Public Works (1896) Department.

G.O., No. 37.1

Dated 15-1-96

[Despatch Abstract.]

Flood damages: Papers in connection with the present — viz the Ahuna L.S., and on the East Coast Railway, and to the officers concerned and the Deputy Engrs I and II Circles, directed to report on certain points raised therein.

BACK PAPERS.

G.O.	No.	Department.	Date.	G.O.	No.	Department.	Date.

FURTHER PAPERS.

G.O.	No.	Department.	Date.	G.O.	No.	Department.	Date.

No. 37 I., 15TH JANUARY 1896.

GOVERNMENT OF MADRAS.

PUBLIC WORKS DEPARTMENT.

Irrigation.
Account.

READ—the following papers:—

From A. S. RUSSELL, Esq., Officiating Superintending Engineer, II Circle, to the Chief Engineer for Irrigation, dated 27th October 1895, No. 1573 K.S.

In continuation of this office letters marginally-noted regarding damages to Ellore and Ryves' canals and the repairs to the same, I have the honour to report that the Executive Engineer, Kistna Eastern Division, expects to be able to submit a detailed report by the end of this month.

No. 1318 K.S., dated 19th September 1895.
„ 1400 K.S., „ 3rd October 1895.

2. Meanwhile the Executive Engineer requests me to bring to your notice the good work done in restoration of damages by the following subordinates, whose names are entered in order of merit:—

(1) M.R.Ry. Ch. Venkataramayya Naidu, Anicut Superintendent.
(2) „ G. Sooryanarayana, Delta Superintendent.
(3) „ M. Ramaswamy Pillai, Overseer.
(4) „ C. Ramasawmy Iyer, Temporary Overseer.

3. Though the Ellore canal, as already reported by me, was re-opened on the 28th ultimo, navigation to Ellore has, since that date, been frequently interrupted by the Tammileru, which has been down in flood repeatedly since the cyclonic rainfall of 5th ultimo, and has caused heavy silting. This in no way detracts from the credit due to Mr. Smith and his staff for re-opening the canals on the 28th ultimo, as the Tammileru commonly stops navigation when it comes down in flood.

4. The sum required by the Executive Engineer for restoration of damages, viz., Rs. 20,000, has already been reported to you in my letter No. 25 C., dated 25th October 1895.

From A. S. RUSSELL, Esq., Officiating Superintending Engineer, II Circle, to the Chief Engineer for Irrigation, dated 2nd November 1895, No. 44 C.

In continuation of this office letters Nos. 1318 K.S. and 1400 K.S., dated 20th September 1895 and 7th October 1895, respectively, and also of subsequent reports, I have the honour to forward six original enclosures received to-day from the Executive Engineer, Kistna Eastern Division, reporting in detail regarding the damages caused in the Kistna Eastern division by the heavy rainfall of 5th September last.

2. As already stated in this office No. 1318 K.S., dated 20th September 1895, the rainfall exceeded on the whole that of any known previous record, and the flood level in the Budameru, Tammileru and Collair lake attained a maximum. The Executive Engineer is, however, of opinion that the rainfall is not sufficiently in excess of previous falls to account for the greatly increased damages, and thinks that

the cause of such increased damages must be attributed to the manner in which the embankment of the East Coast Railway pounded up flood water, which subsequently on the breaching of the railway embankment in numerous places, poured on to the Ellore canal, practically swept everything before it, and breached the canal in 248 places. I entirely concur in this opinion. The proposition is in fact self-evident. The railway embankment is, as regards the Ellore canal, nothing but a long tank with insufficient surplus escapes, is in immediate proximity to the canal, and, if breached through, must almost inevitably breach into the Ellore canal. The matter has already been dealt with elsewhere and is referred to in detail in the report of the Sub-Divisional officer, Northern Sub-division.

3. At the same time there appears to be little doubt that the main cause of damage to the railway is due to the wholesale way in which some 60 tanks above the railway line breached, these tanks consequently damaging the railway in precisely the same way as the railway damaged the Ellore canal. The very great majority of these tanks are private * tanks, and unless legislative measures are taken to enforce that they shall be put in proper repair, a repetition of such disasters cannot be altogether prevented.

* Only six Government tanks breached.

4. On receipt from the railway officials of the statement of waterways and breaches called for, the Executive Engineer proposes to make suggestions regarding measures necessary to mitigate further damage to Ellore canal from breaches in the railway embankment. The provision of further inlets and outlets, and removal of existing banks, wherever advisable, in order to allow cross drainage to pass freely, is certainly necessary.

5. The damage done by the floods to main canals was primarily to the Ellore canal and in a less degree to Ryves' canal. In addition to the breaches caused by the pounding up of flood water by the railway embankment, another chief cause of damage is due to Budameru floods, while to the consequent rising of the Collair lake to 0·88 feet above its previous M.F.L. is directly due the loss by submergence of a very large extent of crops. As already reported elsewhere, the diversion of the Budameru seems the best way of obviating further damage by that river and by an undue rising of flood level in the Collair lake. The subject is now being taken up.

6. The damage done by floods in the Tammileru is also disastrous, and the Sub-Divisional officer, Northern Sub-division, makes definite proposals in regard to the measures necessary to lessen the silting of the bed of the Tammileru below the escape —a matter which calls for early attention. The Executive Engineer is preparing a special report regarding the steps necessary to control and deal with Tammileru floods in future. Investigation of the subject is, it may be noted, already being made in reference to the flooding of Ellore town, and the matter is also attracting the notice of the Gódávari officers, to whom, it is understood, instructions have been issued by the Chief Engineer for Irrigation.

7. The names of officers and subordinates, whose good work in repair of damages calls for special notice, have already been reported.

8. Necessary application for funds for repair of damages has also been already made.

9. As stated in former reports, there is practically no loss of crop from want of water. The Executive Engineer now states, however, that about 30,000 acres have been lost owing to submergence, of which about 22,500 acres are due to Budameru floods and rising of flood level in Collair lake. The importance of the investigation of the project referred to in paragraph 5 above is thus evident.

10. In the original report submitted from this office No. 1318 K.S., dated 20th September 1895, it was stated that no "serious damage" had been done to masonry works. In his statement of breaches the Executive Engineer shows in detail such damage as has been caused to masonry works.

11. It is requested that the six original enclosures forwarded herewith be returned when no longer required.

ENCLOSURES.

From C. A. SMITH, Esq., Executive Engineer, Kistna Eastern Division, to the Superintending Engineer, II Circle, dated Bezwada, 28th October 1895, No. 3210.

[Reference No. 1287 K.S., dated 17th September 1895.]

I have the honour to report as follows on the extraordinary floods which occurred on 6th September and following days.

2. On the 5th night there was heavy rainfall all over the delta as shown in attached statement and also in the upland taluks, due apparently to some cyclonic disturbance.

3. This appears to have breached a large number of tanks, resulting in very rapid rising of all the upland drainages, which cross the Ellore canal, and this canal as detailed elsewhere was very seriously damaged.

4. The largest of these upland drainages is the Budameru and this in addition to other damages breached into Ellore canal at 3rd mile and out of it again at 4th mile into Ryves' canal. It also backed up the Ellore canal to Bezwada with the result that, although the main canal head sluice was fully closed, the Budameru water was running 11·20 feet deep at the junction of Ellore, Ryves' and Bander canals.

5. Ryves' regulator was also closed, but Budameru water which had breached into this canal at 4th mile had backed up to 9·40 on the gauge in rear of the regulator.

6. It will thus be seen that considerably more than full supply was passing down all the three canals, without any possibility of cutting it off, and this on the top of heavy local rainfall throughout the delta, which in itself would be as much as the present system of drains could carry off with all supply to the canals cut off.

7. It was impossible to take any steps to improve matters, and all I could do was to wire to the Sub-Divisional officers directly I heard of the Budameru breach to look out for the flood water. This breach occurred at about noon on the 6th. The bank was safe when I saw it about two hours before, but as the water was then very near the top of the bank and during those two hours the flood rose 2 feet, it was impossible to save it.

8. I was very anxious about the safety of Komatigunta weir, an important regulator at 14th mile of Ryves' canal, but on inspection on the 7th found that fortunately the banks had given way in several places above, and though a large quantity of water had passed the weir, it was quite safe.

9. A breach occurred in the left bank of Ryves' canal at Aginapad at 20/3 and being between the old and new under-tunnels it seemed at one time likely to be a serious one.

10. The Sub-Divisional officer Mr. Rajagopala Aiyangar was there however on the 8th and threw in round the masonry a quantity of jeddy stone which was on the bank to try and prevent further scour, and it was found when water was cut off that the scour had not reached the foundation and no damage occurred to the masonry. This was probably due to the Sub-Divisional officer's promptitude.

11. This breach fortunately relieved the canals below, though at the expense of Gudiváda town, which was seriously flooded and necessitated the cutting of several breaches in Dosapad and Gudiváda channels, in order to let the water escape, as the Chendraya drain into which the breach at 20/3 led was quite insufficient to pass off so much water.

12. Bander canal was hardly damaged at all, there being only two breaches at 16th mile, due to local drainage entering the canal.

13. As will be seen from the detailed statements, the damage to main canals was confined to the Ellore and Ryves' canals, and chiefly to the former.

14. In order to relieve the main canals it was necessary to open fully all distributaries, and many of these have suffered in consequence, but on the whole not very seriously.

15. The Northern Sub-Divisional officer Mr. U. N. Joyce was at Kankipad on the Bander canal on the 5th night and returned to Bezwada on the 6th afternoon after taking such measures as were possible to pass off flood water and ensure the safety of the lock.

16. On the 7th morning he started down the Ellore canal in the paddle boat, but on account of the rapid current through the breaches only got as far as Kesarapally at 12th mile. Beyond this no boat could go, on account of breaches, and he had to go the rest of the way on foot wading through breaches and experiencing considerable discomfort. On his way he made such arrangements as he could for collecting labour and materials, and since that time he has been constantly backwards and forwards on the canal.

17. A large number of the villages along the Ellore canal are zemindari and there is always difficulty in getting labour, and in many places there was difficulty in getting earth and turf for the breaches. I may mention that the Revenue officers and subordinates of both Kistna and

Gódávari gave all the assistance in their power in collecting labour, &c., and by putting in force the Act of 1858 when necessary, the requisite labour was eventually collected.

18. The canal which had been cross-bunded at the head was re-opened on the 28th September, and considering the number of breaches to be closed, the number of miles over which they were scattered and the various difficulties to be overcome, I think that it was exceedingly creditable to Mr. Joyce to get the canal re-opened so soon.

19. The following subordinates are reported by him to have worked very well :—

M.R.Ry. G. Sooryanarayana, Delta Superintendent.
„ M. Ramaswamy Pillai, Overseer.
„ C. Ramasawmy Iyer, Temporary Overseer on Rs. 80, after joining from Gódávari on the 15th September.

And in addition to the above the Anicut Superintendent Ch. Venkataramayya Naidu was of very great assistance to me and worked very well in closing the Budameru breach.

20. It was of course impossible to run the canal full at first, but moderately-loaded boats passed through the Tammileru to Ellore on 2nd October.

21. Since the canal re-opened, there has been considerable interruption to traffic by the Tammileru, which has been down in flood seven times between the flood of 6th September and the 15th October, and each time so much sand was deposited between the flood gates as to take two or three days to clear. This was, however, in no way due to the breaches and would have happened whether the canal had previously been breached or not.

22. On account of the constant showers during the time the Ellore canal was closed; there will be practically no loss of crop for want of water.

23. The probable total loss in the Eastern delta by submersion will be between 25,000 and 30,000 acres, of which about $\frac{3}{4}$ will be due to the Collair and Budameru, the former of which rose rapidly to 0·88 above the previous record flood that of 1892.

24. Ryves' canal was re-opened on the 25th September and there is not likely to be any loss of crop under the canal for want of water.

25. I enclose comparative statements of rainfall and flood-levels (will follow) for the various floods affecting Ellore canal since 1872, completed as far as possible from available records. It will be seen from this that, on the whole, the rainfall was heavier for this last flood than for any of the others. The difference is, however, not sufficient to account for the large increase in the damages, and this in spite of the fact that the waterways have been largely increased in the last ten years or so.

26. I do not think there can be any doubt that the pounding up of the water by the railway embankment and its subsequent sudden release when the bank gave way is the chief cause of the increase in damages.

27. I have applied to the East Coast Railway for a statement of their waterways and breaches and will forward it on receipt with a sketch-map showing the relative positions of the waterways on canal and railway; but as there may be some delay in getting these statements, I will not delay my report for it After considering these statements I will also forward any suggestions I may have to make for preventing damages in the future; but at present I may say that, generally speaking, I consider that any further provision of waterway on the canal should only be in the form of inlets and outlets and removal of banks in suitable places.

28. I do not think that any more surplus sluices are required, as if the flood water is allowed sufficient waterway in the railway bank to reach the canal gradually as it used to do before the railway was made, the existing surplus work with the addition of a few more inlets and outlets will, I believe, pass over extraordinary floods without serious damage.

29. The necessary data are being collected for the preparation of a complete estimate for repairing the flood damages, but the probable total cost will be about Rs. 50,000 for the whole division, of which, as already reported, Rs. 20,000 will be required during the current year.

30. I enclose copies of reports received from the three Sub-Divisional officers.

From Sergeant C. J. SMITH, Sub-Divisional officer, Southern Sub-Division, to the Executive Engineer, Kistna Eastern Division, dated 5th October 1895, No. 1836.

I have the honour to submit, for your information, the following report regarding the storm of 5th and 6th ultimo.

2. It will be seen from the following table that the rainfall varied from 9·50 inches at Viranki to 5·28 inches at the Tidal lock :—

Station.	Rain gauged on		Total for 5th and 6th of September 1895.
	5th September 1895.	6th September 1895.	
Tidal lock	5·28	..	5·28
Akumarru lock	4·35	1·60	5·95
Nidumole „	3·10	2·40	5·50
Pamarru „	4·20	2·70	6·90
Viranki „	9·50	..	9·50
Kankipad „	3·25	5·75	9·00

3. The lock tappal due at Bandur at 1–30 P.M. on 6th ultimo did not arrive until the following morning and at about 10 A.M. on that date, I received information that the Bandur canal had breached in the 17th mile. I started up canal the same day reaching Nidumole at about midnight and Bezwada at 11 P.M. on 8th idem.

4. With the exception of a few trees being blown down no damage was done to the Bandur canal in the 3rd, 4th and 5th reaches, but the water in 3rd reach was only a few inches below tops of banks in 29th and 30th miles. In the 4th reach over 2 feet of water were rushing into the canal from east side channel at Taragatur slope and in order to save the main canal I breached the banks of the east side channel in several places, and thus lowered the water in the channel by over 2 feet in about an hour.

5. On account of the large quantity of water that was being drained off through the masonry sluices in 3rd reach, I found it necessary to breach the right bank of west side channel in several places to save the right bank of Bandur canal.

6. In the 2nd reach of the Bandur canal 34 trees were blown down and both banks were breached near $\frac{1}{5}^{6}$; the breach in left bank was about 10 feet long and 4 feet deep and was closed by noon on 8th idem; in the right bank there were two breaches only a few feet apart, one being about 20 feet long by 1½ feet deep; and the other about 40 feet long by 4 feet deep; these breaches were both closed by 10th idem, but owing to leakage the bank was not made up to its proper section until 17th idem.

7. On 12th idem the right bank was breached by the ryots near 16th mile 3rd furlong for a length of 9 feet by 4′–6″ deep; this breach was closed on 13th idem.

8. The cause of the 2nd reach being breached was due to the enormous volume of flood water held up to the right of the canal between $\frac{1}{0}^{6}$ and $\frac{1}{4}^{9}$; this water on both 7th and 8th ultimo having flown into canal in several places over the right bank thus causing the breaches alluded to above, passed out of the canal over right bank in several places between $\frac{1}{4}^{3}$ and $\frac{1}{6}^{9}$ and over left bank at Vallur slope.

9. In order to pass off this water as quickly as possible Chilladonka dam was entirely removed and Penamakur dam was demolished as far as was possible with the water rushing over it.

10. The left bank of the canal was in great danger of breaching between $\frac{2}{0}^{2}$ and $\frac{2}{0}^{4}$, the water having been within 1 foot of top of bank in several places and this portion was, in all probability, only saved by Medur and Pydimukkala sluices being kept fully open.

11. To the left of canal from Pamarru to Kankipad the whole country was one large lake as far as the eye could see with the exception of isolated high places.

12. This water being much higher than F.S.L. in canal just below Viranki lock the ryots of Inampudy threatened to breach the left bank of canal in several places but abstained from doing so.

13. At 7 A.M. on 8th instant the water surface in Kanakavalli drain just above Inampudy under-tunnel was + 19·97, and, as the water had then fallen about 9″ M.F.L. here can be taken as 20·72 (F.S.L. in canal at this place being 23·03), the head of water discharging through the under-tunnel was 0·45.

14. The M.F.L. of water in Kanakavalli drain at Viranki bridge was 27·31.

15. The masonry works of both main canal and irrigation channels received no damage.

16. The damage done to irrigation channels was found on inspection to be much less than was anticipated and each Government channel is reported on in the following paragraphs.

17. Capileswarapuram channel breached in thirteen places, *i.e.*, in right bank at $\frac{0}{1}$, $\frac{5}{1}$, $\frac{3}{5}$, $\frac{5}{6}$, $\frac{5}{7}$, $\frac{4}{5}$, and a little below Viranki dam; in left bank at $\frac{3}{1}$, $\frac{3}{5}$, $\frac{3}{7}$ one just above Viranki dam and two a little below it. These breaches were all about 9′ long and most of them scoured out 1 foot

below bed of channel. The right bank of this channel was completely submerged in several places and its outer slope from $\frac{1}{3}$ to $\frac{1}{4}$ has been undermined and damaged by wave action. The breaches have all been closed and right bank will be strengthened as soon as possible.

18. A few small breaches occurred in weak places of Ramarazupalem channel, and its branches and the sites of spouts were scoured out in many places. These breaches have been closed.

