NOTE ON AMRENG IRRIGATION PROJECT (MEDIUM) OF KARBI ANGLONG AUTONOMOUS TERRITORIAL COUNCIL, ASSAM FOR CONSIDERATION OF THE ADVISORY COMMITTEE ON IRRIGATION, FLOOD CONTROL AND MULTIPURPOSE PROJECTS

Items	Original Project Cost (as approved by the Planning Commission)	1st Revised Project Cost (Not approved due to deficiencies)	Fresh Proposal submitted in March, 2019 (proposed)	Finalized/ Appraised by CWC
Estimated Cost	Rs.61.54 crore (PL 2000-01)	Rs. 96.967Cr (PL 2008-09)	Rs. 1045.04 Cr (PL:2015-16)	Rs. 540.4585 Cr. (PL: 2019-20)
CCA	6800 Ha	6800 Ha	6800 Ha	6800 Ha
Annual Irrigation/intensity	10880 ha/ 160%	10880 ha/160%	14076 Ha/207%	10450 Ha/ 153.7 %

1. INTRODUCTION& BACKGROUND

The Amreng Irrigation project was incepted after preparation of Feasibility Report by WAPCOS in 1999. The project was planned as a Diversion scheme. Intake from Amreng River was proposed through a concrete uncontrolled head regulator with sloping apron. Based on the inputs provided in the Feasibility Report, Irrigation Department, KAAC, Assam prepared a DPR for the project and was accorded administrative approval for the project in 1999. Further, the WR division of Planning Commission recommended 'Amreng Irrigation Project' in Karbi Anglong District' with an estimated cost of **Rs. 61.54 crore** for funding under Non-Lapsable Central Pool of Resources (NLCPR) vide their letter No. 12(10)99-WRVol.IV dated 20/03/2001**.** Subsequently, **Rs. 12.00 Crore under NLCPR and Rs. 4.5 Cr. under State Plan** were released.

The proposal recommended by Planning Commission envisaged tapping of Amreng River by constructing a **80 m trough type weir**& a head regulator (without gates) at Sansika to divert a design discharge of **8 m^3/s** into the 24 km long main canal and a network of 55.5 km of 7 branch canals and 7 distributaries for irrigating a **CCA of 6800 Ha.** Works of Survey, Construction of off-take head regulator, Construction of 6 km of main canal, 1 Canal Fall, 14 Cross Drainage works and other minor structures were executed with the released funds till 2004.

After a gap of about five years, the DPR of the Amreng Medium Irrigation Project having the same components with 1st revised estimated cost of **Rs. 96.9665 Cr (PL: 2008-09)** was submitted to CWC in 2009. In-principal approval of certain directorates and observations of

various specialized directorates of CWC were conveyed to the project authority and as compliance to the observation communicated were not submitted by the project authorities within prescribed time limit as per CWC's Guidelines, **the project was deleted from the appraisal list of CWC in April 2017**.

2. Original Project Proposal & already executed works (Estimated Cost: Rs. 61.54 Cr.)

The main components of the project as originally proposed were a Trough Type Weir of length 80.00 m at Bed level of 102.50 m at Sansika to divert a design discharge of 8.00 cumec in the main canal; a head regulator, located on the left bank of Amreng river with a design capacity of 8.00 cumecs; Canal system consisting of main canal of length 24.00 Km. along with 7 Nos. of branch canal, 7 distributaries&7 Nos. minors. The total canal length including that main canal was 79.50 Km. The main canal for a length of 5.00 Km was proposed to be lined and the rest was proposed to be earthen and bridges, culverts, fall, cross drainage works etc as per site requirement.

With the financial assistance of Rs 12.00 Cr. from NLCPR and Rs 4.50 Crore from Govt. of Assam, following works of the project were executed upto 2004.

Sl. No	Name of works executed upto 2004	Expenditure (Rs in Lakhs)
1	Survey of Command Area	60.00
2	Construction of off-take Head Regulator	356.40
3	Approach Road	50.00
4	Construction of Main Canal Ch 70 M to Ch 1270 M with rocky mass	492.41
5	Construction of Main Canal Ch 1270 to Ch 6000 M	390.50
6	C.C fall (1 no.)	49.05
7	Cross Drainage Works (14 nos.)	73.33
8	Inlet Structure for tapping natural streams (3 nos.)	10.02
9	RCC Slab Culvert (7 nos.)	84.07
10	Building with fencing	67.00
11	Plantation	2.00
12	Jungle clearance	7.69
13	Maintenance during execution	10.00
	Total:	1652.47

The Project Authority submitted a revised proposal with different components having an estimated cost of **Rs. 1045.0398 Cr (PL: 2015-16)** in March, 2019.As per the submitted DPR, the already executed work, tabulated above is not being utilized in the present fresh proposal.

3. PRESENT PROJECT PROPOSAL (ESTIMATED COST: RS. 1045.0398 CR (PL: 2015-16)

The proposal submitted in March, 2019 having the same name i.e. Amreng Irrigation Project as originally approved by planning commission but different components and not utilizing the executed works already completed. In the present proposal the main components include, construction of **110.5 m long Concrete Barrage across** river Amreng consisting of 6 Nos. gates each of size 15 X 3.3 m at bed level of 104.00 m at Sansika village to divert a design discharge of **8.00 Cumecs** to the main canal; a head regulator located on the left bank of Amreng River with a design discharge capacity of **8.00 cumecs**; Canal system consisting of main canal having a length of 24.00 Km along with 7 Nos. branch canals and 5 distributaries with a total canal length of 62 Km. The main canal for a total length of 24.00 Km. is proposed to be lined and the rest is proposed to be earthen canals and bridges, culverts, fall, cross drainage works etc. as per site requirement.

Amreng River originates near Jongphull village in West Jaintia Hills District of Meghalaya State and traverses a distance of about 42 Km before it enters West Karbi Anglong District of Assam and then further traverses a distance of 80 Km before it out falls into the river Kopili which is a tributary of River Brahmaputra. An Index map of project is placed at **Plate-I.** As intimated by the project Authority, a total of 19 villages namely Ampather, Matikhola, PriloBasti, Langmepi, LangthaBasti, Philangpi, Chengbong, Rikamnigham, Kheroni, Langparpam, Thessobil, Nihangbasti, Thenglong, State Mechanical Farm, Kheroni, Baplong, Bakbey, Jenkha, Mukhimgaon and Rongchupi are getting benefitted from the scheme.

As the command area of the project exists at a lower level than bed level of the river (50 m approx) and the longitudinal profile of the river is very mild, originally it was proposed to construct a trough-type weir for diversion of water to the canal. During execution till 2004, No weir was constructed at the project site, however, by giving reason of sedimentation near its mouth, project authorities proposed to construct a barrage across the river (in place of trough type weir) and a new head regulator for controlling flow in the canal. Though, GCA& CCA of the project remain unchanged, the canal alignment and location of the canal head regulator have been changed.

A total of 9 currently ongoing Surface Minor Irrigation (SMI) Projects are existing within the command of Amreng Medium Irrigation Project. The total area being irrigated through these

SMI schemes funded under PMKSY-HKKP is 2173 Ha with an overall estimated cost of Rs. 47.78 Cr.

The salient features of the project are given at **Annexure-I** and the project components are shown in the **Index Map** enclosed at **plate-I**.

4. HYDROLOGY

The Hydrological aspect of the project has been finalized by CWC. The 75 % dependable water yield based on observed flow discharge at Lower Kopili Dam from 1998-99 to 2009-10 is **421.24 MCM**. One in 50 years return period flood as design flood and Standard Project Flood as Check flood are**2815 m^3/s** and **4330 m^3/s** respectively. The copy of the approval by CWC for yield series& Design Flood is appended at **Annexure-II.**

5. IRRIGATION PLANNING

The irrigation planning aspect has been finalized by CWC. The total cultivable command area of the project is 6800 Ha. The cropping pattern and cropping calendar have been submitted by project authority with approval/ counter-signature of District Agricultural Officer. The total irrigation demand for the project is 64.32 MCM (26.36 MCM in Kharif; 20.07 MCM in Rabi; 16.73 MCM in Hot weather and 1.16 MCM for perineal crops). The success rate for the project has also been checked for the project with respect to the water demand and water availability, the project succeeds a total of 9 times in 12 years giving a success rate of 75 % which is minimum requirement as per prevailing guidelines and hence the same is acceptable. The copy of the approval letter of CWC finalizing the cropping pattern, water demand and success rate is enclosed at **Annexure-III**.

6.0 INTER-STATE AND INTERNATIONAL ASPECTS:

Around 33 % of the catchment area falls under the territory of Government of Meghalaya. Govt. of Meghalaya has accorded No objection for construction of **TROUGH TYPE WEIR ONLY** and with a condition that no objection shall be raised by Government of Assam for future projects proposed upstream on River Amreng by Government of Meghalaya and the same is attached at **Annexure-IV.1.** The approval of CWC conveying clearance of Interstate aspects is enclosed at **Annexure-IV.2.**

The project lies in Brahmaputra basin which is an international basin and shared by India, China, Bhutan and Bangladesh. The clearance of DoWR, RD & GR (erstwhile MoWR) from international angle is enclosed at **Annexure-V.**

7.0 ENVIRONMENTAL AND FOREST CLEARANCE:

It has been certified by project authority that No forest land is involved in the construction of this Project. Further, No Environmental Clearance has been taken for the project by any committee of the Centre/ State/ Council.

8.0 REHABILITATION & RESETTLEMENT ASPECTS:

It has been certified by the project authority that Due to construction of the Amreng Irrigation Project, no population is affected and R&R plan is not required. The project falls under tribal area and since no displacement of tribal people is there, hence no clearance from Ministry of Tribal Affairs has been taken for the project.

9.0 APPRAISAL OF DESIGN ASPECTS BY CWC:

As CDO does not exist in the state of Assam/ KAAC, the canal design aspect of the project has been vetted by CWC. The approval of CWC for the canal design aspect is **Annexed-VI**.

Structural Design of Barrage & canal head regulator may be taken up at the pre-construction period. The Hydraulic design of Barrage and Canal Head regulator has been vetted by CWC and the approval letter is attached as **Annexure-VII**.

The Gates Design Aspects have been vetted by CWC and its approval after incorporating certain observations is attached as **Annexure-VIII**.

10.0 COST ESTIMATES:

The present proposal, having barrage and revised canal alignment without utilizing the already executed works (main & canals and associated structures) has been vetted by CWC. The cost of the project inclusive of the cost of existing & ongoing Surface Minor Irrigation projects funded under PMKSY-HKKP withing the command of the project have been finalized as Rs. 540.46Cr.Out of the total cost works corresponding to Rs. 67.467 Cr. has already been executed The approval letter of CWC is enclosed as **Annexure- IX.**

11.0 BC Ratio:

The pre- & post project yield per hectare and cost of produce have been submitted by project authority duly approved by district agricultural officer, Karbi Anglong District. The cost of drinking water considering 10,000 people and 68 lpcd as water demand has been adopted as 2

paisa per liter. The benefit cost ratio of the project works out to be 2.32:1 at 10% interest on Capital Investment. The approval of CWC along with computation sheet showing the benefit cost ration for the project is **Annexed- X**.

12.0 Certificates as per Check List:

As per prevailing guidelines for submission, appraisal & acceptance of Irrigation & multipurpose projects, 2017 a check list for DPR submission along with certificates has been recommended. Certificate on preparation of DPR, mode of construction, survey & investigation, cadastral survey and certificate on sharing of information to co-basin states have been submitted duly approved/ countersigned by the competent authority.

Certificate on Geological Exploration, rock/ soil mechanics testing, suitability of available construction material, Ground Water Aspects, site specific seismic design parameters, existing crop pattern & productivity pre & post project, aspect on statutory clearances from MoEFCC have been submitted but are not approved/ countersigned by the competent authority as per the prevailing guidelines. The deficiency is submitted documents have been repeatedly conveyed to project authority during meeting discussions as well in letters. If the documents duly countersigned by competent authority are submitted by project authority, the same shall be appended with the TAC Note.

All certificates/ Appendix- A to M as per guidelines submitted by project authority are enclosed as **Annexure-XI**.

13.0 RECOMMENDATIONS:

The broad technical and economical aspects of the DPR of the project, as per the guidelines have been scrutinized in the Central Water Commission. The scrutiny is based on the data, assessment, certificates& statements presented in the report and information / clarifications, received as compliances to the observations/ stated by project officials during meetings. It has been assumed that the data and information furnished are accurate and have been collected reliably by the project authorities, from the dependable sources and/ or after carrying out detailed surveys and investigations as presented in the report. The cost of the project has been finalized as **Rs.540.4585 crores** at **PL 2019-20**, with Benefit Cost Ratio of 2.32, which is greater than 1, the above B.C ratio is acceptable.

The following certificates from the competent authority shall be required

(i) Environmental Clearance

(ii) Certificate from competent authority for No forest land involvement and competent authority for no displacement of tribal population i.e for Forest Department and Tribal Affairs Department

(iii) Geological exploration from GSI/ agency accredited by GSI

(iv) Rock/ soil mechanic tests from CSMRS/ agency accredited by CSMRS

(v) Quarry area and construction material qualitative and quantitative suitability by CSMRS/ agency accredited by CSMRS

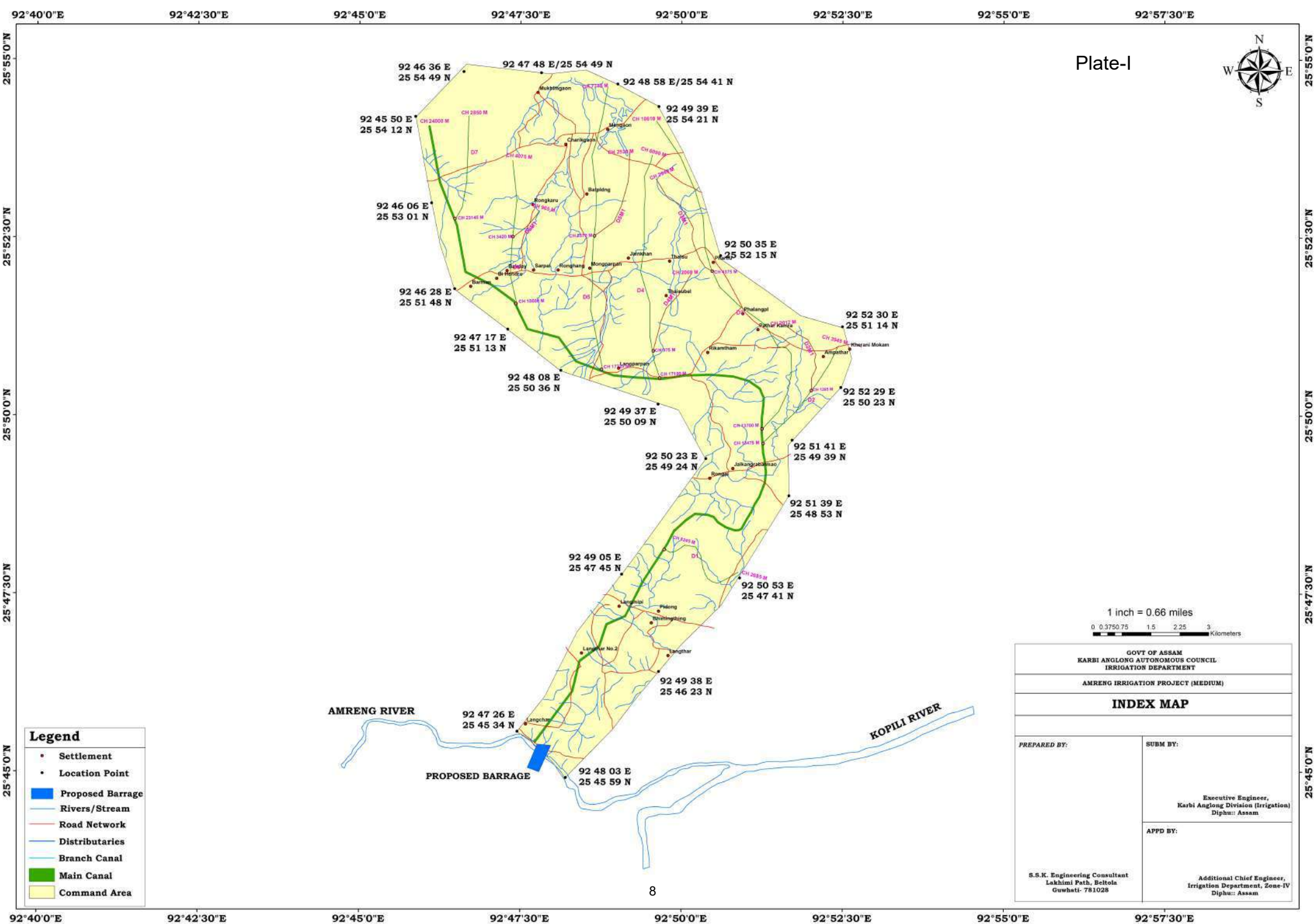
(vi) Aspect of water-logging and depletion of ground water by CGWB

(vii) Aspect of yield, rate and expenditure on cropping pattern by Director, Agriculture Deptt.

(viii) Certificate of submission of seismic study report to National Committee on Seismic Design Parameters (NCSDP). for site specific seismic design parameters countersigned by Director, FE&SA Dte., CWC, New Delhi

In light of the facts mentioned above and certificates required the Amreng Irrigation Project (Medium) is found to be techno-economically viable and is put up for consideration of the Advisory Committee subject

Plate-I



GOVT OF ASSAM
KARBI ANGLONG AUTONOMOUS COUNCIL
IRRIGATION DEPARTMENT

AMRENG IRRIGATION PROJECT (MEDIUM)

INDEX MAP

PREPARED BY:	SUBM BY:
S.S.K. Engineering Consultant Lakhimi Path, Beltola Guwhati- 781028	Executive Engineer, Karbi Anglong Division (Irrigation) Diphu:: Assam
	APPD BY: Additional Chief Engineer, Irrigation Department, Zone-IV Diphu:: Assam

Annexure-I

SALIENT FEATURES

The following salient features (and and others) as applicable to the project, shall be furnished

1.	Name of the Project	:	Amreng Irrigation Project
2.	Type of Project	:	Irrigation (Irrigation or Multipurpose)
3.	Location	:	The proposed location of headworks is Latitude 25.7567^{o}N and longitude 92.7934^{o}E
3.1	River Basin	:	
	a) Name	:	Brahmaputra
	b) Located in (i) State (s)	: :	 Assam & Meghalaya (Catchment area)
3.2	River / Tributary	:	Amreng/ Kopili
3.3	State (s) / District (s) / Taluka (s) or Tehsils in which following are located	:	
	a) Headwork	:	Hamren Civil Sub-Division of Karbi Anglong District
	b) Command Area	:	Karbi Anglong District, KAAC, Assam
3.4	Name of village near the Head works	:	Sansika
3.5	Location of Head-works	:	
	a) Longitude	:	$92^{0}47'50''$
	b) Latitude	:	$25^{0}45'10''$
	c) Lies in Earthquake Zone No.		V(Five)
3.6	Project area reference to	:	
	a) Degree Sheets	:	83 C/B
	b) Index Plan-Enclosed	:	Yes

Access to the Project

	Name	Distance from project site
a) Airport	Gopinath Bordoloi	190 KM
b) Rail head		30 KM
c) Road port	Lanka	30 KM
d) River port	Lanka	30 KM

4. International / Interstate aspects of the project:

a)	Catchments area of the basin	:	777.00 sq.km.
b)	State-wise / country-wise details of catchments area	:	253.00 sq.km. in Meghalaya 524.00 sq.km. in Assam
c)	Submergence due to projects	:	No significant submergence
d)	Water allocation for the state (if any) / country	:	Pro-Rata to Catchment Area & Rainfall
e)	Water allocation for other states/countries	:	Pro-Rata to Catchment Area & Rainfall
f)	Committed utilization	:	No project is existing/ proposed upstream or Downstream of the Amreng river. However, Government of Meghalaya in conditional NOC has stated that Assam should not have no objection for construction of project on River Amreng in Future.

g) Proposed annual utilization by the project

i)Irrigation

- Kharif	:	26.36 MCM
- Rabi	:	20.07 MCM
- Perennial	:	1.16 MCM
- Hot weather	:	16.73 MCM
- Total	:	64.32 MCM
ii) Water Supply	:	0.24 MCM
Gross annual utilization {sum of (i) to (v)}	:	64.56 MCM

h) Minimum agreed/proposed in the river for maintaining ecology : No study has been conducted

5. Estimated life of the project (years) : 50 years

6. Irrigation (ha)

	By flow	By lift
a) Gross command area (GCA)	8500 Ha	NIL
b) Culturable Command area (CCA)	6800 Ha	NIL
c) Area under Irrigation (break up)	6800 Ha	NIL

i) Kharif	:	5200 Ha
ii) Rabi	:	3750 Ha
iii) Hot weather	:	1450 Ha
v) Perennial	:	50 Ha
vi) Gross irrigated area (GIA) **	:	10450 Ha
vii) Intensity of irrigation $\frac{\text{(GIA X 100\%)}}{\text{CCA}}$	:	153.7 %
viii) District (s) Benefitted (if the district benefitted is predominantly tribal is predominantly tribal or drought prone, it may be so indicated against each district	:	Karbi Anglong District (Tribal district 6th schedule area)

** Irrigated area under Khariff, two seasonal, perennial, Rabi and hot weather shall be indicated

a) Cost per hectare of CCA	:	7.95 Lakh/ Ha
b) Cost per hectare of gross area irrigated	:	5.17 Lakh/ Ha
c) Cost per 1000 cum of water delivered at the (Canal head/outlet)	:	7.59 Lakhs/1000 cum

7. Flood Control

There is no component of flood control

8. Navigation

There is no component of navigation.

9. Water Supply

Domestic

a) Names of towns / villages served :Ampather, Matikhola, Prilo Basti, Langmepi, Langtha, Philangpi, Chengbong, Rikamnigham, Kheroni, Langparpam, Thessobil, Nihangbasti, Thenglong, Kheroni, Baplong, Bakbey, Jenkha, Mukhimgaon, Rongchupi

b) Size of population served : 10,000 Nos. (approx.)

c) Quantum of water made available (Cu.m.) : 0.24 MCM

d) Quantum of water per capita (litre) : 68.00 lit (capita/day)

10. Project Performance

	Period of Simulation	No. of failure
a) Irrigation	**1998-99 to 2009-10**	**3**

11. Hydrology

11.1 Catchments

11.1.1 Catchments area at headwork site (sq.km.)

a) Gross : 777 sq.km.

b) Intercepted : NIL

c) Un-intercepted : 777 sq.km.

d) In the State of Assam : 524 sq.km

Note : In case of downstream weir/barrage regulating the supply to the canal (s) similar details shall be furnished for the catchments between head works and the weir/barrage.

11.1.2 Catchments area classification according to mode of precipitation (sq.km.)

a) Rain fed : 777 sq.km.

b) Snow fed : NIL

11.2 Precipitation

11.2.1 Catchments

	Rainfall(weighted average)		Snowfall (mm) Annual
	Annual	Monsoon (Apr- Oct)	
a) Average	1362	1278	0.00
b) Maximum	1909	1790	0.00
c) Minimum	758	711	0.00
d) Co-efficient of variation	21.68	27.83	--

11.2.2 Command

	Cropping Season			
	Annual	Kharif (June-October)	Rabi (November-February)	Hot (March-May)
a) Average	444.5	317.4	74.3	52.8
b) 75% dependable	421.2	300.7	70.5	50.0

1.3 Annual yield calculated at the proposed site (MCM)

		Gross	Net
a)	Maximum	788.6	514.5
b)	Minimum	577.4	376.7
c)	Average	681.3	444.5
d)	Dependable (per cent)	Annual	Monsoon (Apr-October)
	i) 50	427.3	344.7
	ii) 75	421.2	339.7

11.4 Climatic Data (Command) : Rainfall data adopted from 2.5^o x 2.5^o daily gridded data provided by IMD

11.5 Utilisation within the State (Mm^3) – No existing utilization.

11.5.1 Water availability (State's share in case of Interstate River)
Net water availability accounts for the State Share. NOC for construction of trough type weir has been obtained from Meghalaya.

11.5.2 Committed Utilisation : NIL

11.5.3 Proposed utilization by the project

a) Irrigation

i) Kharif	:	5200 Ha
ii) Rabi	:	3750 Ha
iii) Hot Weather	:	1450 Ha
iv) Perennials	:	50 Ha
Total	:	10450 Ha

b) Water Supply : Approx 10,000 persons in 19 villages and cattle.

11.7 Floods near the head work site : NA

11.7.1 Design flood (m^3/s)
a) Weir / Barrage : 2815 m^3/s

11.7.2 River flows (minimum observed) :
a) Water level (E1-m) : Actual level data is not available
b) Discharge (m^3/s) : Observed discharge not available
c) Months of 'nil' flow, if any : It is reported to be a perennial river.

12 Barrage :
Longitude : $92^0$47'50''
Latitude : $25^0$45'10''

12.1 Location with respect to dam, if any : NA

12.2 Length (m) : 110.5 m

12.3 Spillway bays :
a) Total length (m) : 110.5 m
b) Full Pond Level (E1-m) : 116 m
c) Maximum water level (E1-m) : 116 m
d) Maximum height of spillway crest : 14.09 m

above deepest foundation (m)

e)	Length of bay (m)	:	90 m
f)	Crest level (E1-m)	:	104 m
g)	Number of gates	:	6 Nos
h)	Type of gates	:	Fixed wheel vertical lift
i)	Size of gate (mxm)	:	15 m X 3.3 m
j)	Type of energy dissipation arrangement	:	Continuous Concrete Block
k)	Maximum discharging capacity (Mm^3)	:	2815 m^3/s
l)	Tail water level (E1-m)	:	
	i) Maximum	:	114.5 m
	ii) Minimum	:	103.75 m
m)	Type of hoisting arrangement and its capacity	:	Rope drum hoist 20 t. capacity

12.4 Under Sluice Bays : Two (2)

12.5 Guide bunds / afflux bunds

		Left side		Right side	
		Length (m)	Top level (E1-m)	Length (m)	Top level (E1-m)
a) Afflux/ Guide bunds					
Upstream	(i)	1360 m	116 m	1360 m	116 m
Downstream	(ii)	1000 m	112.25 m	1000 m	112.25 m

13 Head Regulator (s)

		Left side	Right side
a)	Total length (m)	37.2 m	NA
b)	Height above deepest foundation (m)	3.5 m	
c)	Length of bay (m)	11.5 m	
d)	Sill level (E1-m)	104.50 m	
e)	Number of gates	2 Nos	
f)	Type of gates	Vertical lift	
g)	Size of gate	3.5 m X 3.5 m	
h)	Number of silt excluder bays	Nil	
i)	Type of energy dissipation arrangement	-	None
j)	Type of hoisting arrangement and its capacity	-	Rope drum hoist

14. Canal System

14.1	Main canal (Name)	:	Main Canal
14.1.1	Purpose of canal (Irrigation/Power/ Navigation/Diversion/Water Supply/ Multipurpose	:	Irrigation/ Water Supply
14.1.2	Type		
a)	Flow / lift	:	Flow
b)	Lined-unlined	:	Lined
c)	Discharging capacity of the channel above which lining is	:	8 m^3/s

proposed

d) Type of lining : RCC/ CC lining

14.1.3 Design data

a)	Length (km)	:	24.0 km
b)	Full supply depth at head/tail (E1-m)	:	1.9 m (head) & 0.6 m (tail)
c)	Bed width at head/tail (E1-m)	:	0.75 m (head) & 0.25 m (tail)
d)	Side slope at head/tail (E1-m)	:	1:2
e)	Bed slope (range)	:	1:2500
f)	Maximum discharging capacity at head/tail (E1-m) m^3/s)	:	8 m^3/s at head/ 0.2 m^2/s at tail
g)	Total number of canal structures *	:	377 nos total
h)	Total assumed head losses across the structure (m)	:	
i)	Gross Command Area (ha)	:	8500 Ha
j)	Culturable Command area	:	6800 Ha

14.1.4 Distribution System :

		Branches	Distributaries	Minors/Water Courses
a)	Number	7 Nos	5 nos	--
b)	Total length (km)	38 km	7.98 km	--

14.2 Efficiencies (percent)

a) Conveyance :70%

b) Field application :85% (Ponded) & 65 % (Non-Ponded)

15. Cropping Pattern

Percentage area (CCA)	
Existing	Proposed
42.60%	153.7 %

16. Power : There is no power component in the project

17. Cost : Rs 54045.85 lakh (Total)

17.1 Cost of the project (Rs. in Lakh) Unit wise (Refer Part II Section-3 Para 18)

Unit-I- Rs 11653.17 lakh

Unit-II- Rs 26784.38 lakh

(Works corresponding to Rs 6746.66 Lakh – already executed)

17.2 Allocated cost (Rs. in lakh) :

a) Irrigation Rs 54045.85 lakh

18. Benefit Cost Ratio :

a) B.C. Ratio

i)Irrigation : **2.32** at 10% interest

संख्या/No.7/42/M&MI/KAAC/Apprl/2012-M&AG/1442-45

भारत सरकार
जल शक्ति मंत्रालय
जल संसाधन नदी विकास एवं गंगा संरक्षण विभाग
केंद्रीय जल आयोग
प्रबोधन एवं मूल्यांकन निदेशालय

सत्यमेव जयते

Government of India
Ministry of Jal Shakti
Dept. of Water Resources, RD&GR
Central Water Commission
Monitoring & Appraisal Dte.

सेवा मे / To

Date: 30.09.2019

अतिरिक्त मुख्य अभियंता (जोन- IV)/ Additional Chief Engineer(zone-IV)
सिंचाई विभाग/ Irrigation Department
कर्बी आंग्लोंग स्वायत्त परिषद/ Karbi Anglong Autonomous Council
दिफू, असम / Diphu, Assam

विषय/ Sub: DPR of Amreng Irrigation Project- Estimated Cost: ₹1045.0398 Cr.-Reg.

संदर्भ/Ref: letter No.ACEI (Zone-IV)/Amreng/DPR/2018-19/01 dated 06.03.2019
letter No.ACEI (Zone-IV)/Amreng/DPR/2018-19/10 dated 22.08.2019

महोदय/Sir,

Kind reference is invited to the above mentioned letters vide which revised DPR of Amreng Medium Irrigation Project was submitted to this office for examination/ vetting. In absence of specialized Central Design Organization with KAAC or with the State of Assam, the project was initially taken up in consultative mode with specialized directorates of CWC (HQ). Comments/ Observations were provided to KAAC, Govt. of Assam in 2013 and 2016 respectively. Now, revised DPR has been submitted complying to the observations of CWC (HQ)/ field Office. The submitted revised DPR has been examined along-with point wise compliance to the earlier observations of CWC (HQ)/ Field units as per CWC Guidelines for "Submission, Appraisal & Clearance/Acceptance of Irrigation & Multipurpose Projects, 2010 & 2017" etc and chapter wise observations/ comments of this office are as under:

I. General Comments

1. Index map provided does not cover all aspects of the project. It is suggested that a clear A-0 size index map, preferably in color showing the details of catchment area, project location, location of G&D sites, availability of Rain gauge stations, headwork, command area of the project, alignment of canal, command of adjacent project (if any), proposed extension of the command area, etc. may be furnished.
2. Page numbers are so provided in the DPR rendering it difficult to comment on the specific issue. It is advised to prepare the DPR with proper uniform nomenclature, numbering and page number for better referencing.

