Appendix A: Facilities Provided by the PQA Environment and Safety Department

See following pages.

PORT QASIM AUTHORITY

ENVIRONMENT & SAFETY DEPARTMENT

FACILITIES BEING PROVIDED

Removal of Sludge/Waste

Port Qasim is providing this facility to the Ships calling at PQA and PQA based Industries through registered private contractors, which is monitored through MPCC, Cargo Operation and Security officials. Being an essential Port reception facility requirement under MARPOL-1973/78 (International Convention), Pakistan being signatory to it.

Combating of Oil Spillage

Port Qasim participated in the Barracuda, Barracuda-II and Sea Horse exercises/drill organized by Directorate of Maritime Affairs & Environmental Control, Naval Headquarters was carried out to improve the skill and coordination with the other organizations etc. The MPCC Team proves the skill of combating of Oil Spillage. PQA is also arranging joint exercises/drill with the stakeholders like FOTCO and EVTL etc. to improve the capability and coordination with each other. On the request of the Ministry of Petroleum & Natural; Resources to Ministry of Port & Shipping, PQA has recently provided the support by manpower and equipments to M/s. FOTCO for handling and discharge of HSD.

Vigilance Teams

In order to keep a vigilance watch on the environment and marine pollution within the Port Qasim jurisdictions/limits, a Vigilance Team has been constituted to maintain the vigilant watch over the environmental conditions. The function of the team is to enter any premises of an industry and inspect the laid down environmental condition/standards for the said industry according to the Environmental Impact Assessment Report and the Agreement Clauses there-to. To recommend imposition of fine if a party is found as defaulter of the Rules, Regulations and Agreements etc. on

Environmental Pollution. One Terminal Operator and eight Companies have been penalized on the recommendations of the above said Team.

Mangroves Forest

Mangroves Forest under the jurisdiction of Port Qasim are spread over the total area of **64,400** hectors, of which **4,900** hectors consist of number of small Islands of seaward side above the high water mark and remaining consist of mudflats and creeks below the high water mark and enjoys a status of PROTECTED FOREST under the administrative control of PQA. PQA has also collaborated with International Union for Conservation of Nature (IUCN) for re-plantation of Mangroves in degraded areas. Presently, M/s. Fauji Oil Terminal & Distribution Company Ltd. (FOTCO) and M/s. Engro Asahi, M/s. Lottee Pakistan are also plating Mangroves at the coastal areas of PQA.

Research Facilities

PQA side by side has also provided field facilities to Federal Urdu University of Arts, Science & Technology. Ph.D. students of Botany Department, Federal Urdu University of Arts, Science & Technology to facilitate their research work inclusive documentary film on Mangroves Forests prepared for the local television. PQA in collaboration with WWF has set-up of nursery in the Port area for the purpose of providing the sampling to the PQA industries, Village Folks for re-plantation in the depleted areas.

Horticulture Activities

To promote healthy coastal ecosystem as well as pollution free atmosphere, Horticulture Section of E&S Department is making all efforts by planting of maximum trees etc. in all over PQA Operational as well as its Industrial Zones. This department has planted over 2,500 plants of Conocarpus, Neem Tress and Bogain Villa for the last three years.

Sewerage Treatment Plant

PQA have one Sewerage Treatment Plant located in Edible Oil & Molasses Area of PQA to facilitate the industries of the vicinity for treatment of their waste/effluent before discharging the same into Sea.

Fire Fighting Services

Fire Fighting facilities are provided to the PQA based Industries as well as ship calling port Qasim at the time of bunkering. Following equipment are available:-

Fire Bowzer	01 No.
Fire Tender	04 Nos.
Diesel Driven Trailer Fire pump	02 Nos.
Petrol Driven Fire Trailer Pump	02 Nos.

SEWERAGE TREATMENT PLANT INSTALLED IN EDIBLE OIL & MOLASSES AREA OF PQA

1. SEWERAGE WATER STORAGE TANK CAPACITY 40,000 GALLONS

2. WATER DISCHARGE PER PUMP 4000 GALLON PER/HOUR

3. 02 MAIN PUMPS 5 H.P EACH

Appendix B: Physical Baseline Appendices

B.1 Laboratory Results for Water Quality, Sediment Quality and Sediment Particle Size Distribution

See following pages

			Sample Station	WW1	WW2	WW4	W1	EC5/W2	EC5/W2	EC4/W3	EC4/W3	EC7/W7	EC3/W8	W5	W13
			Sample ID	WW1	WW2	WW4	W1-1	EC5/W2-1	EC5/W2-7	EC4/W3-1	EC4/W3-8	EC7/W7-1	EC3/W8	W5-1	W13
			Sample Type	Waste Water	Waste Water	Waste Water	Seawater	Seawater	Seawater	Seawater	Seawater	Seawater	Seawater	Fresh Water	Freshwater
			Sample Depth (m)	Surface sample	Surface sample	Surface sample	1	1	7	1	8	1	Surface Sample	1	Surface Sample
			Total Depth	-	-	-	5	14	14	15	15	9	0.5	4	1
			Date of Collection	6/7/2015	6/4/2015	6/7/2015	6/6/2015	6/5/2015	6/5/2015	6/5/2015	6/5/2015	6/6/2015	6/8/2015	6/7/2015	6/7/2015
			Time of Collection	15:50	9:00	14:30	16:15	12:00	12:15	14:50	15:00	12:50	12:30	11:00	12:50
			Coordinates	24 49 20.7	24 48 33.9	24 47 15.6	24 45 49.6	24 43 45.9	24 43 45.9	24 43 53.1	24 43 53.1	24 37 51.8	24 46 08.4	24 35 49.3	24 44 29.8
				67 05 45.8	67 15 53.4	67 20 19.5	67 07 24.4	67 21 13.2	67 21 13.2	67 14 50.3	67 14 50.3	67 17 9.0	67 25 23.6	67 30 58.9	67 35 39.4
			Sample Location	Landi/Korangi Industrial Waste Out fall drain	Lat Basti Drain (Bhains Colony)	Steel Mill Outfall Drain	Korangi Creek	Infront of PQ main Jetty	Infront of PQ main Jetty	Chann Wado Creek	Chann Wado Creek	Near Khuddi Creek	near Shah Hasan Shrine	Near Kakran	Upstream W4
Parameter	***Units***	***LOR***	***Method Ref.***												
pH	-	0.1	US EPA 150.1	8.40	7.82	7.70	7.80	7.76	7.79	7.85	7.90	7.95	8.17	8.25	8.04
Total Dissolved Solids	mg/l	10	US EPA 160.1	4554.00	5279.00	41790.00	37888.00	42968.00	43424.00	41460.00	42624.00	42080.00	47116.00	1190.00	2848.00
Total Suspended Solids	mg/l	4	US EPA 160.2	55.00	584.00	29.00	55.00	22.00	53.00	22.00	37.00	103.00	132.00	69.00	139.00
Salinity	ppt	1	APHA 2520 B	2.54	2.55	26.60	24.50	26.80	27.10	27.10	27.80	27.40	29.90	1.01	1.62
Turbidity	NTU	0	HACH 8237	125.00	2200.00	18.00	20.40	32.00	37.00	28.00	42.00	48.00	52.00	54.00	62.00
Alkalinity, Total (as CaCO3)	mg/l	4	SMEW	916.90	2081.00	175.96	136.00	173.84	190.80	144.16	147.34	179.14	143.10	151.58	188.68
Sulfate	mg/l	10	US EPA 375.3	376.52	213.57	3247.56	2417.00	3677.16	3616.26	3624.49	3117.52	2725.78	3970.15	210.28	453.47
Chloride	mg/l	5	SMEW	2031.28	1497.76	22776.62	22156.25	21447.25	23042.50	23485.65	22776.62	23264.06	24859.31	646.96	941.20
Fluoride	mg/l	0.1	US EPA 340.1	0.22	16.26	1.65	1.66	1.75	1.78	1.70	1.89	1.53	1.55	0.47	0.68
Cyanide	mg/l	1	US EPA 335.2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Nitrate	mg/l	0.1	US EPA 352.1	4.20	64.26	0.26	0.28	0.29	0.24	0.23	0.24	0.25	0.27	0.10	0.12
Nitrite	mg/l	0.01	US EPA 354.1	0.07	8.74	0.70	0.74	0.71	0.69	0.68	0.70	0.71	0.72	0.04	0.05
Total phosphorous	mg/l	0.01	SMEW	0.98	394.68	0.16	0.15	0.17	0.19	0.17	0.17	0.17	0.19	ND	ND
Ortho-phosphate	mg/l	0.01	US EPA 365.3	0.60	174.25	0.10	0.08	0.09	0.10	0.09	0.09	0.09	0.10	ND	ND
Ammonia	mg/l	0.5	SMEW	0.61	1.89	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Oil and Grease	mg/l	5	US EPA 413.1	ND	10.60	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

SMEW: Standard Methods for Examination of Water and Wastewater, 19th Edition
USEPA: United States Environmental Protection Agency
APHA: American Public Health Association
NTU: Nephelometric Turbidity Units
LOR: Level of Reporting
ppt: Parts Per Thousand
mg/l: Milligram Per Liter
ND: Tot Detected

Analyst

Saeed Nawaz

Checked By

Asif Mahmood
Manager, EMA Services

ALS TECHNICHEM (M) SDN BHD

(117964-P)
21, Jalan Astaka U8/84, Seksyen U8, Bukit Jelutong, 40150 Shah Alam, Selangor.
Tel: (603) 7845 8257 Fax: (603) 7845 8258 E-mail: info@alsglobal.com.my

ALS Technichem

CERTIFICATE OF ANALYSIS

MS ISO/IEC 17025
TESTING
SAMM No. 147

DATE : 18 August 2015

ALS REF. : ALSM131365_4

ALS SAMPLE ID. : ALSM131365595671_4

COMPANY : Hagler Bailly Pakistan (PVT.) Ltd.
H-39, Street-3, E-7,
Islamabad, 44000,
Pakistan.
Tel: 92 51 2610 200 -7 Fax: 92 51 2610208
(Attn.: Mr. Hidayat Hasan)

PROJECT : CIA

DATE SAMPLE RECEIVED : 17 June 2015

SAMPLE DESCRIPTION : Two samples were received with the following references:

SAMPLE I.D	MATRIX	DATE	TIME (hrs)	REMARKS
EC11/W10-1	Seawater	5-Jun-15	1700	-
W1-1D	Seawater	6-Jun-15	1615	-

Note : Results apply to sample(s) as submitted.

Lee Yiu Lay
Laboratory Manager - EV
BSc. (Chem & Bio), MSc. (Chem), AMIC
IKM No. : A/2712/4566/04/08

BRANCH & COLLECTION CENTRE:

(JB): No.19, Jalan Kencana Mas 1/1,
Tebrau Business Park, Taman Daya,
81100 Johor Bahru, Johor.
Tel : (607) – 354 9604
Fax: (607) – 354 9554

(KK): Mezzanine Floor, No.3, Lot 5, Lorong Kilang (SLIE),
Off Jalan Kilang Kelombong, Jalan Ulam Raja, Kelombong
Kota Kinabalu 88450 Sabah.
Tel: (6088) – 431 075
Fax: (6088) – 439 517

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DATE : 18 August 2015
ALS SAMPLE ID. : ALSM131365595671_4
PROJECT : CIA
Sample Type : Water

ALS Technichem

		Lab I.D		595671	595672			
		Sample I.D		EC11/W10-1	W1-1D			
		Units	LOR					
Method Reference	**Analysis Description**	**Date of Analysis**		25/6/15				
APHA 4500-H+ B	pH	-	0.1	7.6	7.6			
APHA 2520 B	TDS	mg/l	0.1	32500	33300			
APHA 2540 D	TSS	mg/l	1	147	307			
APHA 2510 B	Salinity	ppt	0.1	32.5	39.5			
APHA 2130 B	Turbidity	NTU	1	215	560			
APHA 2320 B	Alkalinity (as CaCO3)	ug/l	1000	119000	109000			
In house method QWI-CH/17-11 based on APHA 4500-SO42-Cl-E	Sulphate	ug/l	1000	2620000	2830000			
APHA 4110 B	Bromide	ug/l	20	66000	68400			
APHA 4500-Cl-E	Chloride	ug/l	1000	17640000	18400000			
APHA 4500-F-C	Fluoride	ug/l	100	6780	6580			
APHA 4500-NO3-H	Nitrate	ug/l	10	100	260			
APHA 4500-NO2-B	Nitrite	ug/l	10	678	710			
APHA 4500-P B & F	Total Phosphorus	ug/l	10	175	210			
APHA 4500-P F	Ortho-Phosphate	ug/l	10	40	51			
APHA 4500-NH3 G	Ammonia	mg/l	0.01	8.04	16.2			
APHA 5210 B	BOD5 at 20 ° C	mg/l	1	4	7			
APHA 5220 D	COD	mg/l	2	14	21			
APHA 5310 D	Total Organic Carbon	mg/l	0.1	0.2	0.8			
APHA 10200 H	Chlorophyll-a	ug/l	0.5	4.0	3.2			
APHA 5520 B	Oil & Grease	mg/l	1	<1	<1			
APHA 5530 B&D	Phenol	mg/l	0.02	<0.02	<0.02			

		Lab I.D		595671	595672			
		Sample I.D		EC11/W10-1	W1-1D			
		Units	LOR					
Method Reference	**Analysis Description**	**Date of Analysis**		23/6/15				
APHA 4500-CN- C&E	Cyanide	mg/l	0.05	<0.05	<0.05			
USEPA 6020 A	Arsenic	ug/l	1	3	5			
USEPA 6020 A	Boron	mg/l	0.1	5.2	5.6			
USEPA 6020 A	Cadmium	ug/l	1	<1	<1			
USEPA 6020 A	Copper	ug/l	1	2	4			
USEPA 6020 A	Iron	ug/l	10	152	370			
USEPA 6020 A	Lead	ug/l	1	<1	2			
USEPA 6020 A	Nickel	ug/l	1	1	2			
USEPA 6020 A	Strontium	ug/l	1	9220	9230			
USEPA 6020 A	Zinc	ug/l	10	<10	<10			
USEPA 6010 B	Calcium	mg/l	0.1	403	436			
USEPA 6010 B	Magnesium	mg/l	0.1	1280	1360			
USEPA 6010 B	Sodium	mg/l	0.1	11100	12200			
USEPA 6010 B	Potassium	mg/l	0.1	409	436			

LOR: Level of Reporting

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674960

DATE : 18 August 2015
ALS SAMPLE ID. : ALSM131365595671_4
PROJECT : CIA
Sample Type : Water

ALS Technichem

		Lab I.D		595671	595672			
		Sample I.D		EC11/W10-1	W1-1D			
		Units	LOR					
Method Reference	**Analysis Description**	Date of Analysis		19/6/15				
USEPA 5030B, 8260B	**BTEX/TPH (C6-C9)**							
USEPA 5030B, 8260B	TPH (C6-C9 fraction)	µg/l	50	<50	<50			
		Lab I.D		595671	595672			
		Sample I.D		EC11/W10-1	W1-1D			
		Units	LOR					
Method Reference	**Analysis Description**	Date of Extraction		19/6/15				
		Date of Analysis		27/6/15				
USEPA 3510C, 8015B	**Total Petroleum Hydrocarbon (TPH)**							
USEPA 3510C, 8015B	C10-C14 fraction	µg/l	50	<50	<50			
USEPA 3510C, 8015B	C15-C28 fraction	µg/l	100	<100	<100			
USEPA 3510C, 8015B	C29-C36 fraction	µg/l	50	<50	<50			

LOR: Level of Reporting

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BATCH QUALITY CONTROL - LABORATORY CONTROL SAMPLE

ALS Sample ID : ALSM130016588378
Batch : INW150623(1)
Matrix : Water

Date of Digestion : -
Date of Analysis : 23/6/15

COMPOUND	Blank Conc.	Spike Conc.	QC SPIKE RESULTS				Control Limits		
			SCS Conc	DCS Conc	Ave Rec.	RPD	% Recovery		RPD
	mg/l	mg/l	mg/l	mg/l	%	%	Low	High	%
Arsenic	<LOR	5.0	4.5	4.5	90	0	80	120	20
Boron	<LOR	5.0	4.9	5.3	102	8	80	120	20
Cadmium	<LOR	5.0	4.8	4.8	96	0	80	120	20
Copper	<LOR	5.0	5.4	5.3	107	2	80	120	20
Iron	<LOR	5.0	4.6	4.7	93	2	80	120	20
Lead	<LOR	5.0	4.9	4.7	96	4	80	120	20
Nickel	<LOR	5.0	5.5	5.4	109	2	80	120	20
Strontium	<LOR	5.0	5.5	5.4	109	2	80	120	20
Zinc	<LOR	5.0	5.2	5.3	105	2	80	120	20

Batch : INW150623(1)
Matrix : Water

Date of Digestion : -
Date of Analysis : 23/6/15

COMPOUND	Blank Conc.	Spike Conc.	QC SPIKE RESULTS				Control Limits		
			SCS Conc	DCS Conc	Ave Rec.	RPD	% Recovery		RPD
	mg/L	mg/L	mg/L	mg/L	%	%	Low	High	%
Calcium	<LOR	20.0	20.0	20.1	96	8	80	120	20
Sodium	<LOR	20.0	18.4	18.3	92	1	80	120	20
Potassium	<LOR	20.0	18.3	18.2	94	5	80	120	20
Magnesium	<LOR	20.0	19.3	19.2	96	1	80	120	20

COMMENTS :

1) LOR: level of reporting
2) The control limits are based on ALS laboratory statistical data.
3) * : Recovery or RPD falls outside of the recommended control limits.

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BATCH QUALITY CONTROL - MATRIX SPIKE SAMPLE

ALS Sample ID : ALSM130016588378
Batch : INW150623(1)
Matrix : Water

Date of Digestion : -
Date of Analysis : 23/6/15
Spiked Sample : 595671

COMPOUND	Sample Results	Spike Conc.	QC SPIKE RESULTS				Control Limits
			MS Conc	MSD Conc	Ave Rec.	RPD	RPD
	mg/l	mg/l	mg/l	mg/l	%	%	%
Arsenic	3	10	13	12	95	8	20
Boron	5240	1000	6300	5990	91	5	20
Cadmium	<LOR	10	10	9	95	11	20
Copper	2	10	10	11	105	10	20
Iron	152	100	264	227	94	15	20
Lead	<LOR	10	10	9	95	11	20
Nickel	1	10	10	11	95	10	20
Strontium	9220	2000	11800	10400	94	13	20
Zinc	<LOR	10	10	9	95	11	21

Batch : INW150623(1)
Matrix : Water

Date of Digestion : -
Date of Analysis : 23/6/15
Spiked Sample : 595671

COMPOUND	Sample Results	Spike Conc.	QC SPIKE RESULTS				Control Limits
			MS Conc	MSD Conc	Ave Rec.	RPD	RPD
	mg/L	mg/L	mg/L	mg/L	%	%	%
Calcium	403	2000	2150	2190	88	2	20
Sodium	11000	10000	18300	19900	81	8	20
Potassium	409	2000	2330	2330	96	0	20
Magnesium	1280	10000	9620	9790	84	2	20

COMMENTS :

1) LOR: level of reporting
2) The control limits are based on ALS laboratory statistical data.
3) * : Recovery or RPD falls outside of the recommended control limits.

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BATCH QUALITY CONTROL - DUPLICATE SAMPLE

ALS Sample ID : ALSM130016588378
Batch : INW150623(1)
Matrix : Water

Date of Digestion : -
Date of Analysis : 23/6/15
Duplicate sample: 595672

COMPOUND	QC DUPLICATE RESULTS		
	Sample Conc	Check Sample Conc	RPD
	mg/l	mg/l	%
Arsenic	5	5	0
Boron	5580	6010	7
Cadmium	<LOR	<LOR	-
Copper	4	4	0
Iron	370	325	13
Lead	2	2	0
Nickel	2	2	0
Strontium	9230	8530	8
Zinc	<LOR	<LOR	-

Batch : INW150623(1)
Matrix : Water

Date of Digestion : -
Date of Analysis : 23/6/15
Duplicate sample: 595672

COMPOUND	QC DUPLICATE RESULTS		
	Sample Conc	Check Sample Conc	RPD
	mg/L	mg/L	%
Calcium	436	411	6
Sodium	12200	10900	11
Potassium	436	448	3
Magnesium	1360	1280	6

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ALS Technichem

BATCH QUALITY CONTROL - LABORATORY CONTROL SAMPLE

ALS SAMPLE ID. : ALSM131365595671_4
Batch : VOCW150619(1)
Matrix : Water

Date of Extraction : --
Date of Analysis : 19/6/15

COMPOUND	Blank Conc.	Spike Conc.	QC SPIKE RESULTS				Control Limits		
			SCS Conc	DCS Conc	Ave Rec.	RPD	% Recovery		RPD
	ug/l	ug/l	ug/l	ug/l	%	%	Low	High	%
TOTAL PETROLEUM HYDROCARBON									
C6-C9	<LOR	200	221	218	110	1	75	118	20

Batch : TPHW150629(1)
Matrix : Water

Date of Extraction : 17/6/15
Date of Analysis : 29/6/15

COMPOUND	Blank Conc.	Spike Conc.	QC SPIKE RESULTS				Control Limits		
			SCS Conc	DCS Conc	Ave Rec.	RPD	% Recovery		RPD
	µg/l	µg/l	µg/l	µg/l	%	%	Low	High	%
TOTAL PETROLEUM HYDROCARBON									
C10-C14	<LOR	220	213	214	97	0	70	136	20
C15-C28	<LOR	620	683	687	110	1	82	142	20
C29-C36	<LOR	160	136	143	87	5	60	135	20

COMMENTS :
1) LOR: level of reporting
2) The control limits are based on ALS laboratory statistical data.
3) * : Recovery or RPD falls outside of the recommended control limits.

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ALS Technichem

BATCH QUALITY CONTROL - MATRIX SPIKE SAMPLE

ALS SAMPLE ID. : ALSM131365595671_4
Batch : VOCW150619(1)
Matrix : Water

Date of Extraction : --
Date of Analysis : 19/6/15
Spiked Sample : 595671

COMPOUND	Sample Results	Spike Conc.	QC SPIKE RESULTS				Control Limits
			MS Conc	MSD Conc	Ave Rec.	RPD	RPD
	ug/l	ug/l	ug/l	ug/l	%	%	%
TOTAL PETROLEUM HYDROCARBON							
C6-C9	<LOR	200	228	229	114	0	20

Batch : TPHW150629(1)
Matrix : Water

Date of Extraction : 17/6/15
Date of Analysis : 29/6/15
Spiked Sample : 593383

COMPOUND	Sample Results	Spike Conc.	QC SPIKE RESULTS				Control Limits
			MS Conc	MSD Conc	Ave Rec.	RPD	RPD
	µg/l	µg/l	µg/l	µg/l	%	%	%
TOTAL PETROLEUM HYDROCARBON							
C10-C14	<LOR	220	232	235	104	1	20
C15-C28	<LOR	620	753	763	127	1	20
C29-C36	<LOR	160	153	158	120	3	20

COMMENTS :

1) LOR: level of reporting
2) The control limits are based on ALS laboratory statistical data.
3) * : Recovery or RPD falls outside of the recommended control limits.

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ALS Technichem

BATCH QUALITY CONTROL - DUPLICATE SAMPLE

ALS SAMPLE ID. : ALSM131365595671_4
Batch : VOCW150619(1)
Matrix : Water

Date of Extraction : --
Date of Analysis : 19/6/15
Duplicate sample: 595672

COMPOUND	QC DUPLICATE RESULTS		
	Sample Conc	Check Sample Conc	RPD
	ug/l	ug/l	%
TOTAL PETROLEUM HYDROCARBON			
C6-C9	<LOR	<LOR	--

Batch : TPHW150629(1)
Matrix : Water

Date of Extraction : 17/6/15
Date of Analysis : 29/6/15
Duplicate sample: 593402

COMPOUND	QC DUPLICATE RESULTS		
	Sample Conc	Check Sample Conc	RPD
	µg/l	µg/l	%
TOTAL PETROLEUM HYDROCARBON			
C10-C14	<LOR	<LOR	--
C15-C28	<LOR	<LOR	--
C29-C36	<LOR	<LOR	--

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No: 10405-ES- Dated: 07th July, 2015

CERTIFICATE OF ANALYSIS

Ref: **F5034 CIA**

Sample ID: As per client ID

Client: Hagler Bailly Pakistan (Pvt) Ltd
39, Street 3, E7,
Islamabad, 44000
Pakistan.
Tel: +92 (51)-261-2-0200-07
(Attn: Mr. Asif Mahmood)

Project:

Date/Time sample received at lab: 15-06-15 / 09:30 PM

Sample Description: Seven sea water samples were received at lab with following details;

SAMPLE ID	NATURE OF SAMPLE	COLLECTION DATE	TIME	REMARKS
W1-1	Sea Water	Jun 06, 2015		
EC5/W2-1	Sea Water	Jun 05, 2015		
EC5/W2-7	Sea Water	Jun 05, 2015		
EC4/W3-1	Sea Water	Jun 05, 2015		
EC4/W3-8	Sea Water	Jun 05, 2015		
EC7/W7-1	Sea Water	Jun 07, 2015		
EC3/W8	Sea Water	Jun 08, 2015		

Dr. M. Mansha
General Manager
Environmental Monitoring &
Modeling Division

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PAKISTAN

Ph. 34690765-79, FAX: 4694928, 46949413
E-mail: muhammad_mansha@yahoo.co.uk

No: 10405-ES-

Dated: 07th July, 2015

		Lab ID		W1-1	EC5/W2-1	EC5/W2-7	EC4/W3-1	EC4/W3-8	EC7/W7-1	EC3/W8
		Sample ID		W1-1	EC5/W2-1	EC5/W2-7	EC4/W3-1	EC4/W3-8	EC7/W7-1	EC3/W8
		Unit	*LOR							
Method Reference	Analysis Description	Date of Analysis 30 June,15		Result						
US-EPA 200.8	Na	mg/l	<0.001	12653	11978	13308	14379	13652	13987	15018
US-EPA 200.8	K	mg/l	<0.001	367	402	388	350	345	329	336
US-EPA 200.8	Ca	mg/l	<0.001	426	438	420	411	403	392	408
US-EPA 200.8	Mg	mg/l	<0.001	1285	1464	1339	1154	1206	1090	1144
US-EPA 200.8	Br	mg/l	<0.001	59.200	43.719	46.333	62.837	65.928	67.715	63.404
US-EPA 200.8	As	mg/l	<0.001	0.0024	0.0015	0.0021	0.0032	0.0037	0.0019	0.0016
US-EPA 200.8	B	mg/l	<0.001	1.681	2.611	3.080	5.327	4.897	6.778	6.109
US-EPA 200.8	Cd	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
US-EPA 200.8	Cu	mg/l	<0.001	<0.001	0.003	<0.001	<0.001	<0.001	0.002	<0.001
US-EPA 200.8	Fe	mg/l	<0.001	0.004	0.013	0.017	0.022	0.019	0.025	0.0011
US-EPA 200.8	Pb	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
US-EPA 200.8	Ni	mg/l	<0.001	0.007	0.009	0.010	0.015	0.012	0.019	0.011
US-EPA 200.8	Sr	mg/l	<0.001	6.524	7.398	6.928	4.837	5.281	7.800	8.055
US-EPA 200.8	Zn	mg/l	<0.001	0.008	0.014	0.012	0.007	0.009	0.017	0.023

*LOR: Level of Reporting

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No: 10405-ES-

Dated: 07th July, 2015

BATCH QUALITY CONTROL – DUPLICATE SAMPLE

Sample ID	Parameters	QC DUPLICATED RESULTS		
		Sample Conc.	Check Sample Conc.	RPD
		mg/l	mg/l	%
W1-1	Na	12653	12446	1.649
	K	367	358	2.483
	Ca	426	431	-1.167
	Mg	1285	1260	1.965
	Br	59.200	60.1	-1.509
	As	0.0024	0.0025	-4.082
	B	1.681	1.634	2.836
	Cd	<0.001	<0.001	-
	Cu	<0.001	<0.001	-
	Fe	0.004	0.004	0.000
	Pb	<0.001	<0.001	-
	Ni	0.007	0.006	15.385
	Sr	6.524	6.633	-1.657
	Zn	0.008	0.008	0.000
EC5/W2-1	Na	11978	11662	2.673
	K	402	398	1.000
	Ca	438	429	2.076
	Mg	1464	1438	1.792
	Br	43.719	42.001	4.008
	As	0.0015	0.0017	-12.500
	B	2.611	2.733	-4.566
	Cd	<0.001	<0.001	-
	Cu	0.003	0.003	0.000
	Fe	0.013	0.012	8.000
	Pb	<0.001	<0.001	-
	Ni	0.009	0.009	0.000
	Sr	7.398	7.161	3.256
	Zn	0.014	0.015	-6.897

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No: 10405-ES-

Dated: 07th July, 2015

BATCH QUALITY CONTROL – DUPLICATE SAMPLE

Sample ID	Parameters	QC DUPLICATED RESULTS		
		Sample Conc.	Check Sample Conc.	RPD
		mg/l	mg/l	%
EC5/W2-7	Na	13308	13151	1.187
	K	388	395	-1.788
	Ca	420	411	2.166
	Mg	1339	1360	-1.556
	Br	46.333	45.208	2.458
	As	0.0021	0.002	4.878
	B	3.080	3.01	2.299
	Cd	<0.001	<0.001	-
	Cu	<0.001	<0.001	-
	Fe	0.017	0.019	-11.111
	Pb	<0.001	<0.001	-
	Ni	0.010	0.01	0.000
	Sr	6.928	6.689	3.510
	Zn	0.012	0.013	-8.000
EC4/W3-1	Na	14379	13987	2.764
	K	350	346	1.149
	Ca	411	409	0.488
	Mg	1154	1166	-1.034
	Br	62.837	62.177	1.056
	As	0.0032	0.0035	-8.955
	B	5.327	5.533	-3.794
	Cd	<0.001	<0.001	-
	Cu	<0.001	<0.001	-
	Fe	0.022	0.02	9.524
	Pb	<0.001	<0.001	-
	Ni	0.015	0.016	-6.452
	Sr	4.837	4.533	6.489
	Zn	0.007	0.006	15.385

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No: 10405-ES-

Dated: 07th July, 2015

BATCH QUALITY CONTROL – DUPLICATE SAMPLE

Sample ID	Parameters	QC DUPLICATED RESULTS		
		Sample Conc.	Check Sample Conc.	RPD
		mg/l	mg/l	%
EC4/W3-8	Na	13652	13222	3.200
	K	345	341	1.166
	Ca	403	395	2.005
	Mg	1206	1189	1.420
	Br	65.928	64.644	1.967
	As	0.0037	0.0035	5.556
	B	4.897	4.727	3.533
	Cd	<0.001	<0.001	-
	Cu	<0.001	<0.001	-
	Fe	0.019	0.019	0.000
	Pb	<0.001	<0.001	-
	Ni	0.012	0.013	-8.000
	Sr	5.281	5.397	-2.173
	Zn	0.009	0.009	0.000
EC7/W7-1	Na	13987	13639	2.519
	K	329	317	3.715
	Ca	392	384	2.062
	Mg	1090	1095	-0.458
	Br	67.715	66.201	2.261
	As	0.0019	0.0018	5.405
	B	6.778	6.444	5.052
	Cd	<0.001	<0.001	-
	Cu	0.002	0.002	0.000
	Fe	0.025	0.027	-7.692
	Pb	<0.001	<0.001	-
	Ni	0.019	0.019	0.000
	Sr	7.800	7.556	3.178
	Zn	0.017	0.018	-5.714

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No: 10405-ES-

Dated: 07th July, 2015

BATCH QUALITY CONTROL – DUPLICATE SAMPLE

Sample ID	Parameters	QC DUPLICATED RESULTS		
		Sample Conc.	Check Sample Conc.	RPD
		mg/l	mg/l	%
EC3/W8	Na	15018	14959	0.394
	K	336	339	-0.889
	Ca	408	404	0.985
	Mg	1144	1137	0.614
	Br	63.404	62.859	0.863
	As	0.0016	0.0017	-6.061
	B	6.109	5.899	3.498
	Cd	<0.001	<0.001	-
	Cu	<0.001	<0.001	-
	Fe	0.0011	0.0012	-8.696
	Pb	<0.001	<0.001	-
	Ni	0.011	0.013	-16.667
	Sr	8.055	7.905	1.880
	Zn	0.023	0.022	4.444

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No: 10405-ES- Dated: 07th July, 2015

CERTIFICATE OF ANALYSIS

Ref: **F5034 CIA**

Sample ID: As per client ID

Client: Hagler Bailly Pakistan (Pvt) Ltd
39, Street 3, E7,
Islamabad, 44000
Pakistan.
Tel: +92 (51)-261-2-0200-07
(Attn: Mr. Asif Mahmood)

Project:

Date/Time sample received at lab: 15-06-15 / 09:30 PM

Sample Description: Three wastewater samples and two fresh water samples were received at lab with following details;

SAMPLE ID	NATURE OF SAMPLE	COLLECTION DATE	TIME	REMARKS
WW2	Wastewater	Jun 04, 2015	-	-
WW4	Wastewater	Jun 07, 2015		
WW1	Wastewater	Jun 07, 2015		
W5-1	Fresh Water	Jun 07, 2015		
W13	Fresh Water	Jun 07, 2015		

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No: 10405-ES- Dated: 07th July, 2015

		Lab ID		WW2	WW4	WW1	W5-1	W13
		Sample ID		WW2	WW4	WW1	W5-1	W13
		Unit	*LOR	Result				
Method Reference	Analysis Description	Date of Analysis 17-30 June,15						
US-EPA 200.8	Na	mg/l	<0.001	923.55	12169	836.6	192.53	355.81
US-EPA 200.8	K	mg/l	<0.001	167.32	392	95.41	14.28	22.34
US-EPA 200.8	Ca	mg/l	<0.001	215.26	505	184.24	142.79	164.66
US-EPA 200.8	Mg	mg/l	<0.001	474.23	1425	387.28	118.60	191.84
US-EPA 200.8	Br	mg/l	<0.001	108.7	65.2	95.8	45.3	50.2
US-EPA 200.8	As	mg/l	<0.001	0.589	0.013	0.322	0.006	0.017
US-EPA 200.8	B	mg/l	<0.001	8.352	2.308	5.276	0.075	0.060
US-EPA 200.8	Cd	mg/l	<0.001	0.120	<0.001	0.019	<0.001	<0.001
US-EPA 200.8	Cu	mg/l	<0.001	0.108	0.012	0.237	0.019	0.025
US-EPA 200.8	Fe	mg/l	<0.001	1.596	0.076	0.821	0.054	0.068
US-EPA 200.8	Pb	mg/l	<0.001	0.335	0.014	0.195	0.024	0.037
US-EPA 200.8	Ni	mg/l	<0.001	0.181	0.034	0.088	0.043	0.031
US-EPA 200.8	Sr	mg/l	<0.001	21.010	8.166	24.909	3.668	4.593
US-EPA 200.8	Zn	mg/l	<0.001	11.263	0.056	4.861	0.172	0.268

*LOR: Level of Reporting

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No: 10405-ES-

Dated: 07th July, 2015

BATCH QUALITY CONTROL – DUPLICATE SAMPLE

Sample ID	Parameters	QC DUPLICATED RESULTS		
		Sample Conc.	Check Sample Conc.	RPD
		mg/l	mg/l	%
WW2	Na	923.55	904.37	2.099
	K	167.32	169.22	-1.129
	Ca	215.26	208.96	2.970
	Mg	474.23	470.84	0.717
	Br	108.7	103.6	4.805
	As	0.589	0.571	3.103
	B	8.352	8.463	-1.320
	Cd	0.120	0.124	-3.279
	Cu	0.108	0.113	-4.525
	Fe	1.596	1.563	2.089
	Pb	0.335	0.311	7.430
	Ni	0.181	0.172	5.099
	Sr	21.010	20.584	2.048
	Zn	11.263	10.796	4.234
WW4	Na	12169	11945	1.858
	K	392	395	-0.762
	Ca	505	492	2.608
	Mg	1425	1388	2.631
	Br	65.2	63.9	2.014
	As	0.013	0.014	-7.407
	B	2.308	2.279	1.264
	Cd	<0.001	<0.001	-
	Cu	0.012	0.012	0.000
	Fe	0.076	0.074	2.667
	Pb	0.014	0.015	-6.897
	Ni	0.034	0.031	9.231
	Sr	8.166	8.029	1.692
	Zn	0.056	0.053	5.505

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No: 10405-ES-

Dated: 07th July, 2015

BATCH QUALITY CONTROL – DUPLICATE SAMPLE

Sample ID	Parameters	QC DUPLICATED RESULTS		
		Sample Conc.	Check Sample Conc.	RPD
		mg/l	mg/l	%
WW1	Na	836.6	821.44	1.829
	K	95.41	97.39	-2.054
	Ca	184.24	180.27	2.178
	Mg	387.28	381.45	1.517
	Br	95.8	94.7	1.155
	As	0.322	0.311	3.476
	B	5.276	5.257	0.361
	Cd	0.019	0.018	5.405
	Cu	0.237	0.229	3.433
	Fe	0.821	0.81	1.349
	Pb	0.195	0.189	3.125
	Ni	0.088	0.084	4.651
	Sr	24.909	24.622	1.159
	Zn	4.861	4.737	2.584
WW5-1	Na	192.53	190.82	0.892
	K	14.28	14.57	-2.010
	Ca	142.79	144.43	-1.142
	Mg	118.60	116.35	1.915
	Br	45.3	44.7	1.333
	As	0.006	0.006	0.000
	B	0.075	0.072	4.082
	Cd	<0.001	<0.001	-
	Cu	0.019	0.018	5.405
	Fe	0.054	0.057	-5.405
	Pb	0.024	0.023	4.255
	Ni	0.043	0.044	-2.299
	Sr	3.668	3.645	0.629
	Zn	0.172	0.167	2.950

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No: 10405-ES-

Dated: 07th July, 2015

BATCH QUALITY CONTROL – DUPLICATE SAMPLE

Sample ID	Parameters	QC DUPLICATED RESULTS		
		Sample Conc.	Check Sample Conc.	RPD
		mg/l	mg/l	%
W13	Na	355.81	351.07	1.341
	K	22.34	22.01	1.488
	Ca	164.66	161.39	2.006
	Mg	191.84	187.34	2.374
	Br	50.2	51.9	-3.330
	As	0.017	0.017	0.000
	B	0.060	0.06	0.000
	Cd	<0.001	<0.001	-
	Cu	0.025	0.026	-3.922
	Fe	0.068	0.07	-2.899
	Pb	0.037	0.035	5.556
	Ni	0.031	0.03	3.279
	Sr	4.593	4.572	0.458
	Zn	0.268	0.251	6.551

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آغا خان یونیورسٹی ہسپتال، کراچی
The Aga Khan University Hospital, Karachi

MICROBIOLOGY QUALITY CONTROL
MICROBIOLOGY REPORT

Tel: 34930051 Ext. 1552

L18417158
C/O,HAGLER BAILLY PAKISTAN
Unknown2,015Y ACC # C19013762

LOC: LAB STATUS: OSR
2015 : BQ2167R - 32780852 [COMP]
COLL: 05/06/2015 -21:21 RECD: 05/06/2015 - 23:02

CONSULTING PHYSICIAN: UNKNOWN
REQUESTED BY : UNKNOWN
CLINICAL INFORMATION / COMMENTS :

REQUEST SLIP RETURNED TO PATIENT
01 WATER CULTURE BOTTLE RECD
(SAMPLE ID # WW2-1) EC5

SOURCE : WATER

SPECIMEN DATA :- [Final Report]

PLACE/SOURCE	:	C/O HAGLER BAILLY PAKISTAN,
SAMPLE	:	WATER CULTURE (AS MARKED) SAMPLE ID # WW2-1 500 ML STS CONTAINER RECEIVED.

RESULTS:- [Final Report]

TOTAL COLONY COUNT	:	855 CFU/ML
TOTAL COLIFORMS	:	TOO NUMEROUS TO COUNT CFU/100 ML
FECAL E.COLI	:	NIL
FECAL ENTEROCOCCI	:	NIL

COMMENTS:- [Final Report]

The sample submitted is bacteriologically unsatisfactory.(see reference value given below)

Recommended value for drinking water (piped supply/ well water)

Organism	Recomended value
Total colony count	less than 500 cfu/ ml
Total coliforms	0/100 mls
Faecal E.coli	0/100 mls
Faecal streptococci/Enterococci	0/100 mls

Presence of E.coli,faecal streptococci and enterococci is suggestive of faecal contamination.

NOTE: The above results can not be used for advertising purposes.

MICROBIOLOGY QUALITY CONTROL
MICROBIOLOGY REPORT

Tel: 34930051 Ext. 1552

CONSULTING PHYSICIAN: UNKNOWN
REQUESTED BY : UNKNOWN
CLINICAL INFORMATION / COMMENTS :

REQUEST SLIP RETURNED TO PATIENT
01 WATER CULTURE BOTTLE RECD
(SAMPLE ID # W3) ECH

L18417158
C/O,HAGLER BAILLY PAKISTAN
Unknown2,015Y ACC # C19013764

LOC: LAB STATUS: OSR
2015 : BQ2168R - 32780858 [COMP]
COLL: 05/06/2015 -21:22 RECD: 05/06/2015 - 23:02

SOURCE : WATER

SPECIMEN DATA :- [Final Report]

PLACE/SOURCE	:	C/O HAGLER BAILLY PAKISTAN,
SAMPLE	:	WATER CULTURE (AS MARKED) SAMPLE ID# W3 500 ML STS CONTAINER RECEIVED.

RESULTS:- [Final Report]

TOTAL COLONY COUNT	:	530CFU/ML
TOTAL COLIFORMS	:	TOO NUMEROUS TO COUNT CFU/100 ML
FECAL E.COLI	:	NIL
FECAL ENTEROCOCCI	:	NIL

COMMENTS:- [Final Report]

The sample submitted is bacteriologically unsatisfactory.(see reference value given below)

Recommended value for drinking water
(piped supply/ well water)

Organism	Recomended value
Total colony count	less than 500 cfu/ ml
Total coliforms	0/100 mls
Faecal E.coli	0/100 mls
Faecal streptococci/Enterococci	0/100 mls

Presence of E.coli, faecal streptococci and enterococci is suggestive of faecal contamination.

NOTE: The above results can not be used for advertising purposes.

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The Aga Khan University Hospital, Karachi

MICROBIOLOGY QUALITY CONTROL
MICROBIOLOGY REPORT

Tel: 34930051 Ext. 1552

L18417158
C/O,HAGLER BAILLY PAKISTAN
Unknown2,015Y ACC # C19013758

LOC: LAB STATUS: OSR
2015 : BQ2166R - 32780851 [COMP]
COLL: 05/06/2015 -21:21 RECD: 05/06/2015 - 23:02

CONSULTING PHYSICIAN: UNKNOWN
REQUESTED BY : UNKNOWN
CLINICAL INFORMATION / COMMENTS :

REQUEST SLIP RETURNED TO PATIENT
01 WATER CULTURE BOTTLE RECD
(SAMPLE ID # W10-1) /EC11

SOURCE : SEE COMMENTS

SPECIMEN DATA :- [Final Report]

PLACE/SOURCE	:	C/O HAGLER BAILLY PAKISTAN,
SAMPLE	:	WATER CULTURE (AS MARKED) SAMPLE ID# W10-1 500 ML STS CONTAINER RECEIVED.

RESULTS:- [Final Report]

TOTAL COLONY COUNT	:	470 CFU/100 ML
TOTAL COLIFORMS	:	TOO NUMEROUS TO COUNT CFU/100 ML
FECAL E.COLI	:	18 CFU/100 ML
FECAL ENTEROCOCCI	:	NIL

COMMENTS:- [Final Report]

The sample submitted is bacteriologically unsatisfactory.(see reference value given below)

Recommended value for drinking water
(piped supply/ well water)

Organism	Recomended value
Total colony count	less than 500 cfu/ ml
Total coliforms	0/100 mls
Faecal E.coli	0/100 mls
Faecal streptococci/Enterococci	0/100 mls

Presence of E.coli,faecal streptococci and enterococci is suggestive of faecal contamination.

NOTE: The above results can not be used for advertising purposes.

This is a computer generated report therefore does not require any signature. Date: 15/06/2015 10:40:30

ICN # S216131

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The Aga Khan University Hospital, Karachi

MICROBIOLOGY QUALITY CONTROL
MICROBIOLOGY REPORT

Tel: 34930051 Ext. 1552

CONSULTING PHYSICIAN: UNKNOWN
REQUESTED BY : C/O HEGLER BAILLY
CLINICAL INFORMATION / COMMENTS :

REQUEST SLIP ATTACHED
02 WATER CS BOTTLE RECD
W5-1

L18422182
C/O,HEGLER BAILLY PAKISTAN
Unknown2,015Y ACC # C19023287

LOC: LAB STATUS: OSR
2015 : BQ2190R - 32793427 [COMP]
COLL: 07/06/2015 -16:10 RECD: 07/06/2015 - 18:21

SOURCE : WATER

SPECIMEN DATA :- [Final Report]

PLACE/SOURCE	:	C/O,HEGLER BAILLY PAKISTAN W5-1
SAMPLE	:	WATER (AS MARKED) 500 ML STS CONTAINER RECEIVED.

RESULTS:- [Final Report]

TOTAL COLONY COUNT	:	> 5700 CFU / ML
TOTAL COLIFORMS	:	TOO NUMEROUS TO COUNT CFU/100 ML
FECAL E.COLI	:	NIL
FECAL ENTEROCOCCI	:	NIL

COMMENTS:- [Final Report]

The sample submitted is bacteriologically unsatisfactory.(see reference value given below)

Recommended value for drinking water
(piped supply/ well water)

Organism	Recomended value
Total colony count	less than 500 cfu/ ml
Total coliforms	0/100 mls
Faecal E.coli	0/100 mls
Faecal streptococci/Enterococci	0/100 mls

Presence of E.coli,faecal streptococci and enterococci is suggestive of faecal contamination.

NOTE: The above results can not be used for advertising purposes.

This is a computer generated report therefore does not require any signature. Date: 15/06/2015 10:37:57

MICROBIOLOGY QUALITY CONTROL
MICROBIOLOGY REPORT

Tel: 34930051 Ext. 1552

CONSULTING PHYSICIAN: C/O HEGLER BAILLY
REQUESTED BY : C/O HEGLER BAILLY
CLINICAL INFORMATION / COMMENTS :

REQUEST SLIP ATTACHED
02 water cs bollte recd
W 13

L18422182
C/O,HEGLER BAILLY PAKISTAN
Unknown2,015Y ACC # C19023280

LOC: LAB STATUS: OSR
2015 : BQ2189R - 32793416 [COMP]
COLL: 07/06/2015 -16:08 RECD: 07/06/2015 - 18:21

SOURCE : WATER

SPECIMEN DATA :- [Final Report]

PLACE/SOURCE	:	C/O,HEGLER BAILLY PAKISTAN W 13
SAMPLE	:	WATER (AS MARKED) 500 ML STS CONTAINER RECEIVED.

RESULTS:- [Final Report]

TOTAL COLONY COUNT	:	> 5700 CFU / ML
TOTAL COLIFORMS	:	TOO NUMEROUS TO COUNT CFU/100 ML
FECAL E.COLI	:	ISOLATED
FECAL ENTEROCOCCI	:	NIL

COMMENTS:- [Final Report]

The sample submitted is bacteriologically unsatisfactory.(see reference value given below)

Recommended value for drinking water (piped supply/ well water)

Organism	Recomended value
Total colony count	less than 500 cfu/ ml
Total coliforms	0/100 mls
Faecal E.coli	0/100 mls
Faecal streptococci/Enterococci	0/100 mls

Presence of E.coli,faecal streptococci and enterococci is suggestive of faecal contamination.

NOTE: The above results can not be used for advertising purposes.

B.2 Baseline Air Quality

No.	*Project/Research Paper*	*Start Date of Sampling*	*Duration (days)*	*Year*	*Category*	*Latitude*	*Longitude*	*Source*	*Results SO_2 ($\mu g/m^3$)*	*Results NO_2 ($\mu g/m^3$)*	*Results NO ($\mu g/m^3$)*	*Results TSP ($\mu g/m^3$)*	*Results PM_{10} ($\mu g/m^3$)*	*Results $PM_{2.5}$ ($\mu g/m^3$)*
1	EIA of Engro Powergen Limited 225 MW RLNG CCPP[1]	3/4/2015	3	2015	D	24.7984	67.3856	R*	15.9	12.1	19.2	310.0	125.0	25.6
2	EIA of Engro Powergen Limited 225 MW RLNG CCPP	3/4/2015	3	2015	A	24.7913	67.4380	R	12.0	7.0	12.0	232.0	102.0	22.4
3	EIA of 350MW Coal Fired Power Plant by Siddiqsons Energy Limited[2]		1	2015	D	24.7885	67.3855	E*	17.5	3.7	15.4	163.5		14.2
4	ESIA of Reinforcemnet of 220kV KCR - Lalazar Transmission Lines Circuit 1 and 2 and 132kV Port Qasim Pipri west RECP Gharro Transmission Lines[3]		1	2015	B	24.8222	67.3353	E					144.0	
5	ESIA of Reinforcemnet of 220kV KCR - Lalazar Transmission Lines Circuit 1 and 2 and 132kV Port Qasim Pipri west RECP Gharro		1	2015	B	24.8383	67.3083	E					91.0	

1 Hagler Bailly Pakistan (July 2015). "Environmental Impact Assessment of Engro Powergen Limited 225 MW RLNG CCPP Port Qasim Authority, Karachi", Engro Powergen (Pvt) Ltd., Karachi.

2 Environmental Management Consultants (March 2015). "Environmental Impact Assessment of 350 MW Imported Coal Power Project at Port Qasim, Sindh", Siddiqsons Energy Ltd., Karachi.

3 Global Environmental Management Services (May 2015). "Environmental and Social Impact Assessment of Reinforcement of 220kV KCR - Lalazar Transmission Lines Circuit 1 and 2 and 132kV Port Qasim Pipri west RECP-Gharo Transmission Lines", K-Electric Ltd.

No.	*Project/Research Paper*	*Start Date of Sampling*	*Duration (days)*	*Year*	*Category*	*Latitude*	*Longitude*	*Source*	*Results SO_2 ($\mu g/m^3$)*	*Results NO_2 ($\mu g/m^3$)*	*Results NO ($\mu g/m^3$)*	*Results TSP ($\mu g/m^3$)*	*Results PM_{10} ($\mu g/m^3$)*	*Results $PM_{2.5}$ ($\mu g/m^3$)*
	Transmission Lines													
6	EIA of Sinohydro's 2×660 MW Coal Power Plant[4]	3/14/2014	5	2014	D	24.7842	67.3652	R	16.0	12.9	8.9	183.0	80.4	18.6
7	EIA of Sinohydro's 2×660 MW Coal Power Plant	3/14/2014	5	2014	B	24.8068	67.3200	R	11.8	10.1	6.1	216.2	88.9	20.8
8	EIA of Sinohydro's 2×660 MW Coal Power Plant	3/14/2014	5	2014	A	24.7982	67.4064	R	13.4	9.3	6.4	199.6	81.1	18.6
9	EIA of Sinohydro's 2×660 MW Coal Power Plant	3/14/2014	5	2014	A	24.8216	67.3919	R	11.8	10.1	6.1	216.9	88.9	20.8
10	Fauji Akbar Portia Terminal[5]		1	2014	D	24.7664	67.3212	E	83.8	27.1	12.0			
11	Fauji Akbar Portia Terminal		1	2014	D	24.7679	67.3219	E	78.6	24.8	11.0			
12	Fauji Akbar Portia Terminal		1	2014	D	24.7652	67.3207	E	94.3	29.3	13.0			
13	Fauji Akbar Portia Terminal		1	2014	D	24.7658	67.3214	E	89.1	31.6	14.0			
14	Fauji Akbar Portia Terminal		1	2014	D	24.7674	67.3208	E	94.3	24.8	11.0			
15	Engro Vopak Terminal Limited[6]		1	2014	D	24.7763	67.3296	E	11.8	18.3	8.1		122.4	
16	EIA of Coal Power Plant Project Fauji Fertilizer Bin Qasim Complex[7]	7/11/2013	17	2013	A	24.8165	67.4142	R	22.8	20.2	5.4		117.4	

4 Hagler Bailly Pakistan (March 2014). "Environmental Impact Assessment of Sinohydro's 2×660 MW Coal Power Plant, Bin Qasim, Karachi", Sinohydro Holding Ltd., Hong Kong.

