1870.

NEW SOUTH WALES.

FLOODS IN THE HUNTER.

PROGRESS REPORT

OF

COMMISSION APPOINTED TO ENQUIRE INTO AND REPORT RESPECTING.

Presented to both Houses of Parliament, by Command.
Commission.

VICTORIA, by the Grace of God, of the United Kingdom of Great Britain and Ireland, Queen, Defender of the Faith, and so forth,—

To our trusty and well-beloved—

EDWARD ORPEN MORIARTY, Esquire, Engineer-in-Chief for Harbours and River Navigation;
JOHN WHITTON, Esquire, Engineer-in-Chief for Railways;
PHILIP FRANCIS ADAMS, Esquire, Surveyor General;
WILLIAM CHRISTOPHER BENNETT, Esquire, Commissioner and Engineer for Roads; and
MORRIS BIRKBECK TELL, Esquire, Professor of Mathematics, Sydney University;—

Greeting:

WHEREAS it has been represented to us by a numerously signed petition from the inhabitants of the Hunter River District of our Colony of New South Wales, that great damage is caused by Floods in that District: Now know ye that we, reposing great trust and confidence in your zeal, industry, discretion, and integrity, do by these presents authorize and appoint you, or any three or more of you, as hereinafter mentioned, to make a diligent and full enquiry into the premises, and to report as to the means which in your opinion should be adopted with a view to remedying or mitigating the evils complained of: And we do by these presents give and grant to you, or any three or more of you, at any meeting or meetings to which all of you shall have been duly summoned, full power and authority to call before you all such persons as you shall judge necessary, by whom you may be better informed of the truth in the premises, and to require the production of all such charts, maps, plans, drawings, tracings, books, papers, writings, and all other documents as you may deem expedient; and to visit and inspect the same at the offices or places where the same or any of them may be deposited, and to enquire of the premises by all other lawful ways and means: And our further will and pleasure is that you, or any three or more of you, after due examination of the premises, do and shall within the space of three months* after the date of this our Commission, or sooner, if the same can reasonably be certified to us in the office of our Colonial Secretary, under your or any three of your hands and seals, certify what you shall find touching the premises: And this Commission shall continue in full force, although the proceedings thereunder shall not be continued by adjournment from time to time; and you or any three or more of you as aforesaid may from time to time, if you shall see fit, without waiting for your full and complete report, certify your several proceedings into our said office, as the same shall be respectively perfected: And we hereby command all Government Officers, and other persons whomsoever, within our said Colony, that they be assistant to you, and each of you, in the execution of these presents: And we appoint you the said Edward Orpen Moriarty to be President of this Commission, and do give you power, at your discretion, to procure such clerical or other assistance as may be absolutely necessary for enabling you duly to execute this Commission.

In testimony whereof we have caused these our Letters to be made Patent, and the Seal of our said Colony to be hereunto affixed.

Witness our right trusty and well-beloved Cousin and Councillor, SOMERSET RICHOST, EARL OF BELMORE, our Governor and Commander-in-Chief of our Colony of New South Wales, at Government House, Sydney, this thirtieth day of April, in the thirty-second year of our reign, and in the year of our Lord one thousand eight hundred and sixty-nine.

BELMORE

By His Excellency's Command,

JOHN ROBERTSON.

Entered on record in Register of Patents, No. 9, pages 415 to 418, this thirtieth day of April, 1869.

HENRY HALLORAN,
Under Secretary.
Hunter River Floods Commission,
Public Works Office,
Sydney, 24 August, 1870.

Sir,
I have the honor, by direction of the Hunter River Flood Commission, to forward herewith, for the consideration of His Excellency the Governor, a Progress Report of the Commission, dealing with the more urgent part of the question, namely, the protection of the Bank of the River Hunter at West Maitland.

I have, &c.,
GEORGE FAITHFULL,
Secretary.
FLOODS IN THE HUNTER.

PROGRESS REPORT.

To the Right Honorable the Earl of Belmore, Governor and Commander-in-Chief of the Colony of New South Wales, &c., &c.

MAY IT PLEASE YOUR EXCELLENCY,—

We, the Commissioners appointed to inquire into and report upon the best means of mitigating or preventing the evils occasioned by Floods in the District of the Hunter River, have the honor to submit the following Progress Report, which, at the request of the Chairman, has been drawn up by Professor Pell.

