(1) Number of pages 380

(2) Date of repair 6.87

(3) Initials of the Reference bvg

TAMIL NADU ARCHIVES

GOVERNMENT OF TAMIL NADU

PW DEPARTMENT

G.O. No. 841-842 W
B.P. No.

Press
Mis.

Dated 14.3.1883

198

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GOVERNMENT OF MADRAS.

PUBLIC WORKS DEPARTMENT.

Buildings and Roads
Civil Works.

No. 1901.

Read—the following report—

Report by the Executive Engineer, Buckingham Canal Division.

No. 1474-S.

Note by the Chief Secretary, Public Works Department.

The memory, nevertheless, of the historical position, one of the work have been dealt with at such length in the accompanying Report that little more than a brief record of the points will suffice in submitting the project for the consideration of Government.

2. The work now known as the Buckingham Canal, extending along the coast 96 miles south and 126 miles north of Madras (where it unites with the Kistna and Godavari Canal System), had its commencement as early as 1801.

3. Mr. Boscawen, with Mr. Paul Cochrane as security, obtained the first concession for excavating 11 miles of channel (which was then known as Lord Clive's Canal) between Madras and Kaverypak, but Mr. Cochrane, obtaining subsequently entire control, finished this portion in 1806, and afterwards extended the communication to Pulicat 25 miles. The gentleman remained sole proprietor of the work for 45 years, when his rights were resumed by Government. Throughout this period the work was generally known as "Cochrane's Canal," a term which, in spite of the lapse of time and two subsequent changes of title, first, to "East Coast Canal," and then later on, to the "Buckingham Canal," still adheres to the first portion.

To maintain a sufficient height of water in the canal, which otherwise, when the streams ran were risen, would have realised the height of water in the Cooum river at Madras, the Sholavaram lock was built in 1804 at 7½ miles north of Madras; and subsequently the channel was excavated as far as Devanampatnam, 83 miles north. About the same time the canal was pushed south from Madras 40 miles to the Palár river.

The ultimate objects in view at this period were to reach Devanampatnam backwater, 81 miles north of Devanampatnam, thus affording a terminus for Sullurpet, and as regards the southern branch of the canal, to make for Marakanam, and ultimately the French territory (Pondicherry).

That would widen views of the ultimate extension of the work obtained is clear, from all the reports of the time, but want of funds and difficulties connected with the disposal of the cross drainage (every river along the coast passing the channel on its way to the sea) interfered with the natural progress of the work.

Captain Chambers, Mr. Kennedy, Mr. Pearse and other able officers designed extensions of the work north and south, and it was probably as much due to the inde-

The trifling outlay which, as before shown, was found to suffice with shallow boats after a small trade has been practically progressed from a capital outlay of Rs. 1,400 per mile in 1850 to nearly—

Rs. 1,800 per mile at end of 1875-76.
" 2,300 " " of 1877-78.
" 4,200 " " of 1881-82.

[This omits the excess over normal rates due to losses, which amounted in the aggregate to Rs. 1,41,075.]

As compared to the completion estimates hereunto sent up, amounting with all past charges to Rs. 60,87,100, the ultimate cost for a fully completed first-class canal, 261 miles in length, will be a little under Rs. 23,300 per mile.

The returns show that all classes of boats employed on the canal have increased in very marked manner, notwithstanding what is now admitted to have been a considerable and deterrent cutback at Dryden Bottom dues and tolls.

In 1861 there were in all 723 boats with a gross burthen of 6,387 tons. By 1882 these had increased to 1,060 boats aggregating 10,551 tons.

In 1875 the receipts from tolls, &c., were Rs. 91,118, and the total collections had increased to—

Rs. 1,09,809 in 1879.
" 1,16,327 in 1881.
" 1,06,987 in 1882.

The falling off in the last year was due to certain changes in regard to the tolls not necessary to particularize.

As further illustrating the vitality of the trade which in the present imperfect condition of the work exists, it may be mentioned that no less than 241,207 tons passed through the locks north and south of Madras during 1881.

It is now fully recognized that the system on which the tolls have been levied acts as a direct impediment to trade, and on the report of a Committee which has lately taken the whole subject into consideration, Government has decided on modifications which, though reducing the actual receipts for the present, will, it is certain, have a very beneficial effect in stimulating traffic.

Commerce, it is hoped, has been educated to show the growing commercial value of a work which, while being admirably adapted to all the physical conditions of the country, in more ways than native habits are liable to for passengers and produce, opens a field of new and diverse employment to the inhabitants of the littoral tracts, and affords a high way of limitless capacity at a cost of certainly not over one quarter of that of a railway.

Among other benefits indirectly touched on in the Report is the value which may yet attach to the large tracts of land which hitherto from having been open to invasion of tidal water will eventually be reclaimed by the works, and may, like others of a similar character, be turned to the best account as estuarine plantations, the success of which as an industry is now so well established along the older portions of the canal.

As a means of bringing the coal from the Singareni field in Hyderabad at a price which will admit of successful competition with patent fuel and English coal at Madras, the Railway authorities have lately expressed themselves to be very sanguine.

But the main advantage and importance of the work is its probable use during the prevalence of famine. As linking the great delta systems of the Godávari and Kistna with Madras and the country to the south, and thus affording a means, whether the sea-board be closed or not, of depositing grain at any point along the whole line ready for transport into the interior, its value must be held to be incalculable. It is on these grounds that the claims of this work to be classed as "Protective" have been urged on the attention of the Government of India, and, it is hoped, that this view may be fully maintained and recognized.

As shown in Appendix B to the Report, the actual capital amount expended on [illegible] commencement down to 31st March 1882 has been Rs. 20,87,185, [illegible] Rs. 1,25,000, the capital outlay [illegible] and subsequent years will amount to Rs. 21,12,185.

Mrs. A. P. Goodall,
Space Copies

[illegible] for the week, but has also to pay for the weather conditions, for several
[illegible] for which [illegible] made. Instances coming to notice of the above
[illegible] be sent to

I have the honor to be,
Sir,
Your most obedient servant,

[illegible]
[illegible] R.E.

Fort St. Darnell,
14th March, 1915.

Capt. A. V. Goodall,
Spare Copies

ENGINEERS AND SURVEYORS
CIVIL SERVICE.

Estt. of 1858 Madras.

PUBLIC WORKS

14th March 1883. No. 842 W.

MARCH
No. 108.

Buckingham Canal

For estimate plans estimates, &c., for the completion of the —

Public Works Department, 1882-83.

Current No. 6845

Letter No. 2445

Dated the 27 October 1882

From the Chief Engr. Irrigation Circle

Note or Remarks

The following are a series of Revised Estimates, which accompany the above letter, for a Revised scheme for completing the Buckingham Canal, by enlarging the Sluices, by deepening in some places the Canal, by bringing up the Canal to the Standard Cross Section & lining & planting the banks &c. The total outlay on the Canal Contemplated in accordance with that scheme is hereby accepted Amounts to Rs. 69,99,100 —

The general provisions under which the present Estimates have been framed are, that the Canal shall be reclaimed into Reaches, the Lower Lengths draining as heretofore free, whilst those above the line of Canal to the Sea, would being provided with Flood Gates & Sluices, would only be opened at Low Tides, so as

(No. 1054.)

E. W. Stoughton.

Note by Budget Section.

Work

Remarks and References.

Kingston Canal

Total Amount of Services (Completed)
Deduct Amount. 53. Sample Drawings &c. Books
Total Cost of Plan and no Obj.
Expenditure to Capital Books.
Amount of Estimate
Difference, if any, to be accounted for
Total Rs. 53,03100

Note of available funds.

Rs. Budget Grant as per Book. Rs. 160443 & Sch. No. 6

Budget Clerk.

Note by Student Assistant

(R. I. Form No. 10.)

Box Dep. No. 2263

MEMORANDUM.

Enquiries for reference the undermentioned papers:—

Date of Application for Certificate of Registry 1883.

Name of Vessel

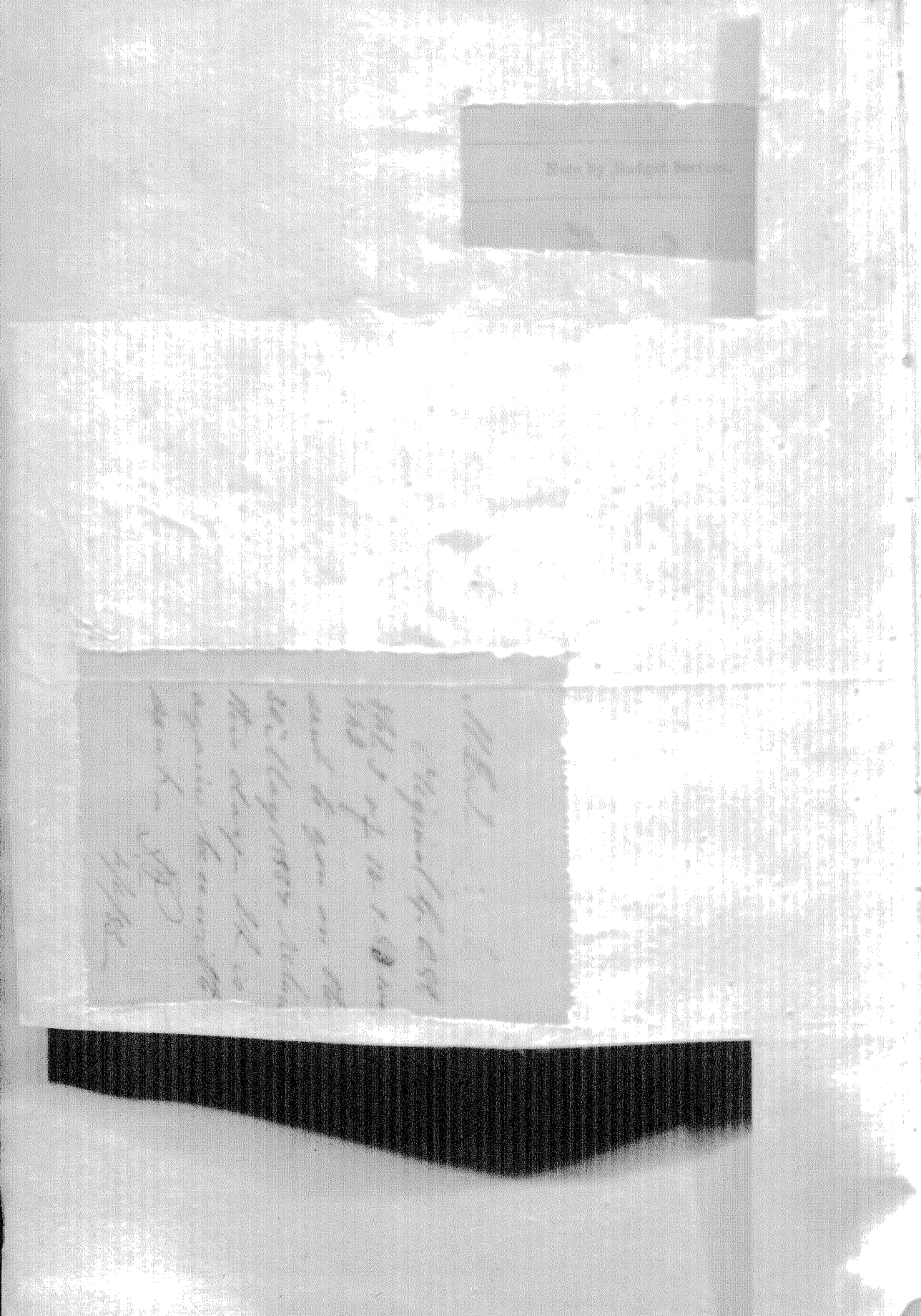
Official No. and Signal Letters.

Steamship, Clyde 1883.

To

The Registrar of the Port

Duke Univ. Perkins Library



Sent 9 of 11 & 50 lbs
Sh2
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30th May 1883 Acknow
this day 4th in
regard the receipt the
same
6/6/83

6545

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Note—The figures entered in the margin of the Report thus 134 to 137 denote miles and furlongs

REPORT ON THE BUCKINGHAM CANAL.

Fund.—Provincial.

Financial Head.—33, Irrigation and Navigation.

Budget Head.—Works for which neither Capital nor Revenue Accounts are kept.

Departmental Head.—Original Works.

Name of Work.—Buckingham Canal.

REFERENCES.

G.O., No. 2163-A, dated 17th August 1876.
Do. „ 920, dated 17th March 1877.
Do. „ 1238, „ 10th April „
Do. „ 336 W., dated 18th June 1877.
Do. „ 845 W., „ 19th February 1878.
Do. „ 283 W., „ 6th „ 1880.
Do. „ 284 W., „ 6th „ „
Do. „ 2030 W., „ 3rd September „
Do. „ 2031 W., „ 3rd „ „

REPORT.

11. The next section of the East Coast Canal undertaken was that from the Kundaleru river, close to Kistnapatam to the Penner river. The work was authorised under G.O. No. 815 of the 23rd March 1875, and the line followed is for the most part identical with that proposed by Captain Chambers thirteen years before; the estimate amounted to Rs. 2,57,000. In G.O. No. 2518 W., of the 18th June 1877, certain modifications, including the Cottapatam basin, were sanctioned, estimated by Mr. O'Shaughnessy (to whom we owe all the details of this section) at Rs. 14,000. This section was commenced in October 1875, in which year 30,000 rupees were spent on it, Rs. 1,71,000 being spent in 1876-77. Six miles were completed in December 1876. In that year 1877-78 this section was employed as a famine work for the distressed of the Nellore District, Rs. 1,00,000 being expended, and the work completed in 1878-79 at a total cost of Rs. 2,00,000. This section was open for traffic in May 1877; having been under Lieutenant C. B. Henderson, R.E., from 1874—76, under Lieutenant Carter, R.E., in 1876, and, lastly, under Sub-Engineer Ottaman and Supervisor Stephens.

12. G.O. No. 1003, of 24th May 1879, shows the state of the work up to that date, and points to the anxiety to have the Penner to Pedda Ganjam, 32 miles, sentment to complete as we only date the connection with the Godavari and Kistna System of Navigation. Lieutenant Carter, R.E., on June 1879, had reported on this section from the Penner to the Chipplelleru, and had pointed out that the high floods of October 1878 in the Penner had proved that some change in the line proposed by Captain Chambers had advantages, and he had suggested that a deviation to the westward should be examined. Lieutenant C. B. Henderson, R.E., was directed to lay the matter before Captain Chambers, and he did so, following Penner to Chipplelleru, 18 miles. closely the proposed line, Captain Chambers' line and proved a bed width of 50 feet with side slopes of 1½ to 1. The bed of the canal was fixed at 3½ feet below a mean of all low tides recorded for six months and 3 feet below the lowest recorded springtides. The section was ordered to be carried out by 10,000 coolies from Bellary and Kurnool. Lieutenant Henderson, R.E., was appointed to the Chipplelleru, Lieutenant C. B. Henderson, R.E., was directed to survey and lay out the section to the north of the Chippelleru for the employment of a separate batch of 10,000 coolies.

13. At the same time Lieutenant C. J. Rawson, R.E., was directed to reconnoitre at Pedda Ganjam and survey and Chipplelleru southwards for 22 miles. set out work for the employment of Workers to come to Pedda Ganjam. 20,000 more coolies on 12 miles.

14. The surveys and estimates were pushed on as quickly as practicable, but in this case, as in all the canal works, it became necessary to employ famine labour where it was available, and so the work of preliminary communication had necessarily to take a secondary place. However, Lieutenant Henderson, R.E., in the Penner to Mannaru section, and Mr. Sreenivasiah, Executive Engineer of the Kurnool Public Works Department, in the Mannaru to Pedda Ganjam, nevertheless pushed on the plans and estimates quickly, at the same time that they superintended the execution of the works.

15. In his original report on the Penner to Pedda Ganjam section of the canal, Mr. O'Shaughnessy states that the Deviation between the line proposed by line is generally the same as that selected Captain Chambers and myself. by Captain Chambers in 1866, but that certain deviations had to be made in the first four miles a deviation to the westward

was made, as Captain Chambers' line was too near the sea; in the 7th and 8th miles a deviation was made to avoid cutting through a high ridge; in the 10th to the 14th miles a deviation was made to obtain a sufficient cutting for towpaths and embankments; in the 15th mile a deviation to avoid a deep cutting was made. Between the Ghauts (about the 30th mile) and the 52nd mile north of the Pennér no deviation was made from Captain Chambers' line; from the 52nd to the 60th miles a trifling deviation was also made to carry the line further from the sea. A considerable deviation was made from the Moosee river near Ethamukala to the Ongole road, between the 59th and 63rd miles, to avoid a very heavy cutting through sand, and also to keep clear of some valuable land.

17. In regard to the level of the bed, Mr. O'Shaughnessy writes:—"Hitherto 4½ feet below mean tide level has been the specified depth of the canal. It was supposed that the range of tides was about 3 feet, and that a depth of 4½ feet below M.S.L. would give a minimum depth of 3 feet for navigation at low tide." * * * "It has been found, however, that the range of the tides is more than 3 feet at Kistnapatam; a gauge has registered a range of 3 feet 10 inches, and at the Mussulim, 71 miles further north of the gauge, has shown a difference of level between high and low water of springtides of over 4 feet; if the canal was cut to 4½ feet below mean tide in those reaches, there would be only 2 feet 6 inches or 2 feet 7 inches of water at low tide, or about 6 inches less than the depth required."

Bed level.

18. Mr. O'Shaughnessy points out that this error has been carried through the section between Kistnapatam and the Pennér, but to the north of the latter river it has been avoided by fixing gauges at the open bays and cutting the canal out to a depth of 3 feet below the lowest readings on the gauges. The width at the bed was made 30 feet, with side slopes of 2, 2½, and 3 to 1, according to the nature of the soil.

Levels in the beds of canal between Kistnapatam and Pennér River.

Bed width.

Canal slopes.

19. Mr. O'Shaughnessy estimated that the whole excavation required for the canal from the Pennér to Pedda Ganjam would be 8,652,146 cubic yards at 1 anna 10 pies per yard, and his subsequent report shows that in actual working 7,959,708 cubic yards completed by the end of May 1878 had cost on an average 2 annas 2¾ pies per yard, an excess which he had attributed to the employment of famine labor.

Total excavation.

Estimated rate.

Actual quantity and rate.

20. The same officer reports that including 16½ miles of the Kistnapatam to Pennér section and 16½ miles of new canal along the margin of the Pulicat lake, a total length of 115½ miles of canal were open to traffic between December 1876 and January 1878, and gave employment to an average of 32,000 work-people daily, while the greatest number of people on the work at one time was 61,200 (or including women and children 100,000 persons were at one time on the work during the famine); and he concludes his report by an allusion to the fact that he had asked for and obtained permission from His Grace the Duke of Buckingham to name the canal after him. It may here be observed that the portion of the canal from Madras to Ennore appears to have been originally (*vide* Atlas Sheet No. 78) named after the great Lord Clive. The designation subsequently applied to the work, "East Coast Canal," so distinctly pointed to the position of the work on the Map of India that it seems doubtful whether, looking also to the fact that Government did not take the initiative in the

Amount of work done.

Total length of canal cut in thirteen months.

Number of people employed on the work.

Named after His Grace the Duke of Buckingham at Mr. O'Shaughnessy's request.

Portion previously named after Lord Clive.

East Coast Canal a more suitable name.

21. Turning to the Southern Canal, Colonel Foord's memorandum, dated the 29th November 1878, printed with G.O. Southern Canal. No. 1102, of the 20th May 1879, puts on record, in paragraphs 26 to 47 the whole history of the work, which is quoted below for ready reference :—

"26. The project of excavating a canal along the Eastern Coast between the Adyar and the Pálár, with the view of protecting the long tract of inland water communication north and south of Madras, was brought forward for consideration in the year 1854. Two points in connection with this project particularly claimed attention—

"(1) The possibility of keeping the canal navigable throughout the year; and

"(2) The practicability of passing bridges in lieu of ferries, recommended by the Court of Directors, at such of the places where the road across the proposed water communication.

"27. The Chief Engineer, who made a personal examination of the canal, reported that it was quite possible to keep up an unfailing supply of water, averaging 4 feet 6 inches, in the canal throughout the year, by judicious regulation of the inlet and outlet sluices. The results of the general survey, by railroad engineers of the Trunk Line, and of the Public Works Department, could only be obtained by a large portion of time with a staff of the Public Works Department, and the attendance of field parties also necessitated an outlay of Rs. 20,000. The whole cost of the work was estimated at Rs. 2,20,800.

"28. The length of the canal was to be 40 miles. The first section selected from the mouth of the Adyar to the town of Sadras, a distance of 25 miles. This section was commenced in May 1856 and completed in the early part of March 1857, with a surface width of 40 feet, and a depth varying from 3 feet 6 inches to 4 feet 6 inches. Boats drawing 4 feet 6 inches were in March 1857 enabled to ply this entire throughout, and it was calculated that there would be sufficient water for passenger traffic and the transport of light goods even when the Adyar, Covelong, and Vemur bars were closed.

"29. The expenditure on the canal amounted to Rs. 1,75,500 against the sanctioned estimate of Rs. 2,31,000.

"30. The extension to the river Pálár, 5 miles south of Sadras, was estimated to cost Rs. 54,750. The average cost of the 40 miles of canal between the rivers Pálár and Adyar, including two large bridges, each 60 feet span, was thus Rs. 7,000 per mile.

"31. In March 1857 an estimate, amounting to Rs. 7,500, was sanctioned for completion of a cut through pure sand, close to the sea, between Sadras and the Pálár, 1¼ miles in length, and the work was to improve the alignment.

"32. In the same year Colonel Goodfellow submitted a report on the question of navigation between Madras and the southern districts, and the measures necessary for its improvement and extension. In regard to the Southern Canal, the Engineer recommended the establishment of landing places in the Southern Canal, the construction of bringing the Ocoum into use for purposes of traffic, different portions of Madras, with the view of the Pálár at its southern the connection of the canal with the Ocoum at its northern end, and the construction of feeder roads.

"33. The Government recognized the importance of the proposed measures and called for plans and estimates.

"34. The estimate of Rs. 7,500, sanctioned in March 1857, for the extension of the canal from Sadras to the Pálár river, was, in December 1859, superseded in favor of an estimate for Rs. 21,000, the alignment being taken farther inland.

"35. In July 1861 the Government, on a representation of the Chief Engineer urging the commencement of the work, remarked that they did not see sufficient prospect of its ultimate success to warrant the necessary large outlay. It was intended, however, that it should ultimately be connected with the canal terminals of the Adyar with the Northern Coast, the scheme would be considered as a whole.

"26. The estimate of Rs. 2,21,800 for the Sadras Canal was subsequently reduced to Rs. 2,16,000, and of this sum Rs. 1,81,000 were spent, when further outlay was suspended for financial reasons, leaving the canal incomplete.

Letter No. 401, dated 23rd April 1862.

In April 1862 the Government sanctioned a further expenditure of Rs. 39,000 for deepening and widening the canal between the Sadras river and Nelvanoopem. This estimate provided for deepening the southern portion of the canal to 4½ feet below mean tide, and was designed to complete the canal as allowed for by the estimate of Rs. 2,16,000.

"28. One of the main considerations in sanctioning the Sadras Canal was its capability of being prolonged to Cuddalore, to join there the canal from Porto Novo, which again is connected with the line of water communication between Combatoor and the sea-coast through the district of Tanjore. This section of canal was sanctioned by the Government of India in July 1856 at an estimated cost of Rs. 40,000, and provided for connecting the ports of Porto Novo and Cuddalore by a cutting from the river Vellar near Porto Novo to the Paravanar or Cuddalore river. The canal was designed to give sea outlet to the traffic carried by the navigation of the Coleroon and Vellar rivers, the former of which runs inland a distance of 100 miles through Tanjore and Trichinopoly into Coimbatore.

"27. There being through water communication along the coast from the Adyar to the Sadras, and from Cuddalore to Porto Novo, it was proposed in March 1856 to excavate a canal through the intervening country. The project was originally framed as a prolongation of the Sadras Canal all the way to Cuddalore, a distance of 60 miles, but the southern part of the canal appearing to need more careful investigation, and arrangements having to be made with the French authorities for the passage of the canal through French territory, the Madras Government laid before the Government of India only a portion of the project, which included 34 miles of canal, estimated to cost Rs. 3,75,000.

"32. The canal was to be cut to a depth of 4½ feet below mean tide, and it was believed that even at the worst season there would be sufficient water in it for passenger and light cargo boats. The framer of the project provided for no locks, preferring to add them afterwards if found necessary; the bed of the canal being left to be acted upon by the flux and reflux of the tide, and to be assisted by the passage of the land drainage to the sea. The Chief Engineer, however, inclined to two locks and falls, being of opinion that in a tract so destitute of large streams sufficient scour would not be obtained. Instead of admitting the intercepted minor drainage into the canal, the Chief Engineer proposed to lead it, wherever practicable, along the outside of the western bank by small channels until it reached a backwater or other main drainage, into which it would be made to enter at some distance from the navigation. Three bridges of masonry and three of timber were provided. The section allowed for the cutting gave a bottom width of 20 yards. This width was considered necessary in consequence of the sandy nature of the soil. Some difficulty was anticipated in keeping the canal free from sand-drifts, and it was intended to plant the top of the banks with palmyra as a protection, and the slopes with shrubs and marine creepers. In some places the banks were considered to require paddling.

"30. The Government of India took exception to the project, on the ground that it did not

Letter No. 401, dated 23rd March 1857.

appear clear how its level could be steadily maintained unless there were a lock at each point where it enters and emerges from the tidal lagoons, through which it passes. To this it was replied that though locks formed no part of the original project, yet two were included in the revised estimate drawn up in the Chief Engineer's Office, that such works would not have been thought so indispensable to maintain a sufficient depth for navigation had the fact been known that the extreme difference of level between spring and neap tides in the backwaters is under 3 feet, while the actual rise and fall is only from 6 to 9 inches; and that the depth of the bed of the canal being assumed at 4 feet 6 inches below mean tide, and the fall of tide in neaps being, as above stated, only 1 foot below this level, the minimum depth of water lasting perhaps not more than a few hours once a fortnight, would still be 3 feet 6 inches. It was added that the locks introduced into the project in the Central Office were doubtless intended for increasing the depth of water in the canal by the retention of land floods, and, though not quite sufficient in number to effect that object entirely, would still add greatly to the efficiency of the communication. The framer of the project, Lieutenant Chambers, was, however, of opinion that tidal locks in estuaries with such little rise and fall as those on the East Coast are not of material good to the canals on which they are constructed. He held that in connection with weirs, their adjuncts, they offer obstruction to the free flux and reflux of the tidal wave, and diminish greatly its scouring power, and he was of opinion, therefore, that their construction need not be simultaneous with the establishment of any one section of the coast line; in fact, that the locks should not be built until experience shall have pointed out their necessity or utility, or at least not until after a few years' scour, to allow the banks, berms, and sides of the main channel and of the drainage cuts of a tidal canal to assume their normal slopes and slopes. These views were concurred in generally by the Superintending and Chief Engineers, the latter of whom

remarked that the two locks added to the estimate were intended for the junction of the canal with the estuary of the Pálar on the north, and that of the Meykanam river on the south, between which points there exist no drainage outfalls which may not be regulated by simple weirs, which, being provided with ample sluices, will always admit as much flood water as will keep the canal full when the locks are open. The Chief Engineer added that the locks would, in his opinion, be necessary to prevent or retard the silting of the canal surface, with the degradation of the backwaters during the hot season. When fully completed the canal would, the Chief Engineer stated, form one long backwater or lagoon, receiving all the drainage of the country it traverses, and discharging the supplies by the waste weirs, both intermediate and terminal, and that on the proper construction of these works would greatly depend the freedom of the channel from deposit.