5 Environmental Management Consultants (July 2014). "Environmental Impact Assessment of Engro Fast Track LNG Regasification Project", Engro Elengy Terminal (Pvt) Ltd.

6 Ibid

7 Hagler Bailly Pakistan (February 2014). "Environmental Impact Assessment of Coal Power Plant (CPP) Project Fauji Fertilizer Bin Qasim Complex", Fauji Fertilizer Bin Qasim Ltd., Karachi.

No.	*Project/Research Paper*	*Start Date of Sampling*	*Duration (days)*	*Year*	*Category*	*Latitude*	*Longitude*	*Source*	*Results SO_2 ($\mu g/m^3$)*	*Results NO_2 ($\mu g/m^3$)*	*Results NO ($\mu g/m^3$)*	*Results TSP ($\mu g/m^3$)*	*Results PM_{10} ($\mu g/m^3$)*	*Results $PM_{2.5}$ ($\mu g/m^3$)*
17	EIA of Coal Power Plant Project Fauji Fertilizer Bin Qasim Complex	7/11/2013	17	2013	A	24.8440	67.4323	R	22.5	18.4	11.1	236.1	142.5	69.4
18	EIA of Coal Power Plant Project Fauji Fertilizer Bin Qasim Complex	7/11/2013	17	2013	A	24.8312	67.3913	R	12.2	12.0	9.7		122.6	
19	EIA of Bin Qasim Coal Conversion Project[8]	6/23/2012	6	2012	D	24.7892	67.3733	R	35.9	13.8	13.7		120.8	43.3
20	EIA of Bin Qasim Coal Conversion Project	6/23/2012	6	2012	D	24.7804	67.3545	R	26.0	9.7	9.6		83.7	32.2
21	EIA of Bin Qasim Coal Conversion Project	6/23/2012	6	2012	D	24.7877	67.3616	R	34.4	14.1	14.3		98.4	36.9
22	EIA of 100MW Wind Power Project at Dhabeji [9]		1	2012	E	24.7900	67.5562	E	25.4	13.1	5.8		140.6	
23	ESIA of Coal Clinker and Cement Terminal[10]	3/28/2011	1	2011	B	24.8163	67.2915	R	30.9	18.3	8.1		124.4	
24	IEE of PPTA Cogeneration Power Plant[11]	7/1/2006	1	2006	C	24.7940	67.3906	E	78.0		73.0	267.9	233.2	
25	EIA of Engro Asahi Polymer and Chemical Limited - Expansion Project[12]	3/7/2006	1	2006	C	24.7942	67.3762	E	62.0	27.0	18.0			

8 Hagler Bailly Pakistan (September 2013). "Environmental Impact Assessment of Bin Qasim Coal Conversion Project", K-Energy (Pvt.) Ltd., Karachi.

9 Environmental Management Consultants (January 2012). "Environmental Impact Assessment of 100MW Wind Power Project at Dhabeji", NBT Wind Power Pakistan (Pvt) Ltd.

10 Environmental Management Consultants (July 2011). "Environmental and Social Impact Assessment of Proposed Coal Clinker and Cement Import/Export Terminal at Port Qasim Karachi", Pakistan International Bulk Terminal.

11 Hagler Bailly Pakistan (May 2007). "Initial Environmental Examination of PPTA Cogeneration Power Plant", Pakistan PTA Ltd., Karachi.

12 Hagler Bailly Pakistan (February 2009). "Environmental Impact Assessment of Engro Asahi Polymer Chemical Ltd. Expansion Project", EAPCL Karachi.

No.	*Project/Research Paper*	*Start Date of Sampling*	*Duration (days)*	*Year*	*Category*	*Latitude*	*Longitude*	*Source*	*Results SO_2 ($\mu g/m^3$)*	*Results NO_2 ($\mu g/m^3$)*	*Results NO ($\mu g/m^3$)*	*Results TSP ($\mu g/m^3$)*	*Results PM_{10} ($\mu g/m^3$)*	*Results $PM_{2.5}$ ($\mu g/m^3$)*
26	EIA of Engro Asahi Polymer and Chemical Limited - Expansion Project	12/8/2005	1	2005	C	24.7942	67.3762	E	60.0	26.4	17.6			
27	EIA of Engro Asahi Polymer and Chemical Limited - Expansion Project	2/9/2005	1	2005	C	24.7900	67.3754	E	58.0	27.6	18.4			
28	EIA of Engro Asahi Polymer and Chemical Limited - Expansion Project	8/6/2005	1	2005	C	24.7972	67.3735	E	58.0	28.8	19.2			
29	EIA of Engro Asahi Polymer and Chemical Limited - Expansion Project	8/3/2005	1	2005	C	24.7926	67.3706	E	68.0	34.2	22.8			
30	Research Paper on Air Quality in the Atmosphere of Karachi City - An Overview[13]		1	2005	C	24.7971	67.3255	E	12.2	7.6				
31	Research Paper on Ambient Air Quality at Port Qasim in Karachi City[14]		7	2005	C	24.7904	67.3388	E	6.3	21.2	2.9		123.5	
32	EIA of Engro Asahi Polymer and Chemical Limited - Expansion Project	9/12/2004	1	2004	C	24.7942	67.3762	E	66.0	32.4	21.6			
33	EIA of Engro Asahi Polymer and Chemical Limited - Expansion Project	9/9/2004	1	2004	C	24.7963	67.3736	E	62.0	34.8	23.2			

[13] Hashmi et al., (revised. June 2004). *"Air Quality in the Atmosphere of Karachi City – An Overview"*, Journal of Chemical Society Pakistan, Vol. 27. No. 1.

[14] Hashmi et al., (revised. October 2005). *"Ambient Air Quality at Port Qasim in Karachi City"*, Journal of Chemical Society Pakistan, Vol. 27. No. 6.

No.	*Project/Research Paper*	*Start Date of Sampling*	*Duration (days)*	*Year*	*Category*	*Latitude*	*Longitude*	*Source*	*Results SO_2 ($\mu g/m^3$)*	*Results NO_2 ($\mu g/m^3$)*	*Results NO ($\mu g/m^3$)*	*Results TSP ($\mu g/m^3$)*	*Results PM_{10} ($\mu g/m^3$)*	*Results $PM_{2.5}$ ($\mu g/m^3$)*
34	EIA of Engro Asahi Polymer and Chemical Limited - Expansion Project	10/6/2004	1	2004	C	24.7934	67.3706	E	85.0	47.4	31.6			
35	EIA of Engro Asahi Polymer and Chemical Limited - Expansion Project	9/3/2004	1	2004	C	24.7895	67.3754	E	83.0	45.6	30.4			

1 shows assumed days for sampling where there is no information on duration of sampling

R shows that the coordinates are actual and reported in the EIA's

E shows that the coordinates are estimated based on the theoratical description of sampling location in the EIA's

Appendix C: Ecological Baseline Studies

C.1 Mangrove Studies C-3

C.1.1 Selection of Study Sites C-3

C.1.2 Analysis of Google Earth™ Images to Study Spatial and Temporal Variations in Mangrove Habitat Types C-5

C.1.2.1 Spatial Variations C-5

C.1.2.2 Temporal Variations C-8

C.1.3 Field Sampling Plan C-12

C.1.3.1 Sampling Methodology C-12

C.1.3.2 Data Collection Forms C-16

C.1.4 Field Log, Data, and Analysis C-18

C.1.4.1 Study Site M1 ..... C-20

C.1.4.2 Study Site M2 ..... C-32

C.1.4.3 Study Site M5 ..... C-46

C.1.4.4 Study Site M7 ..... C-59

C.1.4.5 Conclusions C-71

C.2 Fish Studies C-74

C.2.1 Overview of Aquatic Biodiversity at Keti Bandar and Differences in the Physical and Ecological Setting between Keti Bandar and Port Qasim by Dr. Muhammad Rafique, PMNH C-74

C.2.1.1 Introduction C-74

C.2.1.2 Study Methodology C-75

C.2.1.3 Fish of Economic Importance C-94

C.2.1.4 Overview of Differences in the Physical and Ecological Setting between Keti Bandar and Port Qasim C-94

C.2.1.5 Recommendations for Indicator Fish Species C-95

C.2.1.6 References C-96

C.2.2 Results Fish Tissue Laboratory Analysis – 2015 ..... C-99

C.2.3 Fish Sampling Study at Port Qasim - 2015 ..... C-110

C.2.3.1 Literature Review C-110

C.2.3.2 Sampling Plan C-111

C.2.3.3 Results C-114

C.2.3.4 Discussion and Conclusions C-122

Annexures:

Annexure A: Mangrove Data..... C-123

Annexure B: Port Qasim Fish Sampling Data – 2015..... C-124

C.1 Mangrove Studies

The following studies were conducted to establish the baseline conditions of the mangroves in the Study Area and to understand the trends in changes in their condition over time:

1. Spatial and Temporal Analysis Using Google Earth™ Images
2. Assessment of Mangroves through Field Sampling

Sites within the Study Area selected for assessment and analysis were common to both of the studies.

C.1.1 Selection of Study Sites

Sites first selected for collection of data on mangroves (Study Sites) are marked from M1 to M7 in **Exhibit C.1**. These sites were selected to assess the spatial variations in mangrove habitat, and cover the extent of habitat from North to South (M1, M5, M6, M7) moving from mainland and Port Qasim towards the open sea, and from West to East moving from Port Qasim towards the Indus Delta (M1, M2, M3, M4). Of the identified sites, sampling could only be conducted at the sites M1, M2, M5, and M7.

Exhibit C.1: Map of Study Sites

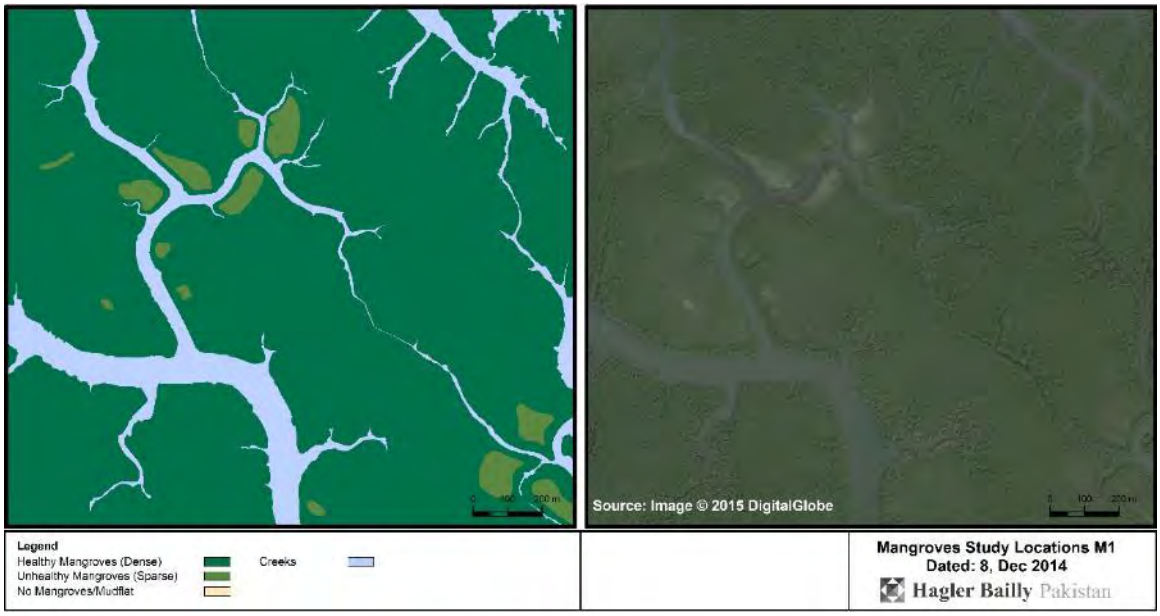


C.1.2 Analysis of Google Earth™ Images to Study Spatial and Temporal Variations in Mangrove Habitat Types

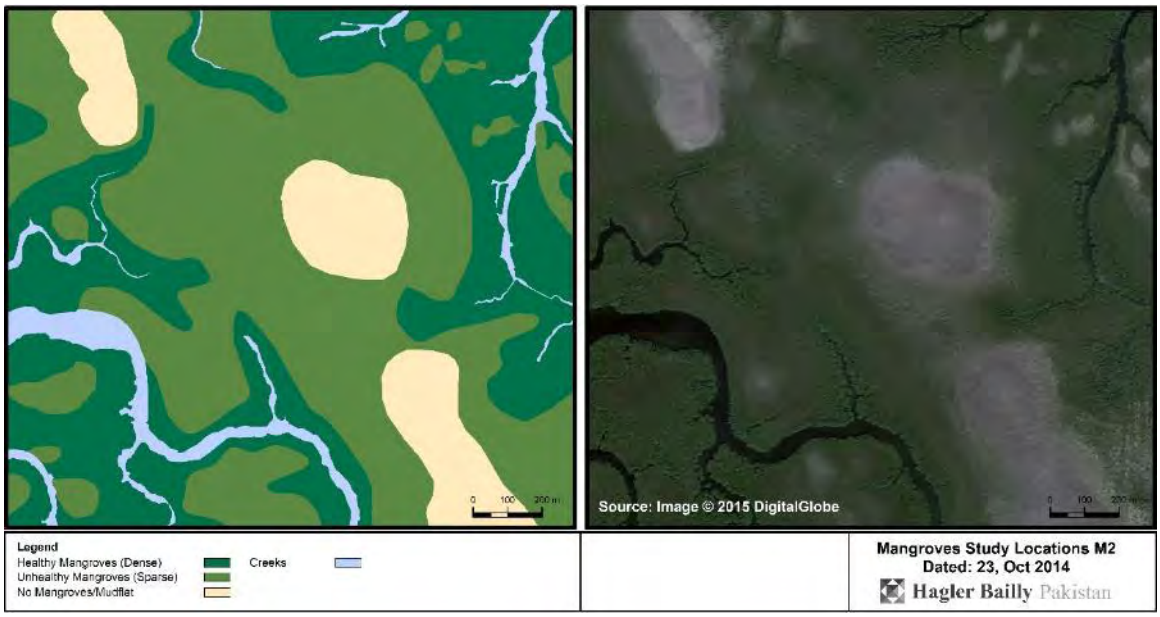
C.1.2.1 Spatial Variations

Google Earth™ Images for the selected sites measuring 1.5 km x 1.5 km (see **Appendix C.1.1**) and identification of mangrove habitat types in the study sites as defined in **Appendix C.1** are shown in the following images.

Study Site M1



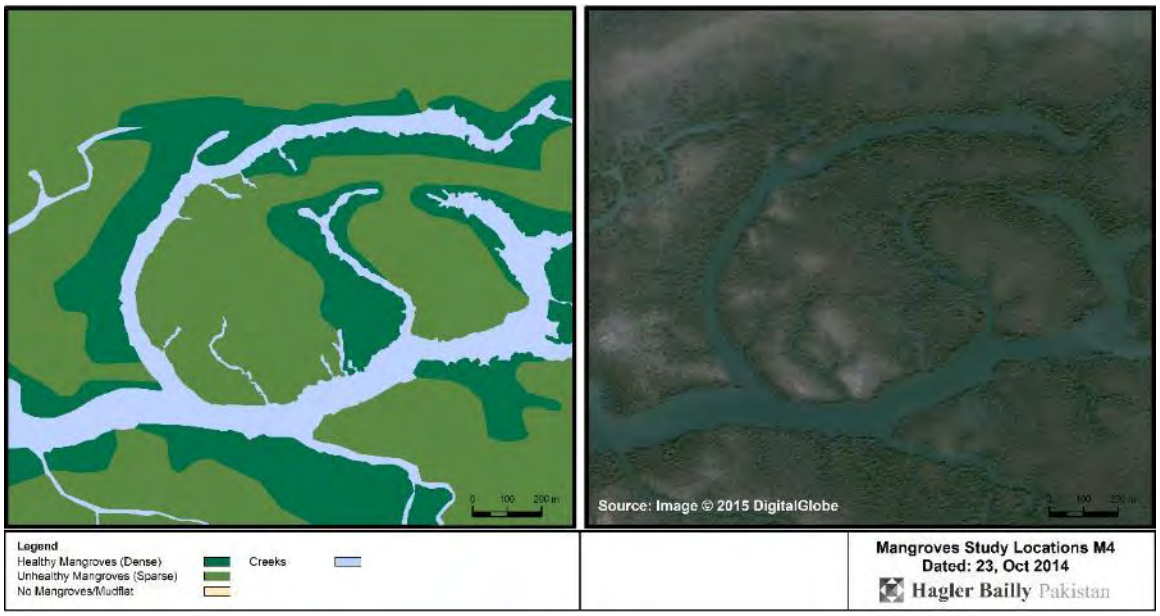
Study Site M2



Study Site M3



Study Site M4



Study Site M5



Study Site M6



Study Site M7



Distribution of habitat types at the selected sites is summarized in **Exhibit C.2**.

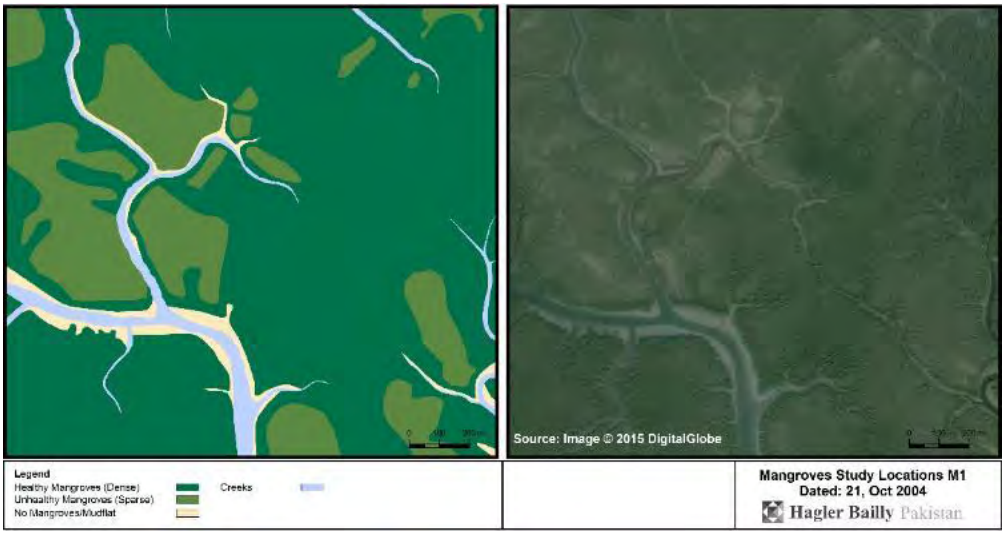
Exhibit C.2: Mangrove Percentage Area Spatial Variations

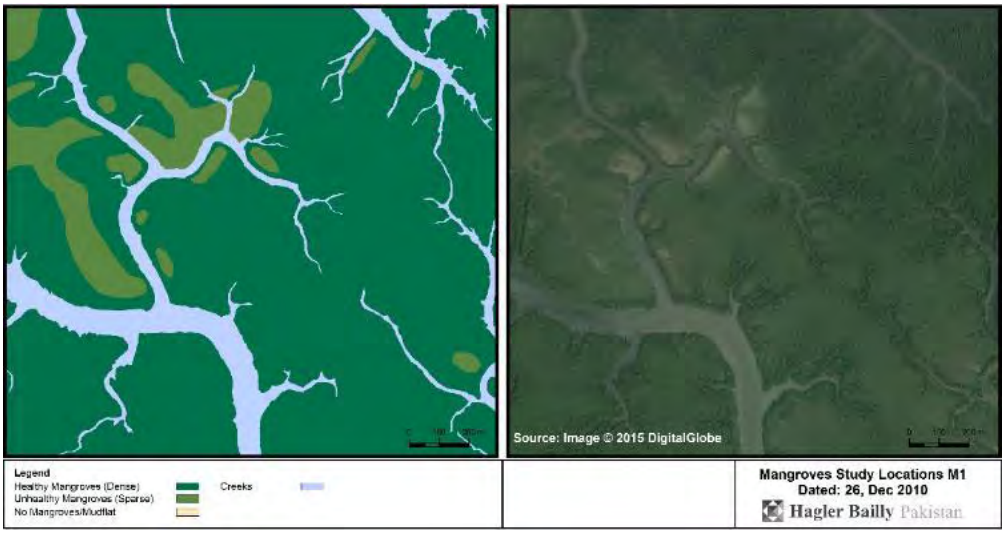
Study Sites	*% Mangrove Category*					
	Healthy Mangroves (Dense)	*Unhealthy Mangroves (Sparse)*	*Mangrove Dieback*	*No Mangroves Area*	*Creek Area*	*Total %*
M1	87	3	0	0	10	100
M2	35	48	0	11	5	100
M3	80	6	0	0	15	100
M4	25	60	0	0	14	100
M5	28	52	0	14	6	100
M6	46	41	0	1	12	100
M7	11	70	0	13	6	100

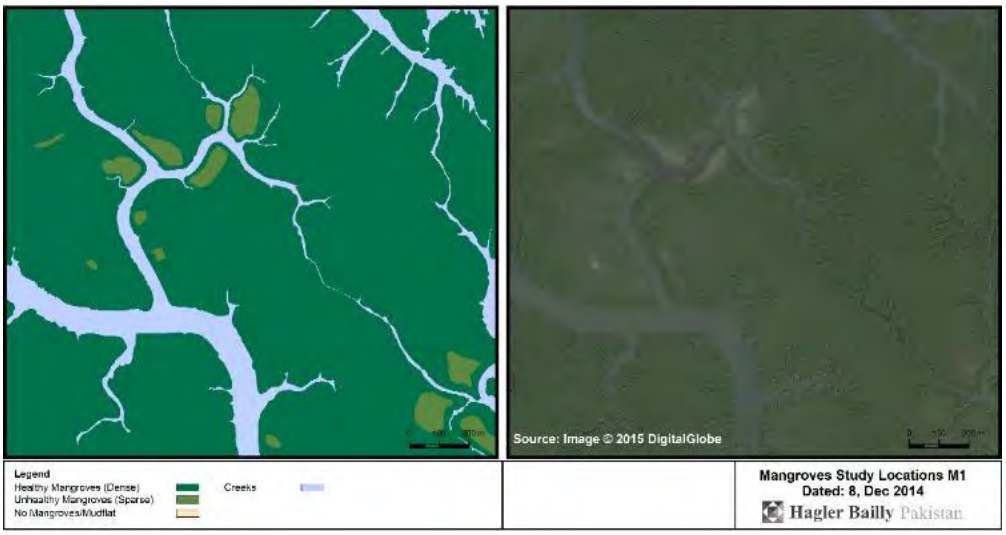
C.1.2.2 Temporal Variations

Time series Google Earth™ Images for sites M1, M2, and M7 (see **Appendix C.1.1**) and identification of mangrove habitat types in the images as defined in **Appendix C.1** are shown in the following images.

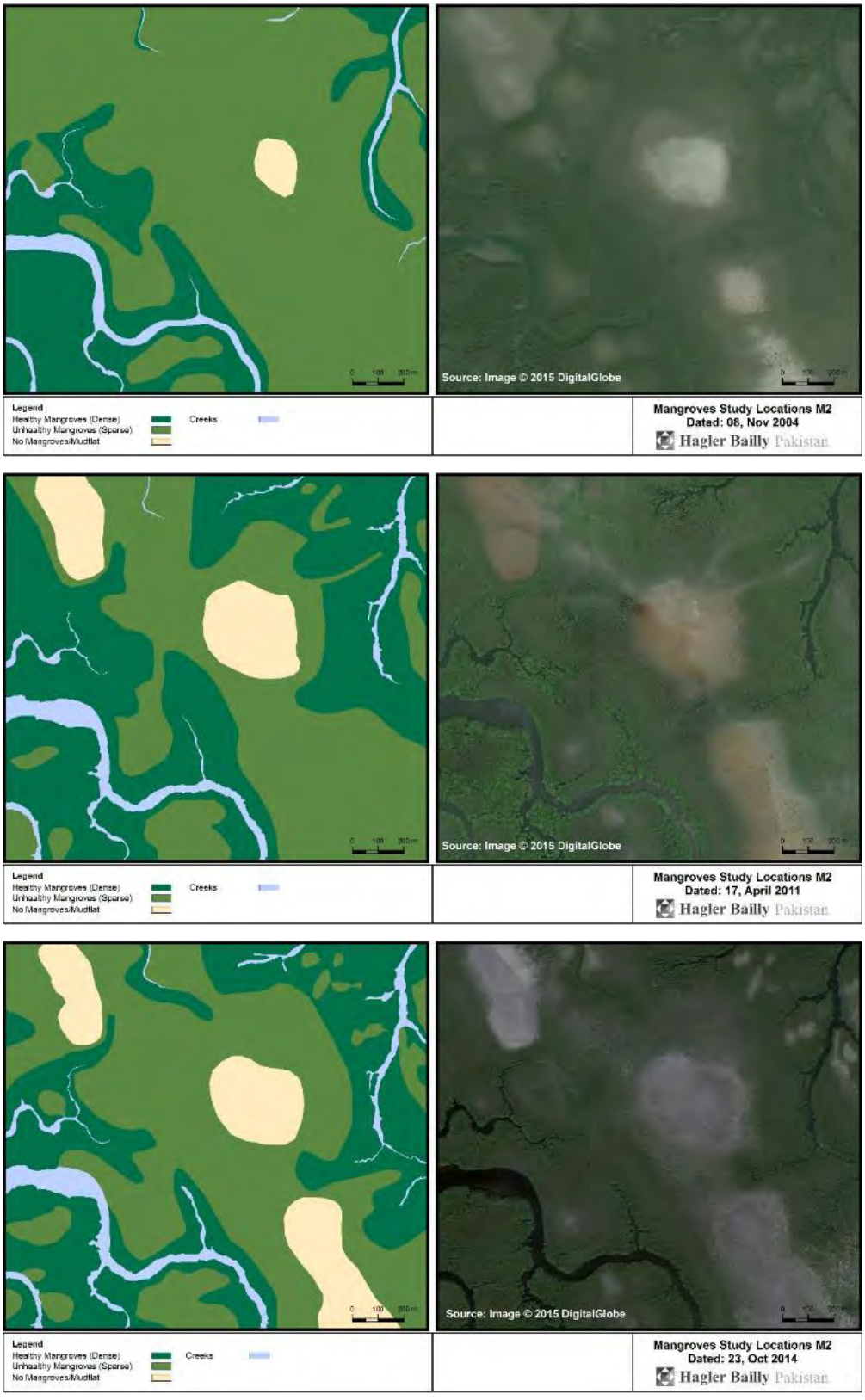
Study Site M1







Study Site M2



Study Site M7







Variations of habitat types over time for study sites M1, M2, and M7 are summarized in **Exhibit C.3**.

Exhibit C.3: Temporal Variations in Mangrove Area

Temporal Variations of Areas in Mangrove Study Sites		*Healthy Mangroves (Dense)*	*Unhealthy Mangroves (Sparse)*	*Mangrove Dieback*	*No Mangroves Area*	*Creek Area*	*Total %*
M1	2004	72	21	0	3	4	100
	2010 (last quarter)	80	9	0	0	11	100
	2014	87	3	0	0	10	100
M2	2004	25	70	0	1	4	100
	2011	47	41	0	8	5	100
	2014	35	48	0	11	5	100
M7	2004	47	49	0	0	3	100
	2011	46	51	0	0	3	100
	2014	11	70	0	13	6	100

C.1.3 Field Sampling Plan

A study on mangroves was carried out to prepare the baseline for 'Mangrove Habitat' (**Section 5.3** of the CIA Report). A mangrove sampling exercise was planned to assess the present condition of the mangroves in the Study Area. This Mangroves Sampling Plan was prepared to provide the framework for collection of field data for this assessment.

C.1.3.1 Sampling Methodology

Literature Review

Studies done elsewhere for assessment and monitoring of mangroves were consulted for development of a methodology for sampling of mangroves. These include the following studies:

- J. Boone Kauffman, Daniel C. Donato, Protocols for the measurement, monitoring and reporting of structure, biomass and carbon stocks in mangrove forests, Centre for International Forestry Research, Working Paper 86, 2012
- Daniel Bucher, Mateus, Baronio & Debra Stokes, Monitoring Mangrove Condition: Gladstone Harbour, Fishermans Landing, Southern Cross University School of Environment, Science and Engineering, 2013
- Professor Colin Field, Local management and rehabilitation of mangroves: present and future, University of Technology, Sydney, Australia, 2007
- Department of Employment, Economic Development and Innovation, Queensland Government, Data collection protocol for mapping and monitoring mangrove communities in Queensland, 2011
- Tania Betts, An Assessment of Mangrove Cover and Forest Structure in Las Perlas, Panama, Submitted as part assessment for the degree of Master of Science

in Marine Resource Development and Protection, School of Life Sciences, Heriot-Watt University, Edinburgh, 2006

The methodologies adopted by the reference studies were found to be comparatively more detailed. For the purpose of this study, given the objectives of the study and resources available, a simplified approach with a relatively smaller number of parameters was selected.

Mangrove Habitat Classification

Health categories selected for the study are defined in **Exhibit C.4**. The health category of mangroves at the sampling location was noted.

Exhibit C.4: Categorization of Mangrove Health

Category	*Definition*
Healthy Mangroves	Excellent condition with trees in good health, very tall and large trees, canopy very compact, leaves not yellowing, daily tidal flushing and drainage
Unhealthy Mangroves	Generally reasonable health but sparse canopy, leaves not yellowing, trees moderate height, young and/or stunted growth, possibly due to low nutrients and high salinity moderate or no extensive epicormic[1] growth, daily tidal flushing and drainage
Mangroves with Die Back	Very bad condition, leaves yellowing or dead, degrading main trunk, canopy very open, lots of broken branches and trees falling, suffering from lack of tidal flushing due to raised ground, extensive epicormic growth

Location of Transects and Quadrats

Sampling was conducted in each Health Category at each Mangrove Study Site with a maximum of three Health Categories at one site (Healthy Mangroves, Unhealthy Mangroves, and Mangrove Dieback). Sampling was conducted in quadrats of 10m x 10m. Depending on the accessibility, a maximum of three quadrats were located on a transect of 100m to record the variations in the Health Category being studied, at the start of the transect, at 50m, and at the end of the transect.

Sampling Parameters

The sampling parameters along with justifications for their selection are provided in **Exhibit C.5**.

[1] Epicormic growth means a shoot or branch growing from a previously dormant bud on the trunk or a limb of a tree (Oxford Dictionaries). Epicormic buds are dormant vegetative buds embedded beneath the bark that have a regenerative function after crown destruction, for example by fire (EUCLID, Centre for Plant Biodiversity Research, Contributors: AV Slee, MIH Brooker, SM Duffy, JG West)

Exhibit C.5: Justifications for Selection of Sampling Parameters

No	*Parameters*	*Justification*
1	General Information	To obtain an understanding of site specific habitat conditions that the mangroves on that site are growing in
2	Adult Tree Density	To assess the overall health of the mangroves
3	Seedling Density	To assess the regeneration of mangroves[2]
4	Adult Tree Height	To assess the maturity of the mangroves[3]
5	Adult Tree Girth	To assess the maturity of the mangroves[4] May indicate a link between girth and age[5]
6	Canopy Cover	To give an indication of the proportion of seedlings that can develop; high canopy cover may hinder seedlings from developing
7	Leaf Quality	To assess the health of the mangrove trees
8	Epicormic Growth	To assess the health and level of destruction of the adult mangrove trees
9	Mangrove Health Category	To assess the proportion of mangrove trees falling into the three health categories: Healthy, Unhealthy and Dieback (**Exhibit 5.9** of the **CIA Report**)
10	Crab Holes Sampling	As part of the measure of mangrove habitat health and its ability to support crabs

Exhibit Sampling Procedure

Step 1: *General Quadrat Information*

The following general plot information was recorded:

- Ecological condition and land use: intact, degraded or deforested;
- Topography (micro relief): flat, depression, levee or hummock.
- Geomorphic setting: river delta, coastal fringe, interior or basin.
- Soil description: organic or mineral soil, sand, clay, silts.
- Cyclone damage: not evident, light, moderate or severe;

---

[2] Daniel Bucher, Mateus, Baronio & Debra Stokes, Monitoring Mangrove Condition: Gladstone Harbour, March 2013 Fishermans Landing, Southern Cross University School of Environment, Science and Engineering, 2013

[3] Tania Betts, An Assessment of Mangrove Cover and Forest Structure in Las Perlas, Panama, Submitted as part assessment for the degree of Master of Science in Marine Resource Development and Protection, School of Life Sciences, Heriot-Watt University, Edinburgh, 2006

[4] Ibid

[5] Department of Employment, Economic Development and Innovation, Queensland Government, Data collection protocol for mapping and monitoring mangrove communities in Queensland, 2011

- Disturbance evidence (timber harvest): not evident, low (<30% basal area), medium (30–70%), or high (>70%).Also describe the harvest;
- Other disease or disturbance: not evident, light, moderate or severe. Also describe the other disease or disturbance.

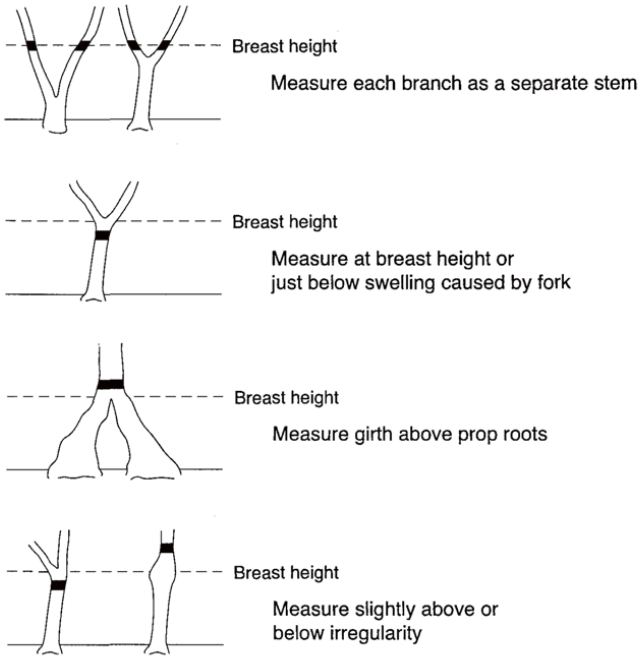
Step 2: *Counting of Adult Trees and Counting of Seedlings*

Adult trees and seedlings in a quadrat were counted to determine adult tree density and seedling density within quadrats. Adult trees were defined as those above 1m in height.[6] Where seedling density was observed to be too high for counting in a $100m^2$ area, number of seedlings were counted in a 1.0m by 1.0m quadrat and this count was multiplied by the total area to provide an estimate for the total number of seedlings in $100m^2$.

Step 3: *Measurement of Adult Tree Heights and Measurement of Adult Tree Girths/Diameter*

A graduated telescoping measuring rod was used to measure adult tree height. For tree girth measurement diameter at breast height was used (dbh). Method for measuring according to the shape of the trunk was taken from methods used in published research.[7] These are pictorially represented in **Exhibit C.6**.

Exhibit C.6: Rules for measuring breast height of mangroves with unusual shapes



[6] Tania Betts, An Assessment of Mangrove Cover and Forest Structure in Las Perlas, Panama, Submitted as part assessment for the degree of Master of Science in Marine Resource Development and Protection, School of Life Sciences, Heriot-Watt University, Edinburgh, 2006

[7] Ibid

Step 4: *Canopy Cover*

Canopy cover was measured as % view obscured by canopy. 16 equidistant grid points within the 10m by 10 m quadrat were walked on and at each point the observer looked up to observe visibility of sky or visibility of sky obscured by canopy. In case the canopy was not high enough for this to be applied, the observer used the same walking pattern but looked down instead of up to observe the visibility of the forest floor or it being obscured by the canopy cover. This observation at each of the 16 points, once completed provided a quantitative measure of the number of points at which the sky/forest floor is visible and hence the canopy cover of that 10m by 10m grid.

Step 5: *Leaf Quality (by Color)*

Leaf color is an indicator of leaf health. As these are the photosynthetic organs of the plant, this gives an indication of plant health. In the literature generally leaf litter is used as a standalone measure. As leaf quality was used as a part of health condition indicator, leaf quality specifically in terms of leaf color was observed. Trees within each quadrat showing leaves that had undergone yellowing were recorded.

Step 7: *Epicormic Growth*

Epicormic growth means a shoot or branch growing from a previously dormant bud on the trunk or a limb of a tree.[8] Epicormic buds are dormant vegetative buds embedded beneath the bark that have a regenerative function after crown destruction, for example by fire.[9] Trees within each quadrat showing epicormic growth were recorded.

Step 8: *Crabs Holes*

Crabs are considered a key stone species and are used as an indicator of productivity and importance of the site to support marine fauna.[10] Within each 10m by 10m quadrat four smaller 1m x 1m sub-quadrats were placed at the four corners and one at center of the 10m by 10m quadrat. Number of crab holes was counted in each 1m x 1m sub-quadrat and were averaged for the 10m x 10m quadrat. Where the exact number of crab holes could not be counted within each sub-quadrat (in most cases), the number counted was rounded off to the nearest 10 or, when possible the nearest 5, to provide as close as approximation as possible.

C.1.3.2 Data Collection Forms

Data collection forms used are included in the following pages.

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[8] Oxford Dictionaries, < http://www.oxforddictionaries.com/definition/english/epicormic> accessed September 1, 2015

[9] Contributors: AV Slee, MIH Brooker, SM Duffy, JG West. EUCLID, Centre for Plant Biodiversity Research, <http://www.anbg.gov.au/cpbr/cd-keys/euclid3/euclidsample/html/glossary.htm#E> accessed September 1, 2015

[10] Department of Employment, Economic Development and Innovation, Queensland Government, Data collection protocol for mapping and monitoring mangrove communities in Queensland, 2011

Hagler Bailly Pakistan

Sampling Form for Mangroves and Crabs

Sampling Location ID: SS ID ____ T # ____ Q # ____ GPS No: _____ Sampled by: _____

Time: H H M M AM/PM Date: D D M M Y Y

GPS Coordinates: **Start** N E WP No **End** N E WP No

General Quadrat Information: Quadrat Size ____ m X ____ m

Apparent Category: ☐ Healthy Mangroves ☐ Unhealthy Mangroves ☐ Mangrove Dieback

Notes

Ecological Condition and land use: ☐ Intact ☐ Degraded ☐ Deforested

Topography (microrelief): ☐ Flat ☐ Depression ☐ Levee[2] ☐ Hummock[2]

Geomorphic setting: ☐ River Delta ☐ Coastal Fringe ☐ Interior[3] ☐ Basin[4]

Soil description: ☐ Organic ☐ Sand ☐ Clay ☐ Silts ☐ Sample Collected

Disturbance evidence (timber harvest): ☐ Not evident ☐ Low (<30% basal area) ☐ Medium (30–70%) ☐ High (>70%)

Cyclone damage: ☐ Not evident ☐ Light ☐ Moderate ☐ Severe

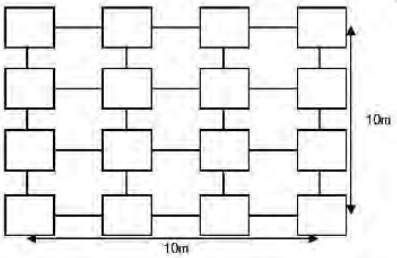
Other disease or disturbance: ☐ Not evident ☐ Light ☐ Moderate ☐ Severe

Number of Seedlings: _____

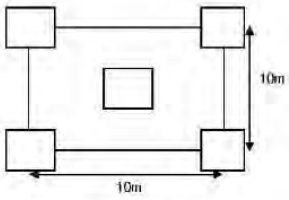
Number of Adult trees: _____

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Tree Height (m)																				
Tree Girth (cm)																				
Epicormic Growth																				
Yellowing of leaves																				

Canopy Cover:



Crab Holes



Quadrat Size ____ m x ____ m

Terms: 1-Levee is a a ridge of sediment deposited naturally alongside a river by overflowing water. 2- Hummock is a hill, a mound, or a ridge. 3- Interior: is a point located away from the coastal fringe but not exposed to the open ocean (approximately 100m away from the open sea). 4- Basin is a topographic region in which all water drains to a common area.

SS = Study Site, T = Transect, Q = Quadrat

Photograph ID

C.1.4 Field Log, Data, and Analysis

The mangrove sampling exercise planned (see **Appendix C.1.3**) was carried out from 18th to 22nd September 2015 as a part of preparation of ecological baseline for the Cumulative Impact Assessment for Industrial and Port Developments at Port Qasim.

Exhibit C.7 shows a map of proposed Study Sites. Reasons for the selection of Study Sites are given in the Mangrove Sampling Plan (**Appendix C.1**). Data collection was carried out at sampling locations near four Study Sites, M1, M2, M5 and M7. Logistic constraints, mainly the time available between the tides to access the sites safely was the reason for limiting the sampling to these four sites. As summarized in **Exhibit C.8** these four Study Sites were given priority to cover the spatial extent of the Study Area, extending from Port Qasim to the open sea towards the south, and extending from Port Qasim to the east towards the Indus Delta. Within each Study Site sampling locations within each of the three health categories of mangroves (see **Appendix C 1.3.1**) were decided beforehand taking into account access issues.

Exhibit C.7: Mangrove Study Site Locations

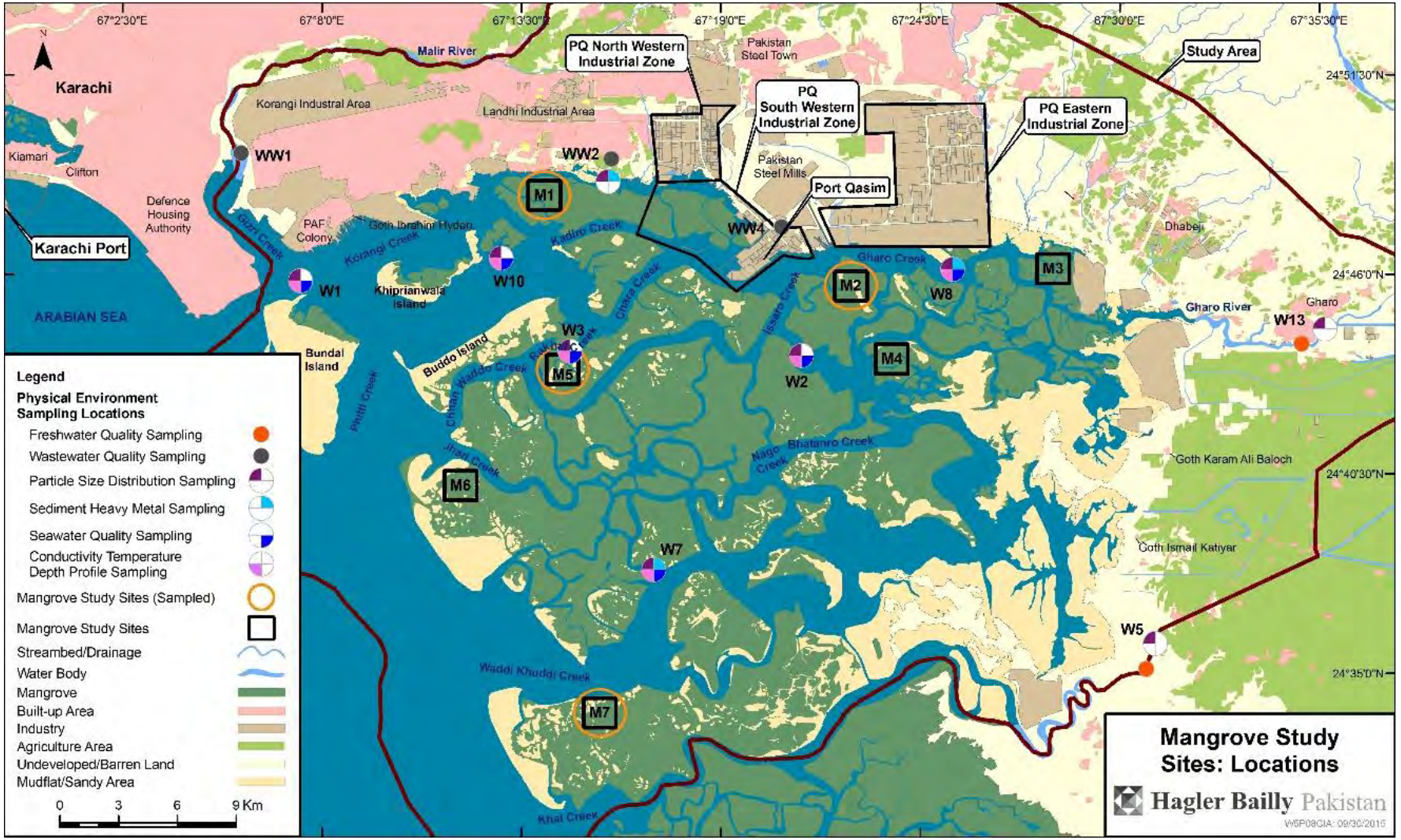


Exhibit C.8: Table showing the Priority Study Sites for Sampling Along with Location and Justification for Selection

Serial Number	*Study Site*	*Location*	*Justification*
1	M1	Closest to coast	Closest to Port Qasim and could show release of industrial and municipal effluents.
2	M2	Along Gharo Creek (also close to coast)	Near a proposed development, therefore, it will make a good monitoring point as development occurs.
3	M5	Chann Waddo Creek	Along the proposed shipping channel. This will make a good monitoring point as development occurs.
4	M7	Waddi Khuddi Creek	This location is most distal from industrial and other human activities, therefore, a good reference point.

One Study Site was visited on each day. Local boats and a Garmin GPSmap 76CSx device was used to reach the Study Sites and points closest to the planned sampling locations. Equipment that was carried and used during the sampling included a telescopic measuring staff, polyvinyl chloride pipes to establish 1.0m by 1.0m quadrats, a tape measure, 10m pieces of ropes, data collection forms and a digital camera.

Sampling was carried out at locations closest to the planned sampling locations that could be accessed. The most significant obstacle encountered with respect to reaching planned sampling locations was the rising water levels with tide causing inundation of the mangrove habitat. This forced the selection of alternative sampling locations near the planned sampling locations. It was also the main limiting factor affecting time availability at each sampling location. A single waypoint was recorded at each sampling location where a $10m^2$ quadrat was established.

For each Study Site at which sampling was carried out both qualitative and quantitative information is presented. Diseases and abnormalities observed on the plants are also described in the field log. The data collected during the sampling exercise in the form of completed data collection forms is provided in **Annexure A**.

C.1.4.1 Study Site M1

Study Site, Planned Sampling Locations and Sampling Locations

Study Site M1 was visited on the 20th of September 2015. The sampling location was reached at approximately 10:00 am Pakistan Standard Time (PKT).

Sampling was carried out at two locations near Study Site M1. **Exhibit C.9** shows the position of the sampling locations relative to the Study Site as well as to the major nearby creek, Korangi Creek. At each of the two sampling locations a $10m^2$ quadrat was established. **Exhibit C.10** shows a close-up image of the area in which sampling was carried out. The following locations are where quadrats were established:

- M1T1Q1A is where the first quadrat was established,
- M1T1Q2A is where the second quadrat was established.

Exhibit C.9: Sampling locations near Study Site M1



Exhibit C.10: Sampling locations near Study Site M1 (Zoom In)



Proximity and General Quadrat Information

Study Site M1 is located closest to industrial activity as well as other anthropogenic activity. It is located opposite the Landhi Industrial Area and the fishing village called Rehri Goth. **Exhibit C.11** shows the visibility of some of this activity including the presence of docked boats and infrastructure.

Exhibit C.11: View of Residential Area from Sampling Location near Study Site M1



The mangroves at the sites at which sampling was carried out appeared to be Healthy Mangroves. **Exhibit C.12**, for example, typifies the appearance of their leaves. **Exhibit C.13** shows a close-up of the appearance of their leaves.

Exhibit C.12: Typical Appearance of Leaves at Sampling Location near Study Site M1



Exhibit C.13: Close up of Typical Appearance of Leaves at Sampling Locations near Study Site M1





The land surface appeared to be intact and the topography was flat. The geomorphic setting of the Study Site and associated sampling locations is along the coastal fringe as described above. The soil conditions appeared to be affected by its proximity to anthropogenic activities; Study Site M1 receives effluent from the Landhi Industrial Area, the nearby fishing village called Rehri Goth and from a nearby cattle colony known as Bhains Colony. **Exhibit C.14** shows the soil conditions that were prevalent at this site. The soil appeared more sludge-like than at other sampling locations and had a more liquid consistency.

Exhibit C.14: Typical Soil Conditions at Sampling Locations near Study Site M1





There was a visible presence of a white colored, soapy liquid on the soil at both sampling locations near this Study Site as shown in **Exhibit C.15**. This is most likely from industrial effluent. It appeared to be the presence of a mixture of chemicals.

Exhibit C.15: Soil with Soapy, White Liquid Visible



Disturbance Evidence: Fodder

Disturbance of the mangroves that was evident at sampling locations near this Study Site included cutting of newly tendered branches of mangroves probably used as fodder by locals at the nearby cattle colony known as Bhains Colony. Locals were photographed transporting mangroves from the Study Site towards the cattle colony as shown in **Exhibit C.16**. As the cutting of mangroves was of newly tendered branches with green leaves, stumps were not observed, therefore, it was not possible to estimate the percentage of cutting within a quadrat.

Exhibit C.16: Local Transporting Cut Leaves from Study Site M1



Other Disturbance Evidence

Cyclone damage and other weather related damage was not observed at the sampling locations. Disturbance evidence related to insect damage was observed. The insects observed to be causing damage to the mangroves included Gall midges (Cecidomyiidae) (**Exhibit C.17**), beetles (**Exhibit C.18**), shoot borers (**Exhibit C.19**) and weevils (**Exhibit C.20**). Shoot borer damage was observed to range from light to severe across the two quadrats established for sampling.

Exhibit C.17: The Yellow Colored Spots were Visually Identified as Gall Midges (Cecidomyiidae)



Exhibit C.18: The White Elongated Structures were Visually Identified as Beetle Eggs (Species could not be Identified)



Exhibit C.19: Visually Identified as Shoot Borers








Exhibit C.20: Excrement of Shoot Borer




Exhibit C.21: The Insect Shown on the Stem was Visually Identified as Weevil (Species could not be identified)




Adult Tree Density

Adult tree density was estimated to be between 25 and 35 adult trees per 100m^2 for each of the two quadrats in which sampling was carried out.

Adult Tree Heights

The heights of the trees ranged from a maximum of approximately 1.0m to 3.2m. **Exhibit C.22** shows the trees along with the presence of a scale.