19. Good water channel was not damaged.

20. The outer banks of both east and west side channels were breached by me in several places to save the banks of main canal. These breaches have all been closed.

21. Medur channel breached in five places, *i.e.*—

		Feet long.
Right bank at	$\frac{1}{7\frac{3}{8}}$	12
Left do.	$\frac{8}{5\frac{1}{4}}$	18
Right do.	$\frac{8}{8}$	12
Left do.	$\frac{10}{6}$	34
Right do.	$\frac{10}{6}$	24

these breaches have all been closed, but require strengthening.

22. Krishnapuram branch channel sustained no damage, but its banks were submerged opposite Baralapudy.

23. Goodapad branch channel was breached in three places, *i.e.*—

		Feet long.
Left bank	$\frac{0}{5}$	33
Right do.	$\frac{0}{6}$	12
Do. do.	$\frac{0}{6}$	30

these breaches have been closed, but require strengthening. In addition to these three breaches the right bank for about 330 feet between $\frac{0}{6}$ and $\frac{0}{7}$ has been lowered for about one foot by flood water passing over it.

24. In Divi Island the inner slopes of almost all the tank bunds were more or less damaged by wave action and the following supply channels were breached:—

Digupallem in two places.
Veeranna in six places.
Pata in two places.
Velagani in one place.
Chodavaram Peda in one place.
Suvarnnamukhi (Kadi) in one place.
Nangegadda Jammi in one place.
Anantuni in two places.
Viswanadhapalli Modalliar in one place.
Modumoody in three places.

25. The actual extent of damage done to the tanks cannot be accurately determined until they are empty when the amount of strengthening of bunds that is necessary will be reported.

26. The Kistna river left flood bank was not damaged with the exception of a small portion of the right slope of the diversion recently erected by Messrs. Napier Brothers between $\frac{2}{1}^2$ and $\frac{22}{5\frac{1}{2}}$ which was slightly undermined by wave action.

27. The bank at $\frac{6}{2}$ (Northern Sub-division) was breached by the ryots to pass off the flood water into bank canal that was held up between present flood bank and an old bank; this breach was about 10 feet long and 8 feet deep and was closed on 9th idem. A small portion of the high lanka between flood bank and river near $\frac{1}{2}^8$ was scoured out.

28. It is impossible until the crops are harvested to say on what acreage remission of water-tax will have to be made, but, with the exception of a few isolated areas under the various channels, which will not exceed 100 acres, the only wet crops that have been much damaged are about 150 acres to the right of canal in 17th mile and from 50 to 100 acres of low level lands between Capileswarapuram channel and the main canal.

29. Delta Superintendent C. T. Mohan Singh reports that no damage has been done to the crops in his portion and Delta Superintendent N. Venkatadri Naidu is now engaged in preparing a detailed report of the damaged crops in his portion which will be forwarded to you when received.

30. In several places to the left of canal between Kankipad and Pamarru, the dry crops were much damaged.

31. No appreciable damage has been done to the wet crops in Divi island.

32. The expenditure that has been or will be incurred in closing breaches and repairing banks damaged by the recent floods may be approximately put down at Rs. 1,000, which is arrived at as follows:—

	Rs.
Bandur canal (otherwise called Masulipatam canal), second reach	200
Capileswarapuram channel	200
East side channel	20
West do.	80
Ramarazupalem channel and its branches	100
Divi island	300
Kistna river left flood bank	5

33. From observations made during the past month, it is quite evident that the drainage of land on both sides of second reach of Bandur canal must be improved as soon as possible.

34. On the left of the canal there appears to be no difficulty in improving the drainage, as the area most effected by flood water is the low lying portion just above Kanakavalli and this flood water could, I think, be easily passed off by excavating a drainage channel from about $\frac{1}{4}^9$ parallel to, to the canal and meeting the Kanakavalli drain at $\frac{20}{4\frac{1}{2}}$ when the left bank of canal becomes the right bank of the drain.

35. On the right of canal the drainage of the lands of Badlapad, Chinapulipaka, Godavarru, &c., enters the west side channel near $\frac{1}{3}^6$, but owing to Chilla donka and Penamakur dams, the discharging capacity of the channel is much reduced and after heavy rains drainage water to a depth of 2′ or 3′ is held up by the right bank of west side channel between $\frac{1}{6}^6$ and $\frac{1}{6}^7$. The question of converting the west side channel into a drain and providing a separate channel for irrigation is, I believe, under consideration. If this is carried out, the drainage water could be rapidly passed off into the Kanikalamadugu, but to get the full benefit of this, the old Mopidevi channel would have to be deepened from Medur head sluice to just below drop No. 1 and given an uniform bed fall.

36. I am informed that previous to the excavation of the west side channel this drainage water used to be passed under the canal by an under-tunnel, which is still in existence, as also is one at $\frac{1}{4}^9$, but I do not think that it would be advisable to re-open them, as before doing so, they would have to be extended underneath the west side channel and a drainage channel would have to be dug parallel to canal from $\frac{1}{6}^6$ to the place $(\frac{20}{4\frac{1}{2}})$ where left bank of canal becomes right bank of Kanakavalli drain.

37. It would, I think, be feasible to get rid of this drainage water by excavating a drain to run along the edge of wet cultivation nearest river bank from about $\frac{1}{2}^6$ Bandur canal to the Kanikalamadugu, a few lines of levels would decide this.

From M.R.Ry. N. RAJAGOPALA AIYANGAR, Cowtaram Sub-Divisional officer, to the Executive Engineer, Kistna Eastern Division, Bezwada, dated Bantumilli, 7th October 1895, No. 2077.

I have the honour to submit herewith a statement of the areas of lands submerged entirely by the flood waters of the last month, and the consequent rising of Collair and Upputeru.

The 2,000 acres submerged under Gudiváda channel lie partly on the left side of the channel where the flood water from Budameru entered through the breaches along Ryves' canal, and mostly at the tail end of the channel, where the lands were submerged by the backing of Collair water, which rose ·88 foot higher than the M.F.L. of 1892. The damage under Mottur channel is purely owing to the backing of Collair above; out of the 1,000 acres damaged by the side of Palacodu and Komaravole affluents, 500 acres are in the village of Penjendra at the head of Palacodu affluent and come under mamul wet; these 500 acres being originally swampy lands, are submerged even in ordinary years and it is no wonder the crops are entirely lost in a year like this, when the rainfall was unusually heavy and untimely and when we had to keep the irrigation sluices fully open for about a week after the heavy rainfall, owing to the Budameru floods entering Ryves' canal; the remaining 700 acres were, of course, spoiled by the backing of Collair water along Polraz drain into which the Komaravole affluent falls.

The 3,700 acres of land submerged by the side of Polraz drain lie mostly towards its tail end where the Collair water backed up.

The areas affected on the borders of Collair and the sides of Pullava, Annava, Vadurva Dammidi, Ellamalli and Pedakommileru drains were all due to the rising of Collair and the Upputeru, which rose ·9 foot more than the flood level of 1892 at Tadinada lock. Out of the 1,000 acres noted on the margin of Upputeru and under Pedalanka channel, 600 are in the villages of Kondangi and Amarávati to the left side of Pedalanka channel below the regulator,

where the flood water of Upputeru breached, Kondangi channel banks and backed against the left bank of Pedalanka channel; the remaining 400 acres lie on the right side of the channel, where the lands were completely free from submersion till the 17th September 1895, when the ryots of Guravayapalem cut a breach on the Pedalanka channel banks, 2 furlongs below the regulator, out of pure jealousy without any appreciable benefit to themselves; by these breaches 400 acres on the right side of Pedalanka channel were entirely spoiled.

Mattagunta and Pedalanka lands lying lower down the Upputeru, although lying under water for a few days were not damaged at all; at Lakshmipuram lock the flood water of Upputeru rose only a few inches higher than the high tide level. From the statement of the areas spoiled, it will be seen that there was no damage at all to the right side of Pedalanka channel anywhere in the sub-division, the damages were confined to those parts only, which were affected by the Collair floods and the consequent rising of Upputeru as far down as Kondangi. Below Kondangi or at any rate below the mouth of Pedalanka drain, I should think Upputeru is sufficiently broad and has broad low lands on the left side for the flood water to spread. From the fact that the flood water passed off quietly without doing damage along all the drains to the right side of Pedalanka channel, I conclude that the tentative widths to which all the drains were excavated are enough for the present, and that there is no use of widening the drains to the left side of Pedalanka channel until some measures are taken up to lower the Collair water level in floods, and prevent the abnormal rising of Upputeru from Tadinada to Kondangi. At present Collair rises and spreads all over the low lands lying above the ridge just above Tadinada lock, which extends to Akveed canal, and the fall of Upputeru up to this ridge is very little.

Between this ridge and the Ellorepad lock, Upputeru flood level has got a good fall, and beyond Ellorepad lock the water spreads itself. Hence I should think that by widening Upputeru between Tadinada lock and the Ellorepad lock and by straightening it with bed level probably at low tide level, the Collair water could be got rid of sooner and Upputeru itself not allowed to rise abnormally, as to damage the lands on both sides of it. I have arranged to get the flood levels taken along the Upputeru from Kottada weir as far as Lakshmipuram and after I receive the levels, I shall make a detailed report on the necessity of widening the Upputeru which would amply pay by relieving the 17,000 acres of land entirely damaged by the floods in this sub-division, in addition to what might have been in the Northern Sub-division and on the Gódávari side.

Statement showing acres of land submerged and spoiled by flood water in Cowtaram Sub-division during 1895–96.

Name of channel under which the submersion took place or name of drain by the side of which there was submersion.	Approximate area of entire submersion for which remission will have to be given.
	ACS.
Gudiváda channel	2,000
Mottur channel	2,000
Palacode and Komaravole affluent	1,200
Polraz drain	3,700
Borders of Collair on the left side of Kykalur channel	2,000
Pullava drain	1,300
Annava affluent	500
Vedarva affluent	700
Damidi drain	500
Ellamalli drain	500
Pedakommileru drain	1,600
On the right margin of Upputeru lands supplied by Pedalanka channel	1,000
Pedalanka drain	*Nil.*
Vadlamannad affluent and Lazzabanda drain	*Nil.*
Total ...	17,000

From U. N. JOYCE, Esq., Sub-Divisional officer in charge, Northern Sub-Division, to the Executive Engineer, Kistna Eastern Division, dated 22nd October 1895, No. 508.

Referring to your No. 2987 of 8th October 1895, I have the honour to report that owing to the abnormal flood of the Budameru, Cheemalavagu, Ramileru and Tammileru rivers, together with the local drainage of elevated lands on the left of Ellore canal coupled with the water from the bursting of sixty tanks (above the railway line) at about the same time, and this great

volume of water not having its free exit over the country was dammed up to a very great extent by the railway embankment till the drainage above rose to a height to top the railway line, and finally ended in the carrying away the railway embankment together with the canal banks in several places for more than half a mile in each place, many culverts were overturned and the afflux starting from this barrier (railway embankment) came off towards the canal at a very abnormal height. Owing to the limited space between the railway line and the canal bank, the flood waters could not possibly run off spreading over the country at any reasonable fall. This sudden head of water backing against the canal bank topped it in several places from $\frac{8}{0}$ to $\frac{38}{0}$ and caused serious damage making the canal a complete wreck. In my humble opinion, I do not believe that there would have been even $\frac{1}{10}$ of the present damage to the canal by floods if the railway embankment did not exist for the following reasons:—

(1) Wherever there is a large breach in the railway line and wherever girder bridges or culverts have been overturned the damage to the canal and its banks is in the self same line.

(2) If no railway embankment existed or if a greater number of bridges were constructed nearer each other of adequate waterway to take the local drainage as it started, the water would have greatly glided over the country and found its way to the several inlets and under-tunnels in the whole length of the canal.

(3) The inlets and under-tunnels have been calculated and constructed to take a definite volume provided the discharge enters them gradually, but a sudden outbreak of such an abnormal quantity could not be passed through the inlets, under-tunnels and escapes and in consequence carried away the banks as well as the berms of canal and further damaged the railings of three aqueducts which now have to be renewed. It must be here stated that the sleepers of the railway line have struck against the standers and railings of the aqueduct in the 11th mile and caused them to be broken off clearly. Some sleepers have been removed and kept for inspection at the aqueduct which may be seen at any time.

In the whole length of the Ellore canal from the 3rd to the 40th mile there are no less than 248 breaches, some of which extend for 1½ furlong, but these are very few. There are several breaches from 100 to 400 feet and considerably deep. In some places ring bunds had to be constructed to re-open the canal. I would here mention that there are twelve under-tunnels between $\frac{1}{0}$ and $\frac{3}{0}$, of these there are no breaches or damage to three—one at $\frac{1}{8}$, $\frac{1}{0}$ and the other at $\frac{2}{1}$—at all other under-tunnels the earth connection on both sides have been breached and in some places deeply scoured especially at $\frac{2}{4}$ and $\frac{3}{8}$ where very great difficulty has been experienced in making up its earth connections at a very great cost.

From most of these places of damage to the canal the corresponding breaches, &c., to the railway line could be seen, which means to convey that this extensive damage has been chiefly caused and aggravated by the railway line not having sufficient water way. The probable cost to repair the canal, its crossings and distributaries will amount to about Rs. 40,000; details to frame the estimate are being collected. The left bank of Ellore canal in only 1891 was made up to 3·5 above F.S.L., at a cost of Rs. 17,000 odd. This recent flood has topped the bank from the 15th to the 36th mile.

The flood level as observed from $\frac{2}{4}$ to $\frac{37}{4}$ is given here under—

$\frac{2}{4}$	59·76.	
$\frac{5}{3}$	53·61.	
$\frac{7}{5}$	51·61	Budameru aqueduct (tow-path wall 48·11).
$\frac{11}{0}$	50·53	Kesarapilly do. (tow-path wall 47·95).
$\frac{15}{6}$	48·91	At Buddahavaram escape.
$\frac{17}{1}$	49·69	At Avitapalle under-tunnel.
$\frac{18}{4}$	49·26	At Atkur under-tunnel.
$\frac{19}{1}$	49·11	Do. escape.
$\frac{20}{0}$	49·50.	
$\frac{36}{0}$	47·00.	
$\frac{37}{4}$	50·11	West Tammileru escape (top of flood stop gate 46·51).

From the above, perhaps, it would not be out of place to notice that there was a surface fall of 4·6 in a distance of 28¼ miles, *i.e.*, $\frac{7}{8}$ to $\frac{36}{0}$; this means a surface fall of ·16 or 2 inches per mile, which further goes to establish the fact that the abnormal flood had backed up instantaneously against the Ellore canal, the very moment the railway embankment had breached; with this rush, trees, bushes, roof timber and other materials were driven down damaging masonry works in some places and blocking up vents in others till it ended in leaving the canal a complete set of scour holes.

I am of opinion that the flood could not possibly rise so high as it did in the last flood, had it not been for the contraction of the waterway of Tammileru river by the construction of a railway girder bridge, with so many huge piers decreasing the waterway of the stream, thus increasing the bottom velocity and driving the sand and silting the chamber of the valuable escape as well as the bed of the stream below for a depth of 4 feet, thereby diminishing the

discharge of the escape and defeating the object of the escape for which it was constructed. The very fact of the flood waters rising above the level of the girder on the up-stream side and being lower on the down-stream side goes to prove the insufficiency of the waterway stated above.

The bed of the Tammileru below the escape about two years ago was 4 feet and more below the sill of the escape, whereas it is now about 4 feet above the level of the sill; from what has happened, it is very clear that some tangible arrangements must be made to prevent this silting, otherwise the escape will in short close itself entirely and if this happens, there will be no communication between Bezwada and Ellore beyond the 37th mile, in addition to which the cultivation of Ellore will have to be given up causing a loss of some Rs. 50,000 of revenue yearly.

To improve present conditions, to make the escape effective to protect the town of Ellore in a measure to ensure cultivation being supplied and to maintain navigation, it is proposed to submit estimates, &c., for works enumerated below, if the suggestion meets the approval of superior authority :—

(1) To put in a line of fender piles about 9 feet above the drop wall of the West Tammileru escape the piles to be let 6 feet below top of drop wall resting on concrete foundations 3′ × 3′ to be connected by a diagonal strut resting against the drop wall and butting against the vertical strut over which a tow-path bridge will be carried out 2 feet wide for the purpose of towing when necessary and to remove trees, brushwood, brought down by the current which now finds its way in the chamber of the escape and blocking up its water-way as was done during the last flood where 70 trees of palmyra and date and one large tamarind tree was left against the escape shutters making it impossible to work them.

(2) To reconstruct the stone dam at the bifurcation of the West and East Tammileru rivers and from the point of bifurcation the bed of the East Tammileru to the Chataparru escape the bed-fall to be made the same as that leading to the West Tammileru from the point of bifurcation. The bed of East Tammileru to be cleared to a width of 120 feet with side slopes of 3 to 1, removing all shoals realizing the course of the stream when the work is being carried out. The spoil bank to be made on the right of East Tammileru leaving the existing road 12 feet wide and no bank to be constructed on the left.

(3) There are three road dams now across the East Tammileru which must be lowered to effect the desired improvements in the welfare of Government and public—

(1) Chintalapudi road dam.
(2) Moondor road dam.
(3) The Great Northern Trunk road dam.

At these places of crossing, ferry ballacuts could be provided as is done all along the canal.

(4) To construct a row of fender piles similar to that proposed above the West Tammileru.

(5) To alter and improve the Chataparru escape by converting the weir portion into an escape to correspond with the existing work.

The estimate and plan for the towpath bridge across the East Tammileru above the Chataparru escape was sent in when a report was made about the high flood of 23rd October 1894.

I would here mention briefly that, during the time the canal had to be closed on account of repairs necessitated by this abnormal flood, no pains were spared to re-open the canal in three weeks. I have been greatly assisted by the following subordinates in restoring navigation, &c. :—

G. Suryanarayana, Delta Superintendent.
M. Ramaswamy Pillay.
C. Ramaswamy Iyer.

The last-named joined this division from the Gódávari about a week later and yet has done his best in carrying out instructions.