II. Hydrology Chapter of Project

1. On delineation of the catchment of Amreng Irrigation Project the catchment's physiographic properties were observed to be different from those adopted by Hydrology (NE) Directorate in 2013. In the present study, higher resolution SRTM 1 arc-sec DEM available in the public domain has been used compared to the original study by Hydrology where, then available SRTM 3 arc-sec DEM was used. The

finalized catchment map along with the catchment's physiographic properties is attached as **Annex-A-I.**

2. Using the shape-file of the catchment, state boundary as available in public domain and TRMM annual average rainfall raster files, the ratios of catchment area and average annual rainfall between proposed Amreng catchment and Lower Kopili dam site (having observed hydrological observation data) were also assessed and is provided at **Annex-A-II**.
3. The gross water availability series developed at Lower Kopili dam site based on consistent data from 1998-99 to 2009-10 by Hydrology (NE) Directorate, CWC in its study in 2013 along with the estimated catchment and rainfall ratio's to assess the gross water availability at Amreng Irrigation Project's catchment. Using the gross water availability series and the catchment and rainfall ratio's between Amreng and Assam portion of Amreng catchment, Net water availability series has been worked out. The net water availability series is attached as **Annex-A-III**.
4. In absence of availability of concurrent short interval rainfall runoff data and change in catchment's physiographic properties, unit catchment response function has been synthetically derived for the Amreng Project using Flood Estimation Report sub-zone 2(a), UG parameters and the smoothened UG are presented at **Annex-A-IV**.
5. Using 1 in 50 year 24 hrs rainfall depth from Isopluvial Maps published by IMD the dominating point rainfall value for the catchment was observed to be 40 cm (In the original study a value of 36 cm was adopted however on superimposing the isopluvial lines on Amreng catchment as shown in Annex-A-V-1, a value of 40 cm as design storm appeared to be more appropriate), areal correction factor of 0.84, time distribution factors from PMP Atlas of Baramhaputra Basin sub-basin 504, loss rate of 0.35 cm/hr, base flow of 38.83 m^3/s and based on procedural methodology as recommended in Manual for Design Flood estimation and FER-2(a), the 1 in 50 year flood at Amreng Irrigation Project is estimated as **2815 m^3/s**. The design flood hydrograph, design storm analysis and brief computations are provided at **Annex-A-IV**.
6. For estimation of check flood, Storm analysis has been carried out to estimate the design storm (Standard Project Storm) and the catchment response function as presented at Annex-IV has been used. The critical storm of 15.09.1984 centered at Mathungari appeared to be transposable and critical for the catchment of Amreng Project. The transposed depth of rainfall has been assessed as 43.4 cm. Adopting a Location correction factor as 1 gives a SPS as 43.4 cm and the same has been adopted as design storm for check flood estimation. On convolution the check flood has been assessed as **4330 m^3/s** and the same is recommended as check flood for design of Barrage. The storm analysis and computations are provided at **Annex-A-V-5.4**

III. Irrigation Planning Aspect

1. Generally, the proposed cropping pattern of irrigation projects are considered on the basis of soil survey report of the command area, existing cropping practices, tendency of farmers to grow crops, etc. These aspects may be looked into before deciding the proposed cropping pattern for the project. Further, the proposed cropping pattern may be got approved by the Director, State Agriculture Department in the format given in the "Guidelines for Submission, Appraisal and Acceptance of Irrigation and

Multipurpose Projects, 2017" of CWC (*Appendix F (1) and F(2))* and a copy of the same may be furnished.

2. The computational details of crop water requirement as per the Modified Penman Method for the proposed cropping pattern have not been furnished in the report. The details of meteorological parameters viz. Max. Temp, Min. Temp, Relative Humidity, Wind Speed, Sunshine Hours etc. of the climatological station used for the calculation of ET_0, calculation sheets for calculation of ET_0 and effective rainfall (ER) may also be furnished for reference and record.
3. Based on the cropping pattern provided by the project authorities, the total irrigated area in eleven 10-daily durations viz. 01-10 Oct (8092 Ha), 11-20 Oct (8092 Ha), 21-30 Nov (8432 Ha), Whole of December (8432 Ha)& January (7140 Ha), 10-20 March(6936 Ha) and 21-31 March (6936 Ha) exceeds the total cultivable command area (6800 Ha) available with the project. The cropping area may be suitably planned so that the overall irrigated area does not exceed the cultivable command available i.e. 6800 Ha.
4. A certificate duly countersigned by the competent authority (Director of Agriculture, Assam) may be provided stating that the cropping calendar provided in the DPR is reasonable and correct for the command area of Amreng Project in KAAC, Assam.
5. The "Effective Rainfall" adopted by the project authorities for estimation of net irrigation requirement do not appear to be in order. The effective rainfall values may be assessed based on methodology described in the Guidelines for Irrigation Planning or CWC's publication "A Guide to prepare chapter on Irrigation Planning Aspects of DPR" and same may be used in estimation of Net Irrigation Requirement. The total rainfall in the command area may be assessed based on areal averaged rainfall observed in or around the Amreng's Command. IMD's Gridded observed daily rainfall dataset available at 0.25^{o}x0.25^{o} spatial resolution can also be adopted.
6. Field irrigation efficiency for the Paddy has been adopted as 90 %. Based on Guidelines for Submission, Appraisal and Acceptance of Irrigation and Multipurpose Projects, 2017, the irrigation intensity for ponded crops is generally adopted between 80-85% and for other crops (non-ponded), 65%. Accordingly field efficiency may be adopted as 85% for ponded crops and 65 % for non-ponded crops.
7. Conveyance efficiency has been uniformly applied as 75% for all canal types. As per Guidelines for Submission, Appraisal and Acceptance of Irrigation and Multipurpose Projects, 2017, the conveyance efficiency for fully lined system is adopted between 70-75%, for partially lined system the conveyance efficiency varies between 65 to 70% and for unlined canal system the conveyance efficiency varies from 55 to 60 %. As the present canal network system is partially lined, the maximum conveyance efficiency may be restricted to 70%.
8. The success rate for the project has not been assessed in the DPR. The success rate for the project is calculated based on its performance on available water yield and the proposed water demand. The availability of water and the proposed water demand for the project needs to be assessed every year and the project is considered a success if the success rate for the project is more than 75%. If the project fails in a particular 10-daily duration, the year is considered as a failure. The working tables/simulation study on 10- daily basis using the net yield series at barrage site and the revised irrigation demand table may be prepared and furnished to assess the success rate of the project.
9. The maximum value of rate per quintal of crop considered by the project authorities appear to be on higher side. The value of produce is generally restricted to the

minimum support price of the crop (MSP). For example: MSP for Paddy for the year 2018-19 is reported as Rs. 1770/quintal, while the same has been considered as Rs. 2227/quintal. Similar errors have been found for other crops like oilseeds (MSP: Rs. 5388/ quintal; considered Rs. 8500/ quintal), sugarcane (MSP of Rs. 275; considered Rs. 595/ quintal) & wheat (MSP of Rs. 1840; considered Rs 3740/ quintal) . Similarly the value of other produce for some crop (for whom MSP is not available) like Vegetables, etc. appear to be quite high. The same may be reassessed by the project authorities.

10. The quantity of produce per hectare of irrigable land as provided by the project authorities are observed to be significantly on higher side compared with the agricultural statistics for Karbi Anglong District provided on the website of Directorate of Agriculture, Govt. of Assam. The values of quantity produced per hectare of the irrigable land may be re-verified from the states agriculture department.

IV. B.C. Ratio aspects

1. The B.C. ratio computation has not been worked out in format (as per the guidelines). The same may be worked in the prescribed format and considering the following points also.

   (i) The price level for the cost of the project and benefits from agricultural produces may be considered at par (same price-level) while carrying out the B.C. Ratio computation. The study may be carried out after finalization/ modification of Cost Estimate Aspect of the project.

   (ii) After complying to the observations as given above, the revised benefits from the project along with approved cost estimate, Benefit Cost Ratio may be re-evaluated.

   The yield, rates and cost of cultivation (viz. seeds, manure, labour etc.) of crops in pre-project and post project scenario may be got approved by the Director, State Agriculture Department in the format given in the "Guidelines for Submission, Appraisal and Acceptance of Irrigation and Multipurpose Projects, 2017" of CWC *(Appendix F (1) and F(2))* for the purpose of estimating the agricultural benefits.

V. Barrage & Canal Design Aspect

Barrage Design

1. The value of average particle size i.e. d_{50} of the river bed material as reported by project authorities at section 1.4 of Volume-I, Part-II of the DPR does not match with the value adopted in design calculations further in the report.
2. The value of silt factor as provided at section 1.4 of Volume-I, Part-II of the DPR does not appear to be in order as per standard equation of silt factor provided in IS 6966:1989. Using the standard equation the silt factor comes out to be 0.96. The value may kindly be reviewed.
3. Details of fixing of the pond level as provided at 1.5, Vol.-I, Part-II of the DPR may be provided by furnishing head loss statement. The detailed computations of back

calculations to estimate the requisite level at pond level may be provided and canal layout may be shown on the contour sheet.

4. In computation of cistern parameters, the total width of waterway has been taken for estimation of intensity of discharge. As the passage of water is through the clear passageway, clear width of the waterway may kindly be adopted to assess the discharge intensity both with & without concentration. All further computations may get modified.
5. The value of retrogression at different discharges has not been adopted from retrogressed G-D curve. Hence, it is suggested to adopt the retrogression depth based on retrogressed GD curve as the same shall give a more genuine estimate.
6. While computing cistern parameters for various scenarios discharges i.e. 100%, 75%, 50% and 25%, the downstream water level has been taken constant as the design discharge level. The downstream discharge water level may be adopted from the Gauge Discharge curve corresponding to the discharge at respective percentage of design discharge.
7. While finalizing the cistern level and cistern length, the values have been rounded to 1 digit. It is suggested to round down the value for cistern level and round up the value for cistern length
8. Reason for lowering the upstream floor level to 103.00 which is lower than downstream end sill average bed level of river (assumed as 103.50) may kindly be provided
9. In computations of exit gradient, end sill level may be adopted for computation of head over the floor instead of the u/s floor level
10. While assessing the number of rows of C.C. blocks, the number of rows may be rounded-up the estimated value.
11. The methodology for design of protection works considering the exit gradient appears to be generally in order
12. Computation of subsoil uplift pressures for checking the stability of barrage for the uplift forces is not provided in the report. Uplift pressures at the recommended points of the barrage floor may be estimated and checked for its stability.
13. Free board is to be provided over the affluxed water level due to a flood with 500 year return period. However, if the pond level is higher than the water level for 500 year flood, the free board is provided over the pond level.
14. The computations of design of Raft foundation as intimated in the point 1, compliance to the comments of BCD (E&NE) Dte., CWC, dated 19.08.2016 are not provided in the DPR, the same may be furnished.
15. The references to plate numbers/ drawings in most of the places have been left blank in the DPR rendering it inconvenient to browse to the relevant figure/ drawing.
16. Computations for assessment of level and length of cistern for head regulator have not been provided in the design. The parameters of the design may be adopted based on suggestions from BCD directorate dated 19.08.2016.
17. The compliance provided to point number 13 of the comments of BCD (E&NE) Dte., CWC, dated 19.08.2016, does not appear to be in concurrence with the write-up provided for canal & canal structures. As per the compliance only CC lining of 75 mm has been provided however, in canal system write-up it has been intimated that 250mm RCC and 350 mm CC of M25 & M15 grade have been adopted.

18. Computations for adopting the horizontal and vertical component of Earthquake acceleration parameters adopted in the stability analysis of barrage may be provided. Further, the soil report providing the angle of internal friction may also be furnished.

Design of Head regulator

1. Procedure for anticipating the full supply level in canal as 105.75 m may be explained. Based on the canal design, the full supply level of canal may be adopted instead of anticipating
2. The cistern level and length may be estimated using the same procedure used in the case of barrage design.
3. Design does not include provision of providing u/s & d/s cutoff for the head regulator. The same may be provided using the similar methodology as used for the design of barrage. Design of protection works/ energy dissipation works may also be included.

Canal Design

1. The rugosity coefficient and side slopes adopted for the trapezoidal canal section appear to be generally in order
2. The discharges adopted for various reaches of canal have not been explained. The canal cut-off statement may kindly be provided.
3. The distributary D_1 is a canal distributary of 2.685 km length, for a small streatch of 2685 m the canal has been segmented into three lined patches (of length 170m, 310 m & 300 m respectively) and remaining four unlined patches. The justification for such division may be provided.

VI. Cost Estimate Aspect

General

1. T-Diagram/ Flow diagram of the canal system indication physical features and location of structures needs to be submitted.
2. Lump sum provisions have been taken in estimate. Effort should be made to avoid lump sum provisions as far as possible. Detailed estimate of each item may be submitted along with relevant supporting documents. However, if lumpsum provisions are necessary at any place, then source of information for lump sum amounts may be appended.
3. Cross referencing of quantities, rates & other important facts etc., may be done/ corrected for ease in checking.
4. A certificate as per Annexure-B duly signed by the competent authority may be enclosed with the cost estimate.
5. Appendix-I is "B-Land" and Appendix-II is "D-Regulator". Part-C regarding Detailed Estimate of Barrage is missing. Detailing of the Part-C may be submitted along with the supporting documents.
6. The SOR adopted by project authorities is as per the Irrigation Department of Government of Assam for the year 2015-16. It is requested to verify whether the rates

given in the same are applicable in 2018-19/ 2019-20 also or a recent SOR is available. Indexing on the rates if used in general may also be intimated.

7. Many of the amount figures under provision of present estimate do not match with the supporting computations. The summary of total cost estimate may be revisited based on computation documents.
8. At many a places the costs/ rates have been mentioned as "Accepted Rates". In case the requisite rates are not available in schedule of rates (SOR) available with the State/ Council, A rate analysis of such items may be carried out and the complete report duly approved by the competent authority may to be submitted.
9. The chapter on "Proposed Balance Work" does not contain any supporting documents. Supporting documents containing the details of proposed balance work may be submitted.
10. As per the "Preface" in SOR provided, the item rates include an average carriage distance of 80 km to work sites. All items for which the carrying distance is more than 80 km may kindly be intimated and after assessing the rate analysis, cost for the additional transportation may be added to the total cost.
11. For many works, the references of rates for certain items have not been mentioned. Detailed estimate along with relevant supporting documents i.e. SOR, quotation; justification note duly certified by the competent authority etc., may be appended.
12. In the section of Hydro-mechanical works, many rates have been provided without specifying the source of information, Supporting documents for adopting the provided rates may be provided. In case the rates are not available in the available SOR of the state, Rate analysis duly countersigned by the competent authority may be provided.

Work Already Executed

1. Cost of Land provided at Appendix-I; B-Land has been taken at the rate of Rs. 60 Lakhs by KAAC, Assam, however, the same needs to be provided/ verified by the Land & Revenue Department of the Council/ State.
2. The unit for land area measurement has been adopted as "Bigha" by the project authorities. The conversion function for converting it to Ha/ SI units may kindly be provided.
3. The technical sanction and expenditure sanction for the executed work may be submitted.
4. A number of works have been shown as "Already Executed" by the project authorities. The Audited expenditure statement in respective sub-heads for the executed work may be submitted by the project authorities for further examination.
5. Executed work has been shown as a chapter without specifying the head under which the amounts have been booked. It may be clarified whether the costs have been booked under this project. If the cost of the executed work is proposed to be booked under this project, Audited expenditure statement may be submitted.
6. The amount of executed work shown in the cost summary does not match with the computations being provided in the "Already executed chapter"

A-Preliminary

1. No references/ supporting documents for the rates adopted have been provided in the estimate. The source for adoption of the rates/ basis of the said rates adopted in A-Preliminary may be indicated along with relevant supporting documents.
2. Expenditure incurred on previous investigations carried upto project formulation have been indicated as 0. If the already executed work is being charged in project head the same as indicated in Appendix-I may be indicated.
3. Many works have been assessed based on Lump sum provisions in the estimate. Detailed estimate of each item may be submitted along with relevant supporting documents.
4. Provision of Rs. 16 Cr. have been kept for design & consultancy charges and a provision of 0.15 Cr. For Maps/ records, photography & documentation. The details of consultancy charges may be appended with the estimate along with supporting documents.

B-Land

1. A certified copy of the land rates of different circle from State revenue department may be submitted.
2. The conversion function for converting the local unit "Bigha" it to Ha/ SI units may kindly be provided.

C-Works

1. The cost of Coffer Dam/ Diversion structures has been adopted as a lump-sum value of 10% 0f the Barrage Cost. Detailed Estimate may be submitted for coffer dam as the cost of the temporary structure is quite huge i.e. more than 30Cr.
2. Estimate for the Approach road has been adopted in C-Appurtenant works of barrage, the same may be considered in R-communication.
3. In Annex-A(i), Sl.no. 1, the unit rates do not match with the rates provided in SOR. For transportation beyond the covered rates a separate rate analysis may be carried out and included in the cost estimate.
4. In Annex-A(i), Sl.no. 2, the reference to SOR provided in the DPR is not correct.
5. In Annex-A(i), Sl.no. 4, the page number & reference to SOR provided in the DPR is not correct. Further, the size of boulder considered in the estimate does not match with the one provided in SOR.
6. In Annex-A(i), Sl.no. 6, the page number reference to SOR provided in the DPR is not correct. Further, the shuttering & scaffolding cost is mentioned to be paid separately however, no cost has been included in the cost estimate. Cost Estimate for Shuttering & scaffolding may be carried out and included in the DPR.
7. In Annex-A(ii), Sl.no. 1, the unit rates do not match with the rates provided in SOR. For transportation beyond the covered rates a separate rate analysis may be carried out and included in the cost estimate.
8. In Annex-A(ii), Sl.no. 4, the reference page number & the adopted unit rates do not match with the rates provided in SOR. For transportation beyond the covered rates a separate rate analysis may be carried out and included in the cost estimate.

9. In Annex-B, Sl. no. 1 & 3, the rate analysis duly approved by the competent authority may be submitted with other supporting documents as the reference is not available in SOR.
10. In Annex-A(ii), Sl.no. 4, the reference page number & the adopted unit rates do not match with the rates provided in SOR. Correct rates i.e. Rs. 3856.48 instead of Rs. 3417.43 may be adopted.

D-Regulators & Measuring Devices

1. Rates for jungle/ site clearance have been adopted based on Lump sum rates. Rate analysis may be carried out along with area and number of trees to be cleared and based on approved rates cost estimate may be submitted. Clearance from Forest Department for clearance of jungle may also be submitted.
2. In Annex-V, Sl.no. 7 i.e "Supplying fitting, fixing & laying reinforcement..... as directed", the rates adopted in the estimate are ten times more than the rates provided in SOR.
3. In Annex-V, Sl.no. 8, 2 items have been clubbed together. The estimate may be prepared by considering the two items separately.
4. The rates adopted for embedded parts, rope drum hoist 20T capacity, stop logs, combined hoist support structure have no referencing, the supporting document for the same may be provided.
5. The cost of Embedded parts has been considered twice at (ii) & (vi). The same may be justified.
6. In sub-estimate-1, Sl.no. 1, it specifies light jungle however, rates have been adopted for medium jungle.
7. In sub-estimate-1, Sl.no. 2, the reference to the SOR provided and the rates adopted do not match with that provided in SOR.
8. In sub-estimate-1, Sl.no. 8, the size of pile adopted in DPR does not match with that provided in SOR.
9. The observations provided in Sub-estimate-1 for Distributary 1 are applicable for distributary D4 & D7.
10. Based in the revision of cost the average rate function for D Regulator shall change and the same may be modified to estimate the cost of Regulators.

E-Falls

1. In sub-estimate-1, Sl.no. 1, it specifies light jungle however, rates have been adopted for medium jungle.
2. In sub-estimate-1, Sl.no. 2, the reference to the SOR provided and the rates adopted do not match with that provided in SOR.
3. In sub-estimate-1, Sl.no. 3, the rates adopted do not match with that provided in SOR.
4. The above observation in Sl. no. 1 to3 also apply to sub-estimate-II & sub-estimate - III
5. The average rate per meter fall per unit discharge as estimated for canal falls is not found to be in order. The average rate per product may be corrected as the same is a very important function determining the total cost of the structure.

F-CD Works

1. In sub-estimate-1, Sl.no. 1, the rates adopted do not match with the rates given in SOR.
2. No reference has been provided for the rates adopted for Sl. number 6. Rate analysis for the item duly approved by the competent authority may be submitted if the rates are not available in SOR.
3. In sub-estimate-1, Sl.no. 7, the rates adopted i.e. Rs. 105 do not match with the rates given in SOR i.e. Rs. 683.21.
4. The average rate per unit discharges as estimated for cross drainage works is not found to be in order. The same may be revised after addressing to the above observations.

G-Bridges

1. In sub-estimate-1, Sl.no. 1, it specifies light jungle however, rates have been adopted for medium jungle.
2. In sub-estimate-1, Sl.no. 2, the reference to the SOR provided and the rates adopted do not match with that provided in SOR.
3. In sub-estimate-1, Sl.no. 3, the rates adopted do not match with that provided in SOR.
4. In sub-estimate-1, Sl.no. 10, 11 & 17, No reference has been provided for the rates adopted. Rate analysis for the item duly approved by the competent authority may be submitted if the rates are not available in SOR.
5. In sub-estimate-1, Sl.no. 15, the size of gravel may also be specified as referred to in SOR.
6. The above observation in Sl. no. 1 to3 also apply to sub-estimate-II & sub-estimate – III
7. The average rate per unit discharge per unit water surface width as estimated for bridges & culvers is not found to be in order. The same may be revised after addressing to the above observations.
8. In sub-estimate-IV, Sl.no. 1, the adopted rates do not match with the rates provided in the referenced section of SOR.
9. No reference has been provided for the rates adopted for Sl. number 6. Rate analysis for the item duly approved by the competent authority may be submitted if the rates are not available in SOR.
10. The above observation in Sl. no. 8 & 9 also apply to sub-estimate-V & sub-estimate – VI

H-Escapes

1. In sub-estimate-I, II & III, Sl.no. 1, the adopted rates do not match with the rates provided in the referenced section of SOR.
2. In sub-estimate-I, II & III for canal outlet, Sl.no. 1, the adopted rates do not match with the rates provided in the referenced section of SOR.

3. In sub-estimate-I, II & III for canal outlet, Sl.no. 3, No reference has been provided for the rates adopted. Rate analysis for the item duly approved by the competent authority may be submitted if the rates are not available in SOR.

K-Buildings

1. Proposed organizational chart duly certified by the competent authority for the project may be submitted. Quantities (number of buildings) and plinth areas (Type-wise) should be as per organizational strength and should be duly certified.
2. Permanent buildings may be considered only if these are required in the post construction period also. The type of construction proposed should be clearly described.
3. Referred CPWD document (relevant portion) for plinth area rate may be appended with the estimate.
4. Details of cost index/ price escalation applied from the year 2012 to the year 2019 may also be indicated in the abstract sheet of the estimate.
5. Plinth area rates have been adopted for calculation of building cost both residential as well as office buildings without referring any SOR. If any recent SOR for buildings/ CPWD is available for the region/ council/ State, the same may be adopted with index.
6. Other charges may be adopted based on percentages provided in the relevant CWC guidelines. Accordingly further calculations may be corrected.

L-Earthwork

1. Certificate of competent authority for jungle clearance may be submitted.
2. Supporting documents for estimation of quantity of items in sub-estimate-1 to 9, jungle clearance sl.no. 2 may be provided.
3. A clarification note on the balancing of earthwork may be appended with the estimate. Net quantity of earthwork may be worked out in the estimate. Also the details of the borrow area may be indicated in the estimate. Further, if filling quantity is more than cutting then extra material for filling may be charged.
4. Survey data of canal network/ canal layout on contour sheet showing the region in cutting & filling may be provided.
5. 30 m of carrying and 1.5 m of lift is included in the SOR of excavation & filling rates. The areas where location of excavation & filling are same the charges for 30 m carrying may not be included. In sub-estimate-11 to 18, sl.no. 2&3 may be explained.
6. Only one item has been considered in the section "Lining of Canals" i.e. concrete. Other items needed in the lining of canals i.e. labour charge for preparation of sub-grade, collection of materials their carriage and spreading, providing expansion joints of bituminous, shuttering, scaffolding, weap holes for drainage etc. may also be added as applicable.
7. In sub-estimate-28 to 36, the item of work detailed in the table is unclear whether the shuttering & scaffolding work is included or excludes. The same may be clarified. Further, if the shuttering & scaffolding work is to be paid separately, cost for the component may be included in the cost estimate.

M-Plantation; O-Miscellaneous; P-Maintenance; Q-Special T&P; R-Communication

1. The total quantity and rate has been adopted in M-Plantation without supporting documents. The rate and procedural assessment of the quantity estimated may be provided.
2. Under the section Q-Special T&P, cost of all construction equipment's have been incorporated. If the work is to be carried out through open bidding the component is the responsibility of the contractor and the same need not be considered in the cost estimate except inspection vehicle, bus & Ambulance. If the work has to be executed by the project authorities, than resale value after the execution may also be computed and accounted for in the cost estimate.
3. A rate of Rs. 2.75 Cr. has been adopted for the component R-Communications. The supporting documents for adopting the same may be provided.

U-Distributaries, minors & sub-minors; V-Water courses; X-Environment & Ecology

1. All aspects of Distributaries have been included along with estimates of Main canal & Branches. Cost estimate part of all aspects of distributaries may be considered in U-Distributaries.
2. The rate adopted for Sl.no.2 in sub estimate-I for water course is incorrect. Rate of Rs. 2919.90 may be adopted instead of Rs. 5019.
3. All the provisions have been made on LS basis. Detailed estimate along with relevant supporting documents need to be furnished. Following points as per guidelines may be followed for the provision under this sub-head:
    a. Provision of items should be made in consultation with the concerned departments like forest department, soil conservation department, health department, central/state Ground Water Board etc.
    b. Rates taken for compensatory afforestation needs to be supported by relevant supporting document.
4. A lumpsum estimate of 50 Lakh has been kept for ecology. A rate analysis duly approved by the competent authority may be submitted.
5. Guidelines recommend conducting of Environmental Impact Assessment Study to be carried out for the project, Cost of Consultancy for the EIA study may be kept in the analysis.

VII. Justification of carrying capacity of canal

1. The irrigation requirement of 9.71 cumec has been assessed assuming the whole area to be cultivated with a crop having duty of 19.84 Ha/cusec which appears to be on higher side. The water requirement may be assessed based on the 110% of maximum irrigation demand along with domestic demand for the considered 10 daily basis

2. The domestic water demand for the tribal population of 10,000 people have been presented as 0.8 m^3/s. Assuming a per capita demand as per urban cities as 135 LPCD, the daily demand for a population of 10,000 works out to be (10000 x 135 / 1000 / 24/ 3600= 0.0156 m^3/s) less than 0.02 m^3/s. Even considering a conveyance efficiency of 75 % the demand of 0.02 m^3/s appears to be reasonable. Similarly a demand of 0.008 m^3/s for the additional 4000 people appears to be reasonable for the proposed future expansion.
3. A geo-referenced index map showing the present and future proposed command area with respect to the project catchment may kindly be provided.

This issues with the approval of Chief Engineer, B&BBO, Shillong.

संलग्न/Encl: *ऊपरोक्त*/ As above.

