HISTORIC STRUCTURE REPORT

THE CULVERTS

HISTORICAL DATA

CHESAPEAKE AND OHIO CANAL NATIONAL HISTORICAL PARK

MD.-D.C.-W.VA.

By

Harlan D. Unrau

DENVER SERVICE CENTER
HISTORIC PRESERVATION TEAM
NATIONAL PARK SERVICE
UNITED STATES DEPARTMENT OF THE INTERIOR
DENVER, COLORADO

January 1976

CONTENTS

PREFACE

This report has been prepared to satisfy in part the research needs for the preservation/stabilization of the culverts on the Chesapeake and Ohio Canal. More than 200 culverts of varying dimensions were built to pass the smaller creeks and streams under the canal. Previous to this report, John R. Miele wrote an historic structure report on Culverts Nos. 114–118 (January 1964). The purpose of this study is to complete the historical research on the culverts along the entire length of the canal. Because of the common histories of these structures, an effort has been made to deal with them in a comprehensive manner while at the same time pointing out distinctive differences in their design.

A number of persons have assisted in the preparation of this report. Thanks are due to Superintendent William R. Failor and Park Ranger Ellwood Wineholt for assistance at the park headquarters; to Maria Joy and Robert Kvasnicka of the National Archives who were helpful in locating unpublished documents; and to Dr. Harry Pfanz and Barry Mackintosh of Park Historic Preservation (WASO), Supervisory Historian John F. Luzader (DSC), Historical Architect Thomas N. Crellin (DSC), and Editor Linda Greene for reading the manuscript and providing editorial assistance.

Harlan D. Unrau
May 31, 1974

ADMINISTRATIVE DATA

A. Name of Structure

Culverts, Chesapeake and Ohio Canal National Historical Park, Montgomery, Frederick, Washington and Allegany counties, Maryland.

B. Proposed Use of Structure

There are more than 200 culverts of various sizes that carry streams or roadways under the 185-mile length of the Chesapeake and Ohio Canal. Although there is no officially-approved master plan, it is recommended that all of the culverts necessary to pass streams under the canal be stabilized, preserved or restored pending a final determination of their condition.

C. Justification for Such Use

Because the culverts are necessary to the adequate passage of streams under the canal, it is important that they function properly. Unless the culverts operate as they should, serious damage will be done to the towpath, berm and canal banks.

D. Provision for Operating Structure

The culverts should be employed to provide an adequate drainage system for the streams from the berm side to the towpath side of the canal.

E. Cooperative Agreement, if Any, Executed or proposed for Operating Structure

There are numerous agreements governing the use of the culverts along the canal. Some culverts are used to convey private farm or county roads under the canal, while others are designed to carry both water and roadways under the canal. Agreements granting these access rights should be thoroughly reviewed before work on any of these structures is commenced.

F. Description of Proposed Construction Activity

To insure that the culverts can carry out their necessary function, the following projects are recommended:

a. The barrels and the inflows and outflows of the culverts should be cleaned and cleared of siltation deposits, logs and debris.

b. Where streams have changed their course because of obstructions, measures should be taken to redirect the streams through the culverts.

c. Where there is structural damage to the culverts, it is recommended that they be stabilized or restored, depending on their relative importance to the canal.

STATEMENT OF HISTORICAL SIGNIFICANCE

Between Georgetown and Cumberland, Maryland, numerous tributaries flow into the Potomac River. Eleven aqueducts were constructed to carry the Chesapeake and Ohio Canal over the rivers and larger creeks, while more than 200 culverts of varying dimensions were built to pass the smaller creeks and streams under the canal. Culverts were also constructed in ravines in order to prevent the canal from being washed out during periods of heavy rain. Road culverts were built in order to provide access from vehicles to places on the river side of the canal. Some culverts served as roadways as well as for the passage of streams.

RECOMMENDATIONS

The records pertaining to the Chesapeake and Ohio Canal Company in the National Archives, the Library of Congress, the Maryland State Archives at Annapolis, and the Maryland State Historical Society at Baltimore have been thoroughly investigated for this report. Therefore, it is the opinion of the author that no further historical research needs to be done on the culverts.

During the planning stages of the restoration and maintenance work on the Chesapeake and Ohio Canal, there is an urgent need to understand the function of the culverts. As water control devices, the culverts were designed to channel the flow of streams under the canal. Unless they are reestablished as such, the canal prism and its embankments will continue to suffer damage during periods of heavy rain. To insure that the culverts perform their intended function, the following points should be considered:

1. All timber and debris that clogs the culvert barrels should be removed to permit a normal flow of water.

2. Where the culvert barrels are heavily silted, they should be cleaned out.

3. In places where the stream channel on the inflow or outflow ends of a culvert has changed its course due to siltation or debris, efforts should be made to realign the flow of water.

4. Attention should be given to the stabilization, repair, or restoration of those culverts in a bad state of disrepair.

I. INTRODUCTION

The Chesapeake and Ohio Canal had to pass over numerous tributaries of the Potomac River between Georgetown and Cumberland. It was necessary to construct aqueducts to carry the waterway over the rivers and large creeks. The smaller creeks and streams were passed under the canal by culverts of varying dimensions. Culverts were also built in hollows to prevent the canal from being washed out during periods of heavy rain. Road culverts were constructed in order to provide access for vehicles to places on the river side of the canal. Some culverts served as road culverts as well as for the passage of a stream.

The culverts below Harpers Ferry were generally about 110 feet long, due to the greater width of the canal, and those above Harpers Ferry were about 100 feet long on the average. The curve of the culvert arch was generally a semicircle, and the thickness of the arch varied according to the length of the span. Wherever possible the culvert was to rest upon solid rock. Foundations of stone or timber were also acceptable, and the final decision as to the proper foundation was left to the engineer.

As was the case for the other canal structures, a detailed general specification was prepared for the culverts. The specification described the type of foundation to be used, the thickness of the arch, the preparation of the ring, and the details for constructing the abutments, wing walls and parapets. The general specification, modified to conform to local building conditions, probably served as a guide in constructing all the culverts along the length of the canal.[1]

The canal company did not give as much attention to the culverts as to the major canal structures, because the former were easier to build and did not present many engineering problems. Consequently, the details of the actual construction of the individual culverts are not reflected in the company records to the extent that they are for locks, aqueducts and dams.

[1] "Specification for Culverts on the Chesapeake and Ohio Canal" (ca. 1829). Because the author could not find a copy of this specification in the course of his research at the National Archives, the Library of Congress, and in the files at the Antietam–C & O Canal Group headquarters, he has taken this document from the historic structure report entitled "Culverts Between Lock No. 40 and Dam No. 4," by John R. Miele, January 1964. A copy of this specification may be seen in Appendix A of this report.

II. THE CANAL PROJECT: 1822–1828

The construction of the Chesapeake and Ohio Canal represented the culmination of several attempts to develop the Potomac River as a trade route to the west. Its immediate predecessor was the Potomac Company, which had been chartered in 1785 to improve navigation by deepening the riverbed and building short canals in various places around the rapids and falls. By 1822 the Potomac Company was deeply in debt and still had not achieved its purpose of making the river navigable throughout the year. Attention turned to building a permanent, artificial waterway that would connect the Ohio Valley with the Chesapeake Bay.[2]

The Chesapeake and Ohio Canal Company was chartered by Congress in a measure approved by President James Monroe on March 3, 1825.[3] With the passage of the charter, friends of the canal project promptly began a vigorous campaign for public support for the new waterway.

On October 23, 1826, however, the Board of Engineers, which had been commissioned by Congress to provide a detailed survey of the proposed route of the canal, issued a report of its findings. The report, which President John Quincy Adams transmitted to Congress on December 7, 1826, asserted that the proposed waterway was physically practicable but estimated the cost of the canal with dimensions required by the Federal Government at approximately $22 million.[4] This estimate dampened the hopes of the canal supporters, who had been thinking in terms of a total cost of between $4–5 million. They now decided to hold a convention in Washington, D.C., on December 6, 1826, to dispel the gloom that paralyzed the canal's friends and to reassure prospective supporters.

The convention adopted a twofold course: to discredit the estimate of the U.S. Board of Engineers and to cause a new survey to be made to ascertain the cost of the work. The report of the Government engineers was exhaustively examined and comparisons were then made with the actual cost of work done on the New York, Pennsylvania and Ohio canals. The critics discovered that allowances for labor costs were much too high, as were the estimates for masonry, walling and excavation. The criticism in part was valid; both on the basis of experience on other canals and on the ground that the allowances made for many types of work were extravagantly generous.[5]

On February 11, 1828, the Central Committee of the Chesapeake and Ohio Canal Convention submitted an exhaustive report of its findings to the House Committee on Roads and Canals. Investigating on its own, the committee found that the Board of Engineers had overestimated the cost of constructing the canal from Georgetown to Cumberland by

---

[2] Walter S. Sanderlin, *The Great National Project* (Baltimore, 1946), pp. 29–44.

[3] U.S. Congress, Senate, *Documents Relating to the Chesapeake and Ohio Canal*, 26th Congress, 1st Session, July 11, 1840, S. Doc. 610, p. 13.

[4] The full report is printed in U.S. Congress, House, *Message of the President of the United States, transmitting a Report from the Secretary of War with that of the Board of Engineers for Internal Improvement, on the Chesapeake and Ohio Canal*, 19th Congress, 2nd Session, Dec. 7, 1826, H. Doc. 10.

[5] Sanderlin, *Great National Project*, p. 56.

nearly $4 million. In its report, this committee made the following observations on the costs of constructing culverts in Ohio:

> Common culverts on the Miami canal [Miami and Erie] have been built on rough limestone at from $2 to $2.25 per perch. Large arches, where the stone is laid in range work in the wings and parapet walls, and in the arch, are building at $2.50, $2.75 and $3.50 per perch, varying with the expense of procuring stone, and the style of the work. On the Ohio canal [Ohio and Erie], small culverts, with 14 to 15 inch rings, every stone cut to a pattern (the stone being very friable sandstone), are built for $2.75 to $3 per perch. Large arches, with rings 18 to 21 inches, stone cut to pattern, are built at from $2 to $2.75 per perch.[6]

In the meantime, friends of the project in Congress prevailed upon President Monroe to submit conflicting estimates made by the convention and Board of Engineers to a review and revision by experienced civil engineers. President Adams agreed and appointed James Geddes and Nathan Roberts to conduct surveys. They completed these in 1827 and estimated that the canal could be constructed as far as Cumberland for approximately $4,500,000.[7]

Fortified with this estimate and reassured of the inaccuracy of the U.S. Board of Engineer's report, the canal protagonists reentered the battle. Subscription books were opened on October 1, 1827, but the formal organization of the company was delayed until Congress passed an act subscribing $1 million of public funds to the stock of the Chesapeake and Ohio Canal Company. The company received additional financial support in the form of subscriptions to its stock from the States of Maryland and Virginia, the three District of Columbia cities, and private investors. At a meeting of stockholders in Washington, June 20–23, 1828, the Chesapeake and Ohio Canal Company was formally organized with a subscribed capital of about $3,600,000.[8]

After completing the business of organization, the canal company held gala ceremonies marking the formal inauguration of the canal project. On July 4, 1828, many representatives of official Washington were present to watch President Adams turn the first spadeful of earth at Little Falls. This affair was highly successful and focused national attention on the canal project. It was confidently expected that the canal would soon be carrying a heavy volume of commerce.[9]

---

6 U.S. Congress, House, *Chesapeake and Ohio Canal Report*, 20th Congress, 1st Session, H. Doc. 141, pp. 1–6, 63 (hereafter cited as *House Document 141*).

7 Sanderlin, *Great National Project*, p. 56.

8 Proceedings of the Stockholders, A, pp. 1–3. All manuscript materials referred to in this report are deposited in the Department of Interior files at the National Archives and are designated Record Group 79.

9 *National Intelligencer*, July 7, 1828.

III. THE CONSTRUCTION OF THE CULVERTS BETWEEN GEORGETOWN AND DAM NO. 5: 1828–1835

In the weeks following the festivals at Little Falls, the board of directors took up the preliminary matters concerning the location and dimensions of the waterway, the selection of a competent staff of engineers, and the procurement of an adequate supply of good building stone and cement. Only after settling these questions could contracts be let and construction begin.

The board, on July 5, determined that proposals would be received from October 1 to 20 for the construction of the locks, aqueducts and culverts between Little Falls and Great Falls. The directors authorized immediate steps to find "the most convenient points upon or near the river at which suitable stone" could be obtained "together with its price and cost of transporting." Similar inquiries were to be made to find suitable lime for making hydraulic cement for use on the masonry works.[10]

On July 19, Benjamin Wright, the chief engineer, reported to the board that the line of the canal between Great Falls and Seneca Creek had been surveyed. Accordingly, the board determined that bids on the masonry works on this subdivision would also be received from October 1 to 20.[11] Several weeks later on August 9, the board announced that it would receive bids from October 15 to 20 for the sections, locks, aqueducts and culverts between Seneca Creek and Point of Rocks.[12]

Chief Engineer Wright, on October 18, wrote to John P. Ingle, the clerk of the company, telling him that he was unable to provide details on "the quantity of each kind of work in each culvert" as the board had requested. Furthermore, Wright did not feel that the matter was important "as the propositions are all to be by perch for each separate kind of work and the comparison as to which is the most favorable proposition is decided at once by the price itself."

In the letter, Wright elaborated on the general specification for the culverts. As a general rule, one third of the perches were considered arch work although this varied to one half in small culverts.

Concerning the abutments, Wright said:

> The height of abutments changes the whole plan, as for instance where it is rock bottom and the surface of the rock considerable inclination, there the abutments would be higher at the lower end than at [the] upper [end] and where there are holes in the rock which is to be cleared out and filled with masonry it changes the whole quantity of perches.

Wright also informed Ingle that he had encouraged some contractors who were experienced in building culverts "to make their propositions for all masonry wanted in culverts

---

10 Proceedings of the President and Board of Directors, A, pp. 11–13.
11 *Ibid*., pp. 24–25.
12 *Ibid*., p. 37.

or aqueducts for 15 or 20 sections." This procedure, in his opinion, was better than "dividing it up among many" contractors.

The chief engineer reminded Ingle that in addition to the culverts that would soon be let, "we may be obliged to change and make some little ones for draining some particular field which will therewith be flooded and has been overlooked." The contracts for the culverts between Little Falls and Seneca creek were "to express it in this full and ample latitude to prevent any cavil by contractors." The engineers, in filling out their returns on the fulfillment of the contracts, were "to state each culvert & the section it is upon and [the] quantity of perches of each kind in it so that you have a full view of the matter."

Wright concluded this letter by stating that "it may be found necessary before we build and after we have become better acquainted with the streams to enlarge some of them."[13]

Three days later, on October 21, President Mercer and Directors Smith, Lenox and May met in Georgetown. After being joined by Chief Engineer Wright, they proceeded up the line of the canal. Their trip continued on October 22, and they arrived at Leesburg, Virginia, the following day, where they were joined by Directors Smith and Janney. Here the board was engaged on October 23–25 in deciding on proposals offered for all the masonry work between Little Falls and Point of Rocks. They declared that the bids from W. W. Fenlon & Co. for the following culverts had been accepted: Nos. 10, 11, 12 (all on Section No. 8), and No. 17 (on Section No. 14).[14]

As the contractors began work on the line of the canal, the resident engineers of the first division issued general instructions regarding the culverts to the assistant engineers supervising the work. On November 10 William M. C. Fairfax sent the following directions to Herman Boye concerning the use of culverts for roadways under the canal:

> Opposite to ferries you will leave room enough for a basin beyond the towing path, capable of receiving a scow containing a wagon and six horses and deep enough to float the same, with any load, say 2 feet.
>
> Where the elevation of the canal is such that an inclined plane towards the river shore, at the ferry can be formed by a culvert conducted under the canal, the basin may be dispensed with, and in that case the nearer the canal is carried to the river bank the better, provided it be secure from abrasion. This will probably be the case at Nolands ferry.[15]

Two days later President Mercer issued the following circular to the Corps of Engineers regarding road culverts:

> Since my last instructions to you and forwarded through Dr. Martineau [a member of the Board of Engineers] it has occurred to me that high freshets in the Potomac and the possible

---

13 Wright to Ingle, Oct. 18, 1828, Ltrs. Recd., C & O Co.

14 Proceedings of the President and Board of Directors, A, p. 97. Within a few days all the masonry work, locks, aqueducts and culverts between Little Falls and Point of Rocks had been let. There were a total of 1,308 proposals for these contracts.

15 Fairfax to Boye, Nov. 10, 1828, Ltrs. Recd., Letter Book of the Resident Engineer of the 5th Residency of the 1st Division.

> erection hereafter of bridges at Nolands ferry and other places across the river, may render a passway for wagons and travelers under the canal, especially in the public roads insufficient even at Nolands ferry; and therefore room must be taken for the Basin, to this I am reconciled by the consideration that in the case even of Bridges the same space must have been taken to ascend them from the river as at said ferry.
>
> But in regard to farm ferries for farm Bridges the proprietors might very reasonably be expected to wait for the freshet to subside and if immediately opposite the river bank (as opposite an Island) the passway might be carried under the canal by a culvert sunk sufficiently low.[16]

The board, on November 22, determined that steps should be taken "to stimulate the just pride of the contractors." A system of rewards "for diligence and fidelity" was instituted under the direction of the president and directors. For the best constructed culvert completed within the contract time, the board offered "a silver medal, with suitable devices, of the value of ten Dollars."[17]

On December 5, the 5 miles between Little Falls and Georgetown were let. Culverts E, F, G, H and I were let to B. S. Forrest & Co., and Culverts K and L were let to Hewes, Lewis and Hewes.[18]

By late March 1829 the progress of work on the culverts was lagging behind other aspects of the construction. Therefore, Nathan Roberts, a member of the board of engineers, issued the following order to the resident engineers along the line of the canal on March 25 to expedite work on the culverts;

> You are requested to inform those contractors who have agreed, or who wish to build the culverts on their respective sections of the canal, that they are requested by the Clerk of the Board of Directors to come forward and enter into contracts for the same; and you are further required to make a list of those culverts not contracted for, and return the same to the Engineers office at Georgetown, as they have been requested to contract for the building of the same with any responsible person at the prices agreed upon, viz.

For arch work laid in good cement mortar a perch	- $2.75
For parapet walls & wings a perch	- $2.50
For dry walls & inverted dry arch a perch	- $2.00[19]

Three days later Resident Engineer Boye replied concerning this order. He informed Roberts that he had already requested all the contractors on the sections to state if they were willing to contract for the culverts in their sections. This had been done according to the terms offered by the company, but in no case had such an offer been accepted.[20]

---

16 Mercer to Corps of Engineers, Nov. 12, 1828, Letter Book of the Resident Engineer of the 1st Residency of the 1st Division

17 Proceedings of the President and Board of Directors, A, p. 116.

18 *Ibid*., pp. 127–28. The work undertaken in the latter months of 1828 included approximately 48 miles of excavation and walling, 2 dams, 2 aqueducts, 60 culverts, 27 locks, 17 lock houses and several basins.

19 Roberts to Boye, Mar. 25, 1829, Letter Book of the Resident Engineer of the 5th Residency of the 1st Division.

20 Boye to Roberts, Mar. 28, 1829, Letter Book of the Resident Engineer of the 5th Residency of the 1st Division.

Before construction could be launched on a large scale, good building stone and an adequate supply of hydraulic lime for cement had to be found. Stone of a suitable quality had been discovered near Shepherdstown, on the Virginia side of the river, in January 1828, and a mill and kiln had been erected to grind and burn the lime.[21] On April 8, 1829, Robert Leckie, the inspector of masonry, informed the board "that a blue hydrate of lime had been discovered about 100 yards from the kilns constructed by Messrs. Butler & Reynolds" that "he considered to be of superior quality to that which had been contracted for'" After considering the letter, the board instructed Leckie "to extend the contract with Butler & Reynolds to 100,000 bushels of water cement, provided they will manufacture it of the blue hydrate at 17 cents per bushel" or at "a reasonable additional price."[22]

When construction of the masonry works began in earnest in the spring of 1829, the board became increasingly concerned about the quality of workmanship on these structures. In a circular issued on May 15 to the resident engineers, their assistants, and rodmen, the board warned:

> As the Locks, Lock Houses, culverts and aqueducts are advancing too much attention cannot be paid to the manner of constructing them prescribed to the contractors, by their contracts with the company, or the instructions of the Engineer in Chief and the Inspector of Masonry.
>
> To accomplish all these duties may be laborious but such is the nature of the trust expressed in the Resident Engineer, his assistant and Rodman, that the labor will, in no case, be dispensed with.[23]

The board of directors, in June, reported to the stockholders that the "cost of the culverts will be nearly in the direct proportion to their breadth, which will be determined by the breadth of the canal."[24]

President Mercer, on June 15, directed Assistant Engineer Boye to make allowance for road culverts wherever they were "opposite to or nearly opposite to any point of the Virginia shore from which a communication can hereafter be made with that of Maryland." These road culverts were to be "made of such breadth and elevation as to admit of the passage of horsemen and laden wagons and carriages beneath the canal." Road culverts were also to be built in some cases for the accommodation of landowners between the canal and the river, because the elevation of the arches would "in fact save embankment and cost us only a few more perches of perpendicular side walls."[25]

One of the largest culverts to be built was the Little Tuscarora Culvert, located just above the Monocacy River. When completed, it was to extend 130 feet under the canal and its

---

[21] *House Document 141*, pp. 38–39. The Potomac mills were creating a new industry in this region, and the lime that the contractors received was not always the high quality that was desired.

[22] Proceedings of the President and Board of Directors, A, pp. 195–96. Also see Leckie to Board of Directors, May 11, 1829, Ltrs. Recd., C & O Co.

[23] Mercer to Corps of Engineers, May 15, 1829, Letter Book of the Resident Engineer of the 1st Residency of the 1st Division.

[24] Proceedings of the Stockholders, A, p. 43.

[25] Mercer to Boye, June 15, 1829, Letter Book of the Resident Engineer of the 5th Residency of the 1st Division.

embankments with a span of 12 feet. When preparations were being made to dig the pit in September 1829, President Mercer recommended that it "should be cut thro the bank opposite or nearly opposite to the great bend of the run, where it approaches within a few feet of the river, and some distance above the present mouth of the run" as had been done for the Little Monocacy Culvert pit. Mercer had just inspected the latter and "felt much apprehension lest the porous and easily washed earth of the present bottom" made it easily susceptible to floodwaters. Accordingly, the canal president urged Assistant Engineer Ellet to guard it "from the danger of being undermined by the future wash of the stream." He also recommended that it and every culvert "be at least 6 feet from inside of the arch to the bottom, in order to enable laborers to pass through them, and clear them out of all obstruction of timber, trees, leaves or earth, when such materials accumulate within them."[26]

On February 19 the board was informed that there was some doubt "as to the capacity of the culverts at Cabin John, Muddy Branch and Watt's Branch to carry off the water of these streams in times of great floods." The chief engineer was ordered to study the problem and interview "the people residing near these streams." If the culverts proved to be too small, he was to report to the board on the best means of removing the danger.[27]

Chief Engineer Wright, on March 12, complained to Thomas F. Purcell that there was "some mortar or other substance in the horizontal culverts" in Georgetown that should be taken out and replaced. This mortar was of poor quality and the culverts on which it was used were leaking.[28]

In early March, the culvert and half-wall above Little Falls gave way. In order to determine whether the culvert and wall should be dispensed with or broken up and commenced anew, the chief engineer was asked to study the damage and submit a report to the board.[29]

On March 24 Chief Engineer Wright recommended that the culvert be rebuilt.[30] Accordingly, president Mercer engaged a number of masons and laborers to reconstruct the culvert and the wall, commencing at the bottom and building as high as the proposed waterline.[31]

From time to time Chief Engineer Wright issued revised instructions to modify the general specifications for culverts to local building conditions. One such instance occurred during construction of the road culvert at Mason's Foundry in Georgetown. In a letter to Engineer Purcell, Wright wrote on March 17:

---

[26] Mercer to Ellet, Sept. 19, 1829. Letter Book of the Resident Engineer of the 5th Residency of the 1st Division.

[27] Proceedings of the President and Board of Directors, B, p. 27.

[28] Wright to Purcell, Mar. 12, 1830, Letter Book of the Resident Engineer of the 1st Residency of the 1st Division.

[29] Proceedings of the President and Board of Directors, B, pp. 42–43.

[30] *Ibid*., p. 50.

[31] *Ibid*., pp. 42–43.