"48. The project was brought forward by the Government of India for an appropriation of funds in the budget of 1858-59, but no funds were granted, and the Court of Directors seemed to think that the time * had not then arrived for expending the large amount of money required for the completion of the line of water communication along the East Coast of the Presidency.

"49. The canal round to the South Arcot and Chingleput Districts was again brought forward in connection with the recent famine as suitable work on which to employ the distressed population.

"50. The section from the south bank of the Pálar to Meykanam at the southern boundary of the Chingleput District was surveyed as per sanction in G.O., No. 412 W., dated 25th January 1876. In August of the same year an estimate of Rs. 1,79,580 was submitted for the completion of work. The total length of the portion of the canal is 20 miles of distance, which, added to the portion already open, will give a length of 40 miles 6 furlongs from the Adyar.

"51. On leaving the Pálar, the canal, as now aligned, starts on a short distance a sandy ridge, and is then taken through 3 miles of wet cultivation. It afterwards follows the course of backwaters almost the whole way to the boundary of the Chingleput District. There is, however, a bit of very high ground, about 2 miles in length, between the Cheyar and Meykanam backwaters. The cutting required here is 7 yards. The estimate, amounting to Rs. 1,79,580, for this portion of the canal received the final sanction of Government in G.O., No. 4182, dated 9th October 1878, P.Dc.

"52. From Meykanam to French boundary estimates for the canal have been prepared. The cost of the earthwork is estimated at Rs. 3,38,000, and that of the masonry at Rs. 1,10,700. To this a sum of Rs. 45,000 has to be added for compensation for land, making a total of Rs. 4,93,700 for the portion of the canal which is in English territory. For a distance of 24 miles the canal runs through French territory. This length is estimated to cost Rs. 1,70,580. The total cost of the portion of the canal between Meykanam and French territory will therefore amount to Rs. 6,64,280.

"53. The section of the canal from the Pálar river near Porto Novo to the Paravanár was submitted for in 1875. This section was originally cut in 1806, and was commenced as a famine relief work, but not completed. The excavation was not taken as far as it should have been. A depth of 4½ feet below M.S.L. and 60 feet bottom width has now been allowed, and an estimate, amounting to Rs. 67,850, sanctioned by Government in the Famine Department in G.O., No. 1918, dated 11th July 1878.

"54. In September 1878 an estimate, amounting to Rs. 31,200, was submitted for completing a channel from Porto Novo southward to the Vellár, which communicates with the Coleroon. The canal was cut many years ago, but not apparently to the full depth of 4½ feet below M.S.L., and it has not been repaired since the work was opened in 1807, there is now a large quantity of silt to be removed. The length to be cleared is 3½ miles. The rest of the communication between the Vellár and Coleroon is by a natural backwater.

"47. The following statement shows the estimate sanctioned for the coast canal within Chingleput and South Arcot limits, and the budget provision made in successive years":—

No.	Work	Amount of Estimate.	Government Order sanctioning the Works.	Amount appropriated in				
				1856-57.	1857-58.	1858-59.	1877-78.	1878-79.
		Rs.		Rs.	Rs.	Rs.	Rs.	Rs.
1	Adyar Junction Canal	*3,07,378	G.O., No. 3071-W., dated 16th July 1878.	..	..	..	+ 3,14,146	+ 15,807
2	From Adyar to Pálár	2,61,673	G.O., No. 211, of 19th January 1858. G.O., No. 1248, dated 7th June 1858. Government of India, 1st June 1858.	1,21,672	46,001	37,000	..	..
3	From Pálár to Markanam	1,70,000	G.O., No. 2209, of 20th October 1876, 3rd.	..	..	..	..	§ 12,582
4	From Markanam to the French boundary	4,64,000	Estimate under consideration.	..	..	..	..	..
5	From the French boundary to Gingi	1,70,000	Ditto. do.	..	..	..	..	..
6	From Cuddalore to Porto Novo	40,000	G.O., No. 226, of 1858.	..	..	..	..	§ 15,000
		16,000	G.O., No. 2209, of 1876.					

* This is the amount at which Mr. Power estimated the canal; a revised estimate is under consideration, sanctioned as a famine relief work.

	Actual Outlay.	Probable Normal Cost.
	Rs.	Rs.
1876-77	28,593	16,962
1877-78	3,83,551	3,15,036
	Rs. 4,12,144	4,32,998
1878-79	13,463	44,007

Sanctioned as a famine relief work.

	Actual Outlay.	Probable Normal Cost.
	Rs.	Rs.
1878-79, 1st April to 30th September	11,442	16,956
Ordered to be carried out as a famine relief work by G.O., No. 1726 of 6th August 1878, P.R.		
	Actual Outlay.	Probable Normal Cost.
	Rs.	Rs.
1877-78	1,655	..
1878-79, 1st April to 30th September	9,887	..
	11,542	8,913

21A. The portion between the Pálár and Muddiyarkuppam (58 miles south of Madras) was opened for traffic in the latter months of 1880, and from this point down to Merkanam (66 miles south of Madras) was opened for traffic since April of the current year. Boats prior to 1880 were able only to ply between Madras and the Pálár river (46 miles south of Madras).

22. The portion beyond Merkanam, not included in the present estimate, for Canal beyond Merkanam for a distance of 23½ miles. a distance of 23½ miles, as far as the northern boundary of French territory (Pondicherry), the line has been surveyed, and for the work an estimate for Rs. 6,64,380 has been prepared, though probably requiring to be again checked and put into shape. This line of canal, though not at present proposed for execution, would form an excellent famine work, and would, it is considered, bring a good deal of traffic to Madras.

23. For many years it had been in contemplation to cut a canal between the Cooum and Adyar rivers, in order to complete the water communication between the northern and southern canals. This work was carried out under instructions in G.O., No. 3225, of 29th November 1876, the bed of the canal being 20 feet wide and the depth 3 feet below low-water springtides with side slopes of 2 to 1. A headway of

Junction Canal.

ft) feet clear above M.S.L. was ordered to be allowed for all bridges, which gives 6 feet above highest water level of the canal. The bridges are without towpaths, and the span of several of them being only 20 feet is inconvenient. The provision of towpaths which must subsequently be made will further contract the already over-restricted space, while the narrowness of the span has added sensibly to the cost of the bridges, owing to the long and heavy wing-walls thereby entailed. While the head of the canal was open to the river Adyar and Cooum, this construction of the waterway was a source of weakness to the bridges owing to the scour set up in the channel; but with the construction of the double lock sanctioned for 1881-82 at the south end of the Junction Canal, and which is intended to shut off the Adyar or Cooum floods, whichever may be the highest, all danger of this kind will be at an end.

21. As a conclusion to the brief history of the Buckingham Canal it may here be noted that before the estimates were submitted in detail for the work done during the famine, and before the banks were protected by well-grown vegetation, that portion of the canal through which it runs to the north of Madras was, in the months of May and November 1879, visited by cyclones, which, though perhaps not of sufficient force to damage the works considerably, and to necessitate violent, were of prove clearly the necessity for modifications of the design in many particulars.

Cyclones of 1879.

22. The several G.Os. quoted at the head of this report under "*References*" show in detail the results of the cyclones alluded to, and Colonel Sankey's memoranda of the 19th April and 23rd May 1880 printed therewith give the conclusions which up to that time had been arrived at.

Results of cyclone.

23. Since then certain points of detail have been discussed, and estimates for several portions of the work framed, and final orders passed on them.

Discussion thereon and estimates framed.

27. With a large work of this character carried across the whole drainage of the country, and exposed in an exceptional manner to cyclones of the greatest severity, it would be impossible, without expanding this report to an undesirable length, to note fully in detail the effects that have been produced by these occurrences, or to set forth all the reasons for the modifications and improvements now considered essential in order to give the desired stability to the work, and make it a safe line of internal navigation throughout the year.

28. As will have been gathered from the history of the work above narrated, the sole aim of the several projects has been to cut a navigable canal close to the sea-coast, taking advantage of all back-waters and depressions lying to the west of the outer line of sand dunes so as to minimise the amount of excavation, and necessarily, therefore, the expense.

Sole aim of the several projectors of making the canal a safe line of inland navigation.

29. With the one exception of the lock at Shaduyankuppam (specially constructed in the interests of Madras sanitation), there were practically no regulating works of any kind. The principle acted on of simply improving a line indicated as it were by nature, allowing rivers and drainages to spill across the canal uninterruptedly on their way to the sea, did not admit of any regulating works which would cause obstruction. As explained by Sir Arthur Cotton, the object to be aimed at was the construction of an "effective" work at the least possible outlay.

Principle acted on did not admit of regulating works.

30. If the conditions which exist in all ordinary years were only permanent, none would be disposed to question the thorough soundness of this principle.

If natural conditions were permanent, above principle correct.

31. Unfortunately, however, experience has shown that the disturbing elements, chiefly cyclone floods, &c., which occur every eight or ten years, and with especial violence to the north of Madras, must be taken into account.

Recurrence of cyclones.

32. In only two or three portions of the line of channel is a beneficial scour set up by the retiring land floods, and elsewhere the tendency, at such times, is to deposit silt, and in some places (particularly in the neighbourhood of the several river mouths and across their deltas) to very nearly, if not entirely, fill up the whole of the bed.

General condition of canal after cyclone.

33. It has thus been incontestibly proved that the principle of non-regulation cannot be maintained if the very serious recurring charges, due to re-opening periodically the channel, are to be avoided, and if the requisite permanence and stability is to be given to the trade, which has not only sprung into vigorous existence throughout the whole line, but which is rapidly increasing as shown by the returns.

Hence the principle of non-regulation cannot be maintained.

34. The recognition of the necessity for regulation throughout the work involves the (1) adoption of means for isolating the several reaches of the canal which intervene between the respective drainages, so as to exclude, whenever desired, all extraordinary floods, and (2) the training of all rivers and drainages as they cross the line of canal, so as to give clear and sufficiently deep crossings at such points for the passage of boats.

Measures necessary to be adopted for regulation.

35. The provisions to which the adoption of these principles have necessarily led are specified below, as being those upon which the estimate now framed has been based; and as it is to be hoped that the reasons for the provisions detailed in each case may be sufficiently obvious, it is only necessary here to advert briefly to the preference which has been given to flood-gates at the ends of the several reaches instead of regular locks.

Principles upon which the completion estimates are based.

36. Locks, no doubt, would have a specific value in retaining throughout a great portion of the year a higher water level in the several isolated reaches than is possible without them. But in the first place, they are expensive works, and, considering the number necessary, would add very materially to the capital outlay.

Reasons for and against the construction of locks as regulating works.

Secondly, it is not as yet clearly proved that the actual gain in depth of water due to their construction would exceed on the average 6 inches.

Thirdly, there is the expense of housing and maintaining a large number of lock establishments.

Lastly, and mainly, is the fact that locks would not only delay traffic, but might very seriously impede and drive it away by the illegal exactions which are almost certain to be made by the establishments entertained.

37. The flood-gates opening outwards at the end of each reach of canal these objections do not, as a rule, apply. They will, in fact, consist of a simple pair of gates to be closed only on the occasion of any extraordinary flood by the ordinary establishment entertained generally for the canal.

Flood-gates.

Their description.

38. Their use is simply to isolate each reach on such occasions, and as it has been shown by calculation that if they only prevent the deposit of 6 inches of silt in the channel, it would be economical to place them even in such short reaches as ones of only 2 miles in length. They can also at any future time be turned into locks, if such be considered desirable, by the simple expedient of adding a pair of similar gates at the required distance (120 or 150 feet) from the first set.

Their utility.

60. The general provisions under which the present estimates have been framed are as follows:—

(1) Isolation of reaches.

That the canal shall be isolated into reaches between rivers or such other large drainages as require free vent across the line of canal to the sea, each end of each reach being provided with flood-gates, and the channel embanked on both sides, where necessary, so as to keep out the highest known floods, above which level the banks will be constructed 8 feet generally, and in certain places 4 feet; that the ordinary minor land floods shall be taken into the canal by

(2) Treatment of minor cross drainages.

pipes or culverts or by open inlets, where such expedient is feasible, and that all cross drainages which do discharge either at ends of the "reach" or at other convenient points by means of masonry sluiced outlets; that all river bars which it is unnecessary to keep open shall be closed, and the

(3) Unnecessary river bars to be closed.

floods concentrated into the rivers and other main natural outlets, thereby increasing the depth of the channels, and consequently improving the crossing of the canal. From the experience gained in two

(4) Details of expenses of cyclone.

successive cyclone years, it has been distinctly demonstrated that many of the bars now held to be superfluous, and that land and river floods if left unregulated, have a tendency to spill in all directions, thus clearly showing the necessity for maintaining the number of bars to those absolutely essential for the discharge of the drainage which must find its way to the sea; that by regulating river floods and preventing spill, the canal can be secured, as a rule, from nearly all injury by floods, and the number of drainage outlets reduced to a minimum; that as the nature of the country along the canal does not permit of the discharge of surplus water at all the existing openings by means of masonry outlets, such works are, as a rule, avoided, and, as already stated, the floods are concentrated on certain selected major openings; and regulation in the manner above noticed; that the canal be given generally a bottom

(5) Details of construction of canal.

width of 30 feet, side slopes 3 to 1 or less on a depth of 3 feet below lowest recorded bed in each "reach;" that the embankments be made up to 6 and 4 feet above the highest known flood recording to circumstances; that all diversions found necessary have a similar cross section to that above specified up to the tow path, which will be 6 feet wide, the slope of the embankment being 2 to 1; that beyond the tow path shall be berms of 15 feet, excepting in cases where the ground is at or below tow-path level, when the berm shall be 27 feet, the tow path being always made up to the standard 4·5 feet above M.S.L.; that all embankments much exposed to the action of floods shall be 10 feet wide at top, slopes 2 to 1 on the canal side, 3 to 1 outside, other banks being given a width of 6 feet at top, but with the same slopes; that the cutting and bank slopes shall be turfed or planted with rubbi wood or other suitable

(6) Shallow rivers to be embanked.

vegetation; that rivers which, owing to the shallowness of their beds as they approach the sea, throw out spill water over the country, shall have their waters confined by flood-banks, the operations, however, of this character being restricted to such rivers only as have been proved in cyclone years to require this mode of treatment;

(7) Cheering lines to be formed.

that the crossings of certain rivers shall be improved by excavating diversion lines and by training works, and, as in the case of Tilla and Tenuer rivers, by concentrating the several defluents into one main channel; that where experience

(8) Canal removed, where necessary, out of backwaters.

has proved it to be necessary, the canal shall be removed out of the backwaters, and a new independent channel excavated, leaving the backwaters for drainage, it having been proved that the

maintenance of canal in such positions is both difficult and expensive, and navigation toilsome and risky; that boat basins shall be provided at the places where experience has shown such to be necessary; that bridges shall be constructed only at such places (and these very few in number) where their necessity has been indisputably established; that certain existing bridges shall be altered so as to give the requisite headway; that necessary inspection bungalows, rest-houses, overseers' quarters, toll offices, and lines shall be provided for meeting the requirements of the canal employés and of the travelling public; that the basin at Madras shall be improved and extended to meet ascertained demands of traffic.

(9) Boat basins and lay-bys to be provided.

(10) New bridges constructed and existing ones altered.

(11) Inspection bungalows and accommodations for toll establishments.

(12) Terminal basin at Madras to be improved.

40. The following notes on the mode of dealing with each of the reaches of the canal so as to render them complete in every way show how the provisions above laid down are to be now applied.

Method of dealing with different reaches of the canal.

41. As experience has shown that this section* has not, as a rule, suffered from the effects of cyclone floods, it is not proposed to isolate the reaches, and the work is therefore of an ordinary character calling for no special remarks.

Junction cut from Buckingham Canal to Commanoor Canal.

Section 1 as per estimate of Northern Canal.

42. It is proposed to isolate this reach by "flood-gates" at the ends, with outlet at selected places, to embank out the Raperla and Oopoogoondur swamp drainages, which spill over the Kanuparti ridge, and to construct a flood-bank for those measures being necessary to obviate the necessity for keeping an opening in the canal near the Kanuparti bar. At this latter place a *diversion*† of canal is proposed in order to take the channel further from sea than it is at present. From the Gundlacamma river to Pedda Ganjam there is a rising ground, on which the village of Kanuparti stands; if the low places at certain points of this ridge are banked off, and spill of river floods diverted by judiciously placed banks, the reach closed at it will be at each end by flood-gates) should be sufficiently secure, especially as otherwise there is but little land drainage to be taken into the canal. On the east or sea side, however, of this reach, the ground being low and exposed, the canal bank will have to be strengthened, and further rendered secure by cross and training banks at all the old bars which are to be closed as being unnecessary.

Index Survey Sheet No. 4.

Pedda Ganjam to Gundlacamma River, 8 miles.

It may be necessary hereafter in this reach to provide for other embankments at the south end of the Kanuparti ridge, but at present it is considered needless to provide specifically for these. The land drainage on west side of Kanuparti ridge finds an outlet northwards through swamp already referred to, to the large masonry outlet at Pedda Ganjam,§ which is now being built by the Executive Engineer, Western Kistna Division.

Section V as per General Abstract.

43. This reach is necessarily short, as the Mudigondi opening must be maintained. It will be isolated by flood-gates, embankments; also be a flood-bank for directing the spill of the Gundlacamma river. The eastern or sea-side bank of the canal in this reach has to be very strong, as the ground up to the sea-shore is very low and exposed. The western bank also requires to be strong, as being much exposed to the Mudigondi floods.

Gundlacamma River to Mudigondi River, 3 miles.

It will be well to mention here that although the Mudigondi stream itself is insignificant when the floods are supplemented by the spill of the Gundlacamma river on one side, and those of the Moosee-Enegalaroo spill on the other, a large quantity

of water is banked up and becomes dangerous to the canal. When once the proposed flood banks, however, have been carried out it is considered that no further danger here need be apprehended.

Madigondi River, to the Moosee River 14 miles.

44. This reach is a large one, but exposed only at the north end for some five miles to Mudigondi floods, and also for about three miles to the effects of storm waves from the sea side. This reach will be isolated by flood-gates, outlet sluices, embankments, also by a flood-bank for the Moosee river. With the elevated line of coast from Kotapatam * to near the Moosee river there is no need for a high canal bank on that side, as also from Thondaroo to Moosee. On certain occasions the flood-waters of the Moosee and Enegadern have been known to extend from near the trunk road on one side up to the sand ridges of the coast line, thus forming a vast sea of water. This was, in fact, twice experienced during construction of canal in this reach, and the Thondaroo drainage is believed to have been formed by these floods. To deal effectually with this reach it is proposed to *abandon* † that portion of the line which runs through the Thondaroo drainage, which is a deep pool of fresh water, and in which the channel as now formed cannot (as shown by experience) be maintained at the proper depth without undue expenditure.

* 179 M.

† 177 to 177. VII

Moosee River to Palaroo River, 1 mile.

45. The Moosee and Palaroo river reach is short and difficult, if not impossible, to maintain as now existing. This reach will be isolated by flood-gates and strong banks, but even with these this short piece of canal is so much exposed to rapid silting that it is considered highly desirable, in order to provide against all inconvenience being experienced by traffic, to have an alternative portion of canal close alongside which can be used while the main line is being cleared.

The Palaroo River to Munnaroo River 8 miles.

The Moosee ‡ river makes an awkward bend at the crossing which it is proposed to cut through, in order to rectify this objectionable feature. The banks of the Moosee river on the east side for about 4 furlongs (up to village) are also to be levelled down, so as to give the river a perfectly free spill. Experience has shown that where perfect isolation cannot be secured by means of sufficiently high banks, &c., the less the obstruction opposed to the flood the better, even at cost of having to maintain yearly the open reach of canal up to the flood-gates. In this case the latter will be placed near the village of Anantapuram.§

‡ 180 M.

46. This reach is exposed seriously every year, and has been much injured by the cyclones of 1879 and 1880. It will be isolated by flood gates and by strong embankments and by flood-banks to both rivers to train the spill water. Outlets are also needed. The east or sea side bank must be strongly constructed, as the coast line is low and exposed and the sea very close to canal. In 1879 the storm wave from the sea reached nearly to top of banks. The west bank, when once the land floods are regulated in the manner proposed, need not be very strong, as the only drainage of any importance derived from the surplus is the Pskala tank series. As this terminal reservoir rarely, however, gets a full supply, no apprehension need exist respecting it.

§ 166 M.

This part of canal reach is also exposed to the spill of the Palaroo ¶ river, which the proposed flood-bank will dispose of. At the other end, the rising ground at Singarayeekonda acts as a sufficient protection, and there is thus only Binginipally * and Somarazapally †† tank drainages to dispose of. None of these tanks are well supplied, and the special arrangements for disposal of their surplus water such as it is will be readily made. In order to improve the crossing of the Munnaroo river, a *diversion* ‡‡ canal, on the north side for a mile, has shown itself to be necessary. The head

* 162 M.

†† 168 M.

Index Survey Sheet No. 7

‡‡ $\frac{169}{VI}$ to $\frac{169}{VII}$ or Munnaroo northern diversion.

of old course of Mannaroo must also be closed, in order to afford proper protection to the diversion line from injury by floods.

46. All the old river openings and bars in this reach are to be securely closed, it being neither desirable nor necessary that they should be kept open.

47. This reach is protected nearly throughout on both sides by high sand dunes, and will not need much banking for isolation, which will be sufficiently secured by the proposed closing-gates with outlets. At the end next to Mannaroo river a short diversion * of canal will be made, to ensure a better crossing than heretofore, as in the storm of November 1880 the river became sensibly widened at the old crossing, 2 furlongs of canal being carried away. The river course will also be trained at the crossing, to ensure a permanent deep channel. At the Elekaroo † crossing, training banks on both sides of canal are required to keep flood-water from taking the canal bank in reverse along the swamps, as also to close the second or north Elekaroo bar, which it is not at all necessary to keep open.

Mannaroo River to Elekaroo River, 10 miles.

* 161 M.

† 157 to 158 M.

48. The isolation of this reach is to be ensured by flood gates and outlets, by training banks to shut off flood, and prevent water through the bar getting behind the banks along the swamps; also by embankments (though of this latter much will not be necessary), and again at the Chippelaroo river end by a *diversion* ‡ in this line of canal, in order to avoid the river bed along which the navigation is now conducted at serious inconvenience and expense.

Elekaroo River to Chippelaroo River, 16 miles.

‡ 143 M.

§ 140 M.

At Chemmeyapallem § the canal cuts through rising ground which extends seaward nearly up to Ramapatam ‖ bar, and thus obviates the necessity for high banks on that side. Similarly on west side, from Chemmeyapallem southward up to the Chippelaroo river, the high ground extends, so that here also the canal is naturally protected and requires no high banks. The canal from Chemmeyapallem to Chippelaroo runs through a depression forming a salt swamp, protected on both sides by high sand dunes. This swamp is under the influence of the Chippelaroo tides, so that by training banks from canal running east and west into the high ground this reach can be protected from all floods without the necessity for much banking.

‖ 140 M.

From Chemmeyapallem to Ramapatam on the west side of canal is all paddy land with banks. Heretofore this section had but one small opening in bank for outlet of drainage.

Owing to very heavy rainfall of November 1880 this drainage opening became overcrowded and a large breach was the result. In the interest of the cultivators and of the canal it seems best to make several openings for venting the surplus water in similar cases, converting these eventually into masonry works, should experience prove this to be essentially necessary. It is proposed to close permanently the Ramapatam bar, as it is not wanted. All drainage of this reach will discharge itself in both directions to the terminal outlets.

From the proposed diversion of the canal here a short flood-bank will be carried to Chippelaroo river across the low saddle in ridge up to the rising ground, so as to prevent flood-water getting behind the bank.

Chippelaroo River to Pydaroo River drainage, 9 miles.

49. The isolation of this reach will be effected in precisely the same way as that of the preceding reach. Old bars will be closed and training banks run across so as to divert any excess of flood

52. This short reach is unavoidable, though experience may possibly show that the Gungapatam* opening will admit of being closed up, and this reach made continuous with the next up to Kódúr.† This is, however, a detail of no particular significance. The present crossing looks formidable now, as no less than three bars are open, but as it is only an old estuary hitherto kept up by Pennér spill water during flood, the operations now in hand for training this through one channel should effectually dispose of any difficulty here. Just now the Pennér discharges much of its flood-water through the Gungapatam bar, but the training banks proposed for this portion will effectually prevent this in future. Should further experience prove the necessity for maintaining any opening between the Pennér river and Kódúr, it is not improbable that the position of Korattúr ‡ about midway, where there is a bar channel, now used for carrying away the land flood from Pennér Delta cultivation, may be found best, but this, like a few other minor details, may with advantage be left open for the present. In the estimate, however, provision is made for making the Gungapatam river discharge opening on the information previously obtained, and this may stand as a provisional arrangement.

Pennér river to Gungapatam river, 3½ miles.

* 111 M.

† $\frac{102}{VI}$

‡ $\frac{107}{IV}$

Any alteration of the design here will not in any material way affect the estimate. The reach will have flood-gates at both ends and an outlet which may conveniently be placed in the bed of the so-called "Old Pennér." The embankments will be strengthened, particularly the eastern one, as the coast line is here low and the channel rather exposed from that side. South bar will be closed.

