OUT OF SIGHT, OUT OF MIND:
DRAINAGE PLAN STUDY (HALIFAX CITADEL)
by Esperanza Maria Razzolini
1979
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Abstract

This largely iconographic report constitutes a plan study which describes the evolution of the complex arrangement of drains and utilities in existence on Citadel Hill to 1950. Although the main emphasis was placed upon the British period to 1906, an overview of the developments of the Canadian period and a chapter on current discoveries have also been included.

I wish to express my most sincere thanks to all of my colleagues for their patience in bearing with me through this subject, especially draughtsmen Neil Conrad, Greg Corkum and Pat Smith, and designer Jean Pierre Camus, whose struggles with the drainage plans have equalled my own.
Introduction

The purpose of this report is to describe the evolution of the complex arrangement of drains and utilities in existence on Citadel Hill to 1950. This collection of surface and subsurface drains and pipes with associated gargoyles, gutters, hoppers and weepers actually constituted three distinct systems: 1) ditch drainage, 2) sewerage, 3) casemate staunching. In addition, there was a fairly elaborate water supply system of tanks and pipes. Confusion stems from the fact that these four elements interconnect to a great degree, and that the constant modification of their pattern has made determining which proposal achieved final acceptance largely extrapolation. Also, due to the general paucity of documentary evidence, especially for the main construction period of 1851-1854, and the overall ambiguity of written sources concerning this subject, this study is largely iconographic in nature. Consequently, the conclusions herein put forward are mainly calculated guesses, as the only sure way to discover extant materials would be to excavate the entire site.

This report has been divided into three parts. The first section consists of two narrative chapters relating the developmental history of the system. The first chapter covers the initial implementation period, a space of time which largely coincided with the British occupation to 1906. The second attempts to piece together the modifying developments of the Canadian ownership to 1950 from plans and as-found reports, drawings and photographs, as there is scanty documentary evidence. The second section is a plan study which identifies and analyzes all presently available plans showing drainage or details thereof. While the Halifax Defence Complex coding has been used to organize and provide a simple referral/retrieval system for the plans, proper acknowledgement of the original sources has been made in the data sheet accompanying each item. The third section summarizes the report findings into an immediate referral finding
aid consisting of composite plans and overlays. Also included are plans of the electrical and fire alarm systems, some discussion of modern archaeological findings, and a glossary.

As a final comment, while it may be argued that the fact that this report covers four relatively distinct elements renders the title "Drainage Study" inadequate and confusing, this appellation, one placed on the study through common usage, has been retained as its ambiguity aptly represents the true nature of the subject.
Part I: Narrative

1. General Comments

The following are excerpts from Paper XXV, Papers on Subjects connected with the Duties of the Corps of Royal Engineers, contributed by Officers of the Royal Engineers (1849-1850), Volume I, pp. 247-261.

Observations on barracks, and on the moral condition of the soldier. By Captain Sir William Dension, Royal Engineers.

The points to be attended to in preparing plans for barracks are:-

1. Situation.
2. General arrangement of buildings.
3. Details of the construction of the different buildings.

The situation should be carefully chosen, with reference--

1. To the objects which may have made it desirable to place a body of troops in that particular locality.
2. To its salubrity.
3. To the means of easy and uninterrupted communication to and from it.
4. To the means of defending the barrack in case of attack, as far as this is influenced by the local position.
5. To the supply of water.

Little need be said upon some of these points. The facilities offered for defence or communication, must depend of course upon the local features of the ground, but they should form elements in the discussion of the site of the barrack; great attention, however, should be paid to the general salubrity of the locality, and to the power of obtaining an ample supply of water. The first
of these has very generally been overlooked, and the consequences have been in many instances most fatal. In the colonies, especially in those climates where the European is subject to attacks of fever, as in the East and West Indies, or the coast of Africa, too much attention cannot be paid to the situation of the barrack; all proximity to low marshy ground should be avoided, but it must not be considered that a situation is necessarily healthy because it is on high ground; all those local influences which bear upon the health of the soldier should be carefully considered, and the medical officers best acquainted with the climate should be called upon for their opinions. I do not mean that they should be called upon to recommend a site for the barrack, but that due weight should be given to their objections (should they offer any when called upon for their opinion) to the situation which would answer the other objects for which the barrack may be intended. An ample supply of water is essential; in those countries where there are no springs, dependence is placed upon the rain; and in such situations, the tanks for rain-water should be large enough to contain all the rain which may fall, and every available inch of roofing should be made use of as a catch. In situations where water can be found by sinking wells, it would be advisable to make use of such means for obtaining a supply; but even here it would be as well to save the rain-water, which would be useful in cooking and washing, and which would offer a ready supply in case of fire.

It is not desirable to be dependent upon water companies for a supply of this necessary of life; accidents may happen at the most inconvenient time; the line of man may be cut during a public outbreak, and the position of the occupants of the barrack rendered once of great difficulty. Rain-water tanks would provide, in some measure, against this; they should therefore always be constructed....

Water-closets should be fixed in the officers' barracks, instead of the privies in the back yards; in placing them, however, great care should be taken to place them in such situations
as will allow of a thorough ventilation, and, to avoid all chance of accident from negligence or carelessness, the construction should be very simple, and the machinery self-acting.... a pantry and a plate room should be attached to the mess-room; and also a washing room and water-closets.

Stables will of course be required...and drains should be laid down to carry off the urine from the stalls.

As to the offices for the staff, .... Washing places and water-closets should be provided....

Lavatories, baths, &c.- The soldier is always expected to appear clean on parade, and yet, till a few years ago, the only means provided for washing was a pump in the back yard, at which a dozen men might be seen at once washing, while one pumped for them; latterly, however, lavatories or washing places have been very generally fitted up, containing not only conveniences for washing the face and hands, but also pans for the feet. The only improvement required is in the position of these washing places: having been added to barracks already built, they have been placed in the back yards, or wherever space could be found for them; at all events, in such a position as to render it necessary for the men to go out into the open air, it would be better to bring them under the roof of the barrack, and as near the rooms of the soldiers as possible; they would then be less exposed when making use of them, and would in all probability make use of them more frequently. Baths, both warm and cold, would be a great addition to a barrack, as being conducive to cleanliness and to health; very little trouble or expense would be incurred in making arrangements for these, and they would add very much to the comfort and convenience of the soldier.

Very great attention should be paid to the drainage of the barrack; all the waste water, &c. should be carried away in a sewer if possible, and all the privies and urinals should be discharged into the same channel; all the drains should be carefully trapped, and every outlet by which air from the drain can find its way into the barrack should also be stopped by a trap.
No cesspools should be allowed, if by possibility they can be avoided, unless, indeed, it may be found profitable to sell the manure from the barrack to the farmers in the neighbourhood, who, if they understood their own interests, would gladly purchase it; in this case, the privies and urinals, the drains from the stables, &c., should be carried to a cesspool at some convenient distance from the barracks, and arrangements should be made with the contractor to empty it at certain specified periods. The cesspool should be constructed in such a manner as either to allow of the soil being pumped out into covered carts, so as to create as little offence as possible; or, if the ground is favourable, it may be made so as to allow its contents to drain out into the carts upon turning a cock or opening a sluice. The carts should be provided by government, as then there will be a certainty that they are properly secured; and, by making it a part of the arrangement that government is to find the carts, the competition for the manure will be thrown more open. The cesspool must of course be made water-tight, as the liquid manure is of most value to the farmer, and nothing should be allowed to drain into it but the soil from the privies and the urine from the urinals, as the contractor will not be desirous of carting away water, his object being to get the manure in as condensed a form as possible. In order to save the construction of drains, the privies should be grouped together pretty closely; the number required will be about 1 for every 40 men. They should be kept separate from each other, and strict cleanliness should be enforced; the ventilation also should be attended to; separate sets of privies should be provided for the non-commissioned officers, and also for the women who may live in the barracks. All the urinals should be made to discharge themselves into the privies, but, in order to secure a proper scour through the soil-pit without using any water, the whole of the urine should be retained in a tank at the head of the soil-pit, and then at certain times discharged through it in a body, by lifting a sluice large enough to allow a great body to rush through at once. The soil-pit should be made with the bottom on as rapid a
slope as possible. Nothing need be said about the cleaning sheds, which will be placed in the back yards as usual; the workshops, especially the tailors', where several are congregated together, should be properly ventilated.

Should a barrack for the married men be constructed, a laundry and wash-house will form a part of it, but otherwise it may be as well to have such a convenience attached to the barrack, as all the washing can then be done within the limits of the barrack. A drying closet should form a part of this building, which will serve not only for drying the linen, but the men may make use of it for drying their clothes when wet with rain, and the barrack-master for drying his stores; if, however, a good system of ventilation be adopted and carried into the stores, as well as the apartments for the men, everything will be kept dry and well as not to require the use of the drying closet. ...

2. The British Period

A. Ditch Drainage
The foundation of the Citadel Hill drainage system was the relatively simple pattern of ditch drainage begun by Colonel Nicolls. Halifax's spring and fall rains and freeze and thaw winters, which proved so detrimental to stone fortifications, inevitably and frequently filled all excavations with water. Consequently, Nicolls devised a drainage system for the new ditches, to be built as soon as each section reached completion. Catchments were sunk mid-ditch at all the salient angles, and stone drains built running from these pits down onto the glacis.  

The drain at the northwest demi-bastion salient was definitely completed in 1829, with the system being extended to the west ravelin, the southwest demi-bastion, and the southeast and northeast salients, probably in that order. In keeping pace with the fortification development, this complex had most likely achieved completion by 1831-1832, although the only mention of these drains after 1829, was an 1836 reference to the existence of such
a drain at the west ravelin salient. Whether or not the ditch drainage also encompassed the north ravelin remains unclear, as plans showed a catchment in the proper position, but no drain. The redan and the south ravelin never constituted part of this system as both were constructed much later. There was no record of any such drain ever having been built at the south ravelin salient. The redan, on the other hand, being the lowest section of the fort, was accompanied during its construction by the almost simultaneous building of a main drain running from the parade ground out beneath the redan salient angle onto the glacis and down to Brunswick Street. As the main drain was initially designed by Nicolls' successor, Colonel Boteler, this structure understandably resembled the ditch drainage, at least in configuration. It incorporated a mid-ditch catchment and glacis drain through the salient, but with an additional section running into the parade to another catchment there. This redan main drain would have been finished by about 1842-1843.²

Two plans, dated 1854 and 1856 respectively, illustrating the soldiers' privies in casemates 54 and 55 showed a drainage complex in which the privies emptied into a soil pit connected to a mid-ditch cesspit behind the west curtain wall by a drain through sallyport 4. Another drain running along the ditch drainage at the west ravelin salient angle, which, in turn, ran down to three cesspits on the glacis. A pump was located at the salient of the west ravelin at the junction of the two systems, and a drain from the west ravelin interior also connected to this complex. Whether all ditch drains had this run-off configuration, or if this was reserved solely for drains also used to carry away privy wastes, has not been determined.³

In the 1858 proposal for a cunette in the ditch, included in the ordnance estimate for 1858-1860, the catchment - drain complex appeared as still existing at the ravelin and northwest demi-bastion salient angles. The southwest demi-bastion and southeast salient arrangements were off the angle, while the catchment at the northeast salient was listed as having been converted to a well due to the fact that it did not freeze in winter.⁴ Another 1858 plan, although largely concerned with the tank water system, showed the ditch drains in the same general locations, but with some alterations. The northeast salient catchment was shown inexplicably moved to the north ravelin salient angle, the southwest demi-bastion drain exited through the south face
rather than the west face, and the northwest demi-bastion salient angle catchment appeared moved closer to the countercarp. In the plan, the main drain at the redan was shown as constructed.

B. Main Drain
General drainage and sewerage, being of less pressing importance to the official mind, were largely ignored, although early privies and stone drains were built at the Artillery Park and the South Barracks in 1801. "I have carried a large and extensive Drain (in all its windings near half a Mile) from the South Barracks to the Harbour to carry off a Nuisance which the Town had long complained of." Also, while Nicolls did institute ditch drainage, no mention of it appeared in his estimates. Interior drainage received a total lack of consideration. With this discovery, Colonel Boteler set about designing a main drain leading from the parade ground, through the redan and down the glacis to Brunswick Street. Boteler's premature death in 1833, and the corresponding loss of plans at sea terminated his proposal, yet his ideas influenced his successors to a great extent. Captain Peake's subsequent proposal placed the drain in the same location but reversed Boteler's design of a stone drain with curved top and level bottom, to one with a straight roof and concave floor. As this plan was not accepted either, Colonel Jones was forced to submit one of his own in his 1834 estimate. This proposal basically constituted a reassertion of Boteler's design, with the drain being of approximately the same size, shape and position. Again, the plan failed to achieve acceptance, and in 1836, Jones submitted another main drain design in his estimate of that year. This new proposal offered two alternative designs, one with a straight floor, and one with a concave floor. Both had curved roofs. The concave version was finally accepted and constructed to the therein listed specifications. This (5'6" H x 6'6" W) main drain, built at a depth of 3 feet below ground level, was designed to extend 761 feet from the parade ground, beneath the redan salient angle, down the glacis to Brunswick Street. It was then supposed to run across Brunswick Street to Buckingham Street, and thence to the sea. Construction of that section of the main drain extending from the parade ground down onto the glacis to Brunswick Street ended in the early 1840's. As the lower end of the line was not built at this time, the drain largely carried away waste
water. As late as 1856, the privies in casemates 54 and 55, continued to empty into a system of drains and soil pits which carried the wastes out to glacis cesspits. In 1860, with the reforming of the glacis and Halifax's first steps towards the moderization and standardization of the city drainage system, tenders for the "Formation of a covered drain from the Citadel Glacis down Buckingham Street, into the dock at the Military Store yard" were received. Subsequent plans show the drain built as originally designed.

C. Wells
The Citadel Hill water supply constituted another substantial problem, and, as a result, absorbed much time and effort in attempts to successfully rectify the situation. Emphasis was initially placed on the hand-built stone wells in casemates 18 and 49. The casemate 18 well, with a diameter of 5 feet and a depth of 160 feet, held about 18850 gallons, while the older casemate 49 well, although wider at 6'3" in diameter, possessed a depth of only 60 feet, with an approximate capacity of 11016 gallons. (It is to be noted that these dimensions and volumes were taken from an 1891 plan which provided the most detailed figures on the wells. While the diameters have remained unchanged, the constant accumulation of silt has affected the depths and, therefore, the capacities of both wells through time. The casemate 49 well was listed as being 54 feet deep in 1846, 50 feet deep in 1855, and 60 feet deep in 1891. The casemate 18 well depth also fluctuates in records from 144 feet in 1855 to 160 feet in 1891.) In 1831-1832, the faces of the north ravelin revetment were constructed of unequal length in order to accommodate the well in casemate 18, and the redan was extended to include the casemate 49 well. As they continued to provide water, even in the driest seasons (the water level in the casemate 18 well never dropped below 50 feet), it was considered worth the inconvenience. It was also proposed that while building the rampart, that the casemate 18 well be covered with an arch and possess a communication with the interior of the fort. The 1836 estimate argued for a new well to supply drinking water for the troops, but this was not acted upon. In the 1846 supplementary estimate, Colonel Calder put forward two proposals concerning wells. Item 4 showed the well in casemate 49 in conjunction with a plan to place a water tank under the gunroom in casemate 50. The tank and well were connected by a pipe through the casemate
common wall, probably indicating that the well was supposed to serve as an overflow catchment. Item 5 put forward a plan for an underground communication from the musketry gallery, north front, to a second well on the glacis directly below the northeast salient angle. The well was to be fitted with a pump, and to have an adjacent manhole. 15

Neither system was ever built, and the glacis well was not mentioned again. 16 By the 1850's the wells had fallen into disfavour. The casemate 49 well was covered with floorboards, and therefore difficult to reach. The casemate 18 well, on the other hand, possessed a much more dramatic reason for its not being used. In February of 1851, the remains of a sergeant missing since the night of the 11th December 1850 fire were found in the well. Citadel Hill personnel were understandably unwilling to use this water thereafter. 17 With the construction of the parade ground water tank complex, interest in the wells waned. In 1858, the catchment at the northeast salient angle was converted to a well since it did not freeze in winter, but this seemed to have been a very temporary measure. However, soon afterward, the wells, were literally forgotten, only to be 'rediscovered' in 1869. Thereafter, record of their locations were kept, at the very least for access to a back-up water supply.

