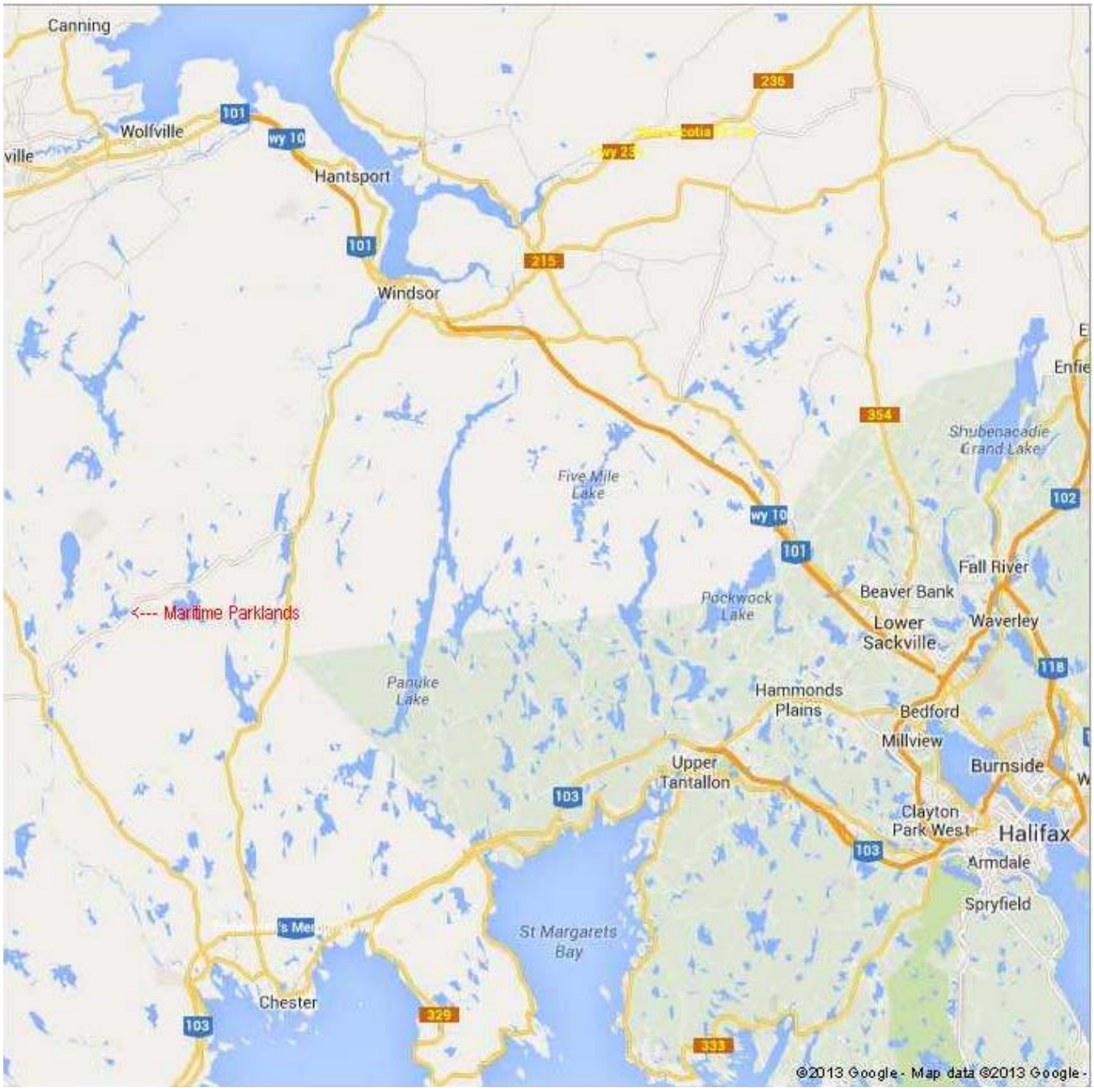
Two-Lane Roadway - A roadway that provides for two lanes of traffic, one in each direction.

Two-Way Traffic - A roadway that allows for vehicles to operate in both directions along its course.