I would here request that necessary credit be given to these subordinates for their willingness and arduous trouble they have taken in helping me so heartily as to re-open the canal earlier than what I anticipated; and therefore request that the Delta Superintendent be promoted, if possible, to a temporary upper subordinate or, if that will interfere with the grade of pension, it is hoped that he may be promoted in the grade of Delta Superintendents.

STATEMENT showing the rainfalls and heavy rainfalls at several stations in the Kistna Eastern division from the year 1872 to 1895.

Name of the station.	October 1872.			September 1882.				August 1886.				October 1892.				September 1895.			
	Total rainfall.	Highest rainfall.		Total rainfall.	Highest rainfall.			Total rainfall.	Highest rainfall.			Total rainfall.	Highest rainfall.			Total rainfall.	Highest rainfall.		
		Quantity.	Date.		Quantity.	Date.			Quantity.	Date.			Quantity.	Date.			Quantity.	Date.	
Masulipatam	13·05	..	..	10·52	2·86	3rd		19·9	5·32	15th		26·37	7·05	29th		7·72	5·28	5th	
Akumarra look	..	..	..	10·31	3·00	3rd		16·16	3·11	15th		21·25	..	..		8·08	5·80	5th	
Nidumole ,,	..	..	..	8·74	2·70	4th		14·75	3·15	15th		23·34	..	..		6·18	4·00	5th	
Viranki ,,	..	..	..	8·77	2·70	7th		15·75	5·50	15th		17·74	7·50	20th		12·98	9·50	5th	
Cowtaram ,,	13·73	..	..	14·68	8·47	3rd and 4th		17·77	4·60	17th		22·11	6·24	20th		10·07	6·75	5th	
Bezwada ,,	..	..	..	8·59	3·49	6th and 7th		12·26	2·78	17th		17·38	5·42	20th		14·92	10·85	5th	
Kesarapally ,,	..	..	..	7·68	1·00	7th		..	..	..		23·35	7·50	20th		12·30	5·98	5th	
Kankipad ,,	..	..	..	6·37	2·10	7th		21·72	7·70	16th		7·50	1·50	30th		16·22	5·75	5th	
Tiruvur ..	..	..	..	13·10	6·30	6th		10·48	2·12	18th		in 11 days 14·7	in 13 days 3·10	29th		5·67	4·46	6th	
Gannavaram ..	..	..	..	7·00	3·00	6th		14·80	..	..		in 13 days 20·20	..	..		13·90	9·20	6th	
Vinjaram look	..	..	..	..	..	..		11·55	3·35	14th		..	..	..		11·40	6·85	5th	
Pamarru ,,	..	..	..	1st to 9th 7·27	3·55	..		15·30	4·32	15th		22·57	..	..		10·41	5·60	5th	
Lakshmipuram ,,	..	..	..	..	..	..		..	..	..		..	..	..		5·13	3·12	5th	
Kamalapuram ,,	..	..	..	..	..	..		..	..	..		20·62	..	..		7·36	5·63	5th	
Tadinada ,,	..	..	..	..	..	..		..	..	..		23·90	..	..		14·60	10·40	5th	
West Tammileru aqueduct	1st to 9th 14·14	8·27	..	9·41	3·33	3rd		9th to 19th 13·50	3·20	..		in 13 days 14·50	..	..		11·35	6·10	5th	
Gudivada ..	11·60	..	..	10·13	..	..		13·87	2·50	17th		18·01	3·37	29th		9·99	6·30	6th	
	Date of flood, 4th.			Dates of flood, 8th and 9th.				Dates of flood, 17th, 18th and 19th.				Date of flood, 27th.				Date of flood, 6th.			

N.B.—The rainfall at Ellore is entered in 1872 and 1892, as there are no statements of rainfall at West Tammileru aqueduct before 1894.

(Signed) C. A. SMITH,
Ex. Engr., Kistna Eastern Division.

23rd October 1895.

STATEMENT OF BREACHES.

Ellore Canal.

The first and largest upland drainage stream affecting this canal is the Budameru. This passes under the East Coast Railway about 3 miles from Bezwada and runs parallel to Ellore canal from 2½ miles to 5½ on canal. It ordinarily crosses the canal by the aqueduct at $\frac{7}{6}$, but when in flood it spills over both banks in the 6th mile, where the banks have been removed for a length of about $\frac{3}{4}$ of a mile for this purpose. It also passes over the side walls of the aqueduct.

Part of the flood water thus entering the canal is passed off through old Ryves' head sluice at 7/2 and joins the Budameru again.

During the current year a cut was in progress from the Budameru aqueduct at 7/6 to the Kasarapully aqueduct at 10/7, but this cut was incomplete.

This was not, however, of much importance in the late flood for the water spread over all the country above the canal, and a large quantity ran down on the left of the railway and breached it opposite Kasarapully aqueduct. There was 3½ feet passing over the side walls of Budameru aqueduct and 2·58 feet over those of Kasarapully aqueduct, the previous records being 3 feet over Budameru aqueduct and 2 feet over Kasarapully aqueduct in 1886.

The side walls of Budameru aqueduct were raised 6 inches in 1891. Therefore the present flood was 1 foot higher at Budameru aqueduct and 0·58 at Kasarapully.

Some railway sleepers were carried over Kasarapully aqueduct, breaking off some of the hand rail stanchions in their way, but, with the exception of this and some of the coping stones being displaced, no damage was done to either to Kasarapully or Budameru aqueducts.

The damages caused by the Budameru were as follows:—

A breach in left bank at 3rd mile 150 feet wide and of considerable depth which was closed by a ring bund over 300 feet long. This was very difficult to close and it took thirteen days continuous work before the water could be completely cut off.

A breach in right bank at 4/2 about 150 feet long and about 10 feet below bed of canal. This is at the Gunadala crossing, where Ellore and Ryves' canals are only separated by the bank. The crossing was paved, but has been entirely scoured out. As soon as Budameru water was cut off, this was easily closed so as to pass water in both canals by bunds about 8 feet high on either side of the scour hole, and the filling in of scour hole and restoration of main bank is now going on.

A breach in right bank at 3/5 where there is an old channel from the quarry.—This was shallow and easily closed.

Breaches in both banks at Yenekepad crossing at 7th mile.—These were small and easily closed as soon as water went down.

Breaches at Saneragudem crossing at 8/2 in right bank 150 feet long, left bank 130 feet long, both being down to bed of canal.

From 8/2 to 8/4 main banks washed away to berm level on left in five places 30 feet, 30 feet, 230 feet, 30 feet and 30 feet long, right bank washed away to ground level (lower than berm) in four places 70 feet, 140 feet, 70 feet and 80 feet long.

From 8/4 to 8/7 left bank washed away to berm level for length of 300 feet and 1,000 feet and right bank to ground level for lengths of 70 feet, 120 feet, 180 feet, 80 feet, 180 feet, 30 feet, 70 feet, 170 feet, 80 feet, 40 feet, 70 feet and 50 feet (total 1,140 feet).

As the berms were left between 8/2 and 8/7 nothing has been done to these breaches at present.

Between 8/7 and 9/5 the new cut had been completed and the spoil having been thrown on left bank, it was not breached.

The right main bank was breached to ground level in this part for lengths of 60 feet, 220 feet and 70 feet.

From 9/5 to 9/6 the left bank, although strengthened by the spoil, was washed away to berm level for a length of 640 feet and right bank washed away to bed level of canal for lengths of 40 feet, 30 feet and 420 feet, but berms were left standing.

From 9/6 to 9/7 three breaches in right main bank 80 feet, 50 feet and 70 feet berm left standing.

At 9/7⅓ is Nakkalam crossing which was breached below canal bed for 220 feet on right and 390 feet on left respectively.

At 10th M.S. is Nakkalam under-tunnel, of which the face walls have been entirely ruined, but tunnel apparently not damaged.

The left bank has a breach 100 feet long, which has been closed straight across, but the breach on right bank could not be closed and had to have a ring bund 400 feet long.

About 100 yards below Nakkalam under-tunnel, left bank was breached 100 feet long. This was first caused by Budameru water breaching in and was afterwards scoured out to below bed level, but Budameru water coming into canal from breach at 3rd mile escaping out into the new cut.

Between 10/1⅓ and 10/3⅓ the right bank washed away to about bed level for a length of 1,000 feet, but, except for a breach 100 feet long, the berm is standing throughout.

The left bank and spoil has been washed away to berm level for 830 feet with two small breaches through berm.

A great deal of the spoil earth was deposited here in bed of canal and had to be cleared out in the form of mud before water could be let down.

From 10/6 to 10/7. One breach 57 feet long through berm and bank. Right bank washed away to about bed level for 640 feet and in this length breaches through berm to bed level 50 feet, 50 feet, 30 feet and 30 feet.

Left bank and spoil washed away to berm level for 460 feet and a good deal of this had to be cleared from canal bed in the form of mud.

At 10/7 is Kasarapully under-tunnel, the left side wall of which is completely and right side partly ruined.

This under-tunnel was closed last year on the orders of the Superintending Engineer, as it was then considered unsafe.

Both banks are badly breached here for lengths of 30 ft. and 40 ft., that on right bank being below bed level. Just below under-tunnel on left side, a breach to bed level 30 feet long.

At 10/7⅓ is Kasarapully aqueduct water passed 2·38 feet deep over side walls, but with the exception of the railings and one or two coping stones, no damage has been done to the work.

Between Kasarapully aqueduct 10/7⅓ and Kasarapully village at 12/0, there are ten breaches in right bank to bed level, but of these only three had to be closed now. The worst breaches are near the crossing of the Bezwada-Gunnaveram road, these are 90 feet and 60 feet long down to bed level and it was difficult to get any earth here at first.

Opposite them on left bank is a deep breach.

This is the last breach caused by Budameru water and those between Budameru and Kasarapully aqueducts are due, I believe, to the Budameru water which ran down on the left of the railway bank and then came across to Kasarapully, for, as a rule, Budameru water does not reach Kasarapully aqueduct in any quantity, and at any rate, it would not have risen so rapidly, had it not been confined at first by the high railway bund. This is clear from the fact that though, in 1886, water rose nearly as high on both works, there was only one breach, 45 feet long at 10/6.

I may also point out that the difficulty in closing all these breaches above Kasarapully was enhanced by the Budameru water entering the canal at the 3rd mile and which, as I have mentioned above, took thirteen days to cut off. From 12/0 to 14/0 only one small breach in right bank at 12/1.

At 14/0 Azzempudi crossing was badly breached on right bank.

At 16/1 breach in right bank 40 feet long.

At 16/7 breach in right bank 50 feet long and below bed level.

Another breach in main branch just below this.

At 17/0 is Avetpully under-tunnel which was not damaged at all.

From this to village at 17/3 left bank topped and considerably scoured, just above village, a deep breach in left bank about 50 feet wide.

At village crossing right bank breached to bed level. These breaches were due to the breaching of Brahmayyalingam, Kristnaveram and Davagigudem tanks.

From 17/3 to Atkur 1st crossing at 18/1, no breaches of any importance, but only slight scour to banks.

Atkur 1st crossing breached to bed level.

At Atkur under-tunnel at 18/3 a bad breach down to foundations of right up-stream wing and this also damaged. Ponukumad left side channel which crosses the drain by an iron trough just below.

Atkur 2nd crossing also breached on right side.

Atkur escape at 19/1 was not damaged at all.

From here to Prattipad escape at 20/2. There are thirteen breaches in right main bank and three in the left but only those each about 30 feet long at Prattipad crossing on right and just above Prattipad escape are to bed level and in the others the berm is left Telaprole crossing at 21/2 was topped but not much damaged.

At Ampapuram under-tunnel at 21/2½ the towpath wall on right side was ruined and the right bank breached to 3½ feet below bed level on both sides of the masonry.

The outer face wall, however, was not damaged and the towpath bund has been strongly made up inside it and protected with turf and stakes.

The flood topped the left bank and scoured it but did not breach it materially.

Ampapuram crossing, which was newly metalled last working season, was breached on both banks to bed level of canal.

At Veeravully No. 1 sluice at 22/4, there was a breach 40 feet long and 3 feet below bed level round left wing of sluice and the left front return cracked in consequence. This breach has been strongly closed and the crack gronted with cement and now appears to be quite safe.

From Veeravully No. 1 to Veeravully under-tunnel at 23/1, both banks are more or less cut about, but no serious damage, as there are several large inlets and outlets here which passed off the flood water.

Veeravully uuder-tunnel was not damaged, nor were there any breaches near it.

Narasannapalem escape at 24/6 was in no way damaged but just below the escape and close to the mile cooly's sheds there was a bad breach 6 feet below canal bed and this had to be ring bunded outside.

At Narasannapalem under-tunnel at 25/1, the right bank was breached on both sides of the masonry down to foundation level, the wings were not damaged but the tunnel has cracked transversely.

On account of the constant rain, it was difficult to get this dry, but Mr. Joyce eventually managed to get the crack grouted and caulked with cement and chopped gunny to stop leakage.

I have not seen the crack myself but Mr. Joyce thinks that it will be safe for the rest of this season and during the closure it will, of course, be thorougly examined and repaired. Just below the under-tunnel there is a bad breach at the box sluice put in temporarily last year for some new cultivation.

This breach had to be ring bunded, being too deep to close without. Altogether between Narasannapalem escape at 24/6 and Perikeed bridge at 27/0 there are eight breaches on right and seven on the left, but with the exception of those noted above, they are all in main bank and can be closed hereafter. There is a large breach in the railway bank just above the escape near which most of this damage occurred.

From Perikeed at 27/0 down to 31/0 the banks are under the influence of the Ramileru, which has a catchment of 135 square miles and the damages are as follows.

Perikeed under-tunnel at 28/0 both banks very badly breached on all sides of the masonry which was left entirely exposed, the breaches on three sides being from 3 to 4 feet below bed level and on the fourth side 8 feet below bed level.

This last one gave considerable trouble to close, as the Ramileru never ceased running and the day after the breach was first closed, it was again breached by heavy rain and consequent rise in the Ramileru.

The foundation of the wing was slightly undermined but was underpinned with stone and turf and though there is an old crack in the wing which has opened out a little, I think the work will stand for the present and in the working season it will probably be advisable to rebuild the wing. The left main bank for some distance above and below the under-tunnel and right bank also washed away but berms were left.

Just below under-tunnel, is an inlet and outlet, the wide berm below the inlet is washed away, the right wing of the outlet was turned and a portion of the masonry knocked down and revetments ruined, the apron has also been considerably displaced.

At present, all that could be done was to put up a ring bund to divert over the sound portion of inlet, any water which may hereafter come, but arrangements will be made if it is possible to get earth to restore the main bank.

Between this outlet and Gundalamma sluice at 28/4 right bank is practically intact.

At Gundalamma sluice there was a small breach but masonry was not damaged and only the old stem shutter broken.

At Kottapally box sluice at 29/4 there is a bad breach scoured out to a great depth and a ring bund about 300 feet long and about 8 feet high was required.

From here to Totagudem under-tunnel at 29/7½, the left bank has been topped and considerably damaged and there are several small breaches in right bank but the berms are intact.

At Totagudem under-tunnel the right bank is breached on both sides of masonry to a little below bed level. These are well and strongly closed.

Breach at Rajupeta sluice and sluice ruined but this has already been abandoned this year and will now be demolished and removed.

Totagudem crossing which was unmetalled was breached on both sides but only that on left bank required closing.

Between this and Pedapad head sluice at 30½ both banks topped and right bank breached in three places, but the towpath bund and berm has been made up.

Just below Pedapad head sluice both banks breached and towpaths made up.

Opposite Pedapad outlet at 30/5 left bank almost entirely gone to berm level and canal shoaled up and the right main bank has also been considerably damaged.

From 30/6 to 31/0 left bank topped and damaged, right bank being high and strong, not damaged. Inlet and outlet at 31/0 not damaged.

Ponukollu metalled crossing just below this breached on left side to bed level and ballacut deposited on top of right bank, about 100 yards below.

Ponukollu crossing to 32/0.

Both banks breached in several places especially just below 31½ in right bank, but berms were left all along and only towpath bund had to be raised.

Opposite 32/0 right bank breached for about a furlong in length. This is probably due to the breaching of Amurtalingampet a tank, about half a mile above canal bank at this place. Left bank also topped and breached.

Just above Pedapad escape at 32 right bank breached 200 feet long but most of the berm was left. Both banks were more or less topped throughout here.

Pedapad escape, which was completed this year, is said to have worked well. No damage has been done, except the displacement of the coping of cushion wall, which was more or less green.

This escape has been of great assistance since the canal was re-opened after the floods in regulating the canal. When the Tammileru comes down and as this was the chief purpose for which it was built it may be considered satisfactory.

At the inlet and outlet just below escape the berms are scoured and apron of outlet displaced.

Gogulapad crossing just below breached on both banks to bed level and ballacut deposited on top of right bank about a furlong below.

The railway appears to have been badly breached opposite this.

Gogulapad box sluice at 32/5 breached to bed level.

From 32/6 to 32/7 both banks almost entirely gone to berm level or below.

32/7 to 33/0 several breaches in right bank and left bank topped and scoured throughout.

33/0 to Pedapad under-tunnel at 33/4 right bank fairly in tact, except a breach 300 feet long, a little above under-tuunel, but left bank has been topped and scoured throughout.

At under-tunnel right bank was breached on both sides of the masonry, the breach on right side being below bottom of concrete, the masonry has not been damaged and the breaches are well and strongly closed.

33/4 to 33/6.

Several breaches in both banks but towpath bund has been made up.

At 33/6 breach at box sluice.

Opposite this, one of the railway bridges is damaged and some other breaches in the embankment.

33/6 to 36/0 no damage to either bank 34/0 to 34/1 left bank topped and scoured.

At 34/1 the Watlur crossing newly metalled this year has been breached across both banks to bed level and the small iron bridge over the side channel ruined.

34/1 to inlet and outlet 34/4 right bank not damaged left bank topped here and there.

34/4 to 34/7 no damage.