D. Surface Drains/Staunching/Tanks
These elements of ditch drainage, main drain, and wells formed, in their development, the basic framework upon which the rest of the system grew. Colonel Jones, in his 1836 estimate, included a proposal for surface drains for the rampart and fort interior (probably parade level). 18 The rampart drain was designed to run along the rear of the retaining wall, but of the location of the interior parade drains there was no indication. The rampart arrangement was a simple pattern of surface drains built of pebbles "laid on edge", and was meant merely to carry surplus water to the fortifications. Inexplicably, no explanation as to how the water would get from the ramparts to the parade ground was ever given. Apparently, this particular system did not seem to have been built at this time. In 1846, however, Calder proposed adding hopperheads, stack pipes and gargoyles, in order to improve the drainage of surplus water away from the masonry. 19 Logically, this indicated that some sort of surface drain complex had been built be-
tween 1836 and 1846 to which these details could be added. As no drainage plans survived from this decade, however, the configuration implemented is a matter for open speculation. Some type of temporary surface gutters was probably built on the ramparts, at the rear of the retaining wall. Since the rampart drainage problems have remained relatively constant through time, this early system was probably quite similar in position and design to what now exists. Possible locations for the mysterious parade ground surface drains were placed around the south magazine and along the south-east salient; the south magazine because of its contents; the east front because it was the low side of the fort, the natural place for parade ground run-off to collect; the northeast salient north face because the north section of the fort possessed a tendency to be wet. But this was not the end to the confusion.

It was at this point that the parallel problems of water supply and casemate staunching began to merge with the basic drainage difficulties. As the water supply from the wells was no longer considered adequate or reliable, due probably to the increase in staff in the fort or a decline in the condition of the wells, Colonel Calder, in 1846, submitted a proposal to construct two filtered water supply tanks under casemate 50. Surface water from the rampart would be collected by a drain complex, run through a charcoal and sand filtering system and stored in the tanks. The well in casemate 49 was to be connected to the tanks by a pipe, perhaps to accommodate water overflow. In response to this proposal, modifications were suggested for the surface drainage. Some plans show surface gutters encircling the south magazine, but nothing definite was indicated for the parade ground. The 1836 and 1846 estimates had allowed for rampart surface drains for only the northeast salient and the redan. This system emerged as inadequate even on the drawing board, especially as the pebble construction proposed would suffer from the climate. It was never built. This made the efficient disposal of rampart water crucial and by 1848, the early plans were abandoned for granite gutters running the entire circumference of the rampart retaining wall. Also, in 1848, a number of drains were installed under the parade ground running: from casemate 54 to cavalier casemate 9, through cavalier casemate 9 and 8 and out across the parade ground to the redan salient inner catchment; in casemates 5 and 6, and from
them to the southeast salient redan re-entrant angle, and then along the redan south face to connect with the main drain at the redan salient; in casemates 7 and 8, and from them to join with the line from the south cavalier to the main drain; from the north magazine southeast corner catchment to cavalier casemate 11, through cavalier casemates 11 and 10, and out across the parade ground to the catchment opposite the rampart stairs between casemates 33 and 34, with a connecting line from casemates 13 and 14 to the line between the north magazine and the cavalier; from the south magazine to connect with the casemates 7 and 8 line to the cavalier pipe, with an adjacent connecting line to a catchment at the northeast corner of the south magazine; along the redan north face and the southeast salient east face from casemate 2 to demi-casemate 11. (This description is as accurate as could be deciphered from a black and white photostat of a color coded original, showing both existing and proposed lines). In 1849, the granite gutter complex, together with the system for draining the northeast salient and redan rampart water into the suggested casemate 50 tanks, was resubmitted in the estimate of that year. Water from other sections of the fort would run into the waste drains. Should this waste water be needed for consumption, however, provision was made to enable the connection of conduit pipes to the vertical run-off pipes in order to carry this water to proposed tanks in casemates 13, 14, 15, or 16, or in fact anywhere most convenient, if required.

At this point, the necessity of instituting an effective staunching program achieved top priority, and all previous schemes for drainage and water supply were quickly modified. The arrangement of gargoyles and parade surface drains, supposedly designed to drain the dos d'anies of the casemates, froze solid in winter. Consequently, the 1849 estimate put forward the concept of substituting an interior down pipe to connect with an underground drain system. A number of variations on this common theme were included, unfortunately without any clear indication as to which proposal was constructed. Granite gutters running all around the interior retaining wall, and with basin stones, gargoyles, and hoppers installed at regular intervals, was also constructed. The entire system connected into a complex of subterranean pipes which carried the water to the tanks.

In terms of the water supply system, the tanks under casemate 50 were
deleted from the plans and three filtered tanks under the parade ground were substituted. Two (62'L x 23'W x 8'D) main tanks of 66,000 gallon capacity were to be built in the northeast and southeast salients, and a smaller (60'L x 10'W x 8'D) reserve tank of 30,000 gallons located behind the redan roughly equidistant between the two others. Water from the granite surface gutters flowed into the tanks through a pipe system and filtered through two gravel-sand-charcoal filters into the five arched storage compartments. The three tanks were constructed of stone, lined with brick, and sealed with a top layer of asphalt (brick?). The reserve tank also possessed an overflow pipe running to the casemate 49 well. Casemate run-off was channelled into the main drain. The northeast salient tank appeared in the section and elevation plan for 1852, and all tanks were definitely in use by 1855. Unfortunately, they did not immediately afford a supply of drinkable water. The 1856 committee instructed to examine the Citadel in its existing state, reported as follows:

10. On the 26th October 1855, after the Citadel had been in the course of construction for 27 years, only one tank was reported as having water in it. -

A Medical Board inspecting it declared it neither fit for culinary or internal purposes. -

What state is it in now, and what supply of water is in the remaining tanks?

10. The water in the North tank is reported by a Medical Board held on 1st April 1856 as being clear, of good quality and fit for all purposes. -

The water contained in the south tank is impregnated with lime and unfit for drinking or culinary purposes. -

That the water contained in the reserve tank is muddy and contaminated with lime and other impurities rendering it also unfit for use. -

The north tank is now 8/9ths full; the other two are quite full. -

In all, the entire system lasted in active service less than twelve years, as the city water was run in from Royal Artillery Park by 1868. The water tanks were maintained, but the rest of the system was neglected.
Subsequent to this concentrated flurry of activity, little changed in
the system aside from the extension of the staunching program to the cavali-
er and the south magazine shifting room. The south magazine rampart
granite gutters were reset in cement at this time, and a subterranean drain
built from the mid-point of the south magazine east wall to the enclosing
blast wall to connect with the catchment drain complex carrying waste water
to the main drain, as well. Construction of a 200 foot drain system for
the south magazine ramp to prevent dampness in the casemate 7 artillery
store also took place (a sixty foot piece of this drain still exists, as
does the main granite catchment stone). Hence, by the 1860's drainage, both
underground and superficial, was considered sufficient, save for those times
when unusual amounts of rain or snow had fallen. Sanitary facilities (lava-
tories, urinals, latrines, sewers) remained scanty, but the water supply
proved abundant, especially after the water from the Halifax waterworks was
introduced into the Citadel.

E. Composite Plans: British Period
An undated basement plan, tentatively dated 1870, showed the entire drain-
age system as probably existing towards the close of the initial develop-
ment period. The ditch drainage still survived as before, but with the
northeast salient catchment again connected to a drain. The north and
south ravelins stood clear of any part of the system. The north ravelin
salient angle ditch, if it had ever existed, had apparently not survived
to this date; the south ravelin, like the redan had never really been part
of this complex. The fate of the ditch drainage system remains unknown, as
subsequent plans never mentioned ditch drainage. The entire water tank com-
plex and casemate staunching arrangement was shown, as was the water line run
in from the Royal Artillery Park, through the south ravelin east ditch, to the
tank house in front of casemate 54 and the parade ground reserve tank. An-
other pipe ran water from the reserve tank into casemate 47B, while water
run-off was carried from the northeast and southeast salient ramparts, the
cavalier, casemates 11 and 33, and the south magazine ramp to the two large
water tanks. The wells in casemates 18 and 49 were also duly recorded as
was the reserve tank-casemate 49 well overflow pipe. Surface drains carry-
ing waste water ran all along the parade side of the two northeast salient
faces, the redan, and the east face of the southeast salient, and emptied into the main drain. Additional subterranean systems from both magazines, the cavalier, casemates 5 and 6, and the west front connected with the fort from the privies in casemates 54 and 55, through sallyport 4, around, mid-ditch, to connect with the main drain at the redan was also added (date unknown). The separate casemates 51-52 and 57-58 surface drain-drain pipe arrangement emptied into the ditch. The main drain remained unaltered. Surface drains were not shown around either magazine. This was rectified by about 1882. A plan of that year showed drainage systems around both magazines. The south magazine had a narrow stone surface drain running all around the circumference of its surrounding wall close to the foot, with a main catchment in the middle of the blast wall, from which the waste water drained into the main drain complex. The north magazine and the wall, with a catchment at the southeast corner, also connected to the main drain complex. It is to be noted that the south magazine corner gutters and down pipes shown on the 1870 plan did not appear on that for 1882, although a similar configuration was shown for the north magazine instead.

In general, beginning in the 1870's, a concentrated move to replace the old cesspits with privies and dry earth closets commenced. Unspecified flushing apparatuses were introduced to the Citadel, although the height of the hill made the generation of sufficient pressure difficult, especially in winter. In 1873, a major flushing out of the entire drainage system occurred, followed by construction of glacis drains and modernizing of existing systems in the years after. At this same time, Halifax also improved their own water and sewerage complexes. A women's latrine appeared in the fort in 1881, although the question as to whether this was a reference to the women's and children's latrine in casemate 55 or to a new development remains unresolved. In 1887 the three water tanks received a thorough cleaning, and the north tank was whitewashed. Adjacent drains were altered to prevent contamination.

Three 1891, ground plans illustrated the entire drainage system as constructed to that year. The 6" cast iron water line run in from Royal Artillery Park had been modified to follow a path directly across the parade ground from where it entered through the south ravelin ditch. It crossed to a point, about forty-five feet north of the north end of that building. Out on the glacis, a subordinate water line ran from the main line to the town
clock, while within the fort, auxiliary lines ran into both large water tanks, the ablution rooms in casemate 23, demi-casemate 12 and cavalier casemate 4, the casemate 42 and demi-casemate 8 latrines, the casemate 46B scullery, the casemate 28 sergeant's mess, and both ends of the cavalier for the cookhouses. The already installed lines to the tankhouse behind the cavalier and the reserve tank had been slightly altered accordingly to accommodate the change in the main line. Also, the flushing tanks themselves had apparently been moved from outside casemate 54, and either re-located into demi-casemates 39 and 40 or replaced by more modern models installed therein. Hence, as of 1891, two flushing tanks were to be found in demi-casemates 40 and 41: a large cast iron tank (6'L x 6'W x 6'D) holding 2592 gallons, and a smaller tank (9'L x 5'9"W x 5'D) of wood lined with lead having a 621 gallon capacity. A urinal had been placed in demi-casemate 41. The reserve tank line remained largely as before, although the overflow line to the casemate 49 well had disappeared. The rampart drainage to the tanks stayed the same, and surface drains had been added around the south-east salient coalstore, the cavalier and the entrance stairwells to casemates 51-52. The wells were illustrated with accompanying descriptions. The casemate 18 well was 5 feet indiameter and 160 feet deep and held 18850 gallons, while that in casemate 49 had a diameter of 6 feet 3 inches, a depth of 60 feet and a capacity of 11016 gallons. Both were built of stone. Altogether, in addition to the water being pumped in from the city, the Citadel had a water supply of 195069 gallons from the three tanks, two wells and two flushing tanks. Both magazines are illustrated with their surface drain systems, but once again the south magazine corner gutters were omitted, while those for the north magazine did appear. The down pipe positions were shown for both. The ditch drain complex was not shown, but the 12" main and catchment arrangement appeared in the north end, connecting with the main drain at the redan. The path of this main brick sewer was also shown running in a direct line down to the junction of Buckingham and Brunswick Streets, and then down Buckingham Street to the sea. This complex was altered slightly with the construction of the brick block in 1899-1900. The area where the building was erected was totally disrupted. The water pipe to the demi-casemate 39-40 tank house was cut off, and the drain from the west front along casemates 7 to 10, and 53, taken up. Proposals were made to replace the case-
mate 54 and 55 urinal drain in sallyport 4, as well as the mid-ditch soil pit, but whether or not this was done has not been verified. The complex of drains, underground pipes and catchments designed to service the new brick block was installed, and the 6" stoneware pipe located between the brick block and cavalier and connecting to the main cavalier drain leading to the redan was stopped up. The 6" cast iron water main remained undisturbed, however. Also, at this time, the sallyport 4 end of the 12" tubular drain was extended to connect to a manhole from which additional lines ran in front of casemates 11 through 14 to a manhole outside the blast wall at the southeast corner of the north magazine, to another manhole opposite the centre of the magazine, to yet another manhole at the northeast corner of the magazine. Subordinate lines from casemate 14 and the north magazine mid-point proper connected to this line, as well. This was the last occurrence of major change recorded for the system in the British period, other than the renewal of the cavalier front surface drain, the introduction of heating apparatus in unidentified latrines and the installation of a drain pipe from the brick block to the main drain in 1904. Aside from some very minor alterations (i.e. gutters), the system remained static until the Canadian takeover.

The Canadian Period

The Canadians promptly initiated alterations. The 1908 ground plan showed a system somewhat changed from that of 1891. The 6" cast iron water main entering from the south ravelin connected to a 4" pipe just inside the interior wall. Whether the previously listed 6" pipe in this location was replaced, or whether that description can be attributed to a draughting error, or whether the contractor installed a 4" pipe and charged for a 6" pipe, the reason has not yet been determined. In addition, pipes were added and removed in all areas of the fort. New lines included pipes from the catchment at the outside southeast corner of the south magazine to the south tank, from the south magazine outside northwest corner to the south magazine ramp catchment, from the catchment at the brick block northwest corner to the cavalier south end
catchment, and from the casemate 9 catchment to that near sallyport 5 to the sallyport 4 catchment linked to the line running to the canteen (north magazine). Small lines were added at the canteen and near casemate 49 to facilitate drainage. The pipe at the cavalier north end was shifted to connect with the northeast salient-redan re-entrant angle manhole. Pipes missing from this plan, either removed or cut off, included two cavalier lines connecting from the mid-point of the east front and from the south end to the main drain at the redan and the line joining the canteen south-east corner manhole to the cavalier northwest corner catchment. The system was simplified by merging a number of small lines at the redan and the north and south ends of the cavalier. Four wells appeared, the old ones in casemates 18 and 49, and two new ones in the ditch. The well in the ditch at the north ravelin serviced the laboratory lightning conductor which had appeared by the 1870's. The other, located mid-ditch opposite sallyport 4 seemed to be the old catchment from the casemates 54 and 55 latrines, rather than a well. The main drain from the redan was still shown following its original course.¹

Subsequent modifications continued to occur, but not frequently. A second plan in 1908, and another in 1910, showed the 4" cast iron water main from the city cutting across the parade ground with subordinate lines to the town clock, all three tanks, the brick block, the north and south cavalier cookhouse, the canteen, the casemate 46B coffee bar, the casemate 23 ablution room, and the casemate 30 front addition and 42 urinals. The 12" main and main drain remained unchanged, as did the tanks. Still extant surface drains serviced the northeast salient, the southeast salient east face, the redan and the cavalier. Drainage systems also existed for the southeast salient south face, the redan, the northeast salient, the cavalier, the brick block, the west front and the canteen.² Various plans showing details, such as weepholes and urinal layouts, also exist.³ By 1922, a meter had been installed at demi-casemate 18, at the point where the city water main linked up with the Citadel system, and new additional lines had been run to the lavatories in casemate 14 and demi-casemate 12. The pipe to casemate 42 disappeared, as did those from the southeast to the southwest corners of the canteen, the casemate 46, and the surface drain at casemates 51-52. New lines appeared from casemate 28 to the mid-ditch catchment at the northeast salient-redan
junction of the main line, from the brick block northeast corner catchment to the main drain and to the south cavalier cookhouse (water). By 1924, the pipe from the brick block to casemate 9, and the water-line to the south cavalier cookhouse no longer existed. The subordinate water line running to casemate 39 had been altered to connect to the main water line at the brick block northwest corner catchment, rather than at the stopcock in front of the brick block as previously shown. The city waterline which connected to the demi-casemate 18 meter appeared as a 9" main, but this most likely constituted an error as all other sources gave the size as 6". Underground cable lines (electrical ? communication ?) from the Royal Artillery Park cable hut to the southeast salient signal station had been laid by 1930. No further developments occurred until 1932.

