Amhara National Regional State

Irrigation and Low Land Areas Development Bureau (BOILLAD)

Revised Study and Design

Of

Gardy – Small-Scale Irrigation project of residual works Report

Consultant: Banja Irrigation and Low land Areas Development Office
Client:-Banja woredaAgri office

Address: P.O.Box: ---------- Telephone: 058-2270686- Fax: ----------

Gardy project over view description

- Name of the project: Gardi irrigation Project
    - Location Amhara Region
    - Awi Zone
    - Banja Woreda
    - Askuna Kebele
- Geographic location of the site:-
    - Easting: ……249273.7 m
    - Northing: …….1215234.9m
    - Altitude: …….1980 m
    - Hydrology
    - Base flow:58.00 l/s
    - Peak flood 17.072m^3/s
    - Catchment area:2.6412Km^2
- Head work structure:-
- Diversion type:-intake structure
- Construction Material:-masonry
    - ✓ Intake Crest length:10m
    - ✓ Intake Height:0.5m
- Irrigationinfra structure
    - ✓ Total length of Lined main canal 1500m
    - ✓ Division boxes two in number
    - ✓ Drop structure six in number
    - ✓ Flow measuring and (Turn out) 16 in number
    - ✓ Road crossing structure (flume) three in number
    - ✓ Escape canal to flush unwanted water which is two in number
- **Irrigation command area and Beneficiary**
    - ✓ Traditional irrigated area 30.75
    - ✓ New irrigation Command area after projected :48.5ha
    - ✓ Beneficiary male = 48 female =6 total=54

- ✓ 48.5 New Comm.
- ✓ 30.75 Exsisting Comm.
- ✓ 79.25 1.5 Each holding
- ✓ 54HH

1:- Introduction

In Ethiopia, under the prevalent rain-fed agricultural production system, the progressive degradation of the natural resource base, especially in highly vulnerable areas of the highlands coupled with climate variability have aggravated the incidence of poverty and food insecurity. The major source of growth for Ethiopia is still conceived to be the agriculture sector. Hence, this sector has to be insulated from drought shocks through enhanced utilization of the water resource potential of the country, (through development of small-scale irrigation, water harvesting, and on-farm diversification) coupled with strengthened linkages between agriculture and industry (agro-industry), thereby creating a demand for agricultural output. In line with the above, efforts have been made by the government and Funding organizations to improve the situation in the country in areas of domestic water supply provision, irrigation, watershed management, etc. The Amhara Region Bureau of Agriculture playing its role in the development of small scale irrigation projects in the region. Accordingly, as part of the water sector development program, the Awi zone agriculture office has initiated the study and design of a small scale irrigation scheme on Gadi River at Askuna Kebele. The development of Ethiopia and it's people development of living standard is based on the mode of agriculture, to increase the productivity of agriculture the government should be contribute a special support for farmers.

1.1 Back ground

The progressive degradation of the natural resource base especially in highly vulnerable areas of the highlands coupled with climate variability has aggravated the incidence of poverty and food insecurity. The major source of growth for Ethiopia is still conceived to be the agriculture sector. Hence, this sector has to be insulated from drought shocks through enhanced utilization of the water resource potential of the country through development of small-scale irrigation. In line with the above, to improve the situation in the country efforts have been made by the government in the area of irrigation. Banja

Woreda Agricultural Office playing its role in the development of small-scale irrigation projects in the Woreda.

1.2Description of the Project Area

The project area has good farm land the farmers have tried to use traditional irrigation, but they failed to succeed due to lack of both technical and financial capacity. The design and study of gardi irrigation project under modern irrigation scheme will enable the farmers to use the available water and the land resources efficiently and get themselves food secured. Designers have identified the intake site location by choosing from upstream and downstream of the site depending on its geographical location. After a good discussion decide on the best of them. The river bed has no any alluvial deposition, rocky or any sound foundation, the abutments are weak zones but the right left side is covered by trees and different plants. Gardi irrigation project will enable the peasants' /IWUs/ of the project area to positive economic change and improve their life standard by producing different crops and live stocks.

1.2.1Location Accessibility of the site

This irrigation project is located mainly at Askuna kebele, in Banja Woreda of Awi Zone in the Amhara Region. The proposed irrigation project is to be undertaken on Gardi river the headwork structures specifically located at an altitude of about 1980m.a.s.l, x=249273.7m, y= 1215234.9m. Accessibility of the site: The site is accessed from Injibara 38km in the eastern direction/to chagini/town. The access road is available during dry season; access to the specific site is possible by vehicle.

1.2.2 Objectives of the study

1.2.3 General Objective

The main objective of the project is to maximize the efficiency and utilize the water resource as well as the land effectively. It also decreases damage of cultivated crops by water logging and saves time and energy that can loss during canal intake construction.

