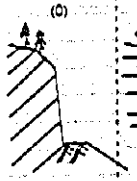
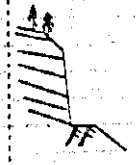
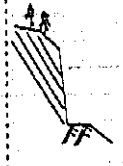
(5) RATING FOR STATE OF NATURE AND HAZARDS ASSESSMENT

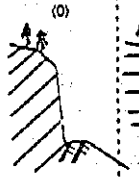
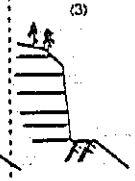
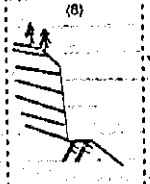
Rating for State of Nature and Hazards Assesment (1/15), Upper Lobeysa Canal (1/2)

Upper Lobeysa Canal (sheet 1/2)

Attribute	Description/ measurement					(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)
Vegetation		tough root anchoring (-3)	thick (0)	moderate (3)	sparce, barren cultivated (5)	3	5	0	0	0	0	0	0	0	3	0	3	0	0	0	0	0	0	5	5
Slope Angle (degrees) up		< 5 (0)	6 - 20 (3)	21 - 45 (5)	> 45 (3)	3	5	5	5	5	5	3	5	5	5	5	5	5	5	3	4	5	5	5	3
Slope Angle (degrees) down		< 5 (0)	6 - 20 (5)	21 - 30 (8)	> 31 (10)	0	5	10	8	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	8
Nearby drainage	none (0)	simple  (3)	under cutting or nil swarm  (5)	gully  (8)	active gully  (10)	0	0	0	0	5	0	5	5	5	5	8	0	0	5	5	8	8	8	0	0
Slope surface		smooth (0)	uneven (3)	mound scattered (4)	irregular with mid-slope flat (5)	2	2	0	0	0	0	0	0	0	0	0	0	0	0	2	0	2	0	0	2
Surface cover thickness		< 3 m (0)	3 - 5 m (3)	5 - 10 m (5)	> 10 m (3)	3	3	3	3	3	5	5	3	3	3	3	3	3	0	0	3	3	3	5	3
Surface cover material		massive debris, soil (3)	colluvium, debris with < 1 m block (5)	debris w/ wet mud or 3 m block (8)	loose debris, rock debris (10)	3	3	3	3	3	3	3	5	5	5	5	5	5	3	3	5	3	3	3	3
Bed rock	massive resistant (0)	jointed hard R. massive soft R. (3)	not observed & others (5)	Weathered R., open-cracked, foliated (8)	crushed, decomposed, argilized (10)	3	8	8	5	8	5	8	5	8	8	5	8	5	5	5	8	8	8	8	8
Orientation of discontinuity	(0) 	nearly flat (3) 	not clear (5) 	5° - 20° (8) 	> 20° (10) 	0	0	5	5	5	0	0	5	0	0	0	0	0	0	5	5	5	0	5	5
Cutting + banking height		< 3 m (0)		3 - 6 m (3)	> 6 m (5)	3	3	3	3	3	3	3	3	5	0	0	3	3	3	5	0	0	0	0	3
Deformation of structure	none (0)	minor < 3 m (3)	med., deform. 3 - 6 m (5)	med. - major deform. repaired temporarily (8)	down warp seems active (10)	8	0	3	0	0	0	0	0	5	0	3	0	0	8	3	3	0	0	0	0
Possible wash out/ rock fall		not likely (0)	possible (3)	probable (4)	in danger (5)	0	0	0	0	0	3	0	0	0	0	0	0	0	0	3	0	0	0	0	0
Existing slide, creep failure (w < 6 m)	none (0)	nil erosion (3)	old slide near-by (< 10 years) (5)	new slide within 20 m (8)	zone of major or active slide (10)	0	0	3	0	0	0	0	0	0	0	0	0	0	0	8	8	5	3	3	0
Total Point (Vulnerability Index)						28	34	43	32	42	34	37	41	46	39	39	37	31	39	52	54	49	40	44	40

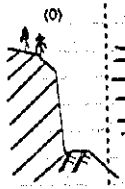
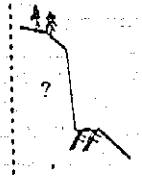
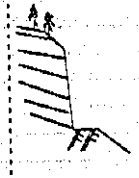
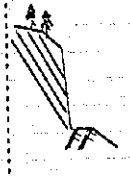
Rating for State of Nature and Hazards Assesment (2/15),
Upper Lobeysa Canal (2/2)

Upper Lobeysa Canal (sheet 2/2)

Attribute	Description/ measurement					(21)	(22)	(23)	(24)	(25)	(26)	(27)	(28)	(29)
Vegetation		tough root anchoring (-3)	thick (0)	moderate (3)	sparce, barren cultivated (5)	5	5	3	5	5	5	3	5	3
Slope Angle (degrees) up		< 5 (0)	6 – 20 (3)	21 – 45 (5)	> 45 (3)	3	5	5	5	3	5	5	3	5
Slope Angle (degrees) down		< 5 (0)	6 – 20 (5)	21 – 30 (8)	> 31 (10)	5	8	5	5	5	10	10	10	8
Nearby drainage	none (0)	simple  (3)	under cutting or nil swarm  (5)	gully  (8)	active gully  (10)	0	0	0	8	5	5	0	8	8
Slope surface		smooth (0)	un-even (3)	mound scattered (4)	irregular with mid-slope flat (5)	2	4	0	0	2	0	2	2	0
Surface cover thickness		< 3 m (0)	3 – 5 m (3)	5 – 10 m (5)	> 10 m (3)	5	5	3	3	3	3	3	3	3
Surface cover material		massive debris, soil (3)	colluvium, debris with < 1 m block (5)	debris w/ wet mud or 3 m block (8)	loose debris, rock debris (10)	8	3	5	3	5	3	5	3	3
Bed rock	massive resistant (0)	jointed hard R. massive soft R. (3)	not observed & others (5)	Weathered R. open-cracked, foliated (8)	crushed, decomposed, argilized (10)	3	3	5	8	3	3	3	3	3
Orientation of discontinuity	(0) 	nearly flat (3) 	not clear (5) 	5° – 20° (8) 	> 20° (10) 	5	5	5	5	5	5	5	5	5
Cutting + banking height		< 3 m (0)		3 – 6 m (3)	> 6 m (5)	0	0	3	0	3	3	3	3	3
Deformation of structure	none (0)	minor < 3 m (3)	med., deform. 3 – 6 m (5)	med. – major deform, repaired temporarily (8)	down warp seems active (10)	0	5	0	0	0	0	0	0	0
Possible wash out/ rock fall		not likely (0)	possible (3)	probable (4)	in danger (5)	0	0	0	0	0	0	0	0	0
Existing slide, creep failure (w < 6 m)	none (0)	nil erosion (3)	old slide near-by (< 10 years) (5)	new slide within 20 m (8)	zone of major or active slide (10)	0	8	3	0	0	0	0	0	0
Total Point (Vulnerability Index)						36	51	37	42	39	42	39	45	41

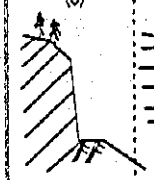
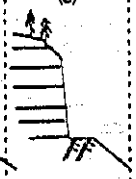
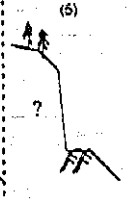
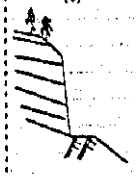
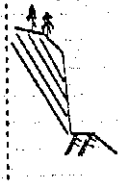
Rating for State of Nature and Hazards Assesment (3/15), Lower Lobeysa Canal

Lower Lobeysa Canal

Attribute	Description/ measurement					(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)
Vegetation		tough root anchoring (-3)	thick (0)	moderate (3)	sparce, barren cultivated (5)	5	3	5	3	3	5	5	5	3	3	3	5	5	5	5	5	5	5	5	5	5
Slope Angle (degrees) up		< 5 (0)	6 ~ 20 (3)	21 ~ 45 (5)	> 45 (3)	3	5	5	5	5	5	5	5	5	5	5	5	3	3	5	3	5	3	5	5	3
Slope Angle (degrees) down		< 5 (0)	6 ~ 20 (5)	21 ~ 30 (8)	> 31 (10)	5	8	8	10	10	8	8	10	10	10	10	8	5	5	5	5	5	5	5	8	5
Nearby drainage	none (0)	simple (3)	under cutting or rill swarm (5)	gully (8)	active gully (10)	3	3	3	3	3	5	5	3	5	3	5	0	0	0	0	5	3	0	0	3	0
Slope surface		smooth (0)	un-even (3)	mound scattered (4)	irregular with mid-slope flat (5)	0	0	0	0	0	0	0	0	2	2	2	2	0	2	2	0	0	2	0	0	0
Surface cover thickness		< 3 m (0)	3 ~ 5 m (3)	5 ~ 10 m (5)	> 10 m (8)	3	5	3	0	0	5	5	0	0	0	3	5	5	3	5	3	3	3	5	3	5
Surface cover material		massive debris, soil (3)	colluvium, debris with < 1 m block (5)	debris w/ wet mud or 3 m block (8)	loose debris, rock debris (10)	5	5	5	3	3	3	5	3	3	3	5	5	5	5	5	3	5	5	3	3	3
Bed rock	massive resistant (0)	jointed hard R. massive soft R. (3)	not observed & others (5)	Weatherd R. open-cracked, foliated (8)	crushed, decomposed, argilized (10)	3	3	5	5	5	3	5	8	5	10	8	8	8	8	8	8	8	8	8	8	8
Orientation of discontinuity	(0) 	nearly flat (3) 	not clear (5) 	5° ~ 20° (8) 	> 20° (10) 	5	3	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
Cutting + banking height		< 3 m (0)		3 ~ 6 m (3)	> 6 m (5)	0	0	0	5	0	5	3	0	3	3	0	0	0	0	0	0	0	0	0	0	0
Deformation of structure	none (0)	minor < 3 m (3)	med., deform. 3 ~ 6 m (5)	med. ~ major deform. repaired temporarily (8)	down warp seems active (10)	0	0	0	0	3	0	5	8	5	5	3	0	0	0	0	0	0	0	0	0	0
Possible wash out/ rock fall		not likely (0)	possible (3)	probable (4)	in danger (5)	0	0	0	3	0	0	5	5	0	5	0	0	0	0	0	0	0	0	0	0	0
Existing slide, creep failure (w < 6 m)	none (0)	nil erosion (3)	old slide near-by (< 10 years) (5)	new slide within 20 m (8)	zone of major or active slide (10)	0	0	0	5	3	0	5	0	5	5	3	0	0	0	0	0	0	0	0	0	0
Total Point (Vulnerability Index)						32	35	39	47	40	44	61	52	51	59	52	43	36	36	40	37	39	36	36	40	34

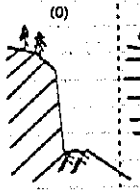
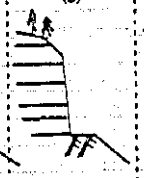
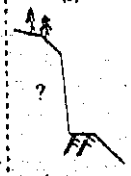
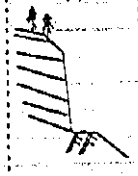
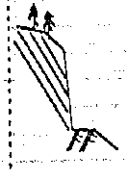
Rating for State of Nature and Hazards Assesment (4/15).
Bajo Canal (1/3)

Bajo Canal (sheet 1/3)

Attribute	Description/ measurement					(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(19')
Vegetation		tough root-anchoring (-3)	thick (0)	moderate (3)	sparce, barren cultivated (5)	5	3	5	3	3	3	3	3	5	5	3	3	0	3	5	3	3	5	5	5
Slope Angle (degrees) up		< 5 (0)	6 - 20 (3)	21 - 45 (5)	> 45 (3)	0	5	5	3	5	5	5	5	5	3	3	5	5	5	3	5	5	3	5	5
Slope Angle (degrees) down		< 5 (0)	6 - 20 (5)	21 - 30 (8)	> 31 (10)	0	10	10	8	10	10	10	10	10	8	10	10	10	10	10	10	10	10	10	10
Nearby drainage	none (0)	simple (3)	under cutting or rill swarm (5)	gully (8)	active gully (10)	5	3	5	3	3	3	3	3	3	3	5	3	8	5	5	5	3	8	3	3
Slope surface		smooth (0)	uneven (3)	mound scattered (4)	irregular with mid-slope flat (5)	0	0	2	0	2	0	0	0	2	0	0	2	0	0	2	0	0	0	0	0
Surface cover thickness		< 3 m (0)	3 - 5 m (3)	5 - 10 m (5)	> 10 m (3)	5	0	3	0	3	10	10	10	3	0	5	3	5	5	0	3	3	0	3	3
Surface cover material		massive debris, soil (3)	colluvium, debris with < 1 m block (5)	debris w/ wet mud or 3 m block (8)	loose debris, rock debris (10)	3	3	5	3	5	10	8	5	5	10	8	8	5	5	5	3	3	3	8	8
Bed rock	massive resistant (0)	jointed hard R, massive soft R. (3)	not observed & others (5)	Weatherd R, open-cracked, foliated (8)	crushed, decomposed, argillized (10)	8	8	8	8	5	8	8	8	8	5	8	8	8	8	5	5	8	8	8	8
Orientation of discontinuity	(0) 	nearly flat (3) 	not clear (5) 	5 ° - 20 ° (8) 	> 20 ° (10) 	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cutting + banking height		< 3 m (0)		3 - 6 m (3)	> 6 m (5)	0	3	0	0	0	0	5	0	0	3	0	3	3	0	5	0	0	0	0	0
Deformation of structure	none (0)	minor < 3 m (3)	med., deform. 3 - 6 m (5)	med. - major deform. repaired temporarily (8)	down warp seems active (10)	0	0	0	0	0	5	5	0	0	5	0	3	0	5	5	0	0	5	0	8
Possible wash out/ rock fall		not likely (0)	possible (3)	probable (4)	in danger (5)	0	0	0	4	0	3	3	0	0	0	0	0	0	3	3	0	0	3	0	0
Existing slide, creep failure (w < 6 m)	none (0)	rill erosion (3)	old slide near-by (< 10 years) (5)	new slide within 20 m (8)	zone of major or active slide (10)	0	0	0	8	0	8	8	0	0	8	0	8	0	8	8	0	0	8	0	8
Total Point (Vulnerability Index)						26	35	43	40	36	65	58	44	41	50	42	56	44	57	56	34	35	53	42	58

