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CORPS OF ENGINEERS BUFFALO N Y BUFFALO DISTRICT
PRESERVATION AND ENHANCEMENT OF THE AMERICAN FALLS AT NIAGARA. (U)
1975

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An IJC Report
to the
Governments
of
Canada
and the
United States

Preservation and Enhancement of the American Falls at Niagara

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cont. → asked to recommend other measures which may be desirable or necessary to preserve or enhance the beauty of the American Falls and the allocation of the work and the costs of construction between the United States and Canada. The Commission was asked to bear in mind the obligations of Canada and the United States contained in the Niagara Treaty of 1950 and the mutual interests of the two countries in refraining from measures which might preserve or enhance one of the Falls to the detriment of the other.

INTERNATIONAL JOINT
COMMISSION
CANADA AND UNITED STATES



**PRESERVATION AND ENHANCEMENT
OF
THE AMERICAN FALLS**

1975

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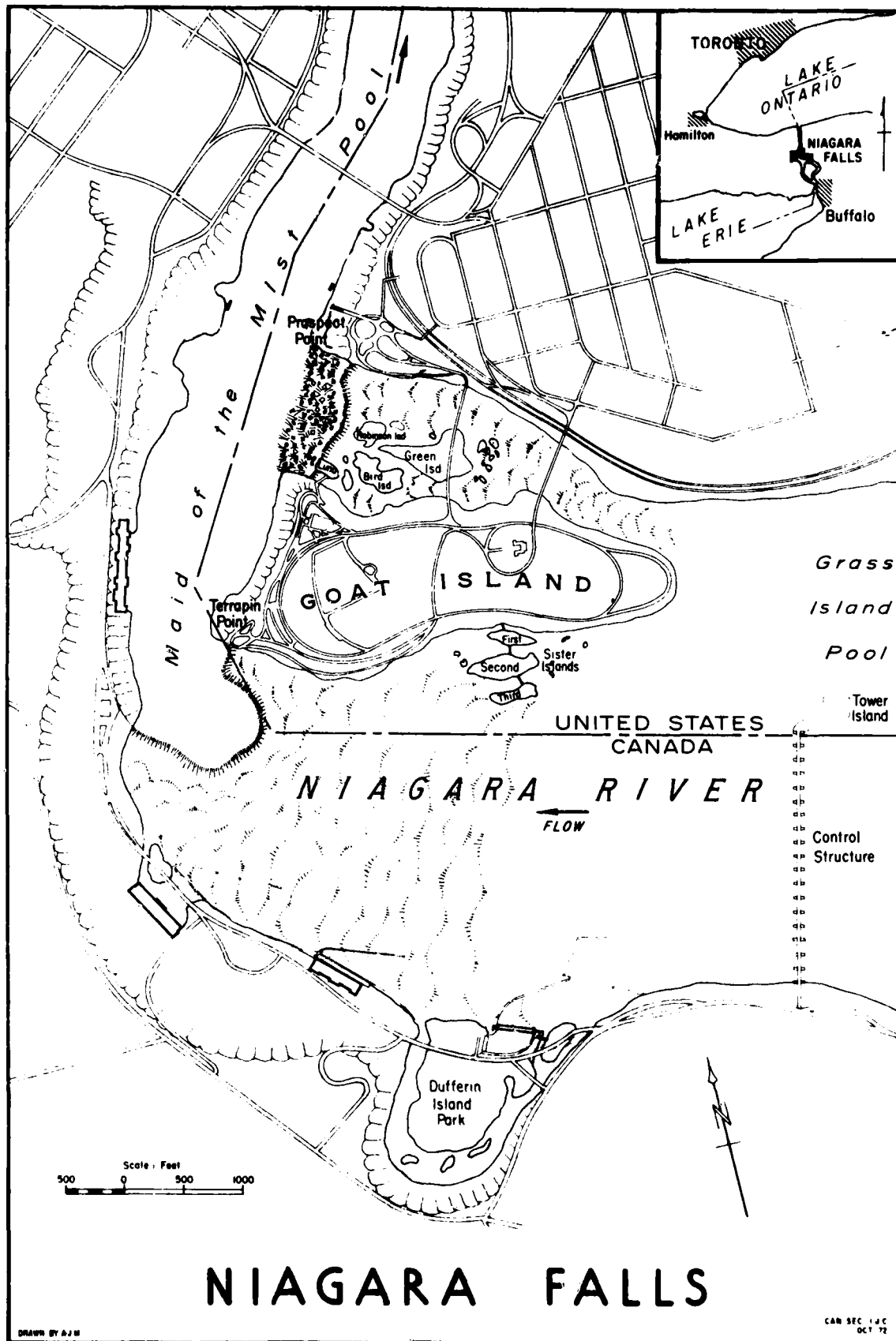
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NIAGARA FALLS

DRAWN BY B.J.M.

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Plate I

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CHAPTER I

INTRODUCTION

The Niagara Falls have long been recognized as one of the most spectacular natural phenomena in the world. They are also a symbol of international amity and cooperation between two nations sharing a vast water system. The United States and Canada as guardians of the Falls have for more than 100 years undertaken studies and taken steps to preserve their beauty. Indeed, the Governments of the United States and Canada have recognized and affirmed by treaty, first in the Boundary Waters Treaty of 1909 and later in the 1950 Niagara Treaty, a primary obligation to preserve and enhance the scenic beauty of the Niagara Falls.

In these Treaties the two Governments also recognized a common interest in developing the hydroelectric potential of the Niagara River. It is important to emphasize that the relationship between these two concerns has remained clear; both countries have committed themselves to the goal of preserving the Falls as a natural wonder of international significance, while at the same time utilizing its power for the benefit of the citizens on both sides of the Boundary.

This inquiry is a consequence of public concern that the accumulation of talus at the base of the American Falls might make their appearance less appealing. Three major rockfalls from the crest of the American Falls occurred in January 1931, July 1954 and December 1959 depositing some 130,000 cubic yards of rock at the foot of the American Falls, thus raising the height of the talus over a large part of their width. There are now about 280,000 cubic yards of talus at the base of the American Falls.

As a result of public concern, the United States Congress in 1965 authorized the Corps of Engineers to study the measures needed to preserve and enhance the beauty of the American Falls. The results of this study were made available to the Commission.

The Commission's involvement began on March 31, 1967, when the Governments of the United States and Canada, in accordance with Article IX of the Boundary Waters Treaty of 1909, requested the International Joint Commission to investigate and report on measures

necessary to preserve or enhance the beauty of the American Falls. Under such References the Commission reports to both Governments on the facts and circumstances of matters referred to it and its recommendations in no way bind either Government.

Specifically, the Commission was asked to investigate and recommend measures that are feasible and desirable to remove the talus which has collected at the base of the American Falls, and to retard or prevent future erosion. The Commission was also asked to recommend other measures which may be desirable or necessary to preserve or enhance the beauty of the American Falls and the allocation of the work and costs of construction between the United States and Canada. The Commission was asked to bear in mind the obligations of Canada and the United States contained in the Niagara Treaty of 1950 and the mutual interests of the two countries in refraining from measures which might preserve or enhance one of the Falls to the detriment of the other.

By similar letters dated October 1 and 5, 1970, the Governments of Canada and the United States requested the Commission to extend its investigation beyond the original terms of the Reference so as to include aspects of public safety at the flanks of the American Falls and at the Goat Island flank of the Horseshoe Falls. The Commission was asked to determine if the immediate areas of the American Falls and of the Goat Island flank of the Horseshoe Falls were endangered by erosion and other geological processes, and if so, what measures are feasible and desirable in order to eliminate hazards to persons, property or to the scenic beauty in the region.

The complete text of the 1967 Reference and the 1970 extension are appended to this report.

This report describes the physical setting of the Falls, the activities of the Commission and its American Falls International Board during the course of this investigation and the Commission's rationale for the conclusions and recommendations that emerged.