At 34/7 an unauthorized cattle crossing is breached across both banks to bed level and there is another long breach to bed level in right bank just below 34/7 to Watlur head-sluice at 35/3, both banks much cut about but berms are standing.

Watlur crossing at 35/4 breached across both banks to bed level and ballacut washed about quarter mile into the fields.

From 35/6½ to Watlur under-tunnel at 36/3, the right bank has been washed away to level of fields in rear or below and there are breaches in five or six places through berm also.

The worst of them is just above the under-tunnel, where both banks and berm are gone to bed level or below for a length of above 400 feet.

There are some of the old breaches of 1872 in this part and these have scoured out to a considerable depth.

The left bank has been much damaged here also.

Watlur under-tunnel right bank breached on both sides to 3 feet below bed level of canal. Left bank just below under-tunnel breached below bed level about 100 feet long.

36/3 to 36/5 left bank topped and scoured. Right bank breached through berm to bed level or below in three places, total length 100 feet and main bank gone for a total length of about a furlong.

36/5 to 36/6 right bank washed away to ground level and two breaches through berm 150 feet and 30 feet.

36/6 to 36/6½ right bank gone and a deep breach through berm 40 feet long. The left bank is high here and there are only four small breaches to berm level.

36/6½ to Mupperu head sluice at 37/2, no breaches as banks or high and strong here.

Between Mupperu head sluice and West Tammileru escape breach about 150 feet long in right bank to bed level.

West Tammileru escape.

No damage done to escape except some cut stone coping displaced from abutments of flood-gates, but these are reported to have been 70 palmyra and date trees and one large tamarind tree jammed in front of the vents which seriously interfered with the discharge and has caused extensive silting of the bed in rear. Water rose 3½ feet over top of flood-gates, and was 4 feet higher than in rear of escape. This caused a breach at Ellore sluice at 37 miles 47 chains and the channel in rear was silted up for about half a mile. The canal bed was also filled up with sand to a depth of about 3 to 4 feet for 1½ furlongs above and 2½ furlongs below the flood-gates.

No damage of any importance occurred to the canal between Ellore sluice and the lock, except a breach about 65 feet long in right bank just below the Jalipudy under-tunnel. This as well as three small cuts in left bank were made by the municipality in order to drain the low-lying part of the town to the left of the canal, but it is doubtful if much relief was afforded and the breaches also cut by them in right and left banks of East Tammileru just above its junction with the canal were probably more effective.

Even here the breach in left bank was probably unnecessary as the Chattaparru escape could easily have run off all the water.

Comparatively small proportion of the total discharge of the Tammileru appears to have come down the Eastern branch chiefly owing to the high level of its bed and to the fact that a good deal of its discharge spills over the left bank near Tangallamudy.

This question will, however, be dealt with in a separate report, as it is believed that the Ellore Municipality has made a reference on the subject to Government.

A portion of the water wing above right up-stream wing of Chattapurru escape was scoured away but the damage is not serious and in all other respects this masonry work was uninjured.

From the above it will be seen that the damages by the Tammileru extending from 35/4 to 37/4 were very serious and, in addition to the above, the bed of the river in rear of the West Tammileru escape has been silted up to about 3 feet above bed of canal, which makes it very difficult to keep the canal bed between the flood gates clear. Since the big flood, the river has been down about seven time (up to 15th October) and on account of the difficulty in clearing the sand has caused considerable obstruction to navigation.

It will probably be necessary to clear sand in bed of river for some distance below the escape, but it is possible that the bed may scour out again during the north-east monsoon.

Ryves' canal.—Breach about 40 feet wide at Matchaveram crossing 3rd mile, caused by Budameru water, breaching out of Ellore canal into old quarry channel, but it is not necessary to close this at present.

Breach at Gunadala crossing already described under Ellore canal.

Ramaverapad crossing topped by Budameru water and scoured but not already breached.

Prasadapadu crossing slightly damaged.

Yenekupadu crossing slightly damaged.

At 6/3 Yenekupadu Polimera, a breach 30 feet wide in left bank but ground level is above F.S.L. The cross bund at channel from old Ryves' head sluice which breached in July was carefully watched and did not go, but the left bank was breached to a length of 150 feet just below. This was not very deep and has been closed.

The small inlet just below Nidamanur bridge on left bank has been entirely washed away. All the above breaches were caused by Budameru water breaching into the canal.

Opposite Velpur, three small breaches in left bank, the water was level with top of bank on both sides at the third of these breaches.

A little below this a small breach on right bank.

Between Velpur crossing and Uppalur under-tunnel five small breaches in right bank.

A breach about 50 feet below Uppalur under-tunnel on left bank. This is the site of an old breach and had fortunately been revetted last working season and though the breach was some 10 feet below bed level at centre of bank, the toe wall of revetment stood and the breach was easily ring bunded as soon as Budameru water was cut off.

The right bank just above the under-tunnel was also topped and scoured.

From Velpur downwards, all the above breaches were caused by the Budameru water breaching out of the canal but none of them are of any importance except that at the under-tunnel.

The water above Komatigunta weir at 14th mile rose to 2·08 above F.S.L., but by opening all the shutters, both of the weir and the distributaries, the water passed off without doing any damage to the masonry; a most satisfactory result, as there is a large acreage dependent on this regulator.

In addition to the large quantity of flood water passed through the weir, a large quantity of local drainage water entered the Ryves' canal below the weir and caused the following breaches.

A bad breach in left bank at Aginipad under-tunnel which has already been described in the general report.

Breaches in left bank each 60 feet long at 21/0 and 21/1.

Breach in right bank at 20/4 due to local drainage entering canal. In addition to the above the new bank raised last working season below Kadavakollu bridge and washed away a good deal of it and the banks were topped in other places but not materially damaged.

No. 249 I.

Submitted to Government.

2. The number of tanks in the Kistna district affecting the East Coast Railway north of Bezwada according to the list received from the Superintending Engineer, II Circle, in July 1893 is 202, all of which are reported to be private tanks—58 being in good order, 120 in need of repairs and 24 recommended to be abandoned. In the list received from the Superintending Engineer, I Circle, with his letter No. 303 G.L., dated 4th August 1894, the number of tanks in the Gódávari district affecting the railway up to 45th mile is shown to be 124, the particulars of which are as follow:—

	In good order.	In need of repair.	Total.
Government tanks under Public Works Department ...	3	...	3
Do. Revenue Department	8	14	22
Private tanks	63	36	99
Total ...	74	50	124

3. The Superintending Engineer, II Circle, has already in G.O. No. 845 I., dated 16th September 1895, been called upon to submit proposals for controlling floods in the Budameru, and these proposals as well as the investigation mentioned in paragraph 6 of the Superintending Engineer's letter will be discussed with the Superintending Engineer when the undersigned visits the Kistna in January next and the result reported to Government.

(Signed) R. R. E. DRAKE-BROCKMAN, Col., R.E.,
Chief Engineer for Irrigation.

16th Dec. 1895.

From F. R. UPCOTT, Esq., Consulting Engineer for Railways, to the Chief Engineer for Irrigation, dated Madras, 17th December 1895, No. 4072.

I have the honour to forward herewith copy of a report * on the damages caused by recent floods to the Bezwada-Gódávari section of the East Coast Railway and to request the favour of remarks on the points raised therein, which will be communicated to the East Coast management and Director-General of Railways.

* With section to be returned with reply.

Enclosure.

Report on flood damages, Bezwada-Gódávari Section, East Coast Railway.

The damage to the line on the first ten miles was caused by the breaching of all the tanks without exception. The tanks having received their full supply from the south-west monsoon, the exceptionally heavy fall of rain on 5th September amounting to 12 inches in 24 hours caused them to breach.

In the Budameru valley eight Government tanks breached, of which one alone has an area of six square miles. There are also several zemindari tanks, one of which opposite Mustabed station is 4 miles in length, 1 mile wide and 12 feet deep. This tank breached in several places, the water rushing down on to the line and discharging through a 12-feet opening. The result is a gap of 600 feet in length with a scour of 16 feet. A great many of the zemindari tanks are unprovided with calingulahs, and those that have them are quite inadequate to pass the discharge except in years of ordinary rainfall.

In the first large bridge in the Budameru valley which crosses the permanent channel of the river consisting of 8 × 40 feet girders, the flood was above the bottom of the girder.

The only damage done to this bridge was one wing wall on the downstream side badly cracked.

The first breach occurred at the 12-feet girder at mile 3/16, the bank being washed away for a distance of 150 feet. The breach was caused by the scour behind the wing-wall on the upstream side. The afflux observed was over 4 feet causing a velocity of more than 16 feet per second through this single 12-feet opening.

The next breach occurred at mile 4/21 where a 12-feet girder bridge was destroyed, caused by the excessive velocity which carried away the approaches.

A breach of 420 feet at mile 5/2 was caused by the bank being topped, and scouring 8 to 10 feet deep.

At mile 8/21 the 12-feet girder bridge, previously alluded to, which received the full force of the flood from the Mustabed tank, was destroyed, the length of breach being 600 feet.

At mile 9/15 a 12-feet girder bridge was destroyed causing a breach of 150 feet.

The discharge of the Budameru river was originally calculated from a total drainage area of 500 square miles. This gave by Dicken's formula, with an assumed constant of 500, a discharge of 50,000 cubic feet per second, of which 29,600 was supposed to pass down the Budameru permanent channel, the remainder 20,700 cubic feet per second being provided for by three bridges, each of three spans of 40 feet girders. As a matter of fact, the large area of 40 square miles between the hills and railway embankment was entirely flooded. Every breach and bridge was discharging the flood water at a velocity varying from a 15 to 20 feet per second, thus:—

	Sq. ft.
Area of bridging	8,900
Do. breaches	9,600
Total ...	18,500

The above area was discharging approximately 300,000 cubic feet per second or about six times the calculated discharge.

It is impossible to calculate with any degree of accuracy the amount of waterway required to pass such abnormal floods. But if the length and position of the breaches be taken into consideration, an idea may be formed of what is necessary.

I would recommend the following additional bridgework :—

At mile 3/16 where there was a breach of 150 feet behind the abutment of the 12-feet girder, a new bridge of three spans of 40-feet girders.

At mile 5/2 where the bank was breached for 420 feet, and close by at 4/21 for 120 feet, a bridge of three spans of 40-feet girders.

At mile 8/21 where there is a breach of 600 feet and also one at 9/15 of 150 feet, a bridge of eight spans of 40 feet girders.

From mile 9/15 to 19/14 about 10 miles, the line being on comparatively high ground suffered no damage.

From 19/14 to mile 21, the flood topped the bank causing the following damage :—

At mile 19/14 there is a large tank about 1,000 feet from the line which breached and destroyed a double 20-feet girder bridge making a gap of 400 feet. A 20-feet girder bridge was similarly destroyed at mile 20/14 and a 6-feet arch at mile 20/22 causing gaps, respectively, of 60 and 30 feet.

I would recommend raising the bank from 19/14 to twenty-one 2 feet and the provision of the following waterway :—

At mile 19/14 to replace the two 20-feet girders by five 20-feet girders.
At mile 20/14 to replace the single 20-feet girder, with two 20-feet girders.
At mile 20/22 to replace the 6-feet arch with one 20-feet girder.

From mile 22/22 to 23/22, a distance of a mile, the flood topped the rails and caused a series of breaches. I would recommend the bank being raised 3 feet and a three 20-feet girder provided at mile 23/2 where a breach of 700 feet occurred. Also the single 12-feet girder at mile 23/19 being increased to three spans.

From mile 23/22 to 26/12 no damage was done, although the flood rose to within a foot of the formation.

After leaving Nuzvid station the line crosses the valley of the Ramileru river. This river is crossed by a four 40-feet girder bridge. There are a series of tanks on the left bank which are fed by the river, bunds being thrown across the channel. These tanks, which begin at Gollapalli near the hills, are of a considerable size and extend down to opposite Kallaparu station. All these tanks breached without exception, and I believe none of them are provided with waste weirs.

The Ramileru catchment basin has an area of about 100 square miles for which a discharge of 11,000 cubic feet per second was originally calculated and an area of 1,861 square feet of waterway allowed.

On inspection of the high flood level marks shows clearly that it is practically impossible to provide openings to discharge the abnormal flood.

The east approach bank of the Ramileru bridge of four spans of 40-feet girders was breached for a distance of 500 feet, the slopes of which were pitched on the upstream side for a distance of 600 feet. From 27/6 to 28/13, a distance of about 1¼ miles, the bank has been almost entirely washed away, a bridge of two spans of 20-feet girders in this length at 27/14 being destroyed. At mile 27/18 the flood level was observed to be 2½ feet above the rails, the height of bank at this point averaging 7 feet.

I would recommend increasing the four spans of 40 feet girder to seven spans and throwing out a spur from the east abutment which would prevent any erosion similar to that which caused the breach behind the abutment. The formation should be lowered from mile 27 to 28½ as shown in the accompanying section. In the place of two 20-feet girders destroyed, a bridge of five 12-feet girders should be provided and 200 running feet of 3 feet slab openings to take ordinary floods about mile 27/19, the bank being heavily pitched to pass abnormal floods over it.

From new Elaparu station to mile 30, the flood varied from one foot below to just over rail level. There were two breaches of about 30 feet each at mile 29/24 and 30/1. A double 12-feet girder is required at mile 29/24.

From mile 30 to 31/18, the flood was over rail level scouring the bank on the downstream side. At mile 30/17 the west abutment of a five 20-feet girder bridge was destroyed with 100 feet of the approach. This bridge takes the surplus water of the Watlur tank which is 2 miles long by ½ mile wide and is fed by a channel from the Tammileru river which crosses the Kistna canal. The Watlur tank breached and was completely emptied within a few hours. The spill water from the channel of the Tammileru continuing to flow through the tank and causing all the damage.

I would recommend the three 26-feet girder at mile 30/17 being increased to seven spans with training bunds to control the channel.

From mile 32 to 34/4 the flood was well over the rails in places as much as 2½ feet. At 32/16 there was a breach of 30 feet where a 2-feet pipe was provided for irrigation purposes. This is a well-defined spill channel from the Watlur tank at its east end, and I would recommend at this point a three 12-feet girder bridge.

From 32/12 to 32/20 about two-third of the bank on the downstream side was scoured. From 32/22 to 33/17 and 33/21 to 33/24 the bank was completely washed away, the permanent-way being swept down on to the berm. As this section of the line is completely intersected with drainage channels from the Watlur and other large tanks, I would recommend the banks being lowered and heavily pitched to pass abnormal floods. The waterways provided on this length, viz., ten spans of 20 feet girders, have been found from experience to be ample in passing ordinary floods. A section showing the proposed lowering of the formation accompanies the report.

The main channel of the Tammileru river is crossed by the railway at mile 34/14 and a branch at 37/8. The drainage area of the Tammileru is 530 square miles and the discharge was originally estimated at 33,400 cubic feet per second. To pass this flood discharge, the following bridges are provided :—

Fifteen spans of 20-feet girders already alluded to, ten spans of 40-feet girders across the two channels of the Tammileru and seven spans of 20-feet girders at mile 38/13.

The canal sluice gates across the main channel of the Tammileru were closed during the flood, thereby the river overflowing both banks destroying the railway embankment between miles 33 and 34 and flooding the town of Ellore. On account of the sluice gates being closed, the six spans of 40-feet girders provided by the railway across this channel practically gave no assistance. Similarly, the branch channel of the Tammileru which is crossed by the railway with four spans of 40-feet girders was also useless as the sluice gates on the canal were closed and the flood was diverted down to the seven 20-feet girders at mile 38/13 destroying three piers and the west abutment.

From 38/15 to 39/15 there were a series of breaches, one of which was 800 feet length, the total length breached being 1,700 feet. The flood was above rail-level from 38/20 to 39/15 and it is proposed to raise the bank on this length 2 feet and provide the following additional waterway.

The seven spans of 20-feet girders at 38/13 to be increased to ten spans and a new bridge of ten spans of 20-feet girders provided at 39/5. Both the above bridges must be provided with spurs. From 42/21 to 45/7 there were a series of small breaches, the flood being above rail-level.

Between 43/7 to 43/9 there was a breach of 400 feet. It is proposed to provide a new bridge of three 20-feet girders, as this is the second time the line has been breached in this place. There were a series of small breaches from mile 43/14 to 43/19 and beyond this up to Bhimadole station, mile 49, no damage was done.

Owing to the insufficient cross drainage provided by the canal, the Bhimadole yard was 6 inches under water and was only relieved by the canal breaching.

The line was also submerged up to mile 50/7, owing to the banking up caused by insufficient cross drainage provided in the canal. I would recommend the raising of the line at this point as shown in the accompanying section.

From the 54th mile to 54/15, there were a series of small breaches ; the flood having been one foot above rail level, I would recommend the raising of the bank as shown in the accompanying section.

From mile 54 to Tadapalligudem station, mile 69, the slopes of the bank on the downstream side have been damaged owing to the want of turfing. All the bridges on this length must be provided with pucca floors and drop walls.

There is no damage done to the bridges and very little to the slopes of the embankment between Tadapalligudam and Nidadavole station ; between Nidadavole station and the river the line has suffered no damage.

(Signed) B. BAXTER,
Ex. Engr., No. 1 Divn., East Coast Ry.

No. 257 I.

Submitted to Government in continuation of this office endorsement No. 249 I., dated 16th December 1895.

(Signed) R. R. E. DRAKE-BROCKMAN, Col., R.E.,
Chief Engineer for Irrigation.

21st Dec. 1895.

Order—No. 37 I., dated 15th January 1896.

Communicated to the officers concerned.

2. The Superintending Engineers, I and II Circles, will report on the points raised in the papers received from the Consulting Engineer for Railways.

(True Extract.)

Under Secy. to Govt., P.W.D.,
Irrigation Branch.

To the Consulting Engineer for Railways.
" Chief Engineer for Irrigation.
" Superintending Engineer, II Circle.
" Superintending Engineer, I Circle.
" Public Works Department, General Branch.
" Revenue Department.

