Public Works (1898) Department.

68 Sheets

1

G.O., No. 750 I

DATED 29th Sept '98

[Despatch Abstract.]

Tungabadra Project

1898

Date _____ Stating that the investigation
that the further investigation of the project be
placed in the hands of local officers and that
the investigation be restricted to any particular
Inter channel.

Indexed.

BACK PAPERS.

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

செப்பனிடுபவர் பெயர்

செப்பனிடுவதற்காக எடுத்துக் கொள்ளப்பட்ட நாள் 12/98

செப்பனிட்டு முடித்த நாள் 3/99

சரிபார்க்கும் மு. பி. எ. கையொப்பம்

தராதரச் சீட்டு கையொப்பம்

FURTHER PAPERS.

	Department.	Date.	G.O.	No.

Public Works (1898) Department.

CURRENT No. 482

(1)

Order

Sent to Comp with G.O. Condemning Loss Billary Project

6/1

Mr Assist Engineer Required

Mr.

Do

Mr Executive Engineer Bellary

From The Executive Engineer on Special duty Bellary

No. 34

Dated 27th December 1897

Received 3rd January 1898

Enclosures 1/4

Spare copies

SUBJECT.

Tungabhadra river. States that the preliminary Survey of the — has been completed & Submits a report with notes concerning the river & a project for irrigation therefrom.

DEI

Note. Papers about the Tungabhadra dist project were sent to DEI on 3/1/98. File about the Kurgi Raidrug project herewith. pmtp. 5/1/98

Mr Assistant Engineer

Do

Mr Executive Engineer

Do

Mr Executive Engineer

15/1

Papers sent

DEI 21/1/98

ICE 5/1/98

BACK PAPERS.

No.	Date.
R 307 W/97	
M 578 L	16-3-98.

FURTHER PAPERS.

No.	Date.

Irrn No. 34. Bellary - 27-12-97

B

To The Chief Engineer for Irrigation
Public Works Dept

FOR FOREIGN
4-JAN
No. R4BL

From W. H. H. O'Connell
Ex. Engr on Spl. Duty

Sir.

With reference G.O. No. 2676. W dated 24th Sept 1897 I have the honor to inform you that I have completed the preliminary survey of the Tungabadra & beg to submit attached the following report, with notes which go into details of rates &c &c.

From an inspection of the "Map of the Bellary District" it will be seen from the levels given thereon that the bed of the river near Harihar is 1704 ft above M.S.L. while the bed of the river at the Tungabadra Station where the Madras Railway crosses is 1045 ft above M.S.L. The distance between these two points is 185 miles. & the total fall of the river between these two points is 659 ft. Further it will

observed that the bed of the river at the Walavapar Anicut is 1559 ft above M.S.L. while at Kampli 30 miles lower down the bed of the river is 1247 ft above M.S.L. which gives a fall of 312 ft. That is nearly half of the total fall of the river occurs in the 30 miles between the Walavapur Anicut & Kampli.

It at once becomes obvious that, if any large area of land is to be commanded, the channel to irrigate such land must take off from above this rapid fall in the river, & consequently the reservoir & any reservoir for storing water must also be above.

There is ample water for storage. The registers kept do not admit of the actual amount available being ascertained but I estimate that over 100,000 millions of cubic feet pass over the Walavapur & Korrigal Anicuts during the months of June - July - August, September & October.

As only 30,000 millions of cubic feet are required for the 100,000 acres if it is proposed to irrigate it will be seen that the supply of water is abundant.

After a good deal of consideration I came to the conclusion that the best site for a storage reservoir comes be just above the Walavapur Anicut. There is every promise of good sound rock for building on being found here. All sites where the rock belongs to the "Dharwar System" & are known as Dherwar Rocks must be avoided, as these rocks constantly vary in character, are full of faults & are soft.

I estimate that a dam 60 ft above the river bed, 6000 ft long, with banks to connect it to the high ground on each side will impound over 30,000 mils. of cubic feet & will cost about Rs 25 l[illegible]. The flood discharge

20 6969
24/11/39

will pass over this dam, & I calculate that maximum flood discharge will pass over with a head of 7·89 ft & a velocity of 8·7 ft per sec. I anticipate that it will be possible by the construction of powerful undersluices in this dam to let the early freshes pass through & keep the bed of the reservoir clean & prevent silting up. There is ample water to allow of this being done.

It has already been shown that if any large area is to be commanded the channel must take off from above the rapids between Walwerapur Anicut & Kampli. Unfortunately all the lines by which a channel can be taken to the land which it is required to irrigate, are blocked by hills or high ground through which the channel must be carried in a tunnel. The line that is least blocked is via the Kamalapur Valley & up to the Nilapoor saddle. This is the line that was chosen by Mr. Gordon of the Madras Irrigation Company & followed by Mr. Norfor

and has rightly been condemned over & over again. I propose now to make use of the first 17 miles of this line, against which there is no objection, & to dam the Kampalapur Valley & raise the water to 542 ft above M.S.L. & then to let the water through the Nilapoor saddle by a tunnel down to Metric, & to commence irrigating from this point.

I estimate the cost of works as below

Reservoir		26 lacs.
Channel		5 lacs.
Head Works & cross drainage works		1. "
Damming up Kamalapur Valley		30 lacs.
Channel & tunnel through the Nilapoor saddle		56, lacs.
Main canal & distributaries @ Rs 10 per acre.		10 lacs.
		127 lacs.
Add 33⅓ % for establishment. 7% for Tools & Plants & 10% for Contingencies. Interest on Capital during Construction.		50 lacs.
	Total.	177 lacs.

The amount of land which the supply of water will irrigate is 100,000 acres at which Rs 4 per acre

~~this~~ will yield a return of 400,000 Rs

177,00,000 : 100 = 400 000 : x

$$x = \frac{400,0\,0,000}{177,00,000}$$

$$= 2{\cdot}26.$$

The gross return therefore will be 2·26 per cent, which would probably be reduced to 2 per cent after paying for the maintenance of the works.

With reference to the Hagari River I have the honor to ~~State~~ that nothing is known as to the supply available for storage – I think it will be advisable to have a register kept for a series of years to ascertain this before proposing any works. I have collected all the facts I can concerning the Hagari which will be found in the accompanying notes.

I have the honor to be

Sir.

Your most obedient Servant

Steph. O'Connell

List of Enclosures.

1. Map of the Bellary District.
1. Map of the Hospet Taluq.
~~1. Section of the Nellapore Saddle~~ Belonging Taluq. (1)
1. Section of the Nellapore Saddle
1. Section of gap near Metri.
1. Section on A.B. & a.a.
1. Vol XXV of Geol. Memo of Govt of India.

Taken by Mr. O'Connell from G.G. on 17/2/58

1 Section of river near Hospet.
1 Longitudinal Section from Right Bank of Hagari
1. D. D. from Left Bank.
1. Tracing of section from Hospet to Daroji.
4 Longitudinal Sections of Channel from Wulvarpeer Hmiel.

Executive Engineers Office
Bellary.
Dated 1st February 1898

No 58

From N. H. O'Connell Esquire
Executive Engineer,
On Special Duty,
Bellary

To The Chief Engineer
for Irrigation
Madras

Sir

In continuation of my No 34 dated 29th December 1897, I have the honor to submit a report of my inspection of the Haggari river

Enclosure:
1. Notes-
2. Map of Reservoir &c
(Sent by book post)

The river has a catchment area of over 8000 sqr miles and has a rainfall varying from 18 inches in the lower portion of its basin to 40 inches in the upper portion. x

x Rice Gazetteer of Mysore.

For nine months of the year this Catchment basin is perfectly dry and exposed to a baking Sun so that it will be prepared to absorb a large quantity of the meagre rainfall.

There

There are also about 200 tanks in the catchment area and they will also absorb a good portion of the rain falls the run off, therefore, cannot be very great.

From enquiries made I estimate that the ordinary flood discharges which would be available for storage will be about 5000 millions of cubic feet, which is equivalent to a run off of about 1/4" from the whole catchment area.

If it were possible to store this it would be sufficient for about 16,000 acres.

The above estimate cannot be depended on, as it is made on what I could learn from the villagers, who made very conflicting statements. It will be necessary to guage the river for several years before any accurate data can be obtained. There is no ancient across this river and the only way to guage will be to set up guages and take cross sections in any part of the straight portion

portion near Janjaramanahalli.

From the point where the river enters the Bellary District up to Kurlugunda, the river runs from South-West to North-East and is about 1/4 mile wide, after it passes Kurlugunda the course is nearly due North, and the river begins to widen until the bed is nearly 1 1/2 miles across. The deep bed of the river is along the left bank. The right bank is composed of drift sand piled up by the strong Westerly Winds.

Along the left bank of the river there is a considerable extent of alluvial deposit, deposited there by the river, which has gradually shifted its course from West to East. All this alluvial deposit which lies a very little above the river bed is irrigated by numerous channels from the river. I estimate that close on 4000 acres are irrigated in this way. From the margin of this alluvial deposit, the ground rises rapidly from the river. I estimate that it

rises

rises at the rate of 30 to 50 feet per mile

From Pulicherla Southwards the ground is stony with every indication of rocks close below the surface. Northwards of Pulicherla the ground is chiefly black cotton with patches of red gravelly soil.

From the levels given on the accompanying map of the Royadrug Talugs it will be seen how impossible it is to get away any distance from the river. The channels shown on this map run on the alluvial deposit mentioned above. If any attempt is made to run a channel farther from the river margin it has to be taken through stony rocky ground

I have estimated for such a channel in my Notes and find that the first twelve miles would cost at least 20 lacs.

I am at a loss where to take the channel after passing the Kolacal Tank,

no site for a reservoir is possible until the valleys beyond the Kanakallu Tank are reached; these are all of black cotton soil and no tank could be made with it.

If it were possible to irrigate 16,000 acres and Government would be Satisfied with a return of 2 per cent, the capital expenditure allowable would be 32 lacs. I have already shown that the first twelve miles of the channel would cost over 20 lacs and the other works such as the anicut and Head works and numerous cross drainages works would run up the cost very largely and added to this, the want of suitable sites for reservoirs makes it impossible to recommend any irrigation work from the Haggari.

I have the honor to be
Sir
Your most obedient Servant

Hugh. O'Connor
Executive Engineer
4/3/1 on Special Duty

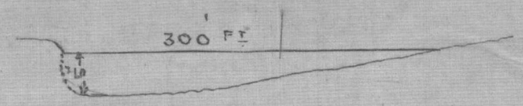
CHIEF ENGINEER
FOR IRRIGATION.
4-FEB. 1898
No. 1015

Gen. 3
Ry 43/98

Notes

Supply available

From enquiries of the villagers, it seems that the ordinary floods last about 25 days and are about 6 feet deep along the left bank. The bed of the river slopes up towards the right bank and 5 feet deep at left bank would make it about 300 feet across.



Fall of river 6 feet per mile

$$\text{Area} = \frac{300 \times 5}{2} = 750 \text{ sq. feet}$$

W. P = 310 feet

$$r = \frac{750}{310} = 2{\cdot}4$$

taking $c = 100$

$$D = 100\sqrt{2{\cdot}4 \times \frac{6}{5280}} \times 750$$

$$= 5 \times 750$$

$$= 3750 \text{ cft per second}$$

$$= 8100 \text{ millions of } \quad \text{in 25 days}$$

So that probably 5000 millions cft could be counted on.

Hrgn

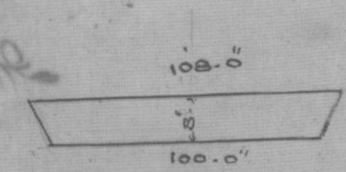
From the levels shown on the Taluq Map of Royadrug, it is evident that if a channel is to command any land it will be necessary to go up at least 3 miles above Janjiramanahalli. The fall of the river is about 6 feet per mile so that at a point 3 miles above Janjiramanahalli the river would be 37 + 18 = +55, and if we build an Anicut to raise the water 10 feet and take the water off in a channel 8 feet deep, the bed of the channel at head would be 65 - 8 = +57. Unfortunately such a channel must run through rocky ground and if it is to discharge 5000 millions of cft in 25 days, it must have a capacity to discharge 2300 cft per second.

A channel.

100 ft bottom width
8 ft deep
1 ft per mile fall
Side slopes $\frac{1}{2}$ to 1

will

will discharge 2650 cft per second.



$$\text{Area} = \frac{108+100}{2} \times 8 = 104 \times 8 = 832 \text{ sqft}$$

It will be a low Estimate if we take half of this as having to be blasted and the other half as hard gravel.

$$\frac{832}{2} \times 5280 = 2196,480 \text{ cft}$$

2196.480 Rock blasted @ Rs 65 per 1000 cft = 1,42,771 Rupees

2196.480 Hard gravel @ Rs 11 per 1000 cft = 24,161

or say 1,67,000 per mile

The length of the channel will be at least 12 miles, before it reaches the Veyarala Tank and would cost ~~over~~ 20 lacs for that distance.

Bluevery
1st May 1878

Sd/- O'Connor
Executive Engineer
on Special Duty

P.W.D

CHIEF ENGINEER
FOR IRRIGATION.
4-FEB. 1898
No. 11 B3

From

N. N. O'Connell Esqr
Ex Engineer on Spl Duty

To

The Chief Engineer
for Irrigation

№ 58

Station Bellary

Dated 1
Despd. 3 } February 98.
Recd

Encr. 2

Subject

Submitting a report of inspection of the Haggari River in point of Irrigation.

Desc
7743/98

Notes concerning the Tungabudra River. & a project for irrigating therefrom.

Amount of Water available. The water register kept at the Wulwoapur Amicut do not admit of the amount of water available for storage being accurately ascertained. The amicut at Wulwoapur is said to be 10 ft above the bed of the river; with a crest about 5 ft wide. I could not get a plan & section of this amicut as apparently none exists. The Amicut runs from the right bank of the river on to an island in the middle of the river. There was 1 foot of water going over when I inspected the amicut. It is said to be 1020 ft long. From the island to the left bank is another amicut called the Kottigal Amicut whose length is said to be 1000 ft. with crest level 1½ higher than the Wulwoapur Amicut. this amicut belongs to the Nizam's Govt.

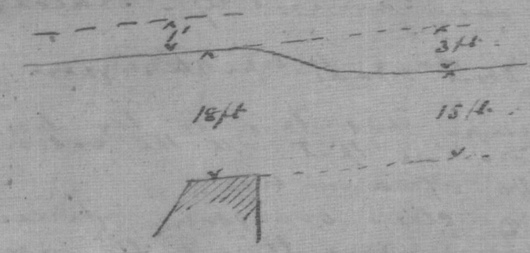
One guage is placed near the amicut attached to a large circular pillar, another guage has been placed half a mile higher up, but no guage has been placed below

the ancient. The ancient has no long
banks, & the water spreads on to the valley
sides of the river when there is no flood.
I am told that the ancient is observed
when 3 ft of water is going over it
I doubt this.
The bed of the river has
a hard shape below the ancient & there
is no reason why it should not be
possible to calculate the discharge
going over ancient by Calculations
have been made for certain years on the
supposition that all the water goes
over in clear overfall -
are for the months June & Nov. both
inclusive and were 325, 209 miles
of water feet for 1890, and 391,746
cubic ft of water feet for 1891. As a
good deal of the water does not
over a clear overfall it is not
too much to estimate that 100,000
cubic ft of water feet are available
for storage -

Maximum Discharge of Rivers. The
registers have only been kept since
1884, the highest flood recorded
during this time is 15 ft on the
crest of the Walawapur Ancut.