CHAPTER II

THE AMERICAN FALLS

The Niagara River flows north from Lake Erie to Lake Ontario for 33 miles. It forms the border between western New York State and the Niagara Peninsula of southern Ontario. The total drop in the River is 326 feet. The long term average flow of the River is 202,000 cubic feet per second (cfs). The mean monthly flows have varied from 116,000 to 274,000 cfs.

The Niagara Falls are located 19 miles downstream from Lake Erie. Goat Island divides the River into two channels. It separates Niagara Falls into the Horseshoe Falls on the Canadian side of the River and the American Falls on the United States side. The vertical drop between the crest of the Falls and the Maid-of-the-Mist Pool is 167 feet. Although far from the highest in the world, the Niagara Falls with their impressive breadth, their immense volume of water and their thundering sound provide a spectacle of awe-inspiring grandeur for over ten million visitors annually.

The American Falls have a crest length of 1100 feet. Except for some irregularities caused by rockfalls, a relatively uniform sheet of water falls over the crest. Luna Island located in the crest separates the smaller cataract, Bridal Veil Falls, from the main cataract. The water plunges about 100 feet onto the accumulated talus and then violently cascades into the Maid-of-the-Mist Pool.

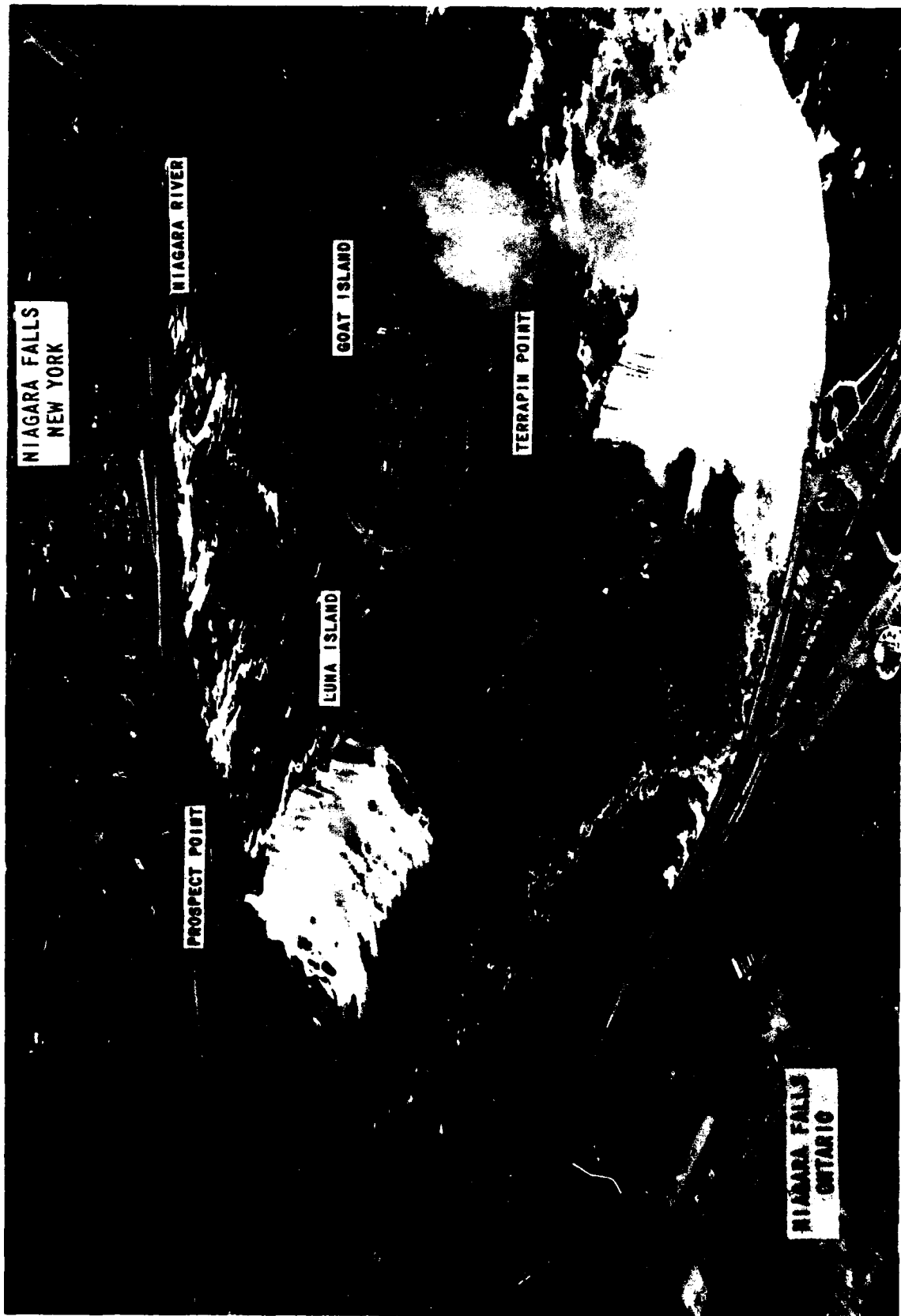
About a half-mile upstream from the Falls is an 18-gate control structure between the Canadian shore and Tower Island. The structure maintains the water levels of Grass Island Pool while permitting the diversions of water from the Pool for the power production allowed by the 1950 Niagara Treaty. The intakes to the diversion tunnels leading to the Ontario Hydro power generating plant are a third of a mile upstream from the control structure; those leading to the Power Authority of the State of New York plant are two miles upstream. The control structure also assures an average flow of 10,000 cfs into the smaller channel along the United States shoreline. The water in this channel drops fifty feet over a series of rock ledges and scattered boulders to the crest of the American Falls. Numerous islands subdivide the American Channel into several smaller channels. See Plate 2.

The attraction of the American Falls is not exclusive to the summer months. In winter the mist and spray convert the immediate area into a beautiful spectacle of ice and snow. Massive ice formations build up on the talus in front of its vertical face. An ice bridge forms in the Maid-of-the-Mist Pool. Its mass constantly changes due to the accumulation and release of ice. See Plate 3.

Originally the Falls were located at the Niagara Escarpment. They have retreated seven miles upstream through natural erosion in the last 12,000 years. This is equivalent to five feet per year. About 700 years ago the receding Falls reached and passed Goat Island, thus creating the American Falls. Since separating, the Horseshoe Falls have carved their way nearly 3,000 feet upstream, while the American Falls have receded only slightly from the gorge walls which were produced by the cutting action of the main Falls. If the recession of the Horseshoe Falls continues at the present rate, they will intercept the American Channel above Goat Island in about 2,000 years and permanently dewater the American Falls.

Erosion and rockfalls are a natural process by which slopes become more stable. The strength of the rock, the nature of the rock defects, the horizontal and hydrostatic pressures and the absence or presence of a talus buttress, all affect the stability of a cliff. The top layer of the bedrock at the American Falls is composed of hard, erosion-resistant Lockport dolomite, about 80 feet thick. Beneath this cap rock is approximately 60 feet of softer Rochester shale. This is underlain by various interbedded layers of limestones, dolomites, sandstones and shales. The enormous force of falling water erodes the softer, less resistant shales and sandstones beneath, thus undermining the dolomite cap rock on the crest. Ultimately the cap rock and shale may fail together, or the cap rock itself may fail when undermined. See Plate 4.

The flow at the Horseshoe Falls has been sufficient to scour out a basin about 200 feet beneath the water surface at its base. The fallen rock is abraded into particles and transported downstream. This process prevents any visible talus accumulation. Conversely,



NIAGARA FALLS
NEW YORK

NIAGARA RIVER

GOAT ISLAND

TERRAPIN POINT

LUNA ISLAND

PROSPECT POINT

NIAGARA FALLS
ONTARIO

Plate 2 Aerial View of Niagara Falls

the flow at the American Falls is not sufficient to abrade and transport much of the talus accumulation or to erode the rock ledges at its base.