Specifically, the project is targeted for the following main objectives.

Irrigation investments will achieve broader food security and poverty reduction impacts.

If efforts geared towards up-grading existing traditional farming practices with support to enhance access to input supply, output marketing and extension to facilitate access to information and innovations, there becomes a paradise change in utilizing our resource.

This objective is to be realized by constructing diversion structures across river and diverting the river flow for irrigation, purpose.

1.2.4 Specific Objectives

The main specific objective of the project completion the rest works that are not completely done are:-

- ☞ To functional the executed part of the project
- ☞ To reduce the conflict between water users due to project incompletion
- ☞ To safe the problems of animal road crosses and flood supper passages
- ☞ To control the flood in rainy seasons entering to the irrigated land and farmers houses
- ☞ increase amount of irrigation water
- ☞ increase irrigated command area
- ☞ safe guard food scarcity
- ☞ reduce the loss of water in entering canal
- ☞ sustain the interest of the users
- ☞ To protecte the irrigated land from water logging

1.2.5 Scope of the study

Since this study focuses on the preparation of Gardi small scale irrigation project the scope included:

- Catchments features pertinent to the analysis and simulation of hydrologic data
- Any other climatic features of importance and indicate the effects on the irrigation scheme.
- The project design flood estimation
- The availability of lean flow
- Detail design of head work structure and its appurtenant hydraulics and structural design should be stated.

The irrigation design shall ensure reliability, equity and flexibility of water delivery to farmers. It aims at reducing conflicts among water users and will lead to lower operation and maintenance costs.

Design proper irrigation system compatible with local conditions and management capabilities,

Check and test hydraulic and structural designs of main canal considering total demand and the required capacity and the base flow availability,

- Prepare general plans and drawings for all irrigation infrastructure and irrigation systems designs,
- Preparation of working drawings, bill of quantities & cost estimation

1.2.6 Previous Irrigation Practices

There is traditional irrigation downstream of this site. The selected farmers also cultivate using traditional gravity irrigation and using pump. At present time, the main problem of the existing traditional diversion and pump system is the loss of water in seepage, and the cost of generator and fuel in utilizing the required amount of water. In addition to this, constructing the canal intake structure regularly is time taking and tiresome.

Therefore, the farmers in the project area are very much interested to the idea of upgrading the traditional scheme to modern scheme. The total users of gardi river before constriction of the project are 48-meal and 4-female total users are 54. The irrigated area before construction of intake is **30.75** ha. As such, the canal upgrading is done with masonry lining for a length of 1500 m to irrigate **48.5 ha** of land to increase water use efficiency and sustain the livelihood of the farmers.

1.2.7 Upstream &downstream utilization

Downstream of the proposed head work site needs water for cattle provisions. Therefore, at least 10%of the minimum flow has to be released for downstream requirements. It is greater than the environmental need for the down streams, which is 5.8l/s so; there will not be shortage in the downstream. During the reconnaissance survey there is drinking water supply by other springs. This indicates that there is no influence of the scheme on the d/s water demand for different purposes. There is no upstream user of the project area. Because the right and left side of the river is mountains and which is covered by natural forest.

2.0 The project execution and termination background

The gardi small scall irrigation project started at 29/10/2013 E.C by Ayana,asaye and their friends water work constraction enterprise by taking the agreement with woreda by 4561184.6 capital beget and this enterprise cannot complete it per the agreement and terminate the agreement at 26/07/2014.

At 29/11/2014e.c the woreda take new agremment with gashu general water works contractor.at acapital beget of birr4,551,187.77 and the contractor started work and soon as excute head work and 500m out of 1500m canal only. again the agreement was terminated at 21/05/2017 and we select out the unexcuted works and estimate the cost based the current market value.the works executed are listed below namely.

- ✓ The intake head work
- ✓ 500meter canal is executed
- ✓ Head work under sluice gates and canal off take gate
- ✓ One cross road structure
- ✓ Flume left and right retaining wall masonry work are executed mainly executed before termination of the agreement.