भवदीय/ Yours Sincerely,

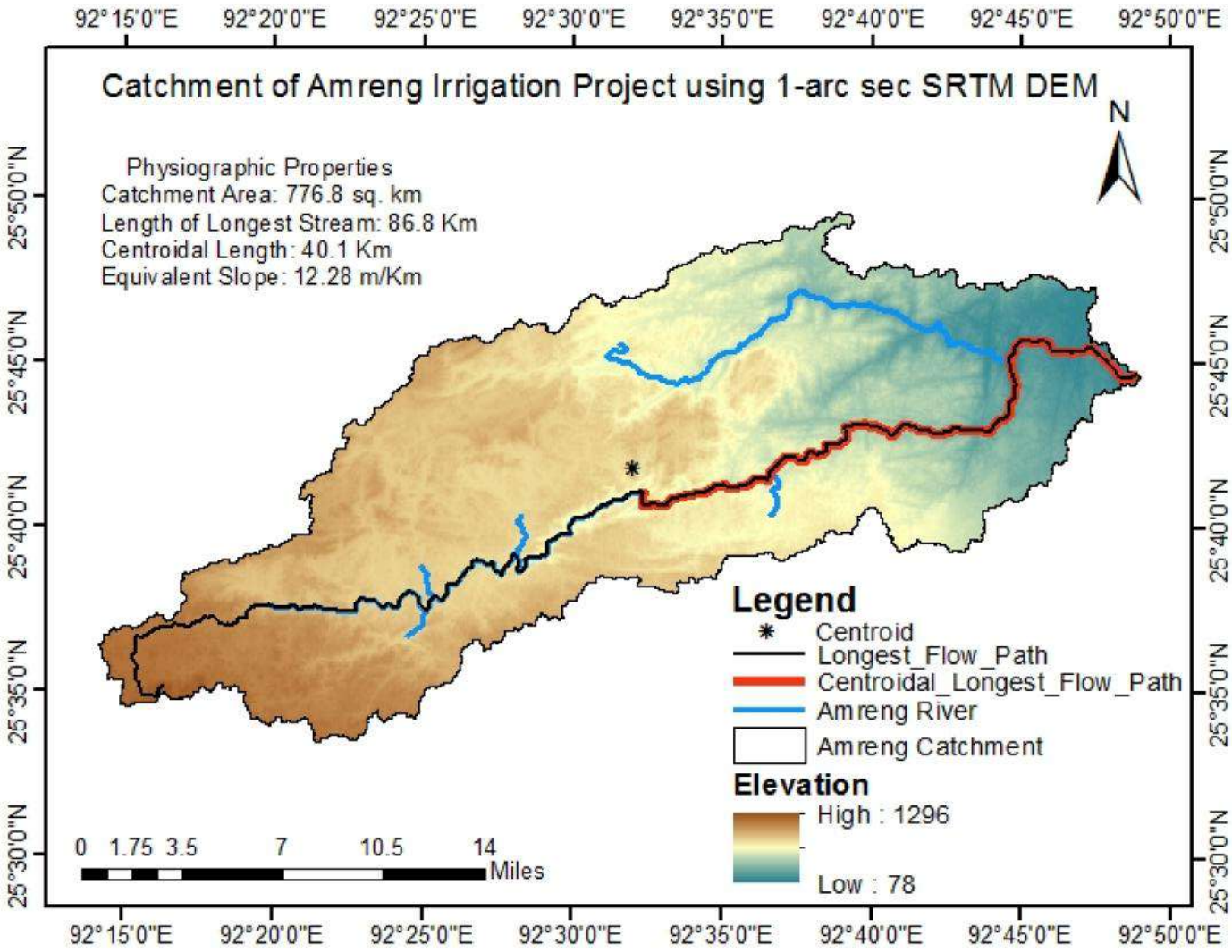
रवि रंजन
30/09/2019

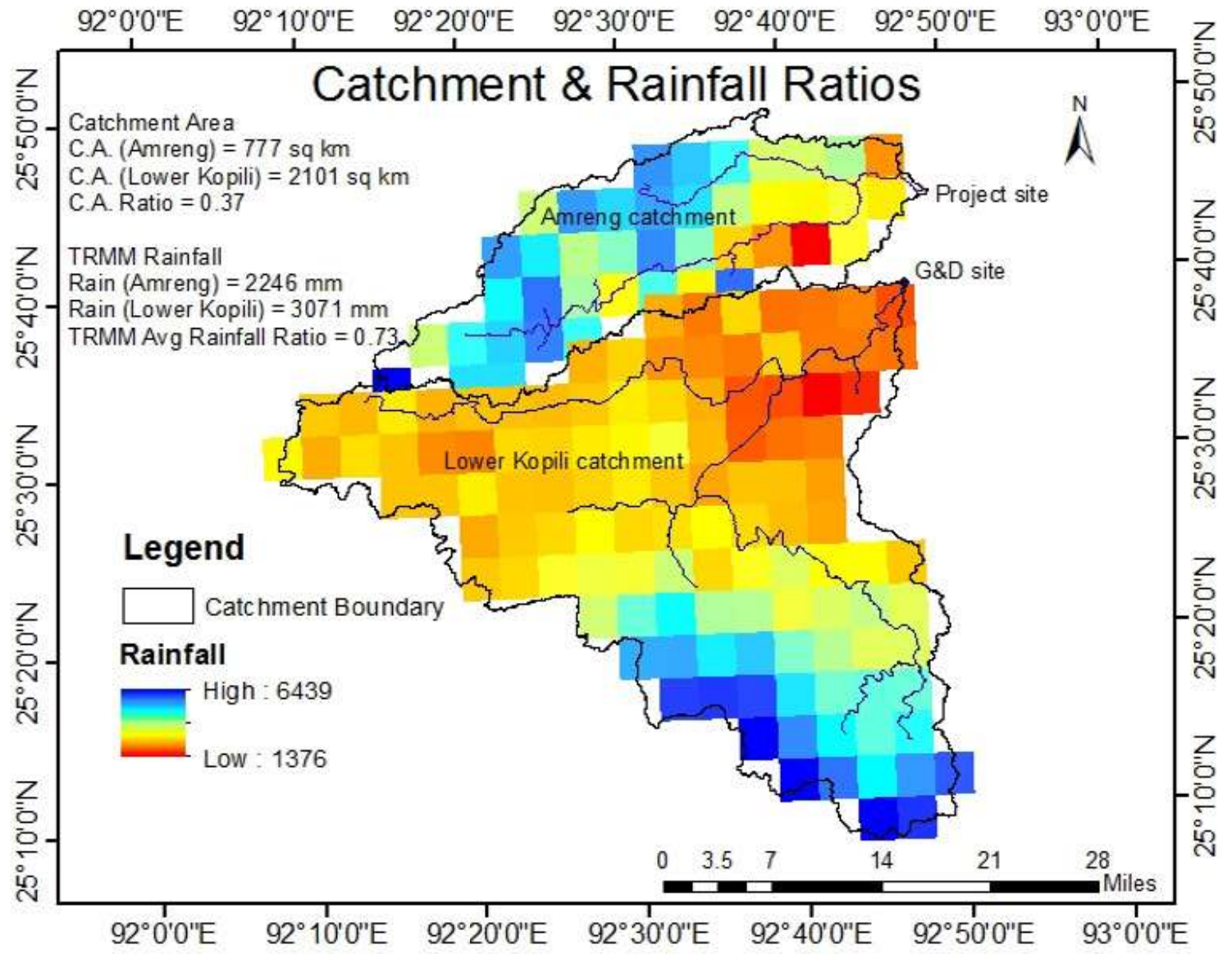
(रवि रंजन/ Ravi Ranjan)
निदेशक/ Director

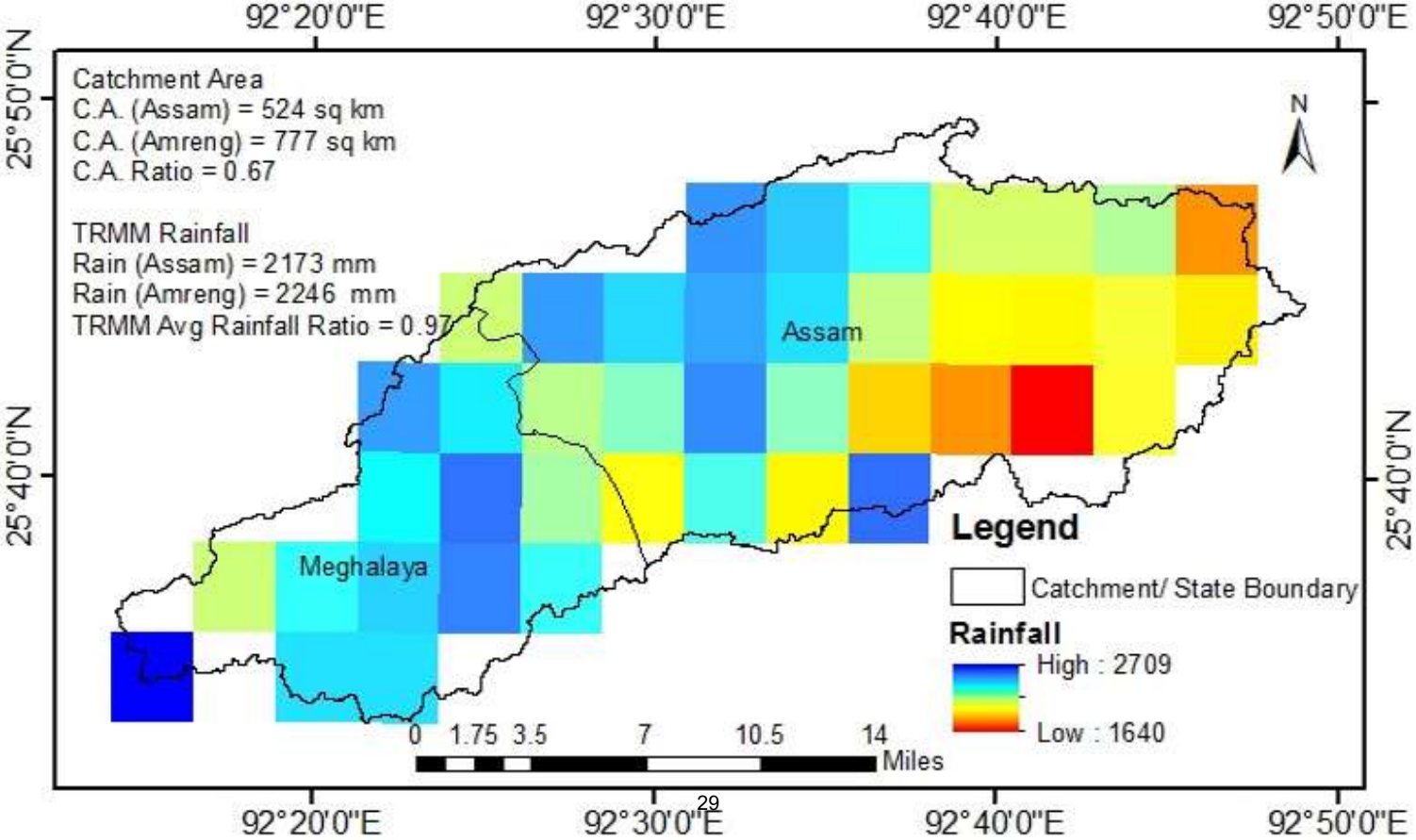
Copy to:

1. प्रमुख सचिव, कर्बी आंग्लोंग स्वायत्त परिषद, दिफू, असम/ Principal Secretary, Karbi Anglong Autonomous Council, Diphu, Assam
2. मुख्य अभियन्ता, परियोजना मूल्यांकन संगठन, केंद्रीय जल आयोग, नई दिल्ली/ Chief Engineer (PAO), CWC, New Delhi-110066
3. अधीक्षण अभियंता (समन्वय), ब्रह्मपुत्र एवं बराक बेसिन संगठन,केंद्रीय जल आयोग, शिलाँग -793001/ Superintending Engineer (C), B&BBO, CWC, Shillong.

Annexure -A-I


Catchment of Amreng Irrigation Project using 1-arc sec SRTM DEM
Physiographic Properties
Catchment Area: 776.8 sq. km
Length of Longest Stream: 86.8 Km
Centroidal Length: 40.1 Km
Equivalent Slope: 12.28 m/Km
N
Legend
Centroid
Longest_Flow_Path
Centroidal_Longest_Flow_Path
Amreng River
Amreng Catchment
Elevation
High : 1296
Low : 78
0 1.75 3.5 7 10.5 14
Miles
92°15'0"E
92°20'0"E
92°25'0"E
92°30'0"E
92°35'0"E
92°40'0"E
92°45'0"E
92°50'0"E
25°50'0"N
25°45'0"N
25°40'0"N
25°35'0"N
25°30'0"N


Catchment & Rainfall Ratios
Catchment Area
C.A. (Amreng) = 777 sq km
C.A. (Lower Kopili) = 2101 sq km
C.A. Ratio = 0.37
TRMM Rainfall
Rain (Amreng) = 2246 mm
Rain (Lower Kopili) = 3071 mm
TRMM Avg Rainfall Ratio = 0.73
Amreng catchment
Lower Kopili catchment
Project site
G&D site
Legend
Catchment Boundary
Rainfall
High : 6439
Low : 1376
0 3.5 7 14 21 28
Miles
N
92°0'0"E
92°10'0"E
92°20'0"E
92°30'0"E
92°40'0"E
92°50'0"E
93°0'0"E
25°50'0"N
25°40'0"N
25°30'0"N
25°20'0"N
25°10'0"N


Catchment Area
C.A. (Assam) = 524 sq km
C.A. (Amreng) = 777 sq km
C.A. Ratio = 0.67
TRMM Rainfall
Rain (Assam) = 2173 mm
Rain (Amreng) = 2246 mm
TRMM Avg Rainfall Ratio = 0.97
Assam
Meghalaya
Legend
Catchment/ State Boundary
Rainfall
High : 2709
Low : 1640
0 1.75 3.5 7 10.5 14
Miles
N
92°20'0"E
92°30'0"E
92°40'0"E
92°50'0"E
25°50'0"N
25°40'0"N

Annexure-A-III.1

Annex-III.1

10 daily Gross water availability series (cumecs) of Lower Kopili Dam site, Assam													
		1998-99	1999-00	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10
June	I	295.66	124.38	269.67	136.73	48.84	105.10	40.19	104.39	128.06	108.45	112.16	86.62
	II	217.55	101.79	306.77	117.52	312.59	248.38	113.01	155.27	108.87	108.19	105.78	77.30
	III	112.19	191.67	367.23	121.49	182.71	491.64	74.66	151.47	111.00	135.71	153.06	41.30
July	I	185.12	345.80	109.47	119.44	267.29	281.72	96.97	109.67	152.86	138.49	130.98	152.38
	II	159.01	292.43	113.24	128.49	120.66	147.34	117.06	125.57	117.46	149.09	142.60	89.12
	III	373.07	131.04	72.53	196.83	339.17	95.04	107.20	86.62	124.66	164.57	175.65	67.97
August	I	190.84	104.14	427.10	233.99	133.62	56.18	163.41	178.46	171.32	136.51	133.45	107.54
	II	195.80	176.87	131.24	35.97	270.38	68.82	109.07	78.68	126.73	93.06	100.11	146.43
	III	142.74	113.78	98.38	89.40	166.78	71.29	76.39	103.09	131.77	138.01	166.01	201.62
Sep	I	170.61	102.75	215.28	143.17	68.34	69.05	165.19	304.39	190.22	235.71	310.57	107.03
	II	44.36	92.57	152.98	116.64	60.23	73.95	119.05	154.59	146.74	132.40	164.63	105.95
	III	43.57	78.43	131.07	131.72	68.79	71.51	165.90	127.30	129.14	127.18	129.22	92.63
Oct	I	46.17	117.29	109.41	156.32	95.89	54.90	118.74	193.76	132.51	130.07	134.64	147.70
	II	53.37	121.43	73.98	85.06	56.38	110.77	101.02	131.26	115.79	115.05	127.75	167.46
	III	42.40	105.33	159.55	56.69	53.29	84.18	63.29	65.45	111.65	124.97	129.85	81.46
Nov	I	32.03	75.57	77.81	58.39	41.47	60.86	57.40	64.71	57.43	96.34	120.29	83.33
	II	29.00	62.59	61.03	45.04	105.95	61.54	50.85	51.64	49.46	95.98	96.00	67.21
	III	78.20	50.65	43.82	30.70	51.56	57.45	32.00	35.29	30.70	84.24	84.38	58.25
Dec	I	31.09	50.00	26.11	25.26	46.63	32.85	27.41	28.80	27.01	79.31	86.31	55.84
	II	24.04	39.82	30.92	23.89	42.60	34.47	27.24	24.18	22.53	67.29	78.94	62.61
	III	31.43	20.32	34.95	34.52	40.11	29.00	28.20	32.31	33.28	57.57	65.05	54.82
Jan	I	26.93	15.65	38.86	39.17	39.03	28.83	26.96	34.13	34.30	57.20	60.43	26.30
	II	26.11	16.07	41.98	41.24	37.13	28.20	24.01	40.82	30.02	43.20	47.34	14.57
	III	28.97	15.93	18.40	42.77	26.22	27.44	26.47	37.53	26.16	42.91	39.40	13.29
Feb	I	23.70	15.65	16.13	38.58	39.63	22.99	26.81	34.33	24.55	51.79	58.05	28.17
	II	10.32	13.72	15.59	37.30	36.88	19.02	25.23	29.59	25.23	40.96	46.94	17.23
	III	16.67	13.15	19.53	26.90	31.04	18.85	27.07	22.82	25.20	36.25	37.76	16.84
Mar	I	15.62	12.93	18.88	22.82	48.21	18.40	25.74	25.79	25.34	33.19	35.52	20.95
	II	15.84	13.07	13.35	22.90	57.20	12.73	26.81	23.44	22.90	35.15	33.76	21.68
	III	31.12	12.95	12.81	25.60	48.78	13.83	26.19	28.43	27.92	34.81	35.01	19.22
Apr.	I	9.58	13.04	18.91	31.86	39.37	14.97	29.31	29.56	29.37	36.76	36.90	131.29
	II	6.07	15.62	19.84	32.94	43.42	59.33	29.22	29.20	30.19	34.84	34.81	87.64
	III	7.28	16.27	15.84	41.04	44.95	23.07	29.54	32.77	38.04	35.60	34.13	153.94
May	I	10.26	15.56	27.21	59.58	31.43	66.92	66.35	26.13	38.24	43.82	34.16	38.15
	II	12.73	28.71	29.02	87.19	22.19	53.17	94.64	30.24	47.31	66.47	32.82	45.86
	III	45.78	161.90	38.41	182.82	24.38	54.73	132.14	30.13	44.90	59.92	60.09	75.68
Total		2785.23	2878.85	3357.28	2819.95	3143.14	2768.51	2470.75	2761.82	2688.83	3171.06	3374.55	2765.39

Annex-III.1

10 daily Gross water availability series (in MCM) of Lower Kopili Dam Site, Assam													
		1998-99	1999-00	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10
June	I	255.45	107.46	233.00	118.14	42.20	90.81	34.73	90.20	110.64	93.70	96.91	74.84
	II	187.96	87.94	265.05	101.53	270.07	214.60	97.64	134.16	94.07	93.48	91.40	66.78
	III	96.93	165.60	317.29	104.96	157.86	424.78	64.51	130.87	95.90	117.26	132.24	35.68
July	I	159.94	298.78	94.58	103.20	230.94	243.40	83.78	94.75	132.07	119.66	113.17	131.66
	II	137.39	252.66	97.84	111.01	104.25	127.30	101.14	108.49	101.49	128.82	123.21	77.00
	III	354.57	124.54	68.94	187.06	322.35	90.33	101.88	82.32	118.48	156.41	166.94	64.60
August	I	164.89	89.98	369.01	202.16	115.44	48.54	141.18	154.19	148.02	117.94	115.30	92.91
	II	169.18	152.82	113.39	31.08	233.61	59.46	94.24	67.98	109.49	80.40	86.50	126.51
	III	135.66	108.13	93.50	84.96	158.51	67.75	72.60	97.98	125.24	131.16	157.78	191.62
Sep	I	147.40	88.78	186.00	123.70	59.04	59.66	142.73	263.00	164.35	203.66	268.33	92.47
	II	38.33	79.98	132.17	100.78	52.04	63.89	102.86	133.57	126.78	114.39	142.24	91.54
	III	37.64	67.76	113.24	113.80	59.44	61.79	143.34	109.98	111.58	109.89	111.65	80.03
Oct	I	39.89	101.34	94.53	135.06	82.85	47.44	102.59	167.41	114.49	112.38	116.33	127.62
	II	46.11	104.91	63.92	73.49	48.71	95.71	87.28	113.41	100.04	99.40	110.38	144.69
	III	40.30	100.10	151.64	53.88	50.64	80.01	60.15	62.20	106.11	118.77	123.41	77.42
Nov	I	27.67	65.29	67.22	50.45	35.83	52.58	49.59	55.91	49.62	83.24	103.93	72.00
	II	25.05	54.07	52.73	38.91	91.54	53.17	43.93	44.62	42.73	82.92	82.95	58.07
	III	67.57	43.76	37.86	26.52	44.55	49.64	27.65	30.49	26.52	72.78	72.91	50.33
Dec	I	26.87	43.20	22.56	21.82	40.29	28.38	23.68	24.88	23.34	68.52	74.57	48.24
	II	20.77	34.41	26.72	20.64	36.81	29.78	23.53	20.89	19.47	58.14	68.20	54.10
	III	29.88	19.32	33.22	32.81	38.12	27.56	26.80	30.71	31.63	54.71	61.82	52.10
Jan	I	23.27	13.52	33.58	33.84	33.72	24.91	23.29	29.49	29.63	49.42	52.21	22.73
	II	22.56	13.89	36.27	35.63	32.08	24.37	20.74	35.27	25.93	37.32	40.90	12.59
	III	27.53	15.14	17.48	40.65	24.92	26.08	25.16	35.67	24.86	40.79	37.44	12.63
Feb	I	20.47	13.52	13.93	33.33	34.24	19.86	23.17	29.66	21.21	44.74	50.16	24.34
	II	8.91	11.85	13.47	32.23	31.86	16.43	21.80	25.57	21.80	35.39	40.56	14.89
	III	11.52	9.09	13.50	18.59	21.45	13.03	18.71	15.77	17.42	25.06	26.10	11.64
Mar	I	13.49	11.17	16.31	19.71	41.66	15.89	22.24	22.29	21.89	28.68	30.69	18.10
	II	13.69	11.29	11.53	19.79	49.42	11.00	23.17	20.25	19.79	30.37	29.17	18.73
	III	29.58	12.31	12.18	24.33	46.36	13.15	24.89	27.02	26.53	33.08	33.27	18.26
Apr.	I	8.28	11.27	16.33	27.53	34.02	12.93	25.32	25.54	25.37	31.76	31.89	113.44
	II	5.24	13.49	17.14	28.46	37.52	51.26	25.25	25.22	26.08	30.10	30.07	75.72
	III	6.29	14.06	13.69	35.46	38.84	19.93	25.52	28.31	32.87	30.76	29.49	133.00
May	I	8.87	13.44	23.51	51.48	27.16	57.82	57.33	22.58	33.04	37.86	29.51	32.96
	II	11.00	24.81	25.08	75.33	19.18	45.94	81.77	26.13	40.87	57.43	28.36	39.62
	III	43.51	153.87	36.50	173.76	23.17	52.02	125.59	28.64	42.67	56.95	57.11	71.93
Total		2406.44	2487.33	2900.69	2436.44	2715.67	2391.99	2134.73	2386.21	2323.15	2739.80	2915.61	2389.30

Annex-III.2

10 daily Gross water availability series (in MCM) at Amreng Irrigation Project, Assam														
		1998-99	1999-00	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	Average
June	I	69.09	29.07	63.02	31.95	11.41	24.56	9.39	24.40	29.93	25.34	26.21	20.24	30.38
	II	50.84	23.79	71.69	27.46	73.05	58.04	26.41	36.29	25.44	25.28	24.72	18.06	38.42
	III	26.22	44.79	85.82	28.39	42.70	114.89	17.45	35.40	25.94	31.71	35.77	9.65	41.56
July	I	43.26	80.81	25.58	27.91	62.46	65.83	22.66	25.63	35.72	32.36	30.61	35.61	40.70
	II	37.16	68.34	26.46	30.03	28.20	34.43	27.36	29.34	27.45	34.84	33.32	20.83	33.15
	III	95.90	33.68	18.65	50.60	87.19	24.43	27.56	22.27	32.04	42.30	45.15	17.47	37.67
August	I	44.60	24.34	99.81	54.68	31.22	13.13	38.19	41.70	40.03	31.90	31.19	25.13	39.66
	II	45.76	41.33	30.67	8.41	63.18	16.08	25.49	18.39	29.62	21.75	23.40	34.22	29.86
	III	36.69	29.25	25.29	22.98	42.87	18.32	19.64	26.50	33.87	35.48	42.68	51.83	29.20
Sep	I	39.87	24.01	50.31	33.46	15.97	16.14	38.60	71.13	44.45	55.08	72.58	25.01	40.55
	II	10.37	21.63	35.75	27.26	14.08	17.28	27.82	36.13	34.29	30.94	38.47	24.76	26.56
	III	10.18	18.33	30.63	30.78	16.08	16.71	38.77	29.75	30.18	29.72	30.20	21.65	25.25
Oct	I	10.79	27.41	25.57	36.53	22.41	12.83	27.75	45.28	30.97	30.40	31.46	34.52	27.99
	II	12.47	28.38	17.29	19.88	13.17	25.89	23.61	30.68	27.06	26.89	29.85	39.13	24.52
	III	10.90	27.08	41.01	14.57	13.70	21.64	16.27	16.82	28.70	32.12	33.38	20.94	21.00
Nov	I	7.48	17.66	18.18	13.65	9.69	14.22	13.41	15.12	13.42	22.51	28.11	19.47	16.08
	II	6.78	14.63	14.26	10.53	24.76	14.38	11.88	12.07	11.56	22.43	22.43	15.71	15.12
	III	18.28	11.84	10.24	7.17	12.05	13.43	7.48	8.25	7.17	19.69	19.72	13.61	12.41
Dec	I	7.27	11.68	6.10	5.90	10.90	7.68	6.41	6.73	6.31	18.53	20.17	13.05	10.06
	II	5.62	9.31	7.23	5.58	9.96	8.05	6.37	5.65	5.27	15.73	18.45	14.63	9.32
	III	8.08	5.22	8.98	8.87	10.31	7.45	7.25	8.31	8.55	14.80	16.72	14.09	8.99
Jan	I	6.29	3.66	9.08	9.15	9.12	6.74	6.30	7.98	8.01	13.37	14.12	6.15	8.33
	II	6.10	3.76	9.81	9.64	8.68	6.59	5.61	9.54	7.01	10.09	11.06	3.40	7.61
	III	7.45	4.09	4.73	10.99	6.74	7.05	6.81	9.65	6.73	11.03	10.13	3.42	6.73
Feb	I	5.54	3.66	3.77	9.02	9.26	5.37	6.27	8.02	5.74	12.10	13.57	6.58	7.41
	II	2.41	3.21	3.64	8.72	8.62	4.44	5.90	6.92	5.90	9.57	10.97	4.03	6.19
	III	3.12	2.46	3.65	5.03	5.80	3.52	5.06	4.27	4.71	6.78	7.06	3.15	5.69
Mar	I	3.65	3.02	4.41	5.33	11.27	4.30	6.01	6.03	5.92	7.76	8.30	4.90	5.91
	II	3.70	3.05	3.12	5.35	13.37	2.97	6.27	5.48	5.35	8.21	7.89	5.07	5.82
	III	8.00	3.33	3.29	6.58	12.54	3.56	6.73	7.31	7.18	8.95	9.00	4.94	6.17
Apr.	I	2.24	3.05	4.42	7.45	9.20	3.50	6.85	6.91	6.86	8.59	8.62	30.68	8.20
	II	1.42	3.65	4.64	7.70	10.15	13.86	6.83	6.82	7.05	8.14	8.13	20.48	8.24
	III	1.70	3.80	3.70	9.59	10.51	5.39	6.90	7.66	8.89	8.32	7.98	35.97	9.20
May	I	2.40	3.64	6.36	13.92	7.35	15.64	15.51	6.11	8.94	10.24	7.98	8.92	8.92
	II	2.97	6.71	6.78	20.37	5.19	12.43	22.12	7.07	11.06	15.53	7.67	10.72	10.72
	III	11.77	41.62	9.87	47.00	6.27	14.07	33.97	7.75	11.54	15.40	15.45	19.45	17.74
Total		650.88	672.76	784.56	658.99	734.52	646.97	577.39	645.41	628.35	741.04	788.60	646.24	

Annex-IV

10 daily Net water availability series (in MCM) at Amreng Irrigation Project, Assam														
		1998-99	1999-00	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	Average
June	I	44.33	18.65	40.43	20.50	7.32	15.76	6.03	15.65	19.20	16.26	16.82	12.99	19.83
	II	32.62	15.26	45.99	17.62	46.87	37.24	16.94	23.28	16.32	16.22	15.86	11.59	25.07
	III	16.82	28.74	55.06	18.21	27.39	73.71	11.19	22.71	16.64	20.35	22.95	6.19	27.12
July	I	27.76	51.85	16.41	17.91	40.08	42.24	14.54	16.44	22.92	20.76	19.64	22.85	26.56
	II	23.84	43.84	16.98	19.26	18.09	22.09	17.55	18.83	17.61	22.35	21.38	13.36	21.63
	III	61.53	21.61	11.96	32.46	55.94	15.67	17.68	14.29	20.56	27.14	28.97	11.21	24.58
August	I	28.61	15.61	64.04	35.08	20.03	8.42	24.50	26.76	25.69	20.47	20.01	16.12	25.88
	II	29.36	26.52	19.68	5.39	40.54	10.32	16.35	11.80	19.00	13.95	15.01	21.95	19.48
	III	23.54	18.76	16.23	14.74	27.51	11.76	12.60	17.00	21.73	22.76	27.38	33.25	19.05
Sep	I	25.58	15.41	32.28	21.47	10.25	10.35	24.77	45.64	28.52	35.34	46.56	16.05	26.46
	II	6.65	13.88	22.94	17.49	9.03	11.09	17.85	23.18	22.00	19.85	24.68	15.89	17.33
	III	6.53	11.76	19.65	19.75	10.31	10.72	24.87	19.09	19.36	19.07	19.37	13.89	16.47
Oct	I	6.92	17.59	16.40	23.44	14.38	8.23	17.80	29.05	19.87	19.50	20.19	22.15	18.26
	II	8.00	18.21	11.09	12.75	8.45	16.61	15.15	19.68	17.36	17.25	19.15	25.11	16.00
	III	6.99	17.37	26.31	9.35	8.79	13.88	10.44	10.79	18.41	20.61	21.41	13.44	13.70
Nov	I	4.80	11.33	11.67	8.75	6.22	9.12	8.61	9.70	8.61	14.44	18.04	12.49	10.49
	II	4.35	9.38	9.15	6.75	15.89	9.23	7.62	7.74	7.42	14.39	14.39	10.08	9.86
	III	11.73	7.59	6.57	4.60	7.73	8.61	4.80	5.29	4.60	12.63	12.65	8.73	8.10
Dec	I	4.66	7.50	3.91	3.79	6.99	4.93	4.11	4.32	4.05	11.89	12.94	8.37	6.56
	II	3.60	5.97	4.64	3.58	6.39	5.17	4.08	3.63	3.38	10.09	11.84	9.39	6.08
	III	5.18	3.35	5.76	5.69	6.61	4.78	4.65	5.33	5.49	9.49	10.73	9.04	5.86
Jan	I	4.04	2.35	5.83	5.87	5.85	4.32	4.04	5.12	5.14	8.58	9.06	3.94	5.44
	II	3.91	2.41	6.29	6.18	5.57	4.23	3.60	6.12	4.50	6.48	7.10	2.18	4.96
	III	4.78	2.63	3.03	7.05	4.32	4.53	4.37	6.19	4.31	7.08	6.50	2.19	4.39
Feb	I	3.55	2.35	2.42	5.78	5.94	3.45	4.02	5.15	3.68	7.76	8.70	4.22	4.83
	II	1.55	2.06	2.34	5.59	5.53	2.85	3.78	4.44	3.78	6.14	7.04	2.58	4.04
	III	2.00	1.58	2.34	3.23	3.72	2.26	3.25	2.74	3.02	4.35	4.53	2.02	3.71
Mar	I	2.34	1.94	2.83	3.42	7.23	2.76	3.86	3.87	3.80	4.98	5.32	3.14	3.85
	II	2.38	1.96	2.00	3.43	8.58	1.91	4.02	3.51	3.43	5.27	5.06	3.25	3.80
	III	5.13	2.14	2.11	4.22	8.05	2.28	4.32	4.69	4.60	5.74	5.77	3.17	4.02
Apr.	I	1.44	1.95	2.83	4.78	5.90	2.24	4.39	4.43	4.40	5.51	5.53	19.68	5.35
	II	0.91	2.34	2.97	4.94	6.51	8.89	4.38	4.38	4.53	5.22	5.22	13.14	5.38
	III	1.09	2.44	2.38	6.15	6.74	3.46	4.43	4.91	5.70	5.34	5.12	23.08	6.00
May	I	1.54	2.33	4.08	8.93	4.71	10.03	9.95	3.92	5.73	6.57	5.12	5.72	5.82
	II	1.91	4.30	4.35	13.07	3.33	7.97	14.19	4.53	7.09	9.97	4.92	6.88	6.99
	III	7.55	26.70	6.33	30.15	4.02	9.03	21.79	4.97	7.40	9.88	9.91	12.48	11.57
Total		427.52	439.65	509.30	431.42	480.80	420.15	376.53	419.15	409.89	483.69	514.88	421.82	444.53

Annexure A-III.5

	Year	Value	Increasing Order	Dependability
1	1998-99	424.68	514.53	7.69
2	1999-00	438.95	511.90	15.38
3	2000-01	511.90	483.51	23.08
4	2001-02	429.97	479.25	30.77
5	2002-03	479.25	438.95	38.46
6	2003-04	422.13	429.97	46.15
7	2004-05	376.73	424.68	53.85
8	2005-06	421.11	422.13	61.54
9	2006-07	409.98	421.65	69.23
10	2007-08	483.51	421.11	76.92
11	2008-09	514.53	409.98	84.62
12	2009-10	421.65	376.73	92.31