The talus at the base of the American Falls will change very slowly since the larger blocks are composed of durable Lockport dolomite. The softer shales have been eroded and transported downstream. The talus extends upward to at least the base of the Lockport cap rock, providing some protection to the vertical rock face. It is not certain whether this process will continue until the American Falls become entirely a cascade or whether the pile of talus will slow down the process of natural erosion.

After a thorough investigation Canada and the United States in the Niagara Treaty of 1950 agreed to reserve sufficient amounts of water for flow over the Niagara Falls to preserve their scenic value. The Treaty provided for a total minimum flow of 100,000 cfs over the Horseshoe and American Falls during the daylight hours of the tourist season, and a minimum flow of 50,000 cfs at all other times. All water in excess of Treaty requirements is available for the generation of electric power.

The twin cities of Niagara Falls, New York with a population of 86,000 and Niagara Falls, Ontario with a population of 67,000 are situated on either side of the Niagara Falls. Their growth is due to the development of hydroelectric power and the desire of the public to view the beauty of the Falls. Ontario Hydro and the Power Authority of New York State have built a large hydroelectric complex that utilizes most of the flow of the Niagara River in excess of the water reserved for scenic purposes by Treaty. The industries in both cities are mainly oriented toward electrochemical and electrometallurgical processes. Tourism and its associated commercialism are a substantial economic benefit to the residents of the area. Over 75 million people live within 300 miles of Niagara Falls; mostly in large metropolitan areas.

In recognition of the importance of the Falls as a great public resource, the Province of Ontario and the State of New York retained or acquired title to adjacent lands and converted them into two park systems. The Niagara Frontier State Parks and Recreation Commission administers all activities within the New York State Niagara Reservation. The Niagara Reservation occupies 139 acres of mainland and island property.



Plate 3 Winter Scene of the American Falls

SCHEMATIC PROFILE OF AMERICAN FALLS

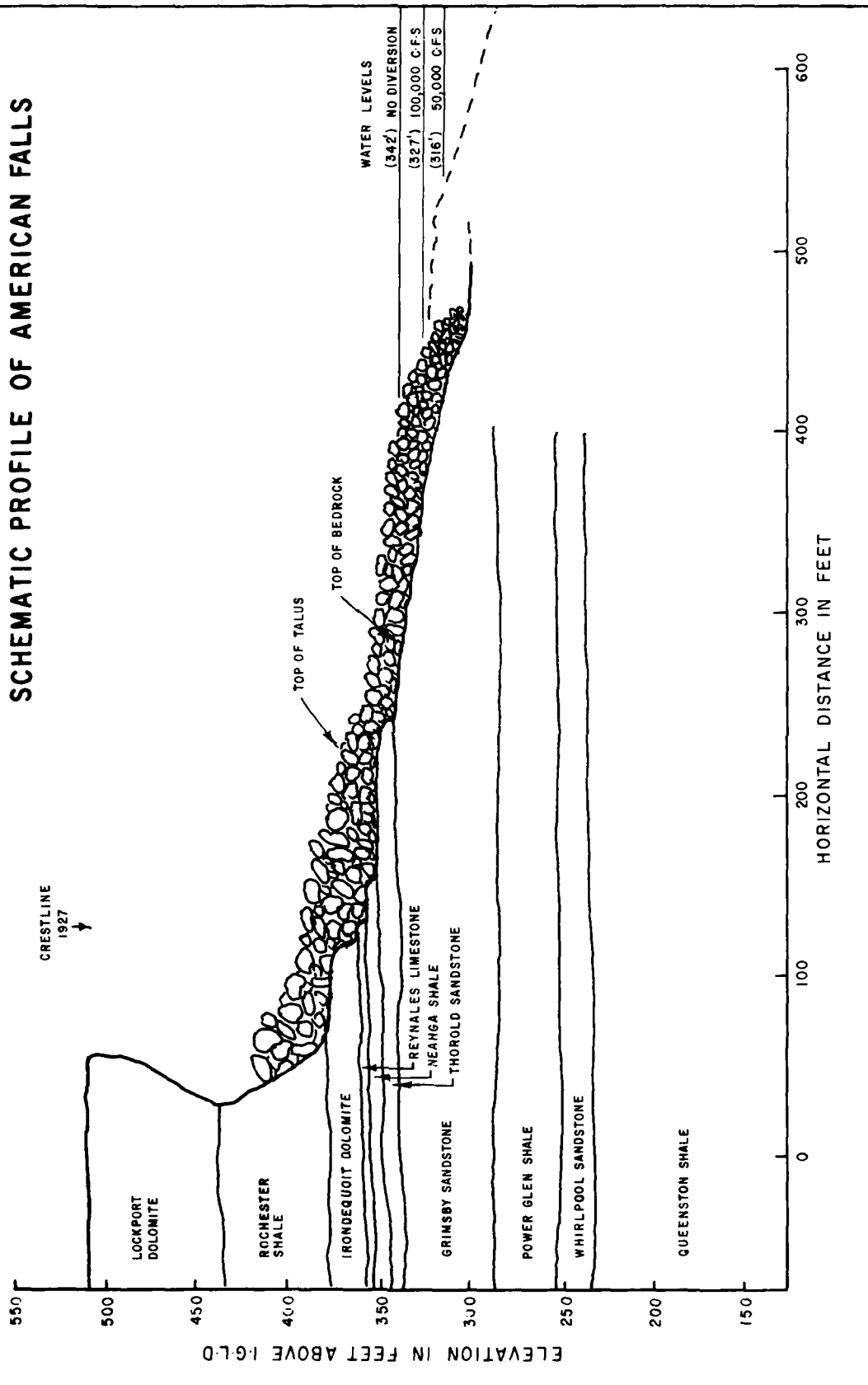


Plate 4

It includes the northern flank of the American Falls, the mainland adjacent to the Rapids above the Falls, Goat Island and the smaller islands. In addition there is the Robert Moses Parkway which consists of a State throughway and a narrow strip of parkland along part of the shoreline of the River.

Seven vantage points within the Niagara Reservation provide close-up oblique views of the two Falls. Two areas are on Prospect Point, one on Luna Island and four on Goat Island. These include a pathway and stone steps from the foot of the Observation Tower to the talus under Prospect Point and a series of wooden

catwalks from the base of the Goat Island flank to the talus below the Bridal Veil Falls.

In Ontario the Niagara Parks Commission administers Queen Victoria Park and the entire Chain Reserve. They extend along the total length of the Niagara River and encompass 3,000 acres. The Table Rock Scenic Tunnels and the Maid-of-the-Mist boat tour permit a close-up view of the Horseshoe Falls. A walkway along the top of the Gorge provides a frontal and panoramic view of the American and Horseshoe Falls.

CHAPTER III

THE COMMISSION'S INQUIRY

After receiving the Reference from the two Governments, the Commission in August 1967 established the American Falls International Board to undertake the necessary technical investigations and to advise the Commission on all matters it would have to consider in responding to the Reference. The Board was composed of persons from the United States Army Corps of Engineers and Environment Canada and an eminent landscape architect from each country. It was the Commission's view that a board of this composition would provide the necessary expertise and perspectives required to give proper consideration to the complex nature of the questions raised in the Reference from the two Governments. On October 6, 1967 the Commission issued a directive to the Board outlining its responsibilities.

Initial public hearings were held by the Commission on October 24, 1967 in Niagara Falls, New York and the next day in Niagara Falls, Ontario. The purpose of these hearings was to obtain the views of interested public and private interests regarding the future of the American Falls and thereby assist the Commission and the Board in planning the necessary studies. The substance of these hearings is discussed in Chapter V.