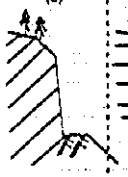
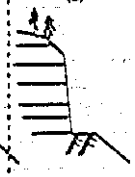
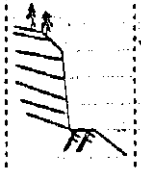
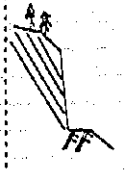
Rating for State of Nature and Hazards Assesment (5/15).
Baji Canal (2/3)

Bajo Canal (sheet 2/3)

Attribute	Description/ measurement					(20)	(21)	(22)	(23)	(24)	(25)	(26)	(26')	(27)	(28)	(29)	(30)	(31)	(32)	(33)	(34)	(35)	(36)	(37)	(38)
Vegetation		tough root anchoring (-3)	thick (0)	moderate (3)	sparce, barren cultivated (5)	0	3	5	5	5	5	3	3	5	5	5	3	3	5	5	3	0	3	5	5
Slope Angle (degrees) up		< 5 (0)	6 ~ 20 (3)	21 ~ 45 (5)	> 45 (3)	5	5	5	3	5	5	5	5	3	5	5	5	3	5	5	3	5	5	5	3
Slope Angle (degrees) down		< 5 (0)	6 ~ 20 (5)	21 ~ 30 (8)	> 31 (10)	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	8	10	10	10	10
Nearby drainage	none (0)	simple (3)	under cutting or rill swarm (5)	gully (8)	active gully (10)	5	5	8	8	8	5	5	5	8	5	5	5	5	10	5	8	8	8	5	5
Slope surface		smooth (0)	un-even (3)	mound scattered (4)	irregular with mid-slope flat (5)	2	5	0	5	5	2	2	2	2	2	5	2	2	2	0	0	2	0	0	0
Surface cover thickness		< 3 m (0)	3 ~ 5 m (3)	5 ~ 10 m (5)	> 10 m (3)	3	3	5	3	5	5	5	5	3	5	5	5	5	5	5	5	3	3	5	3
Surface cover material		massive debris, soil (3)	colluvium, debris with < 1 m block (5)	debris w/ wet mud or 3 m block (8)	loose debris, rock debris (10)	5	8	5	5	5	5	5	5	5	5	5	5	5	3	5	3	5	3	3	3
Bed rock	massive resistant (0)	jointed hard R. massive soft R. (3)	not observed & others (5)	Weathered R. open-cracked, foliated (8)	crushed, decomposed, argillized (10)	8	8	8	8	8	8	8	8	8	8	8	8	8	10	8	8	8	8	8	8
Orientation of discontinuity	(0) 	nearly flat (3) 	not clear (5) 	5 ° ~ 20 ° (8) 	> 20 ° (10) 	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cutting + banking height		< 3 m (0)		3 ~ 6 m (3)	> 6 m (5)	0	0	3	3	0	3	0	3	3	3	3	3	3	3	5	0	0	0	0	0
Deformation of structure	none (0)	minor < 3 m (3)	med., deform. 3 ~ 6 m (5)	med. ~ major deform. repaired temporarily (8)	down warp seems active (10)	0	3	5	5	5	5	5	5	8	5	5	3	5	5	3	3	3	0	3	0
Possible wash out/ rock fall		not likely (0)	possible (3)	probable (4)	in danger (5)	0	0	0	3	0	0	0	3	4	3	0	0	0	3	0	0	0	0	0	0
Existing slide, creep failure (w < 6 m)	none (0)	rill erosion (3)	old slide near-by (< 10 years) (5)	new slide within 20 m (8)	zone of major or active slide (10)	0	5	8	8	8	8	5	8	8	8	8	8	8	8	8	0	0	0	0	0
Total Point (Vulnerability Index)						38	55	62	66	64	61	53	62	67	64	64	57	57	69	59	41	44	40	44	37

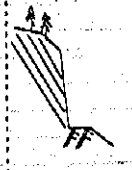
Rating for State of Nature and Hazards Assesment (6/15),
Bajo Canal (3/3)

Bajo Canal (sheet 3/3)

Attribute	Description/ measurement					(39)	(40)	(41)	(42)	(43)	(44)	(45)	(46)	(47)
Vegetation		tough root anchoring (-3)	thick (0)	moderate (3)	sparce, barren cultivated (5)	5	5	5	5	5	5	5	5	5
Slope Angle (degrees) up		< 5 (0)	6 ~ 20 (3)	21 ~ 45 (5)	> 45 (3)	5	5	5	5	3	3	3	5	5
Slope Angle (degrees) down		< 5 (0)	6 ~ 20 (5)	21 ~ 30 (8)	> 31 (10)	10	10	10	10	5	5	5	3	8
Nearby drainage	none (0)	simple  (3)	under cutting or rill swarm  (5)	gully  (8)	active gully  (10)	8	5	5	8	8	5	5	5	0
Slope surface		smooth (0)	un-even (3)	mound scattered (4)	irregular with mid-slope flat (5)	0	0	0	2	2	0	2	4	0
Surface cover thickness		< 3 m (0)	3 ~ 5 m (3)	5 ~ 10 m (5)	> 10 m (3)	3	3	0	5	3	5	3	5	3
Surface cover material		massive debris, soil (3)	colluvium, debris with < 1 m block (5)	debris w/ wet mud or 3 m block (8)	loose debris, rock debris (10)	5	5	3	3	3	3	3	5	5
Bed rock	massive resistant (0)	jointed hard R. massive soft R. (3)	not observed & others (5)	Weatherd R, open-cracked, foliated (8)	crushed, decomposed, argillized (10)	8	8	8	8	8	8	8	5	5
Orientation of discontinuity	(0) 	nearly flat (3) 	not clear (5) 	5 ° ~ 20 ° (8) 	> 20 ° (10) 	0	0	0	0	0	0	0	0	0
Cutting + banking height		< 3 m (0)		3 ~ 6 m (3)	> 6 m (5)	0	0	0	3	0	0	3	0	0
Deformation of structure	none (0)	minor < 3 m (3)	med., deform. 3 ~ 6 m (5)	med. ~ major deform, repaired temporarily (8)	down warp seems active (10)	3	0	3	3	3	0	3	0	0
Possible wash out/ rock fall		not likely (0)	possible (3)	probable (4)	in danger (5)	3	0	0	0	0	0	0	0	0
Existing slide, creep failure (w < 6 m)	none (0)	rill erosion (3)	old slide near-by (< 10 years) (5)	new slide within 20 m (8)	zone of major or active slide (10)	0	0	0	0	3	0	0	3	0
Total Point (Vulnerability Index)						50	41	39	52	43	34	40	40	31

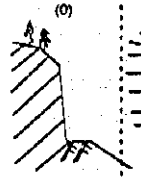
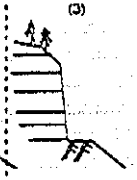
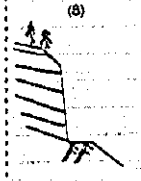
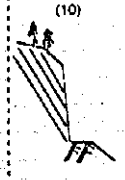
Rating for State of Nature and Hazards Assesment (7/15), Phangyul Canal (1/3)

Phangyul Canal (sheet 1/3)

Attribute	Description/ measurement					(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)
Vegetation		tough root anchoring (-3)	thick (0)	moderate (3)	sparce, barren cultivated (5)	0	-3	-3	0	-3	0	0	0	3	0	0	0	0	0	-3	0	0	3	3	3
Slope Angle (degrees) up		< 5 (0)	6 ~ 20 (3)	21 ~ 45 (5)	> 45 (3)	5	5	3	5	5	3	3	5	3	3	5	5	5	5	5	5	5	5	5	5
Slope Angle (degrees) down		< 5 (0)	6 ~ 20 (5)	21 ~ 30 (8)	> 31 (10)	10	8	5	10	10	10	8	10	8	10	10	10	10	10	10	10	10	10	10	10
Nearby drainage	none (0)	simple (3)	under cutting or rill swarm (5)	gully (8)	active gully (10)	5	0	0	3	0	3	0	0	0	0	0	0	3	3	5	3	0	3	0	8
Slope surface		smooth (0)	un-even (3)	mound scattered (4)	irregular with mid-slope flat (5)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	2	0	0
Surface cover thickness		< 3 m (0)	3 ~ 5 m (3)	5 ~ 10 m (5)	> 10 m (3)	0	5	3	5	3	0	5	3	3	5	5	0	3	3	5	5	3	0	3	3
Surface cover material		massive debris, soil (3)	colluvium, debris with < 1 m block (5)	debris w/ wet mud or 3 m block (8)	loose debris, rock debris (10)	3	3	3	3	3	3	3	3	3	3	5	3	5	3	3	3	3	3	3	5
Bed rock	massive resistant (0)	jointed hard R. massive soft R. (3)	not observed & others (5)	Weatherd R. open-cracked, foliated (8)	crushed, decomposed, argillized (10)	5	8	8	8	8	8	8	8	8	8	10	8	5	5	8	8	5	10	10	10
Orientation of discontinuity	(0) 	nearly flat (3) 	not clear (5) 	5° ~ 20° (8) 	> 20° (10) 	0	5	5	5	5	8	5	5	5	5	5	5	5	5	5	5	5	5	5	5
Cutting + benking height		< 3 m (0)		3 ~ 6 m (3)	> 6 m (5)	3	0	0	0	0	0	0	0	3	0	0	3	0	0	0	3	3	3	3	5
Deformation of structure	none (0)	minor < 3 m (3)	med., deform. 3 ~ 6 m (5)	med. ~ major deform. repaired temporarily (8)	down warp seems active (10)	3	0	0	3	0	3	5	0	0	0	0	0	0	0	0	3	3	8	5	3
Possible wash out/ rock fall		not likely (0)	possible (3)	probable (4)	in danger (5)	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0
Existing slide, creep failure (w < 6 m)	none (0)	nil erosion (3)	old slide near-by (< 10 years) (5)	new slide within 20 m (8)	zone of major or active slide (10)	0	0	3	0	0	5	3	0	0	0	0	5	0	0	0	3	3	3	3	8
Total Point (Vulnerability Index)						37	31	27	42	31	43	40	34	36	34	40	39	36	34	38	50	42	60	50	65

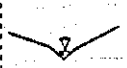
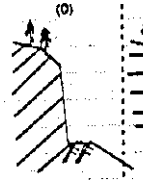
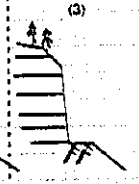
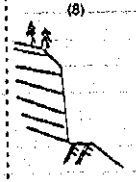
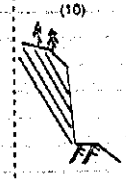
Rating for State of Nature and Hazards Assesment (8/15),
Phangyul Canal (2/3)

Phangyul Canal (sheet 2/3)

Attribute	Description/ measurement					(21)	(22)	(23)	(24)	(25)	(26)	(27)	(28)	(29)	(30)	(31)	(32)	(33)	(34)	(35)	(36)	(37)	(38)	(39)	(40)
Vegetation		tough root anchoring (-3)	thick (0)	moderate (3)	sparce, barren cultivated (5)	3	3	0	0	0	0	3	0	3	0	0	0	0	0	0	0	0	0	5	0
Slope Angle (degrees) up		< 5 (0)	6 ~ 20 (3)	21 ~ 45 (5)	> 45 (3)	5	5	5	3	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
Slope Angle (degrees) down		< 5 (0)	6 ~ 20 (5)	21 ~ 30 (8)	> 31 (10)	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
Nearby drainage	none (0)	simple (3)	under cutting or rill swarm (5)	gully (8)	active gully (10)	8	8	5	0	3	5	8	5	5	3	3	5	3	3	5	0	5	3	3	5
Slope surface		smooth (0)	un-even (3)	mound scattered (4)	irregular with mid-slope flat (5)	2	2	2	2	2	0	2	2	0	0	0	2	0	0	0	0	2	0	0	2
Surface cover thickness		< 3 m (0)	3 ~ 5 m (3)	5 ~ 10 m (5)	> 10 m (3)	5	3	0	5	5	3	0	3	3	3	3	3	5	3	0	3	3	0	0	3
Surface cover material		massive debris, soil (3)	colluvium, debris with < 1 m block (5)	debris w/ wet mud or 3 m block (8)	loose debris, rock debris (10)	3	3	5	8	5	5	5	5	8	3	3	3	3	3	3	3	3	3	3	5
Bed rock	massive resistant (0)	jointed hard R, massive soft R. (3)	not observed & others (5)	Weatherd R, open-cracked, foliated (8)	crushed, decomposed, argillized (10)	10	10	10	10	10	10	10	10	10	10	5	8	8	8	5	8	10	5	8	8
Orientation of discontinuity	(0) 	nearly flat (3) 	not clear (5) 	5 ° ~ 20 ° (8) 	> 20 ° (10) 	5	5	5	5	5	5	5	0	0	5	5	8	5	5	0	5	5	8	10	5
Cutting + banking height		< 3 m (0)		3 ~ 6 m (3)	> 6 m (5)	3	0	5	0	3	0	5	3	5	0	3	0	0	3	5	0	3	3	5	0
Deformation of structure	none (0)	minor < 3 m (3)	med., deform. 3 ~ 6 m (5)	med. ~ major deform. repaired temporarily (8)	down warp seems active (10)	3	3	0	0	3	3	0	0	0	0	5	3	8	0	0	0	0	3	0	3
Possible wash out/ rock fall		not likely (0)	possible (3)	probable (4)	in danger (5)	0	0	0	0	0	0	0	0	0	0	3	0	5	0	3	0	0	0	0	0
Existing slide, creep failure (w < 6 m)	none (0)	nil erosion (3)	old slide near-by (< 10 years) (5)	new slide within 20 m (8)	zone of major or active slide (10)	5	5	0	0	5	0	5	3	5	0	0	5	3	0	0	0	0	0	5	5
Total Point (Vulnerability Index)						62	57	47	43	56	46	58	46	54	39	45	52	55	40	36	34	46	40	54	51