Average	444.533161
75% Dep	421.2448389

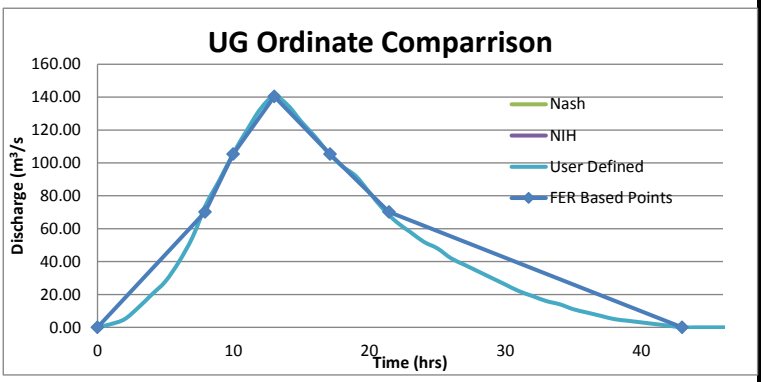
		75% dependable Net Yield
June	I	18.79
	II	23.76
	III	25.70
July	I	25.17
	II	20.49
	III	23.29
August	I	24.52
	II	18.46
	III	18.05
Sep	I	25.07
	II	16.42
	III	15.61
Oct	I	17.31
	II	15.16
	III	12.98
Nov	I	9.94
	II	9.35
	III	7.67
Dec	I	6.22
	II	5.76
	III	5.56
Jan	I	5.15
	II	4.70
	III	4.16
Feb	I	4.58
	II	3.83
	III	3.52
Mar	I	3.65
	II	3.60
	III	3.81
Apr.	I	5.07
	II	5.09
	III	5.69
May	I	5.51
	II	6.63
	III	10.97

Synthetic Unit Hydrograph for Amreng Medium Irrigation Project catchment based on FER Sub-Zone 2(b)										
Name of the Project					Amreng Medium Irrigation Project					
Name of the River					Amreng					
Basin					Bhramaputra					
Sub-Zone								2(b)		
Catchment Area								776.5		Km^2
Length of Longest Stream								86.817		Km
Centroidal Length								40.071		Km
Equivalent Slope							Computed	12.28		m/Km
T_r	1 hr(s)	t_p	12.05 hrs	T_p	13	T_B	43.59 hrs	q_p	0.181	$m^3/s/Km^2$
W_{50}	13.53 hrs	W_{R50}	7.13 hrs	W_{75}	4.64 hrs	W_{R75}	2.58 hrs	Q_p	140.3912	m^3/s

Time	UG Ordinate
0.00	0
7.91	70.1956
9.97	105.2934
13.00	140.3912
17.11	105.2934
21.44	70.1956
43.00	0

UG Ordinates

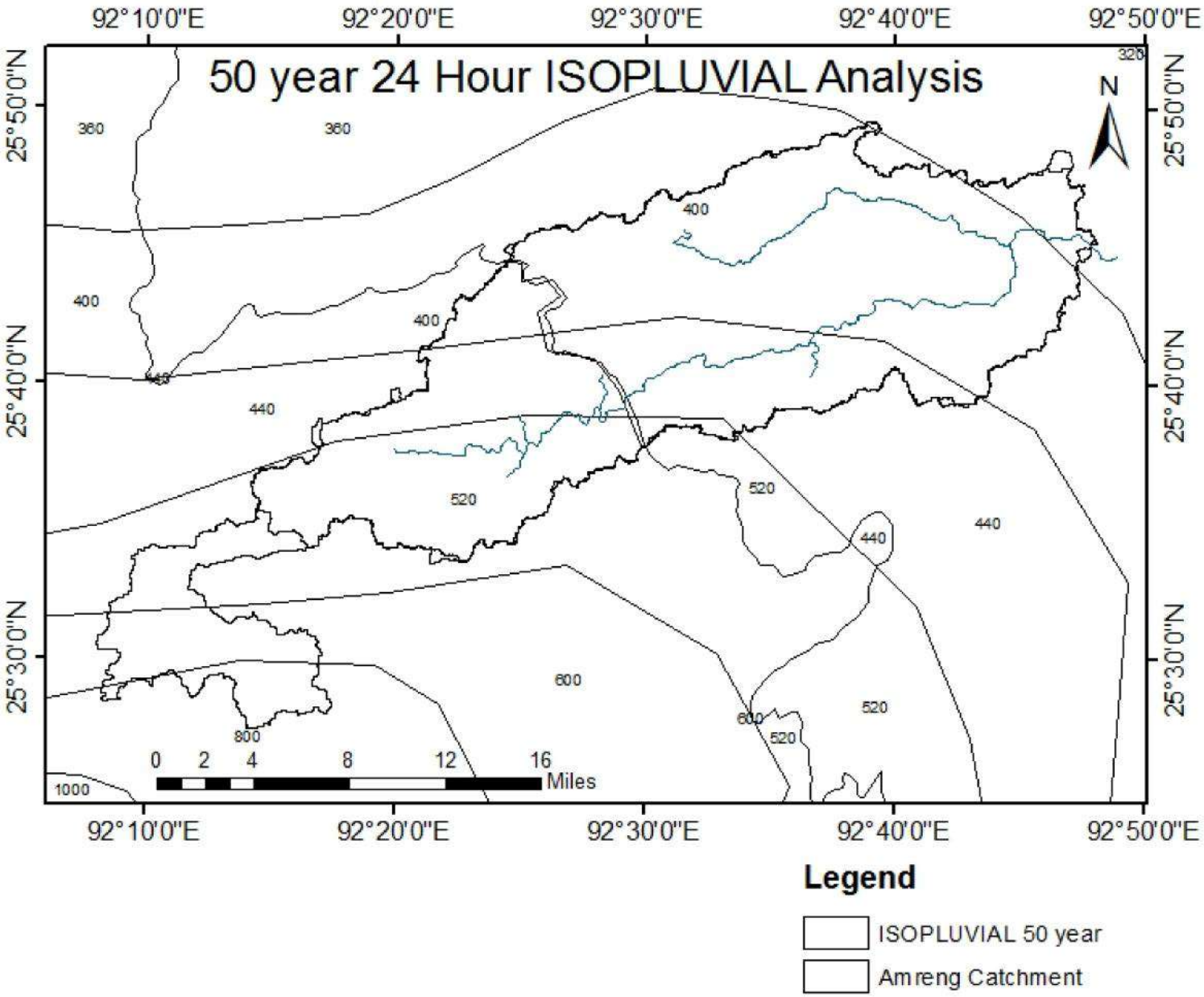
Time			Unit Hydrograph
0			0.00
1			2.00
2			5.00
3			12.00
4			20.00
5			28.00
6			40.00
7			55.00
8			75.00
9			90.00
10			106.00
11			120.00
12			133.00
13			140.44
14			135.00
15			125.00
16			116.00
17			106.00
18			98.00
19			92.00
20			82.00
21			72.00
22			64.00
23			58.00
24			52.00
25			48.00
26			42.00
27			38.00
28			34.00
29			30.00
30			26.00
31			22.00
32			19.00
33			16.00
34			14.00
35			11.00
36			9.00
37			7.00
38			5.00
39			4.00
40			3.00
41			2.00
42			1.00
43			0.00



Volume	
Rainfall	2156.9444
Runoff	2157.44

Recommended Duration	1 Day
Design Flood	B1-B2
	2651.69
	B2-B1
	2815.03

Annexure-A-V.1



Design Storm Analysis for the Catchment of Amreng Medium Irrigation Project Project			
Type of Structure	Barrage		
Type of Design Flood	1 in 50 RP Flood		
Type of Design Storm	1 in 50 RP Rainfall		
Storm Duration	1 day		
Source of Storm	ISOPLUVIAL MAPS		
Time Duration Adopted From PMP Atlas	Brahmaputra Sub-zone 504		
Transposed Depth of Storm	40	cm	From Isopluvial Maps
Correction Factor	0.84		
1 Day 1 in 50 yr rainfall depth	33.6	cm	
24 hours 1 in 50 yr rainfall depth	33.6	cm	
Depth in 1st 12 Hours	25.2	cm	(For 1st 12 hr the rainfall depth as 75 % of 24 hr rainfall depth based on PMP Atlas Brahmaputra Sub-zone 504)
Depth in 2nd 12 Hours	8.4	cm	

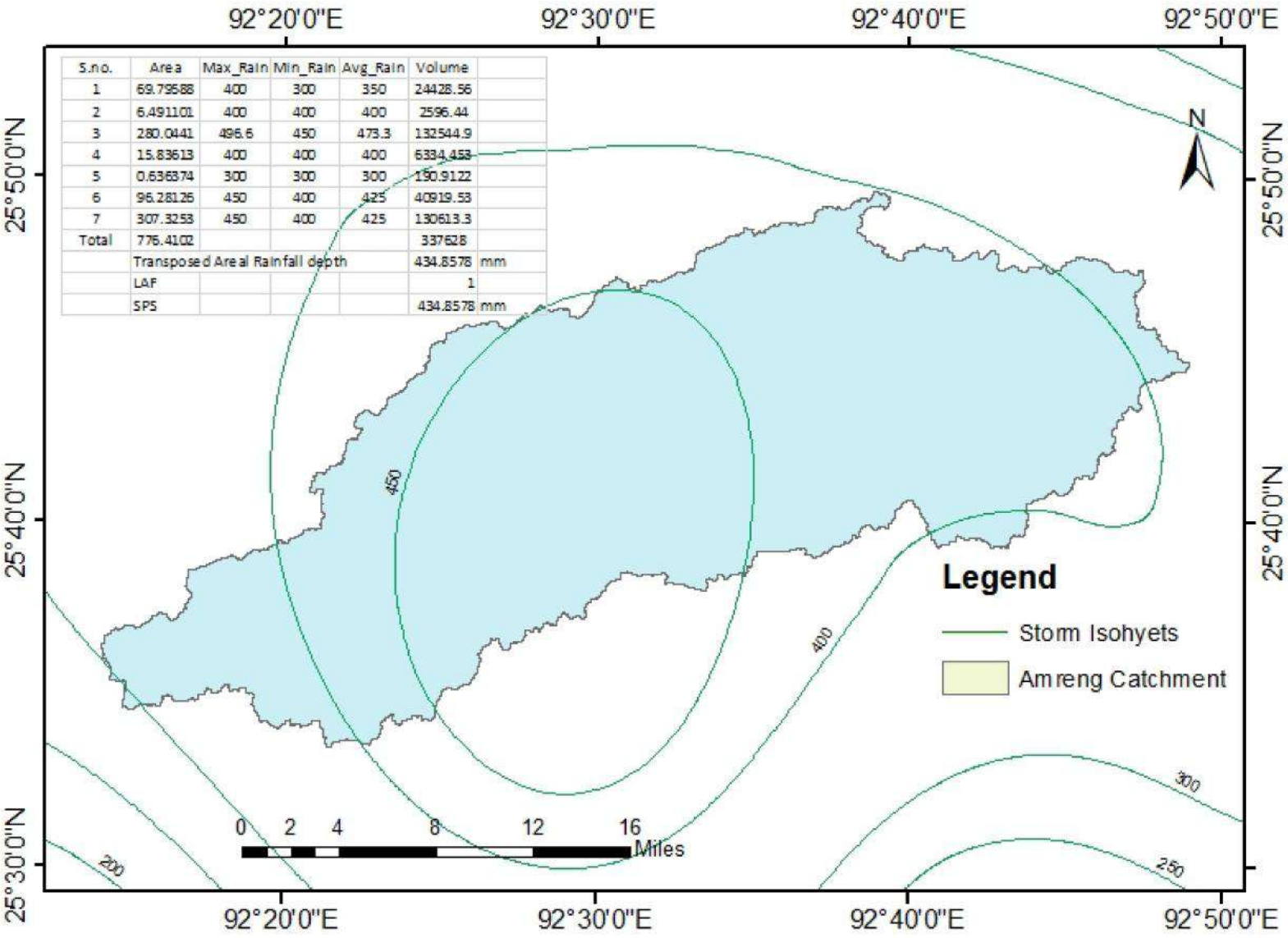
Time hr	Time Distribution coefficient	Normalised Distribution Coefficient	Ist Bell				2nd Bell		
			Cum. Rainfall	Incremental Rainfall	Loss Rate	Rainfall Excess	Cum. Rainfall	Incremental Rainfall	Rainfall Excess
			(cm)	(cm)	cm/hr	(cm)	(cm)	(cm)	(cm)
1	15	20	5.04	5.04	0.35	**4.69**	1.68	1.68	**1.33**
2	26	35	8.74	3.70	0.35	**3.35**	2.91	1.23	**0.88**
3	34	45	11.42	2.69	0.35	**2.34**	3.81	0.90	**0.55**
4	42	56	14.11	2.69	0.35	**2.34**	4.70	0.90	**0.55**
5	48	64	16.13	2.02	0.35	**1.67**	5.38	0.67	**0.32**
6	53	71	17.81	1.68	0.35	**1.33**	5.94	0.56	**0.21**
7	58	77	19.49	1.68	0.35	**1.33**	6.50	0.56	**0.21**
8	62	83	20.83	1.34	0.35	**0.99**	6.94	0.45	**0.10**
9	66	88	22.18	1.34	0.35	**0.99**	7.39	0.45	**0.10**
10	69	92	23.18	1.01	0.35	**0.66**	7.73	0.34	**0.00**
11	72	96	24.19	1.01	0.35	**0.66**	8.06	0.34	**0.00**
12	75	100	25.20	1.01	0.35	**0.66**	8.40	0.34	**0.00**

Annexure-A-5.3

CRITICAL SEQUENCING OF RAINFALL								
Time	UG	Critical Sequencing		Reverse Order		Rainfall Hyetograph		
	ORD	1st	IInd	1st	IInd	Time	BI-B2	B2-B1
(hrs)	(cumecs)	Bell	Bell	Bell	Bell	Hrs	cm	cm
0	0.00			0.66	0.00			
1	2.00			0.66	0.00	1	0.66	0.00
2	5.00			0.99	0.10	2	0.66	0.00
3	12.00			1.33	0.21	3	0.99	0.10
4	20.00			1.33	0.21	4	1.33	0.21
5	28.00			2.34	0.55	5	1.33	0.21
6	40.00			3.35	0.88	6	2.34	0.55
7	55.00			4.69	1.33	7	3.35	0.88
8	75.00			2.34	0.55	8	4.69	1.33
9	90.00	0.66	0.00	1.67	0.32	9	2.34	0.55
10	106.00	0.99	0.10	0.99	0.10	10	1.67	0.32
11	120.00	1.67	0.32	0.66	0.00	11	0.99	0.10
12	133.00	2.34	0.55			12	0.66	0.00
13	140.44	4.69	1.33			13	0.00	0.66
14	135.00	3.35	0.88			14	0.00	0.66
15	125.00	2.34	0.55			15	0.10	0.99
16	116.00	1.33	0.21			16	0.21	1.33
17	106.00	1.33	0.21			17	0.21	1.33
18	98.00	0.99	0.10			18	0.55	2.34
19	92.00	0.66	0.00			19	0.88	3.35
20	82.00	0.66	0.00			20	1.33	4.69
21	72.00					21	0.55	2.34
22	64.00					22	0.32	1.67
23	58.00					23	0.10	0.99
24	52.00					24	0.00	0.66
25	48.00							
26	42.00							
27	38.00							

Computation of Design Flood Hydrograph																										
Synthetic U.G. ordinates in cumecs	Rainfall excess in cm																								Total Design Storm Runoff	Base Flow in m^3/s	Total Flow in m^3/s
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24			
	0.00	0.00	0.10	0.21	0.21	0.55	0.88	1.33	0.55	0.32	0.10	0.00	0.66	0.66	0.99	1.33	1.33	2.34	3.35	4.69	2.34	1.67	0.99	0.66			
0.00	0.00																								0.00	38.83	38.83
2.00	0.00	0.00																							0.00	38.83	38.83
5.00	0.00	0.00	0.00																						0.00	38.83	38.83
12.00	0.00	0.00	0.20	0.00																					0.20	38.83	39.02
20.00	0.00	0.00	0.49	0.42	0.00																				0.91	38.83	39.74
28.00	0.00	0.00	1.18	1.05	0.42	0.00																			2.65	38.83	41.47
40.00	0.00	0.00	1.96	2.52	1.05	1.09	0.00																		6.62	38.83	45.45
55.00	0.00	0.00	2.74	4.20	2.52	2.73	1.76	0.00																	13.96	38.83	52.78
75.00	0.00	0.00	3.92	5.88	4.20	6.55	4.41	2.66	0.00																27.62	38.83	66.45
90.00	0.00	0.00	5.39	8.40	5.88	10.92	10.58	6.65	1.09	0.00															48.92	38.83	87.74
106.00	0.00	0.00	7.35	11.55	8.40	15.29	17.64	15.96	2.73	0.64	0.00														79.56	38.83	118.39
120.00	0.00	0.00	8.82	15.75	11.55	21.84	24.70	26.60	6.55	1.61	0.20	0.00													117.61	38.83	156.44
133.00	0.00	0.00	10.39	18.90	15.75	30.03	35.28	37.24	10.92	3.86	0.49	0.00	0.00												162.86	38.83	201.69
140.44	0.00	0.00	11.76	22.26	18.90	40.95	48.51	53.20	15.29	6.44	1.18	0.00	1.32	0.00											219.80	38.83	258.63
135.00	0.00	0.00	13.03	25.20	22.26	49.14	66.15	73.15	21.84	9.02	1.96	0.00	3.29	1.32	0.00										286.36	38.83	325.18
125.00	0.00	0.00	13.76	27.93	25.20	57.88	79.38	99.75	30.03	12.88	2.74	0.00	7.90	3.29	1.99	0.00									362.73	38.83	401.55
116.00	0.00	0.00	13.23	29.49	27.93	65.52	93.49	119.70	40.95	17.71	3.92	0.00	13.16	7.90	4.97	2.66	0.00								440.63	38.83	479.46
106.00	0.00	0.00	12.25	28.35	29.49	72.62	105.84	140.98	49.14	24.15	5.39	0.00	18.42	13.16	11.93	6.65	2.66	0.00							521.03	38.83	559.86
98.00	0.00	0.00	11.37	26.25	28.35	76.68	117.31	159.60	57.88	28.98	7.35	0.00	26.32	18.42	19.88	15.96	6.65	4.68	0.00						605.67	38.83	644.50
92.00	0.00	0.00	10.39	24.36	26.25	73.71	123.87	176.89	65.52	34.13	8.82	0.00	36.19	26.32	27.83	26.60	15.96	11.69	6.69	0.00					695.22	38.83	734.05
82.00	0.00	0.00	9.60	22.26	24.36	68.25	119.07	186.79	72.62	38.64	10.39	0.00	49.35	36.19	39.76	37.24	26.60	28.06	16.73	9.38	0.00				795.28	38.83	834.11
72.00	0.00	0.00	9.02	20.58	22.26	63.34	110.25	179.55	76.68	42.83	11.76	0.00	59.22	49.35	54.67	53.20	37.24	46.76	40.15	23.45	4.68	0.00			904.98	38.83	943.80
64.00	0.00	0.00	8.04	19.32	20.58	57.88	102.31	166.25	73.71	45.22	13.03	0.00	69.75	59.22	74.55	73.15	53.20	65.46	66.92	56.28	11.69	3.33	0.00		1039.89	38.83	1078.72
58.00	0.00	0.00	7.06	17.22	19.32	53.51	93.49	154.28	68.25	43.47	13.76	0.00	78.96	69.75	89.46	99.75	73.15	93.52	93.69	93.80	28.06	8.33	1.99	0.00	1200.81	38.83	1239.63
52.00	0.00	0.00	6.27	15.12	17.22	50.23	86.44	140.98	63.34	40.25	13.23	0.00	87.51	78.96	105.36	119.70	99.75	128.59	133.84	131.32	46.76	19.99	4.97	1.32	1391.15	38.83	1429.98
48.00	0.00	0.00	5.68	13.44	15.12	44.77	81.14	130.34	57.88	37.35	12.25	0.00	92.41	87.51	119.28	140.98	119.70	175.35	184.03	187.60	65.46	33.32	11.93	3.29	1618.84	38.83	1657.67
42.00	0.00	0.00	5.10	12.18	13.44	39.31	72.32	122.36	53.51	34.13	11.37	0.00	88.83	92.41	132.20	159.60	140.98	210.42	250.95	257.95	93.52	46.65	19.88	7.90	1865.01	38.83	1903.83
38.00	0.00	0.00	4.70	10.92	12.18	34.94	63.50	109.06	50.23	31.56	10.39	0.00	82.25	88.83	139.60	176.89	159.60	247.83	301.14	351.75	128.59	66.64	27.83	13.16	2111.60	38.83	2150.42
34.00	0.00	0.00	4.12	10.08	10.92	31.67	56.45	95.76	44.77	29.62	9.60	0.00	76.33	82.25	134.19	186.79	176.89	280.56	354.68	422.10	175.35	91.63	39.76	18.42	2331.94	38.83	2370.76
30.00	0.00	0.00	3.72	8.82	10.08	28.39	51.16	85.12	39.31	26.40	9.02	0.00	69.75	76.33	124.25	179.55	186.79	310.95	401.52	497.14	210.42	124.95	54.67	26.32	2524.66	38.83	2563.48
26.00	0.00	0.00	3.33	7.98	8.82	26.21	45.86	77.14	34.94	23.18	8.04	0.00	64.48	69.75	115.30	166.25	179.55	328.35	445.02	562.80	247.83	149.94	74.55	36.19	2675.52	38.83	2714.34
22.00	0.00	0.00	2.94	7.14	7.98	22.93	42.34	69.16	31.67	20.61	7.06	0.00	60.54	64.48	105.36	154.28	166.25	315.63	469.91	623.77	280.56	176.60	89.46	49.35	2768.01	38.83	2806.84
19.00	0.00	0.00	2.55	6.30	7.14	20.75	37.04	63.84	28.39	18.68	6.27	0.00	53.96	60.54	97.41	140.98	154.28	292.25	451.71	658.66	310.95	199.92	105.36	59.22	2776.21	38.83	2815.03
16.00	0.00	0.00	2.16	5.46	6.30	18.56	33.52	55.86	26.21	16.74	5.68	0.00	47.38	53.96	91.45	130.34	140.98	271.21	418.25	633.15	328.35	221.58	119.28	69.75	2696.15	38.83	2734.98
14.00	0.00	0.00	1.86	4.62	5.46	16.38	29.99	50.54	22.93	15.46	5.10	0.00	42.11	47.38	81.51	122.36	130.34	247.83	388.14	586.25	315.63	233.97	132.20	78.96	2559.01	38.83	2597.83
11.00	0.00	0.00	1.57	3.99	4.62	14.20	26.46	45.22	20.75	13.52	4.70	0.00	38.16	42.11	71.57	109.06	122.36	229.12	354.68	544.04	292.25	224.91	139.60	87.51	2390.41	38.83	2429.23
9.00	0.00	0.00	1.37	3.36	3.99	12.01	22.93	39.90	18.56	12.24	4.12	0.00	34.22	38.16	63.62	95.76	109.06	215.10	327.91	497.14	271.21	208.25	134.19	92.41	2205.50	38.83	2244.32
7.00	0.00	0.00	1.08	2.94	3.36	10.37	19.40	34.58	16.38	10.95	3.72	0.00	31.58	34.22	57.65	85.12	95.76	191.72	307.83	459.62	247.83	193.26	124.25	88.83	2020.45	38.83	2059.28
5.00	0.00	0.00	0.88	2.31	2.94	8.74	16.76	29.26	14.20	9.66	3.33	0.00	27.64	31.58	51.69	77.14	85.12	168.34	274.37	431.48	229.12	176.60	115.30	82.25	1838.70	38.83	1877.53
4.00	0.00	0.00	0.69	1.89	2.31	7.64	14.11	25.27	12.01	8.37	2.94	0.00	25.00	27.64	47.71	69.16	77.14	149.63	240.91	384.58	215.10	163.27	105.36	76.33	1657.07	38.83	1695.89
3.00	0.00	0.00	0.49	1.47	1.89	6.01	12.35	21.28	10.37	7.08	2.55	0.00	22.37	25.00	41.75	63.84	69.16	135.60	214.14	337.68	191.72	153.27	97.41	69.75	1485.19	38.83	1524.02
2.00	0.00	0.00	0.39	1.05	1.47	4.91	9.70	18.62	8.74	6.12	2.16	0.00	19.74	22.37	37.77	55.86	63.84	121.58	194.07	300.16	168.34	136.61	91.45	64.48	1329.43	38.83	1368.25
1.00	0.00	0.00	0.29	0.84	1.05	3.82	7.94	14.63	7.64	5.15	1.86	0.00	17.11	19.74	33.80	50.54	55.86	112.22	173.99	272.02	149.63	119.95	81.51	60.54	1190.14	38.83	1228.97
0.00	0.00	0.00	0.20	0.63	0.84	2.73	6.17	11.97	6.01	4.51	1.57	0.00	14.48	17.11	29.82	45.22	50.54	98.20	160.61	243.88	135.60	106.62	71.57	53.96	1062.22	38.83	1101.05
0.00	0.00	0.00	0.10	0.42	0.63	2.18	4.41	9.31	4.91	3.54	1.37	0.00	12.50	14.48	25.84	39.90	45.22	88.84	140.53	225.12	121.58	96.63	63.62	47.38	948.51	38.83	987.34
0.00	0.00	0.00	0.00	0.21	0.42	1.64	3.53	6.65	3.82	2.90	1.08	0.00	10.53	12.50	21.87	34.58	39.90	79.49	127.15	196.98	112.22	86.63	57.65	42.11	841.86	38.83	880.69
0.00	0.00	0.00	0.00	0.00	0.21	1.09	2.65	5.32	2.73	2.25	0.88	0.00	9.21	10.53	18.89	29.26	34.58	70.14	113.76	178.22	98.20	79.97	51.69	38.16	747.74	38.83	786.57
0.00	0.00	0.00	0.00	0.00	0.00	0.55	1.76	3.99	2.18	1.61	0.69	0.00	7.24	9.21	15.90	25.27	29.26	60.79	100.38	159.46	88.84	69.97	47.71	34.22	659.04	38.83	697.86
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.88	2.66	1.64	1.29	0.49	0.00	5.92	7.24	13.92	21.28	25.27	51.44	87.00	140.70	79.49	63.31	41.75	31.58	575.85	38.83	614.67
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.33	1.09	0.97	0.39	0.00	4.61	5.92	10.93	18.62	21.28	44.42	73.61	121.94	70.14	56.64	37.77	27.64	497.31	38.83	536.13
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.55	0.64	0.29	0.00	3.29	4.61	8.95	14.63	18.62	37.41	63.57	103.18	60.79	49.98	33.80	25.00	425.31	38.83	464.13
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.32	0.20	0.00	2.63	3.29	6.96	11.97	14.63	32.73	53.54	89.11	51.44	43.32	29.82	22.37	362.32	38.83	401.15
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.00	1.97	2.63	4.97	9.31	11.97	25.72	46.84	75.04	44.42	36.65	25.84	19.74	305.21	38.83	344.04
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.32	1.97	3.98	6.65	9.31	21.04	36.81	65.66	37.41	31.65	21.87	17.11	254.77	38.83	293.60
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.66	1.32	2.98	5.32	6.65	16.37	30.11	51.59	32.73	26.66	18.89	14.48	207.75	38.83	246.57
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.66	1.99	3.99	5.32	11.69	23.42	42.21	25.72	23.32	15.90	12.50	166.73	38.83	205.55
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.99	2.66	3.99	9.35	16.73	32.83	21.04	18.33	13.92	10.53	130.37	38.83	169.19
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.33	2.66	7.01	13.38	23.45	16.37	14.99	10.93	9.21	99.34	38.83	138.17
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.33	4.68	10.04	18.76	11.69	11.66	8.95	7.24	74.34	38.83	113.17
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.34	6.69	14.07	9.35	8.33	6.96	5.92	53.66	38.83	92.49
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.35	9.38	7.01	6.66	4.97	4.61	35.98	38.83	74.81
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.69	4.68	5.00	3.98	3.29	21.63	38.83	60.46
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.34	3.33	2.98	2.63	11.28	38.83	50.11
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.67	1.99	1.97	5.63	38.83	44.45
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.99	1.32	2.31	38.83	41.14
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.66	0.66	38.83	39.48

Storm Analysis



S.no.	Area	Max_Rain	Min_Rain	Avg_Rain	Volume	
1	69.79588	400	300	350	24428.56	
2	6.491101	400	400	400	2596.44	
3	280.0441	496.6	450	473.3	132544.9	
4	15.83613	400	400	400	6334.453	
5	0.636374	300	300	300	190.9122	
6	96.28126	450	400	425	40919.53	
7	307.3253	450	400	425	130613.3	
Total	776.4102				337628	
	Transposed Areal Rainfall depth				434.8578	mm
	LAF				1	
	SPS				434.8578	mm

Design Storm Analysis for the Catchment of Amreng Medium Irrigation Project Project			
Type of Structure	Barrage		
Type of Check Flood	Standard Project Flood		
Type of Check Storm	Standard Project Storm		
Storm Duration	1 day		
Source of Storm	PMP Atlas of Bramputra Basin		
Time Duration Adopted From PMP Atlas	Brahmaputra Sub-zone 504		
Transposed Depth of Storm	43.5	cm	Storm of 15.09.1984 centered at Mathungari
Location Correction Factor	1		
1 Day SPS rainfall depth	43.5	cm	
24 hours SPS rainfall depth	48.5	cm	
Depth in 1st 12 Hours	36.375	cm	(For 1st 12 hr the rainfall depth as 75 % of 24 hr rainfall depth based on PMP Atlas Brahmaputra Sub-zone 504)
Depth in 2nd 12 Hours	12.125	cm	

Time hr	Time Distribution coefficient	Normalised Distribution Coefficient	Ist Bell				2nd Bell		
			Cum. Rainfall	Incremental Rainfall	Loss Rate	Rainfall Excess	Cum. Rainfall	Incremental Rainfall	Rainfall Excess
			(cm)	(cm)	cm/hr	(cm)	(cm)	(cm)	(cm)
1	15	20	7.28	7.28	0.35	**6.93**	2.43	2.43	**2.08**
2	26	35	12.61	5.34	0.35	**4.99**	4.20	1.78	**1.43**
3	34	45	16.49	3.88	0.35	**3.53**	5.50	1.29	**0.94**
4	42	56	20.37	3.88	0.35	**3.53**	6.79	1.29	**0.94**
5	48	64	23.28	2.91	0.35	**2.56**	7.76	0.97	**0.62**
6	53	71	25.71	2.43	0.35	**2.08**	8.57	0.81	**0.46**
7	58	77	28.13	2.43	0.35	**2.08**	9.38	0.81	**0.46**
8	62	83	30.07	1.94	0.35	**1.59**	10.02	0.65	**0.30**
9	66	88	32.01	1.94	0.35	**1.59**	10.67	0.65	**0.30**
10	69	92	33.47	1.46	0.35	**1.11**	11.16	0.48	**0.13**
11	72	96	34.92	1.46	0.35	**1.11**	11.64	0.49	**0.14**
12	75	100	36.38	1.46	0.35	**1.11**	12.13	0.48	**0.13**

