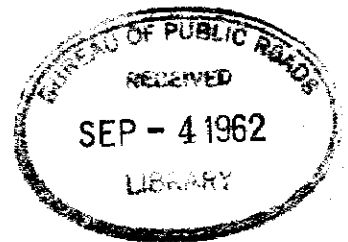


MacDonald, Thomas Morris
Papers, 1943-1947.

C O N T E N T S



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Construction Activities of the Public Roads Administration
and their Contractors in Cooperation with the War Department,
Corps of Engineers, on the Canadian-Alaska Military Highway^{1/}

by

Thos. H. MacDonald, Commissioner of Public Roads
L. I. Hewes, Chief, Western Region, Public Roads
Administration
J. S. Bright, Alaska Highway District, Public Roads
Administration, Edmonton, Canada

A Paper Presented at the ^{91st} 19th Annual Meeting of the
American Society of Civil Engineers
Wednesday, January 20, 1943
New York, N. Y.

^{1/} A paper presented earlier on the program of
the Society by General Sturdevant discussed the
inception of the Alaska Highway and the work of the
Army Engineer troops on construction. This paper
presents a further view of operations from the stand-
point of the Public Roads Administration. The paper
is largely a progress report, covering the two dis-
tinct phases of construction operations by the Public
Roads Administration in 1942.

The Alaska Highway extends approximately 1,480 miles from the railhead at Dawson Creek in British Columbia to the Richardson Highway at Big Delta 90 miles south of Fairbanks. At Fairbanks the extended route meets the Alaska Railroad. There is a branch in Alaska extending 135 miles from the junction of the Tok and Tanana Rivers to Gulkana on the Richardson Highway. There also later was added approximately 150 miles to connect the port of Haines on the Lynn Canal with the main route at a point west of Champagne in Yukon Territory. There results a grand total of 1,765 miles. The main route was determined by the existing line of airports in Canada and Alaska. These airports are at Fort St. John, Fort Nelson, Watson Lake and Whitehorse in Canada, and at Boundary, Big Delta and Fairbanks in Alaska. They are positioned away from the unfavorable weather areas that are associated with the continental mountain ranges nearer the Pacific Coast. The main road runs in a direction generally westerly by north with approximately 224 miles inside Alaska and the remainder in Yukon Territory and the Province of British Columbia in Canada. The nearest considerable population centers in the United States are Spokane, Washington and Great Falls, Montana. From both these cities highways extend northward to Edmonton in Alberta. Edmonton is a modern city of 100,000 population and about 350 air miles east and south of the little village of Dawson Creek where the Alaska Highway starts.

The position of the route is thus extremely favorable for connections in the United States from the heavily populated areas northwest from Chicago, St. Paul, Minneapolis and other points. Ultimately there could be a connection between Prince George in British Columbia and Fort St. John, and thus join the American highways south of Vancouver, British Columbia.

Obviously, the interests of Canada in this route are considerable. The two countries exchanged notes last March consummating full understanding that the United States Corps of Engineers would proceed to construct a pioneer road, and that the Public Roads Administration would follow with American and Canadian contractors to build the pioneer road into a modern standard highway. The original schedule of operations was to finish the standard road in two years.

With distances of from 250 to 350 miles between major control airports and through almost totally unknown terrain, the first task was to reconnoiter the snow-covered country. This job was done jointly by Army and Public Roads engineers. The work began early in March and proceeded by airplane, dog train and other ground parties. Available maps were sketchy. Lakes were out of position and critical elevations almost wholly useless. Indicated mountain passes in one area proved to be in error as much as 3,000 feet. The indicated courses of many considerable rivers were largely schematic. However, there was a corresponding degree of freedom of choice in this wilderness location once the main features of the land began to take form. Right of way was not a problem.

While reconnaissance proceeded with temperatures still as low as 35 degrees below zero, Army Engineer regiments moved into position at control points. In this land the so-called spring "breakup" in April is a formidable obstacle. The ground becomes awash and mud depths are indefinite. For weeks all ground traffic ceases. One pioneer road construction regiment had to beat this wet period by moving in over any available winter trail to Fort Nelson. Other regiments later moved to Fort St. John, Lake Kluane, Teslin Lake and other points. And they accomplished these maneuvers in spite of enormous physical obstacles.