Finding that without further time it will be impossible to report finally upon the whole subject submitted to us for consideration, we deem it desirable at once to call your attention to the dangerous state of certain parts of the river banks at the town of West Maitland. The recent floods have not only inundated a large portion of the town, but have carried away a number of houses, together with the ground upon which they stood; and others, although above flood-level, are in great danger on account of the close proximity of the river, which has encroached almost to their doors. In some cases there is scarcely any space left between the High-street and the river except the ground upon which the houses stand.

It is probable that if a serious flood should occur before some efficient means have been adopted for the protection of the banks, much valuable property would be destroyed, and that the whole town would be placed in greater danger than on any former occasion. The inhabitants seem much alarmed, and being at the same time determined to do something for the protection of their town, they are waiting anxiously for any recommendations which we may have to offer.

The late repeated floods have protracted our inquiry, by entailing upon us the necessity of taking further evidence, of re-examining the ground, and of collating and considering the great mass of additional information which we have been enabled to collect. The difficulty and complexity of the subject upon which we are engaged, as well as the magnitude of the interests involved, render us unwilling to bring our inquiry to a hurried conclusion.

We have determined therefore, with your Excellency's permission, not to report finally until we have given to every point the fullest consideration, and until we are in a position to lay the facts before you in a clear and systematic form. With respect to the town of West Maitland, however, we have unanimously arrived at one definite conclusion. The inhabitants must look to local works alone, and not to any improvement, or alteration in the channel of the river, or diversion of its course, for their protection. Whatever conclusions we may finally arrive at, and whatever works we may recommend or not recommend to be undertaken, it would be obvious folly to leave the town at the mercy of the river, pending the discussions and delays which will inevitably follow, whatever be the nature of the decision at which we may arrive.

Any improvements of the channel of the river of so extensive a character as would materially relieve the town of West Maitland, and justify any reduction in the magnitude and strength of the local works which we are prepared to recommend for its protection, would involve so large an expenditure, and would bring into collision so many conflicting interests and so many diverse opinions, that it may be doubted whether even if proposed they would ever be carried out. And if no delay should occur through want of zeal, or of unanimity or of money, yet a considerable time would necessarily elapse before the works could be completed; and meanwhile the town would be in constant danger, and might not improbably be severely injured.

In an Appendix will be found an account of the works which we recommend for the protection of the banks, and for excluding the flood-waters from the town. There will be found also a plan of the town, showing the line along which in our opinion the levee should be carried. We profess however to indicate only in a general manner the character of the works proposed.
The protection of the banks.

The experience of the last few months has shown the necessity of something to stop the encroachments of the river, which threaten not only injury but destruction to a considerable part of the town.

The plan described in the Appendix of lining the banks with rubble stone thrown in and allowed to find its own slope, seems the best, indeed the only one which could be adopted with any reasonable prospect of success. The banks and bed of the river consist of a light alluvium, extending to a great depth, as was found in sinking the cylinders for the Belmore Bridge. Anything of the nature of solid masonry is therefore quite out of the question, on account of the practical impossibility of obtaining a secure foundation, without which a solid wall, although far more expensive, would certainly not be more effective than a mass of loose stone.

The ordinary effect of a river in undermining and washing away the banks on the concave side of every bend is greatly increased at West Maitland by layers of sand of varying thickness underlying the whole town, at a level somewhat above that of ordinary high-tide. After a flood, especially so long as the back-water stands at a higher level than the river, water percolates through this stratum into the river, keeping the banks moist and soft, and carrying with it sand and other matter. The banks are by this action gradually undermined, and kept in a tottering condition. The whole substratum seems reduced to a pulpy state, ready to be squeezed out by the superincumbent weight. We do not expect that this action will be prevented by the works which we propose. The water will continue to find its way through, and to carry some of the sand with it into the river; and consequently we expect that occasionally some parts of the bank will subside after heavy floods. We do not however anticipate any danger from this cause, if the levee be kept well back from the river, and no houses stand immediately on the bank. The buildings which are now in that position will require some special works to render them permanently secure.

The stone casing will, we believe, prevent any further encroachment; but if, as we expect, the banks here and there, and from time to time, subside, the loss must be made good by fresh supplies of stone. It is probable however that after some time the whole bank will assume a position of permanent equilibrium, and require no further maintenance.