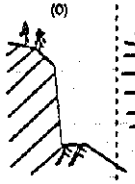
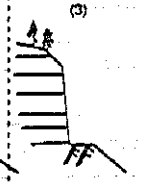
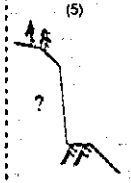
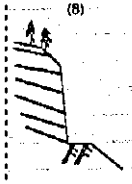
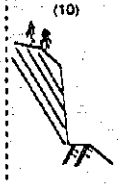
Rating for State of Nature and Hazards Assesment (9/15), Phangyul Canal (3/3)

Phangyul Canal (sheet 3/3)

Attribute	Description/ measurement					(41)	(42)	(43)	(44)	(45)	(46)	(47)	(48)	(49)	(50)	(51)	(52)	(53)	(54)	(55)	(56)	(57)
Vegetation		tough root anchoring (-3)	thick (0)	moderate (3)	sparce, barren cultivated (5)	0	0	3	3	3	3	0	0	0	3	0	0	3	5	3	3	0
Slope Angle (degrees) up		< 5 (0)	6 ~ 20 (3)	21 ~ 45 (5)	> 45 (3)	5	5	5	3	3	5	5	3	3	5	5	3	5	5	5	5	5
Slope Angle (degrees) down		< 5 (0)	6 ~ 20 (5)	21 ~ 30 (8)	> 31 (10)	10	10	10	8	10	10	10	10	10	10	10	10	10	10	10	10	10
Nearby drainage	none (0)	simple  (3)	under cutting or rill swarm  (5)	gully  (8)	active gully  (10)	0	3	0	0	3	3	0	0	0	3	0	3	0	3	0	3	3
Slope surface		smooth (0)	un-even (3)	mound scattered (4)	irregular with mid-slope flat (5)	0	0	0	0	2	0	0	0	0	0	0	0	2	4	0	2	2
Surface cover thickness		< 3 m (0)	3 ~ 5 m (3)	5 ~ 10 m (5)	> 10 m (3)	5	5	5	5	5	5	0	5	3	5	5	3	3	3	5	0	3
Surface cover material		massive debris, soil (3)	colluvium, debris with < 1 m block (5)	debris w/ wet mud or 3 m block (8)	loose debris, rock debris (10)	3	8	3	3	3	3	3	3	3	5	3	3	3	3	5	3	5
Bed rock	massive resistant (0)	jointed hard R. massive soft R. (3)	not observed & others (5)	Weathered R. open-cracked, foliated (8)	crushed, decomposed, argillized (10)	8	8	8	8	8	8	0	8	8	8	8	8	8	8	8	8	8
Orientation of discontinuity	(0) 	nearly flat (3) 	not clear (5) 	-5 ° ~ 20 ° (8) 	> 20 ° (10) 	5	5	5	5	0	0	0	0	0	0	0	0	0	0	0	0	0
Cutting + banking height		< 3 m (0)		3 ~ 6 m (3)	> 6 m (5)	0	0	0	0	0	0	3	0	0	3	5	0	0	0	0	3	0
Deformation of structure	none (0)	minor < 3 m (3)	med., deform. 3 ~ 6 m (5)	med. ~ major deform, repaired temporarily (8)	down warp seems active (10)	0	3	0	0	0	0	3	0	0	5	3	0	3	0	3	3	0
Possible wash out/ rock fall		not likely (0)	possible (3)	probable (4)	in danger (5)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0
Existing slide, creep failure (w < 6 m)	none (0)	nil erosion (3)	old slide near-by (< 10 years) (5)	new slide within 20 m (8)	zone of major or active slide (10)	0	5	0	0	0	0	0	0	0	5	0	0	0	0	8	8	0
Total Point (Vulnerability index)						36	52	39	35	37	37	24	29	27	52	39	30	37	41	47	51	36

Rating for State of Nature and Hazards Assesment (10/15),
Gemkha Canal

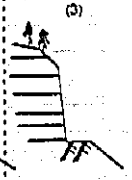
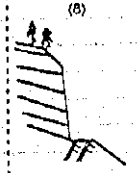
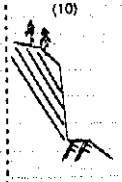
Gemkha Canal

Attribute	Description/ measurement					(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Vegetation		tough root anchoring (-3)	thick (0)	moderate (3)	sparce, barren cultivated (5)	0	0	0	0	0	0	0	0	3	5	5	5
Slope Angle (degrees) up		< 5 (0)	6 ~ 20 (3)	21 ~ 45 (5)	> 45 (3)	5	5	5	5	5	5	5	5	5	5	3	3
Slope Angle (degrees) down		< 5 (0)	6 ~ 20 (5)	21 ~ 30 (8)	> 31 (10)	10	10	10	10	10	8	8	10	10	10	10	5
Nearby drainage	none (0)	simple (3)	under cutting or rill swarm (5)	gully (8)	active gully (10)	0	0	0	5	5	5	5	5	0	5	5	0
Slope surface		smooth (0)	un-even (3)	mound scattered (4)	irregular with mid-slope flat (5)	0	0	0	0	0	0	0	0	0	2	4	0
Surface cover thickness		< 3 m (0)	3 ~ 5 m (3)	5 ~ 10 m (5)	> 10 m (3)	3	5	5	5	5	5	3	5	5	3	5	5
Surface cover material		massive debris, soil (3)	colluvium, debris with < 1 m block (5)	debris w/ wet mud or 3 m block (8)	loose debris, rock debris (10)	5	5	5	5	5	5	8	5	3	5	3	3
Bed rock	massive resistant (0)	jointed hard R. massive soft R. (3)	not observed & others (5)	Weatherd R. open-cracked, foliated (8)	crushed, decomposed, argilized (10)	5	8	5	8	8	8	8	0	8	8	8	8
Orientation of discontinuity	(0) 	nearly flat (3) 	not clear (5) 	5° ~ 20° (8) 	> 20° (10) 	10	0	0	0	0	5	5	3	0	0	0	5
Cutting + banking height		< 3 m (0)		3 ~ 6 m (3)	> 6 m (5)	0	3	3	3	3	3	0	3	0	3	3	3
Deformation of structure	none (0)	minor < 3 m (3)	med., deform, 3 ~ 6 m (5)	med. ~ major deform, repaired temporarily (8)	down warp seems active (10)	3	3	5	3	3	5	5	3	0	3	3	0
Possible wash out/ rock fall		not likely (0)	possible (3)	probable (4)	in danger (5)	0	0	0	0	0	0	0	3	0	0	0	0
Existing slide, creep failure (w < 6 m)	none (0)	nil erosion (3)	old slide near-by (< 10 years) (5)	new slide within 20 m (8)	zone of major or active slide (10)	0	0	0	5	5	10	0	0	0	0	0	0
Total Point (Vulnerability Index)						41	39	38	49	49	59	47	42	34	49	49	37

(5) - 10

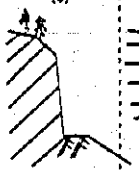
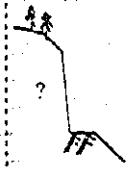
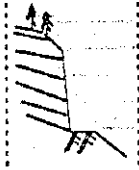
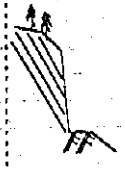
Rating for State of Nature and Hazards Assesment (11/15), Nalakha Canal

Nalakha Canal

Attribute	Description/ measurement					(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
Vegetation		tough root anchoring (-3) *	thick (0)	moderate (3)	sparce, barren cultivated (5)	0	0	0	5	5	0	5	3	3	5	3	3	5	5
Slope Angle (degrees) up		< 5 (0)	6 ~ 20 (3)	21 ~ 45 (5)	> 45 (3)	5	5	5	5	5	5	5	5	5	5	5	5	3	5
Slope Angle (degrees) down		< 5 (0)	6 ~ 20 (5)	21 ~ 30 (8)	> 31 (10)	10	10	10	10	10	10	10	10	10	8	10	10	8	8
Nearby drainage	none (0)	simple (3)	under cutting or rill swarm (5)	gully (8)	active gully (10)	0	0	0	0	0	5	0	5	5	5	0	0	8	0
Slope surface		smooth (0)	un-even (3)	mound scattered (4)	irregular with mid-slope flat (5)	2	2	0	0	0	0	2	0	2	2	4	2	2	0
Surface cover thickness		< 3 m (0)	3 ~ 5 m (3)	5 ~ 10 m (5)	> 10 m (3)	5	5	5	5	5	3	5	3	3	5	5	0	3	3
Surface cover material		massive debris, soil (3)	colluvium, debris with < 1 m block (5)	debris w/ wet mud or 3 m block (8)	loose debris, rock debris (10)	5	8	5	5	5	8	8	5	3	3	3	3	5	3
Bed rock	massive resistant (0)	jointed hard R, massive soft R. (3)	not observed & others (5)	Weatherd R, open-cracked, foliated (8)	crushed, decomposed, argillized (10)	8	10	8	8	8	5	8	8	10	8	8	5	8	8
Orientation of discontinuity	(0) 	nearly flat (3) 	not clear (5) 	5° ~ 20° (8) 	> 20 ° (10) 	0	5	0	0	0	0	0	5	5	0	5	5	5	5
Cutting + banking height		< 3 m (0)		3 ~ 6 m (3)	> 6 m (5)	3	3	3	3	3	3	5	3	3	5	5	5	0	0
Deformation of structure	none (0)	minor < 3 m (3)	med., deform. 3 ~ 6 m (5)	med. ~ major deform. repaired temporaniy (8)	down warp seems active (10)	10	5	5	0	0	0	5	0	0	0	0	0	0	0
Possible wash out/ rock fall		not likely (0)	possible (3)	probable (4)	in danger (5)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Existing slide, creep failure (w < 6 m)	none (0)	nil erosion (3)	old slide near-by (< 10 years) (5)	new slide within 20 m (8)	zone of major or active slide (10)	8	8	3	3	0	0	8	0	0	0	10	10	0	0
Total Point (Vulnerability Index)						56	61	44	44	41	39	61	47	49	46	58	48	47	37

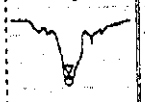
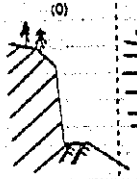
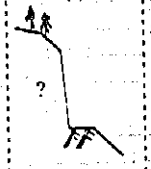
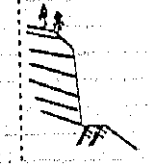
Rating for State of Nature and Hazards Assesment (12/15), Rutekha Canal

Rutekha Canal

Attribute	Description/ measurement					(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
Vegetation		tough root anchoring (-3)	thick (0)	moderate (3)	sparce, barren cultivated (5)	3	0	0	5	5	0	0	5	0	3	3	5	5
Slope Angle (degrees) up		< 5 (0)	6 ~ 20 (3)	21 ~ 45 (5)	> 45 (3)	3	5	3	3	5	5	3	5	5	5	5	5	3
Slope Angle (degrees) down		< 5 (0)	6 ~ 20 (5)	21 ~ 30 (8)	> 31 (10)	8	5	8	5	5	10	5	8	8	8	10	5	5
Nearby drainage	none (0)	simple  (3)	under cutting or nil swarm  (5)	gully  (8)	active gully  (10)	3	3	5	5	5	5	3	0	3	5	3	3	5
Slope surface		smooth (0)	un-even (3)	mound scattered (4)	irregular with mid-slope flat (5)	0	2	0	2	2	0	2	0	0	2	0	4	2
Surface cover thickness		< 3 m (0)	3 ~ 5 m (3)	5 ~ 10 m (5)	> 10 m (3)	5	3	5	5	5	5	5	3	3	3	5	5	5
Surface cover material		massive debris, soil (3)	colluvium, debris with < 1 m block (5)	debris w/ wet mud or 3 m block (8)	loose debris, rock debris (10)	5	3	5	3	8	5	8	3	3	3	3	3	3
Bed rock	massive resistant (0)	jointed hard R. massive soft R. (3)	not observed & others (5)	Weathered R. open-cracked, foliated (8)	crushed, decomposed, argillized (10)	8	8	8	8	8	8	8	8	8	8	8	10	8
Orientation of discontinuity	(0) 	nearly flat (3) 	not clear (5) 	5 ° ~ 20 ° (8) 	> 20 ° (10) 	0	0	0	0	0	0	0	0	0	0	0	0	0
Cutting + banking height		< 3 m (0)		3 ~ 6 m (3)	> 6 m (5)	3	0	0	0	0	0	0	3	0	0	0	5	0
Deformation of structure	none (0)	minor < 3 m (3)	med., deform. 3 ~ 6 m (5)	med. ~ major deform, repaired temporarily (8)	down warp seems active (10)	0	0	0	0	3	0	0	0	0	0	0	0	0
Possible wash out/ rock fall		not likely (0)	possible (3)	probable (4)	in danger (5)	0	0	0	0	0	0	0	0	0	0	0	0	0
Existing slide, creep failure (w < 6 m)	none (0)	nil erosion (3)	old slide near-by (< 10 years) (5)	new slide within 20 m (8)	zone of major or active slide (10)	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Point (Vulnerability Index)						38	29	34	36	46	38	34	35	30	37	37	45	36

