Appendix 6-7 M/D of Stakeholder Meeting

The Time and date of the Stakeholders Meeting：On 13th day of April 2012
Venue: Seasons Hotel, Narok.

Min 1: (Initiation of Meeting)

- The Managing Director welcomed the stakeholders
- Prayer was conducted by Anne Swakei
- The Chairman, Francis Nkako of NARWASSCO emphasized the importance of water and the water issues faced in Narok North District.

Min 2: (Presentation: Current Status of the NARWASCCO)

- Narok Water and Sewerage Company was established on the 27th February 2006
- Commenced its operations as from 1st September 2007 after signing Service Providers Agreement (SPA) with RVWSB
- Total capacity of Narok water treatment plant is 104m^3/hr
- Improvements realized so far by NARWASCCO such as Increased average service hours from 6 hrs to at least 12 hours daily, Increased revenue base an average of Kshs. 600,000 to an average of Kshs. 1.6 Million monthly , Increased water production from 1,700m^3/day to 2,200 m^3/day and Construction of 7 NO Kiosks and 5 NO yard taps in Majengo
- Major challenge, the demand is higher than the supply.

Min 3: (Presentation: Outline of JICA Project)

- Engineer Sampao of NARWASCCO introduced the JICA project to the stakeholders.

Min 4: Open Discussion

- Ali Juma Resident Association Representative of Lenana area wished to know who would provide the meters promised earlier and at whose cost would the replacement be on.
- The technical manager of NARWASSCO replied that for the pilot project in Majengo, the JICA technical cooperation project team had bought the meters and in future they will possibly duplicate the same pilot project in other areas.
- Kirishima of JICA team added that the preparatory survey team was considering giving water meters by the project and to be installed by NARWASCCO. The Chairman added that eventually all residents in Narok would have a meter.
- Isaac Kimani appreciated the presentations and he stated that through the JICA initiative they hoped the residents of Olpopongi would get piped water.
- The physical planner appreciated the JICA project initiative and observed that it had come at an opportune moment. He mentioned that the meeting was a good forum for establishing sect oral partnerships.

- The Chairman asked the stakeholders present to inform their colleagues in the offices and urged them to be proactive in finding the solution to water problems.
- Ali Juma appreciated the work done by NARWASSCO. He stated the displeasure of not feeling involved in the initial stages of planning the project.
- Jesse Mwangi, a water rights officer in WRMA expressed gratitude for the project. He stated WRMA's concern was on the river flows of the Narok River. He emphasized the need for stream storage by construction of dam.
- At 10:15, the forum took a coffee break.

Min 5: (Presentation: Project Design Plan)

- Engineer Sampao took the Stakeholders through the details of the design of the new water treatment plant and introduced the JICA Study team doing the preliminary studies.

Min 6: (District Commissioners speech)

- The D.C of Narok North expressed his honor to chair the meeting. He affirmed the mandate of NARWASSCO to provide water in Narok North District. He observed that the current provision of water was not enough for the current population. He noted that the structures were old and required replacements. He expressed his hope that the project would ensure increased production water and put an end to poor water rationing.
- He observed that Narok Town was growing very fast and no changes had been made in the water systems. He asked the stakeholders to be cooperative to ensure success of the project. He asked NARWASCCO to create more workshops to talk about the upcoming issues.
- He thanked the Government of Japan for their assistance and declared the meeting officially opened.

MIN7: (Presentation: Environmental impact and mitigation measures)

- Kenji Takayanagi , the Environmental Specialist of the JICA study team made a presentation on the environment impact and mitigation measures to be implemented concerning the new water treatment plant.

Min 8: Open Discussion

- The physical planner appreciated the presentations noting that the presentation provided vital information.
- He highlighted the lands issue as pertinent. He asked the council to find out the individual owners of the land before allocating to the project to avoid future problems during the implementation.
- He advised to bring on board relevant road authorities in the discussions.

- He suggested that there is need for an alternative site in case the FTC land is not available. He asked the relevant offices to suggest other areas in the vicinity if need be. He noted that the community would be willing to give up land for the project if the need arose.
- The chairman acknowledged that land is a sensitive issue and the company will look in to it. He noted that development is impossible without water. He stated that they would convene another meeting to address the land issue.
- Seleila a board member of NARWASSCO appreciated the work JICA was doing and acknowledged the concern of the physical planner. He suggested that more stakeholders should be involved in the meeting.
- Cheruiyot of RVWSB appreciated the JICA support in Kenya developments. He informed the members that the period of involving the stakeholders was not yet as the project was at the initial stages. He assured the members present that a full EIA study would be conducted.
- Ali Juma asked the stakeholders to look with seriousness what the physical planner had said. He asked for the creation of a team of stakeholders for follow up purposes.
- The chairman stated that the meeting was one of many to come. He explained that the location of the new treatment plant had engineering and a cost aspect.
- Cheruiyot highlighted the issue about the livestock people feeling left out in the land allocation matters and he asked the awareness to be created among the pastoralist community about the water project. He asked the livestock office not to give wrong information to the people concerning the purpose of the land.
- The chairman of WRUA noted that when the community see the purpose of which the land is allocated for they will not complain.

Min 9: Close of meeting

- The chairman of NARWASSCO gave a vote of thanks and asked the stakeholders to be supportive and ensure the success of the project.
- The closing prayer was conducted by Isaac Kimani.

Appendix 6-8 Results of Topographic Survey

Aiming to prepare temporary design, proposed construction sites for new intake facility, new WTP, new reservoir, raw water conveyance pipe, transmission pipe, distribution pipe and related structures were surveyed and the results were converted into digital drawings.

Work Items	Survey Specifications
Leveling Survey	Ground level：50 points
Plain Survey	Intake facility：500 m^2（S：1/100　contour line：by 1m） Water treatment plant：15,000 m^2（S：1/200　contour line：by 1m） Distribution facility：5,000 m^2（S：1/200　contour line：by 1m） Raw water conveyance pipe：1.5km（S：1/500　contour line：by 1m　survey width：50m） Transmission/distribution pipe：25km（S：1/500　contour line：by 1m　survey width：road edge + 3m）
Longitudinal Survey	Intake facility：L=30m×3 lines（S：1/100） Raw water conveyance pipe：1.5km（S：H＝1/500　V＝1/100） distribution pipe：25km（S：H＝1/500　V＝1/100）
Cross Section Survey	Intake facility：L=50m×3 lines（S：1/100） Water treatment plant：L=100m×10 lines（S：1/200） Distribution facility：L=100m×5 lines（S：1/200） Raw water conveyance pipe：L=50m×20 lines（S：1/100） distribution pipe：L=20m×250 lines（S：1/100　by 100m interval）

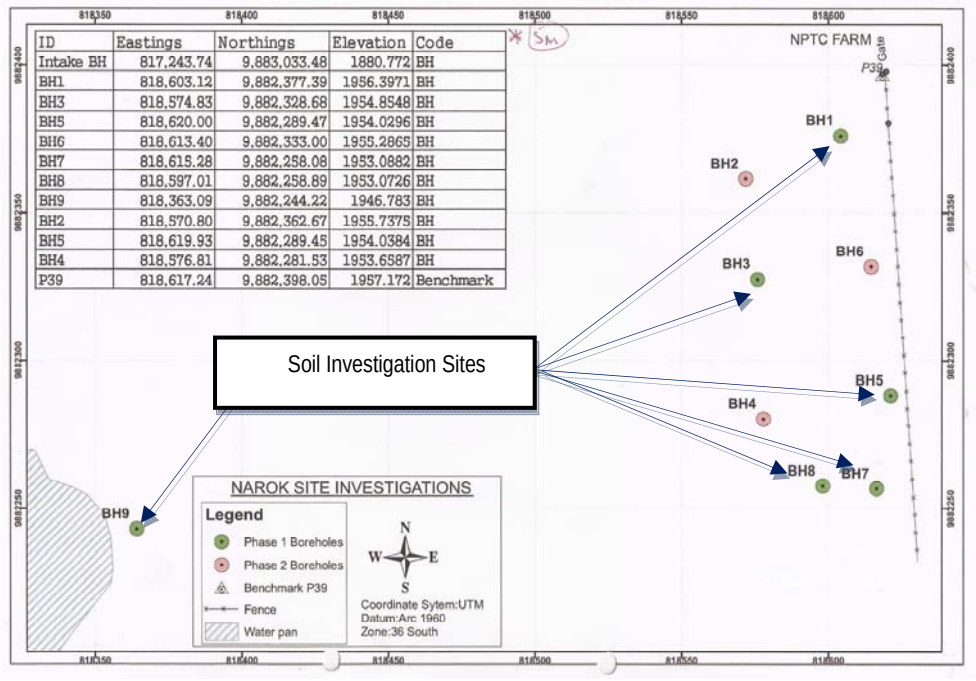
Appendix 6-9 Results of Soil Investigation

Soil investigations were carried out in the proposed construction sites for new intake facility, new WTP, new drainage pond and pipe installation routes and the results were utilized for water supply system plan and design.

Work Items	Work Specifications
Construction site of Intake Facility, WTP and Reservoir	Soil investigation points：7 points（Intake 1 point, WTP 6 points） – Borehole depth= 5 m ～10 m – Borehole diameter＝Greater than 65mm – Standard Penetration Test：Every 1m depth in each point – Confirm foundation layer with N value greater than 50 in each point
Installation Routes of Distribution Pipes	Soil investigation points：3 points – Borehole depth = 5 m – Borehole diameter＝Greater than 65mm – Standard Penetration Test：Every 1m depth in each point – Confirm foundation layer with N value greater than 50 in each point
	Test pit：10 points – Pit depth：Less than 1m – Pit area：0.8m×0.8m

<Soil Investigation of the Intake Facility and WTP>

During field survey, soil investigation was carried out in 1 point at intake facility, 6 points at WTP site to confirm soil condition.



Soil Investigation Sites Location of the WTP and drainage pond

Outline of Soil Investigation Sites

LOCATION	BH NO.	AUGERING DEPTH	CORING DEPTH	U100 NO	S.P.T EVERY 1M INTERVAL	BULK SAMPLE COLLECTED
WTP	01	G.L to 2.0m	2.0 to 10.0m	NIL	1	2
WTP	03	G.L to 3.0m	3.0 to 6.0m	NIL	2	3
WTP	05	G.L to 2.0m	2.0 to 5.0m	NIL	1	2
WTP	07	G.L to 1.30m	1.3 to 5.0m	NIL	1	1
WTP	08	G.L to 2.0m	2.0 to 5.0m	NIL	1	2
WTP	09	GL to 5.0m	0.5 to 5.0m	NIL	NIL	1
INTAKE	10	G.L to 0.75m	0.75 to 5.0m	NIL	NIL	1

SPT profile for non-cohesive soil

Estimated bulk density, γ_b : 20.0 kN/m^3

Correction to 60% free fall energy, e_c : 1.00

Adjustment for Split Spoon or Cone : Applied

Equations:

$\sigma'_v = z_{mid} * \gamma_b' - u$

IF $z_w > z_{mid}$, $u = 0$: ELSE $u = (z_{mid} - z_w) * 9.81$

$(N_1)_{60} = N * C_n * e_c * C_{cone}$

C_{cone} = 1.0 for no adjustment or Split Spoon used, ELSE = 0.5

C_n from correlation with σ'_v after by CIRIA (1995)

ϕ' from look up tables and $(N_1)_{60}$ after Peck et al 1974

Results of Soil Investigation

BH NO	Depth			GWL	SPT	σ'_V	C_n	SPT	φ
	Z_{top} (m)	Z_{base} (m)	Z_{mid} (m)	Z_w (m)	N	(kPa)		$(N_1)_{60}$	degrees
01	1.0	1.45	1.23	10	49	25	2.04	100	44
03	2.0	2.45	2.23	10	50	45	1.48	74	44
05	1.0	1.45	1.23	10	46	25	2.04	94	44
07	1.0	1.45	1.23	10	51	25	2.04	104	44
08	1.0	1.45	1.23	10	41	25	2.04	84	44

For BH No.09 and No.10 less than 1.0m from top of the bore holes hard rocks were found. So in-situ experiment was not done. Therefore the test results are not listed in the table, the ground is good. As shown in the table above, soil spread in intake facility and WTP site is mainly composed of silty clay. Since N values in 1 to 2m depth groom ground surface reached 50, the ground has quite firm nature. Therefore, mat foundation is proposed for water treatment facilities.

Appendix 6-10 Results of Water Quality Analysis

Water quality analysis was conducted on the following water quality indices and based on the results water purification methods for new WTP was examined.

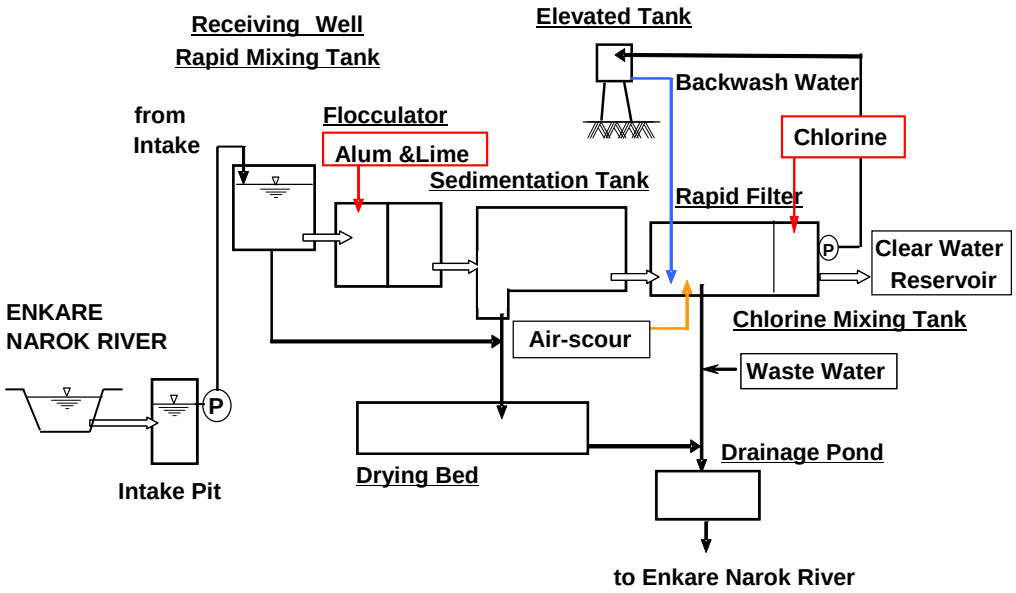
Sampling Points	Work Specifications
Existing Intake Point	Water samples：Raw water Sampling number：2 times（Dry and wet weather） 1st sampling：3rd March 2012 2nd sampling：19th March 2012 Analysis Indices：Temperature, pH, SS, Total Hardness, Total Alkalinity, Cu, Hg, Fe, Pb, COD, Turbidity, Chlorine Ion, Color, Zn, Coliform Group, Fecal Coliform, F, Mn, Cd, As, NH_3^-, NO^{3-}, Residual Chlorine
New Intake Point	Water samples：Raw water Sampling number：2 times（Dry and wet weather） 1st sampling：3rd March 2012 2nd sampling：19th March 2012 Analysis Indices：Temperature, pH, SS, Total Hardness, Total Alkalinity, Cu, Hg, Fe, Pb, COD, Turbidity, Chlorine Ion, Color, Zn, Coliform Group, Fecal Coliform, F, Mn, Cd, As, NH_3^-, NO^{3-}, Residual Chlorine
Existing WTP（All indices）	Water samples：Purified water Sampling number：1 time Sampling date：3rd March 2012 Analysis Indices：Temperature, pH, SS, Total Hardness, Total Alkalinity, Cu, Hg, Fe, Pb, COD, Turbidity, Chlorine Ion, Color, Zn, Coliform Group, Fecal Coliform, F, Mn, Cd, As, NH_3^-, NO^{3-}, Residual Chlorine
Existing WTP（Partial indices）	Water samples：Purified water Sampling number：1 time Sampling date：19th March 2012 Analysis Indices：Temperature, pH, Turbidity, Color, Zn, Coliform Group, Residual Chlorine
New WTP	Water samples：Purified water Sampling number：1 time Sampling date：7th March 2012 Analysis Indices：pH, Turbidity, Color, Zn, Coliform Group, Residual Chlorine
Existing Reservoir	Water samples：Purified water Sampling points：3 points（TTC, Petrol Station, St' Mary's School ） Sampling date：19th March 2012 Analysis Indices：pH, Turbidity, Color, Zn, Coliform Group, Residual Chlorine
Public Faucets （Yard Tap）	Water samples：Purified water Sampling points：2 points（Sosotua Village, Osotua） Sampling date：19th March 2012 Analysis Indices：pH, Turbidity, Color, Zn, Coliform Group, Residual Chlorine

Public Faucets （Kiosk）	Water samples：Purified water Sampling points：3 Points（No1, No5, No7） Sampling date：19th March 2012 Analysis Indices：pH, Turbidity, Color, Zn, Coliform Group, Residual Chlorine
Water Tanker Truck	Water samples：Purified water Sampling points：3 points（Truck, Seasons Hotel, Mara Link Hotel） Sampling date：19th March 2012 Analysis Indices：pH, Turbidity, Color, Zn, Coliform Group, Residual Chlorine

