THE MONTREAL/LAKE ONTARIO SECTION OF THE SEAWAY

The St. Lawrence Seaway, in its broadest sense, is a deep waterway extending some 3,700 km (2,340 miles) from the Atlantic Ocean to the head of the Great Lakes, at the heart of North America. Strictly speaking, however, within the meaning of the legislation which provided for the construction and maintenance of the deep waterway, the St. Lawrence Seaway proper extends from Montreal to Lake Erie.

The Montreal/Lake Ontario section encompasses a series of 7 locks from Montreal (Quebec) to Iroquois (Ontario) enabling ships to navigate between the lower St. Lawrence River and Lake Ontario.

Laker under Mercier Bridge

HISTORY

The opening of the Seaway, in April of 1959, marked the full realization of a 400 year-old dream. In the early part of the 16th century, Jacques Cartier, the French explorer, was turned back by the rushing waters of the Lachine Rapids, just west of what is now Montreal, and thus denied his dream of finding the Northwest Passage and the route to the East. At various times during the intervening 300 years, canals have been dug and locks built around the natural barriers to navigation in the St. Lawrence River. This activity was spurred on by the desire to make use of the economical transport route which the waters of the Great Lakes Basin offered for the movement of goods in and out of this area of the continent.

The first efforts to open an inland navigation route were pioneered by Dollier de Casson, Superior of the Sulpician Seminary in Montreal as early as 1680. Notwithstanding the opposition of his superiors and the apathy of local settlers engaged in their struggle for survival, this man of vision and tremendous energy finally succeeded, after twenty years, in signing a contract for the construction of a canal to link Lake St. Louis and Montreal. At Casson's death, in 1701, his 1.5 m (5 feet) deep canal was 1.6 km (1 mile) long and could not be completed during the French Regime because of lack of funds although sporadic work continued until 1733. The "Casson Canal" was not completed until 1824. Thenceforth known as the Lachine Canal, it had seven locks.

Between the years 1779 and 1783, four small canals were built by Royal Army Engineers on the north shore of the river to carry small vessels from Lake St. Louis to Lake St. Francis. These canals had a depth of 0.76m (2 1/2 feet) and a total of five locks, each 1.8 m (6 feet) wide, the first ever built on the St. Lawrence River and perhaps in North America.

The building of the Erie Canal, in the United States, early in the 19th century, provided the incentive for the construction of additional and deeper canals and locks along the St. Lawrence. The American waterway, which offered a fast, uninterrupted link between the growing industrial heartland of North America and the Atlantic Ocean through New York posed a serious threat to Canadian shipping and, in particular, to the development of the City of Montreal as a major port. Renewed activity resulted in the opening of canals at Cornwall in 1843 and at Beauharnois in 1845; an improved Lachine Canal was also completed in 1848. In the Western section of the Seaway, the first Welland Canal had opened to navigation in 1833 and was completed in 1848.

All in all, by the middle of the 19th century, a continuous water route linking Lake Erie to the sea was available to vessels of less than 2.4 m (8 feet) draught. However, the economic growth and commercial development foreseen by the canal diggers did not materialize immediately. While dedicated men dug canals and built locks, another group of equally dedicated pioneers were also hard at work building a railroad. The viability of water transportation largely depends on the movement of a large volume of goods over long distances. If the embryonic seaway of 1850 could provide distance, its depth and lock dimensions precluded the shipment of heavy bulk cargoes aboard large vessels. Further hampered by the constrictions imposed by cold weather which often reduced the shipping season to a mere seven months in those days, the fledgling waterway offered poor competition to the growing number of locomotives steadily moving men and goods through fog and snow. If inland water transportation was to compete, it had to modernize...and it did.