Rating for State of Nature and Hazards Assesment (13/15), Maphekha Canal

Maphekha Canal

Attribute	Description/ measurement					(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Vegetation		tough root anchoring (-3)	thick (0)	moderate (3)	sparce, barren cultivated (5)	0	0	3	5	0	0	0	0	0	3
Slope Angle (degrees) up		< 5 (0)	6 ~ 20 (3)	21 ~ 45 (5)	> 45 (3)	5	5	3	3	5	5	5	3	5	5
Slope Angle (degrees) down		< 5 (0)	6 ~ 20 (5)	21 ~ 30 (8)	> 31 (10)	8	5	5	5	10	8	10	8	10	10
Nearby drainage	none (0)	simple  (3)	under cutting or rill swarm  (5)	gully  (8)	active gully  (10)	3	3	3	3	0	0	0	0	3	3
Slope surface		smooth (0)	un-even (3)	mound scattered (4)	irregular with mid-slope flat (5)	0	0	0	0	0	2	4	0	4	0
Surface cover thickness		< 3 m (0)	3 ~ 5 m (3)	5 ~ 10 m (5)	> 10 m (3)	3	5	5	3	5	5	5	5	5	5
Surface cover material		massive debris, soil (3)	colluvium, debris with < 1 m block (5)	debris w/ wet mud or 3 m block (8)	loose debris, rock debris (10)	8	8	8	8	5	8	5	5	3	3
Bed rock	massive resistant (0)	jointed hard R. massive soft R. (3)	not observed & others (5)	Weathered R. open-cracked, foliated (8)	crushed, decomposed, argillized (10)	8	8	8	8	8	8	8	8	8	8
Orientation of discontinuity	(0) 	nearly flat (3) 	not clear (5) 	5° ~ 20° (8) 	> 20° (10) 	0	5	5	0	0	0	0	0	0	0
Cutting + banking height		< 3 m (0)		3 ~ 6 m (3)	> 6 m (5)	0	0	0	0	0	0	0	0	0	0
Deformation of structure	none (0)	minor < 3 m (3)	med., deform. 3 ~ 6 m (5)	med. ~ major deform. repaired temporarily (8)	down warp seems active (10)	0	0	0	0	0	3	3	0	3	0
Possible wash out/ rock fall		not likely (0)	possible (3)	probable (4)	in danger (5)	0	0	0	0	0	0	0	0	0	0
Existing slide, creep failure (w < 6 m)	none (0)	nil erosion (3)	old slide near-by (< 10 years) (5)	new slide within 20 m (8)	zone of major or active slide (10)	0	0	0	0	0	8	0	0	0	0
Total Point (Vulnerability Index)						35	39	40	35	33	47	40	29	41	37

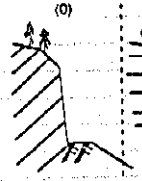
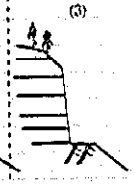
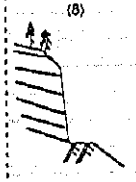
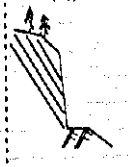
Rating for State of Nature and Hazards assesment (14/15),
Naykoyuwa Canal

Naykoyuwa Canal

Attribute	Description/ measurement					(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Vegetation		tough root anchoring (-3)	thick (0)	moderate (3)	sparce, barren cultivated (5)	-3	-3	0	0	0	0	5	3
Slope Angle (degrees) up		< 5 (0)	6 - 20 (3)	21 - 45 (5)	> 45 (3)	5	3	5	5	5	5	3	3
Slope Angle (degrees) down		< 5 (0)	6 - 20 (5)	21 - 30 (8)	> 31 (10)	10	5	8	8	5	8	5	5
Nearby drainage	none (0)	simple (3)	under cutting or nil swamm (5)	gully (8)	active gully (10)	0	3	3	5	0	0	3	0
Slope surface		smooth (0)	un-even (3)	mound scattered (4)	irregular with mid-slope flat (5)	0	0	0	0	0	0	0	0
Surface cover thickness		< 3 m (0)	3 - 5 m (3)	5 - 10 m (5)	> 10 m (3)	3	3	0	3	3	3	5	3
Surface cover material		massive debris, soil (3)	colluvium, debris with < 1 m block (5)	debris w/ wet mud or 3 m block (8)	loose debris, rock debris (10)	5	5	5	5	5	5	5	5
Bed rock	massive resistant (0)	jointed hard R, massive soft R. (3)	not observed & others (5)	Weatherd R, open-cracked, foliated (8)	crushed, decomposed, argilized (10)	5	5	0	5	8	5	8	8
Orientation of discontinuity	(0)	nearly flat (3)	not clear (5)	5° - 20° (8)	> 20° (10)	5	5	0	5	5	5	5	5
Cutting + banking height		< 3 m (0)		3 - 6 m (3)	> 6 m (5)	0	0	3	0	0	0	0	0
Deformation of structure	none (0)	minor < 3 m (3)	med., deform. 3 - 6 m (5)	med. = major deform, repaired temporarily (8)	down warp seems active (10)	0	0	0	3	0	0	0	0
Possible wash out/ rock fall		not likely (0)	possible (3)	probable (4)	in danger (5)	0	0	0	0	0	0	0	0
Existing slide, creep failure (w < 6 m)	none (0)	nil erosion (3)	old slide near-by (< 10 years) (5)	new slide within 20 m (8)	zone of major or active slide (10)	0	0	0	0	0	0	0	0
Total Point (Vulnerability Index)						30	26	24	39	31	31	39	32

Rating for State of Nature and Hazards Assesment (15/15), Rumina Canal

Rumina Canal

Attribute	Description/ measurement					(1)	(2)	(3)	(4)	(5)	(6)	(7)
Vegetation		tough root anchoring (-3)	thick (0)	moderate (3)	sparce, barren cultivated (5)	5	5	5	3	5	3	3
Slope Angle (degrees) up		< 5 (0)	6 - 20 (3)	21 - 45 (5)	> 45 (3)	3	3	5	3	3	3	5
Slope Angle (degrees) down		< 5 (0)	6 - 20 (5)	21 - 30 (8)	> 31 (10)	5	5	8	5	8	5	8
Nearby drainage	none (0)	simple (3)	under cutting or rill swarm (5)	gully (8)	active gully (10)	0	0	0	0	0	0	5
Slope surface		smooth (0)	un-even (3)	mound, scattered (4)	irregular with mid-slope flat (5)	0	0	0	0	3	0	0
Surface cover thickness		< 3 m (0)	3 - 5 m (3)	5 - 10 m (5)	> 10 m (3)	3	3	3	3	3	5	5
Surface cover material		massive debris, soil (3)	colluvium, debris with < 1 m block (5)	debris w/ wet mud or 3 m block (8)	loose debris, rock debris (10)	5	5	5	5	5	5	5
Bed rock	massive resistant (0)	jointed hard R, massive soft R. (3)	not observed & others (5)	Weathered R, open-cracked, foliated (8)	crushed, decomposed, argillized (10)	8	8	8	8	8	8	8
Orientation of discontinuity	(0) 	nearly flat (3) 	not clear (5) 	5° - 20° (8) 	> 20° (10) 	5	5	5	5	5	5	5
Cutting = banking height		< 3 m (0)		3 - 6 m (3)	> 6 m (5)	0	0	0	0	0	0	0
Deformation of structure	none (0)	minor < 3 m (3)	med., deform. 3 - 6 m (5)	med. ~ major deform, repaired temporarily (8)	down warp seems active (10)	0	0	0	0	0	0	0
Possible wash out/ rock fall		not likely (0)	possible (3)	probable (4)	in danger (5)	0	0	0	0	0	0	0
Existing slide, creep failure (w < 6 m)	none (0)	rill erosion (3)	old slide near-by (< 10 years) (5)	new slide within 20 m (8)	zone of major or active slide (10)	3	0	0	0	3	3	3
Total Point (Vulnerability Index)						37	34	39	32	43	37	47

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IV. MONITORING DATA

IV. MONITORING DATA

1. Monitoring Guideline for the Experimental Facilities

2. Monitoring of the Experimental Facilities

(1) Monitoring Data of Groundwater Scheme

(2) Monitoring Data of Spring Water Scheme

(3) Monitoring Data of River Water Scheme
- 1) Civil and Operation Monitoring Data
  - Pump Operation Schedule
  - Civil and Operation Monitoring Data
- 2) Analysis of Operation Monitoring Data
- 3) Specification of Pump Unit
- 4) Design Dimension and O/M

1. Monitoring Guideline for the Experimental Facilities

JAPAN INTERNATIONAL COOPERATION AGENCY
ROYAL GOVERNMENT OF BHUTAN

THE STUDY ON GROUNDWATER DEVELOPMENT IN WANGDUEPHODRANG DISTRICT

MONITORING GUIDELINE FOR THE EXPERIMENTAL FACILITIES

MARCH 1995

PACIFIC CONSULTANTS INTERNATIONAL
CHUO KAIHATSU CORPORATION

THE STUDY ON GROUNDWATER DEVELOPMENT
IN
WANGDUEPHODRANG DISTRICT OF BHUTAN

MONITORING GUIDELINE
FOR
THE EXPERIMENTAL FACILITIES

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D.2 Instructions of Daily River Water Level at the Chang Chhu	11
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D.5 Instructions of Upper Pump Operation	15
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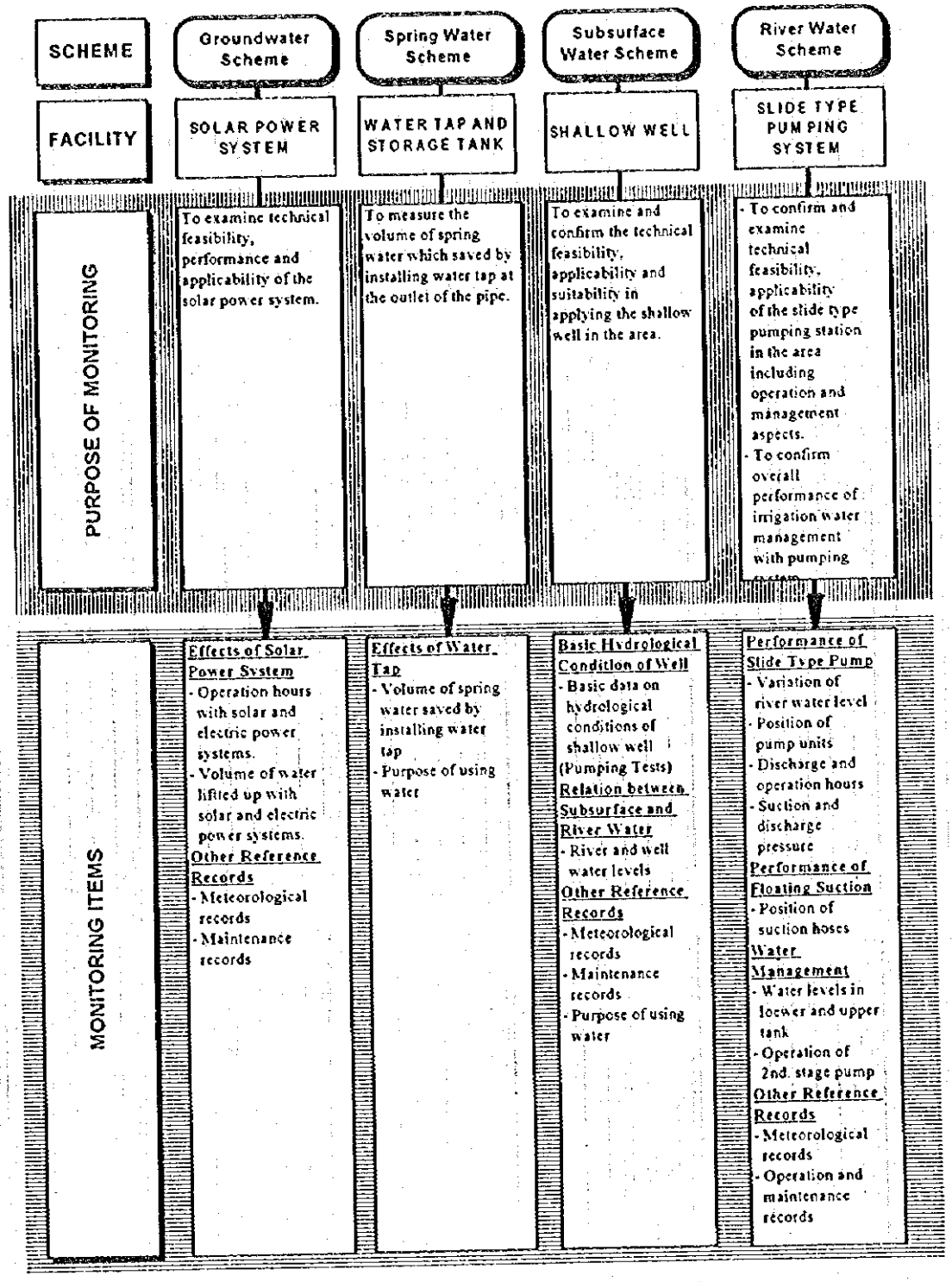
GENERAL INSTRUCTIONS

This Guideline was prepared to show how to operate the monitoring operation for experimental facilities and the monitoring purpose and items are summarized as shown below;



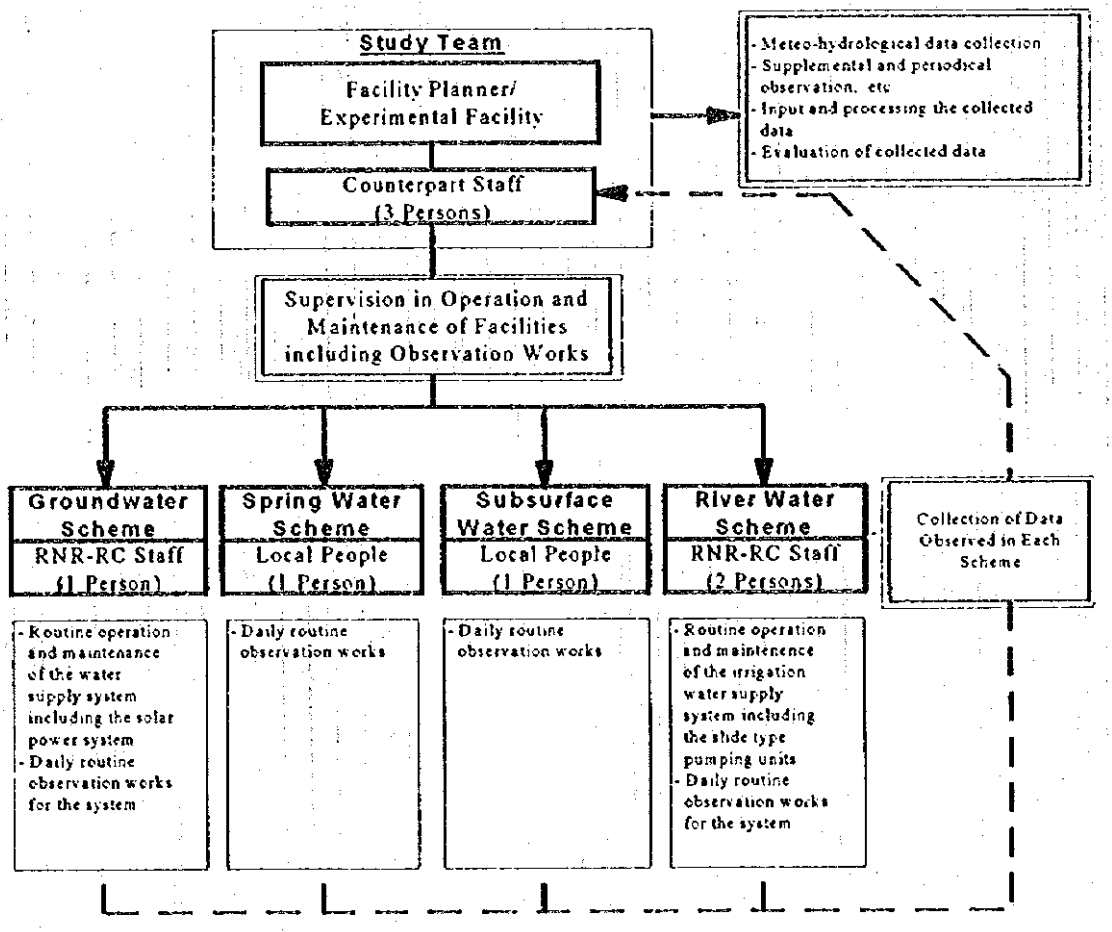
Monitoring Purposes and Items

Since the solar powered pumping facility and the slide type pumping station are located in the farm yard of RNR-RC in Bajo, the operation of such facility will be conducted by the staff of the RNR-RC in Bajo. Therefore, the routine and periodical observation works are recommended to be conducted by such RNR-RC in Bajo. However, it is considered necessary to perform inspection by qualified engineers to technician during the operation period in order to ensure the proper operation.