On November 6, 1967 the Commission, on the advice of its Board, recommended to both Governments that the American Falls be temporarily dewatered so that the study could proceed in a timely and thorough manner. At the same time the Commission reported that the two Power Entities had suggested that they could use the water which normally flows over the American Falls for power production. The Governments agreed with the Commission and, on March 21, 1969, implemented the recommendations by an exchange of notes.

This additional water, diverted for the production of power, provided benefits to the Power Entities and at the same time generated funds which were used for the investigation. It is important to note that the procedure also permitted the natural flow to be continued through

the Niagara River thereby causing no change in the levels or flows of boundary waters except a minor change in the level of the Maid-of-the-Mist Pool.

On October 30, 1968 the Commission recommended to the two Governments that it be authorized to undertake a broad environmental study of the Niagara area, to be part of the studies under the 1967 Reference. The Governments have not formally responded to the Commission's request.

The dewatering program described above took place from June to November 1969. The study undertaken during that time revealed areas of questionable stability, particularly in the vicinity of Prospect Point. In the Spring of 1970 inspections showed that the cracks in the pavement at Luna Island were caused by rock movement. In addition new cracks and soil displacement took place at Terrapin Point adjacent to the Horseshoe Falls. The Commission informed the Governments of these findings by letter on August 14, 1970 and in October of the same year the Governments extended the 1967 Reference to include public safety.

In November 1970 the Board submitted to the Commission a report entitled "Intrusions of Views of Niagara Falls" which reviewed the existing situation and drew attention to the proposals for high-rise buildings which would constitute further intrusions. The commission endorsed this report and forwarded it to the two Governments in January of the next year. In November 1971 the Commission again addressed itself to this matter and urged the Federal, State and Provincial Governments to take appropriate action to assure that authority for such building developments be withheld until all the implications of such private intrusions on the Falls scene had been thoroughly studied.

The Commission visited the American Falls four times during the course of the inquiry to see the Falls under both winter and summer conditions. The Commission inspected the Falls while they were dewatered. It also observed five distinct talus arrangements on the working model of the American Falls. On both these

occasions a detailed briefing was presented by the Board.

In order to receive public comment on the Board's interim report the Commission held a public hearing in Niagara Falls, New York on March 24, 1972. Similarly, a public hearing on March 4, 1975 was conducted by the Commission to obtain comment on the Board's final report. The substance of these hearings is discussed in Chapter V.

The Commission at this time wishes to acknowledge with gratitude the valuable assistance of those persons who served on the Board, their committees and those who otherwise participated in the investigation, and of the agencies and departments whose cooperation made their participation possible. The membership of the Board, the Working Committee and the participating agencies is appended.

CHAPTER IV

THE BOARD'S INVESTIGATION

The American Falls International Board's comprehensive investigation focused on the aesthetic aspects of the American Falls and the safety of the public viewing areas. It included extensive geologic and hydraulic studies as well as thorough feasibility and cost studies of remedial measures such as stabilization of the rock structure and talus removal. The Board, with the Commission's approval, formed a working committee composed of engineers and landscape architects.

During the course of the study the Board submitted two reports to the Commission. The report of November 1970 entitled "Intrusions on the Views of Niagara Falls" dealt with the increasing threat to the integrity of the spectacle from visible intrusions such as high-rise structures and recommended *international and domestic* controls. The Board's Interim Report of December 1971 described the results of the investigations up to that time. In addition the Board submitted 16 progress reports to the Commission.

The completion of the Board's investigation was delayed by insufficient United States funding during the course of the study. Also, the long period required for the exchange of notes and subsequent approval for authority to dewater the American Channel and use the diverted water for power generation delayed the geological field work in the Channel.

The cofferdam was completed on June 12, 1969. The Board took special measures so that the dewatering would not have a lasting detrimental effect on aquatic life in the American Falls Channel. The terrestrial vegetation on the small islands in the Channel was protected and irrigated. The Rochester shale on the face of the American Falls was kept wet by sprinklers. Precautions were taken to protect the viewing public and the workers while the Channel was dewatered. The cofferdam was removed on November 25, 1969. The area did not suffer any irreparable ecological damage, and was still aesthetically pleasing. See Plate 5.

While the American Falls were dewatered the Board undertook a detailed geologic exploration. It included

46 core borings for a total of 4,882 feet, pressure and tracer testing on the completed holes, face mapping which included topographic, stratigraphic and structural studies, terrestrial photogrammetry of the face of the American Falls, mapping of rock fractures and joints, installation of piezometers to measure water pressure in rock joints, and the installation of instruments to measure horizontal movement in the adjacent rock mass. The massive amount of field data collected was compiled, analyzed, correlated and mapped to determine the stratigraphy, structure, ground water conditions, modes of rock failure and rock stability.

The talus studies consisted of an examination of the cobbles and boulders to determine their size, rock type and condition. The talus blocks were photographed and mapped. A seismic survey was made to ascertain the depth of the talus. They found that the talus accumulation is underlain by ledges of bedrock which are up to 65 feet above the water level in the Maid-of-the-Mist Pool. The Board examined in detail the methods of removing all or part of the talus, estimated the cost and time required for a number of alternatives. All costs were based on December 1973 price levels.

In April of 1970 cracks appeared in the asphalt pavement on Luna Island. A report prepared by the U.S. Corps of Engineers concluded that the rupture in the overburden and rock fractures represented the initial phases of a slope failure. It also concluded that failure resulted from the removal of the rock overhang at Luna and Goat Islands; not from the dewatering of the American Falls or the exploration activities.

The Commission approved the Board's plan to extend geological investigation to include the dry flank areas adjacent to the American Falls. As a result of serious concern about possible rockfalls that could endanger the public, the original Reference was extended by the two Governments to cover public safety on the Goat Island flank of the Horseshoe Falls and in the vicinity of the American Falls. The Board installed a safety warning system to ensure timely evacu-



Plate 5 American Falls Dewatered

ation in areas of possible rock failures. The detailed geological investigation was expanded to include these areas.

The Board investigated a wide range of alternative safety measures. These included further instrumentation to detect possible rock movement, relocation of railings in the viewing areas, cantilevered viewing areas, mass rock stabilization, scaling of loose and fractured rock, the installation of rock bolts, relocation of walkways and observation decks, and closing the lower viewing areas. Each alternative was evaluated with respect to improved safety, viewing, appearance, the degree of flexibility and reversibility, and the effect on tourism and costs.

The Board found that realignment of the railings at the viewing areas on Prospect Point, Goat Island and Terrapin Point would increase the visitors' safety from moderate size failures. This would permit close-up viewing from Prospect Point and Goat Island, but not from Terrapin Point. Short of excluding the public from the lower viewing areas, surface stabilization at Prospect Point and Goat Island combined with relocating existing walkways would provide maximum safety for visitors.

In order to evaluate the numerous possibilities of preserving or enhancing the beauty of the American Falls, the Board formed a committee consisting of four landscape architects. Their assignment was to choose a permanent arrangement of talus that would have the most dramatic effect. The possibilities ranged from virtually total talus removal to no removal at all. The Committee also investigated measures to increase the water level of the Maid-of-the-Mist Pool, and increase the flow over the American Falls. It was found necessary to consider the interrelated combinations from the different viewing positions; the oblique views from the Goat Island and Prospect Point flanks and the frontal view from the Canadian side of the Gorge.

While the American Falls were dewatered the talus and the face of the Falls were inspected and photographed to gain an appreciation of their scale and character. The talus was mapped, boulders were measured and the contours of the bedrock determined. The talus depth ranged from 25 to 50 feet.

All this information was used to construct a realistic model of the American Falls at a scale of 1/50th of its actual size. The model included most of the channel above the Falls and a portion of the Maid-of-the-Mist Pool. The talus blocks were fabricated so as to permit partial or total removal. The turbulence, mist, illumination and volume of water were closely duplicated.