Between 1850 and 1904 both the Lachine and Welland Canals were deepened to 4.3 m (14 feet). The Soulanges Canal, built to replace the Beauharnois Canal, was completed in the early 1900s. Also 4.3 m (14 feet) deep, this section was 22.5 km (14 miles) long and contained five locks, each 13.7 m (45 feet) wide and 85.3 m (280 feet) long. A new canal was also constructed at Cornwall. Miles away, at Sault Ste. Marie, Americans and Canadians were hard at work on their respective sides of the border building the canals and locks that would link Lake Superior and Lake Huron. Finally, by 1904, all the canals and locks between Montreal and Lake Erie had the same regulating depth of 4.3 m (14 feet) although some of them - Sault Ste. Marie, for example - were somewhat deeper.

The growth of the waterway throughout the years had closely followed the evolution of the Great Lakes and St. Lawrence River fleets - from the fur traders' canoes to small sailing vessels to schooners and, finally, steamers of larger and larger size. In 1932, Canada completed the Welland Canal, 43.5 km (27 miles) in length with a governing depth of 7.5 m (25 feet). This canal and its eight locks overcame the difference in level of 99.4 m (326 feet) between Lake Ontario and Lake Erie. The construction of the Welland Canal marked the first step in the completion of the Seaway as we know it today. Although a great many improvements have been made since then to increase the efficiency of both equipment and operations on the canal, the number and size of the locks have not been altered. Several factors - in addition to the enormous sums involved - prevented the simultaneous completion of both the Welland Canal and the Montreal/Lake Ontario section of the Seaway.

Laker entering Lock 3 downbound in the Montreal/Lake Ontario Section.

CANADA-U.S. NEGOTIATIONS

The St. Lawrence River flows mainly within the Canadian borders and although its waters were made available to the commerce of the United States by several early treaties, it was not until 1871, with the Treaty of Washington, that the exact boundary line was established and rules of navigation formulated. This is why most of the earlier steps leading to a deep water route between the Great Lakes and Montreal originated in Canada. However, the rapid industrial expansion and population growth that marked the continental interior during the second half of the 19th century resulted in drastically increased shipping requirements, especially for the movement of wheat and iron ore. Public interest in the construction of a deeper waterway on the St. Lawrence River was soon evident on both sides of the border. In 1895, the two governments appointed a Deep Waterways Commission to study the project and, two years later, the Commission reported in favor of it.

The Commission's report was followed by a series of engineering studies and, in 1909, a treaty established the International Joint Commission, a body that held considerably more power than its predecessor. The advent of World War 1 interrupted international negotiations as well as canal improvement work on the St. Lawrence/Great Lakes system. However, the war years provided a number of factors that contributed to a stronger movement to build the Seaway. New industries were created, the Panama Canal opened to navigation, rail transportation could no longer meet all requirements, foreign trade was steadily growing and the need to generate more electric power was ever increasing.

Nevertheless, government efforts in Canada and in the United States, and the keen interest manifested by industries located in the Great Lakes-St. Lawrence River area during the following 35 years were strongly opposed by influential rail and other private industrial sectors in the United States. As a result, the Great Lakes-St. Lawrence Deep Waterway Treaty, signed by both countries in 1932 to provide the joint development of resources in the interest of both navigation and power generation was rejected by the United States Senate. After further studies and urged on by the power needs created by war production, Canada and the United States signed the Great-Lakes-St. Lawrence Basin Agreement in 1941 with the same object in view. This Agreement, also submitted by the United States congress to its Senate for approval, had not been ratified by 1949.

Two years later, the Canadian Government let it be known that Canada was prepared to proceed with an "all-Canadian" seaway as far west as Lake Erie, once the means had been found to have the power works constructed concurrently in the International Rapids Section of the St. Lawrence River. By December of 1951, the *St. Lawrence Seaway Authority Act* and the *International Rapids Power Development Act* were approved by the Canadian Parliament, the first authorizing the construction of navigation works on the Canadian side of the river from Montreal to Lake Ontario as well as in the Welland Canal, the second authorizing the Hydro-Electric Power Commission of Ontario (HEPCO) to join a United States power generating entity in constructing the necessary power works in the International Rapids Section of the St. Lawence River.

In 1952, in order to get the power project underway, the Canadian and United States governments submitted joint applications to the International Joint Commission for the proposed power development, on the understanding that the Canadian Government would undertake to construct, more or less concurrently, and to operate all the works necessary to ensure uninterrupted 8.2 m (27 feet) navigation between Montreal and Lake Erie.