53. This reach will have flood-gates at both ends with "outlets" except for 2 miles at north end, the coast line is very high, consequently no banks are wanted on that side. None are moreover required on the west side, so far as rising ground in the neighbourhood of Kódúr extends; but beyond it northward to the Gungapatam river the country is low and all under wet cultivation, and here protection is essential. A number of old river bars must be closed in this reach, which are not wanted, in addition to the Gungapatam drainage bar. Training banks in the neighbourhood of the bars are to be provided with a view to keep flood water from getting behind the banks along the swampy hollows. A *diversion* § of canal will also be made at south end of this reach, so as to secure a good crossing for the Kódúr river and confine this drainage in a distinct channel capable of carrying off a maximum flood.

Gungapatam river to Kódúr river, 9½ miles.

§ $\frac{101}{VI}$ to $\frac{101}{IV}$.

Further experience of the full effects of the works undertaken with the object of training the Pennér river into one channel may as above show the desirability of amalgamating the two reaches mentioned in this and preceding paragraph with, in addition to the end outlets, two others at intermediate points to discharge surplus drainage.

54. The isolation of this short reach is unavoidable, as the Nalatur ‖ drainage brings in a large volume of water, which must be provided for. At the north end there will be a *diversion* ¶ in continuation of that of preceding reach to avoid the drainage which comes from south and enters on the west of the channel. Similarly at the south end a *diversion* ** is proposed to provide separately for the drainage, which now crosses the canal in several places and runs through the canal doing mischief. At the south end a strong bank will be required on the east side to prevent the flood and tide water from entering swamp and getting behind the bank. On the east side but slight banking will be required, as the ground along the coast line is here high. The west side the bank on the contrary requires to be strong in order to effectually keep out land floods.

Kódúr river to Nalatur river, 6 miles.

‖ $\frac{99}{V}$.

¶ $\frac{100}{IV}$ to $\frac{101}{I}$.

** $\frac{97}{VII}$ to $\frac{97}{II}$.

Nelatur river to Kundaleroo river, 5¼ miles.

56. This reach which is unavoidably short is to be isolated by flood-gates and outlets at both ends. For three miles from north end the cutting is deep through sufficiently high ground, and will not require much banking. After this up to the Kundaleroo * river the line is through swamp and backwater, where to a great extent, heavy banking is required on both sides. A *diversion* † along Kistnapatam backwater is also to be made, as this will be cheaper than to embank both sides through the portion of exposed backwater.

The left border of Kundaleroo river will likewise be embanked at all the low places up to the Mootoocoor ‡ high ground, so as to keep that river spill from getting behind canal along the Kistnapatam swamp on the west side of canal.

This part of reach from the Kundaleroo river to the Kistnapatam § high grounds is exposed to floods and the swamps on both sides and will need strong banking.

Index Survey Sheet No. 5.

Kundaleroo to Soornamookee River, 14 miles.

58. This is a well-protected reach, situated in a hollow between high sand ridges. Flood-gates will isolate it, and an outlet will be constructed for the discharge of the small field drainage. Banks not wanted, but it will be essential to fill in certain gaps in saddle of the ridges, as during the floods of November 1880 these low portions were overtopped by the flood-water, seriously damaging the canal. The side field drains can be disposed of by pottery-pipes across the berms, simple cuts in bank being sufficient to pass the drainage. Originally it was intended to sluice all these openings, but after isolating the reach it is thought that no such measures will be necessary.

A short diversion ‖ cut, ⅔ furlongs long, at the Kundaleroo river end, will be made to give the canal a conveniently placed mouth in deep water.

Section III., as per General Abstract.

At some places in this reach the cuttings are very deep and sandy, and in such places the canal slopes will be altered to 4 to 1, and the banks thrown back.

Soornamookee River to Dugarázpatnam River, 8¾ miles.

57. This reach requires extensive works for its isolation. *First*, a *diversion* ¶ of canal will be made at Soornamookee end, which will have the effect of keeping the canal away from the river, and of training the river to its old bar. *Second*, a *diversion* ** will be formed from above the Tupuli drainage along Kódirpalliem †† and Dugarázpatnam, so as to remove the line from the backwater. The only land drainage that has to be disposed of in this portion is that of Tupuli, and this can be readily received into the canal by proper inlet arrangements. The reach will have flood-gates and outlets as usual with all isolated portions. The Soornamookee diversion works are explained in the annexed estimate, which is among those already sanctioned by Madras Government.

As regards the other diversion, it will suffice to observe that it is essential in order to avoid the backwater. This line will run at the back of Kodirpalliem, which being purely a fishing village would otherwise be inconvenienced by having the canal between it and the sea. The cutting will here be deep, but this is unavoidable.

58. Dugarázpatnam to Ceromandel is the longest isolated reach which it has been found possible to make in the entire canal. It starts with a *diversion* * at the north end to avoid the backwaters of Dugarázpatnam †. At south end there will also be a long *diversion* ‡ of 17 miles to avoid the Pulicat Lake along and indeed almost through which the existing line is carried and which experience has shown is dangerously exposed. There will be flood-gates to isolate it with four outlets, one at each end, and two placed intermediately on the east side; the coast line is high, but there is a great width of land here between the canal and the sea; large provisions for drainage have to be made. On the west side the bank will be made up to full height for 22 miles to keep out the lake floods. With the two diversions and the lake side bank this reach is necessarily a costly one, but under all the circumstances the improvements here proposed will be found well to repay the outlay. On east side a low bank will suffice.

Dugarázpatnam river to Ceromandel, 41 miles.
Section II, as per General Abstract.
* $\frac{67}{1}$ to V
† 69 M.
‡ $\frac{45}{1}$ to 27.

§ 38 M

It may here be mentioned that in the lake diversions the present so-called "Tettupet"§ cut will be included and utilized.

59. Virtually this reach will be but 1½ miles in the land, the rest being along open lake and across the Pulicat river. A short reach here is unavoidable, in order to avoid the backwater along Pulicat, which is much exposed during high wind and proves troublesome to the boatmen, and in which also as in all backwaters it has been found both difficult and costly to maintain a channel efficiently to the needful minimum depth. The *diversion* here proposed will run from Pulicat river, along west border, along Pulicat ¶ and Edamany. The northern arm of

Pulicat Survey Sheet No. 2.
Ceromandel to Arani River, 9 miles.
* 25 M.

Arani river by which spill water now enters the channel will be embanked across on both sides of canal line, and there will be a subsidiary bund higher up the arm so as to render the crossing safe. This arm is virtually the spill of the lake at the back of Pulicat and forms a swamp. By shutting up this opening, the flood-water will concentrate in the main arm of the Arani river and keep the crossing deep, which is the point to be aimed at. The Pulicat backwater is shallowing up very fast, and it is therefore very desirable to have a distinct channel for navigation. The reach will have flood gates, but outlets are not required. Two boat basins formed by simply widening the channel will be formed at Pulicat. The basin for the fishing village will be small and sufficient for immediate wants, the other is needed for traffic and boat building, a large number of boat owners and builders being residents at Pulicat.

60. Arani river to Ennore will be a comparatively costly reach, as it will consist of a *new* ** canal throughout for nearly the whole distance placed beyond reach of backwater along the east border. The expense here is chiefly enhanced by the existing canal along Chintamony †† and ~~Kadangoor~~ †† will be utilized, their western side being strongly embanked. As the ground along the coast is here high, there will be no need for a high bank along the new line; the reach will be isolated by flood-gates, and have outlets for land drainage. Across Chintamony backwater on 21st mile the crossing on west side will be embanked so as to keep out the land floods. The old bar being closed no bank will be required on the east side for the present, though possibly hereafter some special work with this object may be needed.

Arani River to Ennore backwater, 13 miles.
** $\frac{23}{\text{VII}}$ to $\frac{11}{\text{IV}}$
** $\frac{26}{11}$
** $\frac{13}{\text{IV}}$

Kadangoor

61. The work proposed in this reach with a view to the proper isolation of the channel from the backwater is a diversion* extending from Ennore to the lock at Shadayankuppam, and embankments from the latter place to Madras with a drainage channel along the low swampy ground on the east side. This will provide for the Madras drainage being led to a point north of lock, where it will join diversion line, and be furnished with a surplus self-acting sluice on west side. The existing Trivettore surplus sluice will be altered, so as to make the shutters more effective. The Ennore† end of the diversion channel will have a flood-gate. It is not practicable to carry this head of diversion more to the north, and a stretch of about a mile of open lake will therefore have to be crossed. In order moreover to obtain a direct crossing, the shoal now forming across lake, from west border and extending towards bar, will be cut through.

With a flood-gate at Ennore end, and strong high banks from that place to Madras, there will be no need to make any alterations to the existing Shadayankuppam lock.

A flood-gate is not requisite at the point where the canal enters the Cooum river at Madras, as the bar of this river is invariably cut through so soon as the water level rises to 3·0 feet above mean sea level.

At the Madras (better known as "Cochrane's") Basin an extensive wharf will be constructed to supersede the present basin, the walls of which have sunk, and the form found inconvenient. The improvement of basin here provided for will be limited to the east side for the present. The form of wharf will consist of a widening of canal by 50 feet for 1,500 feet in length, 50 feet being allowed for canal. The wharf will be formed by a concrete wall to M.S.L., above which there will be steps of laterite. The basin grounds will be enclosed in with palisading, and the ground adjoining entirely cleared of native huts, provision being made for compensating the owners. The existing lime kilns, with the exception of one or two, will not be touched. To afford the requisite facilities for traffic, roads will be run from the wharf wall directly across to existing line of road.

The only improvement to be made on the west side is the construction of a short branch channel to join the basin at the Government lime kilns. This will allow of the shell boats unloading there instead of at the former shell platforms which have been now encroached.

The Government grounds on which the lime kilns are placed will also be fenced off from the canal. The Trivettore and Washermanpett bridges, as they obstruct navigation, will be altered by removing the arches and substituting iron girders to give the requisite headway.

These bridges, as also all the others up to the Cooum, save the railway and salt bridges, will have tow-paths constructed under the arches. The South Indian Railway bridge, which is now a temporary structure for running trains to the Harbour Works, will if eventually made permanent (a point still open for consideration) need to be much enlarged, but no provision for the work is necessary in this estimate. The Timber Salt Depôt bridge will be altered, as the centre span is quite obstructed.

At the Shadayankupam lock an embankment will be made eastwards to Trivettore, so as to afford means of access across the swamp and fields to the toll and lock establishments.

62. The only work required in this reach will be deepening and forming the channel which along all this portion is carried through the river bed without any special arrangements as far as the north end of the next reach known as the Junction Canal.

Index Survey Sheet No. 2

Ennore backwater to Cooum River, 11 miles.

* 11 to 7/IV.

† 7/II.

‡ 10 M.

Cooum River, 1 mile.

67. A drainage near the Sadras bar will be strongly banked on the sea side and the drainage taken into the channel, as also with the next drainage at Sembadakuppam, which will be banked across on east side and drainage similarly disposed of. An old outlet to the south will now be restored, and will no doubt be kept open by the above two drainages, discharging through the flood-gate and outlet. The direction of this old cut will be altered with reference to the Palár river crossing. Here, contrary to the case of the Pennér river, the southern channel of the Palár will be closed, and northern one only maintained, as the present choked up condition of the bed of the former, and the more free and open passage down the latter favor this arrangement, which in other respects accords with the local features.

A diversion † cut will also be made through the islands to the south, near the end of which the flood-gate will be placed. The estimate, it will be observed, provides for the flood-gates for right bank of Palár at the end of extension canal. No large drainages cross the extension canal.

68. Having thus, as far as possible, detailed the method of treatment proposed for the improvement of each reach of the canal from its most northern limit † from Madras to the Palár river at 47 miles south of Madras, and to a point whence the extension canal into the Mookanum backwater is continued, a summary of the [illegible] of the estimate for each section of the proposed work, together with the [illegible] and the amounts of estimates, will now be given. Vide Statement A. It will be seen that the total outlay on the canal contemplated, as well as that already incurred, amounts to Rs. 63,87,100. It is believed that this sum will be found sufficient for all requirements, and that it is even quite possible savings may be effected by the substitution of artificial stone composed of Portland cement concrete in the quoins and floors of the flood-gates for cut granite, and other of indigenous teak, or by employing Jarrah wood from Australia in the flood-gates, instead of the more expensive Burma teak.

Total outlay on the work. Appendix B.

69. The distribution of the whole outlay, past, present and future, will be seen from Appendix B, and divides itself naturally into three distinct periods, viz.:—

			Rs.
(1) Outlay from the commencement of the work to the last famine			5,49,078
(2) Outlay during the famine, viz., from October 1876 to 31st March 1879			21,93,854
(3) Subsequent outlay, viz.:—			
(a) From April 1879 to 31st March 1882	...	3,44,253	
(b) Probable in current year ...	...	1,54,360	
(c) From end of the current official year	...	31,45,615	
			36,44,168
	Total	...	63,87,100

The figures given under (1), (2), and (3) (a) have been supplied by the Examiner, Public Works Accounts, and have been finally accepted as correct by the Accountant-General.

Soil in foundations of masonry works.

69. The soil all along the canal is pretty constant in its character, a surface layer of sand and light loam with denser clayey strata underlying it. No borings were found necessary, and in the construction of the foundations of the flood-gates grilles of timber with sheeting piles have been provided for with a view to distribute the superincumbent pressure over the subsoil.

70. The data upon which the rates have been based are those obtained from the actual construction of works along the canal and in the neighborhood, and sufficient margin has been allowed to accommodate them to such moderate increase of charge as circumstances may entail.

Principles of Tariff.

Appendix C.

71. The traffic on the canal has shown a tendency to increase in the successive years, during which registers have been continuously maintained. Appendix C gives the abstract of the traffic inwards to and outwards from the terminal station at Madras for the successive half-years from 1st July 1879 to 30th June 1882. In the year 1879 the tonnage arriving at the Madras basin amounted to 145,494 tons, and the departures amounted to 43,153 tons during that period. For 1881 the figures were 211,360 and 206,630 tons respectively.

The first half of the current year shows a considerable falling off owing to the long-continued drought during that period having so far reduced the depth of water in the back-waters through which the canal passes as to close them for over two months against any but the smallest description of boats.

Of the commodities carried over the canal, the largest and most important is salt, after which come firewood, food-grains, and sheep (the bleating lines) in order of their importance. The imports of these articles into Madras amounted in 1881 to 85,001, 54,454, 22,026, and 21,371 tons respectively. Numbers of boats with passengers and goods now find their way from Cocanada and Pondicherry, as also other inter-mediate places to Madras; and it can scarcely be doubted that on the execution of the requisite works of the Godavari and Kistna Delta schemes lately sanctioned by the Government of India, adding greatly to the existing irrigated area, the traffic in grain, &c., must greatly increase, and in the event of famine overtaking the Madras and Southern districts, railways now not impossibly springing up. The fact of the canal as a highway will be then still further established, as through no other such channel communication so economically as by means of the canal could large consignments be carried to the starving people.

In the Presidency Madras Government No. 1161, dated 21st November 1882, reports on the traffic on the Godavari, Kistna and East Coast Canals gave full details regarding the working of the boats employed on these canals. The experience then obtained have not in any great degree altered the rates then fixed for goods, but allowances have not in any great degree altered, and the rates then fixed for passengers were materially decreased. These proceedings were communicated to the Government of India in G.O., No. 3652, of 21st November 1882. The suggestions then made by Colonel Anderson, the Chief Engineer for Irrigation, that a scheme of a canal should be taken up in earnest, met with the approval of the Madras Government, and is now an established fact.

Appendix D.

72. In Appendix D is shown the number, tonnage, and description of boats which ply on the canal. Amongst those that are built specially for cargo, the largest number are of 50 tons burden, whilst the tonnage of the class which carries 28 and 35 tons respectively gives the largest aggregate results. The whole of the cargo boats work out to an average of 103 tons, which is a convenient size both for being handled with ease and of a draught better suited to the various depths of water in that advanced portion of the present canal. The largest boats are used for conveying firewood from the plantations within 15 miles north of Madras, as they alone are able to compensate for the high tolls of the freight carried by them. Of passenger and passenger boats, the most numerous are those of 4 and 6 tons respectively, commonly called "tub" boats, and the total number of these works out to an average capacity of 4 tons per each. The dhoni and dinghy boats are the description used most generally in the Northern Circars, and which, together the Uluvaeri and Kistna Canals, have taken out licenses for the Buckingham Canal as well.

Appendix E.

Appendix E contains the text of the rules for navigation now in force on the canal, which were approved and sanctioned by the Madras Government in their Proceedings, No. 1801-A. W., of 8th July 1879. These rules differ in several respects from those obtaining on the Kistna and Godavari Canals. There is no apparent reason why this difference should exist; the Madras Government have therefore ordered a Committee to convene and take into consideration the advisability of establishing an uniform set of rules for the whole of the coast canal licence system, and abolishing most of the tolls. This, however, will not do away altogether with the toll establishments now maintained, as particulars of traffic will have still to be recorded for each section of the canal as is done at present. As there will be no money collections, this work can in future be carried out by a clerk and one peon on Rs. 15 and Rs. 6 per mensem.

Registration of tides.

73. The fluctuations of the tides were registered at thirty-eight stations along the canal during the years 1879, 1880, 1881, and 1882, but these were necessarily only of value during the period when the several bars were open along the coast. The recorded readings during the times when the rivers were in flood, and again when some of the bars were open, whilst others were closed, gave very conflicting results, and have proved of doubtful value in determining the nature of the works to be carried out for the improvement of the canal. The M.S.L. was the datum to which it was at first proposed to refer all bed levels of different sections of the canal and the sills of the masonry works along them. The M.S.L. in use in this Presidency was, till recently, that established by the late Colonel De Havilland, of the Madras Engineers, and referred to a bench-mark stone placed by him some forty years ago on a marble slab in the Fort wall near the north gate at Madras. The tidal observations carried out in the Great Trigonometrical Survey of India have, however, proved De Havilland's bench-mark to be very nearly 1 foot ~~above~~ its true value. Below

Limiting levels for determining improvements to canal.

In a canal running along the coast line, however, and only here and there connected with the sea, as is the case with the Buckingham Canal, it has appeared necessary to work between two limiting levels, viz., that of the highest storm wave level as yet recorded for the determination of the heights to which the bank of the canal should be raised, and the lowest recorded tide level for the depth to which the bed of each reach should be excavated. The former level was defined from the cyclone of November 1880, when the canal suffered severe damages from the irruption of the sea; and the latter levels, owing to the peculiar circumstances of each reach of the canal, were taken from the tide gauge readings. To simplify the calculations of quantities in the estimates, average lowest recorded tide levels were struck for each reach, and the longitudinal and cross sections drawn out accordingly, a slightly give-and-take arrangement being thus followed. Below this average L.R. tide level the canal bed has been calculated to 3 feet, and it is at this depth that it should always be maintained.

Peculiar circumstances of certain reaches in the canal.

74. Of those sections of the canal where connection with the sea is liable to be temporarily suspended by the closure of the bars, the most notable are the reaches between Madras and Kundelairu (90th mile N.). In this length exist large bars at Ennore (11th mile), Pulicat (26th mile), Dugarajpatnam (62th mile), and Kottapatam (80th mile). The opening of these bars, however, is due chiefly to the fact that large backwaters within the coast line receive upland drainage until they accumulate to a level at which they overtop and clear away the bars formed by the surf. As there are no defined channels out to sea through these bars, it has been found impossible to keep them open when, with the setting in of the south-west monsoon, the wind and littoral current turn northwards up the Bay of Bengal. With the ~~closure~~ of the river bars and the setting in of the hot weather evaporation over the area of backwater goes on apace without any compensating indraught from the ocean, or supplies from local drainage; and the water level in long sections of the canal gradually diminishes ~~until~~ as was evidenced more particularly in the present than in probably any other year.

75. These backwaters may, therefore, be looked upon as huge evaporating basins during a time of the year when the canal is cut off from all its sources of supply, and as such should be avoided.

Necessitating reclamation of the backwaters with which they are connected.

The reclamation of the backwaters in the interests of the canal then is a subject of vital importance, but in doing so the fact must not be overlooked that a certain storage area is necessary to receive water at high tides from the sea in order to maintain the scouring action on the bars during the ebb. But on the other hand, as in the case of the Pulicat lake, where the area to be covered amounts to 178 square miles, and of which one half at least is covered by high tides during the time the Pulicat bar is open to a depth of something under 2½ feet of water, the width of the bars during this period being under 100 yards, it may be taken for granted that from the month of March, when the bars begin to show signs of closing, down to September, when the lowest tidal variation is reached, the indraught through the bars is not commensurate with loss by evaporation from the surface of the backwaters, and that, owing to their great area, the accession of tidal water does not influence the remoter parts before the ebb sets in. There are thus large areas of these backwaters which after a certain time of the year draw upon the canal for its supply to keep pace with the evaporation from their surfaces, and the water level must necessarily diminish until the bars open again by the influence of the sea, or by the receipt of upland drainage waters.

Instance of the Pulicat Lake.

76. The reclamation by embankments of all backwaters is therefore necessary within certain limits, say, to lands not covered at high tides to a greater depth than 2 feet. Were this done, the drainage falling into the backwaters could be pounded up within these embankments, and, as it is presumed that the water will be charged with much silt from the uplands, they may be allowed to deposit the little held in suspension, and then be allowed to flow off through regulating weirs at ebb-tides to increase the action on the bars. By shutters opening towards the backwaters, no salt water need be allowed on to the lands thus reclaimed, which would increase enormously in value owing to their proximity to the canal, and eventually, by their sale, recompense all expenditure incurred on them.

Proposed method of reclamation.

77. As it is on all accounts desirable, therefore, in the interests of the canal, to permanently establish a series of open bars along the coast, and as the only way this *desideratum* can be attained is by the concentrated outflow through a defined channel at frequent periods, both as regards all upland waters and of all the tidal outflow during an ebbtide, and as this can only be effected by extensive reclamation of tracts of backwater which have up to the present served no other purpose than to dissipate rather than conserve the energy of tidal action, the regulation of the canal in the manner now proposed must lead to the conversion of hitherto useless, if not unhealthy, swamps into valuable cultivated areas.

Resultant benefits derived from the canal.

These areas thus reclaimed may, if desired, be taken over by the Forest Conservancy Department for the growth of timber and fuel trees. The practicability of this has already been sufficiently demonstrated at various points along the course of the canal, and testimony is borne to the utility of the scheme in Proceedings of the Board of Revenue, No. 859, dated 25th June 1880, where the inward traffic in firewood in the Nellore District (through which the canal runs for 150 miles of its course) is ascribed to the "facilities afforded by the improvement of the Buckingham Canal" during the year 1878-79. From the information furnished by the Collector of South Arcot District again, it would appear that large tracts of waste land remain to be planted up with casuarina and other fuel trees, which he is confident will be taken up by private enterprise as the benefits afforded by the canal as a cheap means of carriage come to be realized. The effect of opening up the canal to Merkanam and southwards, as contemplated, will be to raise the local price of fuel by at least 25 or 30 per cent., and thus improve the condition of the villagers along the coast. It would be desirable if the whole of the works now estimated for could be completed within the next six years,

which would necessitate an average allotment of 5 lakhs of rupees per annum distributed as follows :—

3 lakhs in 1883-84
5 do. in 1884-85
5 do. in 1885-86
6 do. in 1886-87
6 do. in 1887-88
6 do. in 1888-89

The average amount allotted for New Works on the canal during the last two official years has been Rs. 1,55,000 only.

(Signed) R. R. E. DRAKE-BROCKMAN, Major, R.E.,
Executive Engineer, Buckingham Canal Division.

APPENDIX A.

Summary of Estimates for improving the several reaches of the Buckingham Canal as sanctioned in detail from time to time by the Madras Government.

Total number of Locks and Sluices in each Section.	Total number of Road Bridges in each Section.	Description of Work.	Position.	Reference to Report.	Amount of Estimate as sanctioned in detail by the Madras Government.	Total for each Section.
					Rs.	Rs.
		Northern Canal.				
		Section I.—From St. Mary's Bridge at Madras to Pulicat.				
1	1	Improvements and alterations to Salt Katar Bridge.	1st mile ..	Paragraph 61 ..	13,000	
2	..	Improvements to the locks at Madras ..	2nd ,, ..	Do. 61 ..	25,685	
3	..	Improvements to canal from Vasin to Shadayankuppam Lock.	2nd to 7th mile ..	Do. 61 ..	18,775	
4	..	Improvements and alterations to Washermanpett Bridge.	3rd mile ..	Do. 61 ..	7,039	
5	..	Do. do. to Triveliur Bridge ..	5th ,, ..	Do. 61 ..	7,020	
6	..	Toll Office and Establishment sheds at Shadayankuppam Lock.	7th mile 3rd furlong.	Do. 39 (11).	759	
7	..	Diversion to canal from Shadayankuppam Lock to Ennore.	7th mile 3rd furlong to 11th mile.	Do. 61 ..	42,250	
8	..	Flood-gate south bank of Ennore Backwater.	11th mile ..	Do. 62 ..	19,380	
9	..	Do. south bank of do. ..	13th ,, ..	Do. 59 ..	19,380	
10	..	Superintendent Bungalow at Ennore ..	13th ,, ..	Do. 39 (11).	5,715	
11	..	Diversion and improvements to canal from Ennore to Pulicat.	13th to 25th mile 6th furlong.	Paragraphs 59 and 60.	1,48,200	
12	1	Sluice bridge at Pulicalchittoor, Kattapally, Kalingatoo, and Kanagadoo.	14th, 17th, 19th and 22nd miles	Paragraphs 59 and 39 (9).	4,640	
13	..	Flood-gate south bank of Arni River ..	22nd mile 6th furlong.	Paragraph 60 ..	16,650	
14	..	Do. south bank of do. ..	24th mile ..	Do. 60 ..	16,650	
15	..	Two sluice bridges at Pulicat	25th ,, ..	Paragraphs 59 and 39 (9).	2,085	
16	..	Flood-gate at the Pulicat Lake and ..	25th mile 6th furlong.	Paragraph 59 ..	16,650	
					4,30,779	
		Add Items of accepted Abstract Estimate, Nos. 36, 38 and 39.	..	..	3,653	
						4,34,432
		Section II.—From Pulicat to Buckingham.				
1	..	Flood-gate South bank of Cummandoo ..	27th mile ..	Paragraph 59 (11).	3,160	
2	..	Diversion to canal from Cummandoo to Tetrapalli.	28th to 38th mile.	Do. 58 ..	98,600	
3	..	Flood-gate at Cummandoo and ..	28th mile ..	Do. 58 ..	16,650	
4	..	Sluice bridge at Cummandoo	27th ,, ..	Do. 39 (9).	510	
5	..	Outlet at do.	27th ,, ..	Do. 58 ..	3,360	
6	2	Improvements to canal, 38 miles 2 furlongs to 39 miles.	38th to 39th mile.	Do. 58 ..	7,369	
7	..	Sluice bridge at Tetrapalli	38th mile ..	Do. 39 (9).	635	
8	..	Diversion to canal from Tetrapalli to Jonnagalpolliem. 39 miles 6 furlongs to 43 miles 5 furlongs.	39th to 43rd mile.	Do. 58 ..	70,900	
9	..	Two sluice bridges at Chennagalpolliem and Jonnagalpolliem.	42nd and 44th mile.	Do. 39 (9).	1,056	
10	..	Superintendent House at Jonnagalpolliem	44th mile ..	Do. 39 (11).	5,715	
11	..	Improvements to canal, 44 miles 6 to 65 miles 5 furlongs.	44th to 65th mile.	Do. 58 ..	1,58,765	
12	..	One sluice bridge at Cudalur	46th mile ..	Do. 39 (9).	396	
13	..	Toll office and Establishment sheds at Royadoruvu.	50th ,, ..	Do. 39 (11).	868	
14	..	Superintendent House at Royadoruvu ..	50th ,, ..	Do. 39 (11).	5,715	
15	..	Two sluice bridges at Royadoruvu and Pendeli.	58th and 64th miles	Do. 39 (9).	1,320	
16	..	Diversion to canal, 65 miles 5 furlongs to 67 miles 2 furlongs.	65th to 67th mile.	Do. 58 ..	26,420	
17	..	Outlet at 67 miles 2 furlongs	67th mile 2nd furlong	Do. 58 ..	3,660	
18	..	Flood-gate south bank of Dagarajapatnam river.	Do. do. ..	Do. 58 ..	19,030	
					3,96,208	
		Add Items of General Abstract Estimate, Nos. 65, 66, 69 and 72.	..	..	2,63,590	
						6,59,798

Summary of Estimates for improving the several reaches of the Buckingham Canal, &c.—cont.