2.1 **Works done before termination of agreement and payed in the 1st round**

Sr.No	Activity	Unit	t	L(m)	W(m)	D(m)	Quantity	Remark
1.1	Mobilization cost						1	
1.3	**Store Construction work**							
1.3.1	5m*4m, store construction							
	g-32 corrugated iron sheet	no					51.75	
	Ø 12 cm and 10-12m length of each eucalyptus	no					26	
	Ø 10 cm and 10-12m length of each eucalyptus	no					34	
	12cm,8cm and 6cm nails	kg					17	
	door and window fixing metal	no					4	
	10cm concrete screed	M3		5	4	0.09	1.8	
	20cm*0.4cm masonry work	M3	2	9	0.2	0.4	1.44	
	20cm thick hard core	M3		5	4	0.18	3.6	
1.4	Dewatering at head work and flume retaining wall pumping purpose (cost)per day	day					20	
2.1	**Earth work**							
2.1.1	Clearing trees and unnecessary materials							
2.1.2	Bulk excavation of temporary diversion	m3		10.7	2	0.9	19.17	
2.1.4	Bulk excavation of u/s cut off at average depth of 1.2m, 1m width and cart away up to 50m.	M3		12	1	1	12	

2.1.5	Bulk excavation of intake Foundation at average depth of 1.2m and cart away up to 50m.	M3		10	1	1	10	
2.1.6	Bulk excavation of d/s cut off at average depth of 1.75.and 1m width	M3		12	1	1.75	21	
2.1.7	Bulk excavation of u/s apron at average depth of 0.5m and cart away up to 50m.	M3		10	1	1	10	
2.1.8	Bulk excavation of d/s apron at average depth of 0.7m and cart away up to 50m.	M3		10	3.7	0.7	25.90	
2.1.10	Bulk excavation of u/s left side retaining wall at 2m width, an average depth of 1m, length=4.6and cart away up to 50m.	M3		8.4	2.2	2.5	46.20	
2.1.11	Bulk excavation of d/s right side retaining wall at 1.9m width, 1m average depth, 9.2m length and cart away up to 50m.	M3		8	1.6	3.5	44.80	
2.1.12	Bulk excavation of d/s left side retaining wall at 1.9m width, 1m average depth, 10m length and cart away up to 50m.	M3		8	1.9	3.45	52.44	
2.2	**Back fill work**							
2.2.1	Back fill of u/s cut off with selected material at average depth of 1.2m and 0.8m width	M3		12	0.8	1	9.60	
2.2.2	Back fill of d/s cut off with selected material at average depth of 1.75m and 0.8m width	M3		12	0.8	1.5	14.40	
2.2.4	Back fill of u/s left side retaining wall at 8m length , 0.4m width and 1.7m depth	M3		8.4	1.2	2.1	21.17	
2.2.5	Back fill of d/s right side retaining walls length 9m and 0.5m width,2.5m depth	M3		8	0.5	2.5	10.00	
2.2.6	Back fill of d/s left side retaining wall length 8m and 0.4m width,1.7m depth	M3		8	0.8	2.1	13.44	
2.3	**Head work structures**						0.00	
2.3.1	Lean concrete work of, u/s apron foundation at 5cm depth. Grade→C-15,ratio=1:3:6	m2		9.9	0.8		7.92	
2.3.2	Lean concrete work of, d/s apron foundation at 5cm depth. Grade→C-15,ratio=1:3:6	m2		9.9	1.5		14.85	
2.3.3	Lean concrete work of, intake foundation at 5cm depth. Grade→C-15,ratio=1:3:6	m2		9.9	1		9.90	

2.3.4	Masonry work of u/s apron foundation at L=10m, width=1m,and a depth of 0.3m with 1:3 mortar.	M3		9.9	0.8	0.3	2.376	
2.3.5	Masonry work of d/s apron foundation at L=10m, width=4m, and a depth of 0.4m with 1:3 mortar.	M3		9.9	3.7	0.4	14.652	
2.3.6	Masonry work of intake foundation at L=9.9m, width=0.56m,d=0.7m with 1:3 mortar.	M3		9.9	0.56	0.7	3.8808	
2.3.7	Concrete work of intake body with Grade→C-20,ratio(1:2:3)	M3		9.1	0.56	0.53	2.6754	
2.3.8	3cm thickness Plastering of u/s & d/s face of the intake, i.e. L=10m and h=0.5m ratio(1:2)	m2		9.9	1.61		15.939	
2.3.9	U/s apron concrete capping at 0.20m thickness.Grade→C-20,ratio(1:2:3)	M3		9.9	0.8	0.2	1.584	
2.3.10	D/s apron concrete capping at 0.20m thickness.Grade→C-20,ratio(1:2:3)	M3		9.9	3.7	0.2	7.326	
2.3.11	Concrete work of u/s cut off at 1m depth and 20 cm thikness with Grade→C-20,Ratio(1:2:3)	M3		12	0.2	1	2.4	
2.3.12	Concrete work of d/s cut off at 1.5 m depth and 20 cm thikness with Grade→C-20,Ratio(1:2:3)	M3		12	0.2	1.5	3.6	
2.3.14	Intake bed bar Reinforcement bar ø 16mm 20cm c/c cross-sectional	kg					492.7	
2.3.15	Black wire for tying	kg					8	
3.4	**Retaining walls**							
3.4.1	Masonry work of u/s left side retaining wall foundation at 0.7m depth and 1.1m width respectively. With 1:3 mortar.	M3		7.2	1.2	0.7	6.048	
3.4.2	Masonry work of d/s right side retaining wall foundation at 0.7m depth and 1.1m Bw and 0.4m Tw width respectively. With 1:3 mortar.	M3		7.6	1.1	0.7	5.852	
3.4.3	Masonry work of d/s left side retaining wall foundation at 0.7m depth and 1.1m width respectively. With 1:3 mortar.	M3		7.6	1.1	0.7	5.852	