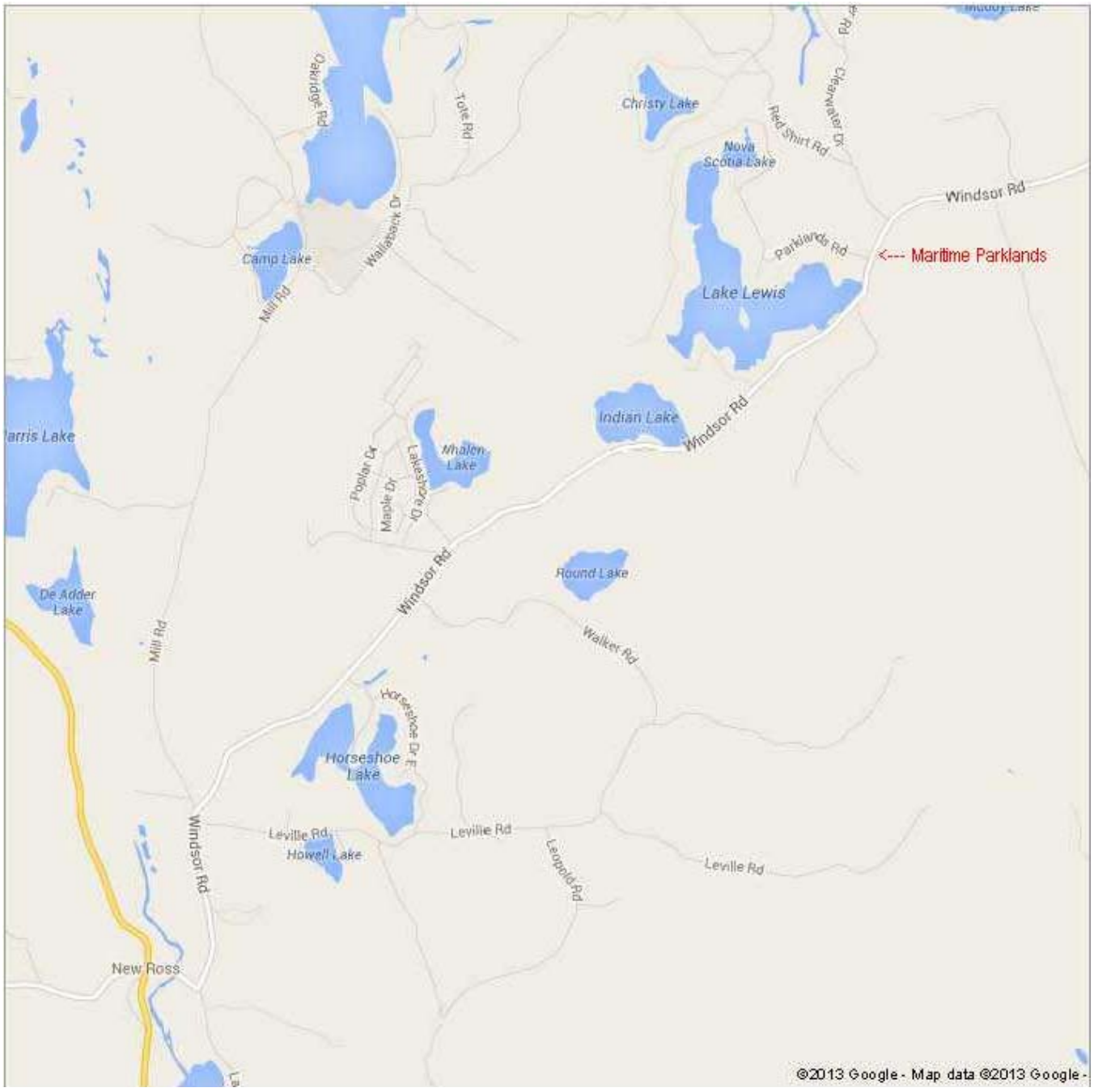
Vertical Alignment - The configuration of a road or roadway as seen in longitudinal section, consisting of straight grades and vertical curves.