The model, built by Ontario Hydro at their laboratory in Islington, Ontario, accurately simulated numerous talus arrangements and proved to be an essential tool in appraising their appearance. The oblique and

frontal views reproduced by the model were carefully evaluated and photographed.

A survey of the Maid-of-the-Mist Pool and the River downstream to the Whirlpool was undertaken to map the underwater topography. This information was used to locate possible sites for a control structure, areas for the disposal of talus and a suitable site for rating the Ashland Avenue gauge.

The Board investigated three methods that could be used to remove the talus. They were a cableway system between Canada and the United States, large cranes on and below the crest of the Falls, and a large rock crusher in conjunction with a portable conveyor. The talus disposal would be either in the deep portion of the Maid-of-the-Mist Pool or on land away from the Falls. The Board found that the most practicable way of removing a significant amount of talus was a cableway with land disposal.

The Board considered the significance of the water levels of the Maid-of-the-Mist Pool as they affect the appearance of the talus at the base of the American Falls and shoreline of the Pool. They found that it was possible to build a submerged weir in the lower Niagara River to raise the water level to levels that existed prior to the diversion of water for hydroelectric power under the 1950 Niagara Treaty. The estimated cost of the control structure was approximately 12 million dollars. The ice behaviour in the Pool was observed for three winters to ascertain the potential for ice jams. Unfortunately, the winters were not representative of extreme conditions that can be expected.

In cooperation with the International Niagara Board of Control, the flow over the American Falls was reduced to 8,000 cfs and then increased to 15,000 cfs. The Board noted that increased volume enriched the appearance of the American Falls. However, it could impair the appearance of the Cascades and the Horseshoe Falls when the total flow of the Niagara Falls is reduced to 50,000 cfs. The Board found it would be feasible to excavate the American Channel at the upstream end of Goat Island and install a gated control structure to maintain the current distribution of flows when the total flow over both Falls is reduced to 50,000 cfs. Such construction would cost 8.3 million dollars and require dewatering the American Falls for one season.

Public opinion was considered to be extremely relevant throughout all phases of the Board's investigation. Two public displays, describing the Falls and the Board's activities, were erected in the vicinity of the Falls in each country. They were popular and educational attractions. The dewatering program received national and international coverage. Over 50 magazines

requested and were furnished with material for articles. Press coverage was continuous. For example, news representatives were briefed and given a demonstration of the model of the American Falls. The subsequent news coverage was factual and extensive.

The Board was concerned with the limited reaction obtained at the March 1972 Public Hearing, conducted by the Commission on the Board's Interim Report. In an endeavour to obtain a greater public reaction to its proposals, the Board distributed 220,000 brochures based on the aesthetic appendix of the Interim Report. Attached was a questionnaire on a prepaid postcard. The brochure received extensive coverage in the mass media. This publicity generated 70,000 replies; the prepaid postcards 5,000.

The Board also brought together fifteen prominent environmental planners and landscape architects for a two-day seminar in June 1973. The group, after seeing the area firsthand and hearing presentations, discussed the aesthetic aspects and the appearance of the Falls. The seminar produced a remarkable unanimity of opi-

nion. The participants were positive in the rejection of changing the natural appearance of the Falls and equally expressive in their concern about the commercial appearance of Niagara Falls, New York and Niagara Falls, Ontario and further intrusions on the skyline.

Throughout the investigation the Board repeatedly and formally expressed their concern about the immediate environment of the Falls, the urban development, the viewing places and traffic conditions.

The American Falls International Board submitted their final report with seven appendices to the *International Joint Commission* late in 1974. Their final report is a comprehensive discussion of the investigation, findings and conclusions on the preservation and enhancement of the American Falls at Niagara. The report is supported by detailed appendices on aesthetics, geology and rock mechanics, hydraulics, safety and appearance options, public involvement, environmental considerations and documents related to the investigations.

CHAPTER V

PUBLIC HEARINGS

Six months after receipt of the Reference from the Governments of the United States and Canada, the Commission held initial hearings in Niagara Falls, New York on October 24, 1967 and the next day in Niagara Falls, Ontario. The purpose of these hearings was to provide convenient opportunity for all persons and organizations, public and private, to express their views on the questions raised in the Reference and to convey relevant information to the Commission.

All witnesses at the initial hearings agreed that the study referred to the Commission was needed. Most stated or implied that they favoured remedial works or other measures to preserve and restore the beauty of the American Falls. At these hearings the temporary dewatering of the Falls to facilitate the necessary investigations was discussed. The prospect of this temporary dewatering was viewed by several witnesses as a potential and unique tourist attraction. Twenty-one submissions were made at these two hearings and two were subsequently received.

In March 1972, following publication and distribution of the Board's Interim Report, the Commission held a public hearing in Niagara Falls, New York. The purpose of the hearing was to provide an opportunity for all parties interested in the American Falls to comment on the studies to date and to make suggestions for topics to be considered in the remainder of the study. Only seven submissions were made at this hearing; three were subsequently received.

The topics suggested included the undesirability of dewatering the American Falls during seasons of freeze or thaw, the possible abandonment of the Ontario Power Plant which is beside the Maid-of-the-Mist Pool, the winter scene as a reason for leaving the talus as it is, the aesthetic aspects of pollution, and the possibility of increasing the flow over the American Falls.

After the Board submitted its final report to the Commission, a public hearing was conducted by the Commission in Niagara Falls, New York on March 4, 1975. The purpose of this hearing was to afford opportunity for all interested individuals, organizations, and governmental agencies to comment on the Board's report and to offer related information which the Commission could consider in developing its own report to the two Governments. Eleven submissions were made

at the hearing; eight were forwarded at a later date.

While a few of the witnesses felt that some of the talus should be removed from the foot of the American Falls, most indicated that it should remain. The witnesses were almost unanimous in agreeing with the Board that the Falls should not be artificially stabilized but rather that the natural process should continue uninterrupted.

With respect to the safety aspects of the report, all witnesses who addressed the question felt strongly that measures should be undertaken to protect the safety of the viewing public. A statement on behalf of the State of New York Parks Commission indicated that it was satisfied that the safety program recommended by the Board offered adequate viewer protection.

The Commission also received considerable testimony from the Director of Planning for the City of Niagara Falls, New York that due recognition was being given by the city to the problem of aesthetics in the development of plans for urban development.

In accordance with the Commission's Rules of Procedure, notices of all four public hearings were published in the Canada Gazette and the United States Federal Register and in newspapers in each country. Notices were also mailed to a great number of individuals and associations, the mass media, governmental agencies and elected representatives in the region.

Statements were made by elected representatives from both countries, officials from governmental agencies, state and provincial organizations, business and concerned individuals. All those interested were given opportunity to express their views orally or to present documentary evidence. The names of those who testified at the hearings or submitted statements are set out in the Appendix. In all, 52 submissions were presented. Given the widespread interest in both countries in the preservation of the Falls, the number of participants at the public hearings was a disappointment to the Commission.

Verbatim transcripts of all hearings and all written submissions made at or subsequent to the hearings are on file and available for examination at the offices of the Commission in Ottawa and Washington.

CHAPTER VI

THE COMMISSION'S CONSIDERATIONS AND CONCLUSIONS

During the Commission's deliberations on the preservation and enhancement of the beauty of the American Falls it has considered all of the reports by the Board,

the written and oral testimony received at and subsequent to the public hearings, and supplementary information obtained from various sources.

ALTERNATIVES FOR THE APPEARANCE OF THE AMERICAN FALLS

Throughout this inquiry the Commission has been faced with the basic question of whether it is desirable to remove the accumulated talus and to stabilize the American Falls by artificial measures or to allow the natural geologic process to continue. These are essentially questions of accepting or interfering with the natural process of change.