The embankments.

It will be seen by a reference to the plan which will accompany this Report that the proposed levee includes only the more densely populated parts of the municipality. We fully recognize the many advantages of Mr. Moriarty's more extensive scheme as explained in his Report to the Minister for Public Works, dated 9th July, 1868; but the saving of expense, and what is perhaps still more important, that of time, involved in the lesser scheme, are alone sufficient to justify its adoption. There are other circumstances also which have influenced us in arriving at this decision. We did not, until the occurrence of the last great flood, fully realize the magnitude of the torrent which pours into the back country by way of the Long Bridge. A portion of the water thus introduced spreads in all directions over the already submerged lands, but a considerable part makes its way by a nearly direct course to the point between East and West Maitland, which is the outlet on such occasions. An embankment extending around the whole of Louth Park would present a very serious obstacle to the progress and distribution of this water. Even without any artificial obstruction, the level of the water during high flood is considerably higher near the Long Bridge than at the outlet, and would no doubt be raised still more by any impediment to the escape of the water. How far this effect would be produced it is impossible to say. A little addition to the height and strength of the embankments upon that side might perhaps be found to be a sufficient provision against the danger, but we cannot recommend that such an experiment should be tried. If at any future time, under altered circumstances, it should appear desirable to enclose a larger area by levees, the inner line which we advise would not lose its value, for it would afford a second defence to the town itself in case of accident to the outer embankments.

If from the experience of a very extended term of years it were possible to assign a limit to the height to which future floods may rise at Maitland, there would be no difficulty in determining the height to which the levees should be carried. But what has happened during the last thirteen years in the valley of the Hunter, and in many other somewhat similarly situated districts in various parts of the Colony, shows that it is impossible to form any definite and certain opinion as to future flood-levels, and that we must be content to deal with probabilities only. Judging by probabilities, we recommend that the levee on the river side should be made 2 feet above the highest flood-level of this year. On the land side they should be 5 feet above the height of the back-water of 1867, and be securely faced with stone to provide against the action of the waves, which sometimes rise to a considerable height. There seems to us little probability that any future flood will rise above these limits. If the addition of a few feet would turn this probability into a certainty, it would no doubt be desirable to make it; but unfortunately

Unfortunately
unfortunately this is a case in which certainty is not attainable. It will be seen by reference to the plan accompanying this Report that the proposed line of embankment does not extend entirely around the town, the natural surface of the ground being itself for a considerable distance more than 2 feet above flood-level. So slight however is the elevation at any point that the addition of a few feet to the height of the levee would involve the necessity of nearly completing the circuit. This would proportionally increase the expense, without adding we think to the safety of the town.

During the height of a great flood a large quantity of water breaks over the right bank of the river at a point near Oakhampton, generally known as Graham's, about 2½ miles above Maitland, and some also escapes from the river on the same side near Hall's Creek. The whole of this, forming of itself a considerable river, flows by way of the Long Bridge into the valley of Wallis' Creek. From observations made by Mr. Moriarty and Mr. Adams during the late great flood, we estimate the volume of this discharge at about 25,000 cubic feet per second. Partial attempts have been made to prevent this overflow, and projects for effecting the same object are, we believe, still entertained. We think it necessary therefore to point out how dangerous it would be to the town of West Maitland to confine this large quantity of water to the channel of the river. If prevented from escaping by the back of the town, it must come down by the front, with the obvious effect of raising the flood-level there. The circumstances of the case are too complex, and the attainable data insufficient, to admit of any exact calculation as to the extent to which the flood-level would be thus raised; but the following data afford the means of forming something approaching to a definite opinion on the subject:—At the height of the flood of 1861 the discharge of the channel at the West Maitland Bridge was about 83,000 cubic feet per second. At the same place, in the great flood of 1857, the discharge was 105,000 feet, the difference being 22,000 feet per second, while the difference in the height of the two floods was about 4 feet. There can be no doubt then that an additional 25,000 feet of water per second forced back into the channel above Maitland would produce a very serious effect. It is not probable that the additional rise would be so much as 4 feet, because some of this water would escape over the opposite bank; but it would be quite enough to destroy the security which the works that we recommend are likely to afford.