3.4.4	Masonry work of u/s left side retaining wall above foundation at 0.4m Tw and 1.1m Bw Tw respectively. With 1:3 mortar.	M3		7.2	0.4	1.6	4.608	rectangular
		M3	0.5	7.2	0.8	1.6	4.608	triangular
	Sub total						9.216	
3.4.5	Masonry work of d/s right side retaining wall above foundation at 0.4m Tw & 1.1m Bw respectively with 1:3 mortars.	M3		7.6	0.4	1.75	5.32	rectangular
			0.5	7.6	0.7	1.75	4.655	triangular
	Sub total						9.975	
3.4.6	Masonry work of d/s left side retaining wall above foundation at 0.4m Tw & 1.1m Bw respectively.	M3		7.6	0.4	1.72	5.2288	rectangular
			0.5	7.6	0.7	1.72	4.5752	triangular
	Sub total						9.804	
3.5	**concrete work of retaining walls**							
3.5.1	Lean Concrete work of u/s right and left side retaining walls foundation at 0.05mthikness with Grade c-15 ratio (1:3:6)	*m2*	2	7.2	1.2		17.28	
3.5.2	Lean Concrete work of d/s right and left side retaining wall foundation based on drawing with Grade c-15 ratio (1:3:6)	m2	2	7.6	1.1		16.72	
3.5.4	3cm thickness plastering of u/s left retaining wall front faces with |ratio1:2|	m2		7.2	2		14.4	
3.5.5	3cm thickness plastering of d/s right & left side retaining wall on front faces with |ratio→1:2|	m2	2	7.6	2.15		32.68	
3.5.6	Pointing of u/s left side at 3cm thickness external retaining walls	m2		7.2	2.5		18	
3.5.7	Pointing of d/s right and left side at 3cm thickness external retaining walls	m2	2	7.6	2.5		38	
3.5.8	Concrete work of off-take slab at 0.1m thickness with Grade →c-20 ratio (1:2:3)	m3	3	0.78	0.75	0.15	0.26	
3.5.9	Reinforcement bar ø 14mm for off tack slab structure.	kg					0.888	
3.5.10	Black wire for tying	kg					0.008	

3.6	**wooden material for different purpose**							
3.6.1	Ø 8-10 cm and 10-12m length of each eucalyptus wooden materials for head work and irrigation infra structure activity.	no					70	
3.6.2	Timber (formwork) for cut off, intake capping and flumes works. form work length=4m, width=0.4m	m2	30	4	0.4		48	
4	**Infrastructure work**							
4.1	Clearing trees and unnecessary materials							
4.1.2	Bulk excavation of canal at 3m width and at average depth of 4m from head work up to 35m length	M3		35	3	4	420	
4.1.3	Bulk excavation of canal after 35m length at 1.5m width and at average depth of 0.6m.	*M3*		350	1.5	0.6	315	
4.1.8	Back fill of canal at 2m width and at average depth of 4m from head work up to 35m length with a well compaction	M3		35	2	4	280	
5	**masonry and concrete work of Infrastructure work**							
5.1	Masonry work of cana bed at 0.15m thick and 1.06m width	M3		350	1.06	0.17	63.07	
5.1.3	Masonry work of canal with Side thickness of 0.3m with 1:3 mortars.	M3	2	350	0.3	0.54	113.4	
5.1.8	Concrete work of canal bed at 8cm thickness. Grade→C-20,ratio=1:2:3	M3		350	0.4	0.08	11.2	
5.1.13	3cm thickness plastering of canal banks and bed with(1:2 mix ration) at length of 350m	m2		*350*	2.08		728	
6	***Drainage flume earth work(1)***							
6.1	Bulk excavation of right and left side retaining wall at 2.6m width, 2.4m average depth, 6.5m length and cart away up to 50m.	M3	2	6.5	2.6	2.4	81.12	
7	***Super passage and animal crossing structures***							
7.1	Bulk excavation of super passage at 0.6m width, 0.3m average depth, 5m length and cart away up to 50m.	m3	4	5	0.6	0.3	3.6	