CRITICAL SEQUENCING OF RAINFALL								
Time	UG	Critical Sequencing		Reverse Order		Rainfall Hyetograph		
	ORD	1st	IInd	1st	IInd	Time	BI-B2	B2-B1
(hrs)	(cumecs)	Bell	Bell	Bell	Bell	Hrs	cm	cm
0	0.00			1.11	0.13			
1	2.00			1.11	0.13	1	1.11	0.13
2	5.00			1.59	0.30	2	1.11	0.13
3	12.00			2.08	0.46	3	1.59	0.30
4	20.00			2.08	0.46	4	2.08	0.46
5	28.00			3.53	0.94	5	2.08	0.46
6	40.00			4.99	1.43	6	3.53	0.94
7	55.00			6.93	2.08	7	4.99	1.43
8	75.00			3.53	0.94	8	6.93	2.08
9	90.00	1.11	0.14	2.56	0.62	9	3.53	0.94
10	106.00	1.59	0.30	1.59	0.30	10	2.56	0.62
11	120.00	2.56	0.62	1.11	0.14	11	1.59	0.30
12	133.00	3.53	0.94			12	1.11	0.14
13	140.44	6.93	2.08			13	0.13	1.11
14	135.00	4.99	1.43			14	0.13	1.11
15	125.00	3.53	0.94			15	0.30	1.59
16	116.00	2.08	0.46			16	0.46	2.08
17	106.00	2.08	0.46			17	0.46	2.08
18	98.00	1.59	0.30			18	0.94	3.53
19	92.00	1.11	0.13			19	1.43	4.99
20	82.00	1.11	0.13			20	2.08	6.93
21	72.00					21	0.94	3.53
22	64.00					22	0.62	2.56
23	58.00					23	0.30	1.59
24	52.00					24	0.14	1.11
25	48.00							
26	42.00							
27	38.00							

Computation of Design Flood Hydrograph																										
Synthetic U.G. ordinates in cumecs	Rainfall excess in cm																								Total Design Storm Runoff	Base Flow in m^3/s	Total Flow in m^3/s
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24			
	0.13	**0.13**	**0.30**	**0.46**	**0.46**	**0.94**	**1.43**	**2.08**	**0.94**	**0.62**	**0.30**	**0.14**	**1.11**	**1.11**	**1.59**	**2.08**	**2.08**	**3.53**	**4.99**	**6.93**	**3.53**	**2.56**	**1.59**	**1.11**			
0.00	0.00																								0.00	38.83	38.83
2.00	0.27	0.00																							0.27	38.83	39.10
5.00	0.67	0.27	0.00																						0.94	38.83	39.77
12.00	1.62	0.67	0.59	0.00																					2.89	38.83	41.71
20.00	2.70	1.62	1.48	0.92	0.00																				6.72	38.83	45.55
28.00	3.78	2.70	3.56	2.29	0.92	0.00																			13.25	38.83	52.07
40.00	5.40	3.78	5.93	5.50	2.29	1.89	0.00																		24.79	38.83	63.62
55.00	7.42	5.40	8.31	9.17	5.50	4.72	2.86	0.00																	43.37	38.83	82.20
75.00	10.13	7.42	11.87	12.83	9.17	11.32	7.14	4.15	0.00																74.03	38.83	112.85
90.00	12.15	10.13	16.32	18.33	12.83	18.87	17.14	10.38	1.89	0.00															118.03	38.83	156.85
106.00	14.31	12.15	22.25	25.21	18.33	26.41	28.57	24.90	4.72	1.24	0.00														178.09	38.83	216.91
120.00	16.20	14.31	26.70	34.38	25.21	37.73	39.99	41.50	11.32	3.10	0.59	0.00													251.03	38.83	289.86
133.00	17.95	16.20	31.45	41.25	34.38	51.88	57.13	58.10	18.87	7.44	1.48	0.27	0.00												336.40	38.83	375.23
140.44	18.96	17.95	35.60	48.58	41.25	70.75	78.56	83.00	26.41	12.40	3.56	0.68	2.21	0.00											439.91	38.83	478.74
135.00	18.22	18.96	39.46	55.00	48.58	84.90	107.13	114.13	37.73	17.36	5.93	1.62	5.52	2.21	0.00										556.76	38.83	595.58
125.00	16.87	18.22	41.66	60.96	55.00	99.99	128.55	155.63	51.88	24.80	8.31	2.70	13.26	5.53	3.18	0.00									686.55	38.83	725.37
116.00	15.66	16.87	40.05	64.37	60.96	113.20	151.40	186.75	70.75	34.10	11.87	3.78	22.10	13.26	7.95	4.15	0.00								817.22	38.83	856.05
106.00	14.31	15.66	37.08	61.88	64.37	125.46	171.40	219.95	84.90	46.50	16.32	5.40	30.94	22.10	19.08	10.38	4.15	0.00							949.87	38.83	988.70
98.00	13.23	14.31	34.41	57.29	61.88	132.48	189.97	249.00	99.99	55.80	22.25	7.43	44.20	30.94	31.80	24.90	10.38	7.06	0.00						1087.31	38.83	1126.14
92.00	12.42	13.23	31.45	53.17	57.29	127.35	200.60	275.98	113.20	65.72	26.70	10.13	60.77	44.20	44.52	41.50	24.90	17.65	9.97	0.00					1230.74	38.83	1269.56
82.00	11.07	12.42	29.07	48.58	53.17	117.92	192.83	291.41	125.46	74.40	31.45	12.15	82.87	60.78	63.60	58.10	41.50	42.36	24.93	13.85	0.00				1387.91	38.83	1426.74
72.00	9.72	11.07	27.29	44.92	48.58	109.43	178.54	280.13	132.48	82.46	35.60	14.31	99.45	82.88	87.45	83.00	58.10	70.60	59.82	34.63	7.06	0.00			1557.51	38.83	1596.33
64.00	8.64	9.72	24.33	42.17	44.92	99.99	165.69	259.38	127.35	87.07	39.46	16.20	117.13	99.45	119.25	114.13	83.00	98.84	99.70	83.10	17.65	5.12	0.00		1762.27	38.83	1801.09
58.00	7.83	8.64	21.36	37.58	42.17	92.45	151.40	240.70	117.92	83.70	41.66	17.96	132.60	117.13	143.10	155.63	114.13	141.20	139.58	138.50	42.36	12.80	3.18	0.00	2003.57	38.83	2042.39
52.00	7.02	7.83	18.99	33.00	37.58	86.79	139.98	219.95	109.43	77.50	40.05	18.96	146.97	132.60	168.54	186.75	155.63	194.15	199.40	193.90	70.60	30.72	7.95	2.21	2286.48	38.83	2325.30
48.00	6.48	7.02	17.21	29.33	33.00	77.35	131.41	203.35	99.99	71.92	37.08	18.23	155.19	146.97	190.80	219.95	186.75	264.75	274.18	277.00	98.84	51.20	19.08	5.52	2622.59	38.83	2661.42
42.00	5.67	6.48	15.43	26.58	29.33	67.92	117.12	190.90	92.45	65.72	34.41	16.88	149.18	155.19	211.47	249.00	219.95	317.70	373.88	380.88	141.20	71.68	31.80	13.26	2984.06	38.83	3022.89
38.00	5.13	5.67	14.24	23.83	26.58	60.37	102.84	170.15	86.79	60.76	31.45	15.66	138.13	149.18	223.30	275.98	249.00	374.18	448.65	519.38	194.15	102.40	44.52	22.10	3344.42	38.83	3383.25
34.00	4.59	5.13	12.46	22.00	23.83	54.71	91.41	149.40	77.35	57.04	29.07	14.31	128.18	138.13	214.65	291.41	275.98	423.60	528.41	623.25	264.75	140.80	63.60	30.94	3665.01	38.83	3703.83
30.00	4.05	4.59	11.27	19.25	22.00	49.05	82.84	132.80	67.92	50.84	27.29	13.23	117.13	128.18	198.75	280.13	291.41	469.49	598.20	734.05	317.70	192.00	87.45	44.20	3943.83	38.83	3982.66
26.00	3.51	4.05	10.09	17.42	19.25	45.28	74.27	120.35	60.37	44.64	24.33	12.42	108.29	117.13	184.44	259.38	280.13	495.75	663.01	831.00	374.18	230.40	119.25	60.77	4159.70	38.83	4198.52
22.00	2.97	3.51	8.90	15.58	17.42	39.62	68.56	107.90	54.71	39.68	21.36	11.07	101.66	108.29	168.54	240.70	259.38	476.55	700.09	921.03	423.60	271.36	143.10	82.87	4288.45	38.83	4327.28
19.00	2.56	2.97	7.71	13.75	15.58	35.85	59.99	99.60	49.05	35.96	18.99	9.72	90.61	101.66	155.82	219.95	240.70	441.25	672.98	972.55	469.49	307.20	168.54	99.45	4291.93	38.83	4330.76
16.00	2.16	2.56	6.53	11.92	13.75	32.07	54.28	87.15	45.28	32.24	17.21	8.64	79.56	90.61	146.28	203.35	219.95	409.48	623.13	934.88	495.75	340.48	190.80	117.13	4165.18	38.83	4204.00
14.00	1.89	2.16	5.64	10.08	11.92	28.30	48.56	78.85	39.62	29.76	15.43	7.83	70.72	79.56	130.38	190.90	203.35	374.18	578.26	865.63	476.55	359.53	211.47	132.60	3953.16	38.83	3991.98
11.00	1.48	1.89	4.75	8.71	10.08	24.53	42.85	70.55	35.85	26.04	14.24	7.02	64.09	70.72	114.48	170.15	190.90	345.94	528.41	803.30	441.25	345.60	223.30	146.97	3693.09	38.83	3731.92
9.00	1.21	1.48	4.15	7.33	8.71	20.75	37.14	62.25	32.07	23.56	12.46	6.48	57.46	64.09	101.76	149.40	170.15	324.76	488.53	734.05	409.48	320.00	214.65	155.19	3407.12	38.83	3445.95
7.00	0.94	1.21	3.26	6.42	7.33	17.92	31.42	53.95	28.30	21.08	11.27	5.67	53.04	57.46	92.22	132.80	149.40	289.46	458.62	678.65	374.18	296.96	198.75	149.18	3119.51	38.83	3158.33
5.00	0.67	0.94	2.67	5.04	6.42	15.09	27.14	45.65	24.53	18.60	10.09	5.13	46.41	53.04	82.68	120.35	132.80	254.16	408.77	637.10	345.94	271.36	184.44	138.13	2837.15	38.83	2875.97
4.00	0.54	0.67	2.08	4.13	5.04	13.21	22.85	39.43	20.75	16.12	8.90	4.59	41.99	46.41	76.32	107.90	120.35	225.92	358.92	567.85	324.76	250.88	168.54	128.18	2556.33	38.83	2595.15
3.00	0.40	0.54	1.48	3.21	4.13	10.38	20.00	33.20	17.92	13.64	7.71	4.05	37.57	41.99	66.78	99.60	107.90	204.74	319.04	498.60	289.46	235.52	155.82	117.13	2290.81	38.83	2329.64
2.00	0.27	0.40	1.19	2.29	3.21	8.49	15.71	29.05	15.09	11.78	6.53	3.51	33.15	37.57	60.42	87.15	99.60	183.56	289.13	443.20	254.16	209.92	146.28	108.29	2049.95	38.83	2088.78
1.00	0.13	0.27	0.89	1.83	2.29	6.60	12.86	22.83	13.21	9.92	5.64	2.97	28.73	33.15	54.06	78.85	87.15	169.44	259.22	401.65	225.92	184.32	130.38	101.66	1833.97	38.83	1872.79
0.00	0.00	0.13	0.59	1.38	1.83	4.72	10.00	18.68	10.38	8.68	4.75	2.57	24.31	28.73	47.70	70.55	78.85	148.26	239.28	360.10	204.74	163.84	114.48	90.61	1635.15	38.83	1673.97
0.00	0.00	0.00	0.30	0.92	1.38	3.77	7.14	14.53	8.49	6.82	4.15	2.16	21.00	24.31	41.34	62.25	70.55	134.14	209.37	332.40	183.56	148.48	101.76	79.56	1458.37	38.83	1497.19
0.00	0.00	0.00	0.00	0.46	0.92	2.83	5.71	10.38	6.60	5.58	3.26	1.89	17.68	21.00	34.98	53.95	62.25	120.02	189.43	290.85	169.44	133.12	92.22	70.72	1293.29	38.83	1332.11
0.00	0.00	0.00	0.00	0.00	0.46	1.89	4.29	8.30	4.72	4.34	2.67	1.49	15.47	17.68	30.21	45.65	53.95	105.90	169.49	263.15	148.26	122.88	82.68	64.09	1147.55	38.83	1186.38
0.00	0.00	0.00	0.00	0.00	0.00	0.94	2.86	6.23	3.77	3.10	2.08	1.22	12.16	15.47	25.44	39.43	45.65	91.78	149.55	235.45	134.14	107.52	76.32	57.46	1010.55	38.83	1049.38
0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.43	4.15	2.83	2.48	1.48	0.95	9.94	12.16	22.26	33.20	39.42	77.66	129.61	207.75	120.02	97.28	66.78	53.04	882.44	38.83	921.27
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.08	1.89	1.86	1.19	0.68	7.73	9.95	17.49	29.05	33.20	67.07	109.67	180.05	105.90	87.04	60.42	46.41	761.66	38.83	800.49
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.94	1.24	0.89	0.54	5.52	7.74	14.31	22.83	29.05	56.48	94.72	152.35	91.78	76.80	54.06	41.99	651.23	38.83	690.06
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.62	0.59	0.41	4.42	5.53	11.13	18.68	22.83	49.42	79.76	131.58	77.66	66.56	47.70	37.57	554.44	38.83	593.26
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.30	0.27	3.31	4.42	7.95	14.53	18.68	38.83	69.79	110.80	67.07	56.32	41.34	33.15	466.75	38.83	505.58
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.14	2.21	3.32	6.36	10.38	14.53	31.77	54.84	96.95	56.48	48.64	34.98	28.73	389.31	38.83	428.13
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.11	2.21	4.77	8.30	10.38	24.71	44.87	76.18	49.42	40.96	30.21	24.31	317.41	38.83	356.24
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.11	3.18	6.23	8.30	17.65	34.90	62.33	38.83	35.84	25.44	21.00	254.79	38.83	293.61
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.59	4.15	6.22	14.12	24.93	48.48	31.77	28.16	22.26	17.68	199.36	38.83	238.18
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.08	4.15	10.59	19.94	34.63	24.71	23.04	17.49	15.47	152.09	38.83	190.92
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.08	7.06	14.96	27.70	17.65	17.92	14.31	12.16	113.83	38.83	152.65
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.53	9.97	20.78	14.12	12.80	11.13	9.94	82.27	38.83	121.10
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.99	13.85	10.59	10.24	7.95	7.73	55.35	38.83	94.18
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.93	7.06	7.68	6.36	5.52	33.55	38.83	72.38
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.53	5.12	4.77	4.42	17.84	38.83	56.67
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.56	3.18	3.31	9.06	38.83	47.88
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.59	2.21	3.80	38.83	42.63
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.11	1.11	38.83	39.93

Annex-IV

(Office letter head with logo of concerned project authority)

Lr. No. _____ dated_____

CERTIFICATE

Sub: Project Name, State Name- Submission of Certificate

The following certificates are given in respect of **Project Name, State Name** for consolidation and approval of the Project cost.

1. All necessary surveys and investigations for planning of the project and establishing its techno-economic feasibility have been carried out as per the State/Central standard guidelines.
2. 100% of main canal, branch canal & 10% of the command area of the project has been investigated in full details representing terrain conditions in the command for estimation of the conveyance/distributary system upto the last farm gates.
3. 100% of main canal, branch canal and 10% of the distributary system have been investigated in full detail for all type of structures.
4. The quantities of work(s) as taken for cost estimation are worked out as per designs and drawings approved by the competent authority and there will be no deviation during construction/tender.
5. The rates taken for cost estimation of work(s) are as follows.

Sl. No.	Name of the Work/ Name of Department	Price Level	Year of SOR
1		mm/yyyy	yyyy

Cost estimate has been prepared and technically sanctioned as per abovementioned year of SOR(s). The SOR considered for this project is the latest in the respective region and no updated edition/ Government Order has been issued thereafter.

6. Those rates not available in SOR are considered as per current market rates for estimation of cost and relevant documents are provided for the rates.
7. Lead/Lift as well as material consumption/design mix statement has been considered as per site locations in conformity with the standard guidelines of SOR for cost estimation of work(s). Relevant documents have been provided for the same.

Signature
(Project Chief Engineer)
Name
Designation
Office Stamp

10

Name of Project:

Price Level : /Amount in Lakh

Sl. No.	Sub-Head	Expenditure Incurred upto	Balance Cost	Total Cost
	Direct Charges			
I	-Works			
1	A - Preliminary			
2	B - Land			
3	C-Works			
4	D - Regulator			
5	E - Falls			
6	F - C.D. Works			
7	G - Bridges			
8	H - Escape			
9	K - Building			
10	L -(a)Earth work			
11	L-(b)Lining			
12	L-(c)Service Road			
13	L-(d)Tunnel			
14	M - Plantation			
15	O - Miscellaneous			
16	P - Maintenance (1% of I - Works, Less - A, B, O, M, Q, X & Y)			
17	Q - Special T & P			
18	R - Communication			
19	U - Distributaries, Minors & sub-minors			
20	V-Water course			
21	X. Environment & Ecology			
22	Y - Loss in Stock (0.25% of I - Works, Less - A, B, O, M, Q, X & Y)			
	Total of I-Works:			
II	Establishment @ ....% of I-works, Less - 'B' Land (Including 1% of Cost of Control Cell)			
III	Tools & Plants @ ...% of cost of I-Works			
IV	Receipt & Recoveries on Capital Amount			
V	Suspense			
	Total Direct Charges:			
	Indirect Charges:			
a)	Audit and account @ 1% of I - Works			
b)	Abatement of land revenue @ 5% of the cost of land only			
	Total Indirect Charges:			
	Total Direct & Indirect Charges			
				Say in Cr Rs -------- Cr

Signature of competent authority

8

Annex-III

CANAL NETWORK DETAIL

NAME OF PROJECT:
CCA:

S.No.	Name of the canal	Type of the canal(Main/branch/	Length of the canal	Discharge at head of the canal	Lining proposed in a length of	Regulators				Falls				Cross drainage works				Bridges				Escapes			
						Nos.	RDs/Chainages	Type (HR/CR/ Outlet)	Remarks	Nos.	RDs/Chainages	Type of fall	Remarks	Nos.	RDs/Chainages	Type (Aqueeduct/ superpas	Remarks	Nos.	RDs/Chainages	Type (SLR/DLR)	Remarks	Nos.	RDs/Chainages	Type	Remarks
		Total																							
Total no. of structres on Main/branch canals=..... Total no. of structres on Distributaries,minors & sub-minors(in 10% sample area of CCA)=.....																									

9

संख्या/No. 7/42/M&MI/KAAC/Apprl/2012-M&AG/ 1908-11 Annexure-III

भारत सरकार
जल शक्ति मंत्रालय
जल संसाधन नदी विकास एवं गंगा संरक्षण विभाग
केन्द्रीय जल आयोग
प्रबोधन एवं मूल्यांकण निदेशालय

सत्यमेव जयते

Government of India
Ministry of Jal Shakti
Dept. of Water Resources, RD&GR
Central Water Commission
Monitoring & Appraisal Dte.

सेवा में/**To,**

Dated: 26.12.2019

अतिरिक्त मुख्य अभियंता (जोन- IV)/ Additional Chief Engineer(zone-IV)
सिंचाई विभाग/ Irrigation Department
कर्बी आंग्लोंग स्वायत्त परिषद/ Karbi Anglong Autonomous Council
दिफू, असम / Diphu, Assam

विषय/**Sub: Irrigation Planning Chapter in DPR of Amreng Irrigation Project-Reg.**

संदर्भ/Ref :- **letter No.ACEI (Zone-IV)/Amreng/DPR/2018-19/07 dated 27.11.2019**

महोदय/Sir,

Kind reference is invited to the above mentioned letter vide which revised chapter for irrigation planning in the DPR of Amreng Medium Irrigation Project was submitted to this office for examination/ vetting. The revised analysis submitted by the project authorities has been examined as per CWC Guidelines for "Submission, Appraisal & Clearance/Acceptance of Irrigation & Multipurpose Projects, 2010 & 2017" etc. and observations/ comments of this office are as under:

I. General Comments

1. Geo-referenced clear index map preferably in A-0 size & in color showing the details of catchment area, project location, location of G&D sites, availability of Rain gauge stations, headwork, Command Area of the Project, alignment of canal, command of adjacent projects (if any), proposed extension of the command area; etc. as requested vide letter no. 7/42/M&MI/KAAC/Apprl/2012-M&AG/1442-45 dated 30.09.2019 has not been furnished. The same may be submitted.
2. The Irrigation Planning chapter of the DPR may be prepared in the format recommended in the CWC Guidelines for "Submission, Appraisal & Clearance/Acceptance of Irrigation & Multipurpose Projects, 2010 & 2017" and "A guide to prepare chapter on Irrigation Planning Aspects of Detailed Project Report, 2018". It is advised to prepare the chapter with proper & uniform nomenclature, numbering and page number for better referencing.

II. Irrigation Planning Aspect

1. The computational details of crop water requirement as per the Modified Penman Method for the proposed cropping pattern have not been furnished in the report. The details of meteorological parameters viz. Max. Temp, Min. Temp, Relative Humidity, Wind Speed, Sunshine Hours etc. of the climatological station used for the

calculation of ET_0, calculation sheets for calculation of ET_0 and effective rainfall (ER) have also not been furnished. The climatological parameters for Assam have been retrieved from India Meteorological Department website http://www.imd.gov.in/section/climate/climateimp.pdf and Weather Atlas India website https://www.weather-ind.com/en/india/guwahati-climate. Using the values, the ET_0 have been assessed using Modified Penmen Method and the computations in brief are at **Annex-I**.

2. The computational details for estimation of "Effective Rainfall" adopted by the project authorities have not been furnished in the submitted chapter of Irrigation Planning. The effective rainfall values may be assessed based on methodology described in the Guidelines for Irrigation Planning or CWC's publication "A Guide to prepare chapter on Irrigation Planning Aspects of DPR, 2018" and same may be used in estimation of Net Irrigation Requirement. The total rainfall in the command area may be assessed based on areal averaged rainfall observed in or around the Command of the project using IMD's Gridded observed daily rainfall dataset available at $0.25^{\circ}x0.25^{\circ}$ spatial resolution.
3. While estimating the total availability of cropping land and distribution of the land for cultivating various crops according to crop calendar, the project authorities have not accounted for the land requirement for land pre-preparation and leaching and same needs to be accounted in the assessment of total area. The cropping area of each crop has been suitably modified by CWC so as to utilize the whole command along with possibly ensuring a minimum of 75% success rate for the project. The suggested cropping area is provided at **Annex-II**.
4. Field irrigation efficiency adopted for oilseeds as 85% and for sugarcane as 65% does not appear to be in order. Based on "A guide to prepare chapter on irrigation planning aspects of DPR, 2018", the irrigation intensity for ponded crops is generally adopted between 80-85% and for other crops (non-ponded), 65%. Accordingly field efficiency may be adopted as 85% for ponded crops and 65 % for non-ponded crops.
5. Conveyance efficiency has been adopted as 75% for paddy and oilseeds and 70% for all other crops. The conveyance efficiency is not a function of crop but a function of canal type. As recommended by CWC in September 2019, the maximum conveyance efficiency may be restricted to 70%. Adopting the above efficiency, CWC has modified the crop water requirement for each of the crops and brief computations along with total water requirement are enclosed as **Annex-III**.
6. No computations related to success rate for the project has been submitted along with the Irrigation Planning Chapter. The success rate for the project is calculated based on its performance on available water yield and the proposed water demand. The availability of water and the proposed water demand for the project needs to be assessed every year and the project is considered a success if the success rate for the project is more than 75 %. If the project fails in a particular 10-daily duration, the year is considered as a failure. The working tables/simulation study on 10- daily

basis using the net yield series at barrage site and the revised irrigation demand table may be prepared to assess the success rate of the project. CWC has carried out a study for assessment of success rate for the project based on the modified values of cropping areas, evolving with a success rate of 75%. The analysis is enclosed at **Annex-IV**.

7. Based on the above analysis, the maximum water demand appears to be of the order of 5.42 m^3/s after taking into account for 10% allowance for rush irrigation and 0.02 m^3/s for domestic water requirement as recommended in the Irrigation Planning Guidelines and same may be considered for further design of the diversion as well as conveyance structures. However, as intimated that the diversion head-works as well as main canal have already been constructed for 8 m^3/s the same may be adopted in further planning and design of canal & headwork structures. The computations in brief are provided at **Annex-V**.
8. Seeing the experience from Dhansiri Irrigation Project where there is siltation on the canal bed, it would be advisable to have a number of silt trapping basins/ tanks along the alignment of the canal to ensure silt free water for irrigation. This will entail keeping an additional discharge provision at the head regulator so that the desilting pipe/ channel/ duct caries the required discharge for silt-flushing, where convenient. Further each desilter should also have surplussing arrangement to dispose off surplus discharge in the canal system.

This issues with the approval of Chief Engineer, B&BBO, CWC Shillong.

भवदीय / Yours Sincerely,

26/12/2019

(अंकित डुडेजा/ Ankit Dudeja)
उप निदेशक /Deputy Director

प्रतिलिपि सूचनार्थ / **Copy for kind information to:**

1. प्रमुख सचिव, कर्बी आंग्लोंग स्वायत्त परिषद, दिफू, असम/ Principal Secretary, Karbi Anglong Autonomous Council, Diphu, Assam
2. मुख्य अभियन्ता, परियोजना मूल्यांकन संगठन, केंद्रीय जल आयोग, नई दिल्ली/ Chief Engineer (PAO), CWC, New Delhi-110066
3. अधीक्षण अभियंता (समन्वय), ब्रह्मपुत्र एवं बराक बेसिन संगठन,केंद्रीय जल आयोग, शिलाँग - 793001/ Superintending Engineer (C), B&BBO, CWC, Shillong.

द्वितीय तल सी डबलयू सी, काम्पलेक्स
अदाबारी बस स्टैंड के पीछे, गुवाहाटी
दूरभाष: 0361–2972124
ई मेल: dirmaguwahati-cwc@nic.in
♦ जल संरक्षण–सूरक्षित भविष्य♦

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♦Conserve Water- Save Life♦

Annexure-I

	Mean Temp.	RH	Sunshine Hrs	Max Sun Hrs	Wind Speed	Sat VP	Actual VP	f(u)	(1-W)	Aerodynamic Term
	T	RH	n	N	U	ea	ed			
	^{o}C	%	Hrs	Hrs	km/hr	mbar	mbar			mm/day
January	16.9	79	7.3	10.7	0.6	19.4	15.33	0.27	0.35	0.39
February	19.05	65	7.6	11.3	1.2	22	14.30	0.27	0.33	0.69
March	22.85	57	7.1	12	1.4	28.1	16.02	0.27	0.28	0.93
April	25.6	68	6.7	12.8	1.7	33	22.44	0.27	0.25	0.72
May	26.85	75	6.2	13.4	0.6	35.7	26.78	0.27	0.24	0.58
June	28.25	81	4.4	13.8	0.4	39	31.59	0.27	0.23	0.46
July	28.65	83	4	13.6	0.5	40	33.20	0.27	0.23	0.42
August	28.8	82	5.2	13	0.5	40.1	32.88	0.27	0.22	0.43
September	28.1	83	4.6	12.3	0.7	37.8	31.37	0.27	0.23	0.40
October	26.05	82	6.6	11.5	0.7	33.6	27.55	0.27	0.25	0.41
November	22.15	82	7.7	10.9	0.7	26.4	21.65	0.27	0.29	0.37
December	18.15	82	7.5	10.5	0.8	20.6	16.89	0.27	0.34	0.34

	f(t)	f(ed)	f(n)	n/N	Ra	Rns	Rnl	Radiation Term	Aero+ Radiation	C	Eto
					mm/ day	mm/day	mm/day	mm/day	mm/day		mm/day
January	14	0.14	0.73	0.68	10	4.43	1.43	1.95	2.34	1.06	2.48
February	14.4	0.13	0.73	0.67	11.7	5.14	1.37	2.53	3.23	0.92	2.97
March	15.2	0.11	0.64	0.59	13.8	5.65	1.07	3.30	4.22	0.95	4.01
April	15.3	0.085	0.55	0.52	15.35	5.89	0.72	3.88	4.61	0.97	4.47
May	16	0.075	0.52	0.46	16.4	5.92	0.62	4.03	4.61	1	4.61
June	16.3	0.065	0.38	0.32	16.6	5.10	0.40	3.61	4.08	1.07	4.36
July	16.4	0.06	0.37	0.29	16.55	4.93	0.36	3.51	3.94	1.06	4.18
August	16.5	0.06	0.46	0.40	15.75	5.32	0.46	3.79	4.22	1.08	4.56
September	16.3	0.075	0.44	0.37	14.4	4.72	0.54	3.22	3.62	1.06	3.84
October	15.9	0.085	0.61	0.57	12.45	5.01	0.82	3.14	3.55	1.07	3.80
November	15	0.12	0.73	0.71	10.5	4.75	1.31	2.44	2.81	1.06	2.98
December	14.2	0.14	0.73	0.71	9.5	4.33	1.45	1.90	2.24	1.05	2.35

Annexure-II

		HYV Sali	HYV AHU	Wheat	Jute Paddy	Oil Seeds	Pulses	Vegetables	Sugarcane	Total
June	I	0	700	0	750	0	0	0	50	1500
	II	0	700	0	750	0	0	0	50	1500
	III	5200	700	0	750	0	0	0	50	6700
July	I	5200	0	0	750	0	0	0	50	6000
	II	5200	0	0	750	0	0	0	50	6000
	III	5200	0	0	0	0	0	0	50	5250
August	I	5200	0	0	0	0	0	0	50	5250
	II	5200	0	0	0	0	0	0	50	5250
	III	5200	0	0	0	0	0	0	50	5250
Sep	I	5200	0	0	0	0	0	0	50	5250
	II	5200	0	0	0	0	0	0	50	5250
	III	5200	0	0	0	0	1550	0	50	6800
Oct	I	5200	0	0	0	0	1550	0	50	6800
	II	5200	0	0	0	0	1550	0	50	6800
	III	0	0	0	0	950	1550	400	50	2950
Nov	I	0	0	0	0	950	1550	400	50	2950
	II	0	0	850	0	950	1550	400	50	3800
	III	0	0	850	0	950	1550	400	50	3800
Dec	I	0	0	850	0	950	1550	400	50	3800
	II	0	0	850	0	950	1550	400	50	3800
	III	0	0	850	0	950	1550	400	50	3800
Jan	I	0	0	850	0	950	1550	400	0	3750
	II	0	0	850	0	950	1550	400	0	3750
	III	0	0	850	0	950	1550	400	50	3800
Feb	I	0	0	850	750	950	1550	400	50	4550
	II	0	0	850	750	0	0	0	50	1650
	III	0	0	850	750	0	0	0	50	1650
Mar	I	0	700	850	750	0	0	0	50	2350
	II	0	700	850	750	0	0	0	50	2350
	III	0	700	850	750	0	0	0	50	2350
Apr.	I	0	700	0	750	0	0	0	50	1500
	II	0	700	0	750	0	0	0	50	1500
	III	0	700	0	750	0	0	0	50	1500
May	I	0	700	0	750	0	0	0	50	1500
	II	0	700	0	750	0	0	0	50	1500
	III	0	700	0	750	0	0	0	50	1500