Approval of this proposal was given by the International Joint Commission in an Order of Approval dated October 29, 1952.

In 1953, the U.S. Federal Power Commission granted a 50-year license to the Power Authority of the State of New York (PASNY) for the development of the United States half of this power project. Because the Order granting this license to PASNY was contested in U.S. courts, it was not until June of 1954 that PASNY had clear authority to join HEPCO in making a start on these works.

In the meantime, the United States Congress had enacted the *Wiley-Dondero Bill* (P.S. 83-358) which authorized and directed the Saint Lawrence Seaway Development Corporation to construct, on United States territory, all the 8.2 m (27 feet) navigation facilities required to get shipping around the navigational barriers in the International Rapids Section. The situation required close consultation between the Canadian and American governments in order to avoid a duplication of locks and canals. A number of compromises and accommodations were eventually worked out and embodied in a series of Official Notes according to which the United States agreed to build a canal and two locks on the United States territory to bypass the Barnhart Island-Cornwall generating dam at the foot of the Long Sault Rapids and, in addition, to do some essential dredging elsewhere, while Canada agreed to build a lock and canal around the Iroquois Control Dam, some 48.3 km (30 miles) upstream and, in addition, to complete to a common standard all the necessary navigation facilities in Canadian territory, namely between Montreal and Cornwall and in the Welland Canal.

After fifty years of extensive studies, discussions and prolonged negotiations, work on the deep waterway could proceed. The feelings of all those whose efforts had led to the Seaway reality were aptly expressed by the then Prime Minister of Canada, Louis St. Laurent, who, at the official inauguration of the construction project, stated: "Rivers, together with mountains and deserts, have been long considered as natural barriers which make excellent national frontiers because they divide peoples from one another. While this may still be true to a certain extent, it is no longer the case as far as the St. Lawrence River is concerned. More and more, this great waterway has become a bond rather than a barrier between Americans and Canadians."

Ocean-going ship in Seaway Channel near Kahnawake (Lake St. Louis in background).

CONSTRUCTION

The first sod on the St. Lawrence Power Project was turned on August 10, 1954. Work on the Seaway began in September of the same year. The construction schedule for the entire power and Seaway project was in great part determined by both the Hydro-Electric Power Commission of Ontario and the Power Authority of the State of New York who were planning to start joint operation in 1958.

In order to allow a 36.6 m (120 feet) clearance to the vessels, the structure of four of the Montreal area bridges had to be modified drastically without interrupting the heavy vehicular and rail traffic to and from the city. The digging of new channels and extensive dredging to existing ones brought unforeseen difficulties - excavators uncovered rock formations that played havoc with standard equipment and necessitated the creation of new methods and the use of stronger machinery. The power development, which called for the flooding of wide areas, required the expropriation of some 260 km^2 (100 square miles) of land and the resettlement of entire communities. In all, some 6,500 people were moved to new homes while some 550 dwellings were transported to awaiting foundations in the newly created towns of Long Sault, Ingleside and Iroquois. In the Welland Canal, rock dredging during the winter months brought the 7.6 m (25 feet) deep channel to the 8.2 m (27 feet) governing depth of the Seaway.

All of the seven locks of the Montreal/Lake Ontario section of the Seaway (St. Lambert, Côte Ste. Catherine, Lower and Upper Beauharnois, Bertrand H. Snell, Dwight D. Eisenhower and Iroquois) as well as those of the Welland Canal, have been built to the following standard dimensions:

Usable length	**233.5 m (766 feet)**
Usable width	**24.4 m (80 feet)**
Depth (over sills)	**9.1 m (30 feet)**

Seaway channels and canals were built to minimum widths of 61 m (200 feet) when provided with two embankments, 91.4 m (300 feet) when there is only one embankment, and 137.2 m (450 feet) in open reaches. Depth throughout is 8.2 m (27 feet).