Numbers of Items of Detailed Estimates	Numbers of Items of General Abstract Estimate	Description of Work.	Position.	Reference to Report.		Amount of Estimate as entered in detail by the Madras Government.	Total for each Section.
						Rs.	Rs.
		Northern Canal—cont.					
		Section III.—*From Ponneriapalem to Kistnapatam.*					
1	..	Diversion to canal, 69 miles 2 furlongs to 71 miles 2 furlongs.	69th to 71st mile.	Paragraph	57 ..	36,870	
2	..	Flood-gate south bank of Dugarajapatam river.	67th mile 3rd furlong.	Do.	57 ..	19,030	
3	..	Cutting on 67 miles 3 furlongs	Do. do.	Do.	57 ..	3,660	
4	..	Superintendent's house at Dugarajapatam.	68th mile	Do.	39 (11)	9,715	
5	..	Bazaar and police at Dugarajapatam	68th ..	Do.		2,340	
6	..	Sailing boats at do.	68th ..	Do.	39 (9)	1,000	
7	..	Do. at Tirupili	72nd mile	Do.		500	
8	..	Cutting on 71 miles 5 furlongs	71st mile 6th furlong.	Do.	57 ..	3,650	
9	..	Improvements to canal, 72 miles 3 furlongs to 75 miles 3 furlongs.	72nd to 75th mile.	Do.	57 ..	17,200	
10	..	Accommodation diversion and flood banks ..	74th to 77th ..	Do.	57 ..	50,700	
11	..	Cutting at 76 miles 3 furlongs	76th mile 6th furlong.	Do.	57 ..	6,450	
12	..	Flood-gate south bank of Seemakankon river.	77th mile	Do.	57 ..	20,880	
13	..	Do. south bank of do. ..	77th .. 1st furlong.	Do.	56 ..	23,880	
14	..	Improvements to canal, 77 miles 1 furlong to 80 miles 1 furlong.	77th to 80th mile.	Do.	56 ..	24,300	
15	..	Superintendent's house at Seddavaram ..	79th mile ..	Do.	39 (11)	5,715	
16	..	Two sailing boats at Seddavaram and Karangapet.	79th and 81st mile	Do.	39 (9)	1,270	
17	..	Diversion to canal, 80 miles 4 furlong to 82 miles 7 furlongs.	80th mile ..	Do.	56 ..	8,400	
18	..	Outlet at 82 miles 3 furlongs	82th mile 6th furlong.	Do.	56 ..	3,450	
19	..	Flood-gate south bank of Kandaleru river.	83th mile ..	Do.	55 ..	18,040	
						2,51,340	
		Add Items of General Abstract Estimate Nos. 85, 86, and 79.	..	..		2,88,109	5,40,249
		Section IV.—*From Kistnapatam to Penner River.*					
1	1	Flood-gate south bank of Kandaleru river.	91st mile ..	Paragraph	55 ..	18,380	
2	..	Improvements to canal, 91 miles 4 furlongs to 92 miles.	90th to 92nd mile.	Do.	55 ..	6,100	
3	..	Outlet at 92 miles 6 furlongs	92th mile 6th furlong.	Do.	55 ..	3,460	
4	..	Sailing boats at 91 miles ..	91st mile ..	Do.	39 (9)	1,480	
5	..	Bridge at Kistnapatam road crossing ..	91st	Do.	39 (10)	10,250	
6	..	Superintendent's house at Kistnapatam ..	92nd mile ..	Do.	39 (11)	6,630	
7	..	Diversion to canal, 92 miles to 93 miles 4 furlongs.	92nd to 93rd mile.	Do.	55 ..	13,680	
8	..	Sailing boats at Kistnapatam	93rd mile ..	Do.	39 (9)	555	
9	..	Improvements to canal, 93 miles 4 furlongs to 95 miles 6 furlongs.	93rd to 95th mile.	Do.	55 ..	7,030	
10	..	Outlet at 95 miles 4 furlongs	95th mile 4th furlong.	Do.	55 ..	3,455	
11	..	Flood-gate south bank of Nalatur river ..	Do. do. ..	Do.	55 ..	18,550	
12	..	Improvements to canal, 95 miles 6 furlongs to 97 miles 2 furlongs.	96th to 97th mile.	Do.	54 ..	11,930	
13	..	Flood-gate south bank of Nalatur river ..	96th mile 6th furlong.	Do.	54 ..	18,550	
14	..	Outlet at 97 miles 6 furlongs	Do. do. ..	Do.	54 ..	3,485	
15	..	Diversion to canal, 97 miles 2 furlongs to 97 miles 7 furlongs, and new cut to drainage channel.	97th mile ..	Do.	54 ..	6,540	
16	..	Improvements to canal, 97 miles 7 furlongs to 101 miles 1 furlong.	97th to 101st mile.	Do.	54 ..	4,350	
17	..	Diversion to canal, 101 miles 1 furlong to 101 miles 6 furlongs and cutting drainage channel.	101st mile to 6th furlong.	Do.	54 ..	7,300	
18	..	Outlet at 101 miles 5 furlongs	101st mile 3rd furlong.	Do.	54 ..	3,690	
19	..	Flood-gate south bank of Kodur river ..	Do. do. ..	Do.	54 ..	16,540	

Summary of Estimates for improving the several reaches of the Buckingham Canal, &c.—*cont.*

Serial No. of Items in the Abstract Estimate	Serial No. of Items in the Detail Estimate	Description of Work.	Position.	Reference to Report.	Amount of Estimate as entered in detail in the Madras Cost Office work.	Total for each Section.
		Northern Circle—*cont.*			Rs.	Rs.
		Section 24.—From Kaduppalam to Pennar River—cont.				
10	..	Flood-gate south bank of Kodur river ..	101st mile 4th furlong.	Paragraph 53 ..	18,540	
11	..	Outlet at 101 miles 4 furlongs	Do. do. ..	Do. 53 ..	3,630	
12	..	Improvements to canal, 101 miles 6 furlongs to 111 miles 2 furlongs and 8 furlongs.	101st to 111th mile.	Do. 53 ..	29,950	
13	..	Toll Office and Establishment sheds at Ennur.	103rd mile ..	Do. 39 (11).	1,400	
14	..	Outlet at 107 miles 4 furlongs	107th mile 3rd furlong.	Do. 53 ..	3,590	
15	..	Do. at 109 miles 6 furlongs	109th mile 5th furlong.	Do. 53 ..	3,510	
16	..	Sluice basin at Mygaud	110th mile ..	Do. 39 (3).	1,075	
17	..	store and office at do.	110th	Do. 39 (11).	2,510	
18	..	Outlet at 111 miles 4 furlongs	111th mile 3rd furlong.	Do. 53 ..	3,910	
19	..	Flood-gate south bank of Gungapatnam river.	111th mile 4th furlong.	Do. 53 ..	20,500	
20	..	Improvements to canal, 111 miles 6 furlongs to 114 miles 2 furlongs.	111th to 114th mile.	Do. 53 ..	12,980	
21	..	Flood-gate south bank of Gungapatnam river.	112th mile 5th furlong.	Do. 53 ..	20,500	
22	..	Outlet at 113 miles 3 furlongs	113th mile 2nd furlong.	Do. 53 ..	3,510	
23	..	Flood-gate south bank of Pennar river ..	114th mile ..	Do. 53 ..	20,500	
					5,83,270	
		Add Items of General Abstract Estimate, Nos. 24, 25 and 26.	..	..	6,02,498	6,12,768
		Section F.—From Pennar River to end of Coonimedu Canal in Ayetur District.				
1	..	Pennar diversion	114th to 117th mile.	Paragraph 51 ..	20,300	
2	..	Flood-gate south bank of Pennar river ..	114th mile 4th furlong.	Do. 51 ..	20,500	
3	..	Training and cross bank of Pennar river ..	Do. do. ..	Do. 51 ..	68,690	
4	..	Inspection Bank-house at Pennar inland ..	116th mile ..	Do. 39 (11).	3,715	
5	..	Outlet at 116 miles 7 furlongs	116th mile 7th furlong.	Do. 51 ..	3,510	
6	..	Improvements to canal, 116 miles 7 furlongs to 119 miles 3 furlongs.	116th to 119th mile.	Do. 50 ..	11,445	
7	..	Ramakkapalam diversion, 119 miles 3 furlongs to 119 miles 4 furlong.	119th to 120th mile.	Do. 50 ..	8,325	
8	..	Sluice basin at Ramakkapalam	120th mile ..	Do. 39 (3).	1,210	
9	..	Outlet at 120 miles	120th	Do. 50 ..	3,250	
10	..	Improvements to canal, 120 miles 1 furlong to 122 miles 6½ furlongs.	120th to 122nd mile.	Do. 50 ..	20,060	
11	..	Diversion to canal, 122 miles 6½ furlongs to 123 miles 5 furlongs.	122nd to 123rd mile.	Do. 50 ..	14,650	
12	..	Two outlets at 123 miles 5 furlongs and 123 miles 6 furlongs.	123rd mile 5th and 6th furlong.	Do. 50 ..	6,500	
13	..	Flood-gate south bank of Pydera river ..	123rd mile 5th furlong.	Do. 50 ..	19,650	
14	..	Diversion to canal, 123 miles 6 furlongs to 126 miles 7 furlongs.	123rd mile to 126th mile.	Do. 49 ..	45,900	
15	..	Flood-gate south bank of Pydera river ..	123rd mile 6th furlong.	Do. 49 ..	19,000	
16	..	Improvements to canal, 126 miles 7 furlongs to 131 miles 7 furlongs.	126th to 131st mile.	Do. 49 ..	25,900	
17	..	Sluice basin at Irungalla	128th mile ..	Do. 39 (3).	1,160	
18	..	Flood-gate south bank of Sakapalle river ..	128th	Do. 49 ..	19,650	
19	..	Do. north bank of do. ..	128th	Do. 49 ..	19,980	
20	..	Diversion to canal, 131 miles 7 furlongs to 132 miles 5 furlongs.	131st to 132nd mile	Do. 49 ..	9,364	
21	..	Outlet at 132 miles 5 furlongs	132nd mile 5th furlong.	Do. 49 ..	3,645	
22	..	Flood-gate south bank of Chippalere river.	Do. do.	Do. 49 ..	18,100	
23	..	Diversion to canal, 132 miles 5 furlongs to 134 miles 4 furlongs.	132nd to 134th mile	Do. 48 ..	18,690	
24	..	Flood-gate south bank of Chippalere river.	133rd mile 6th furlong.	Do. 48 ..	18,100	

Summary of Estimates for improving the several reaches of the Buckingham Canal, &c.—cont.

Numbers in this Map corresponding with those in the Estimate	Numbers of Plans and Sections &c.	Description of Work.	Position.	Reference to Report.		Amount of Estimate as mentioned in Detail in the Margins Give columns.	Total for Reach.
						Rs.	Rs.
		NORTHERN CANAL—cont.					
		Section F.—From Pennar River to end of Chingleput Canal at Kistna District—cont.					
35	..	Two outlets at 152 miles 6 furlongs	152nd mile 6th furlong.	Paragraph 48 ..		6,090	
36	..	Improvements to canal, 134 miles 3 furlongs to 150 miles 5 furlongs.	134th to 150th mile.	Do. 48 ..		33,100	
37	..	Sliding basin at Tavanigunta	139th mile 2nd furlong.	Do. 39 (3) ..		700	
38	..	Second-class Rest-house at Tavanigunta	Do. do.	Do. 39 (11).		5,715	
39	..	Sliding basin at Chennagunpalliem	144th mile	Do. 39 (3) ..		3,150	
40	..	First-class inspection bungalow at Ramagiem.	146th mile 2nd furlong.	Do. 39 (11).		8,894	
41	..	Office and store at do.	Do. do.	Do. 39 ..		5,646	
42	..	Third Officer, duty at do.	Do. do.	Do. 39 ..		1,596	
43	..	Sliding basin at do.	Do. do.	Do. 39 (3) ..		2,500	
44	..	Two outlets at 150 miles 6 furlongs	150th mile 6th furlong.	Do. 48 ..		6,040	
45	..	Flood-gate south bank of Kistna river	Do. do.	Do. 48 ..		18,720	
46	..	Improvements to canal, 151 miles to 153 miles 7 furlongs.	151st to 153rd mile.	Do. 47 ..		21,930	
47	..	Flood-gate south bank of Kistna river	151st mile	Do. 47 ..		13,730	
48	..	Outlet at 151 miles	151st ,,	Do. 44 ..		2,850	
49	..	Two sliding basins at Ghanikanda and Kistna.	152nd and 153rd miles.	Do. 39 (3) ..		1,500	
50	..	Moosera northern diversion	151st to 152nd mile.	Do. 45 ..		3,087	
51	..	Outlet at 152 miles 7 furlongs	152nd mile 7th furlong.	Do. 47 ..		2,500	
52	..	Flood-gate south bank of Kamsera river	153rd mile	Do. 47 ..		22,340	
53	..	Moosera right flood bank	153rd ,,	Do. 48 ..		3,124	
54	..	Do. left do.	153rd ,,	Do. 48 ..		3,124	
55	..	Do. north diversion	153rd mile to 153rd mile 6th furlong.	Do. 48 ..		6,250	
56	..	Flood-gate south bank of Moosera river	153rd mile	Do. 47 ..		22,340	
57	..	Outlet at 153 miles	153rd ,,	Do. 48 ..		3,124	
58	4	Improvements to canal, 153 miles 6 furlongs to 168 miles 3 furlongs.	153rd to 168th mile.	Do. 45 ..		31,680	
59	..	Second-class Rest-house at Gollapalliem	153rd mile	Do. 39 (11).		5,715	
60	..	Sliding basin at Gollapalliem	153rd ,,	Do. 39 (3) ..		1,125	
61	..	Outlet at 154 miles 4 furlongs	154th mile 4th furlong.	Do. 48 ..		3,093	
62	..	Sliding basin at Pulaka	160th mile	Do. 39 (3) ..		675	
63	..	Outlet at 165 miles	165th ,,	Do. 44 ..		3,055	
64	..	Flood-gate south bank of Pulava river	166th ,,	Do. 45 ..		18,440	
65	..	Pulava right flood bank	167th to 183rd mile.	Do. 48 ..		6,250	
66	..	Duplicate cut and improvements to canal, 168 miles 3 furlongs to 169 miles 3 furlongs.	168th to 180th mile.	Do. 48 ..		14,100	
67	..	Flood-gate south bank of Pulava river	168th mile 2nd furlong.	Do. 45 ..		18,440	
68	..	Flood-gate south bank of Moosera river	169th mile 3rd furlong.	Do. 45 ..		18,440	
69	..	Do. north bank of do	Do. do.	Do. 45 ..		18,440	
70	..	Outlet at 169 miles 3 furlongs	Do. do.	Do. 45 ..		3,055	
71	..	Moosera left flood bank and Kongalur diversion to Moosera.	172nd mile	Do. 48 ..		14,060	
72	..	Improvements to canal, 169 miles 3 furlongs to 177 miles.	169th to 177th mile.	Do. 44 ..		19,800	
73	..	Sliding basin at Moosera	172nd mile	Do. 39 (3) ..		2,157	
74	..	Bridge at Ethamanikala	174th mile	Do. 39 (10).		30,250	
75	..	Sliding basin at do.	174th ,,	Do. 39 (3).		2,410	
76	..	Thondaru diversion, 177 miles to 177 miles 7 furlongs.	177th mile	Do. 44		11,150	
77	..	Improvements to canal 177 miles, 7 furlongs to 183 miles 1 furlong.	178th to 183rd mile.	Paragraphs 43 and 44		22,900	
78	..	First-class inspection bungalow at Kothapalam	179th mile	Paragraph 39 (11).		6,630	
79	..	Stores and office at Kothapalam	179th ,,	Do. 39 (11).		2,340	
80	..	Bridge at do.	179th ,,	Do. 39 (10).		19,250	
81	..	Fasen at do. both sides	179th ,,	Do. 39 (3).		8,180	
82	..	Road dam at do.	179th ,,	Do. 39 (10).		5,600	
83	..	Sliding basin at Mottamala	183rd mile	Do. 39 (9).		505	
84	..	Outlet at 183 miles 2 furlongs	183rd mile 2nd furlong.	Do. 44 ..		3,179	

Summary of Estimates for improving the several reaches of the Buckingham Canal, &c.—cont.

Item No.	Description of Work.	Position.	Reference to Report.	Amount of Estimate as sanctioned in detail for the Madras Government.	Total for each Section.
				Rs.	Rs.
	Northern Canal—cont.				
	Section V.—From Power House to end of Commercial Canal to Kuttur Channel—cont.				
75	Wood-gate south bank of Madiganeli lock.	10 rd mile 2nd fur.	Paragraph 41 ..	21,400	
76	Improvements to canal, 183 miles 5 furlongs to 185 miles 6 furlongs.	183rd to 185th mile.	Do. 43 ..	41,220	
77	Wood-gate south bank of Madiganeli lock.	185rd mile 2nd fur.	Do. 41 ..	21,400	
78	Cutting Waste at Pulicondu ..	185th mile ..	Do. 39 (9) ..	315	
79	Clay-puddle eight flood-bank ..	186th mile 6th furlongs.	Do. 43 ..	6,400	
80	Wood-gate south bank of Gundakanama lock.	186th do. ..	Do. 41 ..	21,720	
81	Improvements to canal 187 miles to 190 miles 2½ furlongs.	187th to 190th mile.	Do. 43 ..	12,960	
82	Clay-puddle left flood-bank ..	189th mile ..	Do. 43 ..	15,850	
83	Puddle wall south of lock ..	189th ..	Do. 43 ..	21,720	
84	Waste Weirs at Gummidipundi ..	190th mile ..	Do. 39 (9) ..	315	
85	Improvements to canal, 190 miles 2½ furlongs to 192nd mile 6 furlongs.	190th to 192nd mile.	Do. 43 ..	15,850	
86	Puddle wall Establishment sheds at Gudur Pumping.	192nd mile ..	Do. 39 (11) ..	3,664	
87	Bridge across at Gudur Pumping ..	192nd	Do. 39 (9) ..	450	
88	Flood-gate do. ..	192nd mile ..	Do. 43 ..	18,500	
89	Improvements to canal, 192 miles 4½ furlongs to 193 miles 4 furlongs.	192nd to 193rd mile.	Do. 43 ..	5,160	
				11,24,062	
	Add Items of General Abstract Estimate, Nos. 68, 69, 70 and 72.	.. ..	.. ..	13,45,000	
					24,69,062
	Section VI.—From the Canal from Buckingham Canal to Commercial Canal, Kuttur Channel.				
1	Breaching cut	200th mile ..	Paragraph 41 ..	3,850	
2	Puddle trench	201st	Do. 41 ..	14,000	
3	Cut and refill at the crossing of the Buckingham Canal.	199th	Do. 41 ..	3,770	
				21,620	
	Add Item of General Abstract Estimate No. 73.	.. ..	.. ..	20,654	
					41,274
					67,35,397
	Tools and Plant and Machinery (General Abstract Estimate Item No. 71.)	.. ..	.. ..	..	58,103
	Total, Northern Canal ..	.. ..	.. ..	..	67,93,500
	Southern Canal.				
	Section I.—From St. Mary's Bridge at Madras to Sadras Canal Lock.				
1	Lock at Adyar river left bank ..	.. ..	Paragraph 63 ..	61,200	
	Add Items of General Abstract Estimate, Nos. 68, 69A, 69B and 72.	.. ..	.. ..	6,81,997	
					7,43,197
	Section II.—From Sadras Canal Lock to Palar River.				
1	Improvements to canal from Adyar river to 6 miles 5 furlongs.	6 to 8th mile ..	Paragraph 64 ..	50,300	
2	Lock at Adyar river right bank ..	1st mile ..	Do. 64 ..	42,750	
3	Two skeleton bridges of Granite Dwarf and at Pallava cluster bridges, &c.	1st and 3rd miles.	Do. 39 (9) ..	4,045	
4	Coir Office and Establishment sheds at Perungudi.	6th mile ..	Do. 39 (11) ..	825	

Summary of Estimate for Improving the several reaches of the Buckingham Canal &c.—contd.

Item No.	Reference to Abstract	Description of Work	Quantity	Reference to Specification	Amount	Total
		Southern Circle.			Rs.	Rs.
		Section XV.—From Madras Head to Pulicat Lake.				
		Cutting Excavation.				
1		Cutting 6 feeder at Kottivakkam	5th mile	Paragraph 67 (2)	1,650	
2		Widening on inside, 3 inches a challenge to 1 foot 6 inches at 6 miles 6 furlongs	5th to 14th mile	Do. 66 ..	10,200	
3		Two sudden bends at Kottivakkam, 12 miles 6 furlongs from 5th mile	12th to 14th mile	Do. 66 (5)	3,000	
4		Widening north bank of Ennur head	14th mile 1st furlong.	Do. 44 ..	18,840	
5		Excavation to waste, 14 miles 3 furlongs from 5th mile	15th to 21st mile	Do. 65 ..	1,66,200	
6		Widening north bank of Ennur backwater	15th mile 5th furlong.	Do. 66 ..	14,000	
7		Widening north bank of Ennur	17th mile 5th furlong.	Do. 66 (1)	3,150	
8		Widening north bank of Ennur backwater, 2 miles 4 furlongs from 19th mile.	19th mile 4th furlong.	Do. 66 (2)	27,000	
9		Widening north bank of Ennur backwater	21st mile 2nd furlong.	Do. 66 ..	14,400	
10		Excavation to waste, 11 miles 4 furlongs from 21st mile.	21st to 33rd mile.	Do. 65 ..	2,430	
11		Widening north bank of Ennur backwater	24th mile 4th furlong.	Do. 66 ..	14,000	
12		Widening north bank of Ennur backwater	25th mile 4th furlong.	Do. 66 (1)	4,650	
13		Excavation to waste, 12 miles 4 furlongs from 33rd mile.	33rd to 45th mile.	Do. 65 ..	2,430	
14		Widening north bank of Ennur backwater	33rd mile 4th furlong.	Do. 66 ..	14,000	
15		Widening north bank of Ennur backwater, 2 miles 4 furlongs from 41st mile.	41st to 43rd mile.	Do. 66 ..	22,750	
16		Excavation to waste, 11 miles 4 furlongs from 45th mile.	45th to 57th mile.	Do. 65 ..	2,430	
17		Widening north bank of Ennur backwater	45th mile 4th furlong.	Do. 66 ..	14,000	
18		Widening north bank of Ennur backwater, 2 miles 4 furlongs from 53rd mile.	53rd to 57th mile.	Do. 66 ..	22,750	
19		Widening north bank of Ennur backwater	57th mile 4th furlong.	Do. 66 ..	15,150	
20		Widening north bank of Ennur backwater	59th mile	Do. 66 (2)	2,625	
21		Widening north bank of Ennur backwater	60th mile	Do. 66 ..	18,900	
22		Flood-gate, 3/3 bank, Ennur river	60th mile	Do. 66 ..	14,700	
23-A		Five outlet sluices	13th, 18th, 20th, 23rd and 28th miles.	Do. 66 ..	6,80,745	
					78,600	
		Add Items of General Abstract Estimate, Nos. 68, 69, 69-A, and 73				6,66,855
		Section XVI.—From Ennur River to Korukkam.				
1		Flood-gate, Ennur river, right bank	10th mile	Paragraph 66 ..	18,900	
2		Second-class Boat-house at Pennyur	34th	Do. 89 (11).	6,718	
3		Toll Office and Establishment about 36 miles from Alamparai.	36th	Do. 89 (11).	640	
4		Store and Office at Alamparai	38th	Do. 89 (11)	2,340	
					27,318	
		Add Items of General Abstract Estimate, Nos. 68, 69 and 73			1,87,460	
						2,15,778
		Tools and Plant and Machinery, Item No. 71				10,245
		Total, Southern Canal ..				15,22,000
		Grand Total, Northern and Southern Canals.				65,87,100

CHITAUR,
December 1882.

(Signed) R. R. E. DRAKE-BROCKMAN, Major, R.E.,
Executive Engineer, Buckingham Canal.

APPENDIX E.

STATEMENT showing the Expenditure incurred up to 31st March 1882 and to be incurred on different Sections of the Buckingham Canal.

