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ENGINEERING HISTORY PAPER #60

"The Building of the Trent-Severn Waterway"

by Andrew H. Wilson
(previously produced as Cedargrove Series #33/2015 – February 2015)

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Abstract

This 230-mile-long (400 km) waterway, across Ontario, was built between 1833 and 1920, which was a very long time. It began as a project to assist immigration and natural resource exploitation in the Kawartha Lakes region and ended as a belated attempt to provide an alternative to the Great Lakes-Welland-St. Lawrence route between Lake Huron and Lake Ontario. It was built in various stages, each one becoming a 'political football' of one kind or another, which accounted for the major delays. It was also in constant competition for resources and influence with the Welland Canal and was subject to personal and political clashes among its various builders, supporters and detractors.

This paper provides a relatively rapid telling of the long Trent-Severn story, based principally on the book *A Respectable Ditch* by James T. Angus and on the trip to many of the waterway's present locks and facilities that the author made in the late summer of 2014. It is an expanded version of the talk he gave to the Ottawa Branch of the Canadian Society for Senior Engineers in January 2015.

Most of the photographs of the modern waterway included in this paper were taken by the author during his 2014 trip.

About the Series

Principally, the Cedargrove Series is intended to preserve some of the research, writings and oral presentations that the author has completed over the past half-century or so, but has not yet published. It is, therefore, a modern-day variant of the privately published books and pamphlets written by his forebears, such as his paternal grandfather and grandmother and his grandfather's brother John.

About the Author

He is a graduate in mechanical engineering and the liberal arts and has held technical, administrative, research and management positions in industry in the United Kingdom and the public service of Canada, from which he retired almost 30 years ago.

Over the years, he has written and published on many subjects, from science policy and human resources associated with engineering to building economics, as well as engineering history, in which he became actively interested on his appointment to chair the first history committee of the Canadian Society for Mechanical Engineering in 1975. He has since done work in this field for CSME, the Engineering Institute of Canada and the Canadian Society of Senior Engineers. He has also served as president of CSME and EIC.

Introduction

The plaque erected by the Archeological and Historic Sites Board of Ontario (now the Ontario Heritage Foundation) reads as follows:

> The canalization of the waterway from the Bay of Quinte to Lake Simcoe to provide communications between Lake Ontario and the new settlements around Peterborough was proposed officially in 1827. The project was begun 1833-35 with a survey of the route and the building of a lock at Bobcaygeon. Work proceeded sporadically but by 1872 local navigation was possible on long sections of the route. After 1880 pressure increased on the federal government to complete the waterway (including an extension to Georgian Bay) as a route for traffic from the West, and the final stage of the construction was begun in 1895. Opened for small boats in 1920, the Trent-Severn is one of the province's major recreational waterways.

The land-river-lake route now followed by the modern waterway was, for a very long time, used by First Nations people travelling through the Kawarthas and between Lakes Huron and Ontario. The first European to cross it was Samuel de Champlain in 1615.

As noted in the quotation, the story of the building of this 230-mile waterway is a long one, from 1833 until 1920, some 87 years. My main source, James T. Angus's very detailed book *A Respectable Ditch*, has over 400 pages. His connection with the waterway was personal. His father, Scotty Angus, was a long-time keeper of the Big Chute marine railway. The *Ditch* analogy was undoubtedly modeled on the nickname for the Welland, *Mr Merritt's Ditch*. I have also used Christopher Andreae's *Atlas of Railway and Waterway History in Canada...*'Googled' quite a few sites, biographies and specific pieces of information, and made use of a number of tourist pamphlets published by Parks Canada and other organizations.

For the purposes of this paper, the Trent-Severn story will end with the completion of the waterway in 1920 although, occasionally, an updating note will be added (in parentheses). Consequently, details and actions under Bill C-530, introduced and passed by Parliament in 2013 and covering the most recent proposals for renovations and updates to the waterway, are not included.

My research was supplemented by the trip I took with some family members in the late summer of 2014, when we visited around two-thirds of the locks on the modern waterway - by automobile, not by boat - from Port Severn in the north to Trenton and the Murray Canal in the south. Of the one-third missed, at least one lock - at Swift Rapids - is virtually inaccessible to visitors at any time. Others were under reconstruction, and still others were rather far out of our way. Photographs from this trip have been used to help illustrate the story.

Why is the 'on-off-on again' story of the Trent-Severn so long? There are at least three main reasons: it became a regular political football; it lacked consistent financial (and moral) government support; and, even although it provided a shorter distance between Lake Huron and Montréal, it was in competition as a commercial waterway with the favoured Welland-St. Lawrence route, and later with the railways.

Like the Rideau, the Trent-Severn originally had potential value from the military point of view but, like the Rideau, it eventually became a recreational waterway. Incidentally, the Rideau and first Welland Canals were being completed as work was beginning on the Trent-Severn.

From the political point of view, the Trent-Severn Waterway came under the jurisdiction of the Colonial government of Upper Canada and its Inland Water Commission from 1833 to 1841, the United Province of Canada and its Board of Works from 1841 until Confederation in 1867, and from then to 1920 under the Ontario and, later, the Dominion/Canadian governments. In connection with the latter, the years in office of the prime ministers of Canada are important to note: Macdonald (1867-1873); Mackenzie (1873-1878); Macdonald again (1878-1891); Abbott/Thompson/Bowell/Tupper (1891-1896); Laurier (1896-1911); and Borden (1911-1920).

The waterway passes through the Ontario watersheds of the Severn and Trent Rivers, an area of over 7,100 square miles (18,600 square kilometers). It was eventually built (non-sequentially) in five sections, north to south: from Port Severn and the Severn River to Lakes Couchiching and Simcoe; from Simcoe to Balsam Lake by way of the Talbot River; the Kawartha Lakes; the Otonabee River to Rice Lake; and, finally, from Rice to the mouth of the Trent. The high point of the system is at Balsam Lake, one of the Back Lakes of the Kawarthas, the rise from Lake Ontario being 600 feet and the fall to Lake Huron 235 feet.

The locks on the waterway are presently numbered from 1 through 45, beginning at Trenton. However, #29 is missing. The original flight locks at Burleigh Falls were #28 and #29. They were later rebuilt as a single lock and given #28. #29 was discarded. The original flight locks at Fenelon Falls were #33 and #34. They were also rebuilt as a single lock, retaining #34. The lock at Lindsay (formerly Purdy's Mills), on a side branch of the waterway connecting Lake Sturgeon with Port Perry on Lake Scugog by way of the Scugog River, was given #33.

In addition to its locks, lakes and rivers, the present-day waterway has 160 dams and control structures that manage water levels, 39 swing bridges, 14 power plants and many miles of excavated canals.

The Appendix includes lists of the present day locks, map of their locations, and a cross-sectional diagram of the waterway's elevations.

Some Basics...

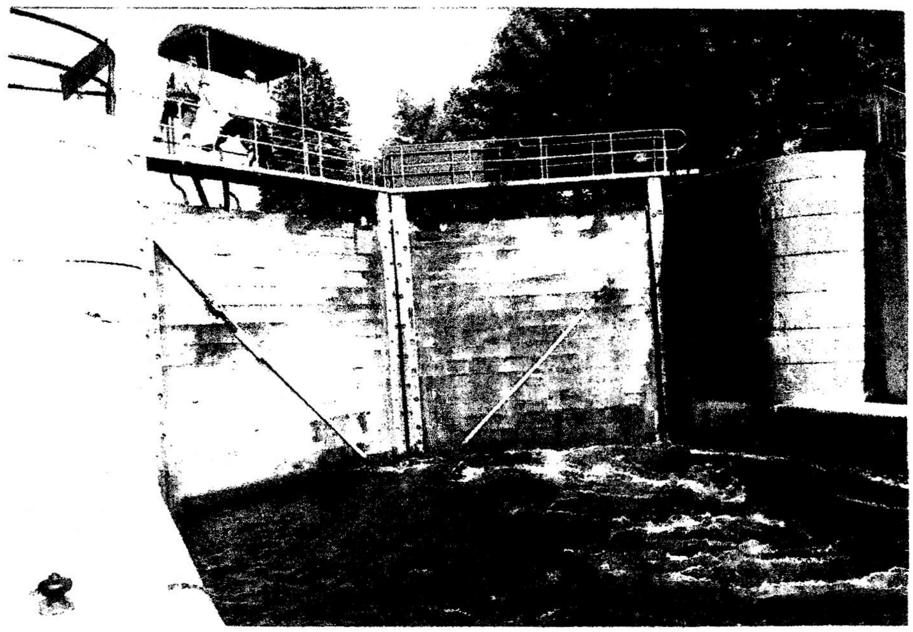
Early canal-building engineering is described this way in Andreae's book:

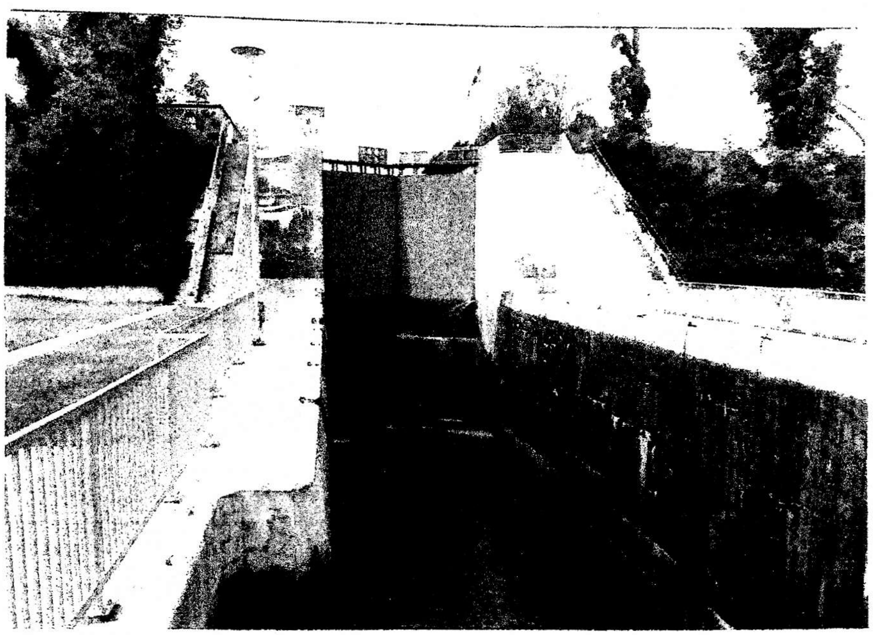
> The optimum size of an artificial waterway was determined by the size and speed of the vessels using the canal. The dimensions were dictated by more than the need to have space for safe navigation. If the cross-section of the channel was too small - either too shallow or too narrow - the water displaced by the vessel reacted with the canal walls to generate a resistance to the hull. This water friction limited the speed of the vessel. One solution - making the channel unnecessarily large - was simply a waste of money. The canal cross-section was known as the 'prism,' from the slope of the channel walls...
>
> Damming a waterway to create a navigable depth of water was an alternative to dredging shallow rivers. This slack-water system was common in Canada, most notably on the Rideau and Trent canals... Navigation round each dam was made possible by locks constructed directly into, or adjacent to, the dam... However, slack-water navigation flooded extensive tracts of land...
>
> Waterways contained a range of water-control structures. Dams stored and regulated the flow of water; locks and, less commonly, marine railways, raised and lowered vessels... Bridges and tunnels were used to avoid interferences with land traffic...
>
> Most locks in Canada were chamber, or pound, locks... Lock walls had to resist the pressure of earth pushing in the sides and support the tremendous weight of water pressing against the gates. The walls had to be waterproof to prevent water from filtering from the chamber into the surrounding ground and destroying the stability of the soil... On the large locks typically found in Canada, mitre gates were used. Two gates met in the middle to form a V pointing upstream. When closed, the gates were held together by water pressure on the upstream side... The bottom of the lock contained a raised sill, called a mitre sill, against which the gates bore when shut, to provide a watertight connection... At various times, locks have been constructed of wood, stone, concrete and steel. Floors and sills in the 19th century were generally built of wood. By 1900, wood was out of favour...and floors were built of masonry or concrete... Until the 20th century, gates were constructed of wood, usually oak. Because of wetting and drying, they had to be replaced periodically.

Despite wood's tendency to rot and require regular replacement, many of the early locks were made of it. They were less expensive to build and the material was readily available. Limestone, on the other hand, required little maintenance but, by 1900, concrete was replacing stone. In 1896, Lock #22 at Nassau Mills on the Trent, was the first to be made of concrete in Canada. Many of the early dams were made of timber cribs filled with stones and earth and sealed with puddle clay. The 20th century arrived before lock gates were made of steel.

Wooden gates at #41 Gamebridge

(2014)





Steel gates at #17 Healey Falls

(2014)

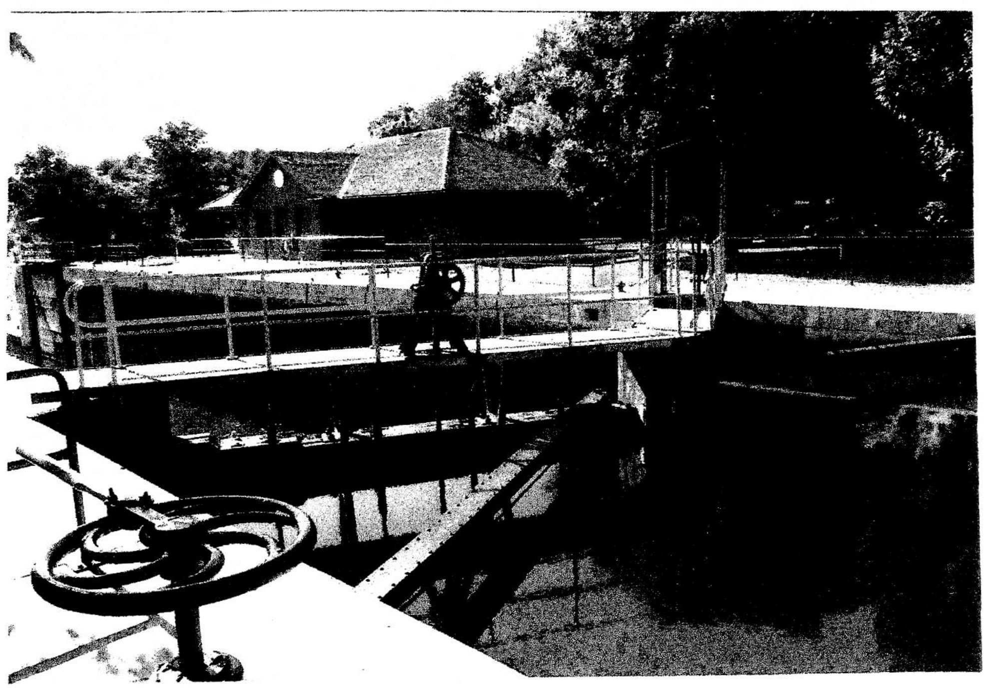
In his book, Angus describes the evolution of the lock gate-opening mechanisms for the gates on the Trent-Severn Waterway:

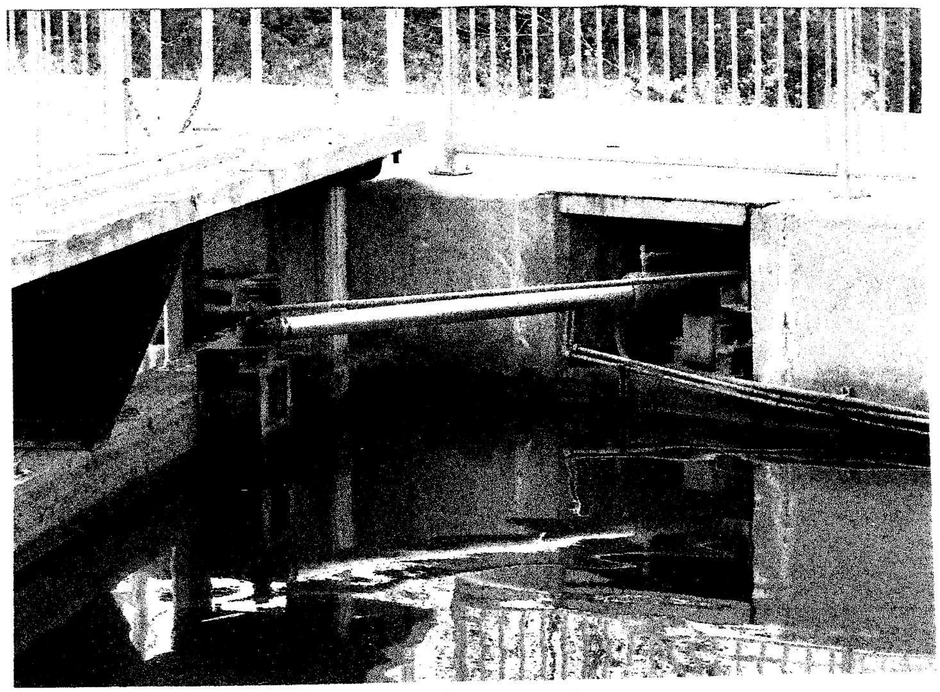
> The first locks built on the Trent were pulled open and shut with ropes. The system used by the Ontario government engineers for the locks built in the

1870s was to extend the top beam of the gate some 20 feet beyond the pivot. Rudder-like, the gates were easily swung open and shut by pushing on the beam. This system was also used on the Hastings lock. The lock gates designed by Tom S. Rubidge and built by Goodwin and Manning for Burleigh, Buckhorn and Fenelon Falls in the 1880s were worked with cables fastened to each side of the outer end of the top beams of the gates. The cables were attached to winches bolted to the coping of the lock; eight sets of winches, two for each gate, were required. Although functional, the winches were unsightly and constantly in the way. Rogers placed the winches in a recess under the coping of the lock. The wire cables were passed around a corrugated drum attached to a capstan placed in the recess. The capstans were turned by hand, with bars attached horizontally to a vertical shaft extending upwards from the capstan through an opening in the coping. Rogers intended to work the capstans with electric motors when the canal was finished. On lock 20 (Ashburnham) built by Corry and Laverdure in 1900, the wire cables were replaced with oak beams attached to the end of the gate and worked out and through a set of gears. Later, iron beams would replace oak beams, resulting in the system used on the Trent today. But more than half a century would pass before Rogers' vision of electrically operated gates would be realized. Indeed, many of the gates on the Trent-Severn locks are still operated by hand.