It is stated however that a flood of 18ft
passed in 1882. Accepting this & assuming
that the difference in the height of the
surface of water above & below the ancut
to be 3 ft & that the head due to velocity
of approach is 1 ft. we get the following
discharges.

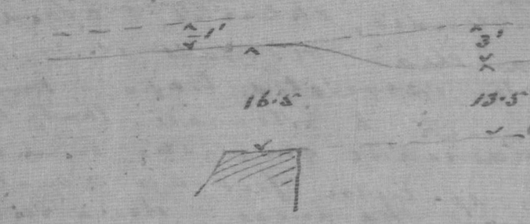
For the Walawapur ancut whose length
is 1020 ft.



$$D = 1020\left[3.1\tfrac{2}{3}(3+1)^{\frac{3}{2}} - 1^{\frac{3}{2}}\tfrac{2}{3} + 6.4 \times 15(3+1)^{\frac{1}{2}}\right]$$

$$= 217.974 \text{ cft per sec.}$$

For the Korniyal Ancut whose length
is 1000 ft.



$$D = 1000\left[3.1\tfrac{2}{3}(3+1)^{\frac{3}{2}} - 1^{\frac{3}{2}}\tfrac{2}{3} + 6.4 \times 13.5(3+1)^{\frac{1}{2}}\right]$$

$$= 194,500 \text{ cft per sec.}$$

or a total discharge of

412, 474 cft per sec.

The drainage area of Kanyakadra above
the Walawapur Ancut is 14,000 sq miles

$$412,474 = C \times 11,000^{\frac{2}{3}}.$$
$$= C \times 494{\cdot}6.$$
$$C = \frac{412,474}{494{\cdot}6} = 834.$$

which I do not think is too high a co-efficient for a river that rises on the western ghats where the rainfall is from 70 to 100 inches.

Sites for dams. An ideal site for a high dam is the gorge just below Hampi, but this is too low down to be of any use.

Just above Hospet the hills approach the river on both sides nearer than anywhere else; from these hills the "Dharwar System" & "consist of schists; hornblendic, chloritic, & argillaceous; but the associated traps, & more especially the hæmatitic quartzites, from their superior hardness & durability, occupy in many places much the most prominent positions while from the same reasons, the talucs they have given rise to in the hilly tracts are of extraordinary extent, & cover up much of the softer rocks & mislead one as to their real extent" (Page 74 of Vol XXV. of Mem. Geo. Surv. of India).

It might be possible to get down to hard rock at Hospet for the foundation of a dam, but there is no probability of getting any hard rock on to which to abut a dam, as the Dharwar rocks are said to lie in a synclinal curve on the top of the granitoid gneiss. At Hospet there is no convenient saddle over which to dispose of the flood discharges, & even if there was such a saddle, it would be most expensive work to pass it over the soft rock.

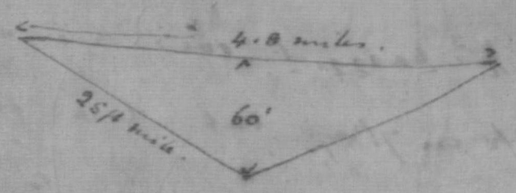
The rain has cut deep gullies in these hills, & it is certain that if a large stream of water were allowed to run down, most expensive works would be required to prevent cutting back. All the other hills where a site for dam might be found are similar to those at Hospet (vide Geological Map accompanying Vol XXV. of Mem. of Geo. Surv. of India)

For these reasons I gave up the idea of a very high dam, & thought it

better to allow for a moderate dam on solid rock, over which the flood water could be passed, & to connect this dam to the high ground on each side by means of earth banks.

The land slopes up from the river at about 25 ft per mile, which the river bed above the Walwaipur anicut has a fall of 2½ ft per mile.

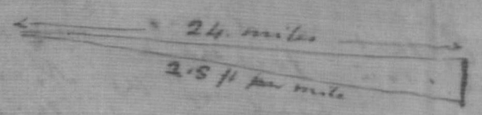
A dam 60 ft high with the connecting Earth banks will have an area of



$$\frac{5280 \times 4 \cdot 8 \times 60}{2}$$

$$= 760320 \text{ sq ft.}$$

and it will ~~back~~ up the water for 24 miles.



So that the cubic contents in the reservoir would be.

$$\frac{24 \times 5280}{3} \times 760320.$$

$$= 32,116 \text{ miles of cubic feet}$$

which is more than enough to irrigate 300,000 cft per 100,000 acres allowing acre —.

The best site for the dam is just above the Walwaipur anicut, as the rock there is sound to build on.

Drawing at foot not available JCC

The length of the masonry part of the dam I propose to make 6000 ft long. The max flood discharge is 412,474 cft per sec. (no velocity of approach)

$$412,474 = 3 \cdot 1 \times 6000 \times h^{\frac{3}{2}}$$

$$h^{\frac{3}{2}} = 22 \cdot 2.$$

$$h = 7 \cdot 89$$

and $V = \frac{D}{A} = \frac{412,474}{6000 \times 7 \cdot 89} = 8 \cdot 7$ ft per sec.

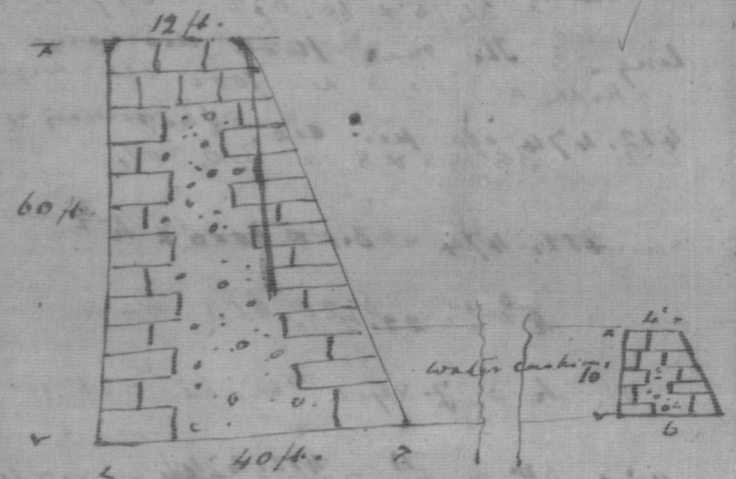
viz. the max flood discharge will pass over this dam with a head of 7·89 ft & a velocity of 8·7 ft per sec.

I note that a dam has been built at the head of the Nira Canal which is 4·2 ft high & passes water over its crest at a depth of 7 ft.

I also note that it is proposed to allow water to surplus over the Periyar

dams in the case of a very high flood occurring. I do not think therefore that the proposed dam is too high to pass this flood discharge provided a sufficient water cushion is allowed.

The cost of the dam & Earth work



Sectional area = $\frac{12+40}{2} \times 60 + \frac{6+4}{2} \times 10$

= 1070 sq ft.

and contents = 6860002 cft.

assume that half is rubble masonry @Rs 25 per 100 cft & half is Concrete @Rs 16 per 100 cft.

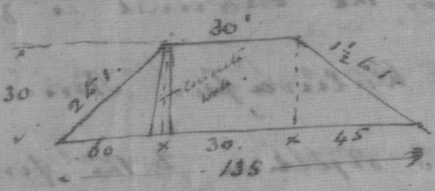
	Rs.
30300 @Rs 25 =	757500
30300 @Rs 16 =	484800
	12,42,300

The total length of the earth bank on one side is. (2.4 × 5280) − 3000 ft

= 15,672 ft.

As used for 80 Tcft mettle. See Hawksley Lecture Civil 132 Assuming Int CE June 08

The average section of the earth bank will be.



$\frac{135+30}{2} \times 30 = 2475$ sq ft.

and the contents

= 2475 × 15,672 = 38788,200

which at Rs 8 per 1000 cft towed cost. 3878878 = 3,10,304

and the banks on both sides towed cost, 6,20,608 Rs.

The concrete bath towed cost for one side

$\frac{3+2}{2} \times 30 \times 15.672$

= 1175400 cft.

@Rs 16 per 100 cft.

= 11754 × 16

= 1,88,064

for both sides — 3,76,128.

The total cost towed therefore be

12,42,300 + 6,20,608 + 3,76,128

= 22,39,036.

or say 25 lacs including compensation & sundries.—

The Channel. Undoubtedly the best off take for the channel is from above the Wuluvapur Anicut, & there is no objection to the first seventeen miles of the line chosen by Mr. Gordon & followed by Mr. Porter. This will lead the water into the Kamalapur Valley.

The channel is designed to irrigate 100,000 acres, & I think the duty of 1 cft per sec may be taken as 50 acres in this district. The discharge required is

$$\frac{100,000}{50} = 2000 \text{ cft per sec.}$$

The crest of the Wuluvapur Anicut is 1569. The proposed depth in the channel is 7 ft. & the head at head sluice is 1 ft. The bed of the channel therefore will start at 1561. The F.T.L of which it is proposed to raise the Kamalapur Tank is 1542.

The channel may therefore have a fall

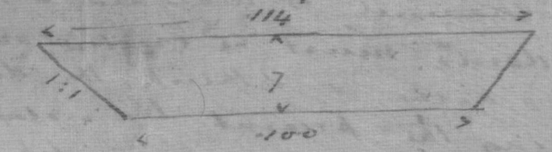
of 1 ft per mile.

A channel 100 ft bottom width.
7 ft depth of water
1:1 side slopes
1 ft per mile bed fall

Full discharge:

$a\sqrt{r} \times c\sqrt{s} \times$ multiplier for 1:1.
$1813 \times 1.156 \times 1.033$.
$= 2062$ cft per sec.

The channel will have to be nearly all in cutting.



The sectional area $= \frac{114+100}{2} \times 7$.
$= 107 \times 7 = 749$ sq ft.

and quantity to be excavated in one mile $= 749 \times 5280$
$= 3956720$ cft.

The rate for excavating gravel is 4.8 per 1000 cft. & 1.8 must be allowed for extra lead & lift, or a total rate of Rs 6 per 1000 cft.

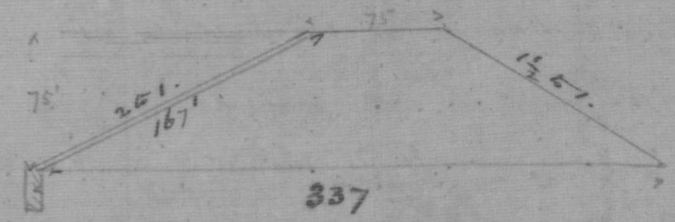
3956.720 @ Rs 6 = 23,740 Rs.

and allowance must be made for rock & cutting deeper than 7 ft. so that it will not be necessary to allow 30,000 Rs per mile for the channel

Rs. 30,000 × 17 = 5,10,000.

It is not feasible to run the channel along the centre of the rocky hills, this part of the line has been inspected by many Officers & condemned. It is now proposed in order to get the water up to the Nallapoor saddle to dam the Kamalapur valley & raise the water to 1542 above M.S.L. Two dams must be erected, one by raising the present Kamalapur Tank 60 ft. & another to stop the flow of water round to hills to the East of the Kamalapur Tank. The latter dam will be much higher than the Kamalapur Tank Bund when raised. A rough estimate for raising the present Kamalapur Tank is attached & the cost of the second bund is assumed to be the same.

Rough Estimate for proposed Tank — length of present bund 8000 ft.



Section at centre.

Area = $\frac{237+75}{2} \times 75 = 11700$ sq ft.

Rate. Excavating per 1000 cft. round. — 4 - 8.

12 units (10%) of ratio bed @ 1/6/- 4. 8

25 units (15%) of ratio 4 ft. @ 1/6/- 9 6

18. .6

Highest Rate —

Lowest Rate. 4. 8

2 / 22 .14

Mean Rate. 11- 7.



Section at end of present Bund

Area = $\frac{270+60}{2} \times 60 = 9900$ sq ft.

Rate. Excavating per 1000 cft. — 4. 8.

9 units (10%) of ratio bed @ 1/6/- 3. 6

20 units (15%) of ratio bed @ 1/6/- 7. 8

Highest rate — 15 .6

Lowest rate 4. 8

2 / 19 .14

Mean Rate — 9. 15

30

~~Approximate~~ Breadth of bund will be ~~6000~~ 8000 ft.

Cost of raising the bund along its present length will be

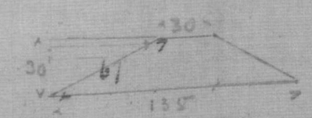
$$\frac{11700 + 9900}{2} \times 8000 \text{ cft.}$$

$$= 86400000 \text{ cft.} =$$

Mean rate $= \frac{\text{Rs } 11.7 + \text{Rs } 9.15}{2} =$ Rs 10.11. per 1000 cft.
Say - 11 Rs.

$$86400 \times 11. = 9,50,400.$$

The bund will have to be extended 2000 ft at one end & 6000 ft at the other. Its mean section will be:



$$\text{Area} = \frac{135 + 30}{2} \times 30 = 2475 \text{ sq ft.}$$

Rate. Excavating per 1000 cft.	4.	8.
4·5 men @ (10 hrs) earth load @ 2/6 p.	1.	11.
10 men @ (10 hrs) earth 4 ft. @ 2/6 p.	3.	12.
Highest rate	9	15.
Lowest rate	4.	8
2	14	7
Mean Rate.	7.	3

$$2475 \times 8000 = 19800000 \text{ cft.}$$

19800 ft @ Rs. 7. = 138,600

The third silt rests on gravel, which in its turn probably rests on fissured rock. It will be necessary therefore to insert a concrete wall (as puddle is not obtainable) to stop water from being forced up & saturating the bund. This concrete wall must be carried down to solid rock.



Section at centre. Section = 20 ft depth.

$4 \times 10 = 40$ $\quad$ $3 \times 10 = 30$

$\frac{4+1}{2} \times 75 = 225$ $\quad$ $\frac{3+2}{2} \times 20 = 50$

265 sq ft. $\quad$ 80

Mean section $= \frac{265+80}{2} = 172$ sq ft.

The approximate length of this concrete wall will be 130 ft.

The contents will be $130 \times 172 =$

$= 22360$

Which @ Rs 16 per 100 cft.

$22360 \times 16 = 3,57,760.$

The revetment the mean width will be

$$\frac{167+67}{2} = \frac{234}{2} = 107 \text{ ft.}$$

The thickness will be 1½ ft & the length 13,000. The contents therefore will be

$$117 \times 1.5 \times 13,000.$$

$$= 1521000 \text{ cft.}$$

which @ Rs 6 per 100 cft

$$15210 \times 6 = 91,260.$$

The cost therefore of raising this band will be.

Earthwork —	9, 50, 400
"	1, 38, 600
Concrete belt.	3, 57, 760
Revetment.	91, 260
	15, 38, 020

Say 15 lacs. and as the other band which is higher, but not so long will cost perhaps more the cost of damming the valley may be taken at 30 lacs. including compensation for land submerged.

2nd

The Tunnel through the Nilagiri Saddle with the channels leading to & from it

The contents of the channel leading to the tunnel have been cut from the accompanying section.

Bed width 100 ft. depth of cutting 7 ft. fall 1 ft per mile. Side slopes ½ to 1.