Appendix 6-11. Capacity Calculation and Hydraulic Calculation for North WTP

1. Capacity Calculation

(1) Flow Diagram



(2) Facility Capacity

2-1) Design Treatment Amount

	m^3/day	m^3/hr	m^3/min	m^3/sec
Intake/Treatment Amount	4,300	179	3.0	0.050

2-2) Receiving Well

Retention Time: >1.5 min

Water surface area aquired: 10 m^2 (adopted 10m^2 as minimum area needed for maintenance works)

Dimensions:

width (m)	effective L (m)	Effective D(m)	Well No.
2.5	4.0	3.0	1

(Check) Retention Time: 10.0 min ⇒OK

2-3) Flocculation Tank

Type: Vertical Detour Flow Type

GT Value: 23,000~210,000 (G Value 10~75/sec)

Retention Time: 30 min (Standard 20~40 min)

Dimensions:

width (m)	length (m)	depth(m)	Tank No.
5.5	8.85	1.2	2

(Check) Retention Time: 33.1 min ⇒OK

(Check) GT Value: 62,359 ⇒OK

Retention Time T (sec)	Head Loss H (m)	G-Value =(gH/μT)^0.5	GT-Value
1986	0.200	31.4	62,359

※ Kinematic viscosity μ= 0.010 cm^2/s

2-4) Coagulated Sedimentation Tank

Type: Horizontal Flow Type, stable for raw water tubidity fluctuation

Standard Surface Load Kenya: 1.0 $m^3/m^2 \cdot hr$ = 16.7 mm/min

Japan: 15 mm/min～30 mm/min

Required Surface Area Kenya: 180 m^2

Japan: 100 ～ 200 m^2

Dimensions:

width(m)	length(m)	Effective D(m)	Tank No.
5.5	17.0	3.0	2

(Check) Surface Area: 187.0 m^2 ⇒OK

(Check) Surface Load: 16 mm/min ⇒OK

2-5) Rapid Sand Filter

Type: Gravity

Standard Filtration Rate Kenya: 5$m^3/m^2/hr$＝120m/day

Japan: 120～150m/day

If filtration rate is set by 120m/day, required filter area is

Required Filter Area: 35.8 m^2

Dimensions:

width(m)	length(m)	Filter No.
2.5	3.6	4

(Check) Filter Area: 36 m^2 ⇒OK

(Check) Filtration Rate: 119.4 m/day ⇒OK

Filter Composition (Combination with Air-washing)

Sand(mm)	Remarks
1,000	Effective grain size φ＝0.8～0.9mm, uniformity coefficient K<1.7

※Sand is supported by Under Drain Unit

2-6) Chlorine Mixing Tank(Dual use as Pump Well for elevated tank)

Build chlorine mixing tank and pump well within rapid sand filter structure

Chlorine is mixed by water falling energy from weir

Dimensions:

width(m)	length(m)	depth(m)	Tank No.
4.0	3.6	1.70	1

(Check) Capacity: 24 m^3

(Check) Retention Time: 8 min

2-7) Sludge Drying Bed

①Sludge Amount (applied Solid Alum)

a) Water Treatment Amount 4,300 m^3/day

Sludge is divided into trubidity-oriented sludge and coagulant-oriented sludge

b) Turbidity-oriented Sludge Amount (t)

Turbidity	100	degree
Turbidity/SS Conversion Rate	1	
Sludge Amount (by turbidity)	0.43	t/day

c) Sludge amount by solid Alum (t)

Content rate of Al_2O_3	17	wt%
Dosing rate	80	mg/L
Solid Alum Dosage Rate	0.344	t/day
Sludge Amount (Solid Alum)	0.089	t/day

d) Total Sludge Amount	0.519	t/day (dried weight)
Water Contents	99	%

e) Total Sludge Volume 51.9 m^3/day

②Structure Dimensions

Solid Load:	10～30	kg/m^2
Drying Days:	30	days (water content 65%)
Sludge Depth:	1.5	m (Max)

Required Bed Area:

By Solid Load 519 m^2 (with Solid Load of 30kg/m^2)

By incoming Sludge Amount 1,038 m^2

⇒Requited area is set by : 1,038≒1,000m^2

Dimensions:

width (m)	length (m)	depth (m)	Bed No.
12.5	20.0	1.5	4

(Check) Drying Bed Area: 1,000 m^2 ⇒OK

(Check) Solid Load: 15.6 kg/m^2 ⇒OK

Remarks: ・4 beds are converted every 10 days

・Set stop logs to allow tentative supernatant discharge

・Install valve to remove seepage at the bottom

2-8) Rapid Sand Filter Backwash Effluent Tank

This tank recieves ont only rapid sand filter backwash effluent but also effluent generated in receiving well, flocculation tank, sedimentation tank and rapid sand filter. Discharge siupernatnat to Enkare Narok River after sludge sedimantation.

Backwash Effluent Amount: 0.6～0.9$m^3/m^2/min$ → 0.7$m^3/m^2/min$

Backwashing Time: 4～ 6min → 7min（Some allowance is needed as manually operated）

Daily Backwashing Amount: Filter Area 36m^2×0.7m^3/m^2/分×7分 ≒180m^3

Required Tank Capacity: Considering remaining turbidity sedimentation and evaporation of residual chlorine, tank capacity can store 3 to 4 days of incoming effluent is needed

Rquired Tank Capacity: 180m^3×4 days = 720m^3

Tank No.: 2 units

Dimensions:

width（m）	length（m）	depth（m）	Tanl No.
14	19	1.5	2

(Check) Capacity: 798 m^3 ⇒OK

Remarks: Set stop logs in discharge side to allow tentative supernatant discharge

2-9) Elevated Tank

Elevated tank shall have sifficient capacity to provide water for rapid sand filter backewashing, sedimentation tank cleaning, chemical solution and other in-plant use

Daily filter backwashing water amount 180 m^3

Tank Capacity: 2 filter backwashing water amount +10% for other effluent

180/4 filter×2 filter× 1.1＝99m^3

Dimensions:

width（m）	length（m）	depth（m）	Tank No.
4.5	4.5	5.0	1

(Check) Capacity: 101 m^3 ⇒OK

2-10) Claerwater Tank（In-plant Reservoir）

Design Capacity(Retention Time): 12 hrs

Required Capacity: 2,000 m^3

Dimensions:

width（m）	length（m）	depth（m）	Tank No.
10	35.0	3.0	2

(Check) Capacity: 2100 m^3 ⇒OK

2. Hydraulic Calculation

(1) Summary of Hydraulic Calculatrion

Design Treatnment Amount	:	=	4,300	m^3/d
	:	=	179	m^3/h
	:	=	3.0	m^3/min
	:	=	0.050	m^3/s

1-1) Rapid Mixing Chamber			
Chamber Water Level	WL1 = +	1,960.000	m
Overflow Weir Level (Chemical Dosing)	Ht=+	1,959.900	m
Water Level in weir downstream	WL2 = +	1,959.050	m
1-2) Flocculation Tank			
Water Level in upstream	WL3 = +	1,958.900	m
Water Level in downstream	WL4 = +	1,958.600	m
1-3) Sedimantation Tank			
Tank Water Lavel	WL5= +	1,958.500	m
Overflow Weir Level	Ht=+	1,958.480	m
Water Level in weir downstream	WL6 = +	1,958.280	m
1-4) Rapid Sand Filter			
Water Level in incoming channel	WL7 = +	1,958.180	m
HWL in Filter	WL8 = +	1,958.000	m
Sand Surface Level	Hs=+	1,956.200	m
1-5) Chlorine Mixing Tank			
Incoming Weir Level	Ht=+	1,956.200	m
Tanlk Water Level	WL9 = +	1,956.000	m

(2) Hydraulic Calculation

Water Level in Receiving Well	:	WL0 = +	1,960.000	m

2-1) Receiving Well (Rapid Mixing Chamber)

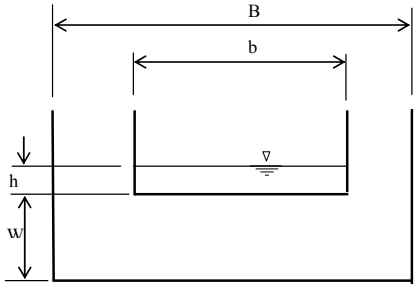
Water Level in Receiving Well WL1 = + 1,960.000 m

Overflow Weir : Chemical is agitated by water falling energy

Number	1	
Flow Amount	0.050	m^3/s
Weir Length	1.0	m

Q=Cbh^3/2

C=1.785+0.00295/h+0.237*h/W - 0.428((B-b)*h/(B*W)^12+0.034(B/W)^1/2



Calculation of C

h=	0.092	m
W=	1.20	m
B=	2.50	m
b=	1.00	m
C=	2	
Q=	0.050	m^3/s
	3.0	m^3/min
	180	m^3/hr
	4,322	m^3/d

Overflow depth 0.092 m Weir Level : Ht=+ 1,959.908

say 1,959.900 m

Water level in weir downstream (Rapid Maxing Chamver W.L.) : 85cm below weir top level (for agitation)

WL2 = + 1,959.050 m

Effluent Pipe	Diameter	300	mm
	Pipe Number	1	pc
	Velocity	0.71	m/s
Head Loss :		0.150	m

2-2) Flocculation Tank

Water Level in upstream : WL3 = + 1,958.900 m

Assumed tank head loss of 30cm

Water Level in downstream : WL4 = + 1,958.600 m

Overflow Weir (submerged)

Head Loss : 0.100 m

2-3) Sedimentation Tank

Water Level in Tank : WL5= + 1,958.500 m

Overflow Weir :

No.= 2

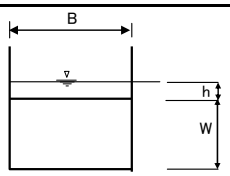
Weir Length : L 5.0 m

Flow Amount : q/tank 0.025 m^3/s

Suppressed Rectangular Weir

Q=CBh^3/2

C=1.785+ (0.00295/ h +0.237* h /W) * (1+ε)



Q : Flow Amount (m^3/s)

B : Weir Width (m)

h : Overflow Depth (m)

C : Quantity Coefficient (m^1/2/ s)

W : Height from channel bottom to weir top (m)

ε : When W≦ 1 m ε=0, when W> 1 m ε=0.55 (W- 1)

C calculation	CASE-1 (W≦ 1 m)		CASE-2 (W> 1 m)	
h =	0.000		h =	0.018
W=	0.00		W=	3.40
B=	0.00		B=	5.00
C=			C=	2
Q=		m^3/s	Q=	0.026 m^3/s
		m^3/m		1.6 m^3/m
		m^3/h		94 m^3/h
		m^3/d		2,262 m^3/d

Overflow Depth 0.018 m Weir Level : Ht=+ 1,958.482

say 1,958.480 m

Water Level in weir downstream : 20cm below weir top level

WL6 = + 1,958.280 m

Effluent Pipe Diameter 400 mm

Pipe Number 1 pc

Velocity 0.40 m/s

Head Loss : 0.100 m

2-4) Rapid Sand Filter

Inlet Chamber Water Level : WL7 = + 1,958.180 m

Assumed head loss of 0.18m by incoming channel, weir and pipe

HWL in Rapid Sand Filter = WL8 = + 1,958.000 m

Secure 1.8m from HWL to sand surface level

(Secure filter loss of 1.8m) Sand Surface Level

Hs=+ 1,956.200 m

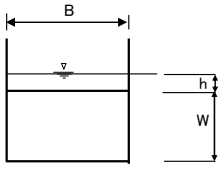
2-5) Chlorine Mixing Tank

Inlet Weir : Weir top level is same to filter sand surface level Ht=+ 1,956.200 m

Suppressed Rectangular Weir

Q=CBh^3/2

C=1.785+ (0.00295/ h +0.237* h /W) * (1+ε)



Q : Flow Amount (m^3/s)

B : Weir Width (m)

h : Overflow Depth (m)

C : Quantity Coefficient (m^1/2/ s)

W : Height from channel bottom to weir top (m)

ε : When W≦ 1 m ε=0, when W> 1 m ε=0.55 (W- 1)

C calculation	CASE-1 (W≦ 1 m)		CASE-2 (W> 1 m)	
h =	0.000		h =	0.056
W=	0.00		W=	1.90
B =	0.00		B =	2.00
C=			C=	2
Q=		m^3/s	Q=	0.050 m^3/s
		m^3/m		3.0 m^3/m
		m^3/h		179 m^3/h
		m^3/d		4,292 m^3/d

Overflow Depth 0.056 m

Water Level in weir downstream : 20cm below weir top level

Water Level in Chlorine Mixing Tank : WL9 = + 1,956.000 m

Appendix 6-12 Examination on Chemical Injection Rate in WTP

(1) Current coagulant injection rate

In the existing WTP, Alum is injected within dosage rate range of 40mg/L to 100mg/L according to raw warter turbidity. Occasionally rate of 140mg/L to 160mg/L is adopted during rainny weather.

(2) Coagulated sedimentation test（Beaker Test）

On 29th Feburary and 6th March, beaker test was carried out using raw water taken at the existing intake point to determine the optimum coagulant dosage ratio. Weather condition of these days were:

29th February: Rain during noon

1st to 5th March: Rain (Heavy rain and wind was observed on 4th)

6th March: No rain

Table 1 Results of Beaker Test (1)

Alum dosage rate (mg/L)	20	40	60	80	100	Raw Water
pH	7.9	7.6	7.4	7.2	7.1	8.5
Turbidity（degree）	30.4	31.6	28.4	12.8	10.4	29.7
Color（degree）	122	126	122	90	72	116
F（mg/L）	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4	1.5

Note) Test date was 29th February, pH was measured by PCT35, Takemura Electric Factory, turbidity and color was measured by WA-PT-4DG,Optic Co.

By Alum dodage rate of 20 and 40mg/L, no remarkable flocculation was observed. By 60mg/L, flocculatio was observed but linferior than oin case of 80/L. By 80 and 100mg/L, floc is formed but in case of 100mg/L, a part of floc was floated without sinking due to exessive dosage. Therefore, in case of this raw water quality, optimum dosage rate range to generate appropriate coagulation effect is 60mg/L to 80mg/L. However, color removal is poor. Compared with raw water turbidity, required Alum injection rate is presumed rather high. Sopposedly, this was caused by high raw water pH. pH was lowered byAluminjection and coagulation was accelerated. Results of 2nd test and photos with higher turbidity raw water during wet weather are shown below:

Table 2 Results of Beaker Test (2)

Alum dosage rate (mg/L)	40	60	80	100	120	Raw Water
pH	7.2	7	7	6.8	6.8	> 7.6
Turbidity（degree）	105	103	52	19.6	22.8	117
Color（degree）	395	390	285	98	130	355
F（mg/L）	< 0.4		—	—	—	1.5

Note) Test date was 6th March, pH was measured by Colorimetry, turbidity and color was measured by WA-PT-4DG, Optic Co.

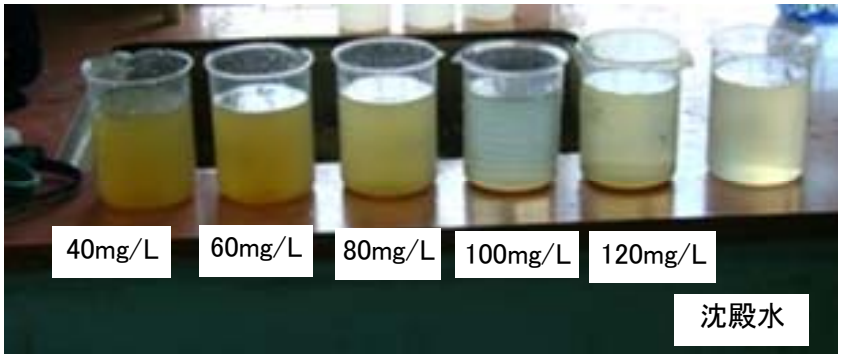


Figure 1 Sedimentation Test Results (6th March)

Table 3 Results of Beaker Test (3)

Alum dosage rate (mg/L)	20	40	60	80	100	Raw Water
pH	7.0	6.6	6.6	6.4	6.4	7.0
Turbidity (degree)	27.2	4.3	5.3	3.3	2.8	100
Color (degree)	194	29.0	28.8	17.5	12.5	360

Note) Test date was 9th March, pH was measured by Colorimatry, turbidity and color was measured by WA-PT-4DG, Optic Co.