Gear-driven, steel beam lock gate opener at #41 Gamebridge, also showing lock gate with sluice valve opening/closing mechanism

(2014)

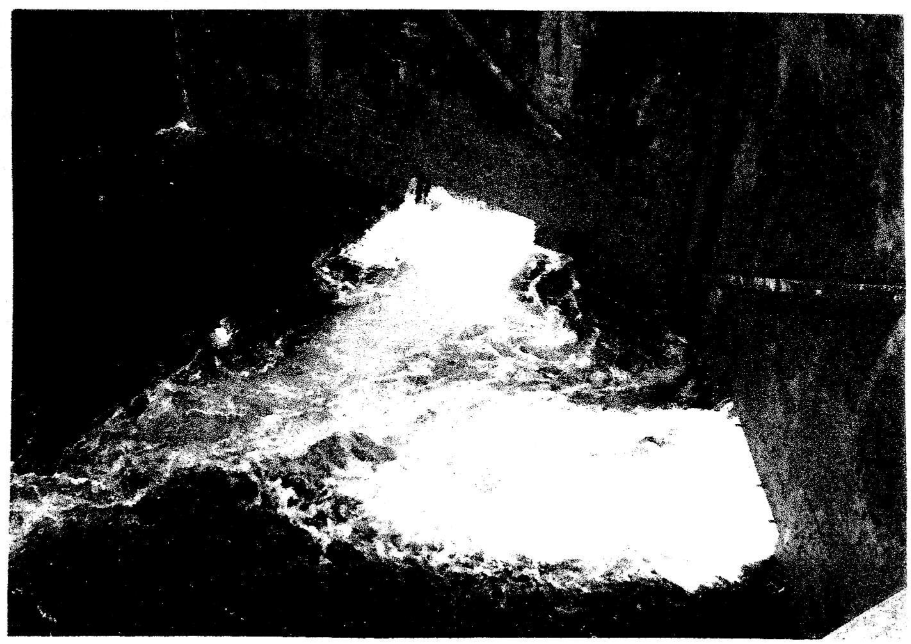




Lock gate with hydraulic/electric opener at #3 Glen Miller

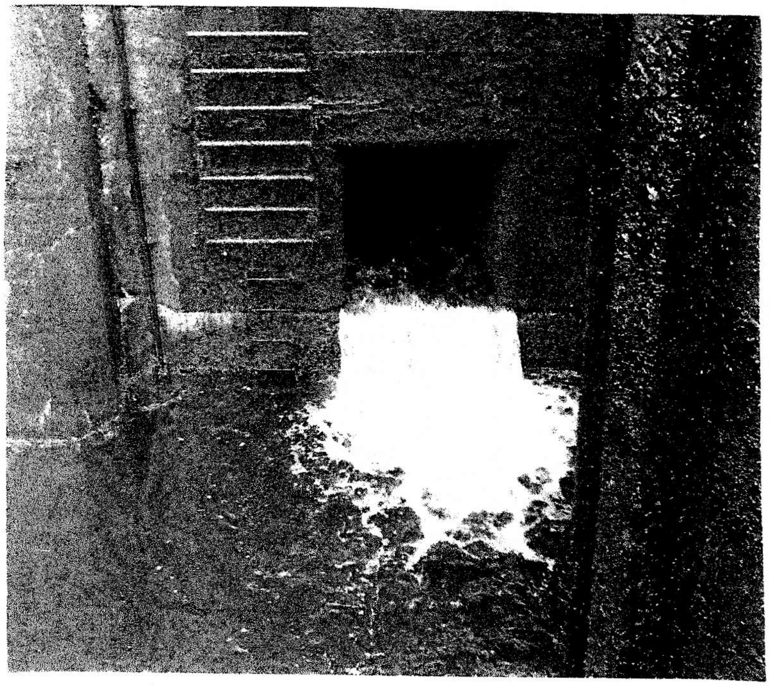
(2014)

Lock water was at first filled and emptied, inefficiently, by means of sluice valves built into the bottoms of gates and actuated by mechanical means. Since the development of concrete, water movement has been improved through the use of valved culverts built into the lock walls. Modern systems have culverts discharging along the entire length of the chamber. They are also electrically, rather than mechanically, controlled.



Water exits through sluice valves in lock gates at #41 Gamebridge

(2014)



Water exits from culvert at

#14 Crowe Bay

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Electrical control panel for lock

functions at #34 Fenelon Falls

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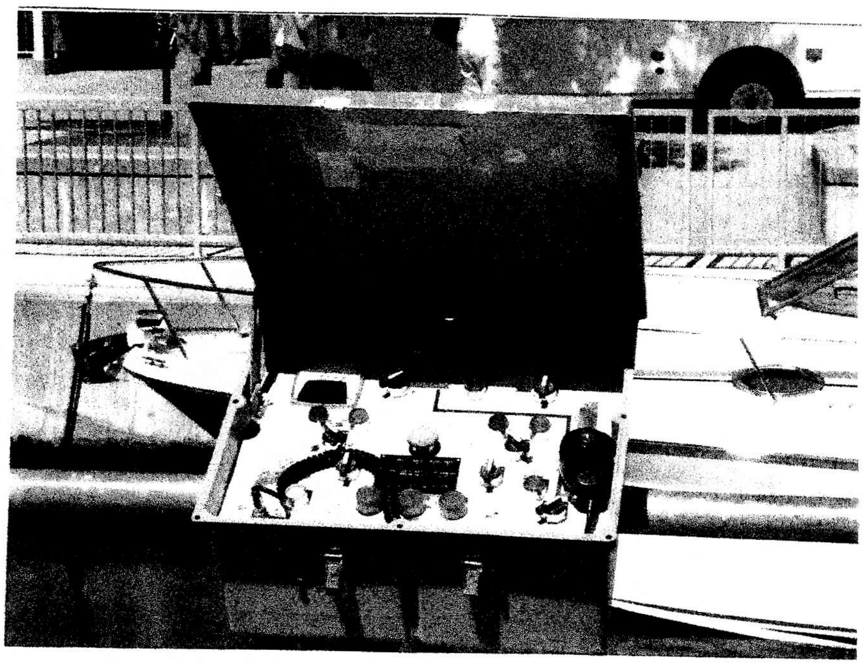
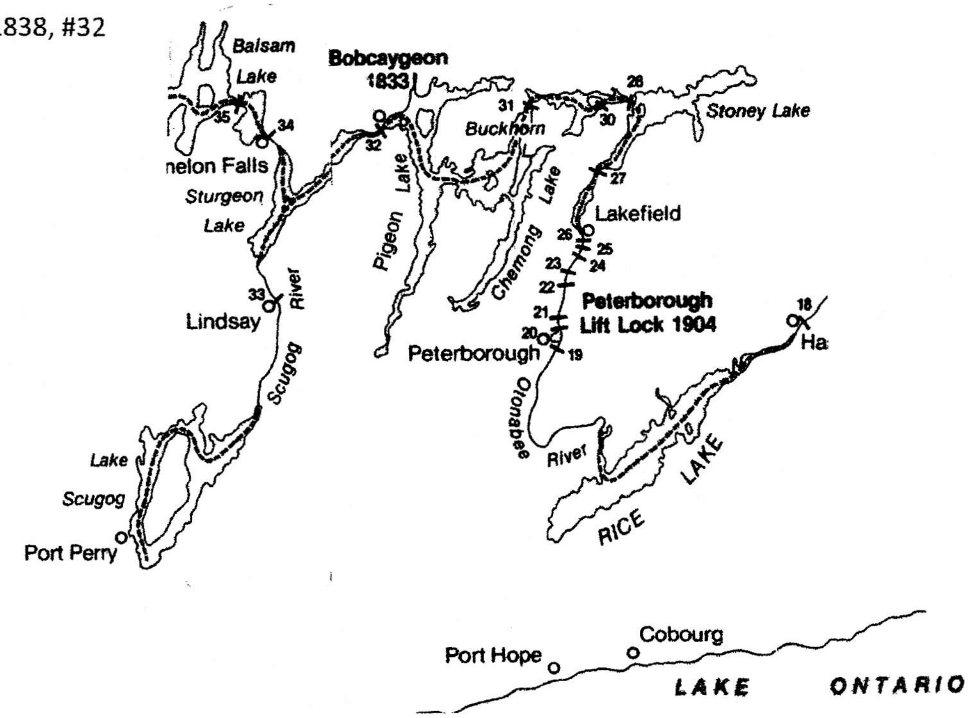


The average size of a Trent waterway lock is 140 feet long, 33 feet wide, with a minimum depth of 6 feet. The principal exceptions are the two lift locks at Peterborough and Kirkfield and Lock #45 at Port Severn.

The Colonial Years

Originally, a full waterway, from Huron to Ontario, was not planned. The incentive was the opening up of the Back (Kawartha) Lakes and the areas to the north and west of them to lumbering, agriculture and settlement. The idea was to connect them to Lake Ontario at Port Hope or Coburg by road and/or rail with Rice Lake, Rice Lake by way of the Otonabee River with Peterborough, Peterborough by 'portage' to Bridgenorth on Lake Chemung, and then on to the Back Lakes and the north. But progress westward to Pigeon, Sturgeon and Balsam Lakes was blocked initially by the rapids at Bobcaygeon. Special steamers were built locally for the lake and river traffic.

Bobcaygeon, 1833-1838, #32



The 'driving force' behind this initial project was John Gray Bethune of Cobourg, but his motivation did not include exploiting the Trent River to the east. In 1832, he had a steamboat built at Sully on Rice Lake for service between the Rice and Whitla's Rapids (later Scott's Mills) on the Otonabee, south of Peterborough. The following summer, he had warehouses at Cobourg and Peterborough, with a stagecoach service between Cobourg and Sully. However, the efforts to extend and improve his plans were contested by political issues and commercial competitors.

As noted, to make the Pigeon-Sturgeon connection, a lock was required at the Bobcaygeon rapids. Bethune and his fellow Commissioners, appointed by the government of Upper Canada, met at Peterb-ough in early June 1833 to award a contract for the building of a wooden one. Regarding this meeting, Angus notes in his book:

> When the men opened the envelopes and chose one of the tenders, a train of events would be set in motion that would extend over four generations and involve hundreds of public meetings, dozens of petitions, countless editorials and newspaper letters, the formation of several canal associations, and a march of thousands of delegates on Ottawa. The same train of events would prompt hundreds of speeches in Parliament, force the passage of numerous statutes and orders-in-council, call for several commissions and investigations, launch dozens of surveys, and produce engineering innovations and construction masterpieces, but also some blunders, scandals and damaged reputations. The discontinuous series of events originating with the construction of a lock at Bobcaygeon would comprise the longest-lasting public enterprise ever undertaken in Canada, which in the end would create a canal extending from Lake Ontario to Georgian Bay and costing $24 million but which, when finished in 1920, would be used in its entirety by few except some wealthy American yachtsmen and a few adventurous Canadian canoemen.

The successful contractor, Pierce, Dumble and Hoar, carpenters in Cobourg, began work on the Bobcaygeon lock on 2 August 1833. It was to be of conventional design, 120 feet long and 28 feet wide, with a 10 foot lift, designed by Cobourg land surveyor Frederick Rubidge, whose experience of lock-building was limited. The side walls and gates were to be made of oak and pine, and there were four valves, the upper ones opening into the bottom of the lock, and the lower ones located in the gates. It was to hold a minimum of four feet of water. The canal was intended to be 50 feet wide at the surface and 36 feet wide at bottom, cut through limestone rock.

Work was suspended for the winter in November 1833 but, by the spring of 1834 there were financial problems involving Bethune, in whose name the financing of the project had been placed, complicated by an election in the Colony in which he was involved. The contractors, however, tried to complete their work on the canal, control dam and lock. But while they built a good enough lock, there were engineering errors affecting the water levels at the dam and in the canal and insufficient water was able to get into the lock for it to operate, and they abandoned the job.

The start of work at Bobcaygeon coincided with activity by the groups opposed to Bethune's plans and supportive of rival schemes to open up the country north of Rice Lake. But the farmers and business people who lived by the Trent River to the east were anxious to have their own commercial connection to Rice Lake, as well as moving timber down the river to Montréal and the overseas market.

In 1833, civil engineer Nichol Hugh Baird was asked by the Lieutenant-Governor's office to survey the Trent route, which he began in September - assisted by land surveyor Frederick Rubidge - and completed in November. Baird foresaw the need for a connection between the Kawarthas and Lake Simcoe, but his suggestion of a through waterway between Lakes Simcoe and Huron was not considered.

A group at Cobourg led by George S. Boulton were keen to establish a railway north to Rice Lake, and had a special interest in using it to get the product of the iron mines at Marmora to market. A stage line went into operation between Cobourg and Rice Lake prior to the building of a railway.

A Port Hope group led by Richard Bullock championed the building of a canal to Rice Lake, to improve access the Back Lakes of Kawartha.

The Trent and Port Hope groups were opposed to the Cobourg railway. Baird later surveyed a possible route for it.

A Peterborough group led by John Hull and John Houston was interested in developing settlements to the Back Lakes and the northwest. It tended to favour the development of the Trent River route to Lake Ontario, in the east, and the development of connections to Lake Simcoe in the west.

In September 1834, Lieutenant-Governor Sir John Colbourne toured the district, from Port Hope and Peterborough, through Chemung and Buckhorn Lakes, Bobcaygeon and Fenelon Falls, Balsam Lake and the Talbot River, which was the natural link between the Back Lakes and Lake Simcoe, and back to Rice Lake and Peterborough. He was impressed with the proposed canal's potential.

At a meeting in Peterborough in November 1834, a petition was drafted that suggested Lake Huron be connected to Lake Ontario by a canal.

The general election in Upper Canada in October 1834 moved some of the main players involved in Trent Canal politics around. Meanwhile, the promoters of the Welland, led by William Hamilton Merritt, championed that route to the ocean as Canada's best option to counter the influence of Americans' Erie Canal, completed in 1825.

Early in 1836 the Upper Canada Legislature established a standing committee on canals and internal improvements, one of whose members was Merritt. It duly report in March. Among other things, it recommended a lock and dam be built at Hastings, at the head of Rice Lake, a lock and dam at Whitla's Rapids (Scott's Mills) south of Peterborough, a renovated lock and dam at Bobcaygeon, and a lock and dam at Purdy's Mills, now Lindsay, opening up navigation some 170 navigable miles from Healey's Falls to Peterborough and from Buckhorn to Lake Scugog. It made no recommendations in regard to the Trent system as a whole. The report and the subsequent bill were passed by the Legislature, but royal assent by the new lieutenant-governor, Sir Francis Bond Head, was withheld. It did, however, permit work to be done around Peterborough.

Meanwhile, it took until March 1837 for the Legislature to approve a Bill for the development of the Trent system, which effectively sanctioned the Trent canal. Nichol Hugh Baird became its first superintendent. His annual salary was $1250 a year, when skilled tradesmen were earning around $400 and labourers around $225.

The contracts for Trent system construction around this time were affected by the 1837 Upper Canada Rebellion, led by William Lyon Mackenzie, and its aftermath and a typhus epidemic in 1838. For example, it increased the costs of hiring and housing labour and reduced the amounts that could be allocated to each contract by the government, added to which was Baird's stubborn reluctance to pay the additional expenses incurred by contractors. These factors, combined with technical ones, such as the availability of suitable limestone, since masonry was now being used for the locks, led to the abandonment of several contracts, including those for the Healey Falls dam, the Lindsay lock, and the locks at Whitla's Rapids (Scott's Mills), Chisholm's Rapids (Glen Ross), Crook's Rapids (Hastings), and Myers Island, and the initial location for the entry lock at Trenton (where the Glen Miller one now is). At Lindsay, delays were also experienced as the result of lake water-level changes in the Scugog River area brought about by Purdy himself.

At Bobcaygeon, a new contractor eventually took over the redesigned work for the lock and finished it successfully in 1838. This *second* lock therefore became, in time, the *first* in the Trent-Severn Waterway. Work on a dam at Buckhorn was also completed around the same time.

The United Province Years

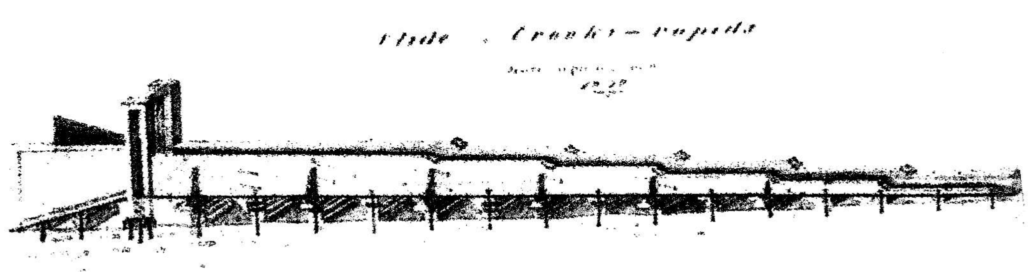
During the Colonial government years, the conduct of individual contracts for the construction of what many years later became the Trent-Severn Waterway had been the responsibility of politically appointed commissioners, whose biggest problems were a lack of technical knowledge of canal building and not having access to enough money to get the jobs done. In February 1841, when it came into being, the United Province government established a Board of Works to administer, among other things, the Trent construction. Its first chair was an Irish-born engineer, Hamilton H. Killaly, who also had a seat on the new executive council. He was experienced on Welland works. His deputy was Samuel Keefer, older brother of engineer Thomas Coltrin Keefer. One of Killaly's first tasks was to make an inspection of the Trent work, accompanied by the nominal superintendent, his friend and fellow engineer Nichol Hugh Baird. There was not much of substance for them to see. As well, the Trent was losing the battle of the 'route to the Atlantic' to the Welland and the St. Lawrence in the political arena, strongly supported by Merritt and by commercial interests in Toronto. The development of railways was also anticipated. And the new political entity needed a sizeable loan from Britain to stave off bankruptcy. Killaly's second task was to propose plans for Board of Works-supported projects, including canals, roads and timber slides. Angus notes in his book:

> The (Trent) plan called for locks 133 feet long, bearing only five feet of water over the sills, because the shallow waterway could not sustain locks of any greater size without a tremendous increase in costs for dredging. Killaly reasoned that the class of steamer navigating this dimension of canal would be unsuited for the rough water of Lakes Michigan and Huron; therefore trans-

shipment would be necessary at the Georgian Bay entrance, increasing costs and eliminating whatever time advantage the route's shorter distance might provide. Moreover, navigation on the Trent route would be impeded by floods and currents in the rivers...and would be seriously obstructed by ice forming earlier and remaining longer in several of the small lakes...than was the case in the more southern and broader waters of the St. Lawrence River.

Basically, Killaly wanted to scrap the Trent. He had, however, to take into account the 'national economy,' which included cutting and moving the timber stocks of the Kawartha Lakes/Trent region, the needs of the various farming communities, and access to Lake Ontario at places such as Port Hope and Cobourg, as well as the physical characteristics of the region. Steamboats on the lakes were still scarce. Also, serious consideration had to be given to the vociferous local lobbies and politicians of the area who were constantly active, prodding the government, and simply wanting their canal built. So Killaly compromised. He recommended only that the partly constructed locks be finished, that timber slides instead of locks - particularly down the Trent River - be built in several places, and that corduroy roads take traffic between Rice Lake and Lake Ontario, all of which effectively downgraded the canal in comparison with the Welland and St. Lawrence route.

Prior to the timber slides, logs were floated singly down to the Trent and Trenton, especially during the annual spring floods. The timber slides, and the locks, allowed cribs of squared timber and rafts of pine logs to be built and floated down to the lake and on to the European market. They were a Canadian invention and had been a success on the Ottawa River. The Trent ones had in fact been first suggested by Nichol Hugh Baird in 1835 as temporary substitutes for locks. They were huge, made of wood, resting usually on a rock base. The ones at Healey Falls, for example, were 713 and 360 feet long. They were all 33 feet wide, to suit the locks. Some had rock-filled wooden dams at their upper ends. Unfortunately, it



Example of a timber slide

took the lumbermen several years to learn how to manage the water, the rafts and the slides. Log jams and accidents were frequent at first. But eventually they did. The slides were in operation for around 40 years, by which time the usable timber available in the area had been harvested.