By May 1958, the Iroquois Lock was in regular use. The Snell and Eisenhower Locks, built by the Americans at Massena, New York, became operative on July 4 and on that same day, first power came from the international Moses Saunders generating station.

On April 25, 1959, the icebreaker "D'IBERVILLE" began the first through transit of the St. Lawrence Seaway which was officially opened by Her Majesty Queen Elizabeth II and the President Dwight D. Eisenhower of the United States on June 26 of that year. Today, the waterway remains a fine example of the spirit of co-operation that can exist between two nations and its successful operation is a tribute to the ingenuity, capability and perseverance of all those who had a hand in its realization.

THE SEAWAY TRANSIT

Ship entering downbound at St. Lambert Lock.

St. Lambert Lock

Starting in Montreal, ships travelling to destinations in the Great Lakes will first transit the 7 locks in the Montreal/Lake Ontario section of the Seaway, beginning with the St. Lambert Lock.

Almost directly across Montreal harbour lies the protecting dyke of the channel giving access to the Seaway. This channel begins just east of the Jacques Cartier Bridge (during Seaway construction, this bridge was literally "jacked up" some 15.2 m (50 feet) to provide the required clearance), passes beneath the bridge and extends for 4.8 km (3 miles) before reaching the first lock of the Seaway, the St. Lambert Lock, located at the southern end of the Victoria Bridge. An ingenious diversion system that includes a lift span at each end of the lock allows the heavy rail and road traffic to proceed uninterrupted to and from the bridge.

The St. Lambert Lock lifts the ship some 4.5 m (15 feet) from the level of the Montreal harbour to that of the Laprairie Basin through which the channel sweeps in a great arc, 13.7 km (8.5 miles) long, between its protecting embankments to the second lock.

Côte Ste. Catherine Lock

The Côte Ste. Catherine Lock lifts ships from the level of the Laprairie Basin some 9.1 m (30 feet) to reach Lake St. Louis. It allows navigation to bypass the swift Lachine Rapids. Its location was carefully chosen so that it would not interfere with any future utilization of the rapids for power development. Beyond this second lock, the channel runs 12.1 km (7.5 miles) before reaching Lake St. Louis.

At one point along this channel tower the piers which give the Honoré Mercier highway bridge the necessary clearance for the large ships using the Seaway. Further upstream is the Canadian Pacific Railway bridge which had two lift spans installed for the same purpose. These mobile spans can be raised or lowered in less than two minutes.

The Beauharnois Lock

Having entered Lake St. Louis, ships sail on for 19.3 km (12 miles) through dredged channels before reaching the Beauharnois Locks, at the west end of the lake. These locks bypass the Beauharnois power plant (owned by Hydro-Quebec, the generating plant has a capacity of 1,656,860 kW) and lifts the ship 12.5 m (41 feet) in order to reach the level of the Beauharnois canal. This 20.9 km (13 mile) canal brings vessels to Lake St. Francis where they may proceed westward for some 48.3 km (30 miles) along dredged channels to the head of the lake.

The U.S. Snell and Eisenhower Locks

Ships leave Lake St. Francis at its southwest corner and soon cross the International Boundary, opposite St. Regis, Quebec. Shortly after entering the International Section of the Seaway, ships sail under the Seaway International Bridge linking Cornwall, Ontario and Massena, New York. Built as part of the overall Seaway project, this toll bridge is administered jointly by The Federal Bridge Corporation Limited and The Saint Lawrence Seaway Development Corporation.

A short distance away lies the Bertrand H. Snell Lock, the first lock on the United States side. There, ships are lifted 13.7 m (45 feet) into the 16 km (10 mile) long Wiley-Dondero Ship Canal where, after proceeding some 6.5 km (3.5 miles), they reach the Dwight D. Eisenhower Lock to be lifted another 11.6 m (38 feet) before entering Lake St. Lawrence. This man-made lake forms the pool from which Ontario Power Generation and The New York Power Authority draw the water used in the turbines of the international Robert Moses-Robert H. Saunders power dam. The generating station has a total capacity of 2,090,000 kW.