7.1.2	Back fill of super passage 5m and 0.3m width,0.3m depth	m3	4	5	0.3	0.3	1.8	
7.1.3	Masonry work of super passage above slab at 0.5m depth and 0.3m thickness respectively.	m3	4	5	0.35	0.6	4.2	
7.1.4	Super passage and road crossing Reinforcement bar ø 12mm longitudinal and ø 12mm cross-sectional	kg					66.8	
7.1.5	Black wire for tying	kg					0.668	
7.1.6	Concrete work of super passage and road crossing slab with Grade c-20 ratio (1:2:3)	m3		5	3	0.2	3	
7.1.7	Plastering of super passage banks at 0.2cm thickness with grad (1:2)	m2	2	6	0.65		7.8	
8	***all flow measuring sheet metals and Gates for off-take canal***							
8.1	Gate for off-take canal are made vertical sheet metals of 4mm thickness, 0.5m*0.5m size respectively	*m2*	0	0.5	0.5		0.25	
8.1.2	Angle Iron t=4mm, 0.5m*0.5m	*m*					3	
8.1.3	ø 12mm reinforcement bar for handling	*kg*					1.77	
8.1.4	Sheet metal of sixteen flow regulators, t=4mm (width of 0.50 mts & 0.50 mts height	*m2*		1	0.9		0.9	
8.1.6	Angle Iron for both, t=4mm 4mm*4mm	*m*					6	
8.1.7	Reinforcement bar ø 12mm for handle & hook.	*kg*					3.55	

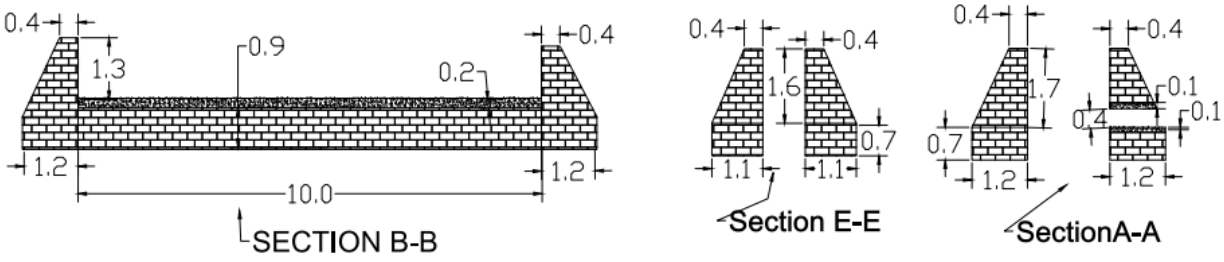
2.2 **Works done before termination of agreement and payed in the 2nd round /take off/**

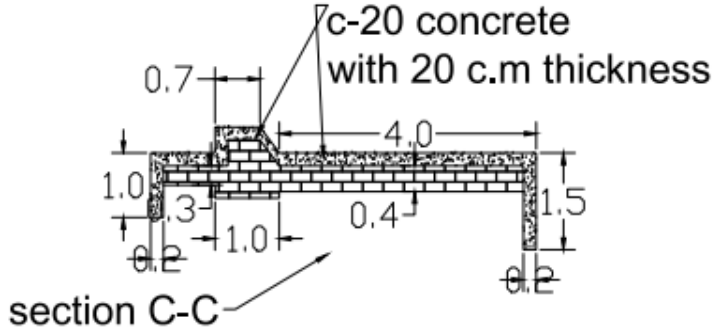
Sr.No	Activity	Unit	t	L(m)	W(m)	D(m)	Quantity	Remark
	Earth work							
2.1.9	Bulk excavation of u/s right side retaining wall at 2m width, an average depth of 1m, length=8 and cart away up to 50m.	M3		8	2	2.5	40.00	
2.2.3	Back fill of u/s right side retaining wall at 8m length , 0.8m width and 2m depth	M3		8	0.8	2	12.80	