In 1843, Nichol Hugh Baird was unceremoniously, bureaucratically and politically 'dumped' by the Board of Works as superintendent, not only of the canal, but also of harbour, bridge, road and other works in the region. Granted, he was under considerable stress and could be difficult to work with. But not even his friend and colleague Hamilton Killaly could 'engineer' his reinstatement. So ended many years of service to successive governments and work on four canals. As Angus, a professional educator, comments in his book:

> Like many of Canada's other fine engineers, who designed and built the canals, the railways, the bridges, the public buildings, the whole physical fabric of the country, Baird has been ignored by history. Generally, it was the politicians, who cut the ribbons, carved their names on public buildings, and captured the limelight, who denied engineers their proper and lasting recognition.

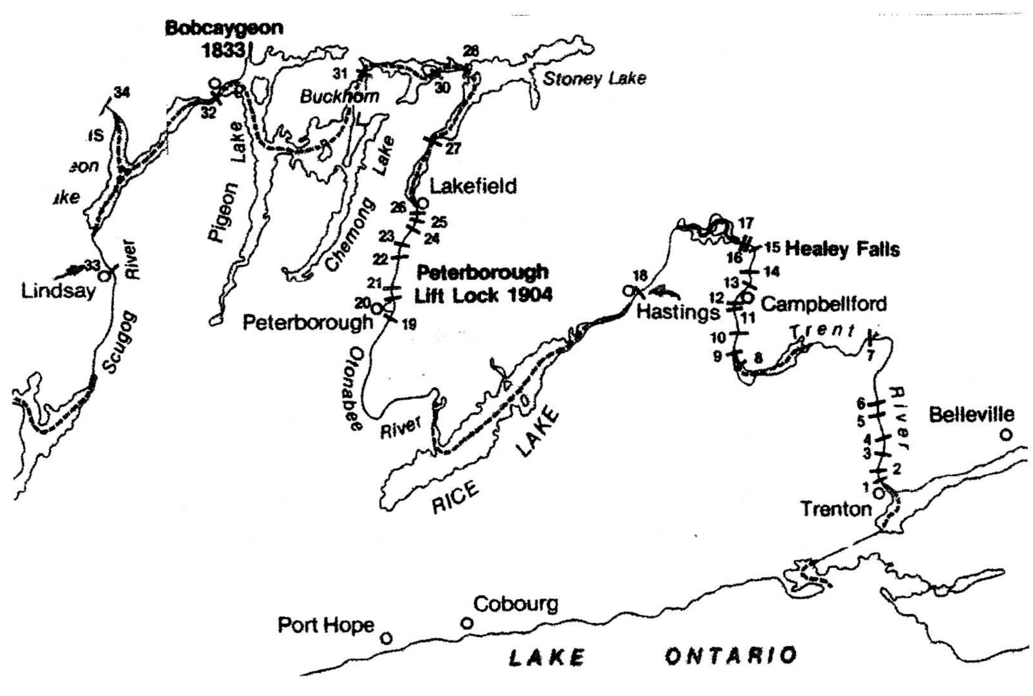
Baird died, in the United States, in 1849. His fate on the Trent was not unique. George Ranney, who became superintendent in 1847, was somewhat similarly 'dumped' after a quarter century of service.

Lindsay, 1844, #33

Scott's Mills, 1844, #19

Hastings, 1844, #18

Glen Ross, 1844, #7



By the mid-1840s, several years after the Union government's Board of Works had taken over, the locks at Lindsay, Scott's Mills, Hastings and Glen Ross were finished, dams were built at Frankfort, Crowe Bay, and Healey Falls, bridges at Bobcaygeon, Lindsay, Buckhorn, Peterborough, Hastings and Campbellford, and timber slides at Buckhorn, Hastings, Healey Falls, Crowe Bay and Ranney Falls. The work was seriously slowed by scarcity of labour and by epidemics of sickness, especially in 1843.

There were therefore five built locks by 1844, all of them neglected in subsequent years. Locks leaked, gates rotted, lumbermen were careless with the locks, dams and slides, saw millers filled the water with sawdust, and vandalism was widespread. There were no lockmasters and no tolls collected. Officially, the Trent was no longer considered a navigable waterway and maintenance costs were kept to a minimum, and no engineer was given charge of it. Government money for repairs and maintenance was only forthcoming when the economy was booming, as in the early 1850s.

Nichol Hugh Baird

Hamilton H. Killaly

Samuel Keefer

Kivas Tully

Then the railways came. Between 1855 and 1872, five of them were built in the Trent watershed and their fortunes and those of the locks and other facilities were linked in competition - and cooperation. They were both required to get lumber out of the backwoods and on its way to markets.

In 1846, the pressure was also on Killaly to reconsider the canalizing of the Trent River. He ordered a new survey, which was done by John Rose in the fall of that year. Samuel Keefer, Killaly's deputy and successor and another non-supporter of the Trent, became involved and revised the cost estimates upwards. It proved to be too expensive.

Also in 1846, Killaly resigned from the Board of Works chair and went back to superintending the reconstruction of the Welland Canal.

Twice around the year 1850 the Board of Works tried unsuccessfully to sell the locks, dams and slides of the Trent Canal and the roads to Lake Ontario, but neither the local municipal governments nor the private sector would buy them. At one stage, the money-consuming timber slides were to be sold, the locks retained. At this time, Trent-opponent William Hamilton Merritt was a government minister, although his own canal had been taken over by the government. And his colleague Francis Hincks was busy getting competing railways established by providing their private owners with generous financial assistance. But had the canal sales gone ahead, the Trent project would likely have ended or, in 1867, responsibility for it might have been assigned to the province of Ontario. In any event, the Canal was effectively ignored by governments for the next 30 years.

The export environment for the Trent lumber industry was changing in the late 1840s. Britain's Corn Laws were repealed and the Colonial timber preferences removed. So the Trent lumbermen turned to the United States for new markets, encouraged by the 10-year Reciprocity Treaty of 1854. Railways were also making inroads into water transportation. And while the Trent timber slides remained in reasonable shape, the locks were earning no revenue and were deteriorating. The 26-foot wide one at Bobcaygeon, for example, was leaking badly. By 1854, the assets of the Trent River had been divided into two groups: the various locks and dams; and the costly timber slides and booms. The latter were again to be sold. Two attempts were made to do this. The first one failed but the second, in 1855, was successful and the government transferred the management of the slides to a committee of lumbermen as trade with the United States began to develop. However, this committee ran into trouble and had to be reorganized in 1859.

The new committee ran the slides effectively until 1870, when disaster struck in the form of unprecedented spring flooding, caused in part by the cutting down of local forest cover and in part by a rapid spring thaw after heavy winter snow falls. Mills were swept away and the slides decimated, although most of the locks and dams held. After negotiations with the government on financing, the lumbermen rebuilt the slides. Mills were also rebuilt. However, by the 1880s they had become less important for the industry since the increasing variety of products they could manufacture reduced significantly the quantity of squared timber and logs requiring water transportation. The slides were last used around 1906, after which they were allowed to rot away. Angus says in his book that, while the slides did not make money for the government, they contributed to the prosperity of the district during the heyday of lumbering.

By 1852 the small-sized, little-used wooden lock at Bobcaygeon had deteriorated so badly that it needed to be completely rebuilt. This work was also needed since new water-rail links were being developed for the Back Lakes. A contract was let in 1855 and the work on the masonry replacement took three years.

After the opening of the railways to Peterborough, the Scott's Mills (Whitla's) lock was seldom used and fell into serious disrepair. By 1862 it was deemed necessary that it be restored, but the work did not begin until 1870 and was finished two years later.

The Lindsay lock also needed to be replaced, the swing bridge rebuilt, and dredging done on the Scugog River. This project was caught in the recession that began in 1857, although some work was begun. Keefer, Killally's successor, visited the site in July 1860. He considered the lock useless. The railway had become well established at Lindsay and the steamer operating on Lake Scugog had been sent elsewhere. He recommended a slide be substituted, and this was approved. The work was done the following summer. However, in 1870, after Confederation, at the request of a railway company with lumber trade interests and for which the slide was of limited use, the wooden lock of similar dimensions to the old one and the swing bridge were rebuilt and the Scugog River dredged by the Province of Ontario, with the approval of the Dominion government. The lock was finished in 1872 and the dredging in 1873.

By the late 1860s, the Hastings lock had fallen into relative disuse for a variety of reasons and had been allowed to deteriorate. One important factor was the absence of a navigation policy for the Trent, combined with low water levels. This allowed the railways to expand and take business from it. There were also the seemingly perpetual disputes between Superintendent Ranney, business owners and local politicians about how to improve the situation. An inquiry was held. A contract was let and the work was done by April 1867. Also, a navigation policy began to emerge.

Such a navigation policy, involving as it did water levels, potential floods, pollution caused by the dumping of sawdust and other unwanted materials and the resolution of the differing views of lumbermen, millers and landowners, was becoming increasingly important as the numbers of steamers operating on the various lakes increased and as water rights for the generation of power for mills and later for electricity grew in importance.

Speaking of lake steamboats and water levels, Angus has this to say:

> The number of steamers increased rapidly as the lumber trade flourished. In 1851, there was only 1 steamer operating on the Back Lakes; in 1853 there were 2; in 1867 there were 7. By 1870, 11 steamers and 40 scows were freighting lumber to the Midland Railway station at Lindsay and, by 1873, 13 steamers and 60 scows were engaged in the lumber trade on the Kawartha

> Lakes. In the absence of any water regulations, it was most difficult for the steamers to operate. There was usually not enough water for the combined needs of the steamboat operators, who wanted the natural discharge of water dammed up in order to maintain navigation levels, and of the loggers and millers, whose trades depended upon constant flow. Steamers had become much larger, with deeper drafts than the district's first primitive steamboats... but no adequate or even consistent navigation levels were maintained in the channels or on the lock sills, where water levels could vary several feet from one season to the next. The dams leaked so badly most of the time that surplus run-off water, which should have been stored for navigation and lockage, was wasted. Nor was there any systematic method of regulating the flow of water down the whole drainage system...
>
> The solution to the problem of maintaining consistent water levels throughout the waterway was to create a network of dams and auxiliary storage basins adjacent to the main stream, so that water could be fed into or out of the system when and where needed. Eventually hydraulic engineers would design such a system, but in the 1860s and 1870s, given the absence of government policy, a shortage of funds, and division of ownership and control of the dams and tributaries, nothing could be done.

In fact, in 1859, the process of writing Trent canal regulations had begun when an Order-in-Council was issued under section 18 of the Public Works Act.

Confederation to 1920

The Ontario Years and the First Macdonald Administration

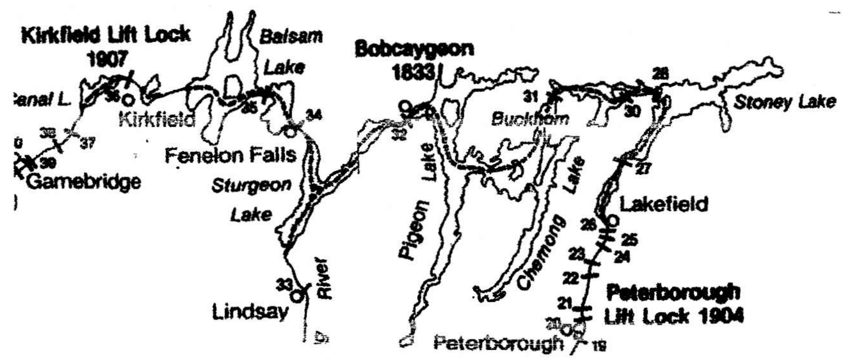
Between Confederation in 1867 and the end of the Laurier government in 1911, debates the Parliament of Canada on matters associated with the Trent waterway were fairly frequent and almost always heated. They were complex, involving legal, administrative and political matters, as was the involvement of the Dominion Department of Public Works and, after 1878, the Department of Railways and Canals. For these reasons, the further unfolding of the Trent story in what follows stays principally with the building of the remaining parts of the waterway.

The British North America Act of 1867 assigned the locks, dams and slides on the Trent Waterway to the Dominion, which apparently dissuaded the Ontario government from taking them over. The Province was given control over the management of rivers and streams and local railways and the lumber industry, which was increasingly being linked to the Trent Waterway. Under these arrangements, some thought it appropriate that the Province should also pay for the maintenance of the Trent works already in existence since these benefitted the industry. In any case, it was not then the Dominion's intention to retain these works.

Among Ontario's first initiatives was to increase immigration to the 'empty' parts of the province and, to help raise money to support the necessary infrastructure, the government substantially increased timber dues. This led to the receipt by the provincial Public Works Department of many petitions for new locks, dams, slides, dredging, bridges and roads. The Dominion government was happy about this since it had no more intention than the previous Union government of incurring the responsibility and expense of owning them. Indeed, in the 1868 annual report of the Ontario Department of Public Works, the province indicated it wanted to build locks at Rosedale, on the Balsam River and Young's Point, near Peterborough. Firm plans to do so were included in the Department's 1869 report.

Young's Point, 1871, #27

Rosedale, 1873, #35



Young's Point is situated well to the east of Rosedale, between Lakes Clear and Katchewanooka, and north of Peterborough and Lakefield. The lock built there was in part to compensate the Midland Railway for the loss of lumber, timber and agricultural business to the Port Whitby and Port Perry Railway by providing it with a steamer connection to the Kawartha Lakes. It also had to do with Kivas Tully, the brother-in-law of a petitioner, being appointed architect and chief engineer of the new Ontario Department of Public Works. Its masonry design and size were modelled on the Whitla (Scott's Mills) lock, 133 feet long and 33 feet wide, with 6.5 feet of water. There would also be a swing bridge. The contract was let in May 1870 to a Hamilton company. Kivas Tully himself supervised its construction. Angus has described its construction as follows:

> Work (began) in June and progressed smoothly through the summer. Stone for the lock was quarried on the south shore of Clear lake, about a mile from the site. Large derricks were erected at the quarry and on the river bank above the lock, permitting the stone to be loaded and unloaded from a large scow of about 60 tons. Conditions had changed a good deal since Hartwell first tried to construct a masonry lock at Whitla's Rapids 30 years earlier. By September the lock pit had been excavated, cofferdams had been built, and the foundation and part of the lock walls had been laid. Early in September, the contractors

encountered labour problems. Several of the workers left the works to engage in harvesting because, curiously, farmers paid higher wages than the contractors were willing to offer. Labour shortages notwithstanding, Tully was able to report in December 1870 that the lock was finished, well within the contract price.

The lock was available for navigation the following spring. The steamer, specially built at Lakefield for this service, was a paddle-wheeler, 60 feet long with a 19 hp engine. It was ready for service in September 1871. Its cargoes usually included passengers and general freight and, after 1874, tourists. It also towed timber rafts and scows. In 1876 and 1878 two more small steamers were added to the service.

The Rosedale lock was built where the Balsam River leaves Balsam Lake, in response to pressure from the Toronto and Nipissing Railway and sawmill operators at Fenelon Falls, to open a route that connected the mills with the railway at Coboconk and provided additional facilities for settlers. The contract was let to a Toronto company in September 1869. It included the construction of a dam halfway between Balsam and Cameron Lakes which flooded the Balsam River and the lock to a navigable depth. The lock itself was wooden, modelled on the one at Lindsay, but was only 100 feet long and 30 feet wide. The dam also had a small timber slide. Construction did not go smoothly and It was not finished until 1873.

Rosedale

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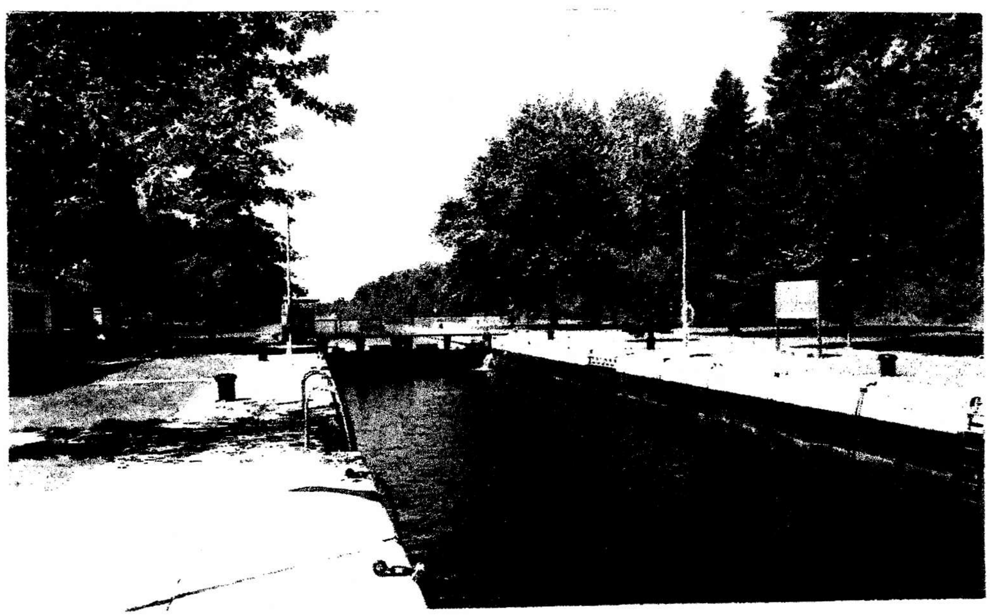


In the early days of lumbering in the Trent watershed, the relatively short distances between the forests and the mills presented few problems for foresters and mill operators. Spring flooding crests were usually enough to get this done. But as timber harvesting moved further and further north and costs rose, lumbermen became concerned about getting the increasing volume of timber and logs to the mills and to market. Angus notes that, latterly, the situation became so serious it was taking two years to float logs the 300 miles from Haliburton to Trenton. Solving this problem pitted the lumbermen against the steamboat operators and the riparian (shoreline) rights of property owners along the waterway. The lumbermen, themselves, devised a way to solve this problem when they began building - admittedly costly - dams and slides, creating a network of large reservoirs of water in the Haliburton Highlands that could be released as required to extend mill operations - and navigation - until late summer. Subsequently, an agreement was reached in September 1873 by which the Ontario government took over the management and maintenance of these dams and slides and built more of them as required, and users paid tolls. But 30 years later, in 1906, with the lumber industry in steep decline and the need for new hydroelectric plants rapidly rising, the dams were handed over to the federal government. Eventually, all the log dams were replaced with concrete ones.

At this point, a general note: the Liberal-leaning weekly newspaper, the Peterborough *Examiner* was a constant and obsessive critic over many years of progress in the building of the Trent Waterway, especially when Conservative administrations were in charge.