> The culvert at the Foundry—for the road under it—I wish filled up at the lower end to within three feet of the spring of the arch. The upper end is right and the paving as begun, if carried thro' so, after the road is raised at lower end and graduated so as to form a regular inclination from one end to the other will be right.[32]

During construction, periodic examinations of the structure were made. On March 30 Inspector of Masonry Leckie informed Purcell that the culvert "near the stone house and just below the viaduct" in Georgetown required attention. Masons were grouting and pointing it well, but water was leaking through under the north abutment. Unless precautions were taken, Leckie felt that the entire embankment around the abutment might be lost. To prevent this, Leckie recommended that:

> the dirt behind both abutments should be carefully removed as low as the rock, on which the abutments are placed, and that a puddle bed be carefully carried up to the line where the masons grout, and point the arch to, or a little above; the puddle for a foot in the thickness behind the abutments should be gravelly loam, carefully pounded in, for one foot in thickness, the rest of the puddle bed should be compact clay, well cut and treaded until it is of a consistence to go into a brick mold; this puddle should raise high enough to cover the whole top of the arch up to the level of the bottom of the canal.
>
> I would also recommend that a passage be opened for the water to the head of the culvert; as at present when swelled by the rains, it runs to the right and left and finds its way under the culvert walls.[33]

In mid-April Leckie was forced to resign his position as inspector of masonry because of ill health. To fill the void left by his resignation, an agent was appointed to supervise the distribution of lime from Shepherdstown and Tuscarora and to supply it in sufficient quantities to the contractors for locks and culverts. The kilns on the Tuscarora were being fired, and with the completion of three new kilns by April 25, Boteler & Reynolds would soon be able to supply all the lime needed along the line of the canal.[34]

As the canal company proceeded to purchase land for its right-of-way, it often came into conflict with landowners whose holdings between the river and canal would be isolated by the waterway. In order to persuade these proprietors to sell or to settle an inquisition in court, the company often agreed to accommodate the landowners by providing a road culvert under the canal. One example of such an agreement, signed on May 28, reads as follows:

> It is agreed between the Ches. & Ohio Canal Co. by their agent Clement Cox, & Daniel Trundle that the said company shall make a road culvert at least 9 ft. wide & 8 ft. high at the branch at the lower end of the farm, next to the land of Wm. Trundle, and that the said Daniel Trundle and his assigns and the future proprietors of this land over which the canal is to pass shall have the right of passing under the said culvert with carriages of every description and

---

32 Wright to Purcell, Mar. 17, 1830, Letter Book of the Resident Engineer of the 1st Residency of the 1st Division.

33 Leckie to Purcell, Mar. 30, 1830, Letter Book of the Resident Engineer of the 1st Residency of the 1st Division.

34 Ingle to Purcell, Apr. 22, 1830, Letter Book of the Resident Engineer of the 1st Residency of the 1st Division.

> stock and this agreement is to be annexed and form a part of the inquisition taken on said farm. It is also agreed that the said D. Trundle shall have the right to form two ferrys across with the necessary basins for the accommodation of ferry and boats and it is to have the right or removing earth from the upper side of Canal for the purpose of forming the necessary roads.[35]

The stockholders were informed at the second annual meeting in June 1830 that "the portion of the canal between the Foundry and the Market House in Georgetown is in rapid progress, and the work is well-executed." During an examination of the culvert at the foundry run, it was found that "the main body of the arch had settled about four inches, in consequence of which the ring stones are cracked." However, the survey team that inspected the culvert felt that it had undergone "no material injury." The culvert over Rocky Run on Section No. 8 was also found to have "moved so much from its original position," that the survey team recommended its reconstruction.[36]

The board, on June 12, determined that the canal president should require the contractor for Culvert No. 12 on Rocky Run "to take immediate measures to render the work secure." If the contractor failed to respond promptly, the president and chief engineer were authorized to have the work done by another contractor.[37]

On August 27 Resident Engineer Purcell informed Clerk Ingle that a brick culvert was to be constructed in the ravine above Francis Scott Key's house to prevent the canal from being washed out in that area. The stone work for the culvert was to be let "at a price not exceeding $4 per perch."[38]

The third annual report of the canal company, issued in June 1831, informed the stockholders that the canal between Little Falls and Seneca Creek had been opened for use the previous November.[39] During the spring of 1831, construction on the 5-mile section of the canal below Little Falls had progressed far enough that a portion was placed in partial use. By June, navigation on the canal had been extended 2 miles below Little Falls "a few hundred yards above and within sight of Georgetown."[40]

At the third annual meeting, the board announced that all the culverts "are constructed, where practicable, so high, as to enable a laborer to walk erect through them." Several culverts had been "enlarged to dimensions which will permit loaded wagons, and all other conveyances for persons or commodities, to pass under them."[41]

---

35 "Agreement," May 28, 1830, Letter Book of the Resident Engineer of the 5th Residency of the 1st Division.

36 Proceedings of the Stockholders, A, pp. 120–21.

37 Proceedings of the President and Board of Directors, B, p. 120.

38 Purcell to Ingle, Aug. 27, 1830, Letter Book of the Resident Engineer of the 1st Residency of the 1st Division. Also see Proceedings of the President and Board of Directors, B, p. 182.

39 Proceedings of the Stockholders, A, pp. 132–33.

40 *Ibid*.

41 *Ibid*., p. 142.

With navigation partially open between the western boundary of Georgetown and Seneca Falls, the canal company anticipated an early opening of navigation along the entire distance from Rock Creek to Point of Rocks. When this section of the canal was nearly completed in mid-June 1831, a careful examination of the waterway was "made by skillful engineers of the topological corps of the army, by order of the President of the United States, at the request of the president and directors" of the canal company.[42] Lieutenant Colonels John A. Abert and James Kearney made a minute survey of this section of the canal in June, reporting favorably in detail on the type of construction actually done on the canal and upon its existing condition. The observations of these two officers concerning the culverts furnish the first critical review of these structures.

Abert and Kearney found that the "first culvert on the line is the one for Market Street run." Upon inspection of this structure, they observed that it had "a span of eight feet, and is well built."[43]

Moving up the still unfinished portion of the canal in Georgetown, the engineers reported that the "width of the canal up to Frederick street is forty-six feet, and its depth six." From this street on to Lock No. 5, the canal gradually widened to 80 feet and increased in depth to 7 feet. The increase in depth of 1 foot was, in the opinion of Abert and Kearney, "a hazard to the embankments and culverts, not compensated by any adequate advantages."[44]

When the engineers arrived at College Creek above Georgetown, they discovered that this stream was allowed to run directly into the canal. Since its bed was 30 feet lower than the bottom of the canal, they concluded that "no bad effect can result from the deposits it will occasionally bring down." However, when the canal was filled with water, this part of it would be exposed "to a pressure of thirty-seven perpendicular feet of water." Considering this problem the engineers at first thought that it would have been better to have constructed a culvert for the delivery of the creek. However, when they discussed this problem with Resident Engineer Purcell, he informed them that the subject had been carefully studied, and the soil examined to a great depth, and found treacherous and unsafe, and that, if a culvert had been constructed, its durability was very doubtful, and the cost would have been much greater than the method ultimately adopted on embanking over the pass, and admitting the creek into the canal.[45]

Following their inspection of the second arched culvert at Mason's Foundry, Abert and Kearney wrote:

---

[42] Proceedings of the President and Board of Directors, B, p. 311.

[43] *Report of Col. John J. Abert and Col. James Kearney of the United States Topographical Engineers, upon an examination of the Chesapeake and Ohio Canal from Washington City to "Point of Rocks"* (Washington, 1831), reprinted in U.S., Congress, House, Committee on Roads and Canals, *Chesapeake and Ohio Canal: Report to Accompany H.R. 94*, 23rd Congress, 1st Session, 1834, H. Doc. 414, p. 91 (hereafter cited as *House Report 414*).

[44] *Ibid*.

[45] *Ibid*.

> The second arched culvert is immediately at Mason's foundry, for the delivery of the foundry stream and for a roadway. The arch does not appear to have yielded at any place, but several of the ringstones, which are of the Aquia creek stone, have broken or split off at their outer surfaces. The sheeting is of rubble work, and many of the stones for such work do not appear to have been well chosen. The use of a great deal of mortar is evident from the intrados of the arch, and it is also apparent in places that the beds of the sheeting stone are not sufficiently extensive.
>
> We know it to be a common practice with builders in our country to use rubble stone for the sheeting stone of arches, but in cases with as great a span as this arch possesses, and in which the work has to support a canal, we doubt the propriety of the practice. Even in arches of a less span, where rubble stone sheeting is used, great care should be bestowed on the choice of the stone, and in laying it.
>
> The water had been let in a few days before our visit, to a depth of three feet over this culvert, but had been drawn off the day before, in consequence of a slight breach in the embankment a short distance above. When we examined it, there were but two or three inches of water left upon it. It leaked, however, considerably, perhaps sufficiently to justify fears of its stability, when exposed to a full pressure of seven feet of water unless some precautionary measures be taken. There was no crack or rupture in the masonry, the leak was between the stones of the sheeting and of the upper abutment.

Within weeks of their visit, the engineers were notified that "the puddle work over this culvert had cracked, from too long an exposure to the sun." The puddling was immediately repaired, and when water was again put in this section "to a depth of three feet" the culvert did not leak.[46]

Between the foundry culvert and Lock No. 5, the engineers reported that there were several

> places where small streams are let directly into the canal. We do not consider this a good plan. From the precipitous character, and the loose texture of the hills which are drained by these streams, the deposits from them into the canal will be considerable, and a filling up in the form of bars or shoals must be a consequence.
>
> When it is not considered advisable to construct culverts for such streams, we think some method should be adopted to catch the deposits before it arrives into the canal.
>
> The stream of Ewell's powder mill passes under the canal by means of an arched culvert.
>
> Culverts are not only advantageous for these immediate objects, but also to deliver the water from back drains, the formation of which, we believe, will be found necessary wherever the canal is located, at the base of this extensive range of hilly land.[47]

Near Lock No. 5, Abert and Kearney found a road culvert "for the convenience of the fish landing below the Little Falls." This structure was "an arched stone culvert, with a span of fifteen feet three inches." Water had been in the canal above it for nearly 9 months, but there was no sign of a leak nor was "there the slightest evidence of yielding." To all appearances, they concluded that it was a "well built and durable structure."[48]

---

46 *Ibid*., p. 92.
47 *Ibid*., pp. 92–93.
48 *Ibid*., p. 93.

Concerning the Cabin John Creek Culvert above Lock No. 7, Abert and Kearney observed:

> About half a mile above lock No. 7, is a fine arched stone culvert, for the passage of Cabin John creek. It has every appearance of being a faithfully executed piece of work, exhibiting not the slightest evidence of yielding or leaking. It is one hundred and twelve feet long, the span or chord of the arch twenty two, and its rise five feet. If any expression of regret might be indulged, in relation to this excellent structure, it would be that the span of the arch is not greater; its rise could not be from the level which was considered advantageous to preserve the canal which passes over it. It has in one instance not been found adequate to the free delivery on the water of the creek, which rose above the embankment, and flowed into the canal. The freshet to which we now allude, is believed to have been a very unusual one, and much increased by a simultaneous rise in the Potomac. The canal suffered no injury from the rise; but this should prove to be a property of this creek, of more frequent occurrence than is now anticipated, it may become advisable to construct another arched culvert near the present one. We deem it, however, a duty to the engineer to add that this is one of those cases better to be known by experience than to have been readily anticipated.[49]

Between Lock Nos. 10 and 11 there was "a skewed arched culvert," which carried Rocky Run under the canal. This culvert "had yielded in some of its parts," but precautionary measures, which had been adopted immediately, had strengthened the structure. Because it "leaked rather too much in places," the engineers "thought it advisable to reconstruct the puddle work, from the base of the abutments, around the entire arch, where the leaks appear."[50]

The engineers observed that the level between Locks Nos. 14 and 15 was "well chosen, and the work well executed." In this distance there was "a well built arched roadway" that passed under the canal.[51]

Abert and Kearney reported that on the level between Lock Nos. 20 and 21 there were "two well constructed culverts, which appeared to be perfectly tight, and of an enduring character." Near the head of Lock No. 21 was an arched culvert, which leaked in "two or three places." Because a slight breach had occurred in the structure after their visit, the culvert was "undergoing a thorough repair" while they were writing their report.[52]

Between Locks Nos. 21 and 22 the engineers found two small arched culverts, "perfectly tight, and with every appearance of faithful workmanship." On this level there was also a large arched culvert to carry Watt's Branch under the canal. This culvert was well built with no visible leaks.[53]

---

49 *Ibid*., p. 94.

50 *Ibid*., p. 95. The length of this culvert was 152 feet, and the span of its arch was 12 feet with a rise of 6 feet.

51 *Ibid*.

52 *Ibid*., p. 96.

53 *Ibid*., The length of this culvert was 115 feet, and the span of its arch was 20 feet with a rise of 10 feet.

A short distance beyond Lock No. 22 Abert and Kearney found "a well made arched culvert for the delivery of Muddy branch." It rested "upon a rock foundation" and showed "no leak or evidence of yielding."[54]

After completing their inspection of the finished section of the canal up to Seneca Falls, the engineers continued their survey of the portion of waterway still under construction to Point of Rocks. The abutments of the culvert were completed at Horse Pen Run. The stone used, according to the engineers, was "well selected and well laid."[55]

Near the head of Lock No. 26, Abert and Kearney found "a well built arched culvert, for the passage of a small stream, and for the convenience of a back drain." The foundation of this culvert was constructed of timber and "so situated as to be always under water." Each end of the culvert was "protected by a firmly driven series of plank piling, extending five feet below the foundation." The masonry was "laid in hydraulic mortar, and then grouted," and the whole structure was "to be covered by a puddle-work."[56]

Between Broad Run and Lock No. 27, the engineers found three road culverts under construction. Their examination of these roadways brought the following comment:

> We cannot forbear here expressing our decided approbation of this method of crossing canal lines over the more usual method by bridges. Its many conveniences to those who use these roadways, as well as to the canal, should in all cases, give to them a preference, where the ground is adapted to their construction.[57]

A short distance above Lock No. 27, there was "a skewed culvert" under construction "for the passage of a small stream" and a roadway. The abutments of this work were completed and were ready for the skewbacks. Alfred Cruger, the engineer for this part of the line, showed Abert and Kearney the ring stones that had been prepared for the arch, and they complimented him for his choice of stone.[58]

On the line of the canal between Lock No. 28 and the Monocacy Aqueduct, the engineers inspected the Little Monocacy Culvert. The foundation was laid, and the walls of the abutments were nearly completed. The engineers observed that the stone used in this work was fine, and the structure had "every appearance of durability."[59]

After inspecting the Monocacy Aqueduct, Abert and Kearney continued up the excavated part of the canal to Point of Rocks. They inspected the Little Tuscarora Culvert a short distance beyond the Monocacy. Extending 130 feet under the canal and its embankments with a span of 12 feet, this culvert had "every appearance of faithful work."[60]

---

54 *Ibid*., p. 97.
55 *Ibid*., p. 99.
56 *Ibid*.
57 *Ibid*., p. 100.
58 *Ibid*.
59 *Ibid*.
60 *Ibid*., p. 102.

When the engineers completed their inspection of the waterway, they reviewed the general principles and methods that had governed the masonry works on the canal. Although these guidelines had been modified in some instances according to the discretion of the canal engineers, Abert and Kearney asserted that their examination of the canal structures revealed that they were closely followed. The method pursued in building the culverts and locks was as follows:

> In all cases where a rock foundation can be conveniently obtained, it has been resorted to; the rock carefully cleaned, its loose and defective parts removed, and the required extent of surface leveled to receive the masonry. Where rock was not accessible, and the earth, after excavation, did not appear sufficiently firm, it was carefully rammed and paved with stone, before the timber foundation for the masonry was laid. Where the earth was judged to be sufficiently firm, the timber was at once laid upon it without further preparation. And in proof that the foundations have been carefully secured, we can bear our testimony, that in no instance whatever, except in the tide-lock, and in lock No. 1, at the Georgetown basin, did we perceive any yielding of the masonry, which could be attributed to any defect in the foundations.
>
> The curve of the culvert arches is generally a semi-circle: where the span is four feet, the average thickness of the arch is fourteen inches; where the span is six feet, the average thickness of the arch is eighteen inches; where the span is eight feet, the average thickness of the arch is twenty inches; and where the span is twelve feet, the average thickness of the arch is twenty-four inches. The sheeting stone of these arches is rubble stone; but all are to have good fair beds, with their joints dressed with the hammer, each stone having a good binding length. The sheeting is laid in hydraulic mortar, and then grouted with the same material; and the whole, including the abutments, is protected with a puddle-work two and a half feet thick.
>
> The ringstones of the culverts are carefully cut, and have hammered faces. Those for a four foot span, are twelve inches deep; for a six foot span, fourteen inches deep; for an eight foot span, sixteen inches deep; and for a twelve foot span, eighteen inches deep. These stones are required to extend into the arch, alternately, from fifteen to thirty inches in culverts of a four foot span, and from twenty to forty inches for those of a greater span. For the wing and parapet walls the stone have hammered faces, are well bedded and jointed, and the work is surmounted by a coping ten inches thick and two feet wide.
>
> These culverts are all of an admirable length, extending well and sufficiently through the embankments.[61]

Navigation on the short section of the canal between the western edge of Georgetown and the basin at Rock Creek was opened on September 19, 1831. On that day the board embarked on the packet boat C. F. Mercer and "descended through Locks 1, 2, 3 and 4 into the Basin at Rock Creek, and landed upon the Pier."[62]

Inspector of Masonry A. B. McFarland, on January 21, 1832, proposed to the board some modifications in the specifications for the masonry works. His proposals, which were designed to upgrade the quality of construction on the masonry structures, were as follows:

> The extra expense at present laid out on the wing walls and parapets should be applied on the arches for which a judicious selection of stones should be made at the quarries to be parallel in their beds and well hammer dressed so as to fit the centers, close on their soffits, and also

---

61 *Ibid*., p. 103.

62 Proceedings of the President and Board of Directors, C, pp. 4–5.

> close joints in beds and ends. It is obvious that many stones will answer in abutments, wings and parapet walls such as the rubble masonry of culverts which would be extremely unsafe to introduce into the arches of the same character of work.
>
> The cement or water lime for arches of every description . . . should be put up into air-tight barrels, and unless this method would be considered by the Board of Directors as increasing too much expense, it would be desirable to have all of the water lime for every department of the work secured in some manner. The delicacy of the article is such as to destroy many of its best properties so long as the present method is pursued of securing it into imperfect lime houses.[63]

On March 17 the board received word that Culvert No. 42, built by P. Bargy, had settled in its foundation and required repair. Because the problem resulted from carelessness on the part of the contractor, the board decided to require Bargy to repair the culvert at his own cost.[64]

Immediately after the successful termination of the controversy with the Baltimore and Ohio Railroad, the canal company ordered contracts to be let on February 23, 1832, for the 12 miles between Point of Rocks and Harpers Ferry.[65] Later the directors reconsidered their action and authorized the president to make contracts for the 2 miles immediately above Point of Rocks in an effort to exclude the railroad from the Maryland side of the river.[66]

On January 9, 1832, the directors solicited contracts for the canal all the way to Williamsport, but the winter continued to be so severe that the board suspended the order for all work above Harpers Ferry. On March 17 and June 5 canal officials let enough of the line above Harpers Ferry to enable the completion of 100 miles by 1833 as required by the charter.[67]

On March 17 the board considered the proposals and approved the following contracts for the culverts:

Nos. 75–79	to	Dawes & Williams
Nos. 80–83	to	James O'Brien
Nos. 84–87, 89	to	Watson, Tainter & Co.
Nos. 88, 90–94	to	John Hay Co.

According to the terms of these contracts, the board accepted "only the proposed prices for masonry, including centering and such bailing as might be necessary after the pit shall have been excavated." The cost of excavating the pit and for the paving foundations of timber was to approximate the estimate of the project engineer. All items were to be estimated, if possible, before commencement of work. If the contractor refused to accept

---

63 McFarland to Ingle, Jan. 21, 1832, Ltrs. Recd., C & O Co.
64 Proceedings of the President and Board of Directors, C, p. 107.
65 *Ibid*., pp. 48–49.
66 *Ibid*., pp. 52–53.
67 Fourth Annual Report (1832), C & O Co., in Proceedings of the Stockholders, A, pp. 204–07.

the estimate of the engineer, the canal company reserved the right "of having such parts of the work performed by other hands."[68]

On June 5 the board let the following contracts for culverts on similar terms:

Nos. 100–104, 106–107, 113–118	to	Gilson, Noonan, Medler & Co.
No. 105	to	Moore and Temple
Nos. 108–110, 112	to	George W. Hunter
No. 111	to	J.P. and J. Doughtery[69]

Because of the tendency of the culverts below Seneca to leak, the board, in July, ordered the lock keepers to inspect these structures on a daily or weekly basis. During their examinations of the canal under their charge, the lock keepers were instructed "to pass thro' the several viaducts or culverts of the canal within their district" by "looking thro' the same, whether any leak exists thereon, and that, where any such leaks are discovered, they be promptly stopped, or effectual measures be take to prevent their enlargement.[70]

By 1832 the finances of the canal company were nearly exhausted. The financial difficulties and the approaching expiration date of 5 years allowed by the charter for the construction of the first 100 miles forced the board into a number of steps to expedite the work. The first of these measures was begun on June 23, when the board determined that

> they [Resident Engineers] be, in like manner, permitted to dispense with the coping of the culverts and aqueducts, till the water, necessary for transportation of the stone, be admitted to the canal, and with the coping of the locks, except that required for hanging the lock gates—provided, in all cases of a postponement of any part of the work, a due reduction be made, having reference to the contract price of the deferred work, of the cost the Company may incur in its subsequent completion.[71]

Less than 2 weeks later, on July 2, the resident engineers reported to the board on the expediency of substituting hammer-dressed for cut work on the faces of the masonry works above Point of Rocks. Accordingly, the board determined that

> the Resident Engineers may, where they shall deem it expedient, dispense with cutting the face work on the Masonry, and require good hammered face work, in place thereof, deducting for the saving of expense, according to existing contracts.[72]

---

68 Proceedings of the President and Board of Directors, C, p. 109. All of these contracts were to expire on Dec. 1, 1832. This stretch of canal extended from Point of Rocks to Harpers Ferry (Sections Nos. 84 to 112).

69 *Ibid*., p. 163. This stretch of canal extended from Harpers Ferry to the mouth of Opequon Creek (Sections Nos. 112 to 157).

70 *Ibid*., p. 111.

71 *Ibid*., p. 163. This stretch of canal extended from Harpers Ferry to the mouth of Opequon Creek (Sections Nos. 112 to 157).

72 *Ibid*., p. 179.

Rising inflation and a cholera epidemic hampered operations between Point of Rocks and the Opequon in the late summer and fall of 1832. To speed the progress of the work despite these obstacles, the board ordered

> that such augmentation be allowed, of the price of the unfinished masonry below the Head of Harpers Ferry falls, as may suffice to ensure the prompt construction of the same and be approved by the President of the Company and the Resident Engineer.[73]

The second official inspection and examination of the canal by a United States Topographical Engineer was made in June 1833. Captain William Gibbs McNeill, after a survey of the waterway, reported:

> Of this portion every part of the work may be said to have been entirely completed to the "Point of Rocks," 48 miles from the basin at Georgetown, and, with very unimportant exceptions, (where the discovery of slight imperfections has already lead to their repair,) exhibited all that faithfulness of execution which insures stability.[74]

In his report submitted to the Topographical Bureau of the War Department on December 1, McNeill stated the character and the condition of the works on the canal. Concerning the culverts on the finished portion of the canal below Point of Rocks, he observed:

> In all, including roadways, there are fifty-nine culverts below the Point of Rocks, the cost of which has been, (agreeably to the statements furnished me) $110,000, of which number the 32 culverts on the first 22 miles contiguous to and below the Point of Rocks, (which, being in general unfinished, were not so particularly attended to at the date of the last inspection,) have cost $59,000. Of this sum, the masonry, amounting to 11,357 perches, cost $50,000, or an average of $4.40 per perch: $9,000 being the cost of the foundations, of puddling the culverts in part, and for the excavation of the pits in part.

According to McNeill, the dimensions of these 32 culverts were as follows:

> 1 of 2 feet span; 11 of 4 feet span; 9 of 6 feet span; 2 of 8 feet span; 1 of 9 feet span; 1 of 10 feet span; 3 of 12 feet span; 2 of 16 feet span; 1 of 2 arches of 16 feet each; 1 of 20 feet span over the Little Monocacy.
>
> The masonry of one of the above culverts, (that of two arches of 16 feet span each,) containing 1,100 perches cost $5,807; the stones for which were boated 8 miles, and hauled nearly half a mile; that of another of 20 feet span over the Little Monocacy, with an oblique arch, $5,354; the number of perches in it being 1,241, and the stone obtained within half a mile. The culvert over the Tuscarora, 2 miles above the Monocacy aqueduct, of 16 feet span, containing 919 perches, cost, for the masonry, $3,676, the stone being brought from Virginia within 1½ miles. The other culvert with an arch of 16 feet span, one mile below the Point of Rocks, (where the materials for its construction were obtained) cost, for its 764 perches of masonry, $2,528.50. The stone for all the others, 22 in number, (deducting 6, the materials of which were transported about half a mile,) was obtained by water from distances varying

---

[73] *Ibid*., p. 233.

[74] *Report of Captain Wm. G. McNeill on the Condition of the Chesapeake and Ohio Canal* (Boston, 1833), reprinted in *House Report 414*, p. 142.