Frd. T. K. Narayana Aiyangar.
Spare Copies

IRRIGATION.
ACCOUNT.

Govt. of {1896} Madras.

PUBLIC WORKS.

Dated January, 15*th*.

Recd. *Encl.*

G.O. No. 37 I., 15th Jan. 1896.

JANUARY.

Flood Damages

Papers in connection with the recent — in the Kistna district and on the East Coast Railway, communicated to the officers concerned; and the Superintending Engineers, I and II Circles, directed to report on certain points raised therein.

No. 37 I., NOVEMBER 1895.

GOVERNMENT OF MADRAS.

PUBLIC WORKS DEPARTMENT.

Irrigation.
Account.

READ—the following papers:—

From A. S. RUSSELL, Esq., Officiating Superintending Engineer, II Circle, to the Chief Engineer for Irrigation, dated 27th October 1895, No. 1573 K.S.

In continuation of this office letters marginally-noted regarding damages to Ellore and Ryves' canals and the repairs to the same, I have the honour to report that the Executive Engineer, Kistna Eastern division, expects to be able to submit a detailed report by the end of this month.

No. 1318 K.S., dated 19th September 1895.
„ 1400 K.S., „ 3rd October 1895.

2. Meanwhile the Executive Engineer requests me to bring to your notice the good work done in restoration of damages by the following subordinates, whose names are entered in order of merit:—

(1) M.R.Ry. Ch. Venkataramayya Naidu, Anicut Superintendent.
(2) „ G. Sooryanarayana, Delta Superintendent.
(3) „ M. Ramaswamy Pillai, Overseer.
(4) „ C. Ramasawmy Iyer, Temporary Overseer.

3. Though the Ellore canal, as already reported by me, was re-opened on the 28th ultimo, navigation to Ellore has, since that date, been frequently interrupted by the Tammileru, which has been down in flood repeatedly since the cyclonic rainfall of 5th ultimo, and has caused heavy silting. This in no way detracts from the credit due to Mr. Smith and his staff for re-opening the canals on the 28th ultimo, as the Tammileru commonly stops navigation when it comes down in flood.

4. The sum required by the Executive Engineer for restoration of damages, viz., Rs. 20,000, has already been reported to you in my letter No. 25 C., dated 25th October 1895.

From A. S. RUSSELL, Esq., Officiating Superintending Engineer, II Circle, to the Chief Engineer for Irrigation, dated 2nd November 1895, No. 44 C.

In continuation of this office letters No. 1318 K.S. and 1400 K.S., dated 20th September 1895 and 7th October 1895, respectively, and also of subsequent reports, I have the honour to forward six original enclosures received to-day from the Executive Engineer, Kistna Eastern division, reporting in detail regarding the damages caused in the Kistna Eastern division by the heavy rainfall of 5th September last.

2. As already stated in this office No. 1318 K.S., dated 20th September 1895, the rainfall exceeded on the whole that of any known previous record, and the flood level in the Budameru, Tammileru and Collair lake attained a maximum. The Executive Engineer is, however, of opinion that the rainfall is not sufficiently in excess of previous falls to account for the greatly increased damages, and thinks that

the cause of such increased damages must be attributed to the manner in which the embankment of the East Coast Railway pounded up flood water, which subsequently on the breaching of the railway embankment in numerous places, poured on to the Ellore canal, practically swept everything before it, and breached the canal in 248 places. I entirely concur in this opinion. The proposition is in fact self-evident. The railway embankment is, as regards the Ellore canal, nothing but a long tank with insufficient surplus escapes, is in immediate proximity to the canal, and, if breached through, must almost inevitably breach into the Ellore canal. The matter has already been dealt with elsewhere and is referred to in detail in the report of the Sub-divisional officer, Northern Sub-division.

3. At the same time, there appears to be little doubt that the main cause of damage to the railway is due to the wholesale way in which some 60 tanks above the railway line breached, these tanks consequently damaging the railway in precisely the same way as the railway damaged the Ellore canal. The very great majority of these tanks are private * tanks, and unless legislative measures are taken to enforce that they shall be put in proper repair, a repetition of such disasters cannot be altogether prevented.

* Only six Government tanks breached.

4. On receipt from the railway officials of the statement of waterways and breaches called for, the Executive Engineer proposes to make suggestions regarding measures necessary to mitigate further damage to Ellore canal from breaches in the railway embankment. The provision of further inlets and outlets, and removal of existing banks, wherever advisable, in order to allow cross drainage to pass freely, is certainly necessary.

5. The damage done by the floods to main canals was primarily to the Ellore canal and in a less degree to Ryves' canal. In addition to the breaches caused by the pounding up of flood water by the railway embankment, another chief cause of damage is due to Budameru floods, while to the consequent rising of the Collair lake to 0·88 feet above its previous M.F.L. is directly due the loss by submergence of a very large extent of crops. As already reported elsewhere, the diversion of the Budameru seems the best way of obviating further damage by that river and by an undue rising of flood level in the Collair lake. The subject is now being taken up.

6. The damage done by floods in the Tammileru is also disastrous, and the Sub-Divisional officer, Northern Sub-division, makes definite proposals in regard to the measures necessary to lessen the silting of the bed of the Tammileru below the escape —a matter which calls for early attention. The Executive Engineer is preparing a special report regarding the steps necessary to control and deal with Tammileru floods in future. Investigation of the subject is, it may be noted, already being made in reference to the flooding of Ellore town, and the matter is also attracting the notice of the Gódávari officers, to whom, it is understood, instructions have been issued by the Chief Engineer for Irrigation.

7. The names of officers and subordinates, whose good work in repair of damages calls for special notice, have already been reported.

8. Necessary application for funds for repair of damages has also been already made.

9. As stated in former reports, there is practically no loss of crop from want of water. The Executive Engineer now states, however, that about 30,000 acres have been lost owing to submergence, of which about 22,500 acres are due to Budameru floods and rising of flood level in Collair lake. The importance of the investigation of the project referred to in paragraph 5 above is thus evident.

10. In the original report submitted from this office No. 1318 K.S., dated 20th September 1895, it was stated that no "serious damage" had been done to masonry works. In his statement of breaches the Executive Engineer shows in detail such damage as has been caused to masonry works.

11. It is requested that the six original enclosures forwarded herewith be returned when no longer required.

ENCLOSURES.

From C. A. SMITH, Esq., Executive Engineer, Kistna Eastern Division, to the Superintending Engineer, II Circle, dated Bezwada, 28th October 1895, No. 3210.

[Reference No. 1287 K.S., dated 17th September 1895.]

I have the honour to report as follows on the extraordinary floods which occurred on 6th September and following days.

2. On the 5th night there was heavy rainfall all over the delta as shown in attached statement and also in the upland taluks, due apparently to some cyclonic disturbance.

3. This appears to have breached a large number of tanks, resulting in very rapid rising of all the upland drainages, which cross the Ellore canal, and this canal as detailed elsewhere was very seriously damaged.

4. The largest of these upland drainages is the Budameru and this in addition to other damages breached into Ellore canal at 3rd mile and out of it again at 4th mile into Ryves' canal. It also backed up the Ellore canal to Bezwada with the result that, although the main canal head sluice was fully closed, the Budameru water was running 11·20 feet deep at the junction of Ellore, Ryves' and Bander canals.

5. Ryves' regulator was also closed, but Budameru water which had breached into this canal at 4th mile had backed up to 9·40 on the gauge in rear of the regulator.

6. It will thus be seen that considerably more than full supply was passing down all the three canals, without any possibility of cutting it off, and this on the top of heavy local rainfall throughout the delta, which in itself would be as much as the present system of drains could carry off with all supply to the canals cut off.

7. It was impossible to take any steps to improve matters, and all I could do was to wire to the Sub-Divisional officers directly I heard of the Budameru breach to look out for the flood water. This breach occurred at about noon on the 6th. The bank was safe when I saw it about two hours before, but as the water was then very near the top of the bank and during those two hours the flood rose 2 feet, it was impossible to save it.

8. I was very anxious about the safety of Komatigunta weir, an important regulator at 14th mile of Ryves' canal, but on inspection on the 7th found that fortunately the banks had given way in several places above, and though a large quantity of water had passed the weir, it was quite safe.

9. A breach occurred in the left bank of Ryves' canal at Aginapad at 20/3 and being between the old and new under-tunnels it seemed at one time likely to be a serious one.

10. The Sub-Divisional officer Mr. Rajagopala Aiyangar was there however on the 8th and threw in round the masonry a quantity of jeddy stone which was on the bank to try and prevent further scour, and it was found when water was cut off that the scour had not reached the foundation and no damage occurred to the masonry. This was probably due to the Sub-Divisional officer's promptitude.

11. This breach fortunately relieved the canals below, though at the expense of Gudiváda town, which was seriously flooded and necessitated the cutting of several breaches in Dosapad and Gudiváda channels, in order to let the water escape, as the Chendraya drain into which the breach at 20/3 led, was quite insufficient to pass off so much water.

12. Bander canal was hardly damaged at all, there being only two breaches at 16th mile, due to local drainage entering the canal.

13. As will be seen from the detailed statements, the damage in main canals was confined to the Ellore and Ryves' canals, and chiefly to the former.

14. In order to relieve the main canals it was necessary to open fully all distributaries, and many of these have suffered in consequence, but on the whole not very seriously.

15. The Northern Sub-Divisional officer Mr. U. N. Joyce was at Kankipad on the Bander canal on the 5th night and returned to Bezwada on the 6th afternoon after taking such measures as were possible to pass off flood water and ensure the safety of the lock.

16. On the 7th morning he started down the Ellore canal in the paddle boat, but on account of the rapid current through the breaches only got as far as Kesarapally at 12th mile. Beyond this no boat could go, on account of breaches, and he had to go the rest of the way on foot wading through breaches and experiencing considerable discomfort. On his way he made such arrangements as he could for collecting labour and materials, and since that time he has been constantly back wards and forwards on the canal.

17. A large number of the villages along the Ellore canal are zemindari and there is always difficulty in getting labour, and in many places there was difficulty in getting earth and turf for the breaches. I may mention that the Revenue officers and subordinates of both Kistna and Gódávari gave all the assistance in their power in collecting labour, &c., and by putting in force the Act of 1858 when necessary, the requisite labour was eventually collected.

18. The canal which had been cross-bunded at the head was re-opened on the 28th September, and considering the number of breaches to be closed, the number of miles over which they were scattered and the various difficulties to be overcome, I think that it was exceedingly creditable to Mr. Joyce to get the canal re-opened so soon.

19. The following subordinates are reported by him to have worked very well:—

M.R.Ry. G. Sooryanarayana, Delta Superintendent.
" M. Ramaswamy Pillai, Overseer.
" C. Ramasawmy Iyer, Temporary Overseer on Rs. 80, after joining from Gódávari on the 15th September;

And in addition to the above the Anicut Superintendent Ch. Venkataramayya Naidu was of very great assistance to me and worked very well in closing the Budameru breach.

20. It was of course impossible to run the canal full at first, but moderately-loaded boats passed through the Tammileru to Ellore on 2nd October.

21. Since the canal re-opened, there has been considerable interruption to traffic by the Tammileru, which has been down in flood seven times between the flood of 6th September and the 15th October, and each time so much sand was deposited between the flood gates as to take two or three days to clear. This was, however, in no way due to the breaches and would have happened whether the canal had previously been breached or not.

22. On account of the constant showers during the time the Ellore canal was closed; there will be practically no loss of crop for want of water.

23. The probable total loss in the Eastern delta by submersion will be between 25,000 and 30,000 acres, of which about $\frac{2}{3}$ will be due to the Collair and Budameru, the former of which rose rapidly to 0·88 above the previous record flood that of 1892.

24. Ryves' canal was re-opened on the 25th September and there is not likely to be any loss of crop under the canal for want of water.

25. I enclose comparative statements of rainfall and flood-levels (will follow) for the various floods affecting Ellore canal since 1872, completed as far as possible from available records. It will be seen from this that, on the whole, the rainfall was heavier for this last flood than for any of the others. The difference is, however, not sufficient to account for the large increase in the damages, and this in spite of the fact that the waterways have been largely increased in the last ten years or so.

26. I do not think there can be any doubt that the pounding up of the water by the railway embankment and its subsequent sudden release when the bank gave way is the chief cause of the increase in damages.

27. I have applied to the East Coast Railway for a statement of their waterways and breaches and will forward it on receipt with a sketch-map showing the relative positions of the waterways on canal and railway; but as there may be some delay in getting these statements, I will not delay my report for it. After considering these statements I will also forward any suggestions I may have to make for preventing damages in the future; but at present I may say that, generally speaking, I consider that any further provision of waterway on the canal should only be in the form of inlets and outlets and removal of banks in suitable places.

28. I do not think that any more surplus sluices are required, as if the flood water is allowed sufficient waterway in the railway bank to reach the canal gradually as it used to do before the railway was made, the existing surplus work with the addition of a few more inlets and outlets will, I believe, pass over extraordinary floods without serious damage.

29. The necessary data are being collected for the preparation of a complete estimate for repairing the flood damages, but the probable total cost will be about Rs. 50,000 for the whole division, of which, as already reported, Rs. 20,000 will be required during the current year.

30. I enclose copies of reports received from the three Sub-Divisional officers.

From Sergeant C. J. SMITH, Sub-Divisional officer, Southern Sub-Division, to the Executive Engineer, Kistna Eastern Division, dated 5th October 1895, No. 1836.

I have the honour to submit, for your information, the following report regarding the storm of 5th and 6th ultimo.

2. It will be seen from the following table that the rainfall varied from 9·50 inches at Viranki to 5·28 inches at the Tidal lock.

Station.	Rain-gauged on		Total for 5th and 6th of September 1895.
	5th September 1895.	6th September 1895.	
Tidal Lock	5·28	..	5·28
Akumarru "	4·35	1·60	5·95
Nidumole "	3·10	2·40	5·50
Pamarru "	4·20	2·70	6·90
Viranki "	9·50	..	9·50
Kankipad "	3·25	5·75	9·00

3. The lock tappal due at Bandur at 1–30 P.M. on 6th ultimo did not arrive until the following morning and at about 10 A.M. on that date, I received information that the Bandur canal had breached in the 17th mile. I started up canal the same day reaching Nidumole at about midnight and Bezwada at 11 P.M. on 8th idem.

4. With the exeception of a few trees being blown down no damage was done to the Bandur canal in the 3rd, 4th and 5th reaches, but the water in 3rd reach was only a few inches below tops of banks in 29th and 30th miles. In the 4th reach over 2 feet of water were rushing into the canal from east side channel at Taragatur slope and in order to save the main canal I breached the banks of the east side channel in several places, and thus lowered the water in the channel by over 2 feet in about an hour.

5. On account of the large quantity of water that was being drained off through the masonry sluices in 3rd reach, I found it necessary to breach the right bank of west side channel in several places to save the right bank of Bandur canal.

6. In the 2nd reach of the Bandur canal 34 trees were blown down and both banks were breached near $\frac{1}{5}^{6}$; the breach in left bank was about 10 feet long and 4 feet deep and was closed by noon on 8th idem; in the right bank there were two breaches only a few feet apart, one being about 20 feet long by 11/2 feet deep; and the other about 40 feet long by 4 feet deep; these breaches were both closed by 10th idem, but owing to leakage the bank was not made up to its proper section until 17th idem.

7. On 12th idem the right bank was breached by the ryots near $\frac{1}{3}^{6}$ for a length of 9 feet by 4'-6" deep; this breach was closed on 13th idem.

8. The cause of the 2nd reach being breached was due to the enormous volume of flood water held up to the right of the canal between $\frac{1}{0}^{6}$ and $\frac{1}{4}^{9}$; this water on both 7th and 8th ultimo having flown into canal in several places over the right bank thus causing the breaches alluded to above, passed out of the canal over right bank in several places between $\frac{1}{5}^{8}$ and $\frac{1}{0}^{9}$ and over left bank at Vallur slope.

9. In order to pass off this water as quickly as possible Chilladonka dam was entirely removed and Penamakur dam was demolished as far as was possible with the water rushing over it.

10. The left bank of the canal was in great danger of breaching between $\frac{2}{0}^{9}$ and $\frac{3}{0}^{1}$, the water having been within 1 foot of top of bank in several places and this portion was, in all probability, only saved by Medur and Pydimukkala sluices being kept fully open.

11. To the left of canal from Pamarru to Kankipad the whole country was one large lake as far as the eye could see with the exception of isolated high places.

12. This water being much higher than F.S.L. in canal just below Viranki lock the ryots of Inampudy threatened to breach the left bank of canal in several places but abstained from doing so.

13. At 7 A.M. on 8th instant the water surface in Kanakavalli drain just above Inampudy under-tunnel was + 19·97, and, as the water had then fallen about 9" M.F.L. here can be taken as 20·72 (F.S.L. in canal at this place being 23·03), the head of water discharging through the under-tunnel was 0·45.

14. The M.F.L. of water in Kanakavalli drain at Viranki bridge was 27·31.

15. The masonry works of both main canal and irrigation channels received no damage.

16. The damage done to irrigation channels was found on inspection to be much less than was anticipated and each Government channel is reported on in the following paragraphs.

17. Capileswarapuram channel breached in thirteen places, *i.e.*, in right bank at $\frac{0}{1}$, $\frac{3}{1}$, $\frac{3}{5}$, $\frac{3}{6}$, $\frac{3}{7}$, $\frac{4}{5}$, and a little below Viranki dam; in left bank at $\frac{3}{1}$, $\frac{3}{5}$, $\frac{3}{7}$ one just above Viranki dam and two a little below it. These breaches were all about 9' long and most of them scoured out 1 foot below bed of channel. The right bank of this channel was completely submerged in several places and its outer slope from $\frac{1}{3}$ to $\frac{1}{1}$ has been undermined and damaged by wave action. The breaches have all been closed and right bank will be strengthened as soon as possible.

18. A few small breaches occurred in weak places of Ramarazupalem channel, and its branches and the sites of spouts were scoured out in many places. These breaches have been closed.