No.	Sections of Canal.	Expenditure up to the commencement of Famine.	Expenditure during Famine.			Expenditure subsequent to Famine up to 31st March 1882.	Total of Columns 3, 4, and 7.	Further Expenditure to be incurred including the probable Outlay in 1882-83.	Total of Columns 8 and 9
			Total Famine Expenditure.	Deduct Receipts after Number Rates levied as Famine.	Net Ordinary Expenditure.				
1	2	3	4	5	6	7	8	9	10
	Southern Canal.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.
1	From St. Mary's Bridge at Madras to Junction Canal Lock	16,002	7,12,497	1,29,395	5,83,102	48,053	6,47,157	56,080	7,03,237
2	From Sadras Canal Lock to Pálár River	48,836	39,719	15,581	24,138	861	73,396	5,92,628	6,66,353
3	From Pálár River to Merkanam	...	32,633	15,016	17,617	1,05,793	1,38,410	36,355	2,19,765
		64,838	7,84,849	1,60,992	6,24,857	2,14,207	9,63,893	6,78,463	15,89,355
	Northern Canal.								
1	From St. Mary's Bridge at Madras to Pulicat ...	...	...	...	...	1,452	1,452	4,62,960	4,64,412
2	From Pulicat to Dugarázpatnam	1,800	3,10,685	69,185	2,41,500	7,473	2,50,973	4,07,826	6,58,799
3	From Dugarázpatnam to Kistnapatam	2,85,782	...	...	...	...	2,85,782	2,54,467	5,40,249
4	From Kistnapatam to Pennér River	1,96,658	85,239	6,541	78,898	52,434	3,07,330	3,04,778	6,12,108
5	From Pennér River to tail of Commamur Canal ...	...	17,39,875	4,94,500	12,45,375	71,047	13,16,422	11,34,474	24,50,896
6	Junction Canal from Buckingham Canal to Commamur Canal	...	4,281	1,047	3,234	17,440	20,674	20,600	41,274
		4,84,240	21,40,080	5,71,273	15,68,807	1,50,046	21,86,293	25,55,104	47,38,397
	Total ...	5,49,078	29,24,929	7,31,275	21,93,654	3,64,253	30,87,185	32,33,567	63,20,752
	Tools and Plant and Machinery provided for in the General Abstract Estimate	...	...	...	...	...	...	...	66,348
	Grand Total ...	...	...	...	...	...	...	...	63,87,100

(Signed) R. R. E. DRAKE-BROCKMAN, Major, R.E.,
Executive Engineer, Buckingham Canal.

Geneva
13th September 1963

APPENDIX D.

Statement shewing the Number, Tonnage, and Description of Boats licensed for each Section of the Buckingham Canal for the Year 1881.

Steamers, Tugs, Boats

Particulars	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	BB	CC	Total
	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.
Government Boats	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Private Boats	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Boats compounded for the whole year	..	..	1	3	..	3	3	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	3
A or Madras Section	..	..	1	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	2
B or Madras do.	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1
C or Pulicat do.	4	3	3	12	3	5	1	11	3	3	3	1	3	3	1	15	10	12	3	10	10	14	3	12	13	10	11	6	1	200
D or Kistnapatam Section	..	..	..	1	1	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	17
E or Ramapatam do.	..	..	..	1	1	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	13
F or Kottapatam do.	..	..	..	1	1	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	13
Total Number of Boats ..	4	3	5	29	5	11	4	11	3	3	3	1	3	3	1	15	10	12	3	10	10	14	3	12	13	10	11	6	1	249
Total Tonnage ..	4	27	24	145	20	33	7	165	24	30	27	10	27	30	10	225	200	240	60	200	200	280	60	240	260	200	220	120	20	3,313

Statement shewing the Number, Tonnage, and Description of Boats licensed for each Section, &c.—contd.

Particulars	Steamers, Tugs, Pontoons and Launch Boats.																		Boats and Budgero Boats.											
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	A	B	C	D	E	F	G	H	I	J	K	L
	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.
Government Boats	..	..	1	1	1	4	2	2	3	..	1	1	1	..	..	..	..	17	..	..	..	..	..	..	..	..	..	..	..	..
Private Boats	..	..	..	1	1	2	1	..	..	..	..	..	..	1	1	1	1	9	..	..	..	..	..	..	..	..	..	..	..	..
Boats compounded for the whole year	..	..	1	2	2	3	3	3	3	3	3	3	3	3	3	3	3	50	..	..	..	..	..	..	..	..	..	..	..	..
A or Madras Section	..	1	7	12	12	4	..	..	..	..	..	..	..	..	..	..	..	36	..	..	..	..	..	..	..	..	..	..	..	..
B or Madras do.	1	1	4	2	..	..	1	..	..	1	..	..	..	..	..	..	..	10	..	..	..	..	..	..	..	..	..	..	..	..
C or Pulicat do.	4	24	18	52	42	42	18	18	18	18	3	18	3	3	3	1	..	403	..	..	..	..	..	..	..	..	1	..	1	3
D or Kistnapatam Section	..	..	..	1	1	..	1	..	1	..	1	1	..	..	..	..	..	23	..	..	..	..	..	..	..	..	..	..	..	..
E or Ramapatam do.	..	..	1	1	1	2	2	2	2	2	..	..	..	..	..	..	..	26	..	..	..	..	..	..	..	..	..	..	..	..
F or Kottapatam do.	..	..	..	1	1	1	2	2	2	2	1	1	..	..	..	..	..	19	..	..	..	..	..	..	..	..	..	..	..	..
Total Number of Boats ..	7	33	31	105	74	61	42	29	27	29	13	24	7	7	7	4	4	593	..	..	..	..	..	..	..	..	1	..	1	3
Total Tonnage ..	1	40	110	134	113	109	107	102	110	102	110	110	40	40	40	40	40	1,293	..	..	..	..	..	..	..	..	32	9	32	..	32

Grand Total ..

Statement showing the Number, Tonnage, and Description of Boats licensed for each Section, &c.—contd.

Particulars	Dawk and Runner Boats—contd.							Passage Boats.							Various sweep Boats.						
	10 and under 20	20 and under 30	30 and under 40	40 and under 50	50 and under 60	60 and upwards	Total	10 and under 20	20 and under 30	30 and under 40	40 and under 50	50 and under 60	60 and upwards	Total	10 and under 20	20 and under 30	30 and under 40	40 and under 50	50 and upwards	Total		
Government Boats	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	17	114
Private Boats	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	9	64
Boats compounded for the whole year	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	41	348
A or Sudras Section	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	133	487
B or Madras do.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	13	..	..	..	..	13	64	307
C or Pulicat do.	..	3	..	1	..	..	4	336	45	3	1	..	..	385	3	3	..	..	..	21	767	1,818
D or Ristnapatam Section	..	..	..	1	..	..	2	..	..	..	..	..	..	..	..	1	..	..	..	1	33	253
E or Bamapatam do.	..	..	..	..	1	..	1	..	..	..	..	..	1	1	..	..	1	..	1	2	48	459
F or Kottapatam do.	..	3	2	1	2	2	17	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Total Number of Boats ..	3	3	1	1	2	2	25	169	45	3	1	..	1	165	21	10	..	1	32	1,128	..	
Total Tonnage ..	22	23	6	10	21	26	107	108	34	2	1	..	6	151	21	23	..	4	43	..	10,115	

CHINGLEPUT,
15th September 1862.

(Signed) R. B. E. DRAKE-BROCKMAN, Major, R.E.,
Executive Engineer, Buckingham Canal.

APPENDIX E.

THE BUCKINGHAM CANAL.

Gazetted, September 29, 1879.

The following Revised Rules for the regulation of the navigation of the Buckingham Canal, passed by the Madras Government with such alterations as appeared necessary, are, under the provisions of Section 59 of Act I of 1879, hereby published for general information :—

I.—The Buckingham Canal includes the following lines of navigation, extending from south of the Pálár river to the District of Chingleput to the junction of the tidal and fresh-water canals in the Kistna District near Pedda Ganjam, together passing over a continuous distance of about 306 miles, viz :—

1st.—The Sadras Canal extending from 12 miles south of the right bank of the Pálár river to Palavakkam, distance about 50 miles.

2nd.—The Madras Canal extending from Palavakkam to the Shadayankuppam Lock, distance about 16 miles.

3rd.—The Pulicat Canal extending from the Shadayankuppam Lock to near Raidurraveo, distance about 46 miles.

4th.—The Kistnapatam Canal extending from near Raidurravoo to near Kodoor, distance about 88 miles.

5th.—The Ramapatam Canal extending from near Kodoor to Ramapatam, distance about 44 miles.

6th.—The Kottapatam Canal extending from Ramapatam to the junction with the Commercial fresh-water canal in the Kistna District, distance about 46 miles.

II.—These lines of navigation include also such portions of all navigable estuaries, backwaters, rivers, and channels, whether salt or fresh, connected with such lines as have been artificially formed, deepened, or protected; except all those minor channels which have been excavated as feeders to the main line of canal for purposes connected with the Salt and Wood Departments; they shall be each and severally distinct lines of navigation as defined in Section 1 of Act I of 1879 (The Canals and Ferries Act), the provisions of which shall apply to each of these distinct lines of navigation separately, and they shall be denominated sections of the Buckingham Canal as follows :—

1st.—A or the Sadras Section.
2nd.—B or the Madras Section.
3rd.—C or the Pulicat Section.
4th.—D or the Kistnapatam Section.
5th.—E or the Ramapatam Section.
6th.—F or the Kottapatam Section.

III.—From and after the 8th day of October 1879, no vessel, but those hereinafter excepted, shall be allowed on, or to use any of the abovementioned distinct lines of navigation without—

(1st) The payment of an annual license fee at the rates specified in the Schedule A annexed for the use of any one of the abovementioned distinct lines of navigation.

Exception (1)—Vessels possessing licenses for the navigation of the canals of the Godávari or Kistna District will not be required to pay a license fee for the use of any section of the Buckingham Canal.

Exception (2)—The Pulicat fishermen (with boats under 2 tons each) should be free to fish in the backwater without the obligation to take out a license.

(2nd) The payment of a toll at the rates specified in the Schedule B annexed for passing from any one to any other of the abovementioned distinct lines of navigation for which the owner does not hold a license.

Exception (3)—Boats leaving their section will not be liable to toll when returning empty within two months.

Exception (2)—Boats licensed for the Kistna and Godávari plying through the length of the canal to Madras will pay 4 annas per ton on the outward journey, but on returning full or empty, they will pass free at any toll-bar at which they had paid toll within one month.

Exception (3)—Boat-owners have the option of compounding for a year's tolls at Rs. 10 per ton.

Exception (4)—Boats licensed for the whole canal will not pay tolls.

Exception (5)—Boats returning into their own sections with a cargo after an absence from it of ten clear days, or if returning empty after an absence from it of two months, must pay tolls.

IV.—The Executive Engineer of the canal will issue licenses (in the Form C annexed) personally or by Agents authorized by him in writing for the purpose, at such times and places as he may notify in the *Fort St. George Gazette* and in the Official

limits of the district in which the line of navigation, for which licenses are to be issued is situated. The vessels to be licensed must be brought at the time specified in the notification to the places where licenses are to be issued to be measured and registered and to have the necessary distinguishing marks put on them.

V.—These marks will show by letter the section of the canal to which the vessel belongs and which it is licensed to navigate. They will show the registered number of the vessel, and the tonnage, or the number of passengers the vessel is licensed to carry. They shall be put on under the direction of the Executive Engineer at the cost of the owner of the vessel, who will be held responsible that they are not defaced or obliterated, and that they are renewed from time to time as required. Yachts, pleasure-boats, and other vessels not intended to ply for hire, may be marked at the owner desires, provided the figures are clearly legible.

VI.—Applications for licenses shall be made in the Form D annexed, at any time before the 15th October for the current calendar year, and on the months of October, November or December for the ensuing calendar year. Printed forms of applications for licenses will be issued by the Executive Engineer of the Canal at his Office in Madras and by the Toll superintendents of the Canal at the Toll Offices at Pulicat, Sullurpettah, Tada, Redderpalem, Kaluvoy, Ramapatam, and Podda Gunjam.

VII.—The maximum dimensions of vessels brought on the canal hereafter will be limited to 80 feet in length, 16 feet beam, and 7½ feet draught; vessels of greater length and beam than may be now on the canal will be allowed to remain upon it at the owner's risk until they are worn out or removed, but the draught of water will be limited to all cases to 7½ feet, which draught will be marked by a painted band or water-line round the outside of the hull, provided that the painted band or water-line thus arrived at shall not allow less freeboard than 12 inches; or, in other words, be less than 12 inches below the lowest point in the gunwales; and no vessel shall be laden so as entirely to submerge this painted band. The height of fixed fittings, such as fenwood, rattan, leaves, &c., will be limited to the same dimensions and in a similar manner.

VIII.—The gross tonnage of all vessels will be obtained by the following rule:—

$$\frac{L \times B \times D}{50}$$

L being equal to the length of the vessel, measured at half the midship depth, from the afterpart of the stem to the foreport of the stern post.

B is equal to the sum of five widths taken from the inner side of the planking to one side of the rib on the other side, at equal distances of one-sixth of the above length, divided by 6.

D is the midship depth taken from the upper surface of the lumber strake (the bottom plank next the keelson, or the centre bottom plank when there is no keelson) to the under surface of the deck planking in decked vessels, or to the top of the upper strake or gunwale in open vessels.

The net or registered tonnage will be for—

Steamers, the gross tonnage less one-third; and for

Other vessels, the gross tonnage less 15 per cent.;

but the carrying capacity of any vessel to the load-line painted round the hull as laid down in Rule VII will be actually tested by weight on the owner of the vessel or his Agent bringing it to the Basin at Madras and making written application to the Executive Engineer to have it so tested, and the result arrived at by such testing shall be the registered tonnage of the vessel and be painted on it and adopted as the registered tonnage of the vessel, with effect retrospective to the commencement of the license under which the vessel is plying, i.e., all excess license fees and tolls collected from the commencement of the calendar year for which the vessel is licensed will be refunded, and vice versâ. In the case of a vessel being tested which is found to have had its tonnage correctly or under-estimated by the method of measurement in this rule, the boat-owner or his agent who applies for the testing will pay a fee for testing of eight annas per ton of the tonnage arrived at by the testing. The cost of testing shall be borne by the Government when it is carried out on the order of the officer in charge of the canal, and in such case its effect shall not be retrospective.

IX.—Vessels adopted to carry passengers, i.e., having a covered space for their protection, may be registered as passenger vessels and will then be licensed to carry one passenger for every 5 square feet of deck surface under cover to be measured as follows:—Length, from stem to stern at the deck level; breadth, the sum of five widths taken at equal distances of one-sixth the length and divided by 6; then length and breadth divided by 5 will give the number of passengers a vessel will be licensed to carry, including 40 lb. of luggage for each passenger. When passenger vessels carry cargo as well as passengers, the quantity of cargo allowable will be the registered tonnage less 400 lb. for each passenger on board.

First-class passenger vessels (such as budgerows) plying for hire and not carrying cargo will be licensed at the commencement of the year at the option of the owners, either like other vessels by a license fee of Rs. 2 per ton for one section and tolls at 6 annas per ton, or by a license

fee on the 1 per ton for the whole Passenger Canal for the year. In the calculation of the tonnage of such boats the gunwale will be taken as of 18 inches and the load-line marked envelopes, the tonnage being determined by sealing. The minimum fee for passing a passenger for the whole canal shall be 1s. 6d.

Vessels the private property of individuals, making use of the canals, but not carrying passengers or goods or plying for hire, will be licensed for a calendar year for the whole Passenger Canal on payment of a fee of 1s. 6d.

X.—Boats will be permitted to navigate the canal at night on the Lancashire Canal on payment of the passing rate and section of the toll specified in Schedule B subscribed on each succeeding 50 s. 3 d. will be charged on the vessel.

XI.—A vessel after the issue of a licence or certificate, if she can again use the canal within two months from the date of such licence or certificate, may have such licence or certificate renewed and re-issued. The new licence will be granted on production of the old licence and on payment of the portion of the fee for the unexpired term.

XII.—No person who has taken out a licence for the navigation of any section of the canal shall have claim to compensation on account of any impediment to navigation that may occur from any cause whatever.

XIII.—Before any vessel is brought into rivers and backwaters for sale, for repair, or for any other purpose except to ply for hire must apply to layer outside the boundary of canal traffic which will be claimed by the Canal Company. All vessels will not be allowed to enter on the public line of the canal for the purpose of proceeding from one river or backwater to another river or backwater or for any other purpose except in accordance with the rules prescribed for the use of the canal.

XIV.—The Executive Engineer in charge of the canal for the time being is authorized to enforce these rules, to collect tolls and licence fees, to appoint officers to be employed, and to detect proceedings under the provisions of Sections [illegible] of the Indian Canals Act, No. 1 of 1890.

[illegible]

[illegible]

[illegible]

XI.—The maximum speed of steamers will be limited to 10 miles an hour by day and to 5 miles an hour by night, reduced to 4 miles an hour when within half a mile of a lock, or vessels about entering in an opposite direction. The steam whistle shall be blown when speed is reduced on the aforementioned occasions and when entering a vessel going ahead in the same direction, or when approaching any sharp bend in the canal. Steamers passing through portions of the canal under repair or through portions of the canal that cannot stand a high speed shall reduce speed at those places to the limit fixed by the Canal Officers on notice-boards erected for this purpose.

XII.—Every vessel shall have the license always on board, and it shall be produced for examination by the Executive Engineer or by any officer authorized by the Executive Engineer to demand an inspection of it.

XIII.—Every vessel plying for hire is liable to be inspected at any time or place by the Executive Engineer or by officers authorized by him to inspect vessels, and the Executive Engineer may withdraw the license of any vessel found to be from any cause unfit for use, and to withhold the license until the vessel is made serviceable.

XIV.—The Executive Engineer may suspend the license of any vessel for any period not exceeding three months, or levy a fine not exceeding 5 rupees in each case, for any infringement of these rules or bye-laws.

THE BUCKINGHAM CANAL, MADRAS.

SCHEDULE A.

Licensed Tolls.

Description of Vessel.	Rate per Ton of Registered Tonnage. Rs. A. P.
For every ship, steamer, barge, boat, or vessel of any description and propelled in any manner entering any of the distinct lines of navigation or sections of the canal other than the section in which it is licensed, and which it can use free of tolls	0 1 0
	Rate per Square Yard. Rs. A. P.
For every raft of floating timber, bamboos, or other floating substance	0 1 0

THE BUCKINGHAM CANAL, MADRAS.

SCHEDULE B.

Licensed Tolls.

Description of Vessel.	Rate per Ton of Registered Tonnage. Rs. A. P.
For every ship, steamer, boat, barge, or vessel of any description, except those specified in the latter part of Rule IX (for the License for the whole month), propelled in any manner and used for any purpose except fishing or pleasure	2 0 0
For every fishing or pleasure boat	0 4 0

Fractions of tons will be counted as one ton, and the maximum charge for any vessel will be one rupee.

Licenses will be issued on payment of the above fees for the use of any distinct line of navigation included in the Buckingham Canal.

A license will not be granted to the same vessel for the use of more than one line of navigation on the canal, except in the instances of the two classes of vessels specified in the latter part of Rule IX.

Vessels licensed in any month of one year must pay the annual fee for the whole of that year.

Licensed vessels will have to pay no other dues or any sort for the use throughout the year of the section of the canal for which the license is granted.

The fee for a duplicate license will be two rupees.

THE BUCKINGHAM CANAL, MADRAS.

FORM C.

License No. of 1879.

This vessel is licensed to use the section of the Buckingham Canal during the calendar year 1879 free of further charge.

Registered No.
Name of owner.
Residence of owner.
Class of vessel (4).
Extreme length.
Do. breadth.
Do. depth.
Draught of water.
Licensed to carry tons cargo.
Do. do. passengers.
Fee paid
Licensed issued by on the day of 1879.

Executive Engineer.

(4) Here enter steamer, budgerow, cargo-boat, passenger-boat, fishing-boat, or pleasure-boat as the case may be.

THE BUCKINGHAM CANAL, MADRAS.

FORM D.

Application for License.

I (or we) the undersigned (1) residing at (2) in the District of (3) hereby apply for license to place (4) on the (5) section of the Buckingham Canal during the year 1879.

Date. Signature.

(1) Here enter name or names of owners.
(2) Place of residence.
(3) Name of district in which residing.
(4) Description of boat and purpose for which it is to be used, such as passenger-boat, cargo-boat, budgerow, &c.
(5) Section of the canal for which a license is required, *i.e.*, the

A or Sadras Section,
B or Madras Section,
C or Pallicat Section,
D or Kistnapatam Section,
E or Bamapatam Section,
F or Kottapatam Section.

R. H. SANKEY, Colonel, R.E.,
Secretary to Government, P.W.D.

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Report on the Panama Canal

Panama

Panama Rail Road Co.

and Interoceanic

Panama Steamship Co.

Panama

Department of Panama

Colombia

Panama

Panama Canal Co.

References

Gen. H. Gay Hodges

Panama

Hon. Henry

Panama

Rear Admiral

Panama

Hon. Thos. H. Ryan

Panama

Rene Bunau-Varilla

Panama

15th September 1902.

Benjamin Harrison

Report

Cockermouth canal

6 miles

Kirkpatrick canal

8 miles

Engrossed Bill

Planters & Pedagangan

82 tons

Pennsylvania
Berks Co.

Pennsylvania

Pennsylvania Northwards
for 22 Inches

Conference between the
Com. produced by Captain
Chambers and adopted

Red Land

Errors in the levels of canal between Rotterdam and Dordrecht.

Lord Lieutenant

Canal Office

Total Excavation Estimated Rock

Estimated quantity and Cost

Amount of work done

Total Length of Canal cut in 13 months.

Number of people employed on the work.

Named after His Grace the Duke of Buckingham at His Excellency's request.

Person previously named after Lord Clare

59

Lord Lieutenant of Ireland
Lord High Treasurer of Ireland
Lord High Chancellor of Ireland
Lord Privy Seal of Ireland
Principal Secretary of State
Lord President of the Council
Lord Chamberlain of His Majesty's Household
Master of the Horse
Vice Chamberlain of His Majesty's Household
Groom of the Stole
Captain of the Band of Gentlemen Pensioners
Captain of the Yeomen of the Guard
Captain General of His Majesty's Forces
Commander in Chief of His Majesty's Forces in Ireland
Lieutenant General of the Ordnance
Master General of the Ordnance
Secretary at War
Chief Secretary to the Lord Lieutenant
Chief Secretary to the Lord Lieutenant
Lords Commissioners of the Treasury
Lords Commissioners of the Admiralty
Lords Commissioners of the Board of Trade and Plantations
Lords Commissioners of His Majesty's Treasury
Lords Commissioners of His Majesty's Treasury
Lords Commissioners of His Majesty's Treasury

Southern Canal

Re Abergavenny to the proposed Brecknock & Abergavenny Canal to commence at or near the Canal Wharf in the Parish of Llanfoist Fawr in the County of Monmouth and to terminate at or near the Basin at the Gas Works in the Parish of Llanover in the said County of Monmouth

Minutes of Evidence taken before the Committee on Wednesday the 29th day of November 1871

Present Mr Whitbread in the Chair

Mr Bagge appeared on behalf of the Bill

Mr Bagge stated that the Bill was for the purpose of making a Canal to commence at or near the Canal Wharf in the Parish of Llanfoist Fawr in the County of Monmouth and to terminate at or near the Basin at the Gas Works in the Parish of Llanover in the said County of Monmouth

Mr Bagge stated that the Bill was promoted by the Abergavenny Canal Company, and that the Engineer was present to give evidence in support of the Bill

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(23)

Copy of Letter from the Secretary
to the Commissioners of Customs
dated 30th January 1857
Transmitting Copy of a Report
from the Commissioners of
Customs with the Views of the
Board thereon, with the Re-
solutions of a Conference
held at the Admiralty, and
of the Observations of the Lords
Commissioners of the Treasury
thereupon, and stating for the
consideration of the Board
the Instructions
which they propose to issue
to the Officers of the Coast
Guard in the event of the
Board concurring in the
Measures proposed by the
Commissioners of Customs
for the Prevention of Illicit
Practices.

Dated 30th January 1857

Letter from the Secretary to the Commissioners of Customs dated 30th January 1857 transmitting Copy of a Report from the Commissioners of Customs with the Views of the Board thereon, with the Resolutions of a Conference held at the Admiralty, and of the Observations of the Lords Commissioners of the Treasury thereupon, and stating for the consideration of the Board the Instructions which they propose to issue to the Officers of the Coast Guard in the event of the Board concurring in the Measures proposed by the Commissioners of Customs for the Prevention of Illicit Practices.

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Dated 30th January 1857

when finally Completed the Canal
herein by the Chief Engineer shall
from time to time Certify in Writing
passing all the damages by the
Company at Common Law, and in
their hearing the Parties by the
Justices thereof, both intermediate
and Ultimate, and Order at once
the proper Construction of
Locks and to be built by
Canal and the freedom of the
Channel from Deposits
&c. &c. the proper and Complete
formed & for the Convenience
of Boats on the Bridges over
and the Banks of the Canal
the Court of Directors Empowered to
Think Fit, And the time for
hath taken upon (for Defraying
the Charges) Amounts of Moneys
Required for the Carrying Forward
of the Canal of Navigation Communi-
cation as Aforesaid and
of the Directors

And the Court Empowered
and to Think Fit and Direct

Canal Legard - Markham 22

for a distance of 23 f 8 inches

Results of Cyclone

25. The Secretary of State
read the Report of the
Select Committee on the
Cyclone and Storm of the
10th April and 29th May 1882
printed therewith, and the
Conclusions which respecting that
Storm had been arrived at

Discussion thereon and
Resolutions framed.

(65) 59

26. Mr. Hon. Carleton
Tennent of Belvedere moved
seconded by the Hon. Colonial Treasurer
That Provision be made
in the Estimates for the
Current Financial Year of the
Sum of £5000 to be
applied in Repairing the Damage
done to Roads, Bridges, Jetties
and Public Buildings throughout
the Colony by the Cyclone
of the 10th April and the Storm
of the 29th May 1882

27. Mr. Hon. Carleton moved
seconded by the Hon. Colonial
Treasurer That the Select
Committee appointed to inquire
into the Cyclone and Storm
of the 10th April and 29th May
1882 and to report thereon
to the House be requested
to consider whether any
and what Steps should be
taken to prevent the
recurrence of such Disasters
in future and to report
thereon to the House

Question put and
Negatived

28. Mr. Hon. Carleton
moved seconded by the Hon.
Colonial Treasurer That
the Select Committee
appointed to inquire into
the Cyclone and Storm of
the 10th April and 29th May
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to the House be requested
to consider whether any
and what Steps should be
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recurrence of such Disasters
in future and to report
thereon to the House
Question put and
Negatived

29. Mr. Hon. Carleton
moved seconded by the Hon.
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thereon to the House
Question put and
Negatived

30. Mr. Hon. Carleton
moved seconded by the Hon.
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thereon to the House
Question put and
Negatived

31. Mr. Hon. Carleton
moved seconded by the Hon.
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Negatived

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Negatived

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Negatived

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Question put and
Negatived

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Question put and
Negatived

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Negatived

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Negatived

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Negatived

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Question put and
Negatived

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Question put and
Negatived

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Question put and
Negatived

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Question put and
Negatived

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Question put and
Negatived

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Question put and
Negatived

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Negatived

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recurrence of such Disasters
in future and to report
thereon to the House
Question put and
Negatived

Of natural conditions 30. Of the conditions which
have permanent relations
principle cannot

Recurrence of cyclones 31. Unfortunately [illegible]

General conditions of Canal operations

Measures necessary to be adopted for regulating Canal

Provisions when to be the Complete Canal Navigation Board

Their description

Their stability

(1) Alteration of remarks

General provisions under which the Inland Navigation Channels have been framed

(2) Heading of Minor Cross drainages.