The Mackenzie Administration, and the Second Macdonald Administration

The Dominion governments under Conservative Sir John A. Macdonald and Liberal Alexander Mackenzie did nothing new for the waterway. But on 8 October 1878, two days before giving up office following its defeat in the general election, Mackenzie's government issued an Order-in-Council transferring all Dominion works on the River Trent to the (Liberal) Government of Ontario. It was being pressured by the Dominion, their owners, to remove the dams at Chisholm's Rapids and possibly also at Healey Falls, which were being blamed for impeding effective settlement. The suspicion was that this had been done principally for political reasons to help the provincial Liberals with their own election (in June 1879, which they also lost). Besides, Mackenzie had made no bones about his wish to 'unload' the Trent. His government had also been saddled with the economic effects of a continental recession. Conservative MP's were indignant. Some weeks after the election, a debate took place in the House of Commons. Both Mackenzie and Macdonald made major speeches, the latter having apparently had a change of mind since 1870 regarding the value of owning the Trent works, and wanted them back. The issue was resolved when it was realized that Mackenzie had not actually published the Order and, consequently, it had no force. The Order was officially rescinded on June 13. As Angus writes:

> All the works on the River Trent and on the inland waters (except the lock at Lindsay which had been transferred separately in 1874 and was not included in the 1878 transfer) were once again brought under the control of the Dominion. The timber slides were put back under the jurisdiction of the Department of Public Works, but control of navigation, including the locks, was taken over by

> the new Department of Railways and Canals. Thus, although the Dominion government did not really want it, the Trent system, then known officially as the Trent Valley Canal, became once again a Dominion works. And it remains so to this day.

But back in power, Sir John had not *really* changed his negative view of the Trent Waterway, although he had some sympathy for reviving the shorter Lake Huron-Lake Ontario waterway idea. One result of his lack of action was the formation of a lobby group composed of politicians and businessmen from towns such as Peterborough, Lindsay and Trenton. The Trent Valley Canal Association (TVCA) was formed in September 1879. Over the 40 years that followed, this Association exerted endless pressure on the Dominion government, its prime ministers, and their ministers of Railways and Canals, and should be given a significant amount of credit for the waterway's eventual completion. Other similar groups, as well as some quite local ones, were formed from time to time to promote more specific objectives. But none would have the influence or persistence of the TVCA.

Initially, the TCVA argued that the Trent should become a 'barge canal' between Lake Huron and Lake Ontario and help to get the produce of Western Canada and the American Midwest to eastern and European markets. It would then be of *national* significance, benefitting the entire Dominion. This was an important argument since resources for the Trent were being denied for *national* reasons. Also, it was a time at which the population of the Prairies was beginning its increase as the CPR opened up more of the Canadian West. And the Dominion government was the key player since the Government of Ontario was not interested in 'barging' and private capital for it was not forthcoming. The millers, merchants and steamboat operators of the region were supportive. A steamship's worth tended to be measured by how many barges it could pull, rather than *what* they could carry. And the tourist trade, including day excursions, was beginning to replace the lumber trade as the principal activity in the region. Hotels were already being built on several lakes. As things stood, however, steamers were being restricted in how far they could go, thanks to a lack of connecting locks between lakes. For example, the Balsam Lake steamer could only go to Fenelon Falls and the Peterborough ones were restricted to the Otonabee River and Rice Lake. They could not compete with railway traffic. There was also the problem of insufficient water depths over certain shoals and rocks that affected dams and dredging activities.

As a result of the early work of the TVCA, Macdonald's first (and 10-year) minister of Railways and Canals, Charles Tupper, was persuaded to make a tour of the eastern end of the waterway in the summer of 1880, the results of which were some rash promises but no real action. However, one positive result was that Tupper authorized David Stark to survey the water route from Fenelon Falls to the Bay of Quinte. His final report actually did more than was asked for. He made a case for the barge canal from Georgian Bay, by way of the Severn and Trent Rivers - very similar to the route Baird had proposed earlier. But this was met by the government's indifference.

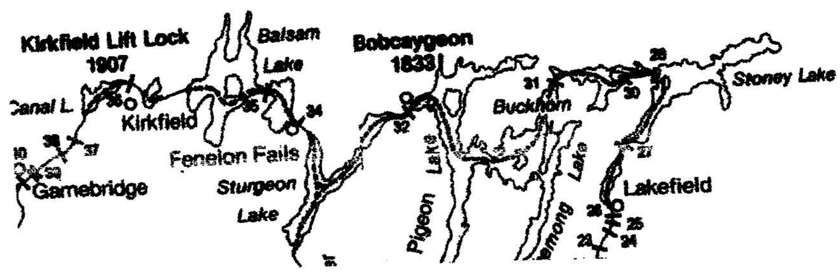
In the spring of 1881, engineer Tom S. Rubidge (nephew of Frederick) was asked by the Department of Railways and Canals to do yet another survey, this time from Georgian Bay to the Bay of Quinte. One problem here was that the Department's chief canal engineer, John Page, was opposed to the Trent since he was convinced there was not enough water in the system to sustain all the lockages that would be required. On the other hand, the Canadian economy was generating revenues that could sustain construction. Rubidge's report had little new to report on the Trent part of the waterway, but he did survey the Severn, supporting it as part of the waterway. He also tackled, but postponed an answer to Page's criticism of the availability of water. Rubidge, it transpired, was as opposed to the waterway as Page was. However, in early 1882, when asked about the next stage in its construction, he recommended that locks be built at Fenelon Falls, Buckhorn and Burleigh Falls, connecting all the Kawartha Lakes. But there were no hints of what might actually be done. However, in the 1882 general election, Macdonald captured all 10 Trent Canal region seats between Balsam and Trenton..

Fenelon Falls, 1888, #33 and #34

Buckhorn, 1884, #31

Burleigh Falls, 1887, #28 and #29

Lovesick, 1887, #30



Prospering as a lumber town in the mid-1800s, the railway had come to Fenelon Falls in 1876. It had three large mills operating in 1883 when work began on the locks. The contract was awarded to A.F. Manning & Company and included two masonry flight locks, each with a lift of 14 feet, and the same dimensions as the other locks then in the system. A 60-foot wide canal about a third of a mile long was dug through the village. Piers and bridges were also built. The new explosive, dynamite, was used for the first time. But, on one occasion, too much was used and the resulting explosion sent limestone pieces crashing through the roofs of nearby buildings. There was also a problem with the unwatering of one of the pits, causing a delay that pushed the July 1885 completion date back by three months. But all was not yet well. In 1887, problems arose over the continued use of the old log slide, and the railway bridge that crossed the canal had to be replaced with a new swing bridge. Before navigation opened in the spring of 1888, an old mill dam that was leaking had to be fixed, and dredging was needed on the Cameron Lake side of the locks. It was not until 1894 that the locks were in full operation.

Buckhorn was originally known as Hall's Bridge, after John Hall who built a dam across the rapids in 1830 to provide water power for his saw and grist mill. The later name was based on Hall's practice of mounting buck's horns on the side of his mill. Hall rebuilt his dam in 1838, and it was rebuilt again in 1858 by the Union government's Board of Works, along with a new bridge and a timber slide, piers and booms. It was for many years the eastern terminus of navigation on the Kawartha Lakes, with barges hauling squared timber, shingles and staves from the mill. Steamboats could travel west as far Lindsay and Port Perry on Lake Scugog.

The contract for the masonry lock at Buckhorn was awarded in September 1882 to George Goodwin and included the lock and a 500-foot canal. Work began in March 1883 and was completed in November 1884. Goodwin had earlier built locks at Grenville and Carillon on the Ottawa River. However, among his construction difficulties at Buckhorn was the removal of the Laurentian granite from which the lock and its canal were excavated. Buckhorn was the first lock in Canada to be cut out of the tough granite of the Canadian Shield. As Angus writes:

> (Goodwin) had eight steam drills. But the rock proved so very hard that it was impossible to keep a drill in working order, the percussion being so severe that the machines could not stand it for any reasonable length of time. Consequently, he could rarely keep more than two drills operating at any one time, the others being constantly in repair shops or in Peterborough being rebuilt. As many men were kept busy in the shops repairing drills as were engaged in the excavation. (The) soft iron bits, although suitable for drilling limestone, were scarcely adequate for boring through hard granite; they had to be changed frequently. Consequently excavation costs were much higher than anticipated.

In 1835, Nichol Hugh Baird had not been enamoured with the beauty of the Burleigh Falls, earlier known as Peninsula Falls, or with the difficulty of 'locking' its 26 foot drop. No mills were built there, but in 1856 lumbermen built a dam and slide to accommodate the annual log drives. As with the locks at Fenelon Falls, there were originally two masonry ones at Burleigh.

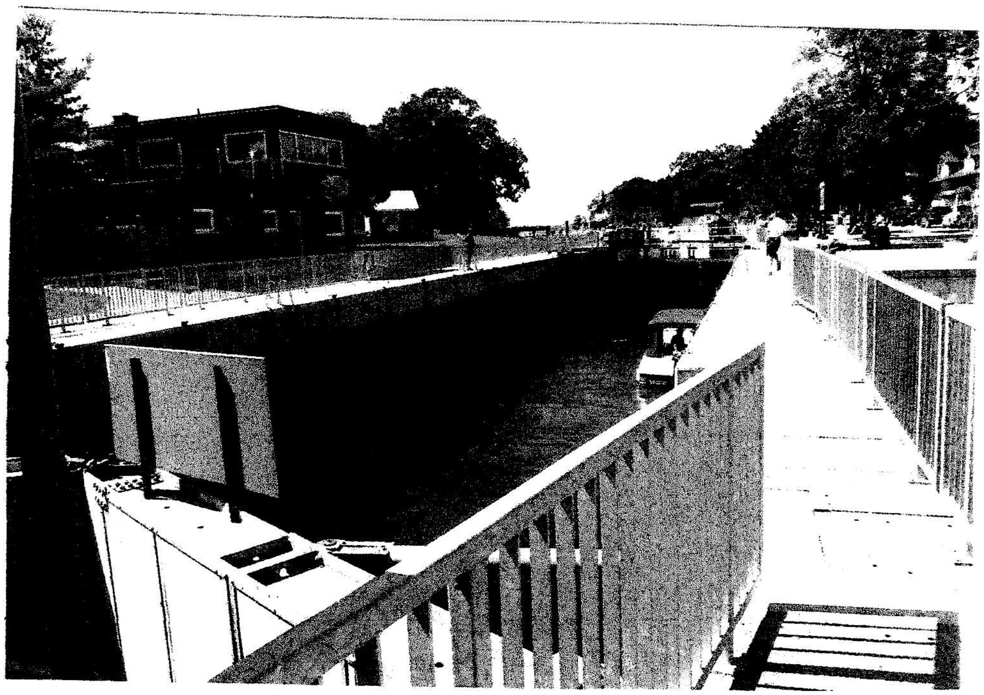
Goodwin again got the contract for the locks at Burleigh, in 1884, after he had finished at Buckhorn. Between 1884 and 1887, he also built the regulating dam, four other dams, a timber slide, and a masonry lock at Lovesick, upstream of Burleigh - an essential subsidiary of it. The first steamboat to pass through the Burleigh locks, on 26 October 1887, was the *Fairy,* from Young's Point.

In addition to his technical problems, Goodwin found it very difficult to get along with the engineer for the project, Tom S. Rubidge. He also questioned Rubidge's original design and John Page, then chief engineer of the Department of Railways and Canals, was called in to adjudicate. It was, indeed, a long and involved story. There were also unsettled questions about contract prices, flooding and riparian rights, payment for the latter being used by the government on occasions for 'pork-barrel' purposes. Eventually, Rubidge was replaced as superintendent engineer by David Stark.

Angus writes that English-born in 1827 Rubidge, unlike the other superintendent engineers, "opposed the development of the canal with a passion that was unrelenting." He had become, earlier in his career, a skilled canal engineer and supporter of the Welland-St. Lawrence system, on which he had worked. In the 1880s. With trade from the West increasing significantly, he felt his views about the Trent had been reinforced. The Trent was simply squandering money. But because of his progressive attitude to the advancement of engineering, he was respected by his peers. His abilities usually overcame his irascible

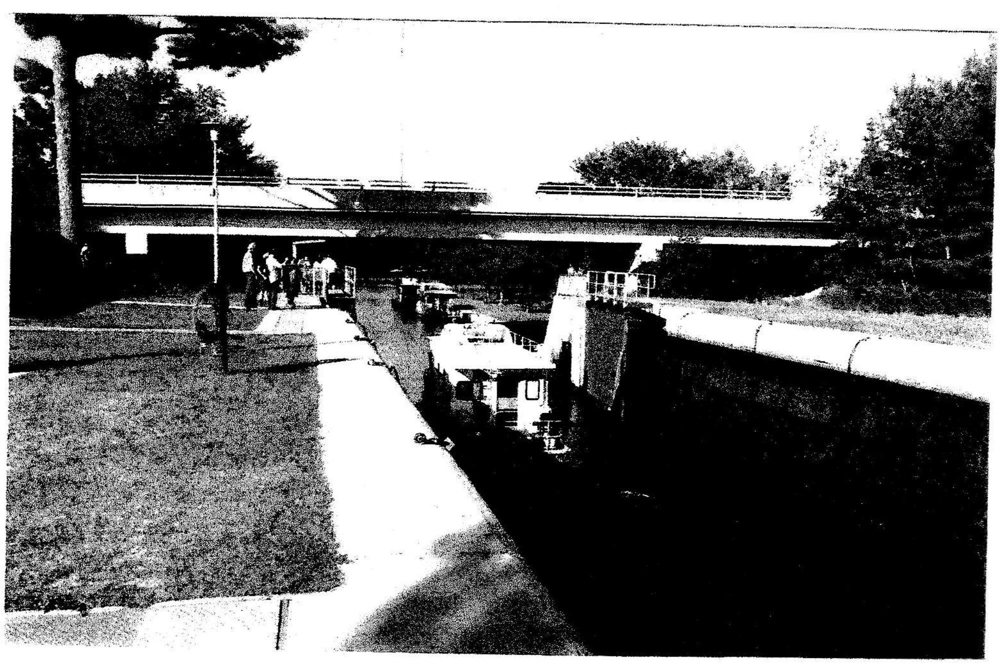
The Falls at Fenelon,

(2014)



Fenelon Falls

(2014)



Buckhorn,

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character and unpopularity. Politically, he was Conservative, but he had the confidence of the Liberals when they were his masters.

In 1882, Rubidge had been asked to do a 'thorough survey of the proposed Trent canal.' Subject to several delays, mostly for political and personal reasons, it was not submitted for five years. It was, as expected, a negative one, especially in regard to costs, and proposed a different exit from Lake Simcoe to Lake Huron. Stark, who had submitted an earlier report much like Baird's in regard to cost, used the Severn route from Simcoe and Couchiching, and submitted his own in rebuttal of Rubidge's report.

Rubidge was blamed by Trent supporters for the delays in funding for the canal introduced by the Conservative government in Ottawa. Political people demanded unsuccessfully that he be fired until, in 1887, he was replaced by Stark. In 1890, when John Page died, Rubidge was offered the chief engineer appointment at the Department of Railways and Canals. He declined this offer and several other prestigious appointments to remain active in the Welland-St. Lawrence system. He died in 1904.

After the election of 1887, during which he had committed no resources to the Trent, Macdonald felt no obligation to restart it since he had got the majority he wanted - but he might need it again later! So it was 'put on ice.' But the TCVA became anxious again and lobbied him and his ministers strenuously.

At the suggestion of James Stevenson, the MP for Peterborough, Macdonald used this situation to appoint a Trent Valley *Commission.* It was established by Order-in-Council in October 1887, with three members: Peterborough Judge Weller, chair, experienced hydraulic engineer Frank Turner, and John Kennedy, chief engineer of the Montreal Harbour Commission. It had two objectives: to 'cool' the issue for a time; and give the government an independent (unimpassioned and non-political) opinion on the merits of the waterway. Its purview was the whole waterway, from Lake Huron to Lake Ontario. Macdonald was in no hurry for its report.

The Commission's start was delayed. John Kennedy developed a serious eye condition that required him to consult medical people on both sides of the Atlantic. But Macdonald did not want to replace him. The first TVC meeting was not held until April 1888. R.B. Rogers, now superintendent engineer, produced evidence that there was indeed enough water in the system to sustain the canal, with plenty left over to generate power. Meanwhile, the commissioners travelled the whole proposed route, visited the Erie Canal and took evidence in a dozen Canadian cities and towns. A comparison with the St. Lawrence was made. The TVCA naturally made a submission. Macdonald assumed the Railways and Canals portfolio himself in November 1889, with still no report in sight.

The report, submitted in December 1890, was withheld by Macdonald until after the March 1891 election. The Commissioners denied that they had been appointed to 'kill' the Trent. Their report recommended that the canal should be extended to complete the route between Lake Simcoe, Balsam Lake and the Bay of Quinte, on the basis of local benefits, but was non-committal with regard to the western exit to Lake Huron. However, it hinted that the project was more provincial than federal and that further research should be done. Alternatives to the Severn route to Lake Huron should also be surveyed. Rogers' views on water supply were accepted. It suggested, however, that the additional locks should only be 23 feet wide, as against Baird's recommendation of 33 feet - the Rideau standard - to save money. It also suggested that lift-locks should be studied.

However, the day before the March 1891 election - worried about the main issue of the election, Liberal support for reciprocity with the United States, as well as losing Trent seats - Macdonald sent a telegram to D.R. Murphy, his political organizer in Trenton, to say that the Commission was supporting more work on the canal and that Parliament would be asked for its approval. It worked, and he won nine of 13 seats. Three of those lost were regained in by-elections in 1892. However, the TVCA - unconvinced - sent yet another delegation to Ottawa to meet with Macdonald. Unfortunately, he was again sick and the meeting took place with more junior ministers. He died on 6 June 1891.

Abbott, Thompson, Bowell and Tupper

Four Conservative prime ministers succeeded Macdonald over the next five years but nothing was done about the Trent until almost time for the next election in June 1896 when surveys were made on the Trent and Otonabee Rivers and between Balsam Lake and Lake Simcoe. Rogers, by then superintendent, who was much easier to deal with than Rubidge, was asked to prepare plans for locks and canals. Two contracts were subsequently let for sections of the route. In April 1896, one went to former CPR contractor Andrew Onderdonk for work on the Balsam Lake to Kirkfield canal. The other, later the same month, went to Brown, Love and Aylmer for a canal between Lakefield and Nassau. Significantly, Rogers was sent to Europe to study the three existing lift-locks there, most likely at the suggestion of Frank Turner.

When he returned, Rogers set up a laboratory to test specifications for the concrete that he insisted was about to replace the limestone formerly used in lock construction. With regard to the introduction of concrete, and after acknowledging the role played by the early Romans in the development of hydraulic cement, Angus notes in part:

> The quality of a concrete mixture depends upon the careful selection of the cement, the cleanliness of the aggregates, the purity of the water, the correct proportioning of the ingredients, and the proper mixing and laying methods. If any of these particulars is neglected, failure will probably follow, resulting in crumbled sidewalks or collapsed bridges. Ignorance of mixing methods (can lead) to many failures, causing an early prejudice against the use of concrete in engineering works...
>
> Its poor reputation notwithstanding, Rogers reckoned that locks built with concrete might be cheaper than the traditional limestone ones; thus the high

> cost of construction, one of the objections to the Trent canal would be removed. And if the Roman example could be emulated, concrete locks might prove just as durable as limestone masonry structures. Rogers endeavoured to solve the mystery of concrete mixing, which seemed to have been commonplace among the ingenious Romans. Having solved the mystery, (in his Peterborough laboratory) he became one of North America's leading authorities on the use of concrete in construction projects...
>
> (Rogers) discovered, through his testing, that a low water-cement ratio produces concrete that is reasonably watertight and abrasion-resistant and therefore more durable than concrete made with a 'wet' or high water-cement ratio. Watertight concrete is absolutely necessary for lock construction, especially in Canada because of its cold winters.