We feel so strong a conviction of the importance of these considerations, that our recommendation respecting the town embankments must be taken as conditional upon there being nothing done to diminish the relief afforded to the river by the escape of the water from Graham's downwards; nothing, at all events, until a corresponding improvement has been made in the main channel, rendering it capable of carrying the additional quantity.

We consider it very desirable that the whole of the High-street, including the Long Bridge, should be raised where necessary to the same height as the levee on the river side. Such a work would be a great convenience in case of accident to the levee, and might be the means of mitigating the disastrous effects of a flood of unusual magnitude, if any such should ever occur.

Early floods.

We must now consider whether there is any reasonable probability of the recurrence of those terrible floods which in the early days are supposed to have swept over the whole of the present site of West Maitland. On this subject we have the evidence of Messrs. John Eckford, John Brown, and Alexander M'Dougall, and some information furnished by Mr. George Wyndham and Rev. Alfred Glennie.

Mr. John Eckford appears to be veritably the "oldest inhabitant" of the Maitland District. He settled there in 1818, and, as far as we can learn, is the only living witness of the great flood of 1820. His recollections seem clear, and his evidence to be relied upon. He showed us three points at some distance apart, in the neighbourhood of Maitland, to which the water rose on that occasion. Upon connecting them by levels we find that they agree with each other, being about 6 feet above the highest flood-level of the same place, in the great flood of 1857, the discharge was 105,000 feet, the difference being 22,000 feet per second, while the difference in the height of the two floods was about 4 feet. There can be no doubt then that an additional 25,000 feet of water per second forced back into the channel above Maitland would produce a very serious effect. It is not probable that the additional rise would be so much as 4 feet, because some of this water would escape over the opposite bank; but it would be quite enough to destroy the security which the works that we recommend are likely to afford.

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Mr. John Brown of Singleton settled in that district in 1823 or 1824. At that time he saw drift left by some flood in the oak-trees on the banks, about 10 or 12 feet above the flood-level of 1857. He witnessed the flood of 1828, but describes it as inferior in magnitude even to those which have occurred more recently. "It broke over the banks," he says, "but not anything to speak of."

Many years ago Mr. Alexander M'Dougall observed near West Maitland traces of some early flood—probably that of 1820—which he believes must have been 4 feet higher than those of 1857 and 1867.

From Rev. Alfred Glennie we learn that his brother, Mr. James Glennie, was a witness of the flood of 1820, at Dulwich, about 8 miles above Singleton, and that its height at that place exceeded that of any subsequent flood. He saw also traces of some former and still higher flood.
In 1823 Mr. Wyndham saw drift in a tree at the ford at Dalwood, which he attributes to the flood of 1826, indicating a height 7 feet greater than the maximum of this year.

The evidence respecting the flood of 1826 is so conflicting that it would be idle to speculate upon it. There seems little doubt however that a great flood did occur in 1820, and that the water rose at Maitland to a height of 40 or 41 feet, measured by the gauge now in use, or about 6 or 7 feet higher than upon any recent occasion.

The important question is, whether anything of the same kind is likely to happen again. There has been nothing to diminish the rate at which the flood-waters come down from the high lands, but on the contrary, it is generally admitted that since the occupation of the country the surface of the land has become more hardened, and that the rain-waters flow off more readily.

The area of the watershed of the Hunter River above West Maitland is 7,000 square miles. One inch of rain in twenty-four hours over the whole of this area corresponds to the rate of 190,000 cubic feet per second. The maximum rate at Singleton Bridge during the flood of August, 1857, was about 131,000 cubic feet per second. This was increased by contributions from tributaries lower down, so that we may roughly conclude that a continuous and uniform rainfall of ½ in. per day over the whole watershed would keep the river in a state of equally continuous high flood.

The total rainfall during the month of March last was about 17 inches, as shown by observations at the Sydney Observatory, at Dalwood by Mr. Wyndham, and near Singleton by Mr. Dangar. The returns are 18.70, 17.52, and 10.45 inches respectively. During nearly the whole of that month the Hunter was bank high. If the rainfall had been distributed uniformly over the whole month, the daily rate would have been about ¼ in., and no serious flood would have occurred. But according to the returns kindly furnished to us by the gentlemen above named, it appears that the average daily rate from the 14th to the 18th was about 1 in., and this caused the great flood which culminated at Maitland on the 20th. We have given these particulars for the purpose of showing how a few inches of rain falling in a few days may produce a great flood, whilst long continued heavy rain may not; and how greatly the difficulty of forming an opinion of what may happen in future is thus increased.