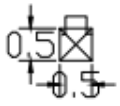
3.4.1	Masonry work of u/s right side retaining wall foundation at 0.6m depth and 1.2m width respectively. With 1:3 mortar.	M3		8.8	1.2	0.6	6.336	
3.4.4	Masonry work of u/s right side retaining wall above foundation at 0.4m Tw and 1.2m Bw Tw respectively. With 1:3 mortar.	M3		8.8	0.4	1.7	5.984	rectangle
		M3	1	8.8	0.8	1.7	5.984	triangle
sum total							11.968	
3.5.4	3cm thickness plastering of u/s right retaining wall front faces with |ratio1:2|	m2		8.8	2.5		22.00	
3.5.6	Pointing of u/s right side at 3cm thickness external retaining walls	m2		8.8	3.2		28.16	
4	**Infrastructure work**							
4.1.3	Bulk excavation of canal after 35m length at 1.5m width and at average depth of 0.6m.	*M3*		135	1.5	0.6	121.5	
4.1.8	Back fill of canal at 0.5m width and at average depth of 0.6m.	M3		417	0.5	0.6	125.1	
5	**masonry and concrete work of Infrastructure work**							
5.1	Masonry work of cana bed at 0.15m thick and 1.06m width	M3		170	1.06	0.17	30.634	
5.1.3	Masonry work of canal with Side thickness of 0.3m with 1:3 mortars.	M3	2	170	0.3	0.54		
5.1.8	Concrete work of canal bed at 8cm thickness. Grade→C-20,ratio=1:2:3	M3		102	0.4	0.08	3.264	
5.1.13	3cm thickness plastering of canal banks and bed with(1:2 mix ration) at length of 350m	m2		*102*	2.08		212.16	
6	**Drainage flume earth work(1)**							
6.1	Bulk excavation of right and left side retaining wall at 2.6m width, 2.4m average depth, 6.5m length and cart away up to 50m.	M3	2	6.5	2.5	2	**65.00**	
6.1.2	Back fill of right and left side retaining walls length 6.5m and 1m width,2m depth	M3	2	6.5	0.9	2	**23.40**	
	Drainage flume masonry work(1)							

6.1.3	Masonry work of right and left side retaining wall foundation at 0.6m depth and 1.5m width respectively.	M3	2	6	1.5	0.6	**10.80**	
6.1.4	Masonry work of right and left side retaining wall above foundation at 1.4m depth and 1.5m bottom and 0.6m top width respectively.	M3	2	6	0.6	1.4	10.08	
		M3	1	6	0.9	1.4	7.56	
sum total							17.64	
	deductions due to flume opining	M3	2	1	0.6	0.7	0.84	rectangle
		M3	1	1	0.3	0.7	0.21	triangle
sum total							1.05	
6.1.4	bet value of masonry work of flume retaining work						**16.59**	
6.2	**Drainage flume concrete work(1)**							
6.2.1	Concrete work of right and left side retaining wall foundation based on drawing with Grade c-20 ratio (1:2:3)	M3	2	6	1.5	0.2	3.6	
6.2.7	Pointing of guide walls	m2	2	6	3		36	

2.3 The executed works figural are shown below



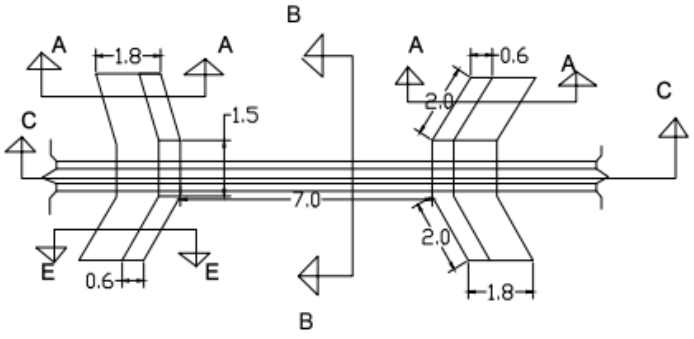




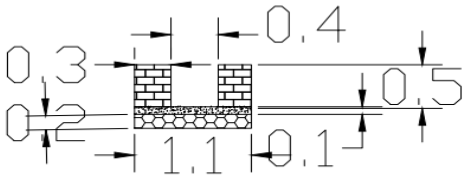
off take sheet metal

2.4 UN EXECUTED WORK TYPES ARE LISTED IN THE FOLLOWING FIGURES

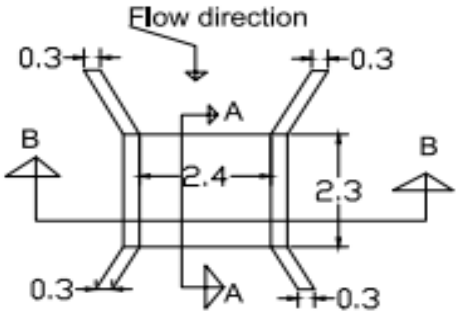
- Two reinforced concrete canal flumes are not executed as shown in the figures
- 16 canal turn outs and flow regulators
- 3 escape canal to flush unwanted water and silt
- 2 cross roads and flood super passages
- 2 division box
- 1000m extended canals are not executed.