The Public Roads Administration began simultaneously to assemble its engineers and to canvass available construction contractors. First, 148 engineers were transferred from our western districts, where our National Forest and National Park work largely has been concentrated for many years. Afterward we drew upon our eastern districts, and for field service recruited temporary engineers in considerable number from the far west and Canada. Many of the younger men came from engineering colleges in the United States and Canada. Ultimately, including accountants, purchasing agents and others, 823 Government employees were regularly assigned to the work, and at one period the number increased to 1,118. The list included U. S. Public Health Service men who generously and effectively took over the important responsibility of health and sanitation. Their physicians and nurses cared for over 13,000 out-patient treatments, and the doctors performed more than 250 operations.

A district office was scarcely established at Seattle when major problems of transportation of men, equipment and material immediately became evident. Field headquarters were set up at Whitehorse in Yukon Territory and at Fort St. John, 42 miles north from the railhead at Dawson Creek, and at Gulkana near the Richardson Highway in Alaska. Whitehorse is reached by a narrow-gauge railway 111 miles long from Skagway at the head of the Lynn Canal. Vessels from the ports of Seattle, Washington, and Prince Rupert, Canada, reached Skagway by the so-called inland passage route, which is available to vessels that cannot be exposed to the open waters of the Gulf of Alaska to reach Valdez at the southern terminal of the Richardson Highway.

We secured a transportation and camp building construction management contractor at Seattle. Owing to the war conditions on the west coast it was extremely difficult for him to obtain vessels. Progressively, however, we secured through him 10 tugs and a fleet of towing barges. Later four power cargo vessels were added with a total combined cargo capacity of about 5,000 net tons. In addition we chartered in the same manner five power yachts for handling personnel. They had a combined carrying capacity of 137 passengers. It is about 480 miles from Prince Rupert in Canada to Skagway, and about 980 miles to Seattle. We also had to land men and cargoes at Valdez by a voyage of about 1,500 miles across the Gulf of Alaska. All of these vessels and also United States Army transports and

commercial vessels were used to move in personnel and equipment. In addition men were flown directly to Fort St. John, Whitehorse and Fairbanks by the Yukon, Southern and Pan-American Airways, and by the United States Ferry Command. The shuttle service of the ocean-going and coastwise fleet still continues.

The canvass of contractors interested in the Alaska Highway construction immediately revealed insufficient equipment in the control of any one or any small number of available contractors. Therefore, it was decided to engage the services of management contractors, who in turn would recruit contractors who would sign construction contracts with the Government. In the absence of surveys, unit price contracts were not possible. The four management contractors that were engaged to cover the total mileage were instructed to recruit contractors on a cost-plus-a-fixed-fee basis. A total of 47 construction contractors were thus engaged. Their men and equipment were moved in by every available means of transport. One Canadian management contractor was obtained, and 10 Canadian construction contractors immediately began the grading of the most southerly 48-mile section between Dawson Creek and Fort St. John, where existing local roads made accessible points on the revised alignment which was immediately staked out for grading. Another management contractor with 14 Iowa highway construction contractors undertook all the work in Alaska. Many of their 1,400 men were flown into Alaska by the Ferry Command. They set up headquarters at Gulkana on the Richardson Highway. Another management contractor from St. Paul took the section

from Fort St. John to Fort Nelson, 256 miles north. From that point to Watson Lake, a distance of 360 miles, the work was assigned to the contractors of the Canadian management contractor. A Seattle contractor took a large part of the 600-mile section between the Alaska-Canadian boundary and Watson Lake.