Annexure-III

	Sl. No.	Item	JUN			JULY			AUG			SEPT			OCT			NOV			DEC			JAN			FEB			MAR			APR			MAY		
			I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III
			10	10	10	10	10	11	10	10	11	10	10	10	10	10	11	10	10	10	10	10	11	10	10	11	10	10	8	10	10	11	10	10	10	10	10	11
HYV SALI PADDY (IA: 4420 Ha)	1	Evapotranspiration ETo (mm)	43.62	43.62	43.62	41.75	41.75	45.93	45.60	45.60	50.16	38.39	38.39	38.39	38.02	38.02	41.82	29.83	29.83	29.83	23.52	23.52	25.88	24.79	24.79	27.27	29.68	29.68	23.74	40.12	40.12	44.13	44.69	44.69	44.69	46.07	46.07	50.68
	2	Crop Factor KC						1.10	1.00	1.03	1.05	1.05	1.03	1.00	1.05	0.95																								
	3	Consumptive use of crop Etc. mm (=ETox Kc)	0.00	0.00	0.00	0.00	0.00	50.52	45.60	46.74	52.66	40.31	39.35	38.39	39.92	36.12																							
	4	Irrigation requirement for land preparation and leaching				100.00	75.00																															
	5	Perculation losses (mm)						33.00	30.00	30.00	33.00	30.00	30.00	30.00	30.00	30.00																								
	6	Nursery requirement (mm)			15.00	10.00																																
	7	Total Water requirement			15.00	110.00	75.00	83.52	75.60	76.74	85.66	70.31	69.35	68.39	69.92	66.12																							
	8	Total IMD Rainfall (mm)			75.06	75.97	82.44	95.54	78.79	72.90	80.93	66.84	60.92	63.91	58.01	29.10																							
		Effective Rainfall (mm)			15.00	69.00	50.00	68.00	51.00	51.00	68.00	45.00	44.00	45.00	40.00	18.00																							
	9	Net Irrigation Requirement (NIR) (mm)			0.00	41.00	25.00	15.52	24.60	25.74	17.66	25.31	25.35	23.39	29.92	48.12																							
	10	Field Irrigation Efficiency			0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85																							
	11	Field Irrigation Requirement (FIR) mm Col.10/Col.11			0.00	48.24	29.41	18.26	28.94	30.28	20.78	29.78	29.82	27.52	35.20	56.61																							
	12	Conveyance Efficiency			0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70																							
	13	Gross Irrigation Requirement (GIR)			0.00	68.91	42.02	26.09	41.34	43.25	29.69	42.54	42.60	39.31	50.29	80.87																							
	14	Gross Water Requirement GIR(mm)xCrop Area (Hect)x10-3 Ha-m	**0.00**	**0.00**	**0.00**	**358.32**	**218.49**	**135.65**	**214.96**	**224.92**	**154.37**	**221.19**	**221.54**	**204.42**	**261.48**	**420.53**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
HYV AHU Paddy (IA:884 Ha)	1	Evapotranspiration ETo (mm)	43.62	43.62	43.62	41.75	41.75	45.93	45.60	45.60	50.16	38.39	38.39	38.39	38.02	38.02	41.82	29.83	29.83	29.83	23.52	23.52	25.88	24.79	24.79	27.27	29.68	29.68	23.74	40.12	40.12	44.13	44.69	44.69	44.69	46.07	46.07	50.68
	2	Crop Factor KC	0.95	0.95	0.95																										0.00	1.10	1.10	1.08	1.05	1.05	1.00	0.95
	3	Consumptive use of crop Etc. mm (=ETox Kc)	41.44	41.44	41.44																						0.00	0.00	0.00	0.00	0.00	48.55	49.15	48.04	46.92	48.38	46.07	48.14
	4	Irrigation requirement for land preparation and leaching																												100.00	75.00							
	5	Perculation losses (mm)	30.00	30.00	30.00																										0.00	33.00	30.00	30.00	30.00	30.00	30.00	33.00
	6	Nursery requirement (mm)																											13.00	12.00								
	7	Total Water requirement	71.44	71.44	71.44																								13.00	112.00	75.00	81.55	79.15	78.04	76.92	78.38	76.07	81.14
	8	Total IMD Rainfall (mm)	50.81	74.06	75.06																								6.20	5.48	14.97	23.61	28.19	33.19	45.14	41.22	43.95	58.28
		Effective Rainfall (mm)	41.44	41.44	41.44																								3.00	2.50	12.00	18.00	23.00	25.00	32.00	30.00	31.00	37.00
	9	Net Irrigation Requirement (NIR) (mm)	30.00	30.00	30.00																								10.00	109.50	63.00	63.55	56.15	53.04	44.92	48.38	45.07	44.14
	10	Field Irrigation Efficiency	0.85	0.85	0.85																								0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85
	11	Field Irrigation Requirement (FIR) mm Col.10/Col.11	35.30	35.30	35.30																								11.76	128.82	74.12	74.76	66.06	62.40	52.85	56.91	53.03	51.94
	12	Conveyance Efficiency	0.70	0.70	0.70																								0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70
	13	Gross Irrigation Requirement (GIR)	50.42	50.42	50.42																								16.81	184.03	105.88	106.80	94.38	89.14	75.50	81.30	75.75	74.19
	14	Gross Water Requirement GIR(mm)xCrop Area (Hect)x10-3 Ha-m	**35.30**	**35.30**	**35.30**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**11.76**	**128.82**	**74.12**	**74.76**	**66.06**	**62.40**	**52.85**	**56.91**	**53.03**	**51.94**
Wheat (IA: 2040 Ha)	1	Evapotranspiration ETo (mm)	43.62	43.62	43.62	41.75	41.75	45.93	45.60	45.60	50.16	38.39	38.39	38.39	38.02	38.02	41.82	29.83	29.83	29.83	23.52	23.52	25.88	24.79	24.79	27.27	29.68	29.68	23.74	40.12	40.12	44.13	44.69	44.69	44.69	46.07	46.07	50.68
	2	Crop Factor KC																	0.70	0.70	0.70	0.70	1.05	1.05	1.05	1.05	0.85	0.65	0.65	0.65	0.65							
	3	Consumptive use of crop Etc. mm (=ETox Kc)																0.00	0.00	20.88	16.47	16.47	18.11	26.03	26.03	28.64	31.16	25.22	15.43	26.08	26.08	28.69							
	4	Irrigation requirement for land preparation and leaching																	75.00																			
	5	Perculation losses (mm)																																				
	6	Nursery requirement (mm)																																				
	7	Total Water requirement																	75.00	20.88	16.47	16.47	18.11	26.03	26.03	28.64	31.16	25.22	15.43	26.08	26.08	28.69							
	8	Total IMD Rainfall (mm)																	7.54	6.19	1.93	3.81	2.58	3.11	3.91	3.63	5.82	8.85	6.20	5.48	14.97	23.61							
		Effective Rainfall (mm)																	4.00	3.00	0.00	1.00	1.00	1.00	1.00	1.00	2.00	5.00	3.00	3.00	10.00	16.00							
	9	Net Irrigation Requirement (NIR) (mm)																	71.00	17.88	16.47	15.47	17.11	25.03	25.03	27.64	29.16	20.22	12.43	23.08	16.08	12.69							
	10	Field Irrigation Efficiency																	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65							
	11	Field Irrigation Requirement (FIR) mm Col.10/Col.11																	109.23	27.51	25.33	23.80	26.33	38.51	38.51	42.52	44.86	31.11	19.13	35.51	24.74	19.52							
	12	Conveyance Efficiency																	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70							
	13	Gross Irrigation Requirement (GIR)																	156.04	39.30	36.19	33.99	37.61	55.02	55.02	60.74	64.09	44.45	27.32	50.72	35.34	27.88							
	14	Gross Water Requirement GIR(mm)xCrop Area (Hect)x10-3 Ha-m	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**132.64**	**33.41**	**30.76**	**28.89**	**31.97**	**46.77**	**46.77**	**51.63**	**54.47**	**37.78**	**23.22**	**43.12**	**30.04**	**23.70**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Jute Paddy (IA: 2380)	1	Evapotranspiration ETo (mm)	43.62	43.62	43.62	41.75	41.75	45.93	45.60	45.60	50.16	38.39	38.39	38.39	38.02	38.02	41.82	29.83	29.83	29.83	23.52	23.52	25.88	24.79	24.79	27.27	29.68	29.68	23.74	40.12	40.12	44.13	44.69	44.69	44.69	46.07	46.07	50.68
	2	Crop Factor KC	0.89	0.91	0.93	0.98	1.00																					0.52	0.50	0.61	0.63	0.65	0.70	0.72	0.74	0.79	0.82	0.84
	3	Consumptive use of crop Etc. mm (=ETox Kc)	38.82	39.70	40.57	40.92	41.75																					15.43	11.87	24.47	25.28	28.69	31.28	32.17	33.07	36.40	37.78	42.57
	4	Irrigation requirement for land preparation and leaching																									152.00											
	5	Perculation losses (mm)	30.00	30.00	30.00	30.00	30.00																					30.00	24.00	30.00	30.00	33.00	30.00	30.00	30.00	30.00	30.00	33.00
	6	Nursery requirement (mm)																								15.00												
	7	Total Water requirement	68.82	69.70	70.57	70.92	71.75																			15.00	152.00	45.43	35.87	54.47	55.28	61.69	61.28	62.17	63.07	66.40	67.78	75.57
	8	Total IMD Rainfall (mm)	50.81	74.06	75.06	75.97	82.44																			3.63	5.82	8.85	6.20	5.48	14.97	23.61	28.19	33.19	45.14	41.22	43.95	58.28
		Effective Rainfall (mm)	38.82	39.70	40.57	40.92	41.75																			1.00	2.00	5.00	3.00	2.00	10.00	18.00	24.00	27.00	32.00	30.00	31.00	40.00
	9	Net Irrigation Requirement (NIR) (mm)	30.00	30.00	30.00	30.00	30.00																			14.00	150.00	40.43	32.87	52.47	45.28	43.69	37.28	35.17	31.07	36.40	36.78	35.57
	10	Field Irrigation Efficiency	0.85	0.85	0.85	0.85	0.85																			0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85
	11	Field Irrigation Requirement (FIR) mm Col.10/Col.11	35.30	35.29	35.29	35.29	35.30																			16.47	176.47	47.57	38.67	61.73	53.27	51.40	43.86	41.38	36.55	42.82	43.27	41.85
	12	Conveyance Efficiency	0.70	0.70	0.70	0.70	0.70																			0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70
	13	Gross Irrigation Requirement (GIR)	50.43	50.41	50.42	50.42	50.43																			23.53	252.10	67.95	55.24	88.19	76.10	73.42	62.66	59.12	52.21	61.17	61.81	59.78
	14	Gross Water Requirement GIR(mm)xCrop Area (Hect)x10-3 Ha-m	**37.82**	**37.81**	**37.81**	**37.81**	**37.82**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**17.65**	**189.08**	**50.96**	**41.43**	**66.14**	**57.07**	**55.07**	**46.99**	**44.34**	**39.16**	**45.88**	**46.36**	**44.84**

Oil Seed (IA: 2108)	1	Evapotranspiration ETo (mm)	43.62	43.62	43.62	41.75	41.75	45.93	45.60	45.60	50.16	38.39	38.39	38.39	38.02	38.02	41.82	29.83	29.83	29.83	23.52	23.52	25.88	24.79	24.79	27.27	29.68	29.68	23.74	40.12	40.12	44.13	44.69	44.69	44.69	46.07	46.07	50.68
	2	Crop Factor KC																0.53	0.53	0.53	0.86	0.86	0.86	0.68	0.66	0.64	0.62											
	3	Consumptive use of crop Etc. mm (=ETo x Kc)																15.81	15.81	15.81	20.23	20.23	22.25	16.86	16.36	17.45	18.40											
	4	Irrigation requirement for land preparation and leaching															75.00																				
	5	Perculation losses (mm)																																			
	6	Nursery requirement (mm)																																			
	7	Total Water requirement															75.00	15.81	15.81	15.81	20.23	20.23	22.25	16.86	16.36	17.45	18.40											
	8	Total IMD Rainfall (mm)															18.48	5.57	7.54	6.19	1.93	3.81	2.58	3.11	3.91	3.63	5.82											
		Effective Rainfall (mm)															12.00	2.00	3.00	3.00	1.00	1.00	1.00	1.00	1.00	1.00	2.00											
	9	Net Irrigation Requirement (NIR) (mm)															63.00	13.81	12.81	12.81	19.23	19.23	21.25	15.86	15.36	16.45	16.40											
	10	Field Irrigation Efficiency															0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65											
	11	Field Irrigation Requirement (FIR) mm Col.10/Col.11															96.92	21.25	19.71	19.71	29.59	29.59	32.70	24.40	23.64	25.31	25.23											
	12	Conveyance Efficiency															0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70											
	13	Gross Irrigation Requirement (GIR)															138.46	30.36	28.16	28.16	42.27	42.27	46.71	34.86	33.77	36.16	36.04											
	14	Gross Water Requirement GIR(mm)xCrop Area (Hect)x10-3 Ha-m	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**131.54**	**28.84**	**26.75**	**26.75**	**40.15**	**40.15**	**44.38**	**33.11**	**32.08**	**34.36**	**34.24**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Pulses (IA: 272 Ha)	1	Evapotranspiration ETo (mm)	43.62	43.62	43.62	41.75	41.75	45.93	45.60	45.60	50.16	38.39	38.39	38.39	38.02	38.02	41.82	29.83	29.83	29.83	23.52	23.52	25.88	24.79	24.79	27.27	29.68	29.68	23.74	40.12	40.12	44.13	44.69	44.69	44.69	46.07	46.07	50.68
	2	Crop Factor KC													0.44	0.45	0.46	0.91	0.91	0.91	0.97	0.97	0.97	0.73	0.73	0.73	0.24											
	3	Consumptive use of crop Etc. mm (=ETo x Kc)													16.73	17.11	19.24	27.15	27.15	27.15	22.82	22.82	25.10	18.10	18.10	19.91	7.12											
	4	Irrigation requirement for land preparation and leaching												52.00																							
	5	Perculation losses (mm)																																			
	6	Nursery requirement (mm)																																			
	7	Total Water requirement												52.00	16.73	17.11	19.24	27.15	27.15	27.15	22.82	22.82	25.10	18.10	18.10	19.91	7.12											
	8	Total IMD Rainfall (mm)												63.91	58.01	29.10	18.48	5.57	7.54	6.19	1.93	3.81	2.58	3.11	3.91	3.63	5.82											
		Effective Rainfall (mm)												42.00	16.73	17.11	12.00	2.00	3.00	3.00	1.00	1.00	1.00	1.00	1.00	1.00	2.00											
	9	Net Irrigation Requirement (NIR) (mm)												10.00	0.00	0.00	7.24	25.15	24.15	24.15	21.82	21.82	24.10	17.10	17.10	18.91	5.12											
	10	Field Irrigation Efficiency												0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65											
	11	Field Irrigation Requirement (FIR) mm Col.10/Col.11												15.38	0.00	0.00	11.13	38.69	37.15	37.15	33.57	33.57	37.08	26.31	26.31	29.09	7.88											
	12	Conveyance Efficiency												0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70											
	13	Gross Irrigation Requirement (GIR)												21.98	0.00	0.00	15.91	55.27	53.07	53.07	47.95	47.95	52.97	37.58	37.58	41.56	11.26											
	14	Gross Water Requirement GIR(mm)xCrop Area (Hect)x10-3 Ha-m	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**34.07**	**0.00**	**0.00**	**24.66**	**85.67**	**82.26**	**82.26**	**74.33**	**74.33**	**82.10**	**58.25**	**58.25**	**64.42**	**17.45**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Vegetables (IA: 680 Ha)	1	Evapotranspiration ETo (mm)	43.62	43.62	43.62	41.75	41.75	45.93	45.60	45.60	50.16	38.39	38.39	38.39	38.02	38.02	41.82	29.83	29.83	29.83	23.52	23.52	25.88	24.79	24.79	27.27	29.68	29.68	23.74	40.12	40.12	44.13	44.69	44.69	44.69	46.07	46.07	50.68
	2	Crop Factor KC															0.46	0.91	0.91	0.91	0.97	0.97	0.97	0.73	0.73	0.73	0.24											
	3	Consumptive use of crop Etc. mm (=ETo x Kc)															19.24	27.15	27.15	27.15	22.82	22.82	25.10	18.10	18.10	19.91	7.12											
	4	Irrigation requirement for land preparation and leaching																																			
	5	Perculation losses (mm)																																			
	6	Nursery requirement (mm)																																			
	7	Total Water requirement															19.24	27.15	27.15	27.15	22.82	22.82	25.10	18.10	18.10	19.91	7.12											
	8	Total IMD Rainfall (mm)															18.48	5.57	7.54	6.19	1.93	3.81	2.58	3.11	3.91	3.63	5.82											
		Effective Rainfall (mm)															12.00	2.00	3.00	3.00	1.00	1.00	1.00	1.00	1.00	1.00	2.00											
	9	Net Irrigation Requirement (NIR) (mm)															7.24	25.15	24.15	24.15	21.82	21.82	24.10	17.10	17.10	18.91	5.12											
	10	Field Irrigation Efficiency															0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65											
	11	Field Irrigation Requirement (FIR) mm Col.10/Col.11															11.13	38.69	37.15	37.15	33.57	33.57	37.08	26.31	26.31	29.09	7.88											
	12	Conveyance Efficiency															0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70											
	13	Gross Irrigation Requirement (GIR)															15.91	55.27	53.07	53.07	47.95	47.95	52.97	37.58	37.58	41.56	11.26											
	14	Gross Water Requirement GIR(mm)xCrop Area (Hect)x10-3 Ha-m	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**6.36**	**22.11**	**21.23**	**21.23**	**19.18**	**19.18**	**21.19**	**15.03**	**15.03**	**16.62**	**4.50**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Sugarcane (IA: 1292 Ha)	1	Evapotranspiration ETo (mm)	43.62	43.62	43.62	41.75	41.75	45.93	45.60	45.60	50.16	38.39	38.39	38.39	38.02	38.02	41.82	29.83	29.83	29.83	23.52	23.52	25.88	24.79	24.79	27.27	29.68	29.68	23.74	40.12	40.12	44.13	44.69	44.69	44.69	46.07	46.07	50.68
	2	Crop Factor KC	0.89	0.91	0.93	0.98	0.99	1.00	1.00	1.00	0.99	0.94	0.92	0.90	0.85	0.83	0.81	0.76	0.74	0.71	0.61	0.57	0.52				0.52	0.51	0.50	0.61	0.63	0.65	0.70	0.72	0.74	0.79	0.82	0.84
	3	Consumptive use of crop Etc. mm (=ETo x Kc)	38.82	39.70	40.57	40.92	41.34	45.93	45.60	45.37	49.65	36.09	35.32	34.55	32.32	31.56	33.87	22.67	21.93	21.18	14.35	13.29	13.46	0.00	0.00	0.00	15.43	15.13	11.87	24.47	25.28	28.69	31.28	32.17	33.07	36.40	37.55	42.57
	4	Irrigation requirement for land preparation and leaching																								152.00											
	5	Perculation losses (mm)	30.00	30.00	30.00	30.00	30.00	33.00	30.00	30.00	33.00	30.00	30.00	30.00	30.00	30.00	33.00	30.00	30.00	30.00	30.00	30.00	33.00	0.00	0.00	0.00	30.00	30.00	24.00	30.00	30.00	33.00	30.00	30.00	30.00	30.00	30.00	33.00
	6	Nursery requirement (mm)																																			
	7	Total Water requirement	68.82	69.70	70.57	70.92	71.34	78.93	75.60	75.37	82.65	66.09	65.32	64.55	62.32	61.56	66.87	52.67	51.93	51.18	44.35	43.29	46.46	0.00	0.00	152.00	45.43	45.13	35.87	54.47	55.28	61.69	61.28	62.17	63.07	66.40	67.55	75.57
	8	Total IMD Rainfall (mm)	50.81	74.06	75.06	75.97	82.44	95.54	78.79	72.90	80.93	66.84	60.92	63.91	58.01	29.10	18.48	5.57	7.54	6.19	1.93	3.81	2.58	3.11	3.91	3.63	5.82	8.85	6.20	5.48	14.97	23.61	28.19	33.19	45.14	41.22	43.95	58.28
		Effective Rainfall (mm)	38.82	39.70	40.57	40.92	41.34	45.93	45.60	45.37	49.65	36.09	35.32	34.55	32.32	23.00	12.00	2.00	3.00	2.00	1.00	1.00	1.00	1.00	1.00	1.00	2.00	3.00	2.00	2.00	10.00	18.00	22.00	20.00	33.07	36.40	37.55	42.57
	9	Net Irrigation Requirement (NIR) (mm)	30.00	30.00	30.00	30.00	30.00	33.00	30.00	30.00	33.00	30.00	30.00	30.00	30.00	38.56	54.87	50.67	48.93	49.18	43.35	42.29	45.46	0.00	0.00	151.00	43.43	42.13	33.87	52.47	45.28	43.69	39.28	42.17	30.00	30.00	30.00	33.00
	10	Field Irrigation Efficiency	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85
	11	Field Irrigation Requirement (FIR) mm Col.10/Col.11	35.30	35.29	35.29	35.29	35.29	38.82	35.29	35.29	38.83	35.29	35.29	35.30	35.29	45.36	64.56	59.62	57.56	57.86	51.00	49.75	53.48	0.00	0.00	177.65	51.10	49.57	39.85	61.73	53.27	51.40	46.21	49.62	35.29	35.29	35.29	38.82
	12	Conveyance Efficiency	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70
	13	Gross Irrigation Requirement (GIR)	50.43	50.41	50.42	50.42	50.41	55.46	50.41	50.42	55.47	50.41	50.42	50.42	50.41	64.80	92.23	85.17	82.23	82.66	72.86	71.08	76.40	0.00	0.00	253.78	72.99	70.81	56.92	88.19	76.10	73.42	66.02	70.88	50.42	50.41	50.42	55.46
	14	Gross Water Requirement GIR(mm)xCrop Area (Hect)x10-3 Ha-m	**2.52**	**2.52**	**2.52**	**2.52**	**2.52**	**2.77**	**2.52**	**2.52**	**2.77**	**2.52**	**2.52**	**2.52**	**2.52**	**3.24**	**4.61**	**4.26**	**4.11**	**4.13**	**3.64**	**3.55**	**3.82**	**0.00**	**0.00**	**12.69**	**3.65**	**3.54**	**2.85**	**4.41**	**3.80**	**3.67**	**3.30**	**3.54**	**2.52**	**2.52**	**2.52**	**2.77**

Total Irrigation Requirement (Ha-m)			75.64	75.63	75.63	398.65	258.83	138.42	217.48	227.44	157.14	223.71	224.06	241.00	264.00	423.77	167.17	140.87	266.99	167.78	168.06	166.11	183.45	153.16	152.13	197.36	303.39	92.29	79.27	242.49	165.03	157.20	116.36	110.28	94.53	105.31	101.91	99.54
Total Requirement (MCM)			0.76	0.76	0.76	3.99	2.59	1.38	2.17	2.27	1.57	2.24	2.24	2.41	2.64	4.24	1.67	1.41	2.67	1.68	1.68	1.66	1.83	1.53	1.52	1.97	3.03	0.92	0.79	2.42	1.65	1.57	1.16	1.10	0.95	1.05	1.02	1.00
Total	Ha-m		75.64	75.63	75.63	398.65	258.83	138.42	217.48	227.44	157.14	223.71	224.06	241.00	264.00	423.77	167.17	140.87	266.99	167.78	168.06	166.11	183.45	153.16	152.13	197.36	303.39	92.29	79.27	242.49	165.03	157.20	116.36	110.28	94.53	105.31	101.91	99.54

Annexure-V

Month		Crop water Requirement (MCM)	Plus 10% extra for rush irrigation	Domestic Demands (MCM)	Total Demand (MCM)	Total Demand (m3/s)
June	I	0.76	0.08	0.02	0.85	0.99
	II	0.76	0.08	0.02	0.85	0.99
	III	0.76	0.08	0.02	0.85	0.99
July	I	3.99	0.40	0.02	4.41	5.10
	II	2.59	0.26	0.02	2.87	3.32
	III	1.38	0.14	0.02	1.54	1.79
August	I	2.17	0.22	0.02	2.41	2.79
	II	2.27	0.23	0.02	2.52	2.92
	III	1.57	0.16	0.02	1.75	2.02
Sep	I	2.24	0.22	0.02	2.48	2.87
	II	2.24	0.22	0.02	2.48	2.88
	III	2.41	0.24	0.02	2.67	3.09
Oct	I	2.64	0.26	0.02	2.92	3.38
	II	4.24	0.42	0.02	4.68	5.42
	III	1.67	0.17	0.02	1.86	2.15
Nov	I	1.41	0.14	0.02	1.57	1.82
	II	2.67	0.27	0.02	2.96	3.42
	III	1.68	0.17	0.02	1.87	2.16
Dec	I	1.68	0.17	0.02	1.87	2.16
	II	1.66	0.17	0.02	1.85	2.14
	III	1.83	0.18	0.02	2.04	2.36
Jan	I	1.53	0.15	0.02	1.70	1.97
	II	1.52	0.15	0.02	1.69	1.96
	III	1.97	0.20	0.02	2.19	2.54
Feb	I	3.03	0.30	0.02	3.36	3.89
	II	0.92	0.09	0.02	1.04	1.20
	III	0.79	0.08	0.02	0.89	1.03
Mar	I	2.42	0.24	0.02	2.69	3.11
	II	1.65	0.17	0.02	1.84	2.12
	III	1.57	0.16	0.02	1.75	2.02
Apr	I	1.16	0.12	0.02	1.30	1.50
	II	1.10	0.11	0.02	1.23	1.43
	III	0.95	0.09	0.02	1.06	1.23
May	I	1.05	0.11	0.02	1.18	1.36
	II	1.02	0.10	0.02	1.14	1.32
	III	1.00	0.10	0.02	1.11	1.29
Maximum Conveyence Requirement					4.68	5.42