However, despite the Conservatives' commitments, the Peterborough *Examiner* was convinced that the government was playing election games and was not serious about eventually finishing the waterway. In any event, although most of the Trent ridings remained Conservative, Laurier and the Liberals won the 1896 election and claimed access to the 'spoils' of the political system.

The Laurier Administration

The Liberals left the Conservatives' recently awarded contracts in place, with some modifications, but no new work was initiated. Rogers, as superintendent, was not allowed to hire or fire without Liberal approval. Known to be a Conservative, he himself became a target for Liberal politicians, but it would take another 10 years to dislodge him. Andrew G. Blair was the new Minister for Railways and Canals. Although not a convinced Trent enthusiast, he formally visited the waterway, including in his tour both existing and potential locks and canals as well as those under construction and ended up being more impressed than he had been initially. He remained, however, opposed to the barge-canal idea for the Trent. Bigger ships, and a bigger and deeper Welland-St. Lawrence Waterway, were now being planned for the movement of wheat eastwards from the Great Lakes. Also, proposals for new transcontinental and other railways were being discussed, and these dominated the government's fund-raising activities.

The TVCA again mounted another very large, 270-person, delegation that included Conservatives as well as Liberals, to plead its case to Laurier in Ottawa. It met Prime Minister Laurier and ministers Andrew Blair and Sir William Mulock, the Postmaster General, in the Railway Committee Room on 6 April 1897. There were over 30 speakers, each with the same pro-Trent message. Laurier said his government policy was supportive, but with an unheard caveat because of the noise this message created, that the work would continue as rapidly as the finances of the country permitted. This was the same condition placed on the continuation of the work placed by the Conservatives in 1896. So the Laurier years were stamped with the same marks as those of its predecessor! Angus notes that it appeared the Liberal government had no intention of completing the eastern and western ends of the waterway.

Brown, Love and Aylmer had begun work on the Lakefield-Nassau section of the waterway in August 1895. Five locks were involved - Lakefield, Sawer Creek, Douro, Otonabee and Nassau Mills - overcoming 66 feet of the 144 drop in the Otonabee River, each with a sill depth of 6 feet. Angus notes that, although the locks were built wholly of concrete, Rogers seems to have been unwilling to risk building the dams of concrete. He built ordinary timber dams with stop-log openings, although each dam did have walls of concrete built along the upper faces of the foundations for their entire length. The Otonabee lock was begun in the spring of 1896 and was the first to be built using concrete. Rogers used it as a 'test bed' for the new technology. In September 1897 he reported to Collingwood Schreiber, the chief engineer of the Department of Railways and Canals, that it had survived winter (and summer) "showing no defects whatever." There was, however, a small defect. Rogers had omitted to allow for the contraction and expansion of the concrete in the 225-foot-long wall and two very thin cracks developed. Experience with Otonabee produced some changes in the construction of the other four, including a solution for the expansion/contraction problem. The Lakefield-Nassau contract was finished in the summer of 1899.

Nassau Mills, 1899, #22

Otonabee, 1899, #23

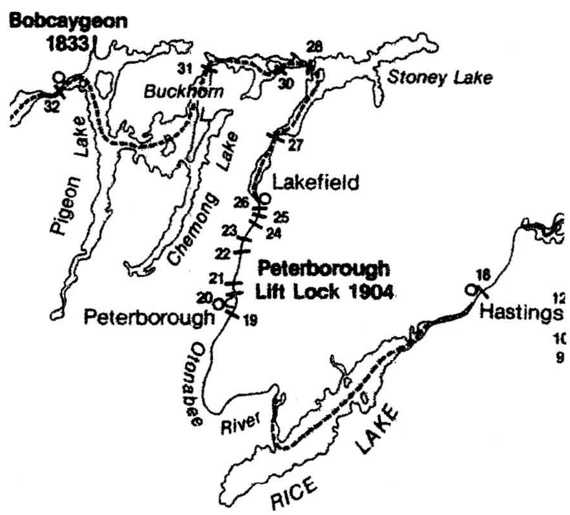
Douro, 1899, #24

Sawer Creek, 1899, #25

Lakefield, 1899, #26

Ashburnham, 1900, #20

Peterborough Lift Lock, 1904, #21



In addition to the two contracts mentioned above, a third contract was awarded by the Conservatives in the spring of 1896, to Corry and Laverdure, in spite of them having Liberal connections, for work on the four-mile stretch of the Otonabee between Nassau and Little Lake in Peterborough. It was in two parts. The first covered the Ashburnham lock and other 'conventional' canal work, such as excavations, embankments, dredging, rock cutting, and the construction of dams, abutments, bridges and culverts. The second, a last moment and supplementary part and a Conservative re-election incentive, was for the concrete and associated work for the proposed Peterborough Lift Lock. The two locks were to overcome a 78-foot fall in the river, 13 feet by the conventional lock and 65 feet by the lift lock. At the time of the signing, none of the details of the lift lock's engineering had been made available and the contractor signed on the understanding that such 'extras' would be dealt with later.

In promoting the idea that concrete should be used to build the lift lock, Rogers had faith in it as a construction material, and especially in the 'dry' variety. Basically, lift locks consist of two large gated caissons - chambers or tanks of water - that were moved upwards and downwards simultaneously under the power of a hydraulic balance mechanism. Such locks could replace a half-dozen or more conventional ones and save a great deal of water and transit time by cutting down on the number of lockages. They were also suitable for barge canals, and Rogers was supportive of the Trent-Severn as one of these. As noted above, Rogers was sent to Europe to study them, but he had apparently designed the one for Peterborough already and his trip did not change it. There were two other Trent-Severn lift lock possibilities – at Kirkfield, which was built, but to a different design, and at Healey Falls, which was not.

Work began on the conventional part of the Peterborough one in late May 1896, a month before the election. Progress was very slow. The contractors had no previous canal/lift lock construction experience and had accepted job rates that they could not meet. Nor did they have qualified personal - such as experienced inspectors - to do some of the jobs during much of the time, and those specialists they did hire were expensive. In addition, during the Boer War years, labour and material costs rose. The Liberal government also declined to intervene in political and personnel matters involving the work or relations with the Department of Railways and Canals. As a result, the conventional part of the contract took eight years to finish.

Work on the concreting of the lift lock part, which began in 1899, fared even worse and, again, was aggravated by the contractors lack of experience and personnel problems, by the refusal of the chief engineer of the Department - Collingwood Schreiber - to amend the rate schedules upwards, and by Rogers' refusal to provide details of the construction plans and specifications well in advance. Angus explains his strategy this way:

> Rogers withheld the plans and specifications deliberately, giving the contractors only what they needed to build one phase of the structure at a time. He did this to protect his job. Being a Conservative sympathizer, Rogers had long known that his position as superintending engineer of the Trent canal under a Liberal government was tenuous. Indeed, there had been a good deal of political agitation in the district aimed at getting rid of him. Not least among the agitators were Corry and Laverdure, and Rogers was aware of this. As long as he held in his own possession the plans and specifications for the complex structure that he had personally designed, his position would be secure. Without him and the plans, the lock could not be finished. So he kept them to

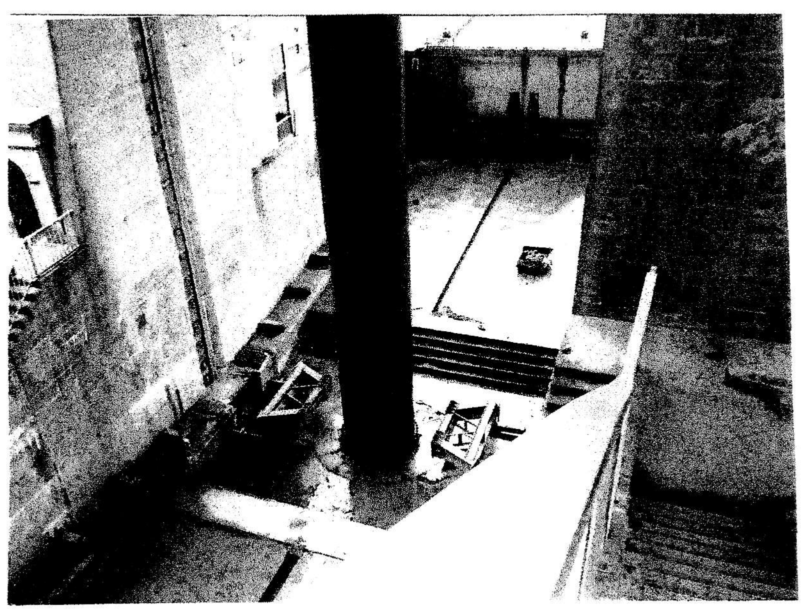
himself, releasing them to his assistants and the contractors only when necessary. Even as late as 30 July 1904, weeks after the lock was finished and in daily use, Rogers was still unable to provide a full set of plans and drawings requested by Schreiber, as "no finished drawings of the lock have yet been made."

Incidentally, when the contractors tried to use a wetter mix - as they did - for the concrete in the lock structure Rogers would have none of it. He called it "Grit water cement."

The separate contract for the lock superstructure and caissons and the installation of the hydraulic balance mechanism was let to the Dominion Bridge Company of Montréal in 1899. As a result of the concreting delays, work did not start until 1902. It was finished in 1904. Otherwise, this particular contract went smoothly. Dominion Bridge wrote its own specifications and did its own design work.

Top and bottom of a Peterborough caisson ram

(2014)

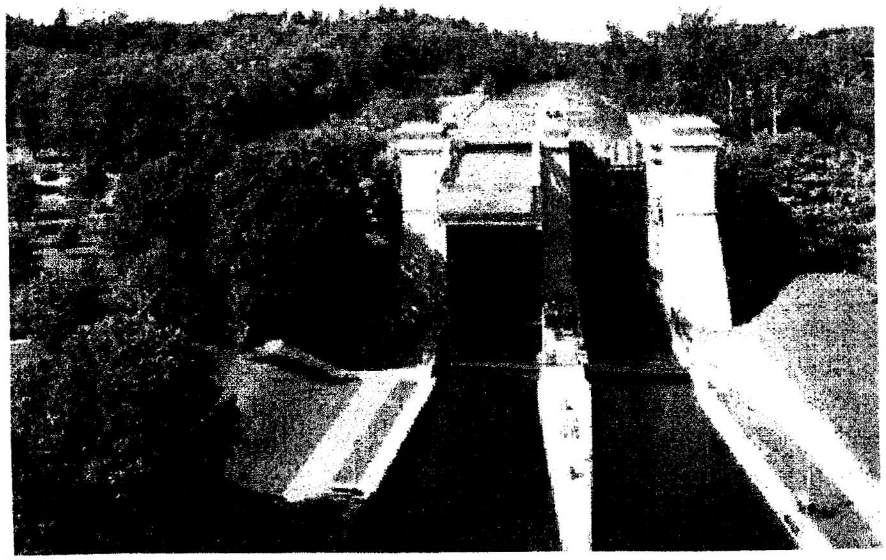


Peterborough Lift Lock,

from the south

(Parks Canada/Wikipedia)

(2015)



The lift lock was opened for business on 9 July 1904 by H.R. Emmerson, who had replaced Andrew Blair as Minister of Railways and Canals. The first steamer to descend using the lock was the *Stony Lake*. Extensive celebrations followed. But, as Angus notes, no vessel that went through the Peterborough Lift Lock ever discharged its cargo alongside any ship in Montréal harbour. Nor would any wheat be barged through it.

(The Peterborough Lift Lock was recognized as a National Historic Site by the Historic Sites and Monuments Board of Canada in 1979 and a plaque to this effect was unveiled six years later. The Peterborough Branch of the Engineering Institute of Canada placed a plaque in honour of R.B. Rogers on a wall of the structure some years after his death in 1927. The Canadian Society for Mechanical Engineering, jointly with the American Society of Mechanical Engineers, erected a commemorative plaque at the Lift Lock site in 1999. In 2015, Peterborough is no longer the highest lift lock. It is now in sixth place, worldwide.)

Collingwood Schreiber

Richard B. Rogers

Andrew G. Blair

The so-called Balsam-Simcoe connection was the key element linking the eastern and western parts of the waterway. A significant piece of it involves the Talbot River, which runs north-eastward from Lake Simcoe. But its story goes back much farther.

Even when the Aboriginal people were the only ones living in the area, they avoided the river because it was sluggish, muddy and choked with fallen trees and other detritus. Instead, they portaged their canoes the 17 overland miles between the two lakes. However, after the War of 1812 and the British concerns for possible American invasions, interest in the Talbot River/Portage revived and a survey was carried out. It reported that the first two miles from Simcoe were navigable, but the rest of the river was still choked. Nichol Hugh Baird surveyed the route between Rice Lake and Lake Simcoe in 1835, including the Talbot and recommended that, since most of the region would be easy to excavate, it might - with the use of cuts and other modifications and the construction of suitable locks - become part of the Trent waterway. This enouraged further settlement of the interlake area and villages such as Kirkfield, Bolsover and Gamebridge were established. However, the Board of Works in 1844 chose to develop the Welland-St. Lawrence alternative. In 1872 the Toronto to Nipissing Railway was built through the Talbot River area to Coboconk. In 1879 David Stark surveyed the Talbot River yet again, in association with a survey of the Severn, reviving talk of completing the waterway between Lakes Huron and Ontario. The following year, as noted above, Sir Charles Tupper visited, and then Tom S. Rubidge did yet another survey. Local MP Hector Cameron, a member of the TVCA, also championed the use of the Talbot area in the Trent scheme.

It was Tory MP Sam Hughes, through whose riding the Talbot passed in part, who pushed Macdonald's government into action on it around the time of the 1891 election and the famous Murphy telegram and, again, before the next one in 1896. He convinced the shaky Conservative authorities to finish the interlake communication *before* thinking about the waterway's terminal links.

In July 1894 Rogers was asked to do yet another survey. Indeed, he made it the principal input to the design of the Simcoe-Balsam connection. A six-mile canal was to be cut from the West Bay of Balsam Lake to connect with the Talbot River. Use was to be made of natural parts of it, with canals being cut in those sections of the river where these could not be used. Rubidge had suggested that 11 locks be built, Rogers decided on five, of standard size and of concrete, with a 50-foot lift-lock at Kirkfield to replace the others.

Andrew Onderdonk, who had contributed to the building of the CPR westwards, was awarded a contract for the first section of it. He began work at the Balsam Lake end and at a leisurely pace just before the 1896 election, mainly on earth and rock excavations and on a variety of canal structures such as concrete abutments for bridges, entrance piers, regulating weirs and a small dam, and finished it four years later. Incidentally, he was the only Trent-Severn contractor to finish under budget. All the others required some post-contract adjustments.

The contracts for the remaining two sections, which included the Kirkfield Lift-Lock, also designed by Rogers, were not begun until 1900, under the Laurier Liberal government. Speculation was that, had the Conservatives not given Onderdonk his contract, the others would not have been awarded and the whole canal project halted since railways were the priority for the Liberals.

Kirkfield Lift Lock, 1907, #36

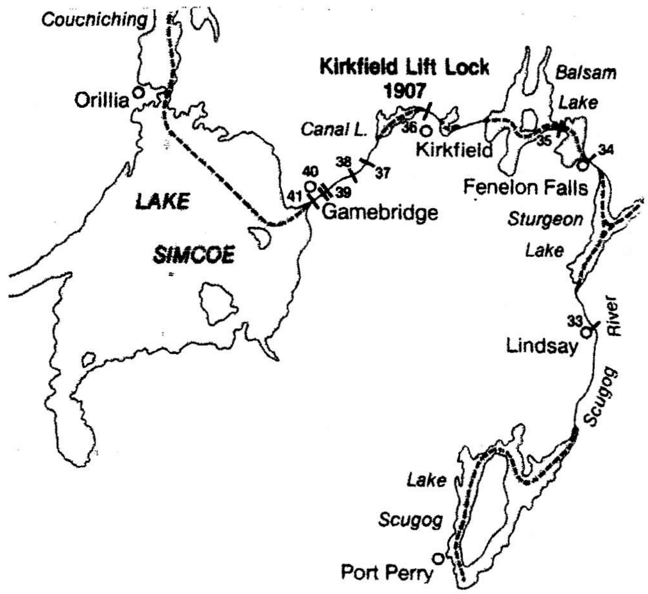
Bolsover, 1907, #37

Talbot, 1907, #38

Portage, 1907, #39

Thorah, 1907, #40

Gamebridge, 1907, #41



The main second section contract was awarded to Larkin and Sangster of St. Catharines in September 1900 for work between the Kirkfield lift-lock and the new lock at Bolsover, about eight miles downstream. Included were the excavations for the lift-lock and the construction of its foundations, pit and entrance walls, a short stretch of canal between the lift-lock and the river, plus the necessary abutments, piers, dams and bridges. A new lake, Canal Lake, was created from the water backed up by the dam at Bolsover. It, together with Mitchell Lake upstream of it, formed reservoirs for the canal, and these were fed when needed through a dam at Balsam Lake. A separate contract was again awarded to the Dominion Bridge Company for the steel structure at Kirkfield. Angus describes the similarities and differences between the two lift-locks this way:

> The entrance walls for the Kirkfield lock were poured in sections 50 feet long with pine stops between each section, using the same mixing ingredients and pouring techniques as were used in the Peterborough lock. The pit for the lock was excavated entirely in the rock, the sides having been cut with a Sullivan channeller. The press wells for the hydraulic rams are 50 feet deep, lined with concrete and floored with blocks of granite as in the Peterborough lock. The principal difference in the design between the two locks is that at Kirkfield three steel towers guide the caissons instead of concrete towers, and a steel aqueduct rather than a concrete one leads to the upper gateways.

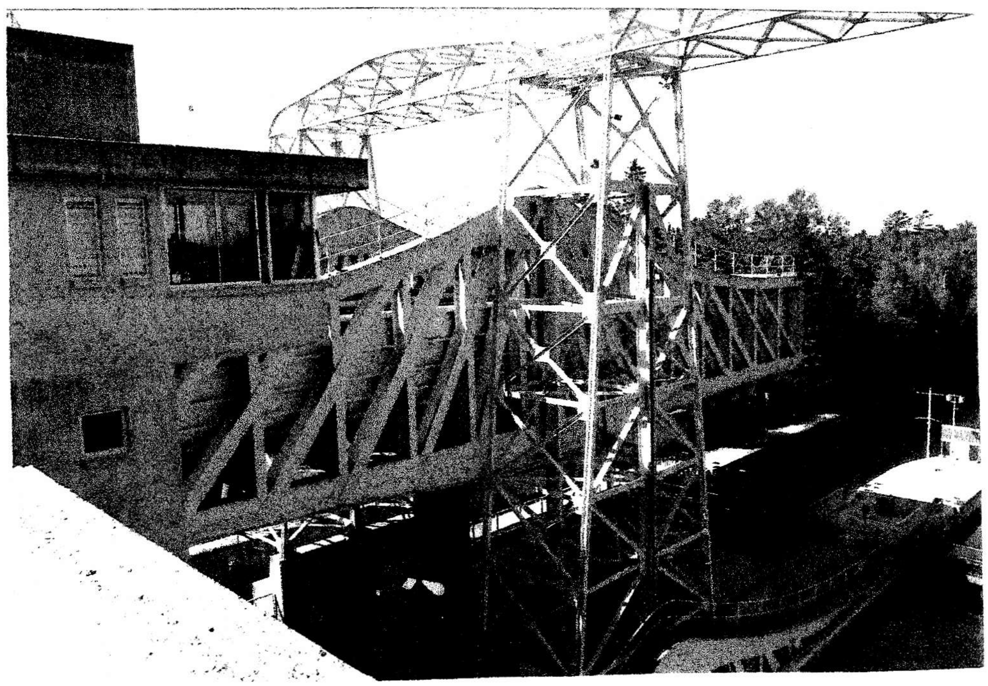
The contract for the third section was also let in September 1900, to Brown, Love and Aylmer. It covered the remaining distance from Bolsover to Lake Simcoe, about six miles. It made use of sections of the Talbot River, with a connecting canal down to the lake. Five concrete locks - Balsover, Talbot, Portage, Thorah and Gamebridge - were built, two in the river and three in the canal.