The Falls are one of the most significant natural phenomena in the world. They serve as a constant

reminder of man's relationship with his environment. Indeed, this is the very essence of their attractiveness. The International Joint Commission believes that this basic characteristic of the American Falls should be maintained and that man should not interfere with the natural process. This is the fundamental conclusion of this report and the basic premise which guided the Commission in its consideration of alternatives for the appearance of the Falls.

TALUS REMOVAL

Because of the accumulated talus, the American Falls are now half waterfall and half cascade, in contrast to the clear plunge of the Horseshoe Falls. Removal of all or part of the talus would restore the Falls to an earlier form and would increase the symmetry between the two Falls. A working model was constructed to ascertain if talus removal would enhance the beauty of the American Falls. The model created a realistic perception of different talus arrangements and facilitated the qualitative and objective evaluation of the appearance and beauty of each arrangement.

The talus arrangements considered in detail included: no removal; minimum removal recreating a condition that existed prior to the 1931 rockfall; removal of talus so that the water could fall directly on the uppermost shelf of bedrock creating the maximum freefall; removal

of a substantial amount of talus so as to expose the stepped bedrock strata down to the Pool level, but leaving talus piles to protect both flanks; and the removal of all talus. Plate 6 is a photograph of the working model showing the American Falls as they are at present without any talus removed. Plate 7 shows all talus removed from the central two-thirds of the bedrock, flanked by considerable width of remaining talus.

If deemed desirable, the talus could be removed by a cableway and transported to a disposal site at a cost of one to fifteen million dollars over a period of one or two seasons, the specific time and cost being dependent on the amount to be removed.

The Commission recognizes that talus removal is a subjective matter. Whether such removal would add to



Plate 6 Model of the American Falls Showing Present Talus Arrangement

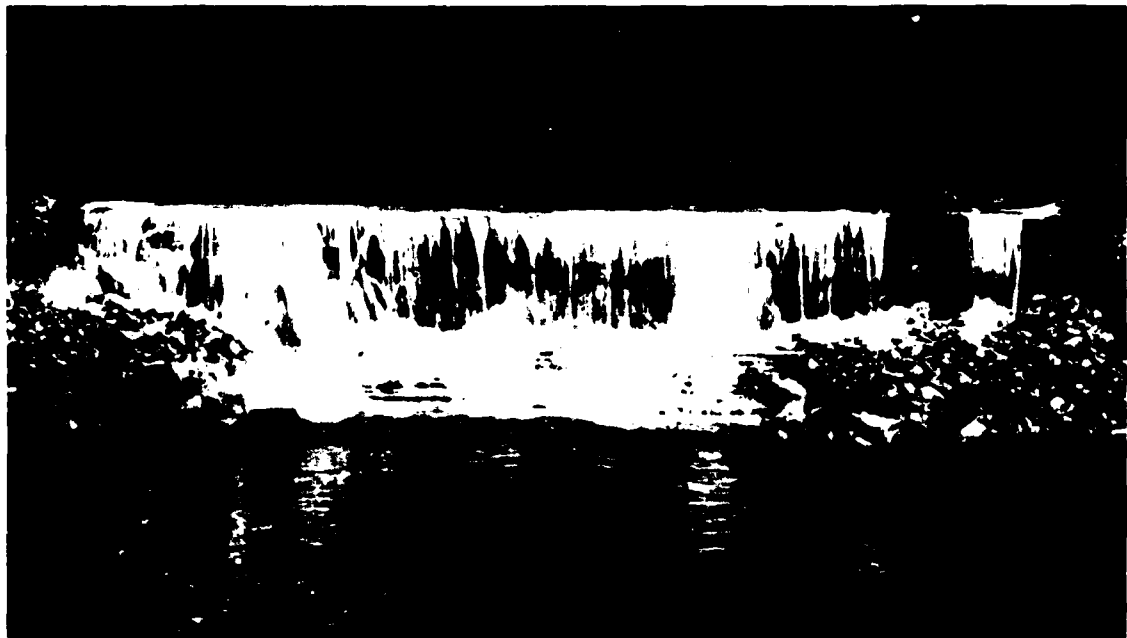


Plate 7 Model of the American Falls Showing Substantial Talus Removal

or detract from the beauty of the spectacle is a matter of considerable conjecture. For example, arguments are made that the removal of talus could improve the overall view without offence to the process philosophy. Without crest stabilization the process would continue and with the talus removed the higher waterfall and the opening up of a visible expanse of water cascading into the pool should give a dramatic impact to the scene. On the other hand, many believe that the present appearance of the American Falls is majestic and exceedingly beautiful and that man can do nothing to add to their natural beauty.

In addition, the removal of talus will expedite the erosion process whereas the present piles of talus will slow down the natural process and maintain the American Falls in essentially the same condition as now exists. Furthermore, talus removal is irreversible and costly. It could take up to 500 years for the talus to

MASS ROCK STABILIZATION

Preserving the American Falls in their present state would require stabilization of the rock masses. This could be achieved by post tensioning the face and flanks of the Falls by cables to hold the rock in place. Drainage tunnels behind the crest and gorge wall would be necessary to relieve hydrostatic pressures.

Stabilization of the crest and adjacent flanks could be accomplished through structural means by a two-year construction program at an estimated cost of 26

SCENIC ENVIRONMENT

Consideration of the preservation and enhancement of the beauty of the American Falls cannot be limited to their physical aspects. The appeal and fascination of the Falls mean different things to different people. Their beauty is in the eye, the mind and the heart of the beholder.

The American Falls are not in an isolated vacuum. Enhancement of the beauty of the American Falls is as dependent on the environment of the total scene as it is on the appearance of an immense volume of water plunging over the crest and violently cascading over the massive blocks of talus. Nearly one hundred years ago the Governments of New York and Ontario acknowledged their responsibility for protecting the scenic environment of Niagara Falls. Parks Commissions in both countries were established to roll back the sordid conditions caused by the commercial and industrial encroachments that concealed the natural grandeur of

build up to its present proportions. Talus removal would also change the majestic winter appearance of ice that now builds up on the huge blocks of rock.

The Commission concludes that while it is technically feasible to remove the talus which has collected at the base of the American Falls, it is not desirable to do so at the present time.

The Commission believes, however, that this question could be appropriately re-examined after a study of the overall environment with a view to enhancement of the public enjoyment of the total Niagara Falls scene. Talus removal, if it then seems desirable, could be given proper priority along with other desirable improvements, in the expenditure of available public funds. The question of talus removal may also receive public attention in the event of future major rockfalls.

million dollars. Such a program would disrupt the local scene and would create, on a grand scale, an artificial waterfall in a formal park. It would interfere with the geologic process and would be contrary to the recent emphasis on environmental values.

The Commission concludes that, while structural solutions are available to arrest erosion at the crest of the American Falls, the Falls should not be stabilized by artificial means.

Niagara at that time. Within their narrow boundaries the two Parks Commissions have created a splendid setting for the unique beauty of the Falls.

The integrity of the Niagara Falls scene is now threatened by the intrusion of viewing towers, high-rise buildings and commercial features. The protective park-belt at ground level is no longer an effective method of achieving the original purpose of the Parks. If unchecked, the steady build-up of new construction on the skyline will result in an artificial encirclement that will overshadow and stifle the magnificence of the Falls.

The intrusions erected in one country degrade the appearance of the Falls as seen from the other country. The mistakes made on one side of the International Boundary are a blight on the panoramic view seen from the other country. Both this Commission and its American Falls International Board have consistently ex-

pressed deep concern over the proposed developments in each country that would intrude upon the framework and setting of the Falls and destroy their magnificence.

Since preserving the integrity of the Niagara Falls scene is of mutual interest to both countries, it is desirable to establish an international consultative body to set general guidelines for development which could be used by existing agencies in both countries. The purpose of the guidelines would be to encourage moderation on changes to existing buildings and to prevent the appearance of future intrusions on the skylines.