19. Good water channel was not damaged.

20. The outer banks of both east and west side channels were breached by me in several places to save the banks of main canal. These breaches have all been closed.

21. Medur channel breached in five places, *i.e.*—

	Feet long.
Right bank at $\frac{1}{7\frac{1}{2}}$	12
Left do. $\frac{8}{5\frac{1}{2}}$	18
Right do. $\frac{4}{6}$	12
Left do. $\frac{1^{0}}{1^{6}}$	34
Right do. $\frac{1^{0}}{1^{8}}$	24

these breaches have all been closed, but require strengthening.

22. Krishnapuram branch channel sustained no damage, but its banks were submerged opposite Baralapudy.

23. Goodapad branch channel was breached in three places, *i.e.*—

	Feet long.
Left bank $\frac{8}{3}$	33
Right do. $\frac{8}{6}$	12
Do. do. $\frac{8}{6}$	30

these breaches have been closed, but require strengthening. In addition to these three breaches the right bank for about 330 feet between $\frac{8}{6}$ and $\frac{9}{7}$ has been lowered for about one foot by flood water passing over it.

24. In Divi Island the inner slopes of almost all the tank bunds were more or less damaged by wave action and the following supply channels were breached:—

Digupallem in two places.
Veeranna in six places.
Pata in two places.
Velagani in one place.
Chodavaram Peda in one place.
Suvarnnamukhi (Kadi) in one place.
Nangegadda Jammi in one place.
Anantuni in two places.
Viswanadhapalli Modalliar in one place.
Modumoody in three places.

25. The actual extent of damage done to the tanks cannot be accurately determined until they are empty when the amount of strengthening of bunds that is necessary will be reported.

26. The Kistna river left flood bank was not damaged with the exception of a small portion of the right slope of the diversion recently erected by Messrs. Napier Brothers between $\frac{2}{1}$ and $\frac{22}{5\frac{1}{2}}$ which was slightly undermined by wave action.

27. The bank at $\frac{8}{3}$ (Northern Sub-division) was breached by the ryots to pass off the flood water into bank canal that was held up between present flood bank and an old bank; this breach was about 10 long and 8' deep and was closed on 9th idem. A small portion of the high lanka between flood bank and river near $\frac{1}{2}$ was scoured out.

28. It is impossible until the crops are harvested to say on what acreage remission of water-tax will have to be made, but, with the exception of a few isolated areas under the various channels, which will not exceed 100 acres, the only wet crops that have been much damaged are about 150 acres to the right of canal in 17th mile and from 50 to 100 acres of low level lands between Capileswarapuram channel and the main canal.

29. Delta Superintendent C. T. Mohan Singh reports that no damage has been done to the crops in his portion and Delta Superintendent N. Venkatadri Naidu is now engaged in preparing a detailed report of the damaged crops in his portion which will be forwarded to you when received.

30. In several places to the left of canal between Kankipad and Pamarru, the dry crops were much damaged.

31. No appreciable damage has been done to the wet crops in Divi Island.

32. The expenditure that has been or will be incurred in closing breaches and repairing banks damaged by the recent floods may be approximately put down at Rs. 1,000, which is arrived at as follows:—

	Rs.
Bandur canal, second reach	200
Capileswarapuram channel	200
East side channel	20
West do.	80
Ramarazupalem channel and its branches	100
Divi island	300
Kistna river left flood bank	5

33. From observations made during the past month, it is quite evident that the drainage of land on both sides of second reach of Bandur canal must be improved as soon as possible.

34. On the left of the canal there appears to be no difficulty in improving the drainage, as the area most effected by flood water is the low lying portion just above Kanakavalli and this flood water could, I think, be easily passed off by excavating a drainage channel from about $\frac{1}{4}$ parallel to the canal and meeting the Kanakavalli drain at $\frac{20}{4\frac{1}{2}}$ when the left bank of canal becomes the right bank of the drain.

35. On the right of canal the drainage of the lands of Badlapad, Chinapulipaka, Godavarru, &c., enters the west side channel near $\frac{1}{5}$, but owing to Chilla donka and Penamakur dams, the discharging capacity of the channel is much reduced and after heavy rains drainage water to a depth of 2' or 3' is held up by the right bank of west side channel between $\frac{1}{9}$ and $\frac{1}{7}$. The question of converting the west side channel into a drain and providing a separate channel for

irrigation is, I believe, under consideration. If this is carried out, the drainage water could be rapidly passed off into the Kanikalamadugu, but to get the full benefit of this, the old Mopidevi channel would have to be deepened from Medur head sluice to just below drop No. 1 and given an uniform bed fall.

36. I am informed that previous to the excavation of the west side channel this drainage water used to be passed under the canal by an under-tunnel, which is still in existence, as also is one at $\frac{1}{4}^{m}$, but I do not think that it would be advisable to re-open them, as before doing so, they would have to be extended underneath the west side channel and a drainage channel would have to be dug parallel to canal from $\frac{1}{8}^{m}$ to the place $(\frac{20}{42})$ where left bank of canal becomes right bank of Kanakavalli drain.

37. It would, I think, be feasible to get rid of this drainage water by excavating a drain to run along the edge of wet cultivation nearest river bank from about $\frac{1}{8}^{m}$ Bandur canal to the Kanikalamadugu, a few lines of levels would decide this.

From M.R.Ry. N. RAJAGOPALA AIYANGAR, Cowtaram Sub-Divisional officer, to the Executive Engineer, Kistna Eastern Division, Bezwada, dated Bantumilli, 8th October 1895, No. 2077.

I have the honour to submit herewith a statement of the areas of lands submerged entirely by the flood waters of the last month, and the consequent rising of Collair and Upputeru.

The 2,000 acres submerged under Gudiváda channel lie partly on the left side of the channel where the flood water from Budameru entered through the breaches along Ryves' canal, and mostly at the tail end of the channel, where the lands were submerged by the backing of Collair water, which rose ·88 foot higher than the M.F.L. of 1892. The damage under Mottur channel is purely owing to the backing of Collair above; out of the 1,000 acres damaged by the side of Palacodu and Komaravole affluents, 500 acres are in the village of Penjendra at the head of Palacodu affluent and come under mamul wet; these 500 acres being originally swampy lands, are submerged even in ordinary years and it is no wonder the crops are entirely lost in a year like this, when the rainfall was unusually heavy and untimely and when we had to keep the irrigation sluices fully open for about a week after the heavy rainfall, owing to the Budameru floods entering Ryves' canal; the remaining 700 acres were, of course, spoiled by the backing of Collair water along Polraz drain into which the Komaravole affluent falls.

The 3,700 acres of land submerged by the side of Polraz drain lie mostly towards its tail end where the Collair water backed up.

The areas affected on the borders of Collair and the sides of Pullava, Annava, Vadurva Dammidi, Ellamalli and Pedakommileru drains were all due to the rising of Collair and the Upputeru, which rose ·9 foot more than the flood level of 92 feet at Tadinada lock. Out of the 1,000 acres noted on the margin of Upputeru and under Pedalanka channel, 600 are in the villages of Kondangi and Amarávati to the left side of Pedalanka channel below the regulator, where the flood water of Upputeru breached, Kondangi channel banks and backed against the left bank of Pedalanka channel; the remaining 400 acres lie on the right side of the channel, where the lands were completely free from submersion till the 17th September 1895, when the ryots of Guravayapalem cut a breach on the Pedalanka channel banks, 2 furlongs below the regulator, out of pure jealousy without any appreciable benefit to themselves; by these breaches 400 acres on the right side of Pedalanka channel were entirely spoiled.

Mattagunta and Pedalanka lands lying lower down the Upputeru, although lying under water for a few days were not damaged at all; at Lakshmipuram lock the flood water of Upputeru rose only a few inches higher than the high tide level. From the statement of the areas spoiled, it will be seen that there was no damage at all to the right side of Pedalanka channel anywhere in the sub-division, the damages were confined to those parts only, which were affected by the Collair floods and the consequent rising of Upputeru as far down as Kondangi. Below Kondangi or at any rate below the mouth of Pedalanka drain, I should think Upputeru is sufficiently broad and has broad low lands on the left side for the flood water to spread. From the fact that the flood water passed off quietly without doing damage along all the drains to the right side of Pedalanka channel, I conclude that the tentaline widths to which all the drains were excavated are enough for the present, and that there is no use of widening the drains to the left side of Pedalanka channel until some measures are taken up to lower the Collair water level in floods, and prevent the abnormal rising of Upputeru from Tadinada to Kondangi. At present Collair rises and spreads all over the low lands lying above the ridge just above Tadinada lock, which extends to Akveed canal, and the fall of Upputeru up to this ridge is very little.

Between this ridge and the Ellorepad lock, Upputeru flood level has got a good fall, and beyond Ellorepad lock the water spreads itself. Hence I should think that by widening Upputeru between Tadinada lock and the Ellorepad lock and by straightening it with bed level probably at low tide level, the Collair water could be got rid of sooner and Upputeru itself not allowed to rise abnormally, as to damage the lands on both sides of it. I have arranged to get the flood levels taken along the Upputeru from Kottada weir as far as Lakshmipuram and after I receive the levels, I shall make a detailed report on the necessity of widening the Upputeru which would amply pay by relieving the 17,000 acres of land entirely damaged by the floods in this sub-division, in addition to what might have been in the Northern Sub-division and on the Gódávari side.

STATEMENT showing acres of land submerged and spoiled by flood water in Cowtaram Sub-division during 1895–96.

Name of channel under which the submersion took place or name of drain by the side of which there was submersion.	Approximate area of entire submersion for which remission will have to be given.
	ACS.
Gudiváda channel	2,000
Mottur channel	2,000
Palacode and Komaravole affluent	1,200
Polraz drain	3,700
Borders of Collair on the left side of Kykalur channel	2,000
Pullava drain	1,300
Annava affluent	500
Vedarva affluent	700
Damidi drain	500
Ellamalli drain	500
Pedakommileru drain	1,600
On the right margin of Upputeru lands supplied by Pedalanka channel	1,000
Pedalanka drain	*Nil.*
Vadlamannad affluent and Lazzabanda drain	*Nil.*
Total ...	17,000

From U. N. JOYCE, Esq, Sub-Divisional officer, in charge, Northern Sub-Division, to the Executive Engineer, Kistna Eastern Division, dated 22nd October 1895, No. 508.

Referring to your No. 2987 of 8th October 1895, I have the honour to report that owing to the abnormal flood of the Budameru, Cheemalavagu, Ramileru and Tammileru rivers, together with the local drainage of elevated lands on the left of Ellore canal coupled with the water from the bursting of sixty tanks (above the railway line) at about the same time, and this great volume of water not having its free exit over the country was dammed up to a very great extent by the railway embankment till the drainage above rose to a height to top the railway line, and finally ended in the carrying away the railway embankment together with the canal banks in several places for more than half a mile in each place, many culverts were overturned and the afflux starting from this barrier (railway embankment) came off towards the canal at a very abnormal height. Owing to the limited space between the railway line and the canal bank, the flood waters could not possibly run off spreading over the country at any reasonable fall. This sudden head of water backing against the canal bank topped it in several places from $\frac{8}{0}$ to $\frac{3\,6}{0}$ and caused serious damage making the canal a complete wreck. In my humble opinion, I do not believe that there would have been even $\frac{1}{1\,0}$ of the present damage to the canal by floods if the railway embankment did not exist for the following reasons:—

(1) Wherever there is a large breach in the railway line and wherever girder bridges or culverts have been overturned the damage to the canal and its banks is in the self same line.

(2) If no railway embankment existed or if a greater number of bridges were constructed near each other of adequate waterway to take the local drainage as it started, the water would have greatly glided over the country and found its way to the several inlets and undertunnels in the whole length of the canal.

(3) The inlets and under-tunnels have been calculated and constructed to take a definite volume provided the discharge enters them gradually, but a sudden outbreak of such an abnormal quantity could not be passed through the inlets, under-tunnels and escapes and in consequence carried away the banks as well as the berms of canal and further damaged the railings of three aqueducts which now have to be renewed. It must be here stated that the sleepers of the railway line have struck against the standers and railings of the aqueduct in the 11th mile and caused them to be broken off clearly. Some sleepers have been removed and kept for inspection at the aqueduct which may be seen at any time.

In the whole length of the Ellore canal from the 3rd to the 40th mile there are no less than 248 breaches, some of which extend for $1\frac{1}{2}$ furlong, but there are very few. There are several breaches from 100 to 400 feet and considerably deep. In some places ring bunds had to be constructed to re-open the canal. I would here mention that there are twelve under-tunnels between $\frac{1\,0}{0}$ and $\frac{3\,6}{0}$, of these there are no breaches or damage to three—one at $\frac{1\,2}{0}$, $\frac{1\,7}{0}$ and the other at $\frac{2\,3}{1}$—at all other under-tunnels the earth connection on both sides have been breached and in some places deeply scoured especially at $\frac{2\,7}{1}$ and $\frac{3\,6}{3}$ where very great difficulty has been experienced in making up its earth connections at a very great cost.

From most of these places of damage to the canal the corresponding breaches, &c., to the railway line could be seen, which means to convey that this extensive damage has been chiefly caused and aggravated by the railway line not having sufficient water way. The probable cost to repair the canal, its crossings and distributaries will amount to about Rs. 40,000 ; details to frame the estimate are being collected. The left bank of Ellore canal in only 1891 was made up to 3·5 above F.S.L., at a cost of Rs. 17,000 odd. This recent flood has topped the bank from the 15th to the 36th mile.

The flood level as observed from $\frac{3}{4}$ to $\frac{37}{4}$ is given here under—

$\frac{3}{4}$	59·76.	
$\frac{5}{5}$	53·61.	
$\frac{7}{6}$	51·61	Budameru aqueduct (tow-path wall 48·11).
$\frac{11}{6}$	50·53	Kesarapilly do. (tow-path wall 47·95).
$\frac{15}{6}$	48·91	At Buddahavaram escape.
$\frac{15}{8}$	49·69	At Avitapalle under-tunnel.
$\frac{17}{4}$	49·26	At Atkur under-tunnel.
$\frac{18}{4}$	49·11	Do. escape.
$\frac{19}{1}$	49·50.	
$\frac{29}{0}$	47·00.	
$\frac{36}{0}$	50·11	West Tammileru escape (top of flood stop gate 46·51).
$\frac{37}{4}$		

From the above, perhaps, it would not be out of place to notice that there was a surface fall of 4·6 in a distance of 28¼ miles, *i.e.*, $\frac{7}{6}$ to $\frac{15}{6}$; this means a surface fall of ·16 or 2 inches per mile, which further goes to establish the fact that the abnormal flood had backed up instantaneously against the Ellore canal, the very moment the railway embankment had breached ; with this rush, trees, bushes, roof timber and other materials were driven down damaging masonry works in some places and blocking up vents in others till it ended in leaving the canal a complete set of scour holes.

I am of opinion that the flood could not possibly rise so high as it did in the last flood, had it not been for the contraction of the waterway of Tammileru river by the construction of a railway girder bridge, with so many huge piers decreasing the waterway of the stream, thus increasing the bottom velocity and driving the sand and silting the chamber of the valuable escape as well as the bed of the stream below for a depth of 4 feet, thereby diminishing the discharge of the escape and defeating the object of the escape for which it was constructed. The very fact of the flood waters rising above the level of the girder on the up-stream side and being lower on the down-stream side goes to prove the insufficiency of the waterway stated above.

The bed of the Tammileru below the escape about two years ago was 4 feet and more below the sill of the escape, whereas it is now about 4 feet above the level of the sill ; from what has happened, it is very clear that some tangible arrangements must be made to prevent this silting, otherwise the escape will in short close itself entirely and if this happens, there will be no communication between Bezwada and Ellore beyond the 37th mile, in addition to which the cultivation of Ellore will have to be given up causing a loss of some Rs. 50,000 of revenue yearly.

To improve present conditions, to make the escape effective to protect the town of Ellore in a measure to ensure cultivation being supplied and to maintain navigation, it is proposed to submit estimates, &c., for works enumerated below, if the suggestion meets the approval of superior authority :—

(1) To put in a line of fender piles about 9 feet above the drop wall of the West Tammileru escape the piles to be let 6 feet below top of drop wall resting on concrete foundations 3′ × 3′ to be connected by a diagonal strut resting against the drop wall and butting against the vertical strut over which a tow-path bridge will be carried out 2 feet wide for the purpose of towing when necessary and to remove trees, brushwood, brought down by the current which now finds its way in the chamber of the escape and blocking up its water-way as was done during the last flood where 70 trees of palmyra and date and one large tamerind tree was left against the escape shutters making it impossible to work them.

(2) To reconstruct the stone dam at the bifurcation of the West and East Tammileru rivers and from the point of bifurcation the bed of the East Tammileru to the Chataparru escape the bed-fall to be made the same as that leading to the West Tammileru from the point of bifurcation. The bed of East Tammileru to be cleared to a width of 120 feet with side slopes of 3 to 1, removing all shoals realizing the course of the stream when the work is being carried out. The spoil bank to be made on the right of East Tammileru leaving the existing road 12 feet wide and no bank to be constructed on the left.

(3) There are three road dams now across the East Tammileru which must be lowered to effect the desired improvements in the welfare of Government and public—

(1) Chintalapudi road dam.
(2) Moondor road dam.
(3) The Great Northern Trunk road dam.

At these places of crossing, ferry ballacuts could be provided as is done all along the canal.

(4) To construct a row of fender piles similar to that proposed above the West Tammileru.

(5) To alter and improve the Chataparru escape by converting the weir portion into an escape to correspond with the existing work.

10 No. 37 I., 15 Jan 96 11th November 1895.

The estimate and plan for the towpath bridge across the East Tammileru above the Chataparru escape was sent in when a report was made about the high flood of 23rd October 1894.

I would here mention briefly that during the time of canal had to be closed on account of repairs by this abnormal flood that no pains were spared to re-open the canal in three weeks. I have been greatly assisted by the following subordinates in restoring navigation, &c. :—

G. Suryanarayana, Delta Superintendent.
M. Ramaswamy Pillay.
C. Ramaswamy Iyer.

The last-named joined this division from the Gódávari about a week later and yet has done his best in carrying out instructions.