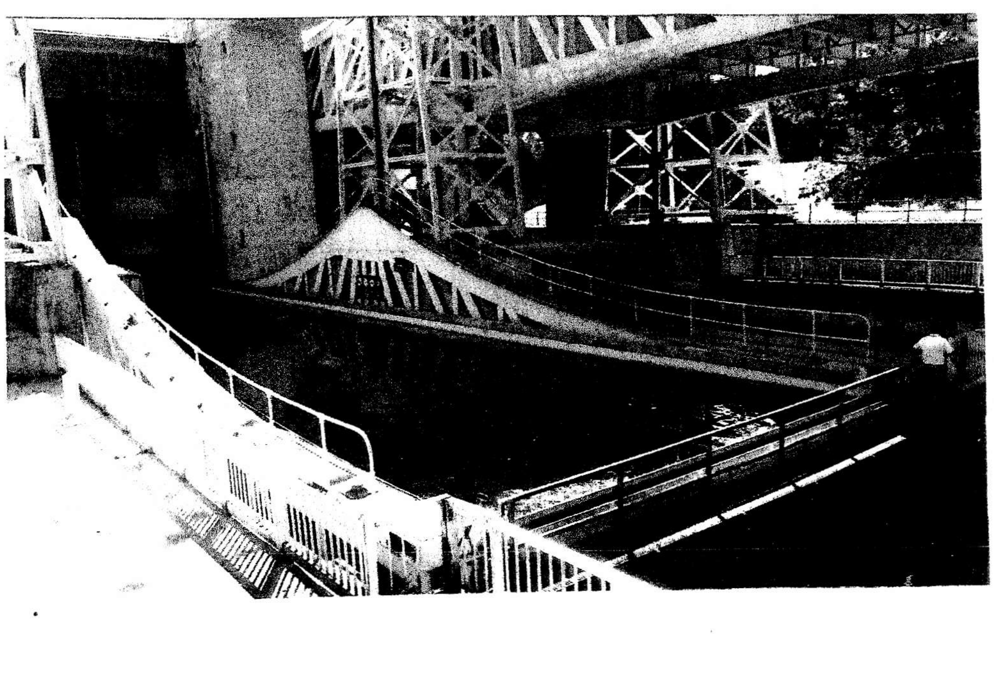
Because of both natural and human impediments, neither of these two sections was finally completed until June 1907. The natural ones included problems with the terrain, the weather and the volume and difficulty of the work, especially at the lift-lock. The human ones ranged from the usual financial ones with the supply of funding to the pouring of the concrete at Kirkfield.

A gala opening for the Kirkfield Lift-Lock was arranged for 6 July 1907. In comparison with the Peterborough one, it was a tame affair. Rogers, having been forced to resign earlier, was not invited. But the steamer *Stony Lake* was again the first vessel to inaugurate the lock!

Kirkfield Lift Lock

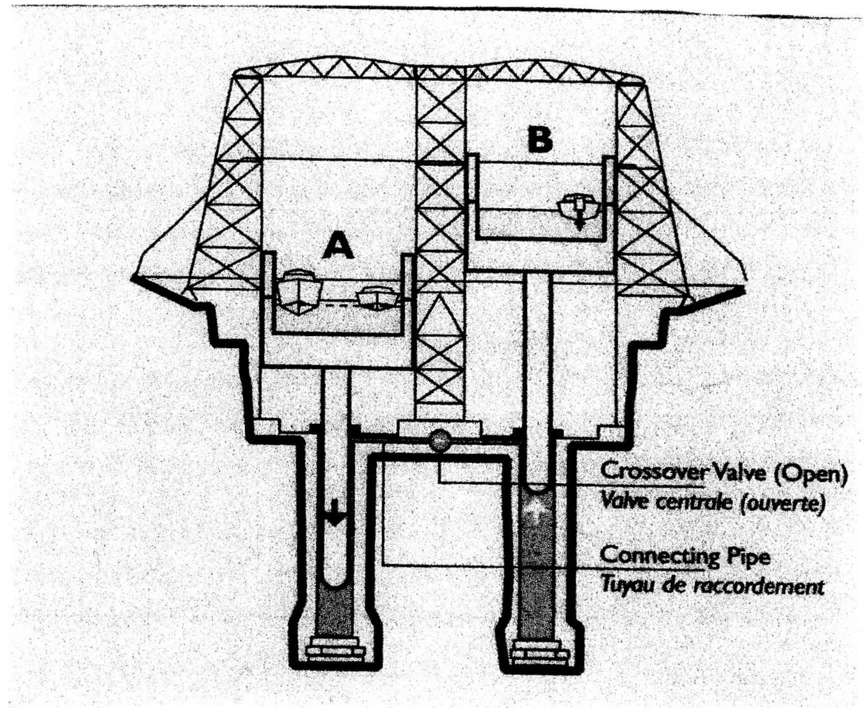
(2014)





Kirkfield Lift Lock,

caisson-ram schematic



Richard Birdsall Rogers

Born at Peterborough in 1857, a graduate of McGill in engineering, he became superintendent of the Trent in 1884. Among other innovations, he contributed significantly to the design of the two lift locks, introduced concrete as the main construction material for locks, and set up a testing laboratory at Peterborough for the new material. He was easier to work with than Rubidge!

But he was a known Conservative, which was quite satisfactory while Macdonald and his four successors were in power. But the election of the Liberals under Laurier in 1896 changed his status significantly and, in spite of his skill as an engineer, a number of prominent members of the Party actively sought his ouster. Eventually his political enemies succeeded. Two incidents, one at each lift lock, were deemed his responsibility. He resigned in 1906, his reputation in ruins, and spent the rest of his working life as a contractor in the private sector.

The Kirkfield incident began with the first test of the lock in August 1905, when the entrance wall concrete was found to be defective. Water poured through it. The supervisor of the work when it was originally done was D.E. Bethune, who had a known drinking problem and was not always 'on the job.' But because of Liberal strictures to him regarding staff, Rogers could not fire him. Rogers 'fixed' the problem quickly, simply and inexpensively after borrowing knowledgeable people from the Dominion Bridge crew on site.

By this time, however, the movement to 'dump' him was in full swing. R.Adams Davy, the division engineer in charge of the Simcoe-Balsam work - a qualified engineer but inexperienced in concrete work - was asked by Matthew J. Butler, an engineer and now deputy minister of the Department of Railways and Canals, to report on the incident. Angus writes that Davy's report was a deliberate distortion of the facts and was designed to damage Rogers. He even took credit for plugging the leaks! Bethune remained blameless. In 1907, with the job finished, Davy was assigned to the canal's Peterborough office. Bethune disappeared.

In May 1905, the experienced Rogers had been relieved by Butler of responsibility for the maintenance of canal works and replaced by J.H. McClellan - a Liberal, a coal merchant with no engineering èxperience. So when leaks were discovered in September 1905 in the Peterborough Lift Lock aqueduct, which Rogers had anticipated and could have corrected quickly and inexpensively, McClellan refused to take action. As time passed, the problem got worse, but still nothing was done. The Peterborough *Examiner* blamed Rogers and demanded that the Department investigate. In frustration, Rogers also requested one, to clear his name. But this turned out to be the trap set by his enemies.

Butler quickly commissioned a Montréal consulting civil engineer, Henry H. Holgate, to carry out the enquiry - involving both lift locks - which he also did quickly. Rogers appeared before him, but was surprised to find that two lawyers with Liberal connections were also involved directly in the enquiry. Sufffice it to say that Holgate's report damned Rogers. However, very shortly before it was made public, Rogers suffered another blow. Early on 26 January, 1906, a 40-foot section of the east bank of the Peterborough canal broke away and water poured into the east side of the city. Even Rogers' own basement was flooded. An old farm drain, over which the canal had been built, had given way. As luck would have it, a guard gate a few feet above the break was forced into position and stopped further flooding. A few hours later, the summary of the Holgate report was leaked. Rogers was asked to resign and did so. As Angus points out, Holgate had good reason to give his clients what they wanted.

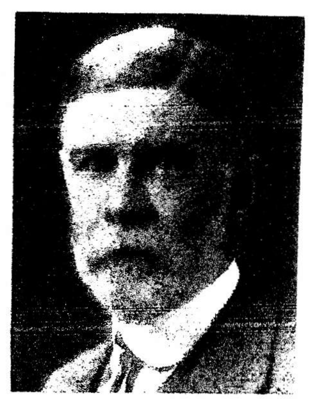
After 1911, the Borden Conservatives were at first disinclined to reopen the Rogers matter. However, as à result of an enquiry carried out in 1914 by Charles Keefer, son of Thomas Keefer and nephew of Samuel, he was exonerated.

Alexander J. Grant, with Soulange and Welland Canal experience, was appointed to succeed Rogers as superintending engineer of the Trent-Severn Waterway. Apparently, he also found McClellan difficult to work with! Grant remained with the Trent-Severn until 1919, when it was almost finished, before returning to the Welland to build the Ship Canal.

(Rogers died in 1927. Not long after his death, the Peterborough Branch of the Engineering Institute of Canada placed a plaque in his memory on the superstructure of the Peterborough Lift Lock.)

Matthew J. Butler

Alexander J. Grant



Newmarket Madness, the Port Hope Canal, and Trent River Hydroelectric Power

These three aspects of the Trent-Severn story do not fit easily with the rest of the narrative and have been separated from it.

The title for the first of the three has been borrowed from the chapter in the Angus book that describes the activities of Sir William Mulock, a distinguished lawyer, Liberal politician and cabinet minister. In the early 1900s, during Laurier's time in office, he promoted the building of a subsidiary branch of the Trent waterway that would connect Cook Bay, at the south end of Lake Simcoe, with the Newmarjket/Aurora area north of Toronto, using the Holland River. The proposal involved a number of locks similar in size to the existing ones on the Trent, together with appropriate dams, reservoirs and bridges. It was not a popularly supported proposal, even among members of the Liberal Party, but studies and planning went ahead anyway. Work began in 1906. But there was a serious problem: not enough water to guarantee annual lockage operations except for a short spell after the spring run-off. Laurier lost the 1911 election. The project was abandoned immediately by the returning Conservatives under Borden, after an estimated $1 million (in 1911 funds) had been spent on it.

From the beginning in the 1830s, citizens of Port Hope on Lake Ontario wanted the eastern end of the Trent waterway to be in their town, by way of Rice Lake, and not at the mouth of the Trent. Even after they got a railway northwards in mid-century, they still wanted a canal, and formed a Canal Association to promote it with political people and governments. As late as 1899, Richard Rogers did a survey that concluded that a Port Hope exit canal might be cheaper than one using the Trent, but that there were other considerations favouring the Trent. It might be cheaper and shorter than having the exit at the mouth of the Trent, but it would be 50 miles further from Montréal, including 36 miles of open water. Rogers did another survey in 1900 but, this time, decided squarely in favour of the Trent. This change of mind was viewed with suspicion within Liberal Party and other political circles. Suffice it to say that, for the next few years, the Port Hope people continued their struggle for a canal, proposing new ideas and reasons for its usefulness...even if a Trent exit was also built. When the Port Hope exit became a major issue for the local riding in the 1904, Mulock pitched in to help, as did Laurier. Borden, as Conservative leader, merely promised "to finish both ends of the Trent." More surveys were done in 1906, for political camouflage, since the Liberal government had apparently decided on the Trent exit, which it did formally early in 1907.

In the late 1890s and the early 1900s the technical advances in alternating current technology and the long-distance transmission of electrical power that had begun in the United States with Nicola Tesla spread to Canada. Potential power-generating sites were therefore under examination, and this included the lower Trent River as it travelled south to Lake Ontario. But in Ontario, in the early 1900s, there was another related issue: whether hydro-generated electrical power should be publicly or privately owned. The proponent of the public ownership, province-wide, was Adam Beck, mayor of London, Ontario, but also a provincial MLA and cabinet minister, who succeeded in forming what later became Ontario Hydro. Those who lived in the Trent watershed had plenty of potential water power and were caught in the public-private argument On the private side, also, there was competition for the ownership and leasing of the hydro rights along the river, among the lakes to the north, and especially at places like Healey and Ranney Falls. The arguments between the sides were as heated as the issues were both politically and technically complex, led by Beck on one side, and people like J.A. Culverwell, a promoter-businessman, and J.G.G. Kerry, the Montréal consulting engineer on the other. Even Max Aitken, later Lord Beaverbrook. became involved. The Liberal government in Ottawa, for its part, preferred to see a single private owner for these rights and senior public servants like Matthew J. Butler, the deputy minister and chief engineer of the Department of Railways and Canals, and Alexander J. Grant were deeply involved. Essentially, Kerry won the fight in the short run but, in the longer term, lost out to Adam Beck and Ontario Hydro. In any event, the hydro-rights question spurred the completion of the eastern end of the waterway, from Rice Lake to Lake Ontario.

The Laurier and Borden Administrations

In 1900 the Trent-Severn Waterway was revived as an election issue, with the Conservatives strongly backing the Waterway's completion. The Liberals were not completely unresponsive. Rogers was ordered in December 1899 to survey the nine-mile section between Trenton and Frankford and the work was advertised for tender, but no contracts were let. Rogers was opposed, as was the then Liberal-dominated TVCA. Rogers was instructed to do his survey again. The Liberals lost two seats in the November 1900 election. The Conservatives also won the other district seats. It was not until 1907, ten years after the TCVA sent the huge delegation to see Laurier in Ottawa, that the decision was made to begin the construction of the Trent River exit locks. By then, the politicians had decided on the shape and size of the eastern end of the Trent waterway and had settled hydro rights and other issues so that the engineers could set about doing the necessary construction work between Rice Lake and Trenton.

Alexander J. Grant, by then superintendent of the Trent, divided the distance into seven sections for construction purposes. Priority was based on hydro potential rather than transportation needs or geographical sequence. As before, the contracts typically covered locks, dams, entrance walls, canals, bridge abutments and piers. Lock gates and bridges were covered separately. The Trent locks were of concrete and 30 feet longer than most of those previously built on the waterway. Instead of the less expensive sluice valves on the gates, the Trent locks had wagon valves which allowed water to enter a chamber along the side walls and required that the walls be thicker. These changes also meant that the older limestone locks at Hastings and Glen Ross had to be rebuilt.

(In 1988, when Angus published his book, the only remaining limestone lock was the one at Scott's Mills.)

The first Trent River section to be built was the three-mile stretch from Campbellford to Crowe Bay. Two locks and two dams were built. The contract was awarded to Brown, Love and Aylmer in August 1907 -

the day after the first bridge disaster at Quebéc. J.G.G. Kerry had an interest in the location of the dam for the hydro plant at Campbellford. The work was finished in 1909.

Incidentally, the Royal Commission appointed to investigate the collapse of the Quebéc Bridge included both Kerry and Henry Holgate, indicative of their standing with 'official' Ottawa. The third member was Professor Galbraith of the University of Toronto.

Campbellford, 1909, #13

Crowe Bay, 1909, #14

Trenton, 1914, #1

Sidney, 1914, #2

Glen Miller, 1914, #3

Batawa, 1918, #4

Trent, 1918, #5

Frankford, 1918, #6

Percy Reach, 1918, #8

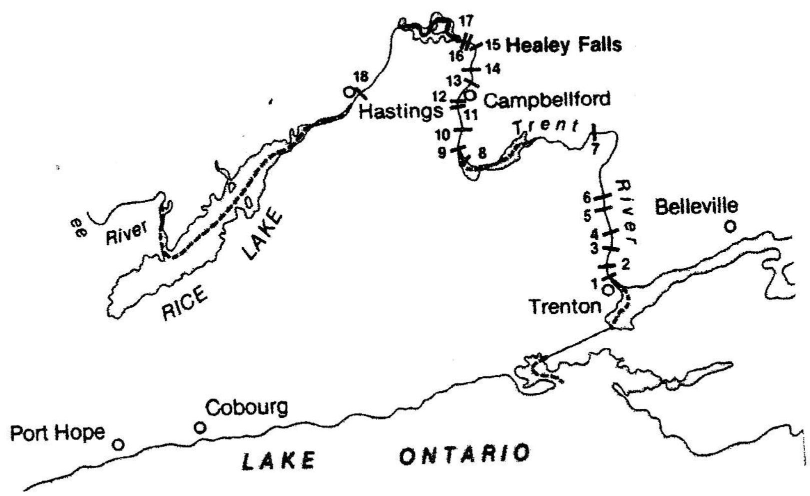
Myers Reach, 1918, #9

Haigues Reach, 1918, #10

Ranney Falls, 1918, #11 and #12

Healey Falls, 1918, #15, #16 and #17

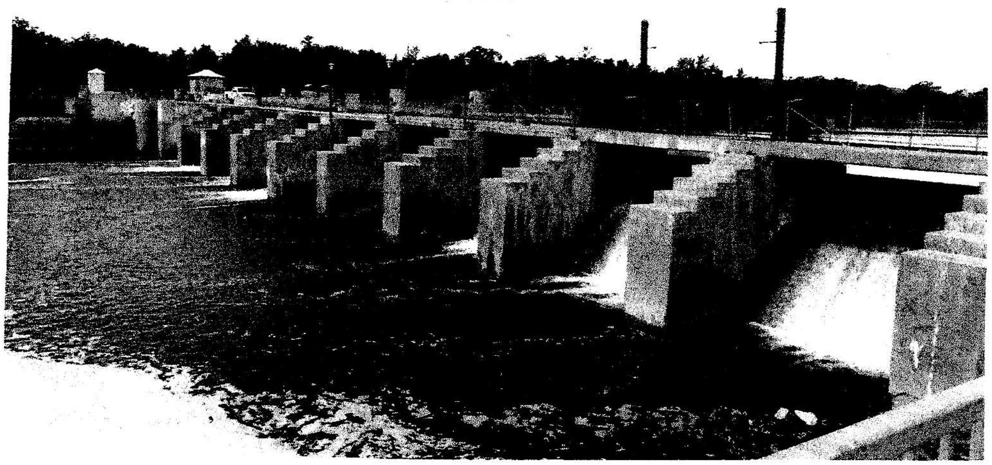
Rebuilds: Hastings, 1916, #18 and Glen Ross, 1918, #7



The next Trent section to be built was the one that included the locks and other facilities at Trenton, Sidney and Glen Miller. The awardee refused to sign the original contract. It was eventually awarded, on the recommendation of Matthew Butler late in 1907 to Larkin & Sangster, who had been involved at Kirkfield, had Welland experience, and were in the Liberal fold. Land claim problems delayed the start of work further, until April 1908. It was completed in January 1914. Both Kerry and Culverwell were involved in negotiations for the hydro rights at Sidney. The contract survived the change of government , from Laurier to Borden, in 1911, as did the remaining sectional contracts.