In that year began an unemployment relief project which remained in operation from 1 November 1932 to 31 May 1936. Of the total man days involved in this program, 3.6% were expended on pathways and drainage. Effort was made to clear the wall and ditch drains, and especially the blocked drain at the corner of the west and south counterscarps of the southwest demi-bastion, probably the old ditch drain. Bad weather conditions forced the abandonment of the latter project before successful completion. Crews also attempted to reactivate unidentified ditch drainage. (Due to alterations between 1838 and 1858, the exact style and configuration of the then surviving ditch drainage remains obscured). They repaired the west ravelin angle drain, and excavated 51 feet of the wooden drain where it opened onto the glacis, and renewed it with tile. The operation required a 17 to 18 foot deep trench. At casemate 28, a new drain to the ditch sewer was installed to accommodate the new toilets, urinals and washbasins therein contained. Yet even though the crews worked on the ditch drainage, the 1936 plan draughted in accordance with the project did not show the old ditch drainage system or any other, for that matter. Instead, in illustrating the surface drainage system for the entire hill and glacis, it showed a surface drain running mid-ditch all around the fort, including encircling the three ravelins, in approximately the same location as the cunette. An aerial photograph from 1942 showed a mid-ditch crease in this position, while a 1963-1964 photograph illustrated an open ditch in the 'moat'. No further or more definite references are available. At present, an underground storm
sewer exists at approximately the same location.9

Between 1936 and 1950, little of consequence occurred concerning the drains. Such items as hydrants, water shut-offs, lavatories and heating and lightning systems were introduced and improved, but they did not result in any major change in the drainage system.10 In 1950, Citadel Hill became the property of what is now Parks Canada. Underground cables for floodlights, fire alarms and electricity were laid, undoubtedly resulting in the disturbance of certain sections of the drainage system. Constant adjustments of such items as gutters, down pipes, pressure pumps, hydrants and public toilets continued in the name of maintenance and visitor services.11 The installation of a service tunnel into the redan in 1969 constituted a final major modification, but subsequent developments have undeniably resulted in unrecorded upheaval.12 The survival status and present condition of the Citadel Hill drainage system remains largely a matter of speculation.
Figure 1

Code: 108-01-2-831-0201

Title: Plan showing the revetment of the north ravelin and section of the same as proposed to be built on Citadel Hill.

Signature/Date: G. Nicolls, Colonel, CRE; 2 May 1831.

Scale: 1" = 15'. Notes: plan, sections, notations, schedules.


Comments: This section plan of the revetment of the north ravelin shows the well in casemate 18. "These faces are not of equal length owing to the well interfering; but as it is very deep, and afforded more than 50 ft. of water in the driest seasons, when other wells gave none, it was thought worth preserving. It is proposed when the rampart is forming, this well should be covered with an arch, and have a communication with the interior of the Fort."
Those lanes are not of equal length owing to the Wall interfacing, but as it is very deep and afforded more than 600 feet of water in the driest seasons when other wells gave none, it was thought worth preserving. It is proposed when the rampart is forming the well should be covered with an arch to have a communication with the interior of the Fort.

[Map with annotations and scale at bottom: Scale of 10 feet to an inch.]
Figure 2


Title: Halifax Citadel - Escarp Eastern front and Main Drain.

Signature/Date: H.W. [Wentworth]; 1 February 1836.

Scale: 1" = 2'. Notes: section, elevation, notations.


Comments: This plan shows two alternate designs for the main drain. That with the curved floor was the version finally constructed. This comprised one of sixteen plans from Jones' revised estimate.
Figure 3


Title: Plan and elevation of counterscarp and gallery.

Signature/Date: S.B.H.; 19 October 1838.

Scale: 1" = 20'. Notes: plan, elevation, notations.

Source: PANS, RE 20, unpaginated.

Comments: This plan and elevation of the counterscarp opposite the north-west demi-bastion shows the foundation, drain and counterscarp, as built. The drain which appears at the angle of the north-west demi-bastion, was listed as having been built in 1829. It was constructed to run from the ditch through the counterscarp wall to the glacis.
A combined with plans dated 10 July 1836 and 13 May 1837. The dimensions are different, those plans being shown as drawn by the surveyor, while the present shown are the plans.

21st Oct. 1830

H. W. Bostrom

Elevation of B.A.C.

Scale 20 feet to one inch.
Figure 4


Title: Halifax Citadel - Elevation and Section of Proposed Hopper Heads to Enclose Weepers.

Signature/Date: Calder, R.E.; 31 March 1846.

Scale: 3" = 1". Notes: elevation, section, scaled.

Source: PAC, MG 12, WO 55, vol. 880, fol. 968

Comments: This was item #8, produced to accompany the supplementary estimate of 30 March 1846. (see 108-01-1-846-0003)
Item No. 2

Elevation and Section of Proposed
Upper Heads to Trunck Wharf

To accompany the Tally Ho

Elevation Dated 31st March 1866
Figure 5


Title: Plan and Elevation showing the Situation of Proposed lightning Conductors to the Magazines.

Signature/Date: P.D. Calder, Lt. Col., CRE; 31 March 1846.

Scale: 1"=10'; 1"=20'. Notes: plan, elevation, scaled.


Comments: This was item #7, produced to accompany the supplementary estimate 30 March 1846. This plan shows the surface drain and the southeast corner catchment between the magazine and the blast wall.
Figure 6


Title: Halifax Citadel - Plan and Section of Proposed Underground Communication from the Gallery North Front to the Well on the Glacis as shown on General Plan at K.

Signature/Date: Calder, R.E.; 31 March 1846.

Scale: 1" = 10'. Notes: plan, section, scaled.


Comments: This was item #5, produced to accompany the supplementary estimate of 30 March 1846. This proposed passage was never built. The plan provides useful information on the glacis well.
Figure 7


Title: Halifax Citadel - Plan and Sections of Tanks for a better Supply of water proposed to be Constructed under Gun Room marked AE East Front.

Signature/Date: Calder, R.E.; 31 March 1846.

Scale: 1" = 10'. Notes: plan, section, scaled.


Comments: This was item #4, produced to accompany the supplementary estimate of 30 March 1846. This illustrates a proposal involving the installation of water tanks under casemate 50. While the proposal was never adopted, the plan and section are useful as they show the well in casemate 49.
Figure 8.


Title: Halifax Citadel - Plan and Elevation showing the proposed method of supplying the Water Tanks with the Surface water from Terre-plan from the point A to E as marked on Plan also Plan and Section of Hopper and Pipe to be inserted in Surface drain to convey Water to main pipe as a,a,a, on Plan.

Signature/Date: Calder, R.E.; 31 March 1846.

Scale: 1" = 40'; 1" = 1'. Notes: plan, elevation, section, scaled, notations.


Comments: This plan details supplying the water tank with terreplein surface water. It also shows the plan, elevation and section of the hopper head and a drawing of a pipe elbow meant for insertion in the surface drain in order to convey water to the main pipe. The elevation illustrates the entire rampart retaining wall from casemates 15 to 50. The water system eventually installed was a greatly modified model. (See 108-01-2-858-0200)
Figure 9

Code: 108-01-2-848-0001

Title: Halifax Citadel - Plan and Sections showing the Method proposed... to prevent the Casemates from leakage at this station.

Signature/Date: Savage, CRE; 28 December 1848.

Scale: 1" = 8'. Notes: plan, section, notations, scaled.

Source: PAC, MG 12, WO55, vol. 883, fol. 838

Comments: This was item #4, produced to accompany the CRE's letter of 28 December 1848. The interior drainage system herein illustrated entailed cutting a hole through the haunch of the casemate arch and placing the pipe down on of the outside corners of the casemate. This is one of five plans encompassing Colonel Savage's proposal.
Figure 10

Code: 108-01-2-848-0002

Title: Halifax Citadel - Plan and Sections shewing Casemates "Flagged, Hipped and Piped" "Flagged and Hipped" and Flagged only.

Signature/Date: A. Smith, Lt. R.E. and others; 28 December 1848.

Scale: 1" = 8'. Notes: plan, section.


Comments: This was item #2, produced to accompany the CRE's letter of 28 December 1848. This plan illustrates the dos d'anes, while the section shows a block of six entire casemates. The proposal, possibly Savage's, presents three different drainage systems.
Figure 11

Code: 108-01-2-848-0005A.

Title: Ground Plan Shewing the Casemates Numbered 1 to 54 and the Situation of Proposed Down Pipes and Drainage, to carry off the Water from the Vallies between the Dos d'anes.

Signature/Date: Savage, Col. CRE; 28 December 1848.

Scale: 1" = 40'. Notes: plan, notations, scaled.


Comments: This is the right side of what was item #1, produced to accompany the CRE's letter of 28 December 1848. This plan shows the proposed casemate drainage system. It was altered substantially in the installation. (see 108-01-2-858-0200)
HALIFAX CITADEL
NEW SCOTIA.

Ground Plan Showing the Garrison. Measured 2d. 6th.
and the Situation of Proposed Drain Pipes and Vents,
&c. to carry off the Water from the Wallies between the

Bar & Canteen. - To accompany the full Plan Agreed
Letter of the 20 Dec. 1820.
Figure 12

Code: 108-01-2-848-0005B

Title: Ground Plan Shewing the Casemates Numbered 1 to 54 and the Situation of Proposed Down Pipes and Drainage, to carry off the Water from the Vallies between the Dos d'anès.

Signature/Date: Savage, Col. CRE; 28 December 1848.

Scale: 1" = 40'. Notes: plan, notations, scaled.


Comments: This is the left side of what was item #1, produced to accompany the CRE's letter of 28 December 1848. This plan shows the proposed casemate drainage system. It was altered substantially in the installation. (see 108-01-2-858-0200)
Figure 13

Code: 108-01-2-848-0007

Title: Plan of Counter flagging Gutter Section AB.

Signature/Date: several unclear; 1848.

Scale: none. Notes: plan, notations


Comments: This sketch details the hipping and counter - flagging undertaken in covering the 1846 casemates. (see 108-01-2-848-0001 and 108-01-2-848-0005}
Said consideration of a mine, will include the ideas of covering the lip of the bank with a wall, which the original drawing was from. As in the manner and method of placing the water from the reservoir and exterior to this side of the bank. If the water is placed behind the wall, and more water added to the pool, it has proved this by which means the water from the bank must pass over the side and face of the wall.

In those cases where the position of the wall is not mentioned the water will be sent directly into the wall although the earth of the deposit and surrounding areas may be Themes in an unfinished state.

Sand in consequence induced to deposit itself, forming the bottom of the canyon.
Figure 14

Code: 108-01-2-848-0200

Title: Longitudinal Section through the line IK shewing the Casemates as Flagged, Hipped and Piped.

Signature/Date: Savage; 28 December 1848.

Scale: none. Notes: section.


Comments: This is a part of 108-01-2-848-0003.
Casemates as Plugged.

Longitudinal Section thru. E.K. No 1.

Shewing the Casemato as Plugged and Hipped, and P'ded

[Signature]

Comm'd. Nath. Greene
19th Dec'r 1769
Figure 15

Code: 108-01-2-849-0004

Title: Fort George or the Citadel - Plan shewing the position of the proposed granite Surface Gutters with reference to the project for Staunching the Casemates.

Signature/Date: Savage, CRE and others; 30 April 1849.

Scale: 1" = 40'. Notes: plan, notations, references.


Comments: This plan shows the gutters as they were built. It was one of eight plans drawn to accompany Colonel Savage's staunching estimate of 30 April 1849. (see 108-01-2-848-0001 to 108-01-2-848-0007 and 108-01-2-856-0002)
Figure 16

Code: 108-01-2-849-0005

Title: Fort George or the Citadel - Sections of Cavalier showing the mode proposed for tendering the arches secure against leakage by the introduction of pipes and drains as proposed for the Casemates.

Signature/Date: Savage, CRE and others; 30 April 1849.


Comments: This plan shows two sections of the cavalier casemates with their drainage system. It is one of eight plans drawn to accompany Colonel Savage's staunching estimate of 30 April 1849. (see 108-01-2-848-0001 to 108-01-2-848-0007 and 108-01-2-856-0002.)
Halisjac Nova Scotia
Fort George, No. 4 Block

Section of Battery shown. The mode, prepared for
Mounting the joinin guns against

Steeply the erases of higher and lower as required
for the casemates

To accompany the Plans of Halisjac Nova Scotia

Commissioned by R. J. B. Jackson

Fortified by R. B. Armstrong

Drawn on 20th April
1838

Section on the line of gunport No. 10

1 mile = 1000 feet
Figure 17

Code: 108-01-2-849-0006

Title: Fort George or the Citadel - Sections...showing the mode proposed for staunching the leakage in the Arches of the Casemates...

Signature/Date: Savage, CRE; 30 April 1849.

Scale: 1" = 10'. Notes: section, figure, notations.


Comments: This plan was part of the 1849 staunching estimate. The sections show the casemate drainage, while the two figures detail the drain pipes. (see 108-01-2-848-0001 to 108-01-2-848-0007, 108-01-2-849-0202 and 108-01-2-856-0002)
Figure 18

Code: 108-01-2-849-0011

Title: Ground Plan - Fort George or the Citadel, Showing the position of the proposed Pipes and Drains with respect to the mode proposed for staunching the leakage in the arches of the Casemates and for providing against a similar contingency in the Cavalier...

Signature/Date: Savage, Lt. Col., CRE; 30 April 1849.

Scale: not given. Notes: plan, memorandum, scaled.


Comments: This ground plan shows the proposed drains for carrying off the water from the casemate dos d'anies. It forms part of the 1849 staunching estimate, and shows existing and proposed drains plus catchments and the two wells. The system illustrated here was later much altered. (The well in casemate 18 is not included in this photograph of the plan.)
Figure 19

Code: 108-01-2-849-0208

Title: Gargoyle and Surface Gutter

Signature/Date: Savage; 30 April 1849

Scale: not given. Notes: section

Source: PAC, MG 12, WO 55, vol. 883, fol. 854

Comments: These two small sections of a gargoyle and one small plan showing
the surface gutter behind the rampart retaining wall and the upper
portion of the wall are included in the text of Savage's staunching estimate of 30 April 1849.
Item 5

can be waste in the engines and boilers, but would it be found in general to
be unnecessary. To communicate by a pipe, it can be collected into a pit by
the natural effect of gravity, provided by means of siphonage, or shallow
trenching in the bank which would be constructed in either of the culverts
13. 14. 15. 16. 17. which are other tributaries that may be considered main drains.

By not removing the earth from the bottom of a surface at all, back of
the crest of the scarp of the west, south front of the
first floor of the building 18 x 24. 239. remove the stuff to a
distance of 200 yards. Provide a 1 ft 30 inch channel down 2948 02 3. 97
which would reach a horizontal water pipe cemented with common cement,
and a 3 ft. 3 inch channel with gages 5 3 2 1 1 0 0 0 0 0 0 0
at 250.2, 250.2, etc. in Roman concrete and the remainder in
common cement for the purpose of introducing the gages of

Before proceeding with the earth from the building, 1st floor, 2nd
floor, 3rd floor of 18 x 24. 239. collect 280 x 5 2 4 6.8 from the ground
over same amount the seepage half 20 x 2 3 2 4 6.8, and close 200 yards.
Boat about 70% to clean 200 x 12, through the side of the
elevator building. 2. Thick the bottom of the left corner of 3 inch
left hand from 3 rice squares painted and laid.