As for the spring water storage facility in the Phangyul area and the shallow well pumping facility in the Bajo area, since the facilities constructed in these areas are not complicated but simple, it is considered possible to operate facility with a certain skill as well as to monitor their performance. The routine monitoring works of these facilities will be conducted by local peoples to utilise these facilities.

The meteorological records required for monitoring will be collected by the counterpart staff in RNR-RC office, and compiled by them. In order to ensure the observation works of the experimental facilities, the observation works will be carried out by RNR-RC staffs and local people at each site of experimental facility under the management and control of the project's counterpart staff. The observation data will be recorded in the monitoring record books of each experimental facility whenever such monitoring works are done.

The formation of the above monitoring system is illustrated as shown below;



Monitoring Formation

Three (3) counterpart staff of the project will be assigned and they will be in charge of overall controlling and managing such necessary monitoring works to be conducted by the RNR-RC staff and local people. Technology transfer to such project counterpart staff was carried out through on-the-job training in the course of the construction of the experimental facilities.

The required number of the staff and local people to be assigned for executing monitoring works of each experimental facility is tabulated below.

Experimental Facility	RNR-RC staff	Local People
Solar Powered Pumping Facility	1	-
Spring Water Storage Facility	-	1
Shallow Well Pumping Facility	-	1
River Pumping Station	2	-
Total	3	2

It is should be noted that it is indispensable to assign the RNR-RC staff and local people in order to proceed with such necessary monitoring works successfully.

The monitoring format sheets were prepared for each monitoring operation. Those format sheets are summarized below;

Monitoring Format Sheet A : Groundwater Scheme
Monitoring Format Sheet B-1 : Spring Water Scheme (1) Daily Format
Monitoring Format Sheet B-2 : Spring Water Scheme (2) for 1 Week Interval
Monitoring Format Sheet C-1 : Subsurface Water Scheme (1) Daily Water Level
Monitoring Format Sheet C-2 : Subsurface Water Scheme (2) Pumping Test
Monitoring Format Sheet C-3 : Subsurface Water Scheme (3) Step Drawdown Test
Monitoring Format Sheet D-1 : River Water Scheme (1) Daily River Water Level
Monitoring Format Sheet D-2 : River Water Scheme - Lower Pumping Station (1)
Monitoring Format Sheet D-3 : River Water Scheme - Lower Pumping Station (2)
Monitoring Format Sheet D-4 : River Water Scheme - Upper Pumping Station

A. GROUNDWATER SCHEME

A.1 Monitoring Item

The monitoring item for the groundwater scheme is shown in the monitoring format sheet A and summarized as shown below;

- Daily Monitoring
  - a) Climate
  - b) Power System Switching Box
  - c) Pumping Operation

- Pump Maintenance
  - e)-1 Cleaning the surface of solar panel (weekly)
  - e)-2 Retightening of bolt and nut (weekly)
  - e)-3 Check wiring, bolt and nut

Every pumping operation and maintenance should be done by staff of RNR-RC, therefore, necessary description for monitoring item should be described by the same staff according to the monitoring format sheet.

A.2 Instruction of Daily Monitoring → Monitoring Format Sheet A

a) Climate

a)-1 Weather

Whether should be described as Fine, Cloudy, Rainy or Snow at the start of 1st pumping operation.

a)-2 Temperature

Mean daily temperature should be described according to the observation data of the meteorological station at RNR-RC every day.

a)-3 Sun shine hrs

Daily sun shine hrs should be described according to the observation data of the meteorological station at RNR-RC every day.

b) Power system switching box

Electric switching box should be checked as for solar power system or public line power system at the start of every pumping operation. The description should be done as shown below;

(1.) Solar 2. Public in case of using the solar power system
1. Solar (2.) Public in case of using the public line power system

c) Pumping operation

c)-1 Operation start time

The start time and minutes of pumping operation should be described at the start of every pumping operation.

c)-2 Cumulative flow mater

The value of cumulative flow mater should be described at the start of every pumping operation, based on the indicator of cumulative flow mater which was installed at outlet pipe from the water tank.

c)-3 Operation end time

The end time and minutes of pumping operation should be described at the end of every pumping operation.

c)-4 Cumulative flow mater

The value of cumulative flow mater should be described at the end of every pumping operation, based on the indicator of cumulative flow mater which was installed at outlet pipe from the water tank.

d) Remark

The special topic should be described if any.

A.3 Instruction of Maintenance

e)-1 Cleaning of solar panel

Condition of the surface of the solar panel should be confirmed by visual inspection and any kind of stains should be cleaned up in every week.

e)-2 Ratightening of bolt and nut

The distortion of the solar panel support should be checked by visual inspection weekly and the retightening of bolt and nut should be required if necessary.

e)-3 Check of the wiring, bolt and nut

The condition of the wiring, bolt and nut should be checked monthly and necessary countermeasure must be done if necessary

B. SPRING WATER SCHEME

B.1 Monitoring Item

The monitoring item for the spring water scheme is shown in "MONITORING FORMAT SHEET B-1" and in "MONITORING FORMAT SHEET B-2", and summarized below:

- Daily Monitoring
  a) Climate
  b) Water Level in the Water Storage Tank

- Spring Water Discharge and Volume Stored in the Tank (Every week)

- The daily monitoring on climate and water level in the water storage tank should be conducted by the village people at the same time everyday, while the spring water discharge and the volume of water stored in the water storage tank should be measured by the counterpart staff once a week periodically.

B.2 Instructions of Daily Monitoring → Monitoring Format Sheet B-1

a) Date

The observation should be conducted by the village people at a same time everyday.

b) Time

The time of measuring should be noted whenever the observation is conducted.

c) Climate

The weather should be noted as "Fine", "Cloudy", "Rainy" or "Snow" when the observation is made.

d) Water Level

The water level of the spring water stored in the water storage tank should be measured everyday. A transparent vinyl hose is set vertically on the tank wall and a steel gauge plate is fixed beside the hose on the wall. The water height in the transparent hose shows the water level in the tank. The villager who is assigned for reading the gauge everyday can read the gauge at the height of water in the hose. The gauge reading should be made to meter order with two (2) decimal points.

B.3 Instructions of Periodical Monitoring → Monitoring Format Sheet B-2

a) Date

The date of the observation should be noted.

b) Time

The time of the observation should be noted when the valve operation is started.

c) Climate

The weather should be noted as "Fine", "Cloudy", "Rainy" or "Snow" when the observation is made.

d) Spring Water Discharge

d)-1 Volume Filled in a Minute

The spring water discharge is measured in the following manner.

- The measurement is conducted with a stopwatch and a bucket.
- The volume of spring water filled within a minute is measured for three (3) times, and the average of these three (3) measured values is taken as a spring discharge.

d)-2 Discharge

The average value obtained in the above manner should be noted.

e) Valve Operation

In order to measure the volume of spring water stored in the water storage tank, the water levels and the readings of commutative flow meter should be observed before and after the valve operation to release the stored water once a week

e)-1 Water Level

The water level of the water in the tank should be read before and after the valve operation. The water height in the transparent vinyl hose on the tank wall is read on the steel gauge plate beside the hose. The height should be read in meter order with two (2) decimal points.

e)-2 Commutative Flow Meter

The commutative flow meter which is installed at the outlet of the storage tank should be read and its readings should be noted before and after the valve operation.

C. SUBSURFACE WATER SCHEME

C.1 Monitoring Item

The monitoring item for the subsurface water scheme is shown in "MONITORING FORMAT SHEET C-1", "MONITORING FORMAT SHEET C-2" and "MONITORING FORMAT SHEET C-3", and summarized below:

- Daily Monitoring
  Water Levels in the Chang Chhu and the Shallow Well
- Pumping Test
- Step Drawdown Test

C.2 Instructions of Daily Monitoring → Monitoring Format Sheet C-1

To grasp the relationship water levels in the Chang Chhu and the shallow well and the seasonal variation of water level in the shallow well, it is necessary to observe such water levels daily. As shown in "MONITORING FORMAT SHEET C-1", the water levels are read as gauge height of the staff gauges installed in the river and the shallow well to a meter order with two decimal points. The time of the observation is also required to be noted.

C.3 Instructions of Pumping Test → Monitoring Format Sheet C-2

a) Water Level at Chang Chhu

The water level of the Chang Chhu should be read on the staff gauge installed in the river before starting the pumping test.

b) Water Level at Well

The water level of the shallow well should be read on the staff gauge installed in the well before starting the pumping test.

c) Commutative Flow Meter

The readings of the commutative flow meter should be noted when the pumping test is started and ended to know the discharge of the pump.

d) Temperature

The water and air temperatures should be measured and noted when the pumping test is started.

e) Continuous Pumping Test

The pumping test consists of the continuous pumping test and the recovery water level test. The former is conducted first to observe the drawdown of the well water level; and the latter is then made to observe the recovery of the well water level.

e)-1 Pumping up Level

As soon as the pumping up test is commenced, the drawdown of the water level starts, and such water level should be observed with time durations mentioned in the time column beside the pump up level column. Careful attention should be paid at the initial stage of the test, because time pitch of the observation is shorter in the initial stage. The observation should be continued for 12 hr (720 min) as stated in the monitoring format.

e)-2 Drawdown

The drawdown is considered as the difference in height from the initial well water level. It should be calculated deducting the present well water level from the initial level.

f) Recovery Water Level Test

The recovery water level test should be conducted to observe the recovery of the well water level after the continuous pumping test.

f)-1 Recovery Level

Immediately after completing the continuous pumping test, the recovery water level test should be commenced, and the well water level rising should be observed. The well water level should be read on the staff gauge at the time after the continuous pumping test as specified in the time column beside the recovery level column. Careful attention should be paid because the velocity of rising water level is expected to be fast at the initial stage of the test. This observation should be continued for 12 hr (720 min) as shown in monitoring format.

f)-2 Fluctuation Level

The fluctuation level of well water is considered as the difference of water level from the previous observation. It should be calculated deducting the previous water level from that of the present observation.

f)-3 Drawup

The drawup is considered as the difference in height from the water level observed at initial time of the test. It should be calculated deducting the initial water level from that of the present.

C.4 Instructions of Step Drawdown Test → Monitoring Format Sheet C-3

The step drawdown test should be conducted to observe the variation of well water level of the various different discharges.

a) Water Level at Chang Chhu

The water level at Chang Chhu should be noted when the step drawdown test is conducted.

b) Water Level at Well

The water level at well should be noted when the step drawdown test is conducted.

c) Commutative Flow Meter at Start

When starting the step drawdown test, the commutative flow meter should be read, and the pump discharge at starting time should be confirmed.

d) 1st. Step

d)-1 Commutative Discharge

The commutative discharge of pump should be read when the 1st. step of test is commenced.

d)-2 Water Temperature

The water temperature should be measured when the 1st step of test is commenced.

d)-3 Dynamic Water Level

As soon as the 1st. step of pumping up is commenced, the drawdown starts, and the water level should be observed with time durations mentioned in the time column beside the pump up level column. Careful attention should be paid especially at the initial stage of the step, because time pitch of the observation is shorter in the initial stage. The observation should be continued for 3 hr (180 min) as stated in the monitoring format.

d)-4 Drawdown

The drawdown is considered as the difference in height from the initial well water level. It should be calculated deducting the present well water level from the initial level.

The procedures from item d)-1 to d)-4 should be conducted for the further steps of the test. The step drawdown test should be conducted with five (5) steps of pumping up at all.

D. RIVER WATER SCHEME

D.1 Monitoring Item

The monitoring item for river water scheme is shown in the monitoring format sheets D-1 ~ D-4 and summarized as shown below;

- Daily river water level at the Chang Chhu (FORMAT SHEET D-1)
  - Time, Climate and water level

- Lower pump operation (FORMAT SHEET D-2 and D-3)
  a) River water level and water temperature at the Chang Chhu
  b) Water level at the lower tank
  c) Necessary parameter of the lower pump
  d) Any special topic

- The lower pump maintenance (FORMAT SHEET D-2)
  - Monthly, 6 monthly, annual, 2 years

- Upper pump operation (FORMAT SHEET D-4)
  a) Water level and water temperature at the lower tank
  b) Water level at the upper tank
  c) Necessary parameter of the upper pump
  d) Any special topic

- The upper pump maintenance (FORMAT SHEET D-4)
  - Monthly, 6 monthly, annual, 2 years

Every pumping operation and maintenance should be done by staff of RNR-RC, therefore, necessary description for monitoring item should be described by the same staff according to the monitoring format sheet.