I would here request that necessary credit be given to these subordinates for their willingness and arduous trouble they have taken in helping me so heartily as to re-open the canal earlier than what I anticipated; and therefore request that the Delta Superintendent be promoted, if possible, to a temporary upper subordinate or, if that will interfere with the grade of pension, it is hoped that he may be promoted in the grade of Delta Superintendents.

Statement showing the rainfalls and heavy rainfalls at several stations in the Kistna Eastern Division from the year 1872 to 1895.

Name of the Station.	October 1872.			September 1882.			August 1886.			October 1892.			September 1895.		
	Total rainfall.	Highest rainfall.		Total rainfall.	Highest rainfall.		Total rainfall.	Highest rainfall.		Total rainfall.	Highest rainfall.		Total rainfall.	Highest rainfall.	
		Quantity.	Date.		Quantity.	Date.		Quantity.	Date.		Quantity.	Date.		Quantity.	Date.
Masulipatam	13·05	..	..	10·52	2·86	3rd	19·9	5·32	15th	26·37	7·05	29th	7·72	5·28	5th
Akumarra lock	..	..	..	10·31	3·00	3rd	16·16	3·11	15th	21·25	..	..	8·08	5·80	5th
Nidumole ,,	..	..	..	8·74	2·70	4th	14·75	3·15	15th	23·34	..	..	6·18	4·00	5th
Viranki ,,	..	..	..	8·77	2·70	7th	15·75	5·50	15th	17·74	7·50	20th	12·98	9·50	5th
Cowtaram ,,	..	..	..	14·68	8·47	3rd and 4th	17·77	4·60	17th	22·11	6·24	20th	10·07	6·75	5th
Bezwada ,,	13·73	..	..	8·59	3·49	6th and 7th	12·26	2·78	17th	17·38	5·42	20th	14·92	10·85	5th
Kesarapally ,,	..	..	..	7·68	1·00	7th	..	..	..	..	..	..	12·30	5·98	5th
Kankipad ,,	..	..	..	6·37	2·10	7th	21·72	7·70	15th	23·35	7·50	20th	16·22	5·75	5th
Tiruvur ..	..	..	..	13·10	6·30	6th	10·48	2·12	18th	7·50	1·50	30th	5·57	4·45	6th
Gannavaram ..	..	..	..	7·00	3·00	6th	14·80	..	..	in 11 days 14·07	3·10	29th	13·90	9·20	6th
Vinjaram lock	..	..	..	..	..	..	11·55	3·35	14th	in 13 days 20·20	..	..	11·40	6·85	5th
Pamarru ,,	..	..	..	1st to 9th 17·27	3·55	..	15·30	4·32	15th	22·57	..	..	10·41	5·60	5th
Lakshmipuram ,,	..	..	..	..	..	..	..	..	..	..	..	..	5·13	3·12	5th
Kamalapuram ,,	..	..	..	..	..	..	..	..	..	20·62	..	..	7·36	5·63	5th
Tadinada ,,	..	..	..	..	..	..	..	..	..	23·90	..	..	14·60	10·40	5th
West Tammileru aqueduct ..	1st to 9th 14·14	8·27	..	9·41	3·33	3rd	9th to 19th 13·50	3·20	..	14·50	..	..	11·35	6·10	5th
Gudivada ..	11·60	..	..	10·13	..	..	13·87	2·50	17th	in 13 days 18·01	3·37	29th	9·99	6·30	6th
	Date of flood, 4th.			Dates of flood, 8th and 9th.			Dates of flood, 17th, 18th and 19th.			Date of flood, 27th.			Date of flood, 6th.		

N.B.—The rainfall at Ellore is entered in 1872 and 1892, as there are no statement of rainfall at West Tammileru aqueduct before 1894.

(Signed) C. A. SMITH,
Ex. Eng., Kistna Eastern Division.

23rd October 1895.

Jan 56

Statement of Breaches.

Ellore Canal.

The first and largest upland drainage stream affecting this canal is the Budameru. This passes under the East Coast Railway about 3 miles from Bezwada and runs parallel to Ellore canal from 2½ miles to 5½ on canal. It ordinarily crosses the canal by the aqueduct at 7/, but when in flood it spills over both banks in the 6th mile, where the banks have been removed for a length of about ¾ of a mile for this purpose. It also passes over the side walls of the aqueduct.

Part of the flood water thus entering the canal is passed off through old Ryves' Head sluice at 7/2 and joins the Budameru again.

During the current year a cut was in progress from the Budameru aqueduct at 7/6 to the Kasarapully aqueduct at 10/7, but this cut was incomplete.

This was not, however, of much importance in the late flood for the water spread over all the country above the canal, and a large quantity ran down on the left of the railway and breached it opposite Kasarapully aqueduct. There was 3½ feet passing over the side walls of Budameru aqueduct and 2·58 feet over those of Kasarapully aqueduct, the previous records being 3 feet over Budameru aqueduct and 2 feet over Kasarapully aqueduct in 1886.

The side walls of Budameru aqueduct were raised 6 inches in 1891. Therefore the present flood was 1 foot higher at Budameru aqueduct and 0·58 at Kasarapully.

Some railway sleepers were carried over Kasarapully aqueduct, breaking off some of the hand rail stanchions in their way, but, with the exception of this and some of the coping stones being displaced, no damage was done to either to Kasarapully or Budameru aqueducts.

The damages caused by the Budameru were as follows :—

A breach in left bank at 3rd mile 150 feet wide and of considerable depth which was closed by a ring bund over 300 feet long. This was very difficult to close and it took thirteen days continuous work before the water could be completely cut off.

A breach in right bank at 4/2 about 150 feet long and about 10 feet below bed of canal. This is at the Gunadala crossing, where Ellore and Ryves' canals are only separated by the bank. The crossing was paved, but has been entirely scoured out. As soon as Budameru water was cut off, this was easily closed so as to pass water in both canals by bunds about 8 feet high on either side of the scour hole, and the filling in of scour hole and restoration of main bank is now going on.

A breach in right bank at 3/5 where there is an old channel from the quarry.—This was shallow and easily closed.

Breaches in both banks at Yenekepad crossing at 7th mile.—These were small and easily closed as soon as water went down.

Breaches at Saneragudem crossing at 8/2 in right bank 150 feet long, left bank 130 feet long, both being down to bed of canal.

From 8/2 to 8/4 main banks washed away to berm level on left in five places 30 feet, 30 feet, 230 feet, 30 feet and 30 feet long, right bank washed away to ground level (lower than berm) in four places 70 feet, 140 feet, 70 feet and 80 feet long.

From 8/4 to 8/7 left bank washed away to berm level for length of 300 feet and 1,000 feet and right bank to ground level for lengths of 70 feet, 120 feet, 180 feet, 80 feet, 180 feet, 30 feet, 70 feet, 170 feet, 80 feet, 40 feet, 70 feet and 50 feet (total 1,140 feet.)

As the berms were left between 8/2 and 8/7 nothing has been done to these breaches at present.

Between 8/7 and 9/5 the new cut had been completed and the spoil having been thrown on left bank, it was not breached.

The right main bank was breached to ground level in this part for lengths of 60 feet, 220 feet and 70 feet.

From 9/5 to 9/6 the left bank, although strengthened by the spoil, was washed away to berm level for a length of 640 feet and right bank washed away to bed level of canal for lengths of 40 feet, 30 feet and 420 feet, but berms were left standing.

From 9/6 to 9/7 three breaches in right main bank 80 feet, 50 feet and 70 feet berm left standing.

At 9/7½ is Nakkalam crossing which was breached below canal bed for 220 feet on right and 390 feet on left respectively.

At 10th M.S. is Nakkalam under-tunnel, of which the face walls have been entirely ruined, but tunnel apparently not damaged.

The left bank has a breach 100 feet long, which has been closed straight across, but the breach on right bank could not be closed and had to have a ring bund 400 feet long.

About 100 yards below Nakkalam under-tunnel, left bank was breached 100 feet long. This was first caused by Budameru water breaching in and was afterwards scoured out to below bed level, but Budameru water coming into canal from breach at 3rd mile escaping out into the new cut.

Between 10/1½ and 10/3½ the right bank washed away to about bed level for a length of 1,000 feet, but, except for a breach 100 feet long, the berm is standing throughout.

The left bank and spoil has been washed away to berm level for 830 feet with two small breaches through berm.

A great deal of the spoil earth was deposited here in bed of canal and had to be cleared out in the form of mud before water could be let down.

p. 13

12

From 10/6 to 10/7. One breach 57 feet long through berm and bank. Right bank washed away to about bed level for 640 feet and in this length breaches through berm to bed level 50 feet, 50 feet, 30 feet and 30 feet.

Left bank and spoil washed away to berm level for 460 feet and a good deal of this had to be cleared from canal bed in the form of mud.

At 10/7 is Kasarapully under-tunnel, the left side wall of which is completely and right side partly ruined.

This under-tunnel was closed last year on the orders of the Superintending Engineer, as it was then considered unsafe.

Both banks are badly breached here for lengths of 30 ft. and 40 ft., that on right bank being below bed level. Just below under-tunnel on left side, a breach to bed level 30 feet long.

At 10/7½ is Kasarapully aqueduct water passed 2·38 feet deep over side walls, but with the exception of the railings and one or two coping stones, no damage has been done to the work.

Between Kasarapully aqueduct 10/7½ and Kasarapully village at 12/0, there are ten breaches in right bank to bed level, but of these only three had to be closed now. The worst breaches are near the crossing of the Bezwada-Gunnaveram road, these are 90 feet and 60 feet long down to bed level and it was difficult to get any earth here at first.

Opposite them on left bank is a deep breach.

This is the last breach caused by Budameru water and those between Budameru and Kasarapully aqueducts are due, I believe, to the Budameru water which ran down on the left of the railway bank and then came across to Kasarapully, for, as a rule, Budameru water does not reach Kasarapully aqueduct in any quantity, and at any rate, it would not have risen so rapidly, had it not been confined at first by the high railway bund. This is clear from the fact that though, in 1886, water rose nearly as high on both works, there was only one breach, 45 feet long at 10/6.

I may also point out that the difficulty in closing all these breaches above Kasarapully was enhanced by the Budameru water entering the canal at the 3rd mile and which, as I have mentioned above, took thirteen days to cut off. From 12/0 to 14/0 only one small breach in right bank at 12/1.

At 14/0 Azzempudi crossing was badly breached on right bank.

At 16/1 breach in right bank 40 feet long.

At (16/5) breach in right bank 50 feet long and below bed level.

Another breach in main branch just below this.

At 17/0 is Avetpully under-tunnel which was not damaged at all.

From this to village at 17/3 left bank topped and considerably scoured, just above village, a deep breach in left bank about 50 feet wide.

At village crossing right bank breached to bed level. These breaches were due to the breaching of Brahmayyalingam, Kristnaveram and Davagigudem tanks.

From 17/3 to Atkur 1st crossing at 18/1, no breaches of any importance, but only slight scour to banks.

Atkur 1st crossing breached to bed level.

At Atkur under-tunnel at 18/3 a bad breach down to foundations of right up-stream wing and this also damaged. Ponukumad left side channel which crosses the drain by an iron trough just below.

Atkur 2nd crossing also breached on right side.

Atkur escape at 19/1 was not damaged at all.

From here to Pattipad escape at 20/2. There are thirteen breaches in right main bank and three in the left but only those each about 30 feet long at Pattipad crossing on right and just above Pattipad escape are to bed level and in the others the berm is left Telaprole crossing at 21/2 was topped but not much damaged.

At Ampapuram under-tunnel at 21/2½ the towpath wall on right side was ruined and the right bank breached to 3½ feet below bed level on both sides of the masonry.

The outer face wall, however, was not damaged and the towpath bund has been strongly made up inside it and protected with turf and stakes.

The flood topped the left bank and scoured it but did not breach it materially.

Ampapuram crossing, which was newly metalled last working season, was breached on both banks to bed level of canal.

At Veeravully No. 1 sluice at 22/4, there was a breach 40 feet long and 3 feet below bed level round left wing of sluice and the left front return cracked in consequence. This breach has been strongly closed and the crack gronted with cement and now appears to be quite safe.

From Veeravully No. 1 to Veeravully under-tunnel at 23/1, both banks are more or less cut about, but no serious damage, as there are several large inlets and outlets here which passed off the flood water.

Veeravully under-tunnel was not damaged, nor were there any breaches near it.

Narasannapalem escape at 24/6 was in no way damaged but just below the escape and close to the mile cooly's sheds there was a bad breach 6 feet below canal bed and this had to be ring bunded outside.

At Narasannapalem under-tunnel at 25/1, the right bank was breached on both sides of the masonry down to foundation level, the wings were not damaged but the tunnel has cracked transversely.

On account of the constant rain, it was difficult to get this dry, but Mr. Joyce eventually managed to get the crack gronted and caulked with cement and chopped gunny to stop leakage.

I have not seen the crack myself but Mr. Joyce thinks that it will be safe for the rest of this season and during the closure it will, of course, be thorougly examined and repaired. Just below the under-tunnel there is a bad breach at the box sluice put in temporarily last year for some new cultivation.

This breach had to be ring bunded, being too deep to close without. Altogether between Narasannapalem escape at 24/6 and Perikeed bridge at 27/0 there are eight breaches on right and seven on the left, but with the exception of those noted above, they are all in main bank and can be closed hereafter. There is a large breach in the railway bank just above the escape near which most of this damage occurred.

From Perikeed at 27/0 down to 31/0 the banks are under the influence of the Rameleru, which has a catchment of 135 square miles and the damages are as follows.

Perikeed under-tunnel at 28/0 both banks very badly breached on all sides of the masonry which was left entirely exposed, the breaches on three sides being from 3 to 4 feet below bed level and on the fourth side 8 feet below bed level.

This last one gave considerable trouble to close, as the Ramileru never ceased running and the day after the breach was first closed, it was again breached by heavy rain and consequent rise in the Ramileru.

The foundation of the wing was slightly undermined but was underpinned with stone and turf and though there is an old crack in the wing which has opened out a little, I think the work will stand for the present and in the working season it will probably be advisable to rebuild the wing. The left main bank for some distance above and below the under-tunnel and right bank also washed away but berms were left.

Just below under-tunnel, is an inlet and outlet, the wide berm below the inlet is washed away, the right wing of the outlet was turned and a portion of the masonry knocked down and revetments ruined, the apron has also been considerably displaced.

At present, all that could be done was to put up a ring bund to divert over the sound portion of inlet, any water which may hereafter come, but arrangements will be made if it is possible to get earth to restore the main bank.

Between this outlet and Gundalamma sluice at 28/4 right bank is practically intact.

At Gundalamma sluice there was a small breach but masonry was not damaged and only the old stem shutter broken.

At Kottapally box sluice at 29/4 there is a bad breach scoured out to a great depth and a ring bund about 300 feet long and about 8 feet high was required.

From here to Totagudem under-tunnel at 29/7½, the left bank has been topped and considerably damaged and there are several small breaches in right bank but the berms are intact.

At Totagudem under-tunnel the right bank is breached on both sides of masonry to a little below bed level. These are well and strongly closed.

Breach at Rajupeta sluice and sluice ruined but this has already been abandoned this year and will now be demolished and removed.

Totagudem crossing which was unmetalled was breached on both sides but only that on left bank required closing.

Between this and Pedapad head sluice at 30½ both banks topped and right bank breached in three places, but the towpath bund and berm has been made up.

Just below Pedapad head sluice both banks breached and towpaths made up.

Opposite Pedapad outlet at 30/5 left bank almost entirely gone to berm level and canal shoaled up and the right main bank has also been considerably damaged.

From 30/6 to 31/0 left bank topped and damaged, right bank being high and strong, not damaged. Inlet and outlet at 31/0 not damaged.

Ponukollu metalled crossing just below this breached on left side to bed level and ballacut deposited on top of right bank, about 100 yards below.

Ponukollu crossing to 32/0.

Both banks breached in several places especially just below 31½ in right bank, but berms were left all along and only towpath bund had to be raised.

Opposite 32/0 right bank breached for about a furlong in length. This is probably due to the breaching of Amurtalingampet a tank, about half a mile above canal bank at this place. Left bank also topped and breached.

Just above Pedapad escape at 32 right bank breached 200 feet long but most of the berm was left. Both banks were more or less topped throughout here.

Pedapad escape, which was completed this year, is said to have worked well. No damage has been done, except the displacement of the coping of cushion wall, which was more or less green.

This escape has been of great assistance since the canal was re-opened after the floods in regulating the canal. When the Tammeleru comes down and as this was the chief purpose for which it was built it may be considered satisfactory.

At the inlet and outlet just below escape the berms are scoured and apron of outlet displaced.

Gogulapad crossing just below breached on both banks to bed level and ballacut deposited on top of right bank about a furlong below.

The railway appears to have been badly breached opposite this.

Gogulupad box sluice at 32/5 breached to bed level.

From 32/6 to 32/7 both banks almost entirely gone to berm level or below.

32/7 to 33/0 several breaches in right bank and left bank topped and scoured throughout.

33/0 to Pedapad under-tunnel at 33/4 right bank fairly in tact, except a breach 300 feet long, a little above under-tuunel, but left bank has been topped and scoured throughout.

At under-tunnel right bank was breached on both sides of the masonry, the breach on right side being below bottom of concrete, the masonry has not been damaged and the breaches are well and strongly closed.

33/4 to 33/6.

Several breaches in both banks but tow path bund has been made up.

At 33/6 breach at box sluice.

Opposite this, one of the railway bridges is damaged and some other breaches in the embankment.

33/6 to 36/0 no damage to either bank 34/0 to 34/1 left bank topped and scoured.

At 34/1 the Watlur crossing newly metalled this year has been breached across both banks to bed level and the small iron bridge over the side channel ruined.

34/1 to inlet and outlet 34/4 right bank not damaged left bank topped here and there.

34/4 to 34/7 no damage.