It will be readily understood that the job of "spotting" the construction contractors along these wilderness miles and moving in their equipment was a difficult one under the best conditions. In this operation it was expected that the Army pioneer road would be helpful. Under war conditions the operation assumed formidable aspects. The situation can be realized from a single example, namely, the need of bringing into Skagway immediately about 20,000 net tons of freight and shipping from there to Whitehorse over 111 miles of narrow-gauge railway, at the time capable of hauling not over 15,000 tons per month, and already overloaded with Army equipment continually arriving at Skagway by transport, where the docks scarcely can accommodate simultaneously two larger vessels. Before the season was over the various contractors had an aggregate of approximately 7,500 men, all of whom of course had to be housed and fed, and their equipment supplied with gasoline, fuel oil and lubricants. During a period of approximately five weeks, over 600 carloads of equipment and supplies arrived at the railhead at Dawson Creek. At one time nearly 200 carloads of equipment and supplies were accumulated at Prince Rupert.

Quite early in the season the work of the Civilian Conservation Corps was terminated and their vast supply of unit construction camp houses and equipment became largely available for use on the Alaska Highway. The transportation problem was thus extended to include demolition and loading at numerous points. Before the season closed, in addition to a large quantity of construction equipment, several hundred demountable buildings were taken down and re-erected all the way from Dawson Creek to Whitehorse and from Gulkana to the Alaska-Canada boundary. This work is continuing through the winter.

As reconnaissance proceeded two major problems arose about the routes between the airport controls in the sections respectively between Fort Nelson and Watson Lake, and between Watson Lake and Whitehorse. It is to be observed here that the Alaska Highway extends across and along the tributaries of both the Mackenzie and Yukon drainage systems. These rivers flow respectively into the Arctic Ocean and Bering Sea.

In the first case it was finally decided to follow from Fort Nelson a branch of the Liard River called the Muskwa to another tributary, the Tetsa River, thence up the Toad River to Muncho Lake, and then down the Trout River to the Liard itself, where the road crosses and follows the North bank to Lower Post near the Watson Lake airport. This portion of the route goes through the northerly extension of the Rocky Mountain Range and reaches the highest points of the entire highway at an elevation of 4,350 feet. The alternate route would have gone considerably to the north from Fort Nelson.

Although the two routes were not much different in length the chosen route was considered to afford the better soil and ground conditions for road construction. In much of the reconnaissance work air photographs were most helpful.

In the second case, between Watson Lake and Whitehorse it was necessary to scout out the lowest summit which available maps indicated had a prohibitive elevation. The route finally crossed the divide between the Mackenzie and Yukon drainages over a pass of approximately 3,250 feet elevation. This pass was spotted from the air with the help of a local pilot.^{1/} The route selected follows up the Rancheria River from the Liard, then crosses Cook's Pass to the Swift River, which flows into the Yukon drainage.

Between Whitehorse and Kluane Lake, 150 miles west and north, was an old trail which sufficiently defined a feasible route. Northwest of Lake Kluane ground reconnaissance on foot was necessary to develop reasonably sure footing and feasible crossings of the Donjek and White Rivers. Here is a section which apparently will unavoidably cross several areas of the permanently frozen underground zone that extends downward from the North Pole. Some 56 miles beyond Lower Canyon on the White River the route enters Alaska and follows along the Tanana River to Big Delta (Buffalo Center) on the Richardson Highway, some 90 miles south of Fairbanks.

^{1/} This pilot, Les Cook, met a tragic death by an airplane crash at Whitehorse early in December 1942.

As the various reconnoitered sections of the Highway were mutually agreed on by the Army Engineers and Public Roads, survey crews were sent in to locate the line. The organization and dispatching of the many survey crews of about ten men each, necessarily continued for several weeks. The accommodations for men at both Fort St. John and Whitehorse at first were so limited that it in fact became necessary, as the flow of men continued, to hustle them out of town on to the line positions as rapidly as possible. They and their supplies went by pack train and by airplane to positions spotted at intervals along the route. Many of these parties had no communication whatever with their headquarters. Some of them that proceeded in airplanes which landed on frozen water later could not be reached directly by airplane, but at intervals their food supplies were dropped from the air and their Indian guides could make contact by painful journeys back to other parties or Army camps.