Exhibit C.22: Heights of Mangrove trees Together with Measuring Scale



Unhealthy mangroves based on reduced adult tree heights, not based on canopy cover

Adult Tree Girths

Adult tree girths could not be measured as some trees within each quadrat were below 1.3m in height. Furthermore, even those trees where height was in excess of 1.3m, the main stems were inaccessible due to the presence of thick foliage and aerial root growth which impeded access to the stems. **Exhibit C.23** shows a typical condition within each quadrat at the Study Site. **Exhibit C.24** shows a rare, more accessible tree but even in that it can be observed that measurement of diameter is impeded.

Exhibit C.23: Typical Mangrove Tree at a Sampling Location near Study Site M1



Exhibit C.24: Mangrove Tree with Relatively More Accessible Main Stem



Seedlings

Seedlings were observed to be distributed in a specific pattern. There was a greater density of seedlings under adult tree canopies relative to in areas exposed to the sun as can be seen in **Exhibit C.25**. However, even in these areas seedlings were observed but in noticeably lower density as can be seen in **Exhibit C.26**.

Exhibit C.25: Seedlings under Adult Tree Canopy



Exhibit C.26: Relatively Few Seedlings in Area Exposed to Direct Sunlight



The location of the seedlings under tree canopies as well as their large numbers per unit area made counting difficult. Therefore, the 1.0m by 1.0m quadrat was used to count the number of seedlings in a 1.0m^2 area and this was multiplied by the total area of a 10m by 10m (100m^2) quadrat to give an estimate of the number of seedlings in the quadrat area. The best estimate that could be reached based on this improvised method was a range of between 5,000 and 6,000 seedlings per 100m^2 for each of the quadrats.

Crab Holes

The distribution of crab holes was observed to be uneven. Crab holes were observed to be absent near the shoreline where effluent was collecting. However, crab holes were observed to be present closer to the mangrove trees especially more inland compared to near the shoreline. Crab holes and a crab present at one of the sampling locations near Study Site M1 have been shown in **Exhibit C.27**. The number of crab holes ranged from approximately 300 to 520 per 1.0m^2. The complete data set is available in **Annexure A**.

Exhibit C.27: Crab Holes and a Mangrove Crab





Other Macrofauna

Other macrofauna observed included snails. These were observed to be distributed throughout the habitat within the $10m^2$ quadrats established at the sampling locations. Some of the snails observed are shown in **Exhibit C.28**.

Exhibit C.28: Snails





Canopy Cover

Percentage canopy cover was estimated using the look down method as oppose to the look up method. This was because the trees were relatively short (less than 2.0m). The canopy cover was estimated to range from a 69% to 75% across the two quadrats established at the sampling locations.

Results

Results for Study Site M1 are presented in **Exhibit C.29**.

Exhibit C.29: Results for Study Site M1

	Sampling Location ID: M1T1Q1	*SD*[11]	*Sampling Location ID: M1T1Q2*	*SD*	*Average (for both quadrats)*
Adult Tree Density (per 100m^2)	35	-	25	-	30
Number of Samples for Mean Tree Height (N)	35	-	25	-	60
Mean Tree Height (m)	1.55	-	2.50	0.69	2.03
Number of Samples for Mean Tree Girth (N)	N/A	-	N/A	-	-
Mean Tree Girth (cm)	N/A	N/A	N/A	N/A	-
% Canopy Cover	68.75	-	75.00	-	71.88
Seedling Density (per 100m^2)[12]	6000	-	5000	-	5500
Crab hole density (per 1.0m^2) (Based on Mean No. of Crab Holes per 1.0m^2)	417	-	402	-	410

[11] S.D. is Standard Deviation. This was only calculated when the data set was normally distributed. The data set was checked numerically for normal distribution using the Shapiro-Wilk test in SPSS Statistics 19 software package. The P value = 0.05 was chosen as cutoff for the null hypothesis (above 0.05 normally distributed, below 0.05 not normally distributed)

[12] In this case the number of seedlings in a 100m^2 area were too high to count in a 100m^2 area, as can be seen from **Exhibit C.25**, therefore, they were estimated by counting the number of seedlings in a 1.0m^2 area and multiplying by 100m^2.

C.1.4.2 Study Site M2

Study Site, Planned Sampling Locations and Sampling Locations

Study Site M2 was visited on 22nd of September, 2015. The first sampling location was reached at approximately 11:30 am PKT.

Sampling was carried out at three locations near Study Site M2. **Exhibit C.30** shows the position of the sampling locations relative to the Study Site. At each of the three sampling locations a 10 m^2 quadrat was established. **Exhibit C.31** shows a close-up image of the area in which sampling was carried out.

The point label locations are as follows:

- M2T1Q1AS is where the first quadrat was established,
- M2T1Q2S, where the second quadrat was established, and
- M2T1Q3S, where the third quadrat was established.

Exhibit C.30: Sampling Locations near Study Site M2

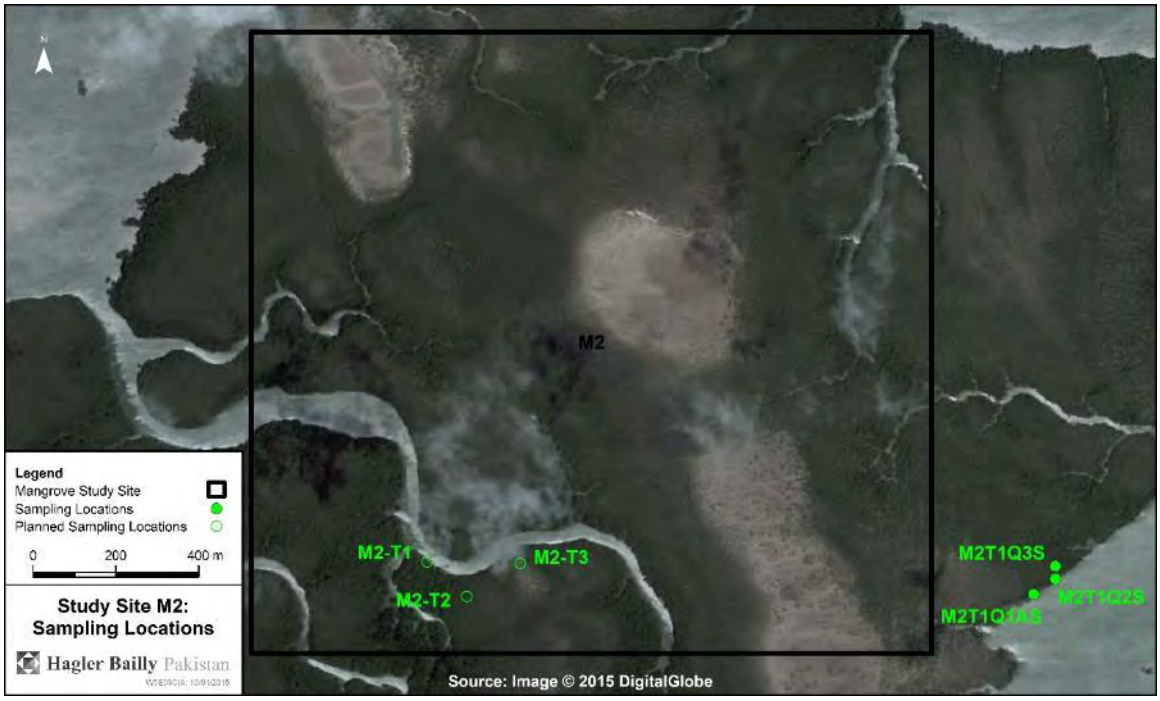


Exhibit C.31: Sampling locations near Study Site M2 (Zoom In)



Proximity and General Quadrat Information

Study Sites M1 and M2 are located in proximity to the coastline (see **Exhibit C.8**). However, only Study Site M1 receives effluents from the industries and municipalities located in Landhi and Korangi industrial areas and adjacent residential areas.

The mangroves observed in the three quadrats established at the sampling locations at Study Site M2 appeared to be in the Healthy Mangroves Category. **Exhibit C.33** shows mangroves typical of those present at the sampling locations. The land appeared to be in intact condition, and the topography was flat. Study Site M2 can also be considered as part of the coastal fringe due to its proximity to Port Qasim. The soil appeared to be clay and was relatively hard compared to soil at sampling locations near Study Site M1.

Exhibit C.32: Industrial Infrastructure Visible from a Sampling Location near Study Site M2



Exhibit C.33: Mangrove Tree Growth Typifying Conditions at a Sampling Location near Study Site M2



Dense mangrove growth at start of forest



Healthy (dense) Mangroves

Disturbance Evidence: Timber Harvest

There was no evidence of timber harvest at sampling locations near Study Site M2. Furthermore, no evidence of cutting of newly tendered branches was observed.

Other Disturbance Evidence

There was no evidence of cyclone damage or other weather related damage to the mangroves at sampling locations near Study Site M2. The leaves of the mangroves appeared healthy. **Exhibit C.34** shows the typical appearance of leaves observed at all sampling locations at this Study Site. However, there was evidence of insect damage on the leaves of the mangroves ranging from light to moderate. This included the presence of Gall midges (Cecidomyiidae) (**Exhibit C.35**) and Leaf miners (**Exhibit C.36**).

Exhibit C.34: Appearance of Leaves which typify those present at Sampling Locations near Study Site M2



Exhibit C.35: Yellow Spots on Leaves Visually Identified as Gall midges (Cecidomyiidae).









Exhibit C.36: The white Spots were Visually Identified as the Presence of Leaf Miners



Adult Tree Density

Adult tree density ranged from 13 trees to 17 trees per 100 m^2 across the three quadrats established at sampling locations near Study Site M2. The complete data set is available in **Annexure A**.

Adult Tree Heights

The heights of the adult trees at sampling locations near Study Site M2 ranged from 2.4m to 4.9 m. **Exhibit C.37** gives an indication of the heights of the trees observed at the sampling locations near this Study Site. The complete data set is available in **Annexure A**.

Exhibit C.37: Mangrove Trees with Measuring Scale to Show Height of Trees Typically Observed at Sampling Locations



Adult Tree Girths

The girths of the adult trees at sampling locations near Study Site M2 ranged from a maximum of approximately 16 cm to 42 cm. The complete data set is available in **Annexure A**.

Seedlings

Seedlings were not observed to be distributed in any specific pattern and generally were rare in all quadrats. A total of 8 seedlings were observed in one of the three quadrats (at sampling location M2T1Q2). The local guide pointed to planted mangrove seedlings and stated that the majority of seedlings planted by the SFD at the sampling locations had not grown into adult mangroves. **Exhibit C.38** shows a seedling photographed near the shoreline of one of the sampling locations at Study Site M2.

Exhibit C.38: A Rare Seedling observed at a Sampling Location near Study Site M2



Crab Holes

Crab holes were observed throughout all sampling locations at this Study Site. Within the 1 m^2 quadrats the number of crab holes ranged from 180 to 220. The complete data set is available in **Annexure A**. Furthermore, crabs were also observed. **Exhibit C.39** shows numerous crabs present on the mudflat (depicted by the white creatures visible in the image). **Exhibit C.40** shows crab holes visible on the surface within one of the quadrats. **Exhibit C.41** shows a crab present within one of the quadrats.

Exhibit C.39: Mangrove Crabs Visible at the Shoreline of a Sampling Location near Study Site M2



Exhibit C.40: Crab holes. The Large Hole Visible is of the more Economically Important Crab species as pointed out by the Local Guide



Exhibit C.41: A Mangrove Crab Visible at a Sampling Location



Percentage Canopy Cover

The percentage canopy cover was estimated to range from 81% to 88% across the three quadrats established at the sampling locations. The trees were relatively high and their canopies were noticeably extensive, creating shading over most of the area. **Exhibit C.42** shows that the canopy along with the branches contributed to impeding mobility between the trees.

Exhibit C.42: Dense Canopy Cover and Branch Growth Visible, Impeding Movement



Other Information

Along the route towards Study Site M2 a number of fallen trees were observed along the shorelines of mangrove habitats as shown in **Exhibit C.43**. The local guide told the team that these trees are subjected to damage caused by the local fishermen, especially when they tether illegal fishing nets with these trees to catch fish. **Exhibit C.44** shows a rope used to tie fishing nets to mangrove trees and **Exhibit C.45** shows a fishing net entangled in a mangrove tree.

Exhibit C.43: Fallen Mangrove Trees, as Pointed Out by the Local Guide, Visible along the Shoreline









Exhibit C.44: Rope used to tie Fishing Net to Mangrove Trees



Exhibit C.45: Net Entangled in Mangrove Tree Reportedly Used for Fishing



No evidence of timber harvest was observed at any of the quadrats established at the sampling locations near Study Site M2. However, along the route transport of harvested mangrove timber was observed. This is shown in **Exhibit C.46**.

Exhibit C.46: Locals Transporting Cut Mangrove Trees Near Study Site M2



Mangrove Dieback was also observed along the route to Study Site M2. **Exhibit C.47** shows the appearance of dieback mangroves that were observed. Generally dieback was observed only in thin strips mainly along shorelines. The reasons for the dieback are unclear, however, suspected causes include erosion related impacts, felling and clearing by people as well as use of destructive fishing practices as described in the above paragraph.

Exhibit C.47: Mangrove Dieback observed along Coastlines on route to Study Site M2





Mangrove Dieback observed along shore lines



Mangrove trees observed along shore line. Moving field of view from left to right, the transition to Mangrove Dieback is visible



Mangrove trees observed along shore lin. Moving field of view from right to left, the transition to mangrove dieback is visible



Shoreline with all mangroves showing the dieback condition

Bird life was frequently observed along the route to Study Site M2, shown in **Exhibit C.48**.

Exhibit C.48: Rich Bird Life Observed near Study Site M2



Results

Results for Study Site M2 are presented in **Exhibit C.49**.

Exhibit C.49: Results for Study Site M2

	Sampling Location ID: M2T1Q1	*S.D.*[13]	*Sampling Location ID: M2T1Q2*	*S.D.*	*Sampling Location ID: M2T1Q3*	*S.D.*	*Average (for all quadrats)*
Adult Tree Density (per 100m^2)	15	-	17	-	13	-	15
Number of Sampling for Mean Tree Height (N)	15	-	17	-	13		45
Mean Tree Height (m)	4.18	-	3.51	0.58	3.49	-	3.73
Number of Samples for Mean Tree Girth (N)	15	-	17	-	13	-	45
Mean Tree Girth (cm)	27.73	9.28	27.41	6.67	28.92	7.73	28.02
% Canopy Cover	81.25		87.5	-	87.5	-	85.42
Seedling Density (per 100m^2)	5	-	8	-	0	-	4.33
Crab hole density (per 1.0m^2) (Based on Mean No. of Crab Holes per 1.0m^2)	204	-	204	-	196	-	201

[13] S.D. is Standard Deviation. This was only calculated when the data set was normally distributed. The data set was checked numerically for normal distribution using the Shapiro-Wilk test in SPSS Statistics 19 software package. The P value = 0.05 was chosen as cutoff for the null hypothesis (above 0.05 normally distributed, below 0.05 not normally distributed)

C.1.4.3 Study Site M5

Study Site, Planned Sampling Locations and Sampling Locations

Study Site M5 was visited on the 21st September, 2015. The sampling locations were reached at approximately 3:05 pm PKT.

Sampling was carried out at three sampling locations near Study Site M2. **Exhibit C.50** shows the position of the sampling locations relative to the Study Site. At each of the three sampling locations, a 10 m^2 quadrat was established. **Exhibit C.51** shows a close-up image of the area in which sampling was carried out. The location of the point labels are as follows:

- M5T1Q1S, where the first quadrat was established,
- M5T1Q2S, the location of the second quadrat, and
- M5T1Q3S is where the third quadrat was established.

Exhibit C.50: Sampling Locations near Study Site M5

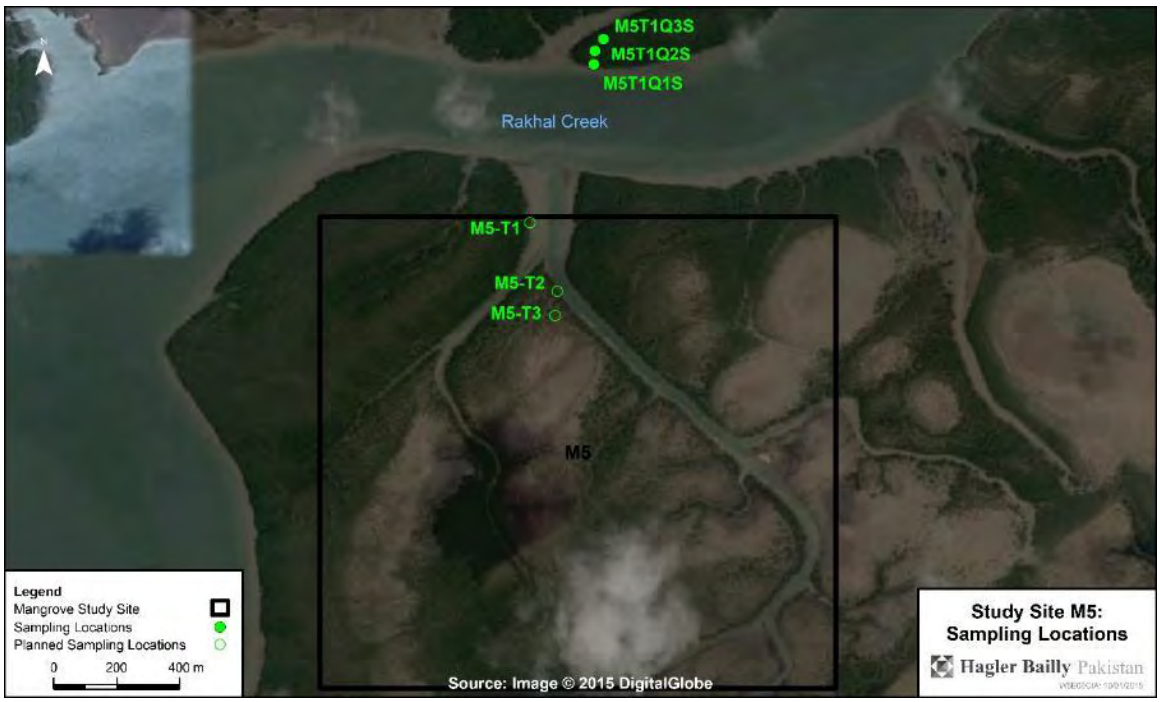


Exhibit C.51: Sampling Locations near Study Site M5 (Zoom In)



Proximity and General Quadrat Information

Study Site M5 is located along the proposed shipping channel at a distance which is relatively far away from industrial and other development activities at Port Qasim.

The mangroves within quadrats established at the three sampling locations near Study Site M5 were observed to be Healthy Mangroves with the exception of those observed within the quadrat established at sampling location M5T1Q1S, which were observed to be diseased. **Exhibit C.52** shows mangroves that characterize those present within the quadrats established at sampling locations at this Study Site. The land was observed to be intact and the topography was flat. The geomorphic setting was considered to be interior as the Study Site is set inwards, away from the open sea, but also not along the coastline. The soil can be described as clay.

Exhibit C.52: Typical Appearance of Trees at Sampling Locations near Study Site M5





Disturbance Evidence: Timber Harvest

There was evidence of timber harvesting within quadrats at all three sampling locations. Timber harvest disturbance evidence was estimated to be medium (30% to 70% of the basal area) in each of the three quadrats. **Exhibit C.53** shows the appearance of the remains of the harvested trees using axe. **Exhibit C.54** shows the appearance of trees cut down and left in a clearing. The situation shown in **Exhibit C.54** was observed frequently within all three quadrats established at sampling locations near this Study Site.

Exhibit C.53: Trees Cut with Axe at Sampling Locations near Study Site M5









Exhibit C.54: Cut Trees Left in a Clearing at a Sampling Location near Study Site M5



Mangrove trees cut down and left in a clearing also contributed to the dieback condition of mangroves observed

Other Disturbance Evidence

Evidence of cyclone or other weather related damage was not observed at any of the sampling locations near Study Site M5. Evidence of other disturbances affecting the mangroves included that caused by insects and fungi. Within the category of insects Gall midges (Cecidomyiidae) were observed on mangrove leaves (**Exhibit C.55**) and insect borer holes were observed on barks and stems (**Exhibit C.56**). Within the category of fungi, fungal growth suspected of causing dieback was observed inside stems (**Exhibit C.57**), fungi were observed growing on tree surfaces (**Exhibit C.58**) and sooty mold (Ascomycete fungi) was observed on mangrove wood (**Exhibit C.59**) as well as on leaf surfaces (**Exhibit C.60**). In addition to this, disturbance evidence on the mangroves included the presence of gummosis (**Exhibit C.61**), canker (**Exhibit C.62**) and abnormal growths on stems and barks resulting in the appearance of rough surface on them (**Exhibit C.63**). Other insects observed on the mangroves included Mealy bug (Pseudococcidae) (**Exhibit C.64**) and Chrysopa Green Lacewing (*Chrysoperla carnea*) (**Exhibit C.65**). Disturbance related to disease and insect damage was estimated to be severe across all three quadrats established at the sampling locations near Study Site M5.

Exhibit C.55: Yellow Spot Visually Identified as Gall Midge (Cecidomyiidae)





Exhibit C.56: Holes in Tree Visually Identified as Borer Insect Holes



Exhibit C.57: Visual Identification of Fungus inside Stem of a Tree Suspected of Causing Mangrove Dieback



Exhibit C.58: Visual Identification of Growth of Fungus (Species Unknown)







Exhibit C.59: Visual Identification of Sooty Mold (Ascomycete fungi)



Exhibit C.60: Visual Identification of Sooty Mold (Ascomycete fungi) on Leaves

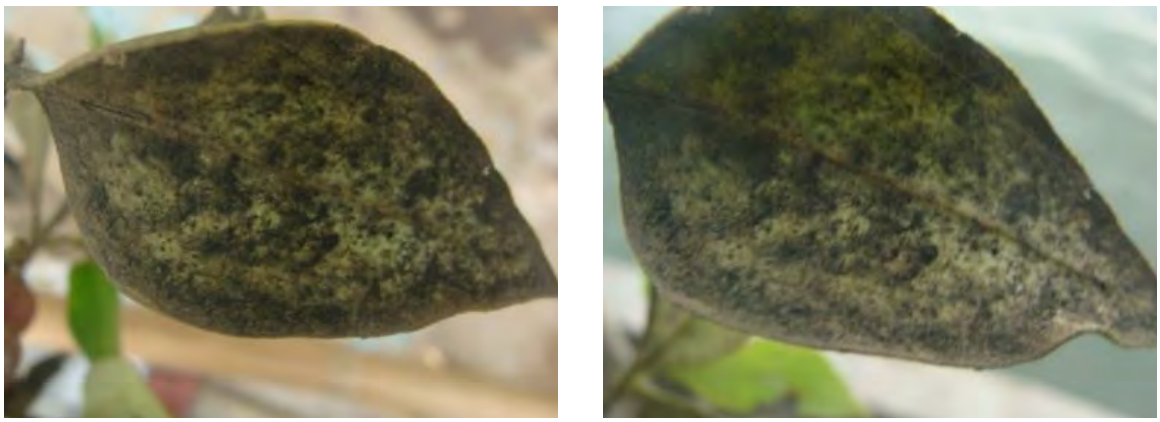




Exhibit C.61: Visual Identification of Gummosis, Oozing Out of Gum from Stem of Mangrove



Exhibit C.62: Visual Identification of Canker Visible on Twig (Cause is Unknown)



Exhibit C.63: Visual Identification of Rough Surfaces on Stems Unknown Growth on Stems, could be Overgrowth.




Exhibit C.64: Visual Identification of Ants Feeding on Mealy bug (Pseudococcidae)




Exhibit C.65: Visual Identification of Adult of *Chrysopa*. Green Lacewing (*Chrysoperla carnea*)



Adult Tree Density

Adult tree density ranged from a maximum of 7 to 12 trees per 100 m^2 across the quadrats established at each of the sampling locations. The complete data set is available in **Annexure A**.

Adult Tree Heights

The heights of the trees in all three quadrats ranged from 3.2m to 8.0m. The complete data set is available in **Annexure A**. **Exhibit C.66** shows an image of a tree that typified the adult trees present within all three quadrats at sampling locations near Study Site M5.

Adult Tree Girths

The girths of the adult trees ranged from 16 cm to 84 cm across the three quadrats established at the sampling locations. The complete data set is available in **Annexure A**.

Exhibit C.66: Tree Typifying Those Present at Study Site M5



Seedlings

The distribution of seedlings was very variable. Within each 10 m^2 quadrat, with the exception of quadrat M5T1Q2, there were patches of the forest floor in which seedling density was extremely high as can be seen in **Exhibit C.67**. Under these circumstances it was difficult to count the number of seedlings in a 100 m^2 area, therefore, the 1.0 m^2 quadrat for crab sampling was used. The number of seedlings counted in a 1.0 m^2 area was multiplied by the total area of the 10m^2 quadrat to give the total number of seedlings in the quadrat. This method gave an estimated 10,000 seedlings in one quadrat and 6,000 seedlings in another. In quadrat M5T1Q2 no dense seedling areas were observed; approximately 22 seedlings were counted.

Exhibit C.67: Distribution of Seedlings Typifying that Observed at Sampling Locations near Study Site M5





Crab Holes

Crab holes were not observed to be distributed in any specific pattern. The number of crab holes across all three quadrats established at the sampling locations ranged from a 120 to 170. The complete data set is available in **Annexure A**. **Exhibit C.68** shows crab holes interspersed between organic matter (mainly seeds) on the forest floor.

Exhibit C.68: Crab Holes



Canopy Cover

The percentage canopy cover in this area was estimated to range from 69% to 81% across the three quadrats established at the sampling locations. **Exhibit C.69** shows canopy cover typical of that visible at sampling locations within this Study Site.

Exhibit C.69: Canopy Cover Typical of that Present at Sampling Locations





Results

Results for Study Site M5 are presented in **Exhibit C.70**.

Exhibit C.70: Results for Study Site M5

	Sampling Location ID: M5T1Q1	*S.D.*[14]	*Sampling Location ID: M5T1Q2*	*S.D*	*Sampling Location ID: M5T1Q3*	*S.D*	*Average (for all quadrats)*
Adult Tree Density (per 100m^2)	12	-	9	-	7	-	9.33
Number of Samples for Mean Tree Height (N)	12	-	9	-	7	-	28
Mean Tree Height (m)	5.85	1.74	5.07	1.75	4.83	0.73	5.25
Number of Samples for Mean Tree Girth (N)	12	-	9	-	7	-	28
Mean Tree Girth (cm)	47.50	0.37	45.78	11.3	47.86	17.9	47.05
% Canopy Cover	68.75	-	75.00	-	81.25	-	75.00
Seedling Density (per 100m^2)	10000[15]	-	22	-	3500	-	4507
Crab hole density (per 1.0m^2) (Based on Mean No. of Crab Holes per 1.0m^2)	159	-	160	-	130	-	150

[14] S.D. is Standard Deviation. This was only calculated when the data set was normally distributed. The data set was checked numerically for normal distribution using the Shapiro-Wilk test in SPSS Statistics 19 software package. The P value = 0.05 was chosen as cutoff for the null hypothesis (above 0.05 normally distributed, below 0.05 not normally distributed)

[15] In this case the number of seedlings in a 100m^2 area was too high to count in certain quadrats, as can be seen from **Exhibit C.67**, therefore, they were estimated by counting the number of seedlings in a 1.0m^2 area and multiplying by 100m^2.

C.1.4.4 Study Site M7

Study Site, Planned Sampling Locations and Sampling Locations

Study Site M7 was visited on the September 18, 2015. The sampling locations were reached at approximately 12:00 pm PKT.

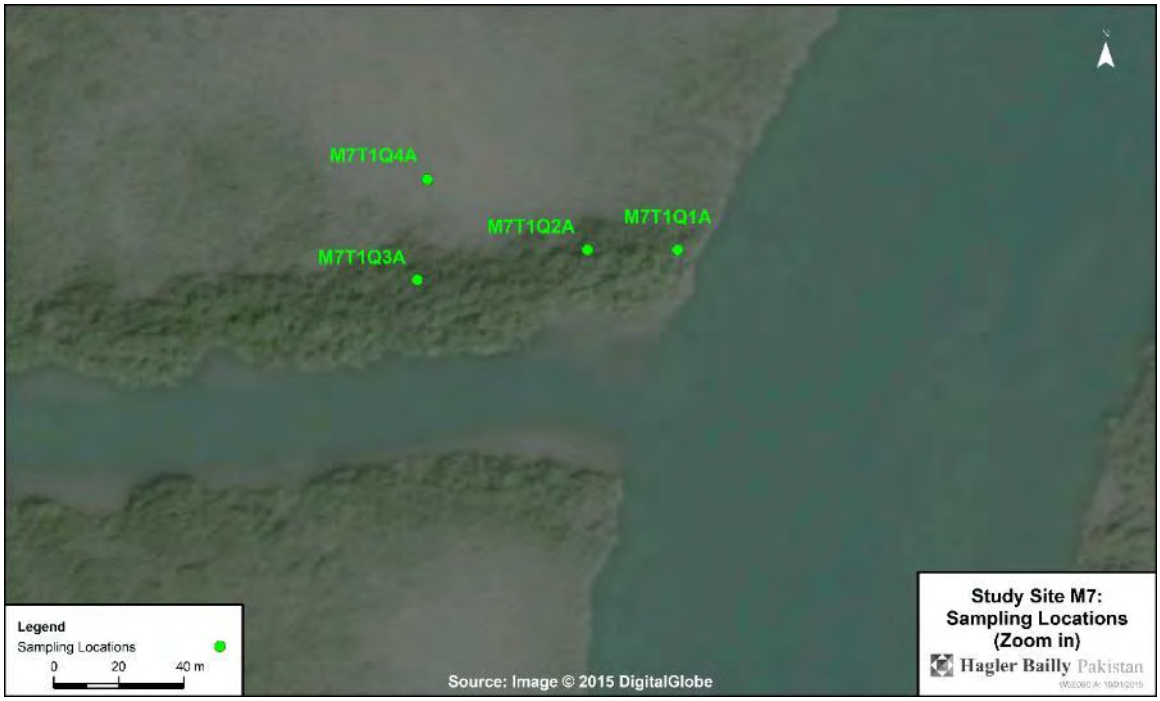
Sampling was carried out at four sampling locations near Study Site M7. **Exhibit C.71** shows the position of the sampling locations relative to the Study Site. At each of the four sampling locations a $10m^2$ quadrat was established. **Exhibit C.72** shows a close-up image of the area in which sampling was carried out. The locations of the point labels are as follows:

- M7T1Q1A, where the first quadrat was established,
- M7T1Q2A, location of the second quadrat,
- M7T1Q3A is where the third quadrat was established,
- M7T1Q4A is where the third quadrat was established.

Exhibit C.71: Sampling locations near Study Site M7



Exhibit C.72: Sampling Locations near Study Site M7 (Zoom In)



Proximity and General Quadrat Information

Study Site M7 is located furthest from Port Qasim and other industrial developments relative to the other Study Sites. In comparison to the other Study Sites, this Study Site is closest to the Indus River Delta system.

The mangroves at this Study Site appeared Healthy Mangroves with the exception of mangroves in one of the quadrats established at sampling location M7T1Q1A, where they were classified as unhealthy mainly due to the widespread presence of disease that was clearly evident. Furthermore, mangroves at sampling location M7T1Q4A were classified as Unhealthy Mangroves as they were stunted. **Exhibit C.73** classifies the mangroves observed at the sampling locations near this Study Site. The stunted mangroves were located more inland away from the inundated shoreline of the mudflat, whilst their larger counterparts were located closer to areas which are at lower elevation and, hence, subjected to greater inundation. **Exhibit C.74** shows the appearance of these undersized mangroves. The land appeared to be intact and the topography was flat at all sampling locations. The geomorphic setting of the location was classified as river delta due to relatively proximity to the Indus River Delta system. The soil can be described as clay.

Exhibit C.73: Mangrove Trees Typical of Those Present at Sampling Locations near Study Site M7





Exhibit C.74: Mangrove Trees Typical of those Present more Inland near Study Site M7, stunted mangroves





Disturbance Evidence: Timber harvest

Evidence of timber harvest was observed in two out of the three quadrats established at the sampling locations. The level of timber harvest was estimated to be low; less than 30% of the basal area. Examples of timber harvested using axes is shown in **Exhibit C.75.** In the quadrat established at the sampling location closest to the shoreline no evidence of timber harvest was observed.

Exhibit C.75: Trees Cut with Axes at Sampling Locations near Study Site M7



Other Disturbance Evidence

Cyclone damage or other weather related damage was not observed in any of the quadrats. Evidence of other disturbances on the mangroves included damage due to insects. These included Gall midges (Cecidomyiidae) (**Exhibit C.76**). Leaves at different stages of health were observed. These were collected and have been shown in **Exhibit C.77**. Fungal growths were also observed along with the presence of sooty mold (Ascomycete fungi) (**Exhibit C.78**). In addition to this evidence of disturbance of mangrove health included the presence of abnormal rough surfaces on the barks and stems of trees (**Exhibit C.79**), the presence of canker (**Exhibit C.80**) and gummosis (**Exhibit C.81**). Other insects observed included the weevil (**Exhibit C.82**) and the lady bird beetle, *Cryptolaemus montrouzieri*, a Mealy bug destroyer (**Exhibit C.83**). Across the three quadrats established at sampling locations comprising normal mangrove trees, disease and insect damage related disturbance was estimated to range from light to severe. In the quadrat established at the sampling location for stunted mangroves, no disturbance evidence related to disease and insect damage was found.

Exhibit C.76: Visual Identification of Gall Midges (Cecidomyiidae)



Exhibit C.77: Different Stages of Leaf from Healthy to Unhealthy. These Range of Leaves were Observed but their Relative Percentage Abundances are Unknown



Exhibit C.78: Visual Identification of Gummosis and Sooty Mold (Ascomycete fungi) as well as Rough Surface of Tree Observed



Sooty Mold (Ascomycete fungi)



Fungal growth



Fungal growth



Fungal growth and insect holes

Exhibit C.79: Visual Identification of Insect Holes and Rough Surface of which Cause is Unknown



Exhibit C.80: Visual Identification of Canker Observed with the presence of Insect Holes as Well



Exhibit C.81: Visual Identification of Gummosis







Exhibit C.82: Visual Identification of Unknown Insect Larva (left) Weevil (right)




Exhibit C.83: Visual Identification of Pupa of Lady Bird Beetle
(*Cryptolaemus montrouzieri)* a Mealy bug (Pseudococcidae) Destroyer





Adult Tree Density

Adult tree density (non-stunted only) ranged from a maximum of 3 to 15 trees per 100 m^2 across the quadrats established at each of the sampling locations. The complete data set is available in **Annexure A**.

Adult Tree Heights

The adult trees heights ranged from 2.2 m to 5.5 m (excluding the undersized mangroves that were observed). The complete data set is available in **Annexure A**. Amongst the stunted mangroves the heights ranged from 1.0m to 1.7 m. **Exhibit C.84** and **Exhibit C.85** show the appearance of shoreline of the mudflat and inland mangroves respectively. From the images, differences in their heights are evident.

Exhibit C.84: Mangrove Trees Typifying the Height of Trees Observed at Sampling Locations near Study Site M7





Exhibit C.85: Stunted Mangrove Trees Located More Inland





Adult Tree Girths

Adult tree girths were only measured for the mangroves which were not undersized. These girths ranged from a maximum of 10cm to 64 cm. The complete data set is available in **Annexure A**.

Seedlings

Seedlings were observed in two of the three quadrats established at the sampling locations near Study Site M7. 22 seedling were counted in M7T1Q1A and 3 in

M7T1Q2A. In the remaining two quadrats no seedlings were observed. **Exhibit C.86** shows three seedlings in one of the quadrats.

Exhibit C.86: Some of the few Seedlings present at Sampling Locations near Study Site M7



Crabs Holes

Crab holes were not distributed in any specific observable pattern in any of quadrats. The number of crab holes ranged from 65 to 260. The complete data set is available in **Annexure A**. **Exhibit C.87** shows the use of the 1.0m by 1.0m quadrat for counting of crab holes.

Exhibit C.87: A 1.0m by 1.0m Quadrat Used for Counting Crab Holes Applied at Sampling Locations near Study Site M7



Canopy Cover

Canopy cover was estimated to range from a 56% to 59% (only considering three of the quadrats in which non-stunted adult trees were present). In the quadrat in which only undersized trees were present canopy cover was estimated using the look down method instead of the look up method. Within the single quadrat in which sampling was carried out for stunted mangroves the canopy cover was estimated to be 63%. **Exhibit C.88** shows both types of trees, as classified by height, in a single frame.

Exhibit C.88: The Presence of Both Stunted Mangroves and a Non-stunted Mangrove Tree at a Sampling Location near Study Site M7



Results

Results for Study Site M7 are presented in **Exhibit C.89**.

Exhibit C.89: Results for Study Site M7

	Sampling Location ID: M7T1Q1	*SD*[16]	*Sampling Location ID: M7T1Q2*	*SD*	*Sampling Location ID: M7T1Q3*	*SD*	*Sampling Location ID: M7T1Q4*	*SD*	*Average (for all quadrats)*
Adult Tree Density (per 100m^2)	13 (3 normal, 10 stunted)	-	18 (15 normal, 3 stunted)	-	16 (12 normal, 4 stunted)	-	55 (all stunted)	-	25.5
Number of Samples for Mean Tree Height (N)	13	-	18	-	16	-	55	-	102
Mean Tree Height (m)	1.61	-	2.88	1.09	3.78	-	1.22	-	2.37
Number of Samples for Mean Tree Girth (N)	3	-	15	-	12	-	N/A	-	30
Mean Tree Girth (cm)	19.67	12.7	28.27	-	35.67	11.5	N/A	N/A	27.87
% Canopy Cover	62.5	-	68.75	-	56.25	-	62.50	-	62.50
Seedling Density (per 100m2)	22	-	3	-	0	-	0	-	6.25
Crab hole density (per 1.0m^2) (Based on Mean No. of Crab Holes per 1.0m^2)	242	-	168	-	141		79	-	157

[16] S.D. is Standard Deviation. This was only calculated when the data set was normally distributed. The data set was checked numerically for normal distribution using the Shapiro-Wilk test in SPSS Statistics 19 software package. The P value = 0.05 was chosen as cutoff for the null hypothesis (above 0.05 normally distributed, below 0.05 not normally distributed)

C.1.4.5 Conclusions

Exhibit C.90 summarizes the information collected in the field sampling exercise.

Exhibit C.90: Sampling Exercise, September 2015

Site Specific Information	*Study Site ID*			
	M1	*M2*	*M5*	*M7*
Proximity and General Quadrat Information	Very close to anthropogenic effluent, typical soil conditions sludge like	Close to anthropogenic activity but not to effluent release	Along proposed shipping channel, away from effluents and anthropogenic activity	Furthest from Port Qasim
Human Disturbance of Mangroves	Fodder collection	None observed	Evidence of timber harvest: Medium (30-70% basal area)	Evidence of timber harvest: Low (less than 30% basal area)
Other Disturbance to Mangroves: Presence of Disease and Insect Damage	Insect damage (Gall midges, shoot borers, weevil)	Insect damage (Gall midges, leaf miners)	Insect damage (Gall midges, insect borer), fungi, fungi causing dieback, sooty mold), gummosis, canker, abnormal growths causing rough surfaces on woody parts	Insect damage (Gall midges, insect borer, weevil), fungi, sooty mold), gummosis, canker, abnormal growths causing rough surface on woody parts
Estimated Range of Intensity of Disease and Insect based disturbance based on number of trees affected per quadrat	light to severe	light to moderate	severe	light to severe
Mean Adult Tree Densities (per $100m^2$)	30	15	9.3	25
Mean Adult Tree Heights (m)[17]	2.03	3.73	5.25	2.37

[17] Excluding stunted mangroves

Site Specific Information	*Study Site ID*			
	M1	*M2*	*M5*	*M7*
Mean Adult Tree Girths (cm)[18]	Not Available as trees below 1.3m in height and impeded by peculiar arrangement of aerial roots	28.02	47.05	27.87
Mean Seedling Density (per 100m^2)	5500	4.33	4507	6.25
Mean Crab Holes Density (per 1.0m^2)	410	201	150	157
Other observations related to macrofauna	Snails very abundant	None noticed	None noticed	None noticed
Mean % Canopy Cover	71.9	85.4	75.0	62.5
Other observations on route	None	Felled trees and '*bulla gujja*', observed entangled in trees	None	None

[18] Excluding stunted mangroves

Proximity to Port Qasim

The variations in mangrove habitats observed at varying distances from Port Qasim were evident. The Study Site closest to Port Qasim and nearby anthropogenic effluent release (such as industrial and municipal activity) was M1. At sampling locations near this Study Site the presence of chemical pollution was visible compared to at the other Study Sites. Furthermore, the soil at Study Site M1 was more liquid and sludge-like relative to soil at sampling locations near other Study Sites.

Cutting and Harvesting

At sampling locations near Study Site M1 (the Study Site closest to Port Qasim and anthropogenic effluent release), there was evidence of cutting of newly tendered branches probably for fodder use by nearby communities raising livestock. At other sampling locations near Study Sites M5 and M7 there was evidence of timber harvest of varying levels (from medium to low in terms of basal area).

Insect Damage and Disease

Variations in other disturbances of the mangroves included variations in insect damage and fungal disease evident on the trees. Insect damage and fungal infection was observed at all sampling locations. Quadrats established near Study Site M5 were all observed to have severe disturbance due to insect damage and fungal disease, whereas at other Study Sites the ranged from not evident to severe. Disturbance evidence due to insect damage and fungal infection generally showed a trend of increasing with increase in proximity to Port Qasim. However, at one of the sampling locations near Study Site M1 (the Study Site closest to Port Qasim) it was observed as severe while at Study Site M7 (the Study Site furthest from Port Qasim) it was estimated as light. A clear trend of increasing disease prevalence with increasing distance from Port Qasim could not be established. Gall midges were observed at sampling locations near all Study Sites.

Seedling and Crab Holes Distribution

Variations in distribution of seedlings between sampling locations close to Study Site M1 and those at other Study Sites distal from Port Qasim was evident. Seedlings were concentrated under the mangrove canopy. A similar trend was observed for crab holes distribution. In addition to this a large number of snails were observed at sampling locations near Study Site M1 but not at sampling locations near other Study Sites.

Variations in Densities, Heights and Girths of Adult Mangroves between Study Sites

The variations in adult mangrove plant sizes observed at sampling locations at varying distances from Port Qasim were also evident. Adult mangroves near the Study Site closest to Port Qasim, M1 were relatively shorter compared to adult mangroves at all other Study Sites which were distal from Port Qasim. This is with the exception of stunted mangrove plants observed at Study Site M7. In addition to this adult mangroves near Study Site M1 also had a higher density relative to adult mangroves at all other Study Sites (between 25 and 35 trees per $100m^2$ relative to the highest value of 17 per

100m^2 at other Study Sites) with the exception of the stunted mangroves observed at Study Site M7. Another difference evident between adult mangroves closest to Port Qasim (M1) compared to those further from Port Qasim was the appearance of aerial roots around the adult mangroves. As shown in **Exhibit C.24** at M1 aerial roots were extremely dense closer to each adult tree's main stem, impeding access to the main stem. This was not observed in adult mangroves at any of the other sampling locations distal from Port Qasim.

Variations in Seedling Densities

Variation in seedling densities between Study Sites was also evident. Sampling locations near two Study Sites, M1 and M5, had extremely high seedling densities (order of magnitude 1000x higher) relative to seedling densities observed at sampling locations near Study Sites M2 and M7.

Variations in Crab Hole Densities

Variations in crab holes densities were observed. It was noticeable that crab holes per m^2 were in higher ranges (402 to 417) at sampling locations near Study Site M1 (the Study Site closest to Port Qasim) than at sampling locations near Study Site M 5 (130 to 160) and M7 (79 to 242), the Study Site furthest from Port Qasim. A high abundance of snails was visible on the forest floor at Study Site M1 closest to Port Qasim.

Variations in Canopy Cover

The highest percentage canopy cover was recorded at Study Site M2 (81% to 88%) followed by Study Site M5 (69% to 81%), M1 (69% to 75%) and M7 (56% to 69% and 63% for stunted mangroves).

Other Observations

The evidence of the use of trees for mooring of nets used for fishing was also observed. According to the local guide a number of trees which were observed to be felled along the shoreline had been brought down by their use for mooring the fishing net known locally as '*Bulla Gujja*'.

C.2 Fish Studies

C.2.1 Overview of Aquatic Biodiversity at Keti Bandar and Differences in the Physical and Ecological Setting between Keti Bandar and Port Qasim by Dr. Muhammad Rafique, PMNH

C.2.1.1 Introduction

Keti Bandar Taluka (Tehsil) of Thatta district of Sindh province is situated at a distance of about 200 km SE of Karachi. It is located in Indus Delta experiencing warm monsoon climatic regime. Mild winters extend from November to February while summer season extends from March to October. Most of the annual precipitation takes place during monsoon which is erratic in distribution. Mean annual rainfall is 220 mm. January is the cooler month with minimum temperature of 9.5 ºC while in June – July minimum and

maximum temperatures range from 23 ºC–26 ºC and from 30 ºC - 36ºC respectively. Humidity is generally higher in the morning than in the afternoon. It also varies from place to place depending upon the proximity to the sea. Wind is another important feature of coastal zone. It is variable and is faster during summer (7. 4 to 20. 5 km/h) than winter (Qureshi 1985). Keti Bandar consists of a total of 42 dehs (cluster of villages) that spread over a total area of 60 969 hectare. It is believed that the sea has engulfed 28 dehs and the total affected area in Keti Bandar Taluka is around 46 137 hectare (WWF 2004). Hoekstra *et al.* (1997) mentioned that Keti Bandar Tehsil includes a total of 19 Dehs and 29 villages while total human population is around 12000. Historically the location of Keti Bandar town has changed thrice during the past 70years due to progressive intrusion of the sea. There are four major creeks in the area viz. Chann Hajamro Khobar and Kangri with innumerable small creeks. Human population of the Keti Bandar town and adjacent creeks is about 12 000. Majority of them are fishermen and belong to Baloch Jat Memon Shiekh Dabla Solangi Syed and Gug tribes. Traditionally agriculture livestock and fishing were three major sources of livelihood of the community of this area. For sweet water needed for drinking and farming Keti Bandar and other coastal region depend entirely on Indus River and its distributaries. Before construction of upstream barrages river water used to reach the tail end during low tides round the year. However, upstream dams and barrages have considerably reduced the river flow to the extent that Kharo Chan and Shah Bandar areas that had good agrarian economy in the past and produced plenty of high quality red rice are now facing acute water shortage. During flood season water is stored in ponds for subsequent human and livestock use. The agriculture has now deteriorated due to water logging and salinity of lands.

During off season (May to August) local people were dependent on agriculture practices in the past and fish during other months of the year (Qureshi 1985). Scarcity of fresh water in the area from the Indus and seawater intrusion into the land has been degrading the area. Currently dominant sources of livelihood include fishing 90% agriculture and livestock rearing 8% and services in various sectors 2%. The women of the area have more freedom as compared to other agricultural and pastoral communities; however they are not involved in livelihood activities and are responsible mainly for household chores and the livestock. Almost 90% population of the area is illiterate. People are living below the poverty line and thus their dependence on natural resource has increased.

Fishing is the main livelihood resource of the community. Fish shrimps and crabs are harvested on regularly basis. Besides providing valuable export earnings to the country it is the primary source of livelihood of the population. There has been reduction in fish catch in recent years. One of the reasons is the unsustainable fishing practices adopted by the community. Detail of fish species found in the area is provided in the table 1 below.

C.2.1.2 Study Methodology

Four different methods viz. drag netting cast netting gill netting and trawl netting were for this study. Trawl netting was used in the creek areas Gill netting in side pools and creeks cast netting in the wade able coastal areas while drag netting technique was used in the shore areas during low tide periods. A general survey of the reservoir area was conducted to identify different habitats in the study area. Field stations were selected

covering all the representative habitats of the study area. Longitude/Latitude of all the field stations was noted to make it more accessible during the study period.

The collected specimens were numbered for each station and by each method. Voucher specimens were preserved in 10% formaldehyde solution in the field. Large specimens were given an incision in the belly to ensure proper preservation. The specimens were identified in the laboratory and taxonomical checklists along with English and local names were compiled. The relevant data for each species was compiled using the standard literature. Any possible change to resident and migratory fish was anticipated on the bases of data collected previous studies carried out in the area and on the basis of interviews of the fishermen and local people agro forestry practices and irrigational pattern in the area and conservational measures that could be expected in future.

The fishes of special concern i. e. fishes of economic value and fishes of ecological concern were given special attention and were documented and enlisted on the basis of the firsthand information collected by the actual data and the information already available through previous studies.