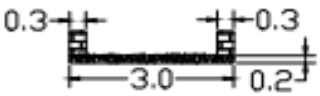
Flume plan veiw 1



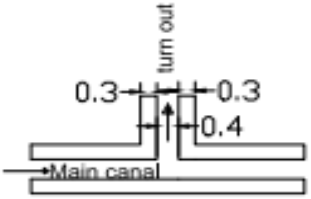
Main canal

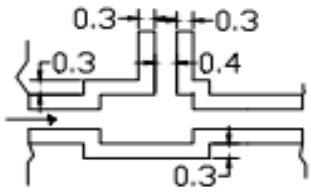


super passage and animal crossing plan veiw



Section B-B





Division box

– turn out and flow regulatore

- **Generally we conclude that If the works listed above are not completed the following problems are continued.**
  - ☞ The executed part of the project cannot be functional and sustainable.
  - ☞ The project cannot feed the required amount of land
  - ☞ The conflict between the water user will be continued
  - ☞ The command area found at the end does not gate sufficient water and becomes out of production.
  - ☞ The production 2times and 3 times a year is impossible
  - ☞ The land that is un functional by water logging will continued
  - ☞ The water loss will be continued
- Hence everyone who are responsible for this project should be contribute the possible roles to maximize production and reduce poverty

BILL OF QUANTITY AND COST ESTIMATION OF NEWLY EXCUTED WORK ITEMS:-

Sr.No	work activity descriptins	Unit	un excuted quatity	New unit rate	new total cost
1.2	Demobilization cost		1.00	10000	10,000.00
4	**infrastructure works**				-
4.1.3	Bulk excavation of canal after 35m length at 1.5m width and at average depth of 0.6m.	M3	1,152.00	350	403,200.00
4.1.4	Bulk excavation of drop structure at 2m length, 2m width and at average depth of 2m.	M3	48.00	350	16,800.00
4.1.5	Bulk excavation of division box at 1m length, 2m width and at average depth of 0.6m.	M3	4.80	350	1,680.00
4.1.6	Bulk excavation of turn outs at 1mlength, 1.5m width and at average depth of 0.6m.	M3	14.40	350	5,040.00
4.1.7	Bulk excavation of escape canal at 2m length, 0.5m width and at average depth of 0.4m.	M3	2.40	350	840.00
4.1.9	Back fill of canal after 35m length at 0.5m width and at average depth of 0.6m with a well compaction	M3	404.40	250	101,100.00
4.1.10	Back fill of drop structure at 1m width and at average depth of 2m with a well compaction	M3	24.00	250	6,000.00
4.1.11	Back fill of division box structure at 0.4m width and at average depth of 0.6m with a well compaction	M3	0.96	250	240.00
4.1.12	Back fill of turn outs structure at 0.4m width and at average depth of 0.6m with a well compaction	M3	4.80	250	1,200.00
5	**masonry and concrete work of infrastructure**				-
5.1	Masonry work of canal bed at 0.15m thick and 1m width	M3	176.30	8500	1,498,550.00
5.1.2	Hard core for turn outs, division box and escape canal bed at 0.15m thick	M3	3.00	8500	25,500.00
5.1.3	Masonry work of canal with Side	M3		8500	

	thickness of 0.3m with 1:3 mortars.		**317.52**		**2,698,920.00**
5.1.4	Masonry work of drop structure with Side thickness of 0.3m with 1:3 mortars.	M3	**7.20**	**8500**	**61,200.00**
5.1.5	Masonry work of turn outs structure with Side thickness of 0.3m with 1:3 mortars.	M3	**4.32**	**8500**	**36,720.00**
5.1.6	Masonry work of escape canal structure with Side thickness of 0.3m with 1:3 mortars.	M3	**0.81**	**8500**	**6,885.00**
5.1.7	Masonry work of division box structure with Side thickness of 0.3m with 1:3 mortars.	M3	**0.86**	**8500**	**7,310.00**
5.1.8	Concrete work of canal bed at 8cm thickness. Grade→C-20,ratio=1:2:3	M3	**51.78**	**13400**	**693,852.00**
5.1.10	plastering of drop structure at 0.3cm thickness with grad (1:2)	m2	**4.00**	**660**	**2,640.00**
5.1.11	plastering of turn outs, division box and escape canal at 0.2cm thickness with grad (1:2)	m2	**34.50**	**660**	**22,770.00**
5.1.12	Concrete work of canal bed at 8cm thickness. Grade→C-20,ratio=1:2:3	M3	**1.54**	**13400**	**20,636.00**
5.1.13	3cm thickness plastering of canal banks and bed with(1:2 mix ration) at length of 1800m	m2	**2,659.84**	**660**	**1,755,494.40**
5.1.14	Pointing work of 1000m length external side canal backs at 0.03m thickness with (1:2 mix ration)	m2	**900.00**	**520**	**468,000.00**
5.1.15	3cm thickness plastering of division box, turn outs and escape canals with(1:2 mix ration)	m2	**41.80**	**660**	**27,588.00**
6	**drainage flume work(1)**				-
6.1.2	Back fill of right and left side retaining walls length 6.5m and 0.8m width,2.4m depth	M3	**1.56**	**250**	**390.00**
6.2.2	Concrete work of flume bed beam width of 0.8 m & 9m length at 20cm thickness with Grade→C-20 ratio=1:2:3	M3	**1.44**	**13400**	**19,296.00**
6.2.3	Concrete work of flume canal banks with 0.45m depth and 0.2m thickness with Grade→C-20 ratio=1:2:3	M3	**1.62**	**13400**	**21,708.00**
6.2.4	Flue Reinforcement bar ø 16mm at 20cm c/c longitudinal	kg	**152.49**	**350**	**53,371.50**
6.2.5	Flume Reinforcement bar ø 12mm 20cm c/c cross-sectional	kg	**79.30**	**350**	**27,755.00**
6.26	Black wire for tying	kg	**2.38**	**350**	