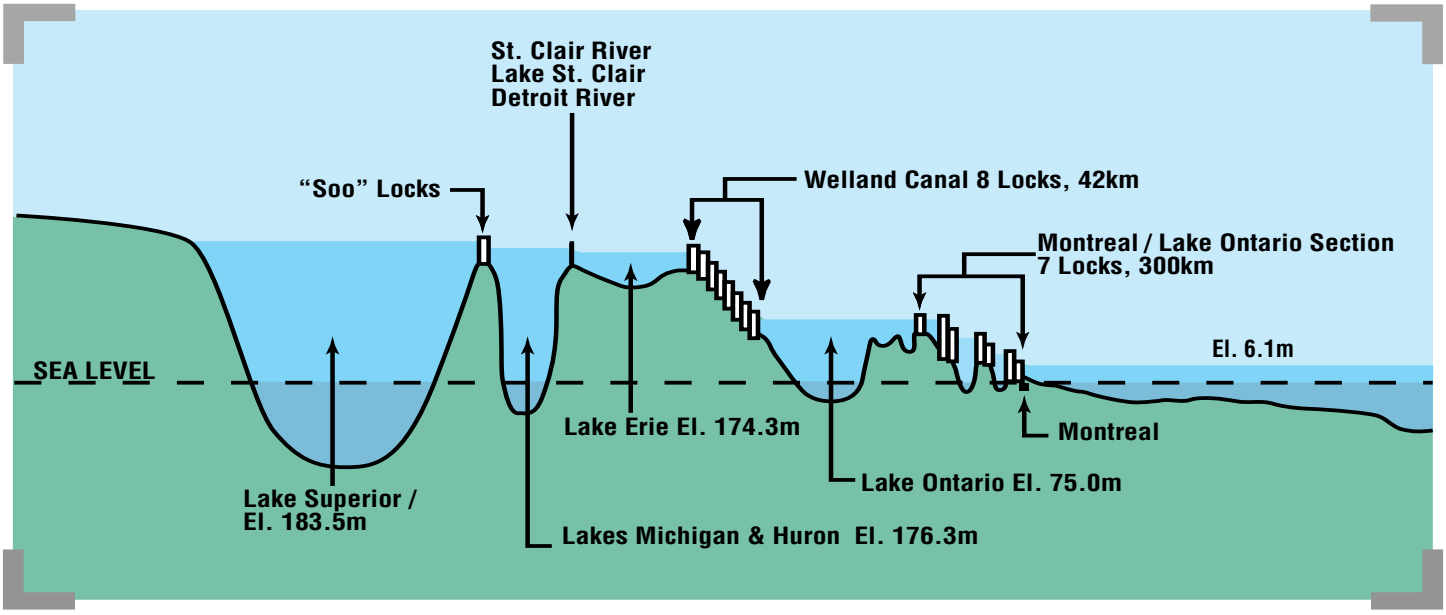
This is the last of the locks in the Montreal/Lake Ontario section of the waterway. It allows ships to bypass the Iroquois Dam and was built mainly as a control lock allowing vessels to

Iroquois Lock

adjust to the water level of Lake Ontario. Accordingly, its lift may vary between 0.6 m and 1.8 m (2 and 6 feet). After leaving this lock, ships can continue on their journey though the Great Lakes, passing the historic City of Kingston before reaching Cape Vincent, which marks the western extremity of the St. Lawrence River portion of the Seaway. At this point, western ships enter Lake Ontario. Ships can continue sailing west on Lake Ontario, gaining access to the industrial heartland of North America. Ahead lie the modern harbors of cities such as Toronto and Hamilton on Lake Ontario.

To gain access to ports on the other Great Lakes, ships sail on to Port Weller, gateway to the Welland Canal, at the southwest corner of Lake Ontario. Having transited the eight locks of the Welland Canal, ships now reach the ports of the great cities of the mid-west, including Cleveland, Toledo, Detroit, Windsor and Chicago. Finally access to Lake Superior and the Canadian Lakehead at Thunder Bay, and the U.S. Lakehead at Duluth-Superior is gained via the four American Locks (Poe, MacArthur, Sabin and Davis) at Sault Ste. Marie which are administered by the U.S. Army Corps of Engineers.