Latimer Dock.

Ponding for 1st 2nd 3rd floor
2.5 3 2 4 6.8 190
4 3 2 1 0 0 0 0 0 0 0 0
Two 2 0 0 0 1 0 0 0 0 0 0 0

Ponding for 1st 2nd 3rd floor
2.5 3 2 4 6.8 190
4 3 2 1 0 0 0 0 0 0 0 0
Two 2 0 0 0 1 0 0 0 0 0 0 0

Ponding for 1st 2nd 3rd floor
2.5 3 2 4 6.8 190
4 3 2 1 0 0 0 0 0 0 0 0
Two 2 0 0 0 1 0 0 0 0 0 0 0

The property of the gages to be painted 9 half
common cement oil.

All the materials & articles calculated for the above division,
under 1 3 1 5 3 can be delivered purely, ordered on the next 25th.

The signature of Roman cement, for which a (Edward) is
accompanied this estimate.
Figure 20

Code: 108-01-2-849-0210

Title: Casemate Gutter

Signature/Date: Savage; 30 April 1849

Scale: not given. Notes: section


Comments: This small section of casemate gutter is within the text of Savage's estimate of 30 April 1849.
The opening and dressing of the retaining and escape walls (shown in the red line on the front and section drawings) is to be taken down and reset in Roman cement and a choice 1:2.5 to cut in. The walls of cement will be the flagging of the best stone and made good with middle mixing in Roman cement. For the purpose, introduce a center table of granite 10.875 furnished with trial blocks and set in Roman cement.

The retaining wall will be the same (see drawing 6:2 and section 5:2) except that it is to be carried up to the height of 3 feet from the bottom of the opening to uncover in grand masses with brown soil bed and vertical plane, to be faced in hewn and dressed in Roman cement and set in Roman cement) to carry (and with the adjoining parapet to which it is to be bolted connected at 12:5.

The soil formed by the junction of the two faces with the escape and retaining walls of cement and stone, brought to the depth of six feet, to be enclosed and the opening made to the depth of six feet to be filled with Roman cement and a fill of the same concrete to be formed on the crown over the grade.

The drain may occur which can be removed with the water to leave the grade exposed and is slightly not to be touched and to be pointed with Roman cement. A drain, 36 inches in diameter, will be surrounded with grating at 6 feet every 12." The storm is to be kept to the right of the drain.

The drain will be formed by the removal within the excavation of the material which is to be removed and the excavation of the masonry which is to be removed and the masonry which is to be removed to the grade and is slightly not to be pointed with Roman cement. The drain will be formed by the removal within the excavation of the material which is to be removed and the excavation of the masonry which is to be removed and the masonry which is to be removed to the grade and is slightly not to be pointed with Roman cement. The drain will be formed by the removal within the excavation of the material which is to be removed and the excavation of the masonry which is to be removed and the masonry which is to be removed to the grade and is slightly not to be pointed with Roman cement. The drain will be formed by the removal within the excavation of the material which is to be removed and the excavation of the masonry which is to be removed and the masonry which is to be removed to the grade and is slightly not to be pointed with Roman cement. The drain will be formed by the removal within the excavation of the material which is to be removed and the excavation of the masonry which is to be removed and the masonry which is to be removed to the grade and is slightly not to be pointed with Roman cement. The drain will be formed by the removal within the excavation of the material which is to be removed and the excavation of the masonry which is to be removed and the masonry which is to be removed to the grade and is slightly not to be pointed with Roman cement.
Figure 21

Code: 108-01-2-850-0200

Title: Plan and Sections of Rain Water Tanks.

Signature/Date: illegible; 1850.

Scale: not given. Notes: plan, section, notations

Source: PAC, C74844

Comments: This is the earliest known plan of the subterranean water tanks.
Figure 22

Code: 108-01-2-852-0202

Title: Plan and Section of Gunpowder Magazine at the Citadel.

Signature/Date: Savage; 27 January 1852

Scale: 1" = 20'. Notes: plan, section, references


Comments: This plan, a section of 108-01-2-852-0005 shows the drain from the mid-east front of the magazine to the blast wall catchment.
Figure 23

Code: 108-01-2-856-0002

Title: A sketch of the covering of the Casemates with Asphalte

Signature/Date: R.M.P., R.E.; 12 June 1856

Scale: 1" = 15'. Notes: plan, section


Comments: This small plan illustrates the method of water-proofing finally adopted for the casemate dos d'anes, although subsequent alterations appeared as time passed. The internal piping system is as finally adopted.
FORT GEORGE
HALIFAX, N.S.

A Sketch of the covering of Casemates with Asphalte.

a. Asphalted Bricks.
b. Course Shingle.
c. Asphalte.
d. Concrete.
e. Rubble Masonry.

Section on AB.

Section on CD.

Level of Rampart.

Plan of Asphalted Arches.

Asphalted

Surface

Scale: 1/2 ft. to 1 inch.
Figure 24

Code: 108-01-2-856-0003

Title: Plans and sections showing the work executed in improving the soil pits of the Soldiers' Privies at the Citadel.

Signature/Date: Stotherd, Lt. Col., CRE; 15 January 1856.

Scale: 1" = 10'; 1" = 40'. Notes: plan, section, notations, scaled.


Comments: This plan shows the privies in casemates 54 and 55, the sallyport between the two casemates, and the cesspools, drains, etc.. The system extended from the privies, out through sallyport 4, along the west ravelin (cesspool in the ditch) and out onto the glacis to three cesspools.
Figure 25

Code: 108-01-2-858-0002

Title: Plan and Section showing...the proposed Cunette.

Signature/Date: R. Howe; 21 July 1858 and P. Nicholl Dawson, Lt. R.E.; 7 August 1858.

Scale: 1/960; 1/240. Notes: plan, sections, scaled, references


Comments: This was item #3, produced to accompany the ordnance annual estimate of 1859-1860. It is a general plan showing the connecting drains and cesspits, with reference notes. This cunette was most probably built. The plan also shows catchments and existing drains at the northeast and southeast salients, northwest demi-bastion, west ravelin, redan; there is also a catchment at the southwest demi-bastion.
Figure 26

Code: 108-01-2-858-0200

Title: Fort George - showing position of Tanks and drains for supplying them.

Signature/Date: N. Gordon, Clerk of Works (copied by J. Milkolt); 11 August 1858.

Scale: 1" = ca. 75'. Notes: plan, notations, scaled.

Source: PAC, National Map Collection H4/250; PAC, C74843.

Comments: This ground plan, a section of 108-01-2-858-0004, shows the water system as finally constructed.
Figure 27

Code: 108-01-2-859-0001

Title: Plan and Sections of Proposed Drainage of the Ramp in the Citadel in order to the Prevention of Dampness in the Artillery Store Adjoining.

Signature/Date: R. Nelson, CRE; November 1859

Scale: 1" = 10'. Notes: plan, sections, references


Comments: This was item #3, fortifications A.E. 1860-61. This proposal, showing a drain from the ramp to the main drain was never adopted.
HALIFAX, N.S.

PLAN AND SECTIONS OF PROPOSED

DRAINAGE OF THE RAMP IN THE CITADEL IN ORDER TO

PREVENT THE Dampness IN THE ARTILLERY STORE

ADJOINING

Fortification and A. E. 1160-11

Plan B.

SECTION ON LINE A-B

Reference

a. a. a. Openings for Ventilation.

Oversized drawing by Mr. Verrall, M.E.

by R. Scott E. Engraver.

Scale Refer to an end.

SECTIONAL ELEVATION THROUGH O-O

29/10/19
Figure 28

Code: 108-01-2-875-0019

Title: Halifax Citadel, Northeast Salient Interior

Photographer/Date: R.E. photo, ca. 1875.

Source: N.H.S.S. Photo Collection

Comments: The photo of the northeast salient retaining wall, right side, taken from over casemates 13 and 14, with the north magazine in the left foreground shows some of the gargoyles and down pipes for leading the water from the surface gutter to the underground pipes connected to the rain water tanks.
Figure 29

Code: 108-01-2-882-0204

Title: Main Magazines

Signature/Date: Ellsdale et. al.; 18 August 1882

Scale: 1"-15'; 1"=10'. Notes: plan

Source: P.A.N.S.

Comments: This section of 108-01-2-882-001 shows both magazines as they stood in 1882. It illustrates the drainage systems around both buildings.
Figure 30

Code: 108-01-2-891-0001

Title: Working Drawing of Tank

Signature/Date: Sapper Sutherland; February 1891

Scale: 1" = 10'. Notes: plan, sections, scaled

Source: P.A.N.S.

Comments: This is the best plan of the 66,000 gallon tank.
Figure 31

Code: 108-01-2-891-0002

Title: The Citadel, Fort George - Block Plan


Scale: 1" = 40'; 1/2500. Notes: plan, site plan, scaled, notations, references.

Source: PAC, National Map Collection

Comments: This plan shows the entire water and drainage system, with two tables listing the water tanks capacities and accommodation. It also shows the main drain route from the redan, across the glacis and Brunswick Street, and then down Buckingham Street to the sea, as well as the 6 inch water main coming in from the city and the 3/4 inch offshoot to the town clock. (see 108-01-2-891-0200 and 108-01-2-891-0203)
Figure 32

Code: 108-01-2-891-0201

Title: The Citadel or Fort George-Ground Plan

Signature/Date: A. Hill, Lieut. Col., CRE; 19 October 1891

Scale: 1" = 40'. Notes: plan, sections

Source: PAC, C4289

Comments: This ground plan shows the water tanks and all of the catchments and manholes.
Figure 33

Code: 108-01-2-891-0203

Title: The Citadel or Fort George-Block Plan

Signature/Date: A. Hill, Lt. Col., CEE; 19 October 1891

Scale: 1" = 40'; 1/2500. Notes: plan, site plan, scaled, notations, references.

Source: PRO; Wo 78/3506 (2-4)

Comments: This is another version of 108-01-2-891-0002, with additions. There are a number of variations of this plan; refer to R.J. Young, Archives in Great Britain: Lists of Acquisitions, Manuscript Report Series no. 278 (Ottawa: Parks Canada, 1977), p. 62. (see 108-01-2-891-0200)
Figure 34

Code: 108-01-2-897-0001

Title: Citadel Laboratory & Flag Staves-Pan of Lightning Conductors.

Signature/Date: Commanding Royal Engineer in Canada [traced by G.W. Jones, Sapr. R.E.]; October 1897 [25 March 1897]

Scale: 1"=15'; 1"=40'. Notes: plans, sections, site plan, notations, references.

Source: PAC, National Map Collection

Comments: The plans show the major 6 inch water main extending south to north from the south ravelin, across the courtyard in front of the cavalier building to the canteen.
Figure 35

Code: 108-01-2-899-0002

Title: Proposed Barrack for 105 Men in Citadel

Signature/Date: C. Wilkinson, Lieut. Col., CRE and others; 1 May 1899.

Scale: 1/16" = 1'. Notes: plan, levels.

Source: PAC, National Map Collection;

Comment: This plan shows existing and proposed drains for the area of the new barracks.
Halifax, N.S.

Proposed Barrack for 105 Men in Citadel.

Plan of Site showing Drains, Levels &c.

Scale 1" = 1 foot.

Casemates.

Magazine.

Cavalier Barracks.

Coal store
(Wooden Hbg)

Parade

Verandah

Ditch.

W. T. E. T. M. M. B. H. (Engineer)
Figure 36

Code: 108-01-2-900-0003

Title: Proposed Canteen on Site of North Magazine

Signature/Date: C. Wilkinson, CRE and others; 20 September 1900

Scale: 1" = 8'. Notes: plan, section, elevations, scaled.

Source: N.H.S.S.; PAC, National Map Collection

Comments: Section of gutter shown.
Figure 37

Code: 108-01-2-900-0012

Title: Canteen-Plan and Section of proposed Cellar.

Signature/Date: McGuire and others; ca. 1900

Scale: 1" = 10'. Notes: plan, section, scaled.

Source: N.H.S.S.; PAC, National Map Collection

Comments: This plan shows a 6 inch drain pipe from the cellar to the ground line.
CITADEL, HALIFAX N.S.
CANTREEN

Plan and Section of proposed Cellar

---

SECTON ON R.B.

---

PLAN

--- SCALE 10 FEET TO AN INCH ---

Sheet No. 10-51-92

45-38-12-9
Figure 38

Code: 108-01-2-902-0002

Title: Record Plans of Canteen

Signature/Date: Linsel and others; 26 August 1902

Scale: 1" = 8'; 1/2500. Notes: plan, site plan, elevations, scaled

Source: N.H.S.S.; PAC, National Map Collection

Comments: This record plan of the canteen shows the building as constructed. It details the gutters and downpipes.
Figure 39.

Code: 108-01-2-902-0003

Title: Record Plans of Canteen

Signature/Date: Linsel and others; 25 August 1902

Scale: 1" = 8'. Notes: record plan, sections

Source: N.H.S.S.; PAC, National Map Collection

Comments: This plan shows the canteen outside drainage system.
Figure 40

Code: 108-01-2-905-0002

Title: New Block Citadel

Signature/Date: none; ca. 1905

Scale: 1" = 2'. Notes: plan, section, elevation

Source: N.H.S.S.; PAC, National Map Collection

Comments: This plan shows the plan, section and elevation of the lavatory with the drain connection detailed.
Figure 41

Code: 108-01-2-908-0001

Title: The Citadel or Fort George-Block Plan

Signature/Date: K.G. Dalton, RCE; April 1908

Scale: 1" = 20'; 1/2500. Notes: plan, site plan, scaled, notations, references

Source: N.H.S.S.; PAC, National Map Collection; PAC, RG 84M, 756-846.

Comments: This plan shows the complete water and drainage system. (see 108-01-2-908-0002 and 108-01-2-915-0002)
Figure 42

Code: 108-01-2-908-0002

Title: The Citadel or Fort George—Ground Plan

Signature/Date: G.H. James, RCE; 18 August 1908

Scale: 1" = 40'. Notes: plan, notations, scaled

Source: N.H.S.S.; PAC, National Map Collection

Comments: This very detailed ground plan with accompanying supplementary plans show all catchments and manholes plus the water tanks. (see 108-01-2-908-0001 and 108-01-2-915-0002)
Figure 43

Code: 108-01-2-910-0003

Title: The Citadel or Fort George-Water and Drainage Plan

Signature/Date: none; ca. 1910

Scale: 1"=40'. Notes: plan

Source: PAC, National Map Collection; PAC, C70942

Comments: This plan shows the drainage system.
Figure 44

Code: 108-01-2-913-0003

Title: Citadel Sergeants' Mess - Proposed Installation of W.C. - Urinals and Lavatory Basin.

Signature/Date: several; 29 June 1913

Scale: 1"=10'. Notes: plan, section

Source: PAC, National Map Collection; Department of National Defence

Comments: The section illustrates the drainage connection.
Figure 45

Code: 108-01-2-922-0001

Title: The Citadel or Fort George - Ground Plan

Signature/Date: Benoit, Maj.; January 1922

Scale: 1"=40'. Notes: Plan

Source: PAC, National Map Collection; N.H.S.S.

Comments: This plan shows the complete water and drainage system.
Figure 46

Code: 108-01-2-930-0201

Title: Citadel - R.A. Park and South Bks.

Signature/Date: H.J. Knight and others; [3 July 1925] 12 June 1930

Scale: 1/2500. Notes: plan

Source: PAC, National Map Collection

Comments: This plan shows underground cables running from the cable hut in R.A. Park to the signal station on the southeast salient of Fort George.
Figure 47

Code: 108-01-2-932-0200

Title: The Citadel or Fort George - Ground Plan. Proposed Quartering for 300 Men.

Signature/Date: Benoit, Lt. Col., RCE, and others; [8 July 1924] 9 November 1932.