Success Rate Analysis

Units: MCM

		Water Demand	1998-99		1999-00		2000-01		2001-02		2002-03		2003-04		2004-05		2005-06		2006-07		2007-08		2008-09		2009-10	
		MCM	Availability	Excess/ De	Availability	Excess/ De	Availability	Excess/ De	Availability	Excess/ De	Availability	Excess/ De	Availability	Excess/ De	Availability	Excess/ De	Availability	Excess/ De	Availability	Excess/ De	Availability	Excess/ De	Availability	Excess/ De	Availability	Excess/ Def
June	I	0.85	44.32909	43.48	18.64788	17.80	40.43208	39.58	20.50077	19.65	7.322311	6.47	15.75806	14.91	6.026139	5.17	15.65181	14.80	19.20035	18.35	16.25953	15.41	16.81624	15.96	12.98722	12.14
	II	0.85	32.6168	31.76	15.26084	14.41	45.99499	45.14	17.61944	16.77	46.86619	46.01	37.24052	36.39	16.94373	16.09	23.28011	22.43	16.32327	15.47	16.22128	15.37	15.86005	15.01	11.58906	10.74
	III	0.85	16.82049	15.97	28.73678	27.88	55.0597	54.21	18.21441	17.36	27.39386	26.54	73.71183	72.86	11.19383	10.34	22.71064	21.86	16.642	15.79	20.34778	19.50	22.94863	22.10	6.191879	5.34
July	I	4.41	27.75509	23.35	51.84689	47.44	16.41252	12.01	17.90843	13.50	40.0751	35.67	42.23822	37.83	14.53838	10.13	16.44226	12.04	22.91888	18.51	20.76426	16.36	19.63807	15.23	22.84663	18.44
	II	2.87	23.84107	20.97	43.84462	40.98	16.97773	14.11	19.2641	16.40	18.09117	15.22	22.09018	19.22	17.55145	14.68	18.82637	15.96	17.61094	14.74	22.35366	19.49	21.38047	18.51	13.3612	10.49
	III	1.54	61.52866	59.99	21.61123	20.07	11.96261	10.42	32.46126	30.92	55.9377	54.40	15.67434	14.13	17.67979	16.14	14.28594	12.74	20.55942	19.02	27.14142	25.60	28.96924	27.43	11.20998	9.67
August	I	2.41	28.61354	26.20	15.61356	13.20	64.03516	61.62	35.08165	32.67	20.0333	17.62	8.422995	6.01	24.49978	22.09	26.7564	24.34	25.68546	23.27	20.46677	18.05	20.0078	17.60	16.12353	13.71
	II	2.52	29.35724	26.84	26.51841	24.00	19.67632	17.15	5.392927	2.87	40.53832	38.02	10.31838	7.80	16.35302	13.83	11.79729	9.28	19.00061	16.48	13.95191	11.43	15.0101	12.49	21.95418	19.43
	III	1.75	23.54189	21.79	18.76433	17.02	16.22595	14.48	14.74407	13.00	27.50605	25.76	11.75692	10.01	12.59837	10.85	17.00196	15.25	21.73277	19.98	22.76121	21.01	27.37983	25.63	33.25128	31.50
Sep	I	2.48	25.57922	23.10	15.40533	12.92	32.27682	29.80	21.46546	18.98	10.24614	7.77	10.35238	7.87	24.76752	22.29	45.63802	43.16	28.52004	26.04	35.34088	32.86	46.56446	44.08	16.04704	13.57
	II	2.48	6.650852	4.17	13.87967	11.39	22.93588	20.45	17.4877	15.00	9.030709	6.55	11.08759	8.60	17.84893	15.36	23.17811	20.69	22.00093	19.52	19.85056	17.37	24.68252	22.20	15.88555	13.40
	III	2.67	6.531859	3.86	11.75905	9.09	19.65082	16.98	19.74857	17.08	10.31413	7.64	10.72211	8.05	24.87376	22.20	19.08561	16.41	19.36184	16.69	19.06861	16.40	19.37459	16.70	13.88817	11.22
Oct	I	2.92	6.922835	4.00	17.58545	14.66	16.40402	13.48	23.43735	20.51	14.37689	11.45	8.231757	5.31	17.80218	14.88	29.05126	26.13	19.86756	16.94	19.50208	16.58	20.18629	17.26	22.14542	19.22
	II	4.68	8.002271	3.32	18.20591	13.52	11.09184	6.41	12.75349	8.07	8.452744	3.77	16.60801	11.93	15.14609	10.46	19.68057	15.00	17.36021	12.68	17.24972	12.57	19.1536	14.47	25.1075	20.43
	III	1.86	6.993381	5.13	17.37126	15.51	26.314	24.46	9.34944	7.49	8.788473	6.93	13.88392	12.03	10.43865	8.58	10.79393	8.94	18.41372	16.55	20.61084	18.75	21.41489	19.56	13.43515	11.58
Nov	I	1.57	4.802212	3.23	11.32982	9.76	11.66555	10.10	8.754476	7.18	6.217378	4.65	9.124203	7.55	8.605734	7.04	9.702169	8.13	8.609984	7.04	14.44488	12.88	18.03592	16.47	12.49425	10.92
	II	2.96	4.34749	1.39	9.383438	6.43	9.149702	6.19	6.752845	3.80	15.88555	12.93	9.226197	6.27	7.624043	4.67	7.743036	4.79	7.415806	4.46	14.38964	11.43	14.39389	11.44	10.07615	7.12
	III	1.87	11.72505	9.86	7.594295	5.73	6.570106	4.70	4.602474	2.74	7.730287	5.86	8.614234	6.75	4.797963	2.93	5.290933	3.43	4.602474	2.74	12.63024	10.76	12.65149	10.79	8.733227	6.87
Dec	I	1.87	4.661971	2.79	7.496551	5.63	3.914016	2.05	3.786523	1.92	6.990831	5.12	4.925455	3.06	4.109504	2.24	4.317741	2.45	4.050007	2.18	11.89079	10.02	12.94047	11.07	8.371998	6.50
	II	1.85	3.603784	1.76	5.970892	4.12	4.636472	2.79	3.582535	1.74	6.387367	4.54	5.16769	3.32	4.084005	2.24	3.625033	1.78	3.378548	1.53	10.0889	8.24	11.83554	9.99	9.387688	7.54
	III	2.04	5.184264	3.15	3.351774	1.31	5.76393	3.73	5.693809	3.66	6.614729	4.58	4.782238	2.74	4.651346	2.61	5.329181	3.29	5.488121	3.45	9.494356	7.46	10.72848	8.69	9.040908	7.00
Jan	I	1.70	4.037258	2.33	2.345859	0.64	5.826401	4.12	5.873148	4.17	5.851899	4.15	4.321991	2.62	4.041508	2.34	5.116693	3.41	5.142192	3.44	8.575986	6.87	9.060457	7.36	3.943764	2.24
	II	1.69	3.914016	2.22	2.409606	0.72	6.293873	4.60	6.18338	4.49	5.567166	3.87	4.228497	2.54	3.599534	1.91	6.119633	4.43	4.50048	2.81	6.476612	4.78	7.097075	5.40	2.184369	0.49
	III	2.19	4.777564	2.59	2.627193	0.44	3.033893	0.84	7.054152	4.86	4.324116	2.13	4.525129	2.33	4.366188	2.18	6.189329	4.00	4.314767	2.12	7.077526	4.89	6.497861	4.31	2.192444	0.00
Feb	I	3.36	3.552787	0.20	2.345859	-1.01	2.418105	-0.94	5.783903	2.43	5.941144	2.58	3.446544	0.09	4.020259	0.66	5.146442	1.79	3.68028	0.32	7.764285	4.41	8.703479	5.35	4.224247	0.87
	II	1.04	1.546907	0.51	2.056877	1.02	2.33736	1.30	5.592665	4.56	5.528919	4.49	2.851579	1.82	3.782273	2.75	4.436734	3.40	3.782273	2.75	6.140882	5.11	7.037578	6.00	2.583845	1.55
	III	0.89	1.99908	1.11	1.577505	0.69	2.34246	1.45	3.226407	2.33	3.722777	2.83	2.260865	1.37	3.246805	2.35	2.736836	1.84	3.022419	2.13	4.348339	3.46	4.528529	3.64	2.019479	1.13
Mar	I	2.69	2.34161	-0.35	1.937884	-0.75	2.83033	0.14	3.421045	0.73	7.228817	4.54	2.758085	0.07	3.858769	1.17	3.867268	1.18	3.799272	1.11	4.976452	2.29	5.324931	2.64	3.140562	0.45
	II	1.84	2.375608	0.54	1.959133	0.12	2.00163	0.17	3.433794	1.60	8.575986	6.74	1.908136	0.07	4.020259	2.18	3.514539	1.68	3.433794	1.60	5.269684	3.43	5.061447	3.23	3.251055	1.42
	III	1.75	5.132842	3.38	2.136347	0.39	2.112973	0.36	4.221272	2.47	8.045193	6.30	2.281263	0.53	4.319441	2.57	4.688744	2.94	4.604599	2.86	5.740556	3.99	5.773279	4.02	3.16946	1.42
Apr.	I	1.30	1.436414	0.14	1.954883	0.65	2.83458	1.53	4.776714	3.48	5.902896	4.60	2.243866	0.94	4.394237	3.09	4.432484	3.13	4.402736	3.10	5.51192	4.21	5.533169	4.23	19.68482	18.38
	II	1.23	0.909446	-0.32	2.34161	1.11	2.974822	1.74	4.938204	3.71	6.51061	5.28	8.894717	7.66	4.381488	3.15	4.377238	3.14	4.525979	3.29	5.222937	3.99	5.218687	3.99	13.14021	11.91
	III	1.06	1.092185	0.03	2.439354	1.38	2.375608	1.32	6.153631	5.09	6.740096	5.68	3.459293	2.40	4.428235	3.37	4.912706	3.85	5.703158	4.64	5.33768	4.28	5.116693	4.06	23.08037	22.02
May	I	1.18	1.538408	0.36	2.33311	1.15	4.079756	2.90	8.932965	7.75	4.712968	3.53	10.03365	8.86	9.948654	8.77	3.918265	2.74	5.732907	4.55	6.570106	5.39	5.120943	3.94	5.720157	4.54
	II	1.14	1.908136	0.77	4.304992	3.16	4.351739	3.21	13.07222	11.93	3.327551	2.19	7.972522	6.83	14.1899	13.05	4.534478	3.39	7.092825	5.95	9.965653	8.82	4.921205	3.78	6.876088	5.74
	III	1.11	7.549673	6.43	26.702	25.59	6.334246	5.22	30.15194	29.04	4.020259	2.91	9.026884	7.91	21.79354	20.68	4.969227	3.85	7.404756	6.29	9.882358	8.77	9.910406	8.80	12.4815	11.37
Total			FAIL		FAIL		FAIL		SUCCESS		SUCCESS		SUCCESS		SUCCESS		SUCCESS		SUCCESS		SUCCESS		SUCCESS		SUCCESS	

Number of Success Years	9
Total Number of Years	12
Success Rate	75%

GOVERNMENT OF MEGHALAYA
WATER RESOURCES DEPARTMENT

****

No. WR(SCH).40/2012/13 Dated Shillong, the 18th October 2012

From: Shri H. L. Pyrtuh,
Secretary to the Govt of Meghalaya

To: **The Additional Chief Engineer,**
Zone - IV, Irrigation Department,
Government of Assam, DIPHU-782460

Sub: ***Issue of No Objection for construction of Amreng Medium Irrigation Project at Sansika in Karbi Anglong district by Assam Government***

Ref: No. ACEI(Zone-IV)/Tech/5/Part-I/96/169 dated 15-04-2012

Sir,

I am directed to refer to your letter quoted above and to say that the Government of Meghalaya has '**No Objection**" against the proposal for construction of Amreng (Medium) Irrigation Project by Assam Government at **Sansika** of Hamren Subdivision on Amreng (Myntriang) River in Karbi Anglong District of Assam, subject to the following conditions -

(1) Construction of a diversion trough type weir **only** shall be carried out by the Government of Assam across the River Amreng (Myntriang) at Sansika for irrigation purposes only.

(2) There should be no opposition/objection from the Assam Government in utilizing the water of the said River by the Government of Meghalaya upstream of the Diversion Weir at Sansika for any purposes in future.

Yours faithfully,

(H. L. Pyrtuh)
Secretary to the Govt of Meghalaya,
Water Resources Department,
Additional Secretariat Building,
Shillong - 793001

[Contd...P/2]

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Memo No.WR(SCH).40/20[illegible]/13-A, Dated Shillong, the 18th October 2012

Copy to

1) The Chief Engineer, Water Resources, Meghalaya, Shillong for information with reference to his letter No. DIR/IRRI-133/Pt-I/2007-08/51 dated 4-9-2012

2) The Deputy Commissioner, West Jaintia Hills District, Jowai for information

3) The Executive Engineer, Water Resources, Jaintia Hills Division, Jowai for information.

By order, etc,

18/10/12

(H. L. Pyrtuh)
Secretary to the Govt of Meghalaya,
Water Resources Department,
Additional Secretariat Building,
Shillong - 793001

*****

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Government of India
Central Water Commission
Inter State Matters Directorate

411(A), Sewa Bhawan,
R.K.Puram, New Delhi-110066

Sub: DPR of Amreng Irrigation Project (Medium), Assam.
Ref: No.7/42/M&MI/KAAC/Apprl/2012-M&AG/426-27 dated 02.04.2013.

CP-35

Please refer to the letter cited above (copy enclosed) from the Monitoring & Appraisal Directorate,CWC,Guwahati enclosing therewith replies to the comments and the DPR of Amreng Irrigation Project(Medium), Assam for examination from inter-State angle. The Proforma Report of the Project was earlier examined by this Directorate and comments on inter State aspects were conveyed vide this office even letter dated 07.10.2009. The same has been examined from inter-State angle now and further observations are given below:

Comments

(i) With regard to comments at Sl No. (1) of ISM Dte. letter dated 07.10.2009 the quantity of consumptive use of water has been indicated 75.75 MCM as per the cropping pattern and incorporated in Annexure-III of DPR.

(ii) In reply to comments at Sl. No. (2), it also has been stated that N.O.C has been obtained from the Government of Meghalaya vide their letter No. WR (SCH) 40/2012/13 dated 18th October 2012.The N.O.C has been issued with the condition at (2) that "there should be no opposition/objection from the Assam Government in utilizing the water of the said River by the Government of Meghalaya upstream of the Diversion Weir at Sansika for any purposes in future". As this condition is likely to render the proposed Project ineffective in future, therefore the views of the State of Assam on this condition may be conveyed to this Directorate.

(iii) Further, it is observed that the compliance to the comments at Sl. No. (3) is not properly attended and hence a copy of modified DPR may be sent to B&B Wing of MOWR, Brahmaputra Board, Guwahati for their views/comments.

This issues with the approval of Chief Engineer (IMO), CWC.

3/5/13
(B.P.PANDEY)
Director

Director, (M&A) Dte. CWC, 206, CWC Complex, Adabari, Guwahati-781014
CWC U.O.No:7/2/12 (NE)/2010-ISM/ 254 Dated. 03/05/2013

Monitoring and Appraisal Directorate, Guwahati
Dairy No: 359
Date: 8.5.13.

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7/22/2008-Ganga
Government of India
Ministry of Water Resources
(Ganga Wing)
******

Block No.11, 8th Floor, CGO Complex,
Lodi Road, New Delhi-110003

Subject: Proforma Report of Amreng Irrigation Project (Medium), Assam

Ref: Your letter No. CWC/ DMAG/APP/AMRENG/ ASSAM/2(G)/2007/227 dt. 06.02.09

Please refer to MoWR letter no. 31/43/2008-BB/875-76 dated 26.03.2009 vide which B&B Wing's comments from international angle in respect of Bhutan and China were communicated. As regards, India –Bangladesh angle, the project envisages the utilization of water up to a maximum of 8 cusecs from tributary of river Brahmaputra. The river Brahmaputra comes from China to India and then flows to Bangladesh. The consumptive use of water by the above said irrigation project may have affect on the water availability of river Brahmaputra in Bangladesh. However, India does not have any Treaty on sharing of waters of river Brahmaputra or its tributaries with Bangladesh. Therefore, India does not have any obligation on this account with Bangladesh. Report sent vide above letter is being returned back.

Encl: As above

(L.K. Taneja)
Sr. Joint Commissioner-IV (Ganga)

Director (Monitoring & Appraisal Directorate), CWC, Guwahati (Assam)
MOWR U.O. NO.7/22/2008-Ganga/ 1831-32 Dated 17.04.2009

संख्या/No.7/42/M&MI/KAAC/Apprl/2012-M&AG/

भारत सरकार
जल शक्ति मंत्रालय
जल संसाधन नदी विकास एवं गंगा संरक्षण विभाग
केन्द्रीय जल आयोग
प्रबोधन एवं मूल्यांकण निदेशालय

सत्यमेव जयते

Government of India
Ministry of Jal Shakti
Dept. of Water Resources, RD&GR
Central Water Commission
Monitoring & Appraisal Dte.

सेवा में / To, दिनांक: 31 / 01 / 2020

अतिरिक्त मुख्य अभियंता / Additional Chief Engineer(zone-IV)
सिंचाई विभाग / Irrigation Department
कार्बी आंगलौंग स्वायत परिषद / Karbi Anglong Autonomous Council
दिफु, असम / Diphu, Assam

विषय / **Sub**: **Submission of Detailed Design & Estimate of Canal System and Hydraulic Structures for Amreng Irrigation Project (Medium)-Reg.**

संदर्भ / Ref:-**letter No.ACEI (Zone-IV)/Amreng/DPR/2018-19/09 dated 04.01.2020**

महोदय / Sir,

Kind reference is invited to the above mentioned letter vide which revised chapter for Canal Design & its Cost Estimate of Amreng Medium Irrigation Project was submitted for examination/ vetting. The revised analysis submitted by the project authorities has been examined as per CWC Guidelines for “Submission, Appraisal & Clearance/Acceptance of Irrigation & Multipurpose Projects, 2010 & 2017” etc. and observations/ comments of this office are as under:

I. General Comments

1. Geo-referenced clear contour map preferably in A-0 size & in color showing the details of Command Area of the Project, alignment of canal, command of adjacent projects (if any), proposed locations for Diversions, locations for Canal Falls, Bridges, Outlets, siphons, etc. may be submitted along with the DPR.
2. The Design Chapter of the DPR may be prepared in the format recommended in the CWC Guidelines for “Submission, Appraisal & Clearance/Acceptance of Irrigation & Multipurpose Projects, 2010 & 2017”. It is advised to prepare the chapter with proper & uniform nomenclature, numbering and page number for better referencing.

II. Canal Design Aspect

1. The canal network system has been designed for a design capacity of 8 m^3/s for the main canal at the head regulator and its interim distribution to branches & distributaries based on command being covered. As recommended along with the study of Irrigation Planning vide this letter number 7/42/M&MI/KAAC/Apprl/2012-M&AG/1908-11 dated 26.12.2019, the canal network requires a design capacity of 5.42 m^3/s at the project head-works but as the existing systems (head-works & a part of main canal) have already been constructed for 8 m^3/s, the same may be

retained. Further, the distribution of design discharge corresponding to 8 m^3/s also is generally in order as the additional 32% (i.e. distribution w.r.t. 8 m^3/s instead of 5.42 m^3/s) shall provide for discharge needed for silt flushing as suggested vide letter dated 26.12.2020.However, if availability of water yield is a constraint, cost of the project may be reduced, if the system is designed for a lesser discharge carrying capacity.

2. The methodology for assessment of design discharging capacity based on pro-rata basis of cultivable command area being catered by the reach of main canal/ branch/ distributaries is generally in order. However, the computations for discharge carrying capacity for Branch/ Distributaries have computational errors. The error has been rectified and the same is attached at **Annexed-I**.
3. The Main Canal for the project is designed entirely as Lined whereas Branch Canals & Distributaries have been designed for earthen which is generally in order. If warranted/ justifiable, the Branches/ Distributaries having discharge more than 0.5 m^3/s may be designed as lined rectangular channels subject to economic viability.
4. The longitudinal alignment of the canal network which has been stated to be designed based on terrain conditions and command of the project is generally in order.
5. The bed slope for the main canal has been adopted as 1 in 3000 by the project authorities. As the design of main canal has been revised from partially lined to fully lined and general topography is steeper, a higher canal gradient that lies within the permissible velocity criteria recommended by the relevant IS code may be adopted. This shall reduce the problem of siltation and reduce the number of canal falls to be provided. Considering the average slope of the terrain along the canal, a bed slope of 1 in 2500 appears to be reasonable for the main canal system. Based on the design of lined canal section for main canal, the velocity of flow may be assessed and the same must be under permissible range as per IS 10430:2000.
6. Rugosity coefficient of 0.018, canal shape as trapezoidal, canal side slope of 2:1 and methodology of canal design for lined main canal as adopted based on IS 10430:2000 for main canal is generally in order.
7. Free Board provided in the main canal, Branch & Distributary based on design capacity of the canal as recommended in IS 10430:2000 is generally in order.
8. Based on the design discharge and ensuring the flow velocity to be within the permissible range, the cross-section of the main canal in each of the reach have been re-assessed and the canal cross- sections for various reaches of main canal have been summarized at **Annex-II**.

9. The silt factor considered by the project authorities for design of un-lined canal does not appear to be in order according to the standard equation provided in IS 6966:1989. Using standard equation, the silt factor comes out to be 0.96 and the same may be adopted in the study.

10. The side slope for un-lined canal adopted as 2:1 by the project authorities do not appear to be in order according to section **4.2.1 of IS 7112:2002**.A side slope of 1.5:1 in cutting and 1:1 to 1.5:1 in filling as per codal provisions may be adopted.

11. Shape of the canal as Trapezoidal based on recommendation in section 4.1 of the IS 7112:2002 appears to be generally in order. However, in case the design discharge for Branch canal / distributary is quantitatively less, a triangular unlined/ rectangular lined channel section may also be considered, if found economically feasible.

12. For design of unlined canal, flow velocity as recommended by Lacey is one of the most critical parameters. It is observed that based on the cross-section adopted by the project authorities, the design depth is significantly lesser compared to the base width. Using the design, the flow velocity is expected to reduce significantly when the discharge is less than the design discharge. Ensuring the flow velocity (and cross-section perimeter) to be near to lacey's recommended velocity, the cross-sections of unlined canals i.e. Branch canals and Distributaries have been re-assessed and a summary of results with computations in brief are given at **Annexed-III**.

III. Canal Cost Estimate Aspect

1. The quantitative estimate for the canal construction may be re-assessed based on the design finalized as above.
2. The cost of the works adopted in the estimate does not match with the SOR for the year 2015-16 submitted by the project authorities. The latest SOR used in the preparation of Cost estimate may kindly be furnished to this office at the earliest.

Should there be any query on the above, kindly do not hesitate to approach this directorate over phone, whatsapp, email, discussion, etc. any time in the interest of expediting the finalization of the DPR.
This issues with the approval of CE, B&BBO, CWC, Shillong.

संलग्नकः यथापरोक्त

भवदीय / Yours Sincerely,

Signature Not Verified
Digitally signed by RAVI RANJAN
Date: 2020.01.31 16:18:21 IST

(रवि रंजन / Ravi Ranjan)
निदेशक / Director

प्रतिलिपि सूचनार्थ / **Copy for kind information to:**

1. मुख्य अभियंता, ब्रह्मपुत्र एवं बराक बेसिन संगठन केन्द्रीय जल आयोग, शिलॉगं।
2. निदेशक, नदी प्रबंधन समन्वय निदेशालय, केन्द्रीय जल आयोग, नई दिल्ली।

द्वितीय तल सीडबलयूसी, काम्पलेक्स
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♦Conserve Water- Save Life♦

AMRENG IRRIGATION PROJECT (MEDIUM)

Calculation of Design Discharge of Canal System

Name of Canal	Chainage (in m)		Length	Catered Command	Required Discharge (in Cumec)	Cumulative / Design Discharge (in Cumec)	Remarks
	From	To					
[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]
	m	m	m	Ha	m3/s	m3/s	
Main Canal	24000.00	23145.00	855.00	204.30	0.24	0.300	
B7	2850.00	0.00	2850.00	268.45	0.32	**0.350**	
Main Canal	23145.00	18600.00	4545.00	828.35	0.97	1.020	
B6	4075.00	3420.00	655.00	25.60	0.03	**0.050**	
B6D6	965.00	0.00	965.00	29.80	0.04	**0.050**	
B6	3420.00	0.00	3420.00	250.00	0.29	**0.300**	
Main Canal	18600.00	17725.00	875.00	1204.45	1.42	1.440	
B5	7745.00	3570.00	4175.00	359.40	0.42	**0.450**	
B5D5	2520.00	0.00	2520.00	241.50	0.28	**0.300**	
B5	3570.00	0.00	3570.00	832.65	0.98	**1.000**	
Main Canal	17725.00	17100.00	625.00	2055.65	2.42	2.450	
B4	6090.00	975.00	5115.00	511.25	0.60	**0.600**	
B4D4	2060.00	0.00	2060.00	267.95	0.32	**0.350**	
B4	975.00	0.00	975.00	816.15	0.96	**1.000**	
Main Canal	17100.00	13700.00	3400.00	3186.70	3.75	3.760	
B3	10610.00	4375.00	6235.00	811.25	0.95	**1.000**	
B3D1	2940.00	0.00	2940.00	302.05	0.36	**0.400**	
B3	4375.00	0.00	4375.00	1713.10	2.02	**2.100**	
Main Canal	13700.00	13475.00	225.00	4916.45	5.78	5.790	
B2	3945.00	1295.00	2650.00	416.45	0.49	**0.500**	
B2D1	2015.00	0.00	2015.00	163.75	0.19	**0.200**	
B2	1295.00	0.00	1295.00	712.70	0.84	**0.850**	
Main Canal	13475.00	8245.00	5230.00	6197.60	7.29	7.290	
B1	2685.00	0.00	2685.00	434.20	0.51	**0.550**	
Main Canal	8245.00	6010.00	2235.00	6800.00	8.00	8.000	

\ *Discharge of Main Canal at Ch. 0.00m = 8.00 Cumec*

Annex-II

Amreng (Medium) Irrigation Project: Canal Design

Design of Main Canal Cross-section

	Slope	**1**	**:**	**2500**				
	n			**0.018**				
	Side Slope	**1**	**:**	**2**				
	MC1	MC2	MC3	MC4	MC5	MC6	MC7	MC8
Reach	0-8245	8245-13475	13475-13700	13700-17100	17100-17725	17725-18600	18600-23145	23145-24000
Design Discharge	**8.0**	**7.3**	**5.8**	**3.7**	**2.4**	**1.4**	**1.0**	**0.2**
Depth	1.90	1.80	1.70	1.50	1.20	1.00	0.90	0.60
Width	0.75	0.75	0.75	0.40	0.75	0.50	0.50	0.25
Area	8.65	7.83	7.06	5.10	3.78	2.50	2.07	0.87
Perimeter	9.25	8.80	8.35	7.11	6.12	4.97	4.52	2.93
Vilocity	1.06	1.03	0.99	0.89	0.81	0.70	0.66	0.49
Discharge Carrying Capacity	***9.18***	***8.05***	***7.00***	***4.54***	***3.05***	***1.76***	***1.37***	***0.43***
Free Board	0.60	0.60	0.60	0.60	0.50	0.50	0.50	0.30
Design Width	**0.75**	**0.75**	**0.75**	**0.40**	**0.75**	**0.50**	**0.50**	**0.25**
Design Depth	**2.50**	**2.40**	**2.30**	**2.10**	**1.70**	**1.50**	**1.40**	**0.90**

Annex-III

Amreng (Medium) Irrigation Project: Canal Design

Design of Branch Canal

Name	Reach	Design Discharge	Lacy's velocity	B	D	Free Board	Base width	Depth of Canal	Bed Slope		Actual velocity
B1	0-2685	0.55	0.39	0.40	1.00	0.50	0.40	1.50	1 in	3200	0.29
B2	0-1295	0.85	0.42	1.00	1.00	0.50	1.00	1.50	1 in	3500	0.34
B2D2	1295-3945	0.5	0.39	0.45	0.90	0.50	0.45	1.40	1 in	3200	0.31
B3	0-4375	2.1	0.49	1.25	1.50	0.50	1.25	2.00	1 in	3900	0.40
B3D3	4375-10610	1	0.43	1.50	1.00	0.50	1.50	1.50	1 in	3550	0.33
B4	0-975	1	0.43	1.50	1.00	0.50	1.50	1.50	1 in	3900	0.33
B4D4	975-6090	0.6	0.40	0.80	0.90	0.50	0.80	1.40	1 in	3300	0.31
B5	0-3570	1	0.43	1.00	1.20	0.50	1.00	1.70	1 in	3600	0.30
B5D5	3570-7745	0.45	0.38	0.60	0.80	0.50	0.60	1.30	1 in	3100	0.31
B6	0-3420	0.3	0.35	0.60	0.70	0.50	0.60	1.20	1 in	3900	0.26
B6D6	3420-4075	0.05	0.26	0.00	0.40	0.50	0.00	0.90	1 in	2000	0.21
B7	0-2850	0.35	0.36	0.50	0.70	0.50	0.50	1.20	1 in	3000	0.32

Design of Distributary

Name	Reach	Design Discharge	Lacy's velocity	B	D	Free Board	Base width	Depth of Canal	Bed Slope		Actual velocity
D2	0-2015	0.2	0.33	0	0.65	0.5	0	1.15	1 in	2750	0.32
D3	0-2940	0.4	0.37	0.3	0.9	0.5	0.3	1.4	1 in	3000	0.27
D4	0-2060	0.35	0.36	0	0.95	0.5	0	1.45	1 in	3000	0.26
D5	0-2520	0.3	0.35	0	0.85	0.5	0	1.35	1 in	3000	0.28
D6	0-965	0.05	0.26	0	0.4	0.5	0	0.9	1 in	2050	0.21

Annexure-VII

भारत सरकार
जल शक्ति मंत्रालय
जल संसाधन नदी विकास एवं गंगा संरक्षण विभाग
केन्द्रीय जल आयोग
बराज एवं नहर अभिकल्प (पू.एवं उ.पू.) निदेशालय

सत्यमेव जयते

Government of India
Ministry of Jal Shakti
Dept. of Water Resources, RD&GR
Central Water Commission
Barrage & Canal Design (E&NE) Dte.

To,
The Superintending Engineer (C)
Office of the Chief Engineer,
Brahmaputra & Barak Basin Organization,
CWC, Shillong

Subject: vetting of DPR stage Design/drawings of Barrage, Head regulator and Canal for Amreng Irrigation Project (Medium) of KKAC, Assam-reg

Ref: File No. T-28014/4/2020-BBBO-SHILLONG, Dated: 11/06/2020

Kind reference is invited to the letter cited above on the subject received via e-mail from Superintending Engineer (C), Brahmaputra & Barak Basin Organization forwarding therewith the design/ drawings of Barrage and Head regulator for Amreng Irrigation Project (Medium) of KKAC, Assam requesting therein vetting of the aforementioned with respect to barrage and canal aspects.

Being a medium project, the DPR was appraised in the regional office of CWC, in the office of Chief Engineer, Brahmaputra & Barak Basin Organization, CWC in line with the guidelines of PAO, CWC, on appraisal of the DPR. However, as mentioned in the letter under reference, due to lack of expertise in regional office of Chief Engineer, Brahmaputra & Barak Basin Organization, CWC, the design/drawings have been forwarded to CWC, headquarters for vetting.

The submitted design has been checked from barrage and canal design aspects in this office in respect of hydraulic design of barrage & canal head regulator and stability analysis of barrage. The structural design of the barrage structure has not been examined as the relevant details are not available. It is observed that:

1. The calculations in respect of hydraulic design of barrage & canal head regulator are almost in order.
2. The project authorities have fixed the length of the floor as 80 m from the consideration of stability analysis, even though as per hydraulic calculation the length of barrage floor required is 70m only. Though, there may be some scope in reducing the length of barrage floor but length provided as 80 m is safe and may be adopted.

Besides above, the following calculation mistakes were also observed:

1. In the stability analysis of barrage, while correcting the value of φ_{C1} for mutual interference of D/S pile, the value of "D" is taken as 7m (97-90), which is incorrect. The value of "D" must be taken below the level at which interference is desired which should be 12m (102-90). Accordingly, the corrected values of residual pressures will be used in the calculations of uplift pressure. Project authorities are requested to revisit the design calculations and correct the anomaly.

2. Similarly, while correcting the value of φ_{E2} for mutual interference of U/S pile, the design calculations may be modified in accordance to the observations made above in point no. “3".
3. In the stability analysis of barrage, depth of cut-off is not mentioned in the figure. However, it is advised that cut-offs at both U/S and D/S end of the raft floor may be provided which will aid in stability of barrage by improving sand box action.
4. While calculating the weight of raft in the stability analysis of barrage, weight of sheet piles is also taken in consideration. It is advisable to neglect the weight of sheet piles and instead use only the weight of cut-off.
5. In the design of canal head regulator, while calculating the effective width of waterway the drowning ratio used is “ratio of D/S water level above crest (h_d) to U/S water level above crest (h_e)” for which value of h_d should be 1.25m (105.75-104.5) instead of (107-105.75). However, the final value calculated is by chance correct and waterway provided is safe.Other design calculations in the design of canal head regulator, seems appropriate and are generally in order.
6. There are some typographical mistakes in the document like number of bays in spillway, discharge in the canal etc. which may be reconciled and corrected.

This issues with the approval of Chief Engineer, Design (E&NE), CWC, New Delhi.

Samir Kumar Shukla
Director, BCD (E&NE)

Copy To:

1) Chief Engineer, Brahmaputra & Barak Basin Organization, CWC, Shillong
2) Chief Engineer, PAO, CWC, Sewa Bhawan, R.K.Puram, New Delhi

926(S), सेवा भवन
आर.के.पुरम, नई दिल्ली-110066
दूरभाष: 011-29583394
ई मेल: bcdenedte@nic.in
जल संरक्षण-सुरक्षित भविष्य

926 (S), Sewa Bhawan
R.K. Puram, New Delhi-110066
Contact No: 011-29583394
E.mail: bcdenedte@nic.in
Conserve water-save life

No. 1/21/2015[6]/GD (E&NE)/
Government of India
Central Water Commission
Gates Design (E&NE) Dte.
***

Tel: +91 11 2958 3393
Email: gdenedte@nic.in
R. No. 919(N), Sewa Bhawan,
R.K. Puram, New Delhi-66
Date: 03.11.2020

To,
Director,
M & A Directorate,
CWC Complex, 2nd Floor,
Behind Adabari Bus stand,
P.O. Jalukbari, Guwahati- 781014

विषय: Technical examination of DPR stage Hydro- mechanical equipment design for Amreng Irrigation Project (Medium) of KAAC –reg.

Ref:- No. T-28014/2/2020-MA-Guwahati Dated: 04.09.2020

Reference is invited to above cited letter vide which DPR stage Hydro- mechanical equipment design for Amreng Irrigation Project (Medium) of KAAC were submitted to this office for technical examination. In this context, it is intimated that design chapter & drawings have been examined so far provisions of Hydromechanical equipment are concerned and our observations are as under:-

i) The weight of gate leaf, embedded parts and their operating arrangements are on slightly higher side which may be revised/ corrected appropriately or alternatively preliminary design calculations may be done for assessment of weight of gate leaf, embedded parts and their operating arrangements.

ii) With the given layout/ civil details, the provision of top seal arrangement for head regulator gate cannot be incorporated. However, the head regulator gates will require provisions of top sealing arrangement (both service and emergency gate) in order to arrest/stop the flow of water from above the top of gate (gate in fully closed position) under HFL conditions. It is therefore, suggested that well type intake arrangement or alternatively Breast wall arrangement may be incorporated in order to fulfill the above said requirement.