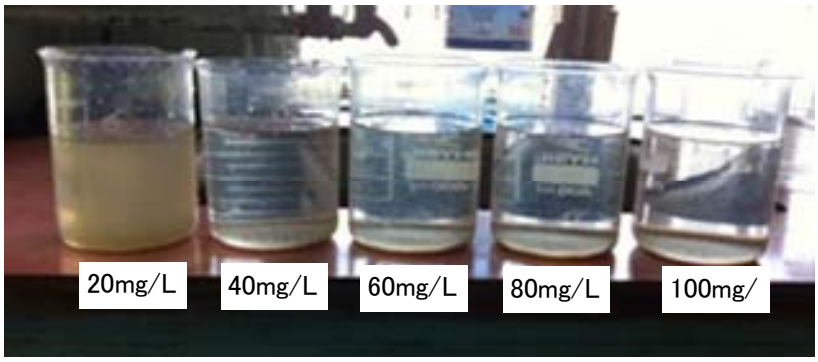


Figure 1 Sedimentation Test Results (9th March)

Test results on 6th and 9th March are shown below:

Table 4 Comparison of Beaker Test Results

Test Date	6th March	9th March
Raw Water Quality	Turbidity and color are almost the same but pH is quite different (>7.6 and 7.0)	
Optimum Injection Rate for Turbidity and Color removal	100mg/L : Flock sunk and turbidity value is the minimum	Flock sinking status is favorable in dosage rate of 40 to 100mg/L and transparency of supernatant is also high
Other Observations	By Alum dosage rate of 40mg/L, flock was not formed. Some flocks were formed and sunk by of 60mg/L but not sufficient. By 80mg/Lm flock sunk but water was cloudy. By 120mg/L, flock sunk but water was cloudy as well.	By 20mg, flock formation was not sufficient and turbidity and color are still high

(3) Chemical Dosage Plan

① Alum

Based on practice in the existing WTP and results of beaker test, Alum dosage plan is prepared.

According to beaker test, observation was as follows:

- 29th February pH = 8.5, turbidity = 29.7, optimumAlum dosage rate = 80mg/L
- 6th March pH>7.6 (equivalant to above), turbidity = 117, optimum dosage rate = 100mg/L
- 9th March pH = 7.0 (lowest and equivalent to appripriate coagulation range forAlum), By dosage rate greater than 40mg/L, flock formation, removal rate of turbidity and color were satisfactory

As oxidized alumina content rate in Alum is 17%, alumina dosage amount for optimum coagulation in 29th February and 6th March was 13.6mg/L (=80×0.17), 17mg/L (=100×0.17) respectively and the later consumed 3.4 mg/L more. Table below is coagulant dosage rate in Kosaku WTP in Tokyo. Against to equivalent turbidity (29.7 degree in 29th February and 117 degree in 6th March), proportion of corresponding oxidized alumina dosage ratio is 2.8 times（= 4.5/2.6）, while in case of abovementoined it was 1.25 times (17/13.6) and this shows that large portion of Alum was consumed to lower pH. This is obvious from results of test conducted on 9th March when raw water pH was low.

Table 5 Examples in Kosaku WTP in Tokyo

Turbidity	liquid aluminum sulfate* Dosage Rate (mg/L)	Conversion into Oxidated Almina Amount (mg/L)
20	30	2.4
30	33	2.6
50	40	3.2
80	48	3.8
100	52	4.2
120	56	4.5
200	70	5.6
300	76	6.1
400	84	6.7
500	90	7.2

*Oxidated alumina content in liquid aluminum sulfate is 8%
Source: Water Supply System Design Guidelines

Since Alum dosage rate is effected by pH and turbidity, dosage rate shall be set as follows:

- High pH and low turbidity >60mg/L
- High pH and high turbidity up to 150mg/L
- Low pH and low turbidity Minimum dosage rate of 20mg/L

Thus, coagulant injection equipment shall be designed with target injection rate range of 20mg/L (Minimum) to 150mg/L (Maximum).

Upon actual dosage, optimum dosage rate shall be determined by jar test considering pH value. Abovementioned are cases without pH control by vitriol for instance. However, based on current plant O&M status, drastic medicine such as vitriol shall not be used from viewpoint of safety and water purification shall be conducted through proper control in Alum injection rate.

② Alkali Agent

Alkali agent is injected to raise pH lowered by Alum. Injection device to raise 1 pH shall be vconsidered as target.

③ Chlorine

Calium hypochlorite is used as chlorine agent and normal chlorine converted dosage rate is 1 to 3mg/L.

Appendix 6-13 Concrete Degradation Diagnosis in existing WTP

1) Survey Plan

i) Basic policy

Field degradation survey on water supply facilities was conducted by physical test such as Schmidt hammer test and neutralization depth measurement. Based on structural characteristics and test results, degradation of structure was evaluated.

ii) Degradation survey（Field survey）

This survey aims to grasp the current degradation degree of existing facilities according to target survey purposes. Main purpose of the survey is data collection related to degradation of target structures. Target of this survey is civil structures of existing WTP and survey methods are described as follows.

iii) Survey methods

Two methods, namely Schmidt Hammer Method and concrete neutralization depth measurement were employed in this degradation survey.

Table 1 Survet Methods Conducted

Tests conducted	Remarks
① Concrete Strength Test	Schmidt Hammer Method
② Neutralization Depth Measurement Test	After chipping concrete body, apply Phenolphthalein solution and observe changes in color

【Concrete Strength Test】

Schmidt Hammer Method was adopted for concrete compression strength test. Target facilities and testing times are shown in Table 2.

【Neutralization Depth Measurement Test】

Chipping target structure and applying Phenol, concrete neutralization depth was measured. Figure1shows the surveyed facilities and test locations.

Table 2 List of surveyed Facilitues and Survey Specifications

Name of Facilities	Schmidt Hammer	N. D. Measurement
Sedimentation Tank No.1	4 times	1 time
Sedimentation Tank No.2	4 times	1 time
Rapid Sand Filter No.1	4 times	1 time
Rapid Sand Filter No.2	4 times	1 time

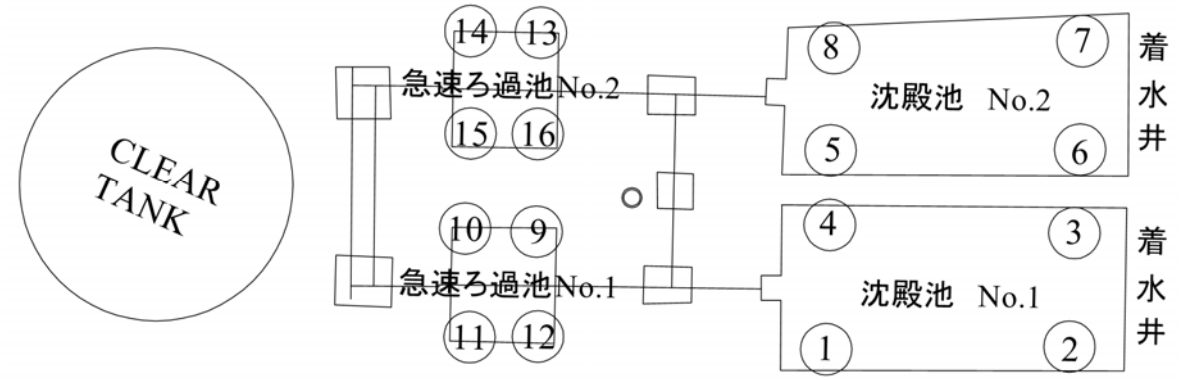


Figure 1 Surveyed Facilities and Test Locations

2) Contents of Survey

【Concrete compression strength assumption by Schmitt Hammer】

As to concrete structures, their concrete compression strength is assumed by Schmitt Hammer. Schmitt Hammer method is conventional concrete strength assumption method by measuring reflected impact after hitting concrete with specific hammer without breaking. If confirmation on concrete strength is the main purpose, this method is popular as nondestructive test.

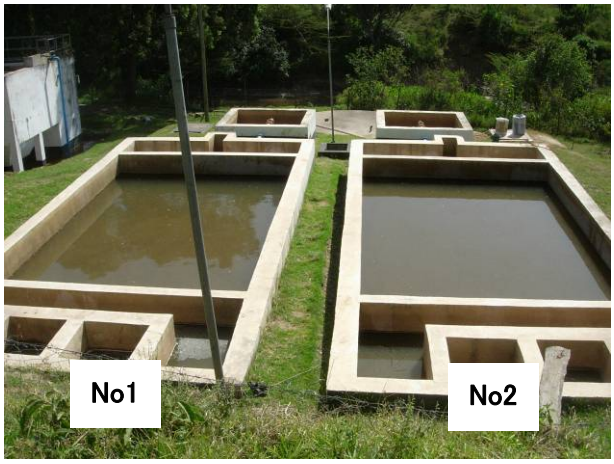
【Neutralization depth measurement by Phenolphthalein solution】

According to JIS A 1152 “Concrete neutralization depth measurement method”, chip concrete up to re-bar installation depth and spray Phenolphthalein solution onto chipped concrete surface to determine its neutralization status and depth.

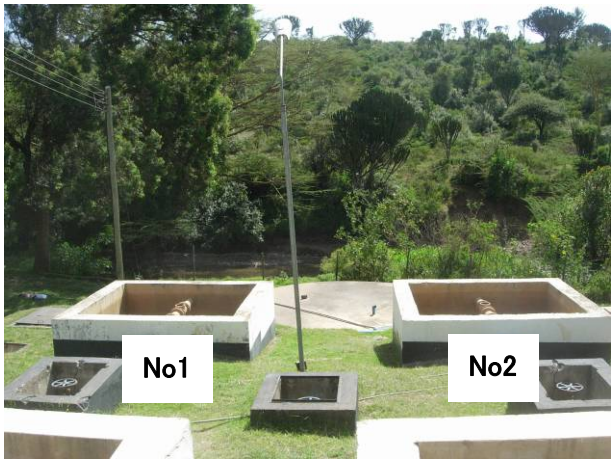
3) Survey Results

Schmidt Hammer survey points, results and photos by facilities are shown in the following pages.
Neutralization test photos and test results are also shown in the following pages.

Photo 1 Test target Facilities



Sedimentation Tank



Rapid Sand Filter

Photo 2 Test Points by Schmit Hammer

Sedimentation Tank No.1 ①

Sedimentation Tank No.1 ②

Sedimentation Tank No.1 ③

Sedimentation Tank No.1 ④

Sedimentation Tank No.2 ⑤

Sedimentation Tank No.2 ⑥

Sedimentation Tank No.2 ⑦

Sedimentation Tank No.2 ⑧

Rapid Sand Filter No.1 ⑨

Rapid Sand Filter No.1 ⑩

Rapid Sand Filter No.2 ⑪

Rapid Sand Filter No.2 ⑫

Rapid Sand Filter No.2 ⑬

Rapid Sand Filter No.2 ⑭

Rapid Sand Filter No.2 ⑮

Rapid Sand Filter No.2 ⑯

Table 3 Results of Schmit Hammer Test

Facilities	Locations	Rebound Degree Rd (－)	Assumed Compression Strength (N/mm^2)	Degradation Degree	Necessity of Repair Work
Sedimentation Tank No1	①	61	59.7	I	Not needed
	②	60	58.4	I	Not needed
	③	47	41.9	I	Not needed
	④	55	52.1	I	Not needed
Sedimentation Tank No2	⑤	53	49.5	I	Not needed
	⑥	54	50.8	I	Not needed
	⑦	55	52.1	I	Not needed
	⑧	55	52.1	I	Not needed
Rapid Sand Filter No1	⑨	61	59.7	I	Not needed
	⑩	59	57.2	I	Not needed
	⑪	60	58.4	I	Not needed
	⑫	50	45.7	I	Not needed
Rapid Sand Filter No2	⑬	58	55.9	I	Not needed
	⑭	63	62.3	I	Not needed
	⑮	56	53.3	I	Not needed
	⑯	57	54.6	I	Not needed

※ 1：Assumed compression strength F (N/㎟) ＝－18.0＋1.27×Rd

※ 2：Providing design standard strength by 24N/mm^2, necessity of repair work was determined in comparison with said standard strength and assumed compression strength

【Degradation classification】

Ⅰ Wholesome：Few deterioration and can be dealt with partial repair

Ⅱ No need Repair：Slight degradation, partial repair is needed

Ⅲ Need Repair：Detailed survey is needed as large-scaled refurbishment might be needed

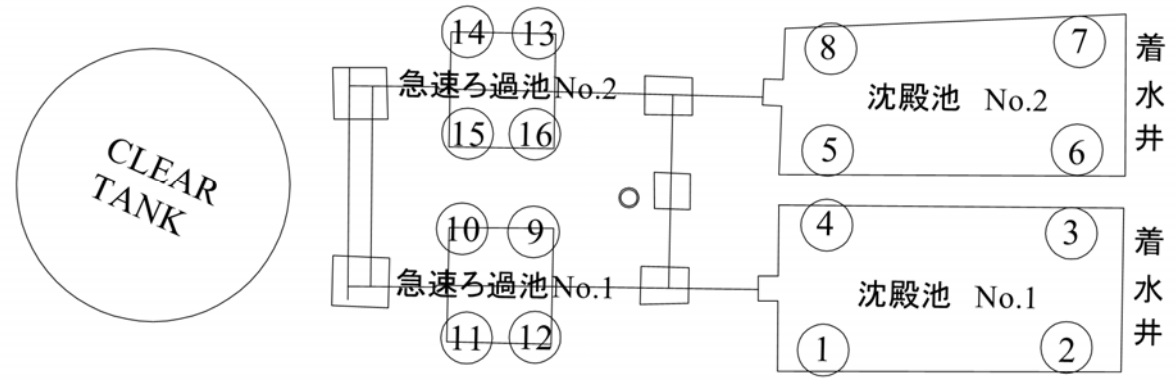
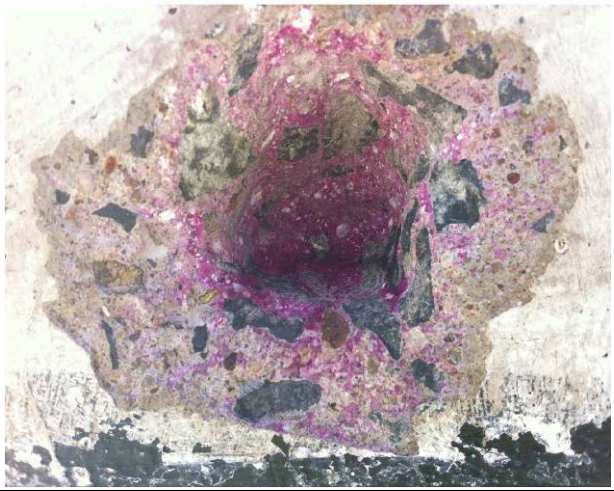


Photo 3 Concrete Neutralization Test

Sedimentation Tank No.1（BEFORE）

Sedimentation Tank No.1（AFTER）

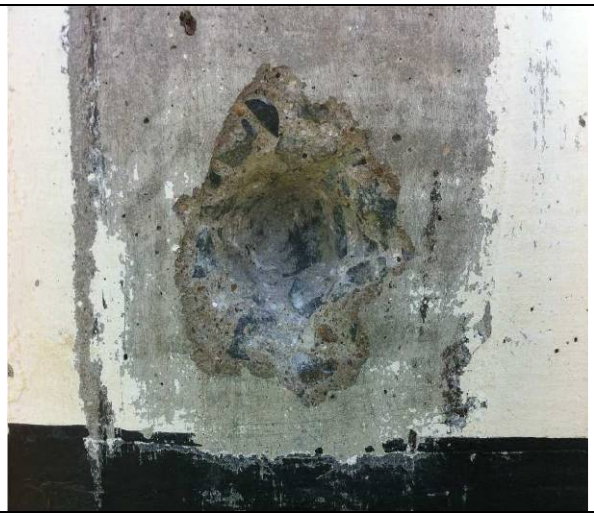
Sedimentation Tank No2（BEFORE）



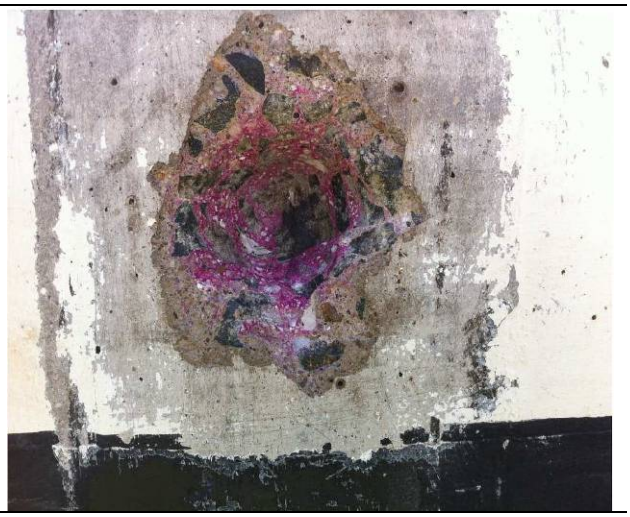
Sedimentation Tank No.2（AFTER）

Rapid Sand Filter No.1（BEFORE）

Rapid Sand Filter No.1（AFTER）



Rapid Sand Filter No.2（BEFORE）



Rapid Sand Filter No.2（AFTER）

Table 4 Results of Concrete Neutralization Test

Item No.	Facility Name	Thickness of Mortar (mm)	Corrosion Degree of Reinforcement Bar*	Depth of Neutralization (mm)
NF-W1	Sedimentation Tank No.1 Tank Wall	No Mortar lining	I	1
NF-W2	Sedimentation Tank No.2 Tank Wall	No Mortar lining	I	1
NF-R1	Rapid Sand Filter No.1 Tank Wall	No Mortar lining	I	1
NF-R2	Rapid Sand Filter No.2 Tank Wall	No Mortar lining	I	1

* Corrosion Degree:

I	No visible Rust
II	Part of Rust visible
III	Almost all part Rust
IV	Damaged by Rust with cracks in bars
V	Due to Rust bars and Concrete expanded

4) Corrosion Degree Judgement

a) Corrosion degree judgement method

Corrosion degree judgement on each concrete structure is referred to “Technology on reinforced concrete structure durability upgrading” issued by the Ministry of Land and Transportation.

b) Corrosion degree judgement results

【Schmitt Hammer Test】

According to the test results, estimated concrete compression strength of Sedimentation Tank was 52.1 N/mm^2 in average and test of rapid Sand Filter was 55.9 N/mm^2. Comparing these to general design standard strength of 24N/mm^2, as they have sufficient compression strength, the existing facilities can be operated without repair works.