> from 2 to 8 miles: this difference in transportation causing the price of masonry (which averages, as above stated, $4.40 per perch) to range between $3.50 and $5.50 per perch.
>
> The hydraulic cement used in the construction of all the culverts cost the contractor at the rate of one dollar per perch.
>
> The remaining culverts of the 59, mentioned as being the total number below the Point of Rocks, and situated on the first 26 miles of the canal, from Georgetown upwards, are spoken of generally in the report of Colonels A. and K.: they are 27 in number, and cost $51,000; the average price per perch being rather less than those above, on account of the greater facility of obtaining stone.[75]

Proceeding on to the unfinished portion of the canal above Point of Rocks, McNeill reported:

> The construction of the culverts above Point of Rocks, so far as they are advanced, was in general satisfactory, and in their general plan and character, they correspond with the details given, respecting these constructions, in the report of Colonels Abert and Kearney, with the exception, that the length of those, below Harpers Ferry, are generally 110 feet, while those above (consequent to the diminished width of the canal) are usually but 100 feet in length. Their other dimensions, of course, vary with the span of the arch; and the following statement will include such further information as may be desired respecting them.
>
> Between the Point of Rocks and the head of Harpers Ferry falls there are nineteen culverts, which, at the date of the inspection, had already been completed, the dimensions and cost of which are as follows:

[75] *Ibid*., pp. 143–144.

	Span of arch in feet.	Number of perches	Price per perch	Cost of Masonry	Cost of founda-tions	Cost of extra excavation	Total cost
Between the Point of Rocks and Berlin, a distance of seven miles	8	318	$4.00	$1,272	$76	$456	$1,804
	4	182	$4.00	728	201	143	1,072
	12	298	4.50	1,341	106	827	2,274
	10	487	4.50	2,192	104	682	2,978
	4	132	4.50	594	38	427	1,059
	16	795	4.12	3,272	106	332	*3,711
	4	183	4.50	824	36	184	1,044
	10	504	4.00	2,016	104	257	2,377
	4	174	4.00	696	36	389	1,121
	6	311	4.25	1,322	315	101	1,738
	8	367	4.50	1,652	82	332	+2,066
Between Berlin and the head of Harpers Ferry falls, a dis-tance of seven and one-third miles.	8	360	4.00	1,440	59	190	1,689
	8	334	4.50	1,503	60	199	1,762
	6	300	4.00	1,201	53	503	1,762
	12	589	4.00	2,355	92	790	3,237
	6	283	4.00	1,132	38	601	1,771
	6	280	4.50	1,260	260	800	2,320
	20	751	4.00	3,004	-	506	±3,510
	6	191	4.00	764	-	669	1,433
	158	6,839	-	28,569	1,766	8,393	38,728

The average price, therefore, of this masonry, per perch of 25 cubic feet, has been $4.18, that of the foundations $92.95 each, that of the culvert pits and extras $441.74 each.

Above the head of Harpers Ferry falls there were, at the date of the inspection, in the progress of construction, (about one-half of the work being then done,) 41 culverts, the estimated cost of which is $44,300, the contract price for the masonry being $4 per perch.[76]

From time to time, the canal company authorized the construction of new culverts on the line already in operation. The board, on September 6, received a letter from Michael Corcoran in which he proposed construction of a culvert near Lock B in Georgetown. The request was referred to Engineer Alfred Cruger, who recommended that a brick culvert be constructed near the lock. Accordingly, the board authorized a committee "on Sections I and K to contract for a culvert."[77]

---

* Over the Little Catoctin

\+ In Berlin

± Over Israel's creek

76 *Ibid*., pp. 147–48.

77 Proceedings of the President and Board of Directors, C, p. 422. Because this culvert does not appear in later company records, it evidently was built by the company to provide for more adequate drainage but wan not included in the numbering system for culverts. It is likely that this procedure occurred more than once along the entire length of the canal.

By October 1, 1833, some 64 miles of the canal above the basin at Georgetown were reported to be "completed and capable of navigation." Water was admitted into the canal at Harpers Ferry on November 1. Within 3 weeks the canal company had contracted for the building of a packet boat to run between Washington and Harpers Ferry.[78]

The board, on November 8, received letters from Alfred Cruger and A. B. McFarland stating that the masonry work above Harpers Ferry was suspended for lack of cement. Boteler and Reynolds, operators of the Shepherdstown Mill, were sending much of their cement to Georgetown, thereby creating a cement shortage along the line of the canal. Clerk Ingle was dispatched to Shepherdstown to secure for the contractors all the cement manufactured by Boteler and Reynolds. After visiting these men, Ingle reported to the board that he "had received their assurance, that all the cement manufactured at their mill should be applied to the Masonry on the Canal."[79]

On April 17, 1834, the House Committee on Roads and Canals made an exhaustive study on the progress of the work on the canal. By this date only $22,280.17 worth of work remained to be done on the section of the canal between Harpers Ferry and Dam No. 4 below Williamsport. Twenty miles more of the canal between Dams Nos. 4 and 5 were under construction, but progress on this section was hampered by the lack of funds.[80]

The House committee report contained the following data on the culverts between Georgetown and Dam No. 5:

> The culverts are in number 136, of which many are enlarged to a breadth of ten feet and upwards. Their length is such, as allows to the canal, every where, its full breadth; and they are of the same materials as the aqueducts; the ring stones of their arches are cut, the rest of the stone hammered, but not ranged. The locks, aqueducts and culverts are laid in hydraulic lime, of approved quality, mixed with pure sand, in equal proportions; except in rare cases, where the oxide of manganese, or an artificial composition of iron filings and common lime, has supplied the place of the natural hydrate of lime.
>
> A small quantity of Parker's Roman cement has also been used, for experiment; but being found expensive, and that its place could be securely supplied by the native hydrate of lime, its consumption was stopped.[81]

With the continuing support of the State of Maryland, the section of the waterway from Harpers Ferry to Dam No. 4, below Williamsport, was finished in May and opened to trade.[82] At this point the canal had been completed for 86 miles. By using the slack water backed up by Dam No. 4, boats could now reach Williamsport. Nearly 1 year later, in the early part of April 1835, the portion of the waterway between Dam No. 4 and Dam No. 5, 8 miles above Williamsport, was completed.[83]

---

78 *Ibid*., pp. 3, 20.
79 *Ibid*., pp. 8, 13.
80 *House Report 414*, p. 16.
81 *Ibid*., pp. 20–21. The report included a tabular statement of the cost of the works from the mouth of Tiber Creek in Washington to Dam No. 5. The data relating to the culverts has been excerpted from these tables and may be seen in Appendix B of this report.
82 *Sixth Annual Report* (1834), C & O Co., p. 4.
83 *Seventh Annual Report* (1835), C & O Co., p. 4.

IV. THE CONSTRUCTION OF THE CULVERTS BETWEEN DAM NO. 5 AND CUMBERLAND: 1835–1842

By the end of 1834, the canal company treasury was nearly depleted, Once again the directors, supported in their petitions by the internal improvement convention that met in Baltimore in December 1834, sought aid from Congress and the States. The meeting, called for by an earlier gathering in Allegany County in October 1834, was attended by representatives of Maryland, Virginia, Ohio, Pennsylvania and the District cities.[84]

With George C. Washington, third president of the canal company, as its chairman, the convention took steps to encourage further assistance for the canal project. Charles F. Mercer, an ex-president of the canal, reported for the principal committee named to ascertain the probable cost of completing the canal. The report stated that $2 million would be required to finish the eastern section, making the total cost of that part of the canal $6,500,000. This figure was based on an estimate made by Alfred Cruger in the spring of 1834 of the probable cost of the 27 miles between Dam No. 5, above Williamsport, and Dam No. 6 at Cacapon, above Hancock.[85]

The report by Cruger had allowed $663,676.20 for the construction of the line between Dams Nos. 5 and 6. The summary of Cruger's estimate was as follows:

1,279,060	cubic yards of excavation	at 12,567/1000	$160,741.70
90,330	cubic yards of rock	at 73,620/1000	66,500.00
608,020	cubic yards of embankment	at 18,805/1000	114,342.20
45 culverts, comprehending 12,344 perches, at $3.72-¾ the perch, exclusive of the pits			48,172.00
Culvert pits, 45 in number			10,880.00
9 locks, of 8 feet lift each, including flumes and lock houses, 89,840 + 5,250 = 95,090			95,090.00
2 aqueducts, of 6,638 perches, at $7.03 the perch			46,666.00
1 dam			35,000.00
10 farm ferries and 1 pivot bridge			5,025.00
Lands			21,340.00
Contingencies			58,394.20
			[86]$663,676.20

Despite the efforts of the company to obtain assistance, the Federal Government and the State of Virginia refused to grant aid. Furthermore, the District cities were in no position to give financial help.[87]

---

84 *Journal of the Internal Improvement Convention* (Baltimore, 1835), pp. 3–10.

85 *Ibid*., pp. 59–63.

86 *House Report 414*, p. 220. A list of the culverts recommended in his estimate may be seen in Appendix C of this report.

87 Sanderlin, *Great National Project*, p. 105.

It was the State of Maryland that came to the aid of the virtually bankrupt company and breathed new life into its operation. In March 1835 the legislature passed an act authorizing a $2 million loan for the construction of the waterway.[88] With the proceeds from the first installment of the loan, the board liquidated the company's entire debt of over $500,000 and resumed the construction of the waterway. On June 17 the board ordered that

> the clerk advertise for proposals for the construction of such Sections, Locks, Aqueducts, Culverts and Dams, as may be reported by Charles B. Fisk, to be ready for contract, between Dam No. 5, and the Cacapon; and, that the time limited for the completion of the Masonry thereof shall be the 1st day of October, 1836 and for the other work, the 1st day of November, 1836.[89]

After examining the proposals received for the masonry works and difficult sections between Dam No. 5 and the Cacapon, the board, on July 3, accepted the following proposals for the culverts:

No. 137, 194, 197	let to John Lambre
Nos. 138–139	let to David Lyles
Nos. 140, 142–143	let to James J. McElheny
No. 141, 189, 195, 197	let to D. K. Cahoon
Nos. 158–159	let to Lee Montgomery
No. 163	let to Anthony Loftus
Nos. 164–167	let to James Lonergan
Nos. 168–170, 172–175	let to Michael Smith
No. 171	let to R. M. Watkins
No. 176	let to James Ryan (at $3 for masonry)
Nos. 177–182	let to E. H. Fielding
Nos. 190–191	let to John Gorman (at $3.75 for masonry)
Nos. 192–193	let to William Brown (at $4 for masonry)[90]

On the same day these contracts were let, the board received word from Engineer Turner concerning the deteriorating condition of the culvert at Mason's Foundry in Georgetown. The "softness of the ring stones" had been "gradually giving way to the pressure of the arch" until now at the cut end of the culvert a crack near the ring was discernible. Within a few weeks Turner expected the arch to fall. It would be necessary "to put in the place of those ring stones, some of harder quality," such as granite.[91]

As construction operations resumed, the canal company's attempt to cut costs discouraged some contractors. Contractor E. H. Fielding, on July 4, informed the board that its reduction of his bid for the Little Tonoloway Culvert from $4.95 to $4.75 per perch would make it impossible for him to build the structure. The culvert was "upwards of 120 feet in length," and the centers would "cost as much as centers for 4 aqueducts" of 40-

---

88 Proceedings of the President and Board of Directors, D, p. 265.
89 *Ibid*., p. 341.
90 *Ibid*., pp. 360–62.
91 Turner to Washington, July 3, 1835, Ltrs. Recd., Chief Engineer.

foot span. For a culvert of that length, he could not "dig all the foundations without bailing water for which" he would not get paid. So that he would not lose money on the job, Fielding asked that his original bid price be restored.[92]

Upon receipt of the first installment of the $2 million loan, the company took steps to survey the route from Cacapon to Cumberland preparatory to putting this last stretch of the eastern section under contract.[93] The board appointed one of its members, George Bender, to fill the new office of commissioner that it created to provide effective supervision of the construction.[94] The work had moved so far westward that it was no longer possible for directors, meeting in Washington, to maintain adequate control of operations. The commissioner had authority over the lesser officials, the acquisition of land, the use of the company property, and the reletting of abandoned contracts. The board, on the other hand, reserved to itself the first letting of contracts and the right of review of all the commissioner's acts.

During the summer Chief Engineer Fisk led a team that surveyed the line between Cacapon and Cumberland. After considering his recommendations in a report he submitted in September, the board adopted the final route for this section of the canal on November 5.[95] One week later, the board determined that proposals would be received until December 21 for "constructing the dams, masonry and 'difficult sections'" of the last 50 miles of the canal.[96]

On November 17, Joshua Gore, an assistant engineer, notified Chief Engineer Fisk of the progress of construction on the culverts from Prather's Neck Culvert (No. 139) to McCoy's Culvert (No. 143). The following quantities of material had been excavated from the culvert pits:

No. 130 -	1,040 cu. yds.	
No. 140 -	760 cu. yds.	(60 to 80 of this may be rock)
No. 141 -	170 cu. yds.	
No. 142 -	920 cu. yds.	
No. 143 -	715 cu. yds.	

Gore recommended that Culvert No. 140 should be "slightly varied from its present location to facilitate the landing on the river bank above the entrance to the ravine to the river." This change would not seriously affect the quantity of excavation. If there was rock to be excavated from the foundation in a solid mass, it would "lessen the amount of excavation as the pit will then have to go about an average of 2 feet less in depth than if the foundation is on timber."[97]

---

92 Fielding to Fisk, July 4, 1835, Ltrs. Recd., Chief Engineer.
93 Proceedings of the President and Board of Directors, D, p. 342.
94 *Ibid*., pp. 294–301.
95 *Ibid*., pp. 423–25.
96 *Ibid*., p. 427.
97 Gore to Fisk, Nov. 17, 1835, Ltrs. Recd., Chief Engineer.

Because there had been confusion in the numbering of the culverts above the Cacapon, Engineer William H. Bryan was ordered by Fisk on December 19 to renumber them. In explaining the problem to Fisk, Elwood Morris, an assistant engineer working with Bryan, reported:

> There are no culvert stakes set upon the line. I have considered that to settle the question of drainage required more time than could be well spent upon it during the location. I am aware that some of the culverts estimated ought to be dispensed with & others added where none are now meant; so that any numbering I might make would only again place the books of the board in the confusion they were once in on Mr. Purcell's late residency where Randolph located & numbered culverts that Byers threw out. But if I am to regard your order as imperative in this particular, I will notwithstanding its difficulty make a numbering, useless though it may be.[98]

The board, on December 19, instructed A. B. McFarland, the inspector of masonry, to "proceed immediately to examine the country through which the line of the Canal will pass" above the Cacapon and "report on the subject of stone and cement required for that line."[99]

On December 25 Assistant Engineer Gore reported to Fisk that the following culverts on Sections Nos. 210–220 were ready to be let for construction:

No. 144 -	6 ft. chord -	Section No. 210
No. 145 -	4 ft. chord -	Section No. 211
No. 146 -	Square Drain -	Section No. 211
No. 147 -	4 ft. chord -	Section No. 212
No. 148 -	6 ft. chord -	Section No. 212
No. 149 -	6 ft. chord -	Section No. 217
No. 150 -	12 ft. chord -	Section No. 217
No. 151 -	6 ft. chord -	Section No. 218
No. 152 -	Square Drain -	Section No. 218
No. 153 -	Square Drain -	Section No. 220[100]

The continued high cost of land and labor during the inflationary cycle of the thirties and the increased construction difficulties above Dam No. 5 soon forced the actual cost of the canal far above the estimates that were the basis of the $2 million loan. Chief Engineer Fisk revised Cruger's estimate for the construction between Dams Nos. 5 and 6 in June 1835 on the basis of work actually done, raising it to $1,022,534. In June 1836 another revision would raise the cost to about four times the original estimate: $2,427,497.[101] As a result of these developments, the resources of the company became increasingly inadequate for the job. Curtailment of operations began as early as January 1836. In that month

---

98 Morris to Fisk, Dec. 19, 1835, Ltrs. Recd., Chief Engineer.
99 Proceedings of the President and Board of Directors, D, p. 441.
100 Gore to Fisk, Dec. 25, 1835, Ltrs. Recd., Chief Engineer.
101 *Eighth Annual Report* (1836), C & O Co., pp. 3–4.

the board suspended the letting of contracts and the condemnation of land above the Cacapon.[102]

Again the company petitioned the District cities, Virginia and Maryland for further aid. The District cities, however, were in no position to offer assistance, and a bill for an additional subscription from the State of Virginia met defeat in its assembly. The State of Maryland again came to the aid of the canal company by authorizing an additional appropriation of $3 million to purchase stock in the company. This subscription made the State of Maryland the majority stockholder in the company, thereby making the "great national project" strictly a Maryland venture.[103]

Chief Engineer Fisk, on April 27, forwarded a list of the culverts to be built between Dams Nos. 5 and 6 to the board. The list was as follows:

No. 138	- Section 205	- double square drain, each 6 ft. x 4 ft.
No. 139	- Section 206	- 12 ft. span road culvert
No. 140	- Section 208	- 10 ft. span road culvert
No. 141	- Section 208	- square drain, 4 ft. x 3 ft.
No. 142	- Section 209	- 12 ft. span road culvert
No. 143	- Section 209	- 6 ft. span
No. 144	- Section 210	- 6 ft. span
No. 145	- Section 211	- 4 ft. span
No. 146	- Section 211	- square drain, 4 ft. x 3 ft.
No. 147	- Section 212	- 4 ft. span
No. 148	- Section 212	- 6 ft. span
No. 149	- Section 217	- 6 ft. span
No. 150	- Section 217	- 12 ft. span road culvert
No. 151	- Section 218	- 6 ft. span
No. 152	- Section 218	- square drain, 4 ft. x 3 ft.
No. 153	- Section 220	- square drain, 4 ft. x 3 ft.
No. 159	- Section 233	- square drain, 4 ft. x 3 ft.
No. 160	- Section 223	- 6 ft. span
No. 162	- Section 224	- square drain, 4 ft. x 3 ft.
No. 164	- Section 226	- 6 ft. span
No. 166	- Section 226	- 8 ft. span
No. 167	- Section 226	- square drain
No. 169	- Section 228	- 11 ft. span road culvert
No. 170	- Section 228	- 6 ft. span
No. 172	- Section 232	- 6 ft. span
No. 173	- Section 232	- 8 ft. span

[102] Ingle to Bender, Jan 9 and 16, Ltrs. Sent, C & O CO. Numerous contracts for culverts were declared abandoned during this period. Among others, the contract for the Little Tonoloway Culvert was terminated in April 1836 because the contractor had not prosecuted "his work so as to insure its completion within the time specified in his contract." Fisk to Bender, Apr. 20, 1836, Ltrs. Sent, Chief Engineer.

[103] *Eighth Annual Report* (1836), C & O Co., p. 6. Also see *Laws and Resolutions Relating to the Chesapeake and Ohio Canal* (Washington, 1855), pp. 55–63.

No. 174	- Section 233	- 6 ft. span
No. 175	- Section 234	- square drain, 4 ft. x 3 ft.
No. 176	- Section 235	- square drain, 4 ft. x 3 ft.
No. 178	- Section 236	- square drain, 4 ft. x 3 ft.
No. 179	- Section 237	- 12 ft. span road culvert
No. 181	- Section 237	- square drain
No. 182	- Section 237	- 40 ft. span
No. 183	- Section 239	- square drain, 4 ft. x 4 ft.
No. 184	- Section 239	- 6 ft. span
No. 185	- Section 241	- 10 ft. span road culvert
No. 186	- Section 242	- square drain, 4 ft. x 4 ft.
No. 188	- Section 245	- square drain, 4 ft. x 4 ft.
No. 192	- Section 249	- 10 ft. span road culvert
No. 192½	- Section 249	- 3 ft. circular brick culvert will probably be required
No. 193	- Section 250	- 10 ft. span road culvert
No. 194	- Section 251	- square drain, 4 ft. x 4 ft.
No. 196	- Section 253	- square drain, 4 ft. x 4 ft.
No. 197	- Section 254	- square drain, 3 ft. x 3 ft.
No. 198	- Section 258	- 12 ft. span road culvert[104]

Assistant Engineer Gore, on September 9, inquired of Fisk whether he wanted all the culverts of less than 10-feet span to have a semi-circular arch. Both Gore and Fisk wanted to have uniformity in the general plan of small culverts, and Fisk replied that the semi-circular arch design was his preference.[105]

On September 29 Assistant Engineer Stone informed Fisk that some of the contractors above Dam No. 5 felt that it was necessary "to have a grating at the upper end" of the culverts to prevent ice from moving under them.[106]

Although many of the culverts were small structures, the contractors building them faced many of the same financial problems that builders of the larger works experienced. Rising labor costs and increasing prices for construction materials and transportation plagued the contractors throughout the 1830s. James O'Reilly, the contractor for Culvert No. 143, complained to Fisk on October 29 that because of the shortage of labor along the line of the canal he had been forced to pay over $100 to bring hands from Georgetown.[107] In December Timothy Cunningham, the contractor for Culvert No. 150, reported to Fisk that the cost of labor had risen from $8 to $10 per month to $1.25 per day.[108] John Moore, the contractor for Culverts No. 151 and 152, informed the chief engineer on February 23, 1837, that his price of $4.50 per perch would "not more than pay for expenses as I have to haul the principal part of the stone from 2 to 3 miles."[109]

---

[104] Fisk to Ingle, Apr. 27, 1836, Ltrs. Sent, Chief Engineer. There was no accompanying statement to explain why some culvert numbers were missing from the list.
[105] Gore to Fisk, Sept. 9, 1836, Ltrs. Recd., Chief Engineer.
[106] Stone to Fisk, Sept. 29, 1836, Letrs. Recd., Chief Engineer.
[107] Reilly to Fisk, Oct. 29, 1836, Ltrs. Recd., Chief Engineer.
[108] Cunningham to Fisk, Dec. 24, 1836, ltrs. Recd., Chief Engineer.
[109] Moore to Fisk, Feb. 23, 1837, Ltrs. Recd., Chief Engineer.

When Michael Smith relinquished his contract for Culverts Nos. 168–170 in April, Clauson Bond submitted bids to Fisk to finish the work. The chief engineer forwarded these bids to Commissioner Bender on April 13, commenting that Bond's offer was higher than Smith's contract prices because of "the high price of labor and a greater difficulty in obtaining stone than he had anticipated." The lack of good building stone above Dam No. 5 made it necessary to transport stone from a much greater distance than had been expected.[110]

Assistant Engineer Gore, on April 22, notified Fisk that George Chambers, who owned land between the river and the canal near Licking Creek, was dissatisfied "with the convenience of the six-foot culvert" (No. 151) that was being constructed as a small roadway for him. Chambers felt that the culvert was too small for the passage of his cattle and horses. Because the abutments and wings were up and the centering was about to be erected, Gore had ordered the abutments to be raised 1 foot at an additional cost of $700. By raising the abutments, the puddling over the arch would be reduced to 3 feet.[111]

Chief Engineer Fisk, on May 26, reported to Commissioner Bender that the contractor for Culverts Nos. 173 and 174 was having critical financial problems. Because the foundations of these culverts were "below [the] low water surface of the river," every rise of the Potomac flooded the culvert pits. The interruptions to the construction of the culverts that had occurred that season had "caused very great expense to the contractor." Unless the contractor was advanced an additional allowance, Fisk feared that the work would be abandoned.[112]

After considering the problem of Culverts Nos. 173 and 174, the board agreed that same day to advance additional money to Smith, the contractor. On June 1 Smith would receive $500, and he would be paid $250 when the walls were completed above the rise of the river. If both culverts were completed within the time limit of his contract, Smith would be given $250.[113]

In the *Ninth Annual Report* issued in June 1837, the board stated:

> The masonry on this line [Dams Nos. 5–6] has been executed in a workmanlike manner, and of excellent materials, chiefly of limestone. At one time fears were entertained that suitable stone could not be obtained, but we have been agreeably disappointed, good quarries having been found at several points, although, in some instances, the stone is hauled a considerable distance. Between dam No. 5 and Cacapon, beside numerous culverts of from four to twelve feet span, and one over Little Tonoloway of forty feet span, there are ten locks of eight feet lift each, including the guard-lock at dam No. 6, and two aqueducts crossing Licking Creek and Great Tonoloway . . . the materials on all are of the most approved kind, and the workmanship cannot be surpassed.

---

110 Fisk to Bender, Apr. 13, 1837, Ltrs. Recd., C & O Co.
111 Gore to Fisk, Apr. 22, 1837, Ltrs. Recd., Chief Engineer.
112 Fisk to Bender, May 26, 1837, Ltrs. Recd., C & O Co.
113 Proceedings of the President and Board of Directors, E, p. 264.

> On all these constructions strength and durability have been the desideratum with the Board, and all unnecessary ornament, which would enhance their cost, has been dispensed with.[114]

On June 26 Fisk wrote to Commissioner Bender concerning "the backward state of the culvert at Charles' Mill lately put under contract to Mr. Byrnes." Before masonry could be commenced on Culvert No. 138, it would be necessary to put "a considerable amount of embankment thereon around the river end of the culvert in 20 feet [of] water to serve as a coffer dam."