Scale: 1"=40'. Notes: plans, sections, notations, details

Source: PAC, RG 24, C9, vol. 3052, File HQ-1376-11-1, vol. 1

Comments: The base plan for this item was done in 1924 (see 108-01-1-924-0002), with revision and additions in 1932 (see 108-01-1-932-0009). It shows the entire water and drainage system and illustrates a design for 400 gallon reserve water tanks in the lower left corner.
Figure 48

Code: 108-01-2-936-0202

Title: Halifax Citadel Unemployment Relief Project

Signature/Date: none; 29 July 1936

Scale: 1"=80'. Notes: plan, sections

Source: IAND, PHQ, HQ HC2 vol.l

Comments: This was the base plan which accompanied L.R. Lafleche's memo of 29 July 1936. It shows the surface drains in Fort George, on the glacis and in the glacis barracks area.
Figure 49:

Code: 108-01-2-940-0004

Title: Halifax Citadel

Signature/Date: none; ca. 1940

Scale: not to scale. Notes: plan, notations

Source: N.H.S.S.

Comments: This plan shows the hydrant and water shut-off positions.
Figure 50

Code: 108-01-2-943-0001

Title: Lavatories G.O.R. - Citadel Hill

Signature/Date: Lt. Col., R.C.E. and others [traced by A.L.F.]; 12 July 1943

Scale: 1"=40'. Notes: plan, notations

Source: N.H.S.S.; PAC, National Map Collection; PAC, RG 84M, 756-1303; Department of National Defence.

Comments: This is a plan of the lavatories proposed to be installed in the south magazine area.
Figure 51

Code: 108-01-2-944-0001

Title: Plumbing, Heating & Electrical Layout. Canteen Building, Citadel.

Signature/Date: 1"=18'. Notes: plans

Source: N.H.S.S.; PAC, National Map Collection

Comments: Two sections illustrate the plumbing layout.
Figure 52

Code: 108-01-2-951-0002

Title: Halifax Citadel or Fort George

Signature/Date: none; September 1951

Scale: 1"=40'. Notes: plan, sections

Source: PAC, National Map Collection; N.H.S.S.

Comments: This is the 1924/1932 general plan again with details added indicating proposed pressure pump, hydrants and indoor hose reels to provide fire protection.
Figure 53

Code: 108-01-2-954-0202

Title: Water Pressure System, The Citadel or Fort George

Signature/Date: G.P.; 8 April 1954

Scale: 1"=40'; 1/2"=1'. Notes:

Comments: The plan shows an elevation of a pumping unit; Outline of the Citadel, a plan of the water main, and the location of the pumping unit.
Figure 54

Code: 108-01-2-963-0009

Title: Open Ditch in Moat, Halifax Citadel

Photographer/Date: unknown; 1963-1964.


Comments: This photograph shows an open trench in the ditch approximately where the cunette was once situated.
Figure 55

Code: 108-01-2-965-0200

Title: Drain, Redan Area

Photographer/Date: unknown; 1965


Comments: This is a photograph of a vertical drain found in the redan area, showing the lower drain pipe.
Figure 56

Code: 108-01-2-965-0201

Title: Drain, Redan Area

Photographer/Date: unknown; 1965


Comments: This is a general view of the vertical drain found in the redan area. (see also plate 38, p. 69).
Figure 57

Code: 108-01-2-965-0204

Title: Drain, Redan Area

Photographer/Date: unknown; 1965.


Comments: The profile of the horizontal drains in the redan area are shown here.
Figure 58

Code: 108-01-2-965-0208

Title: Casemate Drain, Redan Area

Photographer/Date: unknown; 1965


Comments: This photograph shows the drain in the valley between casemates 59 and 60. (see plate 27, p. 57)
Figure 59

Code: 108-01-2-971-0202

Title: Rampart Surface Gutter

Photographer/Date: J.J. Greenough; 1971

Source: Halifax Defence Complex Collection, J.J. Greenough, Halifax Citadel Photographs, Series III: 1971 Set, e/1-18, 18A.

Comments: This is a cut granite rampart surface gutter running along the retaining wall of the southeast salient.
Figure 60

Code: 108-01-2-971-0204

Title: Retaining Wall Face

Photographer/Date: J.J. Greenough; 1971

Source: Halifax Defence Complex Collection, J.J. Greenough, Halifax Citadel Photographs, Series III: 1971 Set, e/1-18, 1A.

Comments: This is the face of the retaining wall at casemate 30 in the northeast salient. Note the top of the north water tank in the foreground, the gargoyle from the rampart surface gutter with accompanying hopper and downpipe on the right, and the gargoyle from the valley between the casemates, also on the right.
Figure 61.

Code: 108-01-2-971-0206

Title: Weep hole

Photographer/Date: J.J. Greenough; 1971


Comments: This is a weep hole in the curtain wall in the west front.
Figure 62

Code: 108-01-2-971-0208

Title: Gargoyle

Photographer/Date: J.J. Greenough; 1971

Source: Halifax Defence Complex Collection, J.J. Greenough, Halifax Citadel Photographs, Series III: 1971 Set, g/20-36, 29A

Comments: This is a gargoyle situated between the buttresses in the left face of the southeast salient.
Figure 63

Code: 108-01-2-971-0213

Title: Gargoyle

Photographer/Date: J.J. Greenough; 1971


Comments: This is a casemate valley gargoyle. Notice the relatively small, sharply-cut mouth, so different from that of a rampart surface gutter gargoyle. (see 108-01-2-971-0213)
Figure 64

Code: 108-01-2-971-0216

Title: Catchment

Photographer/Date: J.J. Greenough; 1971.


Comments: This is the catchment in the redan area to which the ground level surface gutters connect.
Figure 65

Code: 108-01-2-971-0217

Title: Catchment

Photographer/Date: J.J. Greenough; 1971


Comments: This is a simple catchment in the west front area.
Figure 66

Code: 108-01-2-971-0218

Title: Catchbasin Frame

Photographer/Date: J.J. Greenough; 1971

Source: Halifax Defence Complex Collection, J.J. Greenough, Halifax Citadel Photographs, Series III: 1971 Set, g/0-19, 10A.

Comments: This is a grated, cut granite catchbasin frame in the ditch in front of the south ravelin guardhouse.
Figure 67

Code: 108-01-4-976-0206

Title: Basin Stone

Photographer/Date: R.J. Young; November 1976

Source: Halifax Defence Complex Photographic Collection, Parks Canada, Halifax, N.S.

Comments: This basin store is of tooled granite. It is situated on the retaining wall of the west curtain.
Figure 68

Code: 108-01-2-978-0207

Title: Catchbasin Frame

Photographer/Date: R.J. Young; 1978

Source: Halifax Defence Complex Photographic Collection, Parks Canada, Halifax, N.S.

Comments: This is a tooled-granite catchbasin frame with connecting channel on the ramp at the northwest corner of the south magazine.
This final section both sums up the findings of the report in terms of a series of foldout plans but also outlines current discoveries concerning Citadel Hill drainage made by Engineering and Archaeology during 1977 and 1978. The first ten foldouts, numbers 1 to 10, summarize the evolution of the drainage and utilities systems at Fort George to 1936. The next three, numbers 11 to 13, indicate the as-found state of this complex as of 1977, while 14 and 15 show the existing services in conjunction with the city connections. The final foldout, number 16, shows the locations of the discoveries made during 1977-1978, and is number coded to correlate with the following discussion. (For a more complete and detailed account of these items, see: John Connolly, "Archaeology: Halifax Citadel 1977." Manuscript on File, Halifax Defence Complex, Parks Canada, Halifax, Nova Scotia; John Connolly, "Archaeology: Halifax Citadel 1978." Manuscript on File, Halifax Defence Complex, Parks Canada, Halifax, Nova Scotia.)

1. In 1975-1976, a vertical shaft was uncovered above sallyport 2 by Engineering.

2. In the fall of 1977, a similar vertical shaft was found in the salient angle of the southwest demi-bastion.

3. Yet another shaft emerged at the angle of the flank and right face of the southwest demi-bastion. These shafts were built of ironstone, and were approximately 1.5 feet square. As they were blocked with earth, their exact depth and purpose remained unknown, especially as none of these shafts appeared in any plan or document.

4. It remains possible that these shafts were constructed to drain water from the walls, and deposit it in the ditch to be carried away by the drainage system there, but this is supposition. In addition, two stone drains near the southwest demi-bastion, one connected to the ditch manhole, and one towards the west ravelin, both elements of the ditch system, were uncovered.
5. In June 1978, a previously unrecorded underground drainage system was discovered circling the south magazine. The major drain was situated almost directly underneath the surface gutter, midway between the blast wall and the magazine building. The surface gutters, which do show up on the plans, were formed in the magazine area asphalt ground covering. The subterranean drains were of brick covered with flagstone, and consisted of a main line running entirely around the magazine building, with subordinate lines connecting from each of the demi-casemates. The whole system flowed into an underground catchment about midway in the blast wall, which, in turn, connected with the manhole in the parade outside the blast wall. Evidence indicated that this system had been previously abandoned, probably in the nineteenth century. The lightning rod system connection to a catchment in the northwest corner of the south magazine area was also found.

6. In November 1978, a section of the original clay pipe here was uncovered. The line had been cut-off and simply abandoned.

7. In November 1978, a section of the original cast iron pipe here was uncovered.

8. In November 1978, excavations revealed that this line had been replaced at sometime with a modern concrete pipe.

9. Here, a portion of this original cast iron pipe was removed for examination. In addition to the decrease in diameter caused by rust tubercles, it was found to measure 6 inches rather than 9" as appears in a number of plans.

10. Here, another section of original cast iron pipe was removed, revealing tubercles and another difference in measurement. It proved to be 4 inches in diameter, and not the 6 inches indicated on the plans.

11. Here, a section of the 3 inch line running from the main water line to the redan area was removed for examination.

12. Surface drains were noted around the north and south ravelin guardhouses. As can be seen from the above, the only original pipes so far uncovered have been either clay pottery or cast iron. In the nineteenth century, the pottery pipes were considered more economical, but could not support heavy water pressures. They possessed a weakness for setting up as well, and hence, were usually utilized in secondary lines. Cast iron pipes were stronger and
more durable, and hence, had a greater flexibility of use. However, in some areas, such as Halifax, the properties of the water greatly enhanced the development of the internal oxidation in the pipes. This resulted in the formation of rust tubercles which greatly reduced the sectional area of the pipes and made frequent and regular inspection and cleansing essential. In addition, in terms of water filters, as used in the water tanks, the usual configuration was gravel-sand-charcoal. The water flowed through coarse gravel, rough screened gravel, fine screened gravel, fine gravel, fine washed river sand, sand with charcoal and/or charcoal.

As a final point, it must be emphasized that this report was written on the basis of the Halifax Defence Complex Plan Collection as of the 1977-1978 fiscal year. Consequently, this last section has been designed to accommodate the regular update of information as further details are uncovered and new materials received.
Halifax Citadel
National Historic Park

Management Plan

Existing City Services
Existing and Proposed Park Services

- Service Tunnel
- City Sewer
- 24' Storm Sewer
- 12' Sanitary Sewer
- Electrical Line
- 6' Water Line
- 8' Water Line (Optional)
- Electrical Line
- Fire Detection System
- Telephone Overhead
- Telephone Underground
- Telephone

Cross Section - Service Tunnel

Walking Space
Halifax Citadel
National Historic Park

Management Plan

Existing Services Inside
The Fort - Main Lines

- Storm Sewer
- Combination Sewer
- Telephone Service
- Water Supply
- Boiler Room
- Hydrant

Proposed Services

- Storm Sewer
- Water Supply
- Boiler Room
- Hydrant
Endnotes

The British Period

1. 108-01-1-838-0001
2. 108-01-1-858-004
3. 108-01-1-854-0205; 108-01-1-856-0003
4. 108-01-1-858-0002
5. 108-01-1-858-0004
7. 108-01-1-833-0003
8. 108-01-1-833-0009
9. See Appendix 1
10. Interior measurements were about 3'H x 2'W
11. 108-01-1-834-0002; 108-01-1-836-0003
12. 108-01-1-856-0003; See Appendix 2
14. 108-01-1-831-0001; 108-01-1-891-0002; PAC, MG 13, Wo 55, vol. 887, fol. 627V, 628, Boteler to Bryce, 1832; See Appendix 3.
15. 108-01-1-846-0013; 108-01-1-846-0012
16. 108-01-1-847-0006; 108-01-1-848-0005; 108-01-1-849-0002; 108-01-1-849-0011; all of these plans show the wells.
18. See Appendix 4.
19. 108-01-1-846-0002; 108-01-1-846-0003


21. 108-01-1-846-0013; See Appendix 3.

22. 108-01-1-846-0015


24. 108-01-1-848-0005; 108-01-1-849-0011

25. See Appendices 5 and 6


28. 108-01-1-848-0005; 108-01-1-849-0011

29. 108-01-2-850-0200; 108-01-1-858-0004; 108-01-1-891-0001


31. 108-01-1-855-0001; 108-01-1-861-0001; See Appendix 7

32. 108-01-1-859-0001; 108-01-1-852-0005; See Appendix 8

33. 108-01-1-870-0200

34. 108-01-1-882-0001

35. There is some confusion concerning the actual date of the major ground plan (108-01-1-891-0002), due to the existence of various copies with differing additions. Plan 108-01-1-891-0002 includes the brick block and its accompanying water and drainage systems, and hence, was probably draughted in 1899-1900. However, the original base plan (108-01-1-891-0200) as held by the Public Archives of Canada, shows the rest of the fort drainage system as being illustrated in this plan. A third plan
obtained from the Public Record Office shows the brick block and other alterations which appear as completed on 108-01-1-891-0002 as temporary pencil additions. Therefore this plan seems to be an interim plan done between the other two. Consequently 108-01-1-891-0200 shows the drainage system of Citadel Hill as it existed in 1891, while 108-01-1-891-0203 and 108-01-1-891-0002, in that order, illustrated the evaluation of this system between 1891 and 1900.

36. 108-01-1-891-0002; 108-01-1-891-0003; 108-01-1-891-0203; 108-01-1-897-0003
37. 108-01-1-891-0002; 108-01-1-899-0200

The Canadian Period
1. 108-01-1-908-0001
2. 108-01-1-908-0002; 108-01-1-910-0003
3. 108-01-1-913-0003; 108-01-1-920-0001
4. 108-01-1-922-0001; 108-01-1-924-0201
5. 108-01-1-930-0201
6. 108-01-1-932-0200
7. See A.E. Wilson, Halifax Citadel: Tunnel at West Ravelin, Operation 2B8, Manuscript on file, Halifax Defence Complex.
10. 108-01-1-940-0004; 108-01-1-943-0001; 108-01-1-944-0001
Current Developments

1. For use in the project, a set of overlays was also created, consisting of: 1. Ditch Drains/Sewerage; 2. Waste Water; 3. Rampart Drainage; 4. Water Supply; 5. Electrical/Fire Alarm Systems. A base plan and a site plan complete the set.


3. Ibid., pp. 737-738.
Appendix 1: Main Drain (The Escarp Items of the 1836 Estimate)

**Item 1: Escarp Eastern Front, and Main Drain**

This item provides for 600 feet of Escarp...

The main drain to be built according to the dimensions shewn below, following a natural slope of the ground, to join on with the Main Town drains; the bottom of the drain to be laid with iron stone flagging procured from the Government Quarries, as the cheapest mode. [Section of proposed drain. Scale: 2 ft. to 1 in. A marginal note appended to the sketch, probably in London, suggests a "concave floor", and the section is crossed out in pencil - see below.] ...

The main drain is to be 761 feet in length, the excavation is calculated at 8 feet wide for the convenience of building properly, and at a depth of 8 feet so as to keep the drain sufficiently deep as to be secure against the effects of the frost; two cess pits are also provided for 8' x 8' x 10 feet deep. It is proposed to build the whole of the drain with iron stone masonry, the Government Quarries affording a quality of stone sufficiently good for rough arching. The floor may be constructed concave as suggested without increasing the expense by making a proportionate diminution in the depth of the foundation. - [Section of the proposed drain with a concave floor. Scale: 2 ft. to 1 in.]

<table>
<thead>
<tr>
<th>Main Drain</th>
<th>Cubic Yards of Earth Excavated</th>
<th>Perches of Masonry</th>
<th>Lbs Iron Work on Gratings</th>
<th>Cubic Feet Oak in Frame to Cess Pits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1851</td>
<td>10d</td>
<td>14/2</td>
<td>3d</td>
<td>2/11</td>
</tr>
<tr>
<td>1039</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>448</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Appendix 2: Estimate for cess pits and privies, 1856.
The two casemates to which this estimate refers were casemates 54 and 55.