For the first 6000 ft the average depth of cutting = 28.3 ft.

$$\{(100 + 14.15)\,28.3\} \times 6000 = 19382670$$

From 6000 ft to upper end of Tunnel.

$$\{(100 + 28.66)\,57.33\} \times 300 = 2212823$$

$$21,595,493 \text{ cft.}$$

The tunnel has to discharge 2000 cft per sec - The fall is 10 ft per mile

$$dS = \frac{10}{5280} = 0.0019.$$

$A = 380$ sq ft. diam = 22 ft. W.P. = 69

$$\therefore r = 5.5;$$

$$V = \left\{\frac{\left(41.6 + \frac{1.811}{0.035} + \frac{0.00281}{0.0019}\right)\sqrt{5.5}}{\sqrt{5.5} + 0.035\left(41.6 + \frac{0.00281}{0.0019}\right)}\right\}\sqrt{5.5 \times 0.0019}$$

$$= \frac{218.27}{3.8} \times 0.102.$$

$$= 5.9 \text{ ft per sec.}$$

$$D = 380 \times 5.9 = 2142 \text{ cft per sec.}$$

The tunnel is 1½ miles long to

The contents will be:

$7920 \times 380 = 3009600$ cu ft.

The contents of the spur cutting leading from the tunnel

for first 480 ft. (average depth = 56.66 ft.)

bed width 60 ft. side slopes $\frac{1}{2}$ to 1.

$0 \text{ to } 480 = \{(60 + 23.34)\, 56.66\} 480 = 2403413$

$480 \text{ to } 7080 = \{(60 + 11.67)\, 23.35\} 6600 = 11045034$

$7080 \text{ to } 7230 = \{(60 + 0.78)\, 1.33\} 150 = 13944$

Total = 13,462,491 cft.

The grand total of cutting in rock with blasting

21,595,493

13,462,491

35,057,984 cft.

which @ Rs 10 per 100 cft. which is a low rate = Rs. 3505,798.

The rate for the tunnel I have taken @ Rs 70 per 100 cft. after ascertaining from the Peare Rs rates paid for the Periya tunnel.

3009600 @ Rs 70 = 21,06,720

or the best for getting through

the Nilgiri saddle is

35,05,798

21,06,720

56,12,518

Say 56 lacs.

The Hagari River. Rises in Mysore Territory & has a drainage area of 8,524 sq miles. The average rainfall in the upper portion of its catchment area is 30" which increases to 15" in the lower portion of the basin.

For nine months in the year the river is practically dry - & the catchment area becomes really during these nine months, & absorb a considerable portion of the meagre rainfall.

There are also about 200 tanks in its catchment area which must absorb a good deal of the run off.

A large number of these tanks are in the Mysore Territory & no information is available concerning these. Under these circumstances it is impossible to form any opinion as to the amount

Surplus are used in my tent off 2,075 sq miles at Hagari Reservoir

of Water available, I think a Regular
must be maintained & the discharge
calculated for a number of
years before any purchases can be
made.

The River is a very broad & shallow
one, & what looks like a large
amount of water going is probably
deceptive on account of the shallowness

Mr. Lucas that as a rule only
one or two freshes come down each
year last a few days & then

subside.

Mark. O'Connell
C. E. on Special Duty

CHIEF SECRETARY'S OFFICE
19 JAN 1878
No. 7

1878
274

Vs

acts & Enclosures to R No 4 B.L
received from Mr. O'connell
but not shown as Enclosures
~~by him~~ in the list attached.

—

√1 Atlas. Sheet √
√1 Copy of Spirit-Levelled Heights
No 1. Madras Presidency.

√1 Section of the Trace of a Proposed
Channel from crest of proposed
Anicut across the Pedda Huggry
to Chinna Huggry.

+√1 Sketch in pencil
+√1 Cross Sections of Stream proposed
to be diverted.
√1 No 2917 dy 19 Octr 1877.
√1 List of papers connected with the Huggy
Raidrog Project.

√1 No 342 dy 3-10-78
√1 Memo: 8 B L dy 25-2-78
√1 No 3217 dy 31-10-77
√1 No 2897 dy 18-10-77
√1 No 3437 dy 27-10-77
√1 G.O. F.R. No 253 dy 30-1-78
√1 Plan of Elevation & Section
of No 1 Aqueduct proposed to
be built in Basavannah Chan

—

No. 301C

Government of Madras.

PUBLIC WORKS **DEPARTMENT.**

Madras, 18th January 1898.

OFFICE NOTE.

From

W.

To

E. I.

Returned with thanks.

In the absence of any records, I can -not go into details, but I am convinced that the site selected by Mr. O'Connell for the Reservoir is unsuitable, because it would swamp such a large area of Country, and such numerous Villages, the fall being so small. I also think his figures of cost needlessly high, especially with regard to the crossing of the Kamalapur valley and the Nellapur saddle. It was a mistake, I think, not placing Mr. O'Connell under the orders of Superintending Engineer III Circle, because he has thereby been denied the assistance of men who know the Country and of access to records full of information.

2. I would now place him under

Superintending

[P. W. 48]
[500—20-8-97.]

Superintending Engineer III Circle, and give the latter definite instructions to investigate the site for a Reservoir proposed by me, when Suptg.Engineer III Circle, i.e. at the point where the Sandur Range crosses the river, 4 miles above Hospet. The rapids referred to by Mr.O'Connell have hardly commenced there, the principal fall being between that point and Kampli. I believe the investigations ordered by me as Suptg.Engineer III Circle are still in progress, and have been going on simultaneously with Mr.O'Connell's, which is absurd, as he ought to have had the benefit of Mr.Lawrence's assistance.

3. I would assume the top of dam as + 1570 or + 1580, and calculate by proper contours, what amount of water could be stored with that level. I take this level because it is probably about the limit at which high floods could be passed over the dam. I would pass the surplus of all ordinary floods, i.e. say up to 5' on Vallapur anicut, thro' under sluices.

4. When this amount of water is known, it will be time enough to consider how to get it to Metri. I do not think the expensive sinking of the Kamalapur valley at all an essential feature of the scheme. The Channel

Channel might be taken on the Contour originally proposed by Messrs. Gordon & Norfor, whose tunnel was a much shorter one than that proposed by Mr. O'Connell and the Country on this side of the saddle is not nearly so difficult as that on the other side between Nallapur and Dayji Tank which has been definitely abandoned.

5. I hope the project will not be condemned on the figures now given by Mr. O'Connell, because I am sure that, with patient investigation, something is feasible in the way of famine protection for Bellary, and even if the water stored was not used in Bellary except in times of scarcity, it would certainly be used in the interim for second crop under Kurnool Canal.

6. If any point on the river above the Sundur Range is selected for a Reservoir it would be better to go up as far as the Bombay boundry, to avoid difficulties with the Govt. of Hyderabad.

W.

10.2.80

No 130 I. P.W. Current No: 7743

Note by the Chief Engineer for Irrigation.

Encls 8 (4 Plans)

Despd. 17-9-98

In the papers printed with G.O.No: 956 I, dated 13th November 1885, a sufficiently full description is given of the various schemes projected by the Canal Co: for irrigation in Bellary District. The difficulty which finally caused the abandonment of these schemes was the enormous sum which it was found would have to be paid for the sites of indispensable reservoirs. In 1885 a proposal was made to examine into the possibility of carrying out the Upper Bellary project on a greatly reduced scale with the Daroji Tank as the only reservoir. An estimate was made accordingly and the proposed line of channel was subsequently inspected by Mr: Walch (then Chief Engineer for Irrigation) who condemned the project in his note printed with G.O.No: 521 I, dated 29th October 1889.

2. It was noticed that all the schemes which have been reported on aimed at leading water to Bellary or somewhere near it and no explanation was given in any of the reports of the reasons for restricting the proposed lines of channel to one narrow strip of country. Though it seemed most probable that every possible project had been thought of by one or other of the numerous officers who have been interested in the irrigation of the District, there was still some hope that an investigation on new lines would result in the discovery of means of irrigating at moderate cost at least the north eastern

eastern part of the District. Mr:H.H.O'Connell was accordingly placed on special duty in November last with instructions to ascertain (1) whether reservoirs could not be made on some of the valleys running down to the Tungabudra and filled by chan-nels from the river or (2) whether a reservoir could not be made on the river itself in such a position that an irrigation channel could be led from it direct to command a fairly large area, or the water dropped down the river to a place where an anicut could be built and a channel excavated from it.

3. Mr:O'Connell's report and the map which accompanies it show that the Tungabudra has a very slight fall from where it enters the District to Valavapur, a fall of 312 feet in the 30 miles between Valavapur and Kampli and again but a slight fall, 202 feet in 70 miles, between Kampli and the Tunga-budra station on the Madras Railway. The country, moreover, rises pretty rapidly from the river and it is therefore im-possible to command any large area by a channel of moderate length unless the head be well above Kampli. For the same reason any reservoir on the Tungabudra must be above Kampli.

4. The next point to be noticed is that if a channel were taken off much above Hosur there would be two ranges of hills to cross. The Valavapur anicut is the highest point to which one can go and avoid cutting through the Sandur hills. This is the rationale of Mr: Gordon's selection of the Upper Bellary High Level Line. It enabled him to avoid the Sandur hills and cross the Humpi hills with comparatively little tunnelling or deep excavation. Costly as this line is there

is no greater. Taking Col: Mullins' estimate for the first 30 miles that is from Valvapur to the Eastern side of the Humpi hills and adding 20 per cent for rise of rates the amount would be 76.6 lakhs. It should be possible to lay out irrigation channels from the foot of the hills for Rs.20 per acre commanded. Adding the usual 24½ per cent for establishment &c the cost for 150,000 acres would be 37.35 lakhs making a total of 114 lakhs exclusive of the reservoir.

5. There is no place at a suitable level below Hospett where a reservoir of large area could be formed. Above Hospett two sites have been examined. The first of these is about four miles above Hospett where the river passes through the Sandur Hills. A dam to impound water to a level 82 feet above the river bed would form a reservoir of 62 square miles area. Unfortunately there are of this area approximately 27½ square miles with 14 villages in the Nizam's territory and the area includes the Tarikon valley watered from the Koragal anicut. Nothing but money compensation could be offered, the country below this place being too hilly for irrigation. It is believed that this site was investigated once before as this reservoir is marked on one of the ordnance sheets in the Irrigation office. The Sandur range is composed of rocks of the Dharwar system, schists of various kind with associated traps. Where the river has cut through the range there are outstanding masses of haematitic quartzite which alone seems to resist the severe action of the water, the river bed being deeply scoured

where

where the softer rock occurred. The strike of the rock across the river is favourable but the dip which is nearly vertical is unfavourable. I doubt whether it would be quite safe to build a high dam on rock of the character of that seen unless the centre and near could be kept on the hard rock and a good allowance made for uplift. When the land compensation, which is certain to be very high, is also considered I think this site must be regarded as unfavourable for a reservoir.

6. At the village of Valavapur there is a sheet of good sound gneiss which extends across the river but dipping towards the Hyderabad side. It would be possible to build a dam safely here. If this site were adopted probably it would be best to build a masonry dam in the river and on the right bank and a composite dam, of earth with concrete core, on the left bank. Ordinary freshes could be passed through powerful sluices in the river part of the dam and the right flank made low enough to discharge surplus in heavy floods. There might be some difficulty in arranging that the surplus should not pass across the irrigation channel. If this could not be arranged the channel would have to be taken across the line of surplus discharge by an aniout. The compensation for this reservoir would be much less than the other as only dry land would be submerged and, as part compensation, water might be given on the Hyderabad side for some land not commanded by the Koragal channel. The reservoir site has not been contoured except at a level 43 feet above the river bed, which does no

give sufficient capacity. Probably a level 15 feet higher would be about right. It has seemed a waste of time to make any detailed investigation of these reservoirs the cost of the channel alone being more than Government would probably be willing to spend in leading water to land which, as the ex-perience of the Kurnool Canal shows, the ryots may not be willing to irrigate. Mr: O'Connell puts the cost of the reser-voir at 25 lakhs. It would be necessary to add probably 15 lakhs for compensation and allowing 25 per cent for Establish-ment &c the total comes to 50 lakhs. The cost of the project would therefore be 164 lakhs for providing water for 150,000 acres. The proportionate cost for a larger area would be less and for a smaller area greater.

7. The result of all the investigations which have been made is the more disappointing as the average annual discharge of the Tungabudra over Sunkesala anicut during the last 10 years has been 468000 millions and the minimum 292,000 millions or enough for the irrigation of nearly 1½ millions of acres. All this water simply goes waste as the Kistna River yeilds enough for the delta irrigation except at a time when the Kurnool Canal takes all the Tungabudra supply.

8. Mr: O'Connell also endeavoured to find a site for some considerable irrigation project on the Hagari and examin-ed the line estimated for in the Hagari Rayadrug Project. The result of his inspection is given in the accompanying re-port in which he explains why a channel cannot be led far enough

enough away from the river to command any large area. There is nothing to be done unless it be to make small tanks for the irrigation of the alluvial strip along the river but the ryots seem to have already done a good deal in this direction

Chepak
4th April 1898.

W. Hyden
Chief Engineer for Irrigation.

To
The Joint Secretary to Government, P.W.D.,
Irrigation Branch.

No. I., th April 1898.

~~GOVERNMENT OF MADRAS.~~

PUBLIC WORKS DEPARTMENT.

~~Irrigation.~~
~~Account.~~

Read—the following paper:—

From H. H. O'CONNELL, Esq., Executive Engineer on Special duty, to the Chief Engineer for Irrigation, dated Bellary, 27th December 1897, No. 34.

With reference to G.O., No. 2676 W., dated 24th September 1897, I have the honour to inform you that I have completed the preliminary survey of the Tungabhadra and beg to submit the following report, with attached notes which go into details of rates, &c., &c.

From an inspection of the "map of the Bellary district" it will be seen from the levels given thereon that the bed of the river near Harihar is 1,704 feet above M.S.L. while the bed of the river at the Tungabhadra station where the Madras Railway crosses is 1,045 feet above M.S.L. The distance between these two points is 185 miles and the total fall of the river between these two points is 659 feet. Further it will be observed that the bed of the river at the Wulavapur anicut is 1,559 feet above M.S.L. while at Kampli 30 miles lower down the bed of the river is 1,247 feet above M.S.L. which gives a fall of 312 feet. That is nearly half of the total fall of the river occurs in the 30 miles between the Wulavapur anicut and Kampli.

It at once becomes obvious that, if any large area of land is to be commanded, the channel to irrigate such land must take off from above this rapid fall in the river, and any reservoir for storing water must also be above.

There is ample water for storage. The registers kept do not admit of the actual amount available being ascertained, but I estimate that over 100,000 millions of cubic feet pass over the Wulavapur and Korrigal anicuts during the months of June, July, August, September and October.

As only 30,000 millions of cubic feet are required for the 100,000 acres it is proposed to irrigate, it will be seen that the supply of water is abundant.

Site. After a good deal of consideration I came to the conclusion that the best site for a storage reservoir would be just above the Wulavapur anicut. There is every promise of good sound rock for building on being found here. All sites where the rock belongs to the "Dharwar system" and are known as Dharwar rocks must be avoided, as these rocks constantly vary in character, are full of faults and are soft.

Dam I estimate that a dam 60 feet above the river bed, 6,000 feet long, with banks to connect it to the high ground on each side will impound over 30,000 millions of cubic feet and will cost about Rs. 25 lakhs. The flood discharge will pass over this dam, and I calculate that maximum flood discharge will pass over with a head of 7·89 feet and a velocity of 8·7 feet per second. I anticipate that it will be possible by the construction of powerful under-sluices in this dam to let the early freshes pass through and keep the bed of the reservoir clean and prevent silting up. There is ample water to allow of this being done.