According to the chief engineer, Byrnes could "probably get earth enough for this dam from the ravine of Charles' Mill." Scales, a contractor who had just finished several nearby sections, would be hired to move this earth, which was estimated to be 3,000 cubic yards, in carts at 30 cents per cubic yard.[115]

Assistant Engineer Stone, on August 21, notified Fisk that the contractor, Byrnes, was refusing "to build the culvert at Charles' Mill unless the Board either increases the price or pays whatever it costs." Brynes was complaining "that the first plan required from seven to eight hundred perches of masonry," while the new specification only required 300. Thus, the "cost of the centers would amount to more than the profit on the work."[116]

A. B. McFarland reported to Fisk on October 9 that the contractor for Culvert No. 179 was "perfectly independent of any instructions that either myself or assistant can give him." McFarland had "repeatedly objected to his sheeting on the score of its not being what the contract calls for." He had also condemned one of the "keystones now about to be laid, the bottom angles of which, and a part of the extrados, are ridiculously patched up and bedaubed with some composition where the stone has been broken." To remedy this difficulty, McFarland hoped that Fisk "would have the goodness to advise [him] what is best to do."[117]

On December 8 Gore reported to Fisk that Culvert No. 142 was being macadamized instead of undergoing the usual paving. This is the earliest instance found in which this process was applied to a culvert.[118]

Assistant Engineer Morris informed Fisk on January 27, 1838, that he had bargained with a carpenter to build waste gates and platforms for Culverts Nos. 166, 170 and 174. Because he hoped to have all the timber cut before March 1, Morris urged Fisk to approve the contract immediately. Subject to revision by the chief engineer, the following prices were estimated for the work:

---

114 *Ninth Annual Report* (1837), C & O Co., pp. 5–6.

115 Fisk to Bender, June 26, 1837, Ltrs. Recd., C & O Co. The cause of the problem was that the excavation was below the surface of the water in the pool of Dam No. 5. Thus, the water continued to rise up through the bottom of the pit.

116 Stone to Fisk, Aug. 21, 1837, Ltrs. Recd., Chief Engineer.

117 McFarland to Fisk, Oct. 9, 1837, Ltrs. Recd., Chief Engineer.

118 Gore to Fisk, Dec. 8, 1837, Ltrs. Recd., Chief Engineer.

Platform at Culvert No. 174

3,200	ft. bdl. x $30 per dl.	=	$96.00
290	lbs. iron x 15¢	=	43.50
			$139.50

Platform at Culvert No. 170

3,500	ft. bdl. x $30 per dl.	=	$105.00
320	lbs. iron x 15¢	=	48.00
			$153.00

Waste Gate at Culvert No. 174

1,000	ft. bdl. x $45 per dl.	=	$45.00
100	lbs iron x 15¢	=	15.00
			$60.00

Waste Gate at Culvert No. 170

1,300	ft. bdl x $45 per dl.	=	$58.50
150	lbs. iron x 15¢	=	22.50
			$81.00

Waste gate at Culvert No. 166

1,300	ft. bdl. x $45 per dl.	=	$58.50
150	lbs. iron x 15¢	=	22.50
			[119]$81.00

As construction proceeded above the Cacapon River, the lack of good building stone became a hindrance to the masonry works. On May 1 Assistant Engineer Morris drew up a report on the distances between Culverts Nos. 211–215 and their nearest stone quarries. Culverts Nos. 211 and 212, the former a road culvert of 12-foot span and the latter a culvert of 8-foot span, were located 4 miles from the Town Hill quarries. Stone for Culverts Nos. 213–215 had to be hauled from the South Branch limestone quarries for distances of 5-¾, 5-¼ and 4 miles respectively.[120]

On May 23–24, 1838, additional work was put under contract on the "50-mile section" between Dam No. 6 and Cumberland. Proposals for 17 sections, 11 locks and 6 culverts, were accepted by the board. The following culverts were contracted:

No. 204 to C. B. Ford
No. 210 to John Reiley
No. 219 to Mr. Everitt
No. 220 to Mr. Dilley
No. 225 to G. W. Henry
No. 229 to John Reiley[121]

[119] Morris to Fisk, Jan. 27, 1838, Ltrs. Recd., Chief Engineer.
[120] Morris to Board of Directors, May 1, 1838, Recd. of Elwood Morris, Principal Assistant Engineer.
[121] Proceedings of the President and Board of Directors, E, p. 424–25.

The canal company continued to experience difficulty in the construction of Culvert No. 179. Because the lower parapet walls had recently fallen during construction, Morris, on May 27, wrote two letters to Fisk recommending immediate repairs. It would soon be the "Bath Season," and the road culvert would be needed by summer travelers.

Morris felt that the lower parapet of Culvert No. 179 could be secured "by building dry walls with a hammer dressed coping of limestone, with the coping truly sloped & the walls in place each a true quadrant of a circle." The dry walls would be "backed up with rock, thereby bringing more counterposing might against the face." While the sloped coping would "add to the appearance of the work," it was also needed "because the slate cone only sloped at 1 to 1 nest the culvert at which slope when decomposed it would not I think have stood." However, before he arranged for this work to be done, he wanted instructions from Fisk as to whether the repairs should be done "with the paving or before it."[122]

Four days later, Morris informed Fisk that he needed further instructions on a matter relating to the change in the plans for Culvert No. 179. Although the original contract had not provided for paving the culvert, the plan now was to pave the roadway and sustain it "by a low dry wall on each side, one of which answers as a footway." So that the contractor, William Story, would not lose money by building these additional parts of the structure, Morris proposed to estimate these dry walls and those to buttress the lower end of the culvert "at a liberal price" of $6 or $6.50 per perch.[123]

Morris, on June 2, informed Fisk that the citizens of Hancock had raised money to pay an attorney "to prosecute at law their claims for a bridge over the canal, in lieu of the roadway under Culvert 179." This information was to be passed on to the board so that a decision could be made on the paving of the culvert.[124]

Fisk, on June 25, wrote a letter to Assistant Engineer Samuel H. Williams giving directions for the construction of the buttress walls at the lower end of the culvert. The detailed instructions were as follows:

> They are to be at right angles to the parapet wall—to run out 18 feet from the face of the parapet.
>
> The inner face of the buttresses to batter with the pilasters and to be in a line with the inner side of said pilasters. The top of these buttresses to step down 1½ to 1 and to rise with the upper side of the top step to the under side of the coping of the pilasters. These buttresses to be 6 feet thick on top, down to a level 6 feet below the upper side of the top side; then 7 feet thick to a level 6 feet lower; then 8 feet thick to a level 6 feet lower; then 9 feet thick to the foundation: these thicknesses to be exclusive of the front batter, and the variation of the thickness in the rear to be by offsets.

---

[122] Morris to Fisk, May 27, 1838, Ltrs. Recd., Chief Engineer.

[123] Morris to Fisk, May 31, 1838, Ltrs. Recd., Chief Engineer. Also see Story to Fisk, June 1, 1838, Ltrs. Recd., Chief Engineer. Originally, Culvert No. 179 had not been planned as a road culvert, but public pressure for a means of access to Bath forced the company to change its plans.

[124] Morris to Fisk, June 2, 1838, Ltrs. Recd., Chief Engineer.

These buttresses next [to] the pilasters and the parapet wall to be nicely fitted up against them, and to fit in the angle formed by the pilasters and the parapet.

The character of the masonry to be the same as of the culvert exclusive only of mortar.

I have omitted to mention that I decided before leaving that Story should relieve the back of the parapet of pressure by removing a part of the material. He can do this by cutting out the outer slope, and wheeling it to a higher level on the slope above and below the culvert. It can than be readily moved back.[125]

A memorandum of understanding was drawn up and signed with Story on July 3 for the paving and protective dry walls. The memorandum read as follows;

Dry walls at tail of Culvert per perch	$5.00
Dry walls containing between them the paving at the head of the Culvert which protects the roadway per perch the coping of these walls to have close joints for the full width of the wall.	4.00

Cutstone footway to be 18 in. wide & 16 in. high & to be rounded with a radius of 3 inches upon the inner top angle—&, every end joint in this footway is to be cut close & even & full from back to front & no stone to be less than 3 ft. long: the stone to be set in cement mortar, to be well-fitted & mortared against the abut. & to each other—In each vertical joint between two adjacent stones, a dowel of 2 in. round iron & 6 in. long is to be in mortar vertically & well loaded down so that none of the iron will be exposed to the air

Per perch including all - $25.00

All excavation whatsoever the value to be paid by the Canal Company.

The above work to be estimated in with said culvert as work extra to the contract therefore.[126]

When the paving and dry walling were completed in October, Story, on the twenty-second, submitted an account of extra work he had performed on Culvert No. 179. The breakdown of his bill was as follows:

June	112-¾ Days of Men @ $1.20 =	$135.30	
	39 " " Carts 1.50 =	58.50	$232.56
	Superintendence implements &c.	38.76	
July	3 kegs Powder	12.00	
	68 Days of Men @ $1.20	74.40	$136.00
	18 " " Carts @ $1.50	27.00	
	Superintendence & Smithing	22.00	
August	156 Days of Men @ $1.30	$202.80	
	23 " " Carts @ $1.50	34.50	$212.00
	Smithing implements & Superintendence	47.70	
September	129 Days work of Men @ $1.20	167.70	$50.00
	6 " Carts @ $1.50	9.00	

[125] Fisk to Williams, June 25, 1838, Ltrs. Sent, Chief Engineer.

[126] "Memorandum of an Understanding with William Story," July 3, 1838, Ltrs. Sent, Chief Engineer.

Superintendence Tools &c.	35.30	
McAdamizing & Grouting the waterway instead of paving		$254.37
Removal of stone hauled for masonry per Gatton		$50.00
Plastering the rock		$5.00
		[127]$1,174.93

On the same date, Story reported to Fisk that the cost of transporting cement for Culvert No. 179 amounted to $310.37. Because of cement shortages along the canal, he had been forced to haul cement from Leopards Mill and Hooks Mill as well as from cement houses at Williamsport and McCoy's Ferry.[128]

Meanwhile, a misunderstanding had arisen between Michael Smith, the contractor for Culverts Nos. 172–175, and Chief Engineer Fisk over the cost of building the combination waste weir-Culvert No. 174. Smith replied on May 28 to Fisk's request and explained why the cost of building the waste weir parapet of Culvert No. 174 should be worth more than culvert work. According to Smith, work on the waste weir parapet consisted of "the entire downstream wing and so much of the parapet and upstream wing as is above a level plane of three feet below the canal bottom." The work also included construction of "two walls on the platform inside of [the] canal, which are to conduct water to the waste gate."[129]

Concerning the more technical aspects of the work, Smith wrote that on the waste weir there were 60 plummings, "every two of which form a recess, corner, an angle or a step and differs entirely from where it can be built to a line." Part of the recess and bottom coping had been brought from David Rowland's quarry and the balance from Small's quarry. Two pilasters had been built with "scabbled coins," each "commencing one foot below the sill that lays in the bottom of the opening of the culvert." The quantity "of steps which had to be three feet in width and long in proportion to make a bond" bore "no proportion to the quantity of work in the waste weir to that in a culvert."[130]

Fisk, on June 23, informed the board that from "the Narrows to Cumberland, a distance of ten miles, there are eight culverts, all of which are dependent on the Evitts Creek quarry for stone." George G. Johnson, the contractor for Locks No. 73–75 and Aqueduct No. 11, owned the quarry as well as the entire farm surrounding it. Because Johnson was anxious to have the contracts for Culverts Nos. 234–241, Fisk had "sought to obtain from Johnson a reasonable offer of all the culverts."

Earlier the company engineers had estimated the cost of the eight culverts at $30,190. During the recent reception of proposals for additional work above the Cacapon, the lowest offers for these culverts amounted to $34,712, but the lowest bids by responsible con-

[127] Story to Fisk, Oct. 22, 1838, Ltrs. Recd., Chief Engineer.
[128] *Ibid*.
[129] Smith to Morris, may 28, 1838, Rcds. of Ellwood Morris, Principal Assistant Engineer.
[130] *Ibid.*

tractors had been $36,383. Johnson's offer for the culverts amounted to $38,572, but Fisk recommended to the board that his proposal be approved.[131]

The board, on June 25, accepted Fisk's recommendation and let the contract for the eight culverts to Johnson. The prices for Culverts Nos. 234 and 236–241 were as follows:

arch	$12.00
rubble	6.25
paving	3.00
timber	0.40
plank	40.00
rock	1.50
slate	0.70
earth	0.35

The prices for Culvert No. 235 were the same except for:

rubble	$6.50
paving	3.50
timber	0.50
slate	0.80
earth	[132]0.40

On July 3 Fisk informed the board that he had conditionally arranged for the letting of Culverts Nos. 206–209, 211, 215–217, 226–228 and 232–233. He urged the directors to approve the conditional arrangements even though the proposals exceeded the engineers' estimates by some 6 percent. The contracts for these culverts had been offered for bids several times, but lack of confidence in the canal project had kept responsible contractors from making proposals.[133]

Assistant Engineer Joshua Gore, on July 5, sent Fisk a plan to increase the security of a 6-foot culvert being constructed at McCoys Ferry. Gore recommended that "straight wings" be used to protect the structure, but he wanted the opinion of the chief engineer before forwarding the change in specifications to Project Engineer Stone.[134]

After reviewing Gore's recommendations, Chief Engineer Fisk, on July 7, sent the following directions to Stone regarding the changes that should be made in the culvert's construction:

> The buttress now being built at the berm end of the 6 foot span Culvert is to be raised up to a level, for its whole length, to the height of the present parapet of the culvert; having a coping comprehending thereto; and then earth and the slaty material near is to be wheeled in

---

[131] Fisk to Board of Directors, June 23, 1838, Ltrs. Recd., C & O Co.

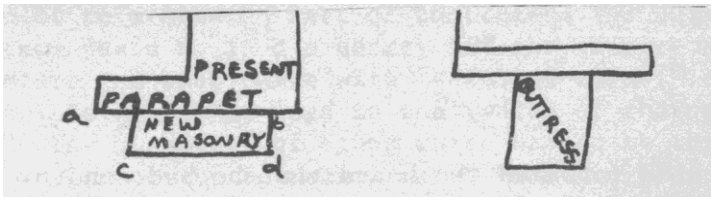
[132] Fisk to Gore, July 5, 1838, Ltrs. Sent, Chief Engineer.

[133] Fisk to Board of Directors, July 3, 1838, Ltrs. Sent, Chief Engineer. See Appendixes D and E for a listing of the proposals and engineers' estimates. These proposals were accepted by the board on July 18.

[134] Gore to Fisk, July 5, 1838, Ltrs. Recd., Chief Engineer. A thorough search of company records has failed to turn up the number of this culvert.

back of this buttress to the height of its coping and to rise up sufficiently above it so as to cover the coping on so much of the present parapet as is back of the buttress and the same filling is to continue on back of the hill.

2nd —At the same end of this culvert on the opposite side of the culvert, there is to be a wall of masonry built of the following form and dimensions:



ac & bd on a level and in the 6 spring will be 5 feet—the face of the new mas.[onry] cd will batter down to the foundation 3 inches to the foot— ac & bd will batter down to the foundation one inch to the foot. ac down at the foundation will be fit up against the end of the rubble wall bd on the level of the top of the abutment will be 2½ feet back from the face of that. There will be coping along bd & dc corresponding to the coping on the parapet.

3rd —At the other end of the same culvert, there will be two buttresses put up, both of which will be upon the same plan. I will describe one of them.

The buttress will run out at right angles and will extend on a level with the underside of the present parapet coping 5 feet—and will then commence stepping down 1½ to 1 feet for 15 feet further and will then batter down 2 inches to the foot. This buttress will be five feet thick on the level under the coping, and will batter down on the side next the waterway of the culvert 1 inch to the foot and will be on the level of the top of the abutment 2½ feet back from its face, and on the other side will continue down plumb for 4 feet and there will then be an increase of one foot in thickness, and will continue down plumb for 4 feet more, and then an increase of thickness of one foot, and so on. There will be an offset and an increase of one foot in thickness for every four feet you descend, down to the foundation.

When this shall have been done then having cleared out all the space down to slate or rock for the length of this buttress out to the end of the present straight wings you will fill in with heavy stone of the surplus of the sections up to the height of the mortared parapet. This stone filling to conform in width at the top of the parapet to that of the length of the buttress, viz. 5 feet, and in slope three down to the slope of said buttress. This stone filling to extend out to the very end of the parapet. The earth excavated for this work shall be filled in against the dry walling on each side that runs in extension of the mortared parapet.

4th —The paving in the bottom of the culvert you will recollect from my directions; great care should be taken that it braces well against the two abutments.

5th —The upper end of the roadway will have the two wings built up against, precisely in the manner described for the masonry that is to be built up against the lower side of the berm end of the 6 feet culvert, the foundation of which must be on a secure material.[135]

Three days later, on July 10, Fisk wrote to Principal Assistant Engineer Morris concerning the need for greater uniformity in the construction of culverts. The lack of proper organization in the chief engineer's office, the staff of which had been cut back due to the financial difficulties of the canal company, had left much of the responsibility for planning the individual culverts to the assistant engineers. This lack of central authority, according to Fisk, had "occasioned a great diversity of plans & dimensions under precisely

[135] Fisk to Stone, July 7, 1838, Ltrs. Sent, Chief Engineer.

similar circumstances, and upon the making up of final estimates, is the cause often of vexations grumblings &c by the contractors."

To promote uniformity in the culverts to be constructed and to insure that the chief engineer's office would henceforth play a key role in the design of the culverts, Fisk advised Morris that he was putting the following procedures into effect:

> Place at the site of each culvert along the line under your charge above the 'Capon, six stakes firmly driven, on each of which will be marked the level below or above Canal bottom: to be situated as follows viz; three in a line at right angles to the center line of Canal favorably situated for enabling a person to determine upon the best direction for the culvert and the best position therefore, one of which will be in the center line of the canal and each of the other two will be at opposite sides of the center line of canal and distant therefrom 43 feet. The remaining three will have the same position in regard to the center line of canal, but will lie in the bed of the branch or ravine,
>
> I wish to determine if possible, upon my next passing over the line of the canal, the plans and positions of the several culverts. Plans &c will then be drawn in my office of each culvert. After which I am desirous that the Prin. assistant shall suggest and advise in writing, such alterations as may appear to him expedient & advisable, accompanied by his reasons therefore, together with an estimate of the difference of cost. Such changes as may be adapted shall be entered upon the original drawing, stating at whose suggestion, &c.
>
> I designedly omit asking for any suggestions from the Principal assistant before the drawings of these plans, as my object is that the work shall profit by the experience and suggestions of each officer of the Company.
>
> By adopting this course, the suggestions of one Principal Assistant in regard to one culvert may perhaps be advantageously applied to other culverts, and uniformity of plan &c will be attained, and (if worth anything) the experience of the Chief Engineer will be brought to bear upon each particular case.[136]

Within 2 months the chief engineer was exercising a measure of supervision over the construction of the culverts. In mid-September he asked Commissioner Sprigg for the span of certain culverts between Sections Nos. 264 and 346. Sprigg responded with the following data:

No. 202½	- 6 feet span	- Section No. 264
No. 203	- 6 feet span	- Section No. 269
No. 204	- 10 feet span	- Section No. 277
No. 205	- 6 feet span	- Section No. 279
No. 210	- 10 feet span	- Section No. 296
No. 212	- 8 feet span	- Section No. 316
No. 213	- 8 feet span	- Section No. 319
No. 214	- 8 feet span	- Section No. 320
No. 218	- 3 feet diameter	- Section No. 332 (circular culvert)
No. 219	- 4 feet span	- Section No. 335
No. 220	- 4 feet span	- Section No. 336
No. 221	- 6 feet span	- Section No. 337

[136] Fisk to Morris, July 10, 1838, Ltrs. Sent, Chief Engineer. Also see Morris to Fisk, July 12, 1838, Ltrs. Recd., Chief Engineer.

No. 222	- 4 feet span	- Section No. 338
No. 223	- 6 feet span	- Section No. 339
No. 224	- 6 feet span	- Section No. 340 (Two Arches)
No. 225	- 4 feet span	- Section No. 341
No. 229	- 4 feet span	- Section No. 344
No. 230	- 4 feet span	- Section No. 346
No. 231	- 10 feet span	- Section No. 346[137]

Fisk also ordered that surveys be taken of the area of surface drained through the culverts in order to enable him to determine whether the plan and dimensions of the structures were adequate. On September 20 the results of the survey for Culverts Nos. 234–241 were forwarded to Fisk by Assistant Engineer Patterson. The areas of surface drained were as follows:

No. 234	- 1.3 square miles
No. 235	- 0.3 square miles
No. 236	- 0.6 square miles
No. 237	- 0.13 square miles
Nos. 238-239	- 0.6 square miles
No. 240	- 0.75 square miles
No. 241	- 0.6 square miles[138]

On September 16 the Chief Engineer wrote to Morris informing him that several changes in the plan for Culvert No. 211, a 12-foot span road culvert, had been made. According to Fisk, the thickness of the arch and ring was to be increased by 3 inches because of the added "depth of puddling." The obliquity of the culvert was to be 1 in 5, and the ends of the structure were to be "at right angles to the direction of the culverts, with a finish of coping as at the Little Tonoloway." The thickness of each abutment was to be increased 5 inches as a result of the greater depth of puddling.[139]

After further study of the plan for Culvert No. 211, Fisk drew up a list of specifications for its construction. Many of these changes from the printed specifications resulted from "the great depth of puddling over the culvert . . . in regard to the height of the middle cross walls, and also in regard to the end cross walls."[140]

Eight days later Fisk notified the board that John Bain, a contractor, had submitted a bill totaling $1,166.41½ for rebuilding the lower end of Culvert No. 170. Because he was in the vicinity, Bain had also been asked to build a dry wall parapet to the drain under the turnpike on Section No. 226. This latter project was necessary because a culvert under the canal that had been planned for that section had been dispensed with. Since the original

---

137 Fisk to Ingle, Sept. 17, 1838, Ltrs. Sent, Chief Engineer.
138 Patterson to Fisk, Sept. 20, 1838, Ltrs. Recd., Chief Engineer.
139 Fisk to Morris, Sept. 16, 1838, Ltrs. Sent, Chief Engineer.
140 Fisk to Morris, Oct. 2, 1838, Ltrs. Sent, Chief Engineer. See Appendix F for the "Specifications for Road Culvert No. 211 on Section No. 313 of 12 Feet Span."

plan had been to connect the turnpike and canal culverts, the decision not to build the canal culvert necessitated building the dry wall.

Fisk informed the board that the repairs to Culvert No. 170 resulted from "a failure caused by the river end of the culvert being finished off with wings parallel to the canal instead of with splayed wings." The chief engineer reported that he had "reluctantly consented to wings upon this plan being used in a few instances at the earnest solicitation of the assistant in charge." However, in the future this problem would "be guarded against by the culvert plans being drawn in my office under my own eye by the draftsmen of the Company." Up to this time, the finances of the company had prevented Fisk from hiring his own draftsmen. As a result, when plans were being drawn, changes were "very often suggested & yielded to sometimes, as in this case for the worse."[141]

Assistant Engineer John A. Byers, on November 12, reported to Fisk on the progress of work on Sections Nos. 263–281. Because of the deteriorating company finances and the shortage of laborers, Byers informed the chief engineer than none "of the contractors above Sideling Hill Creek will be able to lay any stone this season." Most of the contractors, however, were engaged in excavating the foundations and preparing the materials for the next building season.[142]

On November 28 Morris wrote to Fisk suggesting changes in plans for Culverts Nos. 212 and 213. Upon surveying the area, Morris found that the ravine of Culvert No. 212 drained ½ a square mile and that of Culvert No. 213 drained ⅓ of a square mile. These drainage areas compared with 7/9 a square mile for Culvert No. 214 and 2½ square miles for Culvert No. 215. Accordingly, Morris recommended that the company dispense with the plans for Culvert No. 213 and find another location "for the waste we proposed to build there which would be quite costly." In his opinion, a more suitable site for the waste weir was at the "double stop gate contemplated on Section 316 at [the] head of Davis' farm." On the other hand, he advised Fisk that Culvert No. 212 should be kept "as it flows from a flat country which may one day be cultivated."[143]
Work on the section of the canal between Dams Nos. 5 and 6 was completed by April 1, 1839, and the hands were laid off. By April 15 water had been admitted into the recently completed levels of the canal. This meant that 136 miles of the canal from Georgetown to the Cacapon were open to navigation.[144]

In mid-May Fisk sent a letter to the board recommending "that several small culverts" above the Cacapon River "should be dispensed with." The inability of the company to pay the contractors their monthly estimates, the scarcity of good building stone in the upper Potomac Valley, and the rising costs of construction materials had caused many of the contractors to abandon their works. Accordingly, the board accepted the recommen-

---

[141] Fisk to Board of Directors, Oct. 10, 1838, Ltrs. Recd., C & O Co. Also see Morris to Fisk, Sept. 11, 1838, Ltrs. Recd., Chief Engineer.
[142] Byers to Fisk, Nov. 12, 1838, Ltrs. Recd., Chief Engineer.
[143] Morris to Fisk, Nov. 28, 1838, Ltrs. Recd., Chief Engineer. A thorough search of the company records in Record Group 79 at the National Archives failed to turn up a reply to this letter.
[144] Byers to Fisk, Apr. 15, 1839, and Stone to Fisk, Apr. 19, 1839, Ltrs. Recd., Chief Engineer.

dation of the chief engineer to dispense with Culverts Nos. 202½, 203, 205, 209, 213, 214, 219, 220, 222, 225, 226, 227, 229 and 232, whose contracts had already been abandoned.[145]

Morris, on June 10, wrote Chief Engineer Fisk advising that changes be made in the plans of the culverts at Green Run and Greenwells Hollow on the Tunnel Residency. After observing these two ravines during the heavy spring rains, Morris concluded that plans for both culverts should be enlarged. He informed Fisk that according to recent surveys Green Run and Greenwells Hollow drained 4-1/3 and 3-1/5 square miles of watershed respectively. Green Run, one of the largest drains between the South Branch and Hancock, had a strong declivity and lay between Town Hill and Green Ridge, both of which sloped directly to the bed of the run, making its 4-1/3 square miles of drainage surface chiefly mountain slope. Greenwells Hollow, with its exterior branches, embraced the country "from Montgomerys Road, on the east, to the top of Town Hill on the north draining its point for a distance of nearly 3 miles." Mountain torrents in these ravines brought down considerable amounts of brush and drift timber that would easily choke small culverts. The flow of water in these ravines was so rapid "that if the culverts of either should become at all obstructed, they would mount over the canal bank in a very short time."