As fast as the survey notes developed they were returned to headquarters for design. The first sections designed necessarily were those that could be started near headquarters. It was, of course, not necessary immediately to work up quantities since the construction contracts did not involve unit prices. The spotting of culverts and the adjustment of the profile went on relentlessly. Standard through-truss and deck-truss timber bridge designs were developed in the San Francisco office. Just as designs for 1600-pound structural grade timber were completed for various standard span lengths, complete re-design was necessary for 1200-pound timber

owing to an unexpected shortage in the higher grade. As approximate lengths for various sized pipe culverts were developed by design they were used as the basis for placing orders, and many thousands of feet of culvert including mostly wood stave pipe culvert, were ordered and shipped in to Dawson Creek, Whitehorse and Gulkana.

It is to be observed here that during the 1942 season the entire location line survey finally was run. The survey is not yet quite complete, however, on the 160-mile extension to Haines. As the second phase of the construction work developed it also was necessary to rerun all those portions of the Army pioneer road that are not adjacent to or coincidental with the "L" line previously run. This work also has been developed. The remaining portions of the design work, principally the adjustment of profiles, curvature and drainage to the Army pioneer road are proceeding this winter in our Western District Offices as well as at Whitehorse and Fort St. John.

Up until the first week in August this initial phase of the Alaska Highway, namely, reconnaissance and survey and pioneer truck road construction by the Army and full standard construction of sections near the Fort St. John, Whitehorse and Gulkana headquarters by Public Roads, proceeded as previously arranged. On August 8, however, this phase of the Alaska Highway work was substantially modified.

This change was caused by a joint directive to use all forces to complete a usable truck road throughout the entire length of the route before winter freezing. As a result construction contractors

under the direction of the management contractors of the Public Roads Administration had their work almost completely rearranged. They were thrown in behind the Army operations on the pioneer road to widen it and otherwise better the roadbed and above all to place gravel surfacing on the improved roadbed.

It is to be remarked here that the subgrade soil for practically the entire distance between Dawson Creek and the Sikinni River north of Fort St. John is of our A-7 or A-8 classification or even worse. This is roughly a distance of 175 miles. Tests showed that for this mileage the subgrade contained generally from 80 to 100 per cent of material passing a 200-mesh screen. In combination with flat swampy areas a worse subgrade soil could scarcely be conceived. The need for surfacing the pioneer road in such areas will easily be apparent to all highway engineers.

To add to the difficulties of the situation at this southern end of the job it is to be observed further that soil survey parties were unable to discover any usable surfacing material for a hundred miles north of Fort St. John after many weeks of unremitting search. However, after the pioneer road had been put through by the Army and travel here became possible, sandstone ledges were discovered. By crushing this material the threatened long hauls for all forms of surfacing for this 100 miles can be reduced greatly.

To provide surfacing for the pioneer road built by the Army, it was necessary to set up crushing plants as rapidly as possible along sections of the route where other material failed to develop. It was also necessary to enlarge greatly the number of dump trucks, but deliveries were not prompt.

Except for part of the force of Canadian contractors left on the section south of Fort St. John, practically all of the remainder of the 47 construction contractors during August began to improve and gravel the Army pioneer road. This road now was widened to approximately 20 to 24 feet to provide a two-way passing condition. A lift of gravel or other surfacing material then was applied. This surfacing varied in thickness from four inches to two or three times that amount, depending on the need and the availability of gravel or its equivalent.

Not only was it necessary to expedite the completion of the Army pioneer road, it also was necessary for the construction contractors to apply themselves to the construction of temporary bridges over larger streams where the Army crossings had been made either by ferry or by temporary pontoon bridges or other temporary structures. Almost without exception all of the new bridges are of the pile trestle type, and the construction contractors with the Army's help finally have finished them.