It has already been shown that if any large area is to be commanded the channel must take off from above the rapids between Wulavapur anicut and Kampli. Unfortunately all the lines by which a channel can be taken to the land, which it is required to irrigate, are blocked by hills or high ground through which the channel must be carried in a tunnel. The line that is least blocked is *viâ* the Kamalapur valley and up to the Nellapur saddle. This is the line that was chosen by Mr. Gordon of the Madras Irrigation Company and followed by Mr. Norfor and has rightly been condemned over and over again. I propose now to make use of the first 17 miles of this line, against which there is no objection, and to dam the Kamalapur valley and raise Channel the water to 1,542 feet above M.S.L. and then to let the water through the Nellapur saddle by a tunnel down to Metri, and to commence irrigating from this point.

I estimate the cost of works as below :—

	LAKHS.
Reservoir	25
Channel	5
Head works and cross drainage works	1
Damming the Kamalapur valley	30
Channel and tunnel through the Nellapur saddle	56
Main canal and distributaries at Rs. 10 per acre	10
	127
Add 23 per cent. for establishment, 7 per cent. for tools and plant and 10 per cent. for contingencies and interest on Capital during construction	50
Total ...	177

The amount of land which the supply of water will irrigate is 100,000 acres which at Rs. 4 per acre will yield a return of Rs. 400,000.

$$177{,}00{,}000 : 100 = 400{,}000 : x.$$

$$x = \frac{400{,}00{,}000}{177{,}00{,}000} = 2{\cdot}26.$$

The gross return therefore will be 2·24 per cent. which would probably be reduced to 2 per cent. after paying for the maintenance of the works.

With reference to the Hagari river I have the honour to state that nothing is known as to the supply available for storage. I think it will be advisable to have a register kept for a series of years to ascertain this before proposing any works. I have collected all the facts I can concerning the Hagari which will be found in the accompanying notes.

ENCLOSURE.

Notes concerning the Tungabhadra River and a project for irrigating therefrom.

Amount of water available.—The water register kept at the Wulavapur anicut do not admit of the amount of water available for storage being accurately ascertained. The anicut at Wulavapur is said to be 10 feet above the bed of the river, with a crest about 5 feet wide. I could not get a plan and section of this anicut as apparently none exists.

The anicut runs from the right bank of the river on to an island in the middle of the river. There was 1 foot of water going over when I inspected the anicut. It is said to be 1,020 feet long. From the island to the left bank is another anicut called the Korrigal anicut whose length is said to be 1,000 feet, with crest level 1½ higher than the Wulavapur anicut. This anicut belongs to the Nizam's Government.

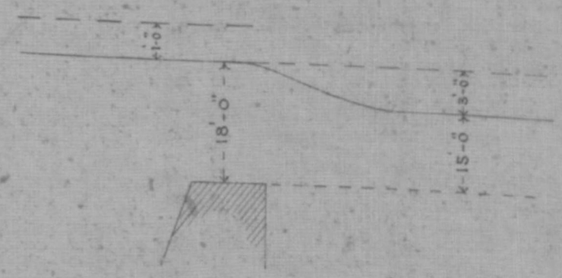
One gauge is placed near the anicut attached to a large circular pillar, another gauge has been placed half a mile higher up, but no gauge has been placed below the anicut. The anicut has no wing walls, and the water spreads on to the rocky sides of the river when it is in flood.

I am told that the anicut is drowned when 3 feet of water is going over, but I doubt this. The bed of the river has a good slope below the anicut. As there is no rear gauge it is impossible to calculate the amount of water going over accurately. Calculations have been made for two years on the supposition that all the water goes over a clear overfall. The calculations are for the months of June to November, both inclusive and give 325,209 millions of cubic feet for 1890, and 291,746 millions of cubic feet for 1891. As a good deal of the water does go over a clear overfall it is not too much to estimate that 100,000 millions of cubic feet are available for storage.

Maximum discharge of river.—The registers have only been kept since 1884 and the highest flood recorded during this time is 15 feet on the crest of the Wulavapur anicut.

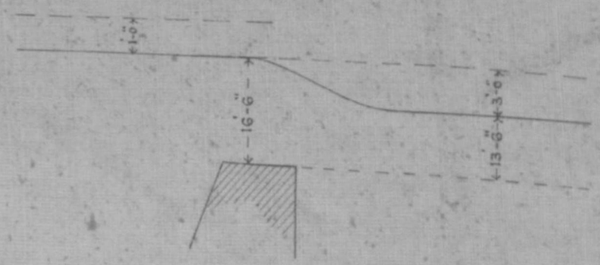
It is stated, however, that a flood of 18 feet passed in 1882. Accepting this and assuming that the difference in the height of the surface of water above and below the anicut to be 3 feet and that the head due to velocity of approach is 1 foot we get the following discharges:—

For the Wulavapur anicut whose length is 1,020 feet—



$$D = 1{,}020\left[3{\cdot}1\left\{(3+1)^{\frac{3}{2}}-1^{\frac{3}{2}}\right\}+6{\cdot}4\times 15\,(3+1)^{\frac{1}{2}}\right] = 217{,}974 \text{ c. ft. per second.}$$

For the Korrigal anicut whose length is 1,000 feet—



$$D = 1{,}000\left[3{\cdot}1\left\{(3+1)^{\frac{3}{2}}-1^{\frac{3}{2}}\right\}+6{\cdot}4\times 13{\cdot}5\,(3+1)^{\frac{1}{2}}\right] = 194{,}500 \text{ c. ft. per second.}$$

Or a total discharge of ... ... 412,474 c. ft. per second.

The drainage area of Tungabhadra above the Wulavapur anicut is 11,000 square miles

$$412{,}474 = C \times 11{,}000^{\frac{3}{4}} = C \times 494{\cdot}6.$$

$$C = \frac{412{,}474}{494{\cdot}6} = 834$$

which I do not think is too high a co-efficient for a river that rises on the western ghâts where the rainfall is from 70 to 100 inches.

Sites for dams.—An ideal site for a high dam is the gorge just below Hampi, but this is too low down to be of any use.

Just above Hospet the hills approach the river on both sides nearer than anywhere else. The rocks which form these hills belong to the "Dharwar system" and "consist of schists, hornblendic, chloritic and argillaceous; but the associated traps, and more especially the hamatitic quartzites from their superior hardness and durability, occupy in many places much the most prominent position, while from the same reasons, the taluses they have given rise to in the hilly tracts are of extraordinary extent, and cover up much of the softer rocks and mislead one as to their real extent." (Page 74 of Volume XXV of Mem. Geological Survey of India).

It might be possible to get down to hard rock at Hospet for the foundation of a dam, but there is no probability of getting any hard rock on to which to abut a dam, as these Dharwar rocks are said to lie in a synclinal curve on the top of the granitoid gneiss. At Hospet there is no convenient saddle over which to dispose of the flood discharges, and even if there was such a saddle, it would be most expensive work to pass it over this soft rock. The rain has cut deep gullies in these hills, and it is certain that if a large stream of water were allowed to run down, most expensive works would be required to prevent cutting back. All the other hills where a site for dam might be found are similar to those at Hospet (*vide* geological map accompanying volume XXV of Memoir of Geological Survey of India).

For these reasons I gave up the idea of a very high dam, and thought it better to allow for a moderate dam on solid rock, over which the flood water could be passed, and to connect this dam to the high ground on each side by means of earth banks.

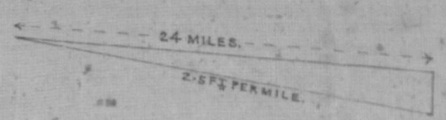
The land slopes up from the river at about 25 feet per mile, while the river bed above the Wuluvapur anicut has a fall of 2½ feet per mile.

A dam 60 feet high with the connecting earth banks will have an area of—



$$\frac{5{,}280 \times 4{\cdot}8 \times 60}{2} = 760{,}320 \text{ sq. ft.}$$

and it will back up the water for 24 miles.



so that the cubic contents in the reservoir would be—

$$\frac{24 \times 5{,}280}{3} \times 760{,}320 = 32{,}115 \text{ miles of c. ft.}$$

which is more than enough to irrigate 100,000 acres allowing 300,000 cubic feet per acre.

The best site for this dam is just above the Wuluvapur anicut, as the rock there is sound to build on.

The length of the masonry part of the dam I propose to make 6,000 feet long. The maximum flood discharge is 412,474 cubic feet per second (no velocity of approach)—

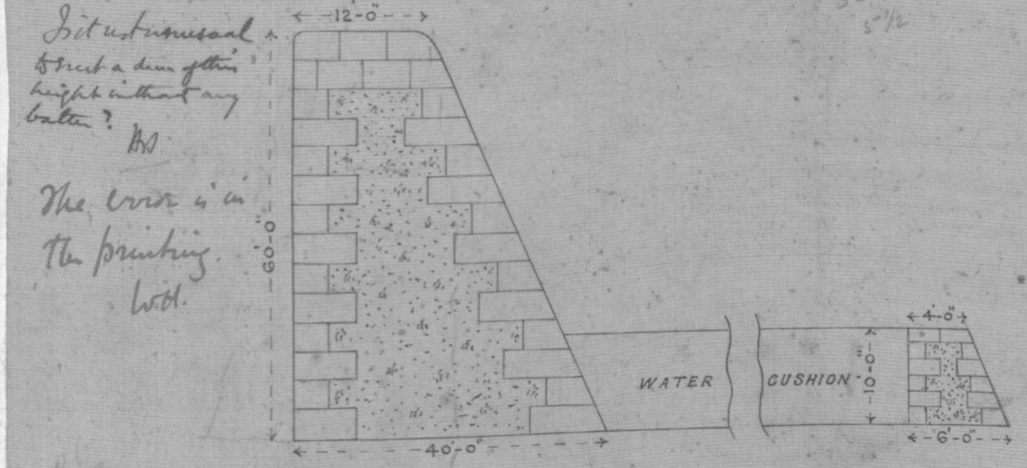
$$412{,}474 = 3{\cdot}1 \times 6{,}000 \times h^{\frac{3}{2}}.$$
$$h^{\frac{3}{2}} = 22{\cdot}2.$$
$$h = 7{\cdot}89.$$
$$\text{and } v = \frac{D}{A} = \frac{412{,}474}{6{,}000 \times 7{\cdot}89} = 8{\cdot}7 \text{ ft. per sec.}$$

viz., the maximum flood discharge will pass over this dam with a head of 7·89 feet and a velocity of 8·7 feet per second.

I note that a dam has been built at the head of the Nira canal which is 42 feet high and passes water over its crest at a depth of 7 feet.

I also note that it is proposed to allow water to surplus over the Periyár dam in the case of a very high flood occurring. I do not think, therefore, that the proposed dam is too high to pass this flood discharge provided a sufficient water cushion is allowed.

The cost of the dam and earthwork—



Sectional area $= \frac{12 + 40}{2} \times 60 + \frac{6 + 4}{2} \times 10 = 1{,}010$ sq. ft.

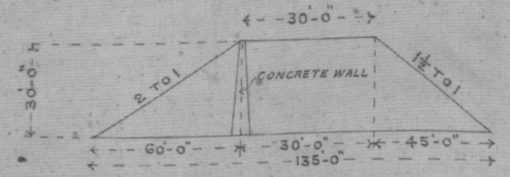
and contents = 6,060,000 c. ft.

assume that half is rubble masonry at Rs. 25 per 100 cubic feet and half is concrete at Rs. 16 per 100 cubic feet.

								Rs.
30,300 at Rs. 25	...	...	...	...	...	...	=	7,57,500
30,300 at „ 16	...	...	...	...	...	...	=	4,84,800
Total	...							12,42,300

The total length of the earth bank on *one* side is (2·4 × 5,280) — 3,000 feet = 15,672 feet.

The average section of the earth bank will be—



$\frac{135 + 30}{2} \times 30 = 2{,}475$ sq. ft.

and the contents = 2,475 × 15,672 = 38,788,200

which at Rs. 8 per 1,000 cubic feet would cost 38,788 × 8 = 3,10,304 and the banks on both sides would cost Rs. 6,20,608.

The concrete wall would cost for one side—

$\frac{3 + 2}{2} \times 30 \times 15{,}672 = 1{,}175{,}400$ c. ft.

and at Rs. 16 per 100 c. ft. = 11,754 × 16 = 1,88,064 and for both sides — 376,128.

The total cost would therefore be—

12,42,300 + 6,20,608 + 3,76,128 = 22,39,036.

or say 25 lakhs including compensation and sundries.

The channel.—Undoubtedly the best off-take for the channel is from above the Wuluvapur anicut, and there is no objection to the first 17 miles of the line chosen by Mr. Gorden and followed by Mr. Norfor; this will lead the water into the Kamalapur valley.

The channel is designed to irrigate 100,000 acres, and I think the duty of 1 cubic foot per second may be taken as 50 acres in this district. The discharge required is—

$$\frac{100,000}{50} = 2,000 \text{ c. ft. per sec.}$$

The crest of the Wuluvapur anicut 1,569. The proposed depth in the channel is 7 feet and the head at head sluice is 1 foot. The bed of the channel therefore will start at 1,561. The F.T.L. to which it is proposed to raise the Kamalapur tank is 1,542.

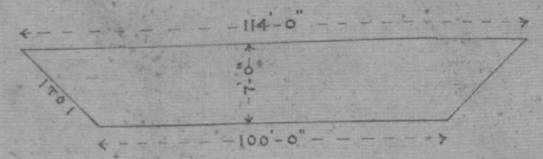
The channel may therefore have a fall of 1 foot per mile.

A channel 100 ft. bottom width; 7 ft. depth of water; 1 : 1 side slopes; 1 ft. per mile bed fall, will discharge—

$a \sqrt{r} \times c \sqrt{s} \times$ multiplier for 1 : 1

1,813 × 1·156 × 1·033 = 2,062 c. ft. per sec.

The channel will have to be nearly all in cutting—



The sectional area = $\frac{114 + 100}{2} \times 7 = 107 \times 7 = 749$ sq. feet.

and quantity to be excavated in one mile = 749 × 5,280 = 3,956,720 c. ft.

The rate for excavating gravel is 4·8 per 1,000 cubic feet and 1·8 must be allowed for extra lead and lift or a total rate of Rs. 6 per 1,000 cubic feet.

3,956·720 at Rs. 6 = Rs. 23,740

and allowance must be made for rock and cutting deeper than 7 feet so that it will not be excessive to allow Rs. 30,000 per mile for the channel.

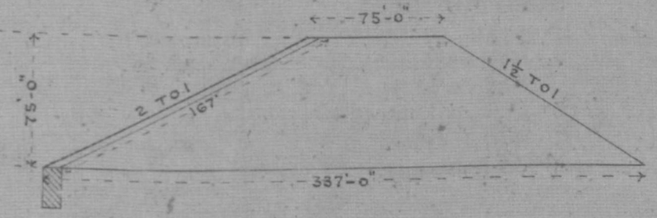
Rs. 30,000 × 17 = Rs. 5,10,000.

It is not feasible to run the channel along the sides of the rocky hills; this part of the line has been inspected by many officers and condemned over and over again. It is now proposed in order to get the water up to the Nellapur saddle to dam the Kamalapur valley and raise the water to 1,542 above M.S.L.

Two dams must be erected—one by raising the present Kamalapur tank 60 feet and another to stop the flow of water round the hill to the east of the Kamalapur tank.

The latter dam will be much higher than the Kamalapur tank bund when raised. A rough estimate for raising the Kamalapur tank is attached and the cost of the second bund is assumed to be the same.