【Neutralization Test】

No visible rusts were observed at field test. According to color changing of Phenolphthalein solution, neutralization depth is deemed less than 1 mm from the surface and neutralization has not progressed to deep portion.

Appendix 6-14 Calculation of Enkare Narok River Flow Amount and Probability Year

Measured Agency：WRMA

Measurement Location：2K03

Measurement Duration：January 1981 to January 2012

Measured Data：Monthly minimum water level and river flow amount

Conversion Formula to calculate flow amount by water level：$Y = 3.8408 \times X^{3.8414}$

Where: X：River water depth (m), Y：River flow amount (m^3/sec)

Monthly Minimum Water Level and Flow Amount of Enkare Narok River (1/5)

Year/Month	Minimum Water Level (m)	Minimum Flow Amount (m^3/sec)	Year/Month	Minimum Water Level (m)	Minimum Flow Amount (m^3/sec)
January 1981	0.42	0.137	January 1984	0.51	0.289
February 1981	0.41	0.125	February 1984	0.45	0.179
March 1981	0.40	0.114	March 1984	0.43	0.150
April 1981	0.69	0.923	April 1984	0.44	0.164
May 1981	0.75	1.272	May 1984	0.44	0.164
June 1981	0.60	0.540	June 1984	0.42	0.137
July 1981	0.71	1.030	July 1984	0.42	0.137
August 1981	0.92	2.788	August 1984	0.46	0.195
September 1981	0.85	2.057	September 1984	0.46	0.195
October 1981	0.38	0.093	October 1984	0.46	0.195
November 1981	0.30	0.038	November 1984	0.44	0.164
December 1981	0.48	0.229	December 1984	0.47	0.211
January 1982	0.43	0.150	January 1985	0.43	0.150
February 1982	0.43	0.150	February 1985	0.44	0.164
March 1982	0.43	0.150	March 1985	0.41	0.125
April 1982	0.,44	0.164	April 1985	0.68	0.873
May 1982	0.57	0.443	May 1985	0.72	1.087
June 1982	0.60	0.540	June 1985	0.71	1.030
July 1982	0.56	0.414	July 1985	0.63	0.651
August 1982	0.55	0.386	August 1985	0.92	2.788
September 1982	0.73	1.147	September 1985	0.75	1.272
October 1982	0.56	0.414	October 1985	0.53	0.335
November 1982	0.88	2.350	November 1985	0.52	0.312
December 1982	0.79	1.553	December 1985	0.48	0.229
January 1983	0.55	0.386	January 1986	0.44	0.164
February 1983	0.52	0.312	February 1986	0.44	0.164
March 1983	0.49	0.248	March 1986	0.54	0.360
April 1983	0.46	0.195	April 1986	0.56	0.414
May 1983	0.69	0.923	May 1986	0.68	0.873
June 1983	0.56	0.414	June 1986	0.60	0.540
July 1983	0.70	0.976	July 1986	0.64	0.692
August 1983	0.70	0.976	August 1986	0.76	1.338
September 1983	0.90	2.562	September 1986	0.80	1.630
October 1983	0.81	1.710	October 1986	0.67	0.825
November 1983	0.64	0.692	November 1986	0.55	0.386
December 1983	0.54	0.360	December 1986	0.55	0.386

Monthly Minimum Water Level and Flow Amount of Enkare Narok River (2/5)

Year/Month	Minimum Water Level (m)	Minimum Flow Amount (m^3/sec)	Year/Month	Minimum Water Level (m)	Minimum Flow Amount (m^3/sec)
January 1987	0.57	0.443	January 1991	0.48	0.229
February 1987	0.54	0.360	February 1991	0.47	0.211
March 1987	0.69	0.923	March 1991	0.47	0.211
April 1987	0.56	0.414	April 1991	0.57	0.443
May 1987	0.69	0.923	May 1991	0.61	0.575
June 1987	0.82	1.792	June 1991	0.78	1.479
July 1987	0.63	0.651	July 1991	0.69	0.923
August 1987	0.60	0.540	August 1991	0.82	1.792
September 1987	0.59	0.506	September 1991	0.10	0.001
October 1987	0.50	0.268	October 1991	0.60	0.540
November 1987	0.50	0.268	November 1991	0.52	0.312
December 1987	0.57	0.443	December 1991	0.49	0.248
January 1988	0.56	0.414	January 1992	0.43	0.150
February 1988	0.46	0.195	February 1992	0.45	0.179
March 1988	0.48	0.229	March 1992	0.43	0.150
April 1988	0.54	0.360	April 1992	0.45	0.179
May 1988	0.94	3.028	May 1992	0.63	0.651
June 1988	0.75	1.272	June 1992	0.50	0.268
July 1988	0.74	1.208	July 1992	0.92	2.788
August 1988	0.92	2.778	August 1992	0.95	3.154
September 1988	1.20	7.737	September 1992	0.89	2.455
October 1988	0.76	1.338	October 1992	0.97	3.417
November 1988	0.60	0.540	November 1992	0.64	0.692
December 1988	0.64	0.692	December 1992	0.55	0.386
January 1989	0.60	0.540	January 1993	0.52	0.312
February 1989	0.55	0.386	February 1993	0.77	1.407
March 1989	0.50	0.626	March 1993	0.55	0.386
April 1989	0.72	1.087	April 1993	0.49	0.248
May 1989	0.87	2.250	May 1993	0.53	0.335
June 1989	0.63	0.651	June 1993	0.57	0.443
July 1989	0.67	0.825	July 1993	0.71	1.030
August 1989	0.78	1.479	August 1993	0.58	0.474
September 1989	1.00	3.841	September 1993	0.61	0.575
October 1989	0.86	2.152	October 1993	0.51	0.289
November 1989	0.65	0.734	November 1993	0.47	0.211
December 1989	0.95	3.154	December 1993	0.48	0.229
January 1990	0.91	2.674	January 1994	0.30	0.038
February 1990	0.88	2.350	February 1994	0.40	0.114
March 1990	0.90	2.562	March 1994	0.46	0.195
April 1990	1.18	7.254	April 1994	0.45	0.179
May 1990	-	-	May 1994	0.58	0.474
June 1990	1.38	13.236	June 1994	0.75	1.272
July 1990	1.12	5.936	July 1994	-	-
August 1990	-	-	August 1994	0.70	0.976
September 1990	-	-	September 1994	0.65	0.734
October 1990	0.58	0.474	October 1994	0.48	0.229
November 1990	0.59	0.506	November 1994	0.47	0.211
December 1990	0.54	0.360	December 1994	0.60	0.540

Monthly Minimum Water Level and Flow Amount of Enkare Narok River (3/5)

Year/Month	Minimum Water Level (m)	Minimum Flow Amount (m^3/sec)	Year/Month	Minimum Water Level (m)	Minimum Flow Amount (m^3/sec)
January 1995	0.45	0.179	January 1999	-	-
February 1995	0.45	0.179	February 1999	0.68	0.873
March 1995	0.48	0.229	March 1999	0.69	0.923
April 1995	0.46	0.195	April 1999	0.70	0.976
May 1995	0.63	0.651	May 1999	0.70	0.976
June 1995	0.55	0.386	June 1999	0.68	0.873
July 1995	0.60	0.540	July 1999	0.68	0.873
August 1995	0.54	0.360	August 1999	0.80	1.630
September 1995	0.49	0.248	September 1999	0.65	0.734
October 1995	0.59	0.506	October 1999	-	-
November 1995	0.59	0.506	November 1999	-	-
December 1995	0.40	0.114	December 1999	-	-
January 1996	0.45	0.179	January 2000	0.57	0.443
February 1996	0.45	0.179	February 2000	0.74	1.208
March 1996	0.46	0.195	March 2000	0.73	1.147
April 1996	0.42	0.137	April 2000	0.73	1.147
May 1996	0.47	0.211	May 2000	0.75	1.272
June 1996	0.45	0.179	June 2000	0.74	1.208
July 1996	0.45	0.179	July 2000	0.76	1.338
August 1996	-	-	August 2000	0.80	1.630
September 1996	-	-	September 2000	0.78	1.479
October 1996	-	-	October 2000	0.78	1.479
November 1996	-	-	November 2000	0.76	1.338
December 1996	-	-	December 2000	0.70	0.976
January 1997	-	-	January 2001	0.70	0.976
February 1997	-	-	February 2001	-	-
March 1997	0.40	0.114	March 2001	0.60	0.540
April 1997	0.55	0.386	April 2001	-	-
May 1997	0.65	0.734	May 2001	-	-
June 1997	0.50	0.268	June 2001	0.59	0.923
July 1997	0.69	0.923	July 2001	0.87	2.250
August 1997	0.70	0.976	August 2001	0.90	2.562
September 1997	0.55	0.386	September 2001	0.83	1.877
October 1997	0.59	0.506	October 2001	0.83	1.877
November 1997	0.46	0.195	November 2001	-	-
December 1997	-	-	December 2001	-	-
January 1998	0.90	2.562	January 2002	0.68	0.873
February 1998	1.10	5.539	February 2002	0.65	0.734
March 1998	0.80	1.630	March 2002	0.64	0.692
April 1998	0.70	0.976	April 2002	0.62	0.612
May 1998	0.54	0.360	May 2002	0.86	2.152
June 1998	0.99	3.695	June 2002	0.68	0.873
July 1998	0.90	2.562	July 2002	0.65	0.734
August 1998	-	-	August 2002	0.67	0.825
September 1998	0.70	0.976	September 2002	0.69	0.923
October 1998	0.85	2.057	October 2002	0.70	0.976
November 1998	0.65	0.734	November 2002	0.67	0.825
December 1998	0.50	0.268	December 2002	0.60	0.540

Monthly Minimum Water Level and Flow Amount of Enkare Narok River (4/5)

Year/Month	Minimum Water Level (m)	Minimum Flow Amount (m^3/sec)	Year/Month	Minimum Water Level (m)	Minimum Flow Amount (m^3/sec)
January 2003	0.76	1.338	January 2007	1.10	5.539
February 2003	0.65	0.734	February 2007	0.90	2.562
March 2003	0.55	0.386	March 2007	0.70	0.976
April 2003	0.56	0.414	April 2007	0.66	0.778
May 2003	-	-	May 2007	0.85	2.057
June 2003	-	-	June 2007	1.07	4.981
July 2003	-	-	July 2007	0.97	3.417
August 2003	-	-	August 2007	1.20	7.737
September 2003	1.20	7.737	September 2007	1.10	5.539
October 2003	-	-	October 2007	0.31	0.043
November 2003	0.60	0.540	November 2007	0.58	0.474
December 2003	-	-	December 2007	0.60	0.540
January 2004	0.50	0.268	January 2008	0.37	0.084
February 2004	0.45	0.179	February 2008	0.54	0.360
March 2004	0.50	0.268	March 2008	0.48	0.229
April 2004	0.60	0.540	April 2008	0.65	0.734
May 2004	0.70	0.976	May 2008	0.60	0.540
June 2004	-	-	June 2008	0.59	0.506
July 2004	-	-	July 2008	0.59	0.506
August 2004	-	-	August 2008	1.00	3.841
September 2004	-	-	September 2008	0.82	1.792
October 2004	-	-	October 2008	0.80	1.630
November 2004	-	-	November 2008	0.80	1.630
December 2004	-	-	December 2008	0.47	0.211
January 2005	-	-	January 2009	0.53	0.335
February 2005	-	-	February 2009	0.50	0.268
March 2005	-	-	March 2009	0.48	0.229
April 2005	-	-	April 2009	0.50	0.268
May 2005	-	-	May 2009	0.56	0.414
June 2005	-	-	June 2009	0.59	0.506
July 2005	0.45	0.179	July 2009	0.54	0.360
August 2005	0.89	2.455	August 2009	0.54	0.360
September 2005	1.00	3.841	September 2009	0.59	0.506
October 2005	0.74	1.208	October 2009	0.55	0.386
November 2005	0.58	0.474	November 2009	0.60	0.540
December 2005	0.48	0.229	December 2009	0.53	0.335
January 2006	0.47	0.211	January 2010	0.65	0.734
February 2006	0.40	0.114	February 2010	0.60	0.540
March 2006	0.47	0.211	March 2010	0.80	1.630
April 2006	0.48	0.229	April 2010	0.90	2.562
May 2006	0.71	1.030	May 2010	1.00	3.841
June 2006	0.53	0.335	June 2010	0.88	2.350
July 2006	0.55	0.386	July 2010	0.74	1.208
August 2006	0.71	1.030	August 2010	0.80	1.630
September 2006	0.75	1.272	September 2010	1.00	3.841
October 2006	0.53	0.335	October 2010	0.90	2.562
November 2006	0.52	0.312	November 2010	0.75	1.272
December 2006	0.95	3.154	December 2010	0.50	0.268

Monthly Minimum Water Level and Flow Amount of Enkare Narok River (5/5)

Year/Month	Minimum Water Level (m)	Minimum Flow Amount (m^3/sec)	Year/Month	Minimum Water Level (m)	Minimum Flow Amount (m^3/sec)
January 2011	0.50	0.268			
February 2011	0.50	0.268			
March 2011	-	-			
April 2011	0.54	0.360			
May 2011	0.77	1.407			
June 2011	0.80	1.630			
July 2011	0.83	1.877			
August 2011	0.85	2.057			
September 2011	0.89	2.455			
October 2011	0.67	0.825			
November 2011	0.90	2.562			
December 2011	0.80	1.630			
January 2012	0.53	0.335			

Appendix 6-15 Monitoring Forms

The latest results of the below monitoring items shall be submitted to the lenders as part of Quaternary Progress Report throughout the construction phase

1. Imposed conditions for EIA approval and countermeasures

No.	EIA Approval Number	Approval Conditions	Monitoring Result
Control Measures for Earthworks and Construction			
1	EIA Approval Condition 1		
2	EIA Approval Condition 2		
Erosion Control			
3	EIA Approval Condition 3		
4	EIA Approval Condition 4		
	-Continues-		

2. Proposed conditions for Environmental Countermeasures in Preparatory Study

No.	Monitoring Factor	Monitoring Place	Monitoring Method	Frequency	Monitoring Result
1	Soil erosion and turbidity of surface water	Downstream point near construction site of intake weir and of outlet of discharge pipes.	Measure of turbidity	At the transportation time of sludge	
2	Disturbance to flowing course of the river	Downstream point near construction site of intake weir and of outlet of discharge pipes.	Physical observation	Once/week	
3	Ground and surface water contamination by oil, grease and fuel	Downstream point near construction site of intake weir and of outlet of discharge pipes.	Physical observation	Once/week	
4	Keeping safety and sanitary dumping site	Waste dumping site	Physical observation	Once/week	
5	Noise and vibration	All construction sites	Complain by people	During construction	
6	Fog and dust	All construction sites	Complain by people	During construction	
7	Adequate safety traffic control manners	All piping laying work sites	Physical observation	Two times/week	

No.	Monitoring Factor	Monitoring Place	Monitoring Method	Frequency	Monitoring Result
8	Adequate safety traffic control manners	Entrance and exit for construction of new water treatment plant, ground reservoir, transmission pipelines, water intake weir.	Physical observation	Two times/week	
9	Dirty grade of roads	Passage roads of vehicles for transportation of equipment and materials, and surplus excavation soils.	Physical observation	Two times/week	
10	Confirmation of adequate discharge countermeasures of wastewater	All construction sites	Physical observation	Once/week	
11	Adequate treatment of wastewater and solid wastes	All construction sites, laborers camps and its neighboring areas	Physical observation	Once/week	
12	Wear of safety shoes and hats and safety control manners at construction sites	All construction sites	Physical observation	Once/week	

The latest results of the below monitoring items shall be submitted to the lenders as part of Yearly Report throughout the operation phase