We find that with a rise at Singleton of 12 feet above the flood-level of 1857—the height to which the flood of 1826 is supposed by Mr. Brown to have attained—the present channel would discharge about 152,000 cubic feet of water per second, and the total discharge, including what would not pass under the bridge, would probably not exceed 250,000 feet per second. Accepting however all the evidence that we have respecting that flood, it is by no means certain, indeed very improbable, that so large a quantity of water came down on that occasion. The condition of the channel was probably very different then from what it is at present. Mr. W. C. Leslie, who has resided at Singleton since 1841, and who appears to have been a close observer of everything relating to the river, and who is a most intelligent and trustworthy witness, is of opinion that within his own experience the channel has doubled in width, and been cleared of many obstacles to the free discharge of the flood-waters. From Mr. Alexander Munro also we have some valuable evidence as to the enlargement of the channel near Singleton within his experience, which extends back to the year 1830. It is quite possible then that the great rise at Singleton in 1820 may have been caused by a quantity of water which would now flow harmlessly within the banks. Some of the apparent contradictions in the accounts which we have of the effects of the flood of 1826 at different parts of the river might perhaps be explained, if we had any exact information as to the changes which have since taken place in the magnitude and condition of the channel.

Mr. Moriarty, in his Report to the Minister for Works, has explained so clearly and satisfactorily that the great height of the flood of 1820 at Maitland is attributable probably to the obstacles presented to the escape of the water by the condition of the banks of the river and of the low lands at that time, rather than to the quantity of water which came down, that we have little more if anything to say on the subject. The banks of the river and portions of the adjacent flats were then covered with a dense and tangled scrub, greatly impeding the progress and distribution of the flood-waters. Now that the land is cleared the flood-waters when at their height escape with comparatively little impediment from the neighbourhood of Maitland, the point at which the river in such cases empties itself as it were into a basin. A rise of 6 feet above the flood-level of this year would leave scarcely a dry spot between Dagworth and Dunmore, or from Bolwarra House to Morpeth. The general slope of the surface of the land from Maitland to Hinton being considerable, the discharging capacity of the river when swollen to such dimensions, would be enormous. Such an elevation then, could scarcely be produced with the present condition of the surface, except by a supply of water from above twice or perhaps three times greater than what came down during any recent flood.
Upon a review of all the evidence and of all the circumstances, we are inclined to think that the water came down to Maitland at greater rate during the height of the flood in April last than it had ever done since the settlement of the country. At the same time we know that a steady rainfall of 2 inches a day for five or six days over the whole watershed of the Hunter, or a proportionally greater fall over a part only of that area, would almost double the quantity. It cannot be said that such a rainfall is so much in excess of what is known to have occurred, as to be entirely out of the range of ordinary probabilities; nor can it be said certainly that such a rainfall might not raise the water at Maitland to the flood-level of 1820. We feel bound therefore to point out what would probably be the effect of such a flood upon the town in its present state.

With an addition of 6 feet to the flood-level of this year the waters would cover very nearly the whole site of West Maitland.

With such an increased elevation, the quantity which escapes from the river at Graham's would be enormously increased, and instead of passing round through the back country would break into the town, and being joined there by the main body of the river, would sweep the High-street from one end to the other, and probably leave the town in ruins. We cannot recommend that any attempt should be made to protect the town against such a flood. It would be a dangerous experiment to put an embankment almost directly in the path of the great river which would under such circumstances roll down from Graham's. The town if embanked to a sufficient height would be completely isolated from any high land, and be surrounded on all sides by a raging torrent. If the swollen river, refusing to submit to the impediment thus placed in its path, should break its way through the levées, it would find the inhabitants beyond the reach of succour from without, and with their lives depending on the stability of their houses.

To carry the embankments to any higher level than what we recommend would increase the danger, by tempting the inhabitants to remain in the town after the position had become untenable. When the river shall have risen 2 feet above the level of the great flood of this year, without any symptoms of an immediate decline, it will be time for the inhabitants to seek safety upon higher ground. And although we are of opinion that it is improbable that such an occasion will ever arise, no reasonable man acquainted with the facts can doubt the possibility of such an occurrence.