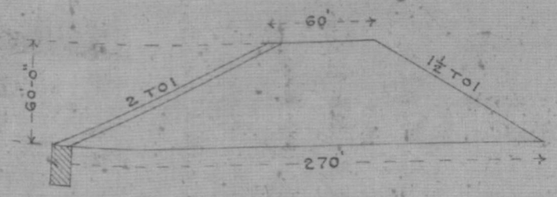
Rough estimate for proposed tank. Length of present bund 8,000 feet.



Section at centre.

$$\text{Area} = \frac{237 + 75}{2} \times 75 = 11{,}700 \text{ sq. ft.}$$

		Rs.	A.	P.
Rate.—Excavating per 1,000 cub. ft. gravel		4	8	0
12 units (10 yards) of extra lead at 6 annas		4	8	0
25 units (1 yard) of extra lift at 6 annas		9	6	0
Highest rate ...		18	6	0
Lowest rate ...		4	8	0
	2)	22	14	0
Mean rate ...		11	7	0



Section at end of present bund.

$$\text{Area} = \frac{270 + 60}{2} \times 60 = 9{,}900 \text{ sq. ft.}$$

		Rs	A.	P.
Rate.—Excavating per 1,000 cub. ft.		4	8	0
9 units (10 yards) of extra lead at 6 annas		3	6	0
20 units (1 yard) of extra lift at 6 annas		7	8	0
Highest rate ...		15	6	0
Lowest rate ...		4	8	0
	2)	19	14	0
Mean rate ...		9	15	0

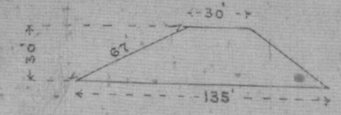
Cost of raising the bund along its present length will be—

$$\frac{11{,}700 + 9{,}900}{2} \times 8{,}000 = 86{,}400{,}000 \text{ cub. ft.} =$$

$$\text{Mean rate} = \frac{\text{Rs. } 11\text{-}7 + \text{Rs. } 9\text{-}15}{2} = \text{Rs. } 10\text{-}11 \text{ per } 1{,}000 \text{ cub. ft., say, Rs. } 11.$$

$$86{,}400 \times 11 = 9{,}50{,}400$$

The bund will have to be extended 2,000 feet at one end and 6,000 feet at the other. The mean section will be—

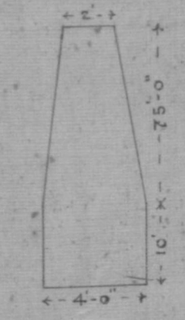


$$\text{Area} = \frac{135 + 30}{2} \times 30 = 2{,}475 \text{ sq. ft.}$$

		Rs.	A.	P.
Rate.—Excavating per 1,000 cub. ft.		4	8	0
4·5 units (10 yards) extra lead at 6 annas		1	11	0
10 units (1 yard) extra lift at 6 annas		3	12	0
	Highest rate ...	9	15	0
	Lowest rate ...	4	8	0
		2)14	7	0
	Mean rate ...	7	3	0

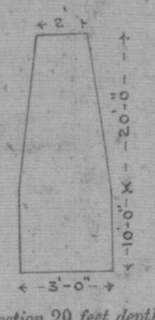
$2{,}475 \times 8{,}000 = 19{,}800{,}000$ cub. ft.
19,800 cub. ft. at Rs. 7 = 138,600.

The bund will rest on gravel, which in its turn probably rests on fissured rock. It will be necessary, therefore, to insert a concrete wall (as puddle is not obtainable) to stop water from being forced up and saturating the bund. This concrete wall must be carried down to solid rock.



Section at centre.

$4 \times 10 = 40$
$\frac{4+2}{2} \times 75 = 225$
265 sq. ft.



Section 20 feet depth.

$3 \times 10 = 30$
$\frac{3+2}{2} \times 20 = 50$
80

$$\text{Mean section} = \frac{265 + 80}{2} = 172 \text{ sq. ft.}$$

The approximate length of this concrete wall will be 13,000 feet.

The contents will be $13{,}000 \times 172 = 2{,}236{,}000$ which at Rs. 16 per 100 cub. ft. $22{,}360 \times 16 = 3{,}57{,}760$.

The revetment, the mean width will be—

$$\frac{167 + 67}{2} = \frac{234}{2} = 117 \text{ ft.}$$

The thickness will be $1\frac{1}{2}$ feet and the length 13,000. The contents therefore will be—

$117 \times 1{\cdot}5 \times 13{,}000 = 1{,}521{,}000$ cub. ft. which at Rs. 6 per 100 cub. ft. $15{,}210 \times 6 = 91{,}260$

The cost, therefore, of raising this bund will be—

	Rs.
Earthwork	9,50,400
,, ...	1,38,600
Concrete wall	3,57,760
Revetment	91,260
	15,38,020

say, 15 lakhs, and as the other bund, which is higher but not so long, will cost probably more, the cost of damming the valley may be taken at 30 lakhs, including compensation for land submerged.

The tunnel through the Nellapur saddle with the channels leading to and from it.—The contents of the channel leading to the tunnel have taken out form the accompanying section—

Bed width 100 ft.; depth of water 7 ft.; fall 1 ft. per mile; side slopes $\frac{1}{4}$ to 1.

⊗ Is this enough for such banks? I should have thought not half enough.

For the first 6,000 ft. the average depth of cutting = 28·3 ft.

$\{(100 + 14{\cdot}15)\ 28{\cdot}3\} \times 6{,}000 = 19{,}382{,}670$

From 6,000 ft. to upper end of tunnel—

$\{(100 + 28{\cdot}66)\ 57{\cdot}33\} \times 300 = 2{,}212{,}823$

21,595,493 cub. ft.

The tunnel has to discharge 2,000 cubic feet per second.

The fall is 10 ft. per mile

and $S = \frac{10}{5{,}280} = 0{\cdot}0019.$

$A = 380$ sq. ft. diam. = 22 ft. W. B. = 69

and $T = 5{\cdot}5.$

$$V = \left\{ \frac{\left(41{\cdot}6 + \frac{1{\cdot}811}{0{\cdot}035} + \frac{0{\cdot}00281}{0{\cdot}0019} \right) \sqrt{5{\cdot}5}}{\sqrt{5{\cdot}5} + 0{\cdot}035 \left(41{\cdot}6 + \frac{0{\cdot}00281}{0{\cdot}0019} \right)} \right\} \sqrt{5{\cdot}5} \times {\cdot}0019.$$

$$= \frac{218{\cdot}27}{3{\cdot}8} \times 0{\cdot}102$$

$= 5{\cdot}9$ ft. per second

$D = 380 \times 5{\cdot}9 = 2{,}142$ cub. ft. per second.

The tunnel is $1\frac{1}{2}$ miles long, so the contents will be—

$7{,}920 \times 380 = 3{,}009{,}600$ cub. ft.

The contents of the open cutting leading from the tunnel—

For first 480 ft. (average depth = 56·68).

Bed width 60 ft.; side slopes $\frac{1}{2}$ to 1.

0 to 480	$\{(60 + 28{\cdot}34)\ 56{\cdot}68\}\ 480$	2,403,413
480 to 7,080	$\{(60 + 11{\cdot}67)\ 23{\cdot}35\}\ 6{,}600$	11,045,034
7,080 to 7,230	$\{(60 + 0{\cdot}76)\ 1{\cdot}53\}\ 150$	13,944
	Total ...	13,462,491 cub. ft.

The grand total of cutting in rock with blasting—

21,595,493
13,462,491

35,057,984 cub. ft.

which at Rs. 10 per 100 cubic feet, which is a low rate = Rs. 35,05,798.

The rate for the tunnel I have taken at Rs. 70 per 100 cubic feet, after ascertaining from Mr. Pears the rates paid for the Periyár tunnel—

3,009,600 at Rs. 70 = 21,06,720

or the total for getting through the Nellapur saddle is—

35,05,798
21,06,720

53,12,518

say, 56 lakhs.

The Hagari river—rises in Mysore territory and has a drainage area of 8,524 square miles. The average rainfall in the upper portion of its catchment area is 10 inches which increases to 15 inches in the lower portion of the basin.

For nine months in the year the river is practically dry, and the catchment area becomes ready during these nine months to absorb a considerable portion of the meagre rainfall.

There are also about 200 tanks in the catchment area which must absorb a good deal of the run off.

A large number of these tanks are in the Mysore territory and no information is available concerning them. Under these circumstances it is impossible to form any opinion as to the amount of water available, and I think a register must be maintained and the discharge calculated for a number of years before any proposals can be made.

The river is a very broad and shallow one, and what looks like a large amount of water going is probably deceptive on account of its shallowness.

It is said that, as a rule, only one or two freshes come down each year, last a few days and then subside.

(Signed) H. O'CONNELL,
Executive Engineer on special duty.

No. I., MARCH 1898.

GOVERNMENT OF MADRAS.

PUBLIC WORKS DEPARTMENT.

~~Irrigation.~~
~~Account.~~

READ—the following papers:—

From H. H. O'CONNELL, Esq., Executive Engineer on Special duty, Bellary, to the Chief Engineer for Irrigation, dated 1st February 1898, No. 58:

In continuation of my No. 34, dated 29th December 1897, I have the honour to submit a report of my inspection of the Haggari river.

The river has a catchment area of over 8,000 square miles and has a rainfall varying from 18 inches in the lower portion of its basin to 10* inches in the upper portion.

* Rice Gazetteer of Mysore.

For nine months of the year this catchment basin is perfectly dry and exposed to a baking sun, so that it will be prepared to absorb a large quantity of the meagre rainfall.

There are also about 200 tanks in the catchment area and they will also absorb a good portion of the rainfall. The run-off, therefore, cannot be very great.

From enquiries made, I estimate that the ordinary flood discharges which would be available for storage will be about 5,000 millions of cubic feet, which is equivalent to a run-off of about one-fourth from the whole catchment area.

If it were possible to store this it would be sufficient for about 16,000 acres.

The above estimate cannot be depended on, as it is made on what I could learn from the villagers, who made very conflicting statements. It will be necessary to gauge the river for several years before any accurate data can be obtained. There is no anicut across this river and the only way to gauge will be to set up gauges and take cross sections in any part of the straight portion near Janjimaranahalli.

From the point where the river enters the Bellary district up to Kurlugunda, the river runs from south-west to north-east and is about ½ mile wide, after it passes Kurlugunda the course is nearly due north, and the river begins to widen until the bed is nearly 1½ miles across. The deep bed of the river is along the left bank. The right bank is composed of drift sand piled up by the strong westerly winds.

Along the left bank of the river there is a considerable extent of alluvial deposit, deposited there by the river, which has gradually shifted its course from west to east. All this alluvial deposit which lies a very little above the river bed is irrigated by numerous channels from the river. I estimate that close on 4,000 acres are irrigated in this way. From the margin of this alluvial deposit, the ground rises rapidly from the river. I estimate that it rises at the rate of 30 to 50 feet per mile.

From Pulicherla southwards the ground is stony with every indication of rocks close below the surface. Northwards of Pulicherla the ground is chiefly black cotton with patches of red-gravelly soil.

From the levels given on the accompanying map of the Rayadrug taluk, it will be seen how impossible it is to get away any distance from the river. The channels shown on this map run on the alluvial deposit mentioned above. If any attempt is made to run a channel farther from the river margin it has to be taken through stony rocky ground.

I have estimated for such a channel in my notes and find that the first twelve miles would cost at least 20 lakhs.

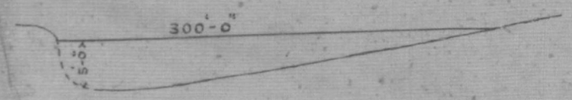
I am at a loss where to take the channel after passing the Kolacal tank, no site for a reservoir is possible until the valleys beyond the Kanakallu tank are reached; these are all of black cotton soil and no tank could be made with it.

If it were possible to irrigate 16,000 acres and Government would be satisfied with a return of 2 per cent., the capital expenditure allowable would be 32 lakhs. I have already shown that the first twelve miles of the channel would cost over 20 lakhs and the other works such as the anicut and head works and numerous cross drainage works would run up the cost very largely and added to this, the want of suitable sites for reservoirs makes it impossible to recommend any irrigation work from the Haggari.

NOTES.

Supply available.

From enquiries of the villagers, it seems that the ordinary floods last about 25 days and are about 5 feet deep along the left bank. The bed of the river slopes up towards the right bank and 5 feet deep at left bank would make it about 300 feet across.



Fall of river 6 feet per mile

$$\text{Area} = \frac{300 \times 5}{2} = 750 \text{ square feet.}$$

W.L. = 310 feet.

$$r = \frac{750}{310} = 2{\cdot}4$$

taking C = 100

$$D = 100 \sqrt{2{\cdot}4 \times \tfrac{6}{5280}} \times 750$$

$$= 5 \times 750$$

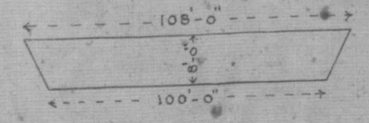
= 3,750 cubic feet per second

= 8,100 millions of cubic feet in 25 days.

So that probably 5,000 millions cubic feet could be counted on.

From the levels shown on the taluk map of Rayadrug, it is evident that if a channel is to command any land it will be necessary to go up at least 3 miles above Janjiramanahalli. The fall of the river is about 6 feet per mile, so that at a point 3 miles above Janjiramanahalli the river would be 37 + 18 = + 55, and if we build an anicut to raise the water 10 feet and take the water off in a channel 8 feet deep, the bed of the channel at head would be 65 — 8 = + 57. Unfortunately such a channel must run through rocky ground, and if it is to discharge 5,000 millions of cubic feet in 25 days, it must have a capacity to discharge 2,300 cublic feet per second.

A channel, 100 feet bottom width, 8 feet deep, 1 foot per mile fall, side slopes $\frac{1}{2}$ to $\frac{1}{4}$1, will discharge 2,650 cubic feet per second.



$$\text{Area} = \frac{108 + 100}{2} \times 8 = 104 \times 8 = 832 \text{ square feet.}$$

It will be a low estimate if we take half of this as having to be blasted and the other half as hard gravel.

$$\frac{832}{2} \times 52{\cdot}80 = 2{,}196{\cdot}480 \text{ cubic feet,}$$

2,196·480 rock blasted at Rs. 65 per 1,000 cubic feet = Rs. 1,42,771.

2,196·480 hard gravel at Rs. 11 per 1,000 cubic feet = Rs. 24,161,

or say Rs. 1,67,000 per mile.

The length of the channel will be at least 12 miles, before it reaches the Veparala tank and would cost over 20 lakhs for that distance.

BELLARY,
1st February 1898.

(Signed) H. O'CONNELL,
Executive Engr. on Special duty.

No. 130 I.

Note by the Chief Engineer for Irrigation.

In the papers printed with G.O., No. 956 I., dated 13th November 1885, a sufficiently full description is given of the various schemes projected by the Canal Company for Irrigation in Bellary district. The difficulty which finally caused the abandonment of these schemes was the enormous sum, which it was found would have to be paid for the sites of indispensable reservoirs. In 1885 a proposal was made to examine into the possibility of carrying out the upper Bellary project on a greatly reduced scale with the Daroji tank as the only reservoir. An estimate was made accordingly and the proposed line of channel was subsequently inspected by Mr. Walch (then Chief Engineer for Irrigation) who condemned the project in his note printed with G.O., No. 521 I., dated 29th October 1889.