D.2 Instructions of Daily River Water Level at the Chang Chhu

→ Monitoring Format Sheet D-1

It may not be always to operate the pump system due to seasonal cropping pattern and daily rainfall. Even if pump is not operated, it is necessary to measure the river water level at the Chang Chhu for the purpose of clarifying the river condition at the site. Following items should be monitored daily according to the monitoring format sheet D-1.

- Time

  The river water level should be measured at around 8 ~ 9 o'clock in the every morning and time and minutes should be described.

- Climate

  Climate should be described as Fine, Cloudy, Rainy or Snow at the same time as mentioned above.

  River water level at the Chang Chhu

The reading of gauge height should be described as for the river water level at the Chang Chhu

D.3 Instructions of Lower Pump Operation → Monitoring Format Sheet D-2, Monitoring Format Sheet D-3

2 set of pump were installed as shown in the format sheet D-3 and 2 type of pumping operation such as single pump or double pump operation are expected.

a) Monitoring item for the Chang Chhu

a)-1 River water level at the Chang Chhu

The river water level at the Chang Chhu should be described at the start time of every pumping operation based on the gauge height in the river.

a)-2 River water temperature

The river water temperature at the start time of every pumping operation should be measured using the thermometer more than 5 minutes and described.

b) Water level at the lower tank

b)-1 Water level at the start time

The water level of the lower tank should be measured when pumping operation is started, based on the staff gauge which is installed at the lower tank.

b)-2 Water level at the end time

The water level of the lower tank should be measured when pumping operation is finished, based on the staff gauge which is installed at the lower tank.

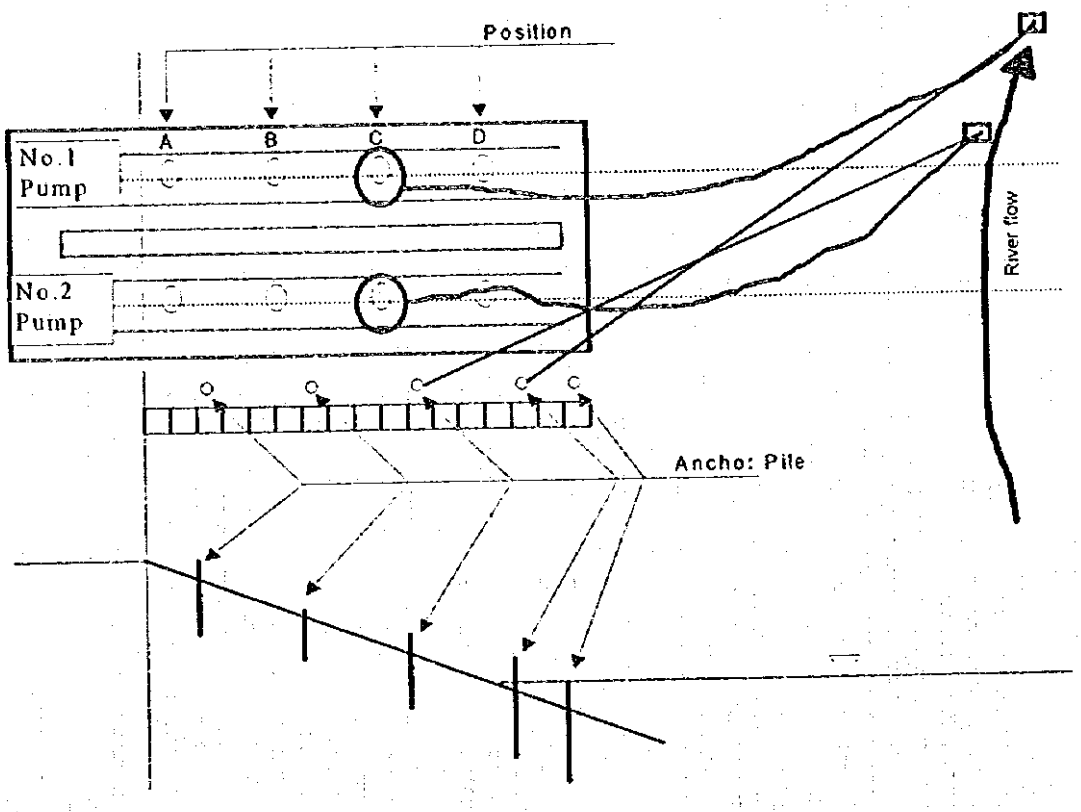
c) The lower pumping operation

c)-1 Position

The position of pump should be described according to the indicator of "A" ~ "D" as shown in the format sheet D-3 for both pump. In case of single use, the blank of "-" should be described for the position for No.1 or No. 2 pump.

The following items should be sketched in the format sheet D-3 as shown below;

- Position and direction of stream line of river flow
- Position of suction hose with number of suction hose connected
- Position of pumping unit
- The anchor and wire
- Special topic if any



c)-2 Operation start time

The start time and minutes of pumping operation should be described at the start of every pumping operation.

c)-3 Cumulative flow mater at start

The value of cumulative flow mater should be described at the start of every pumping operation, based on the indicator of cumulative flow mater which was installed at outlet pipe from the pump.

c)-4 Suction pressure

The suction pressure should be measured after 10 minutes running from the switched on, based on the indicator at the pump.

c)-5 Delivery pressure

The delivery pressure should be measured after 10 minutes running from the switched on, based on the indicator at the pump.

c)-6 Ampere

The ampere should be measured after 10 minutes running from the switched on, based on the ampere mater of the control panel.

c)-7 Voltage

The Voltage should be measured after 10 minutes running from the switched on, based on the voltage mater of the control panel.

c)-8 Bearing temperature

The temperature of bearing should be measured using the thermometer when pumping operation is finished.

c)-9 Stuffing box temperature

The temperature of stuffing box should be measured using the thermometer when pumping operation is finished.

c)-10 Operation end time

The end time and minutes of pumping operation should be described at the end of every pumping operation.

c)-11 Cumulative flow mater

The value of cumulative flow mater should be described at the end of every pumping operation, based on the indicator of cumulative flow mater which was installed at outlet pipe from the pump.

d) Remark

The special topic should be described if any.

D.4 Instructions of Lower Pump Maintenance → Monitoring Format Sheet D-2

The following items should be maintenance periodically

- Monthly maintenance
  - Adjustment of leakage from joints.
  - Examination and exchange of oil
  - Check of shaft temperature

- 6 monthly maintenance
  - Check and adjustment of shaft center
  - Check of vibration and noise

- Annual maintenance
  - Check of shaft sleeve and exchange of grand packing
  - Check and exchange of mechanical-seals
  - Exchange of oil for bearing shaft

- 2 Years maintenance
  - Overhaul and exchange O-ring, Gasket, V-ring and others

- Check of wearing at revolving part
- Check of inside casing
- Adjustment of all the others parts

D.5 Instructions of Upper Pump Operation → MonitoringFormat Sheet D-4

Although the upper pump has not been installed yet, After the installation the following items should monitored.

a) Monitoring item for the lower tank

a)-1 Water level at start

The water level at the lower tank should be measured at the start time of every upper pumping operation based on the gauge height in the tank.

a)-2 Water level at end

The water level at the lower tank should be measured at the end time of every upper pumping operation based on the gauge height in the tank.

a)-3 Water temperature

The water temperature at the start time of every upper pumping operation should be measured using the thermometer more than 5 minutes and described.

b) Water level at the upper tank

b)-1 Water level at the start time

The water level of the upper tank should be measured when upper pumping operation is started, based on the staff gauge which is installed at the upper tank.

b)-2 Water level at the end time

The water level of the upper tank should be measured when upper pumping operation is finished, based on the staff gauge which is installed at the upper tank.

c) The upper pumping operation

c)-1 Operation start time

The start time and minutes of pumping operation should be described at the start of every pumping operation.

c)-2 Operation end time

The end time and minutes of pumping operation should be described at the end of every pumping operation.

c)-3 Bearing temperature

The temperature of bearing should be measured using the thermometer when upper pumping operation is finished.

c)-4 Stuffing box temperature

The temperature of stuffing box should be measured using the thermometer when upper pumping operation is finished.

d) Remark

The special topic should be described if any.

D.6 Instructions of Upper Pump Maintenance

The following items should be maintenance periodically

- Monthly maintenance
  - Adjustment of leakage from joints.
  - Examination and exchange of oil
  - Check of shaft temperature
- 6 monthly maintenance
  - Check and adjustment of shaft center
  - Check of vibration and noise
- Annual maintenance
  - Check of shaft sleeve and exchange of grand packing
  - Check and exchange of mechanical-seals
  - Exchange of oil for bearing shaft
- 2 Years maintenance
  - Overhaul and exchange O-ring, Gasket, V-ring and others
  - Check of wearing at revolving part
  - Check of inside casing
  - Adjustment of all the others parts

MONITORING FORMATS FOR EXPERIMENTAL FACILITIES

1. Monitoring Format Sheet A : Groundwater Scheme
2. Monitoring Format Sheet B-1 : Spring Water Scheme (1) Daily Format
3. Monitoring Format Sheet B-2 : Spring Water Scheme (2) for 1 Week Interval
4. Monitoring Format Sheet C-1 : Subsurface Water Scheme (1) Daily Water Level
5. Monitoring Format Sheet C-2 : Subsurface Water Scheme (2) Pumping Test
6. Monitoring Format Sheet C-3 : Subsurface Water Scheme (3) Step Drawdown Test
7. Monitoring Format Sheet D-1 : River Water Scheme (1) Daily River Water Level
8. Monitoring Format Sheet D-2 : River Water Scheme - Lower Pumping Station (1)
9. Monitoring Format Sheet D-3 : River Water Scheme - Lower Pumping Station (2)
10. Monitoring Format Sheet D-4 : River Water Scheme - Upper Pumping Station

MONITORING FORMAT SHEET A : GROUNDWATER SCHEME

Date :

a)	Climate	a)-1	Weather		a)-2 Temperature		°c	a)-3 Sun shine hrs		hrs	
				1st operation		2nd operation		3rd operation		4th operation	5th operation
b)	Electric Switching box			1.Solar	2.Public	1.Solar	2.Public	1.Solar	2.Public	1.Solar 2.Public	1.Solar 2.Public
c)	Pumping Operation	c)-1	Operation start time	:		:		:		:	:
		c)-2	Cumulative flow meter								
		c)-3	Operation end time	:		:		:		:	:
		c)-4	Cumulative flow meter								
d)	Remark										

e)	Maintenance	Weekly	e)-1 Cleaning the surface of solar panel	Note:
			e)-2 Retightening of bolt and nut	
		Monthly	e)-3 Check wiring, bolt and nut	

Date :

a)	Climate	a)-1	Weather		a)-2 Temperature		°c	a)-3 Sun shine hrs		hrs	
				1st operation		2nd operation		3rd operation		4th operation	5th operation
b)	Electric Switching box			1.Solar	2.Public	1.Solar	2.Public	1.Solar	2.Public	1.Solar 2.Public	1.Solar 2.Public
c)	Pumping Operation	c)-1	Operation start time	:		:		:		:	:
		c)-2	Cumulative flow meter								
		c)-3	Operation end time	:		:		:		:	:
		c)-4	Cumulative flow meter								
d)	Remark										

e)	Maintenance	Weekly	e)-1 Cleaning the surface of solar panel	Note:
			e)-2 Retightening of bolt and nut	
		Monthly	e)-3 Check wiring, bolt and nut	

MONITORING FORMAT SHEET B-1 : SPRING WATER SCHEME (1) DAILY FORMAT (1/2)

a) Date	b) Time	c) Climate	d) Water level (m)	a) Date	b) Time	c) Climate	d) Water level (m)	a) Date	b) Time	c) Climate	d) Water level (m)	a) Date	b) Time	c) Climate	d) Water level (m)
1-Mar	:			1-Apr	:			1-May	:			1-Jun	:		
2-Mar	:			2-Apr	:			2-May	:			2-Jun	:		
3-Mar	:			3-Apr	:			3-May	:			3-Jun	:		
4-Mar	:			4-Apr	:			4-May	:			4-Jun	:		
5-Mar	:			5-Apr	:			5-May	:			5-Jun	:		
6-Mar	:			6-Apr	:			6-May	:			6-Jun	:		
7-Mar	:			7-Apr	:			7-May	:			7-Jun	:		
8-Mar	:			8-Apr	:			8-May	:			8-Jun	:		
9-Mar	:			9-Apr	:			9-May	:			9-Jun	:		
10-Mar	:			10-Apr	:			10-May	:			10-Jun	:		
11-Mar	:			11-Apr	:			11-May	:			11-Jun	:		
12-Mar	:			12-Apr	:			12-May	:			12-Jun	:		
13-Mar	:			13-Apr	:			13-May	:			13-Jun	:		
14-Mar	:			14-Apr	:			14-May	:			14-Jun	:		
15-Mar	:			15-Apr	:			15-May	:			15-Jun	:		
16-Mar	:			16-Apr	:			16-May	:			16-Jun	:		
17-Mar	:			17-Apr	:			17-May	:			17-Jun	:		
18-Mar	:			18-Apr	:			18-May	:			18-Jun	:		
19-Mar	:			19-Apr	:			19-May	:			19-Jun	:		
20-Mar	:			20-Apr	:			20-May	:			20-Jun	:		
21-Mar	:			21-Apr	:			21-May	:			21-Jun	:		
22-Mar	:			22-Apr	:			22-May	:			22-Jun	:		
23-Mar	:			23-Apr	:			23-May	:			23-Jun	:		
24-Mar	:			24-Apr	:			24-May	:			24-Jun	:		
25-Mar	:			25-Apr	:			25-May	:			25-Jun	:		
26-Mar	:			26-Apr	:			26-May	:			26-Jun	:		
27-Mar	:			27-Apr	:			27-May	:			27-Jun	:		
28-Mar	:			28-Apr	:			28-May	:			28-Jun	:		
29-Mar	:			29-Apr	:			29-May	:			29-Jun	:		
30-Mar	:			30-Apr	:			30-May	:			30-Jun	:		
31-Mar	:							31-May	:						