Results and Discussion

Exhibit C.91: Marine and Brackish water Fishes found in Keti Bandar Area

No	*Species*	*Family*	*English name*	*Local Name*	*Max Size (cm)*	*Weight (Grms)*	*Commercial value*	*Habitat*	*Feeding habit*
1.	*Albula vulpes*	Albulidae	Bonefish ladyfish	Viaat	80	9 000	Average	Inhabits shallow coastal waters estuaries and bays	Feeds on the bottom Mollusks
2.	*Arius arius*	Ariidae	Threadfin sea catfish	Singhara	20	150	Medium	Coastal waters	Prawns shrimps crabs
3.	*Arius caelatus*	Ariidae	Engraved catfish	Khagga	45	250	Medium	Coastal waters	Prawns shrimps crabs
4.	*Arius crossocheilus*	Ariidae	Roughback sea catfish	Khagga	40	220	Medium	Coastal waters	Prawns shrimps crabs
5.	*Arius dussumieri*	Ariidae	Blacktip sea catfish	Khagga	30	200	Medium	Demersal; freshwater; brackish; marine;	Feeds on invertebrates and small fishes
6.	*Arius maculatus*	Ariidae	Spotted catfish	Khagga	60	400	Medium	Inshore and estuarine water	Invertebrate and small fishes
7.	*Arius teniuspinis*	Ariidae	Thin spine catfish	Khagga	35	200	Medium	Coastal waters up to 50 m depth	Invertebrate and small fishes
8.	*Arius thalassinus*	Ariidae	Giant catfish	Khagga	185	1 000	High	Estuaries brackish waters	Invertebrate and small fishes
9.	*Osteogeneiosus militaris*	Ariidae	Soldier catfish	Khagga	35	200	Medium	Demersal; potamodromous freshwater; brackish; marine	Invertebrate and small fishes

No	*Species*	*Family*	*English name*	*Local Name*	*Max Size (cm)*	*Weight (Grms)*	*Commercial value*	*Habitat*	*Feeding habit*
10.	*Strongylura leiura*	Belonidae	Banded needlefish	Kangi Kango	80	250	Medium	Occur in marine as well as brackish and fresh waters.	Small fishes
11.	*Strongylura strongylura*	Belonidae	Banded needlefish	Kangho	100	500	Average	Coastal waters estuaries as well as freshwaters	Small fishes
12.	*Pseudorhombus arsius*	Bothidae	Largetoothed flounder	Kuker-jeeb	30	200	High	Esturine Continental shelf	Bottom living animals
13.	*Alepes djedaba*	Carangidae	Shrimp scad	Seem Bangra	40	124	Average	Saltwater Coastal water and reef areas.	Crustacean and copepods
14.	*Carangoides chrysophrys*	Carangidae	Longnose trevally	Seem Bangra	72	4 350	Average	Open waters of coastal reefs	Crustacean copepods
15.	*Caranx para*	Carangidae	Banded scad	Bangra Kakkar	20	200	Low	Inshore coastal	Zooplankton
16.	*Decapterus macrosoma*	Carangidae	Short fin Scad	Seem	30	240	Low	A schooling species usually occurring	Planktonic invertebrates
17.	*Megalaspis cordyla*	Carangidae	Tarpedo Scad	Bangra	80	1 000	High	A pelagic schooling species	Feeds on fish and small crustaceans
18.	*Parastromateus niger*	Carangidae	Black pomfret	Kala poplet	55	700	High	Usually found over muddy bottoms between 15 and 40 m depth.	Zooplankton crustaceans and small fishes
19.	*Scomberoides commersonnianus*	Carangidae	Blacktip leatherskin	Aal Saram	120	12 000	high	Coastal waters	Fish crustacean
20.	*Trachinotus blochii*	Carangidae	Snubnose Pompano	Sonab	65	9000	high	Juveniles in shallow sandy or muddy bays near river mouths	Molluscs and crabs

No	*Species*	*Family*	*English name*	*Local Name*	*Max Size (cm)*	*Weight (Grms)*	*Commercial value*	*Habitat*	*Feeding habit*
21.	*Trachinotus mookalee*	Carangidae	Indian pompano	Sonaf	90	1 200	Medium	Inhabits shallow coastal waters	Feeds on molluscs and on crabs
22.	*Scoliodon latucaudus*	Carcharhinidae	Spadenose shark	Mangra	75		Low	Coastal waters in rocky areas	Feeds on small schooling fishes
23.	*Chirocentrus dorab*	Chirocentridae	Dorab wolf herring	Kerli gairi	100	700	Average	Pelagic inshore	Small fishes and crustaceans
24.	*Nematalosa nasus*	Clupeidaae	Long-ray bony bream	Daddi-palli	22	200	Average	Pelagic coastal waters entering estuaries creeks	Detritus phyto and zooplankton
25.	*Sardinella albella*	Clupeidaae	White Sardinelle	Tarli Luar	14	100	Low	A schooling species usually in coastal waters	Feeds on zooplankton and on phytoplankton
26.	*Sardinella gibbosa*	Clupeidaae	Goldstripe sardinella	Tarli Luar	17	75	Low	Coastal pelagic schooling.	Feeds on zooplankton and on phytoplankton
27.	*Sardinella longiceps*	Clupeidaae	Oil Sardine	Tarli/ Luar	23	80	Medium	Pelagic species mainly coastal	Feeds on planktons and detritus
28.	*Sardinella sindensis*	Clupeidaae	Sindh Sardinelle	Tarli Luar	17	70	Low	A pelagic schooling species found in coastal waters	Feeds on planktons and detritus
29.	*Anodontostoma chacunda*	Clupeidae	Shortnose Gizzard Shad	Daddi-palli	17	100	Low	Pelagic in inshore waters	Detritus phyto and zooplankton
30.	*Dussumieria acuta*	Clupeidae	Rainbow Sardine	Tel-tempori	20	130	Medium	Pelagic in inshore waters	Detritus phyto and zooplankton
31.	*Escualosa thoracata*	Clupeidae	White sardine	Mithoo	10	50	Low	Pelagic in coastal waters	Phytoplamkton and Zooplankton(copepods crabs bivalve larvae fish eggs

No	*Species*	*Family*	*English name*	*Local Name*	*Max Size (cm)*	*Weight (Grms)*	*Commercial value*	*Habitat*	*Feeding habit*
32.	*Hilsa kelee*	Clupeidae	Kelee shad	Palli	25	75	Low	Pelagic in coastal waters	Small fish and crustacean
33.	*Ilisha megaloptera*	Clupeidae	Bigeye ilisha	Palli	28	200	Low	Pelagic in coastal waters	Fish and crustacean
34.	*Ilisha melastoma*	Clupeidae	Indian ilisha	Palli	12	70	Low	Pelagic in coastal waters	Mollusks
35.	*Opisthopterus tardoore*	Clupeidae	Tardoore	Koor Palli	20	90	Low	Shallow waters Creeks	Small crustacean and zooplankton
36.	*Pellona ditchela*	Clupeidae	Indian pellona	palli	16	80	Low	Shallow coastal waters estuaries creeks lagoons.	Small crustacean and zooplankton
37.	*Tenualosa ilisha*	Clupeidae	Hilsa shad	Palla	60	2 490	High	pelagic; anadromous	plankton mainly by filtering but apparently also by grubbing on muddy bottom
38.	*Tenualosa toli*	Clupeidae	Toli shad	Nur-Palla	50	1 000	High	Coastal waters bays lagoons	Detritus Phytoplankton and Zooplankton
39.	*Cynoglossus macrostomus*	Cynoglossidae	(Malabar tonguesole	Sole	17	60	Medium	Inhabits shallow muddy and sandy bottoms of the continental self	Feeds mainly on benthic invertebrates especially worms.
40.	*Cynoglossus puncticepus*	Cynoglossidae	Speckled tonguesole	Sole	18	60	Medium	Inhabits shallow muddy and sandy bottoms of the continental self	Feeds mainly on benthic invertebrates especially worms.
41.	*Cynoglossus bilineatus*	Cynoglossidae	Tongue soles	sole	44	225	High	Coastal areas and estuaries. May ascend into the freshwater	Bottom-living invertebrates
42.	*Cynoglossus dubius*	Cynoglossidae	Tonguesoles	sole	50	300	High	Continental shelf	Bottom-living invertebrates

No	*Species*	*Family*	*English name*	*Local Name*	*Max Size (cm)*	*Weight (Grms)*	*Commercial value*	*Habitat*	*Feeding habit*
43.	*Cynoglossus arael*	Cynoglossidae	Brown Tongue soles	Sole	38	200	High	Continental shelf estuaries	Bottom-living invertebrates
44.	*Aphanius dispar dispar*	Cyprinodontidae	Killi fish	Killi fish	7	15	No	Occurs in coastal zones also found in oasis pools with hypersaline to fresh water	Chiefly a herbivorous species
45.	*Himantura walga*	Dasyatidae	Dwarf whipray	Pittan	-	-	No	Demersal; marine	Feeds on invertebrates and small fishes
46.	*Drepane punctata*	Drepanidae	Spotted sicklefish	Rupichand	40	1 000	High	Coastal estuaries	Bottom-living invertebrates
47.	*Echeneis naucrates*	Echeneididae	Live Sharksucker	Masi	75	500	Medium	Shallow coastal waters	Food scraps of the host species
48.	*Elops machnata*	Elopidae	Tenpounder	Kinarhal	120	11 000	Average	Inhabits shallow coastal waters estuaries and bays	Small fishes mollusks shrimps crabs
49.	*Coilia dussumieri*	Engraulidae	Anchovy	Patia	20	15	low	Pelagic; Amphidromous	copepods prawn and fish larvae
50.	*Thryssa dussumieri*	Engraulidae	Thryssa	Physa	11	50	No	Mostly inshore and estuarine conditions	Feeds on diatoms prawn larvae copepods and cypris.
51.	*Thryssa hamiltonii*	Engraulidae	Thryssa	Physa	20	40	Low	Pelagic in coastal waters estuaries	Mainly on crustaceans (zoea larvae amphipods Acetes)
52.	*Thryssa mystax*	Engraulidae	Moustached thryssa	Physa	16	50	Low	Pelagic in coastal waters estuaries	Mainly on crustaceans (zoea larvae amphipods Acetes)

No	*Species*	*Family*	*English name*	*Local Name*	*Max Size (cm)*	*Weight (Grms)*	*Commercial value*	*Habitat*	*Feeding habit*
53.	*Thryssa setirostris*	Engraulidae	Thryssa	physa	15	40	Low	Pelagic in coastal waters estuaries	Mainly on crustaceans (zoea larvae amphipods Acetes)
54.	*Thryssa vitrirostris*	Engraulidae	Orangemouth Anchovy	Physa	20	50	Low	Coastal waters also in estuaries	Mainly feeds on crustaceans
55.	*Gerres filamentosus*	Gerreidae	Long-rayed silver- biddy	Jerkari	25	125	Medium	Shallow coastal waters	Crustaceans polychaetes and forams on sand or muddy-sand bottoms
56.	*Gerres poieti*	Gerreidae	Strongspine silver biddy	Jerki	20	125	Medium	Lives near the bottom	Small benthic invertebrates
57.	*Gerres oyena*	Gerreidae2	Lined silver-biddy	Jerki	30.	125	low	coast saltwater lagoons and estuaries	Crustaceans polychaetes and forams on sand or muddy-sand bottoms
58.	*Boleophthalmus dussumieri*	Gobiidae	Mud skipper	Gullo	10	40	No	Coastal areas	Small fish crabs and other arthropods
59.	*Scartelaos tenuis*	Gobiidae	Indian Ocean slender mudskipper	Gullo	10	30	No	Coastal areas	Small fish crabs and other arthropods
60.	*Carangoides mal abaricus*	Gobiidae	Malabar trevally	Kakkar	25	150	Medium	Sandy bays rocky and coral reefs	Feeds on crustaceans squids and shrimps
61.	*Psammogobius b iocellatus*	Gobiidae	Sleepy goby	Gullo	12	50	No	Inhabits intertidal areas estuaries and lagoons	Small fish crabs
62.	*Glossogobius giuris*	Gobiidae	Tank gobby	Gobby	50	50	Low	Rivers and Brackish water	Small insects crustaceans and small fish

No	Species	Family	English name	Local Name	Max Size (cm)	Weight (Grms)	Commercial value	Habitat	Feeding habit
63.	*Periophthalmus barbarus*	Gobiidae	Atlantic mudskipper	Gobby	25	30	Low	Marine; freshwater; brackish; reef-associated	Arthropods (crabs insects etc.) of the mud surface
64.	*Periophthalmus weberi*	Gobiidae	Weber's mudskipper	Gobby	10	20	Low	Brackish mangroves including the margin of estuaries and tidal creeks	Crabs and insects
65.	*Pomadasys argenteus*	Haemulidae	Grunter	Dhother	50		High	Coastal waters	Benthic invertebrates and small fishes
66.	*Pomadasys kaakan*	Haemulidae	Grunter	Dhother	80	3 5000	High	Coastal waters	Benthic invertebrates and small fishes
67.	*Pomadasys maculatum*	Haemulidae	Saddle grunt	Dhother	50	2 000	High	Coastal waters	Benthic invertebrates and small fishes
68.	*Pomadasys stridens*	Haemulidae	striped grunter	Bukra	20	15000	High	Coastal waters	Benthic invertebrates and small fishes
69.	*Harpadon nehereus*	Harpadontidae	Bumbay duck	Bombil	40	150	Low	Coastal waters and estuaries	Benthic invertebrates and small fishes
70.	*Hemiramphus far*	Hemiramphidae	Blackbarred halfbeak	Thute	45	150	Low	Marine and brackish waters	Benthic invertebrates and small fishes
71.	*Hyporamphus dussumieri*	Hemiramphidae	Dussumieri halfbeak	Thute	30	100	Medium	Marine and brackish waters	Feed on small fishes
72.	*Hyporamphus(Hyporamphus) limbatus*	Hemiramphidae	Congaturi halfbeak	Thute	55	200	Average	Marine and brackish water	Omnivorous
73.	*Lactarius lactarius*	Lactariidae	False trevally	Bukko	40	175	Medium	Found in various types of habitats	Feeds on benthic invertebrates

No	*Species*	*Family*	*English name*	*Local Name*	*Max Size (cm)*	*Weight (Grms)*	*Commercial value*	*Habitat*	*Feeding habit*
74.	*Lates calcarifer*	Latidae	Baramundi	Dangri	200	80 000 (8kg)	High	Demersal; catadromous	Crustaceans molluscs and smaller fishes
75.	*Leiognathus blochi*	Leiognathidae	Twoblotch ponyfish	Kaanteri	10	30	Low	Inhabit shallow coastal waters	Feeds on small crustaceans foraminifera and bivalves
76.	*Leiognathus brevirostris*	Leiognathidae	Short nose ponyfish	Kaanteri	13	30	Low	Inhabit shallow coastal waters	Feeds on small crustaceans foraminifera and bivalves
77.	*Leiognathus equulus*	Leiognathidae	Common Ponyfish	Kaanteri	25 cm	45	Low	Inhabit shallow coastal waters	Feed on polychaetes small crustaceans small fishes and worms
78.	*Leiognathus daura*	Leiognathidae	GoldstripePonyfish	Kaanteri	14	30	Low	Shallow waters	Polychaetes bivalves small crustaceans and sponges
79.	*Leiognathus splendens*	Leiognathidae	Splendid ponyfish	Kaanteri	17	40	Low	Coastal waters	Fish crustaceans foraminiferans and bivalves
80.	*Secutor insidiator*	Leiognathidae	Slender barred ponyfish	Kaanteri	11. 3	25	Low	Shallow waters	Zooplankton including copepods mysids and larval fishes and crustaceans
81.	*Lutjanus johnii*	Lutjanidae	One spot golden snapper	Hira	90	10 000	High	Shallow coastal waters mainly around mangroves	Fishes and benthic invertebrates including shrimps crabs and cephalopods

No	*Species*	*Family*	*English name*	*Local Name*	*Max Size (cm)*	*Weight (Grms)*	*Commercial value*	*Habitat*	*Feeding habit*
82.	*Lutjanus argentimaculatus*	Lutjanidae	Red snapper	Hira	120	10 000	High	Shallow coastal waters mainly around mangroves	Fishes and benthic invertebrates including shrimps crabs and cephalopods
83.	*Liza carinata*	Mugilidae	Keeled mullet	Boi Mori	25	40	Average	Marine coastal waters	Small benthic invertebrates planktonic organism alga and detritus
84.	*Liza melinoptera*	Mugilidae	Large scale gery Mullet	Boi Mori	22	30	Low	Coastal waters Estuaries	Feeds on plant detritus microalgae minute benthic organisms and organic matter in sand and mud
85.	*Liza parsia*	Mugilidae	Gold spot mullet	Boi Parsi	16	30	Low	Shallow coastal waters	Small benthic invertebrates planktonic organism alga and detritus
86.	*Liza subviridis*	Mugilidae	Green back mullet	Chhodi	30	500	High	Coastal waters estuaries	Small algae diatoms and benthic detrital material taken in with sand and mud
87.	*Mugil cephalus*	Mugilidae	Large scale mullet	Pharra Boi	60	12 000	High	Coastal areas enters estuaries and rivers	Omnivorous zooplankton benthic organisms and detritus
88.	*Valamugil cunnesius*	Mugilidae	Long arm mullet	Pharra Boi	50	1000	high	Coastal waters estuaries enters rivers	Organic matter contained in sand and mud
89.	*Upeneus vittatus*	Mullidae	Yellow-striped goatfish	Manori	28	300	Average	Turbid waters	Small crustaceans

No	*Species*	*Family*	*English name*	*Local Name*	*Max Size (cm)*	*Weight (Grms)*	*Commercial value*	*Habitat*	*Feeding habit*
90.	*Congresox talabonoides*	Muraenesocidae	Pike congers	Bam	250	50000	High	Continental shelf	Feeds at night on bottom fishes and crustaceans
91.	*Muraenesox cinereus*	Muraenesocidae	Silver conger eel	Bam	200	2 000	High	Continental shelf	Feeds at night on bottom fishes and crustaceans
92.	*Pisodonophis cancrivorus*	Ophichthidae	Longfin snake-eel	Bam	50	400	low	Demersal brackishwater saltwater and entering freshwater	Spend most of the time buried in sand and hunt small fishes and crustacean.
93.	*Grammophites suppositus*	Platycephalidae	Softfiin flathead	Kuker	25	300	Average	Rocky shores	Crustaceans and small fish
94.	*Platycephalus indicus*	Platycephalidae	Bartail flathead	Kuker	100	3000	High	Rocky shores	Crustaceans and small fish
95.	*Eleutheronema tetradactylum*	Polynemidae	Four finger threadfin	Seeri Ranwas	200	80000	High	Shallow coastal waters entering river mouths	Prawns and fish
96.	*Filimanus heptadactylus*	Polynemidae	Sevenfinger Threadfin	Seeri	200	5000	High	Shallow coastal waters entering river mouths	Prawns and fish
97.	*Polynemus indicus*	Polynemidae	Indian threadfin	Seeri Ranwas	200	8 0000	High	Shallow coastal waters	Feeds on diatoms copepoda crustaceans and smaller fish
98.	*Polynemus sexfilis*	Polynemidae	Sixfinger threadfin		70	1 000	High	Shallow coastal waters	Feeds on diatoms copepoda crustaceans and smaller fish
99.	*Polynemus sextarius*	Polynemidae	Black spot threadfin	Seeri	150	4000	High	Shallow coastal waters	Feeds on diatoms copepoda crustaceans and smaller fish

No	Species	Family	English name	Local Name	Max Size (cm)	Weight (Grms)	Commercial value	Habitat	Feeding habit
100.	*Psettodes erumei*	Psettodidae	Indian flounder	Hajjam	60	900	High	Muddy and sandy bottomsof the continental shelf	Feeds on diatoms copepoda crustaceans
101.	*Scatophagus argus*	Scatophagidae	Spoted scat	Korgi	38	2000	Average	Inhabit brackish estuaries and the lower reaches of freshwater	Worms crustaceans insects and plant matter
102.	*Johnieops sina*	Sciaenidae	Small salmon	sua	30	500	High	Inshore waters	Feeds on diatoms copepoda crustaceans
103.	*Johnius dussumieri*	Sciaenidae	Bearded croacker	Mushka	25	400	High	Coastal waters	Feeds on small fishes and invertebrates
104.	*Johnius belangerii*	Sciaenidae	Jewfish	Mushka	30	450	High	Coastal waters. Enters estuaries	Invertebrates worms
105.	*Otolithes ruber*	Sciaenidae	Rosy jewfish	Mushka	90	7 000	High	Coastal waters	Fishes prawns and other invertebrates
106.	*Protonibea diacanthus*	Sciaenidae	Jewfish	Sua	120	40000 (20kg)	High	Coastal waters	Crustaceans and small demersal fishes
107.	*Rastrelliger kanagurta*	Scombridae	Indian mackerel	Bangra	35	300	High	Coastal water	Fish and shrimp larvae
108.	*Scomberromorus guttatus*	Scombridae	Indo-Pacific king mackerel	Kalgund	76	800	High	Coastal to deeper water	Fishes and cephalopods
109.	*Epinephelus diacanthus*	Serranidae	Thornycheek grouper	Gisser	52	3 000	High	Continental shelf area	Fishes and large crustaceans
110.	*Epinephelus fuscoguttatus*	Serranidae	Brown-marbled Grouper	Gisser	90	11 000	High	Continental shelf area	Fishes and large crustaceans
111.	*Promicrops lanceolatus*	Serranidae	Giant Grouper	Dhambo	270	400 000	High	Common in estuaries	Feeds on fishes and large crustaceans

No	Species	Family	English name	Local Name	Max Size (cm)	Weight (Grms)	Commercial value	Habitat	Feeding habit
112.	*Sillago sihama*	Sillaginidae	Silver whiting	Bhambore	25	40	High	Shores Bays Creeks estuaries	Mainly on polychaetes and other benthic organisms
113.	*Mystus gulio*	Siluridae	Long whiskers catfish	Tengara	45	100	Medium	Primarily a brackish water fish that enters and lives in fresh water.	Benthic invertebrates
114.	*Brachirus orientalis*	Soleidae	Oriental sole	Phani	24	75	Low	Shallow coastal waters	Feeds mainly on bottom-dwelling invertebrates
115.	*Solea elongata*	Soleidae	Elongate Sole	Phani	30	45	Low	Shallow coastal waters	Benthic invertebrates especially small crustaceans
116.	*Solea ovata*	Soleidae	Uvate Sole	Bans Patta	10	20	Low	Inhabits shallow sand and mud bottoms in coastal waters.	Feeds mainly on benthic invertebrates
117.	*Acanthopagrus berda*	Sparidae	Black Bream	Dandya	50	1 500	High	Muddy grounds in estuarine areas	Invertebrates including worms mollusks crustaceans and echinoderms
118.	*Acanthopagrus latus*	Sparidae	Yellow fin sea Bream	Dandya	50	1 500	High	Coastal waters estuaries river mouth	Echinoderms worms crustaceans and mollusks.
119.	*Sparidentex hasta*	Sparidae	Sobaity seabream	Dandya	35	50	Medium	Demersal; brackish; marine	Carnivorous
120.	*Sphyraena putnamiae*	Sphyraenidae	Barracuda	Kund	90	4000	High	Inshore-pelagic	fishes and large invertebrates
121.	*Pampus argenteus*	Stromateidae	Silver pomfret	Achopito Sufaid poplet	60	30000	High	Inshore species Benthopelagic	Ctenophores salps medusae and other zooplankton groups

No	*Species*	*Family*	*English name*	*Local Name*	*Max Size (cm)*	*Weight (Grms)*	*Commercial value*	*Habitat*	*Feeding habit*
122.	*Pseudosynanceia melanostigma*	Synanceiidae	Blackfin stonefish		13	20	No	Demersal; brackish; marine	Carnivore
123.	*Terapon jerbua*	Teraponidae	Jerbua terapon	Ginghra	36	10000	Average	Vicinity of river mouths Estuarine demersal; catadromous	Omnivorous feeds upon fishes insects benthic invertebrates and algae
124.	*Terapon puta*	Teraponidae	Smallscale terapon	Ginghra	15	25	Low	Inshore waters estuaries	Small fishes and invertebrates
125.	*Gastrophysus lunaris*	Tetradontidae	Moontail blassop	Ginghra	45	50	Low	Brackish water environment	Aquatic insects
126.	*Lagocephalus lunaris*	Tetraodontidae	Lunartail puffer	Toroo	75	100	No	Mainly marine occasionally enters estuaries	Invertebrates
127.	*Lepturacanthus savala*	Trichiuridae	Hairtail	Talwar	120	350	High	Benthopelagic	Variety of small fishes and crustaceans
128.	*Trichiurus lepturus*	Trichiuridae	Large head hairtail	Talwar	46	150	Medium	tropical and temperate waters	Fishes crabs mollusks

Exhibit C.92: Freshwater Fish Fauna Found in Keti Bander Area

No.	*Species*	*Families*	*Common Name*	*Habitat*	*Feeding Habits*
1.	*Parambassis ranga*	Ambassidae	Indian glassy fish	Freshwater brackish	Feeds on invertebrates worms and crustaceans
2.	*Mystus gulio*	Bagridae	Long whiskers catfish	Freshwater; brackish	Feeds on invertebrates worms and crustaceans
3.	*Mystus bleekeri*	Bagridae	Day's mystus	Freshwater	Feeds on invertebrates worms and crustaceans
4.	*Mystusc cavasius*	Bagridae	Gangetic mystus	Freshwater brackish water	Feeds on invertebrates worms and crustaceans
5.	*Channa punctata*	Channidae	Spotted Snakehead	Freshwater; brackish brackish water	Feeds on invertebrates worms and crustaceans
6.	*Oreochromis mossambica*	Cichlidaec	Tilapia	Freshwater brackish water	Omnivore
7.	*Tenualosa ilisha*	clupiedae		Freshwater brackish water	Feeds on invertebrates worms and crustaceans
8.	*Puntius sarana sarana*	Cyprinidae	Olive barb	Freshwater	Variety of small fishes and crustaceans
9.	*Puntis sophore*	Cyprinidae	Pool barb	Inhabits rivers streams and ponds	Omnivore
10.	*Esomus danricus*	Cyprinidae	Flying barb	Occurs in ponds weedy ditches	benthopelagic;
11.	*Chela laubuca*	Cyprinidae	Indian glass barb	Freshwater brackish water	Feeds mainly on insects but also takes plants
12.	*Amblypharyngodon mola*	Cyprinidae	Mola carplet	Freshwater	Omnivore
13.	*Glossogobius giuris*	Gobiidae		Freshwater brackish water	Carnivore
14.	*Macrognathus arel*	Mastacembelidae	One-stripe spinyeel	Found in fresh and brackish waters	Nocturnal feeder on insects and worms.
15.	*Ompok pabda*	Siluridae	Pabdah catfish	Freshwater	Carnivore
16.	*Wallago attu*	Siluridae	Wallago	Freshwater brackish water	A large voracious predatory fish

A total of 128 fish species belonging to 42 families has been recorded from marine brackish and freshwater habitats of Keti Bandar area (**Exhibit C.91**). Only 16 species were collected from freshwater while all the rest have been reported from marine water. The most specious families were Clupeidae, Carangidae, Mugilidae and Sciaenidae represented by 9, 6, 5 and 4 species respectively. Each of the families Engraulidae, Haemulidae and Leiognathidae were represented by 3 species and all the other families were represented by two or one species. The marine fish fauna of Keti Bandar was dominated by two species of Engrulids *Thryssa hamiltonii* and *Coilia dussumieri*. The next three most abundant species were the clupeids viz. *Ilisia melastoma*, *Ilisha megaloptera* and *Anodontostoma chacunda* while juvenile of catfish *Arius thalassinus* and a mullet *Liza parsia* was also in rich number. Some other common species were *Arius maculatus* (catfish) and *Boleophthalmus dussumieri* (mudskippers). A typical coastal/estuarine fish Barramundi (*Lates calcarifer*) was represent by single specimen. The freshwater species belonged to nine families viz. Amabsidae, Bagridae, Channidae, Cyprinidae, Siluridae, Gobiedae, Cichlidae, Mastacembelidae and Clupeidiae. A freshwater catfish *Mystus golio* of the family Siluridae was also collected from marine water of Keti Bandar.

The species belonging to family Clupeidae, Engrulidae and Mugilidae are small ranging from 15 to 20 cm in total length except for *Tenualosa ilishia* (clupeids) and *Mugil cephalus* (mullets) which can attain total length of 60 and 90 cm respectively. These species are pelagic in nature; concentrate in shallow waters inhabit marine coastal water to estuaries and some species known to enter the freshwater. Most of these species like *Sardinella longiceps*, *Thryssa hamiltonii*, *Coilia dussumieri* and *Pellona ditchela* form schools (Bianchi 1985). Ahmed *et al*. (1985) reported *Nematalosa nasus* and *Scatophsgus argus* from Leth Nullah bellow the salinity of 10 ppt while in our collection these fishes were collected from 37 ppt from KT Bandar Creeks. Other pelagic species such as *Albula vulpes*, *Elops machnata*, *Chirocentrus dorab*, *Scombemorus guttatus*, *Sphyraena putnamiae* and *Polynemus indicus* can reach large size (up to 100 cm) inhabit marine and coastal waters and enter into estuaries and lagoons. Jayaram (1999) indicated that *E. machnata*, *S. argus* and *P. indicus* also visit freshwater.

The species of family Schianidae, Sillaginidae, Teraponidae, Gerridae, Leognathidae, Mullidae, Solidae and Gobiidae are mainly demersal fishes. These species have also small in size ranging from 10-25 cm in total length except the Schianid *Protonibea diacanthus* that reaches up to 120 cm. Schianids prefer muddy bottoms found in coastal to estuarine water. Albaret *et. al.* (2004) noted that Schianid (*Pseudotolithus elongates*) had a remarkably wide distribution and found in relatively clear as well as in the more turbid waters and in all salinities from sea water to totally fresh water. The species *Sillago sihama* of family Sillaginidae inhabits in shallow sandy cum muddy bottoms in coastal water creek and estuaries and Jayaram (1999) included this species as freshwater visitor. Juveniles of family Teraponidae inhabits inshore waters estuaries and in fresh water (Bianchi 1985) while adult one caught in relatively deeper marine water. The species of family Gerridae, Leognathidae and Mullidae are frequently caught in creek areas found in shallow coastal water brackish water lagoons and estuaries. Some species of leognathidae live in schools like *L. splendens* and *Secutor insidiator*. Two species of family Soleidae (*Solea ovata* and *Solea elegance*) were often present in our collection form shallow coastal waters over sandy cum muddy bottoms. Members of the family

Gobiidae are the important component any estuarine ecosystem and often the most abundant fish in inter-tidal area represented in the present collection by two species *Boleophthalmus dussumieri* and *Scartelaos tenuis.* Ahmed *et al.* (1985) captured *Therapon jarbua*, *Sillago sihama*, *Leiognathus fasciatus*, *Johnius diacanthus*, *Glossogobius giuris*, *Boleophthalmus dussumeri* and *B. dentatus* from Leth nullah between 20-24 ppt salinity ranges.

The species of family Carangidae, Arridae, Cynoglossidae, Bothidae, Psettodidae, Platycephalidae, Lutjanidae, Serranidae, Haemulidae and Sparidae are the larger size demersal species. They have all marine origin and occur in coastal water estuaries creek and backwater while few visit freshwater. Number of species of family Carangidae inhabits diverse habitats with different behavior. Some species are pelagic and some forming schools. In the present collection young ones of *Scomberoides commersonnianus* were found in estuaries in school form. The species of family Arridae are known as sea catfishes. Jayaram (1999) mentioned that a sea catfish *Arius thalassinus* visits freshwater while Bianchi (1985) mentioned that it never enters into freshwater. Only juveniles of *A. thalassinus* were captured during these studies from the Keti Bandar creek area. The estuaries and creek areas of KT Bandar provide an excellent habitat for the flat fishes (Cynoglossidae, Bothidae and Psettodidae). Four commercially important flat fish species were present in our collection (**Exhibit C.91**). Mangroves associated creeks of KT Bandar is serving as nursery grounds for the juveniles of species of family Lutjanidae, Serranidae, Haemulidae and Sparidae etc. Ahmed *et al*. (1985) reported *Pomadasys maculates*, *Acanthophagrus datina* and *A. argus* from Leth nullah between 20-24 ppt salinity ranges.

The KT Bandar area has typical ecosystems that support a number of biotic and abiotic processes including different trophic levels. The species of family Clupeidae, Engrulidae and Mugilidae are abundant in estuarine and creek areas mainly feed on detritus and phyto/zooplankton by filtering or grubbing on muddy-bottom like *Tenualosa ilisha*, *Nematalosa nasus* and *Anodontostoma chacunda*. Diatoms copepods and planktonic crustaceans were the main food items in the stomach of Sardines and Anchovies. *Opisthopterus tardoore*, *Ilisha megaloptera and I. melastoma* feed on fish molluscs and crustaceans. On the other hand these clupids, sardines and anchovies form the major food of many fishes higher in the trophic level. Needlefish (*Strongylura leiura*) and halfbeak (*Hyporamphus limbatus*) are piscivorous and omnivorous respectively. Bonefish (*Albula vulpes)*, Tenpounder (*Elops machnata*), Spotted Spanish mackerel (*S. guttaus*) and barracudas (*Sphyraena putnamiae*) are the larger pelagics frequently visited to creeks of KT Bandar in search of food. Bonefish and Tenpounder feed on small marine organism like mollusk shrimp crabs and small fishes. Mackerel and barracudas are the larger carnivore fishes feeding on a variety of fishes and to a lesser extent on crustaceans and cephalopods. They usually target schooling species of sardines and anchovies for their food. Indian mackerel *Rastrelliger kanagurta* is an epipelagic fish and the diets of Indian mackerel consist of diatoms dinoflagellates, bivalve larvae and zooplanktons.

Ribbonfish (Trichiurus lepturus), Horse mackerel (Megalaspis cordyla), *Scomberoides commersonnianus*, wolf herring (*Chirocentrus dorab*) catfish (*Tachysurus sp*) and pomphret (*Parastromateus niger* and *Pampus argenteus*) are the large Benthopelagic species. These fishes feed on different variety of fishes mainly anchovies followed by

scads and Acetes sp. Crustaceans and cephalopods are also taken by some species except pomphret. Black pomphret feeds on zooplankton crustaceans and small fishes while silver pomfret feed on ctenophores, salps, medusae and other zooplankton groups. Carangids (*Alepes djedaba*, *Carangoides chrysophrys* and *Caranx para*) and killifishes (*Aphanius dispar dispar*) are also benthopelagic species. Carangids feeds on invertebrates (crustacean and copepods) occasionally feed on small fishes while killifishes are chiefly herbivourous.

Groupers *Epinephelus fuscoguttatus*, *Epinephelus diacanthus and* Pike congers *Congresox talabonoides* are the Large Benthic Carnivores. The diet of *Epinephelus* sps consists of a variety of fishes crustaceans and cephalopods. Crabs are reported the most dominate group in food items of some species of groupers. Pike congers active during night feed on bottom fishes and crustaceans. A wide variety of groups come under Medium Benthic Carnivores. Among scianeids *Protonibea diacan*, *Johnius dussumieri*, *Johnius belangerii*, *Johnieops sina* and *Otolithes ruber* are the dominant species. Shrimp, squilla and small fishes are the major food items among schenid groups followed by large variety of planktonic crustaceans, polychaetes and foraminiferans. Other major fishes under this group are Flatheads (*Platycephalus indicus* and *Grammoplites suppositus*), snappers (*Lutjanus johnii* and *L. argentimaculatus*), seabreams (*Acanthopagrus berda* and *A. latus)* and grunters (*Pomadasys kaakan*, *P. stridens* and *P. argenteus*). Other minor fish groups are threadfins (*Polynemus* sp) and *Pseudorhombus arsius.* Ladyfish (*Sillago sihama*) *Therapon* sp, whitefish (*Lactarius lactarius*), pony fishes (*Leiognathus splendens* and *Secutor insidiator*) and goatfishes (*Upeneus vittatus*) are the dominant species small benthic carnivores. The diets of all these species consist of particularly crustacean and worms. Some leiognathus species may also take detritus phytoplankton diatoms and planktonic crustaceans as their food. *Cynoglossus dubius* and *C. bilineatus* are benthic omnivores. They are detritus feeder; food items are molluscan shells diatoms planktonic crustaceans polychaetes and crustaceans.

Juveniles of all the former species inhabit very shallow water usually in schools while larger one prefer deeper water and open sea. Bachok et al 2004 revealed the information from his study of the diet contents of numerous marine fishes that fully adult fishes were carnivores feeding on small marine animals mainly teleosts while Cephalopods crustaceans, echinoderms and molluscs were also the part of their diet. However it is important to recognize the actual complexity of the situation because species may feed at different stages of their life cycle. For instance Landry (1997) found that fully adult codfish are predators on herring but when they are small <50 cm long, they feed on copepods and other planktonic crustaceans. The food preference of predatory fishes is very complex and is influenced by many factors such as prey accessibility and mobility prey abundance prey energy content prey size selection and seasonal changes (Nieland 1980; Hart and Ison 1991; Stergious and Fourtouni 1991; Brewer and Warburton 1992; Barry and Ehret1993).

Number of studies acknowledge that diversity distribution abundance and occurrence of estuarine tropical fish are influenced by many biological and physical factors like salinity temperature turbidity depth current strength dissolved oxygen and availability of foods (Whitfield 1998; Albaret 1999; Blaber 2000). Keti Bandar is a part of Indus delta and consisted of four major creeks including mangroves forest. Indus delta and associated

creek areas receive low freshwater input as compared to past that has changed the environment of the area. This situation led to the hyper saline condition in the area (Moazzam 1994; Rizvi *et al*. 1994). The faunal diversity in the creek areas is still high. Abbas and Ahmed (1999) reported 27 species from Bhambore area according to which abundant species were *Colia dusumieri* and *Liza carinata*. Ahmad *et al*. (1985) indicated during the study of Leth Nullah that species diversity was high in esturine ecosystem and all capture species were of marine origin. Blaber (2000) stated that the distribution of fishes influenced by the environmental factors and varies from species to species.

It is concluded form the present study that nearly all of the main fish families are represented in the Keti Bandar area. While population censuses of important commercial species like barramundi (*Lates calcarifer*) and palla (*Tenualosa ilisha*) is urgently needed. Their population may be at risk due to environmental degradation also mentioned by Mahmood *et al*. (1999). Some other threats like using of illegal fishing gears and fishing of undersize fish are harmful and may effect on the faunal diversity of the area.

C.2.1.3 Fish of Economic Importance

Indus Delta and associated creek areas provide rich fishery resources. The estimated production of fish from Sindh coast is about 350,000 metric tons (Moazzam 1999). Small species that are concentrated in estuaries creek and shallow coastal water and like sardinellas anchovies thryssas and mullets production were noted about 39,300 metric tons by Abildgaard and Khan (1992) from fish landing site. Studies of Abildgaard and Khan (1992) further indicated the contribution of *Sardinella sindensis* and *S. fimbriata* was 33,087 metric tons, *S. longiceps* about 3,300 metric tons and *Thryssa sp*. contribute about 2 900 metric tons. The fish species investigated during this study (**Exhibit C.91**) are categorized according their economic value.

The fish like snappers, groupers, grunts, and mackerel locally known as hira, surmai, dhotar, gasser, and aall/sarum (**Exhibit C.91**) fetch high value due to large size and good taste. These are consumed in local market and are also exported. Clupids, sardines and anchovies, are considered low value species and are generally of small sizes. These species are targeted only for fishmeal production. Even high value commercial species are also used in fishmeal if they are caught in small sizes or flesh is under grade due to improper preservation.

C.2.1.4 Overview of Differences in the Physical and Ecological Setting between Keti Bandar and Port Qasim

No.	*Physical and Ecological parameters*	*Keti Bandar Area*	*Port Qasim Area*
1	Freshwater fish fauna	16 species	No any record available
2	Marine Fish fauna	128 species	98 species
3	Pollution	No major industry or source of major pollution	► 6000 industries mostly located along the coastal belt ► Karachi coast. Mangrove habitats in the vicinity of Karachi serve as

No.	*Physical and Ecological parameters*	*Keti Bandar Area*	*Port Qasim Area*
			sink for heavy metals. ▶ The effluent from Pakistan Steel Bin Qasim power plant and cattle colony ▶ 90 000 tons of oil products from vessels and port terminals are dumped every year ▶ Large-scale shipping traffic at Port Qasim. ▶ Waste water pollution
4	Habitat and Biodiversity loss	▶ Less susceptible ▶ Less spatial variation in fish abundance and diversity expected at Keti Bandar	▶ More susceptible due to pollution and disturbance ▶ More spatial variation in fish abundance and diversity expected at Port Qasim
5	Freshwater supply	▶ More creeks supplying rain and flood water ▶ Canal endings supplying freshwater ▶ Close to Indus confluence	▶ Few creeks receiving pollution from the industries and severage water ▶ No canal endings ▶ Far from influence of the Indus delta
6	Fishing pressure	Fishing boats and trawlers are not highly mechanized	Fishing boats and trawlers are highly mechanized
7	Level of Disturbance	Low	High due to turbulence created by shipping loading unloading high sea traffic
8	Overexploitation of resources	Low	High

C.2.1.5 Recommendations for Indicator Fish Species

The following fish species could be used as indicators for characterization and monitoring of fish populations over time taking into account economic value conservation status and representation of major families or classes of fish.

Nos.	*Indicator Species*	*Reasoning*
1	*Arius arius*	▶ A carnivore cat fish
2	*Tenualosa ilisha*	▶ Commercially important fish ▶ Migratory species

Nos.	*Indicator Species*	*Reasoning*
		▶ Under threat of overexploitation ▶ Well known in Sindhi culture
3	*Lutjanus argentimaculatus*	▶ High commercial value ▶ Inhabits Mangroves ▶ Common in the area
4	*Liza subviridis*	▶ Excellent food fish ▶ Common species in KB area ▶ Herbivore fish
5	*Johnius dussumieri*	▶ Carnivore fish ▶ Very important fisheries in Pakistan ▶ Vast group of species in the genus
6	*Cyanoglossus arel*	▶ Common in Keti Bandar area ▶ Excellent food fish ▶ Bottom deviling mainly on muddy bottoms ▶ Genus represented by many species

C.2.1.6 References

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C.2.2 Results Fish Tissue Laboratory Analysis – 2015

See following pages.

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CERTIFICATE OF ANALYSIS

DATE : 30 June 2015 Page 1 of 2

MS ISO/IEC 17025
TESTING
SAMM No. 147

ALS REF. : ALSM131366_1

ALS SAMPLE ID. : ALSM131366595673_1

COMPANY : Hagler Bailly Pakistan (PVT.) Ltd.
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Islamabad, 44000
Pakistan.
Tel: + 92(51)-261 0200-07 Fax: + 92(51)-2610-208
(Attn.: Mr. Hidayat Hassan / Aziz Karim)

PROJECT : CIA

DATE SAMPLE RECEIVED : 17 June 2015

SAMPLE DESCRIPTION : Five samples were received with the following references:

SAMPLE I.D	MATRIX	DATE	TIME (hrs)	REMARKS
EC5-Fish1	Fish	5-Jun-15	-	-
EC5-Fish2	Fish	5-Jun-15	-	-
EC5-Fish3	Fish	5-Jun-15	-	-
EC5-Crab	Crab	5-Jun-15	-	-
EC5-Shrimp	Shrimp	5-Jun-15	-	-

Note : Results apply to sample(s) as submitted. This report supersedes any previous reports of the same reference number.

.....

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(KK): Mezzanine Floor, No.3, Lot 5, Lorong Kilang (SLIE), Off Jalan Kilang Kelombong, Jalan Ulam Raja, Kelombong, Kota Kinabalu 88450 Sabah.
Tel: (6088) – 431 075
Fax: (6088) – 439 517

DATE : 30 June 2015
ALS SAMPLE ID. : ALSM131366595673_1
PROJECT : CIA
Sample Type: Fish

		Lab I.D		595673	595674	595675	595676	595677
		Sample I.D		EC5-Fish1	EC5-Fish2	EC5-Fish3	EC5-Crab	EC5-Shrimp
		Units	LOR					
Method Reference	**Analysis Description**	Date of Digestion		21/6/15				
		Date of Analysis		22/6/15				
USEPA 6020 A	Arsenic	mg/kg	0.05	0.30	0.49	1.06	2.89	0.53
USEPA 6020 A	Copper	mg/kg	0.05	0.49	1.03	0.62	15.4	2.52
USEPA 6020 A	Lead	mg/kg	0.05	0.13	0.18	0.15	0.24	0.13
USEPA 6020 A	Mercury	mg/kg	0.05	<0.05	<0.05	0.26	<0.05	<0.05
USEPA 6020 A	Nickel	mg/kg	0.05	<0.05	<0.05	0.06	0.20	<0.05
USEPA 6020 A	Selenium	mg/kg	0.1	0.8	0.4	2.6	0.5	0.8
USEPA 6020 A	Zinc	mg/kg	0.1	0.9	6.8	8.4	22.8	11.4

LOR: Level of Reporting

BATCH QUALITY CONTROL - LABORATORY CONTROL SAMPLE

ALS SAMPLE ID. : ALSM131366595673_1
Batch : INF150622(1)
Matrix : Fish

Date of Digestion : 21/6/15
Date of Analysis : 22/6/15

COMPOUND	Blank Conc.	Spike Conc.	QC SPIKE RESULTS				Control Limits		
			SCS Conc	DCS Conc	Ave Rec.	RPD	% Recovery		RPD
	mg/kg	mg/kg	mg/kg	mg/kg	%	%	Low	High	%
Arsenic	<LOR	0.50	0.50	0.45	95	11	80	120	20
Copper	<LOR	0.50	0.56	0.49	105	13	80	120	20
Lead	<LOR	0.50	0.53	0.48	101	10	80	120	20
Mercury	<LOR	0.50	0.56	0.49	105	13	80	120	20
Nickel	<LOR	0.50	0.50	0.44	94	13	80	120	20
Selenium	<LOR	0.50	0.55	0.48	103	14	80	120	20
Zinc	<LOR	0.50	0.49	0.43	92	13	80	120	20

COMMENTS :
1) LOR: level of reporting
2) The control limits are based on ALS laboratory statistical data.
3) * : Recovery or RPD falls outside of the recommended control limits.

BATCH QUALITY CONTROL - MATRIX SPIKE SAMPLE

ALS SAMPLE ID. : ALSM131366595673_1
Batch : INF150622(1)
Matrix : Fish

Date of Digestion : -
Date of Analysis : 22/6/15
Spiked Sample : 595673

COMPOUND	Sample Results	Spike Conc.	QC SPIKE RESULTS				Control Limits
			MS Conc	MSD Conc	Ave Rec.	RPD	RPD
	mg/kg	mg/kg	mg/kg	mg/kg	%	%	%
Arsenic	0.30	1.0	1.2	1.1	86	7	20
Copper	0.49	1.0	1.4	1.2	80	9	20
Lead	0.13	1.0	1.1	1.2	100	11	20
Mercury	<LOR	1.0	1.0	1.2	112	17	20
Nickel	<LOR	1.0	1.0	0.9	94	4	20
Selenium	0.8	1.0	2.0	1.9	113	3	20
Zinc	0.9	1.0	2.0	1.9	109	5	20

COMMENTS :
1) LOR: level of reporting
2) The control limits are based on ALS laboratory statistical data.
3) * : Recovery or RPD falls outside of the recommended control limits.

BATCH QUALITY CONTROL - DUPLICATE SAMPLE

ALS SAMPLE ID. : ALSM131366595673_1
Batch : INF150622(1)
Matrix : Fish

Date of Digestion : -
Date of Analysis : 22/6/15
Duplicate sample: 595677

COMPOUND	QC DUPLICATE RESULTS		
	Sample Conc	Check Sample Conc	RPD
	mg/kg	mg/kg	%
Arsenic	0.53	0.60	12
Copper	2.52	2.10	18
Lead	0.13	0.14	7
Mercury	<LOR	<LOR	-
Nickel	<LOR	<LOR	-
Selenium	0.8	0.8	0
Zinc	11.4	12.8	12

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(117964-P)
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Tel: (603) 7845 8257 Fax: (603) 7845 8258 E-mail: info@alsglobal.com.my

ALS Technichem

CERTIFICATE OF ANALYSIS

DATE : 30 June 2015

MS ISO/IEC 17025
TESTING
SAMM No. 147

ALS REF. : ALSM131366_1

ALS SAMPLE ID. : ALSM131366595673_1

COMPANY : Hagler Bailly Pakistan (PVT.) Ltd
39, Street3, E7,
Islamabad, 44000
Pakistan.
Tel: + 92(51)-261 0200-07 Fax: + 92(51)-2610-208
(Attn.: Mr. Hidayat Hassan / Aziz Karim)

PROJECT : CIA

DATE SAMPLE RECEIVED : 17 June 2015

SAMPLE DESCRIPTION : Five samples were received with the following references:

SAMPLE I.D	MATRIX	DATE	TIME (hrs)	REMARKS
EC5-Fish1	Fish	5-Jun-15	-	-
EC5-Fish2	Fish	5-Jun-15	-	-
EC5-Fish3	Fish	5-Jun-15	-	-
EC5-Crab	Crab	5-Jun-15	-	-
EC5-Shrimp	Shrimp	5-Jun-15	-	-

Note : Results apply to sample(s) as submitted. This report supersedes any previous reports of the same reference number.

Lee Yiu Lay
BSc. (Chem & Bio), MSc.(Chem), AMIC
IKM No. : A/2712/4566/04/08
Senior Chemist

BRANCH & COLLECTION CENTRE:

(JB): No.19, Jalan Kencana Mas 1/1, Tebrau Business Park, Taman Daya, 81100 Johor Bahru, Johor.
Tel : (607) – 354 9604
Fax: (607) – 354 9554

(KK): Mezzanine Floor, No.3, Lot 5, Lorong Kilang (SLIE), Off Jalan Kilang Kelombong, Jalan Ulam Raja, Kelombong Kota Kinabalu 88450 Sabah.
Tel: (6088) – 431 075
Fax: (6088) – 439 517

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DATE : 30 June 2015
ALS SAMPLE ID. : ALSM131366595673_1
PROJECT : CIA
Sample Type: Fish

Page 2 of 2

ALS Technichem

		Lab I.D		595673	595674	595675	595676	595677
		Sample I.D		EC5-Fish1	EC5-Fish2	EC5-Fish3	EC5-Crab	EC5-Shrimp
		Units	LOR					
Method Reference	**Analysis Description**	Date of Digestion		21/6/15				
		Date of Analysis		22/6/15				
USEPA 6020 A	Arsenic	mg/kg	0.05	0.30	0.49	1.06	2.89	0.53
USEPA 6020 A	Copper	mg/kg	0.05	0.49	1.03	0.62	15.4	2.52
USEPA 6020 A	Lead	mg/kg	0.05	0.13	0.18	0.15	0.24	0.13
USEPA 6020 A	Mercury	mg/kg	0.05	<0.05	<0.05	0.26	<0.05	<0.05
USEPA 6020 A	Nickel	mg/kg	0.05	<0.05	<0.05	0.06	0.20	<0.05
USEPA 6020 A	Selenium	mg/kg	0.1	0.8	0.4	2.6	0.5	0.8
USEPA 6020 A	Zinc	mg/kg	0.1	0.9	6.8	8.4	22.8	11.4

LOR: Level of Reporting

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BATCH QUALITY CONTROL - LABORATORY CONTROL SAMPLE

ALS SAMPLE ID. : ALSM1313665956 73_1
Batch : INF150622(1)
Matrix : Fish

Date of Digestion : 21/6/15
Date of Analysis : 22/6/15

COMPOUND	Blank Conc.	Spike Conc.	QC SPIKE RESULTS				Control Limits		
			SCS Conc	DCS Conc	Ave Rec.	RPD	% Recovery		RPD
	mg/kg	mg/kg	mg/kg	mg/kg	%	%	Low	High	%
Arsenic	<LOR	0.50	0.50	0.45	95	11	80	120	20
Copper	<LOR	0.50	0.56	0.49	105	13	80	120	20
Lead	<LOR	0.50	0.53	0.48	101	10	80	120	20
Mercury	<LOR	0.50	0.56	0.49	105	13	80	120	20
Nickel	<LOR	0.50	0.50	0.44	94	13	80	120	20
Selenium	<LOR	0.50	0.55	0.48	103	14	80	120	20
Zinc	<LOR	0.50	0.49	0.43	92	13	80	120	20

COMMENTS :
1) LOR: level of reporting
2) The control limits are based on ALS laboratory statistical data.
3) * : Recovery or RPD falls outside of the recommended control limits.

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BATCH QUALITY CONTROL - MATRIX SPIKE SAMPLE

ALS SAMPLE ID : ALSM131366595673_1
Batch : INF150622(1)
Matrix : Fish

Date of Digestion : -
Date of Analysis : 22/6/15
Spiked Sample : 595673

COMPOUND	Sample Results	Spike Conc.	QC SPIKE RESULTS				Control Limits
			MS Conc	MSD Conc	Ave Rec.	RPD	RPD
	mg/kg	mg/kg	mg/kg	mg/kg	%	%	%
Arsenic	0.30	1.0	1.2	1.1	86	7	20
Copper	0.49	1.0	1.4	1.2	80	9	20
Lead	0.13	1.0	1.1	1.2	100	11	20
Mercury	<LOR	1.0	1.0	1.2	112	17	20
Nickel	<LOR	1.0	1.0	0.9	94	4	20
Selenium	0.8	1.0	2.0	1.9	113	3	20
Zinc	0.9	1.0	2.0	1.9	109	5	20

COMMENTS :
1) LOR: level of reporting
2) The control limits are based on ALS laboratory statistical data.
3) * : Recovery or RPD falls outside of the recommended control limits.