It is not expected that many of these pile bridges finished last fall and early in the winter will stand up under the spring breakup in April. A number of the rivers, especially on the northern

portion of the Highway, freeze from the banks inward toward the thread of the stream and along the bottom. The channel thus choked is unable to carry the flow, which in turn spreads over the banks and tends to inundate the approaches to the bridge. In the spring there are ice jams and, of course, always a hazard of drifting material. A further word should be included here about the 100 or more streams that cross this highway. Their bridging is a major problem. Several of the rivers like the Tanana, Lewis (Yukon), Liard, Muskwa and the Peace River are streams comparable to the Missouri and the Mississippi. Others flow more directly from glaciers and their action is unpredictable. Summer rains may form lakes on the glaciers that suddenly find outlets and flow under the glacial ice bringing down volumes of debris. Many streams are very broad and shallow with "braided" channels. When these rivers begin freezing in their lower reaches at the bottom the water fans out again and again, piling up ice in a shingle-like pattern across their wide beds. Wild tales of 150-foot ice piles are not, however, corroborated by the 30-foot forest growth along their banks. Surveys of bridge sites now show that this Highway ultimately will need about 23,000 linear feet of bridging and the indicated cost runs to about \$11,000,000. We are designing some of these spans and building others this winter. We are stockpiling material for spring construction at still other sites. The longest bridge of all will be an 1800-foot suspension bridge across the Peace River south of Fort St. John. It is hoped to finish this bridge early in the spring.

With the first phase of the Alaska Highway now practically completed it is possible to return to the standard design construction during the coming season. Under the controlled materials priority plan to be operated in the second quarter of this year there may be an improvement in the delivery of materials to the Highway. In the past the scarcity of spare parts for trucks and other equipment has been an annoying handicap. The construction during 1943 will have the benefit of a going setup of repair shops, camp facilities, and overhauled equipment on the ground ready to go. The working season in 1942 was partly consumed in establishing the contractors' forces. The working season of 1943 ought to double the working season of 1942. The designed route following the Army pioneer road also will be ready for staking. Seasoned engineering crews will be on the ground as the snow melts. Transportation along the truck road may be somewhat interrupted during the breakup but will be available during the construction season. The days of isolated parties and hazardous conditions are largely behind us.

In respect to the cost-plus-a-fixed-fee contracts, our experience has been favorable. The construction contractors have been uniformly efficient. Their agreed wage scales were patterned after the established scales in other going Alaska work for the United States Government. Similarly in Canada the Canadian contractors used only Canadians, and we paid their established scale in Canadian dollars. The 47 contractors utilized equipment with a new value of about \$10-3/4 million, of which the Government owned 35 per cent. The

basic Federal Works Agency rental rate was about 27 per cent of new value plus a 50 per cent rate on second shift time actually in use. The Government pays freight, fuel and repairs, and basic rent from the day of loading to return to the United States on all equipment accepted as ready and available to work. The average work hours per day varied among the four groups of construction contractors from 10.3 low to a high of 11.4. Thus, the overtime above 8 hours ran from 2.3 to 3.4 hours. On this kind of work men seemed willing to work 12 hours a day every day in the week. From June 1 to October 1 practically all the contractors worked from 20 to 22 hours daily in two shifts. Much of this period sunlight was sufficient.

The cost of the Alaska Highway has not yet been fully developed. The cash outlay by Public Roads to November 30, 1942 was about \$14,000,000 and a somewhat larger amount of encumbrances are on the books. Much of the latter amount is applicable to future construction. Fairly close estimates should be available before the construction season begins.

Before closing this report it is particularly desirable to emphasize the fine spirit of the Army officers who commanded engineer troops in the field in the various Engineer regiments. Their cooperation was conspicuous and their persistent efforts against any odds truly inspiring. The cooperative spirit of the Canadian officials throughout the past year must be recorded. Canada's part in the undertaking included the furnishing of all rights of way, the remission of all taxes and duties, and the permission to use all local roadbuilding

material. The provincial and national government officials of Canada have cooperated most kindly, and the Royal Canadian Mounted Police also have been alert and forehanded in aiding in many ways the Alaska Highway construction. Nowhere else on the North American Continent is there an area comparable in size where a highway could be projected into such a wilderness area, or where comparable transportation difficulties would be met. Perhaps there never has been a unit of highway construction of comparable length planned for completion in so short a time. With a reasonable amount of favorable breaks it is hoped that a standard design road completed at least to a dry gravel surface condition throughout the Highway and its two branches may be available before another New Year comes around.