Encl.: As above

This issue with the approval of Chief Engineer, Designs (E&NE).

भवदीय,
Signature Not Verified
Digitally signed by HARKESH KUMAR
Date: 2020.11.06 13:49:38 IST

(हरकेश कुमार)
(Harkesh Kumar)
निदेशक/**Director**

भारत सरकार
जल शक्ति मंत्रालय
जल संसाधन नदी विकास एवं गंगा संरक्षण विभाग
केन्द्रीय जल आयोग
प्रबोधन एवं मूल्यांकण निदेशालय

Government of India
Ministry of Jal Shakti
Dept. of Water Resources, RD&GR
Central Water Commission
Monitoring & Appraisal Dte.

सेवामें / To,

Annexure-IX

अतिरिक्त मुख्य अभियंता / Additional Chief Engineer(zone-IV)
सिंचाई विभाग / Irrigation Department
कार्बी आंगलौंग स्वायत परिषद / Karbi Anglong Autonomous Council
दिफु, असम / Diphu, Assam

विषय / Sub : Technical examination of DPR stage Cost Estimate of Amreng Irrigation Project (Medium) of KAAC –reg.

संदर्भ / Ref: letter no. ACEI(Zone-IV)/Amreng/DPR/2018-19/46 dated 23.11.2020

महोदय / Sir,

Kindly refer to the letter under reference vide which fresh cost estimate chapter of DPR for Amreng Irrigation Project with an estimated cost of Rs. 760 Cr. has been submitted to this office for examination/ appraisal. The cost estimate chapter has been examined and the head wise finalised cost of the project is tabulated below:

(Rs. In Lakhs)

Head	Works	Already Executed	Balance	Total
	Existing SMI Schemes within command	4778.00	0.00	4778.00
	I-Works		0.00	
A	Preliminary L.S.	316.19	46.00	362.19
B	Land	60.00	1846.70	1906.70
C	Works			
	(i) Coffer Dam	0.00	746.34	746.34
	(ii) Barrage	0.00	10433.57	10433.57
	(iii) Appurtenant works of barrage	0.00	9347.12	9347.12
D	Regulator	356.40	225.06	581.46
E	C.C. Falls	50.00	725.42	775.42
F	Crossed drainage work syphon & Aqueduct/Tail Cluster	81.43	201.30	282.73
G	Bridges and culverts	85.00	623.37	708.37
H	Escapes and outlets	0.00	9.02	9.02
K	Buildings	67.00	2471.20	2538.20
L	Canal system			
	i) Jungle clearance	7.69	63.30	70.99
	ii) Earth work Main canal /Distributory/ Minor / sub-minor	882.91	2559.36	3442.27
	iii) Turfing	0.00	415.26	415.26
	iv) C.C. lining	0.00	1920.36	1920.36
	v)Inspection Path	0.00	1706.14	1706.14
M	Plantation	2.04	33.16	35.20
O	Miscellaneous	0.00	993.80	993.80
P	Maintenance	10.00	247.19	257.19
Q	Special T & P	0.00	149.49	149.49

R	Communication	50.00	666.40	716.40
U	Distributory, Minor and Sub-minor	0.00	292.10	292.10
V	Water course and field channel	0.00	2047.00	2047.00
W	Drainage	0.00	247.55	247.55
X	Environment and ecology	0.00	5.00	5.00
Y	Losses on stock	0.00	59.93	59.93
	Total of I-Works	6746.66	38081.15	45184.21
II	Establishment charges (9% of I-works less B-land)			3894.98
III	Tools and plants (1% of I-Works)			451.84
IV	Suspense			0.00
V	Receipt and recoveries (-)			-807.35
	Total Direct charges			48723.67
	Indirect charges			0.00
	i) Capital abatement of land (5% of the culturable land cost)			92.34
	II) Audits and Accounts (1% of I works)			451.84
	Total cost of the project	6746.66	47299.19	54045.85

The Finalised cost of the Amreng Irrigation project is Rs. 540.4585 Cr. (Rupees Five Hundred and Forty Crore Forty-Five Lakhs and Eighty-Five Thousand Only) out of which works equivalent to Rs. 67.4666 Cr (Rupees sixty-seven crore, forty-six lakhs and sixty-six thousand only) has already been executed (which may or may not be utilised in the proposed proposal) and the balance amount for the project is Rs. 472.9919 Cr (Rupees Four Hundred and Seventy-two crore, ninety-nine lakhs and nineteen thousand only).

The approval of Chief Engineer, B&BBO, CWC Shillong has been accorded vide letter no. 2(5)/2016-BBB/Amreng/016-20 dated 30.11.2020.

Further, it is re-iterated that the certificates enclosed along with the check list as recommended in prevailing guidelines have not been issued/ countersigned by the recommended authority. The certificates titled from Appendix-A to Appendix-M may be submitted issued/ countersigned by the competent authority as per the recommendation of prevailing guidelines.

भवदीय / Yours Sincerely

संलग्नः यथापरोक्त

Signature Not Verified
Digitally signed by SUDHIR KUMAR
Date: 2020.12.03 10:07:32 IST

(सुधीर कुमार/ Sudhir Kumar)
निदेशक / Director

प्रतिलिपि सूचनार्थ / Copy for kind information to

a) अधीक्षण अभियंता (स•)ए ब्रह्मपुत्र एवं बराक बेसिन संगठन एकेन्द्रीय जल आयोग, शिलांग।

भारत सरकार
जल शक्ति मंत्रालय
जल संसाधन नदी विकास एवं गंगा संरक्षण विभाग
केन्द्रीय जल आयोग
प्रबोधन एवं मूल्यांकण निदेशालय

Government of India
Ministry of Jal Shakti
Dept. of Water Resources, RD&GR
Central Water Commission
Monitoring & Appraisal Dte.

सेवा में / To,

अतिरिक्त मुख्य अभियंता (जोन- IV)
सिंचाई विभाग, कर्बी आंग्लोंग स्वायत्त परिषद
दिफू, असम।

विषय / Sub: Approval of BC Ratio for the project and Submission of certificates as per check list of prevailing guidelines w.r.t. DPR of the Amreng Irrigation Project Reg.

संदर्भ/ Ref: ACEI(Zone-IV)/Amreng/DPR/2018-19/46 dated 23.11.2020

महोदय / Sir,

Kindly refer to the above letter vide which compliance to the observations of this office/ discussions in various meetings have been submitted for examination/ vetting. The approval of Cost Estimate for the project has already been conveyed vide this office letter No. T-28014/2/2020-MA-GUWAHATI-Part(1) dated 03.12.2020.

Based on the finalised cost of the project, the benefit cost ratio of the project has been re-assessed keeping all other parameters same as adopted by project authority, the Benefit Cost Ratio of the project works out to be **2.32:1** considering the interest on capital at a rate of 10%. The final Benefit Cost ratio estimation sheet is enclosed as **Annexure-I**.

Further, along with the compliance, recommended certificates as per the check list prescribed in prevailing guidelines (Appendix-A to Appendix-M) have also been submitted. The submitted certificates have been examined, and following observations have been noted:

a) Certificate of Geological Exploration (Appendix-B) duly countersigned by Principal Secretary, KAAC stating that complete Geological Exploration for the Amreng Irrigation project has been carried out by SSK engineering consultant during July, 2019. As per guidelines the certificate needs to be submitted with Authorized signatory of GSI or by an agency accredited by GSI along with seal. The submitted certificate is neither signed by the consultant not the certificate provided accreditation of the consultant by GSI has been provided along.

b) Certificate of rock/ soil mechanic test (Appendix-C) duly countersigned by principal secretary, KAAC has been submitted stating that rock & soil mechanics test have been caried out during July, 2019. Firstly, the testing has been reported to have been carried out after designing of the project and submission of DPR. Secondly, as per prevailing guidelines the rock/ soil test have to be carried out by CSMRS or an agency acceded by CSMRS. The submitted certificates have neither been signed by CSMRS/ acceded agency of CSMRS nor the name of agency that has carried out the test has been mentioned in the certificate.

c) Certificate of suitability of available construction material (Appendix-D) duly countersigned by principal secretary, KAAC has been submitted stating that availability of construction material both qualitatively and quantitatively within economical reach has been assessed by KAAC in January, 2019. However, as per prevailing guidelines the suitability of available construction material has to be carried out by CSMRS or an agency acceded by CSMRS. The submitted certificates may be got approved/ countersigned by CSMRS or an acceded agency of CSMRS.

d) Certificate on Ground Water Aspects (Appendix-E) duly countersigned by principal secretary, KAAC has been submitted stating that the district under consideration will not be affected by water logging and there will not be further ground water depletion. However, as per prevailing guidelines the said certificate needs to be signed by Member (SML), Central Ground Water Board. The submitted certificates may be got approved/ countersigned by Member (SML), Central Ground Water Board before submission.

e) Certificate on submission of site-specific seismic design parameters (Appendix-F) duly countersigned by Principal Secretary, KAAC, Assam has been submitted. As per the prevailing guidelines, the certificate needs to be counter-signed by Director, FE&SA directorate, CWC, New Delhi. Further No report on seismic design study has been submitted by project authority. The same may be submitted along with the approval of Director, FE&SA, CWC, New Delhi.

f) As per prevailing guidelines, the seismic study report needs to be submitted to National Committee of Seismic Design Parameters in prescribed proforma by an authorized representative of project authority and a copy of the same needs to be submitted to CWC (As Appendix-G). No such submission has

been made/ reported by project authority along with the DPR. The same may be carried out at the earliest.

g) Certificate on Status of Action taken for Statutory Clearance (Appendix-H) countersigned by Principal Secretary, KAAC, Assam has been submitted stating that Environmental (EIA, EMP & Other) and Forest clearances are not required for the project and clearance from MoTA is not required as KAAC is the sole authority under 6th schedule area. As per prevailing guidelines, as Amreng Irrigation Project is not utilizing the executed portion of the project and is designed afresh, clearance from MoEF & CC is required. Forest Clearance from State Forest Department/ committee is also required for the project and as the project is falling under tribal area, clearance from MoTA is also mandatory. The same may be submitted at the earliest.

h) Letter regarding non-existence of CDO in the council/ State of Assam has not been submitted by the project authority.

The above certificates duly approved/ countersigned by the competent authority as recommended in the prevailing guidelines of CWC may be submitted at the earliest for further necessary action and preparation of TAC note for the Amreng Irrigation Project (Medium). The approval of competent authority has been accorded vide letter no. T-28014/4/2020-BBBO-SHILLONG dated 07.12.2020.

भवदीय / Yours Sincerely

संलग्नः यथापरोक्त

Signature Not Verified
Digitally signed by ANKIT DUDEJA
Date: 2020.12.08 11:03:27 IST

(अंकित डुडेजा / Ankit Dudeja)
उप निदेशक / Deputy Director

Copy to:

अधीक्षण अभियंता (स•), ब्रह्मपुत्र एवं बराक बेसिन संगठन, केन्द्रीय जल आयोग, **शिलांग**।

द्वितीय तल सी डबलयू सी, काम्पलेक्स
अदाबारी बस स्टैंड के पीछे, गुवाहाटी
दूरभाषः 0361–2972124
ई मेलः dirmaguwahati-cwc@nic.in
♦ जल संरक्षण–सूरक्षित भविष्य♦

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♦Conserve Water- Save Life♦

ANNEXURE-II.2

CALCULATION OF BENEFIT COST RATIO
AMRENG IRRIGATION SCHEME (MEDIUM)

Estimated cost of the Project	:Rs. (Lakh)	54045.85
Cost of Head work	:Rs. (Lakh)	20527.04
Project CCA	:	6800
Annual Irrigation (Irrigation Potential /AIA)	:	10450 Ha
G.C.A.	:	8500 Ha

Description	Before Irrigation/ Pre Project (in Lakh)		After Irrigation/ Post Irrigation (in Lakh)	
A. Gross Receipts				
1. Gross value of farm produce (values x Irrigation potential)		708.7878		21668.945
B. Expenses				
1. Expenditure on seeds = values x Irrigation potential)		35.54		174.06
2. Expenditure on manure etc.		197.06		947.50
3. Expenditure on hire labour (human & Bullock)		169.73		934.50
4. Fooder expenses	15% of A1	106.32	10% of A1	2166.89
5. Depreciation on implements	2.7% of A1	19.14	2.7% of A1	585.06
6. Share and cash rent	5% of A1	35.44	3% of A1	650.07
7. Land Revenue	2% of A1	14.18	2% of A1	433.38
Total B Expenses		**577.40**		**5891.46**
C. Net Value of Produce (A – B) =		**131.39**		**15777.49**
D. Annual Agriculture Benefits (Net Value after Irrigation – Net Value before Irrigation)		--		15646.10
E. Other Benefits (Drinking Water Supply to Human and Cattle)		NIL		50.00
F. Total Net Annual Benefits				**15696.10**
G. Annual Cost				
1. Interest on Capital			@ 10%	5404.58
2. Depreciation of the project @ 2% of Project Cost				1080.92
(Considering 50 years project life)				
3. Annual Operation & maintenance cost				
@ 1175/- per ha (CCA)				79.90
4. Maintenance of Head work @ 1% of cost of Head work				205.27
5. Total (G) Annual Cost (1 to 4)				6770.67
Benefit Cost Ratio			**@ 10%**	**2.32**

(BY E-MAIL)

टेलीफोन/Tel.No.0364-2220644, 2220568, 2220517
टेली फैक्स/Tel.Fax:0364-2220644

भारत सरकार
GOVERNMENT OF INDIA
जल शक्ति मंत्रालय / MINISTRY OF JAL SHAKTI
जल संसाधनए नदी विकास और गंगा संरक्षण विभाग
DEPARTMENT OF WATER RESOURCES,
RIVER DEVELOPMENT & GANGA REJUVENATION
केंद्रीय जल आयोग/CENTRAL WATER COMMISSION

सत्यमेव जयते

मुख्य अभियंता कार्यालय
OFFICE OF THE CHIEF ENGINEER
ब्रह्मपुत्र एवं बराक बेसिन संगठन
BRAHMAPUTRA & BARAK BASIN ORGANISATION
रेबेक्का विल्लेए बारीक़ पॉइंट लोअर लाशुमियर
REBEKKA VILLE, BARIK POINT, LOWER LACHUMIERE
शिलांग.793001ई SHILLONG – 793001

Sub: Approval on appraisal of BC Ratio and submission of certificates as per check list of prevailing guidelines in r/o DPR of the Amreng Irrigation Project (Medium), KAAC, Govt. of Assam – Reg

Ref: Letter No.T-28014/2/2020-MA-GUWAHATI Dated: 04.12.2020 (copy enclosed)

With reference to the above-cited letter, the appraisal of BC Ratio and submission of certificates as per check list of prevailing guidelines for 'Submission, Appraisal and Acceptance of Irrigation and Multipurpose Projects, 2017' of DPR for Amreng Irrigation Project (Medium), Assam under Irrigation Department, KAAC, Govt. of Assam as conveyed/recommended by Director, M&A Dte., Guwahati has been approved by the Competent Authority.

Further, it is requested to prepare the TAC note for the afore-cited Project and send the same to PAO, CWC, New Delhi under intimation to this office at the earliest.

This issues with the approval of Chief Engineer, B&BBO, Shillong.

Yours faithfully,

Encl.: As above

(Mohd. Faiz Syed)
Superintending Engineer (C)

Director, M&A Dte.,CWC, Guwahati

Copy to :

1. Addnl. Chief Engineer(Irrgn), Zone IV, KAAC, Govt of Assam, Diphu
2. Chief Engineer(PAO), CWC, Sewa Bhawan, RK Puram, New Delhi

Appendix - A

Certificate on Preparation of DPR

This is to certify that Detailed Project Report (DPR) of Amreng Irrigation Project (Medium), Assam under Karbi Anglong Autonomous Council (KAAC) has been prepared in a consultative mode with the specialized directorates of CWC i.e. Hydrology, Irrigation Planning, Inter-State Matters and Project Planning from concerned unit under Design & Research Wing.

Hydrology:
Cleared by Hydrology (NE) Directorate of CWC Vide Letter No. 4/234/2009-Hyd (NE)/262-263 by N.N.Rai, Director. Subsequently revised by Director, CWC (M&A), Adabari, Guwahati-14 Vide Letter No. 7/42/M&MI/KAAC/Apprl./2012-M&AG/1442-45 dated 30/09/2019.

Irrigation Planning:
The Irrigation Planning approved by the Director, CWC (M&A), Adabari, Guwahati-14 Vide Letter No. 7/42/M&MI/KAAC/Apprl./2012-M&AG/908-11 dtd. 26/12/2019.

Inter-State Matters:
The Amreng river originates from Meghalaya. The Additional Chief Engineer (Zone-IV) Irrigation Assam, Diphu under Karbi Anglong Autonomous Council (KAAC), has obtained the NOC from H. L. Pyrtuh, Secretary to the Govt. of Meghalaya, Water Resources Department, Additional Secretariat Building, Shillong – 793001 Vide Letter No. WR(SCH).40/2012/13 Dtd.18/10/2012 in respect of proposed Amreng Irrigation Project (Medium).

Project Planning:
Project has been planned as per requirement & approved by the Competent Authority (KAAC, Diphu).

Addl. Chief Engineer
(Zone-IV) Irrigation Assam,
Diphu
Competent Authority of
Irrigation Deptt. Govt. of Assam
Under KAAC

Addl. Chief Engineer (Zone-IV) Irrigation, Assam Diphu

Appendix - B

Certificate on Geological exploration

This is to certify that complete Geological exploration for the Amreng Irrigation Project (Medium), located in the State of Assam under Karbi Anglong Autonomous Council (KAAC) required for the DPR stage has been carried out by S.S.K Engineering Consultant during the period of July 2019 in the gross command area 8500 Ha and barrage area 1 Ha of proposed Amreng Irrigation Project (Medium), Donkamokam Tehsil, West Karbi Anglong District. Copy of the report is attached.

Principal Secretary
Karbi Anglong Autonomous Council,
Diphu

Addl. Chief Engineer
(Zone-IV) Irrigation Assam,
Diphu
Competent Authority of
Irrigation Deptt. Govt. of Assam
Under KAAC

Appendix — C

Certificate on rock/soil mechanic tests

This is to certify that the required rock/soil mechanic tests have been carried out from the rock/soil samples collected through Geological exploration for the proposed Amreng Irrigation Project (Medium) located in the State of Assam under Karbi Anglong Autonomous Council (KAAC) during the period July 2019 in the gross command area 8500 Ha and barrage area 1 Ha of proposed Amreng Irrigation Project (Medium), Donkamokam Tehsil, West Karbi Anglong District. Copy of the report is attached.

Principal Secretary
Karbi Anglong Autonomous Council,
Diphu

Addl. Chief Engineer
(Zone-IV) Irrigation Assam,
Diphu
Competent Authority of
Irrigation Deptt. Govt. of Assam
Under KAAC

Appendix — D

Certificate on suitability of available construction material

This is to certify that quarry area and suitability of available construction material both qualitatively and quantitatively within economical reach has been assessed for the project parameters at DPR stage for the proposed Amreng Irrigation Project (Medium), located in the State of Assam under Karbi Anglong Autonomous Council (KAAC) during January 2019. The quarry area is Sarlengsor in Donkamokam Tehsil, which is 50 Km away from the project barrage site, West Karbi Anglong District. A copy of the report is enclosed as Annex-A.

Principal Secretary
Karbi Anglong Autonomous Council,
Diphu

Addl. Chief Engineer
(Zone-IV) Irrigation Assam,
Diphu
Competent Authority of
Irrigation Deptt. Govt. of Assam
Under KAAC

Appendix — E

Certificate on Ground Water Aspect

This is to certify that the command area of Amreng Irrigation Project (Medium), located in the State of Assam under Karbi Anglong Autonomous Council (KAAC) covering Donkamokam Tehsils, of West Karbi Anglong District will not be affected by water logging and there will not be further ground water depletion.

Principal Secretary
Karbi Anglong Autonomous Council,
Diphu

Addl. Chief Engineer
(Zone-IV) Irrigation Assam,
Diphu
Competent Authority of
Irrigation Deptt. Govt. of Assam
Under KAAC

Appendix –G(1)

Certificate on submission of site specific seismic design parameters

This is to certify that site specific seismic design parameters in accordance with the guidelines for preparation and submission of site specific seismic study report of river valley project has been submitted by Project Authority for the Amreng Irrigation Project (Medium), located in the State of Assam under Karbi Anglong Autonomous Council (KAAC) on January 2019. Study report of the river valley project has been submitted as per Appendix – G(2).

Principal Secretary
Karbi Anglong Autonomous Council,
Diphu

Addl. Chief Engineer
(Zone-IV) Irrigation Assam,
Diphu
Competent Authority of
Irrigation Deptt. Govt. of Assam
Under KAAC

Appendix –H

Certificate on status of action taken for Statutory Clearances

This is to certify that necessary actions have been taken for obtaining Statutory clearances for the Amreng Irrigation Project (Medium), located in the State of Assam under Karbi Anglong Autonomous Council (KAAC) and status of the action taken is as follows:

a. **Environment Clearance from MoEF&CC :**

i. EIA

Not required, as project falls under 'B' category as per MOEF Notification dated 14.9.2006 as it is a Medium Irrigation Project (CCA< 10000 Ha) and there is no submergence of land.

ii. EMP

Not Required

iii Others

Not Required

b. **Forest Clearance from MoEF&CC :**

Not required, as no forest land is involved in the project. The certificate of DFO, Hamren Division, Hamren is enclosed.

c. **Clearance in respect of R&R of Tribal population from MoTA:**

The clearance in respect of R&R of Tribal population from MoTA is the sole authority under Karbi Anglong Autonomous Council (KAAC). The KAAC falls in 6th Schedule Area. The project falls under 6th Schedule Area and KAAC has already given clearance for the project.

Principal Secretary
Karbi Anglong Autonomous Council,
Diphu

Addl. Chief Engineer
(Zone-IV) Irrigation Assam,
Diphu
Competent Authority of
Irrigation Deptt. Govt. of Assam
Under KAAC

Appendix –I

Certificate on mode of construction

This is to certify that the Amreng Irrigation Project (Medium), located in the State of Assam under Karbi Anglong Autonomous Council (KAAC) is going to be constructed through contract and special team has been planned for timely construction of project as per the MoWR,RD&GR "Guidelines for preparation of Detailed Project Reports of irrigation and multipurpose projects, 2010. The constitution of the special team is as follows:

Sl. No.	Designation of officers of the team for Civil Works	
1.	Principal Secretary, Karbi Anglong Autonomous Council, Diphu.	
2.	Secretary, Irrigation Deptt., Karbi Anglong Autonomous Council, Diphu.	
3.	Addl. Chief Engineer (Zone-IV) Irrigation, Assam, Diphu (Competent Authority of Irrigation Deptt., KAAC).	
4.	Superintending Engineer, Project Circle, Amreng Irrigation Project, West Karbi Anglong (Proposed)	
5.	Executive Engineer, Barrage Division, Amreng Irrigation Project, West Karbi Anglong (Proposed)	
	Asstt. Executive Engineer, Barrage Sub-Division, Amreng Irrigation Project, West Karbi Anglong (Proposed).	Asstt. Executive Engineer, H/Q Sub-Division (Central store, colony & Water Supply) (Proposed).
6.	Executive Engineer, Canal and CAD Division, Amreng Irrigation Project, West Karbi Anglong (Proposed)	
	Asstt. Executive Engineer, Canal Sub-Division, Amreng Irrigation Project, West Karbi Anglong (Proposed)	Asstt. Executive Engineer, CAD Sub-Division, Amreng Irrigation Project, West Karbi Anglong (Proposed)
	Designation of officers of the team for Mechanical Works	
7.	Principal Secretary, Karbi Anglong Autonomous Council, Diphu.	
8.	Secretary, Irrigation Deptt., Karbi Anglong Autonomous Council, Diphu.	
9.	Addl. Chief Engineer (Zone-IV) Irrigation, Assam, Diphu (Competent Authority of Irrigation Deptt., KAAC).	
10.	Executive Engineer, Diphu Mechanical Division (Irrigation), Bokolia (Existing).	
11.	Asstt. Executive Engineer, Kheroni Mechanical Sub-Division (Irrigation), Kheroni (Existing).	

Principal Secretary
Karbi Anglong Autonomous Council,
Diphu

Addl. Chief Engineer
(Zone-IV) Irrigation Assam,
Diphu
Competent Authority of
Irrigation Deptt. Govt. of Assam
Under KAAC

Appendix –K

Certificate on Survey and Investigation

This is to certify that the Amreng Irrigation Project (Medium), located in the State of Assam under Karbi Anglong Autonomous Council (KAAC) involves 24 Km. of Main Canal for which 100% survey has been carried out. For Distributaries & Minors, in the command there are alluvial types of soil group and 100% of survey has been carried out.

Principal Secretary
Karbi Anglong Autonomous Council,
Diphu

Addl. Chief Engineer
(Zone-IV) Irrigation Assam,
Diphu
Competent Authority of
Irrigation Deptt. Govt. of Assam
Under KAAC

Appendix – L

Certificate on Cadastral Survey

This is to certify that proper Cadastral Survey has been carried out for all the property coming under submergence, for reservoir and canal network for the Amreng Irrigation Project (Medium), located in the State of Assam under Karbi Anglong Autonomous Council (KAAC). The list of properties coming under submergence are as follows:

Sl. No.	Name of Properties	Area in Ha
1	**Land in ha**	NIL
	Forest land:	
	i) Agriculture land (Land acquisition for construction of canal and other appurtenant structure)	122.69
	ii) Govt. land	23.40
	Revenue land (Land acquisition for construction of office building, staff colonies, store, laboratories etc.)	2.50
	Others:	NIL
	Total	148.59
2	**Houses and Buildings (in Nos.)**	NIL
3	**Other structures such as road bridges, Railway bridges etc. (in Nos.)**	NIL
4	**Others**	NIL

Principal Secretary
Karbi Anglong Autonomous Council,
Diphu

Addl. Chief Engineer
(Zone-IV) Irrigation Assam,
Diphu
Competent Authority of
Irrigation Deptt. Govt. of Assam
Under KAAC

Appendix –M

Certificate on sharing of information to co-basin States

This is to certify that the proposed Amreng Irrigation Project (Medium), located in the State of Assam under Karbi Anglong Autonomous Council (KAAC) that the project is located in Brahmaputra Basin. In this connection it is brought to notice that proforma report of Amreng Irrigation Project (Medium), Assam received from L. K. Taneja, Sr, Joint Commissioner-IV (Ganga), letter no. 7/22/2008-Ganga/1831-32 dtd. 17/04/2009 Government of India, Ministry of Water Resources, (Ganga Wing) is enclosed for ready reference. Government of Meghalaya has also been informed about the project.

Principal Secretary
Karbi Anglong Autonomous Council,
Diphu

Addl. Chief Engineer
(Zone-IV) Irrigation Assam,
Diphu
Competent Authority of
Irrigation Deptt. Govt. of Assam
Under KAAC

STATEMENT -I

ESTIMATED VALUE OF PRODUCE OF PRE -IRRIGATION STAGE

AMRENG IRRIGATION PROJECT (MEDIUM)

Sl.No	CROPS	Area in Hect	Produce Per Hect In Qtl	Total Produce In Qtl	Rate Rs./Qtl	Value of total Produce In Rs.	Inputs			Total Of Input in Rs.	Net Income In Rs,.
							Seeds @ Rs./Hect In Rs	Manure @ Rs./Hect In rs.	Labour @ Rs./Hect In Rs.		
1	2	3	4	5	6	7	8	9	10	11	12
1	Sali	1360	10	13600	2965	40324000	2067200 @1520	13600000 @10000	10880000 @8000	26547200	13776800
2	Ahu	476	15	7140	2495	17814300	723520 @1520	4760000 @10000	3808000 @8000	9291520	8522780
3	Wheat	136	10	1360	3740	5086400	456960 @3360	544000 @4000	816000 @6000	1816960	3269440
4	Oil Seed	122.4	6.5	795.6	5000	3978000	68544 @560	428400 @3500	734400 @6000	1231344	2746656
5	Pulses	54.4	3	163.2	11900	1942080	101728 @1870	136000 @2500	326400 @6000	564128	1377952
6	Maize	68	15	1020	1700	1734000	136000 @2000	238000 @3500	408000 @6000	782000	952000
					Total	**70878780**	**3553952**	**19706400**	**16972800**	**40233152**	**30645628**

* Rate of produce is considered as per the present market rates prevailing in Karbi Anglong District

APPROVED

District Agriculture Officer
Karbi Anglong, Diphu
District Agricultural Officer
Karbi Anglong, Diphu

Addl. Chief Engineer
(Zone-V) Irrigation, Assam
Diphu

Executive Engineer
Karbi Anglong Division (Irri)
Diphu
Executive Engineer
Karbi Anglong Division (Irri)
Diphu

STATEMENT -II

ESTIMATED VALUE OF PRODUCE OF POST -IRRIGATION STAGE

AMRENG IRRIGATION PROJECT (MEDIUM)

Sl. No	CROPS	Area in Hect	Produce Per Hect In Qtl	Total Produce In Qtl	Rate Rs./Qtl	Value of total Produce In Rs.	Inputs			Total Of Input in Rs.	Net Income In Rs,.
							Seeds @ Rs./ Hect In Rs	Manure @ Rs./ Hect In rs.	Labour @ Rs./ Hect In Rs.		
1	2	3	4	5	6	7	8	9	10	11	12
1	Sali	5200	75	390000	2965	1156350000	7904000 @1520	62400000 @12000	52000000 @10000	122304000	1034046000
2	Ahu	700	65	45500	2495	113522500	1064000 @1520	8400000 @12000	7000000 @10000	16464000	97058500
3	Wheat	850	33	28050	3740	104907000	2856000 @3360	5100000 @6000	6800000 @8000	14756000	90151000
4	Oil Seed	950	16	15200	5000	76000000	532000 @560	4750000 @5000	7600000 @8000	12882000	63118000
5	Pulses	1550	12	18600	11900	221340000	2898500 @1870	7750000 @5000	12400000 @8000	23048500	198291500
6	Vegetables	400	150	60000	6000	360000000	400000 @1000	2000000 @5000	2400000 @6000	4800000	355200000
7	Jute	750	30	22500	4800	108000000	351000 @468	3750000 @5000	4500000 @6000	8601000	99399000
8	Sugarcane	50	900	45000	595	26775000	1400000 @28000	600000 @12000	750000 @15000	2750000	24025000
					Total	**2166894500**	**17405500**	**94750000**	**93450000**	**205605500**	**1961289000**

* Rate of produce is considered as per the present market rates prevailing in Karbi Anglong District