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BATCH QUALITY CONTROL - DUPLICATE SAMPLE

ALS SAMPLE ID. : ALSM1313666595673_1
Batch : INF150622(1)
Matrix : Fish

Date of Digestion : -
Date of Analysis : 22/6/15
Duplicate sample: 595677

COMPOUND	QC DUPLICATE RESULTS		
	Sample Conc	Check Sample Conc	RPD
	mg/kg	mg/kg	%
Arsenic	0.53	0.60	12
Copper	2.52	2.10	18
Lead	0.13	0.14	7
Mercury	<LOR	<LOR	-
Nickel	<LOR	<LOR	-
Selenium	0.8	0.8	0
Zinc	11.4	12.8	12

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40150 Shah Alam, Selangor Darul Ehsan.
Tel: (603) 7845 8257 Fax: (603) 7845 8258

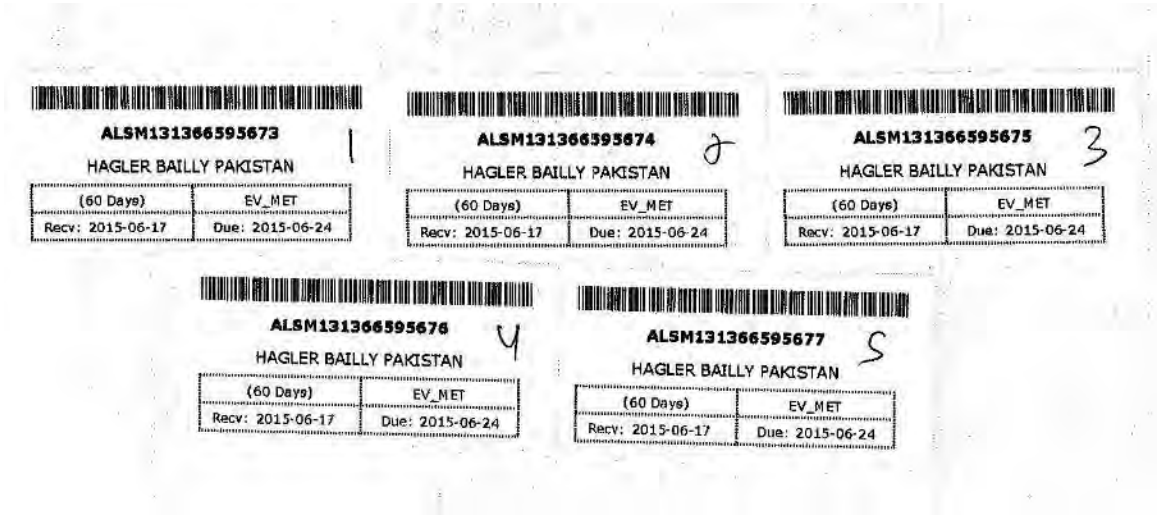
CHAIN OF CUSTODY RECORD

No. 40703

COMPANY: Hagler Bailly Pakistan	PROJECT: C I A	PURCHASE ORDER NO.:	
		FOR LAB USE ONLY	
POSTAL ADDRESS: H-39, Street-3 E-7, Islamabad		LAB BATCH NO.:	
		NO OF SAMPLES:	
PHONE: 92 51 2610200-7 FAX: 92 51 2610208		ANALYSIS REQUIRED	
SEND REPORT TO: Hidayat Hasan / Aziz Karim / Asif Mahmood			
SEND INVOICE TO: Humayun Mansoor			

	SAMPLE ID	MATRIX	DATE	TIME	TYPE & PRESERVATIVE	NO.	Arsenic	Copper	Lead	Mercury	Nickel	Selenium	Zinc	REMARKS
01	ECS-Fish 1	Fish	5/6/2015	-	Fish Tissue	01	✓	✓	✓	✓	✓	✓	✓	
02	ECS-Fish 2	"	5/6/2015	-	" "	01	✓	✓	✓	✓	✓	✓	✓	
03	ECS-Fish 3	"	5/6/2015	-	" "	01	✓	✓	✓	✓	✓	✓	✓	
04	ECS-Crab	Crab	5/6/2015	-	Crab Tissue	01	✓	✓	✓	✓	✓	✓	✓	
05	ECS-P Shrimp	Shrimp	5/6/2015	-	Shrimp Tissue	01	✓	✓	✓	✓	✓	✓	✓	

Sampled by: Aziz Karim	Shipped Via: Fed Ex			Consignment No.:
Relinquished by: Asif Mahmood Print Name	Date: 13/2/15 Time:	Received by: NAZ Print Name	Date: 13/6/15 Time:	COMMENTS / SPECIAL HANDLING
Relinquished by: Print Name	Date: Time:	Received by: Print Name	Date Time	
Received by Lab: Print Name	Date: Time:	**Container Type & Preservatives Codes:** P=Plastic; G=Glass; V=Vial; J=Jar; HN=Nitric acid preserved; HC=Hydrochloric acid preserved; HS=Sulfuric acid preserved; ST=Sterile bottle; B=Sodium hydroxide preserved; Z=Zinc acetate preserved; E=EDTA preserved.		


ALSM131366595673
1
HAGLER BAILLY PAKISTAN
(60 Days)
EV_MET
Recv: 2015-06-17
Due: 2015-06-24
ALSM131366595674
2
HAGLER BAILLY PAKISTAN
(60 Days)
EV_MET
Recv: 2015-06-17
Due: 2015-06-24
ALSM131366595675
3
HAGLER BAILLY PAKISTAN
(60 Days)
EV_MET
Recv: 2015-06-17
Due: 2015-06-24
ALSM131366595676
4
HAGLER BAILLY PAKISTAN
(60 Days)
EV_MET
Recv: 2015-06-17
Due: 2015-06-24
ALSM131366595677
5
HAGLER BAILLY PAKISTAN
(60 Days)
EV_MET
Recv: 2015-06-17
Due: 2015-06-24

C.2.3 Fish Sampling Study at Port Qasim - 2015

The objective of the sampling exercise carried out during September 2015 at Port Qasim was to collect information on the abundance and diversity of fish species within the Study Area (**Section 3** of the main report).

C.2.3.1 Literature Review

A literature review was carried out to find studies on fish fauna in the creeks of the Karachi coast. However, no studies exclusive to this subject for these areas could be found. Nevertheless many studies pertaining to the fauna associated with the mangroves and coastal area were found. These include the following:

The ecology, population structure and relative growth of the abundant species from the mangroves of Karachi have been analyzed by Barkati and Tirmizi (1988a[19],b[20], 1987[21], 1990[22], 1991[23], 1994[24]) and Barkati et al. (1990)[25]. Studies on the distribution and diversity of meiobenthos, microalgae and cyanobacteria have also been carried out namely by Qureshi and Sultana (1999)[26], Saifullah and Taj (1995)[27], Siddiqui et al. (2000)[28] and Zaib un-Nisa et al. (2000)[29], respectively. Macrofaunal population

---

[19] Barkati, S. And Tirmizi, N.M., Allometric growth in the snail *Telescopium telescopium* (Mollusca: Gastropoda) from Karachi mangroves. In: Marine Science of the Arabian Sea. Proceedings of an International Conference, Karachi, Pakistan (eds. M.F. Thompson and N.M. Tirmizi), pp. 417-426, 1988 American Institute of Biological Sciences, Washington, D.C.

[20] Barkati, S. And Tirmizi, N.M., Studies on woodborers from the mangroves of Karachi. pp. 203-213, 1988 In: Marine Biodeterioration and advanced techniques applicable to the Indian Ocean. Goa, India (eds. M.F. Thompson, R. Sarojini and R. Nagabhushanam), Oxford and IBH Publishing Co. Pvt. Ltd, New Delhi.

[21] Barkati, S. And Tirmizi, N.M., Population structure and some aspects of the breeding behavior of three gastropod species from Karachi mangroves. Pakistan. J. scient. Ind. Res., 30: 539-544, 1987

[22] Barkati, S. And Tirmizi, N.M., The crustacean woodborer *Sphaeroma terebrans* Bate from Karachi mangroves (Pakistani border of the northern Arabian Sea). Pakistan J. scient. Mar. Res., 33: 335-338, 1990.

[23] Barkati, S. And Tirmizi, N.M., The environmental impact of wood borers in mangrove swamps. Symp. Zool. Soc. Lond., No. 63: 251-263, 1991

[24] Barkati, S. And Tirmizi, N.M., Studies on the edible clam Marcia cor from Karachi mangroves. In: Proceedings of National Seminar on Fisheries Policy and Planning (eds. A. Majid, M.Y. Khan, M. Moazzam and J. Ahmed), pp. 261-263. 21-23 September 1986. Marine Fisheries Department, Government of Pakistan, Karachi.

[25] Barkati, S., Tirmizi, N.M., Hussain, I. And Zehra, I., Some aspects of population structure and breeding in pulmonate, Onchidella sp. Karachi Univ. J. Sci., 18: 119-12, 1990

[26] Qureshi, N.A. And Sultana, R., Temporal variations in the abundance, distribution and diversity of meiobenthos from the mangrove area near Karachi. In: Proceedings of the National Seminar on Mangrove Ecosystem Dynamics on the Indus Delta, pp. 132-140. June 14-16, 1999, Sind Forest and Wildlife Department, Government of Sindh and The World Bank.

[27] Saifullah, S.M. And Taj, G., Marine algal epiphytes on the pneumatophores of mangroves growing near Karachi. In: The Arabian Sea. living marine resources and the environment (eds. M.F. Thompson and N.M. Tirmizi), pp. 407-418, 1995 Vanguard Books (Pvt) Ltd., Lahore, Pakistan.

[28] Siddiqui, P.J.A., Mansoor, S.N., Zaib-Un-Nisa, Hameed, S., Shafique, S., Farooq, S., Abdul Aziz, R. And Saeed, S., Associated fauna and flora of macroalgal puffs inhabiting mangrove strands at Sandspit backwaters, Karachi. Pakistan J. Mar. Biol., 6: 43-53, 2000

inhabiting the mudflats of Baba Island have been done by Jawed and Khan (1974)[30] and the diversity of algal associated epifauna on the rocky shores of Manora and Buleji was carried out by Zehra et al. (1995).[31] In addition to this Ahmed (1999)[32] discussed the abundance and distribution of seaweeds, mangroves, zooplankton, macroinvertebrate and vertebrate fauna of the Indus delta.

C.2.3.2 Sampling Plan

The sampling plan was determined taking into consideration spatial variations associated with impacts of human activity (mainly release of pollutants through effluents) and spatial coverage of the Study Area. The locations at which sampling was carried out are shown in **Exhibit C**.93. Fish surveys were conducted in Korangi Creek (FS1), Chhan Waddo Creek (FS2), Issaro Creek (FS3), Kadiro Creek area (FS4), Waddi Khuddi Creek (FS5) and junction of Sarain Creek with Waddi Khuddi Creek (FS6).

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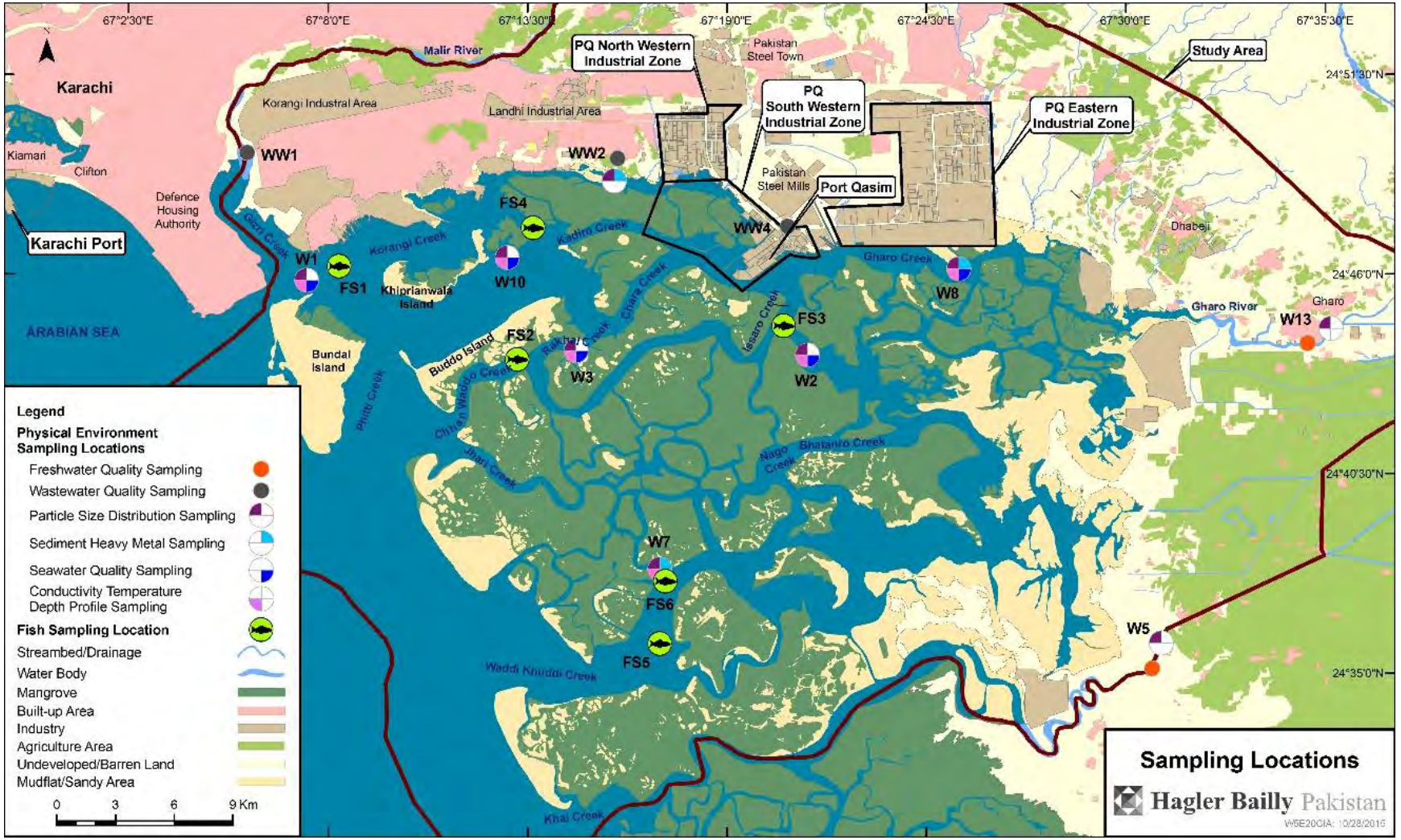
[29] Zaib-Un-Nisa, Mansoor, S.N. And Siddiqui, P.J.A., Species diversity of cynobacteria growing on pneumatophores and in the adjacent surface sediments in the mangrove swamp at Sandspit backwater, Karachi. Pakistan J. mar. Biol., 6: 59-68, 2000

[30] Jawed, M. And Khan, M.A., Zonation in the macrofauna inhabiting the mud flats of Baba Island with special reference to Lingula murphiana. J. Sci. Uni. Kar., 3: 78-83, 1974

[31] Zehra, I., Shaukat, S.S. And Saeed, H., Diversity of algal associated communities from the northern Arabian Sea. In: The Arabian Sea. living marine resources and the environment (eds. M.F. Thompson and N.M. Tirmizi), pp. 87-98. Vanguard Books (Pvt) Ltd., Lahore, Pakistan, 1995

[32] Ahmed, M. And Hameed, S., Animal communities of the exposed sandy beach at Clifton in Karachi (Pakistan). Pakistan J. Zool., 31: 211-218, 1999

Exhibit C.93: Fish Sampling Locations



Sampling Methodology

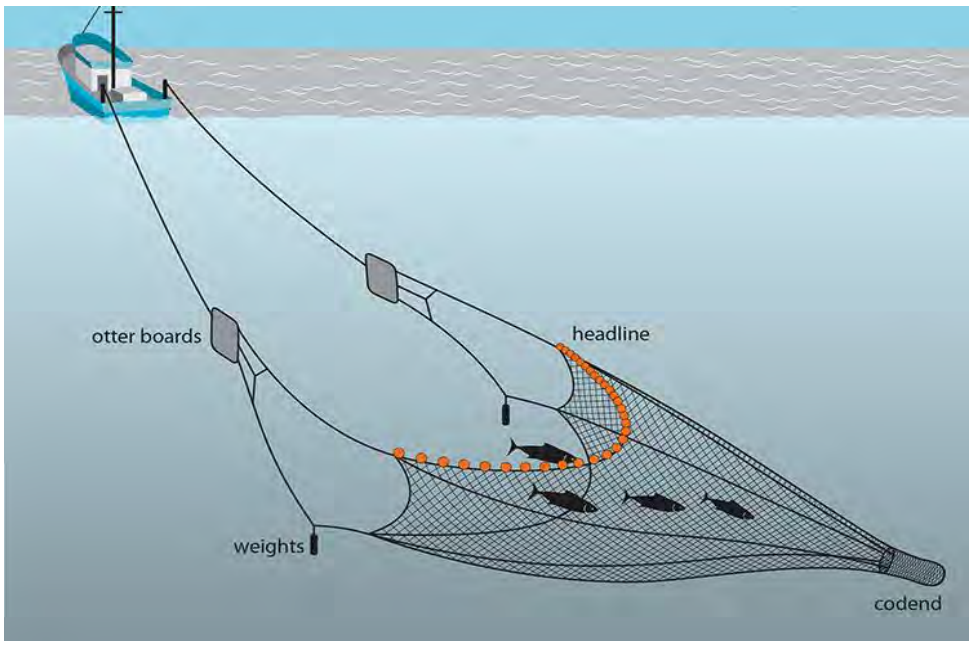
The sampling methodology involved collection of fish samples at each of the sampling locations using trawling. Trawling is one of the most common methods of fishing, and involves the use of trawl nets. A trawl net is shaped like a cone (or funnel) with a wide opening to catch fish or crustaceans and a narrow, closed end known as the 'cod-end'. Trawls can be used at various depths and nets differ by their mesh size. All trawl nets use otterboards/trawl doors to keep the mouth of the net open (see **Exhibit C.94**). In the trawl method the horizontal opening of the net is maintained by otter boards.[33]

Trawl net used for this study consisted of a 40 meter long net with 2 inch mesh size on the interior end (15 meter), 1.5 inch in the middle portion (15 meter) and 1 inch on the posterior cod end (10 meter). The wings were 12 meter long and 8 meter wide with 2 inch mesh size. The circumference of the mouth was 8 meter. The net was tied with otter boards on both sides which were connected with the boat by 60 meter long ropes.

Mechanism of Action of Trawl Nets

Trawl nets are towed by boat. They may be towed in the water column (midwater trawl) or along the sea floor (bottom trawl). A generalized view of the mechanism of action of a trawl net is shown in **Exhibit C.94**. During this sampling exercise bottom trawling was used.

Exhibit C.94: Generalized View of the Trawl Net



Trawling could not be carried out to the extent that saturation of fish species caught could be reached. This was mainly due to limited time available for the study.

[33] Information taken from < http://www.fao.org/fishery/geartype/309/en>, accessed October 2015

Treatment of Fish following Collection by Trawling

Fish collected after each trawling sweep were immediately transferred in a tub half filled with water. The collected fish fauna was mainly identified in the field and number of specimens of each species was counted, photographed and released in the water. Only voucher specimens of each species were preserved for record and deposited in fish repository of Pakistan Museum of Natural History.

C.2.3.3 Results

A total of 66 species were collected from all sampling locations. **Exhibit C.95** shows the list of fish species which were observed from trawling. It also gives the number of each species observed at each sampling location along with calculated abundance. Furthermore, at the end of **Exhibit C.95** the count for total number of species observed at each sampling location are given along with measures for diversity and evenness using the Shannon diversity and Shannon evenness indices. **Exhibit C.96** shows the economic importance, IUCN status and restricted range information for each of the fish species.

Exhibit C.95: Fish Fauna of different Creeks adjacent to Port Qasim Area

		FS1		FS2		FS3		FS4		FS5		FS6	
No	Species	Count	Relative Abundance (%)	Count	Relative Abundance (%)	Count	Relative Abundance (%)	Count	Relative Abundance (%)	Count	Relative Abundance (%)	Count	Relative Abundance (%)
1.	*Acanthopagrus berda*	6	3.8	2	1.2	0	0.0	0	0.0	0	0.0	8	1.4
2.	*Acanthopagrus latus*	3	1.9	22	13.3	3	0.9	0	0.0	0	0.0	12	2.2
3.	*Alepes djedaba*	1	0.6	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
4.	*Anodontostoma chacunda*	0	0.0	0	0.0	3	0.9	0	0.0	1	0.4	0	0.0
5.	*Arius caelatus*	0	0.0	0	0.0	0	0.0	0	0.0	1	0.4	15	2.7
6.	*Arius maculatus*	0	0.0	0	0.0	30	8.6	0	0.0	0	0.0	0	0.0
7.	*Arius thalassinus*	0	0.0	1	0.6	0	0.0	0	0.0	2	0.9	0	0.0
8.	*Bathygobius fuscus*	0	0.0	1	0.6	0	0.0	0	0.0	3	1.3	1	0.2
9.	*Caranx para*	1	0.6	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
10.	*Cociella crocodila*	0	0.0	7	4.2	1	0.3	0	0.0	1	0.4	0	0.0
11.	*Colletteichthys dussumieri*	0	0.0	0	0.0	0	0.0	3	3.8	0	0.0	0	0.0
12.	*Cynoglossus arel*	0	0.0	1	0.6	0	0.0	0	0.0	0	0.0	0	0.0
13.	*Cynoglossus carpenteri*	0	0.0	0	0.0	1	0.3	0	0.0	2	0.9	70	12.6
14.	*Cynoglossus puncticeps*	0	0.0	0	0.0	1	0.3	0	0.0	5	2.2	0	0.0
15.	*Drepane punctata*	1	0.6	0	0.0	4	1.1	0	0.0	2	0.9	1	0.2
16.	*Dussumieria acuta*	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	8	1.4
17.	*Epinephelus tauvina*	0	0.0	0	0.0	0	0.0	1	1.3	0	0.0	0	0.0
18.	*Escualosa thoracata*	0	0.0	2	1.2	0	0.0	0	0.0	0	0.0	12	2.2
19.	*Euryglossa orientalis*	2	1.3	0	0.0	2	0.6	0	0.0	0	0.0	0	0.0

		FS1		FS2		FS3		FS4		FS5		FS6	
No	Species	Count	Relative Abundance (%)	Count	Relative Abundance (%)	Count	Relative Abundance (%)	Count	Relative Abundance (%)	Count	Relative Abundance (%)	Count	Relative Abundance (%)
20.	*Gerres filamentosus*	3	1.9	9	5.5	10	2.9	6	7.5	2	0.9	9	1.6
21.	*Gerres oyena*	1	0.6	6	3.6	20	5.7	4	5.0	1	0.4	11	2.0
22.	*Grammoplites suppositus*	3	1.9	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
23.	*Himantura walga*	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	0.2
24.	*Ilisha megaloptera*	0	0.0	0	0.0	1	0.3	0	0.0	0	0.0	0	0.0
25.	*Johnieops sina*	0	0.0	2	1.2	40	11.4	0	0.0	1	0.4	0	0.0
26.	*Johnius glaucus*	0	0.0	0	0.0	0	0.0	4	5.0	0	0.0	0	0.0
27.	*Johnius belangerii*	0	0.0	17	10.3	30	8.6	0	0.0	0	0.0	0	0.0
28.	*Johnius carutta*	0	0.0	18	10.9	0	0.0	0	0.0	0	0.0	0	0.0
29.	*Johnius dussumieri*	0	0.0	8	4.8	30	8.6	0	0.0	1	0.4	0	0.0
30.	*Johnius glaucus*	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
31.	*Kathala axillaris*	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	34	6.1
32.	*Leiognathus daura*	3	1.9	7	4.2	5	1.4	0	0.0	23	10.1	35	6.3
33.	*Leiognathus dussumieri*	0	0.0	3	1.8	0	0.0	0	0.0	0	0.0	0	0.0
34.	*Leiognathus fasciatus*	3	1.9	5	3.0	6	1.7	3	3.8	35	15.4	70	12.6
35.	*Leiognathus splendens*	2	1.3	6	3.6	3	0.9	5	6.3	30	13.2	64	11.5
36.	*Liza subviridis*	13	8.3	0	0.0	0	0.0	1	1.3	1	0.4	0	0.0
37.	*Lutjanus johnii*	9	5.7	2	1.2	1	0.3	0	0.0	1	0.4	1	0.2
38.	*Megalaspis cordyla*	0	0.0	0	0.0	0	0.0	0	0.0	1	0.4	0	0.0
39.	*Otolithes cuvleri*	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	56	10.1
40.	*Otolithes ruber*	0	0.0	12	7.3	4	1.1	0	0.0	8	3.5	40	7.2

		FS1		FS2		FS3		FS4		FS5		FS6	
No	Species	Count	Relative Abundance (%)	Count	Relative Abundance (%)	Count	Relative Abundance (%)	Count	Relative Abundance (%)	Count	Relative Abundance (%)	Count	Relative Abundance (%)
41.	*Oxyurichthys ophthalmonema*	1	0.6	1	0.6	0	0.0	0	0.0	2	0.9	1	0.2
42.	*Platycephalus indicus*	1	0.6	1	0.6	0	0.0	0	0.0	0	0.0	18	3.2
43.	*Pomadasys argyreus*	0	0.0	15	9.1	0	0.0	50	62.5	0	0.0	0	0.0
44.	*Pomadasys commersonni*	0	0.0	0	0.0	0	0.0	0	0.0	12	5.3	0	0.0
45.	*Pomadasys kaakan*	15	9.6	0	0.0	8	2.3	0	0.0	0	0.0	15	2.7
46.	*Pomadasys stridens*	10	6.4	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
47.	*Promicrops lanceolatus*	1	0.6	0	0.0	0	0.0	0	0.0	1	0.4	0	0.0
48.	*Pseudorhombus arsius*	4	2.5	0	0.0	0	0.0	0	0.0	2	0.9	0	0.0
49.	*Pseudorhombus elevatus*	0	0.0	0	0.0	2	0.6	0	0.0	0	0.0	7	1.3
50.	*Pseudorhombus javanicus*	0	0.0	1	0.6	0	0.0	0	0.0	0	0.0	8	1.4
51.	*Pseudosynanceia melanostigma*	0	0.0	3	1.8	2	0.6	0	0.0	1	0.4	5	0.9
52.	*Rhabdosargus sarba*	0	0.0	0	0.0	1	0.3	1	1.3	0	0.0	0	0.0
53.	*Scomberoides tol*	0	0.0	0	0.0	0	0.0	0	0.0	1	0.4	0	0.0
54.	*Secutor insidiator*	70	44.6	7	4.2	5	1.4	2	2.5	22	9.7	42	7.6
55.	*Sillago sihama*	3	1.9	2	1.2	37	10.6	0	0.0	50	22.0	4	0.7
56.	*Solea elongata*	0	0.0	1	0.6	60	17.1	0	0.0	5	2.2	0	0.0
57.	*Sparidentex hasta*	0	0.0	0	0.0	0	0.0	0	0.0	4	1.8	0	0.0
58.	*Synaptura commersoniana*	1	0.6	0	0.0	40	11.4	0	0.0	0	0.0	0	0.0
59.	*Terapon jebua*	0	0.0	1	0.6	0	0.0	0	0.0	0	0.0	0	0.0
60.	*Terapon puta*	0	0.0	1	0.6	0	0.0	0	0.0	0	0.0	0	0.0
61.	*Terapon theraps*	0	0.0	0	0.0	0	0.0	0	0.0	1	0.4	5	0.9

		FS1		FS2		FS3		FS4		FS5		FS6	
No	*Species*	*Count*	*Relative Abundance (%)*	*Count*	*Relative Abundance (%)*	*Count*	*Relative Abundance (%)*	*Count*	*Relative Abundance (%)*	*Count*	*Relative Abundance (%)*	*Count*	*Relative Abundance (%)*
62.	*Thryssa hamiltonii*	0	0.0	0	0.0	0	0.0	0	0.0	2	0.9	2	0.4
63.	*Thryssa malabarica*	0	0.0	0	0.0	0	0.0	0	0.0	1	0.4	0	0.0
64.	*Thryssa mystax*	0	0.0	0	0.0	0	0.0	0	0.0	1	0.4	0	0.0
65.	*Trypauchen microcephalus*	0	0.0	1	0.6	0	0.0	0	0.0	0	0.0	0	0.0
66.	*Uroconger lepturus*	0	0.0	0	0.0	0	0.0	0	0.0	1	0.4	0	0.0
Total Specimens Collected		**157**	**100.0**	**165**	**100.0**	**350**	**100.0**	**80**	**100.0**	**227**	**100.0**	**555**	**100.0**
Number of species		**23**		**30**		**27**		**11**		**34**		**28**	
Shannons' Diversity Index		**2.17**		**2.93**		**2.62**		**1.46**		**2.59**		**2.79**	
Shannons' evenness index		**0.69**		**0.86**		**0.8**		**0.61**		**0.73**		**0.84**	

Exhibit C.97 shows the bar chart for number of fish species observed at each of the sampling locations. Similarly **Exhibit C.98** shows the Shannon diversity index values for the fish species observed at each of the sampling locations. From **Exhibit C.97** it can be observed that the number of fish species is lowest at sampling locations FS1 and FS4. Both these sampling locations are situated closest to the coastline at Port Qasim relative to all the other sampling locations. The Shannon diversity index reflects the distribution trend that the number of species at different localities seems to be a factor of distance from the Karachi coast, Port Qasim and Ibrahim Hyderi. The Korangi Creek (FS1) and the Kadiro Creek (FS4) have the lowest number of species (23 and 11 respectively) as compared to the other sampling locations which are comparatively far from the coastal area. The number of species at the other four sampling locations which are comparatively further from the coast varies from 27-34 (30 at FS2, 27 at FS3, 34 at FS5 and 28 at FS6). The Shannon's evenness index (values given in **Exhibit C.98**) shows that evenness has a similar trend with lowest values observed for sampling locations FS1 and FS4 relative to all other sampling locations.

Exhibit C.96: Fish Species Economic Importance, IUCN Status and Restricted Range Information

Nos.	*Species*	*Economic Importance*	*IUCN Red list Status*	*Restricted Range*
1.	*Acanthopagrus berda*	High	Least Concern	
2.	*Acanthopagrus latus*	High	Data Deficient	
3.	*Alepes djedaba*	Average	Not Assessed	
4.	*Anodontostoma chacunda*	Low	Not Assessed	
5.	*Arius caelatus*	Medium	Not Assessed	
6.	*Arius maculatus*	Medium	Not Assessed	
7.	*Arius thalassinus*	High	Not Assessed	
8.	*Bathygobius fuscus*	Low	Least Concern	
9.	*Caranx para*	Low	Not Assessed	
10.	*Cociella crocodila*	Medium	Not Assessed	
11.	*Colletteichthys dussumieri*	Low	Not Assessed	Western Indian Ocean: Apparently restricted to the western coast of India from Cochin north at least to the Malabar area.
12.	*Cynoglossus arel*	High	Not Assessed	
13.	*Cynoglossus carpenteri*	High	Not Assessed	
14.	*Cynoglossus puncticeps*	High	Not Assessed	
15.	*Drepane punctata*	High	Not Assessed	

Nos.	*Species*	*Economic Importance*	*IUCN Red list Status*	*Restricted Range*
16.	*Dussumieria acuta*	Medium	Not Assessed	
17.	*Epinephelus tauvina*	High	Data Deficient	
18.	*Escualosa thoracata*	Low	Not Assessed	
19.	*Euryglossa orientalis*	Low	Not Assessed	
20.	*Gerres filamentosus*	Medium	Least Concern	
21.	*Gerres oyena*	Low	Not Assessed	
22.	*Grammoplites suppositus*	Medium	Not Assessed	
23.	*Himantura walga*	No	Near Threatened	
24.	*Ilisha megaloptera*	Low	Not Assessed	
25.	*Johnieops sina*	High	Not Assessed	
26.	*Johnius glaucus*	High	Not Assessed.	
27.	*Johnius belangerii*	High	Not Assessed	
28.	*Johnius carutta*	High	Not Assessed	
29.	*Johnius dussumieri*	High	Not Assessed	
30.	*Johnius glaucus*	High	Not Assessed	
31.	*Kathala axillaris*	High	Not Assessed	
32.	*Leiognathus daura*	Low	Not Assessed	
33.	*Leiognathus dussumieri*	Low	Not Assessed	
34.	*Leiognathus fasciatus*	Medium	Least Concern	
35.	*Leiognathus splendens*	Low	Least Concern	
36.	*Liza subviridis*	High	Not Assessed	
37.	*Lutjanus johnii*	High	Not Assessed	
38.	*Megalaspis cordyla*	High	Not Assessed	
39.	*Otolithes cuvleri*	High	Not Assessed	
40.	*Otolithes ruber*	High	Not Assessed	
41.	*Oxyurichthys ophthalmonema*	Low	Not Assessed	
42.	*Platycephalus indicus*	High	Data Deficient	
43.	*Pomadasys argyreus*	High	Not Assessed	
44.	*Pomadasys commersonni*	High	Not Assessed	
45.	*Pomadasys kaakan*	High	Not Assessed	

Nos.	*Species*	*Economic Importance*	*IUCN Red list Status*	*Restricted Range*
46.	*Pomadasys stridens*	High	Not Assessed	
47.	*Promicrops lanceolatus*	High	Not Assessed	
48.	*Pseudorhombus arsius*	High	Not Assessed	
49.	*Pseudorhombus elevatus*	Low	Not Assessed	
50.	*Pseudorhombus javanicus*	Low	Not Assessed	
51.	*Pseudosynanceia melanostigma*	No	Not Assessed	
52.	*Rhabdosargus sarba*	High	Least Concern	
53.	*Scomberoides tol*	High	Not Assessed	
54.	*Secutor insidiator*	Low	Not Assessed	
55.	*Sillago sihama*	High	Not Assessed	
56.	*Solea elongata*	Low	Not Assessed	
57.	*Sparidentex hasta*	Medium	Least Concern	
58.	*Synaptura commersoniana*	Low	Not Assessed	
59.	*Terapon jarbua*	Average	Least Concern	
60.	*Terapon puta*	Low	Not Assessed	
61.	*Terapon theraps*	Medium	Least Concern	
62.	*Thryssa hamiltonii*	Low	Not Assessed	
63.	*Thryssa malabarica*	Medium	Not Assessed	
64.	*Thryssa mystax*	Low	Least Concern	
65.	*Trypauchen microcephalus*	Low	Not Assessed	
66.	*Uroconger lepturus*	Low	Not Assessed	

Exhibit C.97: Number of Fish Species Captured

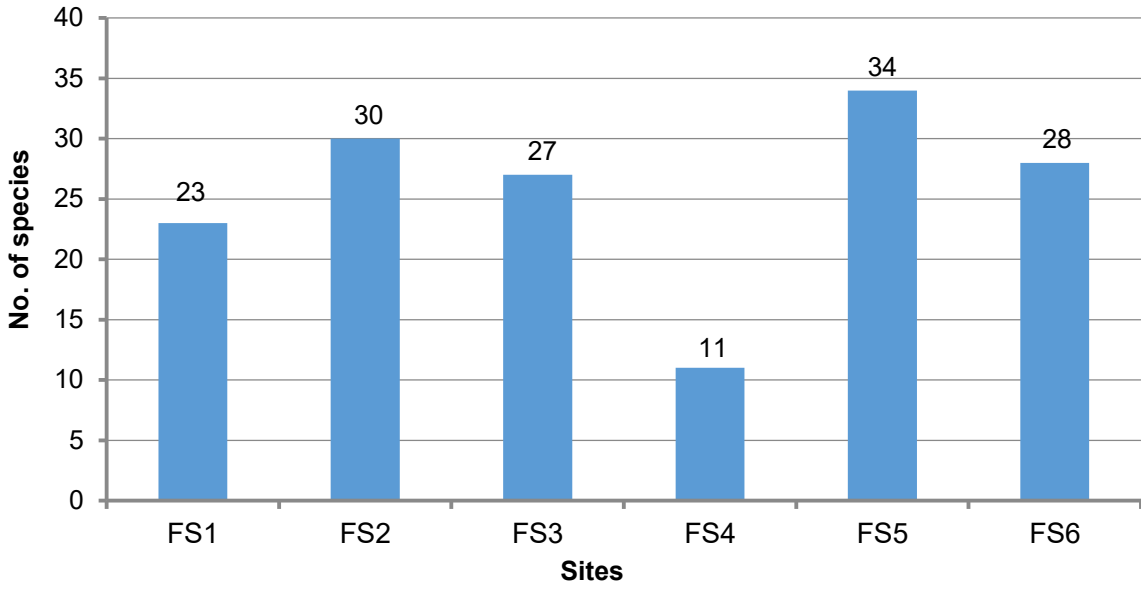
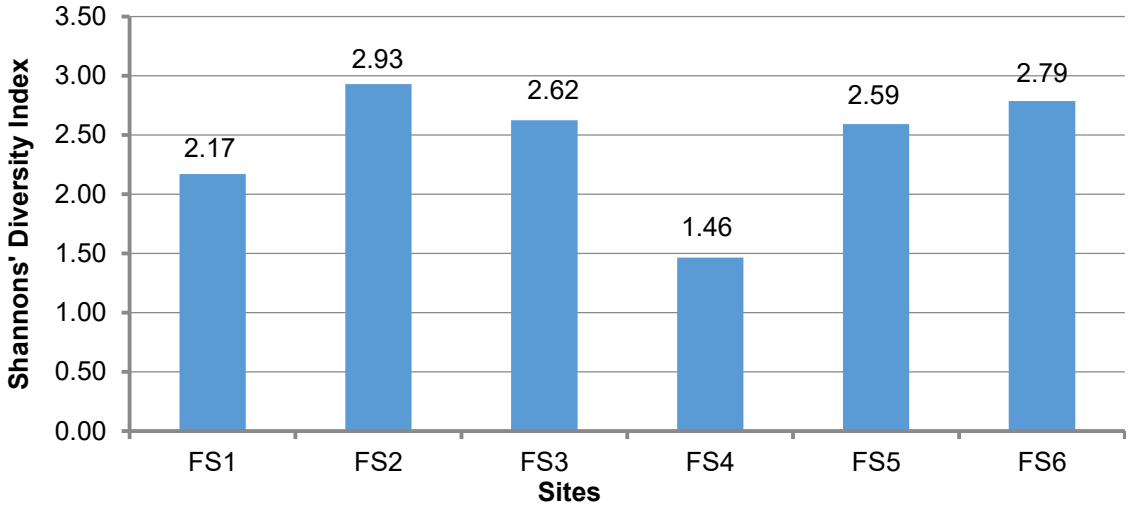


Exhibit C.98: Shannon Diversity Index at Surveyed Sites



The complete data set is available in **Annexure B**.

C.2.3.4 Discussion and Conclusions

Lower number of species at the two sampling locations close to the coastal areas (FS1 and FS4) can be attributed to more pollution, higher level of disturbance, and industrial and domestic sewerage at these sampling locations compared to the sampling locations further away from the coast (FS2, FS3, FS5 and FS6).

Annexure A: Mangrove Data

See following pages.

Hagler Bailly Pakistan

Sampling Form for Mangroves and Crabs

Sampling Location ID: SS ID M 1 T # 1 Q # 1 GPS No: 0 3 1 2 Sampled by: Kamran Minai

Time: 1 0 0 4 AM Date: 2 0 0 9 1 5

GPS Coordinates: **Start**

2	4	4	8	40	0.7	N	WP No	
6	7	1	3	59	0.5	E	M1T1Q1A	

End

						N	WP No
						E	

General Quadrat Information:

Quadrat Size 10 m X 10 m

Apparent Category:
☑ Healthy Mangroves ☐ Unhealthy Mangroves ☐ Mangrove Dieback

Notes
Leaves appear healthy but trees are short

Ecological Condition and land use:
☑ Intact ☐ Degraded ☐ Deforested

Topography (microrelief):
☑ Flat ☐ Depression ☐ Levee[1] ☐ Hummock[2]

Geomorphic setting:
☐ River Delta ☑ Coastal Fringe ☐ Interior[3] ☐ Basin[4]

Soil description:
☐ Organic ☐ Sand ☑ Clay ☐ Silts ☑ Sample Collected

Disturbance evidence (timber harvest):
☐ Not evident ☐ Low (<30% basal area) ☐ Medium (30–70%) ☐ High (>70%)

cutting of soft and newly tendered branches for livestock feeding

Cyclone damage:
☑ Not evident ☐ Light ☐ Moderate ☐ Severe

Other disease or disturbance:
☐ Not evident ☑ Light ☐ Moderate ☐ Severe

Shoot borer observed

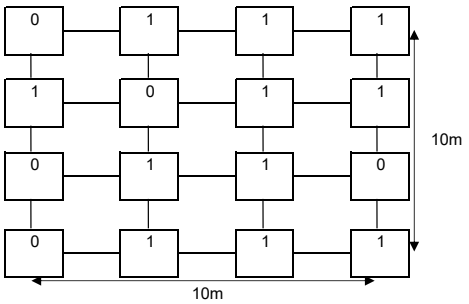
Number of Seedlings: 6000 (estimated for 100m^2 from approx. 60 seedlings counted in a 1.0m by 1.0m quadrat)

Number of Adult trees: 35

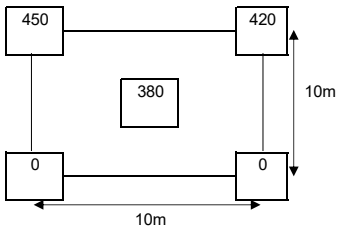
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Tree Height (m)	1.10	1	1.3	2.1	1	1.2	1.3	1.5	1.1	1	1.2	2	2.2	1.2	2	1.5	1.3	2.4	2.5	2.2
Tree Girth (cm)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Epicormic Growth	None	None	None	None	None	None	None	None	None	None	None	None	None	None	None	None	None	None	None	None
Yellowing of leaves	None	None	None	None	None	None	None	None	None	None	None	None	None	None	None	None	None	None	None	None

	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
Tree Height (m)	1	2.1	1.3	1.4	2	2.2	1.5	1	2.2	1.2	2	1.2	1.5	1.3	1.4					
Tree Girth (cm)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A					
Epicormic Growth	None	None	None	None	None	None	None	None	None	None	None	None	None	None	None					
Yellowing of leaves	None	None	None	None	None	None	None	None	None	None	None	None	None	None	None					

Canopy Cover:



Crab Holes



Quadrat Size 1 m x 1 m

Terms: 1-Levee is a a ridge of sediment deposited naturally alongside a river by overflowing water. 2- Hummock is a hill, a mound, or a ridge. 3- Interior: is a point located away from the coastal fringe but not exposed to the open ocean (approximately 100m away from the open sea). 4- Basin is a topographic region in which all water drains to a common area.

SS = Study Site, T = Transect, Q = Quadrat

Photograph ID

7511	7520	7529	7538	7547
7512	7521	7530	7539	7548
7513	7522	7531	7540	7549
7514	7523	7532	7541	7550
7515	7524	7533	7542	7551
7516	7525	7534	7543	7552
7517	7526	7535	7544	7553
7518	7527	7536	7545	7554
7519	7528	7537	7546	7555

Hagler Bailly Pakistan

Sampling Form for Mangroves and Crabs

Sampling Location ID: SS ID M 1 T # 1 Q # 2 GPS No: 0 3 1 2 Sampled by: Kamran Minai

Time: 1 0 4 7 AM Date: 2 0 0 9 1 5

GPS Coordinates: **Start**								WP No	**End**							WP No
	2	4	4	8	40	0.4	N	M1T1Q2A								
	6	7	1	3	59	0.6	E								E	

General Quadrat Information:

Quadrat Size 10 m X 10 m

Apparent Category:

☑ Healthy Mangroves ☐ Unhealthy Mangroves ☐ Mangrove Dieback

Notes

Leaves appear healthy but trees are short

Ecological Condition and land use:

☑ Intact ☐ Degraded ☐ Deforested

Topography (microrelief):

☑ Flat ☐ Depression ☐ Levee[1] ☐ Hummock[2]

Geomorphic setting:

☐ River Delta ☑ Coastal Fringe ☐ Interior[3] ☐ Basin[4]

Soil description:

☐ Organic ☐ Sand ☑ Clay ☑ Silts ☑ Sample Collected

Disturbance evidence (timber harvest):

☐ Not evident ☐ Low (<30% basal area) ☑ Medium (30–70%) ☐ High (>70%) cutting of soft and newly tendered branches for livestock feeding

☑ Not evident ☐ Light ☐ Moderate ☐ Severe

Other disease or disturbance:

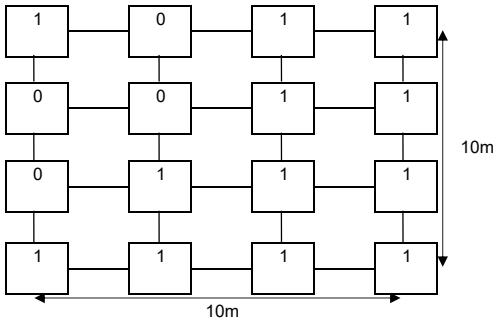
☐ Not evident ☐ Light ☐ Moderate ☑ Severe Some top borer insect damage observed

Number of Seedlings: 5000 (estimated for 100m^2 from approx. 50 seedlings counted in a 1.0m by 1.0m quadrat)

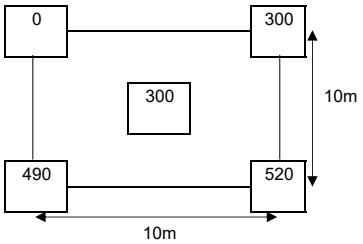
Number of Adult trees: 25

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Tree Height (m)	1.2	2.1	3.1	2.5	3.4	2.2	2.3	4.2	3.2	2.3	2.6	1.6	2.2	1.6	2.1	2.2	3.1	2.4	2.5	3.2
Tree Girth (cm)	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	NIL
Epicormic Growth	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	NIL
Yellowing of leaves	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	NIL
	21	22	23	24	25															
Tree Height (m)	1.3	2.5	3	2.6	3.1															
Tree Girth (cm)	nil	nil	nil	nil	nil															
Epicormic Growth	nil	nil	nil	nil	nil															
Yellowing of leaves	nil	nil	nil	nil	nil															

Canopy Cover:



Crab Holes



Quadrat Size 1 m x 1 m

Terms: 1-Levee is a a ridge of sediment deposited naturally alongside a river by overflowing water. 2- Hummock is a hill, a mound, or a ridge. 3- Interior: is a point located away from the coastal fringe but not exposed to the open ocean (approximately 100m away from the open sea). 4- Basin is a topographic region in which all water drains to a common area.

SS = Study Site, T = Transect, Q = Quadrat

Photograph ID

DSC06784	DSC06786
DSC06785	DSC06787
DSC06788	DSC06789

Hagler Bailly Pakistan

Sampling Form for Mangroves and Crabs

Sampling Location ID: SS ID M 2 T # 1 Q # 1 GPS No: 0 3 1 2 Sampled by: Kamran Minai

Time: 1 1 4 6 AM Date: 2 2 0 9 1 5

GPS Coordinates: **Start** 24 45 21 0.2 N / 67 23 9 0.7 E WP No M2T1Q1AS **End** 24 45 21 0.7 N / 67 23 9 0.1 E WP No M2T1Q1AE

General Quadrat Information:

Quadrat Size 10 m X 10 m

Apparent Category:

☑ Healthy Mangroves ☐ Unhealthy Mangroves ☐ Mangrove Dieback

Notes

Trees have greater height near shoreline than those inland

Ecological Condition and land use:

☑ Intact ☐ Degraded ☐ Deforested

Topography (microrelief):

☑ Flat ☐ Depression ☐ Levee[1] ☐ Hummock[2]

Geomorphic setting:

☐ River Delta ☑ Coastal Fringe ☐ Interior[3] ☐ Basin[4]

But placed interior relative to open sea

Soil description:

☐ Organic ☐ Sand ☑ Clay ☐ Silts ☑ Sample Collected

Disturbance evidence (timber harvest):

☑ Not evident ☐ Low (<30% basal area) ☐ Medium (30–70%) ☐ High (>70%)

Cyclone damage:

☑ Not evident ☐ Light ☐ Moderate ☐ Severe

Other disease or disturbance:

☐ Not evident ☐ Light ☑ Moderate ☐ Severe

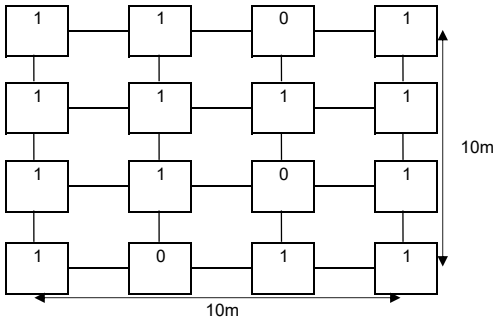
Insect Damage

Number of Seedlings: 5

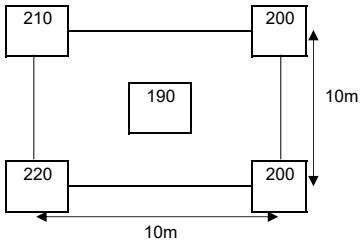
Number of Adult trees: 15

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Tree Height (m)	4	2	5	3	3.5	4	3.4	4.5	5	5	5	4.8	5	5	3.5					
Tree Girth (cm)	20	15	28	16	32	25	12	35	30	42	23	32	36	42	28					
Epicormic Growth	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil					
Yellowing of leaves	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil					

Canopy Cover:



Crab Holes



Quadrat Size 1 m x 1 m

Terms: 1-Levee is a a ridge of sediment deposited naturally alongside a river by overflowing water. 2- Hummock is a hill, a mound, or a ridge. 3- Interior: is a point located away from the coastal fringe but not exposed to the open ocean (approximately 100m away from the open sea). 4- Basin is a topographic region in which all water drains to a common area.

SS = Study Site, T = Transect, Q = Quadrat

Photograph ID

7685	
7686	
7687	
7688	
7689	
7690	
7691	
7692	
7693	

Hagler Bailly Pakistan

Sampling Form for Mangroves and Crabs

Sampling Location ID: SS ID M 2 T # 1 Q # 2 GPS No: 0 3 1 2 Sampled by: Kamran Minai

Time: 1 2 2 8 PM Date: 2 2 0 9 1 5

GPS Coordinates: **Start** 24 45 22.4 N 67 23 11.5 E WP No M2T1Q2S **End** N E WP No

General Quadrat Information:

Quadrat Size 10 m X 10 m

Apparent Category: ***Notes***

☑ Healthy Mangroves ☐ Unhealthy Mangroves ☐ Mangrove Dieback

Ecological Condition and land use:

☑ Intact ☐ Degraded ☐ Deforested

Topography (microrelief):

☑ Flat ☐ Depression ☐ Levee[1] ☐ Hummock[2]

Geomorphic setting:

☐ River Delta ☑ Coastal Fringe ☐ Interior[3] ☐ Basin[4]

Soil description:

☐ Organic ☐ Sand ☑ Clay ☐ Silts ☑ Sample Collected

Disturbance evidence (timber harvest):

☑ Not evident ☐ Low (<30% basal area) ☐ Medium (30–70%) ☐ High (>70%)

Cyclone damage:

☑ Not evident ☐ Light ☐ Moderate ☐ Severe

Other disease or disturbance:

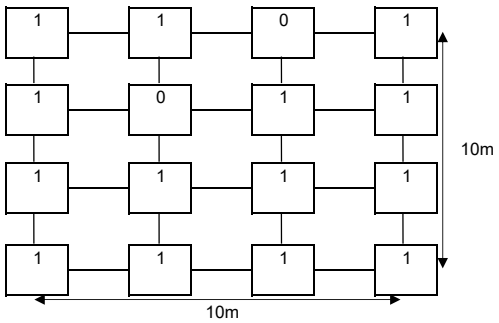
☑ Not evident ☐ Light ☐ Moderate ☐ Severe

Number of Seedlings: 8

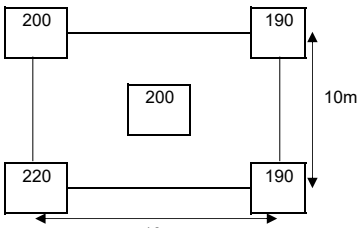
Number of Adult trees: 17

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Tree Height (m)	3.50	4.2	4.2	3.5	3.5	3.5	3.5	4	2.9	4.9	3.5	3.2	3.4	3.3	3.3	2.9	2.4			
Tree Girth (cm)	32	30	28	18	20	32	24	32	32	42	36	28	24	24	24	24	16			
Epicormic Growth	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil			
Yellowing of leaves	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil			

Canopy Cover:



Crab Holes



Quadrat Size 1 m x 1 m

Terms: 1-Levee is a a ridge of sediment deposited naturally alongside a river by overflowing water. 2- Hummock is a hill, a mound, or a ridge. 3- Interior: is a point located away from the coastal fringe but not exposed to the open ocean (approximately 100m away from the open sea). 4- Basin is a topographic region in which all water drains to a common area.