Operation phase

1. Imposed conditions for EIA approval and countermeasures

No.	EIA Approval Number	Approval Conditions	Monitoring Result
Water Quality Monitoring and Control			
1	EIA Approval Condition 1		
2	EIA Approval Condition 2		
Noise Monitoring and Control			
3	EIA Approval Condition 3		
4	EIA Approval Condition 4		
Solid Waste Management			
5	EIA Approval Condition 6		
6	EIA Approval Condition 7		
	-Continues-		

2. Proposed conditions for Environmental Countermeasures in Preparatory Study

No.	Monitoring Factor	Monitoring Place	Monitoring Method	Frequency	Monitoring Result
1	Proper delivery and transportation manners by contractor licensed by NEMA for disposal of sludge	Water treatment plant	Physical observation	At the transportation time of sludge	
2	Noise	Near NPTC manager house	Day time(6:01a.m.- 20.00 p.m.)and nighttime(20:01-6:00 am),measurement (Equivalent sound level)within one day, day time for 6 hours; night time for 6 hours and for ten minutes after the hour; using integrating sound level meter at height of 1.5 m, hopeful in wind direction of sound source to measuring point and in no rainy day.	Every 4 month	

No.	Monitoring Factor	Monitoring Place	Monitoring Method	Frequency	Monitoring Result
3	Quality of discharged water from WTP to the River	Sampling point: discharge outlet at drain pond of new WTP	Chemical analysis items: Water temperature, Color, pH, Turbidity, Conductivity, Acidity （pH=8.3）and （pH=10.8）、Alkalinity （phenolphthalein）and （total, pH=4.5）、 Hardness total, Total solid （residue dried at 110□）, TDS（residue dried at 180□）、 Settleable solids, SAR（Sodium Absorption Ratio）、RSC （Residual sodium carbonate）, SI （Saturation index）; Ca, Fe, Mg, K, Mn, Na, CO_2, HCO_3, CO_3, Chorine（Cl）、NO_3-N, Total reactive phosphorous（P）、Chloride （Cl）、F, SiO_2, SO_4	Every month	

【Environmental Standards】

1) Drinking Water quality standards （Kenya）

No	Substance or Characteristic	Unit	Drinking Water Standards
1	Color	True color unit	15
2	Taste and odor		Shall not be offensive to consumers
3	Suspended matter		Nil
4	Turbidity	NTU, max	5
5	Total dissolved solids （TDS）	mg/L, max	1,500
6	Hardness as $CaCO_3$	mg/L, max	500
7	Aluminum as A1	mg/L, max	0.1
8	Chloride as Cl^-	mg/L, max	250
9	Copper as Cu	mg/L, max	0.1
10	Iron as Fe	mg/L, max	0.3
11	Manganese as Mn	mg/L, max	0.1
12	Sodium as Na	mg/L, max	200
13	Sulphate as SO_4	mg/L, max	400
14	Zinc as Zn	mg/L, max	5
15	pH	mg/L	6.5 - 8.5
16	Magnesium as Mg	mg/L, max	100
17	Chlorine concentration		0.2±0.5
18	Calcium as Ca	mg/L, max	250
19	Ammonia （N）	mg/L, max	0.5
20	Fluoride as F （*）	mg/L, max	1.5
21	Arsenic as As	mg/L, max	0.05
22	Cadmium as Cd	mg/L, max	0.005
23	Lead as Pb	mg/L, max	0.05
24	Mercury （total Hg）	mg/L, max	0.001
25	Selenium as Se	mg/L, max	0.01
26	Chromium as Cr	mg/L, max	0.05
27	Cyanide as CN	mg/L, max	0.01
28	Phenol substances	mg/L, max	0.002
29	Barium as Ba	mg/L, max	1.0
30	Nitrate as NO_3	mg/L, max	10
31	Coliforms in 250 ml		Shall be absent
32	E. Coli in 250 ml		Shall be absent

（Source） Drinking water quality and effluent monitoring guideline, Water Services Regulatory Board

2) Guideline values for discharge into public water

No	Parameter	Unit	Guideline value
1	1.1.1-trichloroethane	mg/L	3
2	1.1.2-trichloroethane	mg/L	0.06
3	1.1.-dichloroethylene	mg/L	0.2
4	1.2-dichloroethane	mg/L	0.04
5	1.3-dichloropropene	mg/L	0.02
6	Alkyl mercury compounds	mg/L	Not detected
7	Ammonia, Ammonium compounds, NO_3, compounds and NO_2 compounds	mg/L	100
8	Arsenic	mg/L	0.02
9	Arsenic and its compounds	mg/L	0.1
10	Benzene	mg/L	0.1
11	pH		6.5 – 8.5
12	BOD （5 dayss at 20℃） max	mg/L	30
13	COD, max	mg/L	50
14	Temperature, max	□	±3□of ambient temperature of the water body
15	Boron	mg/L	1.0
16	Boron and its compounds - non marine	mg/L	10
17	Boron and its compounds - marine	mg/L	30
18	Cadmium	mg/L	0.01
19	Cadmium and its compounds	mg/L	0.1
20	Carbon tetrachloride	mg/L	0.02
21	Chromium VI	mg/L	0.05
22	Chloride	mg/L	250
23	Chloride free residue	mg/L	0.10
24	Chromium total	mg/L	2
25	Cis-1,2 –dichloro ethylene	mg/L	0.4
26	Copper	mg/L	1.0
27	Dichloromethane	mg/L	0.2
28	Dissolved Iron	mg/L	10
29	Dissolved manganese	mg/L	10
30	E. Coli		Nil
31	Fluoride	mg/L	1.5
32	Fluoride and its compounds （marine and non-marine）	mg/L	8
33	Lead	mg/L	0.01
34	Lead and its compounds	mg/L	0.1
35	n-Hexane extracts （animal and vegetable fats）	mg/L	30
36	Oil and grease		Nil
37	Phenols	mg/L	0.001
38	Selenium	mg/L	0.01
39	Selenium and its compounds	mg/L	0.1
40	Hexavalent chromium VI compounds	mg/L	0.5
41	Sulphide	mg/L	0.1
42	Simazine	mg/L	0.03
43	Total suspended solids （TSS）	mg/L	30
44	Tetrachloroethylene	mg/L	0.1
45	Triobencarb	mg/L	0.1
46	Thiuram	mg/L	0.06
47	Total coliforms		30
48	Total Cyanogen	mg/L	Not detected
49	Total Nickel	mg/L	0.3
50	Total dissolved solids （TDS）	mg/L	1,200
51	Color		15
52	Detergents	mg/L	Nil

No	Parameter	Unit	Guideline value
53	Total mercury	mg/L	0.005
54	Trichloroethylene	mg/L	0.3
55	Zinc	mg/L	0.5
56	Total phosphorous	mg/L	2
57	Total nitrogen	mg/L	2

（Source） The Environmental Management and Co-ordination （Water Quality） Regulations, (2006)

3) Noise and Vibration

Maximum Permissible Noise Limit for Categorized Area

Category Zone for Noise Control		Maximum Noise Level (dB) (Laeq)		Noise Rating Level (dB) (Laeq)	
		Daytime (6:01 a.m.- 20:00 p.m.)	Nighttime (20:01 p.m.- 6:00 a.m.)	Daytime (6:01 a.m.- 20:00 p.m.)	Nighttime (20:01 p.m.- 6:00 a.m.)
A.	Silent Zone	40	35	30	25
B.	Places of Worship	40	35	30	25
C.	Residential （Indoor）	45	35	35	25
	（Outdoor）	50	35	40	25
D.	Mixed Residential （with some commercial and places of entertainment）	55	35	50	25
E.	Commercial	60	35	55	25

Source: Environmental Management and Coordination (Noise and Excessive Vibration Pollution) (Control) Regulations, (2009)

Maximum Permissible Noise Level for Construction Sites
(Measurement taken within the facility)

Facility		Maximum Permissible Noise Level (Leq) （dB）	
		Daytime (6:01 a.m.- 20:00 p.m.)	Nighttime (20:01 p.m.- 6:00 a.m.)
(i)	Health Facilities, Educational Institutions, Homes for Disabled, etc.	60	35
(ii)	Residential	60	35
(iii)	Areas other than Those Prescribed in (i), (ii).	75	65

Source: Environmental Management and Coordination (Noise and Excessive Vibration Pollution) (Control) Regulations, (2009)

4) Waste Management of Hazardous (Indicating only abstraction of fluoride due to regulation volume of 14 pages)

Environmental Management and Co-ordination (Waste Management） Regulation, 2006, Fourth Schedule（Regulation 22）– Waste considered Hazardous（Fluoride）

Y32: Waste containing inorganic fluorine compound excluding calcium fluoride listed as follows:

(a) Waste containing 0.1 % or more by weight of any of the following inorganic fluorine compounds:

Fluorosilicic acid, Bromide pentafluoride, Bromide trifluoride, Bromide trifluoride dehydrate, Potassium bifluoride, Difluorphosphoric acid, Ammonium fluoride, Potassium fluoride（spray dide）, Chromic fluoric, Hydrofluoride, Ammonium hydrogen fluoride, Hydrofluoric acid, Sodium fluoride, Fluorosulphonic acid, Fluorophosphoric acid anhydrous, Hexafluorophosphoric acid, Fluobolic acid.

(b) Waste containing 1 % or more by weight of any of the following inorganic fluorine compounds:

Ammonium fluoroborate, Ammonium fluorosilicate, Barium fluoride, Barium fluorosilicate, Iodine pentafluoride, Lithium borofluoride, magnesium borofluoride, Magnesium fluorosilicate, Potassium fluoroborate, Potassium fluorosilicate, Potassium hydrogen fluoride, Sodium fluorosilicate, Sodium hydrogen fluoride, Stannous fluoride, Sodium fluoroborate, Zinc fluorosilicate.

(c) Waste containing inorganic fluorine compounds other than those listed in（a）and （b）above.

APPENDIX 6-16 Environmental Checklist

Environmental Check List (1/9)

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations （Reasons, Mitigation Measures)
1 Permits and Explanation	(1) EIA and Environmental Permits	(a) Have EIA reports been already prepared in official process? (b) Have EIA reports been approved by authorities of the host country' government? (c) Have EIA reports been unconditionally approved? If conditions are imposed on the approval of EIA report, does the conditions satisfied? (d) Aside from the above EIA report, are the project required to acquire necessary approvals and licenses on the environment from relating authorities?	(a) N (b) N (c) N/A (d) N/A	(a) In EIA procedures, there are two kinds of steps consisting of submission of “project report” and “EIA report” to NEMA. Firstly, the project report is finalized and if this report is approved by NEMA, EIA approval letter is issued. The Project Report was finalized on June 2012 and NARWASSCO submitted it to NEMA. (b)As a result of reviewing of the Project Report, NEMA satisfied in the contents of the Project Report for environmental impact assessment. NEMA intends to issue EIA approval after payment of EIA license fee by November 2012. (c) As the project report and the EIA report are not approved, it is not applicable. (d) Authorization letter for Land acquisition was issued by Narok Town Council on April 12, 2012 and Authorization letter for water rights was issued by WRMA on May 9, 2012. EIA Project Report was submitted to NEMA on June 6, 2012. Each application letter (excluding water rights after EIA approval) is under processing. Other necessary permissions are necessary before the start of construction works and they are permitted within several days or weeks after application.
	(2)Explanation to Local Stakeholders	(a) Have contents of the project and the potential impacts been adequately explained to local stakeholders based on appropriate procedures, including information disclosure? Is understanding obtained from local stakeholders? (b) Have the comment from residents reflected to project contents?	(a) Y (b) Y	(a) In the stage of finalization of the EIA report, NEMA requests to conduct proper explanation to local stakeholders and to attach its evidence to the EIA report. Since planned construction sites for water supply system (excluding pipelines) are located in public lands, resettlement is not caused. Thus, implementation organization (NARWASSCO) carried out stakeholder meeting by gathering about 30 interested persons, who relate to the project, from government officers, Town’s zone representatives, chamber of commerce and industry, representative of water user association, and NGOs on April 13, 2012. (b) Though relative agencies and water users association had opinions to implement in the early-stage, there were no comments which may affect the project contents.

Environmental Check List (2/9)

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations （Reasons, Mitigation Measures)
1 Permits and Explanation	(3)Examination of Alternatives	(a) Have alternative plans of the project been examined with social and environmental considerations?	(a) Y	a) As described in this report, “2-2-3-1-4 Comparison of Project alternatives (Including Zero Option)”, Alternative plan 1: Rift Valley Water Supply and Sanitation (F/S) Project (to install only water intake facility in the upper stream of the river away about 5 km from the existing intake facility and to convey raw water through transmission pipelines by gravity to the existing WTP.), and Alternative plan 2: to intake raw water at the existing WTP and to build distribution reservoir in the side of upper stream, and Alternative plan 3: the project plan-intake facility, WTP, and distribution reservoir are built in the side of upper stream. These alternatives were comprehensively evaluated from viewpoints of (1) difficulty of construction works, (2) space of construction area for WTP and topography, (3) environmental conditions such as land use and possibility of flooding and vegetation, (4) operation cost. As a result, though alternative plans 1 and 2 comparatively satisfy environmental conditions, they had no appropriateness on difficulty of construction works and space of construction lands for WTP. Alternative 3 satisfies all the conditions and it was adopted as the project plan.
2 Pollution Control	(1) Air Quality	(a) Is there a possibility that chlorine from chlorine storage facilities and chlorine injection facilities will cause air pollution? Are any mitigating measures taken? (b) Do chlorine concentrations within the working environments comply with the country’s occupational health and safety standards?	(a) N (b) N/A	(a)Air pollution by chlorine gas from injection facilities will not happen because bleaching powders (calcium hypochlorite) obtainable at the local with high safety as disinfectant chlorine are used. (b) It is not applicable due to the above reasons.
	(2) Water Quality	(a) Do pollutants, such as SS, BOD, COD contained in effluents discharged by the facility operations comply with the country’s effluent standards?	(a) Y	(a) Discharge water generated by operation of new WTP is water derived from deposited sludge and backwashing. To discharge only supernatant water to the river after backwashing water including sludge stores and precipitates in a drain pond, more clean water than the original river water will be discharged to the river. Thus, discharge water fits to the country's effluent standards (such as SS, BOD, COD, pH etc.) regulated by Water Act, (2002).

Environmental Check List (3/9)

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations （Reasons, Mitigation Measures)
2 Pollution Control	(3) Waste	(a) Are wastes, such as sludge generated by the facility operations properly treated and disposed in accordance with the country's regulations?	(a) Y	(a) Sludge generated from WTP is sand and soils which are contained in the river water. In the water treatment process, fluoride containing in raw water is removed and is concentrated in the sludge. Thus, the sludge is estimated to contain fluoride concentration beyond the norm of Environmental Management and Coordination (Waste Management) Regulation, (2006) and it becomes hazardous waste. The sludge is disposed by contractor licensed by NEMA in complying with the environmental regulation.
	(4) Noise & Vibration	(a) Do noise and vibrations generated from the facilities, such as pumps comply with the country's standards?	(a) Y	(a) Planned water intake facility and WTP are constructed in a part of wide public lands (scattered bush).There are no houses of the public and it is no influence of noise and vibration by pumps and generator. In addition, though there is a manager house for National Pastoral Training Center near planned WTP, noise problem will be not caused by the long distances from noise sources and it complies with Kenya's standards.
	(5) Land Subsidence	(a) In case of extraction of a large volume of groundwater, is there possibility that the extraction of groundwater will cause land subsidence?	(a) N	(a) Land subsidence does not generate because water supply source is the river water and a large volume of groundwater is not extracted.
3 Natural Environment	(1) Protected Area	(a) Does the project site locate in protected areas designated by the country's laws or international treaties and conventions? Is there a possibility that the project will affect the protected areas?	(a) N	(a) The project site does not locate in protected areas designated by the Kenya's laws or international treaties and conventions. Thus, the project will not affect the protected areas.

Environmental Check List (4/9)

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
3 Natural Environment	(2) Ecosystem	(a) Does the project site encompass primeval forests, tropical rain forests, ecologically valuable habitats (e.g., coral reefs, mangroves, or tidal flats)? (b) Does the project site encompass the protected habitats of endangered species of which protection and conservation are need by country's laws and international treaties? (c) In case that significant adverse impacts to ecosystem are apprehend, does the project conduct the countermeasure to reduce the adverse impacts to ecosystem? (d) Does the implementation of the project affect aquatic environment in rivers, etc.? Does the countermeasure to reduce adverse impacts to aquatic organisms etc?	(a) N (b) N (c) N/A (d) N/A	(a) The project site does not encompass primeval forests, tropical rain forests, ecologically valuable habitats (e.g., coral reefs, mangroves, or tidal flats). (b) The project site does not encompass the protected habitats of endangered species of which protection and conservation are need by Kenya's laws and international treaties. (c) It is not applicable due to the above reasons. (d) According to AfDB F/S survey (2006), 95% probability minimum monthly flow in the Enkare Narok River equals to 17,130 m^3. Total of intake water volume (5,350 m^3) by sum of proposed intake water volume (4,300 m^3) and the intake water volume (1,050 m^3) of existing supply system corresponds to about 31 % of 95% probability minimum monthly flow. Thus, this intake volume will generally not affect aquatic environment in rivers. However, as 98 % probability minimum monthly flow is 9,790 m^3, if river flow may become near the borderline of proposed intake volume or less in small flow months in extremely dry years. In that case, its system shall be handled by reduction of intake water volume or abeyance of water intake for keeping river maintenance flow. Thus, water intake by new water supply system will not affect adverse impact to aquatic organisms etc.
	(3) Hydrology	(a) Is there a possibility that the amount of water used (e.g., surface water, groundwater) by the project will adversely affect surface water and groundwater flows?	(a) N	(a) Water intake by the Project is only about 31 % of minimum monthly flow. In addition, other months excluding the period of May and June have comparatively larger river flow. However, if river flow may become near the borderline of proposed intake volume or less in small flow months in extremely dry years, its system shall be handled by reduction of intake water volume or abeyance of water intake for keeping river maintenance flow. Thus, its water intake will not adversely affect surface water and groundwater flow.