MONITORING FORMAT SHEET B-1 : SPRING WATER SCHEME (1) DAILY FORMAT (2/2)

a) Date	b) Time	c) Climate	d) Water level (m)	a) Date	b) Time	c) Climate	d) Water level (m)	a) Date	b) Time	c) Climate	d) Water level (m)	a) Date	b) Time	c) Climate	d) Water level (m)
1-Jul	:			1-Aug	:			1-Sep	:			1-Oct	:		
2-Jul	:			2-Aug	:			2-Sep	:			2-Oct	:		
3-Jul	:			3-Aug	:			3-Sep	:			3-Oct	:		
4-Jul	:			4-Aug	:			4-Sep	:			4-Oct	:		
5-Jul	:			5-Aug	:			5-Sep	:			5-Oct	:		
6-Jul	:			6-Aug	:			6-Sep	:			6-Oct	:		
7-Jul	:			7-Aug	:			7-Sep	:			7-Oct	:		
8-Jul	:			8-Aug	:			8-Sep	:			8-Oct	:		
9-Jul	:			9-Aug	:			9-Sep	:			9-Oct	:		
10-Jul	:			10-Aug	:			10-Sep	:			10-Oct	:		
11-Jul	:			11-Aug	:			11-Sep	:			11-Oct	:		
12-Jul	:			12-Aug	:			12-Sep	:			12-Oct	:		
13-Jul	:			13-Aug	:			13-Sep	:			13-Oct	:		
14-Jul	:			14-Aug	:			14-Sep	:			14-Oct	:		
15-Jul	:			15-Aug	:			15-Sep	:			15-Oct	:		
16-Jul	:			16-Aug	:			16-Sep	:			16-Oct	:		
17-Jul	:			17-Aug	:			17-Sep	:			17-Oct	:		
18-Jul	:			18-Aug	:			18-Sep	:			18-Oct	:		
19-Jul	:			19-Aug	:			19-Sep	:			19-Oct	:		
20-Jul	:			20-Aug	:			20-Sep	:			20-Oct	:		
21-Jul	:			21-Aug	:			21-Sep	:			21-Oct	:		
22-Jul	:			22-Aug	:			22-Sep	:			22-Oct	:		
23-Jul	:			23-Aug	:			23-Sep	:			23-Oct	:		
24-Jul	:			24-Aug	:			24-Sep	:			24-Oct	:		
25-Jul	:			25-Aug	:			25-Sep	:			25-Oct	:		
26-Jul	:			26-Aug	:			26-Sep	:			26-Oct	:		
27-Jul	:			27-Aug	:			27-Sep	:			27-Oct	:		
28-Jul	:			28-Aug	:			28-Sep	:			28-Oct	:		
29-Jul	:			29-Aug	:			29-Sep	:			29-Oct	:		
30-Jul	:			30-Aug	:			30-Sep	:			30-Oct	:		
				31-Aug	:							31-Oct	:		

MONITORING FORMAT SHEET B-2 : SPRING WATER SCHEME (2) FOR 1 WEEK INTERVAL

a) Date	b) Time	c) Climate	d) Spring Water Discharge				e) Valve Operation				Remarks
			d)-1 Volume of Water Filled in a Minute			d)-2 Discharge	At Start		At End		
			1st.	2nd.	3rd.		e)-1 Water Level	e)-2 Cumulative Flow Meter	e)-1 Water Level	e)-2 Cumulative Flow Meter	
1)	:		l/min	l/min	l/min	l/min	m	m³	m	m³	
2)	:		l/min	l/min	l/min	l/min	m	m³	m	m³	
3)	:		l/min	l/min	l/min	l/min	m	m³	m	m³	
4)	:		l/min	l/min	l/min	l/min	m	m³	m	m³	
5)	:		l/min	l/min	l/min	l/min	m	m³	m	m³	
6)	:		l/min	l/min	l/min	l/min	m	m³	m	m³	
7)	:		l/min	l/min	l/min	l/min	m	m³	m	m³	
8)	:		l/min	l/min	l/min	l/min	m	m³	m	m³	
9)	:		l/min	l/min	l/min	l/min	m	m³	m	m³	
10)	:		l/min	l/min	l/min	l/min	m	m³	m	m³	
11)	:		l/min	l/min	l/min	l/min	m	m³	m	m³	
12)	:		l/min	l/min	l/min	l/min	m	m³	m	m³	
13)	:		l/min	l/min	l/min	l/min	m	m³	m	m³	
14)	:		l/min	l/min	l/min	l/min	m	m³	m	m³	
15)	:		l/min	l/min	l/min	l/min	m	m³	m	m³	
16)	:		l/min	l/min	l/min	l/min	m	m³	m	m³	
17)	:		l/min	l/min	l/min	l/min	m	m³	m	m³	
18)	:		l/min	l/min	l/min	l/min	m	m³	m	m³	
19)	:		l/min	l/min	l/min	l/min	m	m³	m	m³	
20)	:		l/min	l/min	l/min	l/min	m	m³	m	m³	

MONITORING FORMAT SHEET C-1 : SUBSRFACE WATER SDHEME (1)
DAILY WATER LEVEL (1/2)

Date	Time	Gauge Height at Chang Chhu m	Gauge Height at Well m	Date	Time	Gauge Height at Chang Chhu m	Gauge Height at Well m	Date	Time	Gauge Height at Chang Chhu m	Gauge Height at Well m	Date	Time	Gauge Height at Chang Chhu m	Gauge Height at Well m
1-Mar	:			1-Apr	:			1-May	:			1-Jun	:		
2-Mar	:			2-Apr	:			2-May	:			2-Jun	:		
3-Mar	:			3-Apr	:			3-May	:			3-Jun	:		
4-Mar	:			4-Apr	:			4-May	:			4-Jun	:		
5-Mar	:			5-Apr	:			5-May	:			5-Jun	:		
6-Mar	:			6-Apr	:			6-May	:			6-Jun	:		
7-Mar	:			7-Apr	:			7-May	:			7-Jun	:		
8-Mar	:			8-Apr	:			8-May	:			8-Jun	:		
9-Mar	:			9-Apr	:			9-May	:			9-Jun	:		
10-Mar	:			10-Apr	:			10-May	:			10-Jun	:		
11-Mar	:			11-Apr	:			11-May	:			11-Jun	:		
12-Mar	:			12-Apr	:			12-May	:			12-Jun	:		
13-Mar	:			13-Apr	:			13-May	:			13-Jun	:		
14-Mar	:			14-Apr	:			14-May	:			14-Jun	:		
15-Mar	:			15-Apr	:			15-May	:			15-Jun	:		
16-Mar	:			16-Apr	:			16-May	:			16-Jun	:		
17-Mar	:			17-Apr	:			17-May	:			17-Jun	:		
18-Mar	:			18-Apr	:			18-May	:			18-Jun	:		
19-Mar	:			19-Apr	:			19-May	:			19-Jun	:		
20-Mar	:			20-Apr	:			20-May	:			20-Jun	:		
21-Mar	:			21-Apr	:			21-May	:			21-Jun	:		
22-Mar	:			22-Apr	:			22-May	:			22-Jun	:		
23-Mar	:			23-Apr	:			23-May	:			23-Jun	:		
24-Mar	:			24-Apr	:			24-May	:			24-Jun	:		
25-Mar	:			25-Apr	:			25-May	:			25-Jun	:		
26-Mar	:			26-Apr	:			26-May	:			26-Jun	:		
27-Mar	:			27-Apr	:			27-May	:			27-Jun	:		
28-Mar	:			28-Apr	:			28-May	:			28-Jun	:		
29-Mar	:			29-Apr	:			29-May	:			29-Jun	:		
30-Mar	:			30-Apr	:			30-May	:			30-Jun	:		
31-Mar	:							31-May	:						

MONITORING FORMAT SHEET C-1 : SUBSRFACE WATER SDHEME (1)
DAILY WATER LEVEL (2/2)

Date	Time	Gauge Height		Date	Time	Gauge Height		Date	Time	Gauge Height		Date	Time	Gauge Height	
		at Chang Chhu m	at Well m			at Chang Chhu m	at Well m			at Chang Chhu m	at Well m			at Chang Chhu m	at Well m
1-Jul	:			1-Aug	:			1-Sep	:			1-Oct	:		
2-Jul	:			2-Aug	:			2-Sep	:			2-Oct	:		
3-Jul	:			3-Aug	:			3-Sep	:			3-Oct	:		
4-Jul	:			4-Aug	:			4-Sep	:			4-Oct	:		
5-Jul	:			5-Aug	:			5-Sep	:			5-Oct	:		
6-Jul	:			6-Aug	:			6-Sep	:			6-Oct	:		
7-Jul	:			7-Aug	:			7-Sep	:			7-Oct	:		
8-Jul	:			8-Aug	:			8-Sep	:			8-Oct	:		
9-Jul	:			9-Aug	:			9-Sep	:			9-Oct	:		
10-Jul	:			10-Aug	:			10-Sep	:			10-Oct	:		
11-Jul	:			11-Aug	:			11-Sep	:			11-Oct	:		
12-Jul	:			12-Aug	:			12-Sep	:			12-Oct	:		
13-Jul	:			13-Aug	:			13-Sep	:			13-Oct	:		
14-Jul	:			14-Aug	:			14-Sep	:			14-Oct	:		
15-Jul	:			15-Aug	:			15-Sep	:			15-Oct	:		
16-Jul	:			16-Aug	:			16-Sep	:			16-Oct	:		
17-Jul	:			17-Aug	:			17-Sep	:			17-Oct	:		
18-Jul	:			18-Aug	:			18-Sep	:			18-Oct	:		
19-Jul	:			19-Aug	:			19-Sep	:			19-Oct	:		
20-Jul	:			20-Aug	:			20-Sep	:			20-Oct	:		
21-Jul	:			21-Aug	:			21-Sep	:			21-Oct	:		
22-Jul	:			22-Aug	:			22-Sep	:			22-Oct	:		
23-Jul	:			23-Aug	:			23-Sep	:			23-Oct	:		
24-Jul	:			24-Aug	:			24-Sep	:			24-Oct	:		
25-Jul	:			25-Aug	:			25-Sep	:			25-Oct	:		
26-Jul	:			26-Aug	:			26-Sep	:			26-Oct	:		
27-Jul	:			27-Aug	:			27-Sep	:			27-Oct	:		
28-Jul	:			28-Aug	:			28-Sep	:			28-Oct	:		
29-Jul	:			29-Aug	:			29-Sep	:			29-Oct	:		
30-Jul	:			30-Aug	:			30-Sep	:			30-Oct	:		
31-Jul	:			31-Aug	:							31-Oct	:		

MONITORING FORMAT SHEET C-2 : SUBSURFACE WATER SCHEME (2)
PUMPING TEST

Date : Time : Weather (Fine , Cloud , Rain , Snow)

a) Water Level at Chang Chhu	m	b) Water Level at Well	m
c)-1 Cumulative flow mater at Start	m^3	d)-1 Water Temp.	°c
c)-2 Cumulative flow mater at end	m^3	d)-2 Temperature	°c

e) Continuous pumping test			f) Recovery water level test			
Time (hr) (min)	e)-1 Pump up level (gauge height)	e)-2 Drawdown	Time (hr) (min)	f)-1 Recovery level (gauge height)	f)-2 Fluctuation level	f)-3 Draw up
0	m	m	0	m	m	m
1	m	m	1	m	m	m
2	m	m	2	m	m	m
3	m	m	3	m	m	m
4	m	m	4	m	m	m
5	m	m	5	m	m	m
6	m	m	6	m	m	m
7	m	m	7	m	m	m
8	m	m	8	m	m	m
9	m	m	9	m	m	m
11	m	m	11	m	m	m
13	m	m	13	m	m	m
15	m	m	15	m	m	m
18	m	m	18	m	m	m
21	m	m	21	m	m	m
24	m	m	24	m	m	m
27	m	m	27	m	m	m
30	m	m	30	m	m	m
35	m	m	35	m	m	m
40	m	m	40	m	m	m
45	m	m	45	m	m	m
50	m	m	50	m	m	m
55	m	m	55	m	m	m
1 hr 60	m	m	1 hr 60	m	m	m
70	m	m	70	m	m	m
80	m	m	80	m	m	m
90	m	m	90	m	m	m
100	m	m	100	m	m	m
110	m	m	110	m	m	m
2 hr 120	m	m	2 hr 120	m	m	m
135	m	m	135	m	m	m
150	m	m	150	m	m	m
165	m	m	165	m	m	m
3 hr 180	m	m	3 hr 180	m	m	m
195	m	m	195	m	m	m
210	m	m	210	m	m	m
225	m	m	225	m	m	m
4 hr 240	m	m	4 hr 240	m	m	m
260	m	m	260	m	m	m
280	m	m	280	m	m	m
5 hr 300	m	m	5 hr 300	m	m	m
320	m	m	320	m	m	m
340	m	m	340	m	m	m
6 hr 360	m	m	6 hr 360	m	m	m
7 hr 420	m	m	7 hr 420	m	m	m
8 hr 480	m	m	8 hr 480	m	m	m
9 hr 540	m	m	9 hr 540	m	m	m
10 hr 600	m	m	10 hr 600	m	m	m
11 hr 660	m	m	11 hr 660	m	m	m
12 hr 720	m	m	12 hr 720	m	m	m

MONITORING FORMAT SHEET C-3 : SUBSURFACE WATER SCHEME (3)

STEP DOWN PUMPING TEST

Date:	Time	a) Water Level at Chang Chhu : m	b) Water Level at Well : m	c) Cumulative Discharge at Start:	