SS = Study Site, T = Transect, Q = Quadrat

Photograph ID

DSC07158	
DSC07159	
DSC07161	
DSC07162	
DSC07163	
DSC07177	

Hagler Bailly Pakistan

Sampling Form for Mangroves and Crabs

Sampling Location ID: SS ID M 2 T # 1 Q # 3 GPS No: 0 3 1 2 Sampled by: Kamran Minai

Time: 1 2 4 5 PM Date: 2 2 0 9 1 5

GPS Coordinates: **Start**								WP No	**End**								WP No
	2	4	4	5	23	0.5	N	M2T1Q3S		2	4	4	5	23	0.7	N	M2T1Q3E
	6	7	2	3	11	0.4	E			6	7	2	3	11	0.6	E	

General Quadrat Information:

Quadrat Size 10 m X 10 m

Apparent Category: ***Notes***

☑ Healthy Mangroves ☐ Unhealthy Mangroves ☐ Mangrove Dieback

Ecological Condition and land use:

☑ Intact ☐ Degraded ☐ Deforested

Topography (microrelief):

☑ Flat ☐ Depression ☐ Levee[1] ☐ Hummock[2]

Geomorphic setting:

☐ River Delta ☑ Coastal Fringe ☐ Interior[3] ☐ Basin[4]

Soil description:

☐ Organic ☐ Sand ☑ Clay ☐ Silts ☑ Sample Collected

Disturbance evidence (timber harvest):

☑ Not evident ☐ Low (<30% basal area) ☐ Medium (30–70%) ☐ High (>70%)

Cyclone damage:

☑ Not evident ☐ Light ☐ Moderate ☐ Severe

Other disease or disturbance:

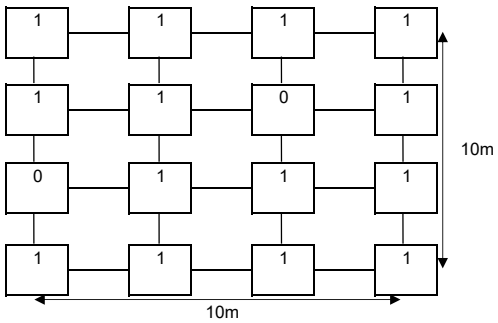
☐ Not evident ☑ Light ☐ Moderate ☐ Severe Insect Damage

Number of Seedlings: 0

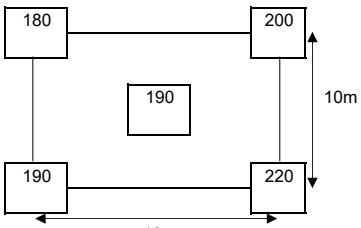
Number of Adult trees: 13

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Tree Height (m)	3.50	4	3.4	3.3	4	4	3.4	3.5	3.7	4	3.7	2.4	2.5							
Tree Girth (cm)	24	42	26	20	32	26	32	28	30	38	40	18	20							
Epicormic Growth	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil							
Yellowing of leaves	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil							

Canopy Cover:



Crab Holes



Quadrat Size 1 m x 1 m

Terms: 1-Levee is a a ridge of sediment deposited naturally alongside a river by overflowing water. 2- Hummock is a hill, a mound, or a ridge. 3- Interior: is a point located away from the coastal fringe but not exposed to the open ocean (approximately 100m away from the open sea). 4- Basin is a topographic region in which all water drains to a common area.

SS = Study Site, T = Transect, Q = Quadrat

Photograph ID

Hagler Bailly Pakistan

Sampling Form for Mangroves and Crabs

Sampling Location ID: SS ID M 5 T # 1 Q # 1 GPS No: 0 3 1 2 Sampled by: Kamran Minai

Time: 0 3 2 3 PM Date: 2 1 0 9 1 5

GPS Coordinates: **Start**								WP No	**End**								WP No
	2	4	4	4	3	0.1	N	M5T1Q1S		2	4	4	4	3	0.4	N	M5T1Q1E
	6	7	1	4	39	0.9	E			6	7	1	4	39	0.9	E	

General Quadrat Information:

Quadrat Size 10 m X 10 m

Apparent Category: ***Notes***

☐ Healthy Mangroves ☑ Unhealthy Mangroves ☐ Mangrove Dieback — Dieback observed in some trees

Ecological Condition and land use:

☑ Intact ☐ Degraded ☐ Deforested

Topography (microrelief):

☑ Flat ☐ Depression ☐ Levee[1] ☐ Hummock[2]

Geomorphic setting:

☐ River Delta ☐ Coastal Fringe ☑ Interior[3] ☐ Basin[4]

Soil description:

☐ Organic ☐ Sand ☑ Clay ☐ Silts ☑ Sample Collected

Disturbance evidence (timber harvest):

☐ Not evident ☐ Low (<30% basal area) ☑ Medium (30–70%) ☐ High (>70%) — Closer to 70%

Cyclone damage:

☑ Not evident ☐ Light ☐ Moderate ☐ Severe

Other disease or disturbance:

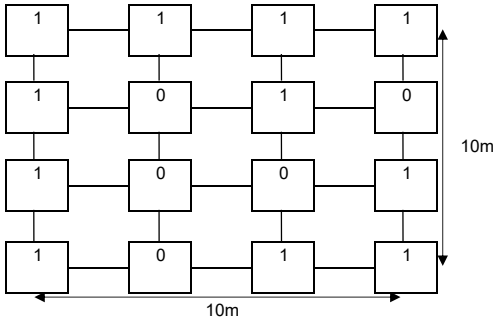
☐ Not evident ☐ Light ☐ Moderate ☑ Severe — Insect Damage and other disease

Number of Seedlings: 10000 (estimated for 100m^2 from approx. 100 seedlings counted in a 1.0m by 1.0m quadrat)

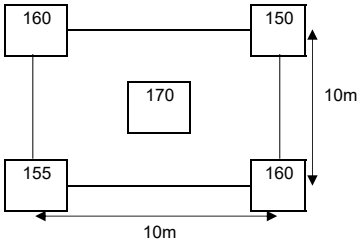
Number of Adult trees: 12

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Tree Height (m)	7	3.3	7.7	6	4	6.5	6.5	3.2	5	8	5	8								
Tree Girth (cm)	86	16	84	50	25	60	35	15	32	60	35	72								
Epicormic Growth	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil								
Yellowing of leaves	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil								

Canopy Cover:



Crab Holes



Quadrat Size 1 m x 1 m

Terms: 1-Levee is a a ridge of sediment deposited naturally alongside a river by overflowing water. 2- Hummock is a hill, a mound, or a ridge. 3- Interior: is a point located away from the coastal fringe but not exposed to the open ocean (approximately 100m away from the open sea). 4- Basin is a topographic region in which all water drains to a common area.

SS = Study Site, T = Transect, Q = Quadrat

Photograph ID

7587	7596
7588	7597
7589	7598
7590	7599
7591	
7592	
7593	
7594	
7595	

Hagler Bailly Pakistan

Sampling Form for Mangroves and Crabs

Sampling Location ID: SS ID M 5 T # 1 Q # 2 GPS No: 0 3 1 2 Sampled by: Kamran Minai

Time: 0 3 4 7 PM Date: 2 1 0 9 1 5

GPS Coordinates: **Start** 24 44 44 4 0.5 N 67 1 4 40 0 E WP No M5T1Q2S

End 24 44 44 4 0.8 N 67 1 4 40 0 E WP No M5T1Q2E

General Quadrat Information:

Quadrat Size 10 m X 10 m

Apparent Category: ***Notes***

☑ Healthy Mangroves ☐ Unhealthy Mangroves ☐ Mangrove Dieback — Dieback observed in some trees

Ecological Condition and land use:

☑ Intact ☐ Degraded ☐ Deforested

Topography (microrelief):

☑ Flat ☐ Depression ☐ Levee[1] ☐ Hummock[2]

Geomorphic setting:

☐ River Delta ☐ Coastal Fringe ☑ Interior[3] ☐ Basin[4]

Soil description:

☐ Organic ☐ Sand ☑ Clay ☐ Silts ☑ Sample Collected

Disturbance evidence (timber harvest):

☐ Not evident ☐ Low (<30% basal area) ☑ Medium (30–70%) ☐ High (>70%)

Cyclone damage:

☑ Not evident ☐ Light ☐ Moderate ☐ Severe

Other disease or disturbance:

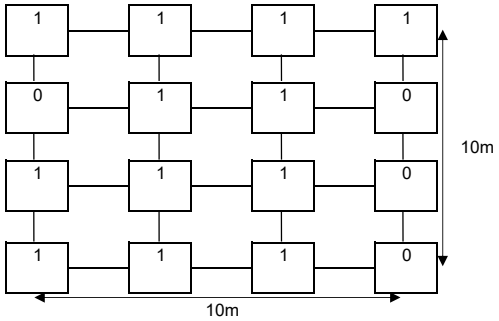
☐ Not evident ☐ Light ☐ Moderate ☑ Severe — Insect Damage

Number of Seedlings: 22

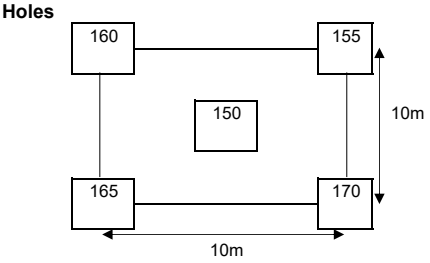
Number of Adult trees: 9

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Tree Height (m)	5.50	5.5	4	1.5	5.5	8	4.4	5.2	6											
Tree Girth (cm)	52	45	48	38	35	70	32	42	50											
Epicormic Growth	nil	nil	nil	nil	nil	nil	nil	nil	nil											
Yellowing of leaves	nil	nil	nil	nil	nil	nil	nil	nil	nil											

Canopy Cover:



Crab Holes



Quadrat Size 1 m x 1 m

Terms: 1-Levee is a a ridge of sediment deposited naturally alongside a river by overflowing water. 2- Hummock is a hill, a mound, or a ridge. 3- Interior: is a point located away from the coastal fringe but not exposed to the open ocean (approximately 100m away from the open sea). 4- Basin is a topographic region in which all water drains to a common area.

SS = Study Site, T = Transect, Q = Quadrat

Photograph ID

7600	7609	7618
7601	7610	7619
7602	7611	7620
7603	7612	7621
7604	7613	7622
7605	7614	7623
7606	7615	7624
7607	7616	7625
7608	7617	

Hagler Bailly Pakistan

Sampling Form for Mangroves and Crabs

Sampling Location ID: SS ID M 5 T # 1 Q # 3 GPS No: 0 3 1 2 Sampled by: Kamran Minai

Time: 0 4 1 1 PM Date: 2 1 0 9 1 5

GPS Coordinates: **Start** 24 44 44 5 0.7 N 67 14 40 0.9 E WP No M5T1Q3S

End 24 44 44 5 0.5 N 67 14 41 0.1 E WP No M5T1Q3E

General Quadrat Information:

Quadrat Size 10 m X 10 m

Apparent Category: ***Notes***

☑ Healthy Mangroves ☐ Unhealthy Mangroves ☐ Mangrove Dieback — Dieback observed in some trees

Ecological Condition and land use:

☑ Intact ☑ Degraded ☐ Deforested

Topography (microrelief):

☑ Flat ☐ Depression ☐ Levee[1] ☐ Hummock[2]

Geomorphic setting:

☐ River Delta ☐ Coastal Fringe ☑ Interior[3] ☐ Basin[4]

Soil description:

☐ Organic ☐ Sand ☑ Clay ☐ Silts ☐ Sample Collected

Disturbance evidence (timber harvest):

☐ Not evident ☐ Low (<30% basal area) ☑ Medium (30–70%) ☐ High (>70%)

Cyclone damage:

☑ Not evident ☐ Light ☐ Moderate ☐ Severe

Other disease or disturbance:

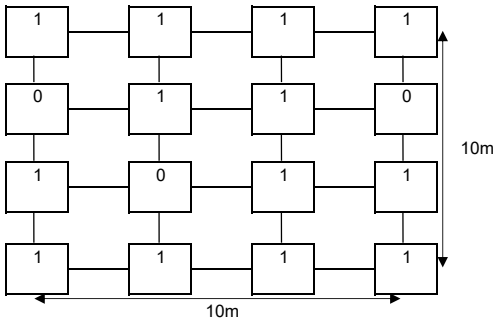
☐ Not evident ☐ Light ☐ Moderate ☑ Severe — Insect Damage

Number of Seedlings: 3500 (estimated for 100m^2 from approx. 35 seedlings counted in a 1.0m by 1.0m quadrat)

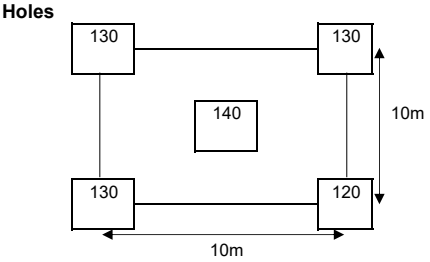
Number of Adult trees: 7

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Tree Height (m)	5.20	3.6	5.2	5	5.5	4	5.3													
Tree Girth (cm)	68	28	55	30	58	30	66													
Epicormic Growth	nil	nil	nil	nil	nil	nil	nil													
Yellowing of leaves	nil	nil	nil	nil	nil	nil	nil													

Canopy Cover:



Crab Holes



Quadrat Size 1 m x 1 m

Terms: 1-Levee is a a ridge of sediment deposited naturally alongside a river by overflowing water. 2- Hummock is a hill, a mound, or a ridge. 3- Interior: is a point located away from the coastal fringe but not exposed to the open ocean (approximately 100m away from the open sea). 4- Basin is a topographic region in which all water drains to a common area.

SS = Study Site, T = Transect, Q = Quadrat

Photograph ID

Hagler Bailly Pakistan

Sampling Form for Mangroves and Crabs

Sampling Location ID: SS ID M 7 T # 1 Q # ! GPS No: 0 3 1 2 Sampled by: Kamran Minai

Time: 1 2 1 6 PM Date: 1 8 0 9 1 5

GPS Coordinates: **Start** 24 33 34.9 N 67 13 0.6 E WP No M7T1Q1A **End** N E WP No

General Quadrat Information:

Quadrat Size 10 m X 10 m

Apparent Category: ***Notes***

☐ Healthy Mangroves ☑ Unhealthy Mangroves ☐ Mangrove Dieback — Dieback observed in some trees

Ecological Condition and land use:

☑ Intact ☐ Degraded ☐ Deforested

Topography (microrelief):

☑ Flat ☐ Depression ☐ Levee[1] ☐ Hummock[2]

Geomorphic setting:

☑ River Delta ☐ Coastal Fringe ☐ Interior[3] ☐ Basin[4]

Soil description:

☐ Organic ☐ Sand ☑ Clay ☐ Silts ☑ Sample Collected

Disturbance evidence (timber harvest):

☑ Not evident ☐ Low (<30% basal area) ☐ Medium (30–70%) ☐ High (>70%)

Cyclone damage:

☑ Not evident ☐ Light ☐ Moderate ☐ Severe

Other disease or disturbance:

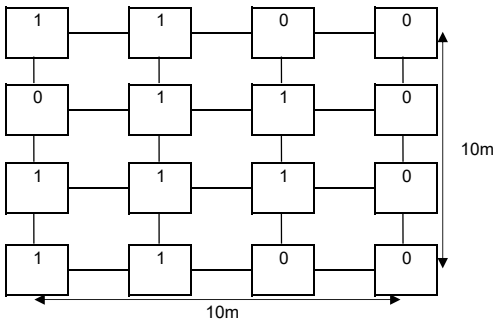
☐ Not evident ☐ Light ☐ Moderate ☑ Severe — Holes in leaves observed

Number of Seedlings: 22

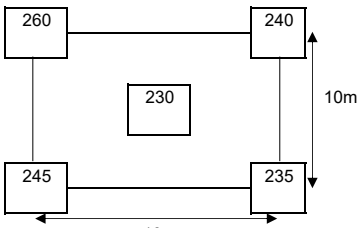
Number of Adult trees: 3 10 stunted — bunchy growth of stunted mangro

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Tree Height (m)	3.80	2.5	2.6	1	1.2	1.5	1.1	1	1.3	1.2	1.1	1.5	1.1							
Tree Girth (cm)	34	15	10	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A							
Epicormic Growth	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil							
Yellowing of leaves	yes	yes	no	no	no	no	no	no	no	no	no	no	no							

Canopy Cover:



Crab Holes



Quadrat Size 1 m x 1 m

Terms: 1-Levee is a a ridge of sediment deposited naturally alongside a river by overflowing water. 2- Hummock is a hill, a mound, or a ridge. 3- Interior: is a point located away from the coastal fringe but not exposed to the open ocean (approximately 100m away from the open sea). 4- Basin is a topographic region in which all water drains to a common area.

SS = Study Site, T = Transect, Q = Quadrat

Photograph ID

7463	7472
7464	7473
7465	7474
7466	7475
7467	7476
7468	7477
7469	7478
7470	
7471	

Hagler Bailly Pakistan

Sampling Form for Mangroves and Crabs

Sampling Location ID: SS ID M 7 T # 1 Q # 2 GPS No: 0 3 1 2 Sampled by: Kamran Minai

Time: 0 1 2 2 PM Date: 1 8 0 9 1 5

GPS Coordinates: **Start**								WP No	**End**							WP No
	2	4	3	3	34	0.8	N								N	
	6	7	1	7	12	0.7	E	M7T1Q2A							E	

General Quadrat Information:

Quadrat Size 10 m X 10 m

Apparent Category: ***Notes***

☑ Healthy Mangroves ☐ Unhealthy Mangroves ☐ Mangrove Dieback — Dieback observed in some trees

Ecological Condition and land use:

☑ Intact ☐ Degraded ☐ Deforested

Topography (microrelief):

☑ Flat ☐ Depression ☐ Levee[1] ☐ Hummock[2]

Geomorphic setting:

☑ River Delta ☐ Coastal Fringe ☐ Interior[3] ☐ Basin[4]

Soil description:

☐ Organic ☐ Sand ☑ Clay ☐ Silts ☑ Sample Collected

Disturbance evidence (timber harvest):

☐ Not evident ☑ Low (<30% basal area) ☐ Medium (30–70%) ☐ High (>70%)

Cyclone damage:

☑ Not evident ☐ Light ☐ Moderate ☐ Severe

Other disease or disturbance:

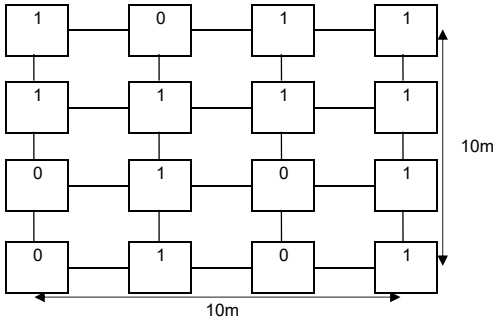
☐ Not evident ☐ Light ☑ Moderate ☐ Severe — Holes in leaves observed

Number of Seedlings: 3

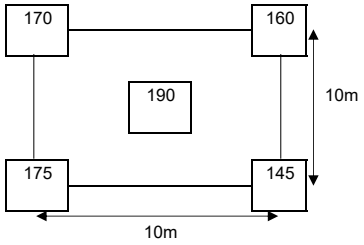
Number of Adult trees: 15 3 stunted — bunchy growth of stunted trees

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Tree Height (m)	4.20	3.8	4.8	3.5	4	3.5	3.7	3.2	3.3	2.2	2.3	2.8	2.5	2.2	2.6	1.1	1	1.2		
Tree Girth (cm)	46	40	64	28	25	23	22	22	26	18	20	20	25	20	25	N/A	N/A	N/A		
Epicormic Growth	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil		
Yellowing of leaves	yes	yes	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no		

Canopy Cover:



Crab Holes



Quadrat Size 1 m x 1 m

Terms: 1-Levee is a a ridge of sediment deposited naturally alongside a river by overflowing water. 2- Hummock is a hill, a mound, or a ridge. 3- Interior: is a point located away from the coastal fringe but not exposed to the open ocean (approximately 100m away from the open sea). 4- Basin is a topographic region in which all water drains to a common area.

SS = Study Site, T = Transect, Q = Quadrat

Photograph ID

7479	7488
7480	7489
7481	
7482	
7483	
7484	
7485	
7486	
7487	

Hagler Bailly Pakistan

Sampling Form for Mangroves and Crabs

Sampling Location ID: SS ID M 7 T # 1 Q # 3 GPS No: 0 3 1 2 Sampled by: Kamran Minai

Time: 0 2 0 2 PM Date: 1 8 0 9 1 5

GPS Coordinates: **Start**								WP No	**End**							WP No
	2	4	3	3	34	0.5	N								N	
	6	7	1	7	11	0	E	M7T1Q3A							E	

General Quadrat Information:

Quadrat Size 10 m X 10 m

Apparent Category: ***Notes***

☑ Healthy Mangroves ☐ Unhealthy Mangroves ☐ Mangrove Dieback — Dieback observed in some trees

Ecological Condition and land use:

☑ Intact ☐ Degraded ☐ Deforested

Topography (microrelief):

☑ Flat ☐ Depression ☐ Levee[1] ☐ Hummock[2]

Geomorphic setting:

☑ River Delta ☐ Coastal Fringe ☐ Interior[3] ☐ Basin[4]

Soil description:

☐ Organic ☐ Sand ☑ Clay ☐ Silts ☑ Sample Collected

Disturbance evidence (timber harvest):

☐ Not evident ☑ Low (<30% basal area) ☐ Medium (30–70%) ☐ High (>70%)

Cyclone damage:

☑ Not evident ☐ Light ☐ Moderate ☐ Severe

Other disease or disturbance:

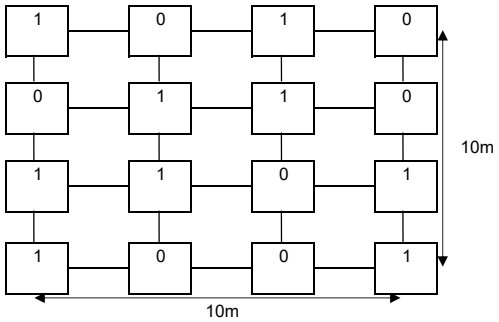
☐ Not evident ☑ Light ☐ Moderate ☐ Severe — Holes in leaves observed

Number of Seedlings: 0

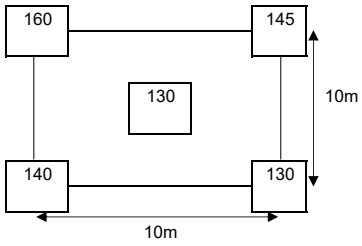
Number of Adult trees: 12 4 stunted — Bunchy growth of stunted trees

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Tree Height (m)	4.40	3.1	5.3	5.2	3.3	5.2	5.5	4.8	4.6	4.2	5.5	4.6	1	1.5	1.2	1				
Tree Girth (cm)	54	20	50	25	21	49	40	44	30	31	32	32	N/A	N/A	N/A	N/A				
Epicormic Growth	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil				
Yellowing of leaves	yes	yes	no	no	no	no	no	no	no	no	no	no	no	no	no	no				

Canopy Cover:



Crab Holes



Quadrat Size 1 m x 1 m

Terms: 1-Levee is a a ridge of sediment deposited naturally alongside a river by overflowing water. 2- Hummock is a hill, a mound, or a ridge. 3- Interior: is a point located away from the coastal fringe but not exposed to the open ocean (approximately 100m away from the open sea). 4- Basin is a topographic region in which all water drains to a common area.

SS = Study Site, T = Transect, Q = Quadrat

Photograph ID

7490	7499
7491	
7492	
7493	
7494	
7495	
7496	
7497	
7498	

Hagler Bailly Pakistan

Sampling Form for Mangroves and Crabs

Sampling Location ID: SS ID M 7 T # 1 Q # 4 GPS No: 0 3 1 2 Sampled by: Kamran Minai

Time: H H M M AM/PM Date: 1 8 0 9 1 5

GPS Coordinates: **Start**								WP No	**End**							WP No
	2	4	3	3	35	0.5	N								N	
	6	7	1	7	11	0.1	E	M7T1Q4A							E	

General Quadrat Information:

Quadrat Size 10 m X 10 m

Apparent Category: ***Notes***

☑ Healthy Mangroves ☐ Unhealthy Mangroves ☐ Mangrove Dieback — Stunted

Ecological Condition and land use:

☑ Intact ☐ Degraded ☐ Deforested

Topography (microrelief):

☑ Flat ☐ Depression ☐ Levee[1] ☐ Hummock[2]

Geomorphic setting:

☑ River Delta ☐ Coastal Fringe ☐ Interior[3] ☐ Basin[4]

Soil description:

☐ Organic ☐ Sand ☑ Clay ☐ Silts ☑ Sample Collected

Disturbance evidence (timber harvest):

☑ Not evident ☐ Low (<30% basal area) ☐ Medium (30–70%) ☐ High (>70%)

Cyclone damage:

☑ Not evident ☐ Light ☐ Moderate ☐ Severe

Other disease or disturbance:

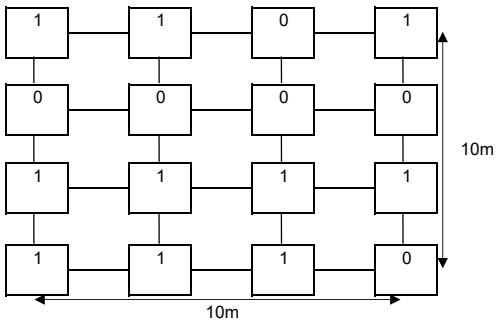
☑ Not evident ☐ Light ☐ Moderate ☐ Severe

Number of Seedlings: 0

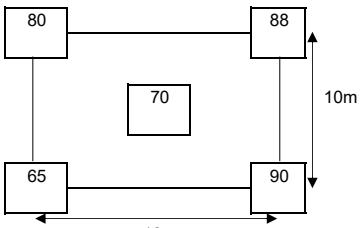
Number of Adult trees: 55 stunted

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Tree Height (m)	1.7	1.4	1.2	1.1	1	1.1	1.2	1.1	1.3	1	1.1	1	1.4	1.6	1.2	1.1				
Tree Girth (cm)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A				
Epicormic Growth	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil				
Yellowing of leaves	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no				

Canopy Cover:



Crab Holes



Quadrat Size 1 m x 1 m

Terms: 1-Levee is a a ridge of sediment deposited naturally alongside a river by overflowing water. 2- Hummock is a hill, a mound, or a ridge. 3- Interior: is a point located away from the coastal fringe but not exposed to the open ocean (approximately 100m away from the open sea). 4- Basin is a topographic region in which all water drains to a common area.

SS = Study Site, T = Transect, Q = Quadrat

Photograph ID

7500	7509
7501	7510
7502	
7503	
7504	
7505	
7506	
7507	
7508	

Annexure B: Port Qasim Fish Sampling Data 2015

See following pages.

Locality	**Korangi Creek**	**Date**	**Sep 20, 2015**
Fish Study Site	**FS 1**	Start Time	07:30
Starting Coordinates	WP 71	End Time	08:30
End Coordinates:	72	Trawl speed	2km/hr

No	*Scientific name*	*Sindhi Name*	*Common name*	*Family*	*Count*	*Pic. No.*
	Fish					
1.	*Rhopilema nomadica*	Jelly fish		Rhizostomatidae	2	75
2.	*Gerres filamentosus*	Jerki	Longrayed silverbiddy	Gerreidae	3	76
3.	*Gerres oyena*	Jerki	Lined silverbiddy	Gerreidae	1	76
4.	*Platycephalus indicus*	Bachu, khuker	Bartail flathead	Platycephalidae	1	78
5.	*Grammoplites suppositus*	Kuker	Spot fin flathead	Platycephalidae	3	79
6.	*Promicrops lanceolatus*	Gisser	Grouper	Sciaenidae	1	80
7.	*Oxyurichthys ophthalmonema*	Hashi Gullo	Eyebrow Gobby	Gobiidae	1	81
8.	*Sillago sihama*	Bumbore	Silver whiting, Lady fish	Sillaginidae	3	82
9.	*Acanthopagrus berda*	Dandya	Black Bream	Sparidae	6	83
10.	*Acanthopagrus latus*	Sufaid Dandya	Silver Bream	Sparidae	3	84
11.	*Drepane punctata*	Phanna (Chand Pomfret)	Spotted batfish	Drepaneidae	1	85
12.	*Pomadasys kaakan*	Dotheria	Javelin grunter	Haemulidae	15	86
13.	*Pomadasys stridens*	Bukra	Stripped grunter	Haemulidae	10	86
14.	*Alepes djedaba*	Bangra	Shrimp scad	Carangidae	1	87
15.	*Caranx para*	Bangra	Banded scad	Carangidae	1	87
16.	*Leiognathus daura*	Kandra kanteri	Goldstripe Ponyfish	Leiognathidae	3	88

No	Scientific name	Sindhi Name	Common name	Family	Count	Pic. No.
17.	*Leiognathus splendens*	Kanteri	Splended ponyfish	Leiognathidae	2	88
18.	*Leiognathus fasciatus*	Kanteri	Striped ponyfish	Leiognathidae	3	88
19.	*Secutor insidiator*	Kanderi	Pugnose ponyfish	Leiognathidae	70	89
20.	*Liza subviridis*	Mori		Mugilidae	13	91
21.	*Lutjanus johnii*	Hira	One spot golden snapper	Lutjanidae	9	92
22.	*Pseudorhombus arsius*	Hajamro	Largetoothed flounder	Bothidae	4	93
23.	*Euryglossa orientalis*	Phani	Oriental sole	Soleidae	2	94
24.	*Synaptura commersoniana*	Surrh	Commersonians' Sole	Soleidae	1	95
	Lobsters					
25.	*Puerulus sewelli*	Kikat	Whip lobster	Palinuridae	2	90
26.	*Thenus indicus*	Khabel Koonk	Flathead locust	Scyllaridae	15	101
	Shrimps					
27.	*Parapenaeopsis sculptilis*	Kiddi	Tiger shrimp	Penaeidae	5	96
28.	*Penaeus indicus*	Jaira	Indian white shrimp	Penaeidae	50	97
29.	*Penaeus japonicus*	Kalri Prawn	Kuruma shrimp	Penaeidae	3	98
	Crabs					
30.	*Charybdis feriatus*	Lal Soda (Crab)	Coral Crab	Portunidae	1	99
31.	*Portunus segnis*	Blue Soda (Crab)	Nila kakra	Portunidae	10	100
32.	*Portunus sanguinolentus*	Takeri	Redspot swimming crab	Portunidae	5	102

Locality	**Chhan Waddo Creek**	**Date**	**Sep 20, 2015**
Fish Study Site	**FS 2**	Start Time	10:25
Starting Coordinates	WP 73	End Time	10:40
End Coordinates	74	Trawl speed	2km/hr

No	*Species*	*Sindhi name*	*Common name*	*Family*	*Count*	*Pic. No.*
	Fish					
1.	*Johnius dussumieri*	Mushka, Bora	Silver Jewfish	Sciaenidae	8	107
2.	*Johnius carutta*	Mushka, Bora	Purple jewfish	Sciaenidae	18	107
3.	*Johnius belangerii*	Mushka, Bora	Jewfish	Sciaenidae	17	107
4.	*Otolithes ruber*	Mushka, Bora	Rosy jewfish	Sciaenidae	12	
5.	*Acanthopagrus latus*	Safaid Dandia	Picnic seabream	Sparidae	2	108
6.	*Pseudorhombus javanicus*	Hajam	Java flounder	Bothidae	1	109
7.	*Cynoglossus arel*	Sole	Brown tongesole	Cyanoglossidae	1	110
8.	*Solea elongata*	Surrh	Elongate sole	Soleidae	1	111
9.	*Arius thalassinus*	Khagga	Giant cat fish	Ariidae	1	112
10.	*Platycephalus indicus*	Khokhar	Bartail flathead	Platycephalidae	1	113
11.	*Leiognathus dussumieri*	Kanteri	Dussumiers' ponyfish	Leiognathidae	3	115
12.	*Acanthopagrus latus*	Safaid Dandia	Picnic seabream	Sparidae	20	122
13.	*Acanthopagrus berda*	Kala Dandia	Black bream	Sparidae	2	124
14.	*Pomadasys argyreus*	Dothera	Silver grunter	Haemulidae	15	123
15.	*Leiognathus daura*	Kandra kanteri	Goldstripe Ponyfish	Leiognathidae	7	125
16.	*Leiognathus splendens*	Kanteri	Splended ponyfish	Leiognathidae	6	
17.	*Leiognathus fasciatus*	Kanteri	Striped ponyfish	Leiognathidae	5	

No	Species	Sindhi name	Common name	Family	Count	Pic. No.
18.	*Secutor insidiator*	Kanteri	Pugnose ponyfish	Leiognathidae	7	
19.	*Cociella crocodila*	Bachu, khuker	Crocodile flathead	Platycephalidae	7	126
20.	*Johnieops sina*	Sua Bora	Drab Jewfish	Sciaenidae	2	127
21.	*Sillago sihama*	Bumbore	Silver whiting	Sillaginidae	2	128
22.	*Pseudosynanceia melanostigma*	Sehri	Blackfin stonefish	Synanceiidae	3	129
23.	*Trypauchen microcephalus*	Hashi Gulla (Red)	Comb gobby	Gobiidae	1	130
24.	*Oxyurichthys ophthalmonema*	Hashi Gulla (white)	Eyebrow Gobby	Gobiidae	1	131
25.	*Terapon jarbua*	Ghingra	Crescent perch	Teraponidae	1	132
26.	*Terapon puta*	Ghingra	Small scaled terapon	Teraponidae	1	132
27.	*Bathygobius fuscus*	Kala Bachu	Brown Goby	Gobiidae	1	133
28.	*Gerres oyena*	Jarkani	Lined silver biddy	Gerreidae	6	134
29.	*Gerres filamentosus*	Jarkani	Long rayed silver biddy	Gerreidae	9	
30.	*Secutor insidiator*	Kanderi	Pugnose ponyfish	Leiognathidae	2	135
31.	*Escualosa thoracata*	Mithoo	White sardine	Clupeidae	2	136
32.	*Sepia pharaonis*	Cuttlefish	Broadclub cuttlefish	Sepiidae	3	137
33.	*Lutjanus johnii*	Hira	One spot golden snapper	Lutjanidae	2	138
34.	*Loligo duvauceli*	Cuttle fish (Damboori Mayya)	Indian squid	Loliginidae	5	114
35.	*Stichodactyla helianthus*	Sea Anemone	Sea Anemone	Aliciidae	2	118
	Shrimps					
36.	*Parapenaeopsis stylifera*	JHinga (Patas)	Kiddi shrimp	Penaeidae	100	116
	Crabs					
37.	*Portunus sanguinolentus*	Takeri (Crab)	Redspot swimming crab	Portunidae	1	117

Locality	**Issaro Creek**	**Date**	**Sep 20, 2015**
Fish Study Site	**FS 3**	Start Time	1400:1430
Starting Coordinates	Waypoint 77	End Time	08:30
End Coordinates	78	Trawl speed	2km/hr

No	*Species*	*Sindhi name*	*Common name*	*Family*	*Count*	*Pic. No.*
	Fish					
1.	*Sillago sihama*	Bumbore	Silver whiting, Lady fish	Sillaginidae	37	146
2.	*Pseudosynanceia melanostigma*	Sehri	Blackfin stonefish	Synanceiidae	2	147
3.	*Cynoglossus carpenteri*	Lal sole	Hooked tongue sole	Cyanoglossidae	1	148
4.	*Cynoglossus puncticeps*	Safaid sole	Speckled tonguesole	Cyanoglossidae	1	149
5.	*Synaptura commersoniana*	Surre	Commersonians' sole	Soleidae	40	150
6.	*Solea elongata*	Surre	Elongate sole	Soleidae	60	
7.	*Euryglossa orientalis*	Phani	Oriental sole	Soleidae	2	151
8.	*Pseudorhombus elevatus*	Hajam	Deep flounder	Bothiidae	2	152
9.	*Ilisha megaloptera*	Paddan	Palli	Clupeid	1	153
10.	*Anodontostoma chacunda*	Daddi	Shortnose gizzard shad	Soleidae	3	154
11.	*Rhabdosargus sarba*	Kappartaan	Goldline seabream	Sparidae	1	155
12.	*Acanthopagrus latus*	Safaid Dandia	Picnic seabream	Sparidae	3	156
13.	*Cociella crocodila*	Bachu, khuker	Crocodile flathead	Platycephalidae	1	157
14.	*Pomadasys kaakan*	Dotheria	Javelin grunter	Haemulidae	8	158
15.	*Drepane punctata*	Phanna (Chand Pomfret)	Spotted batfish	Drepaneidae	4	159
16.	*Leiognathus daura*	Kandra kanteri	Goldstripe Ponyfish	Leiognathidae	5	

No	*Species*	*Sindhi name*	*Common name*	*Family*	*Count*	*Pic. No.*
17.	*Leiognathus splendens*	Kanteri	Splended ponyfish	Leiognathidae	3	
18.	*Leiognathus fasciatus*	Kanteri	Striped ponyfish	Leiognathidae	6	
19.	*Secutor insidiator*	Kanteri	Pugnose ponyfish	Leiognathidae	5	162
20.	*Lutjanus johnii*	Hira	One spot golden snapper	Lutjanidae	1	161
21.	*Gerres filamentosus*	Jerki	Longrayed silverbiddy	Gerreidae	10	163
22.	*Gerres oyena*	Jerki	Lined silverbiddy	Gerreidae	20	163
23.	*Arius maculatus*	Sonkiari Khagga	Spotted catfish	Ariidae	30	164
24.	*Johnius belangerii*	Mushka, Bora	Jewfish	Sciaenidae	30	165
25.	*Johnieops sina*	Sua	Small salmon	Sciaenidae	40	
26.	*Johnius dussumieri*	Mushka	Silver jewfish	Sciaenidae	30	
27.	*Otolithes ruber*	Mushka	Long toothed salmon	Sciaenidae	4	166
28.	*Thenus orientalis*	Teeth	Flathead locust lobster	Scyllaridae	2	167
29.	*Sepia pharaonis*	Cuttlefish	Broadclub cuttlefish	Sepiidae	2	168
30.	*Rhopilema nomadica*	Jelly fish	Jelly fish	Rhizostomatidae	1	170
	Shrimp					
31.	*Parapenaeopsis sculptilis*	Kiddi	Tiger Prawn	Penaeidae	2	169

Locality	**Kadero Creek (Incomplete sweep)**	**Date**	**Sep 20, 2015**
Fish Study Site	**FS 4**	Start Time	17:45
Starting Coordinates	WP 79	End Time	1800
End Coordinates	80	Trawl speed	2km/hr

No	*Species*	*Sindhi name*	*Common name*	*Family*	*Count*	*Pic. No.*
	Fish					
1.	*Liza subviridis*	Pharr	Green back mullet	Mugilidae	1	172
2.	*Johnius glaucus*	Boro, Mushka	Pale spot fin croaker	Sciaenidae	1	173
3.	*Epinephelus tauvina*	Gisser	Greasy Grouper	Serranidae	1	174
4.	*Rhabdosargus sarba*	Kappartaan	Goldline seabream	Sparidae	1	175
5.	*Colletteichthys dussumieri*	Sehri (False)	Flat toad fish	Batrachoididae	3	176
6.	*Johnius glaucus*	Boro Mushka	Pale spot fin croaker	Sciaenidae	3	177
7.	*Leiognathus splendens*	Kanteri	Splended ponyfish	Leiognathidae	5	178
8.	*Leiognathus fasciatus*	Kanteri	Striped ponyfish	Leiognathidae	3	178
9.	*Secutor insidiator*	Kanteri	Pugnose ponyfish	Leiognathidae	2	178
10.	*Pomadasys argyreus*	Dotheria	Bluecheek Silver grunt	Haemulidae	50	179
11.	*Gerres filamentosus*	Jerki	Longrayed silverbiddy	Gerreidae	6	180
12.	*Gerres oyena*	Jerki	Lined silverbiddy	Gerreidae	4	180

Locality	**Waddi Khuddi Creek**	**Date**	**Sep 21, 2015**
Fish Study Site	**FS 5**	Start Time	10:00
Starting Coordinates	WP 83	End Time	10:40
End Coordinates	84	Trawl speed	2.5km/hr

No	*Species*	*Sindhi name*	*Common name*	*Family*	*Count*	*Pic. No.*
	Fish					
1.	*Leiognathus daura*	Kandra kanteri	Goldstripe Ponyfish	Leiognathidae	10	183
2.	*Leiognathus splendens*	Kanteri	Splended ponyfish	Leiognathidae	30	183
3.	*Leiognathus fasciatus*	Kanteri	Striped ponyfish	Leiognathidae	35	183
4.	*Secutor insidiator*	Kanderi	Pugnose ponyfish	Leiognathidae	22	183
5.	*Leiognathus daura*	Kandra kanteri	Goldstripe Ponyfish	Leiognathidae	13	183
6.	*Sparidentex hasta*	Dhandia	Goldlined seabream	Sparidae	4	184
7.	*Pomadasys commersonni*	Dhotheria	Silver grunter	Haemulidae	12	185
8.	*Thryssa hamiltonii*	Chaqoo	Hamiltons' thryssa	Engraulidae	1	186
9.	*Gerres filamentosus*	Jerki	Longrayed silverbiddy	Gerreidae	2	187
10.	*Gerres oyena*	Jerki	Lined silverbiddy	Gerreidae	1	187
11.	*Lutjanus johnii*	Hira	One spot golden snapper	Lutjanidae	1	188
12.	*Arius thalassinus*	Khagga	Giant catfish	Ariidae	2	189
13.	*Drepane punctata*	Phanoon	Spotted sicklefish	Ephippidae	1	190
14.	*Otolithes ruber*	Goli Bora	Tiger toothed croaker	Sciaenidae	7	191
15.	*Promicrops lanceolatus*	Gisser	Brindle grouper	Serranidae	1	192
16.	*Sillago sihama*	Bumbore	Silver whiting, Lady fish	Sillaginidae	50	193

No	Species	Sindhi name	Common name	Family	Count	Pic. No.
17.	*Solea elongata*	Surrh	Elongate sole	Soleidae	5	194
18.	*Cynoglossus puncticeps*	Safaid sole	Speckled tonguesole	Cyanoglossidae	5	195
19.	*Cynoglossus carpenteri*	Lal sole	Hooked tongue sole	Cyanoglossidae	2	196
20.	*Megalaspis cordyla*	Ahal, bangra	Torpedo scad	Carangidae	1	197
21.	*Pseudorhombus arsius*	Hajamro	Largetoothed flounder	Bothidae	1	
22.	*Cociella crocodila*	Bachu, khuker	Crocodile flathead	Platycephalidae	1	198
23.	*Bathygobius fuscus*	Kala Bachu	Brown Goby	Gibiidae	3	199
24.	*Oxyurichthys ophthalmonema*	Hashi Gulla (white)	Eyebrow Gobby	Gobiidae	2	200
25.	*Pseudosynanceia melanostigma*	Sehri	Blackfin stonefish	Synanceiidae	1	201
26.	*Pseudorhombus arsius*	Hajamro	Largetoothed flounder	Bothidae	1	202
27.	*Sepia pharaonis*	Cuttlefish Mayya	Broadclub cuttlefish	Sepiidae	1	205
28.	*Sepiella inermis*	Shishi Mayya	Spineless cuttlefish	Sepiidae	3	206
29.	*Terapon theraps*	Gengira	Large scaled banded grunt	Teraponidae	1	208
30.	*Scomberoides tol*	Aal	Queen fish	Carangidae	1	209
31.	*Thryssa malabarica*	Paddan	Malabar Anchovy	Engraulidae	1	210
32.	*Drepane punctata*	Phanna (Chand Pomfret)	Spotted batfish	Drepaneidae	1	211
33.	*Anodontostoma chacunda*	Daddi	Shortnose gizzard shad	Soleidae	1	212
34.	*Liza subviridis*	Choodi	Green back mullet	Mugilidae	1	213
35.	*Uroconger lepturus*	Chin	Slender conger	Congridae	1	214
36.	*Arius caelatus*	Khagga	Engraved cat fish	Ariidae	1	215
37.	*Thryssa mystax*	Karari	Moustached thryssa	Engraulidae	1	216
38.	*Johnius dussumieri*	Mushka, Bora	Silver Jewfish	Sciaenidae	1	217

No	*Species*	*Sindhi name*	*Common name*	*Family*	*Count*	*Pic. No.*
39.	*Thryssa hamiltonii*	Kararri	Hamiltons' thryssa	Engraulidae	1	Gill net first day
40.	*Johnieops sina*	Sua Bora	Drab Jewfish	Sciaenidae	1	Gill net first day
41.	*Otolithes ruber*	Dohtar	Mushka	Sciaenidae	1	Gill net first day
	Lobsters					
42.	*Thenus orientalis*	Keet	Flathead locust lobster	Scyllaridae	3	203
	Shrimps					
43.	*Parapenaeopsis sculptilis*	Kiddi	Tiger Prawn	Penaeidae	10	204
44.	*Parapenaeopsis stylifera*	Jhinga (Patas)	Kiddi shrimp	Penaeidae	25	207

Locality	**Waddi Khuddi Creek at the mouth opening of Sarain Creek**	**Date**	**Sep 21, 2015**
Fish Study Site	**FS 6**	Start Time	11:15
Starting Coordinates	Waypoint 85	End Time	11:45
End Coordinates		Trawl speed	2.5km/hr

No	*Species*	*Sindhi name*	*Common name*	*Family*	*Count*	*Pic. No.*
	Fish					
1.	*Bathygobius fuscus*	Kala Bachu	Brown Goby	Gobiidae	1	224
2.	*Platycephalus indicus*	Bachu, khuker	Bartail flathead	Platycephalidae	5	225
3.	*Acanthopagrus latus*	Safaid Dandia	Picnic seabream	Sparidae	12	226
4.	*Acanthopagrus berda*	Kala Dandia	Black bream	Sparidae	8	
5.	*Sillago sihama*	Bumbore	Silver whiting, Lady fish	Sillaginidae	4	227
6.	*Oxyurichthys ophthalmonema*	Hashi Gullo	Eyebrow Gobby	Gobiidae	1	228
7.	*Lutjanus johnii*	Hira	One spot golden snapper	Lutjanidae	1	229
8.	*Platycephalus indicus*	Bachu, khuker	Bartail flathead	Platycephalidae	13	230
9.	*Terapon theraps*	Gengira	Large scaled banded grunt	Teraponidae	5	231
10.	*Pomadasys kaakan*	Dotheria	Javelin grunter	Haemulidae	15	232
11.	*Drepane punctata*	Phanna (Chand Pomfret)	Spotted batfish	Drepaneidae	1	233
12.	*Thryssa hamiltonii*	Chaqoo	Hamiltons' thryssa	Engraulidae	2	234
13.	*Escualosa thoracata*	Mithoo	White sardine	Clupeidae	12	235
14.	*Dussumieria acuta*	Paddan	Rainbow sardine		8	236
15.	*Gerres filamentosus*	Jerki	Longrayed silverbiddy	Gerreidae	9	237

No	Species	Sindhi name	Common name	Family	Count	Pic. No.
16.	*Gerres oyena*	Jerki	Lined silverbiddy	Gerreidae	11	
17.	*Cynoglossus carpenteri*	Lal sole	Hooked tongue sole	Cyanoglossidae	70	238
18.	*Pseudorhombus elevatus*	Hajam	Deep flounder	Bothiidae	7	239
19.	*Pseudorhombus javanicus*	Hajam	Java flounder	Bothidae	8	
20.	*Arius caelatus*	Khagga	Engraved cat fish	Ariidae	15	240
21.	*Otolithes ruber*	Goli Bora	Tiger toothed croaker	Sciaenidae	40	241
22.	*Kathala axillaris*	Mushka	Blackspot jewfish	Sciaenidae	34	241
23.	*Otolithes cuvleri*	Mushka	Lesser tiger toothed croaker	Sciaenidae	56	241
24.	*Leiognathus daura*	Kandra kanteri	Goldstripe Ponyfish	Leiognathidae	35	242
25.	*Leiognathus splendens*	Kanteri	Splended ponyfish	Leiognathidae	64	242
26.	*Leiognathus fasciatus*	Kanteri	Striped ponyfish	Leiognathidae	70	242
27.	*Secutor insidiator*	Kanderi	Pugnose ponyfish	Leiognathidae	42	242
28.	*Himantura walga*	Kutti Pittan (Ray fish)	Sting ray	Dasyatidae	1	243
29.	*Pseudosynanceia melanostigma*	Sehri	Blackfin stonefish	Synanceiidae	5	244
	Lobsters					
30.	*Thenus orientalis*	Keet	Flathead locust lobster	Scyllaridae	5	246
	Shrimp					
31.	*Parapenaeopsis stylifera*	Jhinga (Patas)	Kiddi shrimp	Penaeidae	70	245

Appendix D: Socioeconomic Baseline and Consultation Appendices

D.1 Stakeholder Engagement Plan D-2

D.2 Records of Community Consultations D-3

D.3 Record of Institutional Consultation, Briefing and Workshops D-60

D.3.1 Record of Consultations and Briefings D-60

D.3.2 February Workshop Report and Logs D-117

D.4 Socioeconomic Survey Plan D-118

D.4.1 Objectives D-120

D.4.2 Methodology D-120

D.4.3 Household Questionnaire D-128

D.4.4 Settlement Level Questionnaire D-139

D.5 Socioeconomic Survey Results Summary D-152

D.5.1 Household Level Data D-153

D.5.2 Fish Catch Analysis D-167

D.5.3 Vulnerability Matrix D-170

D.6 Resettlement Investigation Questionnaire D-174

D.6.1 Resettlement Investigation Questionnaire (Template) D-175

D.6.2 Resettlement Investigation Questionnaire (Filled) D-177

D.1 Stakeholder Engagement Plan

See following pages.

Hagler Bailly Pakistan
Associated with PA Consulting Group
Technical, Management, and Economic Counsel

Ecosystem Service Review and Cumulative Impact Assessment for Port Qasim

Stakeholder Engagement Plan

HBP Ref.: D5SP1CIA

VERSION 01

June 3, 2015

International Finance Corporation (IFC)

Washington D.C

Contents

1. Introduction 1-1

1.1 Terminologies 1-2

1.2 Objectives of SEP 1-2

1.3 Good Practice Principles 1-3

1.4 World Bank Group Guidelines 1-4

1.5 Engagement Activities and Steps 1-4

1.6 Future Development of SEP 1-5

2. Identified Stakeholders 2-1

3. Stakeholder Consultation 3-1

3.1 Consultation Plan 3-1

3.2 Consultation Material 3-2

3.3 Consultation Mechanism 3-2

3.3.1 Consultations with Institutional Stakeholders 3-2

3.3.2 Consultations with Communities 3-3

3.4 Feedback Consultations 3-3

3.5 Tentative Schedule 3-3

3.6 Documentation and Reporting 3-4

Appendices

Appendix A: Initial Stakeholder List and Analysis

Appendix B: Background Information Document

Appendix C: Consultation Log Template

1. Introduction

The International Finance Corporation (IFC), the private sector arm of the World Bank Group (WBG), plans to invest in a liquefied natural gas (LNG) terminal 'Elengy Terminal Project' at Port Qasim in Karachi, Pakistan. Port Qasim Authority (PQA), the federal government agency mandated to manage port and associated industrial developments is planning another eleven jetties in future.