Environmental Check List (5/9)

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
4 Social Environment	(1) Resettlement	(a) Is involuntary resettlement caused by project implementation? If involuntary resettlement is caused, are efforts made to minimize the impacts caused by the resettlement? (b) Is adequate explanation on compensation and resettlement assistance for rebuilding the livelihood of involuntary resettlement' residents given in advance? (c) Are resettlement plans including recovery of livelihood base after resettlement, compensation by requisition price of lands and houses established with the survey for resettlement? (d) Does the payment of compensation fee conducted prior to resettlement? (e) Are the compensation principals shown in written document? (f) Of involuntary resettlement residents, does the resettlement plans properly consider vulnerable groups, especially, females, children, elderly people, poverty groups, ethnic minorities, and indigenous people etc.? (g) Does the agreement by resettlement people prior to resettlement conducted? (h) Is the implementation system to properly carry out residents' resettlement arranged together with implementation budget and budget measures? (i) Is the monitoring plan for resettlement impact established? (j) Does the complaint handing countermeasures established?	(a) N (b) N/A (c) N/A (d) N/A (e) N/A (f) N/A (g) N/A (h) N/A (i) N/A (j) N/A	(a) There are no inhabitants in the planned construction sites. Thus, implementation of the project does not cause involuntary resettlement. (b) It is not applicable due to the above reasons. (c) It is not applicable due to the above reasons. (d) It is not applicable due to the above reasons. (e) It is not applicable due to the above reasons. (f) It is not applicable due to the above reasons. (g) It is not applicable due to the above reasons. (h) It is not applicable due to the above reasons. (i) It is not applicable due to the above reasons. (j) It is not applicable due to the above reasons.
	(2) Living & Livelihood	(a) Does project implementation affect adverse impact to living condition of inhabitants by change of land use and of utilization of water bodies? (b) Is there a possibility that the project will adversely affect the living conditions of inhabitants? Are adequate measures considered to reduce the impact, if necessary.	(a) N (b) N/A	(a) Project implementation has no possibility to affect adverse impact to living condition of inhabitants by change of land use and of utilization of water bodies. Adversely, it will provide positive impact by improvement of water supply condition. (b) It is not applicable due to the above reason.
	(3) Heritage	(a) Is there a possibility that the project will damage the local archeological, historical, cultural, and religious heritage? Are adequate measures considered to protect these sites in accordance with the country's laws?	(a) N	(a) In the project area, there are no local archeological, historical, cultural, and religious heritages. Thus, its construction activities will not provide any damage.
	(4) Landscape	(a) Is there a possibility that the project will adversely affect the local landscape? Are necessary measures taken?	(a) N	(a) As the planned water intake and WTP sites are not located at special landscape area, the project will not affect local landscape.

Environmental Check List (6/9)

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations （Reasons, Mitigation Measures)
4 Social Environment	(5) Ethnic Minorities and Indigenous Peoples	(a) Are considerations given to reduce impacts on the culture and lifestyle of ethnic minorities and indigenous people? (b) Are all of the rights of ethnic minorities and indigenous peoples in relation to land and resources respected?	(a) N/A (b) N/A	(a) There are no issues on ethnic minorities and indigenous people because equity rights of inhabitants are guaranteed by enactment of new constitution in 2010. (b) It is not applicable due to the above reason.
	(6) Work Environment	(a)Is the project proponent not violating any laws and ordinances associated with the working conditions of the country which the project proponent should observe in the project? (b) Are tangible safety considerations in hardware side for individuals relating to the project such as the installation of safety equipment to protect labor accidents and the management of toxic substances involved? (c) Are soft side countermeasures such as tangible safety education for labors and the formulation of safety sanitary plans (including traffic control and public health) to interested persons to the project planned and conducted? (d) Are proper countermeasures taken not so as to threaten the safety of inhabitants' peoples and interested persons of the project by guardsmen for the project?	(a) Y (b) Y (c) Y (d) Y	(a) As work environment which must comply with at the project implementation is described in "2-2-3-1-7 Survey Result of Environment and Social Consideration", "2-2-3-1-8 Environmental Impact Assessment, (2) Adverse Impact and Mitigation Measures at Construction Stage", and "2-2-3-1-10 Environmental Management Plan and Monitoring Plan" of this report, the implementation organization should comply with contents of these descriptions. (b) As the installation of safety equipment and wear of safety shoes and safety hats to protect accidents at works are described in "2-2-3-1-7 Survey Result of Environment and Social Consideration", "2-2-3-1-8 Environmental Impact Assessment, (2) Adverse Impact and Mitigation Measures at Construction Stage", and "2-2-3-1-10 Environmental Management Plan and Monitoring Plan" of this report, contractor and implementation organization should comply with these descriptions. (c) As the establishment of safety sanitary plans (including traffic control and public health) to interested persons to the project and tangible safety education for labors is described in "2-2-3-1-7 Survey Result of Environment and Social Consideration", "2-2-3-1-8 Environmental Impact Assessment, (2) Adverse Impact and Mitigation Measures at Construction Stage", and "2-2-3-1-10 Environmental Management Plan and Monitoring Plan" of this report, contractor and implementation organization should comply with these descriptions. (d) The project will take enough education not so as to be threatened to safety of inhabitants and interested people by guardsmen for the project.

Environmental Check List (7/9)

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
5. Others	(1) Impacts During Construction	(a) Are adequate mitigation countermeasures considered to reduce adverse impacts during construction (cg.. noise, vibrations, turbid water, dust, exhaust gases, and wastes) (b) Do construction activities adversely affect the natural environment (ecosystem)? In that case, are adequate mitigation countermeasures prepared? (c)'Do constriction activities adversely affect to social environment? In that case, are adequate mitigation countermeasures prepared? (d) Do construction activities cause traffic congestion? Are mitigation countermeasures prepared?	(a) Y (b) N (c) Y (d) Y	(a) Since mitigation measures against impact during construction are described in "2-2-3-1-7 Survey Results of Environmental and Social Consideration, 2-2-3-1-8 Environmental Impact Assessment, (2) Adverse Impact and Mitigation Measures at Construction Stage" of this report, the implementation organization should comply with contents of these descriptions. (b) As construction works are conducted in bush public lands with semi-dry conditions which have important natural environment (ecology), construction activities will not affect adverse impact. (c) Pipe laying works at crowded roads in Narok Town may cause traffic jam and in addition, incoming labors may increase pathogenesis risk of infectious diseases of HIV/AIDS. As indicated in 2-2-3-1-8 Environmental Impact Assessment, these mitigation measures are to set up sign posts for construction works, to enclose by tapes, and to arrange watchmen and security guards so as not to interrupt vehicles and passers-by and to control traffics, in addition, to enhance incoming labors' consciousness by conducting explanatory session for hazardous nature of pathogenesis of infectious diseases of HIV/AIDS. (d) Construction activities of pipe laying works shall cause traffic jam. As the mitigation countermeasures are described in" 2-2-3-1-7 Survey Results of Environmental and Social Consideration, 2-2-3-1-8 Environmental Impact Assessment, (2) Adverse Impact and Mitigation Measures at Construction Stage, 2-2-3-1-10 Environmental Management Plan and Monitoring Plan" of this report, the implementation organization should comply with the contents of these descriptions.

Environmental Check List (8/9)

Category	Environmental Items	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations （Reasons, Mitigation Measures）
5. Others	(2) Monitoring	(a) Does the proponent develop and implement monitoring program for the environmental items that are considered to have potential impacts? (b) How are the items, methods, and frequencies of the monitoring program planned? (a) (c) Can the proponent establish an adequate monitoring system (organization, personnel, equipment, and budget and their continuity)? (d) Do reporting manners and its frequencies from proponent to concerned agency regulate?	(a) Y (b) Y (c) Y (d) N	(a) Monitoring plan is conducted by contractor and implementation organization. The monitoring plan is showed in 2-2-3-1-10 Environmental Management Plan and Monitoring Plan. The contractor and implementation agency should implement monitoring plan in the construction and operation stages. (b) Monitoring parameters and methods were selected by supposing adverse impacts by implementation of the project and their frequencies were determined by the experiences such as past local villages' water supply project and supervising for construction works of water supply systems. (c) Monitoring system will be successfully established because it is carried out in the existing water supply system. In addition, as water charges are almost collected in the existing water supply system, the budget for monitoring system will be also secured. (d) Reporting manners and its frequencies of monitoring results from proponent to NEMA are not regulated in Environmental Management and Coordination Act and Environmental (Impact Assessment and Audit) Regulations but they will be requested as imposed conditions for EIA approval. In addition, according to interview survey to NEMA, as shown in “2-2-3-1-10 Environmental Management Plan and Monitoring Plan, (3) Submission of Monitoring Report” of this report, monitoring report must be quarterly submitted and environmental audit report must have been yearly submitted since two years after completion of planned water supply system.

Environmental Check List (9/9)

Category	Environmental Items	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations （Reasons, Mitigation Measures)
6.Note	Refer to Other Environmental Checklist	(a) Where necessary, pertinent items described in the Dam and River Project checklist should also be checked. (b) If necessary, the impacts to trans-boundary or global issues should be confirmed (e.g., the project includes factors that may cause problems, such as trans-boundary waste treatment, acid rain, destruction of the ozone layer, or global warming). (b)	(a)N/A (b) Y	(a) It is not applicable for the project. (b) The Enkare Narok River of intake source empties into Lake Natron which is located about 120 km away from Narok Town. Lake Natron is registered site for Lam Sar Convention where a plenty of flamingo make their habitats. Since Lake Natron is located in very far place, if drain water including chlorine from planned WTP is directly discharged to the river, it almost may has no impact to their habitats. However, if backwashing water is directly discharged to the river, It may impact to aquatic ecology in the natural river. Thus, drain water is stored one time in a drain pond and after releasing naturally chlorine gas to the atmosphere, its supernatant water is discharged to the river. On significance of the implementation of the Project, it shall alleviate its impact against climate change by improvement of unstable conditions which are in intermittent water supply and overload operation of WTP. It will realize stable water supply even in the dry seasons and it is of some help for social condition On the impact to climate change by implementation of the Project itself, there is no positive impact to environmental issues in global scale by implementation of the project. Adversely, water supply facilities including WTP consume commercial electric charge 119.5 kWh and CO_2 amount of 585.2 /tons/year equal to its consumable electric powers is estimated to be released in the atmosphere.

Note 1) Regarding the term "Country's Standards" mentioned in the above table, in the event that environmental standards in the country where the project is located diverge significantly from international standards, Appropriate environmental considerations are required to be made.
In case where local environmental regulations are yet to be established in some areas, considerations should be made based on comparisons with appropriate standards of other countries (including Japan's experience).
2) Environmental checklist provides general environmental items to be checked. It may be necessary to add or delete an item taking into account the characteristics of the project and the particular circumstances of the country and locality in which the project is located.

Appendix 6-17 Pipe Calculation

(1) Raw Water Transmission Pipe

Adding treatment loss in the proposed North WTP, design raw water transmission amount is 4,300m^3/day, 0.04977m^3/sec. The following Hazen-Williams Formula was applied in conveyance pipe diameter calculation:

$H=10.666 \cdot C^{-1.85} \cdot D^{-4.87} \cdot Q^{1.85} \cdot L$

where: H : Head Loss (m)
C : Velocity Coefficient (130)
D : Diameter (m)
Q : Flow Amount (m^3/sec)
L : Pipe Length (m)

【Diameter φ150mm】

H $=10.666 \cdot 130^{-1.85} \cdot 0.15^{-4.87} \cdot 0.04977^{1.85} \cdot 1,540$
$=80.90$ (m)
V $=0.04977$ (m^3/sec) $\div 0.01767$ (m^2)
$=2.82$ (m/sec)

【Diameter φ200mm】

H $=10.666 \cdot 130^{-1.85} \cdot 0.20^{-4.87} \cdot 0.04977^{1.85} \cdot 1,540$
$=19.93$ (m)
V $=0.04977$ (m^3/sec) $\div 0.03142$ (m^2)
$=1.58$ (m/sec)

【Diameter φ250mm】

H $= 10.666 \cdot 130^{-1.85} \cdot 0.25^{-4.87} \cdot 0.04977^{1.85} \cdot 1,540$
$=6.72$ (m)
V $=0.04977$ (m^3/sec) $\div 0.04909$ (m^2)
$=1.01$ (m/sec)

Since raw water is to be pumped from new intake facility to new North WTP, head loss and velosity shall be properly maintained. As difference of elevation interval between new intake facility and the proposed North WTP is 80m, quite large, head loss shall be minimized and velocity shall be within the range of 1.0m/sec to 3.0m/sec, which is regarded as appropriate pumping velocity. In case of diameter 150mm, velocity is satisfactory but total pump head is exceeding 160m.

While in case of diameter 250mm, head loss can be minimized but velocity is small. So, if pumped amount reduced, velocity might become lower than the said proper pumping velocity limit. Thus, DI pipe and 200mm diameter is determined as the optimum specification for raw water transmission pipe connecting new intake facility and the

proposed NorthWTP.

As differences of elevation between new intake facility and the proposed NorthWTP is 80m, quite large and to be partially exposed installation, pipe strength and pipe installatrion workability shall be carefully examined upon selection of pipe material for conveyance pip. Considering these conditions, DI pipe was selected.

Raw water transmission Pipe Diameter: 200mm
Raw water transmission Pipe Material: DI Pipe

(2) Clear Water Transmission Pipe

Basically, clear water transimission pipe plan is prepared as gravity flow system. Gravity flow water transmission plan from clear water reservoir 2,000m^3 to Fanaka Highschool Tank 500m^3.

1) Pipe installation route

Pipe route started from clear water reservoir 2,000m^3 to be constructed in the proposed North WTP to the existing Majengo Reservoir 100m^3 shall be the same to the existing one crossing Lenana and Samburumburr Drift. From Majengo Reservoir to the existing Fanaka Highschool Reservoir 500m^3, pipe is planned to be laid along with public road.

2) Pipe material and diamter selection

As shown in エラー! 参照元が見つかりません。, elevation difference between reservoir 2,000m^3 to be constructed in the proposed North WTP and the existing Fanaka Highschool reservoir 500m^3 is 4m. Distance between them is 3,780m.

Table 1 Elevation Difference of Clear Water Transmission Pipe

	Amsl at New WTP Reservoir	Amsl at Fanaka High school Reservoir	Elevation Difference
Elevation	+1,952m	+1,948m	4m

Currently, φ75mm uPVC pipe is installed from the existing FTC Reservoir 100m^3 to the existing Fanaka Highschool Reservoir. However, as shown in **Figure ,** after completion of new reservoir 2,000m^3 planned in the proposed North WTP, transmission amount will increase and accordingly, transmission amount from new reservoir to the existing Fanaka Highschool Reservoir will also be multiplied. If existing pipe are further used, pipe friction loss will be higher than the current status due to increasing in transmission flow. Therefore, it is desirable to install new transmission pipe between the proposed reservoir and the existing reservoir at Fanaka Highschool.