(3) Communications across Lines to the coast

(4) Results of Experience of Cyclones.

(69)

which Canals shall be constructed

& first generally, and in certain places specified, that the ordinary minor Inland drainage shall be taken by

under the Canal & sluices or culverts or [illegible] by flow into such [illegible]

[illegible] and that all waters of [illegible] drainage & the discharge either at ends of the canals or at other convenient places by means of necessary channels or otherwise, that all persons shall be entitled to use the Canals for the purposes of navigation, subject to such rules & regulations as may be made from time to time by the Commissioners for the due regulation of the navigation thereof, and that all persons shall be entitled to use the towing paths of the Canals for the purposes of towing boats navigating the same, subject to such rules & regulations as may be made from time to time by the Commissioners for the due regulation of the towing paths, that it is necessary to keep open the Canals & channels, and the flood waters carried across the Canals and other major natural & artificial channels thereby increasing the depth of the Channels, and correspondingly increasing the capacity of the Canals, that the experience gained from the Cuttack cyclone of 1885, and the Backergunge cyclone of 1876 has shewn conclusively that many of the trees referred to are underground, and that

(6) Detail of Construction

Y Canal

(9) Land Revenue when the Revenue shall exceed

(10) Land Revenue when the Revenue shall exceed

(11) Road Cess Cap 62 Amended

(12) Ferry Boats Constructed and Ferry Fees altered

Indore Survey Sheet No 6
Pelda Canyon & Canada
Camma Ram 8 Inches.

Section V as per general Abstract
No 191 to 190
IW IIE

Cancellazione Ipoteca
Gandigendolfino Paola.

135

* 177 & 177
VII

X 160 M.

X 170 M.

Line
Hw. Palaroo. to Inunmaroo
Travl — 8 Miles.

X 166 M.

X 162 M.

X 165 M.

Index Survey Sheet No. 6/6

No. 160 & 159 or
VII VII½

Hammocks Northern
Division

X 166 M.

Hennessey Point

Reef to bricks

Hennessey & Chesapeake

River to bricks

Hennessey & Scotland

Diversion

Venting the Cuffed water

Directions for the Improved Gutters

Upon the proposed diversion of the Canal along the East Bank of the Cuffe to be cut from above the Lower Gutter as per Plan to the proposed Gutter

All drainage from the Canal will be effected

Chiffaleros & Pyderos drainage & Gutters.

122 to 131 VII Chiffaleros
126 to 129 VII Pyderos

× 127 M.

Gutters

Canal

Gutters

Gutters

Gutters

Penrice River Reach

2½ Miles

Section IV. as per General Abstract

Permanent Gungapatam

River 3½ Miles

1771

Embankment upon the Northern Bank of the River Gungapatam

Commencing at the Eastern Extremity of the Embankment and proceeding Westward thereon, the Bank is to be cut down to the Level of the Ground, and the Earth is to be thrown on the Land side of the Bank, so as to form a Ditch 4 feet wide at Top and 2 feet deep, except at Openings, where the Ditch is to be carried quite through the Bank, and the Earth is to be laid on the Land side of the Openings, and the Bank is to be planted with Stakes 2 feet apart, and 4 Rows deep, in the Manner directed by the Chief Engineer, where necessary protected by Piling

52 Miles 1 Chain 50 Links is remaining to be done

Estimate remaining to be done

52 Miles 1 Chain 50 Links at £ 1000 per Mile £ 52100

Deduct for Openings 1 Mile at £ 1000 per Mile £ 1000

£ 51100

Road 6 Miles

Road 6 Miles

Salvator River to Gundaling

River 5½ Miles

(83)

Section III. as first general Abstract

+ 89/VII & 89/½

Nagerajapatam Road to Trichinopoly

Nagerajapatam Road to Trichinopoly 77 Miles

Nagerajapatam Road to Trichinopoly 77 Miles

Nagerajapatam Road to Trichinopoly 77 Miles

M 25 M.

Index Survey Sheet. No. 7/6
Coromandel & Thames River
3 Parts.

Section I. Surveyor General's Abstract
* 25/11 & 24

* 25 M.

Shannon river to Enniscorthy

Backwater 13 Perches

× 23/VIII 6 11/12

× 20/11

× 18/IV

Judge Lang dist. No 2
Comm. Roads & Comm. Revs. & Taxes

Cocïon River Sheet

Index Survey sheet № 2/6.
The Inverness and Caledonian Canal.

× zero of Mileage as per Profile

X The Aldyn River the bed of which at times and before the practice of Cropping of the Banks of Canals has been very much lessened Cropping by the silting up of the Entire previously used the Commissioners of Sewers considerably improved & it is proposed to effect this by a System of groynes and the Construction of flood gates to Confine the flood water from Limits and thereby increasing the Scour to establish a deep & permanent waterway for the main for some distance upwards from the mouth. Steam vessels to be employed for Carrying on these improvements have been provided by Sanction of the General Act of the Commissioners for the Sewers Canals

Jetties

The Cost of the Jetties will not exceed £ under present circumstances and Local requirements, but the Commissioners are empowered to borrow for the purpose of the Act a Sum not exceeding £ and to charge the Expenses thereof upon the Drainage District in proportion to the Benefits which they will derive from the Improvements

(105)

Index Survey Sheet No. 1/6.

Kokkelanneedee to Palar

River 8 Miles

No. 21/11 & 22

(105)

Kokkelanneedee to Palar River 8 Miles

No. 21/11 & 22

Commencing from the Kokkelanneedee Bridge proceeding thence Northerly along the East bank of the River to the Palar Bridge.

Remarks.

Kokkelanneedee Bridge is a Stone Bridge of 3 Arches in good repair.

The Kokkelanneedee River is fordable at all seasons of the year.

The Palar Bridge is a Stone Bridge of 3 Arches in good repair.

The Palar River is fordable at all seasons of the year.

Kokkelanneedee to Palar

River 8 Miles

No. 21/11 & 22

Commencing from the Kokkelanneedee Bridge proceeding thence Northerly along the East bank of the River to the Palar Bridge.

Remarks.

Kokkelanneedee Bridge is a Stone Bridge of 3 Arches in good repair.

The Kokkelanneedee River is fordable at all seasons of the year.

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(105)

Kokkelanneedee to Palar

River 8 Miles

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The Palar Bridge is a Stone Bridge of 3 Arches in good repair.

The Palar River is fordable at all seasons of the year.

(105)

from by the above two Channels
discharging themselves into the
flood gate and comblet.
The direction of this
Old Cut will be altered
with reference to the Tide
power ongoing. Here Contrary
to the Case of the Former
Plan, the Southern Channel
of the Pier with the Cut
and Northern one only
Deepened as the present obst
ofs Condition of the Bed of the
former and the more free and ofs
passage down the latter former
which in other respects
the arrangement accords with
the Local Features of
the direction cut will be
kept made through the islands
near the
Old Channel which
the flood gate will be placed.
The Estimate stands for
Deepening proposed for the
flood gate perfect through
of Pier at the ends of

39 b 41/100

From the Statement A
it will be seen that the
total outlay on the Canal
contemplated as well as
that already incurred
amounts to £2,87,100.
It will be seen that this
sum will be found
sufficient for all repairs
works and that the sources
specified for defraying may
be effected by the substitution
of earthenware stoneware composed
of Portland Cement Concrete
in the grooves and floors
of the flood gates for cut
granite, and either of
underground tank or by
reinforcing portable wood frames
constructed in the flood gates
instead of the stone as proposed
Burma to Sea C

Schedule of Masonry Work

Appendix B

Schedule of Foundations of Masonry not to be Opened

Data for rates allowed in Estimates

for the distribution of the cubic contents of the Masonry of the several foundations of the Bridges and Culverts on the Line of Railway

(a) Foundations in Cement Concrete

(b) Plinth Course in Cement Concrete

(c) Footings of the Cement Concrete

(d) Footings of the Rubble Masonry

(e) Plinth Course in Rubble Masonry

(f) Footings of the Brick Masonry

(g) Plinth Course in Brick Masonry

(h) Footings of the Cement Concrete

(i) Plinth Course in Cement Concrete

(j) Footings of the Rubble Masonry

(k) Plinth Course in Rubble Masonry

(l) Footings of the Brick Masonry

(m) Plinth Course in Brick Masonry

Total

The figures given under (a) (b) (c) (d) (e) (f) (g) (h) (i) (j) (k) (l) (m) have been supplied by the Executive Engineer

for the distribution of the cubic contents of the Masonry of the several foundations of the Bridges and Culverts on the Line of Railway

(a) Foundations in Cement Concrete

(b) Plinth Course in Cement Concrete

(c) Footings of the Cement Concrete

(d) Footings of the Rubble Masonry

(e) Plinth Course in Rubble Masonry

(f) Footings of the Brick Masonry

(g) Plinth Course in Brick Masonry

(h) Footings of the Cement Concrete

(i) Plinth Course in Cement Concrete

(j) Footings of the Rubble Masonry

(k) Plinth Course in Rubble Masonry

(l) Footings of the Brick Masonry

(m) Plinth Course in Brick Masonry

Total

The figures given under (a) (b) (c) (d) (e) (f) (g) (h) (i) (j) (k) (l) (m) have been supplied by the Executive Engineer

Par Lieu Cons of Ye Office

Appendix C

period to Forest, the figures
were 241,207 and 208,600
tons respectively.

The first half of the
Current year's hours a
Considerable falling off
owing to the long Continued
Drought & during the C
period owing to far
reduced the depth of Water
in the Canal Locks through
to be to the Coast & prevent
over
us to close them for days
months ~~and some~~ against
any but the Small Class
descriptions of boats.

Of the Commercial Canals
over the Canal the largest
canal carries is important is
Salt afterwards Canal
Surveys Food grains wood
Stalls (for burning lime)
&c

long low keel forward
to owing to the forced
reductions of tolls and the
simplification of steamer
fees. The mode of
travelling by boats is
decided by popular with
the natives and efforts
of this character cannot
fail to produce beneficial
results.

With the opening
moreover of the Sugarman
Coal fields in the
Negara Dominions about
80 miles nor thwest of
Banjermasin a traffic in
carrying Coal down for
the use of the Mail steamers
South Borneo Railways
may not unprobably
spring up the foot of the

Cana C

and in the event of
famine ensuing the
value of such trade
communication to the
northern delta would
would be incalculable
benefit

of India in Council No. 262 of 2nd December 1868. The Appeal there made by Colonel Anderson, the Chief Engineer for Irrigation, that a Scheme of Canal from the Cauvery in connexion with the approval of the Secretary of State for India in Council, and is now in the course of execution, should be kept distinct from the Project for the improvement of the navigation of the Cauvery Canal.

Description of boats plying on the Canal

Appendix D

92. In Appendix D is shown the number, tonnage and description of boats which ply on the Canal. Amongst the classes that are built specially for cargo the largest number are of 20 tons burden, while the tonnage of the class which carries 28 to 29 tons

Appendix E.

Appendix E. Contains the
text of the Rules for Navigation
now in force in the Canal C
which were approved and
sanctioned by the Madras
Government in their Proceedi
&c. recited Page 7th July 1779
These Rules differ in Severa
respects from those established
on the Bengal Hooghly Canal
as appears
Here to appear as by the
differences above set forth
Page

tides were registered at 38
Stations along the Coast
during the years 1879, 1880 & 1881
but these were necessarily
only of a few days during the
period when the Levels
were run along the
Coast. The records during
during the time when the
Testers were in flood, and
again when those of the
Board were going to be taken
were closed, gave
very few Readings possible,
and have proved of
doubtful value in determ-
ining the nature of the
work to be carried out for
the improvement of the Coast
The Mr. Scott was therefore
not able to visit
proposed to report on the Coast
Levels of different Stations
of the Coast, and the
Tides

Registration of Tides

Kenilworth Canals for determining improvements to Canal

Ellis of the Mediterranean having
along Mem. The Ex Pol
in this Province
and the main Ship
established by the Lake
Dr Hall Canals of the
Engineers and surveyed
& Branch Ship Canal
filled by him known as
as swamp like that
in the Fortmall river
the North Gate
Inner Ex Pol
Information Connected
in the Great Survey of
Indian Lower
proved Dr Hall
Branch Ship Canal
Report for
Lower valley

Short Canal Running
along the East Lake known
and only here and Other
Engineers

(1)

Connected with the Lake Canals
as the Case with the
Peterborough Canals, it
has appeared necessary to
work Sections two Limiting
Levels, viz that of the highest
Storm water Level as yet
recorded for the determi
nation of the heights to
which the bank of the Canal
should be raised, and
the lowest recorded Low
Level for the depth to
which the bed of each
reach should be excavated.
The former Level was
declared from the Epoch
of November 1850, to have
the Canals suffered damage
damage from the Inundation
of that day, and the latter
Level owing to the peculiar
Circumstances of each reach
of

the Coast to the Northward
of Madras between Pt Calimere
and Karical (30 miles)
Nagore (40 miles) Negapatam
(50 miles) Porto Novo (60 miles)
Cuddalore (70 miles) Pondicherry
(80 miles) Sadras (90 miles)
Pulicat (96 miles) Durgapatam
(110 miles) and Madras (120 miles)
The Opening of these Bars
towards the Sea is also subject to the
same Inconvenience as the Mouths
of Canals drawing so much Water
as they commonly do, for which
reason the Boats employed in
conveying Cargoes from the Ships
to the Shore are obliged to wait
for the Tide to carry them over
the Bars, and frequently have been
detained for several Days together
before they could get out to Sea
or in from the Sea, and in the
Monsoons when the Surf runs high
they cannot get in or out at all
[illegible]

Instance of the Patent Lake

a certain limit of the Jetty
draw upon the Canals for
the supply to keep pace with the
evaporation from the surface
and the wastage necessary to
maintain until the bars of sand
& gravel by the influence of the
sea or by the receipt of surface
drainage waters.

Proposed method of reclamation

76. The reclamation by
Portsmouth Corpn of all the foreshores
is therefore necessary within
certain limits, & Canals
not covered at high tides
to a greater depth than
2 feet. Were this done, the
drainage falling into the
Canals would be found
up on those sub aerial
mud, as it is presumed that
the area will be changed
into Land from
with the influence of the tides

Hay

is by the Commissioners
thereby be objected to
and frequent periods be
as regards Captain
and of all the locks
during our able trade,
they can only be effected
by extensive precautions
of trees to afford shelter
have up to the present
no other purpose than to
dissipate rather than
conserve the energy of
tides in raising the regulation
of the canal in the manner
most proper and most
to the purposes of irrigation
water is not embarking
[illegible] to be
practicable to be obtained
of
may be taken over by the
Inland Communications Department
for

Revised Report
Arrived from the Canal

Appendix A.

[illegible]

[illegible]

[illegible]

Summary of Estimates for Improving the Several Harbours of the Madras Coast as Severally Laid in detail from time to time by the Madras Government

No.	Description of Work	Position	Reference to Report	Amount of Estimate as Sanctioned or Laid by the Madras Government	Total for
	Nor Thereof Same				
1	Improvement and Alteration to Pulicat Harbour Bridge	1st Mile	Para 61	13,000	
2	Improvement to the Port of Madras	2d Mile	Do	95,625	
3	Improvement to Canal from Ennore to the Duplicate Sluice	2d by 3d Mile	Do	19,750	
4	Improvement to Canal from Ennore to Pulicat Harbour	2d by 3d Mile	Do	7,090	
5	Do Do Do	Do	Do	Do	
6	Toll Officers Godowns Guard Sheds at Shadayanoopham Road	7th Mile & 7 Furlongs	Para 39(n)	789	
7	Diversion of Canal from Shadayanoopham Road to Ennore	7th Mile 3 Furlongs to 11th Mile	Para 61	43,250	
8	Flood Gate South Bank of Ennore Backwater	11th Mile	Do	19,380	
9	Do North Bank of Do	12th Mile	Para 60	19,380	
10	Second Class Rest House at Ennore	13th Mile	Para 39(n)	5715	
11	Diversions and Improvement to Canal from Ennore to Pulicat	12th to 20th Mile 6th Furlong	Paras 59 & 60	114,360	
12	Tiding Basins at Pulicat Vakkam Kalingalli, Kalingee & Kurungalee	15th, 17th 19th & 20th Miles	Paras 59 & 39(g)	4,640	
13					
	Carried over			378,124	

	Brought forward				270,124	
13	Flow Sake South bank Pathan Pass	30th Mile	Up to Para		1,150	
14	Do north bank Do	31st Mile	Do of Ramgunge		1,180	
15	Survey Basin at Pathan	32 Mile	Ramgunge		1,200	
16	Flow Sake to the Pathan Lake Pass	33rd Mile	Up to Para		1,260	
	Add Sum of Gross Highest Discharge				4,790	
					2,395	1,03,615
1	Second Class Rest House at Gorai	33rd Mile	Para 39 (9)		2,850	
2	Diversion & Canal Gorai Jessore to Kaligunge	34th Mile	Para 39 (9)		2,850	
3	Flow Sake at Coranadel	26th Mile	Para 58		16,650	1,72
4	Sluicing Basin at Coranadel	27th Mile	Para 39 (9)		810	
5	Outlet at Do	37th Mile	Para 58		3,960	
6	Improvement to Canal Do					
	36 to 50 Mile	36th to 50th Mile	Do		7,350	
7	Sluicing Basin at Tetulpelli	38th Mile	Para 39 (9)		630	
8	Diversion to Canal from Tetulpelli to Jonaghopolla	38th to 43rd Mile	Para 58		7,0000	
9	Two Sluicing Basins at Chaumgunpotta and Jonaghopolla	42nd 44th Mile	Para 39 (9)		1,260	
10	Second Class Rest House at Jonaghopolla	44th Mile	Para 39 (9)		5,715	
11	Improvement to Canal Do to Do	46th to 65th Mile	Para 58		1,35,765	
12	One Sluicing Basin at Kesbala	46th Mile	Para 39 (9)		395	
	Carried over				3,44,185	1,04,615

	Brought forward				3,40,685
13	Post Office and Telegraph Quarters at Rajahmundry	69 Mile	Para 39 (ii)		350
14	Second class Rest House at Rajahmundry	Do	Do		3,710
15	Forwarding Godown at Rajahmundry and Wharf	69 Mile	Para 39 (ii)		1200
16	Diversion Channel No. 1 to No. 12	69 Mile	Para 39 (ii)		2,000
17	Outfall Do No. 11	69 Mile	Para 39 (ii)		8,000
18	Flood Gate South bank of Rajahmundry Anicut	69 Mile	Para 39 (ii)		1,20,000
	Total Value of Ground Allotted to Irrigation Works				3,75,285

24

1	Diversion Channel No. 11 to No. 27	69 Mile	Para 39 (ii)		55,370
2	Flood Gate North bank of Dugarajapatnam Anicut	69 Mile, 3rd Table	Do		19,000
3	Outlet at Do No. 1	Do	Do	Do	3,650
4	Second class Rest House at Dugarajapatnam	69 Mile	Para 39 (ii)		3,715
5	Store & Office at Dugarajapatnam	69 Do	Do		2,340
6	Fencing Patta at Do	Do	Para 39 (i)		1090
7	Do at Thupili	92 Mile	Do		590
	Carried over				87,995 10,23,210

8	Outlet at [illegible]					
9	Improvements to Canal [illegible]					
	Ft [illegible]	[illegible]	[illegible]	[illegible]		
10	Improvements to Diversion Canal					
	Head Gate	[illegible]	[illegible]	[illegible]		
11	Outlet at [illegible]	[illegible]	[illegible]	[illegible]		
12	Flood Gate South bank of					
	Lagoon near the town	[illegible]	[illegible]	[illegible]		
13	[illegible] near the South [illegible]	[illegible]	[illegible]	[illegible]		
14	Improvements to Canal [illegible]					
	to [illegible] Ft	[illegible]	[illegible]	[illegible]		
15	Levee Canal Bank between					
	Indio and [illegible]	[illegible]	[illegible]	[illegible]		
16	Two Sinking Basins at Indio					
	Canal and Hanson's	2	Feet cubic	Para 59 (2)	1770	70
17	Diversion Canal [illegible]					
	Ft [illegible]	89	Cubic	Para 56	8450	
18	Outlet at [illegible] Ft	89	Cubic Yards	Do	8450	
19	Flood Gate South bank of					
	Alamo Canal near	90	Cubic	Do	18040	
					2,51,840	
	Add Items of General & Street Estimate abst			65,687/3	2,88,409	
						5,40,249
1 5/6	Flood Gate Near the bank of					
	Alamo Canal near	90	Cubic	Para 55	18,380	
	Carried over				18,380	16,33,459

		Brought forward			14,1645	16,334,59
11	Flood Gate South bank of Salatar River	Do	Do	Do	18,350	
12	Improvement of Canal Do to Do	95 to 97 Mile	Para 54		11,930	
13	Flood Gate North bank of Salatar River	95 Mile to Finlay	Do		18,350	
14	Outlet at Do Do	Do	Do	Do	3,485	
15	Diversion Canal Do to Do	97 Mile	Do		6,340	
16	Improvement of Canal Do to Do	97 to 101 Mile	Do		4,350	
17	Diversion Canal Do to Do	101 Mile to 6 Finlay	Do		7,300	
	Carried over				14,1645	16,334,59

	Brought forward				Rupees	Rupees
28	Ord Cut at [illegible]	No. 1	[illegible]	[illegible] Rs. 53	3570	67
29	Flood Gate South bank of Ganges [illegible]	No. 1	[illegible]	[illegible] Rs.	20,500	
30	Superstructure of Canal [illegible]	No. 1 to No. 3	[illegible]	[illegible] Rs. 53	19,980	
31	Flood Gate North bank of Ganges [illegible]	No. 1	[illegible]	[illegible] Rs.	20,500	
32	Ord Cut at [illegible]	No. 1	[illegible]	[illegible] Rs.	3570	
33	Flood Gate South bank of Ganges [illegible]	No. 1	[illegible]	Rs.	20,500	
					3,03,270	
	Add Items of ground & boat Estimate at				65,68,473	3,09,498
						6,12,768
						22,46,227

Brought forward

1	Ramathorthan Durrumsal					
2	Ramathorthan Durrumsal to the South of Ramathorthan Tank	1	120	Miles Furlongs	Rupees	1,310
3	Ramathorthan Tank to the South of Ramathorthan Tank	1	120	Miles	Rupees	2,250
4	Improvements to Canal					
	From the 1st to the 2nd Furlong	1	120	Miles	Rupees	20,000
5	Durrumsal to Canal					
	From the 1st to the 2nd Furlong	1	120	Miles	Rupees	11,030
6	Two Outlets at the 1st Furlong		2	Miles	Rupees	6,500
7	Flood gate South bank of Pyderoorcoil		1	Miles	Rupees	19,000
8	Durrumsal to Canal from the 1st to the 2nd Furlong		1	120	Miles	Rupees	45,900
9	Flood gate South bank of Pyderoorcoil		1	120	Miles	Rupees	19,000
	Carried over						316,200	22,462

	Brought forward				6,74,513
52	Fishing Boats at Pulicat	110	Pulicat	Para (1)	440
53	Do at Coconada	110	Do	Para	2,000
54	Masula Boats at Pulicat	110	Pulicat	Para	11,000
55	Pulicat Right to Flood Tax	110	Pulicat	Parah	4,000
56	Duftadars Establishment at Pulicat	110	Pulicat	Parah	14,400
57	Masula Boats at Madras	180	Madras	Para	14,400
58	Fishing Boats at Madras	180	Madras	Para (1)	2,160
59	Do at Armagon	180	Armagon	Para	1,440
60	Do at Cuddalore	180	Do	Para	3,960
61	Fishing Boats at Porto Novo	178	Porto Novo	Para (1)	1,440
62	Do at Sadras	178	Sadras	Para	1,080
63	Fishing Boats at Pondicherry	178	Pondicherry	Para (1)	2,130
64	Do at Chinnacalle	178	Chinnacalle	Para (1)	10,530
65	Fishing Boats at		Do	Para (1)	2,610
66	Fishery Division				
	at	177	Karical	Para 46	11,160
	Do at				
67	Fishery Establishment at Carical	175 & 183	Karical	Para 38 & 44	23,700
68	Fishery Inspectors Bungalow at Nattapatam	179	Nellore	Para 39 (1)	6630
	Carried over				8,64,163 22,46,237

	Brought forward					
69	Stores & Office at Ambikapatam	1	Pole	Rupees	Rupees	2,500
70	Bridges at Do	2	Do	Do	Do	10,000
71	Police at Ambikapatam	2	Do	Do	Do	4,000
72	Road Peons at Do	2	Do	Do	Do	360
73	Station Master at Ambikapatam	1	Do	Do	Do	600
74	Sub Conductor Do	1	Do	Do	Do	360
75	Store Sale Godown Sircar	1	Do	Do	Do	240
	Store Keeper					
	Superintendent of Canal &c	1	Do	Do	Do	2,400
	Do Do					
	Head Clerk Do	1	Do	Do	Do	1,200
	Store Sale Godown Sircar	1	Do	Do	Do	360
	Superintendent of Canal &c	1	Do	Do	Do	2,400
	Do Do					
	Store Sale Godown Sircar	1	Do	Do	Do	360
	Sirdars	2	Do	Do	Do	1,200
	Overseer at Kumaphatam	1	Do	Do	Do	600
	Do Do					
	Head Clerk Rest House at Kumaphatam	1	Pole	Rupees	Rupees	240
	Sirdars Peons at Do	2	Do	Do	Do	720
	Overseer at Do	1	Do	Do	Do	600
	Head Clerk at Kumaphatam	1	Do	Do	Do	720
	Carried over					1,07,703

50

90	Brought Forward				1077033	22,402
	Repairs of Canal &c. No 3					
	do do 4					
91	Locks Offices and Lockkeepers Cottages					
	at Pedlars Rapids	190	Rods	Perch	2,204	
92	Locks Offices at Pedlars Rapids		do	Perch		
93	Locks Culverts &c		do	Perch		
94	Repairs of Canals No 3	195	Rods	Perch	10,920	
	do do 4					
					3,100	
					1,326,257	
	Add Amount of General & Contingencies Estimate for Pedlars Rapids				120,000	
						24,57,257
1	Deepening Cut	190	Rods	Perch	2,204	
2	Lowering Sills &c	90	do	Perch	14,000	5,2
3	Locks Walls Gates Culverts Carpenters					
	Ice Pedlars Rapids Locks	90	do	Perch	3,750	
					2,600	
	Add Amount of General & Contingencies Estimate for Pedlars Rapids				24,650	
						47,384,257
	Total of Canals & Reservoirs Engineers & General Contingencies Estimate					36,103
	Total Northern Canals					4,794,500

	Brought forward					
23	Flow Lake Left bank Relief Piers	8	Miles	Parallel	18,480	
23A	Piers at Lot 1 Alcove	1	Pier	Do	10,000	
		30	Feet Radius		10,000	
	Total Number of Ground Machines Estimated to [illegible]					38,480
					7,680	
						46,160
1	Flow Lake Relief under Regulation Works	40	Miles	Parallel	184,800	
2	Piers (Canal Bank) Foundations Superstructure	2	Miles	Parallel	[illegible]	
3	Toll Office Established under Act at Lambaraie	50	Miles	Do	440	
4	Store & Office at Lambaraie	Do		Do	2,940	
					27,316	
	Total Items of General Abstract Estimate				186,450	213,765
	Tools & Plant Machinery Items &c. &c.					10,245
	Total Southern Canals					1592,600
	Grand Total Northern & Southern Canals					6387,100

Office of the Executive Engineer
Dum Duma Canal Division
Cachar
December 1902

Rye Date - Burdwan
Executive Engineer - Bengal

Appendix B.