Port Qasim was established in early 1970s. Due to lack of awareness and weak regulatory regime, to date, no comprehensive environmental and social impact assessment has been conducted for the port and the industrial area at strategic level. Tools, such as Strategic Environment Assessment (SEA), are relatively recent developments. Some provinces, including Sindh, recently introduced the legal requirement for SEA. However, use of SEA in large-scale development plans prepared by the federal and provincial government agencies is rare.

There are currently five existing industry jetties at Port Qasim of which IFC has invested in three. IFC may invest in other projects planned by PQA. Recognizing that environmental and social impacts from existing developments combined with the potential incremental impacts resulting from proposed future developments, may result in significant cumulative impacts that would not be expected in the case of a stand-alone development, IFC has acquired the services of Hagler Bailly Pakistan (Pvt) Ltd (HBP) to conduct an ecosystem service review (ESR) and a cumulative impact assessment (CIA) for the current and planned developments at Port Qasim. The ESR and CIA will be prepared according to local regulatory requirements, IFC Performance Standards, and applicable WBG Environmental Health and Safety (EHS) Guidelines. The methodology of the *IFC Good Practice Handbook Cumulative Impact Assessment and Management: Guidance for the Private Sector in Emerging Markets 2013* will be utilized for the CIA.

This document describes the Stakeholder Engagement Plan (SEP) for the ESR and CIA of the planned developments at Port Qasim. The purpose of the SEP is to define a technically sound and culturally appropriate approach to engage stakeholders at the very early stage of the planned developments at Port Qasim. The SEP is designed to ensure that a) adequate and timely information is provided to the stakeholders, and b) the stakeholders are given sufficient opportunity to voice their opinions and concerns. Stakeholder engagement will act as a bridge between proposed development proponents (PQA and IFC in this case) and key stakeholders (government and regulatory authorities, affected communities and industries). Thus, participation of stakeholders will be a key determining factor in finalizing the proposed development designs and operations and also in successful completion of PESR and CIA.

Stakeholder engagement will be an ongoing exercise that will start immediately after commencement of the ESR and CIA studies and will continue till its completion. Likewise, the SEP will be a dynamic document and will be updated as more information on proposed developments becomes available or more stakeholders are identified. Initially, the SEP will be used for the Study, however, it is the intention that this

document will be developed into an stakeholder engagement plan for the PQA covering all aspects of stakeholder engagement including the grievance redress mechanism and involvement of stakeholders in monitoring the impacts of the Development.

1.1 Terminologies

Following terminologies are used in this document:

Port Area:	The areas falling within the limits of Port Qasim as notified by the Government of Pakistan under the Port Qasim Authority Act 1973.[1]
PQA Industrial Zones	The industrial zones under the jurisdiction of, and managed by, PQA.[2]
Developments:	The plans and anticipated developments as envisaged by PQA in the Port Area.
Stakeholders	Persons or groups who are directly or indirectly affected by a project, as well as those who may have interests in a project and/or the ability to influence its outcome, either positively or negatively. Stakeholders may include locally affected communities or individuals and their formal and informal representatives, national or local government authorities, politicians, religious leaders, civil society organizations and groups with special interests, the academic community or other businesses.[3]
Study	Collectively the ecosystem service review (ESR) and cumulative impact assessment (CIA) for the current and planned developments at Port Qasim being conducted by HBP in accordance with the terms of reference provided by the IFC.
Study Area	The area where Developments are planned or are anticipated; or where the environmental or social impacts of the Developments are likely to take place; or where the direct beneficiaries of the ecosystem services likely to be impacted by the Developments are present.

1.2 Objectives of SEP

The objectives of stakeholder engagement for the Study are to:

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1 It is not certain whether *Port Area* includes the industrial area under the PQA or not. If needed, the definition will be modified.

2 Ibid.

3 International Finance Corporation "*Stakeholder Engagement: A Good Practice Handbook for Companies Doing Business in Emerging Markets"* World Bank Group, Washington, D.C. United States of America, May 2007. http://www1.ifc.org/wps/wcm/connect/938f1a0048855805beacfe6a6515bb18/IFC_StakeholderEngagement.pdf?MOD=AJPERES

- Ensure involvement of the stakeholders in decision-making of the Study;
- Inform stakeholders of the future developments and their consequences;
- Aid in identification of ecosystem services that the Developments may impact and communities and companies' dependence and perceptions on, as well as vulnerability to, these ecosystem services;
- Seek input from key stakeholders on planned activities to increase its positive outcomes and avoid or mitigate negative impacts, and
- For the VECs:
  - Identify VECs for the Port Qasim;
  - Identify how the VECs have been affected by the existing developments and hence are likely to affected by Developments; and
  - Gather data and information from the stakeholders' perspective on the VECs, as well as about their relations/dependence on them.

Identification of appropriate mechanism for grievance mechanism and involvement of the stakeholders in the monitoring of environmental and social impacts of the Development.

1.3 Good Practice Principles

The consultations will be undertaken in good faith, while remaining impartial. The good practice principles which will be observed during the consultations are:[4]

- *Cultural sensitivity* – this requires understanding and appreciation of the social institutions, values, and culture of the communities in the project area and respect for the historical, cultural, environmental, political and social backgrounds of the communities which are affected by a project;
- *Interactive approach* – stakeholders' engagement should not be limited to one-way dissemination of information. Stakeholder comments should be fed into the decision making processes for the proposed project design;
- *Open, transparent and informative* – government, institutions, industries and communities who are interested or can be affected by the proposed developments should have access to relevant information, in a simple and understandable format;
- *Inclusive and equitable* – Ensure that all stakeholder groups are represented, including less represented groups such as women, children, elderly and poor people;
- *Appropriateness and flexibility* – stakeholder engagement methodologies (meetings, workshops etc.) must be appropriate to the specific phase of the PESR and CIA process and the stakeholder groups identified. The consultation should also be adjusted according to the resources available;

[4] Stakeholder Engagement: A Good Practice Handbook for Companies Doing Business in Emerging Economies, IFC, 2007

- *Capacity building* – capacity building should be a part of interaction with stakeholders, wherever appropriate and practicable.

1.4 World Bank Group Guidelines

The IFC Performance Standards (IFC PS) and 'IFC Stakeholder Engagement: Good Practice Handbook for Companies doing Business in Emerging Markets' lay out the objectives and approach for stakeholder engagement. Stakeholders' involvement is required for all development initiatives that lead to environmental and social impacts. Some of the main principles laid out for consultations include: [5,6,7,8]

- *Stakeholder identification:* Stakeholders include individuals and/or groups that can be affected by or are interested in the development initiative. Consultations should be held with the stakeholders engaging all types of stakeholders, which can include potentially affected communities, local government and regulatory authorities, regulatory institutions, NGOs, academia and other civil society bodies.
- *Selection of consultation techniques:* Sufficient information should be shared with the stakeholders in a timely and effective manner, with consideration for stakeholder interests, linguistic and educational backgrounds, and socio-cultural setting;
- *Arrangements for consultations:* Venue and timing for consultation meetings should be chosen in a manner that encourages maximum participation on behalf of stakeholders.
- *Stages of consultation:* Consultations should be conducted during the early cycle of project development (scoping stage), so that the results and outcomes of the consultations can contribute to the design process. Following this, stakeholders should be provided feedback before finalization of the project's environmental design (feedback stage) on how their concerns, raised at the scoping stage, were addressed through suitable mitigation or design changes.
- *Stakeholder feedback and use of results:* The views of stakeholders should be documented and then analyzed for use in more effective decision-making.

1.5 Engagement Activities and Steps

There are various steps involved in stakeholder engagement starting from stakeholder identification to management functions adopted to address the concerns and incorporate

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5 International Finance Corporation "*Performance Standard 1"*, World Bank Group, Washington, D.C. United States of America, January 2012.

6 Shelton H. Davis and Nightingale Rukuba–Ngaiza, based on the World Bank's Operational Directive 4.01 on Environmental Assessments "*Meaningful Consultations in Environmental Assessment*", September 1998.

7 International Finance Corporation "*Stakeholder Engagement: A Good Practice Handbook for Companies Doing Business in Emerging Markets*" World Bank Group, Washington, D.C. United States of America May 2007.

8 The World Bank Operational Manual "*Operational Directive OD 4.20"*, World Bank Group Washington, D.C. United States of America, September 1991.

the suggestions of the stakeholders in decision making processes pertaining to Developments.

The key steps to be followed in this stakeholder engagement are provided in **Exhibit** 1.1. Additional details are provided in **Section 2** and **3**.

Exhibit 1.1: Summary of Stakeholder Engagement Activities and Steps

Steps	*Description*
Stakeholder identification and analysis	▶ Identification of government bodies, regulatory agencies, industries and communities which are associated or have a stake in VECs in the Port Qasim area and ecosystems that Developments may affect.
Information disclosure	▶ A background information document will be prepared keeping in mind the linguistic limitations of local communities. The document will be shared with the identified stakeholders providing them information about the purpose of engaging them, and key issues within the area.
Stakeholder consultation	▶ Stakeholders will be informed prior to the consultations. The time and venue for the consultations will be shared and agreed with the stakeholders. ▶ Consultations with the communities will be held within the settlements, to extent possible. Where due to logistic or security concerns, it is not possible to hold consultations with the community, a nearby community or location will be selected, to ensure maximum participation. Separate consultations with the female members of the community will be held. ▶ The consultations will be targeted and meaningful i.e. directly related to the Development, while also aiming to distinguish between impacts of Development and other nearby developments (such as Landhi and Korangi Industrial areas, Bhains Colony, and housing developments). ▶ The consultation mechanism will include: ▷ Providing a short summary of the Developments and distinguishing between other non-PQA developments. ▷ Structured interviews with the key informants from PQA, government, industries and communities, participatory workshops, combined consultation session and informal interviews. ▷ Unstructured interviews and discussions directly following the structured discussion. ▶ The proceedings of the consultation meetings will be recorded. The findings of the consultations will be shared with PQA and IFC.
Reporting to Stakeholders	▶ Feedback consultations will be held to inform the stakeholders about the results of the Study and the recommendations for corrective actions to to address their concerns and mitigate the impacts associated with the proposed Developments (see **Section 3.4**).

1.6 Future Development of SEP

Although, the current SEP is designed for the Study only and will be focused on the environmental and social assessment process, it is expected that in the long term, SEP can be developed into a process to strengthen the planning process of PQA. The eventual SEP will be a platform through which the PQA can:

- Identify and address the concerns, suggestions and interests of the stakeholders in the planning, design and implementation of the Developments;
- Collect vital information to assess the cumulative impacts of the existing and future developments at Port Qasim;
- Identify appropriate mitigation measures;
- Coordinate on decisions with other regulatory authorities and institutional stakeholders on whether to approve the future developments and corresponding conditions of approval;
- Have a means of receiving the grievance of the public in a timely manner and addressing them to the satisfaction of the community; and
- Involve stakeholders in monitoring the impacts of the current and future developments.

In summary, the SEP will be designed to integrate the stakeholder engagement into the core business activities of PQA. It is envisaged that the SEP will be a broad, inclusive, and continuous process between PQA and its stakeholders. In particular, the following areas need to be developed:

Grievance Redress Mechanism

Timely and effective redress of stakeholder grievances contribute to bringing sustainability in the developments in an area. In this context, the SEP will help advocate the process of forming and strengthening relationships between Port Qasim management and the stakeholder community groups and bridge any gaps to create a common understanding, providing the PQA management the 'social license' to operate in the area. The grievance redress mechanism proposed for the Developments will help achieve the objectives of sustainability and cooperation by dealing with the environmental and social issues of the Project.

A mechanism to handle grievances and complaints from stakeholders for future developments will be included in the updated SEP. The purpose of the complaints procedure will be to ensure all complaints from local communities are dealt with appropriately, with corrective actions being implemented and the complainants being informed of the outcome. The SEP will aim to ensure that grievances are treated without prejudice. The grievance mechanism to be included in the SEP will possess the following salient features:

- Designated contact points and/or personnel to receive and register complaints,
- All grievances (verbal and written) will be registered in a Complain Log and a generic report will be generated on a quarterly basis,
- PQA and other decision makers will respond to all grievances within 30 days of submission – and more quickly in cases where there is specific urgency,
- PQA and other decision makers will screen and assess the severity of the complaint,

- PQA and other decision makers may reject a complaint with justifications provided to the complainant or refer the matter to other authorities as appropriate,
- If accepted, PQA and other decision makers will define an approach to resolve it, implement the approach, communicate approach to the complainant and keep track of the measures included in approach,
- PQA and other decision makers will conduct feedback consultations to determine the effectiveness of the approach taken to resolve issues and record community perception on the grievance resolution mechanism, and
- Communicate with relevant authorities regarding outcomes and any further actions to be taken.

Involvement of Stakeholders in Monitoring

The monitoring program to be developed by PQA can include participation by stakeholders in specific aspects that are on concern to them. Independent third party monitoring managed by regulatory agencies such as Sindh EPA, the Sindh Forest Department, and the Sindh Wildlife Department can also be considered where capabilities of PQA are not developed, or where there is a trust deficit between PQA and stakeholders to start with. These actions will help in maintaining transparency and credibility of monitoring by PQA and improve the confidence of stakeholders in the results of monitoring.

2. Identified Stakeholders

Stakeholders were identified through:

- review of existing developments within the Port Qasim notified area;
- preliminary review of Port Qasim Developments;
- review of existing land-use to identify additional developments in the region (e.g. Landhi Industrial area).
- review of previous consultations carried out as part of ESIAs for proposed developments at Port Qasim;
- pre-scoping field visit and unstructured discussions with community and some institutional stakeholders; and
- an ecological profile and a social profile developed for the area on the basis of literature review and previous ESIAs carried out by HBP.

Exhibit 2.1 presents a map of the Study Area. The land under the jurisdiction of PQA is shown in the map. The Developments are likely to take place mainly in this area or area south and southwest of the Port Qasim. The creek system receives effluent from nearly all directions from industrial, domestic and agricultural sources. The fishermen communities mainly reside in the northwest of the Study Area. Communities living all around the Port Qasim, particularly in the north and the west, are either receptors of the impact from the activities in PQA or are sources of labor.

Based on the available information, the Study Area has been divided into various zones and separate strategies have been proposed for each type of zone. The proposed zones are shown in **Exhibit 2.2.** The key stakeholder groups for each zone are discussed below.

In the central Study Area (see details in **Exhibit 2.3**), the zones are:

Port Area (PQA Southwest Zone)	▶ Owners, operators and employees of industrial jetties and terminals ▶ Interested investors in the area
PQA Northwest Industrial Zone	▶ Owners, operators and employees of industrial units ▶ Interested investors in the area
PQA Eastern Industrial Zone	▶ Owners, operators and employees of industrial units ▶ Interested investors in the area
Pakistan Steel Mills Area	▶ Owners, operators and employees of steels mills, water treatment plant, and railway yard

	▶ Interested investors in the area
Planned Housing Schemes	▶ Residents of the housing schemes who are potentially adversely affected by Port Qasim developments.
Non-fishing Rural Communities	▶ Non-fishing communities, with expected or established reliance on existing Port Qasim developments as a source of livelihood and potentially adversely affected by Port Qasim developments (e.g. air quality issues, traffic, noise, etc.).
	▶ Residents
	▶ Local government

In the western Study Area (see details in **Exhibit 2.4**), the zones are:

Korangi and Landhi Industrial Areas	▶ The industry associations
	▶ Owners and operators of large industrial units
Urban communities	▶ Local government
	▶ Agencies responsible for treatment and disposal of sewerage
Fishing communities	▶ Fishing communities located along at or near shoreline and possibly reliant on fishing within the PQA notified area, and possibly affected by existing activities within the Port Qasim shipping lane.
	▶ Owners and operators of salt works
	▶ Government agencies responsible for fishery management

In the eastern Study Area (see details in **Exhibit 2.5**), the zones are:

Gharo-Dhabeji Area	▶ Fishing Communities
	▶ Owners and operators of salt works
	▶ Other non-fishing communities with expected or established reliance on existing Port Qasim developments as a source of livelihood and potentially adversely affected by Port Qasim developments

Institutional Stakeholders:

- Decision-making and planning institutions;
- Key owners and developers with existing or proposed industries in the creek area;

- Key owners and developers with existing or proposed port infrastructure within the south-western PQA zone (**Exhibit 2.1**).
- Government and regulatory authorities directly or indirectly connected to, overseeing the development activities or having natural resource protection responsibilities within the PQA notified area and surrounds.
- Non-governmental organizations that have interest in or can affect or influence the Developments.
- Key relevant scientific and research organizations.

A comprehensive list of stakeholders which have been affected, or those which may be affected by degradation due to the existing operations and proposed Developments is provided in **Appendix A**.

Exhibit 2.1: The Proposed Study Area

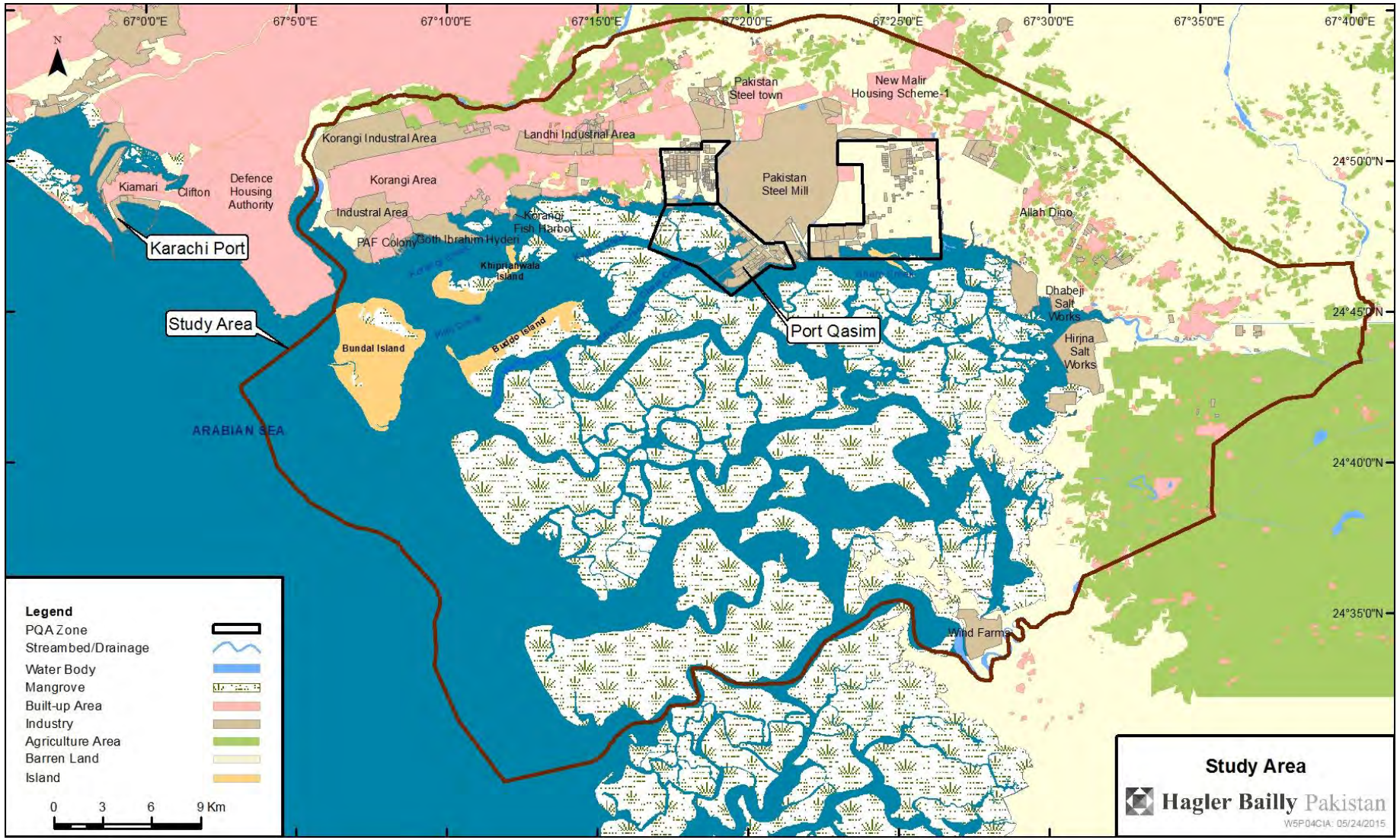


Exhibit 2.2: The Proposed Zones

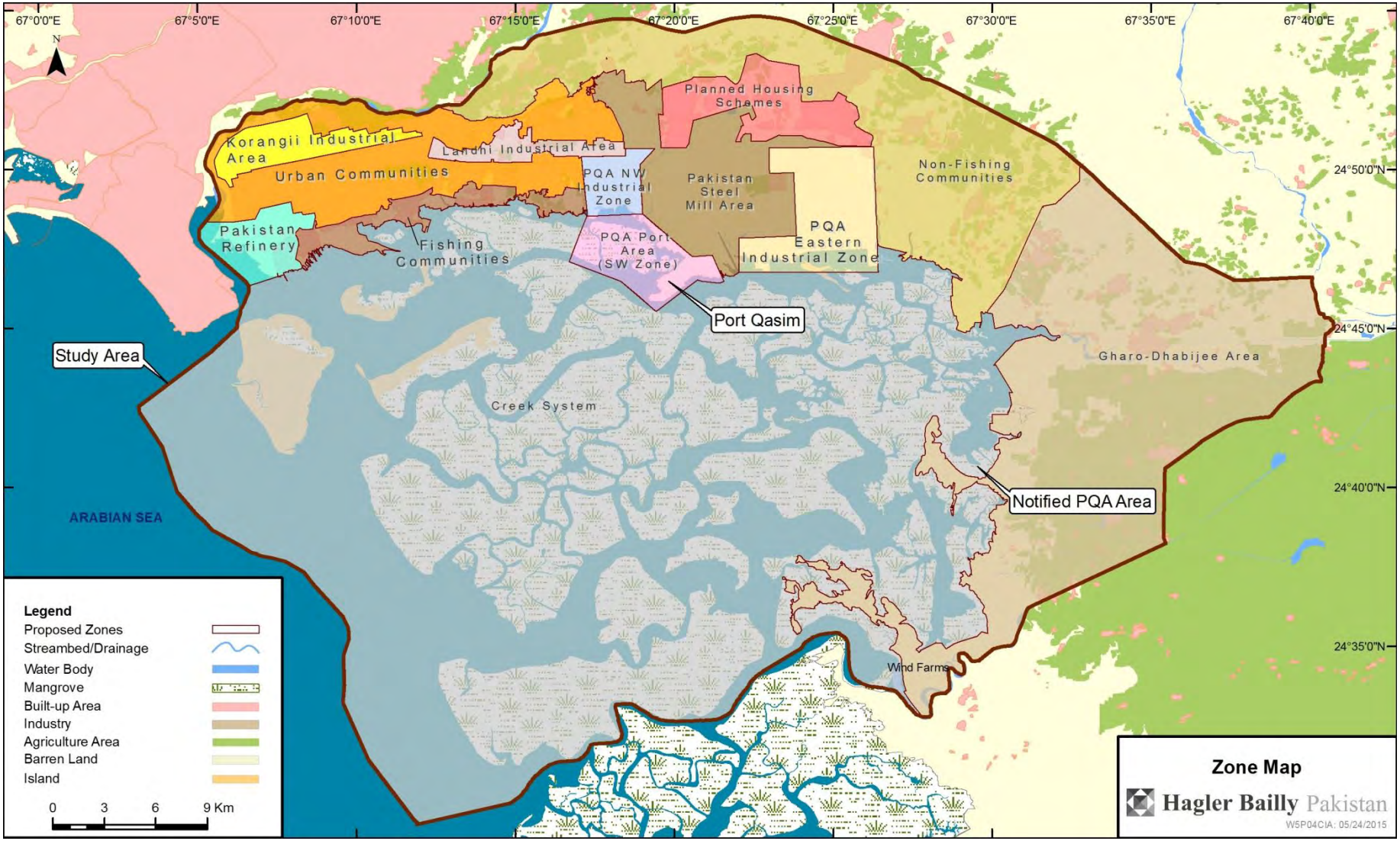


Exhibit 2.3: The Central Study Area

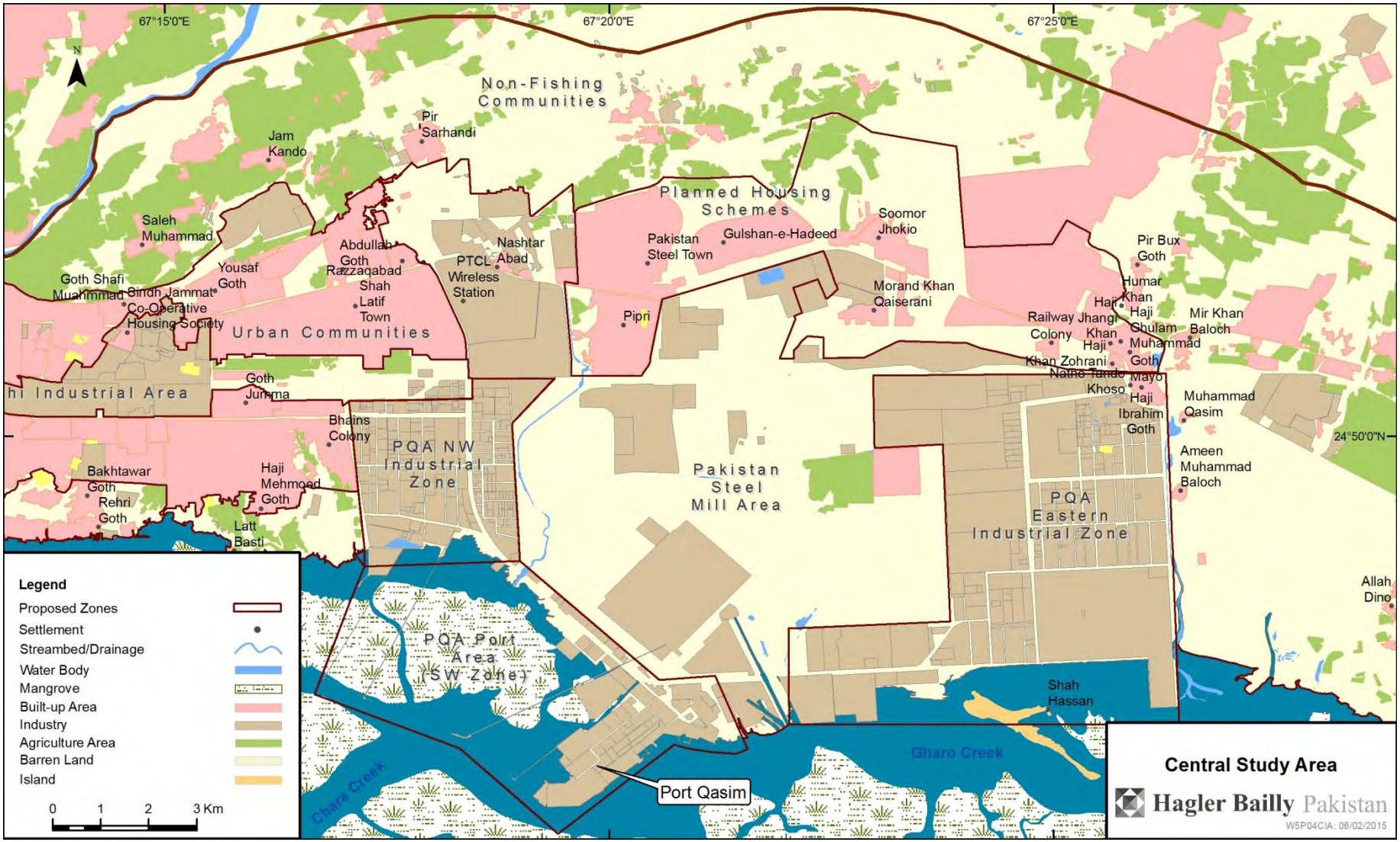


Exhibit 2.4: The Western Study Area

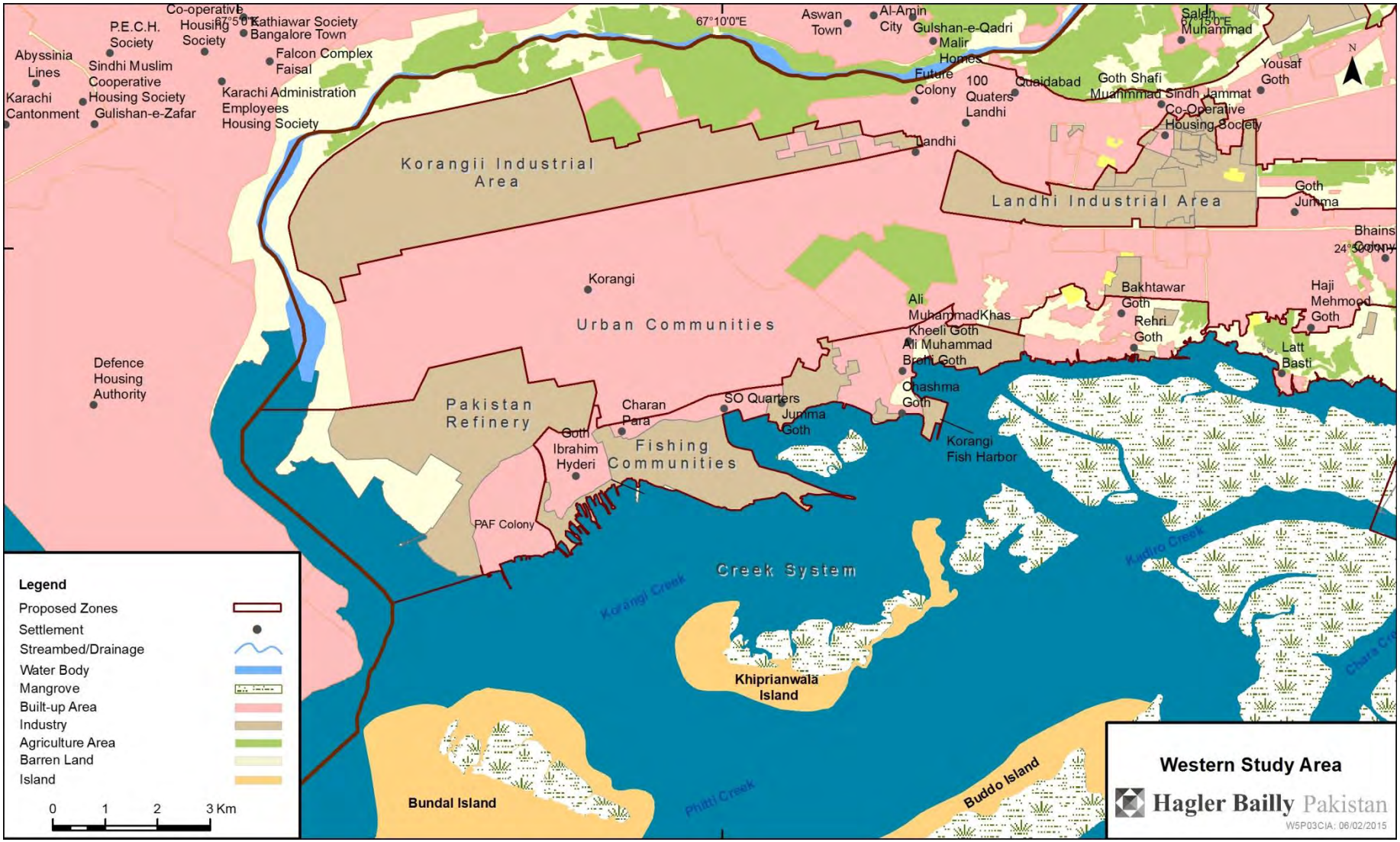
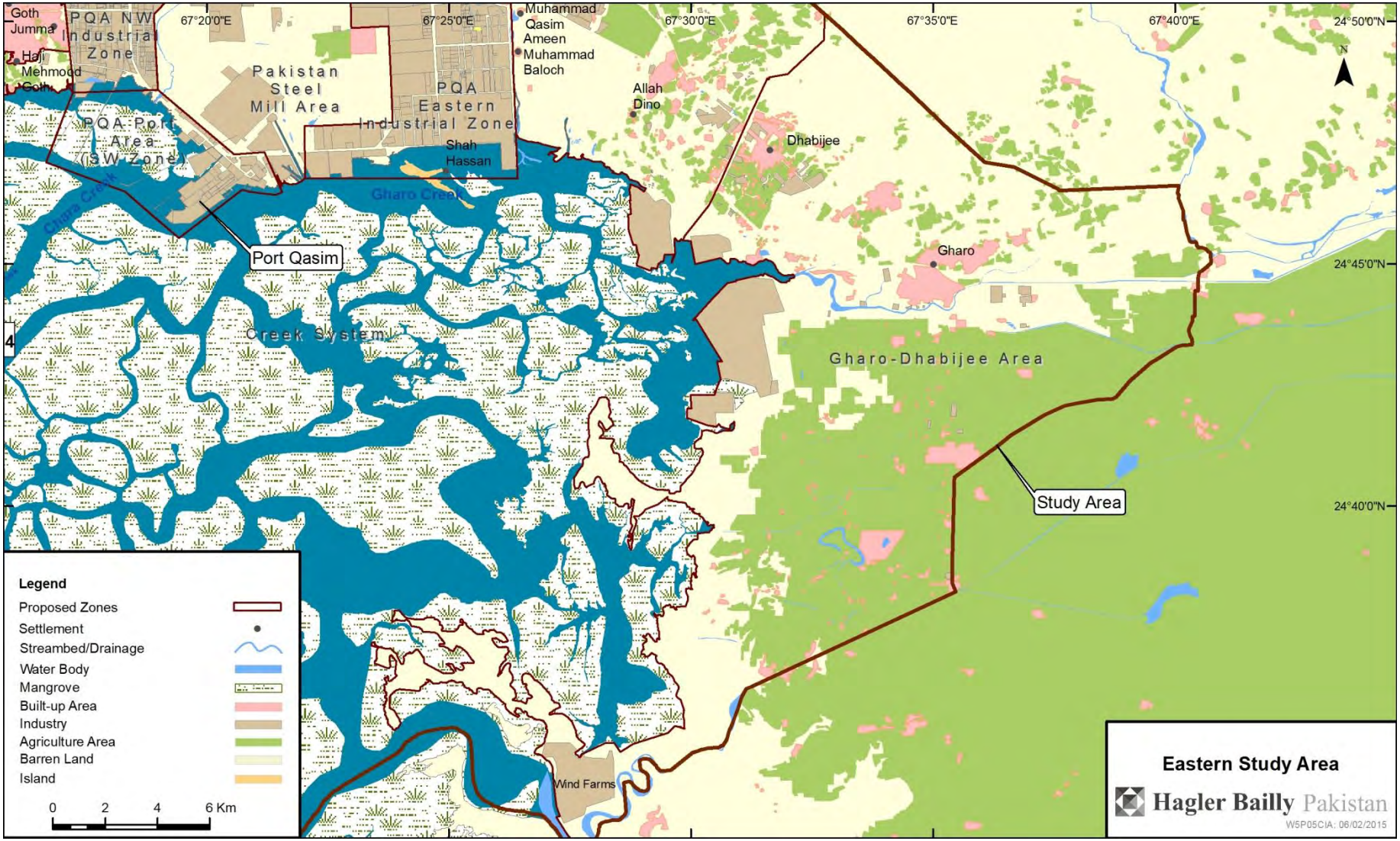


Exhibit 2.5: The Eastern Study Area



3. Stakeholder Consultation

This section describes the stakeholder consultation plan for the ESR and CIA activities.

3.1 Consultation Plan

Consultations will be carried out in two main phases tied in with the CIA and ESR timelines:

- ESR Consultations
- CIA Consultations

The following will be covered for the ESR:

- **ESR Scoping Consultation:** to identify those ecosystems and ecosystem services that the existing and proposed Developments at Port Qasim may impact, and to identify whether the companies' and communities are dependent on these ecosystem services.

  Focus will be on PQA, key industry groups within PQA, fishing communities (including women in fishing communities), and other communities that may be reliant on ecosystem services from the mangrove area.

- **ESR Perceptions and Vulnerability Consultations**: to determine the perceptions of the local communities (particularly fishing communities) on the Developments and ecosystem services identified as part of the scoping consultations, as well as their vulnerability to and dependence on these. Attention will be given to women within the communities as part of these consultations. Separately, a consultation to determine dependence and vulnerability to changes in the ecosystem and ecosystem services for the PQA will be carried out.

  Focus will be on consultations with PQA, local fishing communities and other communities with established reliance on ecosystem services from the mangrove area.

- **ESR Mitigation Consultations**: to determine possible mitigation to impacts of existing and proposed Developments on ecosystem services.

  Focus will be on PQA and scientific institutions (to determine possible mitigation and approach for mitigating impacts) and other institutional stakeholders such as IUCN, WWF, SWD and SFD.

The following consultations will be covered for the CIA:

- **CIA Scoping Consultation**: scoping-level consultation with communities (fishing and non-fishing communities) and institutional stakeholders including the PQA to aid in identification of VECs.

  Focus will be on PQA, key industries within the PQA, communities (including fishing and non-fishing communities)

- **CIA Consultation:** for validation of VECs identified through secondary information; the relative and, to extent possible, absolute importance of VECs; determination of VECs to be assessed further; and their threshold criteria.

  Focus will be on institutional stakeholders for determining threshold criteria.

- **CIA Mitigation Consultation:** to determine possible mitigation for impacts of existing and proposed Developments on identified VECs.

  Focus will be on PQA, communities, and other institutional stakeholders such as IUCN, WWF, SWD and SFD.

Following completion of the CIA and ESR:

- **Feedback Consultation:** specifically with the communities on the proposed mitigation approaches agreed with PQA.

3.2 Consultation Material

The stakeholders will be informed about the development of jetties and other future industrial developments at PQ through distributing background information document (BID). The document will be shared with industrial and institutional stakeholders prior to the consultation, while the document will be shared with the communities during consultation visit. The documents will contain information about the development activities at the Port Qasim and the purpose of the PESR and CIA studies.

The stakeholders will be informed about the stakeholder engagement process.

The BID for the Project is attached as **Appendix B.** The document will be made available to the institutional stakeholders in English and community stakeholders in Urdu[9].

3.3 Consultation Mechanism

The consultation mechanism to engage industrial, institutional and community stakeholders is as follows.

3.3.1 Consultations with Institutional Stakeholders

The identified key industrial and institutional stakeholders (see **Appendix A**) will be informed in advance about the consultations through visits, letters, emails or telephone. During the consultations, HBP's consultation team will present information related to Developments at Port Qasim and the stakeholder engagement process, and respond to and record any comments and queries from the participants. Wherever possible, combined consultations will be held with industrial and institutional stakeholders through representative organizations such that the stakeholders can hear the concerns expressed by others and responses provided if any and make the consultation more interactive.

[9] Urdu is language used for written communication in the communities of interest. Verbal communication will be in Sindhi where it is considered helpful.

3.3.2 Consultations with Communities

The community groups in the surroundings of the Port Qasim that are most likely to be impacted, both negatively and positively, by the future developments will be consulted within their settlements and combined consultation sessions will be arranged. In order to ensure maximum participation, field staff will visit the communities a day or two in advance to inform the residents about the upcoming consultations.

The HBP consultation team, comprising of both male and female consultation specialists will visit these communities to conduct consultations. Separate consultations will be conducted with male and female members of the communities keeping in mind cultural sensitivity within Pakistan and Sindh.

Representatives, notables, educated personnel, government and private employees and other interested groups (on the basis of difference in ethnicities and culture) from the potentially affected communities will be invited. Copies of the BID in Urdu will be provided to the participants.

3.4 Feedback Consultations

Towards the end of the PESR and CIA studies, 'feedback consultations' will be organized and the stakeholders will be informed about the measures that have been proposed to address the issues raised by them in the previous consultation session and conducting cumulative impact assessment for the Developments. This feedback consultation will progress in the following manner:

- The participants will be provided an overview of the ESR and CIA process;
- They will be provided an overview of key issues raised by them and how these have been addressed in the CIA and ESR process;
- The consultation team will answer any queries and record any additional concerns.

3.5 Tentative Schedule

The tentative schedule for the ESR consultations is the second week of June, 2015 and will be completed in about 7-10 days.

The CIA scoping consultation will be carried out in second week of June in conjunction with the ESR consultations. This will be followed by CIA consultation and mitigation consultations in July and August.

Consultations with the institutions and with the communities will be held in parallel by different members of the consultation team.

The feedback consultations will be carried out after completion of the CIA and ESR in August or September.

3.6 Documentation and Reporting

The HBP consultation team will keep a record of all discussions during the consultation meetings. An attendance record will be maintained and photographs will be taken.

HBP will report the meeting minutes in the form of a table logging all stakeholder issues with names of stakeholders and dates of consultations. A template of the consultation log is provided as **Appendix C** of this document.

Appendix A: Initial Stakeholder List and Analysis

In the following pages the

Exhibit A.1: List of Institutional Stakeholders

Stakeholder	*Relevance*	*Relevance Level*	*Consultation Mode*	*Topics for Discussion*
Government Authorities				
Port Qasim Authority	Responsible for Management of Port Qasim	High	Meeting in the offices of the organization	
Sindh Environmental Protection Agency	Regulatory agency for environmental protectionr	High	Meeting in the offices of the organization	
Ministry of Ports and Shipping, Islamabad Represented in Karachi by Office of Ports and Shipping Wing (OPSW)	The Ministry is "the central administrative authority of the Government of Pakistan primarily assigned to facilitate the ports and shipping industry of Pakistan by providing policy guideline to encourage port development and growth in shipping while maintaining safety standards"[10] The relevant functions of OPSW are: ▶ Pollution control from ships in harbor and territorial waters" ▶ Examination of international conventions pertaining to ports and shipping and following ratification of conventions, formulation of maritime laws and regulations for implementation by shipping industry	Medium	Meeting in the offices of the organization	
Mercantile Marine Department	"ensure the safety of life and property at sea and inland waters, safety of navigation and protection of Marine Environment through implementation of Merchant Shipping	High	Meeting in the offices of the organization	

[10] http://www.mops.gov.pk/gop/index.php?q=aHR0cDovLzE5Mi4xNjguNzAuMTM2L21vcHMvLi9mcm1EZXRhaWxzLmFzcHg%2Fb3B0PWJhc2IjJmlkPTE%3D

Stakeholder	*Relevance*	*Relevance Level*	*Consultation Mode*	*Topics for Discussion*
	Ordinance, National Rules and International Maritime Conventions"[11]			
Pakistan Maritime Security Agency	"enforcement of national and international laws, policies and conventions at sea"[12]	Medium	Meeting in the offices of the organization	
Sindh Forest Department (SFD)	Managing, developing and administering the mangrove forests	High	Meeting in the offices of the organization	
Sindh Wildlife Department (SWD)	Managing, developing and administering the wildlife resources in the mangrove forests	High	Meeting in the offices of the organization	
Culture, Tourism and Antiquities Department, Government of Sindh	"protects the historical / heritage buildings through; ensures preservation / conservation of archaeological sites and monuments in addition to their management and upkeep; regulates protection of heritage buildings"[13] Relevant due to presence of archeological sites on island in the creek system	High	Meeting in the offices of the organization	
Karachi Water and Sewerage Board	Water supply and treatment	Medium	Meeting in the offices of the organization	
Non-Governmental Organizations				
International Union for Conservation of Nature (IUCN)	"influence, encourage and assist societies … to conserve the integrity and diversity of nature and to ensure that any use of natural resources is equitable and ecologically sustainable. To ensure sustainable development in Pakistan, IUCN Pakistan aims at: Integration of environment and	High	Meeting in the offices of the organization	

[11] http://mercantilemarine.gov.pk/

[12] http://www.msa.org.pk/His.html

[13] http://web.culture.gos.pk/index.php/about-us/introduction

Stakeholder	*Relevance*	*Relevance Level*	*Consultation Mode*	*Topics for Discussion*
	development; Facilitation for the creation of a supportive policy and legal framework; Support to institutional and human resource development for environment; and Increasing popular support for the environment."[14] Operates "Mangroves for the Future" Project in the Study Area[15]			
Worldwide Fund for Nature (WWF)	"WWF-Pakistan carries out conservation work according to the Global Programme Framework. The Framework includes biodiversity and human footprint meta-goals"[16]. Was involved in mangrove conservation projects in the past currently developing "Design Implementation of Creek Survey and Detailed Creek Survey Manual" for FAO	High	Meeting in the offices of the organization	
Society for Conservation and Protection of Environment (SCOPE)	"protect environment at local, national and global level to implement Agenda21, through advocacy, research, non-political, non-religious and non-racial approach."[17] Have undertaken projects in coastal areas. *Present relevance needs to be investigated*	Low	Meeting in the offices of the organization	
Shehri—Citizens for Better Environment	"research, investigate, compile and disseminate information regarding existing laws, rules and regulations and/or	Medium	Meeting in the offices of the organization	

[14] www.iucn.org/about/union/secretariat/offices/asia/asia_where_work/pakistan/about_iucnp/

[15] http://www.iucn.org/about/union/secretariat/offices/asia/asia_where_work/pakistan/projects/proj_mff/

[16] http://www.wwfpak.org/aboutwwf/

[17] http://www.scope.org.pk/mission.htm

Stakeholder	*Relevance*	*Relevance Level*	*Consultation Mode*	*Topics for Discussion*
	contraventions thereof, or proposed legislation, pertaining to every aspect of the environment" and "create public awareness on issues pertaining to the organization and maintenance of a healthy and secure physical and social environment"[18] The organization has been active in commenting on environmental issues.			
Pakistan Fisher Folk Forum	"a non-governmental organization that works to advance the goal of social, economic, cultural and political rights of small scale indigenous fisher communities in Pakistan"[19]	High	Meeting in the offices of the organization	
Scientific and Research Organizations				
National Institute of Oceanography	Research in oceanography[20]	High	Meeting in the offices of the organization	
Center of Excellence Marine Biology, University of Karachi	Research and education in marine biology[21]	High	Meeting in the offices of the organization	
Industrial Associations				
Landhi Association of Trade and Industry (LATI)	"Jurisdiction of this estate begins from Farooque Textile Mill located at 8000 road to Port Qasim including Export Processing Zone	Medium	Meeting in the offices of the organization	

[18] http://www.shehri.org/about-shehri.html

[19] http://pff.org.pk/node/4

[20] http://www.niopk.gov.pk/homepage.html

[21] http://cemb-ku.edu.pk/about-us/

Stakeholder	*Relevance*	*Relevance Level*	*Consultation Mode*	*Topics for Discussion*
	and all industries located at National Highway to Khagar Phatak"[22] Directly or indirectly the effluent from the estate is discharged to the creek system[23]			
Korangi Association of Trade and Industry (KATI)	Represents the 4,500 industrial and commercial units in Korangi[24]	Medium	Meeting in the offices of the organization	

[22] http://landhi.org/aboutus/history.php

[23] According to the association website, there are 1,200 plots in the estate. It has a water supply of 35 million gallons per day (mgpd) representing a shortfall of 65 mgpd. Assuming that the shortfall is met by other means, the estate would be discharging at least 50 mgpd of effluent.

[24] http://www.kati.pk/about.php

Exhibit A.2: List of Community Stakeholders

Community	*Size*	*Type*	*Zone and Location*
Ameen Muhammad Baloch	Small	Non-Fishing	Non-Fishing Community—Northeast
Goth Mayo	Small	Fishing	Non-Fishing Community—Northeast
Haji Ghulam Muhammad	Medium	Non-Fishing	Non-Fishing Community—Northeast
Haji Ibrahim	Medium	Non-Fishing	Non-Fishing Community—Northeast
Haji Jhangi Khan	Medium	Non-Fishing	Non-Fishing Community—Northeast
Haji Khan Zohrani	Medium	Non-Fishing	Non-Fishing Community—Northeast
Humar Khan	Medium	Non-Fishing	Non-Fishing Community—Northeast
Mir Khan Baloch	Small	Non-Fishing	Non-Fishing Community—Northeast
Muhammad Qasim	Small	Non-Fishing	Non-Fishing Community—Northeast
Natho Tando Khoso	Medium	Non-Fishing	Non-Fishing Community—Northeast
Pir Bux	Small	Non-Fishing	Non-Fishing Community—Northeast
Morand Khan Qaiserani	Medium	Non-Fishing	Non-Fishing Community—Northeast
Soomar Jokhio	Medium	Non-Fishing	Non-Fishing Community—Northeast
Allah Dino	Small	Non-Fishing	Gharo-Dhabeji Area
Ghulam Mohd Khaskheli	Small	Non-Fishing	Gharo-Dhabeji Area
Goth Hashim Mirbar	Small	Fishing	Gharo-Dhabeji Area
Goth Ismail Katiyar	Small	Fishing	Gharo-Dhabeji Area
Goth Karam Ali Baloch	Small	Fishing	Gharo-Dhabeji Area
Goth Khuda Ali Dino Sheikh	Small	Fishing	Gharo-Dhabeji Area
Ali M Brohi Goth	Medium	Fishing	Fishing Communities—West (South of Korangi)
Ali Mohd Khashkheli Goth	Medium	Fishing	Fishing Communities—West (South of Korangi)

Community	*Size*	*Type*	*Zone and Location*
Bangalies	Medium	Fishing	Fishing Communities—West (South of Korangi)
Charan Para	Medium	Fishing	Fishing Communities—West (South of Korangi)
Chashma Goth	Medium	Fishing	Fishing Communities—West (South of Korangi)
Goth Ibrahim Hyderi	Large	Fishing	Fishing Communities—West (South of Korangi)
Juma Goth	Medium	Fishing	Fishing Communities—West (South of Korangi)
Bakhtawar Goth	Large	Fishing	Fishing Communities—East (South of Landhi)
Bhains Colony	Large	Non-Fishing	Fishing Communities—East (South of Landhi)
Haji Mehmood Goth	Medium	Fishing	Fishing Communities—East (South of Landhi)
Latt Basti	Large	Fishing	Fishing Communities—East (South of Landhi)
Rehri Goth	Large	Fishing	Fishing Communities—East (South of Landhi)
Abdullah Goth	Medium	Non-Fishing	Non-Fishing Community—Northwest
Goth Shafi Muhamad	Medium	Non-Fishing	Non-Fishing Community—Northwest
Pipri	Large	Non-Fishing	Non-Fishing Community—Northwest
Razzaqabad	Medium	Non-Fishing	Non-Fishing Community—Northwest
Saleh Muhammad	Medium	Non-Fishing	Non-Fishing Community—Northwest
Yousaf Goth	Medium	Non-Fishing	Non-Fishing Community—Northwest
Shah Latif Town	Planned Township	Non-Fishing	Planned Housing Schemes
Gulshan-e-Hadeed	Planned Township	Non-Fishing	Planned Housing Schemes
Nashtar Abad	Planned Township	Non-Fishing	Planned Housing Schemes
Pakistan Steel Town	Planned Township	Non-Fishing	Planned Housing Schemes
Railway Colony	Planned Township	Non-Fishing	Planned Housing Schemes

Notes: Community sizes are classified as follows: Small (Population < 500); Medium (Population 500-5,000); Large (Population > 5,000)

Exhibit A.3: List of Industrial Stakeholders in PQA Zones

Sector	*Industry Unit*	*Zone*	*Consultation Mode*	*Status (Where Know)*
Food	Edible Oil Refinery	Eastern Zone	Workshop	
Hydrocarbon processing	TransAsia Refinery Limited	Eastern Zone	Meeting	Land prepared, installation of machinery on hold
	Sabirs Feeds	Eastern Zone	Workshop	
	P & G Laundary Plant	Eastern Zone	Workshop	
Food	Kausar Ghee Mill	Eastern Zone	Workshop	
	Exide Sulfuric Acid Plant	Eastern Zone	Workshop	
Food	Wali Oil Mill Ltd.	Eastern Zone	Workshop	
Food	Sabirs Egg Hatchery	Eastern Zone	Workshop	
Food	Rasul Floor Mills	Eastern Zone	Workshop	
	Northwest Mineral	Eastern Zone	Workshop	
	Textile Institute of Pakistan	Eastern Zone	Meeting	Operational
Fertilizer & Chemical	Fauji Fertilizer Bin Qasim Limited	Eastern Zone	Meeting	Operational
	ASG Metals Ltd.	Eastern Zone	Workshop	
	Linde Pakistan Limited	Eastern Zone		Operational
	Lotte Pakistan Limited	Eastern Zone		Operational
Fertilizer & Chemical	Engro Polymer & Chemicals Limited	Eastern Zone		Operational
Fertilizer & Chemical	Engro Zarkhez	Eastern Zone		Operational
	Geolinks Incineration Plant	Eastern Zone	Workshop	
Power	PQEPC Power Plant	Eastern Zone		Proposed
Power	225 MW RLNG CCPP	Eastern Zone		Proposed
	Textile City	Eastern Zone		
Power	K-electric Thermal Power Plant (Formerly KESC)	Steel Mills	Meeting	Operational
	Skill gas Pvt Ltd.	NW Zone	Workshop	

Sector	*Industry Unit*	*Zone*	*Consultation Mode*	*Status (Where Know)*
	Total Oils Pakistan (Blending Plant)	NW Zone	Workshop	
Car manufacturing	Indus Motors Company Ltd.	NW Zone	Meeting	Operational
	Auvitronics Ltd. (PQA)	NW Zone		
	Agha Steel Industry	NW Zone		
	Master Agro Plant	NW Zone		
	Rehmpack Pvt Limited	NW Zone		
	Pakistan International Bulk Terminal			
	Tri pack Films ltd.	NW Zone		
	Faisalabad Oil Refinery	NW Zone		
	Platinum Pharmaceuticals (Pvt.) Ltd.	NW Zone		
	Ali Danyal Industries Pvt Limited	NW Zone		
	Procon Engineering (Pvt) Ltd.	NW Zone		
	Karachi Grains Pvt Ltd	NW Zone		
	Master Motor Corporation Ltd	NW Zone		
	Ari Pvt Ltd.	NW Zone		
	Astro Plastics (PVT.) LTD.	NW Zone		
	Barki Enterprises Oil Refinary	NW Zone		
	Bin Qasim Packages(PVT.) Ltd.	NW Zone		
	Denim International 2	NW Zone		
	Fine Gas Company Ltd.	NW Zone		
	Garibsons (PVT) LTD.	NW Zone		
	Gamalux OleoChemicals	NW Zone		
	Ghandara Nissan Ltd.	NW Zone		
	National Foods Plant	NW Zone		
	Nestle Water Plant	NW Zone		

Sector	*Industry Unit*	*Zone*	*Consultation Mode*	*Status (Where Know)*
	Novins International	NW Zone		
	Pak Petrochemicals Industries (PVT) LTD.	NW Zone		
	PharmEvo (PVT) LTD.	NW Zone		
	Prime Liquid Emulsion Industries	NW Zone		
	PSL-2	NW Zone		
	Tuwairqi Steel Mills	Pakistan Steel Mill	Meeting	
	Pak Suzuki Motor			
	Aisha Steel Mills	Pakistan Steel Mill		
	Pakistan Steel Mill	Pakistan Steel Mill	Meeting	
	Qasim International Container Terminal	SW Zone		
	Engro Vopak Terminal	SW Zone		
	IFFCO Pakistan	SW Zone		
	Mapak Edible Oil Refinery	SW Zone		
	FOTCO Oil Terminal	SW Zone		
	Gasport LNG Floating Terminal	SW Zone		
	Fauji Akbar Portia Marine Terminal PQ	SW Zone	Meeting	

Appendix B: Background Information Document

See following pages.