To insure that such problems did not arise, Morris recommended that the plans for Green Run Culvert be enlarged to "the span [of] 16 ft. semicircle, with abutments of 4 ft. clear height." At Greenwells Hollow, he advised "that the span of the road culvert be increased to 14 feet semicircle, the abutments being kept at 6 ft. high."[146]

Because the company finances continued to deteriorate, various expedients were considered to cut the cost of construction and maintenance of the culverts. On May 27 W. S. Elgin, a member of the board, reported "that he had procured the timber necessary to renew the covering of the road culvert at Conrad's ferry."[147] After considering the use of timber on the culverts, the board, on June 17, ordered Fisk to "make a report on the expediency of preserving it from decay by the chemical process of which you have spoken and also an estimate of the cost thereof."[148]

Following an examination of the entire line of the canal from Georgetown to Cumberland, the board, on August 5, 1839, reported that

> Below the level of the Point of Rocks, at an elevation of 217 feet above the basin at Georgetown, there are constructed 27 locks, generally 8 feet lift; 29 culverts, including road-

---

[145] Proceedings of the President and Board of Directors, F, p. 56. Also see Ingle to Fisk, May 25, 1839, Ltrs. Sent, C & O Co., and Fisk to Ingle, May 27, 1839, Ltrs. Recd., C & O Co. This decision to dispense with certain culverts for financial reasons may explain the difficulty in determining a comprehensive chronological numbering system for the culverts.

[146] Morris to Fisk, June 10, 1839, Ltrs. Recd., Chief Engineer.

[147] Proceedings of the President and Board of Directors, F, p. 61.

[148] Ingel to Fisk, June 17, 1839, Ltrs. Recd., Chief Engineer. This chemical process, known as kyanization (after J. H. Kyan [1774–1850], Irish inventor of the process), made wood resistant to decay by treating it with a solution of corrosive sublimate.

> ways of various dimensions, from a single one of two feet span to the longest, having two arches of 16 feet span each.
>
> Between the Point of Rocks and dam No. 5, there are 60 culverts of various dimensions.[149]

The report elaborated on the recently completed works between Dams No. 5 and 6 as well as on the progress of construction above the Cacapon River. Excerpts from the report concerning the culverts above Dam No. 5 were as follows:

> On this level [Locks Nos. 46–47], there is formed a culvert of eight feet span at Charles's creek . . .
>
> Between locks 47 and 48 is a road culvert 12 feet wide and 12 feet high in the clear, for the accommodation of the land cut off by carrying the canal across Prather's neck.
>
> [From Lock No. 50 to McCoy's Ferry], there are also a road culvert of ten feet wide, and a small drain culvert.
>
> A short distance above the stop[gate, at McCoy's ferry, and in the same vicinity, are several smaller culverts.
>
> Continuing along this 14-mile level [Locks Nos. 50–51], we pass over a road culvert and several smaller culverts.
>
> From the aqueduct over the Licking [Creek] to the upper end of the 14-mile level, lock No. 51, a distance of little more than 6 miles, the canal passes over several culverts, with the berm end of three of which are connected masonry waste weirs, that have their outlets through the culverts.
>
> Immediately below Hancock there is a road culvert of 12 feet span, and 12 feet elevation, for the accommodation of the road to Bath; and a short distance above the town is a large culvert of 40 feet span and 14 feet rise over the Little Tonoloway. . .
>
> The level above lock No. 52 extends 7 miles, and passing Hancock, we cross between that place and lock No. 53, at a distance of 5½ miles, a road culvert and four of smaller dimensions, with the head of one of which is connected a masonry waste-weir.
>
> Upon the 4½ miles which intervene between this lock [No. 53] and dam No. 6, are two road culverts, three common culverts, and a waste connected with the tow-path end of one of the culverts.
>
> A short distance below dam No. 6 is lock No. 54, which connects with the canal above the dam. The feeder from the river enters the canal at the foot of this lock, running close alongside of the canal between locks Nos. 54 and 55; the latter lock, of 8 feet lift, being connected with the abutment of the dam. The guard-lock to the feeder is also connected with the same abutment. Alongside of this lock is a culvert, built like an ordinary canal culvert, which serves as a flume for feeding the canal.[150]

The inspection team "were much gratified with the appearance of the work" throughout the completed portion of the canal up to Dam No. 6. While "errors both in location and construction" had been committed in the early stages of work, the examination team found that the problem areas had been skillfully repaired. The work above Shepherdstown, according to the report, exhibited "a manifest improvement in the whole of its

---

149 *Report of the General Committee of the Stockholders of the Chesapeake and Ohio Canal Company* (Washington, 1839), p. 7.

150 *Ibid*., pp. 8–11.

character." The improvement in construction was directly attributable to the "vigilance, fidelity and skill on the part not only of the engineers, but of the superintendents."[151]

The inspection team also reported on the status of the construction work above Dam No. 6. Excerpts from the report relating to these culverts were as follows:

> Upon this level [Locks Nos. 55–56], there are four culverts, three of which are completed; the other, though commenced, was abandoned by the contractor, and has not been relet.
>
> The succeeding level to lock No. 59, extending a distance of 2½ miles, is, nearly throughout its whole line, on the face of a steep hillside, along the margin of the river. . . There will be only a single culvert upon this level, with a waste-weir at the berm end of it, and a waste near the upper end of the level.
>
> This work [between Locks Nos. 59–60], being of a light and easy character, has not been put under contract, with the exception of a road culvert of 12 feet span. There will also be one smaller culvert and a waste-weir upon this level.
>
> A road culvert will be required upon this part of the canal, near the upper end of the seven-mile bottom [between Locks Nos. 60–61]. It was at one time under contract, but the contractor abandoned the work, and it has not been relet.
>
> The distance from this lock [No. 61] to [Lock No. 62] is one mile and a half. . . . It will pass over a culvert, which is not yet under contract, and will also have a waste.
>
> There will be required on this level [Locks Nos. 66–67] one road and one common culvert; neither of which has yet been placed under contract.
>
> From that lock [No. 67] to the one next above, No. 68, opposite the mouth of the South Branch, is a distance of 3 miles. . . Near the lower end of the level will be a culvert of 16 feet span. This was once under contract; but, having been abandoned, has not been as yet relet.
>
> Upon this level [Locks Nos. 68–69] there will be a large culvert of two arches of 10 feet span each, and a smaller one. Neither is, at this time, under contract, having been abandoned by the contractor before he commenced the work.
>
> Upon this level [Locks Nos. 71–72] there will be several culverts and a waste-weir; none of which are now under contract, although some of them, which are abandoned, have been let.
>
> Upon this level [Locks Nos. 72–73] there will be two culverts; one of which is under contract, but the construction is not yet begun; the other is nearly finished, the arch being closed.
>
> There are seven culverts upon this level [Lock No. 75 to Cumberland], all of which are under contract to the same individual to whom are let the locks Nos. 73, 74 and 75. Several of these culverts have been commenced, and preparations for all are going on.[152]

In early December, the arch of a road culvert near Licking Creek collapsed, damning up a small stream and flooding a field of oats farmed by Mr. Brien. When Brien asked the company to rebuild the culvert, Fisk, eager to save money and speed construction, recommended that iron pipes "be put in to answer the purposes of drainage." Although the company offered to pay Brien $1,000 in damages, and improved a "low water road" un-

---

151 *Ibid*., pp. 11–12.

152 *Ibid*., pp. 12–19. This report included a "Summary of the 27½ Miles of Canal, Recently Opened for Navigation Between Dam No. 5 and Dam No. 6" and a "Summary of the 50 Miles of Canal Between Dam No. 6 and Cumberland." For a listing of the culverts in these summaries, see Appendixes G and H.

der Aqueduct No. 6, Brien continued to insist on the rebuilding of the culvert for his transportation needs.[153]

The board, on July 5, had directed Chief Engineer Fisk to prepare a plan, estimate and specification for reconstructing the road culvert on Brien's land near Antietam Village. This data was desired as early as possible, despite the fact that the board still had not determined that the culvert should be rebuilt. In the report Fisk was instructed to assess the value of the old materials and whether they could be used in the reconstruction.[154]

Before he began to draw up a plan for the reconstruction of Brien's road culvert, Fisk had Superintendent George W. Rodgers review the first construction of the collapsed culvert. Rodgers, on August 13, informed the chief engineer that the length of the road culvert was about 100 feet. The height of the abutments was 4 feet and the paving was about 1 foot thick. The depth of puddling over the semicircular arch was not more than 6 inches, while the thickness of the arch was about 15 inches. Its span was 14 feet, and the ordinary low water level of the Potomac was about even with the foundation of the abutments.

Rodgers reported that suitable building stone to reconstruct the culvert was located in quarries within a mile of the site above Lock No. 37 near Shepherdstown. Approximately 260 perches of old material suitable for rebuilding were left in the remains and nearly 150 perches of the old walls could be used. In his opinion, it would take 2 months to rebuild the road culvert.[155]

On August 20 Fisk submitted to the board a plan and estimate for the reconstruction of Brien's culvert. The amount of reconstruction work needed and the estimated costs were as follows:

By calculation		
160 perches of arch masonry at $15	=	$2,400
810 perches of other masonry at $6.50	=	5,265
By supposition		
2,500 cubic yards of excavation at 25¢	=	625
1,500 cubic yards of puddling at 30¢	=	450
2,500 cubic yards of embankment at 30¢	=	750
		$9,490
Contingencies		964
		$10,454
Deduct value of old materials		1,365
		$9,089

[153] Fisk to Ingle, Dec. 8,1838, Ltrs. Recd., C & O Co. Also see Rodgers to Fisk, Dec. 14, 1838, Ltrs. Recd., Chief Engineer.
[154] Ingle to Fisk, July 5, 1839, Ltrs. Recd., Chief Engineer.
[155] Rodgers to Fisk, Aug. 13, 1839, Ltrs. Recd., Chief Engineer.

In his report Fisk warned the board that he was "unwilling to build" upon the old materials, thereby increasing his estimate. He reminded the directors of his earlier suggestion to cut costs by putting in iron pipes to conduct the water under the canal rather then rebuilding the road culvert. Because the vicinity of the culvert was subject to lime sinks, the chief engineer feared that the rebuilt culvert "would be one equally subject with the old one to failure."[156]

In December 1839 Fisk ordered that a general statement of estimates of the work done between Dam No. 6 and Cumberland be compiled. The estimates for work accomplished on the culverts up to November 30, 1839, were as follows:

Culvert	Contractor	Estimate	Status
199	Robert Taylor	$2,521.63	Completed
200	Robert Taylor	3,106.93	Completed
201	Robert Taylor	3,902.91	Completed
202	Robert Taylor	1,036.20	Abandoned
206	James Brownlie	5,493.00	Continuing
211	John Waldron	871.30	Continuing
234	George G. Johnson	4,238.25	Continuing
236	George G. Johnson	1,459.00	Continuing
237	George G. Johnson	1,230.00	Continuing
239	George G. Johnson	3,565.00	Continuing
240	George G. Johnson	1,271.00	Continuing
241	George G. Johnson	1,171.50	Continuing
		[157]$30,078.71	

Chief Engineer Fisk informed the stockholders concerning the progress of the work in the *Twelfth Annual Report* submitted in June 1840. In his communication he made the following observations on the masonry works:

> This class of works, generally, is very much behind the sections. It consists of 22 lift-locks of 182 feet total lift; 4 aqueducts of one arch each, averaging 60 feet span; 30 culverts of the aggregate span of 248 feet; one dam and one guard-lock, besides bridges, wastes, waste-weirs, &c. . .
>
> Of the thirty culverts, five are finished, six others have been commenced, the remaining nineteen may be considered as not having been begun. . .
>
> Speaking in reference to the whole of the masonry, there are at this time, not under contract, twelve locks and nineteen culverts that have never been commenced, and five locks, six culverts, and two aqueducts that have been commenced, besides all the bridges, wastes and waste-weirs.

[156] Fisk to Board of Directors, Aug. 20, 1839, Ltrs. Sent, Chief Engineer. For a copy of the drawings Fisk submitted to the board of the reconstruction of the culvert, see Appendix I. A thorough search of the C & O company records in record Group 79 failed to turn up evidence that this plan submitted by Fisk was ultimately followed, but physical evidence on the site appears to indicate that it was not.

[157] Bryan to Fisk, Dec. 18, 1839, Ltrs. Recd., Chief Engineer. The amount of work done on the culverts as of Nov. 30, 1838, had been estimated at $15,771.96. Bryan to Fisk, Dec. 20, 1839, Ltrs. Recd., Chief Engineer.

> The masonry done, is mostly upon the ten miles next above dam No. 6, and upon the ten miles next below Cumberland. Along the intermediate thirty miles there has been very little masonry, indeed, built. This has been owing in a great degree to the difficulty along the thirty miles in obtaining, at reasonable cost, stone suitable for building purposes. I am still of the opinion given in former communications to the board, that structures of kyanized wood may be resorted to as a temporary, if not permanent, substitute for some of the works of masonry where this scarcity of stone exists. The adoption of wood, to the extent spoken of, and the use of brick in the culvert arches laid in pure cement, as has also been advised by me on a former occasion, would lessen somewhat the time otherwise requisite for the completion of the canal.[158]

Fisk, on June 1, again directed that a statement of the work done on the "50-mile section" be compiled. The company engineers estimated that the cost of the culverts on this line of the canal was $241,760. Of this amount, $31,498 worth of work had been completed by June 1, leaving $210,262 worth still to be finished.[159]

On June 7, 1841, Chief Engineer Fisk notified the stockholders that work on the "50-mile section" had suffered greatly due to the disastrous financial state of the company. According to Fisk, the "case of the contractors now upon the line, and of the hands who have been in their employ, is truly a hard one." For months the contractors and laborers had "not received a dollar from the Company, when thousands are due to them." They were "without money and without provisions, and, in the present state of things, without credit."

Fisk estimated that it would take 3,000 men "in constant employ" from the present 2 years to complete the "50-mile section." Currently there were about one half that number at work. The masonry works were "fully one year behind the sections," partially because of the shortage of mechanics, "whose employment is always chiefly upon the masonry." Although the works presently under contract could be completed in less than 2 years, there was a "distance of nearly thirty miles with its masonry scarcely commenced." Besides the difficulty in finding good building stone in this region, the masonry works had frequently been delayed "from the want of cement which circumstances generally require (particularly when the Company is embarrassed) to be manufactured not long in advance of the time when it is needed for use."[160]

Fisk also submitted a statement showing "the character of the unfinished 50 miles of canal between dam No. 6 and Cumberland." This statement included the following observations on the progress of the construction of culverts:

---

158 *Twelfth Annual Report* (1840), C & O Co., pp. 14–15.

159 Bryan to Fisk, June 30, 1840, Ltrs. Recd., Chief Engineer. For a listing of amounts of work done and to be done on the individual culverts above Dam No. 6 as of June 1, 1840, see Appendix J. Compared with Appendix D, these figures show that the changing of plans for some of the culverts and the rising costs of construction had significantly increased the cost of their construction over the original estimates.

160 *Thirteenth Annual Report* (1841), C & O Co., pp. 61–63.

CULVERTS		
Culvert No.	on section No.	Remarks
199	259	Finished
200	260	
201	261	
202	262	Pit excavated, but masonry not commenced; was once under contract, but is not now.
204	277	Nothing done; was once allotted but the contract was not entered into.
206	283	One-third done; not now under contract. Contact was abandoned by the Board in December, 1839.
207	285	These two culverts have never been commenced. They were at one time under contract, but were abandoned, and have not been relet.
208	291	
210	296	Nothing done; was once allotted, but the contract was never entered into.
211	313	Pit excavated, but masonry never commenced; was once under contract but is not now
212	316	Not under contract. Nothing done.
215	322	Nothing done; was once under contract, but is not now.
216	330	Nothing done; were once under contract, but are not now.
217	331	
218	332	Nothing done; some of these culverts were once under contract, and most of the rest have been allocated, but contracts were not entered into. None of them are now under contract.
221	337	
222	338	
223	339	
224	340	
228	342	
230	345	
231	346	
233	348	
234	350	Finished
235	353	Was under contract, but when barely commenced was abandoned by the Board in December, 1839.
236	357	Nearly one-half done; not now under contract. Contract was abandoned by the Board in December, 1839.
237	357	Nearly one-fourth done; not now under contract. Contract was abandoned by the Board in December, 1839.
239	358	Finished.
240	361	one-sixth done; not now under contract. Contract was abandoned by the Board in December, 1839.
241	364	Three-tenths done; not now under contract. Contract was abandoned by the Board in December, 1839.
N.B. The missing numbers were for culverts that have been dispensed with.[161]		

[161] *Ibid.*

V. THE COMPLETION OF THE CULVERTS BETWEEN DAM NO. 6 AND CUMBERLAND: 1842–1850

By 1842 the financial condition of the company was deplorable, if not hopeless. Company officials acknowledged debts of $1,196,400 above all means. Many of the company's resources were tied up in the few remaining 5 percent bonds it owned.[162]

Further progress on the canal was impossible without additional help, but because of the straitened financial circumstances of the State of Maryland, further aid from that source was problematical. State leaders were hostile toward the company because of the way it had disposed of the bonds authorized by the Act of 1836, and with the completion of the Baltimore and Ohio Railroad to Cumberland in 1842 many legislators saw little need to extend the canal. Thus, 3 years were to pass before means were provided to resume work on the waterway. Meanwhile the Baltimore and Ohio Railroad, being in a stronger position, was able to continue with the construction of its line to the Ohio River.[163]

During this 3-year lull in construction, most of the canal company's efforts were directed toward maintenance operations on the 135-mile stretch of waterway between Georgetown and the Cacapon River. Superintendent John Y. Young of the Georgetown Division reported to Fisk on December 2, 1842, that the whole foundation of the small culvert below Fletchers "has been put upon solid rock for 26 ft. in length." The abutments for this length were "now ready for the centers and would have been closed if the weather had remained mild for 8 or 10 days more." The small culverts below Conrad's Ferry had also been secured.[164]

A heavy freshet struck the canal in April 1843, washing away portions of the towpath and berm. Four miles below Williamsport, the top of the bank and berm sides of a culvert were "carried away to the bottom of [the] canal." Embankments at several other culverts were washed down, necessitating repairs.[165]

Superintendent Young, on August 20, notified Fisk that a recent freshet had carried away the entire Cobbin Branch Culvert just below Edwards Ferry. This 6-foot span culvert, according to the engineers, had been "heretofore considered safe," but the rise of water had swept it away "from one end to the other." According to reports, the culvert arch had either been "forced up or undermined by the stream."

Young proposed to repair immediately the damaged culverts above Edwards Ferry. To do this, a dam would have to be thrown across the canal "below the outlet locks and pass the trade down the river to Seneca."[166]

---

162 Sanderlin, *Great National Project*, p. 139.
163 Walter S. Sanderlin, *A Study of the History of the Potomac River Valley* (Washington, 1950), p. 78.
164 Young to Fisk, Dec. 2, 1842, Ltrs. Recd., Chief Engineer.
165 Stone to Fisk, Apr. 20, 1843, Ltrs. Recd., Chief Engineer.
166 Young to Fisk, Aug. 20, 1843, Ltrs. recd., Chief Engineer.

Ten days later, Young informed Fisk that the Abrams Branch Culvert (No. 45 on Section No. 54) had been severely damaged during the recent freshet. Upon a close examination, he had found "that one half the arch from the crown down, reaching into the lower wing walls to a line with the inner edge of the berm" had collapsed. Several feet "below the foundation on the upstream canal side" were entirely washed away.

At first, Young reported, he had "endeavored to find a foundation and rebuild it." But after he had gone "down about 12 feet below the crown," he had discovered that the bottom was "so soft as to be able to pass a crow bar down with ease."

According to Young, repairs on the Cobbin Branch Culvert below Edwards Ferry were progressing. He was busily engaged in "constructing it 50 feet in length." Th bolster the foundation, he was "placing large timbers 25 ft. long, 12 inches square below the original foundation two feet from center to center and at right angles to the stream." Upon these timbers he intended to place "2 inch oak planks at least under the abutments." If he had lumber to spare, Young planned to floor the whole culvert with wood "in addition to which the lower and upper timbers will be sheet sided." The walls were to be "40 ft. in length in the base stepping of to 30 ft. at the top, 5 feet thick at bottom, 3½ at top, with good stone and well laid in cement.[167]

Superintendent W. S. Elgin of the Second Division wrote to Fisk on September 8 that the late heavy rains had not damaged any structures on his division. However, he reported on two main breaches on the First Division between Locks Nos. 25 and 26 that he had just witnessed. The embankment that had been recently put in "at the culvert above Broad run" was "entirely washed out say 60 feet at [the] top [and] 5 or 6 feet below bottom." A similar washout had occurred near Conrad's Ferry "over the culvert near the 36 mile post" where nearly 20 feet of embankment on the berm side had been washed away.[168]

A freshet struck the canal south of Harpers Ferry in mid-September, leaving large sand bars in the waterway. The high water caused the "east berm corner" of the Little Monocacy Culvert to settle.[169]

When the high water subsided, Assistant Engineer Clark Eldridge, on October 18, inspected the damage to the Little Monocacy Culvert. He found "the abutment wall to be undermined nearly all the way." The "upper wall & all the paving" was gone "so that the water stands nearly 4 feet under the culvert." A part of the abutment wall at the upper corner had fallen "down on the berm side." Because the culvert had little to support it, Eldridge recommended that it be repaired before the winter months.[170]

---

[167] Young to Fisk, Aug. 30, 1843, Ltrs. Recd., Chief Engineer.
[168] Elgin to Fisk, Sept. 8, 1843, Ltrs. Recd., Chief Engineer.
[169] Elgin to Fisk, Oct. 1, 1843, Ltrs. Recd., Chief Engineer.
[170] Eldridge to Fisk, Oct. 18, 1843, Ltrs. Recd., Chief Engineer.

Efforts to repair the Little Monocacy Culvert were hindered by continual rains during the autumn season. In mid-November, the coffer dams that had been put up while repairs were being made were washed away by another freshet.[171]

Meanwhile, following a lengthy political battle, the Maryland State Legislature, on March 7, 1845, passed a crucial bill enabling the resumption of construction on the canal. The canal bill provided that the Chesapeake and Ohio could issue $1,700,000 worth of preferred construction bonds on the mortgage of its revenues when it received guaranties from interested parties for 195,000 tons of trade annually for 5 years.[172]

The canal companies hastened to secure the guaranties required and to insure the full benefits of the act. President Coale went to Boston and New York to confer with officials of the Cumberland coal companies.[173] Twenty-eight instruments, including both personal and corporate ones, were eventually signed and delivered, for a total of 225,000 tons. The Governor formally accepted the guaranties and certified his approval in August 1845.[174]

After the guaranties were approved, the canal board proceeded to the letting of the contract. On September 23, 1845, the directors accepted the offer of Walter Gwynn, William Thompson, James Hunter and Walter Cunningham. All the sections were sublet in October, and the contractors placed a token force on the job on November 1, pending successful negotiations for the necessary funds to finance large-scale construction.[175]

The new contractors sublet the remaining culverts, but work proceeded slowly. A. B. McFarland, on April 13, 1846, notified Fisk that "Ritman & Co. have 2 or 3 hands and a team hauling stone to Culvert No. 208, and they have about 100 perches delivered." However, he warned the chief engineer that the contractors would "be hard pressed to raise enough stone from the present quarry to finish this culvert."