This Estimate shews the Additional expense, £157.12.9. Sterling, incurred in completing the improvements in the Non Com. Offrs, Privates and Womens Privies at the Citadel. Halifax N.S. which were rendered necessary in consequence of having to reconstruct the drain leading from the Cess pool in the Ditch, and constructing three Additional Cesspools on the Glacis, and altering the shape of the bottoms of the Pits under the floors, and reconstructing the floor and seats in the Mens Privy, as shown on the Accompanying Plan, and as reported in the Com Royal Letters [sic] No. 684.

This additional Service...has received the Approval of His Excellency the Major General Commanding; - the expense of which, £157.12.9. has been charged to Item 8 of the Ordnance Annual Estimate for 1855-6, and will cause a corresponding excess on that Item, but which it is expected will be covered by savings on the gross Amount of the Estimate for the Current Year -

Ordnance
Special Service
Constructing Cess Pits and Drains leading from the Soldiers Privies Citadel to the Glacis, and altering Main Cess Pit of Privies, &c -

520 days Military Labourers excavating
for Cess pit and drain 10d day 21.13.4
213 do Sappers & Miners, sinking & binding do. 1/- 10.13.0
47 do Military Artificers do. 1/8 3.18.4
158 do Civil Masons, building Cess pool &c. 6/- 47.8.0
21 do Civil Labourers, assisting do. 3/- 3.3.0
\(\frac{1}{2}M\) Bricks 60/M 1.10.0
100 Bushels Cement 3/-bl. 15.0.0
100 do Lime 1/6" 7.10.0
This estimate describes the proposed construction of the two casemate 50 water tanks. While never implemented, it provides a useful insight into the materials probably used in building the three existing parade ground.
Item 4
This Item provides for construction two Tanks with a filter under the floor of the defensible casemate next to the Guard Room at the main entrance (See accompanying plan no 4) to be supplied with rain water collected from the rampart of the work, but the surface [sic] drains and conveyed to the filter by an under ground 6 inch Metal main as shown on the accompanying Plan (No 5) these tanks will contain about 12000 Gallons, and should they become full the overflow will pass into the well in the adjoining casemate which receives only a scanty water supply from springs.

The small supply of water that can be obtained from the two wells within the Citadel renders this service as well as following Item necessary. -

Dig and throw out the earth 38'.4" x 15'.6" x 10.0 for tanks, and line the walls all round and construct the filtering chambers with 14 inch Brick work, turning an 18 inch arch of brick over the tanks with proper man hole in the crown, and lay the floor with brick on edge, The whole of the work to be set in roman cement & sand and all the walls and floor to be rendered and floated 2 coats with similar Materials.

The Tank (vide drawings N\(^2\) 4 & 5) [sic] to be supplied by a Main at N\(^0\) 5 as follows the surface drains shown by a yellow line on the plan and elevation N\(^0\) 5 is [sic] provided for in the revised estimate, the blue lines on elevation denote the supply pipe which is to be of cast iron with socket joints put together with oakum, and run with lead, the excavation for which is 820 x 2 x 3.

The pipes at \(\text{a}\) are to be cast with a neck as shown at \(\text{B}\), to receive the trough pipe \(\text{C}\), which is to be of cast iron \(\frac{1}{4}\) inch thick Set and run with lead in a block of Chiselled Granite at \(\text{D}\), The trough pipes to be covered with a cast iron perforated grating 1 inch thick.

The pipes at \(\text{E}\), to pass thro' the wall to \(\text{F}\), and descend in front of the wall as shown at the elevation on \(\text{G}\), at the foot of which it again passes thro' the wall of \(\text{H}\), in plan (N\(^0\) 5.) into the filtering chamber of the Tank, which is to be constructed in the following manner.

The first chamber filled with coarse [sic] gravel resting on cast iron
perforated plate 3\textsuperscript{4/8} inch thick 1\textsuperscript{1/4} inch holes & 12 inches from the bottom of the Tank supported on 4" chiselled Granite corbels 6 inches square, similar to those shown in the section, - the water after filtration down through the Gravel will pass into the 2\textsuperscript{nd} chamber through the openings 6 x 4\textsuperscript{1/2} inches at I. - in Section 4, - this chambers [sic] to be in [three] Vertical compartments, the middle division filled with fine washed gravel and sand on a cast iron plate, as above described, - the upper Compartment filled with Charcoal on a perforated lead plate, the holes 3\textsuperscript{8/10} inch in diameter, the Top plate to be of cast iron as above described, and the whole of the plate supported on chiselled granite corbels as above described; the water after passing up through this chamber discharges itself into the tank thro' the openings at K the inner tanks to be filled by the overflow openings at L, left on upper part division wall, the waste or overflow Water to be carried off to the well through the 6 in cast iron pipe M. - Provision is also made for breaking through and making good all openings in the walls for insertion of all the pipes of supply, as well as those for the discharge, and drawing off the water by a pump which is to be of Cast iron with 3\textsuperscript{1/2} ins brass working barrel buckets, and valves, to be enclosed in a Square Cast Iron case \(\frac{1}{4}\) in thick and secured to the wall with wrought iron hold fasts run with lead, the case to have a door hung with [blank in ms.] front and provided with an iron lock.

The suction pipe for the pump at N, - from the working barrel to the cock to be of cast iron two thirds of the diameter of the working barrel the cock to be of brass 3 in bore and a lever shifting handle enclosed in the wall with a cast iron door and frame, and iron lock O. - The suction pipes communicating from the cock with the tank to be perforated at the foot resting on a chiselled granite shoe cupped to receive the end, - the suction pipe communicating to the inner tank to have a copper perforated rose head at the end, resting on a cupped granite shoe. -

The lead pipes to be put together with soldered joints those of iron with flanges [?] put together with leather and white lead.

N.B., the surface drains are provided for in the Revised estimate of 1836. -
## Additional Services, Viz Water Tanks

Additional Item for North and South Ravelins...

<table>
<thead>
<tr>
<th>Description</th>
<th>Quantity</th>
<th>Unit</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>220 yards cube excavating and removing</td>
<td>10d</td>
<td></td>
<td>9.3.4</td>
</tr>
<tr>
<td>182 do. do. and filling in</td>
<td>1/2</td>
<td></td>
<td>10.12.4</td>
</tr>
<tr>
<td>108 perches stock brick work in roman Cement</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 Sup\textsuperscript{1} Yards brick on edge paving in roman cement</td>
<td>5/6</td>
<td></td>
<td>12.13.0</td>
</tr>
<tr>
<td>102 Sup\textsuperscript{1} Yards rendering and floating in roman cement</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9 cubic feet granite stone in Corbels and Curb stones set.</td>
<td>1/-</td>
<td></td>
<td>0.9.0</td>
</tr>
<tr>
<td>57 sup\textsuperscript{1} do. plain chiselled work on the above</td>
<td>1/4</td>
<td></td>
<td>3.16.0</td>
</tr>
<tr>
<td>40 cubic do Granite Stone in blocks for trough pipes (D)</td>
<td>1/-</td>
<td></td>
<td>2.0.0</td>
</tr>
<tr>
<td>20 sup\textsuperscript{1} ft. plain chiselled \textsuperscript{[sic]} work on do</td>
<td>1/4</td>
<td></td>
<td>1.6.8</td>
</tr>
<tr>
<td>95 sup\textsuperscript{1} ft. circular chiselled work on granite</td>
<td>2/-</td>
<td></td>
<td>9.10.0</td>
</tr>
<tr>
<td>80 do $\frac{1}{2}$ plain do on do -</td>
<td>8d</td>
<td></td>
<td>2.13.4</td>
</tr>
<tr>
<td>4 holes broken in masonry and the work made good round pipes at E.H.N.&amp;M.</td>
<td></td>
<td></td>
<td>12.0.0</td>
</tr>
<tr>
<td>1 hole broken in masonry and forming chamber for 3 way cock and setting cast iron door frame at 0.</td>
<td>80/-</td>
<td></td>
<td>4.0.0</td>
</tr>
<tr>
<td>6 holes jump\textsuperscript{d} in granite and run with lead to secure pump case</td>
<td>8d</td>
<td></td>
<td>0.4.0</td>
</tr>
<tr>
<td>2 Cups dished out in granite</td>
<td>2/6</td>
<td></td>
<td>0.5.0</td>
</tr>
<tr>
<td>5\textsuperscript{1} cwt cast Iron in perforated plates for filtering chamber</td>
<td>18/-</td>
<td></td>
<td>4.19.0</td>
</tr>
<tr>
<td>4\textsuperscript{1} cwt cast iron in pump case including Locks, hinges, bolts and nuts and putting up</td>
<td>18/6</td>
<td></td>
<td>3.18.7\textsuperscript{1/2}</td>
</tr>
<tr>
<td>3\textsuperscript{4} cwt cast iron in door and frame to cock chamber including lock and hinges</td>
<td>18/6</td>
<td></td>
<td>0.13.10\textsuperscript{1/2}</td>
</tr>
</tbody>
</table>
b) Asphalt

Asphalt constituted a major component in the final construction of the water tanks. The ingredients and application of Seyssel Asphalt, the type of asphalt used at the Citadel, is described in J.J. Greenough, The Halifax Citadel, 1825-60: A Narrative and Structural History, Manuscript Report

<table>
<thead>
<tr>
<th>Item Description</th>
<th>Quantity</th>
<th>Unit Cost</th>
<th>Total Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>252 cwt do pipes and troughs and laying with lead &amp; all materials</td>
<td></td>
<td>23/-</td>
<td>289.16.0</td>
</tr>
<tr>
<td>1 cwt sheet lead, milled in plate for filtering chamber</td>
<td></td>
<td>30/-</td>
<td>1.10.0</td>
</tr>
<tr>
<td>4 cwt milled lead pipes, $\frac{1}{4}$ in bore</td>
<td></td>
<td>38/-</td>
<td>7.12.0</td>
</tr>
<tr>
<td>1 cast iron lifting pump $\frac{3}{4}$ in brass working barrel buckets and valves, 8 to 10 stroke fixed Complete</td>
<td></td>
<td>160/-</td>
<td>8.0.0</td>
</tr>
<tr>
<td>1 Three way brass Cock 3&quot; bore with lever handle complete</td>
<td></td>
<td>60/-</td>
<td>3.0.0</td>
</tr>
<tr>
<td>1 Copper Rose Head</td>
<td></td>
<td>30/-</td>
<td>1.10.0</td>
</tr>
<tr>
<td>5 solder joints on head pipe &amp; cock, all materials</td>
<td></td>
<td>2/6</td>
<td>0.12.6</td>
</tr>
<tr>
<td>23,655 holes drilled in the cast iron plates</td>
<td></td>
<td>$\frac{1}{4}$d</td>
<td>24.12.9$\frac{3}{4}$</td>
</tr>
<tr>
<td>637 dozen holes punched in lead plates for filtering chamber</td>
<td></td>
<td>1d</td>
<td>2.14.9</td>
</tr>
<tr>
<td>Supplying &amp; cleansing Gravel sand and charcoal for filtration</td>
<td></td>
<td>20/-</td>
<td>1.0.0</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td>£604.12.2$\frac{3}{4}$</td>
</tr>
<tr>
<td>Contingent 1/10</td>
<td></td>
<td></td>
<td>60.9.2$\frac{1}{4}$</td>
</tr>
<tr>
<td>[Total]</td>
<td></td>
<td></td>
<td>£665.1.5$\frac{1}{4}$</td>
</tr>
</tbody>
</table>

PANS, RE 56, unpaginated, "Supplementary Report and Estimate...", 31 March 1846.
Series No. 154, Vol. 2, pp. 262-265. For further information regarding case-mates staunching at the Plymouth Citadel, see Colonel John Oldfield's account in the Professional Papers of the Royal Engineers.

c) Report on the use of asphalt, 1854

... Two tanks each to contain 66,000 gallons of water and their filtering chambers together with a smaller Reserve Tank for 30,000 Gallons have been built.

The top of the arches being 4 feet below the surface of the Parade in the Fort the groined inverts at the bottom being floated over with Asphalte, fine quality $\frac{3}{4}$" thick laid in two coats $\frac{3}{8}$" thick, the wall, lined with Asphalted brick, and the dos d'anes asphalted $\frac{3}{8}$" thick with fillet over the joint, (thus in Section) [drawing in text] these three Tanks have been found perfectly free from external leakage, and are perfectly watertight, neither has the water in them, been apparently affected in any way by the Asphalte. In the before mentioned services 122,000 Asphalted bricks were laid, and in every way have answered the purpose to which they were applied, forming a very compact and watertight lining to Wall.

...


Appendix 4: Surface Drainage (Staunching Estimate, 1849)

[Item 3]
This Item is a revision of Item 16 of the Revised Estimate dated 1st Feb., 1836, which provides for "2000 ft in length of surface drains 3' wide for the interior 2300 for the Ramparts, "the drains to be formed of pebbles laid on edge in fine gravel &c" But as has been stated in the prefactory part of the Report to this Estimate par: N. 4 that surface gutters formed of pebbles
are objectionable (more especially on the Ramparts over the casemates) and there being no provision made for carrying off the water from the surface gutters of the ramparts on the west and South faces & part of the east face. Therefore this Item provides for substituting a granite channel course instead of the "2300 feet" of pebble surface drains for the Ramparts only. & for granite basin stones with gargoyles, cast Iron hopper heads & pipes & underground drains in the interior as shewn on the drawings 1 & 5 accompanying this Estimate. The water it is to be observed is by this arrangement permitted to run to waste in the underground drains, but should it be hereafter found desirable to save it for consumption by the Troops, it can be collected with facility from the vertical pipes (herein provided) by means of conduit pipes connected thereto & leading to a Tank which may be constructed in either of the casemates 13. 14. 15 or 16 or in any other situation that may be considered more desirable [sic].

Dig out & remove the earth for the reception of surface gutters at back of parapet of retaining wall of Rampart of the west, south & part of the East faces to the extent of (collected) 1171.0 x 2.3 x 9 & remove the stuff to a distance of 200 yards. Provide & set Granite channel course (2192. x 2.3) 9" thick tooled, sunk, & set in mortar & jointed with Roman Cement and 5 granite Basin stones with gargoyles 5.0 x 2.0 x 1.0 (vide drawing N. 5 at b.b.b.b.b.) tooled sunk & set in Roman Cement the underside of the projection of the gargoyle to be throated thus [section drawn in text]. Take down coping 5/4.0 x 3.0 and the masonry under the same 5/4.0 x 2.6 x 2.0 5/4.0 x 3.0 x 1.0 and reset in Roman cement for the purpose of introducing the gargoyles.

Dig out ground for receiving the drains from the proposed pipes (vide drawing N. 1 at V.W.X.Y.Z) collected 88 [?] x 5.6 x 4.6 & ram the ground over same and remove the surplus stuff 88.0 x 3.2 x 1.10 to a distance of 200 yards. - Build drains 14" x 14" in clear 88.0 in length the sides of dry rubble masonry 12" thick the bottom & the top covering of 4 inch self faced Iron stone flagging jointed and laid dry.

Smiths Work.
Provide & fix (at c.c.c.c.c. drawing N. 5) 5/24.0 of 4" cast Iron rain water pipe and 5/60 lb. Hopper heads with wrought Iron bands and Holofasts [sic].
Painter.
The pipes & hopper heads to be painted 4 coats common colours in oil. -
All the materials & articles estimated for the above services under Item 1,
2 & 3 [sic] can be advantageously procured on the spot, with the exception
of Roman Cement, for which a Demand of Stores accompanies this Estimate. -

[Item 3 - estimate]

Surface Drainage of Ramparts &c.