2. It was noticed that all the schemes which have been reported on aimed at leading water to Bellary or somewhere near it and no explanation was given in any of the reports of the reasons for restricting the proposed lines of channel to one narrow strip of country. Though it seemed most probable that every possible project had been thought of by one or other of the numerous officers who have been interested in the irrigation of the district, there was still some hope that an investigation on new lines would result in the discovery of means of irrigating at moderate cost at least the north-eastern part of the district. Mr. H. H. O'Connell was accordingly placed on special duty in November last with instructions to ascertain (1) whether reservoirs could not be made on some of the valleys running down to the Tungabhadra and filled by channels from the river; or (2) whether a reservoir could not be made on the river itself in such a position that an irrigation channel could be led from it direct to command a fairly large area, or the water dropped down the river to a place where an anicut could be built and a channel excavated from it.

3. Mr. O'Connell's report and the map which accompanies it show that the Tungabhadra has a very slight fall from where it enters the district to Valavapur, a fall of 312 feet in the 30 miles between Valavapur and Kampli and again but a slight fall, 202 feet in 70 miles, between Kampli and the Tungabhadra station on the Madras Railway. The country, moreover, rises pretty rapidly from the river and it is therefore impossible to command any large area by a channel of moderate length unless the head be well above Kampli. For the same reason any reservoir on the Tungabhadra must be above Kampli.

4. The next point to be noticed is that if a channel were taken off much above Hosur there would be two ranges of hills to cross. The Valavapur anicut is the highest point to which one can go and avoid cutting through the Sandur hills. This is the *rationale* of Mr. Gordon's selection of the upper Bellary high level line. It enabled him to avoid the Sandur hills and cross the Humpi hills with comparatively little tunnelling or deep excavation. Costly as this line is there is no better. Taking Colonel Mullins' estimate for the first 30 miles that is from Valavapur to the eastern side of the Humpi hills and adding 20 per cent. for rise of rates the amount would be 76·6 lakhs. It should be possible to lay out irrigation channels from the foot of the hills for Rs. 20 per acre commanded. Adding the usual 24½ per cent. for establishment, &c., the cost for 150,000 acres would be 37·35 lakhs, making a total of 114 lakhs exclusive of the reservoir.

5. There is no place at a suitable level below Hospet where a reservoir of large area could be formed. Above Hospet two sites have been examined. The first of these is about 4 miles above Hospet where the river passes through the Sandur hills. A dam to impound water to a level 82 feet above the river bed would form a reservoir of 62 squre miles area. Unfortunately there are of this area approximately 27½ square

G.181

miles with fourteen villages in the Nizam's territory and the area includes the rich valley watered from the Koragal anicut. Nothing but money compensation could be offered, the country below this place being too hilly for irrigation. It is believed that this site was investigated once before as this reservoir is marked on one of the ordnance sheets in the Irrigation office. The Sandur range is composed of rocks of the Dharwar system, schists of various kind with associated traps. Where the river has cut through the range there are outstanding masses of hæmatitic quartzite which alone seems to resist the severe action of the water, the river bed being deeply scoured where the softer rock occurred. The strike of the rock across the river is favourable, but the dip which is nearly vertical is unfavourable. I doubt whether it would be quite safe to build a high dam on rock of the character of that seen unless the centre and rear could be kept on the hard rock and a good allowance made for uplift. When the land compensation, which is certain to be very high, is also considered, I think this site must be regarded as unfavourable for a reservoir.

6. At the village of Valavapur there is a sheet of good sound gneiss which extends across the river but dipping towards the Hyderabad side. It would be possible to build a dam safely here. If this site were adopted probably it would be best to build a masonry dam in the river and on the right bank and a composite dam, of earth with concrete core, on the left bank. Ordinary freshes could be passed through powerful sluices in the river part of the dam and the right flank made low enough to discharge surplus in heavy floods. There might be some difficulty in arranging that the surplus should not pass across the irrigation channel. If this could not be arranged the channel would have to be taken across the line of surplus discharge by an anicut. The compensation for this reservoir would be much less than the other as only dry land would be submerged and, as part compensation, water might be given on the Hyderabad side for some land not commanded by the Koragal channel. The reservoir site has not been contoured except at a level 43 feet above the river bed, which does not give sufficient capacity. Probably a level 15 feet higher would be about right. It has seemed a waste of time to make any detailed investigation of these reservoirs the cost of the channel alone being more than Government would probably be willing to spend in leading water to land which, as the experience of the Kurnool canal shows, the ryots may not be willing to irrigate. Mr. O'Connell puts the cost of the reservoir at 25 lakhs. It would be necessary to add probably 15 lakhs for compensation and allowing 25 per cent. for establishment, &c., the total comes to 50 lakhs. The cost of the project would therefore be 164 lakhs for providing water for 150,000 acres. The proportionate cost for a larger area would be less and for a smaller area greater.

7. The result of all the investigations which have been made is the more disappointing as the average annual discharge of the Tungabhadra over Sunkesala anicut during the last ten years has been 468,000 millions and the minimum 292,000 millions or enough for the irrigation of nearly $1\frac{1}{2}$ millions of acres. All this water simply goes waste as the Kistna river yields enough for the delta irrigation except at a time when the Kurnool canal takes all the Tungabhadra supply.

8. Mr. O'Connell also endeavoured to find a site for some considerable irrigation project on the Hagari and examined the line estimated for in the Hagari-Rayadrug project. The result of his inspection is given in the accompanying report in which he explains why a channel cannot be led far enough away from the river to command any large area. There is nothing to be done unless it be to make small tanks for the irrigation of the alluvial strip along the river, but the ryots seem to have already done a good deal in this direction.

CHEPÂK,
4th April 1898.

(Signed) W. HUGHES,
Chief Engineer for Irrigation.

PUBLIC WORKS DEPARTMENT,

IRRIGATION BRANCH.

PROCEEDINGS OF THE MADRAS GOVERNMENT.

UNDER date the

READ the following

From Proceedings of the Madras Govt: (H.E.No:2676 W, dated 24th Septr/97)
From Ex:Engr:on special duty, Bellary (H.E.No:34, dated 27th Decr/97), with notes,
From Do Do Do (H.E.No:50, dated 1st Febry/98), with notes.
Note by the Chief Engineer for Irrgtn (H.E.No:180 I, d/4th April/98).

Recorded.

2. In the circumstances reported in the foregoing papers the Government is of the opinion that the further consideration of the projects referred to may be dropped.

To,

The Chief Engineer for Irrigtn:
" Suptg:Engineer, Third Circle.
" Examiner, P.W.Accounts.
W.H.O'Connell Esquire.
The Revenue Department.

SECRETARY TO THE GOVERNOR
NEW SOUTH WALES

GOVERNMENT HOUSE
Sydney
15th April 1858.

No 48

My dear Labouchere,

Before I send
you the enclosed Petition
which arrived by the last Mail
I should like to know
if you would have any objection
to my presenting it myself
to the Queen.

I should wish to do so
because I feel that I may be
able to explain to Her Majesty
the circumstances which
induced me to sign the Petition
& to express my hope that
Her Majesty will not withhold
Her Royal Assent from the
Bill.

I have written on the subject
to Sir Edward Lytton
& to Lord Derby
but I have not received
any answer from either
of them.

Yours very truly
Sir Henry Labouchere
&c &c &c

48

I would be glad if you would look into the papers and, as I have said, favour him with your opinion on the point

Yours sincerely

Chas

Where here the Lawyers
limited as directed
if this Lease is done in
her Office

20. 4. 98.

Papers submitted in person

3 May 98

P. W. D.
D.O. C. No. 37
R/ 13.5.98.

19 VI

Government of Madras
Public Works Department
Ootacamund
12th May 1898.

No. 278 D., dt/13th May 1898.

My dear Sim,

As requested in your D.O. letter of 18th April I have had printed, and herewith return the paper on the Tungabadra and Hagari Irrigation Projects together with a short note giving my view of the matter, for His Excellency's information.

Yours Sincerely by
(Sd) W.B. de Winton.

Dft. 13/5/98

Received from the Hon'ble Sir Spencer E.C. 15/8

50

VII

Tungabadra Project

...ic Works Department.

Note by the Acting Chief Engineer, P.W. Department.

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1. In para 4 of his report dated 27th December 1897, No. 34, Mr. O'Connell says "there is ample water for storage", and in para 7 of his Note thereon, No. 130 I, dated 4th April 1898, Mr. Hughes says "the average annual discharge of the Tungabadra is enough for the irrigation of nearly 1½ millions of acres. All this water simply goes waste". This being the case, I think it is a mistake to decide that the further consideration of the project, as far as the Tungabadra is concerned, may be dropped; on the contrary, I think, that so long as this magnificent body of water is allowed to run to waste, so long will the Government of Madras fail in its duty to the people in not storing it. If it is not used in the Bellary District, it will be used to extend existing irrigation, but I hope and believe that it will be used in Bellary and help to some extent to save that District from future famines.

2. I therefore recommend that estimates be prepared at once on the following lines, to be carried out either.

(1) H. C. de Donnelan

(2) The Honourable Sir W. Hughes K.C.I.E.

(3) The Honourable Mr. Justice C.I.E.

I do not intend to dwell on the Chief Engr's views & stands in this matter. Mr. O'Connell's report is addressed to the C.E.I., who sent it on 15/1/98 to Mr. Johnston for perusal. Mr. Johnston returned it on 18/1/98 with an office note, [illegible] and there, so far as the papers show, his connection with the matter ceased. How the papers got back with his hands, I cannot make out. The matter is one which pertains to the Irrigation side of the P.W. office & for which the C.E.I. is alone responsible. He with his note that the project is not worth pursuing further in irrigation. Mr. O'Connell puts the cost at 177 lakhs, but his calculations are extremely rough & (to the best of my belief) contain serious errors (vide notes on p. 2, 4, 5, 7 & 8 of the proof). The C.E.I. roughly estimates the cost at 184 lakhs, but in doing so he accepts Mr. O'Connell's estimate of the reservoir etc. which cannot stand on the face of them. Allowing further that, so far as I know, no really big work has ever been carried out in any part of the world for the estimated cost, I think the fact that the scheme will be very fortunate if it completes it for less than 200 lakhs.

As to the possible return, Mr. O'C puts it at 2½% on his outlay of 177 lakhs, out of which he allows ½% for maintenance - that is, 1/9 of the total return - 400000 = 44444. I think it for without saying that works of such magnitude & such character can be kept up by the annual expenditure of such a sum - but, however, as this return of certainly under 2% is, it is to be obtained by the irrigation of 100000 acres of land, mostly black i.e., Nallan, black cotton soil - the best soil in the district. The prospect is there that the scanty population of the Bellary Taluk would undertake & undertake to put in irrigation first cultivation, or that if they were unable, they would be any more willing & able than the people in Kurnool have in thirty years shown themselves to be willing & irrigate from the Kurnool-Cuddapah Canal? I cannot see any, & therefore seem to me extremely likely that before the 100000 acres are supplied

1. Mr. de Winton's recommendations should be adopted.

2. Hon. Member will see the papers.

A.G.H. 17.8.98

17.8.98

either during the next famine, by concentrating all the able bodied labour in the Bellary District on the work, or as soon as funds can be made available in the ordinary way, as Government may decide.

(1) The construction of a reservoir on the Tungabadra either at the site selected by Mr. O'Connell, immediately above the Wulvapur anicut, or at a site to be selected at a point higher up, where the Bombay Presidency adjoins the left bank of the river, to avoid complications with the Hyderabad Government.

(2) The construction of a channel therefrom approximately on the line selected by Messrs. Gordon and Norfor, round the Sandur hills at Hospet, across the Kamalapur valley and Nellapur saddle and dropping into the Bellary plain at Metri. The channel to be 50' bed width at first, the banks being so placed that it can be widened hereafter to 100' or more if required and the side slopes ½ to 1.

(3) The construction of a distribution system from Metri-planned for 1,00,000 acres, but to be carried out by degrees as ryots learn to appreciate the value of the water. The water stored can be, in the meanwhile, utilised, if necessary, for extending existing cultivation under the Tungabadra.

3. To prepare these estimates-

where...taken & the project despatched as urgent

under but call the accumulation of interest will have raised the cost of the project ~~also exceed~~ to something just short of 40 lakhs.

Apart from all this, the proposal to erect an anicut slap in front of the Nizam's Konigal anicut & flood a large area of his territory, that will

It is difficult to know what the C.E. wants! In Jan 18 he condemned the Valavapur site as unsuitable, advocated a site below Valavapur. Now he accepts either the Valavapur site or another mile (25 miles) higher up than Valavapur, the selection of which would involve laying the chl. by 15 or 20 miles.

BS

X Why? Will he consent to pay, what will he charge us for this canal pleasance? Surely we should dare to take before we spend time & money on further investigations.

Supposing, however, that further investigations are decided on, I object altogether to the C.E.'s proposals as to the way in which they are to be carried out. In the first place it is for the C.E.? to make inquiries as to irrigation investigations; and in the second, it seems to me quite wrong to take ~~planning~~ an officer entirely unconnected with the duty of preparing the estimate for a project of such difficulty & magnitude. He would probably make even more of a mess of it than Mr. O'Connell seems to have done - if the project were for a railway & not merely one for 20 lakhs an officer of Supt Engr's standing ~~as~~ assisted by several Exec Engrs would be deputed to the duty. I cannot agree to the proposal & dispute an Superintendent of same these duties - It would be unfair neither to the man himself ~~&~~ nor to the country to do so -

Better late however, than never, I think that the advice of the C.E. should be taken & the project despatched as urgent

-1-

(Even if the Nizam will consent) at any cost which India with Govt. would sanction —

BS
20/5/98

I agree with the hon. Mr. Bliss in doubting whether the work will be done at the estimated expense, or whether it will succeed in the heart of Black Cotton soil, in the County E. of the Canal. Skilled is discretion in the Public Works Dept. Where I did like the C.E. to give us further information justifying the Lake that the water will be used by the Railway, especially if not kind here, will be used to extend existing irrigation

I should like to know, too, how the enquiry passed out of the hands of the C.E.!

The fact that so many serious errors in Mr. O'Connell's figures were not brought to notice in the official digests that his scheme might have been more carefully examined.

JG
20/5/98

-2-

there is no occasion for appointing a special staff, beyond, perhaps, a Surveyor and his lascars. There is an upper subordinate now in the Bellary Division, Mr. Lawrence, who is well acquainted with the country, and is quite competent to do all that is necessary under the guidance of the Executive Engineer of the Division. I should like to see the work taken up at once.

L Bethune

Acting Chief Engineer, P.W. Dept.

With regard to the Nizam I think agree that the risk is too untrustworthy to form the basis of any extensive irrigation project, & further investigations may be dropped

L Bell

12-5-98

152

Public Works DEPARTMENT.

C. No. VIII

HIS EXCELLENCY THE GOVERNOR.
THE HON'BLE SIR HENRY BLISS, K.C.I.E.
THE HON'BLE MR. GROSE, C.I.E.

SUBJECT.
Tungabhadra Project

FOR ORDERS.

The Private Secretary seems to have made a mistake in sending the papers to me. In writing direct they should go through the Secretary in the Dept. concerned. HS

Flag C

× Flag A

With reference to Mr. H. Bliss' first portion, the attached demi-official correspondence will explain my views & stands in the matter.

2. I did not check Mr. O'Connell's figures, because they are avowedly only approximate, & does only serve to give my views on the subject generally. I am a firm believer in the principle that storage of water in India if carried out in well considered, & scientific lines, is absolutely certain to pay, & to pay handsomely in the long run, and in certain of the long runs, and in such are unfailing ones as the Tungabhadra project which takes a broad view of the

I fear, then, that I don't take a rosy view HS

$\left[\frac{\text{P.W.}\ 45.}{500-27\frac{1}{2}=45.}\right]$

matter can have any reasonable
chance of success.