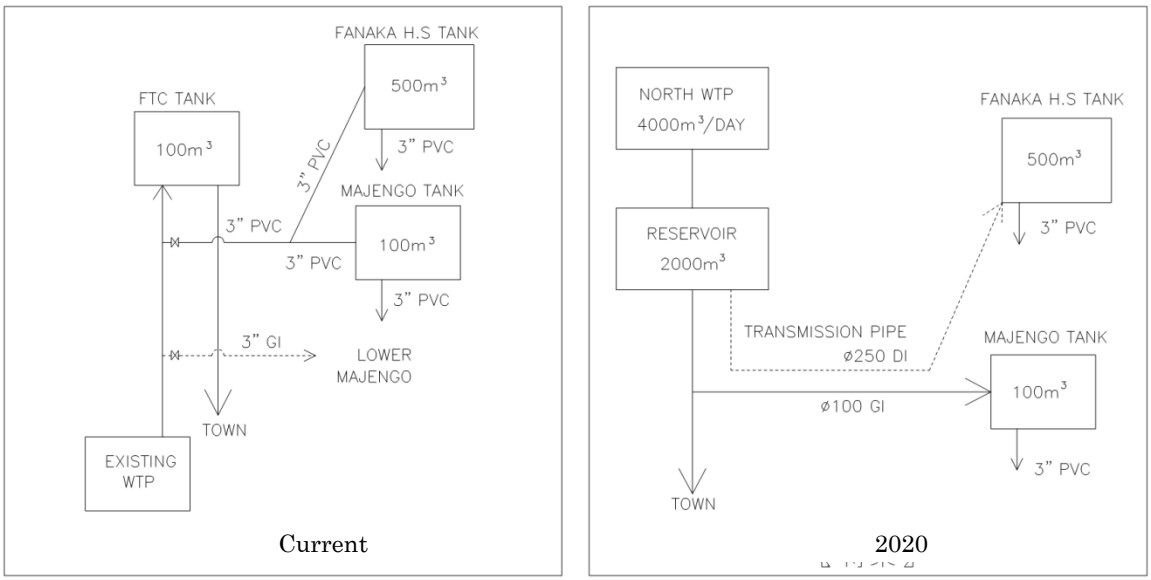


Figure 1 Schematic Drawing of Clear Water Transmission Pipe Layout

Daily maximum water demand is used applied for using clear water transmission pipe. Providing 12 hours storage capacity against daily maximum water demand to be secured in the existing Fanaka Highschool Reservoir, which capacity is set by 1,000m³/day, 0.01157m³/sec. The following Hazen-Williams Formula is applied in hydraulic calculation:

$H=10.666 \cdot C^{-1.85} \cdot D^{-4.87} \cdot Q^{1.85} \cdot L$

where: H：Head Loss（m）
C：Velocity Coefficient（=130）
D：Diameter（m）
Q：Flow Amount（m^3/sec）
L：Pipe Length（m）

【Diameter φ150mm】

H $=10.666 \cdot 130^{-1.85} \cdot 0.15^{-4.87} \cdot 0.01157^{1.85} \cdot 3780$
$=13.31375m > 4m$・・・NG
V $=0.01157m^3/sec \div 0.01767m^2$
$=0.65478m/sec$

【Diameter φ200mm】

H $=10.666 \cdot 130^{-1.85} \cdot 0.20^{-4.87} \cdot 0.01157^{1.85} \cdot 3780$
$=3.27981m < 4m$・・・OK
V $=0.01157m^3/sec \div 0.03142m^2$
$=0.36824m/sec$

【Diameter φ250mm】

H $=10.666 \cdot 130^{-1.85} \cdot 0.25^{-4.87} \cdot 0.01157^{1.85} \cdot 3780$

＝1.10636m＜4m・・・OK

V ＝0.01157m^3/sec÷0.04909m^2

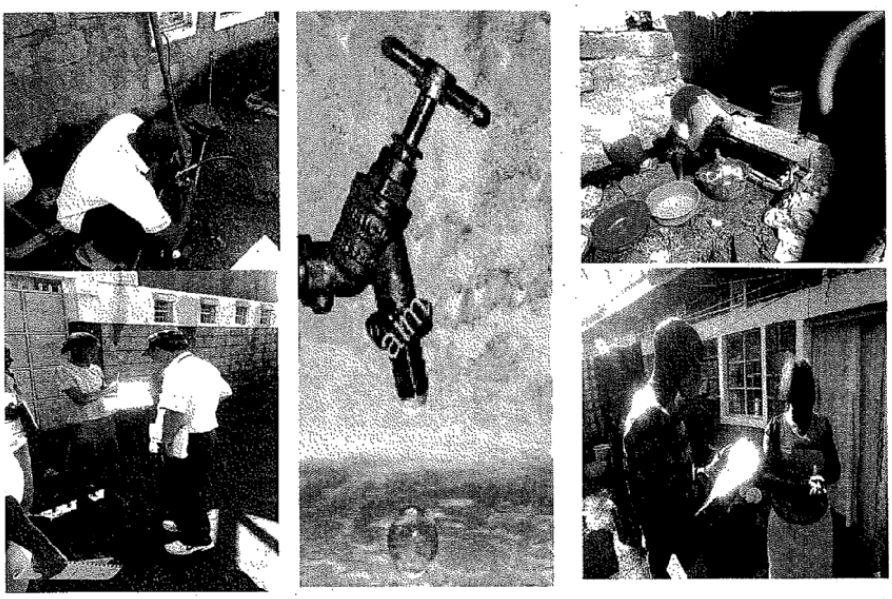
＝0.23569m/sec

Although the head loss of the pipe with 200 mm reaches less than the elevated difference with 4m obtained from the topographic survey the pipe diameter with 250mm is adopted taking into consideration allowance merginal factor. Compared with the existing clear water transmission pipe, both pipe diameter and length become larger. Needless to say, clear water transmission pipe is significant water supply facility through the future, durable and sustainable pipe material shall be properly selected. DI pipe is adopted.

Diameter of Clear Water Transmission Pipe: 250mm
Material of Clear Water Transmission Pipe: DI Pipe

Appendix 6-18 Results of Social Environmental Consideration Survey

NAROK WATER AND SEWERAGE COMPANY LTD



SOCIAL SURVEY

SOCIAL SURVEY ON THE PROJECT FOR AUGMENTATION OF WATER SUPPLY SYSTEM NAROK TOWN –KENYA

Final Report

NJS CONSULTANTS Co., LTD. **(NJS Group)**	JICA Japan International Cooperation Agency	MASHARIKI environment and management consultancy

1.0 INTRODUCTION

1.1 Purpose

This Social Survey Report has been prepared following a request by the Client- NJS Consultants on behalf of ***Narok Water and Sewerage Service Company*** to the consultant **Mashariki Environmental and Management Consultancy (MEMC)** to undertake a **Social Survey on the Project for Augmentation of Water Supply System for Narok Town –Kenya**

1.2 Background

The General Social Survey is recognized for its regular collection of cross-sectional data that allows for trend analysis, and its capacity to test and develop new concepts that address emerging issues.

The average length of the interviews was 20 to 30 minutes per household. The survey contained a core topic, focus or exploratory questions and a standard set of socio-demographic questions used for classification, also included were qualitative questions which explore perceptions.

1.3 Objectives of the Survey

The two primary objectives of the General Social Survey (GSS) are:

1. To gather data on social trends in order to monitor changes in the living conditions and well-being of the project area of influence over time; and
2. To provide immediate information on specific social policy issues of current or emerging interest.

1.4 Target Population

The survey team collected data for 6 days period from the population living in private households in the 11 residential and business areas of Narok town. For all project area sites the population aged 18 and older were sampled.

1.5 Methodology

A socio-economic survey was conducted from 1st March 2012 to 7th March 2012. This provided a baseline description for the socio-economic setting of the project area. The survey adopted a descriptive study design using the household as the sampling unit. The area falls within Narok County with administrative locations as indicated in **Appendix 1**

1.5.1 Survey Tools

A household questionnaire was used to collect the data. The questionnaire used in the survey was a standard instrument so as to make the methodology and findings of the survey comparable to those of other counties, regions and countries. With the assistance of the JICA, NJS and lead consultant team, an appropriate data collection tool was developed for this study. This was used to collect background information at the household level and also to screen person's access to water by type in the household for subsequent questions in the individual questionnaire. The questionnaire has different sections including: incomes; environmental factors; service

assessment analysis; support services; and employment and income. Sample questionnaire is herein attached as **Appendix 2**

1.5.2 Socio-Economic Indicators

Five socio-economic indicators were considered in studying the baseline characteristics of the area. These are:

- **Demographic characteristics:** Which covered aspects such as; age of members, sex, family size and income of household members;
- **Income and poverty levels:** Income and expenditure of the household was computed;
- **Health characteristics:** Covered main water borne diseases suffered, causes, recurrence and medical bills;
- **Household amenities:** Focused on water and sanitation, quality of water sources, level of satisfaction with water services as well as type of toilet facility; and
- **Project acceptance:** Respondents were asked about their general perception of the proposed project augmentation of water supply system, expectations, priorities and acceptance.

1.5.3 Survey Sample

Stratified random sampling was used to select a sample of 545 households within the project's sphere of influence. A structured questionnaire was used to collect information on the identified socio-economic indicators.

1.5.4 Data Collection

Key components of this exercise were:

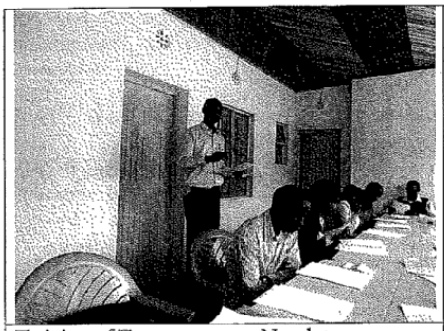
- Recruitment and training;
- Data collection;
- Quality control;
- Data capture and analysis.

1.5.5 Recruitment and Training

Two supervisors, eighteen enumerators, one editing staff, and three data entry clerks were recruited to collect, edit and process baseline survey information. Enumerators were sourced from Narok town to reduce resistance in the local community and also enhance penetration by the study team.

A one-day training workshop was held in a Narok hotel on 29 February 2012. The training largely involved instructions on administering the questionnaire. It was participatory in nature and used both demonstration and mock interviews. The mock interview was carried out in Kiswahili in order to simulate the actual conditions expected in the field. Pre-testing of the questionnaire was carried out later in the afternoon, after which participants reviewed challenges encountered and appropriate solutions suggested.

Table 1.1 Photo Plates of Training and Pre test.

	
Training of Enumerators at Narok town.	One of the enumerators and supervisor during pre test.

1.5.6 Data Collection

Actual data collection was undertaken from 01 March 2012 to 04 March 2012. Elaborate logistics were put in place during the data collection process to ensure safety and ease of access to sampled households. There was an overall team leader who coordinated all the data collection process in all the observation points. Two groups were formed each with a supervisor and nine enumerators. The enumerators worked in pairs.

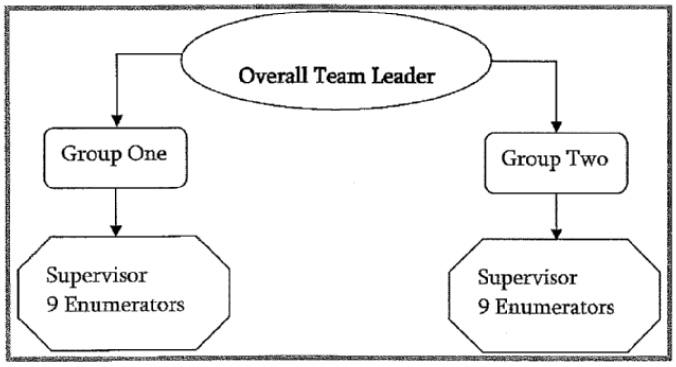


Figure 1.1 The Data Collection Organo Chart.

The area chiefs and village elders were informed of the study team to notify residence and village guides were also part of the team.

1.5.7 Quality Control

Completed questionnaires were received from the field and were passed to the supervisors who checked for completeness, consistency of responses and any other errors. Any mistakes encountered was either corrected by the editor or referred back to the enumerators for correction.

1.5.8 Data Capture and Analysis

Edited questionnaires were used by the data entry team to key collected information into Statistical Package for Social Scientists (SPSS). Programming for generation of data tables and all data processing was done using SPSS version 17, and tables formatted in Microsoft Excel.

Data entry in MEMC head quarters

One of our Team leaders back checking collected data.

2.0 FINDINGS AND DISCUSSIONS

This section of the report provides results of the key socio economic indicators from the analysis based on the data collected from the field study. A total of 545 households were sampled by our team of enumerators (17 no.) each having an average of 8 questionnaires a day

2.1 Demographic Characteristics

2.1.1 Family structure and distribution

The Figure 2.1 below shows the general family composition in the project area. Generally, children between age 0 and age 4 account for about 12.7%. For those above the age of five, 44.1 per cent were male while 43.2 per cent were female. Household composition from the surveyed population indicates that over 87.3 per cent are over age five years. This could be attributed to the fact that Narok town is urban where most human resources are non native and native populations live in the farmlands.

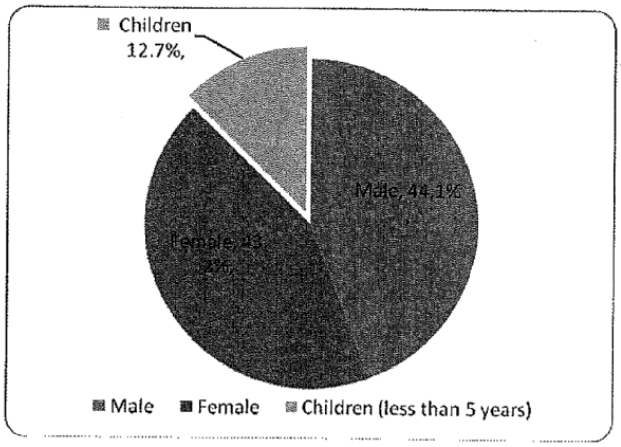


Figure 2.1: Household Composition

Further analysis show that there more males (50.8%) than females (49.2%) in the study area.

Table 2.1: Distribution of Households Membership by Gender

Gender	Frequency	Percent
Male	268	49.2
Female	277	50.8
Total	545	100

2.2 Income Levels and Expenditure

2.2.1 Income

Overall average monthly income for the surveyed households is shown in Table 2.2. Income distribution shows that about 32.5 per cent of the households have an income of below Kshs. 12,000, while 15.6 per cent have an average income of between Kshs. 9,001 and Kshs. 12,000. While 67.2 percent of the total population have incomes less than KShs 21,000. This indicates that populations in Narok have below average living standards.

Table 2.2: Distribution of Average Household Monthly Income

Income per Household (Kshs/Month/Family)	Frequency	% of Income per Household.	Cumm. Percent
1Kshs-3000Kshs	12	2.2%	2.2%
3001Kshs-6,000Kshs	47	8.6%	10.8%
6,001Kshs-9,000Kshs	33	6.1%	16.9%
9,0001kshs-12,000Kshs	85	15.6%	32.5%
12,001Kshs-15,000Kshs	85	15.6%	48.1%
15,001Kshs-18,000Kshs	32	5.9%	54.0%
18,001Kshs-21,000Kshs	72	13.2%	67.2%
More than 21,000Kshs	179	32.8%	100.0%
TOTAL	545	100.0%	100%

2.2.2 Expenditure

Table 2.3 shows that household expenses are relatively higher than income. This is the norm as most studies have similar outcomes. About 56.0 per cent of the households spend up to Kshs 9,000 per month.

Table 2.3: Distribution of Household Income and Expenditure

Expenditure per Household (Kshs/Month/Family)	Frequency	% Expenditure per Household.	Cumm. Percent
1Kshs-3000Kshs	70	12.8%	12.8%
3001Kshs-6,000Kshs	108	19.8%	32.7%
6,001Kshs-9,000Kshs	127	23.3%	56.0%
9,0001kshs-12,000Kshs	90	16.5%	72.5%
12,001Kshs-15,000Kshs	47	8.6%	81.1%
15,001Kshs-18,000Kshs	11	2.0%	83.1%
18,001Kshs-21,000Kshs	36	6.6%	89.7%
More than 21,000Kshs	56	10.3%	100.0%
TOTAL	545	100.0%	100%

As compared also to the water billing further analysis indicate that expenditure on water is relatively low in relation to other expenditure as over 93.8% of the sampled population surveyed spend less than Kshs. 2,500 in water.

Table 2.4: Distribution of Household water billing

Water Bill (include sewage water)	Frequency	% of Water Bill per Household.	Cumulative percent
1Kshs-500Kshs	209	38.4%	38.4%
501Kshs-1,000Kshs	205	37.6%	76.0%
1,001Kshs-1,500Kshs	60	11.0%	87.0%
1,5001kshs-2,000Kshs	34	6.2%	93.2%
2,001Kshs-2,500Kshs	3	0.6%	93.8%
2,501Kshs-3,000Kshs	13	2.4%	96.2%
3,001Kshs-3,500Kshs	1	0.2%	96.3%
3,501Kshs-4,000Kshs	4	0.7%	97.1%
4,001kshs-4,500Kshs	1	0.2%	97.2%
4,501Kshs-5,000Kshs	3	0.6%	97.8%
More than 5,001Kshs	12	2.2%	100.0%
TOTAL	545	100.00%	100%

2.3 Disease Prevalence

Good health is considered a pre-requisite for socio economic development of any country since healthy population is capable of participating in economic, social and political development. Figure 2.2 presents the distribution of the household disease prevalence cue to water borne. The study pointed out that less than half (4.5%) of the population were affected due to water quality related diseases. Of those affected, Typhoid had the highest prevalence (53.5%) followed in the distant second by diarrhoea (22.1%). Only about one in five (12.9%) had cholera. Typhoid has a high prevalence and other water borne diseases due to poor water handling in Narok town ranging from lack of elaborate sewerage services, poor water storage in households, lack of basic hygiene knowledge and water purification strategies e.t.c.