Revision of Item 16, of the Revised Estimate dated 1st Feb. 1836

<table>
<thead>
<tr>
<th>Description</th>
<th>Quantity</th>
<th>Unit Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>73 cubic yards digging &amp; removing earth</td>
<td>10 d</td>
<td>3.0.10</td>
</tr>
<tr>
<td>61 3/4 &quot; &quot; digging throwing out filling in &amp; ramming earth</td>
<td>10 d</td>
<td>2.11.5 1/4</td>
</tr>
<tr>
<td>19 cubic yards removing stuff on average distance of 200 yards</td>
<td>8 d</td>
<td>0.12.8</td>
</tr>
<tr>
<td>9 3/4 Perches taking up &amp; rebuilding ashlar masonry in cement</td>
<td>16/-</td>
<td>7.16.0</td>
</tr>
<tr>
<td>60 feet sup. taking up Granite coping &amp; resetting in cement</td>
<td>5 d</td>
<td>1.5.0</td>
</tr>
<tr>
<td>88 feet lineal rubble masonry laid dry in drains 14&quot; x 14&quot; with Iron stone flagging</td>
<td>2/5</td>
<td>10.12.8</td>
</tr>
<tr>
<td>4932 Feet sup. chiselled Granite surface drains set in mortar &amp; jointed with cement</td>
<td>2/</td>
<td>493.4.0</td>
</tr>
<tr>
<td>5 Chiselled Granite Basons [sic] properly dished to receive surface water, with a channel projecting 6&quot; beyond the retaining wall</td>
<td>30/</td>
<td>7.10.0</td>
</tr>
<tr>
<td>13:1:7 Cw. Cast Iron in down pipes 1/2&quot; and fixing -</td>
<td>20/-</td>
<td>13.6.3</td>
</tr>
<tr>
<td>2:1:0 N. D. in Hopper heads &amp; fixing</td>
<td>20/-</td>
<td>2.5.0</td>
</tr>
<tr>
<td>14 Yards 4 Oils common colour -</td>
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[Total] £542.15.6 1/2
Add contingent 10th

[Total] £597.1.1
Recapitulation

1. Staunching leakage in Casemates -------------- 3766.2.2\(\frac{3}{4}\)
2. Water Tanks ---------------------------------- 665.1.5\(\frac{3}{4}\)
3. Surface Drainage of Ramparts &c --------------- 597.1.1

[Total] £5028.4.9


Appendix 5: a) Staunching Estimate 1848 (never implemented)

Special Report and Estimate of the expense of remedying the leakage of the Officers, Soldiers and Guard room Casemates. Halifax Citadel 1848.9. Amounting to £1369.18.4 Sterling.

The service here brought forward has arisen from leakage over the Windows and doors of the Officers, Soldiers, and Guard room Casemates in the Redan and East Front the cause of which and remedy proposed is explained in my accompanying letter of this date.

Provision is here made for uncovering as much of the dos d'anes of these casemates as may be found necessary to construct or lay to [?] or hipped counterflagging of Iron stone in Cement and mortar on rubble masonry in the Vallies between the dos d'anes, and setting a continuous water table into the front and rear wall along its ridge or apex, to cover the joining of the flagging with the walls. It also provides for taking up and resetting the upper course and masonry and coping in the inner or retaining wall & as well as for taking up & resetting the flagged coping of the outer or escarp wall - and Carpenters time for forming the necessary ...

b. **Report on the State of the Casemates, 1848.**

The casemate numbering system used in this 1848 report and that used by the Halifax Defence Complex have been correlated below.

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... The Guard-rooms in the North & South Ravelins are dry - as regards the mode of construction of the [*] Casemates I have to state that they are covered as follows viz: the Brick arch is 2'..3" in thickness backed in and covered with rubble masonry, having the vallies between each arch formed into a gutter lined with cement and lead. The gutters lead through the interior retaining wall into [crossed out in pencil and "of" substituted] the body of the place, having gargoyle projecting about 8 inches beyond the face of the wall, but the openings of which are entirely exposed to the action of the weather and consequently are, during the winter months, completely closed by the frost acting upon the water that would otherwise drain off; and I have no doubt that Ice is formed in the gutters the whole thickness of the wall, by which means the exit of the remaining portion of the water is prevented until the gargoyle be cleared out, by the thaws in the spring thus putting the masonry of the arch to a most severe and unfair test. The dos d'anies of the arches are flagged & counterflagged ["counter" underlined in pencil with "Q" in the margin] (over the backing up of the arch with rubble masonry) with flagging of from 4 to 8 inches in thickness, set in mortar and jointed with cement with the exception of the Gun Casemates on the South front Nos. 21. 22. 26 & 27. which are covered with tiles set in mortar and

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*Originally "these". Pencil notation above "the"- "Q Y Mc" and in margin, "Q Y".
flagging laid dry and Nos. 17 & 18, which are tiled only.
Nos 1 to 11 are hipped and flagged
No 12 flagged
Nos 13 & 14 are flagged hipped and piped
Nos 15 & 16 flagged
Nos 17 & 18 tiled only
Nos 19 & 20 flagged hipped and piped
Nos 21 & 22 tiled and dry flagged
No 23 flagged and hipped [pencil notation in margin: "Shifting Rooms"]
Nos 24 & 25 flagged hipped & piped
Nos 26 & 27, tiled and dry flagged
Nos 28 to 54 flagged only
Guard rooms in North and South ravelins stated.

From the foregoing it appears that those casemates which are flagged hipped & piped are in every respect dry, as regards leakage, and that altho' the gargoyles may freeze the water passes off through the pipes there thus being no chance for the water remaining on the covering of the arch & soaking through by being retained there, also that those that are flagged and hipped are dry, and have hitherto been found completely staunch, the hipping and flagging being sufficiently water tight to resist the soakage of the water when the gargoyles are closed, those that are flagged only with the exception of Nos 12, 15, 16 29. 30.31. leak, and this leaks [sic] invariably occurs at the end of the arches the water not being thrown off as in the other casemates from the retaining scarp and interior walls by being hipped, that those which are dry flagged and tiled or tiled only are likewise defective in a similar manner, and I must observe that the retaining walls on the south front have receeded [sic] from the ends of the arches of the Gun casemates [pencilled notation: "No 21, 22": The 'scarp wall from three to four arches, and the interior retaining wall perhaps half an inch to an inch; this is also the case with the scarp wall of Nos 17 & 18 [originally "13-14" - crossed out Marginal comment: "Qy if not 15 & 16] but in a lesser degree. I have further to state that the arches are dry throughout their whole length in every case, and although Nr 27 appears a little damp in the arch no leakage has yet occurred.

[Suggest Remedies 1."

From the foregoing it appears that the remedy to prevent the leakage of those arches which are flagged only would be to uncover them and have them hipped, as has been done in those which have been found to answer up to the present time, and which was recommended in the letter Nr 234 of the 5\textsuperscript{th} Feb\textsuperscript{v} 1848, and accompanying Est\textsuperscript{e} forwarded from Colonel Calder Com\textsuperscript{q} R\textsuperscript{i} Engineer at this station to the Inspector General [of] Fortifications, so as to turn the water off from the retaining walls, should this plan be adopted care should be taken to examine the existing flagging & Gutters to see that no failure has taken place in the Cement pointing of the former or in the lead of the latter, and that metal hopper heads with stock pipes be fixed to the gargoyles and carried down the face of the interior wall as
provided for in Item 8 of Supplimentary Estimate dated 31 March 1846, transmitted in furtherance of the Inspector Gen. Fortifications order of 18 July 1843, N.° 628, [marginal note in pencil, "Qy, if these pipes can be obtained on the strength of that Estimate if not. And when provided in the proposed Est. the Estim. or Item attached to [it] should be revised so as to give credit for the pipes. J. [or T.] F.H." the Items of which estimate are to be brought forward in the Year it is proposed to execute the service, and in which funds can be allotted, vide Insp. Gen. Fortifications letter N.° 809, dated 15 th Sep. 1846, and in addition to which I submit that the hopper heads and pipes be secured in stone casings built as buttresses which would not disfigure the appearance of the work in General but tend to break the present straight line of wall, and give an additional strength to the work both in reality and appearance, and that the shoe of the pipes be carried into under ground drains for which provision must be made when required.

[Marginal note in pencil: "2 nd Suggestion"]

With respect to those casemates which are tiled and dry flagged, or tiled only, viz. Nos 17. 18. 21. 22. 26 & 27. I submit that they be entirely uncovered and either flagged and counterflagged and hipped, having stock pipes &c as pointed out above, or that the remedy pointed out by Colonel Holloway R.E. to have succeeded at Fort Henry, Kingston, C.W. be adopted, but with reference to the means used at Fort Henry I most respectfully submit the following remarks, viz.

It appears from Colonel Holloway's [sic] letter 19 th July 1848, that the water percolated through the whole length of the arches which has hitherto not been the case at Fort George, Halifax, if I may except casemate No. 27, referred to above, and which appears a little damp, but having no decided leakage throughout the length of the arch. - with reference to the plan of cutting through the arch and forming a chase down the piers for the insertion of a pipe to carry off the water from the Vallies at Fort George, Halifax, this plan would be attended with considerable expense, the piers being built of Iron stone rubble masonry, coursed, the piers of casemates Nos: 1 to 9. 13. 14. 19. 20. 24 & 25 and 48 to 54 having 4 1/2 inch brick linings; taking these circumstances into consideration I submit that the flagging and counter flagging together with having the arches hipped be adopted for the remedy of those casemates which are found defective, the
stock pipes being carried down the face of the interior retaining walls, and
secured as proposed, in preference to the plan followed at Fort Henry C.W.
but should the method of securing the casemates in the Citadel from damp be
adopted as at Fort Henry C.W., data must be furnished either from England
or Montreal as to the price of the Asphalte and the means of applying it.

I must also call your attention to the proposed plan of collecting
the water that falls on the terre plein of the ramparts into tanks already
submitted in the supplementary Estimate dated 31st March 1846 Item 4 and
agreeable to the instructions from the Insp. General Fortifications dated
15th Sep. 1846 No. 809, postponed until brought forward in the annual
Estimate [marginal note above, in pencil: "ought not this be executed while
the ground is open for the staunching of the arches as it would save expense
and prevent the necessity of again disturbing the surface-"], and provided
for as funds can be allotted, which when carried into execution, will in a
great measure tend to remove the evil complained of by turning the water
almost entirely off the covering of the arches, the water being drained
off into the different mains leading to the tanks....

[signed] R. Burmester

November 1848.

Appendix 6: Staunching Estimate, 1849.

While a staunching style different from that described in item 1 was finally
implemented, this estimate remains a useful source of information on the types
of materials and labour involved. For casemate number equivalents see Appen-
dix 3 b).

Provision is also made for rendering the Cavalier secure against similar
leakage by the introduction of cast Iron pipes, underground drains and hipping
the dos d'anes as proposed to be done in the Casemates. The whole of
which project is explained in the accompanying Drawings No. 1. 2. 3. 4 (6 5)
and in the specification. -
And further, the better to secure the permanence of the work in connection with the staunching of the Casemates by carrying off the surface water from the ramparts. - Item 16, of the revised Estimate dated 1st Feb: 1836 and Item 4 of the supplementary Estimate date 31st March 1846 are brought forward. Item 16, of the Revised Estimate provides for the surface gutters of the place, but it has been thought advisable to further revise this Item, from the consideration but gutters formed with pebbles [?] in this country have proved defective from the action of the frost, consequently requiring annual reparation [?]. Independent of which from the heavy rains of this climate a large quantity of water must necessarily penetrate between the interstices of the pebbles, and consequently tends very much to promote the defects which it is now sought to remedy in the casemates. Wherefore, it is proposed to substitute for the pebble gutters on the ramparts a granite channel course. -

And still further, as no provision appears to have been made for carrying off this water from the surface gutters (except that made under Item 4 of the supplementary Estimate dated 31st March 1846, which provides for the drainage of the ramparts of the North & part of the east faces into a Tank with a Filter to be constructed in the casemate (N. 30) South of the Guard room and which service is herein brought forward) a plan (N. 5) is herewith submitted shewing the situation of the proposed surface gutters, and the mode proposed for carrying off the water from the west and south fronts and from a portion of the East front and which will be further explained in the specification to the revision of Item 16 above adverted to. -

Casemates & Cavalier.

Specification. ...

The ground also to be dug out to the requisite depth and width for the reception of the proposed drains as shewn in the sections (Drawings 3 & 4) the situation of which drains is shown on drawing N. 1 by the blue dotted lines marked abc. de. fg. hi. k. l. mn. op. and qr. and for the branch drains leading from the proposed pipes in the casemates and cavalier, and also within the casemates and cavalier to admit of the footings being cut through at the angles where it is proposed to carry down the pipes as shewn in the Sections (Drawings 3 & 4)...
Masons Work

The footing of retaining walls of the casemates and cavalier to be cut through as shewn by the red dotted lines and by the Yellow tint (?) at x in the sections (Drawings 3 & 4) and drains 6" x 5" in clear of brick work \( \frac{1}{2} \) brick flat bottom and covered with a brick flat in Roman Cement to be constructed through the openings and to be respectively connected with the existing drains outside and with the proposed drains abc. de. fg. hi. kl. mn. op. qr (Drawing N. 1) which are to be 14" x 14" in the clear the sides of dry rubble masonry 12 inches thick the bottom & the top covering the self faced Iron stone flagging 4 inches thick jointed and laid dry, the bottoms with an inclination of \( \frac{1}{2} \) inch in ten feet towards the existing drains to which they are to be properly connected.

A chase to be cut in the masonry of the footings for receiving the pipes and the openings through the footings to be made good round the brick drains with rubble masonry in mortar using the stone removed in the formation of the openings one half of which it is calculated will be serviceable. And part of the masonry of the footing of verandah of Cavalier to be taken up and reset in mortar for the purpose of carrying the branch drains through – the old tiles and dry flagging of the dos d'anès of Casemates 17. 18. 21. 22. 27 & 28 to be taken up, the tiles removed to store and the flagging to be used in making good any deficiency in the flagging and counter flagging of the hopper ends of the dos d'anès of casemates 1 to 11 inclusive, which as well as the rubble masonry beneath it and a portion of the side flagging and counter flagging next the retaining walls of casemates and Cavalier to be taken up (for the purpose of inserting the hopper heads and pipes) and reset the masonry in mortar, and the flagging and counterflagging in half mortar half cement vizt: the center part of each flag in mortar and the remainder portion [sic] and the joints in Roman Cement. -

The lead gutters to be turned back (vide plumbers work) from the retaining wall of casemates and cavalier & holes to be cut through haunch of the arches (as shewn in sections drawings 3 & 4) for inserting the cast Iron Hopper Heads and elbow pipes, which are to be securely built in and those openings as also the gargoyle openings to be [fitted?] up and made good with brick work in Roman Cement.

The coping and masonry of the retaining and escarp walls (shewn by the
reddish brown tint on plan and section drawing 2.3 & 6) to be taken down
and reset in Roman Cement and a chase 12" x 9" to be cut in the walls of
cavalier over the flagging of the dos d'anes and made good with rubble
masonry in Roman Cement) [sic] for the purpose of introducing a water
table of granite 18" x 9" punched weathered sunk and set in Roman Cement.
...

The Casemates 21. 22. 26 & 27. not being provided with gutters at vvvv,
Drawing N° 2, it is proposed to supply that deficiency. The gutters to be
formed (for receiving the lead lining vide Plumber work) 9 inches wide of
brick work in Roman Cement (the backing and sloping sides at top of rubble
masonry in mortar) and the concave surface rendered throughout with Roman
Cement.

The proposed cast Iron pipes in the angles within the casemates as
numbered from 1 to 54 inclusive on drawing N°. 2 as well as those within
the cavalier to be cased round with brick work one brick thick in Roman
Cement (shown on plan Drawing N°. 3. Fig: 10 & 11 [numbers crossed out and 9
and 10 substituted] every fourth course to be toothed into the walls right
and left alternately) on footings of rubble masonry in mortar. The hopper
ends of the Dos d'anes of Casemates from 15 to 54 inclusive and those of
the Cavalier to be constructed to the angles indicated by the dotted lines
in the sections (Drawing Nos. 3 & 4) of rubble masonry in mortar for receiv­ing
the flagging and counter flagging, which together with the sides and edges
of N° 17. 18. 21. 22. 26 & 27. to be of Iron stone averageing [sic] from 4
to 6 inches thick joined and bedded flush in $\frac{1}{2}$ cement $\frac{1}{2}$ mortar and jointed
with cement as before described, with dry flagging and counterflagging of a
like description over the gutters of 17. 18. 21. 22. 26 & 27. - Holes to be
cut in the walls of officers' rooms in the redan, and in Soldiers rooms of
first floor of Cavalier for receiving the ends of trimming Joists round
pipe casing. - ...