3. I have now looked into the
Hon O'Connell's figures in the
light of the Hon members criticisms
& find that they are certainly
very untrustworthy as far as
the cost of the Reservoir is
concerned. I have made some
rough calculations & estimate
that it will cost 40 lakhs,
made up as follows.

	Rs
Dam. 6000' long & 60' high	24,15,000
Irrig sluices to do	1,00,000
Earthwork	7,25,000
Revetment	2,20,000
Gravel lacking to do, &	
on top & rear slope of bund	60,000
Compensation for land &	
contingencies	4,60,000
Rs	40,00,000

This provides for
(1) a dam & earthen bank at each of middle
(2) an earthen bund 11364' long, on
either side of the Dam, with its
top 20' above crest of Dam at
the Irrig sluices, i.e 12' above M.F.L.
Sloping to 3' above M.F.L at the

How, I should like to know what
notice is going to be taken of Mr. O'Connell's
utter carelessness or want of capacity
shown - i.e. - in omitting the
scandalous item in his Supt. of only
2 years service should send up a
list of figures of that nature
without, as any ordinary person with
rudimentary knowledge of arithmetic
and of the methods of the construction
of irrigation works can at once detect.
I think some distinct punishment should
be imposed on him.

RS

I think it will be sufficient to confirm the
sanctioning and discontinuance of post.
at finding that an officer of Mr. O'Connell's high
standing and reputation should have
made such mistakes.

A.H
18.7.98
HL

I don't understand this.
HL

* Mr. O'Connell estimate
was for dam not a channel
The Chief estimate is Mr Gridlay
revised by last Chief Engineer and
a 4 pr channel 100 ft wide

TWH

[P. W. 13.
500—27-1-98.]

53

DEPARTMENT.

C. No.

HIS EXCELLENCY THE GOVERNOR.
THE HON'BLE SIR HENRY BLISS, K.C.I.E.
THE HON'BLE MR. GROSE, C.I.E.

SUBJECT.

2.

FOR ORDERS.

Channel - slopes front &
rear 2 to 1. Top width 20'
at irrig sluices 6' at other sections
(3) Stone revetment 2' thick, on
front slope for whole length
(4) Gravel lacking to do 6" thick,
on top, & rear slope of
bund.

I have attached workings, &
believe the Reservoir could
be made for the above money.

4. But however much Mr O'Connell
may have underestimated the
cost of the Reservoir I am
convinced that he has much
overestimated the cost of
taking the Channel through
the Ramalapur valley, & the
Nellapur saddle. There is

no need for such high lands, nor for such a long tunnel. Therefore his figures to be very misleading, that the Project could be done for half the cost he estimates.

But the lower the lands are, the longer the tunnels will be! BS.

5. My course, prior to taking the consent of the Hyderabad Govt must first be obtained before any investigation is commenced. It appears to me desirable a similar investigation in the Tungabhadra at Nadivi recommended by the Chief Engr III Circle, & I see no reason why permission should be refused me. He states that I come here to settle the peasant lands under the Kurnool agreement; also to select for a suitable area as the price of current to the formation of the Reservoir, and he should have to pay compensation to Land & village submerged. If the are unexamined

Department.

C. No.

His Excellency The Governor.
The Hon'ble Sir Henry Bliss, K.C.I.E.
The Hon'ble Mr. Grose, C.I.E.

Subject.

3

FOR ORDERS.

Flag B

Flag C

me can then investigate
ate in the Reservoir
Bombay territory as
commended in Para 6 of
Office note of 10.1.28 &
2 (ii) of my current note.
6. I have abandoned the
near Nirpet proposed by
in January last because
gation has since shown
a very large number of
would be submerged by
Reservoir in that position
& I accept the Valapur
instead because Land
Land that the villages
be submerged are cu
bearing less & there
reported to be good

[P. W. 45.
500—27-1-18.]

to found the dam on. I cannot recommend the higher site in Bombay territory if negotiations with the Hyderabad Govt fail through. But I think the investigation of this Project will not be complete until that portion of the area has been carefully examined, which it has not been yet. More on this.

7. I proposed that Mr Lawrence should be placed in charge of the investigation under the guidance of the Collector of the Division, because I consider that the despatch of a special officer like Mr O'Connell who has nothing to do with the affairs of the country, to take up the Project, & removing him from all contact with the local officers has, & has been proved to be, a mistake, because he did not bring to further advanced the knowledge of the Project, but have a mass of typed

But who is responsible for the selection of this officer, who was entirely ignorant of the ~~duty~~ country & incapable as well? Is it not the C.E. himself?

Mr O'Connell was not allowed from Contact with the Local Officers but directed to ask them for assistance. It may only have been the case that the Surveyor Lawrence was more known

Yes, certainly Mr O'Connell's deputation has proved a mistake. Who recommended him for this work? His selection was an unhappy one —

I presume Mr C.C. has not been tried & found wanting before, but has a good reputation as Engr.

HB

C. No. 57

DEPARTMENT.

SUBJECT.

HIS EXCELLENCY THE GOVERNOR.

THE HON'BLE SIR HENRY BLISS, K.C.I.E.

THE HON'BLE MR. GROSE, C.I.E.

4

FOR ORDERS.

Col. Haddeley has had almost no experience at all in the ~~work~~ designing & execution of large irrigation works. Indeed, during almost so far has had none, for, so far as I can make out, the only Engineering he has been in executive charge of was in the Red Hills, Tank Restoration, for 27 days, for which alone was in the famine relief of 1884! Nearly all his experience has been in the P.W. Secretariat & workshops.

Mr Clark was in Sindh in 1880-81 as an asst Engr. for less than a year. Irrigation working designed or carried out there at that time by James Strachan. Since then he has been in the Secretariat or in various districts in which he cannot have obtained any experience in the designing & execution of works of the magnitude of this project.

Of Mr Lawrence I know nothing except that he is some temporary hands who has only been 2 years in the Dept & cannot therefore [illegible] because any experience.

Should the altogether contrary to custom and I venture to think to any precedent to ~~put~~ a person with the investigation of such a project, especially under the direction & supervision of superiors who have little or no more knowledge & experience than he has. Of course, if the Chief Engr for Irrigation, Sind, and ~~the~~ Mr Inspector, is the person responsible for such investigation, I anticipate better results with Mr Lawrence, I shall have more to say. But in my opinion, if further investigation of this project is to be made, it should be carried out by some such officer as Mr Pears[illegible] or Mr Mackenzie, both which we cannot touch.

I know Mr Lawrence well, & know that he knows the country to be examined well & I most respectfully submit that Mr Lawrence is the best person to look after the necessities of the case than is the Hon. Member. I am quoted in Col. Haddeley, the S.E., Mr Clark the Collr. & Mr Lawrence, Supervisor, we have a staff fully competent to place this fine Project before Govt in a thorough efficient manner. & I see no reason for giving it to any body else.

P. W. 1.
500—27-1-18

to [illegible] with regard to Mr. Mr Grose's
re [illegible] portion. I base my belief
[illegible] that water will successfully be
taken in any available portion
for cultivation in Bellary District
in the following tract
1) A large ⊗ area is already
cultivated under Dangi tank,
on practically the same soil
as that we propose to irrigate.
2) Thousands of acres lie waste
every third year in this
region owing to absence of
rains. Water will be taken
for cultivating this with dry
crops, & if it has given
free returns at first, by
flooding the black cotton soil
& bringing the salts to the
surface, that soil is thereby
as suitable as any other for
wet cultivation
3) The area of cultivation under
the Kurnul Canal is steadily
& slowly increasing year by
year, a fact for unsympathetic
unintelligent management in
past years, will be considered of

× Flag D

of us have had practical experience in carrying out the sort of work of the kind which has been & is being undertaken in this Presidency — & I may almost say, in India — and who therefore know the difficulties & the requirements of the case. This is the reason, too, that Col. Baddeley, or Mr. Clark or Mr. Lawrence were driven almost mad when they were visiting it was being driven?

HS

⊗ Between 2000 & 3000 acres, I think — more or less in this connection.

HS

Yes. See the last report on this subject.

P.S.M.

Now, but supposing the whole area commanded had been irrigated from the first, would the project would have been as remunerative financially — for it must be with the project. Let us suppose that 2 or 300 square miles in the west of Bellary Taluk are brought under cultivation & carry a population of 150

DEPARTMENT.

C. No. 9

SUBJECT

HIS EXCELLENCY THE GOVERNOR.

THE HON'BLE SIR HENRY BLISS, K.C.I.E.

THE HON'BLE MR. GROSE, C.I.E.

250000 people — will that have
not from the necessity of relief measures
the next time the rains fail FOR ORDERS.
in Adoni, Adoni & the other Talukas of
the Bellary district? Certainly not.
It must be remembered that Protective
Works are protective in the sense that
they save the crops & prevent the people from
suffering by the failure of the local rains, only
in the tract which they actually command &
in the few villages closely contiguous to that
tract. In the other parts of the districts in
which they are situated they are protective
only in the sense that they contain, or should contain
stores of food to be at hand that transport
to the places where the crops have failed will
be comparatively easy. But Bellary will be al-
ready protected in this latter sense
by the Railway which connects it with the
Kistna delta. There is no need, therefore,
it should be protected again, and consequently
no justification for spending crores
from January on a project which it is hoped
to pay — can never be made to pay more
than 1 or 2 per cent, if so much. It must
always be remembered that the 100 Lakhs
(to take the estimate) which sanguine
Engineers think, this if spent on this project,
will irrigate perhaps 100000 acres sometime
in the latter half of the 20th century
would probably suffice to irrigate 500000
acres if spent in the Punjab, & that the
Govt. of India, which has to find the money,
is not likely to consent to do so unless it is
until it can be shown that the project will
be remunerative, for as a protective work
it is, as I have shown, not needed. In my
opinion, therefore, before going further & spending
any of our poor resources and to using any of
our scanty Establishments in the preparation
of estimates for this scheme, we should do
well to state the case to the Govt. of India,
and to ask whether, if the project can

P. W. 43.
200—27-1-08.

greater than it is now. The
Canal can, of course, never
recover the money spent on
the project, but it is ridiculous to call
it a 'Canal of failure'
Times, on the contrary, are
untold blessing in 1896
& but for its presence & Cuddapah
famine in Kurnul would
undoubtedly have been
even more & intensified.
Avoid the same mistake in the
construction of the Tungabhadra
Project, the result will be an
equal, & perhaps, blessing at
reasonable cost.

9. While Bellary tanks are being
-ing to supersede the native

it can be used for second crop irrigation under the Kurnool canal where water fails annually at end of December, & very little second crop is now sown in consequence. It would also be useful to extend irrigation under the numerous channels in Bellary District.

10. I advocate this Project

11. because it is a tank to waste water which is so much needed.

(2) because storage of water is bound to lay in the long run.

(3) because, in the very scanty famine, the Head Sahib of supply no utility under maintenance, when he might concentrate all the able bodied labour on this fine project, & do a work of lasting benefit. He spent something like 70 lakhs in the Ceded Districts in the last famine, & what have we to show

be shown to be feasible for such a cut, they will give us the money to carry it out as a protective work. First, one lakh of rupees will probably be wanted. It will be a wise precaution to take counsel with the Rs? of the Chr. as to the total of the tract to be commanded being brought under cultivation. I do not know that the area commanded by the Sanji tank is said of the same class.

HS

Island available? I should say not, from the look of the map.

HS

My impression is that the C.E. for I. and P. has plenty of assistance in this Presidency himself.

HS

This very doubtful whether the line through which the Canal will run is in soil which could be dealt with by unskilled labour. It might be, no doubt, but from various details of the work could only be carried out by skilled labour.

As to the Estimate below of 100 lacs for the whole project, it is obvious that it is a mere guess, and nothing more. Mr. Dalrymple has raised Mr. O'Connell's estimate for the Canal by 60%. I don't think that he shows a proper sense of his responsibility as Chief Engr. by persuading himself that the work can be carried out for 40% less than Mr. O'Connell has estimated.

HS

57

11

DEPARTMENT.

C. No.

SUBJECT.

HIS EXCELLENCY THE GOVERNOR.

THE HON'BLE SIR HENRY BLISS, K.C.I.E.

THE HON'BLE MR. GROSE, C.I.E.

FOR ORDERS.

I fear I have not expressed my views on this project as clearly or as fully as I might have expressed them. It appears that there is in the Tungabhadra a very quantity of water running to waste through the heart of a district, specially liable to famine. It seems to me to be the duty of Govt. to make use of this water, if possible. It can not be said to be impossible to make use of it, until it has been proved to be so; and this cannot be said to any such proof, until the result of a detailed plan and estimate demonstrates the practicable impossibility. The preparation of a detailed plan and estimate

for it? Next to nothing. I believe in the case of the employment the Tungabhadra Project would be one for 100 lakhs. Whilst the Govt. of India orders extensive during most a part famine commences a [illegible] may

preparation of the necessities to meet famine, one will confer benefit in this thickly contract of and perform most [illegible] duty.

HBell

23.1.98

[P. W. 43. 500—27-1-98.]

12

estimate is what I propose. This would not be the least check before commencing the work, as Hon. Members seem to understand it. It is in fact only the first stage of many. There will be much discussion on the project before anything like final sanction can be given. The Agency for the preparation of the plans and estimate, proposed by Mr de Winton in this Note seems to me much as may be accepted.

The Periyar work is now practically complete. The time has not yet come for closing our irrigation establishments. Some new work, on a larger scale, should be taken in hand as soon as may be. The next works of this kind will probably be the Bhavani project, the two preliminaries of which will, I hope, soon be ready. What is now required is to have another big project investigated, to succeed the Bhavani project. The Tungabadra project may, I think, be favorably a suitable work of such character. That project may prove to be impossible. If so, some other project could be investigated. I hold that it is the duty of Government to see and whether the Tungabadra project is or is not practically impossible, and not to jump to a conclusion that it is practically impossible, without a thorough investigation. I would add that if the project should prove to be feasible we, it might afford suitable employment, in the event of another famine in Bellary. Two recent instances could be attached to the provision beforehand of a profitable programme for Famine works.

A.H.
27.5.98

I will not object Bhavani Project being investigated as proposed.

JG
2/6/98

During session, money spent on the further investigation of this project will be money thrown away - However this may be, nothing further should be done until the general approval of the Govt of India has been obtained & the Hon. the Chairman consulted; and in any case no special arrangements for the investigation should be made until the Chief Engr for Irrigation has been consulted as to the agency proposed to be employed - He is the responsible person in such matters & should not be set aside -

LD
3/6/98

Circ

58

PUBLIC WORKS DEPARTMENT,

IRRIGATION BRANCH.

READ the following:—

This note was received direct from the Hon. the Chief Secretary officially addressed to Circ from the Private Secretary's office It has not been sent to Sir H. Bliss, as his opinion has been awaited JCL 7/7/98

Tungabadra Reject.

FOR ORDERS.

What we should have is a rough but yet sufficiently detailed investigation and estimate to inform Govt. what the cost will be and channels would be. This investigation should be placed in the hands of the Chief Engineer, assisted by such officers of the subordinate staff as may be found necessary. I would not tie down the investigation to any particular line or channel. It may be made over the whole ground. Govt. should be told clearly and definitely that different lines are, and what channels should be made, — at what cost. After that, it will be time to entertain [illegible] the Revenue authorities

The Private Secretary's error in sending the papers direct to Mr de Winton has been pointed out by the Hon Sir H. Bliss. I beg respectfully to submit that Mr de Winton also should, in accordance with the rules of the Secretariat, have returned the papers to the Private Secretary through the Chief Engineer for Irrigation.