The St. Lawrence Seaway Profile View



LOCK PROCEDURE

Ships remain under their own power at all times and are each secured in the lock chamber by a crew of St. Lawrence Seaway linesmen. Once a vessel is safely moored, huge steel gates close behind it and valves are put into operation to fill or empty the lock by gravity flow. About 91 million litres (20 million gallons) of water are required and the time needed to fill a lock is approximately 9 minutes. As the new level is reached, the forward gates are opened and, at a sign from the lockcrew, a short blast of the ship whistle signals "cast off" and the vessel proceeds out of the lock. Some 32 large vessels can go through a lock on a very busy day.

SHIPS AND TRAFFIC

The locks of the Seaway can accommodate vessels 225.5 m (740 feet) long, 23.8 m (78 feet) wide and loaded to a draft not exceeding 8.08 m (26 ft. 6 in.). The large lakers which make up the inland commercial fleet bring iron ore from the Quebec Labrador mining centres to the steel mills located in the Great Lakes region. These same vessels are used to carry grain to ports along the lower St. Lawrence for transshipment aboard ocean vessels destined for European and other world ports. Other major commodities shipped through the Seaway include corn, barley, soybeans and other grains, coal, salt, stone and various mine products, fuel oil, scrap iron and steel, newsprint and a great variety of manufactured products.

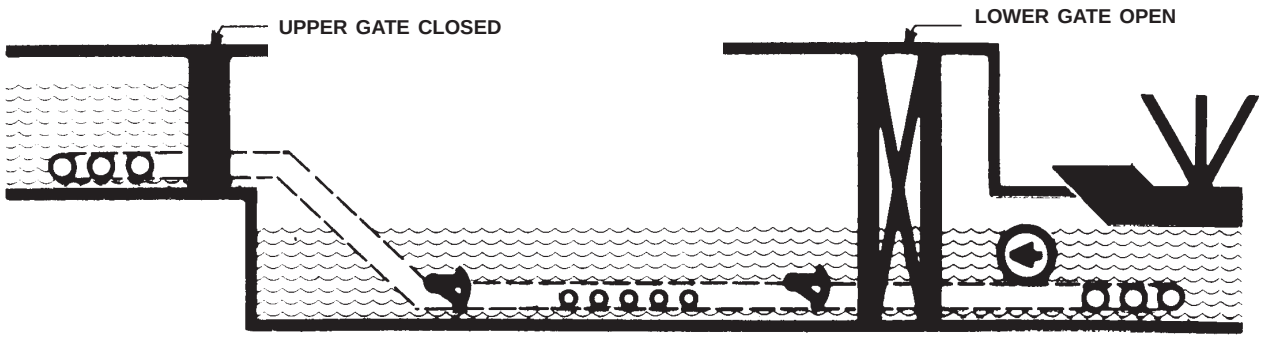
The Seaway opened the North American heartland to international shipping and vessels from all over the world now make their way to St. Lawrence and Great Lakes ports carrying the large quantities of finished products, manufactured iron and steel and general cargo imported by Canada and the United States. Return voyages can include a myriad of cargoes from the inland industrial centres.

The navigation season on the waterway now extends from late March to late December. Since the Seaway opened in 1959, new technologies against ice formation in locks and canals have been implemented and some 25 days have been added to the shipping season.