1sr Step			2nd Step			3rd Step			4th Step			5th Step		
d)-1 Cumulative discharge			e)-1 Cumulative discharge			f)-1 Cumulative discharge			g)-1 Cumulative discharge			h)-1 Cumulative discharge		
d)-2 Water Temp.		°c	e)-2 Water Temp.		°c	f)-2 Water Temp.		°c	g)-2 Water Temp.		°c	h)-2 Water Temp.		°c
Time (hr) (min)	d)-3 Dynamic water level (m)	d)-4 Drawdown (m)	Time (hr) (min)	e)-3 Dynamic water level (m)	e)-4 Drawdown (m)	Time (hr) (min)	f)-3 Dynamic water level (m)	f)-4 Drawdown (m)	Time (hr) (min	g)-3 Dynamic water level (m)	g)-4 Drawdown (m)	Time (hr) (min)	h)-3 Dynamic water level (m)	h)-4 Drawdown (m)
0			0			0			0			0		
1			1			1			1			1		
2			2			2			2			2		
3			3			3			3			3		
4			4			4			4			4		
5			5			5			5			5		
6			6			6			6			6		
7			7			7			7			7		
8			8			8			8			8		
9			9			9			9			9		
11			11			11			11			11		
13			13			13			13			13		
15			15			15			15			15		
18			18			18			18			18		
21			21			21			21			21		
24			24			24			24			24		
27			27			27			27			27		
30			30			30			30			30		
35			35			35			35			35		
40			40			40			40			40		
45			45			45			45			45		
50			50			50			50			50		
55			55			55			55			55		
1 hr 60			1 hr 60			1 hr 60			1 hr 60			1 hr 60		
70			70			70			70			70		
80			80			80			80			80		
90			90			90			90			90		
100			100			100			100			100		
110			110			110			110			110		
2 hr 120			2 hr 120			2 hr 120			2 hr 120			2 hr 120		
135			135			135			135			135		
150			150			150			150			150		
165			165			165			165			165		
3 hr 180			3 hr 180			3 hr 180			3 hr 180			3 hr 180		

MONITORING FORMAT SHEET D-1 : RIVER WATER SCHEME (1) DAILY RIVER WATER LEVEL (1/2)

Date	Time	Climate	Water level at Chang Chhu (m)	Date	Time	Climate	Water level at Chang Chhu (m)	Date	Time	Climate	Water level at Chang Chhu (m)	Date	Time	Climate	Water level at Chang Chhu (m)
1-Mar	:			1-Apr	:			1-May	:			1-Jun	:		
2-Mar	:			2-Apr	:			2-May	:			2-Jun	:		
3-Mar	:			3-Apr	:			3-May	:			3-Jun	:		
4-Mar	:			4-Apr	:			4-May	:			4-Jun	:		
5-Mar	:			5-Apr	:			5-May	:			5-Jun	:		
6-Mar	:			6-Apr	:			6-May	:			6-Jun	:		
7-Mar	:			7-Apr	:			7-May	:			7-Jun	:		
8-Mar	:			8-Apr	:			8-May	:			8-Jun	:		
9-Mar	:			9-Apr	:			9-May	:			9-Jun	:		
10-Mar	:			10-Apr	:			10-May	:			10-Jun	:		
11-Mar	:			11-Apr	:			11-May	:			11-Jun	:		
12-Mar	:			12-Apr	:			12-May	:			12-Jun	:		
13-Mar	:			13-Apr	:			13-May	:			13-Jun	:		
14-Mar	:			14-Apr	:			14-May	:			14-Jun	:		
15-Mar	:			15-Apr	:			15-May	:			15-Jun	:		
16-Mar	:			16-Apr	:			16-May	:			16-Jun	:		
17-Mar	:			17-Apr	:			17-May	:			17-Jun	:		
18-Mar	:			18-Apr	:			18-May	:			18-Jun	:		
19-Mar	:			19-Apr	:			19-May	:			19-Jun	:		
20-Mar	:			20-Apr	:			20-May	:			20-Jun	:		
21-Mar	:			21-Apr	:			21-May	:			21-Jun	:		
22-Mar	:			22-Apr	:			22-May	:			22-Jun	:		
23-Mar	:			23-Apr	:			23-May	:			23-Jun	:		
24-Mar	:			24-Apr	:			24-May	:			24-Jun	:		
25-Mar	:			25-Apr	:			25-May	:			25-Jun	:		
26-Mar	:			26-Apr	:			26-May	:			26-Jun	:		
27-Mar	:			27-Apr	:			27-May	:			27-Jun	:		
28-Mar	:			28-Apr	:			28-May	:			28-Jun	:		
29-Mar	:			29-Apr	:			29-May	:			29-Jun	:		
30-Mar	:			30-Apr	:			30-May	:			30-Jun	:		

MONITORING FORMAT SHEET D-1 : RIVER WATER SCHEME (1) DAILY RIVER WATER LEVEL (2/2)

Date	Time	Climate	Water level at Chang Chhu (m)	Date	Time	Climate	Water level at Chang Chhu (m)	Date	Time	Climate	Water level at Chang Chhu (m)	Date	Time	Climate	Water level at Chang Chhu (m)
1-Jul	:			1-Aug	:			1-Sep	:			1-Oct	:		
2-Jul	:			2-Aug	:			2-Sep	:			2-Oct	:		
3-Jul	:			3-Aug	:			3-Sep	:			3-Oct	:		
4-Jul	:			4-Aug	:			4-Sep	:			4-Oct	:		
5-Jul	:			5-Aug	:			5-Sep	:			5-Oct	:		
6-Jul	:			6-Aug	:			6-Sep	:			6-Oct	:		
7-Jul	:			7-Aug	:			7-Sep	:			7-Oct	:		
8-Jul	:			8-Aug	:			8-Sep	:			8-Oct	:		
9-Jul	:			9-Aug	:			9-Sep	:			9-Oct	:		
10-Jul	:			10-Aug	:			10-Sep	:			10-Oct	:		
11-Jul	:			11-Aug	:			11-Sep	:			11-Oct	:		
12-Jul	:			12-Aug	:			12-Sep	:			12-Oct	:		
13-Jul	:			13-Aug	:			13-Sep	:			13-Oct	:		
14-Jul	:			14-Aug	:			14-Sep	:			14-Oct	:		
15-Jul	:			15-Aug	:			15-Sep	:			15-Oct	:		
16-Jul	:			16-Aug	:			16-Sep	:			16-Oct	:		
17-Jul	:			17-Aug	:			17-Sep	:			17-Oct	:		
18-Jul	:			18-Aug	:			18-Sep	:			18-Oct	:		
19-Jul	:			19-Aug	:			19-Sep	:			19-Oct	:		
20-Jul	:			20-Aug	:			20-Sep	:			20-Oct	:		
21-Jul	:			21-Aug	:			21-Sep	:			21-Oct	:		
22-Jul	:			22-Aug	:			22-Sep	:			22-Oct	:		
23-Jul	:			23-Aug	:			23-Sep	:			23-Oct	:		
24-Jul	:			24-Aug	:			24-Sep	:			24-Oct	:		
25-Jul	:			25-Aug	:			25-Sep	:			25-Oct	:		
26-Jul	:			26-Aug	:			26-Sep	:			26-Oct	:		
27-Jul	:			27-Aug	:			27-Sep	:			27-Oct	:		
28-Jul	:			28-Aug	:			28-Sep	:			28-Oct	:		
29-Jul	:			29-Aug	:			29-Sep	:			29-Oct	:		
30-Jul	:			30-Aug	:			30-Sep	:			30-Oct	:		
31-Jul	:			31-Aug	:							31-Oct	:		

MONITORING FORMAT SHEET D-2 : RIVER WATER SCHEME - LOWER PUMPING STATION (1)

Date :

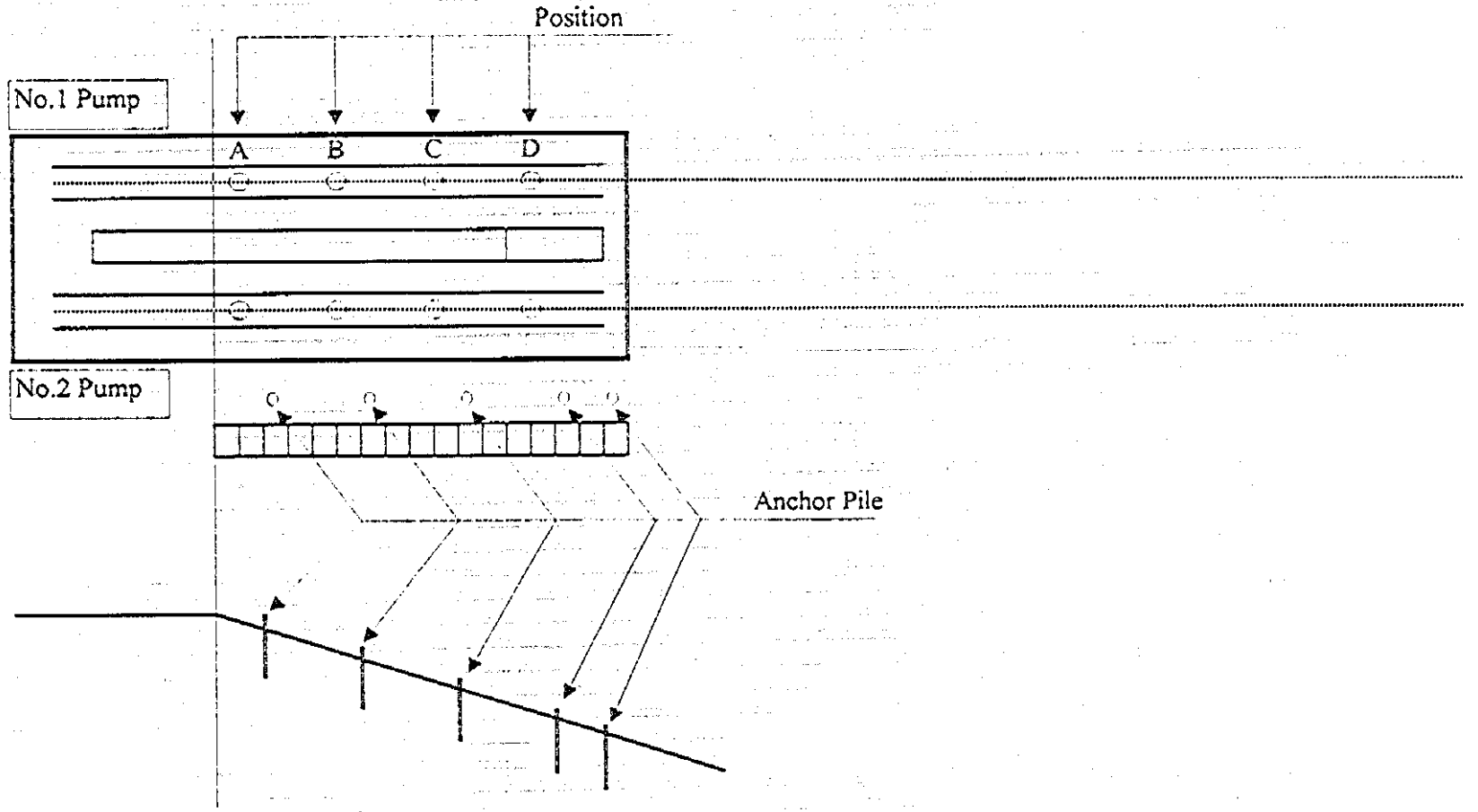
			1st operation		2nd operation		3rd operation		4th operation		5th operation		6th operation		7th operation	
			No.1	No.2	No.1	No.2	No.1	No.2	No.1	No.2	No.1	No.2	No.1	No.2	No.1	No.2
a) Chang Chhu	a)-1	River Water Level	m		m		m		m		m		m		m	
	a)-2	Water Temp.	°c		°c		°c		°c		°c		°c		°c	
b) Lower Tank (Stage-1)	b)-1	Water level at start	m		m		m		m		m		m		m	
	b)-2	Water level at end	m		m		m		m		m		m		m	
c) Lower Pump	c)-1	Position														
	c)-2	Operation start time	:		:		:		:		:		:		:	
	c)-3	Cumulative flow meter at start														
	c)-4	Suction Pressure														
	c)-5	Delivery Pressure														
	c)-6	Ampere														
	c)-7	Voltage														
	c)-8	Bearing Temp.														
	c)-9	Stuffing box Temp.														
	c)-10	Operation end time	:		:		:		:		:		:		:	
	c)-11	Cumulative flow mater at end														
d)		Remark														

e) Maintenance	Monthly	☐ Adjustment of leakage from joints. ☐ Examination and exchange of oil. ☐ Check of shaft temperature.
	6 Monthly	☐ Check and adjustment of shafts center. ☐ Check of vibration and noise.
	Yearly	☐ Check of shaft sleeve and exchange of grand packing. ☐ Check and exchange of Mechanical-seals. ☐ Exchange of oil for bearing shaft. ☐ Overhaul and exchange O-ring, Gasket, V-ring, and others.
	2 Years	☐ Check of wearing at revolving part. ☐ Check of inside casing. ☐ Adjustment of all the other parts.

Note;

MONITORING FORMAT SHEET D-3 : RIVER WATER SCHEME - LOWER PUMPING STATION (2)

Date :



Note :

MONITORING FORMAT SHEET D-4 : RIVER WATER SCHEME UPPER PUMPING STATION

Date :

			1st operation	2nd operation	3rd operation	4th operation	5th operation	6th operation	7th operation	8th operation
a) Lower Tank (Stage-1)	a)-1	Water level at start	m	m	m	m	m	m	m	m
	a)-2	Water level at end	m	m	m	m	m	m	m	m
	a)-3	Water Temp.	°c	°c	°c	°c	°c	°c	°c	°c
b) Upper Tank (Stage-2)	b)-1	Water level at start	m	m	m	m	m	m	m	m
	b)-2	Water level at end	m	m	m	m	m	m	m	m
c) Pump	c)-1	Operation start time	:	:	:	:	:	:	:	:
	c)-2	Operation end time	:	:	:	:	:	:	:	:
	c)-3	Bearing Temp.	°c	°c	°c	°c	°c	°c	°c	°c
	c)-4	Stuffing box Temp.	°c	°c	°c	°c	°c	°c	°c	°c
d)		Remark								

e) Maintenance	Monthly	☐ Adjustment of leakage from joints. ☐ Examination and exchange of oil. ☐ Check of shaft temperature.	Note :
	6 Monthly	☐ Check and adjustment of shafts center. ☐ Check of vibration and noise.	
	Yearly	☐ Check of shaft sleeve and exchange of grand packing. ☐ Check and exchange of Mechanical-seals. ☐ Exchange of oil for bearing shaft.	
	2 Years	☐ Overhaul and exchange O-ring, Gasket, V-ring, and others. ☐ Check of wearing at revolving part. ☐ Check of inside casing. ☐ Adjustment of all the other parts.	