According to McFarland, Robert Syms & Co. "of Culverts 211 & 212 have done very little." These men would "soon commence their brick operations," but he feared that they would "not make good brick." They had also recently "opened a quarry on the line of the canal about halfway between the 2 culverts that turn out tolerably good rubble stone."[176]

In late June a heavy freshet struck the canal, causing extensive damage to Dam No. 4 and washing out two culverts on the 9-mile level below Harpers Ferry.[177] Broad Run Culvert, between Locks Nos. 25 and 26, was destroyed by the flood, and the board decided to replace it with a wooden trunk as a temporary expedient in order to restore navigation as quickly as possible.[178]

---

171 Elgin to Fisk, Nov. 28, 1843, Ltrs. Recd., Chief Engineer.
172 Sanderlin, *Great National Project*, p. 152.
173 Proceedings of the President and Board of Directors, G, p. 228.
174 *Eighteenth Annual Report* (1846), C & O Co., pp. 4–5.
175 *Ibid*., pp. 8–11.
176 McFarland to Fisk, Apr. 13, 1846, Ltrs. Recd., Chief Engineer.
177 Harris to Fisk, July 3, 1846, Ltrs. recd., Chief Engineer.
178 Coale to Fisk, July 5, 1846, Ltrs. Recd., Chief Engineer. Also see Fisk to Hogmin, July 8, 1846, Drafts of Ltrs. Sent, Chief Engineer.

By May 1 the work done amounted to only $55,384 worth and the force employed on the canal continued to diminish. The contractors were unable to improve their efforts due to the Mexican War and the collapse of financial arrangements. The number of laborers at work on the canal dwindled from a total of 50 at the end of May to only 10 by the end of June. After negotiations for the sale of the bonds collapsed in July, work on the canal ceased entirely, remaining suspended during the rest of 1846 and most of 1847.[179]

The canal experienced a series of heavy rains in the fall of 1846. On December 7 the foundation of the Little Catoctin Culvert was undermined, causing a large breach in its walls. Repairing the culvert would take 8 to 10 days of labor.[180]

Meanwhile, the canal company had been negotiating to sell the bonds that would finance the final construction. In October a final agreement was reached whereby 29 capitalists from New York, Boston and Washington agreed to take $500,000 worth of bonds and the subcontractors $200,000 worth, in addition to the $400,000 already pledged by the State of Virginia and the District cities.[181]

Work was resumed on November 18, 1847, under a slightly modified contract. The old company was reorganized and a new one succeeded to its contract with the canal board. Gwynn and Cunningham retired, but the remaining partners, Hunter and Thompson, continued on with a third man, Thomas Harris. Prices in the new contract were not to exceed the 1845 allowances by more than 12½ percent, and the work was to be completed by October 1, 1849.[182] The directors adopted various economy measures to facilitate the completion of the canal. They decided to substitute kyanized wood for stone in the locks, and they postponed the construction of lock keepers' houses and the arching of the tunnel until after the canal was formally opened to Cumberland.[183]

On June 5, 1848, the board informed the stockholders that of the 23 remaining culverts to be built, 17 had been sublet to the following contractors:

Culvert No.	on section No.	Contractor
202	262	Moyle, Randal & Co.
201	277	probably ditto
206	283	Ritner & Co.
207	285	do
208	291	do
210	296	Henry Gallagher
211	313	R. Sims & Co.
212	316	do
215	322	Steritt & Co.

[179] *Eighteenth Annual Report* (1846), C & O Co., pp. 10–11. Also see Proceedings of the President and Board of Directors, G, p. 443 and H, pp. 8–11.
[180] Elgin to Fisk, Dec. 8 and 12, 1846, Ltrs. Recd., Chief Engineer.
[181] Proceedings of the President and Board of Directors, H, pp. 94–96. Also see *Twentieth Annual Report* (1848), C & O Co., pp. 5–6.
[182] *Twentieth Annual Report* (1848), C & O Co., pp. 7–8.
[183] Proceedings of the President and Board of Directors, G, p. 285.

216	330	Bruce & Haughey
217	331	do
218	332	do
221	337	do
223	339	do
224	340	do
238	342	do
230	345	do
231	346	do[184]

According to the board, the five remaining culverts, located between Section No. 352 and Cumberland, were about half finished. The masonry of three of them was "more than one half laid, and a large proportion of the materials prepared." When the other masonry work was further along, these culverts would be put under contract.[185]

Fisk, on June 21, informed the trustees that "the force upon the line still continues to be wholly inadequate to the completion of the work within the contract time." To remedy this situation, he drew up a list of the number of laborers that each subcontractor would be required to employ within one month. If any subcontractor did not have the required force at work by August 1, the chief engineer warned that he would advise that the subcontract be declared abandoned.

Accordingly, the chief engineer ordered the subcontractors to hire the following:

Culverts No. 206–208	-	100	men
Culvert No. 210	-	2	masons
Culverts Nos. 211–212	-	4	masons
Culvert No. 215	-	4	masons
Culverts Nos. 216–218, 221, 223–224, 228, 230–231	-	10	masons
Culverts Nos. 235–237, 241	-	4	masons

Fisk also recommended that "the necessary attendants," such as quarrymen, stonecutters and laborers, be employed to keep the work progressing.[186]

In the same letter the chief engineer warned the trustees that the "making of bricks at the Tunnel is not going on at a rate that will carry the bricklaying through the season." Nor was "there a sufficiency of clay thrown up either there or at the culverts for the bricks that ought to be made this season." In addition to the lack of sufficient quantities of clay, problems had arisen along the canal where contractors had used improperly tempered clay that had not been exposed to frost. As a result, Fisk directed "that no clay shall in [the] future be used for the making of bricks at any point along the line that has not been so exposed, or if not, that has not been treated in such a manner by welting &c for a suf-

184 *Twentieth Annual Report* (1848), C & O Co., p. 18.
185 *Ibid*.
186 Fisk to Trustees, June 21, 1848, Ltrs. Sent, Chief Engineer.

ficient length of time to make it equally good." All bricks made the following season were to "be of clay exposed to the weather through the coming winter."[187]

Fisk, on August 24, wrote two of the subcontractors, Bruce and Haughey, reminding them that he had directed them not to commence the arches of the Patterson Creek Culvert "until after suitable bricks were separated from those that were not." Because they had begun building the arch without following his instructions, he ordered the work suspended "until the orders first given are strictly complied with, and a close inspection is had of all the bricks laid." All unsuitable bricks already put into the arch would "be removed before further progress" was made on the structure.[188]

While construction was proceeding on the western portion of the canal, canal company officials continued to receive reports of the deterioration of the structures on the older part of the waterway. Superintendent Bryan, on January 27, 1849, reported to Fisk that the condition of the culverts below Lock No. 29 was such "that not one in 3 could be properly inspected." Some culverts were filled with debris on their berm end while others were virtually closed on their river end by sand bars. Many of the worst culverts were "so filled up at the upper end as to force the water to cut a new channel." He urged that in such cases "it is worth the expense of clearing, if only to save the culvert."[189]

Four days later Superintendent Bryan wrote to Fisk informing him that none of the culverts between Lock No. 29 and Knoxville were in any danger. Only two small culverts required any repairs, one "needing only a little protection at the lower end" and the other needing its head cleared of debris.[190]

Canal company officials, anxious to have the waterway completed, continued to prod the contractors to speed up their operations. Fisk, on May 1, informed Hunter & Co. that "the force at present employed on Culverts No. 217, 221, 223, 224, 228 & 231 is wholly inadequate to complete them in the time stipulated in your contract." Accordingly he directed that they

> have at work, on or before the 15th instant, and thereafter, such number of masons, tenders, quarrymen, brickmakers, bricklayers, laborers &c as will insure the completion of Culvert No. 223 by the 20th instant, Culvert No. 231 by the 1st of June next, Culvert No. 221 by the 10th of June next, Culvert No. 217 by the 1st of July next, Culvert No. 224 by the 15th of July next and Culvert No. 228 by the 1st of August next.[191]

Assistant Engineer James C. Turner, on May 5, reported to Fisk concerning his examination of the pits for Culverts No. 224 and 228. He found that the pit of the former had "rock at 13 [feet] at the upper end and gradually falling to 16.5' at the lower end." The pit of the latter culvert had slate rock, which appeared "at the upper end at 26.3 [feet] and at the lower end at 27'." While the rock in the pit of Culvert No. 224 was "all partly solid,"

---

187 *Ibid.*
188 Fisk to Bruce and Haughey, Aug. 24, 1848, Drafts of Ltrs. Sent, Chief Engineer.
189 Bryan to Fisk, Jan 27, 1849, Ltrs. Recd., Chief Engineer.
190 Bryan to Fisk, Jan 31, 1849, Ltrs. Recd., Chief Engineer.
191 Fisk to Hunter & Co., May 1, 1849, Ltrs. Sent, Chief Engineer.

Turner discovered that the earthy material in the pit of Culvert No. 228 was of "inferior character."[192]

The twenty-first annual report, submitted to the stockholders on June 4, informed them that $63,423 worth of work had been done on the culverts in the past year, leaving $58,250 still available. Because few breaches in the canal had occurred in the last year, the company had been able to make important repairs that had long been needed. Concerning work on the culverts between Georgetown and Dam No. 6, the board reported that

> Much has been done in securing the foundations and materially repairing the following culverts, viz: The Cabin John and Rock Creek Culverts below Seneca, a culvert of 12 feet span on the 29th mile which has been nearly three quarters rebuilt; one of four feet span upon the 34th mile; one of ten feet span on the 51st mile; and one of 16 feet span (the Little Catoctin) on the 53rd mile.[193]

When work began to lag in the autumn, Fisk again wrote to Hunter & Co., directing that the number of masons and bricklayers on the line be more than doubled. As of September 25 only 60 masons had actually been at work on the canal while 146 "steadily and regularly at work," were required to complete the masonry. Although the deadline for the completion of the work was near, there were still "about 10,000 perches of mortared and 15,000 of dry masonry to be laid."[194]

According to Fisk's letter, the number of masons and bricklayers working on the masonry structures as of September 25 compared with the number required to complete the work on schedule was as follows:

Locks Nos. 59–60 and Culverts Nos. 206–208
- 16 masons required
- 9 masons working
- 6 bricklayers required
- 0 bricklayers working

Lock No. 61 and Culvert No. 210
- 4 masons required
- 0 masons working

Culvert No. 211
- 3 masons required
- 2 masons working

---

192 Turner to Fisk, May 5, 1849, Ltrs, Recd., Chief Engineer.
193 *Twenty-First Annual Report* (1849), C & O Co., pp. 14, 25.
194 Fisk to Hunter & Co., Oct. 8, 1849, Ltrs. Sent, Chief Engineer.

Culvert No. 212 and Waste Weir on Section No. 319
4 masons required
4 masons working
Culvert No. 215
3 masons required
0 masons working
Culverts Nos. 216–217, 221, 223–224, 238, 231
11 masons required
7 masons working
8 bricklayers required
0 bricklayers working
Culverts Nos. 235–237, 241
2 masons required
2 masons working[195]

While construction proceeded on the "50-mile section," the company paid increasing attention to the repair of structures along the line of the canal that was already in operation. This repair work during the autumn was hampered by the inability of the company to pay competitive wages, but by November 26 Superintendent John Lambie of the First Division reported to Fisk that he had about 25 men and 16 carts at Seneca. Six carts were being employed to put in embankment at Rock Run Culvert and Lock No. 11. All the necessary repairs had been completed at "the culvert at Powder Mill branch, the one above Lock No. 6, the one at Wilburns, the one below Lock No. 9 and the one at Rockrun." Repairs were presently being made at "the Road Culvert on the 4 mile level and the 2nd culvert above the Falls near Sandyspring."[196]

The twenty-second annual report of the company, submitted to the stockholders in June 1850, observed:

> The amount of work done, therefore, and to be done, by Messrs. Hunter & Co., is, at the August 1845 prices, considerably less than that of the estimate upon which they undertook the completion of the Canal. This arises, in part, from the general contingent item in the estimate having been found higher than the actual construction of the work required; —in part, from the substitution, in many cases, of less, for more costly plans of construction: and in part, from several works embraced in the estimate having been altogether dispensed with. There has been, for instance, a substitution of the composite plan, for masonry, in the construction of five lift-locks,—of wooden, for stone coping, to a considerable extent, upon the composite locks,—along the Tunnel tow path, and upon several of the wastes,—and there have been two culverts, a bridge and forebay over the Canal, one stone and one wooden waste weir, and one lock house, with much other work altogether dispensed with.[197]

Superintendent Lambie, on June 13, informed the chief engineer that the following costs had been incurred up to May 1 in repairing the culverts on the First Division:

---

195 *Ibid*.
196 Lambie to Fisk, Nov. 26, 1849, Ltrs. Recd., Chief Engineer.
197 *Twenty-Second Annaul Report* (1850), C & O Co., p. 13.

Powder Mill Branch	-	$97.12
On level above Lock No. 6	-	411.29
On level above Lock No. 7	-	282.64
On level above Lock No. 8	-	9.13
On level above Lock No. 10	-	607.34
Road Culvert No. 14	-	368.38
On level above Lock No. 20	-	202.40
		$1,978.30

During the month of May, repairs to the Cabin John Culvert and to the road culvert on the eleventh mile of the line had cost $33 and $53.85 respectively.[198]

After consulting with his assistant engineers on the line of the canal, Fisk, on July 14, compiled an estimate of work still necessary before water could be admitted into the "50-mile section." The estimates for the culverts were as follows:

Culvert No. 206	-	50	days labor
Culvert No. 207	-	30	perches paving
		150	cu. yds. gravelling
		500	cu. yds. earth excavation
		100	cu. yds. rip rap
Culvert No. 208	-	40	perches dry wall
		180	perches paving
		3,000	cu. yds. earth excavation
		100	cu. yds. rip rap
Culvert No. 210	-	5	perches coping
		55	cu. ft. timber
		40	lbs. iron
		400	cu. yds. excavation
Culvert No. 211	-	100	cu. yds. earth and rock excavation
Culvert No. 212	-	5	perches coping
		54	cu. ft. timber
		40	lbs. iron
Culvert No. 215	-	400	cu. yds. excavation
Culvert No. 211	-	21	lineal ft. coping
			Repairing roadway —3 days labor
Culvert No. 224	-		Finishing roadway, $85
Culvert No. 228	-		Finishing roadway, 25 days labor
Culvert No. 237 and waste weir	-	2½	perches masonry in coping
		46	cu. ft. timber
		66	iron belts
		110	cu. ft. timber
		132	lbs. iron belts
		50	cu. yds. embankment
			Finishing, 5 days labor
Culvert No. 240	-	125	cu. yds. earth excavation.[199]

[198] Lambie to Fisk, June 13, 1850, Ltrs. Recd., Chief Engineer.

[199] "Estimate of work to be done, necessary for the admission of water," July 14, 1850, Ltrs. Recd., Chief Engineer.

Superintendent Bryan on August 17, reported to Fisk that he had just examined a breach that had taken place at Dr. White's culvert on the twenty-nine mile. Although he could not determine the cause of the breach, it appeared "to have given way at the foot of the towpath slope, near & below the culvert." About 1,500 to 2,000 yards of earth had caved in, as had the lower end of the culvert "from a point nearly under the top outer angle of the towpath outwards & the lower abutment and 2/3 of the arch from this to a point nearly under the foot of the tow path slope." The eastern abutment and two-thirds of the arch had collapsed, but the western abutment and nearly one third of the arch were still standing, with a vertical bank of earth resting upon them.

Upon closer inspection, Bryan observed that the masonry of the culvert had been "rather good tho' rough" and "the foundation bad." He had instructed Assistant Engineer Eldridge to make preparations for underpinning the part of the structure still standing. A temporary bank would replace the breach so that navigation could be restored while the repairs to the culvert were being completed.[200]

On September 19 Assistant Engineer Dungan informed the chief engineer that he had examined Culvert No. 208, the wings "of which were reported to be cracked." Prior to his arrival on the site, the centers had been removed and "were found quite tight at each end." However, on the berm end there was "a perceptible crack, about 3 ft., in extending from the spring on either side to the keying course." At the towpath end the crack at the spring was "3½ ft. in on the upper side and 2½ ft. in on the lower side and extending from the keying course on this side down through the abutment cracking the corner stretcher in the 5th course below the spring." The crack went "entirely through 9½ inches in from the face, the stone being about a foot square at the fracture which is gaped [sic] about ¼ of an inch widening to 2 inches in the arch." Only two bricks on this side were broken, and no bond greater than 2 inches could be found in the rest. From "the keying course on the upper side" there was "a space of 18 inches showing no crack," but four broken bricks were visible halfway down the side. Because other portions of the culvert were not sufficiently bonded, this crack parted "the points down the face of the abt. as far as [was] uncovered about five feet down."

Dungan was at a loss as to the cause of the crack because he considered "the cement in the work as good as that at other points on the line." Furthermore, the foundation had been constructed on solid rock. He felt the remedy would "be to clean off the rock and boat in heavy riprap to sustain the parapet walls." Although there would be no danger in passing water over the culvert, he urged that "early steps should be taken to guard against a disaster."[201]

Finally, on October 10, 1850, the eastern section of the Chesapeake and Ohio Canal was formally opened to trade at Cumberland. Gala ceremonies were held to celebrate the event, as invited guests and curious visitors arrived from all parts of Virginia, Maryland

---

[200] Bryan to Fisk, Aug. 17, 1850, Ltrs. Recd., Chief Engineer. Also see Elgin to Fisk, Aug. 22, 1850, Ltrs. Recd., Chief Engineer.

[201] Dungan to Fisk, Sept. 17, 1850, Ltrs. Recd., Chief Engineer. A copy of the pit quantities and ground surface of the centerline of Culvert No. 208 may be seen in Appendix K.

and the District of Columbia. After 22 years of intermittent enthusiasm and despair, the canal was completed to Cumberland.[202]

[202] Proceedings of the Stockholders, D, pp. 390–95.

VI. THE OPERATION AND MAINTENANCE OF THE CULVERTS: 1850–1924

The culverts continued to suffer from breaches after the construction period ended. Superintendent Benton, on May 20, 1851, reported to Fisk that the culvert below Miller's Basin had been damaged on its berm side. Part of the wall of the arch had collapsed, and all the dirt above the arch to the foundation had fallen. Because a loaded boat lay across the breach, repairs were not begun for 12 hours after the break. Within 3 days, however, navigation had been resumed on this section of the canal.[203]

The culverts were giving good service in 1853 when General Superintendent T. L. Patterson informed the stockholders that "the culverts are in good condition with very few exceptions, and these will repaired in time."[204]

The board, on July 1, 1857, ordered that the division superintendents "be directed to examine all culverts upon their respective divisions, to have the same properly cleared out."[205]

During the Civil War, parts of the canal were severely damaged. Before Stonewall Jackson's men forded the Potomac at White's Ford in the invasion of Maryland on September 5, 1862, General Hill had a fatigue party wreck Lock No. 27, breach the Little Monocacy Culvert and cut down the berm and towpath banks on the 7-mile level.[206] After the battle of Antietam, General Lee's Army of Northern Virginia recrossed the Potomac at White's Ford and pulled back into the Winchester area.[207]

As soon as the Confederate artillerists were no longer considered a threat to crews charged with getting the canal back in operation, Superintendent George Spates made an inspection of the Monocacy Division above Edwards Ferry. While the banks could be fixed with little difficulty, he predicted that the repairs to Lock No. 27 and the Little Monocacy Culvert would take 2 or 3 weeks, provided he had a large force and sufficient funds.[208]

General McClellan, on September 30, gave orders that large fatigue parties would be detailed to assist the canal people in making the repairs. On October 1, a 65-man detail reported to Spates at the mouth of the Monocacy River. Spates assigned the soldiers to closing the breach at Little Monocacy Culvert, thus freeing his people to work on Lock No. 27. Meanwhile, Col. Daniel H. Rucker, officer in charge of the Washington Quartermaster Depot, ordered the force increased to 150 men. Good weather facilitated the

---

[203] Benton to Fisk, May 20, 1851, Ltrs. Recd., Chief Engineer.
[204] *Twenty-Fifth Annual Report* (1853), C & O Co., p. 9.
[205] Proceedings of the President and Board of Directors, I, pp. 364–65.
[206] Edwin C. Bearss, "1862 Brings Hard Times to the Chesapeake and Ohio Canal," *West Virginia History* 30 (January, 1969): pp. 449–50.
[207] *Ibid*., p. 453.
[208] Spates to Ringgold, Sept. 13, 1862, Ltrs. Recd., C & O Co.

work, and Spates, on October 14, reported that his division was again ready for navigation.[209]

The board, on March 24, 1864, ordered that the towpath in Georgetown be changed from the south to the north side of the canal in order to provide for increased wharf facilities. Accordingly the superintendent of the Georgetown Division was instructed "to change the towpath of the canal, by passing the same from the South side under the culvert above the Foundry to the road on the North bank of the Canal." The wall along the road was to be repaired and secured, and "a post railing not less than four feet high" was to be "built along the wall where necessary in a substantial manner."[210]

In June 1866 the stockholders were informed by the board that "in general the masonry of the aqueducts, culverts and locks is both substantial and in good repair, the only exception requiring special remark being the aqueduct that spans the Conococheague River." This structure had been "wantonly and most seriously injured by rebel soldiers during the late rebellion."[211]

Two years later, in June 1868, the board reported to the stockholders that a sudden rise of the Potomac in mid-May had caused the canal to overflow, "damaging culverts and the tow-path in many places, to such an extent, as to delay navigation for eight or ten days."[212]

In June 1869 the stockholders were informed that the expenditures for ordinary and extraordinary repairs during the previous year were $169,258.40 and $10,453.42 respectively. Referring to these figures, the board observed:

> Whilst the above-mentioned expenditures may be considered heavy, yet the condition of the canal was such after the close of the war, from the fact of its being continually damaged by the contending armies, as to make it absolutely necessary to employ a large force to enable the Board to place its condition beyond any ordinary contingency. This the Board, with judgment and discreetness, have done; and they now have the pleasure of reporting to the Stockholders the canal fully recovered from all damages growing out of the war. The whole line is now in thorough, complete and safe condition.
>
> During the past ten years little or nothing had been done towards repairing and Improving lock-houses, bridges, culverts, aqueducts, locks, lock-gates and waste-weirs of the Company; many of them had become entirely unfit for use and were becoming worthless, rendering it absolutely essential to the requirements of the Company to have them repaired. This the Board have done, and, although at heavy cost, they now present a comfortable and substantial condition, and the fact may now be confidentially stated that the condition of the canal in all its departments is such as to justify a largely decreased expenditure during the current year, unless overtaken by unforeseen and unexpected disaster."[213]

---

209 Spates to Ringgold, Sept. 30 and Oct. 6 and 14, 1862, Ltrs. Recd., C & O Co.

210 Proceedings of the President and Board of Directors, K, p. 375. On May 12, 1864, the board ordered that the railing "be not less than 3 feet high, in accordance with the recommendation of the Supt."

211 *Thirty-Eighth Annual Report* (1866), C & O Co., p. 7.

212 *Fortieth Annual Report* (1868), C & O Co., p. 7.

213 *Forty-First Annual Report* (1869), C & O Co., pp. 4–5.

Chief Engineer William R. Hutton, on July 12, 1870, gave the board estimates "for putting the canal into good condition" in the Georgetown and Seneca divisions. The loose coping on the Watts Branch Culvert needed to be reset at a cost of $25. Repairs to the culverts on the Seneca Division would total $250.[214]

The board was notified on December 7, 1871, that the culvert below Chain Bridge "has been leaking badly all summer and at one time caused a small break." It was estimated that $450 would be needed to repair the puddling on this structure.[215]

During the summer of 1872, Chief Engineer Hutton made a thorough inspection of the condition of the canal. Following the survey, he submitted a report of recommended repairs to the board. The total cost of repairing the culverts was estimated at $2,867.42.

On August 14, 1872, Chief Engineer William R. Hutton reported to President Arthur P. Gorman regarding the condition of the canal and recommendations for its repair. Concerning the culverts, he observed that

> one on the Georgetown level, above Edes' Mill, should be rebuilt when the water is off next winter.
>
> The upper angle of [the] abutment of the one next above Lock 7, must be underpinned.
>
> The abutments of Rocky Run Culvert, near the upper end, need to be underpinned, and some loose masonry about the spring of arch reset.
>
> The culvert above Lock No. 8 is too high, and boats ground on it unless the level is kept too full. It should be cleaned off, and by a covering of good concrete be made tight enough to spare some of the puddling over it.
>
> In a large culvert on nine mile level, above "Haunted House," some stone should be replaced in the offset in [the] abutment, and the end of the broken culvert, about twenty-five feet in length, ought to be rebuilt.
>
> Little Monocacy Culvert is cracked across the upper end—needs to be watched. The arch also requires repair and pointing.
>
> Kanawa Culvert, below Point of Rocks, has a very bad arch, and but little puddling over it. The arch ought to be carefully pointed and filled, and next winter should be stripped, and the part near [the] canal bottom, covered with concrete.
>
> The paving, in [the] lower end of [the] 8 foot culvert, below Knoxville, should be restored at once—at small cost if attended to in time.
>
> The culvert at Lock 39 is bad, and the arch stones loose.
>
> That [the culvert] above Lock 43 needs to be sheet-piled and secured at the lower end.
>
> The end wall of Lefever's Culvert, near Falling Waters, threatens to fall. The arch is cracked across and pushed out about four inches. It should be secured by buttresses, or it may be found cheaper, on examination, to take it down and rebuild with greater thickness and more batter.
>
> The culvert next above Williamsport Aqueduct is badly cracked across at the upper end. Its repair is not urgent, but it should not be overlooked. Many of the culverts below Dam No. 5 are badly built, old and loose. An intelligent mason should be employed on each division, to go through them all during the warm weather, and make such small repairs as may be appar-

[214] Proceedings of the President and Board of Directors, L, pp. 241–45.
[215] *Ibid*., pp. 489–94, 561–64.