I only partly understand on what points my report is considered inconclusive. The full file is not at Ootacamund but the more important information contained in the absent papers has been summarized in later papers which are put up

I beg first to offer some explanation about Mr O'Connell's appointment and work. He was about to be moved from Salem to a more important division and I suggested that he should first take up this enquiry. I knew him to be experienced and expected that

he would prie me facts and a
Sober estimate, if any work was
to be taken up. He would no
doubt have done much better and
made a more complete preliminary
report, if he had not been greatly
hampered by the difficulty of getting
assistance. With regard to the errors
in his figures he was without a
~~Something must happen~~
~~to~~ clerk at the time he sent
in the report and he must have
carelessly omitted to check the figures.
I cannot agree with Mr. Deloncle
that Mr. O'Connell's mission was fruitless
Mr. O'Connell went straight to the mark
by first studying the geology and other
principal features of the river. This enabled
him to fix within narrow limits possible
sites for reservoirs and lines for channels
and to explain — which had never been
done before — why it was that the choice,
as far as concerned the Kellary district
East of the Darji Hill, was so restricted.
The site he selected for a reservoir is
probably the best on the river for any
irrigation to the east, if the difficulty
about Hyderabad territory can be overcome.
He was instructed to see whether, assuming
that the Lower instead of the Upper Kellary
Project line East of the Darji Hill were
adopted, any cheaper line than Mr Gedney's
between the reservoir and the plains Eastly
the hills could be found. He suggested as an
alternative to Mr Gedney's line from about the
17th mile that the Kamalapur bank should be
raised & puddled and a valley to the North closed
by a masonry dam. The so-called estimates in
his preliminary report are merely rough figures
intended to illustrate the report and
show how he arrived at his

FOR ORDERS.

authorities what portion of the area commanded
is likely to be irrigated, and what profit
therefrom, the work is likely to bring in.
With this information before it, Govt.
could address the Govt. of India with
some chance of being listened to. To
address the Govt. of India at this stage
would, I fear, be to court a snub.

A.94
15.7.98

I agree with H.S. that the
preparation of the
project should be completed
and a rough estimate of its
cost prepared with sufficient
accuracy to enable Govt
to decide whether it is worth
while to proceed further with
~~the~~ scheme.

H.A. 13.8.98

PUBLIC WORKS DEPARTMENT,

IRRIGATION BRANCH.

READ the following:—

FOR ORDERS.

totals and to enable me to come to
a decision whether estimates should
be made and in what lines.
Having sent in his report he had to
await my orders which I could not
give until I had seen the place.
Having inspected it I came to the
conclusion that it would be taking
too great a risk to recommend the
raising of the Kamalapur Bank to hold
70 ft of water and reserve the
reservoir, which this and the dam
in the other Valley would form,
would cause much loss of water through
evaporation and would be perfectly
useless as a reservoir, since they would
have to be kept full in order that
water should flow through the sluice
under the Kotapur Saddle. The
alternative was Gedney's line or
some line very near it. The channel
on this line had been estimated
in great detail, though [illegible]

he would give me [illegible]

Sunk at short intervals and Capt. (Conolly/Connell) [illegible], with the [illegible] which characterised all his work, had gone over the whole line and revised the estimate. His estimate, with necessary additions for rise in rates, is not unlikely to be far wrong. Whether anything would be saved by taking the line in lower ground with the accompanying disadvantage of an increased length of tunnel cannot be determined without comparative estimates. The channel was designed for 150,000 acres. That which formed the subject of the Irrigation Chief Engineer's note printed with G.O. No. 582 I. of 29 Oct. 1889 is a smaller channel to irrigate 20,000 acres west of the Durgi hills and 30,000 east of them. Mr. Walch considered that the channel would cost at least 60 lakhs and no one could say how much more. It does not appear how the large area east of the hills was arrived at. [illegible] whatever there is can be irrigated comparatively cheaply and easily [illegible] hills is [illegible] [illegible] [illegible] As to the prospects of irrigation [illegible] of the hills [illegible] Govt. will perceive from [illegible] report which in the latest [illegible] Mr. Russell's report [illegible] information we have. Colt. O'Connell's [illegible] estimate [illegible] further reservoir are of [illegible] the height of dam necessary [illegible] [illegible]

FOR ORDERS.

... Mr. Russell's report ... flagged E

+ flagged N

PUBLIC WORKS DEPARTMENT,

IRRIGATION BRANCH.

READ the following :—

FOR ORDERS.

[illegible] altered in the manner sketched in my note. If I had detected Mr. O'Connell's mistake in calculation I [illegible] have largely increased my es[timate]. A difference of a few lakhs in [the] estimate of the dam does not make [m]uch difference in the total estimate. It was the cost of the channel which decided my recommendation. The Govt. of India and Secretary of State cannot be expected to sanction more than one work like the Kurnool Canal. The project is not at all impracticable as an engineering work. The objections to it are [pur]ely financial and as they have been [s]tated pretty fully by the Hon. Sir H. [Bl]iss I need add nothing.

If Govt. desires that the investigation should be re[sum]ed what has first to be done is [to] ascertain what area ~~will~~ would be protected and is likely to be irrigated [sou]th of Mr. Gordon's Lower Bellary Project line between Metri and the Ha[gari]. Until this is done no estimate [of an]y value can be made for a reservoir [or] channel.

I beg to bring to [the] notice ^of Government that my report con[cer]ns the irrigation only

^ The information already available is sufficient to show that the irrigation of an area of 30000 acres east of the hills would cost probably Rs 200 per acre. The maintenance charges would probably be Rs 1½. These figures would probably be reduced to Rs ~~100~~ 125 and Rs ~~¾~~ 1 for an area of ~~300,000~~ 150,000

for portion of the Bellary district and has nothing to do with the general question of utilizing the Tungabudra water. In my opinion time will, in course of time be ample use for receivers but I doubt whether the time for projecting them has yet come. When the Kurnool Canal has become fit to carry the 8 ft. supply for which it was designed it will be possible to supply a large area in Cuddapah for 9 or 10 months a year and possibly send some into the Penner for nellore. Again in the Kistna Delta there is still some waste land but when that is taken up and population has increased sufficiently to bring pressure on the land there should be a demand for water for second crops. There is now only 1 per cent of double crop land against over 20 in the Godavari. There is also a certain irrigable area in Bellary west of the Durgi Hills. All these extensions must be taken into consideration together if possible as it would be inadvisable to have any but very large reservoirs. Small ones on such a river would soon silt up. Perhaps the Rev. Supt might be asked to give a general expression of opinion on the matter, judging from past experience it would take a good many years to do anything substantial.

16.6.98. W.H.
Joint Secy & Chief P.W.D.
Irrign Branch.

FOR ORDERS.

because the Kistna does not supply water for a second crop
M.V.

E.I. Form No. 4—100—16 9-96.

PUBLIC WORKS DEPARTMENT,

IRRIGATION BRANCH.

61

H. E. the Governor

READ the following:—

Tungabudra Irrigation Investigation

FOR ORDERS.

In accordance with the views & remarks on the accompanying notes × the site for a reservoir on the Tungabudra, selected by Mr. O'Connell, having been found suitable (indeed a more suitable one I have never seen); further investigation is to be undertaken & more reliable estimates are to be framed of the probable cost. The question now arises, in what direction are we next to turn?

Since the year 1857 reports without end & estimates to any amount have been made & with what result?

× received Ry'me on 13th/8

Flags A.B., C.D.E.F.H.

It is not for the C.E. Irrigation to make critical remarks on the orders of Govt., but to carry them out. The line adopted in this Note is improper.
Mr. W. Lawrence writes that with one exception all the irrigation did, he investigated, did him forward this file to Mr. Winter for his opinion and recommendation on these points.

A.H. 24.8.98

(2)

of a portion of the Bellary district
and has noted [illegible]
gau[illegible] Sir de Lawton-Lay feels that
In[illegible] the Cauvery Delta cannot be
th[illegible] Cauvery Delta [illegible] painted
u[illegible] out by Lieut. Shenton he
a[illegible] examined. This had already
[illegible] examined.

[illegible] as we
the Delta of Tanjore, [illegible] (3)
being too low, even the Kings
and found to afford too
small a capacity
[illegible] that
[illegible] Hills east of the Cauvery and employed
for same time as the
the results were pretty similar
to those marked [illegible] by Mr O'Connell
at Balabalur. is a
reservoir, of an area of
watershed, out of all
proportion to the amount of
water stored. This is a most
important factor, which
has not yet been commented on,
for it means, an enormous
loss from evaporation!
The reservoir four miles East
of Hesketh would also have
an area of some 60 sq miles.
taking a mean area of
50 sq miles, the Annual
loss from evaporation

x sufficient to irrigate
48000 acres

would be 9700 millions
of C feet, or a net ⅓ the
total content of the reservoir!

(4) I beat another site investigated some four miles above Kamplee just where the river leaves the Hills, it looked a promising site. but turned out much too small for a reasonable height of dam (60 feet).

(5) Sir de Lawton must suggest then, to re-fasten up the river, it only says again our old remark: the whole subject has been thrashed out years ago in connection with the Kurnool Canal as the accompanying memorable will show. (page 37)
flagged m.
It will be noticed that any other possible sites are either in Mysore or Bombay I were all condemned for one reason or another.

(6) In the face of foregoing facts

it seems almost superfluous to
discuss further, the questions of
Establishment for investigation, or the
possibilities of Irrigation.
But in regard to the former it may (7)
be remarked, that to make a
detailed examination of the
River would take the Executive Engineer
away from his legitimate duties
for probably a couple of months.
Mr Laurence tho' an excellent man
in his way, could not be entrusted
to originate schemes & for a
simple Project that he marked
out, his details were very defective,
& would all require revision, were
the work to be started. × × ×
In regard to Irrigating Bellary (8)
even were a Project feasible my
conviction is that it would never
come off. The fractional increase
of wet crop on the Hurnool Canal
form no criterion. Of course
under the Hurnool Canal, in bad years
water would be taken for dry crop.
The case of the Daroji Tank in Bellary
instanced by Mr Le Hunte, actually
points in the same direction, for this
Tank could irrigate two or three times
its present ayacut. if the people
cared to do so. The Danayakankoke
Tank, on the South side of the Sandur
range is another instance.
Anyone who has been along (9)

FOR ORDERS.

× × × Consequently if further inquiry & trials are to be carried out a special staff should be nominated

E.I. Form No. 4 (a)—500—14-4-93.

(2) 63

PUBLIC WORKS DEPARTMENT,
IRRIGATION BRANCH.

READ the following:—

FOR ORDERS.

the Hurnool Canal cannot
have impressed the thousands
of acres extending right
up to the Hurnool banks
& commanded by an ample
head of water, without
the smallest attempt being
made to cultivate wet.
along reaches of the canal
too, where the supply is
ample.
(10) I have quite recently issued
instructions on the details
for the extension of the
Chaidheer Channel (taking
off from mile 171/6)
the channel will command
8000 acres. but it remains
to be seen how much will be
cultivated wet. Some of

FOR ORDERS.

the land is already supplied with water, but as I saw last February, Gingelly & other dry crops were all in ruin. With examples like these & others that might be quoted I cannot believe in Irrigation in Bellary. Even were a suitable site (11) for a reservoir selected, which we now have ample evidence to show, cannot be done, there still remains the Channel to convey the water to the Bellary plains. If in this connection I would invite special attention to Mr Walker's Public note on the subject printed with GO No 521 I of 29/10/89. which forms one of the few accompaniments to this note.

Flag. N.

J C R
9.

Canl Sattyamangalam
24/8/98

E. I. Form No. 22—2,000—8-8-96.

GOVT. OF MADRAS. } 189 . { P. W. DEPT.

CHIEF ENGINEER FOR IRRIGATION.

Madras, 189 .

OFFICE NOTE No.

Circulation Register.

To	From	Despatch Date.	Receipt Date.
F to	EI		
		2/8	2/8

KEEP-WITH.

No. , dated 189 .

The Valmapur site has been condemned, but it has not been investigated by Mr O'Connell, and requires further inspection. The Nadiri site has nothing to do with this question. It refers only to the supply to the Kaunol canal - The site is under Kaunol & not subject to heavy Cm - demned, I believe, because the Madras Government

Please see accompanying note re Lemabhanam Investigation & P & E's order. As I mentioned the around the Balancher site is practically Condemned in light of remarks regarding other sites I feel a difficulty as to what we should do next. I am sending a short note to P & E explaining

that criticism was not quite foreign to my meaning & that my remarks on Irrigation in Bellary were merely my individual opinion after some experience of the Presidency.

If G O can indicate, for future guidance, the impropriety of the remarks noted by H E, in the note he will kindly do so.

J.C.L
27/8/98

privileges it would not be wise to withdraw.

Results of the investigations ordered by the late Govt

Ld III. I should now direct Ld III to examine carefully the whole river system within the limits of the Bellary District from Hospet upwards, in conjunction with the Ld Sup Bellary Div & submit a report in the manner & to the extent which they consider it possible to form a reservoir site & descriptive account, accompanied by a map of the district, of each site, of the country through which a channel would have to be led, & the report should be accompanied by an expression of their opinion on the best site to be adopted & reasons. The next step can then be decided upon. The Ld should be told that Govt is most anxious to find such a site, & that the investigations should be conducted in a sympathetic & not obstructive spirit

29/8/98

x & Mad. & Bom. Govts in connection with the Tungabhadra Project.

H.S. is most anxious to find a method of utilising the large amount of water now running to waste in the Tungabhadra, & is chief talukdar with a very unfavourable opinion of any spirit of seeming obstruction in that proposal.

o. 4—200—14-4-93.

PUBLIC WORKS DEPARTMENT,

IRRIGATION BRANCH.

XII 65

H E the Governor.

READ the following:—

Tungabhadra Irrigation Investigation.

FOR ORDERS.

Referring to His Excellency's remarks on my previous note on this question, I beg most respectfully to explain, that anything in the shape of criticism, was quite foreign to my intention & I can only most earnestly repeat that any note could have carried such a meaning.

I was most anxious to bring to notice information which had been gained subsequent to the submission of the papers to Government, in the form of investigations

x It is not for the CE brig to make critical remarks on the orders of Govt, but to carry them out. The terms used in the note is improper. As the Learning asks what site & channel should be investigated, let him forward the file to the Collector, for his opinion thereon in connection with his remarks on this point. CC

Signed H E H
24-8-98

Seen
B.24
30.8.98

Record

of these proposed Railways
Sites; carried out after
her O' Connell's report
had been submitted &
the Gentlemen regarding
Sites, on the other Longobardia,
contained in the Memorandum
on the Grand Canal.

The remarks on the
treatments of Irrigation
in Bellary — I ventured
to offer merely as my
individual opinion, and
the impression that it
was my duty to do so,
after so much experience
in most parts of the Presidency.
The Rates will now be
considered, in consultation
with Sir Le Hunter, as
recommended by His Excellency.

J C C

7/10/05.

Ag. Jt. Secy to Govt
P.W.D. J. K.

66

(68)

be found necessary -
the investigation may be
made over the whole ground
and it should be clearly
and definitely reported
Government what different
routes are, what changes
would be made and at
what cost -

The Chief Engr for Irl
Supt Engr III Circle
Ex Engr "
Asst Engr "
Chief Engr P.W.D.