Table B

Statement showing the population, number of houses, number of occupied and unoccupied houses, number of families, number of persons per square mile, number of persons per house, and number of persons per family in the Districts of the Province of Punjab

No.	Districts	Area in square miles	Number of towns and villages	Number of houses	Number of occupied houses	Number of unoccupied houses	Number of families	Population	Number of persons per square mile	Number of persons per house	Number of persons per family
1	2	3	4	5	6	7	8	9	10	11	12
1	Umballa	1,851	1,000	57,249	49,993	7,256	61,000	263,237	142	4.60	4.31
2	Ludhiana	1,395	1,092	39,209	36,192	3,017	52,384	222,222	159	5.66	4.24
3	Ferozepore	3,615	1,211	33,613	29,691	3,922	47,340	203,240	56	6.04	4.29
4	Jullundur	1,431	1,000	76,249	69,005	7,244	87,227	363,492	254	4.76	4.16
5	Hoshiarpur	2,268	1,000	76,249	69,005	7,244	87,227	363,492	160	4.76	4.16
6	Kangra	9,978	2,000	31,685	29,165	2,520	36,978	149,223	15	4.71	4.03
7	Simla	1,141	1,000	23,782	23,782	-	29,782	93,469	82	3.93	3.14
8	Mandi	1,200	1,000	13,258	13,258	-	16,258	52,000	43	3.92	3.19
9	Suket	420	1,000	6,341	6,341	-	7,841	24,000	57	3.78	3.06
10	Simla Hill States	28,492	1,000	65,259	65,259	-	78,898	304,770	10	4.67	3.86
11	Delhi	1,739,875	1,000	494,500	424,376	71,047	131,422	1,134,474	24,508	2.29	8.63
12	Hissar	4,281	1,000	9,967	9,234	1,740	20,674	20,600	4,812	2.07	2.23
13	Rohtak	1,740	1,000	54,000	51,092	2,908	56,000	266,104	153	4.93	4.75
14	Gurgaon	1,978	1,000	92,499	78,676	13,823	94,000	362,000	183	3.91	3.85
15	Karnal	2,520	1,000	76,249	69,005	7,244	87,227	363,492	144	4.76	4.16
16	Ambala	1,851	1,000	57,249	49,993	7,256	61,000	263,237	142	4.60	4.31
17	Kaithal	1,395	1,092	39,209	36,192	3,017	52,384	222,222	159	5.66	4.24
18	Rohtak	3,615	1,211	33,613	29,691	3,922	47,340	203,240	56	6.04	4.29
19	Jind	1,431	1,000	76,249	69,005	7,244	87,227	363,492	254	4.76	4.16
20	Nabha	2,268	1,000	76,249	69,005	7,244	87,227	363,492	160	4.76	4.16
21	Patiala	9,978	2,000	31,685	29,165	2,520	36,978	149,223	15	4.71	4.03
22	Faridkot	1,141	1,000	23,782	23,782	-	29,782	93,469	82	3.93	3.14
23	Kapurthala	1,200	1,000	13,258	13,258	-	16,258	52,000	43	3.92	3.19
24	Malerkotla	420	1,000	6,341	6,341	-	7,841	24,000	57	3.78	3.06
25	Nalagarh	28,492	1,000	65,259	65,259	-	78,898	304,770	10	4.67	3.86
26	Maler Kotla	1,739,875	1,000	494,500	424,376	71,047	131,422	1,134,474	24,508	2.29	8.63
27	Loharu	4,281	1,000	9,967	9,234	1,740	20,674	20,600	4,812	2.07	2.23
28	Dujana	1,740	1,000	54,000	51,092	2,908	56,000	266,104	153	4.93	4.75
29	Pataudi	1,978	1,000	92,499	78,676	13,823	94,000	362,000	183	3.91	3.85
30	Farrukhnagar	2,520	1,000	76,249	69,005	7,244	87,227	363,492	144	4.76	4.16
31	Kalsia	1,851	1,000	57,249	49,993	7,256	61,000	263,237	142	4.60	4.31
32	Bilaspur	1,395	1,092	39,209	36,192	3,017	52,384	222,222	159	5.66	4.24
33	Chamba	3,615	1,211	33,613	29,691	3,922	47,340	203,240	56	6.04	4.29
34	Lahaul	1,431	1,000	76,249	69,005	7,244	87,227	363,492	254	4.76	4.16
35	Spiti	2,268	1,000	76,249	69,005	7,244	87,227	363,492	160	4.76	4.16
36	Kulu	9,978	2,000	31,685	29,165	2,520	36,978	149,223	15	4.71	4.03
37	Lahaul and Spiti	1,141	1,000	23,782	23,782	-	29,782	93,469	82	3.93	3.14
38	Kulu and Lahaul and Spiti	1,200	1,000	13,258	13,258	-	16,258	52,000	43	3.92	3.19
39	Kulu and Lahaul and Spiti	420	1,000	6,341	6,341	-	7,841	24,000	57	3.78	3.06
40	Kulu and Lahaul and Spiti	28,492	1,000	65,259	65,259	-	78,898	304,770	10	4.67	3.86
41	Kulu and Lahaul and Spiti	1,739,875	1,000	494,500	424,376	71,047	131,422	1,134,474	24,508	2.29	8.63
42	Kulu and Lahaul and Spiti	4,281	1,000	9,967	9,234	1,740	20,674	20,600	4,812	2.07	2.23
43	Kulu and Lahaul and Spiti	1,740	1,000	54,000	51,092	2,908	56,000	266,104	153	4.93	4.75
44	Kulu and Lahaul and Spiti	1,978	1,000	92,499	78,676	13,823	94,000	362,000	183	3.91	3.85
45	Kulu and Lahaul and Spiti	2,520	1,000	76,249	69,005	7,244	87,227	363,492	144	4.76	4.16
46	Kulu and Lahaul and Spiti	1,851	1,000	57,249	49,993	7,256	61,000	263,237	142	4.60	4.31
47	Kulu and Lahaul and Spiti	1,395	1,092	39,209	36,192	3,017	52,384	222,222	159	5.66	4.24
48	Kulu and Lahaul and Spiti	3,615	1,211	33,613	29,691	3,922	47,340	203,240	56	6.04	4.29
49	Kulu and Lahaul and Spiti	1,431	1,000	76,249	69,005	7,244	87,227	363,492	254	4.76	4.16
50	Kulu and Lahaul and Spiti	2,268	1,000	76,249	69,005	7,244	87,227	363,492	160	4.76	4.16
51	Kulu and Lahaul and Spiti	9,978	2,000	31,685	29,165	2,520	36,978	149,223	15	4.71	4.03
52	Kulu and Lahaul and Spiti	1,141	1,000	23,782	23,782	-	29,782	93,469	82	3.93	3.14
53	Kulu and Lahaul and Spiti	1,200	1,000	13,258	13,258	-	16,258	52,000	43	3.92	3.19
54	Kulu and Lahaul and Spiti	420	1,000	6,341	6,341	-	7,841	24,000	57	3.78	3.06
55	Kulu and Lahaul and Spiti	28,492	1,000	65,259	65,259	-	78,898	304,770	10	4.67	3.86
56	Kulu and Lahaul and Spiti	1,739,875	1,000	494,500	424,376	71,047	131,422	1,134,474	24,508	2.29	8.63
57	Kulu and Lahaul and Spiti	4,281	1,000	9,967	9,234	1,740	20,674	20,600	4,812	2.07	2.23
58	Kulu and Lahaul and Spiti	1,740	1,000	54,000	51,092	2,908	56,000	266,104	153	4.93	4.75
59	Kulu and Lahaul and Spiti	1,978	1,000	92,499	78,676	13,823	94,000	362,000	183	3.91	3.85
60	Kulu and Lahaul and Spiti	2,520	1,000	76,249	69,005	7,244	87,227	363,492	144	4.76	4.16
61	Kulu and Lahaul and Spiti	1,851	1,000	57,249	49,993	7,256	61,000	263,237	142	4.60	4.31
62	Kulu and Lahaul and Spiti	1,395	1,092	39,209	36,192	3,017	52,384	222,222	159	5.66	4.24
63	Kulu and Lahaul and Spiti	3,615	1,211	33,613	29,691	3,922	47,340	203,240	56	6.04	4.29
64	Kulu and Lahaul and Spiti	1,431	1,000	76,249	69,005	7,244	87,227	363,492	254	4.76	4.16
65	Kulu and Lahaul and Spiti	2,268	1,000	76,249	69,005	7,244	87,227	363,492	160	4.76	4.16
66	Kulu and Lahaul and Spiti	9,978	2,000	31,685	29,165	2,520	36,978	149,223	15	4.71	4.03
67	Kulu and Lahaul and Spiti	1,141	1,000	23,782	23,782	-	29,782	93,469	82	3.93	3.14
68	Kulu and Lahaul and Spiti	1,200	1,000	13,258	13,258	-	16,258	52,000	43	3.92	3.19
69	Kulu and Lahaul and Spiti	420	1,000	6,341	6,341	-	7,841	24,000	57	3.78	3.06
70	Kulu and Lahaul and Spiti	28,492	1,000	65,259	65,259	-	78,898	304,770	10	4.67	3.86
71	Kulu and Lahaul and Spiti	1,739,875	1,000	494,500	424,376	71,047	131,422	1,134,474	24,508	2.29	8.63
72	Kulu and Lahaul and Spiti	4,281	1,000	9,967	9,234	1,740	20,674	20,600	4,812	2.07	2.23
73	Kulu and Lahaul and Spiti	1,740	1,000	54,000	51,092	2,908	56,000	266,104	153	4.93	4.75
74	Kulu and Lahaul and Spiti	1,978	1,000	92,499	78,676	13,823	94,000	362,000	183	3.91	3.85
75	Kulu and Lahaul and Spiti	2,520	1,000	76,249	69,005	7,244	87,227	363,492	144	4.76	4.16
76	Kulu and Lahaul and Spiti	1,851	1,000	57,249	49,993	7,256	61,000	263,237	142	4.60	4.31
77	Kulu and Lahaul and Spiti	1,395	1,092	39,209	36,192	3,017	52,384	222,222	159	5.66	4.24
78	Kulu and Lahaul and Spiti	3,615	1,211	33,613	29,691	3,922	47,340	203,240	56	6.04	4.29
79	Kulu and Lahaul and Spiti	1,431	1,000	76,249	69,005	7,244	87,227	363,492	254	4.76	4.16
80	Kulu and Lahaul and Spiti	2,268	1,000	76,249	69,005	7,244	87,227	363,492	160	4.76	4.16
81	Kulu and Lahaul and Spiti	9,978	2,000	31,685	29,165	2,520	36,978	149,223	15	4.71	4.03
82	Kulu and Lahaul and Spiti	1,141	1,000	23,782	23,782	-	29,782	93,469	82	3.93	3.14
83	Kulu and Lahaul and Spiti	1,200	1,000	13,258	13,258	-	16,258	52,000	43	3.92	3.19
84	Kulu and Lahaul and Spiti	420	1,000	6,341	6,341	-	7,841	24,000	57	3.78	3.06
85	Kulu and Lahaul and Spiti	28,492	1,000	65,259	65,259	-	78,898	304,770	10	4.67	3.86
86	Kulu and Lahaul and Spiti	1,739,875	1,000	494,500	424,376	71,047	131,422	1,134,474	24,508	2.29	8.63
87	Kulu and Lahaul and Spiti	4,281	1,000	9,967	9,234	1,740	20,674	20,600	4,812	2.07	2.23
88	Kulu and Lahaul and Spiti	1,740	1,000	54,000	51,092	2,908	56,000	266,104	153	4.93	4.75
89	Kulu and Lahaul and Spiti	1,978	1,000	92,499	78,676	13,823	94,000	362,000	183	3.91	3.85
90	Kulu and Lahaul and Spiti	2,520	1,000	76,249	69,005	7,244	87,227	363,492	144	4.76	4.16
91	Kulu and Lahaul and Spiti	1,851	1,000	57,249	49,993	7,256	61,000	263,237	142	4.60	4.31
92	Kulu and Lahaul and Spiti	1,395	1,092	39,209	36,192	3,017	52,384	222,222	159	5.66	4.24
93	Kulu and Lahaul and Spiti	3,615	1,211	33,613	29,691	3,922	47,340	203,240	56	6.04	4.29
94	Kulu and Lahaul and Spiti	1,431	1,000	76,249	69,005	7,244	87,227	363,492	254	4.76	4.16
95	Kulu and Lahaul and Spiti	2,268	1,000	76,249	69,005	7,244	87,227	363,492	160	4.76	4.16
96	Kulu and Lahaul and Spiti	9,978	2,000	31,685	29,165	2,520	36,978	149,223	15	4.71	4.03
97	Kulu and Lahaul and Spiti	1,141	1,000	23,782	23,782	-	29,782	93,469	82	3.93	3.14
98	Kulu and Lahaul and Spiti	1,200	1,000	13,258	13,258	-	16,258	52,000	43	3.92	3.19
99	Kulu and Lahaul and Spiti	420	1,000	6,341	6,341	-	7,841	24,000	57	3.78	3.06
100	Kulu and Lahaul and Spiti	28,492	1,000	65,259	65,259	-	78,898	304,770	10	4.67	3.86
101	Kulu and Lahaul and Spiti	1,739,875	1,000	494,500	424,376	71,047	131,422	1,134,474	24,508	2.29	8.63
102	Kulu and Lahaul and Spiti	4,281	1,000	9,967	9,234	1,740	20,674	20,600	4,812	2.07	2.23
103	Kulu and Lahaul and Spiti	1,740	1,000	54,000	51,092	2,908	56,000	266,104	153	4.93	4.75
104	Kulu and Lahaul and Spiti	1,978	1,000	92,499	78,676	13,823	94,000	362,000	183	3.91	3.85
105	Kulu and Lahaul and Spiti	2,520	1,000	76,249	69,005	7,244	87,227	363,492	144	4.76	4.16
106	Kulu and Lahaul and Spiti	1,851	1,000	57,249	49,993	7,256	61,000	263,237	142	4.60	4.31
107	Kulu and Lahaul and Spiti	1,395	1,092	39,209	36,192	3,017	52,384	222,222	159	5.66	4.24
108	Kulu and Lahaul and Spiti	3,615	1,211	33,613	29,691	3,922	47,340	203,240	56	6.04	4.29
109	Kulu and Lahaul and Spiti	1,431	1,000	76,249	69,005	7,244	87,227	363,492	254	4.76	4.16
110	Kulu and Lahaul and Spiti	2,268	1,000	76,249	69,005	7,244	87,227	363,492	160	4.76	4.16
111	Kulu and Lahaul and Spiti	9,978	2,000	31,685	29,165	2,520	36,978	149,223	15	4.71	4.03
112	Kulu and Lahaul and Spiti	1,141	1,000	23,782	23,782	-	29,782	93,469	82	3.93	3.14
113	Kulu and Lahaul and Spiti	1,200	1,000	13,258	13,258	-	16,258	52,000	43	3.92	3.19
114	Kulu and Lahaul and Spiti	420	1,000	6,341	6,341	-	7,841	24,000	57	3.78	3.06
115	Kulu and Lahaul and Spiti	28,492	1,000	65,259	65,259	-	78,898	304,770	10	4.67	3.86
116	Kulu and Lahaul and Spiti	1,739,875	1,000	494,500	424,376	71,047	131,422	1,134,474	24,508	2.29	8.63
117	Kulu and Lahaul and Spiti	4,281	1,000	9,967	9,234	1,740	20,674	20,600	4,812	2.07	2.23
118	Kulu and Lahaul and Spiti	1,740	1,000	54,000	51,092	2,908	56,000	266,104	153	4.93	4.75
119	Kulu and Lahaul and Spiti	1,978	1,000	92,499	78,676	13,823	94,000	362,000	183	3.91	3.85
120	Kulu and Lahaul and Spiti	2,520	1,000	76,249	69,005	7,244	87,227	363,492	144	4.76	4.16
121	Kulu and Lahaul and Spiti	1,851	1,000	57,249	49,993	7,256	61,000	263,237	142	4.60	4.31
122	Kulu and Lahaul and Spiti	1,395	1,092	39,209	36,192	3,017	52,384	222,222	159	5.66	4.24
123	Kulu and Lahaul and Spiti	3,615	1,211	33,613	29,691	3,922	47,340	203,240	56	6.04	4.29
124	Kulu and Lahaul and Spiti	1,431	1,000	76,249	69,005	7,244	87,227	363,492	254	4.76	4.16
125	Kulu and Lahaul and Spiti	2,268	1,000	76,249	69,005	7,244	87,227	363,492	160	4.76	4.16
126	Kulu and Lahaul and Spiti	9,978	2,000	31,685	29,165	2,520	36,978	149,223	15	4.71	4.03
127	Kulu and Lahaul and Spiti	1,141	1,000	23,782	23,782	-	29,782	93,469	82	3.93	3.14
128	Kulu and Lahaul and Spiti	1,200	1,000	13,258	13,258	-	16,258	52,000	43	3.92	3.19
129	Kulu and Lahaul and Spiti	420	1,000	6,341	6,341	-	7,841	24,000	57	3.78	3.06
130	Kulu and Lahaul and Spiti	28,492	1,000	65,259	65,259	-	78,898	304,770	10	4.67	3.86
131	Kulu and Lahaul and Spiti	1,739,875	1,000	494,500	424,376	71,047	131,422	1,134,474	24,508	2.29	8.63
132	Kulu and Lahaul and Spiti	4,281	1,000	9,967	9,234	1,740	20,674	20,600	4,812	2.07	2.23
133	Kulu and Lahaul and Spiti	1,740	1,000	54,000	51,092	2,908	56,000	266,104	153	4.93	4.75
134	Kulu and Lahaul and Spiti	1,978	1,000	92,499	78,676	13,823	94,000	362,000	183	3.91	3.85
135	Kulu and Lahaul and Spiti	2,520	1,000	76,249	69,005	7,244	87,227	363,492	144	4.76	4.16
136	Kulu and Lahaul and Spiti	1,851	1,000	57,249	49,993	7,256	61,000	263,237	142	4.60	4.31
137	Kulu and Lahaul and Spiti	1,395	1,092	39,209	36,192	3,017	52,384	222,222	159	5.66	4.24
138	Kulu and Lahaul and Spiti	3,615	1,211	33,613	29,691	3,922	47,340	203,240	56	6.04	4.29
139	Kulu and Lahaul and Spiti	1,431	1,000	76,249	69,005	7,244	87,227	363,492	254	4.76	4.16
140	Kulu and Lahaul and Spiti	2,268	1,000	76,249	69,005	7,244	87,227	363,492	160	4.76	4.16
141	Kulu and Lahaul and Spiti	9,978	2,000	31,685	29,165	2,520	36,978	149,223	15	4.71	4.03
142	Kulu and Lahaul and Spiti	1,141	1,000	23,782	23,782	-	29,782	93,469	82	3.93	3.14
143	Kulu and Lahaul and Spiti	1,200	1,000	13,258	13,258	-	16,258	52,000	43	3.92	3.19
144	Kulu and Lahaul and Spiti	420	1,000	6,341	6,341	-	7,841	24,000	57	3.78	3.06
145	Kulu and Lahaul and Spiti	28,492	1,000	65,259	65,259	-	78,898	304,770	10	4.67	3.86
146	Kulu and Lahaul and Spiti	1,739,875	1,000	494,500	424,376	71,047	131,422	1,134,474	24,508	2.29	8.63
147	Kulu and Lahaul and Spiti	4,281	1,000	9,967	9,234	1,740	20,674	20,600	4,812	2.07	2.23
148	Kulu and Lahaul and Spiti	1,740	1,000	54,000	51,092	2,908	56,000	266,104	153	4.93	4.75
149	Kulu and Lahaul and Spiti	1,978	1,000	92,499	78,676	13,823	94,000	362,000	183	3.91	3.85
150	Kulu and Lahaul and Spiti	2,520	1,000	76,249	69,005	7,244	87,227	363,492	144	4.76	4.16
151	Kulu and Lahaul and Spiti	1,851	1,000	57,249	49,993	7,256	61,000	263,237	142	4.60	4.31
152	Kulu and Lahaul and Spiti	1,395	1,092	39,209	36,192	3,017	52,384	222,222	159	5.66	4.24
153	Kulu and Lahaul and Spiti	3,615	1,211	33,613	29,691	3,922	47,340	203,240	56	6.04	4.29
154	Kulu and Lahaul and Spiti	1,431	1,000	76,249	69,005	7,244	87,227	363,492	254	4.76	4.16
155	Kulu and Lahaul and Spiti	2,268	1,000	76,249	69,005	7,244	87,227	363,492	160	4.76	4.16
156	Kulu and Lahaul and Spiti	9,978	2,000	31,685	29,165	2,520	36,978	149,223	15	4.71	4.03
157	Kulu and Lahaul and Spiti	1,141	1,000	23,782	23,782	-	29,782	93,469	82	3.93	3.14
158	Kulu and Lahaul and Spiti	1,200	1,000	13,258	13,258	-	16,258	52,000	43	3.92	3.19
159	Kulu and Lahaul and Spiti	420	1,000	6,341	6,341	-	7,841	24,000	57	3.78	3.06
160	Kulu and Lahaul and Spiti	28,492	1,000	65,259	65,259	-	78,898	304,770	10	4.67	3.86
161	Kulu and Lahaul and Spiti	1,739,875	1,000	494,500	424,376	71,047	131,422	1,134,474	24,508	2.29	8.63
162	Kulu and Lahaul and Spiti	4,281	1,000	9,967	9,234	1,740	20,674	20,600	4,812	2.07	2.23
163	Kulu and Lahaul and Spiti	1,740	1,000	54,000	51,092	2,908	56,000	266,104	153	4.93	4.75
164	Kulu and Lahaul and Spiti	1,978	1,000	92,499	78,676	13,823	94,000	362,000	183	3.91	3.85
165	Kulu and Lahaul and Spiti	2,520	1,000	76,249	69,005	7,244	87,227	363,492	144	4.76	4.16
166	Kulu and Lahaul and Spiti	1,851	1,000	57,249	49,993	7,256	61,000	263,237	142	4.60	4.31
167	Kulu and Lahaul and Spiti	1,395	1,092	39,209	36,192	3,017	52,384	222,222	159	5.66	4.24
168	Kulu and Lahaul and Spiti	3,615	1,211	33,613	29,691	3,922	47,340	203,240	56	6.04	4.29
169	Kulu and Lahaul and Spiti	1,431	1,000	76,249	69,005	7,244	87,227	363,492	254	4.76	4.16
170	Kulu and Lahaul and Spiti	2,268	1,000	76,249	69,005	7,244	87,227	363,492	160	4.76	4.16
171	Kulu and Lahaul and Spiti	9,978	2,000	31,685	29,165	2,520	36,978	149,223	15	4.71	4.03
172	Kulu and Lahaul and Spiti	1,141	1,000	23,782	23,782	-	29,782	93,469	82	3.93	3.14
173	Kulu and Lahaul and Spiti	1,200	1,000	13,258	13,258	-	16,258	52,000	43	3.92	3.19
174	Kulu and Lahaul and Spiti	420	1,000	6,341	6,341	-	7,841	24,000	57	3.78	3.06
175	Kulu and Lahaul and Spiti	28,492	1,000	65,259	65,259	-	78,898	304,770	10	4.67	3.86
176	Kulu and Lahaul and Spiti	1,739,875	1,000	494,500	424,376	71,047	131,422	1,134,474	24,508	2.29	8.63
177	Kulu and Lahaul and Spiti	4,281	1,000	9,967	9,234	1,740	20,674	20,600	4,812	2.07	2.23
178	Kulu and Lahaul and Spiti	1,740	1,000	54,000	51,092	2,908	56,000	266,104	153	4.93	4.75
179	Kulu and Lahaul and Spiti	1,978	1,000	92,499	78,676	13,823	94,000	362,000	183	3.91	3.85
180	Kulu and Lahaul and Spiti	2,520	1,000	76,249	69,005	7,244	87,227	363,492	144	4.76	4.16
181	Kulu and Lahaul and Spiti	1,851	1,000	57,249	49,993	7,256	61,000	263,237	142	4.60	4.31
182	Kulu and Lahaul and Spiti	1,395	1,092	39,209	36,192	3,017	52,384	222,222	159	5.66	4.24
183	Kulu and Lahaul and Spiti	3,615	1,211	33,613	29,691	3,922	47,340	203,240	56	6.04	4.29
184	Kulu and Lahaul and Spiti	1,431	1,000	76,249	69,005	7,244	87,227	363,492	254	4.76	4.16
185	Kulu and Lahaul and Spiti	2,268	1,000	76,249	69,005	7,244	87,227	363,492	160	4.76	4.16
186	Kulu and Lahaul and Spiti	9,978	2,000	31,685	29,165	2,520	36,978	149,223	15	4.71	4.03
187	Kulu and Lahaul and Spiti	1,141	1,000	23,782	23,782	-	29,782	93,469	82	3.93	3.14
188	Kulu and Lahaul and Spiti	1,200	1,000	13,258	13,258	-	16,258	52,000	43	3.92	3.19
189	Kulu and Lahaul and Spiti	420	1,000	6,341	6,341	-	7,841	24,000	57	3.78	3.06
190	Kulu and Lahaul and Spiti	28,492	1,000	65,259	65,259	-	78,898	304,770	10	4.67	3.86
191	Kulu and Lahaul and Spiti	1,739,875	1,000	494,500	424,376	71,047	131,422	1,134,474	24,508	2.29	8.63
192	Kulu and Lahaul and Spiti	4,281	1,000	9,967	9,234	1,740	20,674	20,600	4,812	2.07	2.23
193	Kulu and Lahaul and Spiti	1,740	1,000	54,000	51,092	2,908	56,000	266,104	153	4.93	4.75
194	Kulu and Lahaul and Spiti	1,978	1,000	92,499	78,676	13,823	94,000	362,000	183	3.91	3.85
195	Kulu and Lahaul and Spiti	2,520	1,000	76,249	69,005	7,244	87,227	363,492	144	4.76	4.16
196	Kulu and Lahaul and Spiti	1,851	1,000	57,249	49,993	7,256	61,000	263,237	142	4.60	4.31
197	Kulu and Lahaul and Spiti	1,395	1,092	39,209	36,192	3,017	52,384	222,222	159	5.66	4.24
198	Kulu and Lahaul and Spiti	3,615	1,211	33,613	29,691	3,922	47,340	203,240	56	6.04	4.29
199	Kulu and Lahaul and Spiti	1,431	1,000	76,249	69,005	7,244	87,227	363,492	254	4.76	4.16
200	Kulu and Lahaul and Spiti	2,268	1,000	76,249	69,005	7,244	87,227	363,492	160	4.76	4.16
201	Kulu and Lahaul and Spiti	9,978	2,000	31,685	29,165	2,520	36,978	149,223	15	4.71	4.03
202	Kulu and Lahaul and Spiti	1,141	1,000	23,782	23,782	-	29,782	93,469	82	3.93	3.14
203	Kulu and Lahaul and Spiti	1,200	1,000	13,258	13,258	-	16,258	52,000	43	3.92	3.19
204	Kulu and Lahaul and Spiti	420	1,000

Appendix. B.