					833.00
6.2.7	Pointing of guide walls	m2	2.40	520	1,248.00
6.3	**drainage flume work(2)**				-
6.3.1	Bulk excavation of right and left side retaining wall at 1.5m width, 1m average depth, 5m length and cart away up to 50m.	m3	15.00	350	5,250.00
6.3.2	Back fill of right and left side retaining walls length 5m and 0.5m width,1m depth	m3	5.00	250	1,250.00
6.4.1	Masonry work of right and left side retaining wall foundation at 3m length, 0.5m depth and 1m width respectively.	m3	3.00	8500	25,500.00
6.4.2	Masonry work of right and left side retaining wall above foundation at 1.3m depth and 1m bottom and 0.3m top width respectively.	m3	7.80	8500	66,300.00
6.5	**drainage flume concrete work**				-
6.5.1	Lean concrete work of, intake foundation at 5cm depth. Grade→C-15,ratio=1:3:6	m2	3.00	10400	31,200.00
6.5.2	Concrete work of flume bed beam width of 0.9 m & 6m length at 30cm thickness. and 0.6m flume canal depth with Grade→C-20 ratio=1:2:3	m3	0.66	13400	8,844.00
6.5.3	Concrete work of flume canal banks with 0.6m depth and 0.2m thickness with Grade→C-20 ratio=1:2:3	m3	0.74	13400	9,916.00
6.5.4	Flume Reinforcement bar ø 14mm at 20cm c/c longitudinal	kg	54.54	350	19,089.00
6.5.5	Flume Reinforcement bar ø 12mm 20cm c/c cross-sectional	kg	37.96	350	13,286.00
6.5.6	Black wire for tying	kg	0.93	350	325.50
6.5.7	Pointing of guide walls	m2	10.80	520	5,616.00
7	**supper passage and cross road structures**				-
7.1	Bulk excavation of super passage at 0.6m width, 0.3m average depth, 5m length and cart away up to 50m.	m3	3.60	350	1,260.00
7.1.2	Back fill of super passage 5m and 0.3m width,0.3m depth	m3	1.80	250	450.00
7.1.3	Masonry work of super passage above slab at 0.5m depth and 0.3m thickness	m3	1.20	8500	10,200.00

	respectively.				
7.1.4	Super passage and road crossing Reinforcement bar ø 12mm longitudinal and ø 12mm cross-sectional	kg	**66.93**	**350**	**23,425.50**
7.1.5	Black wire for tying	kg	**0.67**	**350**	**234.50**
7.1.6	Concrete work of super passage and road crossing slab with Grade c-20 ratio (1:2:3)	m3	**4.20**	**13400**	**56,280.00**
7.1.7	Plastering of super passage banks at 0.2cm thickness with grad (1:2)	m2	**21.00**	**660**	**13,860.00**
7.1.8	Trash rack iron of off take ø 16mm	kg	**0.79**	**350**	**276.50**
8	**all flow sheet metals and flow regulators**				-
8.1.4	Sheet metal of sixteen flow regulators, t=4mm (width of 0.50 mts & 0.50 mts height	m2	**3.10**	**18500**	**57,350.00**
8.1.5	Sheet metal of sixteen turn outs, t=4mm (width of 0.50 mts & 0.50mts height	m2	**4.00**	**18500**	**74,000.00**
8.1.6	Angle Iron for both, t=4mm 4mm*4mm	m	**90.00**	**1200**	**108,000.00**
8.1.7	Reinforcement bar ø 12mm for handle & hook.	kg	**53.25**	**350**	**18,637.50**
	Total cost without vat				**8,547,317.40**
	Vat				**1,282,097.61**
	Grand total with vat				**9,829,415.01**