> ent to him. By this means their deterioration will, at small cost, be prevented, and the occasion for more extensive repairs, should any prove necessary, be made known.
>
> The culverts from Dam No. 5 to Cumberland are better. Several of them have cracks across the ends, notably the road culvert at Hancock, but none of them are dangerous. The road culvert referred to also leaks badly, and should be partly stripped, that the leaks may be stopped with a coat of Portland cement or good concrete.[216]

At the forty-fifth annual meeting of the canal company in June 1873, the board reported:

> The condition of the culverts on portions of the line has been much improved by the use of large quantities of cement, to replace that which had been washed out and allowed to remain out for many years. The road culvert below Point of Rocks, which was leaking badly, had been thoroughly and permanently repaired. This work upon the culverts is still going on, so far as it can be done without interference with the navigation of the canal.[217]

President Arthur P. Gorman, on September 10, 1873, reported the following to the board:

> As you are aware the Canal under your charge, in common with other works of internal improvement in the State has been seriously damaged by the very extraordinary storms of the past month. The damage to this work was more extensive than it has sustained since 1852, and but for the substantial manner in which it was constructed possibly its navigation would not be resumed; unlike all previous injury from high water this was caused from the small mountain streams which are conducted under the Canal by culverts which have heretofore been sufficient to carry the water, but on this occasion the streams were converted into such torrents that they proved inadequate.
>
> Within a few hours after the damage several hundred additional men were employed upon the repairs, and notwithstanding there was rain for fourteen consecutive days by the extraordinary exertions of the Officers of the Company and men employed the damage was so far repaired as to pass boats on the 26th.[218]

Superintendent D. T. Lakin of the Monocacy Division notified President Gorman on April 15, 1874, that the "Haunted House Culvert" on the 9-mile level had been damaged:

> I find that there is some mason work needed at the Culvert known as the haunted house culvert on the nine Mile level. There are several of those Seneca sand stones at the upper and lower ends of this culvert that are crumbling in pieces and must be replaced. It will not take more than a week or ten days for one mason. It should be attended to at once.[219]

On November 24, 1877, another great flood swept down the Potomac Valley—the worst in 150 years of recorded history of the region. In its wake it left the canal a total wreck and brought trade to an end for the season.[220]

---

[216] *Report of W. R. Hutton, Chief Engineer, As to condition of Chesapeake and Ohio Canal, With Estimate of Cost of Extraordinary Repairs Required During the Current Year, August 14th, 1872* (Annapolis, 1872), pp. 13–15.

[217] *Forty-Fifth Annual Report* (!873), C & O Co., pp. 9, 28.

[218] Gorman to Board of Directors, Sept. 10, 1873, Ltrs. Recd., C & O Co.

[219] Lakin to Gorman, Apr. 15, 1874, Ltrs. Recd., C & O Co.

[220] Sanderlin, *Great National Project*, pp. 241–42.

President Gorman, on May 15, 1878, announced to the board that the damage to the canal had been repaired and the entire waterway opened to trade on April 15. He observed that the waterway was "now in as good condition or better than it has been for many years past." However, much remained "to be done to strengthen and complete the work," because the embankments and masonry were in only fair condition and "not as substantial as they were prior to the flood."[221]

Although the canal was restored to full operation, trade did not improve, for business remained generally depressed and coal prices continued low.[222] In 1886 three heavy floods again left the canal a wreck, and in 1889 a flood of titanic proportions forced the canal company to go into receivership, with the Baltimore and Ohio Railroad emerging as the majority owner of the canal company bonds.[223]

Under the railroad's management, trustees were appointed and the canal entered the last period of its operation. In 1924, after the railroad had captured almost all of its carrying trade, the Chesapeake and Ohio Canal ceased to operate. While documentary data in the company records dealing with maintenance and reconstruction problems during the period 1850–89 is sketchy, there is virtually no information dealing with these subjects for the years 1889–1924. However, secondary sources, such as Sanderlin, seem to indicate that the canal operated under the railroad much as it had in previous years.

---

[221] Proceedings of the President and Board of Directors, N, p. 23.
[222] Sanderlin, *Great National Project*, p. 243.
[223] Proceedings of the President and Board of Directors, N, pp. 329–31, 413. Also see *Sixty-First Annual Report* (1889), C & O Co., pp. 8–11.

APPENDIXES

APPENDIX A

"Specification for Culverts on the Chesapeake and Ohio Canal"
(ca. 1829)

The culverts below Harper's Ferry will be about one hundred and ten feet long, and those will be varied according to circumstances.

The pits and foundations will be excavated of such width and depth as the Superintending Engineer may direct; and no foundation shall be built upon until he or the Superintendent of Masonry shall inspect and approve it.

When practicable the Culverts will be founded on rock; when this cannot be done, the Engineer may require the foundations of all the walls, as well as the span or water way, to be made firm by paving the same with suitable stone, large and small, well rammed and driven, in which case, the first course of wall on such foundation shall be laid with large flags or stones having broad beds, laid in header form, and bound at the ends. Or foundations of timber may be required by the Engineer, made in the following manner, viz: Timbers of suitable size, hewed on two sides, shall be laid one foot apart, and extending under the Culvert and both of the side walls, three rows of sheer piling, of plank two inches thick, shall extend entirely across the Culvert and its walls, and to the depth of four feet below the bottom of the aforesaid timbers. These timbers shall be first puddled between and level with their upper surface; and their whole extent shall be floored over with a course of jointed two inch yellow plank, and each plank secured to the timber by at least six locust pins, eight inches long and one and a quarter inches square. On this foundation the walls of the Culvert will be erected.

For all Culverts of four feet span, the arch shall be fourteen inches thick; six feet span, sixteen inches; eight feet span, eighteen inches; twelve feet span, twenty one inches; and sixteen feet span, twenty four inches thick; the space for puddle over the arch generally two and a half feet deep. The arches shall be semi-circular, or the segment of a circular, as may be required. The sheeting stones shall have good parallel pads, and fair joints, dressed with the hammer, and of a proper length to form a good bond. They shall also be of a equal depth, and the extrados of the arch hammered off smooth.

The ring stones shall be well cut and shaped, so as to form joints radiating from a center. Those for a culvert of four feet span shall be twelve inches deep; those for six feet span, sixteen inches; those for twelve feet span, eighteen inches; and those for sixteen feet span, twenty inches. They shall form a good bond with the arch, for which purpose, those of a four foot span must run alternately in the arch, from twelve to fifteen inches, and from twenty-four to thirty inches long. For any arch of greater size there must be alternately from fifteen to twenty inches, and from thirty to forty inches long. The ring stones are to be rusticated one inch, which rustic is to project or be in relief, one inch from the parapets and wings.

The abutments to be of such thickness as will be hereafter directed, to bear a proper proportion to their height, or large stones, well laid in rubble form, except the corners, which must be cut and counted to conform with the ring stones and wings.

[Appendix A continued]

The key stones shall be well shaped, hard, and of durable quality, and shall be accurately driven by a wooden mallet before the centers are removed.

The wing walls and parapets to be of hammered range work, to be well bedded and jointed stones, with a due proportion of heads; the whole to be surmounted with a well cut coping, eight inches thick, two feet wide, to project four inches over the face of the wall, unless a water table is preferred by the Engineer. The whole work to be well laid in cement and grouted, with at least three bushels of cement to the perch. When the case will permit the abutments to be at least two feet high.

When the culvert has been, in other respects, finished, the outer surface of the arch shall be plastered half an inch thick with cement mortar.

The centers shall be constructed in such manner as the Engineer may prescribe.

The cement used must be of the best quality which the upper country will afford, to be approved by the Superintending Engineer, and shall be transported from the mill to the works, and preserved there until used, in such manner as the Engineer may in writing direct. The sand must be clean and sharp, and if not found naturally combining these qualities, it must be washed. No materials to be used, until they are so approved.

The plan of the masonry, and of its foundation, shall be furnished each Contractor, and if any explanations are necessary, they shall be given by the Engineer or Superintendent of Masonry, at all times when required.

Any stone excavated from the culvert pit, if approved by the Engineer, may be used in the construction of the culvert, but the surplus material excavated, shall be deposited at any place the Engineer may direct within the distance of one hundred and twenty feet from the pit.

Where stone may be required for the construction of the Culvert, and the Contractor cannot agree with owner thereof for the same on reasonable terms, the President and Directors will upon application, cause the same to be condemned according to the Charter of the Company, and the contractor paying the expense of condemnation, as well as the sum awarded by Jury, for the stone.

APPENDIX B

"Tabular Statement of the Cost of the Works from the Mouth of Tiber Creek,
In Washington City, to the Mouth of Seneca Creek"
March 31, 1834

Tiber Creek–Seneca Creek

Section	Culvert No.	Cost
A–B	A	$4,432.29
B	B, C	9,734.96
	(Culvert C is a viaduct)	
E	H	931.75
	Viaduct	6,074.47
F	I	1,392.15
G–H	K	3,578.21
2	2	593.50
5	5	803.60
6	8	3,623.87
7	9	762.59
8	10, 12	7,225.82
	(12 is a viaduct)	
10	14	572.08
11	15	2,079.98
	(15 is a viaduct)	
14	17	1,070.07
15	18	760.38
20	21	665.40
21	22	734.00
24	23, 24½	1,595.75
26	25	4,780.29
30	30	1,933.00
31	31	482.90
32	31½, 32	1,859.25
		803.20
		$56,489.51

[Appendix B continued]

Seneca Creek–Point of Rocks

Section	Culvert No.	Cost
36	35	$664.50
37	37	1,953.75
43	38	2,261.93
46	39	1,288.65
48	41	879.38
49	42	2,178.50
53	44½	6,522.82
	(44½ is a viaduct of two arches)	
54	45	1,265.10
55	46	663.75
57	46½, 47, 47½	4,809.65
	(47 is a viaduct)	
58	48,49	1,261.56
59	50,51	4,151.85
60	52, 52½	4,286.61
	(52½ is a viaduct)	
61	53	1,012.62
62	54	1,196.37
63	56	1,232.28
66	60	874.42
67	63	1,325.00
68	64,65	5,243.66
70	66	1,470.50
72	68	1,383.30
73	69, 70	9,228.98
	(69 is a viaduct)	
76	71	4,173.26
	(71 is a viaduct)	
84	72, 73, 74	5,149.69
	(72 is a viaduct)	
		$65,346.67

[Appendix B continued]

Point of Rocks–Harpers ferry

Section	Culvert No.	Culvert Cost
87	75	$1,803.70
88	76	1,072.20
90	78,79	5,231.50
	(79 is a viaduct)	
93	81	772.10
	82	4,850.53
	(82 is a viaduct road to culvert)	
94	83	1,043.95
95	84	2,849.40
	(84 is a viaduct)	
96	85	1,266.40
97	86, 87	3,805.31
99	88	1,688.60
100	89	1,123.80
102	90, 91	5,268.76
	(91 is a viaduct)	
103	92	1,751.10
105	93	3,510.43
107	94	1,432.65
		$37,470.40

[Appendix B continued]

Harpers Ferry–Dam No. 4

Section	Culvert No.	Cost
116	95	$1,113.60
117	96, 97	2,312.48
122	100	1,881.55
124	101	3,297.05
	(101 is a viaduct)	
127	102	924.35
128	103	1,080.80
129	104	1,420.50
130	105	1,127.20
134	107	955.00
135	108	1,404.90
136	109	1,110.80
140	111	1,470.00
143	112	186.00
147	114	707.75
148	115	1,205.00
150	116	2,538.00
154	117	56.00
155	118	1,808.50
		$24,599.48

Dam No. 4–Dam No. 5

Section	Culvert No.	Cost
173	120	$1,741.17
174	121	164.03
178	122	962.00
179	123	1,449.84
180	124	1,510.96
181	125, 126A	2,647.98
184	127	684.60
186	128	745.60
189	129	1,816.88
190	131	1,055.50
191	133	1,263.20
194	134,135	2,969.36
201	136	3,155.60
		$20,166.72

[Appendix B continued]

SUMMARY

Tiber Creek–Seneca Creek	$56,489.51
Seneca Creek–Point of Rocks	65,346.67
Point of Rocks–Harpers Ferry	37,470.40
Harpers Ferry–Dam No. 4	24,599.48
Dam No. 4–Dam No. 5	20,166.72
	$204,072.78

∗These figures give the cost of all the culverts that have been paid for or estimated as of March 31, 1834.

From *House Report 414*, pp. 178–87.

APPENDIX C

"General summary: March 30, 1834" by Engineer Alfred A. Cruger

Culverts

Section	Span	Perches	Price	Cost	Pits
203	4	164	$3.75	615.00	200
204	6	300	3.75	1,125.00	250
205	6	258	3.75	967.00	300
	4	164	3.75	615.00	200
208	10	468	3.87½	1,813.50	250
	4	164	3.76½	635.50	150
209	12	695	3.75	2,606.25	200
210	10	463	3.75	1,755.00	350
211	4	164	3.87½	635.50	250
	4	164	3.76½	635.50	250
212	4	164	3.87½	635.50	250
	4	164	3.87½	635.50	250
214	4	164	4.00	656.00	250
217	4	164	4.00	656.00	300
	12	615	4.00	2,460.00	300
218	4	260	4.00	1,040.00	250
219	4	164	4.00	656.00	200
	4	164	4.00	656.00	300
222	4	164	4.00	656.00	250
	4	164	4.00	656.00	200
224	4	164	4.00	656.00	300
225	6	258	3.75	967.50	300
226	8	343	3.75	1,286.25	250
	4	164	3.75	615.00	250
227	6	258	4.00	1,032.00	300
228	10	388	4.00	1,552.00	250
229	4	164	4.00	656.00	250
	6	258	4.00	1,032.00	300
230	6	258	4.00	1,032.00	250
231	8	343	4.00	1,372.00	200
232	6	258	4.00	1,032.00	250
233	4	164	4.00	656.00	200
235	4	164	4.00	656.00	200
	4	164	4.00	656.00	150
237	30	778	4.00	3,112.00	200
238	4	164	4.00	656.00	200
241	10	468	3.75	1,755.00	200
242	6	258	3.75	967.50	300
243	4	164	3.75	615.00	230
245	6	258	4.00	1,032.00	250
248	10	468	3.75	1,755.00	-
250	10	468	4.00	1,872.00	350
251	6	258	4.00	1,032.00	200
	6	258	4.00	1,032.00	300
252	6	258	4.00	1,032.00	250
	-	12,344	-	$43,172.00	10,880

From *House Report 414*, pp. 216–17.

APPENDIX D

"Proposals and Estimates for Culverts Nos. 206–209, 211, 215–217, 226–228, 232–233"
July 3, 1838

Culvert	Section	Contractor	Proposal	Engineers' Est.
206	283	James Browntil	$9,320.00	$8,805.00
207	286	James Browntil	4,535.00	4,250.00
208	291	James Browntil	9,520.00	9,140.00
209	296	John Riley	7,285.00	7,210.00
211	313	John Waldron	9,160.00	8,890.00
215	322	J. Lobdell	8,895.00	8,505.00
216	330	Robert McGregor	3,787.00	3,470.00
217	331	Robert McGregor	9,109.50	8,530.00
226	342	Patrick Crowley	4,462.50	4,275.00
227	342	Patrick Crowley	3,620.00	3,415.00
228	342	Patrick Crowley	8,486.50	7,663.00
232	347	William Lockwood	3,780.00	3,490.00
233	348	William Lockwood	4,090.00	3,840.00
			$86,050.50	$81,483.00

APPENDIX E

"List of Prices for Culverts Nos. 206–209, 211, 215–217, 226–228, 232–233"
July 3, 1838

Culverts 206–208:

Arch	-	12.00
Rubble	-	6.00
Paving	-	3.50
Timber	-	.34
Plank	-	34.50
Rock	-	1.00
Slate	-	.70
Earth	-	.33

Culvert 209:

Arch	-	12.50
Rubble	-	5.75
Paving	-	3.00
Timber	-	.31½
Plank	-	34.50
Rock	-	.95
Slate	-	.62½
Earth	-	.33

Culvert 211:

Arch	-	11.00
Rubble	-	6.00
Paving	-	3.00
Timber	-	.30
Plank	-	30.00
Rock	-	1.50
Slate	-	1.00
Gravel & Loose Slate	-	.75
Earth	-	.30

Culvert 215:

Arch	-	12.00
Rubble	-	6.00
Paving	-	3.00
Timber	-	.40
Plank	-	40.00
Rock	-	1.25
Slate	-	.50
Earth	-	.30

[Appendix E continued]

Culvert 216:

Arch	-	11.00
Rubble	-	6.00
Paving	-	3.00
Timber	-	.31
Plank	-	25.00
Rock	-	1.25
Slate	-	.40
Earth	-	.34

Culvert 217:

Arch	-	12.00
Rubble	-	6.00
Paving	-	3.00
Timber	-	.31
Plank	-	25.00
Rock	-	1.25
Slate	-	.40
Earth	-	.34

Culverts 226–228:

Arch	-	12.00
Rubble	-	6.25
Paving	-	3.00
Timber	-	.35
Plank	-	40.00
Rock	-	1.25
Slate	-	.62½
Earth	-	.30

Culverts 232–233:

Arch	-	12.00
Rubble	-	6.25
Paving	-	3.00
Timber	-	.35
Plank	-	40.00
Rock	-	1.25
Slate	-	.62½
Earth	-	.35

APPENDIX F

"Specifications for Road Culvert No. 211 on Section No. 313 of 12 Feet Span"
(ca. October 1838)

1st —The culvert will not be at right angles to the canal; its obliquity will be 1 in 5.

2nd —The level of the foundation of the abutments is assumed to be 24 feet below canal bottom.

3rd —The increase of puddling is for the assumed level (24-7+6+1-⅔+4=) 5-⅓ feet.

4th —The increase of thickness of each abutment will be 5 inches, & of the arch & ring 3 inches, on account of the increase of puddling, thus making (3 ft. 8 in. + 5 inches =) 4 ft., 1 inch for the top thickness of each abutment, and (20 inches + 3 in. =) 23 inches for the thickness of [the] arch.

5th —The two middle cross walls will rise to 3 feet above the top of the abutments, and at that level will be 3 feet thick, and from thence down, will batter on each side, two inches to the foot as mentioned in the printed specifications. The two ends or parapets will rise to 1 ft. 9 inches above the two extrados of the arch (the same as the printed specifications after deducting the 3 inches increase of arch thickness).

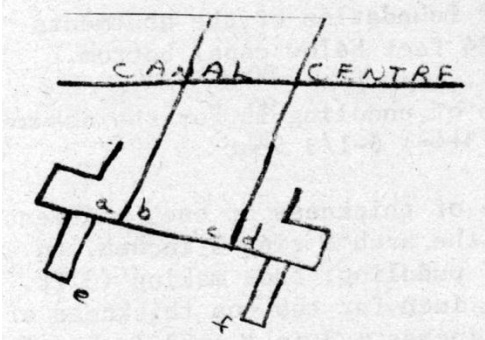
6th —The two middle cross walls will be at right angles to the culvert, and in the center of their length will be the usual distance from canal center—viz: 37 feet, measuring at right angles to & from the canal center to the middle of the cross wall. These two middle cross walls will extend back of each abutment (6 ft. 5 inches =) 5 feet 7 inches.

7th —The end walls of the culvert shall be at right angles to it, and shall also extend the same distance back of each abutment, as the middle cross walls, viz. 5 feet 7 inches.

8th —The length of the culvert. First add to the length of the specifications 3 times the increase of puddling —second, increase the length thus obtained in the ration of √25 : √which (as it is very near) we will put at, as 5 : 5.1 —and lastly add 3-70/100 feet in order to allow of the parapet being kept level. These several additions will make the length of the abutments on top (119 ft. 1 inch + 5-⅓ x 3 + 2-7/10 + 3-70/100 =) 141 feet 6 inches.

9th —At each end of the Culvert the wings will be, one at right angles to the canal, the other at right angle to the parapet, thus:

[Appendix F continued]



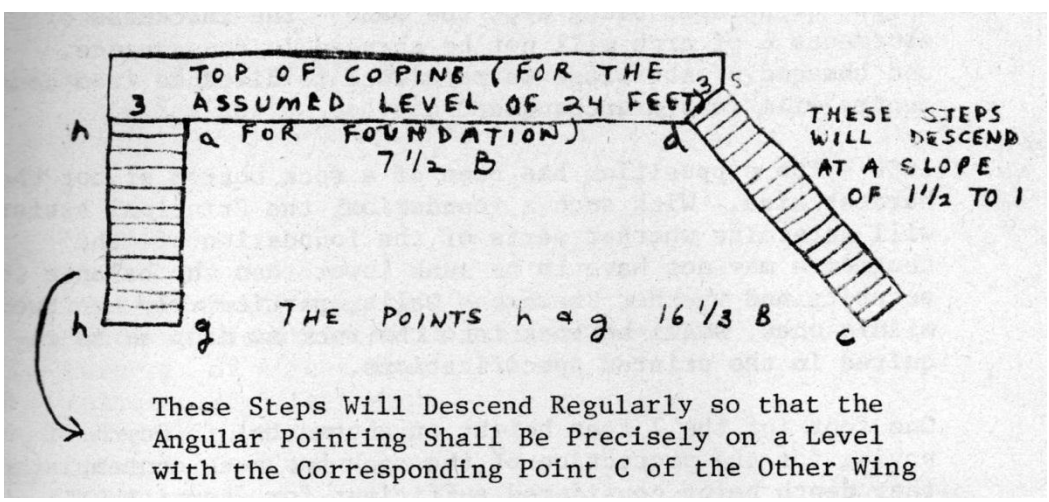
ae being at right angles to the parapet and df being at right angle to the canal. The points e & f will be equivalent from canal center, and the point f will be 13½ feet round.

10th —The points of intersection of the wings with the end walls, viz.—a & d, on the level of the top of the abutments, will be 2½ feet back from the face of said abutments.

11th —The wings will batter one inch to the foot in front of their ends; they shall be plumb and have offsets in the rear, thus; their thickness on the level of the bottom of the parapet coping shall be 4 feet, thence down plumb to the level of the intrados of the arch at the crown, here will be an offset of nine inches; thence plumb down to the level of the spring of the arch; here will be another offset of nine inches; and thence to the foundation, the wall will be plumb.

12th —Thus far the two end cross walls have been spoken of as raised their full height from end to end, instead of which they will be built of their full dimensions only to the top of the abutments, above this level they will be deficient by as much as the extension of the rear of the wings across the end or parapet walls will cut off.

13th —The coping of the parapets will be finished at their junction with the wings in the following manner—



[Appendix F continued]

as the two wings will be at precisely the same height at the points a & d, and also at the points g & h and as the wings are of unequal length, it will be necessary to make the steps of the longer wing (a, g) of greater tread compared with the rise, than the shorter wing (d, c). The steps will be of single stone as to width across the wall, which width will be about 3 feet or roughly scabbled heavy stone. The wall back of these steps need not be leveled off to the top of the steps, but to their bottom as is the case with lock coping.

The stepping down will commence directly at the lines na & ds, which lines are at right angles to the wings and up to which lines the parapet coping will be truly cut.

14th —It is supposed that the level of the foundation of the wings will be about the same as of the abutments. The masonry of the wings will be bound in with the culvert masonry.

15th —The level of the foundation of the abutments has been assumed to be 24 feet below canal bottom: but from this the Principal Assistant will vary if he sees fit either with a view to security or economy—it being understood with regard to the latter (viz. economy) that we do not desire abutments exceeding 7 feet in height, and that in preference to exceeding that height, the culvert should be lowered, if thereby the foundation is made much more secure.

If the level of the foundation should be raised from 24 feet, the only change of dimensions &c from what is given above, will be simply in increasing or diminishing the length of the culvert, to conform to an outer slope of 1½ to 1. The height of the parapet being kept the same—the thickness of abutments & of arch will not be changed in consequence, and the end of the wings in reference to distance from canal center will remain unchanged.

16th —The supposition has been of a rock bottom of not the hardest kind. With such a foundation, the Principal Assistant will determine whether parts of the foundation of the abutments may not have to be sunk lower than the balance for security and whether the cross walls, particularly the two middle ones, shall be sunk into the rock as deep as is required in the printed specifications.
One foot (of the 7 feet height of abutments) in depth of paving for the protection of the rock has been contemplated that depth being considered sufficient for security.
In place of paving it is left open to determine whether grouted macadamizing shall not be substituted.

17th —The inner offset required by arrangement with Davis will be provided for. It will be formed of heavy roughly scabbled stone well bound under the abutment.

18th —The plan of the roadway to and from the culvert—also the paving outside of the culvert is left open for the present.

19th —Except where changed in the preceding directions the printed specifications will be the guide in every other part of the work.

APPENDIX G

"Summary of the 27-½ Miles of Canal, Recently Opened for Navigation Between Dam No. 5 and Dam No. 6"

Culverts

8 —road culverts, some of 10, some of 12 feet span, with an elevation of 12 feet in the clear
5 —culverts of 4 feet span
18 —culverts of 6 feet span
4 —culverts of 8 feet span
1 —culvert of 40 feet span
36 TOTAL

5 wastes and waste-weirs connected with culverts and aqueducts.