Appendix. C.

Appendix C

Return showing the Number and description of Boats recorded for each Section of the Port of Dublin Coast for the year 1881

Number of Boats

Cargo Boats

| Section | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |

Appendix C

National Survey No. 1 Table showing the length and description of Roads recorded for each division of the Buckingham Canal for the year 1911

Divisions	Length of Roads	Earth Roads	Gravel Roads	Metal Roads	Bridges
Government Roads					
Private Roads					
Roads maintained partly by Government					
Cart Tracks					
Cart Roads					
Bullock Roads					
Foot Paths					
Total					

Statement showing the Names, Surnames and Description of Roads Awarded for Construction of the Public Roads in the Parish of Cavan for the year 1877

Appendix A

Name of Road	Length of Road	Width of Road	Estimated Cost of Road	Remarks
Commencing at the Gate				
Thence to the Gate				
Thence to the Gate				
Thence to

Appendix B

THE BUCKINGHAM CANAL.

Ootacamund, September 22, 1879.

The following Revised Rules for the regulation of the navigation of the Buckingham Canal, passed by the Madras Government with such alterations as appeared necessary, are, under the provisions of Section 23 of Act I of 1879, hereby published for general information:—

I.—The Buckingham Canal includes the following lines of navigation, extending from south of the Palár river in the District of Chingleput to the junction of the tidal and fresh-water canals in the Kistna District near Pedda-ganjam, together passing over a continuous distance of about 260 miles, namely:—

1st.—The Sadras Canal extending from 12 miles south of the right bank of the Pálár river to Palavakkam, distance about 36 miles.

2nd.—The Madras Canal extending from Palavakkam to the Shalayancoppam Lock, distance about 16 miles.

3rd.—The Pulicat Canal extending from the Shalayancoppam Lock to near Raidurravoo, distance about 48 miles.

4th.—The Kalastpatam Canal extending from near Raidurravoo to near Kodoor, distance about 48 miles.

5th.—The Ramapatam Canal extending from near Kodoor to Ramapatam, distance about 48 miles.

6th.—The Kottapatam Canal extending from Ramapatam to the junction with the Commanur fresh-water canal in the Kistna District, distance about 46 miles.

II.—These lines of navigation include also such portions of all navigable estuaries, back-waters, rivers, and channels, whether salt or fresh, connected with each such lines as have been artificially formed, deepened, or protected; except all those minor channels which have been excavated as feeders to the main line of canal for purposes connected with the Salt and Wood Departments; they shall be each and severally distinct lines of navigation as defined in Section 1 of Act I of 1879 (The Canals and Ferries Act), the provisions of which shall apply to each of these distinct lines of navigation separately, and they shall be denominated sections of the Buckingham Canal as follows:—

1st.—A or the Sadras Section.
2nd.—B or the Madras Section.
3rd.—C or the Pulicat Section.
4th.—D or the Kistnapatam Section.
5th.—E or the Ramapatam Section.
6th.—F or the Kottapatam Section.

III.—From and after the 8th day of October 1879, no vessel, but those hereinafter excepted, shall be allowed on, or to use any of the abovementioned distinct lines of navigation without—

(1st) The payment of an annual license fee at the rates specified in the Schedule A annexed for the use of any one of the abovementioned distinct lines of navigation.

Exception (1).—Vessels possessing licenses for the navigation of the canals of the Godávari or Kistna District will not be required to pay a license fee for the use of any section of the Buckingham Canal.

Exception (2).—The Pulicat fishermen (with boats under 2 tons each) should be free to fish in the backwater without the obligation to take out a license.

(2nd) The payment of a toll at the rates specified in the Schedule B annexed for passing from any one to any other of the abovementioned distinct lines of navigation for which the owner does not hold a license.

Exception (1).—Boats leaving their section will not be liable to toll when returning empty within two months.

Exception (2).—Boats licensed for the Kistna and Godávari plying through the length of the canal to Madras will pay 4 annas per ton on the outward journey, but on returning full or empty, they will pass free at any toll-bar at which they had paid toll within one month.

Exception (3).—Boat-owners have the option of compounding for a year's tolls at Rupees 10 per ton.

Exception (4).—Boats licensed for the whole canal will not pay tolls.

Exception (5).—Boats returning into their own sections with a cargo after an absence from it of ten clear days, or if returning empty after an absence from it of two months, must pay tolls.

Rupees 2 per ton for one section and tolls at 4 annas per ton, or by a license fee at Rupees 4 per ton for the whole Buckingham Canal for the year. In the calculation of the tonnage of such boats the free-board will be taken as at 18 inches and the load-line marked accordingly, the tonnage being determined by testing. The minimum fee for licensing a badgerow for the whole canal shall be Rupees 15.

Vessels, the private property of individuals, making use of the canals, but not carrying passengers or goods or playing for hire, will be licensed for a calendar year for the whole Buckingham Canal on payment of a fee of Rupees 15.

XI.—Rafts will be permitted to navigate the several sections of the Buckingham Canal on payment when entering each such section of the toll prescribed in Schedule B annexed; no raft exceeding 25' × 15' × 2' will be allowed on the canal.

XII.—If a vessel after the issue of a license be enlarged, it shall not again use the canal until it has been re-measured and re-licensed. The new license will be granted on surrender of the old license and on payment of the prescribed fee per ton on the difference between the old and new tonnage.

XIII.—No person who has taken out a license for the navigation of any section of the canal shall have claim for compensation on account of any impediment to navigation that may occur from any cause whatever.

XIV.—Sea-going vessels brought into rivers and backwaters for shelter, for repair, or for any other purpose (except to ply for hire) must anchor or lay up outside the fairway of canal traffic which will be defined by the Canal Officers; such vessels will not be allowed to enter on the main line of the canal for the purpose of proceeding from one river or backwater to another river or backwater or for any other purpose except in accordance with the rules prescribed for the use of the canal.

XV.—The Executive Engineer in charge of the canal for the time being is authorized to enforce these rules, to collect tolls and license fees, to remove obstructions to navigation, and to direct prosecutions under the provisions of Sections 7, 8, 9, 10, 12, and 25 of Act No. I of 1870.

BYE-LAWS.

I.—No vessel shall moor on the towing path side of the canal when there is only one towing path, nor on the windward side when there are two towing paths, except when actually loading or unloading, or with the special permission of the Canal Officers.

II.—No cargo shall be loaded or unloaded, and no passengers shall be shipped or landed at any lock or masonry work other than the quays or wharfs specially provided for the purpose.

III.—No vessel shall be repaired or fitted on the main line of the canal without the written permission of the Executive Engineer or other officer authorized to give such permission on the Executive Engineer's behalf.

IV.—No vessel shall be moored in a lock channel defined as such by notice-boards erected for the purpose by the Canal Officers.

V.—Vessels when moored in main line of the canal shall be made fast stem and stern to the banks in single file, and there must be a person always in charge of each vessel; vessels when thus moored must, between sunset and sunrise, show a clear bright light not less than 4 feet above the water-level and visible all round the vessel.

VI.—When vessels, other than steamers, going under sail in opposite directions, meet, the vessel going with the wind shall give way, while the vessel going against the wind shall hold on its course.

VII.—Vessels not under sail shall give way to vessels under sail, and steamers shall in all cases give way to other vessels.

VIII.—When vessels not under sail including steamers, meet those going north should keep to the east, and those going south should keep to the west.

IX.—When a vessel passes another vessel going in the same direction, it should keep to the leeward of vessels under sail, and on the opposite side of the towing line of vessels not under sail.

X.—Vessels when not moored must, between sunset and sunrise, carry lights as follows:—

Steamers, three lights—

1st.—A clear white light not less than 9 feet above water and in the centre line of the vessel.

2nd.—A bull's eye bright red light on the port (left) side.

3rd.—A bull's eye bright green light on the star-board (right) side.

The bull's eye lights to be not less than 8 inches diameter and not less than 4 feet above water.

Vessels other than steamers must carry a clear white light at the fore end not less than 4 feet above water.

Passenger boats must, in addition to the above lights, carry a light in each cabin or compartment for passengers.

THE BUCKINGHAM CANAL, MADRAS.

FORM C.

License No. of 1879.

This vessel is licensed to use the section of the Buckingham Canal during the calendar year 1879 free of further charge.

Registered No.
Name of owner.
Residence of owner.
Class of vessel (a).
Extreme length.
Do. breadth.
Do. depth.
Draught of water.
Licensed to carry tons cargo.
Do. do. passengers.
Fee paid.
License issued by on the day of 1879.

Executive Engineer.

(a) Here enter steamer, budgerow, cargo-boat, passenger-boat, fishing-boat, or pleasure-boat as the case may be.

THE BUCKINGHAM CANAL, MADRAS.

FORM D.

APPLICATION FOR LICENSE.

I (or we) the undersigned (1) residing at (2)
in the district of (3) hereby apply for license to place (4) on the (5) section of the Buckingham Canal during the year 1879.

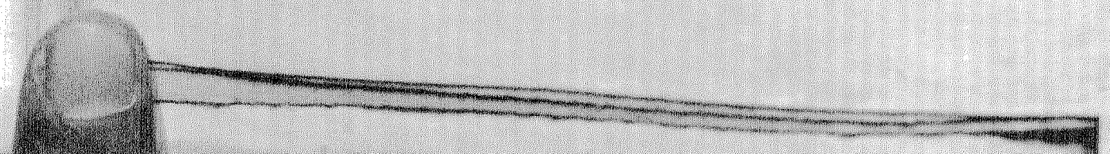
Date Signature.

(1) Here enter name or names of owners.
(2) Places of residence.
(3) Name of district in which residing.
(4) Description of boat and purpose for which it is to be used, such as passenger-boat, cargo-boat, budgerow, &c.
(5) Section of the canal for which a license is required, i.e., the
A or Sadras Section,
B or Madras Section,
C or Pulicat Section,
D or Kistnapatam Section,
E or Ramapatam Section,
F or Kottapatam Section.

R. H. SANKEY, Colonel, R.E.,
Secretary to Government, P.W.D.

MADRAS: PRINTED BY E. REYS, AT THE GOVERNMENT PRESS, FORT ST. GEORGE.

Appendix



Buckingham Canal

Report on the Buckingham Canal & proposed improvements

Sub-Engr Office 5th Circle
No. 2448. Vizagapatam 1st October 1852

154

From
Capt. A. Frankegan & M.C.E.
Superintending Engineer
5th Circle

To
Lieutenant (as per List)
Assistant

Sir,

I have the honor to submit for discussion & alternates for improvements to the Buckingham Canal in the Southern Division

For Improvements on the first 8½ miles	Rs.	50,700
Diversion of the Canal from 8½ Miles to 15-1/4		55,200
Diversion from 15½ to 31½ Mile		169,300
Do. from ½ mile to 22-11/2		1,430
Improvements on the Canal from 22nd 3 F. to 36th 3 F.		14,850

to keep out sea water. Where
ever the first bottle of drainage on the
East side, there will be led into the
Canal. The bank on the East
side will be put low pucks level;
that on the West will be raised
to full height.

2nd. The Canal inside Bower the
Cowlong bank is under 1 pt. 3 miles
and is to be steered to by a sharp cut
of the Cowlong to gave the salt channel
which is well known formerly to
exist. The plan now is thus pro-
posed: on the East side, with the
Edinguer bridge removed, and
at 3/4 mile. The East bank is
required better protection, the West
bank will be in parts exposed to
land floods, and will therefore raised
to full height. Flood gates are
to be provided for both ends of the
diversion at the Cowlong and
at the Edinguer bank waters-

some

7. after leaving the Sedgefield Steam pt shall the Canal will continue in its present Course for 3/4 mile. as Flood gates will be pro-vided pt the Lands the ground level is high, and no Banking up is required.

From 3 Mile pt the Canal is to be diverted to the East, from the old line pt 38 all 1 f. and thence taking the line of present pt Ditching to the pt and to the River Tees. From 37-1 to 38-1 the ground is higher than East side but on the West, the Bank is to be raised to suit height as it is supposed to floods.

Sluices intended to keep off only the Stock Branch of the Tees pt and to exclude the floods; where the Canal passes the Sandborn Crevices, the banks will be made up to 6 ft above high floods level, and that on the upstream side will have a Berm 20 feet in width, with the further protection of wooden filled pt Crushed wood

Improvements between the [illegible] 159
Guagepalicans River and
the Dams at 11½ mile R. 29 80
Dams Diversion & flood bank 130 800
A diversion from the Pontoon
River at 12¾ mile 6 miles 75 chs 415 900
Improvements to the Canal bet.
the 13th & 15th miles 33 100
Improvements between Calcasieu
River at 15 miles and the other
miles at 159 chs 7 L 21 530
Mermentau Western Diversion 6 250
Improvements between 11th½ mile
and 16th½ mile 31 660
Do between the above named
16 miles 3 f and 17 f wide 15 800
Do between 17th & 18th f and
adjacent river at 18th & 19 23 700
Do between 18th & 18½ 3 f and 18½ 11 220
Do between 18 miles & 19½ 13 280
Do between 19 miles and 19½ 21 800
Do between 19½ & 19 miles 3 f 3 100

9.

and the Coach will be Raised to
full height, but the Front boards need
not be above the Coming Seats level.
The Northern Branch of the Dungar
pestram Street will be closed
and the Central Branch will be the
only part through which the Load
Drawn Carts will pass to the Canal.
The Side Boards of the Inner Gates
into the Canal at Mamoile Bay
to be pleded at the Head, and the
Small Drawn Carts will be taken
into the Canal.

11. With the Passing of the Inner
Road through it, to Cancel the pres-
ent Course of the Road, through the
Southern Branch, and to close the Road
opening from the Mouth of Good Jacks
on Back Lane to the Canal with Low
Protected Fence like existing from
which at two places Barrier Gates
of Strong Iron Rails to be required

height of flood level. The flood bank would be of the same height & would be so thrown parallel the present line of the River Calcutta Canal for a distance of 10 miles & from thence be protected by piling & brushwood.

12. To prevent the present line through the Ryderwal Swamp it would be necessary to have a strong & efficient bank thrown up on each side.

A Diversion of the Canal is proposed for a length of 8 miles 1.5 from the Ryderwal Swamp to the Calcutta Canal at 122 3/4 mile, to run 26 ch 7 f. The main point to be taken to the Eastward, to the North end of the back water of the Ryderwal Swamp: the Calcutta Canal of this Swamp is now shut from the general Swamp, and the Banks not often open: the Estimate provided for closing this Communication is expected that the drainage would be carried

the two parts below.

Up From 151 miles to 159 all of — improvements are estimated for between the Elkhorn and Summers Rivers. The Northern part of the Elkhorn — will be closed, and the River will — pass out thro' the Southern opening. Flood gates will be provided at both ends of this Reach. For 1 mile from the South end, the West — bank to be raised to full — height; but for the rest of the distance the West side is protected by a light Ridge; On the East side, also, for 4 miles at the South end, the bank is kept — from 1 to 2 ft below the high water line.

15. From a point near the end of the 14th mile to 16 3/4 miles, a short deviation of the Canal is required to the West of the present line. The Canal — and bank is liable to encroachment by

with be provided to shut off the Mitel power. For the first 9 furlongs the bank shall be made up to full height on the East side; but for the rest of the distance, there is a high coast line. On the West side, the bank must be raised to full height on the whole length.

18. From 177 ch 7 f on to 183 ch 1 f. the Canal is to be improved in the present line up to the Attigonde River; from which it will be protected by a flood gate. The bank on the West side is exposed to flood, and must be raised to full height; but on the East side, the Canal is safe from damage and the bank must be laid on the low back canal.

19. From the Attigonde River for 183 ch 3 f to the Gindlakamma River

21. From 191½ mile to a point near the end of the 195 mile, where there will be the most Northern flood gate, the present line of Canal is to be improved. On the Port side, there are high ridges with a comparatively low towpath, but as high bank is not required, the Canal line is low, and therefore on that side the bank has to be made up to full height.

22. From 195 Mile to 196 mile 3 f the Canal is to be improved & deepened. This short reach is open to the water of the Pompeii Stream. On 195 M 1 f an under tunnel is under construction, pa the crossing of the Oppukonden Cagay

23. The general Estimate provi takes provision for flood gates

The sills will be 6½ feet below low water level. The flooring is estimated — to be of pot granite, 1 foot in thickness; and — an apron 10 feet wide of Cabion Rubble is provided, above and below the gates. The sides will be covered with dry stone to the height of the wall, or ½ foot above highest flood on the River Side, and to ½ foot above high Spring tides on the Canal Side. The wooden gates have been valued six feet by two, for the purpose of flushing.

24. Estimates are furnished likewise for Flood gates with sluices, sections similar to the above.

Viz. At Covelong two sets Rs 29 600

At Cadaiyur — Do — — 29 600

At Nemeli — Do — — 30 260

At the Palar — Do — — 37 570

Rs 127 030

of the walls of pucka gravel. In front apron is provided of dry stone to per width of 9 feet pucka per rain pipe of stone in plaster with per rough stone apron pitched beyond the retaining wall.

26. Latrines Outlets are provided for in the Southern Section of the town principally for pabooes &c 5 Latrines @ 9 feet 40 ft. } 2 lakhs
visited at Rupees 2940 - }

27. In the Northern Section of the Canal two first class Rest Houses are proposed, for Peithapooram 93 miles, and for Pottapatam 179 miles. The Estimate for the pucka buildings at the Caravanserai Bungalow comes to Rs 1,00,000

The first Rest House is designed for 2 Rooms with a Verandah all round first floor at the ends, steps to make at drawing Room and both Rooms

Plan

Adyar, Madras, as made on the general estimate for similar buildings at Allumbaroi, at the 63 rate per Rupee 630.

31. On the Southern Section, 15 Sitting Board are proposed, between the Adyar and Palar Rivers, two of these are designed to be 500 feet in length, and the remainder 300 feet. The Madras end of the former Road previous to the Southern Section is for which the Estimates just submitted for donation under letter No 207 of the 1st September 1882. The part of the 15 boards on the Southern Road is estimated at Rs 24,000

32. Four Store Sheds and Office Establishment sanctioned per proceedings of Rs 9360 in G.O. No 1079 of the 25th April 1881, for the Northern Section of the

30. On the Southern Section, there is yet found per the Office and Field Establishment yet Palaveram Road, to which from the

On the Red Hills Road
and Adyar Bridge
of Boats for passengers Bullocks
Carriages, Palanquins &c
over Temporary Platforms
Rupees 5715

Sum

3/4. For the Rod pointed at the head of the Sluices Contract per Perch Estimated is formed the Sluices as per Plan Dated 1st Feb 1860 per pieces as Detail on the Comparative Statement. The foundation of wood work being the foundation being Laid on the clay marginal of the Canal, there was a wooden platform laid upon great pressure being done & secured. For the execution of foundation, as greater depth was required for in the Estimate. The Contractor from the Dorsetshire for the Sluices gates is higher than was provided for, and as large stones of different sizes as found in the work in part of the Sluices. Stone walling & Brickwork in Lime Mortar, this Last Comes to 14 Rupees per Cubic ft. as named the Estimate, allowed only 12 Rupees.

Kambau Pinnacle Island Island
Island — a slight depression also
also here marked in Island Island
from the general elevation in Island
forming this to Island Island, reaches
to mean sea level. The length of
the direction and expanded by
about one half, in Island the
River to Island Island at Kanapatau
and taking the general along the
Channel to the Orange Bar.
This portion of the River could be
buoyed and lighted. The
Journals Report of the Examination
to Show a Saving of Papers 5300.

By Order dated the 1st of
this instant, Major Raine
Brockman has furnished
the undersigned comprehensive Papers
giving the history of the Examination
to commencement and progress of
some months, and the final determination
of the Secretary, to the present Convention
having for many years been under the

12585867

The Estimated mone just
needed comes to the
sum of Rupees ——— 20370458

Sorry I cannot to the above
the expenditure up to the pre-
sent time of 1899-98 mon Rs 30571185
fall the part of the whole
Project therefore as est.
remain pt Rupees 6585100

I have the honor to be
Sir
your obt Servt
Chas Pender
Colld R.E.
Superintg Engineer
5 Circle.

Note by the Chief Engineer P.W. Dept

The history, construction
details, financial position
&c. of this work have
been dealt with at such
length in the accompanying
Report that little more
than a brief résumé of
the points will be necessary
in submitting the Project
for the consideration of
Government.

2. The Port Road known
as the Buckingham
Canal extending along the
East Coast 60 miles south



Extended the communication
to Seaford 27 miles. This
gentleman remained sole
proprietor of the work
for 4½ years when his
rights were bought out
by Government. Throughout
the period, the work was
generally known as
"Cochrane's Canal", a term
which spite of the lapse
of time and two subsequent
changes of title first to
"East Coast Canal"
and then later to the
"Buckingham Canal", still
adheres to the first portion
To maintain a sufficient

prosecution of the work

was resolved on.

Under the orders of

His Grace the Duke of

Buckingham large gangs

of work people from the

famine stricken districts

of Killary, Kerry and

Cork also were marched

down to the coast and

are working the whole

line partly in excavating

the 18m Cutting named

partly in Excavating the

new Canal Cutting from

Lough Corrib to

Lough Mask in the

Line of the Ship Canal

[illegible] may now be
briefly noticed.

From the shallow
of the general backin
along the coast, out
the connection of whi
no doubt arose the o
Conception of the Cam
flat bottomed boat
with only trifling dra
were at first used
to this the several C
Connecting cut or chan
were given very little
depth - 12 or at mo
15 inches.

In many places
backwaters were accep

of an island coast
trade, it would not only
suffice thus as it were
to "model" out a
shallow channel but
that it would be quite
a matter to attempt
anything more.

Here again as itself
can by no means be regarded
as, in addition to providing
for the small craft of
coasts there in question, it
certainly met in a way
the difficulties arising
out of silt bearing floods
which, in crossing the line
of "Canal all along the

of an inland coast
trade it would not only
suffice thus as it were
to "protect" at a
shelter channel but
that it would be quite
a matter to attempt
anything more.

Two means are thereby
seen by no means illogical
as, in addition to providing
for the small class of
boats there, it
certainly met in a way
the difficulties arising
out of pilot bearing floods
which, in crossing the line
of "Canal all along the

to pass the basin to

and used on the Canal

It was cause to

be recognized, that if

the work was to meet in

any adequate way the

drain through, or pass it,

a depth of not less than

3 feet everywhere at

low water must be

secured; and, although

as will be observed

from an Examination of

the present Report, this

has led to greatly

enhanced outlay the

Conclusions arrived at

to based appear to be

in many places have been
shewn to rise to no
less than 10 or 11 feet
above mean Sea Level,
Such floods, owing to
the flatness of the Cotton
land, take sometime to
run themselves out, and
after two or three days,
they have, in many places
been shewn not only to
bring in silt sufficient
to fill up the Canals,
but even to raise the
bed above mean Sea
level. The enormous
recurring outlay required
by the re-Excavation

fees and tolls.

In 1879 there were
in all 723 boats with
a gross burden of
6257 tons - Reg. 882 there
had been a decrease of 1855
boats aggregating 10,537
tons.

In 1875 the receipts
from tolls &c were
£ 51,113 and the total
collections had increased to
£ 109,508 in 1850
" 116,537 in 1857
" 100,037 in 1862.

The falling off in the
last year was due to
certain changes in regard
to the tolls - notice of any

report of a Committee
which has lately taken
the whole subject into
consideration, Government
has decided on recommending, which though
reducing the actual
receipts for the present,
will, it is certain, have
a very beneficial effect
in stimulating traffic.
Sufficient, it is
hoped, has been adduced
to shew the growing
Commercial Importance of
our Red which will be seen
admirably adapted to

value which may get
attached to the large
tract of land which
hitherto from having
low yet to diminish
of the County will
readily be reclaimed
by the works, and many
like rises of adventitious
thereby to count to
the last amount as
Cocoa plantations,
the proof of which
as an industry is now
so well established
along the older portions
of the Coast

the great delta system
of the Godavari and
Kistna with Madras
and the country to the
south, and thus affording
a means, whether the
harbour and the closed
mouth of depositing
spoil at any point
along the whole line
ready for transport into
the interior, to make
most beneficial to the
inhabitants. As to
another ground that
the claim of the work
to be classed as protective

Living 1883/84 and subse-

quent years will amount

to £ 31,63,915

From Experience

I find working at is

Lingfield Park with

Company owned to

the present permanent

staff the Expenditure in

subsequent year may be

safely to round to

I should be inclined

to regard Capital ex-

-penditure and Current

Expenditure as

Capital Expenditure

Current Expenditure

PROCEEDINGS OF THE MADRAS GOVERNMENT