We feel acutely the painful nature of the subject upon which we are dwelling, and the possible tendency of our remarks to increase the anxiety of those most concerned; but the duty of speaking plainly is imposed upon us, and we could not undertake the responsibility of recommending that the town of West Maitland should be embanked, without at the same time drawing your Excellency's attention to the fact that floods are said to have occurred, and may possibly occur again, from the effects of which neither the works proposed in this Report, nor any others which we are able to recommend, would afford any protection.

We have the honor to be,
Your Excellency's
Most obedient Servants,

E. O. MORIARTY.
JOHN WHITTON.
M. B. PELL.
WILLIAM C. BENNETT.
P. F. ADAMS.
APPENDIX.

The works recommended for the protection of the right bank of the Hunter River at West Maitland are as follows:

From near the Falls, a little above the Belmore Bridge, to a point as far down as may be deemed advisable—say to Victoria-street—and thence round the concave side of the bank opposite Potts’ Point (in all, for a distance of about 150 chains), the projections and irregularities of the present exposed surface of the river bank should be trimmed down, and the whole brought to a gentle curve, with as uniform a slope or cross section as is attainable without incurring undue expense. The material taken off the prominences may be deposited in filling up the depressions, where it should be well rammed or puddled in regular layers.

The face of the alluvial bank should then be covered with a protecting coat of stone tipped in from the top, and left to assume such slopes as the stone will ultimately rest at after having been subjected to the action of the floods. Any slips or subsidences which may take place from time to time (and their occurrence must be anticipated) should be made up by the deposit of fresh stone.

The stones generally should be in as large blocks as can be conveniently handled, but the whole produce of the quarry, large and small, may be used.

The protecting coat of stone will probably require to be about 4 yards in thickness, on an average, varying however according as it is exposed in a greater or less degree to the force of the current.

The external face of the stone-work should present a fair and easy curve to the river, as free as possible from projections and irregularities which might be likely to affect the currents.

Stone of suitable quality, and in sufficient quantity for the work, may be obtained from Campbell’s Hill, where the rock crops out on the surface at a place a little to the north of the Hospital.

A sufficient extent of ground for the quarry, together with a strip of land for the railway which it will be necessary to construct from thence to the river bank at the Falls, should be at once secured, so that the stone may be run down in trucks to where it is to be tipped over the bank, at the least possible cost.

From the Falls, the line of rails will have to be continued under the land bay of the Belmore Bridge, and thence behind the houses bordering High-street, on along the top of the natural bank, to admit of the stone being discharged over the slope from side and end tip wagons.

The stone-work cannot be expected to attain anything like stability at first; it must be left for the action of the river to adjust the slope of the mass to such angle as it will ultimately stand at. Care must therefore be taken to provide fresh material whenever it shall be required, and to this end it will be necessary to keep the railway and plant in good order for some years to come.

The cost of this work may be estimated at £45,000.

The Levee.

The general course of the levee is shown on the plan which will accompany this Report. It should commence near High-street, about 6 chains to the westward of Charles-street, and be continued thence in a line generally parallel with the right bank of the river round Horse-shoe Bend, past the High-street embankment, along High-street to where the Great Northern Railway crosses the street itself forming the levee for this distance; thence returning in a course parallel to the railway as far as the intersection of East Melbourne-street; along that street to its junction with Melbourne-street, and along the latter street to Nicholson’s Racecourse, curving in across the racecourse, and terminating on the ridge at the railway cutting, about 8 chains to the westward of the Elgin-street Station. It should be kept well back from the river’s edge, so as to be out of risk of injury from slips of the bank.

The levee, the core or centre part of which should consist of a wall of well-puddled strong tenacious clay, should be constructed throughout of the best materials procurable. It should be fully 12 feet in width on the top; the slope on outer side should be not less than to 2 to 1, and on the inner side 1½ to 1.

Where exposed to the waves of the back-water the levee should be faced with heavy stone pitching, not less than 18 inches in thickness, bedded in a layer of clay puddle, fully 3 feet in depth. On Melbourne and East Melbourne-street, where the levee would probably be formed by raising the embankment of the street, the stone facing might be laid in the form of a dwarf wall, well backed with clay puddle.

The levee may be estimated to cost about £12,500.

The embankment at the Falls should be enlarged and strengthened, so as to afford commensurate protection to the upper part of the town.