August 5, 1839

APPENDIX H

"Summary of the 50 miles of Canal Between Dam No. 6 and Cumberland"

Culverts

5 —road culverts
24 —culverts of spans varying from 6 to 16 feet
29 TOTAL

12 wastes and waste-weirs connected with culverts and aqueducts.

On the "50 miles" -

1. 13 culverts are completed

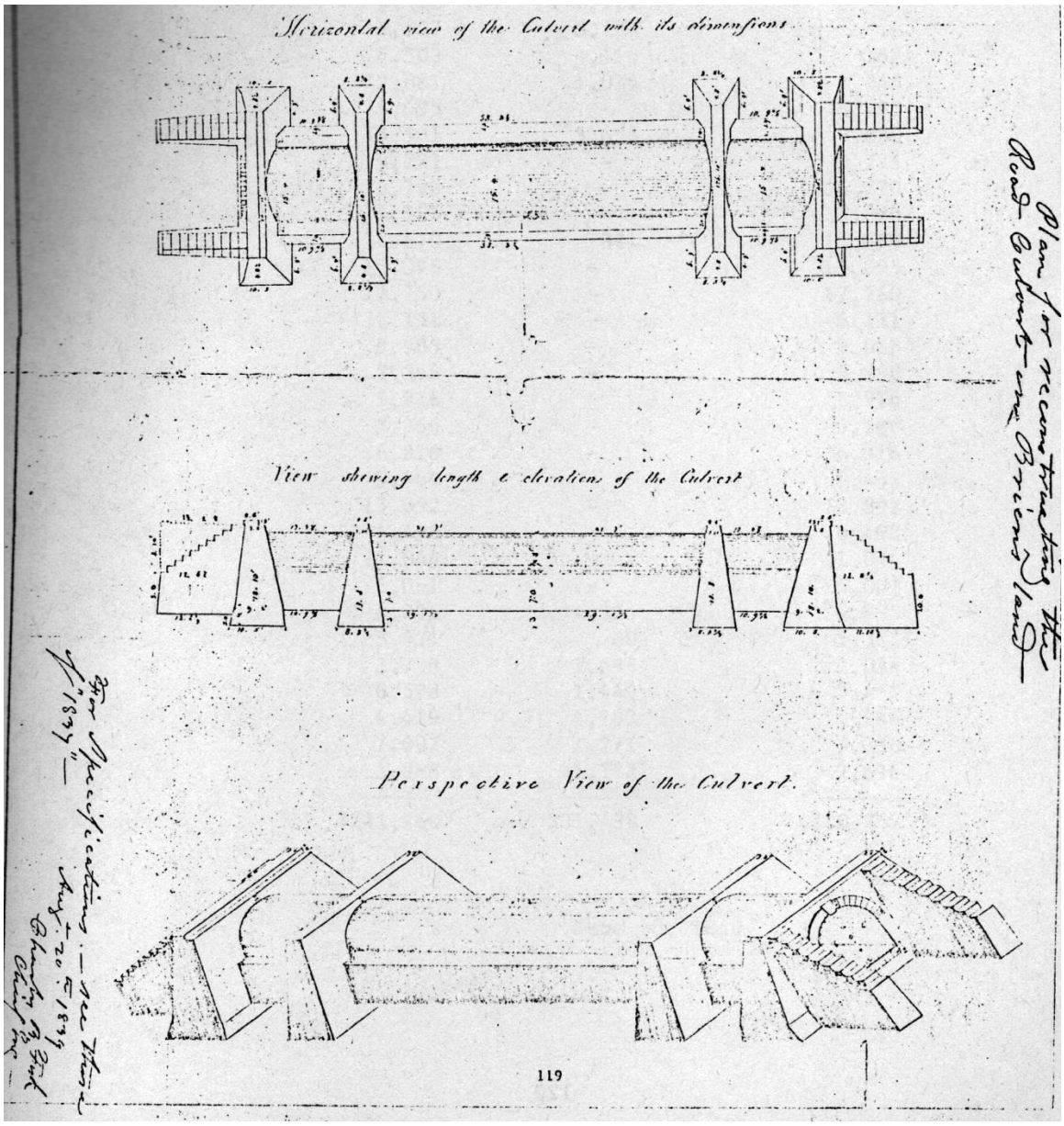
2. 9 culverts have been under contract, subsequently abandoned and not relet.

3. 7 culverts never placed under contract.

August 5, 1839

APPENDIX I

"Plan for reconstructing the Road Culvert on Brien's land"



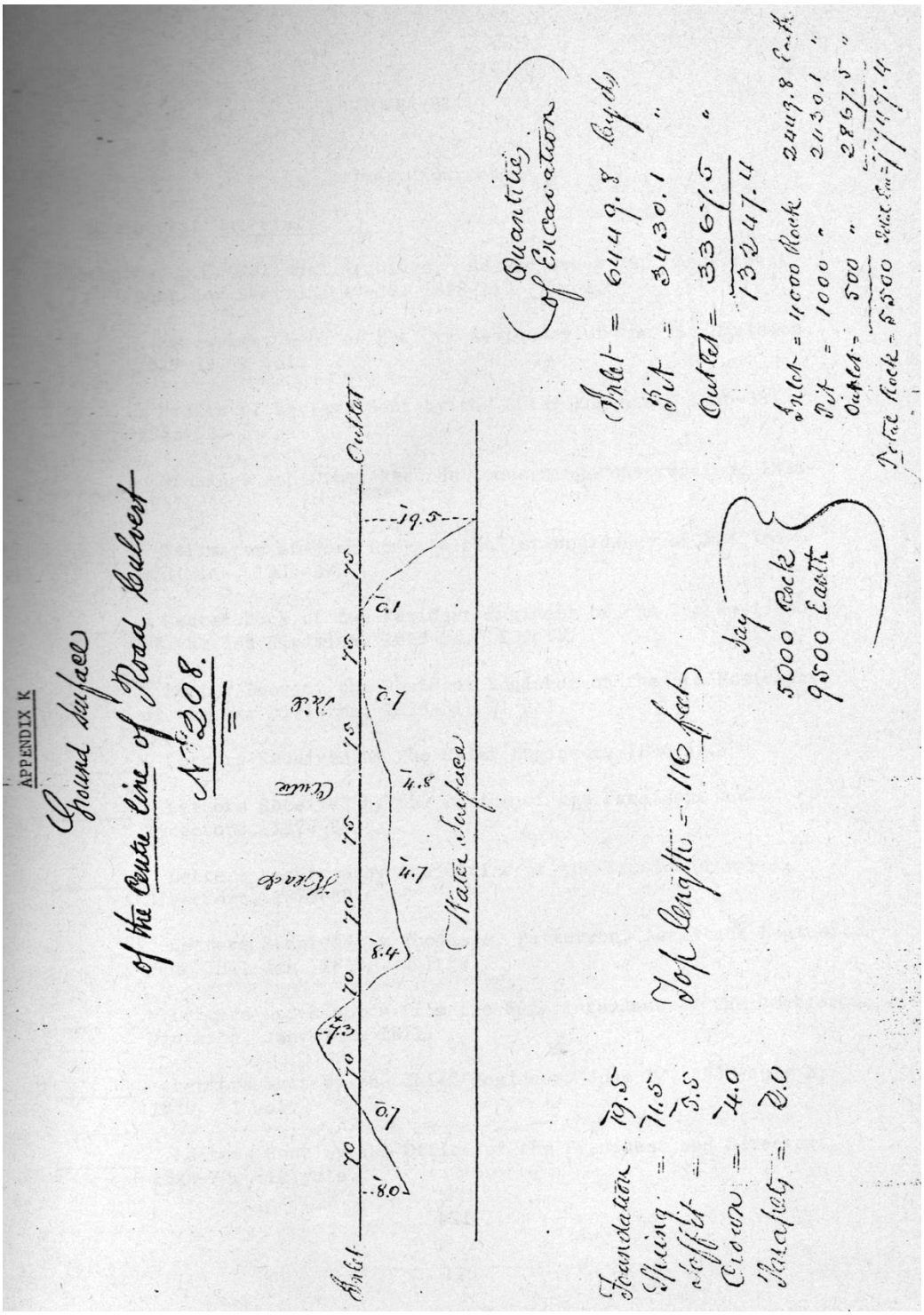
APPENDIX J

"50-Mile Section Estimates"
June 30, 1840

Culvert No.	Eng's Est. of Dec. 28, 1839	June 1, 1840 Work Done	To Be Done
199	$2,522	$2,522	-
200	3,107	3,107	-
201	4,303	4,115	$188
202	2,881	1,036	1,845
204	5,695	-	5,695
206	15,581	5,693	9,888
207	9,721	-	9,721
208	16,790	-	16,790
210	14,868	-	14,868
211	16,570	871	15,699
212	15,095	-	15,095
215	17,750	-	17,750
216	6,131	-	6,131
217	9,985	-	9,985
218	2,368	-	2,368
221	5,916	-	5,916
222	5,266	-	5,266
223	6,316	-	6,316
224	9,464	-	9,464
228	13,892	-	13,892
230	4,498	-	4,498
231	11,044	-	11,044
233	6,061	-	6,061
234	4,895	4,325	4,895
235	5,421	60	5,361
236	3,728	1,694	2,034
237	6,598	1,449	5,149
239	4,419	4,183	236
240	7,007	1,271	5,736
241	3,868	1,172	2,696
	$241,760	$31,498	$210,262

June 30, 1840

APPENDIX K
"Ground Surface of the Center line of Road Culvert No. 208,"
and Pit Quantities



ILLUSTRATIONS

Note: The original illustrations with the HSR were not located and other images of significant culverts have been substituted

Culvert 12 for Rock Run, at mile 8.93, is a 12 ft. span, skew arch.

Today Culvert 44, known as the Broad Run Trunk at mile 21.94, is neither culvert nor aqueduct. Originally this was constructed as a masonry culvert with double arches. On June 29th, 1846, it washed out in a local flood and was rebuilt as an aqueduct with a wooden trunk. The Broad Run Trunk aqueduct was generally not included in the list of aqueducts on the canal because it's trunk was not masonry as were the others. Photograph by Mike Mastrangelo.

Whites Ferry Culvert 51, mile 35.47 was unusual. “The culvert consisted of stone arches under the towpath and the berm banks, with a wooden culvert supported by vertical stone walls in between. The canal bed itself was also made of wood.” —*Towpath Guide*, by Thomas F. Hahn.

Whites Ferry Culvert 51

Photos by F. R. Holland, dated 10-20-1968, Towpath Side, Identified as culvert 95.

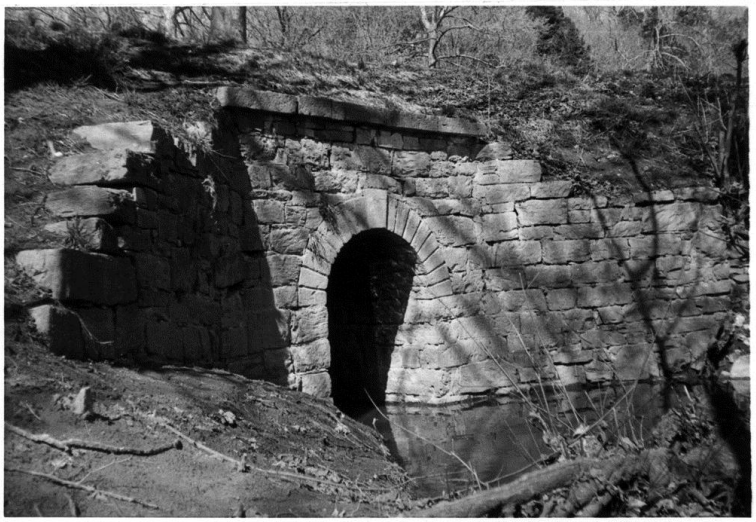
Note: Hahn's *Towpath Guide* refers to culvert 95 as a "lost culvert" located at 64.20 and Davies' *Geology and Engineering Structures* queries at his mi. 59.67 if it was the location of culvert 65; and at his mi. 64.14 states "site culvert no. 95 (no indication of culvert)". The List of Classified Structures locates culvert 95 at mile 64.68, which is the culvert Hahn and Davies identify as culvert 96.

Culvert 95 (?),
mile 64.68
Towpath side,
5-21-76.
(See note above)

Culvert 95 (?),
mile 64.68,
berm side.
5-21-76.
(See note above)

Culvert 103,
mile 70.38
Berm side
4-5-1976

Culvert 103,
mile 70.38
Towpath side
4-5-1976



Culvert 104,
Millers Saw Mill Basin,
Mile 70.68,
Towpath side
4-5-1976.

Culvert 104,
Millers Saw Mill Basin,
Mile 70.68,
Berm side,
4-5-1978

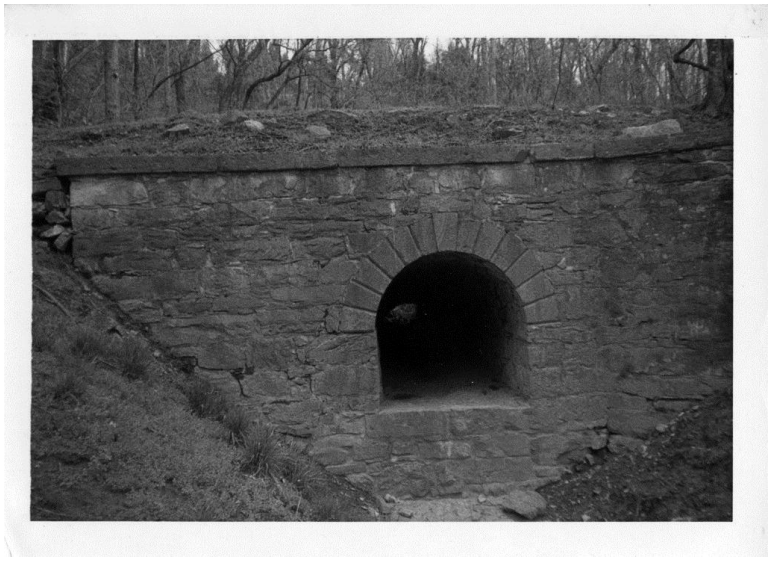
Culvert 105,
Mile 71.58,
Berm side,
4-5-1976

Culvert 105,
Mile 71.58,
Towpath side,
4-5-1976

Culvert 107,
Mile 73.46,
Berm side
4-5-1976.

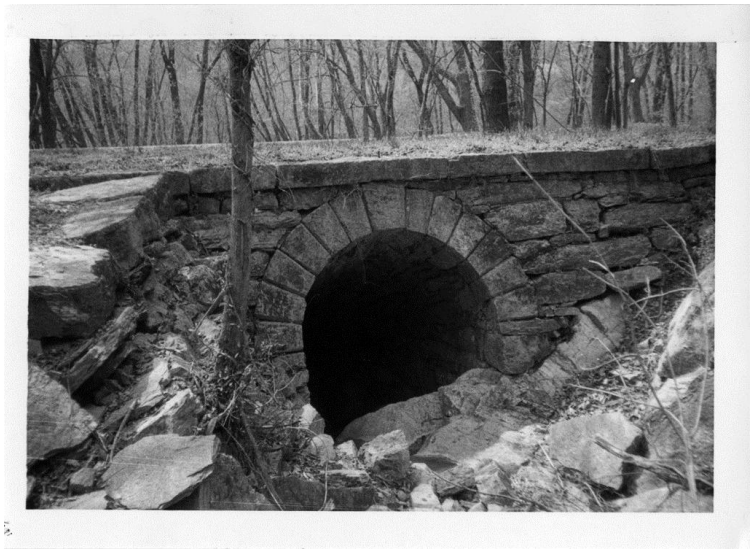
Culvert 107,
Mile 73.46,
Towpath side,
4-5-1976.

Culvert 108,
Mile 74.01,
Berm side,
4-6-1976.



Culvert 108,
Mile 74.01
Towpath side,
4-6-1976

Culvert 109,
Mile 74.28
Towpath side,
4-6-1976

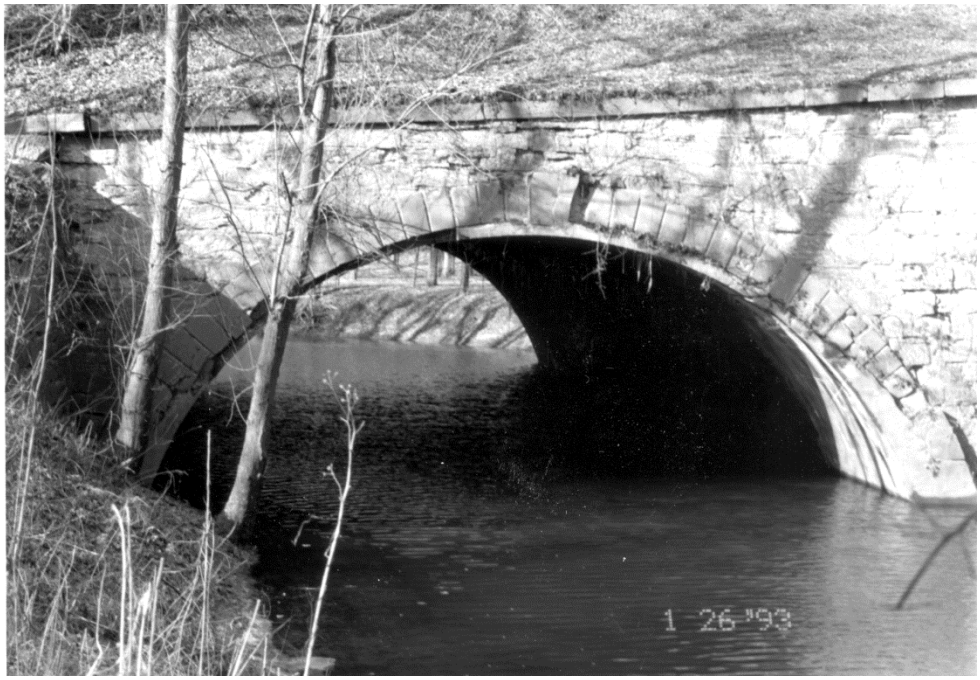


Culvert 109,
Mile 74.28
Berm side,
4-6-1976

Reconstruction of
Culvert 111,
Mile 76.78
at Snyders Landing,
4-6-1976

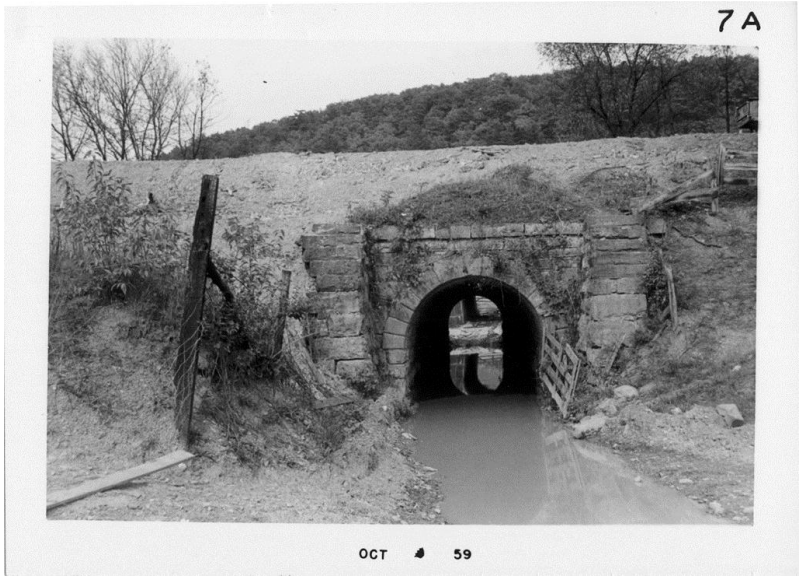
Culvert 124,
Mile 96.60
Towpath side,
4-16-1976

Culvert 139,
Mile 108.74
Prather's Neck Culvert
at Four Locks between
Locks 48 and 49.
River/Towpath side.
This culvert has a 12 foot
span and is used today for
access to the recreation area
and boat ramp on the river
side of the canal.



Culvert 182 at Mile 124.38 over the Little Tonoloway Creek has a 36 ft. span and has been referred to as “the culvert that wanted to be an aquaduct.” It is the largest culvert in the C&O Canal NHP. In older sources this stream was designated Tonoloway Creek and the larger one, spanned by Aqueduct 7, was designated Great Tonoloway.

Culvert 217 for Seven Springs Run at mile 166.1 in Oldtown, below Lock 69, had a brick arch from the spring line. This 20 ft. span was rebuilt with a concrete arch although the stone masonry faces and wingwalls were maintained.



Culvert 223,
Mile 170.84
Kellys Road culvert,
10 ft. span

BIBLIOGRAPHY

I. Primary Sources

1. Manuscript Materials

Washington, D.C. National Archives, Record group 79, Assessment Book for Sections 19–38, 1828–31. 1 vol.

_____, Assessment Book of the 5th Residency of the 1st Division, 1829–33. 1 vol.

_____, Drafts of Letters Sent by the Chief Engineer, 1836–38, 1846–52.

_____, Drawings and Other Records Concerning Construction, 1828–1937.

_____, Estimates of Work Done in the 1st Residency of the 3rd Division, 1836–37.

_____, Letter Book of the Resident Engineer of the 1st Residency of the 1st Division, 1828–31. 1 vol.

_____, Letter Book of the Resident Engineer of the 5th Residency of the 1st Division, 1828–31. 1 vol.

_____, Letters Received by the Chief Engineer, 1834–52.

_____, Letters Received by the Office of the President and Directors, 1828–89.

_____, Letters Received by the Office of the President and Directors, 1873–80.

_____, Letters Received by Thomas L. Patterson, Assistant Engineer, June 1841–Jan. 1842. 4 ltrs.

_____, Letters and Reports from the Superintendent of the Georgetown Division, Jan.–June 1871

_____, Letters Sent by the Chief Engineer, June 12, 1838–July 3, 1839. 1 vol.

_____, Letters Sent by the Office of the President and Directors, 1828–70. 12 vols.

_____, Letters Sent by the Office of the President and Directors, 1879–81. 1 vol.

_____, Letters Sent from the Engineer's Office at Cumberland, 1835–39. 1 vol.

_____, Printed Materials, 1816–1907.

_____, Proceedings of the President and Board of Directors, 1828–90. 13 vols.

_____, Proceedings of Stockholders, 1828–89. 5 Vols.

_____, Records of Ellwood Morris, Principal Assistant Engineer, 1838–40.

_____, Records of William A. Pratt, Assistant Engineer, July–Nov. 1838.

2. Printed Documents

Annual Reports, Chesapeake and Ohio Canal Company, 1829–89.

Journal of the Internal Improvement Convention. Baltimore, 1835

Laws and Resolutions Relating to the Chesapeake and Ohio Canal, Washington, 1855.

Report of the General Committee of the Stockholders of the Chesapeake and Ohio Canal Company. Washington, 1839.

Report of W. R. Hutton, Chief Engineer, As to Condition of Chesapeake and Ohio Canal, With Estimate of Cost of Extraordinary Repairs Required During the Current Year, August 14th, 1872. Annapolis, 1872.

U. S. Congress, House. *Message of the President of the United States, Transmitting a Report from the Secretary of War with that of the Board of Engineers for Internal Improvement, on the Chesapeake and Ohio Canal*. 19th Congress, 2nd Session, 1826, H. Doc. 10.

_____, *Chesapeake and Ohio Report*. 20th Congress, 1st Session, 1828, H. Doc. 141.

_____, *Letter from the Secretary of War, Transmitting Estimates of the Cost of Making a Canal from Cumberland to Georgetown*. 20th Congress, 1st Session, 1828, H. Doc. 192.

_____, Committee on Roads and Canals. *Chesapeake and Ohio Canal: Report to Accompany H. R. 94*. 23rd Congress, 1st Session, 1834, H. Doc. 414.

_____, Senate. *Documents Relating to the Chesapeake and Ohio Canal*. 26th Congress, 1st Session, 1840, S. Doc. 610.

II. Secondary Sources

1. Books

Davies, William E. *The Geology and Engineering Structures of the Chesapeake and Ohio Canal: An Engineering Geologist's Descriptions and Drawing.* This work was a draft last worked on in 1989 and published by the C&O Canal Association

posthumously in 1999 in a limited edition composed of scans of the original pages with typed texts, and handwritten notes, corrections, and drawings.

Hahn, Thomas F., *Towpath Guide to the C & O Canal*. 4 vols. Glen Echo, Maryland, 1971.

Sanderlin, Walter S., *The Great National Project*. Baltimore, 1946.
_____, *A Study of the History of the Potomac River Valley*. Washington, 1950.

2. Periodicals

Bearss, Edwin C. “1862 Brings Hard Times to the Chesapeake and Ohio Canal.” *West Virginia History* 30 (January 1969): pp. 436–62

3. Technical Studies

Miele, John R. “Historic Structure Report, Culverts Between Lock No. 40 and Dam No. 4.” MS

_____, “The Chesapeake and Ohio Canal: A Physical History.” NPS MS 1968.

4. Newspapers

National Intelligencer