Plumbers Work
Milled sheet lead of 8 lbs. to the superficial foot to be provided and laid
in the gutter at v.v.v.v over Casemates 21. 22. 26 & 27. and which together
with the existing gutters of these and the other casemates and cavalier to
be dressed and chased into the retaining walls and run with lead, and the
bottoms over the cast iron hopper heads to have a hole 5" diameter cut in
same and to be fitted with a lead soldered pipe of the same diameter &
soldered to the gutter to dip 6 inches below the bottom of gutter into the
hopper head thus in section [drawing in text]. The several existing lead
gutters of the uncovered casemates to be carefully examined and repaired
where found defective making good such (probable) defects and deficiencies
with new lead and solder.

The Plumbers and Laborers time solder [sic]. Lead coals & tallow is
for dressing back the gutters (preparatory to the masons inserting the hop­
per heads) and dressing down same, making and connecting the drip or nozz­
le pipes to gutters and repairing defects.

Carpenters Work.
The boarding [?] and joist in the Casemates officers & Soldiers Quarters
(and in Cavalier) to be cut out (as shewn in Sections drawing N. 3) to
admit of the introduction of the Cast Iron pipes and brick casing round
same and to be made good again using the same materials and supplying the
deficiency by new boarding nails and trimming Joists round the pipe casing
shewn in Drawing N. 3, Figs: 10 & 11, and the planking & Joisting of the
footway under the verandah of Cavalier to be taken up and relaid [sic]
for the purpose of admitting the branch drains being constructed. The
existing battening [?] to walls and dado in Officers rooms in Redan to be
removed at the angles for admitting the cast iron pipes and brick casing
and trimming the floors round same. The circular brick casing to be lined
with inch deal wrought one side and rebated dado, and fixed on rough fir
bond timber 4\(\frac{1}{2}\) x 3 to be built into the brickwork. The existing dado to be
made good to the new circular part which is to have a capping of inch deal
2 inches wide, wrought and rounded and scribed to the brickwork and mitred
at the angles of junction with the existing straight capping with Inch torus
moulded skirting at bottom & mitred to the existing skirting. The rough fir
2 inch rough deal and the nails is [sic] for making good the deficiencies
consequent on taking up the flooring & Joisting, and trimming round the pipe
casing, and the carpenters time is for making good the dado and battening of
walls in officers rooms consequent on the same.
Plasterers Work.
The lathed and plastered ceiling at angles of officers Kitchens and the lath & plaster on walls in officers rooms over dado where the pipes are to be carried through to be taken down and made good with Lath and plaster 2 coats and set with fine stuff, and the brick casing of pipes in officers rooms above the dado to be rendered 2 coats and set with fine stuff, and that in the officers Kitchens. Soldiers Quarters in Casemates and Cavalier to be lime whited 2 Coats. –

Smiths Work.
Cast Iron Hopper heads with 3" bore cast Iron rain water pipes and wrought Iron bands to be provided and fixed in the Casemates and Cavalier as shown in the Sections drawings N. 3 & 4.
The joints to be staunched with white lead ground in oil to prevent effluvia ascending into the room from the drains.

Painters Work.
The cast Iron Hopper heads and pipes including the wrought Iron bands, and the new dado in officers rooms to be painted 4 Coats common color in oil....

[Item 2]
This Item which is the service provided for under Item 4 of the supplementary Estimate dated 31 March 1836 for Tanks & Filters amounting to £665..l..5\(\frac{1}{4}\)
is herein brought forward for authority, it being considered essential to have this work executed in connection with that proposed under Item 1 of this Estimate. The only alteration suggested in its provisions is to carry the vertical part of the conduit pipe in the interior angle of the casemate (N. 30 where it is proposed to construct the Tank) instead of bringing it down the exterior face of retaining wall as has been proposed and also to fix the pump within the casemates [sic] N. 31. in which the well is situated by which means it will be protected from the frost the point y on Drawings N. 1. 2 & 5 shows the suggested altered position of the pipe and Z Drawing N. 1 that of the pump. This alteration will not it is considered affect the amount of the Item as originally estimated.
[Item 2 - estimate]

Water Tanks.

For the detail of this Service See Item 4 of the Supplementary Estimate dated 31st March 1846 £665 1 5 1/4


Appendix 7: Shifting Rooms (The Civil Buildings Annual Estimate, 1862-63, Items 6 and 7)

Item 6: This Item provides, at the request of the Deputy Superintendent of Stores, for Securing the Shifting rooms of the North and South Magazines at the Citadel Halifax N.S., against leakage.

This Service appears to be very necessary, as the rain water Soaks through the walls and arches to such an extent as to render the rooms useless for any purpose whatever.

It is therefore proposed to uncover the arches and back of walls and to remove the rough iron Stone flagging which at present covers the dos d'ane, Substituting a coating of Portland Cement Concrete, and to render the back of the walls, and the dos d'anes so formed with Portland Cement concrete one inch thick; also to form a Gutter at the base, round the sides of the walls with Portland Cement concrete, the surface of which to be rendered and graded so as to discharge the Soakage through the weep-holes to be cut through and formed in the front walls, as shewn on plan. Loose stones and coarse gravel to be filled in over the gutters to facilitate in carrying off the Soakage from the Superincumbent Soil. ...

Appendix 8: South Magazine Ramp (The Fortifications Annual Estimate, 1860-61, Item 3)...

To excavate for Wall and area, and under drain, fill in and well ram the same, make good the gravelling on parade, and ramp, and remove the rubbish; to build the Wall of the area and then turn the arch of same on proper centers, in flat bedded iron stone rubble masonry, laid dry, and to form drain 9" x 9" in the clear, from area to the existing under drain, at opposite of the parade, (distant 200 feet) with rubble Masonry, side 9" thick, and flagged top and bottom with iron stone flags, the whole to be laid dry, and to have a fall of not less than \( \frac{1}{2}" \) in 20 feet, the side of the old drain to be opened, and the new one properly connected thereto. - ...


Appendix 9: Cast Iron Pipes, 1852.

The following table has been extracted from G.R. Burnell, C.E., "Water Supply", Aide-Memoire to the Military Sciences (1852), Volume 6, Part R...Z, p. 732.

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Glossary


basin, catch
a reservoir, especially for catching and retaining surface drainage, in which sediment may settle before the water reaches the drain lines.

basin, wash
a shallow-vessel of greater width than depth, with sloping or curving sides, used for holding water and other liquids, especially for washing purposes.

cable
a bundle of insulated electric conductors, passing through a pipe laid underground.

catchment
HDC: a general term applied to any pit designed for the reception of rainwater; catch pit, catch basin.

cesspit
a pit for the reception of night-soil and refuse; a midden.

cesspool
a lined and covered excavation in the ground which receives the discharge of domestic sewage or other organic wastes from a drainage system, so de-
signed as to retain the organic matter and solids, but permitting the liquids to seep through the bottom and sides.

closet, dry earth
an exact definition of this item has not yet been found; presumably this is a sanitary arrangement closely resembling a dry latrine or an outhouse.

closet, water (W.C.)
a plumbing fixture used to receive human excrement and to discharge it through a waste pipe, using water as a conveying medium; a room containing a water closet.

cookhouse
a building or room in which cooking is done.

ditch
an excavation narrow in proportion to its length; a long and narrow hollow dug in the ground; such a hollow dug out to receive or conduct water, especially to carry off the surface drainage of a road, a field, etc.; extended rhetorically to any watercourse or channel, including those of natural formation.

drain
a channel by which liquid is drained or gradually carried off, especially an artificial conduit or channel for carrying off waste water, storm water, sewerage, etc.

drain, main
HDC: this drain ran from the parade ground, beneath the redan salient angle down the glacis to Brunswick Street, across Brunswick Street to Buckingham Street, and thence to the sea.

drainage
a system of drains, artificial or natural; that which is drained off by a system of drains; sewage.
filter
any contrivance for freeing liquids from suspended impurities, especially
an apparatus consisting of a vessel in which the liquid is made to pass
through a stratum of sand, charcoal, or some porous substance.

floodlight
a projector type of luminaire, designed for lighting a large area or an
object to a level of illumination which is considerably greater than that
of its surroundings.

frame, catch basin
a tooled granite frame inserted into the mouth of a catch basin or general
catchment at ground level, often containing a grate or plate; usually flush
with the ground or surrounding area, it may also possess a connecting
channel for the collection and proper direction of water (e.g. south
magazine ramp).

gargoyle
a spout, projecting from the gutter of a building in order to carry the
rainwater clear of the walls, often grotesquely carved; a projection
resembling a gargoyle.

gutter
a shallow trough fixed under the eaves of a roof, or a channel running
between two sloping roofs, to carry off the rainwater; a hollowed channel
to carry away surface water; a shallow trough or open conduit pipe for
outflow of fluid.

hopper (head) (leader head)
a funnel-shaped enlargement or catch basin designed to receive rainwater
from the gutter at the top of a downspout.

hydrant
an apparatus for drawing water directly from a main; consists of a hollow
metal cylinder provided with one or more nozzles to which a hose maybe
attached, or with a valve or faucet, used for supplying large quantities
of water.
latrine
a privy or public toilet, especially in a camp, barracks, hospital, or similar place.

lavatory
a basin with water supply and drainage piping, for washing the hands and face; a washbasin; a room containing a washbasin and a water closet, but not a bathtub; same as toilet or watercloset.

lime
the alkaline earth which is the chief constituent of mortar: calcium oxide (CaO). It is obtained by submitting limestone (carbonate of lime) to a red heat, by which the carbonic acid is driven off, leaving a brittle white solid, which is pure lime (quick-lime). It is powerfully caustic and combines readily with water, evolving great heat in the process and forming hydrate of lime (slaked lime).

main
a principal channel, duct, or conductor for conveying water, sewage, gas, or electricity; in any system of continuous piping, the major artery of the system to which branches may be connected.

main, 12" tubular
H.D.C. the circular major drain running from the lavatories in casemates 54 and 55, around the north end of the fort, approximately mid-ditch, and finally connected to the main drain at the redan salient.

main, water
H.D.C.: the chief water artery run into Fort George from the city via Royal Artillery Park. It ran from R.A. Park under the glacis to the salient of the south ravelin, down mid-ditch to the main 'moat' and across to demi-casemate 18, where it entered the parade. From there it traversed the parade in front of the cavalier. It possessed a number of subordinate lines leading to most areas of the fort and especially to the two water tanks.
manhole
a covered hole or opening in a floor, pavement, boiler, sewer, etc. which provides access for cleaning and repairing of certain parts beneath, or for repairing a conduit for electric underground piping or electric cables.

pipe
a continuous tubular conduit of wood, metal, or other substance, generally leak-proof, for the conveyance of liquids and gases.

pipe down (downspout; leader)
a vertical pipe, often of sheet metal, used to conduct water from a roof drain or gutter to the ground or cistern.

pipe, overflow
pipe used to remove excess water and/or to prevent flooding in certain sanitary fixtures, storage tanks, and plumbing fittings; an outlet for a storage tank, used to prevent flooding or to set the water level in the tank.

privy
a private place of ease, a latrine, a necessary, an outhouse which serves as a toilet.

pump, pressure
a mechanical device, commonly consisting of a tube or cylinder in which a plunger is moved up and down by means of a lever, so as to raise water by pressure, the movement of the water being regulated by a suitable arrangement of valves or clacks.

sewer
an artificial channel or conduit, now usually covered and underground, for carrying off and discharging waste water, sewage and other liquid waste.

sewer, common
a drain through which all or a large part of the sewage of a town passes, a main drain collecting and discharging the contents of auxiliary drains.
sewer, storm
a sewer for conveying rainwater or other similar discharges, but not sewage or industrial waste, to a point of disposal.

shut-off (water)
something which shuts off: a tap, valve.

sink
a basin or receptacle made of stone, metal, or other material, and having a pipe attached for the escape of water to a drain, etc; especially such a basin fitted in a kitchen or scullery, and having a supply of water connected to it.

stack (pipe)
any vertical pipe, such as a soil pipe, waste pipe, vent, or leader stack; such pipes, collectively.

staunching
H.D.C.: a general term given to a variety of schemes designed to make casemates water-tight.

stone, basin
H.D.C.: cut granite basin-shaped vessel, having sloped or curved sides, fitted into a surface gutter to direct water to a gargoyle or into a catchment. The latter type, very similar to a catch basin frame, has no bottom, and often possesses a grate.

stopcock
a tap or short pipe furnished with a valve operated from the outside by turning a key or handle, for the purpose of stopping or permitting as required the passage of liquid, air, steam, gas or the like.

system, drainage
the piping net work within a structure which conveys sewage, rainwater, or other wastes from their point of origin to a point of disposal, such as a public sewer or a private treatment facility.
tank, flushing
a tank which holds a supply of water for flushing or cleansing, by a rush of water, one or more plumbing fixtures.

tank, water
an artificial receptacle, usually rectangular or cylindrical and often of plate-iron, used for storing water in large quantities; H.D.C.: two subterranean structures, rectangular in shape, with 5 arched interior storage compartments, and two gravel-sand-charcoal filters each, built of stone, lined with brick, and sealed with a top layer of asphalt. Situated, one in the southeast and one in the northeast salients, they were each capable of holding 66,000 gallons of water. A third, reserve tank, with a capacity of 30,000 gallons, was situated in the redan area, between the two main water tanks.

toilet
a water closet, W.C.; the room containing the water closet.

tunnel, service
H.D.C.: a subterranean passage, entering Fort George through the redan right face, containing fire detection lines, the 12 inch sanitary sewer, and the 24 inch storm sewer.

urinal
a sanitary fixture equipped with a water supply and drain for flushing away urine; a building, erection, or enclosure for accommodating persons when requiring to pass urine; a chamber pot.

water, rampart
H.D.C.: surface rainwater collected from the tops of the ramparts by a series of surface drains, down pipes and subterranean drains and deposited into the water tanks.

water, waste
H.D.C.: surface rainwater from the parade and precipitation drained from the casemates collected by a system of ground level surface gutters and deposited in the main drain.
weep hole
an opening through which moisture percolates; a small opening in a wall or window member, through which accumulated condensation or water may drain to the building exterior as from the base of a cavity wall, a wall flashing, or a skylight; a hole near the bottom of a retaining wall, backfilled with gravel or other free-draining material, to permit water to drain to the outside of the wall, so as to prevent the build-up of pressure behind the wall.

well
a pit or shaft dug in the ground to obtain a supply of spring-water, specifically a vertical excavation, usually circular in form and lined with masonry, sunk to such a depth as to penetrate a water-bearing stratum.

whitewash
a liquid composition of quicklime dissolved in water, or of whiting (finely powdered chalk), slaked lime, size (a glutinous substance) and water, applied as a thin film like paint to whiten walls, ceilings, etc.
Bibliography

Burnell, G.R., C.E.
"Wells", Aide-Memoire to the Military Sciences (1852, Volume 6, Part R...Z, pp. 775-782.

Canada. Public Archives.

Canadian-British Consultants Limited.

Central Mortgage and Housing Corporation


Connolly, John

Denison, Captain William, R.E.
"Paper XXV. Observations on Barracks, and on the Moral Condition of the Soldier." Papers on Subjects connected with the Duties of the Corps of Royal Engineers, contributed by Officers of the Royal Engineers (1849-1850), Volume I, pp. 247-261.


Dunn, Brenda.

Fergusson, W., M.D.

Galton, Douglas
Lectures. Sanitary Engineering Delivered at the School of Military Engineering, Chatham. Winter Session, 1876. The School of Military Engineering, Chatham, 1877.

Great Britain. War Office.
Regulations for Personnel (Army Medical Department). War Office, Pall Mall, 1858.
Greenough, John Joseph.

Halifax Defence Complex

Hansen, Chris.
"177-year-old drain uncovered in Halifax."

Harris, Cyril M.

The Mail Star, Tuesday, 1 August 1978, p. 37.

Lane, Richard B.

The Nova Scotian.
Volume 20, no. 35, 20 August 1860.

Parks, Edmund A., M.D.

Wilson, A.W.
Woods, Robert

Young, Richard J.