In addition, the capacity of the Niagara Falls area to accommodate visitors is essential. The overall environmental objective should be to eliminate as much as possible the individual's legitimate concern over easy access and egress, traffic difficulties and the problem of getting suitable meals and accommodation. These conditions become more acute with increasing visitor attendance and the size of the crowds. The Commission considers that this broader social aspect of the environmental conditions created by and for the viewing public should, like the intrusions on the views of Niagara Falls, be the subject of an international study. Niagara Falls is a prime example of an international resource for the enjoyment and use of the citizens of both Canada and the United States and should be dealt with accordingly.

The proposed study would develop general policies for the future protection and development of the area, strengthen existing international collaboration, and investigate measures to provide a better interpretation of the Falls scene for visitors.

The Commission is fully aware of the difficulties inherent in the development of coordinated action by the many parallel levels of government in the Niagara Falls area. The Commission believes that the proposed study will assist in achieving this goal.

The Commission concludes that a broad environmental study should be jointly carried out by Canada and the United States to identify and give priority to those measures which would best enhance the total setting and beauty of the Niagara Falls area.

The Commission also considered two other measures to preserve and enhance the beauty of the American Falls: increasing the flow over the American Falls; and raising the Maid-of-the-Mist Pool to the levels which existed prior to the 1950 Niagara Treaty.

Increasing the volume of water over the American Falls would create a deeper and more turbulent flow over the cliff face and talus slope. An enriched appearance was observed both on the working model and during a demonstration of increasing the diversion into the American Falls Channel. There was no discernible impairment in the appearance of the Horseshoe Falls or the Cascades when the total flow over the two Falls was 100,000 cfs. However, there could be a noticeable detrimental effect on the appearance of Horseshoe Falls and the Cascades when the total flow over both Falls is reduced to 50,000 cfs. Dredging and a control structure would be required.

Restoring the level of the Maid-of-the-Mist Pool to a former condition would submerge about one-third of the present talus slope. A control structure in the Niagara Gorge would be required to raise the water level about 15 feet when 100,000 cfs is flowing over the two Falls and 25 feet when the total flow is 50,000 cfs. The Commission is concerned that the structure would have adverse effects on ice flow through the Pool, on the formation and break-up of the scenic ice bridge, and on the appearance of the Gorge. These possible adverse effects coupled with the cost of the control structure outweigh the benefits that might be achieved.

ALTERNATIVES FOR PUBLIC SAFETY

The Commission believes that a problem of public safety exists in the immediate areas of the American Falls and in the Goat Island flank of the Horseshoe Falls. Evidence developed in the course of the inquiry suggested that the problem was so urgent that steps were taken to restrict entry to several viewing areas. Some safety warning systems were installed to permit

timely evacuation in the event of significant rock movement.

The Commission rejects the concept of massive works at Niagara Falls. While such works might very well be appropriate to other problems in other areas, their construction at the Falls would be contrary to the philo-

sophy of allowing the natural evolution of the Falls to continue, through the process of erosion. In addition, the cost of such works would be prohibitive and they would create future environmental problems as the Gorge wall deteriorates, leaving the unsightly evidence of the works.

The history of the American Falls indicates that the major rockfalls occur at the crests. Rockfalls at the flanks have been small in comparison with the crest failures. However, available records indicate that four rockfalls have resulted in injury and death. In 1907 a man was struck on the head and seriously injured while standing near the Cave-of-the-Winds walk at the base of Luna Island. In 1917 a rockfall near the Whirlpool Rapids Bridge pushed a car from the Gorge Trolley Lines into the River, killing several tourists. A second mishap at the Cave-of-the-Winds in 1972 killed two people and injured three others. A major rockfall in 1956 above Schoellkopf Power Plant destroyed much of the plant, resulted in the death of one plant operator and led to the abandonment of the plant. Also, in May 1967 one hundred tons of soil and rock fell from the cliff at Prospect Point. Some of the material landed on the Souvenir building below, but no injuries resulted.

The Commission believes that the frequency and severity of such accidents could be reduced by the program suggested by the Board. The program includes: new railing alignments in the upper viewing areas; an expanded safety warning system; surface stabilization; and relocation of lower footpaths. While the Commission recognizes that such improvements would not provide absolute protection against sudden rock or soil failure, it believes that they would provide a safer environment for visitors viewing the Falls while not significantly interfering with their enjoyment of the view or requiring massive works.

The Commission fully appreciates that the responsi-

bility for visitor safety rests with Park Authorities of the State of New York. Testimony at the public hearing in March 1975 by the Regional Administrator of the New York State Park Commission indicated that the Park Authorities are satisfied that the suggested safety program offers adequate viewer protection.

The safety program would cost an estimated 2.8 million dollars and take one year to complete. It is important to note that additional studies may be required by the responsible agencies to more fully define the details of some of the measures for public safety, such as the precise alignment of the railings.

In addition to these measures, a program of periodic surveillance and mapping and photographing of surface cracks and other features to record progressive rock or soil movement would be effective in identifying potential failure areas. The initial investment for surveillance is estimated at about seventy thousand dollars, with annual cost thereafter of about ten thousand dollars.

The Commission concludes that the two flanks of the American Falls and the Goat Island flank of the Horseshoe Falls are sufficiently unstable to warrant remedial action. With respect to the allocation of the work and cost of construction, the Commission concludes that, since no works except the measures for safety of the viewing public are required under the 1967 Reference and since these costs are to be allocated to the United States under the terms of the 1970 extension of the Reference, the cost of all works recommended in this report will be allocated to the United States.

The Commission further concludes that a statistically minor element of risk from unpredictable rock movement will remain and must be accepted by the viewing public.

CHAPTER VII


RECOMMENDATIONS


In response to the Reference dated March 31, 1967 and the extension of the original Reference, dated October 1970, from the Governments of the United States and Canada, the International Joint Commission recommends that:


1. No measures be undertaken at this time to remove the talus which has collected at the base of the American Falls and to retard or prevent future erosion.
2. The American Falls not be stabilized by artificial means.
3. No other major measures be taken at this time to preserve and enhance the beauty of the American Falls.
4. As a minimum the measures for safety of the public, outlined earlier in Chapter VI, should be implemented.
5. A study be jointly conducted as soon as practicable by the United States and Canada to examine the full range of possibilities of preserving and enhancing the Niagara Falls as an international scenic wonder, recognizing not only the "jewel" of the Falls, but also the surrounding "setting" in which they are placed. The study should give consideration to the economic impact and the necessary institutional arrangements which might be affected.
6. The two Governments discourage the local jurisdictions from undertaking or permitting future developments that would detract from the visual enjoyment of the Niagara Falls.

Signed this 23rd day of July 1975 as the International Joint Commission's report to the Governments of the United States and Canada on the measures necessary to preserve or enhance the beauty of the American Falls at Niagara and on the public safety measures at the flanks of the American Falls and at the Goat Island flank of the Horseshoe Falls.



Maxwell Cohen


Bernard Beaupré


Henry P. Smith III


Keith A. Henry


Charles R. Ross


Victor L. Smith

APPENDIX

TEXT OF REFERENCE TO THE INTERNATIONAL JOINT COMMISSION

On March 31, 1967, the Secretary of State for External Affairs for the Government of Canada, and the Secretary of State for the Government of the United States sent the following Reference to the International Joint Commission, through similar letters addressed respectively to the Canadian and United States Sections of the Commission:

The Governments of the U.S.A. and of Canada have agreed to request the International Joint Commission, pursuant to Article IX of the Boundary Waters Treaty of 1909, to investigate and report upon measures necessary to preserve or enhance the beauty of the American Falls at Niagara. The Commission is specifically requested to investigate and recommend:

- 1) what measures are feasible and desirable
 - (a) to effect the removal of the talus which has collected at the base of the American Falls; and
 - (b) to retard or prevent future erosion;
- 2) other measures which may be desirable or necessary to preserve or enhance the beauty of the American Falls;
- 3) the allocation, as between the United States and Canada, of the work and costs of construction.