Tables / Figures / Maps / Plans

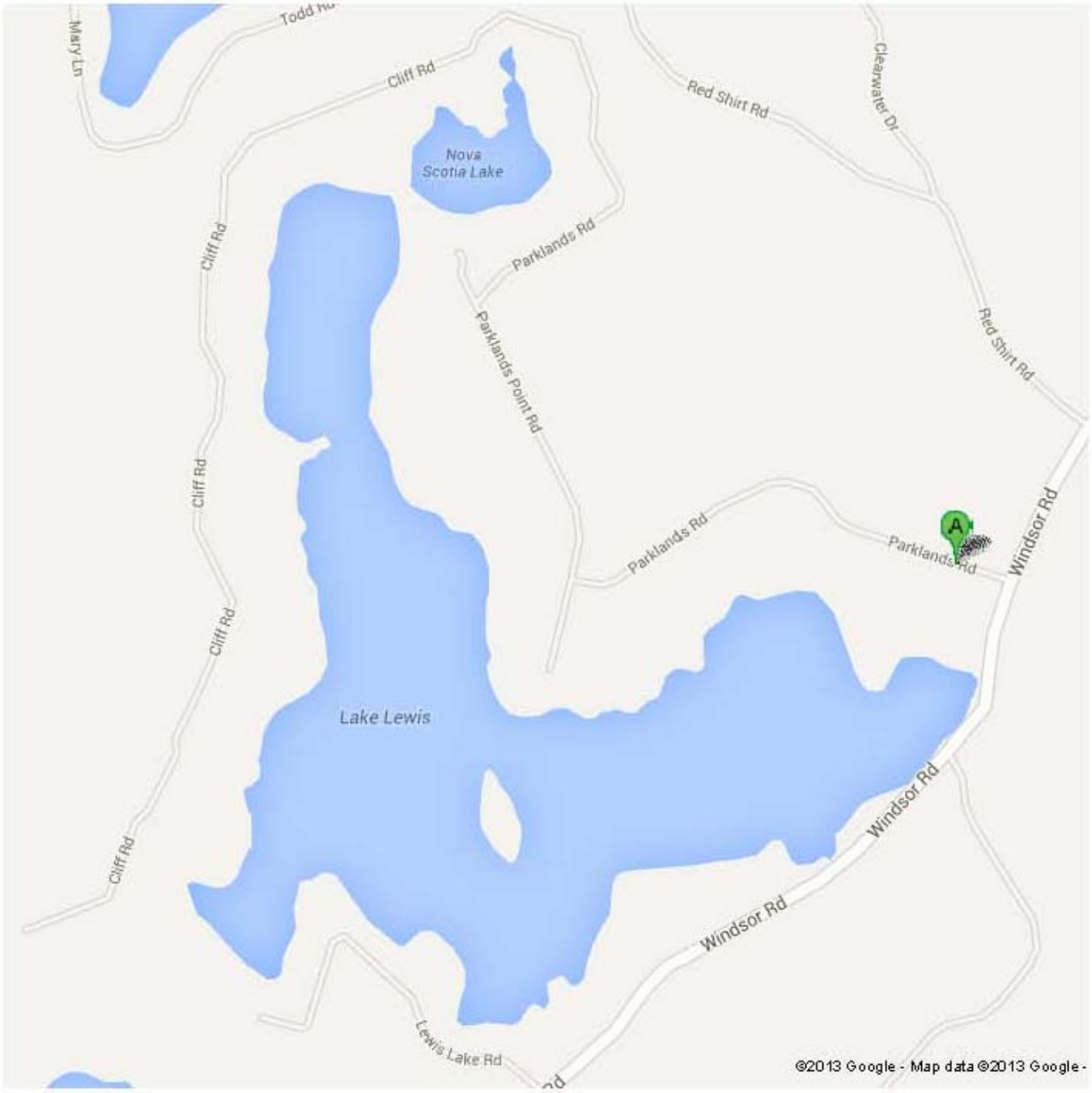
Map A - Halifax to Maritime Parklands (Lewis Lake)



Map B - New Ross to Maritime Parklands (Lewis Lake)



Map C - Maritime Parklands Roads around Lewis Lake



Air Photo D - Maritime Parklands Roads around Lewis Lake