Trenton

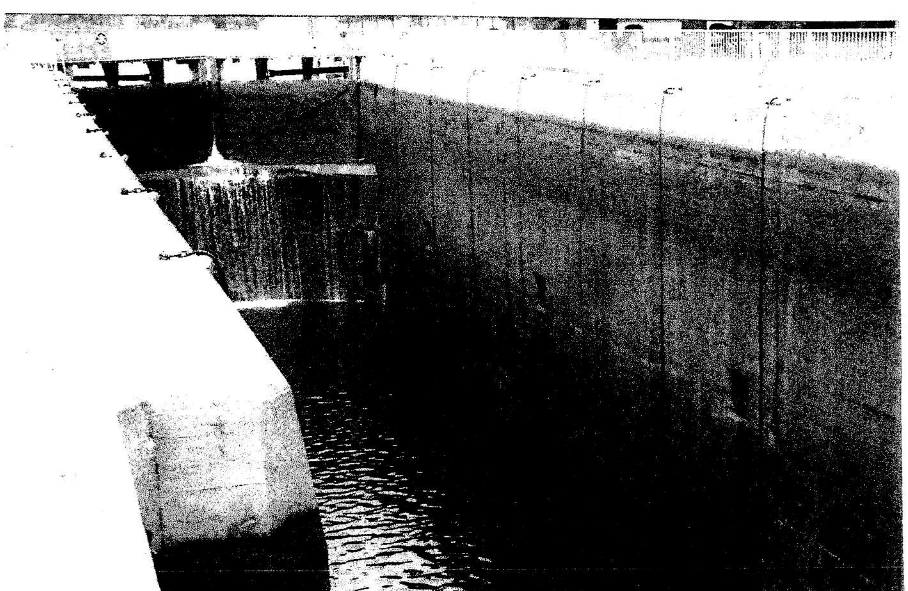
(2014)



Batawa dam, with

slip-log machinery

(2014)



Crowe Bay

(2014)

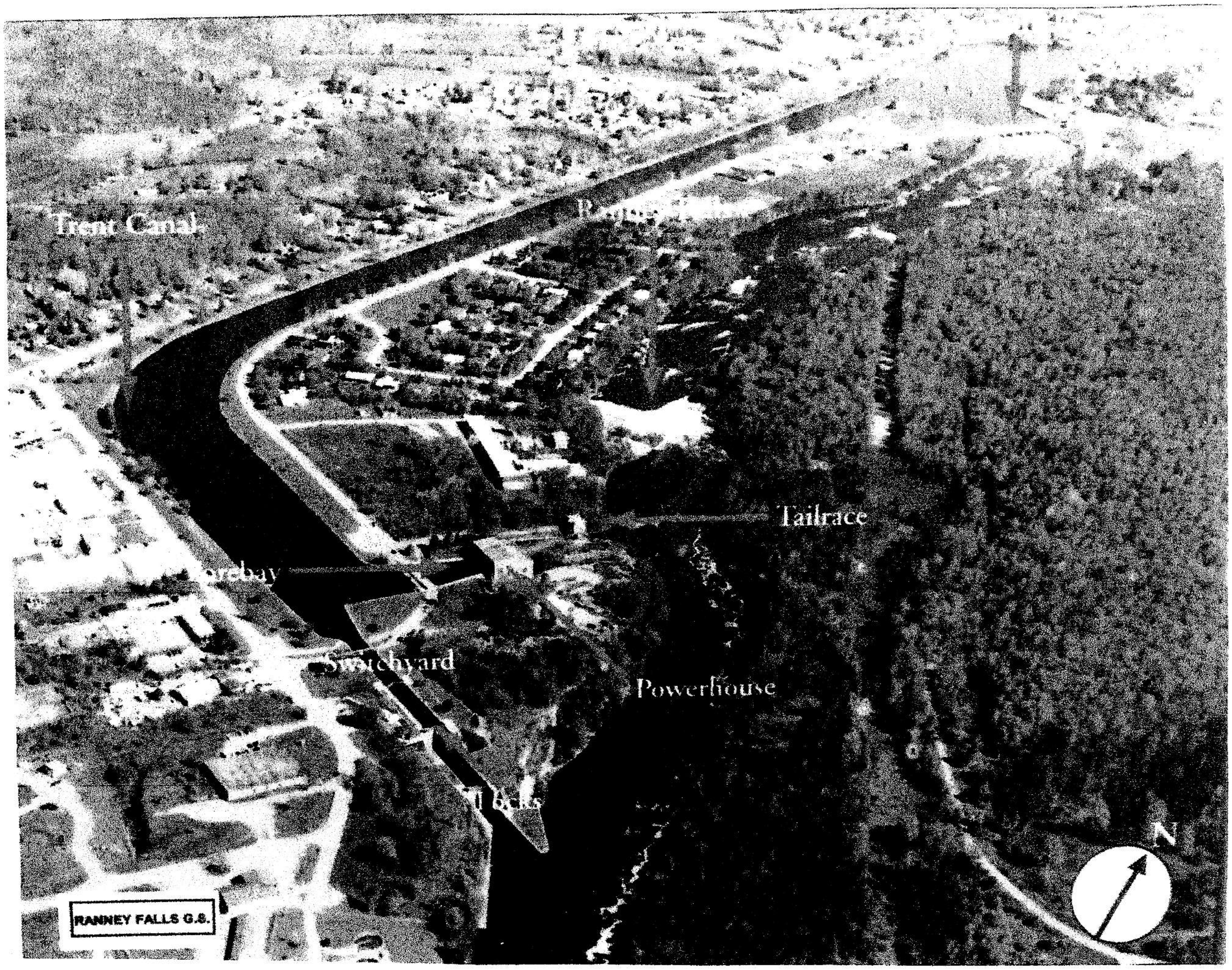
The third section was from Glen Miller to Frankford, around four miles in length. Three locks - at Batawa, Trent and Frankford – plus dams, bridges and dredging were included. The contract was won in March 1908 by a firm, one of whose principals was Richard Rogers. But it brought him and his partner, William Denton, a great deal of trouble over the 10 years the contract lasted. The problem lay in Rogers' lack of capital, plant and direct contracting experience. His interests were basically in the engineering and the management. He was also pressured constantly by Grant to make faster progress. Grant, in turn, was being pressured by Kerry, who was competing with Culverwell for the water power lease at Glen Miller.

The next section to be tackled was the one from Frankford to three miles west of Glen Ross (formerly Chisholm's Rapids) - the smallest of the seven - and included the rebuilding of the original Glen Ross masonry, the construction a new concrete dam at Glen Ross, widening of the old canal, and river dredging. The contract was won by the Canadian General Development Company. Work began in April 1908. The contract was almost finished by 1911 but problems with the Rogers' section delayed it and, meanwhile, CGDC went bankrupt. Re-awarding prolonged completion until near the end of World War I.

The fifth, and largest, river section covered 14 miles, from west of Glen Ross to Campbellford, as well as the largest contract at around $1.5 million. The awarding of the contract to Haney, Quinlan & Robertson was delayed until June 1910 while some very complicated political and technical problems involving mills and power plants (and J.G.G. Kerry) were solved. It included the building of the two flight locks at Ranney Falls and single locks at Percy Reach, Myers Island and Haigues Reach, three miles of excavated canal, dams, bridges, river walls and a supply weir for power development. Work began in July 1910 and was finished eight years later. It also survived the change in Dominion government. Michael J. Haney was an Irish-born engineer, who had earlier participated with Onderdonk in the building of the CPR, and who was a friend of both Laurier and Butler.

The sixth Trent River section covered a three-mile stretch from the dam at Crowe Bay to just above Healey Falls Bridge. To overcome the 76-foot drop at Healey Falls, the contract called for a flight of two locks and a third, single, lock just downstream. The old Healey log dam was replaced at the head of the Falls was replaced and became the longest concrete dam in the Trent system. Retaining walls were also built and some dredging done. The final details of the contract - awarded again to Haney, Quinlan and Robertson in the summer of 1910 - were again held up by water power problems. Relatively isolated, the Healey site was also difficult to service. Yet the contract was essentially complete, except for some dredging that awaited the completion of word further down river had been completed, by the fall of 1913.

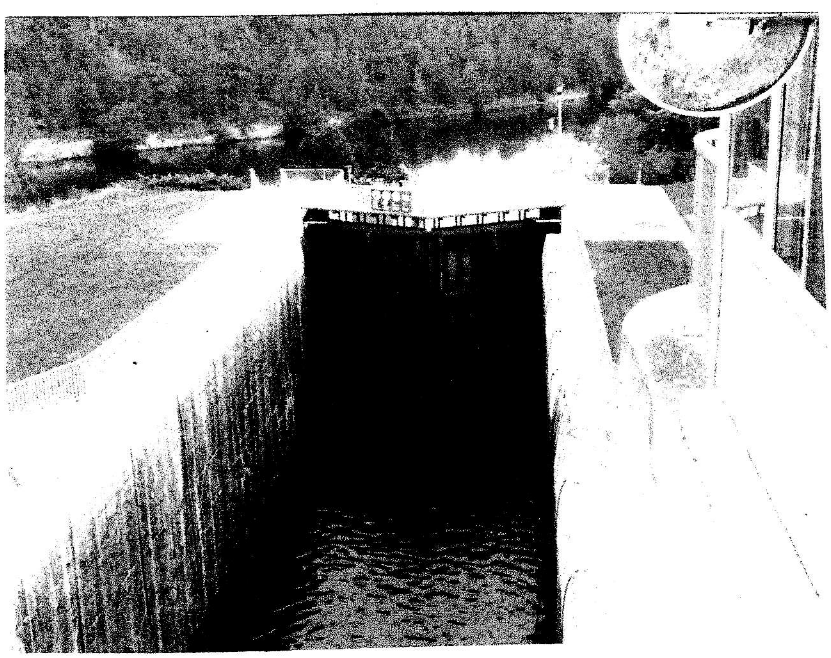
The final Trent section was the 20-mile stretch westward from Healey Falls to Rice Lake. The main work involved much dredging and the construction of the new longer concrete lock and dam at Hastings, replacing the 1844 limestone and wooden ones built by Baird, plus the usual bridges and piers. The contractor was the Randolph Macdonald Company of Toronto was awarded the contract in January 1909, but its completion in 1916 was delayed by shortages during World War I.



Ranney Falls, from the air (Ontario Power Corporation) (2014)

Ranney Falls, #11

(2014)



Healey Falls, #17

(2014)

The full Rice Lake - Trenton section of the waterway was opened in June 1918, but no boats came through until a month later. It opened the way for boats to travel from Lake Couchiching to Lake Ontario. The western outlet from the waterway remained the barrier to Lake Huron and the West.

The Borden Administration and the Finishing of the Waterway

A modern road bridge arches over the water connection between Lakes Simcoe and Couchiching. The first lock on the western exit from the Trent-Severn Waterway is just above the head of Lake Couchiching, where the River Severn begins.

Borden's Minister for Railways and Canals, Frank Cochrane, committed the Dominion government to the completion of the 33-mile long Severn River section and the waterway as a whole. In this case, hydro leases were not an issue since all possible Severn sites had already been exploited, and the barge canal proposal was a dead issue. Rather, the problem was: the project is not yet complete. But politics and patronage were still alive!

To recap briefly... Baird in the 1830s had recommended the Severn route as the western exit for the Trent waterway, but did not survey it. Tom S. Rubidge did survey it, in the 1880s, but concluded that massive amounts of Canadian Shield granite would have to be removed for a canal to be built and recommended another western exit, like Kivas Tully before him and the TVC after him, to the south end of Georgian Bay. While in office, the Laurier Department of Railways and Canals studied several exit options without reaching a decision.

Nevertheless, Cochrane ordered a complete survey of the Severn route late in 1911. The work was done in several sections. A year's delay in awarding contracts for the completion of the waterway work led to yet another large TVCA delegation - the very last in the series begun 30 years earlier - going to Ottawa to meet with the prime minister. All sorts of reasons were again given for getting the work done. Sam Hughes presented a new one: the tourist trade which, if encouraged, would actually do more good for Ontario than for the Dominion. This, indeed, was the reason that carried the day. But Borden and his people also realized that the work already done would be wasted if the waterway was not completed. He promised to consider the matter carefully. Some questions, such as the exit port, the fate of the existing power plants, and access to one of the potential sites, at Big Chute, remained to be settled.

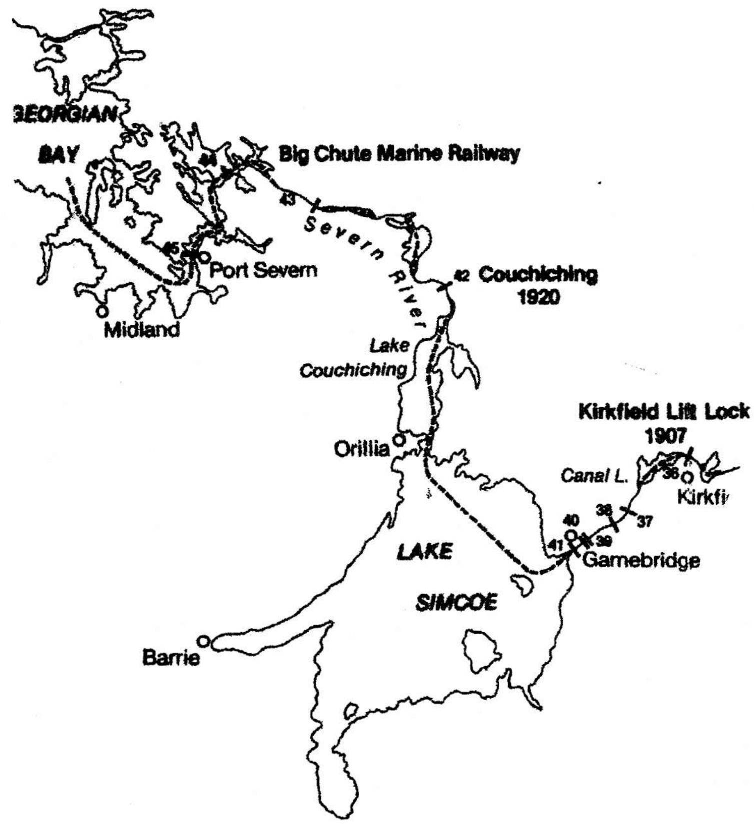
It was agreed that, in the interim, the exit would be at Port Severn and that a smaller 100-foot by 25-foot lock would be built there while the building at Go Home Bay of a Trent-sized lock was being considered. The Port Severn lock was built, and remains in service today as the smallest Trent lock. The other one was never built.

Port Severn, 1915, #45

Big Chute, 1918, #44

Swift Rapids, 1919, #43

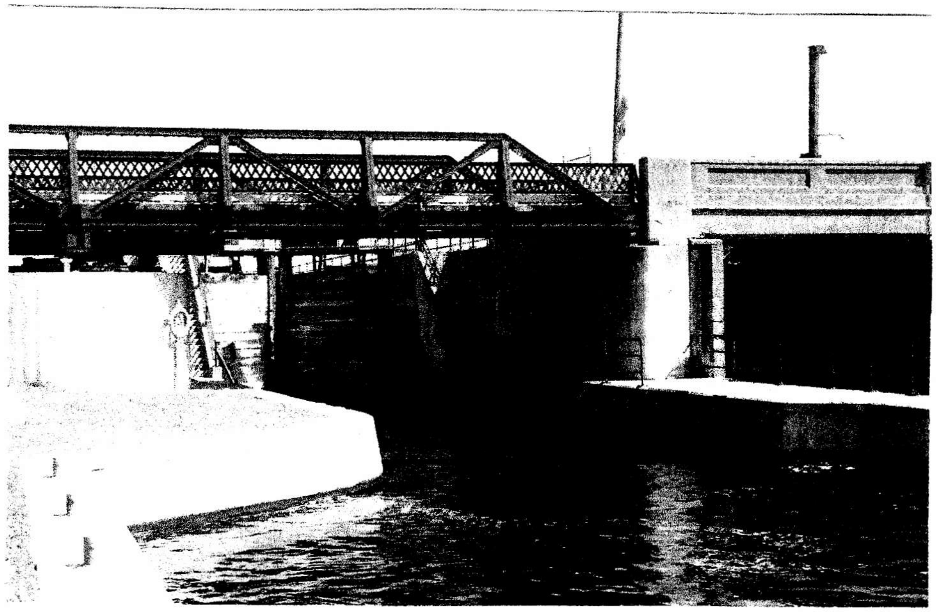
Couchiching, 1920, #42



Starting this time in the far west, a contract for the work at Port Severn was awarded in September 1913 to York Construction, a company with connections to both parties. It covered the lock, several dams, retaining walls and rock excavations. The work began in October and was finished two years later. During construction, a serious problem arose when the water between the temporary cofferdams was removed, revealing mountains of waste from nearby saw mills, as well as hundreds of live fish. The project also experienced labour shortages due to World War I.

Port Severn, #45

(2014)



The next section of the Severn route for which tenders were called extended from Big Chute eastwards for 11 miles. The work was to include dams across two channels and a third dam, plus a single lock with a 47-foot lift, a dam and a powerhouse at Swift Rapids, the reconstruction of a CNR bridge, and considerable excavation of granite rock. The contract was awarded to Inland Construction in April 1914 and work began soon afterwards. The CPR built a short siding at Severn Falls to help with the delivery of materials and equipment. The channel dams were completed first. Further work was delayed due to a series of extended negotiations involving power supplied by plants in the Swift Rapids region. However, the new plant was built there in 1917, after which Inland - suffering from financial and labour problems due to the War - gave up its contract. After the War, in 1919, the government decided not to finish the Swift Rapids lock and persuaded the power plant company to accept a marine railway in its stead, as a temporary measure. York Construction was awarded a contract to build it.

(This marine railway remained in service until replaced by a lock in 1965, which became the deepest conventional lock in the waterway, with a 47-foot lift.)