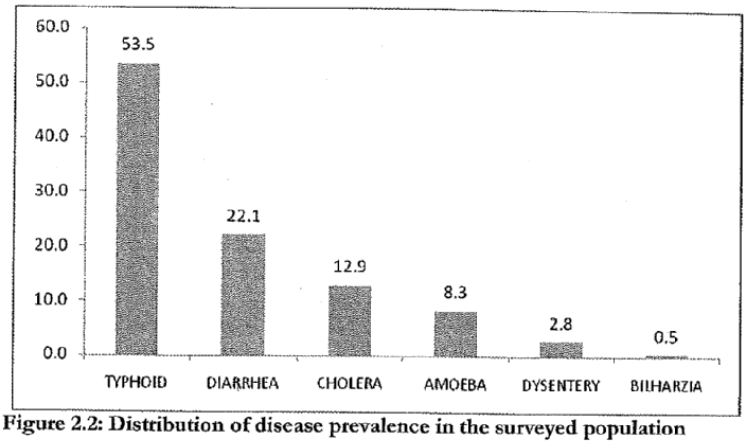


Figure 2.2: Distribution of disease prevalence in the surveyed population

Access to health facility is a key objective to protection of life. Respondents were asked to indicate the number of times they were affected by the water borne diseases. Over 76.4 per cent of the households had about dual recurrence of the diseases with about a fifth having between three to five recurrences. Respondents overwhelmingly (97%) confirmed that the main cause of these infections were use of contaminated water.

Table 2.5: Recurrence of water borne diseases per household

Average number of time	Frequency	Percent
1-2	181	76.4
3-5	52	21.9
6+	4	1.7
Total	237	100.0

2.4 Sanitation Facilities

Narok Town does lacks an elaborate public sewerage system. The disposal of effluents and sludge in the open within the study area could be a major source of pollution and contamination of surface and underground water sources leading to many of the reported water-borne diseases. This is mainly because clean water is mainly used for domestic purpose as compared to other uses.

The survey also established the type of sanitation facilities in the project area. Over six in ten households use pit latrines as only 32.8 per cent use flush toilets. This is a serious health hazard in the study area. Of those using toilets, about 62 per cent use septic tanks with only 38.5 per cent using infiltated system.

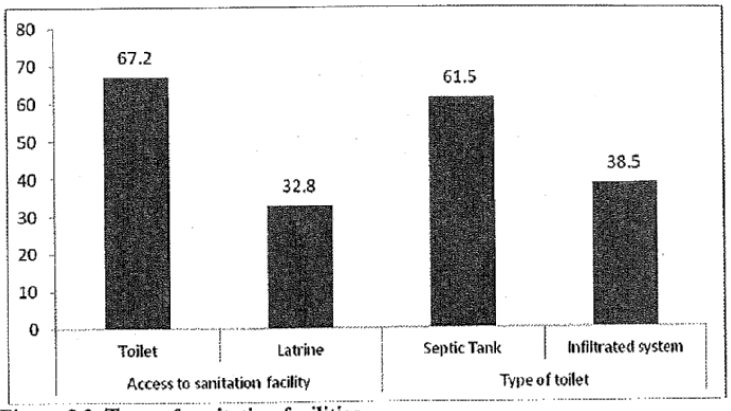


Figure 2.3: Type of sanitation facilities

2.5 Water Supply

2.5.1 Source of drinking water

Surface water sources (dams, lakes, ponds, rivers and streams) are generally unprotected and often deemed to be 'unsafe' for drinking, contaminated by animal, human and agricultural waste. Respondents were asked to ascertain whether they are connected to water source or not. An overwhelming majority (71%) affirmed to this statement. Of those who are connected, 89.2 per cent have their own connections, with 92.2 per cent confirming that their meters are in working condition

Water is largely from piped water (72.9%). However, water bourses, rainwater collection and borehole still remain water sources as presented in Table 2.5

Table 2.5: Distribution of Water Source

Source of water	Percent	Cumulative Percent
Piped	72.9	72.9
Tankers	14.9	87.8
Rain water	7.3	95.1
Borehole	3.7	98.8
Water Pans	0.8	99.6
Spring	0.4	**100.0**
Total	**100.0**	100%

2.5.2 Distance to the nearest water source

Easy availability of water supplies reduces water-carrying burdens, which in turn increases children attendance at school as well as mothers time for household activities. Respondents were asked to estimate the distance they cover to fetch water. Most of the households (31.9%) take less than 500 metres to get water as about one in four get water within 100 meters. It is

important to mention that on a similar scale, over twenty per cent of households get water for over 500 meters.

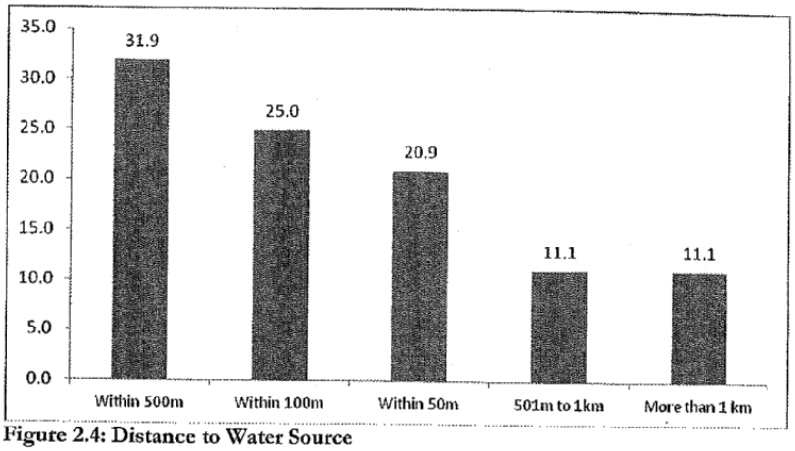


Figure 2.4: Distance to Water Source

Figure 2.5 provides data on the quantity of water usage at the household level per day. About 26 per cent of the surveyed households use upto 100 liters per day with about 26.2 per cent using between 81 to 100 liters a day. This therefore shows that around 51.8 per cent of residents use about 80 liters and above of water per day. This is quite a lot of water consumption given the the area has a low water supply coverage.

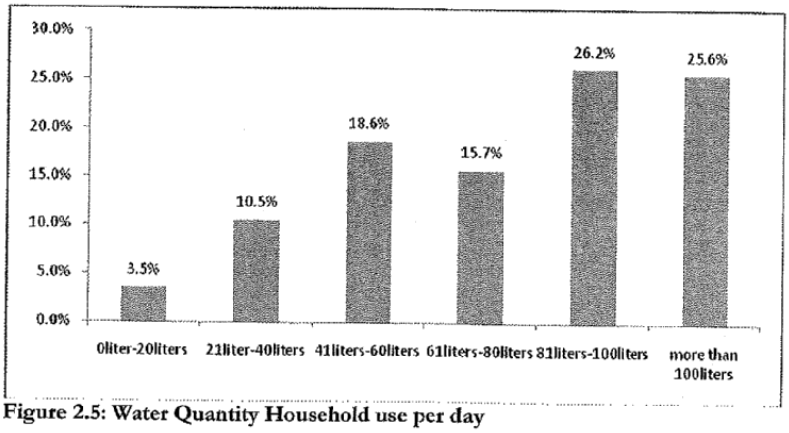


Figure 2.5: Water Quantity Household use per day

On the perception of the water quality in Narok town, nearly 49.6 per cent of the household percieve water quality as good, with about 50.3 per cent stating that water is of poor/bad quality. Reason given is that the water is either contaminated, dirty or not treated for human consumption.

Asked whether they are satisfied with the water service provide, about 63 per cent pointed that they are not satisfied with the services provided. Main reasons fronted were that the water provider offers poor service and quality and that the water is equally expensive.

2.5.3 Willingness to Pay

Majority of the respondents (98.2%) are willing to connect for water services with 93.6 per cent willing to pay for water services. On the amount willing to pay preferring to have home water supply. Slightly above 37.3 percent of those willing to pay for water services would be comfortable paying less than Kshs. 500 with 43.9 per cent paying between Kshs. 500-Kshs. 1000. water through kiosks as 22.3 per cent proposing for a shared tap.

Table 2.6: Distribution of Willingness to pay Water Supply

Amount willing to pay.	% willing to pay
0Kshs-500Kshs	37.3%
501-1,000Kshs	43.9%
1,001Kshs-1,500Kshs	8.2%
1,501kshs-2,000Kshs	7.5%
2,001Kshs-2,500Kshs	1.0%
2,501Kshs-3,000Kshs	1.4%
3,001Kshs-3500Kshs	0.2%
3,501Kshs-4,000Kshs	0.0%
more than 4000Kshs	0.6%
TOTAL	100.0%

2.6 Perceptions on the Proposed Project

2.6.1 Expectations after augmentation of water supply

When asked if they knew about their expectations after the completion of Augmentation of water supply system program proposed, nearly two thirds (69.7 per cent) access to clean water as 28.7 per cent see it in terms of saving time as water will be readily available for their use. This will make water affordable hence reducing high morbidity due to water borne diseases.

The respondents believe that priority of augmentation of water supply system in connection to rehabilitation for own connection should be highly prioritized (79.7%) compared to priority of augmentation of water supply system in connection to rehabilitation for kiosk (11.4%). Similarly, augmentation of water supply system in connection to supply tanks (15.9%)

2.6.2 Project acceptance

Majority (93.4%) of the surveyed respondents accept the water augmentation project in Narok. Only 6.6 per cent are against the project. Their reason for not accepting this project are; some feel that they are satisfied with the current supply, a few have boreholes that they get water for their daily chores, while some believe that the project is costly.

3.0 CONCLUSION AND RECOMMENDATIONS

The findings of the Social Survey on the Project for Augmentation of Water Supply System for Narok Town –Kenya conclude that augmentation of Narok Water Supply System is positive overall on the socio-economics of the area. The impact of the project on the water, sanitation and access to basic services as envisaged in Kenya Vision 2030 and the Constitution is positive in overall.

2.1 Conclusions

The social survey concludes that:

1. There is need to augment and supply Narok town with supply of clean water as most residents access poor quality water either supplied by NARWASSCO or otherwise;
2. NARWASCO should improve their service delivery and efficiency in the entire system;
3. Majority of the residence 98% are willing to get connected to improved water services while almost equal number 93.6% are willing to pay for the connected services and 81% will to pay less than Kshs 1000 per month;
4. Two thirds of the sampled population prioritise own connection the rest prioritise water tankers and kiosks respectively;
5. The sampled residence of Narok town (93.4%0 accept the project while the paltry (6.4%) either have own boreholes or fear the costs of improved water services being passed down to consumers

2.2 Recommendations

From the studies we recommend the following:

1. Income levels in Narok town are low to moderate hence the necessity to develop a low cost/cheap water supply system to ensure the town is sufficiently and well connected to the services;
2. The project is accepted in overall by the stakeholders in Narok town and the residents anticipate improvement of living standards in the area. The project should proceed as planned.
3. All legislative, policy and legal guidelines should be observed during project implementation.

Appendix-7 References

Appendix 7-1 List of collected Data

Data No.	Title of Data	Detailed Contents	Forms of Data				Agents where data was collected
Data 1	Climate data	Past 10 years before February 2012	1	piece	A-4	Copy	Narok Meteorological Station
Data 2	River data	Past 10 years before January 2012	1	set	Data File	Copy	WRMA
Data 3	WSP 5 Year Plan	Covers 2011-2015	1	booklet	A-4	Copy	WSP(NARWASSCO)
Data 4	NARWASSCO 5 Years Business Plan	Covers 2011-2015	1	booklet	A-4	Copy	WSP(NARWASSCO)
Data 5	Catalogues of Kenyan Power Companies	Year 2012 versoin	2	pieces	B-5	Original	KPLC Narok Branch
Data 6	Kenyan Annual Report in 2010	Data related to school, agriculture and hospital	1	booklet	B-5	Binded Book	
Data 7	Copy of WSP Budget Summary	2011/2012	1	piece	A-4	Copy	WSP(NARWASSCO)
Data 8	500m^3 Tank Construction Work Contract - Water Service Trust Fund		1	booklet	A-4	Copy	WSP(NARWASSCO)
Data 9	Environmental Survey Documents	Narok Town agricultual documents	1	booklet	A-4	Copy	Ministry of Agricalucure Office
Data 10	Application for Japanese Grant Aid Assistance	Documents submitted to Japanese Government	1	booklet	A-4	Copy	WSP(NARWASSCO)
Data 11	WSP Water Qulity Analysis Results	Past 5 Years	1	File	A-4	Copy	WSP(NARWASSCO)
Data 12	Students number of schools in Narok Town	2011	1	set	A-4	Copy	Narok District Education Office
Data 13	Audit Report (Copy)	2009/2010	1	set	A-4	Copy	WSP(NARWASSCO)
Data 14	Audit Report (Copy)	2011	1	set	A-4	Copy	WSP(NARWASSCO)
Data 15	WSBs related Suvey Documents	Rift Vally Water Services Board and others	1	set	A-4	Copy	Deputy District Water Office (Narok)
Data 16	Narok City Development Map	Revised Version, 2008	1	File	Data File	Copy	Narok County Council Headquaters
Data 17	The Independent Electoral and Boundaries Commission (IEBC)	New electoral division in 2012 National Election and number of electors in Narok State	1	piece	A-4	Copy	Advertaiser's Announcement /pageXXIFriday, March 10, 2012/ The standard
Data 18	Narok WSP Asset List	Assets List in 2010	1	set	A-4	Original	WSP(NARWASSCO)
Data 19	Narok WSP self-Work Evaluation	WRMA 2010	1	set	A-4	Copy	WSP(NARWASSCO)
Data 20	Narok North District Development Plan 2008-2012	Kenya Vison 2030 towards a globally competitive and prosperous Kenya	1	booklet	A-4	Copy	WSP(NARWASSCO)
Data 21	2009 Kenya Population and Houseing Census Volume I B	Kenya Census 2009 August 2010 Population and Household Distribution by Socio-Economice Characteristics	1	booklet	A-4	Copy	Narok District Develpemt Office
Data 22	2010 Kenya Population and Houseing Census Volume II	Kenya Census 2009 August 2011 Population Distribution by Political Units	1	booklet	A-4	Copy	Narok District Develpemt Office
Data 23	Water Bill Schedule of Appears of March 2012	Water bills for public offices and schools	1	set	B-5	Original	WSP(NARWASSCO)
Data 24	Narok Water & Sewerge Compny Area : Schedule of Arrears	Block-A and Block-Bfor on 2/2012	1	set	A-4	Copy	WSP(NARWASSCO)
Data 25	Montyly Revenue Collections	Monthly water charge collection record (2009～2011)	3	pieces	A-4	Copy	WSP(NARWASSCO)
Data 26	Narok Province Population Data	Area-wise population breakdown 2009	1	set	A-4	Copy	WSP(NARWASSCO)
Data 27	Livestock Production	Number of Livestock 2007	1	set	A-4	Copy	WSP(NARWASSCO)
Data 28	Water Tariff	Water Tariff Table 1999	1	set	A-4	Copy	WSP(NARWASSCO)
Data 29	WRMA Water News	WRMA Reports Nov. 2011～Feb. 2012	1	set	A-4	Copy	WSP(NARWASSCO)
Data 30	Meeting Minutes on Power Supply	Minutes of Meeting with KPLC on 3 April 2012	1	set	A-4	Copy	WSP(NARWASSCO)
Data 31	Practice Manual	Kenyan Design Guideline 2005	1	set	A-4	Copy	WSP(NARWASSCO)
Data 32	Strategic PLAN	Stragetic Plan 2007～2012	1	set	A-4	Copy	WSP(NARWASSCO)
Data 33	Harmonized Draft Constitution of Kenya	Nov.17 2009	1	set	A-4	Copy	Committee of Experts on Constitutional Review
Data 34	District Profile	2007	1	set	A-4	Copy	Narok North District
Data 35	Crop Production Report Narok North	2011	1	set	A-4	Copy	Ministry of Agricalucure Office
Data 36	Constitution of Kenya 2010	2010	1	set	A-4	PDF	National Council for Law Reporting with the authority of the attorney general
Data 37	CAP318		1	set	A-4	Power Point	Ministry of Agricalucure Office
Data 38	Farm Forestry Rules 2009		1	set	A-4	Power Point	Ministry of Agricalucure Office
Data 39	Rift Valley Water Supply and Sanitation Project Water Supply and Sanitation Improvement for 13towns		1	set	A-4	PDF	AfDB
Data 40	Surface Water Assessment and Issuance/Renewal Fees for Water Use Application/Permit		1	set	A-4	Copy	WRMA
Data 41	Sample of Water Permit		1	set	A-4	Copy	WRMA
Data 42	A Staff Guide(Staff Re-organization in the Water Sector)	April 2006	1	set	A-4	Copy	Ministry of Water and Irrigation
Data 43	Report from OHCHR fact-finding Mission to Kenya	February 2008	1	set	A-4	Copy	UNHCHR
Data 44	National Cohesion and Integration Act,2008,Simplified Version	2008	1	set	A-4	Copy	General Secretary
Data 45	Draft National Land Policy	2008	1	set	A-4	Copy	Ministry of Land