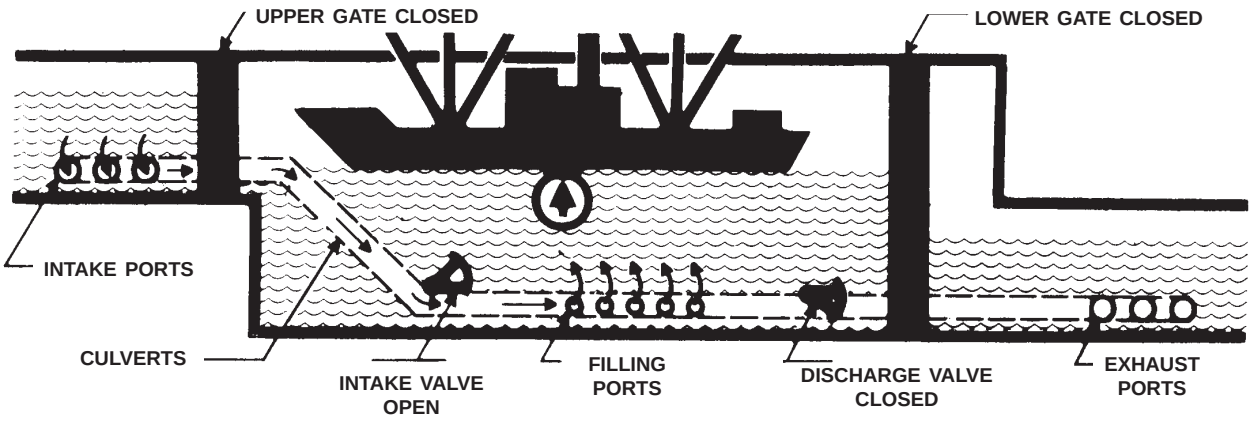
Between the opening of the Seaway in 1959 and 1983, the Seaway carried 1 billion tonnes of cargo. The rational utilization of ships which may carry one commodity upbound (such as iron ore) and a different commodity downbound (such as grain) makes the Seaway a competitive mode of transportation for a wide variety of bulk products and project cargoes. Today, handling over 4,000 ship transits per year, the Seaway carries well over 40,000,000 tonnes of cargo during a typical navigation season.

TYPICAL METHOD OF LOCKING A SHIP IN THE ST. LAWRENCE SEAWAY

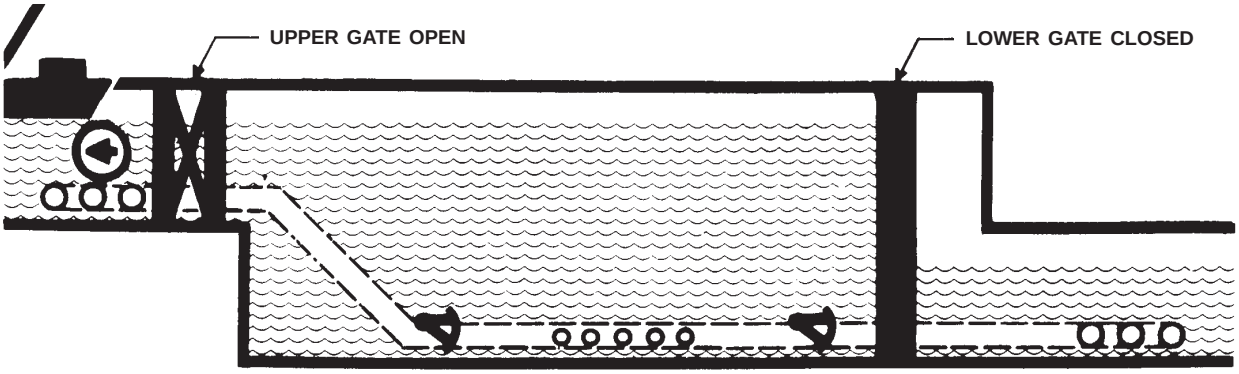
STEP 1 SHIP ENTERING



STEP 2 FILLING OF THE LOCK



STEP 3 SHIP LEAVING THE LOCK



A VITAL TRADE ROUTE

The area affected by the Seaway is larger than all of western Europe and contains nearly a third of the combined populations of Canada and the United States. The waterway has created thousands of jobs in related industries. Goods of all kinds are shipped over long distances at a reasonable cost by ships which remain the most energy-efficient mode of transportation.

Although world market conditions may result in tonnage fluctuations from year to year on the Seaway, the future viability of the waterway is ensured by the fact that it is first and foremost a bulk-cargo route strategically located along the border of two countries that are world leaders in both agriculture and mineral resources.

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