At 34/7 an unauthorized cattle crossing is breached across both banks to bed level and there is another long breach to bed level in right bank just below 34/7 to Watlur head-sluice at 35/3, both banks much cut about but berms are standing.

Watlur crossing at 35/4 breached across both banks to bed level and ballacut washed about quarter mile into the fields.

From 35/6½ to Watlur under-tunnel at 36/3, the right bank has been washed away to level of fields in rear or below and there are breaches in five or six places through berm also.

The worst of them is just above the under-tunnel, where both banks and berm are gone to bed level or below for a length of above 400 feet.

There are some of the old breaches of 1872 in this part and these have scoured out to a considerable depth.

The left bank has been much damaged here also.

Watlur under-tunnel right bank breached on both sides to 3 feet below bed level of canal. Left bank just below under-tunnel breached below bed level about 100 feet long.

36/3 to 36/5 left bank topped and scoured. Right bank breached through berm to bed level or below in three places, total length 100 feet and main bank gone for a total length of about a furlong.

36/5 to 36/6 right bank washed away to ground level and two breaches through berm 150 feet and 30 feet.

36/6 to 36/6½ right bank gone and a deep breach through berm 40 feet long. The left bank is high here and there are only four small breaches to berm level.

36/6½ to Mupperu head sluice at 37/2, no breaches as banks or high and strong here.

Between Mupperu head sluice and West Tamileru escape breach about 150 feet long in right bank to bed level.

West Tamileru escape.

No damage done to escape except some cut stone coping displaced from abutments of flood-gates, but these are reported to have been 70 palmyra and date trees and one large tamarind tree jammed in front of the vents in which seriously interfered with the discharge and has caused extensive silting of the bed in rear. Water rose 3½ feet over top of flood-gates, and was 4 feet higher than in rear of escape. This caused a breach at Ellore sluice at 37 miles 47 chains and the channel in rear was silted up for about half a mile. The canal bed was also filled up with sand to a depth of about 3 to 4 feet for 1½ furlongs above and 2½ furlongs below the flood-gates.

No damage of any importance occurred to the canal between Ellore sluice and the lock, except a breach about 65 feet long in right bank just below the Jalipudy under-tunnel. This as well as three small cuts in left bank were made by the municipality in order to drain the low-lying part of the town to the left of the canal, but it is doubtful if much relief was afforded and the breaches also cut by them in right and left banks of East Tummileru just above its junction with the canal were probably more effective.

Even here the breach in left bank was probably unnecessary as the Chattaparru escape could easily have run off all the water.

Comparatively small proportion of the total discharge of the Tammileru appears to have come down the E. branch chiefly owing to the high level of its bed and to the fact that a good deal of its discharge spills over the left bank near Tungallamudy.

Eastern

This question will, however, be dealt with in a separate report, as it is believed that the Ellore Municipality has made a reference on the subject to Government.

A portion of the water wing above right up-stream wing of Chatapurru escape was scoured away but the damage is not serious and in all other respects this masonry work was uninjured.

From the above it will be seen that the damages by the Tammeleru extending from 35/4 to 37/4 were very serious and, in addition to the above, the bed of the river in rear of the west Tammeleru escape has been silted up to about 3 feet above bed of canal, which makes it very difficult to keep the canal bed between the flood gates clear. Since the big flood, the river has been down about seven time (up to 15th October) and on account of the difficulty in clearing the sand has caused considerable obstruction to navigation.

It will probably be necessary to clear sand in bed of river for some distance below the escape, but it is possible that the bed may scour out again during the north-east monsoon.

Ryves' canal.—Breach about 40 feet wide at Matchaveram crossing 3rd mile, caused by Budameru water, breaching out of Ellore canal into old quarry channel, but it is not necessary to close this at present.

Breach at Gunadala crossing already described under Ellore canal.

Ramaverapad crossing topped by Budameru water and scoured but not already breached.

Prasadapadu crossing slightly damaged.

Yenekepadu crossing slightly damaged.

At 6/3 Yenekupadu Polimera, a breach 30 feet wide in left bank but ground level is above F.S.L. The cross bund at channel from old Ryves' head sluice which breached in July was carefully watched and did not go, but the left bank was breached to a length of 150 feet just below. This was not very deep and has been closed.

The small inlet just below Nidamanur bridge on left bank has been entirely washed away.

All the above breaches were caused by Budameru water breaching into the canal.

Opposite Velpur, three small breaches in left bank, the water was level with top of bank on both sides at the third of these breaches.

A little below this a small breach on right bank.

Between Velpur crossing and Uppalur under-tunnel five small breaches in right bank.

A breach about 50 feet below Uppalur under-tunnel on left bank. This is the site of an old breach and had fortunately been revetted last working season and though the breach was some 10 feet below bed level at centre of bank, the toe wall of revetment stood and the breach was easily ring bunded as soon as Budameru water was cut off.

The right bank just above the under-tunnel was also topped and scoured.

From Velpur downwards, all the above breaches were caused by the Budameru water breaching out of the canal but none of them are of any importance except that at the under-tunnel.

The water above Komatigunta weir at 14th mile rose to 2.08 above F.S.L., but by opening all the shutters, both of the weir and the distributaries, the water passed off without doing any damage to the masonry; a most satisfactory result, as there is a large acreage dependent on this regulator.

In addition to the large quantity of flood water passed through the weir, a large quantity of local drainage water entered the Ryves' canal below the weir and caused the following breaches.

A bad breach in left bank at Aginipad under-tunnel which has already been described in the general report.

Breaches in left bank each 60 feet long at 21/0 and 21/1.

Breach in right bank at 20/4 due to local drainage entering canal. In addition to the above the new bank raised last working season below Kadavakollu bridge and washed away a good deal of it and the banks were topped in other places but not materially damaged.

PUBLIC WORKS DEPARTMENT,

IRRIGATION BRANCH.

PROCEEDINGS OF THE MADRAS GOVERNMENT.

UNDER date the

READ the following

Letter from the Supg:Engr:Second circle(H.E.NO1573.KS.dated 27th Octr/1895)

---------- DO ---------- DO -----(H.E.NO:44.C.dated 2nd November1895)

Endst:from the Chief Engr:for Irrigatn (H.E.NO2489.I.dated 16th December/95)

~~NO: 2489.I.~~

Submitted to Government.

2. The number of tanks in the Kist -na district affecting the East Coast Railway North of Bezwada according to the list received from the Superintend -ing Engineer,Second circle in July/93 is 202 all of which are reported to be private tanks,58 being in good order, 120 in need of repairs and 24 recommen -ded to be abandoned. In the list re- ceived from the Supg:Engr:First circle with his letter NO:303.CL.dated 4th August 1894 the number of tanks in the Godavari district affecting the rail- way up to 45th mile is shewn to be 124 the particulars of which are as follow

	In good order	In need of repair	Total
Govt:tanks under P.W.D.	3	"	3
---- DO ---- Rev:Dept:-	8	14	23
Private tanks	63	36	99
Total	74	50	124

3. The Superintending Engineer,II circle has already in G.O.NO:845.I. dated

September 1895 been called upon to submit proposals for controlling floods in the Budameru and these proposals as well as the investigation mentioned in para 6 of the Supg:Engr's letter will be discussed with the Supg:Engr: when the undersigned visits the Kistna in January next and the result reported to Government.

Letter from the Consulting Engr:for Rys (H.E.NO:4072, dated 17th December/95)
No.257. dated 21 December 1895.
Submitted to Government in continuation of this office endorsement. NO: 249.1. dated 16th December 1895.

ORDER THEREON:- NO: 37 I. dated 15th January 1896

Communicated to the Officers concerned.

2. The Superintending Engineers, First and Second circles will report on the points raised in the papers received from the Consulting Engineer for Railways.

It is to be hoped that the C. E. for Irr. will be able to devise some scheme for the improvement of the drainage in the Godavari and Kistna deltas including the Colair lake. It looks as if some very heroic measures will have to be undertaken to get rid of the surplus water, and even possibly to insist on the owners of banks keeping them in proper order. This is a thorny question, and legislation will have to be resorted to, if it is decided to adopt the latter course.

S Jaw

I see there is mention of villagers having cut canal banks & let off flood waters. If the persons who did this can be identified they should be prosecuted.

S Jaw

Apart, and if this sort of thing is at all common in the Kistna dist, it will be a question whether Police should not be employed at the expense of the villagers to guard the canal banks, as it has recently been decided to do in Bellary. WD

To
The Consulting Engr:for Railways 10/1/96
The Chief Engr:for Irrigation.
The Supg:Engr:Second circle-
------ DO ---- First circle.
The P.W.Departt, General Branch.
The Revenue Department.

DESPATCHED 4-FEB.96

Revenue 21/12

(3) Works should also be repaired whether
(4) the villagers who breached canal banks have been identified and whether the breaching of irrigation works by villagers is common in the Godavari Kistna districts

E. I. Form No. 1—500—14-5-95.

26

A

A.W. CURRENT No. 34

His ~~Excellency the~~ Governor.
The ~~Honorable~~ Mr:Bliss.C.I.E.
The ~~Honorable~~ Mr:Grose. C.I.E

No. 65741-10-95 Rev. ✓
- 8459 - 16-10-95 ✓
- 8859 - 29-10-95 ✓
- 8869 - 29-10-95 ✓

Flood damages in the Kistna District---September 1895.

Encl 7
Recd: 3.1.96

Print vide S.S.I. Extract.

To

R. for favor of counterinitials

I

Influence Tradition under

Recd 11/1

7/1

Issue: Recd 11/1

BR 6.1.96

Encl 7/1.R 11/1

REPORT ON FLOOD DAMAGES.

---o:O:o---

Bezwada-Godavari Section.

EAST COAST RAILWAY.

1988

The damage to the Line on the first ten miles was caused by the breaching of all the tanks without exception. The tanks having received their full supply from the S.W.monsoon, the exceptionally heavy fall of rain on 5th September amounting to 12 inches in 24 hours caused them to breach.

In the Budimeru Valley eight Government tanks breached of which one alone has an area of six square miles. There are also several Zemindary tanks, one of which opposite Mustabad station is four miles in length, 1 mile wide and 12 feet deep. This tank breached in several places, the water rushing down on to the line and discharging through a 12 feet opening. The result is a gap of 600 feet in length with a scour of 18 feet. A great many of the Zemindari tanks are unprovided with sulingulahs and those that have them are quite inadequate to pass the discharge except in years of ordinary rain fall.

In the first large bridge in the Budimeru Valley which crosses the permanent channel of the river consisting of 8 x 40 feet girders, the flood was above the bottom of the girder.

The only damage done to this bridge was one wing wall on the down stream side badly cracked.

The first breach occurred at the 12 feet girder at mile 8/16 the bank being washed away for a distance of 150 feet. The breach was caused by the scour behind the wing-wall on the upstream side. The afflux observed was over 4 feet causing a velocity of more than 16 feet per second through this single 12 feet opening.

The next breach occurred at mile 8/21 where a 12 feet girder bridge was destroyed, caused by the excessive velocity which carried away the approaches.

A breach of 420 feet at mile 8/8 was caused by the bank being topped, and scouring 8 to 10 feet deep.

At mile 8/21 the 12 feet girder bridge, previously alluded to, which received the full force of the flood from the Mustabad tank was destroyed, the length of breach being 600 feet.

At mile 9/15 a 12 x feet girder bridge was destroyed causing a breach of 180 feet.

The discharge of the Budimeru river was originally calculated from a total drainage area of 800 square miles. This gave by Dicken's Formula with an assumed constant of 500 a discharge of 50,000 cubic feet per second of which 30,000 was supposed to pass down the Budimeru permanent channel, the remainder 20,700 cubic feet per second being provided for by three bridges, each of 5 spans of 40 feet girders. As a matter of fact, the large area of 40 square miles between the hills and

Bund with S.S.'s Report

and Railway embankment was entirely flooded. Every breach and bridge was discharging the flood water at a velocity varying from 15 to 20 feet per second, thus:-

Area of bridging	8,900 sft.
Do. breaches	9,600 "
Total	18,500 "

2 0 S P

The above area was discharging approximately 500,000 c feet per second or about six times the calculated discharge.

It is impossible to calculate with any degree of accuracy the amount of waterway required to pass such abnormal floods. But if the length and position of the breaches be taken into consideration an idea may be formed of what is necessary.

I would recommend the following additional bridge work.

At mile 3/16 where there was a breach of 150 feet behind the abutment of the 12 feet girder a new bridge of 3 spans of 40 feet girders.

At mile 5/2 where the bank was breached for 120 feet, and close by at 5/31 for 120 feet a bridge of 5 spans of 40 feet girders.

At mile 8/21 where there is a breach of 800 feet and also one at 9/15 of 150 feet a bridge of 8 spans of 40 feet girders.

From mile 9/15 to 19/14 about 10 miles the line being on comparatively high ground suffered no damage.

From 19/14 to mile 21 the flood topped the ~~xxxx~~ bank causing the following damage.

At mile 19/14 mile there is a large tank about 1,000 feet from the line which breached and destroyed a double 20 feet girder bridge making a gap of 400 feet. A 20 feet girder bridge was similarly destroyed at mile 20/14 and a 6 feet arch at mile 20/22 causing gaps respectively of 60 and 30 feet.

I would recommend raising the bank from 19/14 to 21/2 feet and the provision of the following waterway.

At mile 19/14 to replace the 2,20 feet girders by 5,20 feet girders.

At mile 20/14 to replace the single 20 feet girder with 2,20 feet girders.

At mile 20/22 to replace the 6 feet arch with one 20 feet girder.

From mile 23/22 to 23/22 a distance of a mile, the flood topped the rails and caused a series of breaches. I would recommend the bank being raised 3 feet and a 5 20 feet girder provided at mile 23/2 where a breach of 700 feet occurred. Also the single 12 feet girder at mile 23/19 being increased to 3 spans.

From mile 23/22 to 26/12 no damage was done, although the flood rose to within a foot of the formation.

After leaving ~~the~~ Nuavid station the line crosses the valley of the Ramaleru river. This river is crossed by a 4,40 feet girder bridge. There are a series of tanks on the left bank which are fed by the river, bunds being thrown across the channel. These tanks, which begin at Collapelly near the hills, are of a considerable size and extend down to opposite Kallaparu station. All these tanks breached without exception and I believe none of them are provided with waste weirs.

The Ramaleru catchment basin has an area of about 100 square miles

22 SP

ordinary floods. A section showing the proposed lowering of the formation accompanies the report.

The main channel of the Tamiloru river is crossed by the Railway at mile 54/14 and a branch at 57/8. The drainage area of the Tamiloru is 530 square miles and the discharge was originally estimated at 55,400 cubic feet per second. To pass this flood discharge the following bridges are provided.

15 spans of 20 feet girders already alluded to, 10 spans of 40 feet girders across the two channels of the Tamiloru and 7 spans of 20 feet girders at mile 58/15.

The canal sluice gates across the main channel of the Tamiloru were closed during the flood, thereby the river overflowing both banks destroying the Railway embankment between miles 53 and 54 and flooding the town of Ellore. On account of the sluice gates being closed the 6 spans of 40 feet girders provided by the Railway across the this channel practically gave no assistance. Similarly the branch channel of the Tamiloru which is crossed by the Railway with 4 spans of 40 feet girders was also useless as the sluice gates on the canal were closed and the flood was diverted down to the 7 20 feet girders at mile 58/15 destroying 3 piers and the west abutment.

From 58/15 to 59/15 there were a series of breaches one of which was 800 feet length the total length breached being ± 1,700 feet. The flood was above rail level from 58/30 to 59/15 and it is proposed to raise the bank on this length 2 feet and provide the following additional waterway.

The 7 spans of 20 feet girders at 58/15 to be increased to 10 spans and a new bridge of 10 spans of 20 feet girders provided at 59/5. Both the above bridges must be provided with spurs. From 48/81 to 48/7 there were a series of small breaches, the flood being above rail level.

Between 48/7 to 45/3 there was a breach of 400 feet. It is proposed to provide a new bridge of 5/20 feet girders as this is the second time the line has been breached in this place. There were a series of small breaches from mile 48/14 to 48/19 and beyond this up to Bhimadol station mile 49 no damage was done.

Owing to the insufficient cross drainage provided by the canal the Bhimadole yard was six inches under water and was only relieved by the canal breaching.

The line was also submerged up to mile 50/7 owing to the banking up caused by insufficient cross drainage provided in the canal. I would recommend the raising of the line at this point as shown in the accompanying section.

From the 54th mile to 54/15, there were a series of small breaches the flood having been 1 foot above rail level, I would recommend the raising of the bank as above in the accompanying section.

From mile 54 to Tadepalligudem station mile 68 the slopes of the bank on the down stream side have been damaged owing to the want of turfing. All the bridges on this length must be provided with pucca floors and drop walls.

There is no damage done to the bridges and very little to the slopes of the embankment between Tadepalligudem and Nidadavole station

Between

Between Nidadavole station and the river the line has suffered no damage.

(Signed) E.Baxter,
Executive Engineer,
No.1 Division,
E.G.Railway.

23864

ENC. No. 6 TO E.R's C. N. 6075Q 1895
LETTER No. 9528 D 27-11-95
FROM Manager S C Ryp.

Rw 4.5
300/96

Form No. 11.

Madras, 17 December 1895.

No. 4072.

From

THE CONSULTING ENGINEER FOR RAILWAYS,

MADRAS,

To

The Chief Engineer,

for Irrigation.

1807

SIR,

I have the honor to forward herewith copy of a --

th section to
returned with
r.

report on the damages caused by recent floods to the -- Bezwada Godavari section of the East Coast Railway and to request the favor of remarks on the points raised -- therein, which will be communicated to the East Coast -- Management and Director General of Railways.

I have the honor to be,

Sir,

Your Most Obedient Servant,

F Rupcott.

Consulting Engineer for Railways.

Documents accompanying:-
1. Note on flood damages with sketch in Rupee
2. Note by H.E. the Governor in Council
3. Letter from the E.C.R. No: 9528/397 27.11.95 with report
4. Note by H.E. the Governor