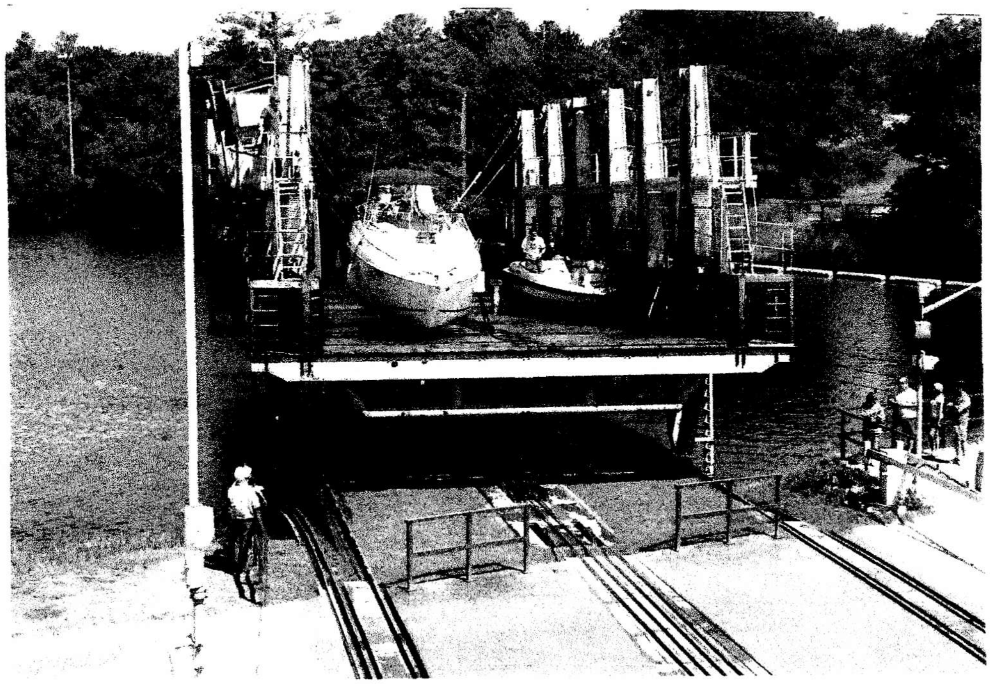
The third section of the Severn route extended from Sparrow Lake to deep water at Lake Couchiching. The work included a lock at Couchiching, with a 20-foot lift, three swing bridges, several small dams and a considerable amount of rock excavation. The contract was awarded to the Randolph Macdonald Company and work began in the fall of 1914. Since the construction sites were accessible to the CNR deport at Washago, the work proceeded smoothly for two years, when serious wartime shortages were felt. The contractor asked to be relieved, but was reinstated in January 1919 and work resumed. It was finished in June 1920.

The fourth section of the Severn route was originally to include locks at Go Home Bay and Big Chute. As noted already, the former was never built and, in 1916, the Department of Railways and Canals decided to prepare for a marine railway at Big Chute. It was designed by J.B. Jost of the Department and built by York Construction. It was the world's first electrically-operated marine railway, the power being suppliedby the hydro plant at the bottom of the Chute. It was built and installed in 1917. A standard gauge track, 750 feet long, was laid over the land barrier between the water at the top and the bottom of the Chute. The steel frame for the car was built by the William Hamilton Company under sub-contract. The car was 24 feet long and 9 feet wide, with six-foot sides and could carry a boat 35 feet long with a beam of nine feet and weighing no more than five tons. A portage could take half an hour. By 1920, wheat barges had been forgotten and Big Chute was catering solely to the tourist trade. Author James Angus' father, Scotty, was an operator of the Big Chute railway for almost 30 years. It was where Angus himself grew up.

Big Chute Marine Railway, #44

(2014)

'Up top'



'On the way down'

(By the end of the 1960s, the Big Chute marine railway could not keep up with demand. The original intention was to replace it with a series of locks. However, it was found that the invasion of sea lamprey from Lake Huron could be prevented from invading Lakes Couchiching and Simcoe if a marine railway remained in place. So a new, larger car and tracks were installed in 1978.)

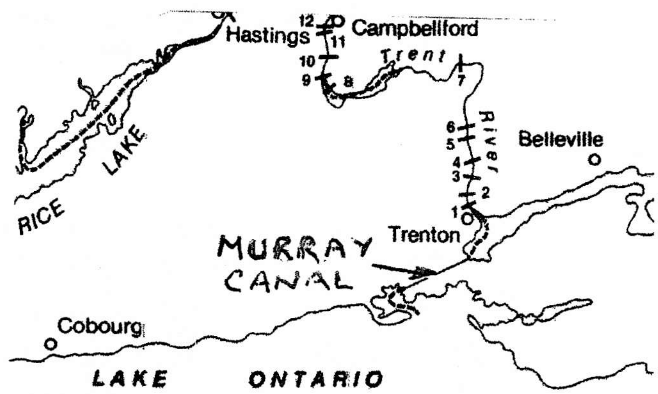
With the Port Severn lock, the two marine railways and the Couchiching lock in place, the Trent-Severn waterway was complete. It was officially opened on 6 July 1920, but only two small boats participated. On 3 July, the launch *Irene* left Trenton to make the first transit of the waterway, arriving at Port Severn on 20 July.

The Murray Canal

This last element in the Trent-Severn Waterway was actually built back in the 1880s. The Murray Canal was a 5 mile long, 50 foot wide and 9 foot deep (toll) waterway designed to link the western end of the Bay of Quinte with Presqu'ile on Lake Ontario. It was built to provide a shorter and smoother access route for vessels going to, and coming from, Lake Ontario and Trenton, at the eastern end of the waterway, avoiding the long trip round Prince Edward County. Construction began in 1882, but was not completed until 1889. Tom S. Rubidge was the supervising engineer on the Murray Canal.

(Nowadays, highway traffic can cross it at two swing bridges, one at either end. Once used frequently by commercial boats, it now serves recreational boaters.)

Murray Canal



(2014)

Postscript

In 1835, Nichol Hugh Baird estimated that the waterway would cost $3 million to build. Tom S. Rubidge estimated $9 million in 1888. James Angus has estimated that the cost of construction was $19 million, plus another $4 million for operations and maintenance between 1833 and 1922, using (as spent) current dollars throughout and spread over the 90 years.

And here is where the waterway

began...at Bobcaygeon

(2014)

In his book, James Angus mentions, very briefly, connections between engineers associated with the Trent-Severn and the Canadian Society of Civil Engineers. Some must have known one another rather well and attended many of the same CSCE meetings. But he does not expand on these interactions. The list includes, for example, Kivas Tully, Samuel Keefer, Collingwood Schreiber, Matthew J. Butler, R. Adams Davy, John Kennedy, Frank Turner, Richard B. Rogers, Henry H. Holgate, J.G.G. Kerry, and Alexander J. Grant. The CSCE became the Engineering Institute of Canada in 1918 but, by this time, the Trent story was almost complete.

Looking back, the Trent-Severn Waterway should never have been built. But it was!

Acknowledgements

Grateful thanks go to my daughter Mary for arranging the logistics of the trip round the Trent locks in the late summer of 2014, to her husband Rod Trider - a former boat owner who used the Lake Simcoe-Port Severn section of the waterway - for chauffeuring us, including my wife, throughout the long trip, and to Mary and Rod for their awesome navigation skills. Some of the locks were not actually easy to find!

My travelling companions,

at the start of our trip:

Mary and Rod Trider

and Shirley Wilson

(2014)

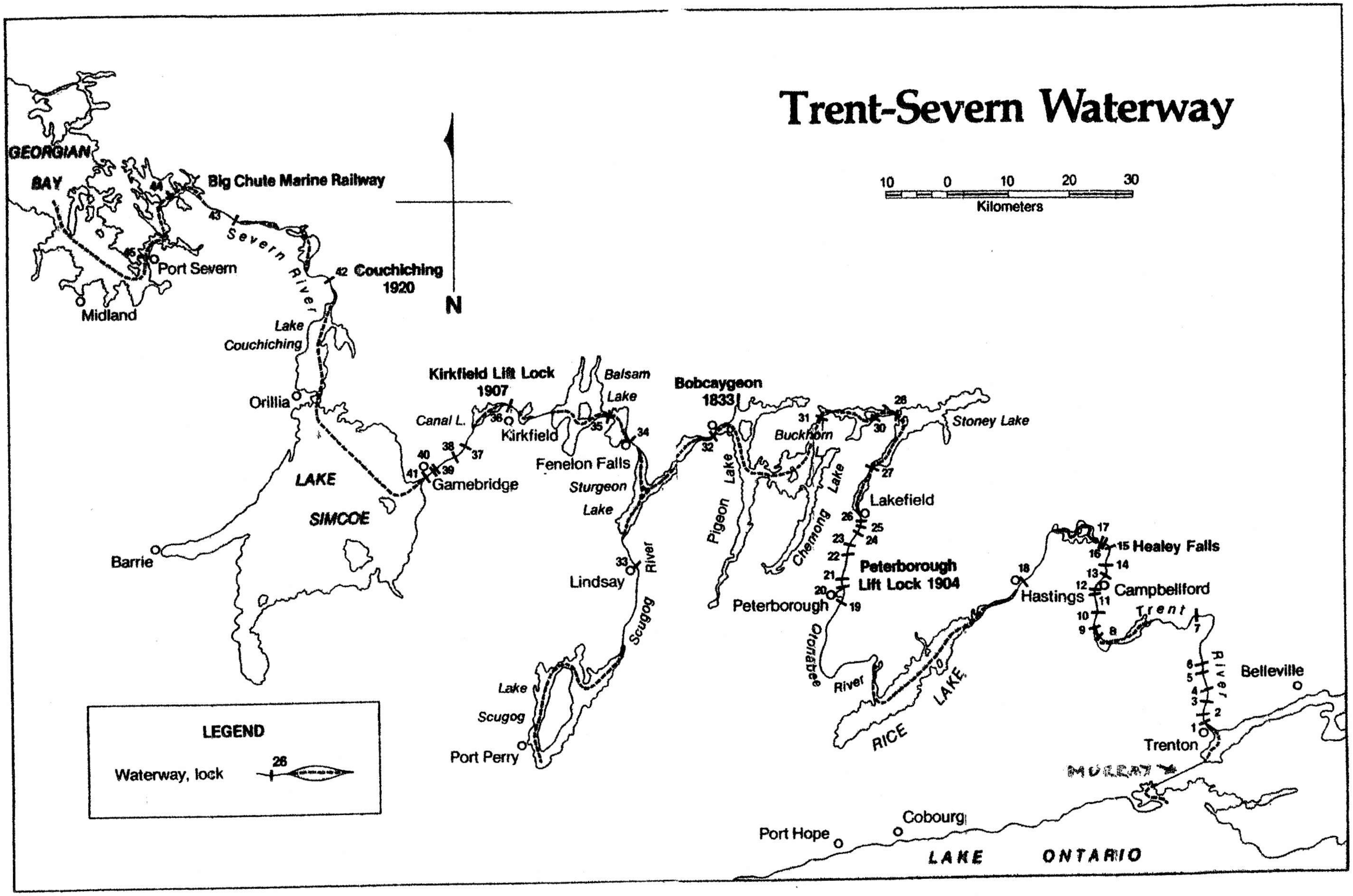
Also, my thanks to the Ottawa Section of the Canadian Society of Senior Engineers for the opportunity to present this paper at a luncheon meeting.

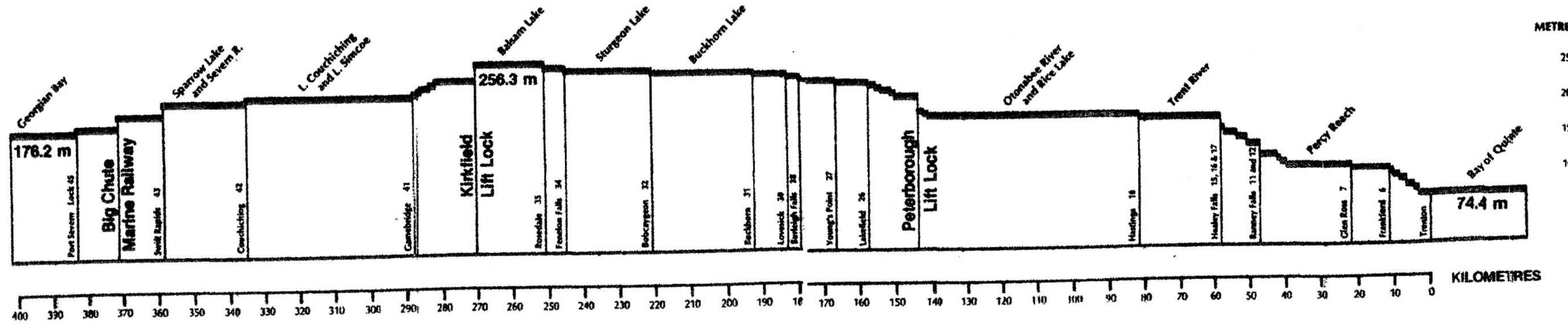
Appendix

Locks on the Trent-Severn Waterway

Lock	Station	Type	Chart	From Lake Ontario Kilometer - Miles	Region	GPS (proximity)
1	**Trenton**	Lock	2021	0 - 0	Trent	44.12071°N - 77.59160° W
2	Sydney	Lock	2021	3.9 - 2.4	Trent	44.13072°N - 77.59152° W
3	Glen Miller	Lock	2021	6.2 - 3.9	Trent	44.15055°N - 77.57970° W
4	Batawa	Lock	2021	8.3 - 5.2	Trent	44.16818°N - 77.58638° W
5	Trent	Lock	2021	10.3 - 6.4	Trent	44.18484°N - 77.59188° W
6	Frankford	Lock	2021	11.7 - 7.3	Trent	44.19776°N - 77.59123° W
7	Glen Ross	Lock	2021	22.2 - 13.8	Trent	44.26569°N - 77.59697° W
8	Percy Reach	Lock	2021	40.7 - 25.3	Trent	44.23592°N - 77.78407° W
9	Meyers	Lock	2021	42.5 - 26.4	Trent	44.24690°N - 77.80009° W
10	Hauges Reach	Lock	2021	45.0 - 28.0	Trent	44.26730°N - 77.79337° W
11/12	Ranney Falls	Flight Lock	2021	47.8 - 29.7	Trent	44.29031°N - 77.80160° W
13	**Campbellford**	Lock	2021	51.8 - 32.2	Trent /Rice Lake	44.31979°N - 77.78615° W
14	Crowe Bay	Lock	2021	54.2 - 33.7	Rice Lake	44.33516°N - 77.77303° W
15	Healy Falls	Lock	2021	58.2 - 36.2	Rice Lake	44.36891°N - 77.77434° W
16/17	Healy Falls	Flight Lock	2021	58.8 - 36.5	Rice Lake	44.37283°N - 77.77988° W
18	**Hastings**	Lock	2022	82.3 - 51.1	Rice Lake	44.30865°N - 77.95703° W
19	Scott's Mill	Lock	2022	142.8 - 88.7	Rice Lake /Kawartha	44.28926°N - 78.30814° W
20	Ashburnham	Lock	2023	144.5 - 89.5	Kawartha	44.29924°N - 78.30441° W
21	**Peterborough**	Lift Lock	2023	145.0 - 90.1	Kawartha	44.30763°N - 78.30098° W
22	Nassau Mills	Lock	2023	151.7 - 94.3	Kawartha	44.36464°N - 78.29033° W
23	Otonabee	Lock	2023	152.6 - 94.8	Kawartha	44.37248°N - 78.28864° W
24	Douro	Lock	2023	155.1 - 96.4	Kawartha	44.38872°N - 78.26960° W
25	Sawer Creek	Lock	2023	156.6 - 97.3	Kawartha	44.40017°N - 78.26287° W

26	**Lakefield**	Lock	2023	158.9 - 98.7	Kawartha	44.42001°N - 78.27093° W
27	Young's Point	Lock	2023	168.1 - 104.5	Kawartha	44.48823°N - 78.23302° W
28	**Burleigh Falls**	Lock	2023	181.8 - 113.0	Kawartha	44.55972°N - 78.20815° W
30	Lovesick	Lock	2023	18.7 - 114.8	Kawartha	44.56196°N - 78.25072° W
31	**Buckhorn**	Lock	2023	194.2 - 120.7	Kawartha	44.55558°N - 78.34607° W
32	**Bobcageon**	Lock	2025	222.4 - 138.2	Kawartha	44.53906°N - 78.54654° W
	Port Perry	*Lake Scugog Start*	*2026*	*294.5 - 183.3*	*Scugog*	44.0905°N - 78.9479°W
33	*Lindsay*	Lock	2026	251.6 - 156.3	*Scugog*	44.35684°N - 78.73527° W
34	**Fenelon Falls**	Lock	2025	247.2 - 153.6	Kawartha	44.53591°N - 78.73718° W
35	**Rosedale**	Lock	2025	252.9 - 157.2	Kawartha	44.57171°N - 78.77842° W
36	**Kirkfield**	**Lift Lock**	2025	272.6 - 169.4	Kawartha /Simcoe	44.58956°N - 78.98955° W
37	Bolsover	Lock	2025	284.9 - 177.0	Simcoe	44.53457°N - 79.07110° W
38	Talbot	Lock	2025	286.5 - 178.1	Simcoe	44.50959°N - 79.10661° W
39	Portage	Lock	2025	289.1 - 179.6	Simcoe	44.50276°N - 79.12626° W
40	Thorah	Lock	2025	289.8 - 180.1	Simcoe	44.49881°N - 79.13262° W
41	Gamebridge	Lock	2025	290.9 - 180.7	Simcoe	44.48667"N - 79.14889"W
42	Couchiching	Lock	2028	337.8 - 209.9	Simcoe /Severn	44.76953°N - 79.35024° W
43	Swift Rapids	Lock	2029	361.2 - 224.5	Severn	44.85772°N - 79.54036° W
44	**Big Chute**	**Marine Railway**	2029	374.1 - 232.5	Severn	44.88501°N - 79.67474° W
45	**Port Severn**	Lock	2029	387.1 - 240.6	Severn	44.80354°N - 79.72033° W


Trent-Severn Waterway
10 0 10 20 30
Kilometers
N
GEORGIAN BAY
Big Chute Marine Railway
Severn River
Port Severn
Midland
Couchiching 1920
Lake Couchiching
Orillia
LAKE SIMCOE
Barrie
Gamebridge
Kirkfield Lift Lock 1907
Canal L.
Kirkfield
Balsam Lake
Fenelon Falls
Sturgeon Lake
Lindsay
Scugog River
Lake Scugog
Port Perry
Bobcaygeon 1833
Pigeon Lake
Buckhorn
Chemong Lake
Stoney Lake
Lakefield
Peterborough Lift Lock 1904
Peterborough
Otonabee River
RICE LAKE
Hastings
Healey Falls
Campbellford
Trent River
Belleville
Trenton
Port Hope
Cobourg
LAKE ONTARIO
LEGEND
Waterway, lock
26


METRES
Georgian Bay
Sparrow Lake and Severn R.
L. Couchiching and L. Simcoe
Balsam Lake
Sturgeon Lake
Buckhorn Lake
Otonabee River and Rice Lake
Trent River
Percy Reach
Bay of Quinte
176.2 m
256.3 m
74.4 m
Big Chute Marine Railway
Kirkfield Lift Lock
Peterborough Lift Lock
KILOMETRES

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House of Commons Bill C-530

Wikipedia material for Nichol Hugh Baird, Collingwood Schreiber, Samuel Keefer, James T. Angus, Trent-Severn Waterway, Canals of Canada, Big Chute, Burleigh Falls, Murray Canal, Kirkfield and Peterborough Lift Locks and the European Lift Locks, Lake Scugog, Swift Rapids Lock, Erie Canal.

Appendix: List of Locks: http://www.thetrentsevernwaterway.com/

Full and partial maps: *The Peterborough Hydraulic Lift Lock* (above)

Photographs

Timber slide, p 13: Angus (above) p 180

Baird, Killaly, Tully: p 15: Angus (above) pp viii, ix and x

Keefer, Butler, Grant: pp 15 and 37: *Engineering Journal*, June 1937

Schreiber, Rogers, Blair: p 32: *Peterborough Hydraulic Lift Lock* (above)

All other photographs: the Author's 2014 tour, or as noted beside photographs

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