At the same time, the Commission is asked to bear in mind the obligations of Canada and the United States contained in the Niagara Treaty of 1950 and the mutual interest of the two countries in refraining from measures which might preserve or enhance one of the Falls to the detriment of the other.

For the purpose of assisting the Commission in its investigation and otherwise in the performance of its duties under this Reference, the two Governments will upon request make available to the Commission the services of engineers and other specially qualified personnel of their governmental agencies and such information and technical data as may have been acquired or as may be acquired by them during the course of the investigation.

The Commission is requested to submit its report to the two Governments as soon as may be practicable.

TEXT OF LETTER EXTENDING REFERENCE

On October 1 and October 5, 1970, the Secretary of State for External Affairs for the Government of Canada, and the Secretary of State for the Government of the United States extended the original Reference to the International Joint Commission, through identical letters addressed to the Canadian and United States Sections of the Commission:

The Governments of Canada and the United States have agreed pursuant to Article IX of the Boundary Waters Treaty of 1909 to request that the International Joint Commission extend its investigation of measures necessary to preserve or enhance the beauty of the American Falls at Niagara which it has been conducting pursuant to the Reference of the two governments dated March 31, 1967 to the following questions:

- 1) Are the immediate areas of the American Falls and of the Goat Island Flank of the Horseshoe Falls endangered by the possibility of erosion and other geological conditions.
- 2) If so, what measures are feasible and desirable to protect these areas in order to eliminate any hazard to persons or property or to the scenic beauty in the region.

At the same time the Commission is asked to determine the specific costs involved in the carrying out of the work and construction under this extension to the 1967 Reference and to include these costs in the costs that it will be allocating to the United States under the terms of the 1967 Reference as extended by this Reference.

The Governments will continue to make available to the Commission the services of individuals to serve on the existing American Falls International Board for purposes of this additional inquiry, as set forth in the Reference dated March 31, 1967.

The Commission is requested to submit its report to the two Governments as soon as may be practicable.

AMERICAN FALLS INTERNATIONAL BOARD

The International Joint Commission appointed the American Falls International Board on July 24, 1967. When the Board submitted their report to the Commission in June 1974, membership of the Board consisted of the following:

United States Section

Brig. Gen. W. O. Bachus, Division Engineer, North Central Division, U.S. Army Corps of Engineers, Chairman
G. Eckbo, Chairman, Department of Landscape Architecture, University of California

Canadian Section

N. H. James, Director, Water Planning & Management Branch, Inland Waters Directorate, Environment Canada, Chairman
H. S. M. Carver, Consulting Landscape Architect, Ottawa

Former Board Chairmen

Canada

T. M. Patterson
J. D. McLeod

United States

Brig. Gen. R. T. Dodge
Brig. Gen. R. M. Tarbox
Brig. Gen. W. W. Watkin, Jr.
Col. W. G. Stewart
Maj. Gen. E. Graves, Jr.

WORKING COMMITTEE

The Board established a Working Committee with Commission approval. When the Board's report was submitted to the Commission the membership of the Working Committee consisted of the following:

United States

Col. B. C. Hughes, District Engineer, Buffalo District, U.S. Army Corps of Engineers
K. R. Hopkins, Regional Director, Niagara Frontier State Park Commission
D. Carruth, Kane, Carruth & O'Brien, P.C., Landscape Architects & Consulting Engineers

Canada

N. P. Persoage, Water Planning & Management Branch, Environment Canada
D. R. Wilson, General Manager, Niagara Parks Commission, Niagara Falls, Ontario
J. E. Secord, Landscape Architect, St. Catharines, Ontario
K. A. Rowsell, Engineering Program Branch, Canada Department of Public Works

Former Working Committee Members

Canada

B. E. Russell
C. A. McGregor
M. T. Gray

United States

Col. A. L. Wright
A. B. Williams
G. D. Clark
Col. R. S. Hansen
Col. R. L. Moore

PARTICIPATING AGENCIES

Valuable and cooperative assistance was provided by the following agencies:

In the United States

United States Department of the Army, Corps of Engineers
Power Authority of the State of New York
Niagara Frontier State Park Commission

In Canada

Environment Canada
Department of Public Works
Ontario Hydro
Niagara Parks Commission

**PERSONS PRESENTING BRIEFS
OR TESTIMONY AT THE
INTERNATIONAL JOINT COMMISSION
PUBLIC HEARINGS**

Where witnesses testified at both hearings in 1967 only one appearance is recorded hereunder.

October 24, 1967 at Niagara Falls, New York

Representative Henry Smith, U.S. Congress
V. Sumner Carroll, State Assembly New York
Gregory J. Pope, State Assembly New York
His Honour Mayor E. Dent Lackey, Mayor of Niagara Falls, N.Y.
Arthur Williams, General Manager, Niagara Frontier State Park Commission
William Latham, for W. S. Chapin, General Manager, Power Authority State of New York
Ralph Barnes, Erie County Government
Walter Schulmeister, Director, Niagara County Industrial and Planning Commission
Dr. Frank J. Dobrovolney, President, Niagara Area Chapter, American Association of Retired Persons
Charles M. Offenbauer, Niagara Falls Area Chamber of Commerce
Thomas G. Berrigan, Editor-in-Chief, Niagara Falls Gazette

October 25, 1967 at Niagara Falls, Ontario

His Worship F. Miller, Mayor of Niagara Falls, Ontario
Carl Huggins, City Manager, Niagara Falls, Ontario
Ross Kenzie, Manager, Niagara Falls Convention Bureau
M. T. Gray, Niagara Parks Commission
M. L. MacDonald, Q.C., Counsel for Hydro Electric Power Commission of Ontario
Blake Robertson, Niagara Falls, Ontario

March 24, 1972 at Niagara Falls, New York

Conrad H. Eidt, Regional Municipality of Niagara, St. Catharines, Ontario
Keith R. Hopkins, Regional Director, Niagara Falls State Park Commission, Niagara Falls, New York
Stan Spisiak, New York State Conservation Council, Buffalo, New York
Norman R. Mitchinson, Committee of a Thousand, Niagara Falls, Ontario
Derek M. Foulds, Ontario Hydro, Toronto, Ontario
R. W. Rodman, City Engineer, Niagara Falls, Ontario

March 4, 1975 at Niagara Falls, New York

Mrs. M. L. Reeves, Niagara Group, Sierra Club, Eggertsville, New York
Dr. W. Englebrecht, New York Archaeological Council, Amherst, New York
M. J. Dixon, Sudbury, Ontario
Harvey N. Albond, Director of Planning, Niagara Falls, New York
Keith R. Hopkins, Niagara Frontier State Park Commission, Niagara Falls, New York
Mark Latham, Thorold, Ontario
John MacLeod, Rockwood, Ontario

Subsequent to the above public hearings the Commission received submissions from those listed hereunder:

After the October 1967 Hearings

Frank LeBlond, President of Maid-of-the-Mist Steamship Company, Niagara Falls, Ontario
Greater Niagara Chamber of Commerce, Niagara Falls, Ontario.

After the March 1972 Hearing

James N. Allen, Chairman, Niagara Parks Commission, Ontario
William H. Wendel, Carburundum Company, Niagara Falls, New York
Great Lakes Laboratory, State University College, Buffalo, New York

After the March 1975 Hearing

H. M. Doyle, San Carlos, California
Ralph E. Braddon, Cleveland, Ohio
Glenn C. Forrest, Youngstown, New York
Marjorie F. Williams, City Historian, Niagara Falls, New York
Thomas Kelchner, Williamsport, Pennsylvania
Jack D. Paxton, Urbana, Illinois
Michael G. Marsh, Roslyn Heights, New York
Mr. & Mrs. Ivan Valiela, North Falmouth, Massachusetts