June 2015

Background Information Document on Ecosystem Service Review and Cumulative Impact Assessment for Port Qasim, Pakistan

Introduction

The International Finance Corporation (IFC), the private sector arm of the World Bank Group (WBG), plans to invest in a liquefied natural gas (LNG) terminal 'Elengy Terminal Project' at Port Qasim in Karachi, Pakistan. Port Qasim was established in early 1980s as an alternate deep sea port to Karachi Port with the added feature of an associated industrial area.

The present port facilities at Port Qasim include, among others, fifteen berths and jetties for handling iron ore, coal, chemicals, liquefied natural gas (LNG), crude oil, liquefied petroleum gas (LPG), grain, fertilizer, liquid cargo, and bulk containers. The port and associated industrial area covers 4,856 hectares of which nearly 40% is currently either occupied or industrial units are being constructed on it. Currently, 273 projects are operational and another 233 are under construction.[1]

Port Qasim Authority (PQA), the federal government agency mandated to manage port and associated industrial developments, has plans to develop the port further by acquiring additional land and providing incentives to the private sector to develop new jetties and industrial units.

IFC has invested in three terminals in PQA and it may invest in other projects planned by PQA. Recognizing that environmental and social impacts from existing developments combined with the potential incremental impacts resulting from proposed future developments, may result in significant cumulative impacts that would not be expected in the case of a stand-alone development, IFC has acquired the services of Hagler Bailly Pakistan (Pvt) Ltd (HBP) to conduct an ecosystem service review (ESR) and a cumulative impact assessment (CIA) for the existing and planned developments at Port Qasim.

Port Qasim

Port Qasim is built along a navigable creek, 15 km from the coast. The creek area forms part of Indus River Delta (**Exhibit A**). Port Qasim was constructed in 1970s and presently has more than a dozen terminals for bulk cargo, cargo containers, liquid, oil, coke, chemicals, liquefied petroleum gas and compressed natural gas (**Exhibit B**). On average it presently handles about 1,150 vessels annually from which about 25 million

[1] Information on Port Qasim has been obtained from the following sources: 1) Engineering Consultants International (Pvt.) Ltd., *Strategic Planning Study for Port Qasim*, June 2001. 2) Presentation given to IFC Delegation and HBP by Port Qasim Authority, June 2015.

tonnes of cargo are imported or exported. An industrial zone is associated with the port. There are several large industrial units operational in the area including steel mills, fertilizer plant, chemical plants, and power plants.

There are plans to expand the port facilities to accommodate larger vessels as well as to increase the cargo handling capacity of the port. This entails deepening of navigation channel, and construction of new terminals.

Although all the available plots in the industrial zone have been acquired by various investors, more than half of the plots are still vacant. Major industrial installations which are either planned or under-construction in Port Qasim include industrial jetties, coal and gas-fired power plants, and an oil refinery.

Environmental Significance of the Port Qasim Area

The Indus River delta covers an area of about 6,000 square kilometers and is characterized by 16 major creeks and a large number of minor creeks. The coastal morphology is characterized by a network of tidal creeks, number of small islands, mangrove vegetation, mud flats, and lagoons formed because of changes in river courses. Port Qasim lies on the northwestern fringe of the Indus Delta. The major creeks in the area are the Korangi Creek, Gharo Creek, Kadiro Creek and the Phitti Creek. The navigational channel of Port Bin Qasim is in the Phitti Creek whereas the port itself is located on confluence of Phitti Creek with the Gharo Creek.

The mangroves are the most significant feature of the Indus Delta. The mangroves have high biological productivity and consequently are important for the nutrient balance of coastal waters. They export organic matter, mainly in detritus form (leaf litter) to the marine environment, thus providing a highly nutritious food source. The mangroves are also important to offshore fishery as they act as nurseries and shelters for many species of commercially important finfish and crustaceans. In addition to supporting fishery, mangroves act as a natural barrier to shoreline erosion. This is achieved through the binding and stabilization of soil by plant roots and deposited vegetative matter, the dissipation of erosion forces such as wave and wind energy, and the trapping of sediments.

The natural meandering of the Indus River, spread over centuries, changes the availability of freshwater in various part of the Indus Delta. This consequently also affects the density of mangroves. However, destabilization of mangroves in the Indus Delta has been attributed mainly to the progressive reduction in freshwater discharge over a period of many decades. It may be noted that the current course of the Indus River is more than 60 kilometers to the southeast of the Port Qasim and there are other minor sources of freshwater in the Port Qasim Area. However, the dependence of the mangroves in the Port Qasim area to the various sources of water is not fully understood.

Other reported stresses on the mangrove ecosystem in the area are:

1. Overgrazing particularly browsing by camels resulting in destruction of mangrove tree canopy
2. Excessive cutting of trees for fuel wood by the communities
3. Discharge of wastewater into the coastal water. The main sources include:

a. Sewerage from Karachi city through the Malir River into the western part of creek system[2]
b. Industrial wastewater from Port Qasim, Korangi and Landhi industrial areas. The discharge from some of the large industrial units is treated, however, the smaller units do not have treatment plants and in the absence of any combined treatment plant the effluent eventually finds its way to the sea.
c. Discharges and spills from shipping vessels and the port
d. Biological waste from the coastal communities including waste from Korangi fish harbor, sewerage from fishing villages and waste from cattle farms to the west of PQA.

4. Over-fishing in the coastal areas

Ecosystem Services

Ecosystem services are the many benefits—large and small, direct and indirect—that ecosystems provide to people. These consist of all the natural products and processes that contribute to human well-being, as well as the personal and social enjoyment derived from nature. For example, forests provide wood products and a host of non-timber products and act as a venue for recreation and spiritual renewal; they also help to mitigate climate change by sequestering carbon. Wetlands absorb pollutants, purify water, and help reduce floods.

Priority Ecosystem Services

Priority ecosystem services are those ecosystem services on which project operations,

- are most likely to have an impact and, therefore, which result in adverse impact to Affected Communities; and/or
- those services on which the project is directly dependent for its operations (e.g., water).

Priority ecosystem services are identified using a systematic review and prioritization.

Source: IFC Performance Standards and Guidance Notes

Objective and Methodology

There is little understanding of the ecosystem services that may be impacted and cumulative environmental and social impact of the existing projects and planned future developments. The developments may result in significant cumulative impacts that would not be expected in the case of a stand-alone development and hence are unlikely to be captured in environmental assessment studies of individual projects.

This study is commissioned by the IFC to develop an understanding of the ecosystem services that may be affected and cumulative impacts of future investments in Port Qasim.

IFC would like conduct an ecosystem service review (ESR) and a cumulative impact assessment (CIA) for the current and planned operations at Port Qasim, prepared according to local regulatory requirements, IFC Performance Standards, applicable World Bank Group Environment Health and Safety (EHS) Guidelines and following the

[2] According to Karachi Water and Sewerage Board (http://www.kwsb.gos.pk/View.aspx?Page=26, accessed April 16, 2015) Karachi generates 402 million gallons per day (mgd) of sewerage. Of this about 90 mgd is treated whereas the remaining 312 mgd untreated waste is discharged to the sea through Malir and Lyari Rivers.

requirements of IFC Guidance Notes, especially Guidance Notes 4 and 6, and *IFC Good Practice Handbook Cumulative Impact Assessment and Management: Guidance for the Private Sector in Emerging Markets, 2013* (**CIAGPH**).

The following are the key objectives of the study:

1. Identify and prioritize the ecosystem services that may be impacted by the developments under the control of the Port Qasim Authority, or that the Port Qasim Authority depends on.
2. Evaluate the degree of dependence of the PQA, developers within the PQA industrial areas, as well as vulnerable communities, on these ecosystem services.

Cumulative Impacts

Cumulative impacts are those that result from the successive, incremental, and/or combined effects of an action, project, or activity (collectively referred to in this document as "developments") when added to other existing, planned, and/or reasonably anticipated future ones. For practical reasons, the identification and management of cumulative impacts are limited to those effects generally recognized as important on the basis of scientific concerns and/or concerns of affected communities.

Valued Environmental and Social Components (VECs)

Because it is unrealistic to think that every environmental and social aspect that can be subject to cumulative impacts can be appropriately factored into a CIA, it is good practice to focus the assessment and management strategies on Valued Environmental and Social Components (VECs). VECs are environmental and social attributes that are considered to be important in assessing risks; they may be:

- physical features, habitats, wildlife populations (e.g., biodiversity),
- ecosystem services,
- natural processes (e.g., water and nutrient cycles, microclimate),
- social conditions (e.g., health, economics), or
- cultural aspects (e.g., traditional spiritual ceremonies).

While VECs may be directly or indirectly affected by a specific development, they often are also affected by the cumulative effects of several developments. VECs are the ultimate recipient of impacts because they tend to be at the ends of ecological pathways.

Source: IFC Good Practice Handbook on Cumulative Impacts

3. Establish a management strategy to address affected priority ecosystem services.
4. Identify and prioritize the Valued and Environmental and Social Components (VECs) to address in the Cumulative Impact Assessment.
5. Determine and predict the impact on valued environmental and social components (VECs) due to proposed developments and external drivers consisting of other developments activities and natural environmental and social factors;
6. Establish a mitigation measures as part of a management strategy to address impacts on VECs.

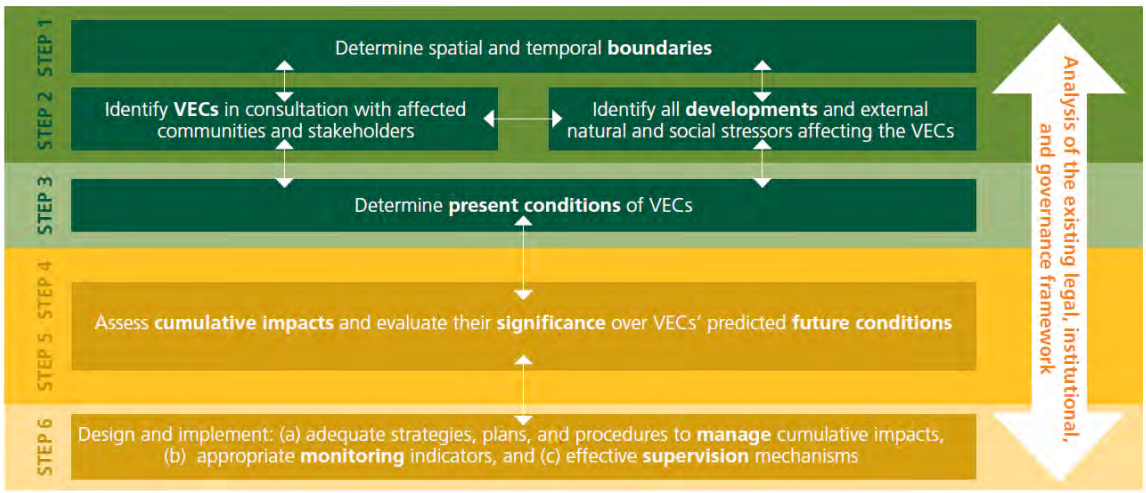
The ecosystem service review and cumulative impact assessment will be carried out in the broad steps as outlined on the following page.

An over-arching theme of the study will be to ensure that the concerns of all stakeholders—the potentially affected communities, regulatory agencies, relevant government departments, industries, businesses, and the relevant non-governmental organizations—are identified, recorded, documented, and addressed in the ESR and the CIA.

Steps in ESR Study

Step 1:	Identification of ecosystem services that PQ developments will impact
Step 2:	Assessment of communities' and companies' dependence on Ecosystem Services
Step 3:	Assessment of potential impacts to ecosystem services
Step 4:	Identification of Priority Ecosystem Services on the basis of impact and dependence
Step 5:	Identification of management actions where possible to mitigate for their loss

Steps in CIA Study



Consultations

In the first phase, HBP is conducting consultations with the stakeholders to identify those ecosystems, ecosystem services, that the proposed developments at Port Qasim may impact, prioritizing these ecosystem services, and to assess the companies' and communities' dependence on ecosystem services and management options for these. Within the first phase Valued Environmental and Social Components (VECs) will also be identified as part of the CIA.

In the second phase, additional consultations will be carried out to determine those VECs that should be prioritized and assessed further, establish thresholds for the VEC and determine viable mitigation of impacts on VECs.

In later stages, feedback consultations will be held to inform the stakeholders about the results of the studies and the recommendations for corrective actions to address their

concerns and to mitigate the impacts associated with the existing and proposed developments.

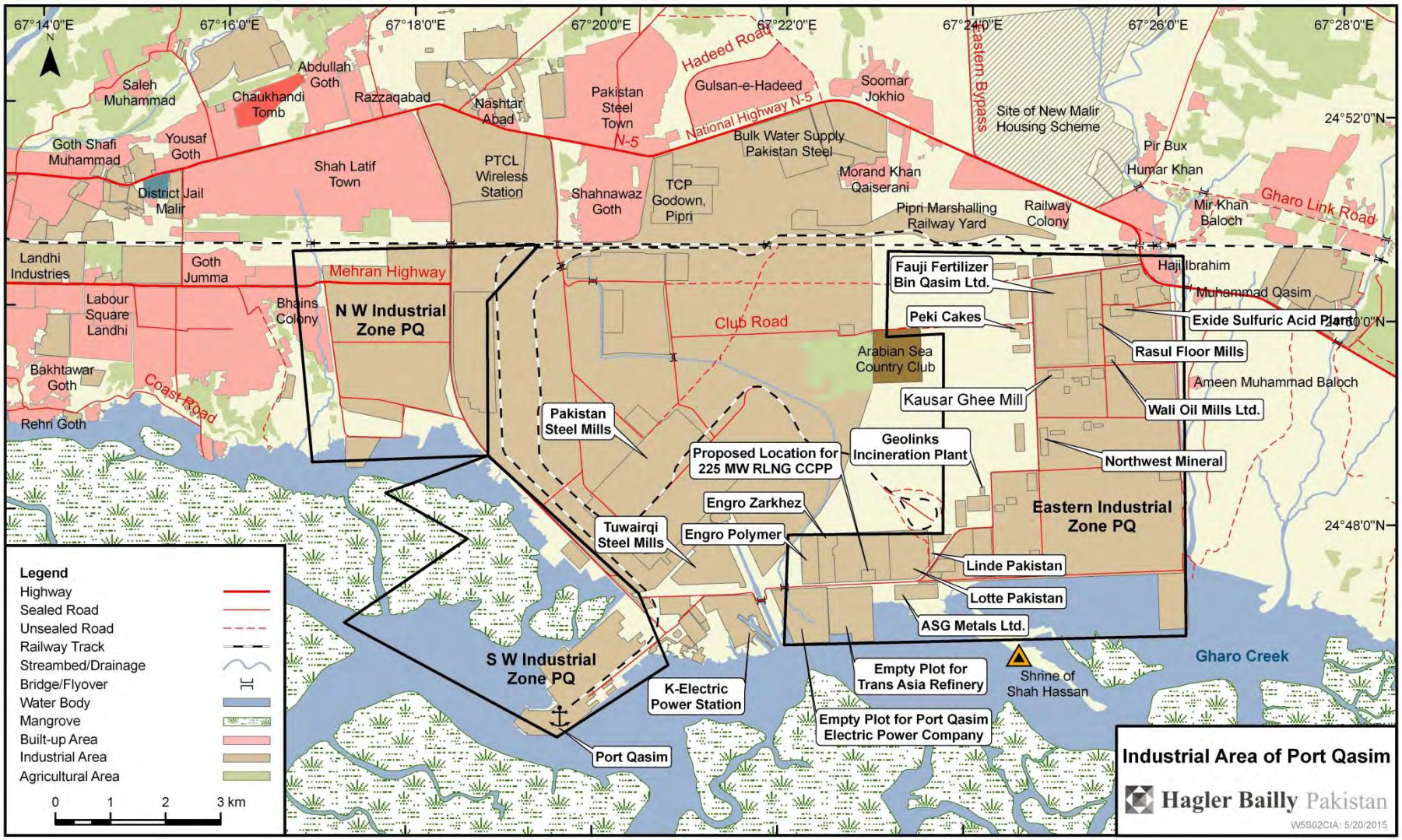
Contacts for Further Information

Should you have any questions or concerns that you would like to share with HBP or IFC at any point in relation to this study, please contact Mr. Bilal Khan at 0345 8888 987, bkhan@haglerbailly.com.pk, or Mr Hidayat Hasan at 051-261 0200 or hhasan@haglerbailly.com.pk.

Exhibit A: Project Setting



Exhibit B: Port Qasim Industrial Area



Appendix C: Consultation Log Template

ESR and CIA for Port Qasim

Record of the Consultation Meeting

Stakeholder/s:	
Consultation	PESR Scoping, PESR Perceptions and Vulnerability, PESR Mitigation CIA Scoping, CIA Consultation, CIA Mitigation Consultation
Date:	
Time:	
Meeting Venue:	
Attended by:	
Contact details of Attendees:	
Conducted by:	
Recorded by:	
Language:	
Preamble:	

No.	*Issues Raised*	*By*	*Response Provided*

Other Comments:

D.2 Records of Community Consultations

See following pages.

ESR and CEA for Port Qasim

Male

Stakeholder/s:	Goth Ibrahim Hyderi	
Consultation:	ESR Scoping (Identification of Ecosystem Services) ESR Perceptions and Vulnerability CIA Scoping (Identification of Possible VECs, Issues, etc.)	
Date:	June 10, 2015	
Time:	11:45 am	
Meeting Venue:	Goth Ibrahim Hyderi: Muhammad's Office (fishermen and owner of a local petrol depot)	
Coordinates:	N 24° 47' 39.4", E 67° 08' 29.7"	
Key Respondents:	Name	Contact Number
	Abbas Ali	0324 328 7537
	Maimand Lakhia	0321 854 8285
	Khamma	0333 208 6277
	Hussain	–
	Mehran Shah	0311 065 642
	Ahmed Phoolani	0322 259 9547
HBP Consultation Team:	Hidayat Hasan Hussain Ali M Salman Ahmed Waris Ali	
Conducted by:	Hidayat Hasan	
Recorded by:	M Salman Ahmed	
Language:	Urdu	
Preamble:	The discussion started with an introduction of the consultation team members. The community was briefed about the purpose of the meeting by providing a brief information to the attendees about the ESR and CIA studies. A comprehensive picture of the current and proposed developments at Port Qasim and briefed about the future plans of IFC for developing jetties at Port Qasim was given. At the end of the informative session, the attendees were invited to share their comments and concerns about the current and future developments at Port Qasim and provide their overview about ecosystem services (particularly those offered by their neighboring creek system) and their dependence on these ecosystem services. The consultation also focused on; identifying possible Valued Environmental and Social Components, as well as identifying any key perceptions, vulnerability and issues of these communities. The meeting minutes are documented below to provide the record.	

1. Ecosystem Services and Percentage of Community Dependent on Ecosystem Services

Ecosystem Service	*Description of Specific Service and Notes*	*Reported Percentage of Community Dependent on Ecosystem Services*
Food from crops, livestock, capture fisheries, aquaculture, and wild foods	Fish serve as food and a source of livelihood from mangrove areas including creeks within the PQ notified area. The settlement mostly is a home to small scale fishermen. Therefore, they are more reliant on creeks for fishing rather than open seas. Due to their total reliance on fishing as the source of income, the fishing communities' fish round the year.	80
Habitat	Mangroves of PQ area creeks offering ideal habitat to fish fry to reach maturity.	>70
Biological raw materials from timber and other wood products, fibers and resins, animal skins, sand, and ornamental resources	Mangrove forest serving as the main source of fuel wood	25
Food from crops, livestock, capture fisheries, aquaculture, and wild foods	Local communities extract fodder for livestock from mangrove areas	20
Food from crops, livestock, capture fisheries, aquaculture, and wild foods	Food from honey production	1
Regulation of natural hazards	Protection against strong currents and floods	100

Alternative means of livelihood

Along with fishing, the respondents from the community identified net weaving, fish and shrimps processing and daily wage labor as the alternate resource of livelihood.

2. Possible Valued Environmental and Social Components (VECs) based on discussions:

- **Marine ecosystem:** offering the only source of livelihood for the local fishermen by proffering fish. The large boat owning fishermen sail to deep sea to catch fish. Whereas, small fishermen mostly rely on the fish near the shoreline.
- **Mangrove ecosystem**: the fish from the deep sea lays eggs near the shoreline. The fish frys rely on during their maturity period. The mangrove ecosystem provides essential nutrients for the fish fry to mature.
- **Fresh Water**: as an identified VEC, holds major significance in determining the health of marine and mangrove ecosystems. The quality and quantity of fish greatly depends upon the water quality of the creeks (Korangi and Phitti Creeks).

3. Key Issues Identified and Perception	
The summary of issues raised by the key respondents from the community related to the ecosystem services and the impact of current developments of Port Qasim on the ecosystem services is provided below:	
1	**Access issues due to location of Port Qasim:** The existing jetties and their associated shipping lanes in Port Qasim Area (PQA) have adversely affected the fishing business by restricting the movement of the small fishermen. The small fishermen are now forced to fish near the shoreline. Shoreline only offers small fish catch with no such significant economic value. These access issues are existing since the development of the first jetty at Port Qasim, which is dated back to 1972. Due to restricted access, the small and medium scale fishermen, who used to fish near and around the existing PQA before its development are now forced to sail to deep sea for fishing. This has increased their fishing cost reducing their profit margins. Therefore, small and medium fishermen have been marginalized and their livelihood is compromised.
2	**Issues related to discharge of Karachi City Liquid Waste:** The liquid effluents from Karachi city, through Malir nullah are discharged into the Korangi Creek near the shoreline of Goth Ibrahim Hyderi. This discharge of liquid waste has resulted in degradation of existing water quality. The fish is mostly found in clean and healthy sea water. Due to the discharge of the waste water into the creek, the quality and quantity of fish has been reduced to an alarming level adversely impacting the fishing business.
3	**Deterioration in fish quantity due to excessive fishing:** There is no data available on the existing fish population and its quality in the Arabian Sea near the shores of Pakistan. The number of fishermen has considerably increased over the last couple of decades. The fishermen do not know about the fish population on which they rely. Therefore, they are fishing blind in the sea without knowing the optimum catch which should be obtained in order to maintain the ecological balance of the marine ecosystem and providing opportunity to fish to repopulate at the pace greater and if not greater equal to the fish catching practices. This increased and blind fishing has overburdened the marine ecosystem, exhausting its ecosystem service of proffering fish as livelihood, causing a decline in the fish population of Korangi and Phitti Creeks.
4	**Issues related to role of fishermen rights organizations:** There are two organizations (Fishermen Cooperative Society 'FCS' and Pakistan Fishermen folk Forum 'PFF') active in protecting rights of local fishermen and help fishing communities gaining the political and socioeconomic justice. The key respondents from the community termed both these as 'Dummy Organization; which are only active in protecting rights of large scale fishermen. These organizations have never raised a voice in protecting rights of the local fishermen, subsidize fishing business or raise issues of small scale fishermen at political forums. The FCS also played its role as "middle man' earning their share while sale of fish in both local and international markets. In addition, fishermen supported by the members of these organizations practice illegal fishing activities including use of very small sized fishing net (*Bulla Gujja*) and enter deep seas for fishing during prohibited months.

Female

Stakeholder/s:	Ibrahim Hyderi	
Consultation	PESR Scoping, PESR Perceptions and Vulnerability and CIA Scoping	
Date:	June 10, 2015	
Time:	12:00 pm	
Meeting Venue:	Goth Ibrahim Hyderi: Naseema Gabol's residence (Social worker and member of Pakistan Fishermen folk Forum)	
Key Respondents	Name	Contact Number
	Naseema Gabol Marium Nosheen Hajraan	
HBP Consultation Team	Dr Anne Sweetser Sadia Khalid	
Conducted by:	Sadia Khalid	
Recorded by:	Dr Anne Sweetser Sadia Khalid	
Language:	Urdu, Sindhi	
Preamble:	The discussion started with an introduction of the consultation team members. The community was briefed about the purpose of the meeting by providing a brief information to the attendees about the ESR and CIA studies. A comprehensive picture of the current and proposed developments at Port Qasim and briefed about the future plans of IFC for developing jetties at Port Qasim was given. At the end of the informative session, the attendees were invited to share their comments and concerns about the current and future developments at Port Qasim and provide their overview about ecosystem services (particularly those offered by their neighboring creek system) and their dependence on these ecosystem services. The consultation also focused on; identifying possible Valued Environmental and Social Components, as well as identifying any key perceptions, vulnerability and issues of these communities. The meeting minutes are documented below to provide the record.	

1. Ecosystem Services and Percentage of Community Dependent on Ecosystem Services

Ecosystem Service	*Description of Specific Service and Notes*	*Reported Percentage of Community Dependent on Ecosystem Services*

Alternative means of livelihood

Approximately 30% of women from community work as housemaids in urban areas of Karachi. 10% women work as daily wagers in fish cleaning units in the local area. There are 6 midwives who are not professionally trained but are practicing midwifery.

2. Possible Valued Environmental and Social Components (VECs) based on discussions:

3. Key Issues Identified and Perception

The summary of issues raised by the key respondents from the community related to the ecosystem services and the impact of current developments of Port Qasim on the ecosystem services is provided below:

1	**Issues due to lack of alternate economic resources:** The community is mostly dependent upon fishing due to unavailability of other resources for men and the role of women in fishing activities is limited. The over-fishing has caused the decrease in quality and quantity of good catch; therefore a few families have switched to alternate modes of livelihood. Mostly, women in the family go to other communities and work as housemaid. There was also a garment factory (MASC0) in the community where 50% of women used to work and helped their family, but later, the factory went on fire and was closed two years ago, which caused more joblessness..
2	**Issues due to use of Bulla Gujja:** Bulla Gujja is a very fine net that catches even the fish' eggs. The use of this net has really disturbed the ecosystem and everyone complains about the illegal use of this net.
3	**Issues due to cutting of mangroves:** Mangroves are decreasing in number because of illegal cutting by the locals. They use it as fuel and also as fodder for livestock. According to the key respondent, the cattle give more milk if they are given mangrove fodder.
4	**Issues due to absence of drinking water:** Drinking water is one of the main issues of the community. There is no water supply through municipality and each family collects for days in order to buy water which costs 3000 rupees and this water lasts for 8 to 12 days only.
5	**Issues due to absence of basic health facilities:** Females and children suffer due to the absence of proper health services in the village. They have to go to the other localities in order to get treated in case of emergency after being ill-treated by the local doctors. Quackery is also very common in the village. Problems of allergies and joint pains have been reported.

4. Ecosystem service and its vulnerability status (based on Diversity of Income, Education, Health, Assets, Access to Alternative Sources of Income and Issues Raised by the Community).

Ecosystem service	*Vulnerability*
Food from crops, livestock, capture fisheries, aquaculture, and wild foods	High
Habitat	High
Biological raw materials from timber and other wood products, fibers and resins, animal skins, sand, and ornamental resources	Low
Regulation of natural hazards	Low

ESR and CEA for Port Qasim

Male

Stakeholder/s:	Latt Basti	
Consultation:	ESR Scoping (Identification of Ecosystem Services) ESR Perceptions and Vulnerability CIA Scoping (Identification of Possible VECs, Issues, etc)	
Date:	June 10, 2015	
Time:	14:30 pm	
Meeting Venue:	Latt Basti: Residence of Mohd Umar Jat (Ex-Nazim) and Yard of local fishermen	
Coordinates:	N 24° 48' 42.9" E 67° 15' 46.8"	
Key Respondents:	Name	Contact Number
	Mohd Umar Jat Sikandar Ali Jat Ghulam Mustafa Umar Jat	0321 242 0442 0306 265 5539 0300 250 5539 0333 305 4636
HBP Consultation Team:	Hidayat Hasan Hussain Ali M Salman Ahmed Waris Ali	
Conducted by:	Hidayat Hasan	
Recorded by:	M Salman Ahmed	
Language:	Urdu	
Preamble:	The discussion started with an introduction of the consultation team members. The community was briefed about the purpose of the meeting by providing a brief information to the attendees about the ESR and CIA studies. A comprehensive picture of the current and proposed developments at Port Qasim and briefed about the future plans of IFC for developing jetties at Port Qasim was given. At the end of the informative session, the attendees were invited to share their comments and concerns about the current and future developments at Port Qasim and provide their overview about ecosystem services (particularly those offered by their neighboring creek system) and their dependence on these ecosystem services. The consultation also focused on; identifying possible Valued Environmental and Social Components, as well as identifying any key perceptions, vulnerability and issues of these communities. The meeting minutes are documented below to provide the record.	

1. Ecosystem Services and Percentage of Community Dependent on Ecosystem Services

Ecosystem Service	*Description of Specific Service and Notes*	*Reported Percentage of Community Dependent on Ecosystem Services*
Food from crops, livestock, capture fisheries, aquaculture, and wild foods	Fish serve as food and a source of livelihood from mangrove areas including creeks within the PQ notified area. The settlement mostly is a home to small scale fishermen. Therefore, they are more reliant on creeks for fishing rather than open seas. Due to their total reliance on fishing as the source of income, the fishing communities catch fish round the year.	90
Habitat	Mangroves offering ideal habitat to fish fry to reach maturity.	>70
Biological raw materials from timber and other wood products, fibers and resins, animal skins, sand, and ornamental resources	Mangrove forest serving as the main source of fuel wood	25
Food from crops, livestock, capture fisheries, aquaculture, and wild foods	Local communities extract fodder for livestock from mangrove areas	20
Food from crops, livestock, capture fisheries, aquaculture, and wild foods	Food from honey production	1
Regulation of natural hazards	Protection against strong currents and floods	100
Regulation of nutrient cycling	Mangrove ecosystem contributes to nutrient cycling in marine ecosystem	>60

Alternative means of livelihood

Along with fishing, the respondents from the community identified net weaving and daily wage labor as the alternate resource of livelihood.

2. Possible Valued Environmental and Social Components (VECs) based on discussions:

- **Marine ecosystem:** offers the only source of livelihood for the local fishermen by proffering fish. The large boat owning fishermen sail to deep sea to catch fish. Whereas, small fishermen mostly rely on the fish near the shoreline.
- **Mangrove ecosystem:** The fish from the deep sea lays eggs near the shoreline. The fish frys rely on mangrove ecosystem during their maturity period. The mangrove ecosystem provides essential nutrients for the fish fry to mature.

Water quality: Water holds major significance in determining the health of marine and mangrove ecosystems. The quality and quantity of fish greatly depends upon the water quality of the creeks (Korangi and Phitti Creeks).	
3. Key Issues Identified and Perception	
The summary of issues raised by the key respondents from community related to the ecosystem services and the impact of current developments of Port Qasim on the ecosystem services is provided below:	
1	**Access due to location of Port Qasim and shipping channel:** The existing jetties and their associated shipping lanes in Port Qasim Area (PQA) have adversely affected the fishing business by restricting the movement of the small fishermen. The small fishermen are now forced to fish near the shoreline. Shoreline only offers small fish catch with no such significant economic value. These access issues are existing since the development of the first jetty at Port Qasim, which is dated back to 1972. Due to restricted access, the small and medium scale fishermen, who used to fish near and around the existing PQA before its development are now forced to sail to deep sea for fishing. This has increased their fishing cost reducing their profit margins. Therefore, small and medium fishermen have been marginalized and their livelihood is compromised.
2	**Deterioration in fish quantity due to excessive fishing:** There is no data available on the existing fish population and its quality in the Arabian Sea near the shores of Pakistan. The number of fishermen has considerably increased over the last couple of decades. The fishermen do not know about the fish population on which they rely. Therefore, they are fishing blind in the sea without knowing the optimum catch which should be obtained in order to maintain the ecological balance of the marine ecosystem and providing opportunity to fish to repopulate at the pace greater and if not greater equal to the fish catching practices. This increased and blind fishing has overburdened the marine ecosystem, exhausting its ecosystem service of proffering fish as livelihood, causing a decline in the fish population of Korangi and Phitti Creeks.
3	**Movement of large cargo carrying vessels:** Mostly, the cargo vessels approaching jetties at Port Qasim reduce their speed while passing through creeks. However, few incidents have been reported by the key respondents where asset and life loss was recorded due to generation of strong currents produced by a passing vessel at a considerable high speeds.
4	**Payments against acquired land by Port Qasim:** The respondents of Latt Basti reported that Port Qasim land was occupied by locals before its development. The government acquired land from the locals committing payment of adequate amount against purchase land. Till to date, very few locals have received compensations which are less than market rates. A number of people, even after three decades, have not received any compensation or payment for the land acquired by Port Qasim for the port development.

Female

Stakeholder/s:	Latt Basti	
Consultation	ESR Scoping (Identification of Ecosystem Services) ESR Perceptions and Vulnerability CIA Scoping (Identification of Possible VECs, Issues, etc)	
Date:	June 10, 2015	
Time:	14:45 pm	
Meeting Venue:	Latt Basti: Residence of a local fisherman	
Key Respondents	Name	Contact number
	Khatija Aasiya Halima Rahima	03208318249
HBP Consultation Team	Dr. Anne Sweetser Sadia Khalid	
Conducted by:	Dr. Anne Sweetser Sadia Khalid	
Recorded by:	Sadia Khalid	
Language:	Urdu, Sindhi	
Preamble:	The discussion started with an introduction of the consultation team members. The community was briefed about the purpose of the meeting by providing a brief information to the attendees about the ESR and CIA studies. A comprehensive picture of the current and proposed developments at Port Qasim and briefed about the future plans of IFC for developing jetties at Port Qasim was given. At the end of the informative session, the attendees were invited to share their comments and concerns about the current and future developments at Port Qasim and provide their overview about ecosystem services (particularly those offered by their neighboring creek system) and their dependence on these ecosystem services. The consultation also focused on; identifying possible Valued Environmental and Social Components, as well as identifying any key perceptions, vulnerability and issues of these communities. The meeting minutes are documented below to provide the record.	

1. Ecosystem Services and Percentage of Community Dependent on Ecosystem Services

Ecosystem Service	*Description of Specific Service and Notes*	*Reported Percentage of Community Dependent on Ecosystem Services*
Women are indirectly reliant on ecosystem, however they do not participate in any economic activity related to ecosystem services.		

Alternative means of livelihood

Women do not participate in any activity related to fishing. The only activity allowed for women is doing embroidery for their own clothes.

2. Possible Valued Environmental and Social Components (VECs) based on discussions:

3. Key Issues Identified and Perception

The summary of issues raised by the key respondents from community related to the ecosystem services and the impact of current developments of Port Qasim on the ecosystem services is provided below:

1	**Manure and wastage from Cattle Colony:** The wastage and manure from Cattle Colony has reached Lat Basti which is causing several issues related to health. There is strong demand for cleaning of this manure as soon as possible.
2	**Pollution of drinking water:** The women from the community complained that the water supply lines for drinking purpose which were provided two years ago have come in contact with waste water and the water is not clean anymore, there is smell of manure in drinking water which is difficult to consume. There are reports of internal parasites in the children and women. Hepatitis B and C are common and one case of Tuberculosis has been reported.
3	**Lack of basic health facilities:** There is not a single unit of basic health services in the village. People go to the doctors in Cattle Colony and get treated at very high cost.
4	**Use of bulla gujja:** Bulla gujja is a very fine net that catches even the fish' eggs. The use of this net has really disturbed the ecosystem and everyone complains about the illegal use of this net.
5	**Deterioration in fish quantity due to excessive fishing:** Excessive fishing has deteriorated the quality and quantity of fish in water. This has directly impacted the community as Lat Basti is a complete fishermen's society and they do not any other resources of livelihood. Women complained about starving during the days in which fishing is banned.
6	**Sense of deprivation due to unequal distribution of power within the community:** Women were very vocal about the sense of deprivation due to the upper and lower classes existing within the community which belongs to one and only *Jat* caste. Ismailiani, Rehmani, and Saabwani neighborhoods consisting different classes were reported to exist in the village
7	**Demand for proper schools:** Women raised the issue of absence of proper schools for their children in the village. There is a primary school building in very poor condition, without teachers. A few boys go to schools in Cattle Colony but it is not affordable for them. They demand a separate school for girls in the village as girls are very keen to study.

4. Ecosystem service and its vulnerability status (based on Diversity of Income, Education, Health, Assets, Access to Alternative Sources of Income and Issues Raised by the Community).

Ecosystem service	*Vulnerability*
Food from crops, livestock, capture fisheries, aquaculture, and wild foods	High
Habitat	High
Biological raw materials from timber and other wood products, fibers and resins, animal skins, sand, and ornamental resources	Low
Regulation of natural hazards	High
Regulation of nutrient cycling	Medium

Additional Comments:

A very little information is available on bee farming for honey production and role of mangroves in honey production in the area. During upcoming surveys, a true picture of honey production in mangrove forests of Korang, Phitti and Gharo Creeks needs to be developed.

ESR and CIA for Port Qasim

Male

Stakeholder/s:	1. Rehri Goth 2. Chashma Goth 3. Siddique Khaskheli Goth	
Consultation:	ESR Scoping (Identification of Ecosystem Services) ESR Perceptions and Vulnerability CIA Scoping (Identification of Possible VECs, Issues, etc.)	
Date:	June 11, 2015	
Time:	10:30 am	
Meeting Venue:	Office of Community Based Organization (*Firdous Tarbiyati Tanzeem*)	
Coordinates:	N 24° 49' 00.5'', E 67° 13' 58.5''	
Key Respondents:	*Name*	*Contact Number*
	Abid Khaskhlei	0323 273 3079
	Younas	0321 634 6717
	Muhammad Jumman	0322 398 5895
	Abdullah	0320 340 8627
	Ali Muhammad	0302 898 9649
	Shabbir Ahmed	0322 233 4486
	Abdullah Mir Hasan	0322 253 6237
HBP Consultation Team:	Hussain Ali M Salman Ahmed Waris Ali	
Conducted by:	Hussain Ali	
Recorded by:	M Salman Ahmed	
Language:	Urdu	
Preamble:	A combined consultation session for the three stakholder communties was held a the office of the local community based organziation. Representatives from the three communities fully participated in the discussion and reported their views about the valuable environmental and social components (VECs), ecosystem services and shared their concerns about the existing and proposed development at Port Qasim and its industrial zones. The discussion started with an introduction of the consultation team members. The community was briefed about the purpose of the meeting by providing a brief information to the attendees about the ESR and CIA studies. A comprehensive picture of the current and proposed developments at Port Qasim and briefed about the future plans of IFC for developing jetties at Port Qasim was given. At the end of the informative session, the attendees were invited to share their comments and concerns about the current and future developments at Port Qasim and provide their overview about ecosystem services (particularly those offered by their neighboring creek system) and their	

	dependence on these ecosystem services. The consultation also focused on; identifying possible Valued Environmental and Social Components, as well as identifying any key perceptions, vulnerability and issues of these communities. The meeting minutes are documented below to provide the record.

1. Ecosystem Services and Percentage of Community Dependent on Ecosystem Services

Ecosystem Service	*Description of Specific Service and Notes*	*Reported Percentage of Community Dependent on Ecosystem Services*
Food from crops, livestock, capture fisheries, aquaculture, and wild foods	Fish serve as food and a source of livelihood from mangrove areas including creeks within the PQ notified area. The settlement mostly is a home to small scale fishermen. Therefore, they are more reliant on creeks for fishing rather than open seas. Due to their total reliance on fishing as the source of income, the fishing communities catch fish round the year.	60
Habitat	Mangroves of the PQ area creeks offers ideal habitat to fish fry to reach maturity.	>70
Food from crops, livestock, capture fisheries, aquaculture, and wild foods	Food from honey production	1
Fresh Water	Dependence of mangrove forests and fish population on addition of fresh water to the creeks to support their growth and nutrient cycling	70

Alternative means of livelihood

Along with fishing, fishing boat building and daily wage labor are identified as alternate sources of income.

2. Possible Valued Environmental and Social Components (VECs) based on discussions:

- ► Marine ecosystem: offering the only source of livelihood for the local fishermen by proffering fish. The large boat owning fishermen sail to deep sea to catch fish. Whereas, small fishermen mostly rely on the fish near the shoreline.
- ► Mangrove ecosystem: the fish from the deep sea lays eggs near the shoreline. The fish frys rely on mangrove ecosystem during their maturity period. The mangrove ecosystem provides essential nutrients for the fish fry to mature.
- ► Water quality: as an identified VEC, holds major significance in determining the health of marine and mangrove ecosystems. The quality and quantity of fish greatly depends upon the water quality of the creeks (Korangi and Phitti Creeks).

Air: identified as one of the major easements enjoyed by the locals of the communities. Due to prevailing power outages in the country, especially in the rural areas, sea breeze serves as the main medium to ease down the scorching heat of the coastal areas and controls climatic conditions.

3. Key Issues Identified and Perception

The summary of issues raised by the key respondents from the communities related to the ecosystem services and the impact of current developments of Port Qasim on the ecosystem services is provided below:	
1	**Issues related to increased number of fishermen:** The Port Qasim Area (PQA) and its associated creeks offer a number of fishing grounds to the fishermen. Bona fide fishermen of the PQA are mostly small fishermen relying on the fish population in Korangi and Phitti Creeks. The creeks, due to their abundant fish population have been a great attraction for migrants to the area (especially people from interior Sindh, Kashmir and Khyber Pakhtunkwa). This has increased the number of fishermen in the area resulting in a major decline in the existing fish population.
2	**Issues related to in-migration of Bengalis:** The huge number Bangalis migrated to the PQA in last couple of decades. Along with them, they have brought unsustainable fishing practices resulting in deterioration of both fish population and sea water quality. Their practices include use of very small spaced net (common name; *bulla Gujja*). The net has the capacity to catch the smallest, immature fish of the creeks. As the fish are caught without reaching their maturity age, a large number of existing fish population fails to breed. In addition, the Bengalis do not reuse their fishing nets without proper cleaning and washing. This causes the fish remains and very small fish attached to the fishing nets. When it is reused for fishing, the decaying and ill smelling fish reenters the sea water debasing its quality. This in turns pollute the sea water forcing the fish to migrate to the clean sea water at a considerable distance from the creeks.
3	**Access lisues due to location of Port Qasim:** The existing jetties and their associated shipping lanes in PQA have adversely affected the fishing business by restricting the movement of the small fishermen. The small fishermen are now forced to fish near the shoreline. Shoreline only offers small fish catch with no such significant economic value. These access issues are existing since the development of the first jetty at Port Qasim, which is dated back to 1972. Due to restricted access, the small and medium scale fishermen, who used to fish near and around the existing PQA before its development are now forced to sail to deep sea for fishing. This has increased their fishing cost reducing their profit margins. Therefore, small and medium fishermen have been marginalized and their livelihood is compromised.
4	**Issues related to discharge of sewerage water from Karachi City:** The sewerage from Karachi city, through Malir nullah is discharged into the Korangi Creek near the shoreline of Goth Ibrahim Hyderi. This discharge of liquid waste has resulted in degradation of existing water quality of the entire korangi Creek. The fish is mostly found in clean and healthy sea water. Due to the discharge of the waste water into the creek, the quality and quantity of fish has been reduced to an alarming level adversely impacting the fishing business.

Female

Stakeholder/s:	1. Rehri Goth 2. Chashma Goth 3. Siddique Khaskheli Goth	
Consultation	ESR Scoping (Identification of Ecosystem Services) ESR Perceptions and Vulnerability CIA Scoping (Identification of Possible VECs, Issues, etc.)	
Date:	June 11, 2015	
Time:	10:40 am	
Meeting Venue:	House of Anisa	
Key Respondents	*Name*	*Contact Number*
	Anisa Hamida Jumman Jamila Hajra Fazila	0320 202 0587 0303 907 1854
HBP Consultation Team	Dr. Anne Sweetser Sadia Khalid	
Conducted by:	Sadia Khalid	
Recorded by:	Dr. Anne Sweetser Sadia Khalid	
Language:	Urdu, Sindhi	
Preamble:	A combined consultation session for the three stakholder communties was held a the office of the local community based organziation. Representatives from the three communities fully participated in the discussion and reported their views about the valuable environmental and social components (VECs), ecosystem services and shared their concerns about the existing and proposed development at Port Qasim and its industrial zones. The discussion started with an introduction of the consultation team members. The community was briefed about the purpose of the meeting by providing a brief information to the attendees about the ESR and CIA studies. A comprehensive picture of the current and proposed developments at Port Qasim and briefed about the future plans of IFC for developing jetties at Port Qasim was given. At the end of the informative session, the attendees were invited to share their comments and concerns about the current and future developments at Port Qasim and provide their overview about ecosystem services (particularly those offered by their neighboring creek system) and their dependence on these ecosystem services. The consultation also focused on; identifying possible Valued Environmental and Social Components, as well as identifying any key perceptions, vulnerability and issues of these communities. The meeting minutes are documented below to provide the record.	

Ecosystem Service	*Description of Specific Service and Notes*	*Reported Percentage of Community Dependent on Ecosystem Services*
Livestock farming, Mangroves Ecosystem	25 women (mainly windows) were donated one cow/ buffalo each. These women sell milk from these cattle in order to run their kitchen. The mangroves are used as fodder for these cattle as they are easily available.	1

Alternative means of livelihood

Around 600 hundred women from the community are reported to work as daily wage labor in Export Processing Zones Landhi.

1. Possible Valued Environmental and Social Components (VECs) based on discussions:

Mangrove ecosystem: Mangroves are cost free and easily available form of fodder.

2. Key Issues Identified and Perception

The summary of issues raised by the key respondents from the communities related to the ecosystem services and the impact of current developments of Port Qasim on the ecosystem services is provided below:

1	**Issues due to excessive fishing and increased number of fishermen:** the in-migration of other communities including Bengalis has increased the number of fishermen. This has caused the decrease in quantity of the catch. The women in the village help their family by working in factories in garment factories where they get salary ranging from 12000 to 22000 rupees depending upon the level of work. This has helped this huge community a lot. Currently more than 600 females are working in the garment factories.
2	**Honey bee farming in mangroves:** There have been a few reports of bee farming in the mangroves done by local male residents. The use of beekeeping dress is also reported by key respondent.
3	**Issues due to cutting of mangroves:** Mangroves are decreasing in number because of illegal cutting by the locals. They use it as fuel and also as fodder for livestock. According to the key respondent, the cattle give more milk if they are given mangrove fodder. Single pack of mangrove fodder available at shops costs 20 rupees while the same pack supplied at door step is worth 30 rupees.
4	**Fishing in prohibited season:** Fishermen are reported to go for fishing in banned season at night time.

3. Ecosystem service and its vulnerability status (based on Diversity of Income, Education, Health, Assets, Access to Alternative Sources of Income and Issues Raised by the Community).

Ecosystem service	*Vulnerability*
Food from crops, livestock, capture fisheries, aquaculture, and wild foods	Medium
Habitat	High
Fresh water	Medium

Additional Comments:

A very little information is available on bee farming for honey production and role of mangroves in honey production in the area. During upcoming surveys, a true picture of honey production in mangrove forests of Korang, Phitti and Gharo Creeks needs to be developed.

ESR and CIA for Port Qasim

Male

Stakeholder/s:	Ali M Brohi Goth	
Consultation:	ESR Scoping (Identification of Ecosystem Services) ESR Perceptions and Vulnerability CIA Scoping (Identification of Possible VECs, Issues, etc.)	
Date:	June 11, 2015	
Time:	13:00 pm	
Meeting Venue:	Outside Residence of Muhammad Alam (President Youth Welfare Association)	
Coordinates:	N 24° 49' 07.1'', E 67° 11' 58.1''	
Key Respondents:	*Name*	*Contact Number*
	Muhammad Alam	0347 817 2776
	Saeed Alam	-
	Khwaja Ali Akhter	0324 236 4590
	Gul Muhammad	0323 297 8011
	Syed Noor	0321 207 3780
	Siraj ul Hasam	-
HBP Consultation Team:	Hussain Ali M Salman Ahmed Waris Ali	
Conducted by:	Hussain Ali	
Recorded by:	M Salman Ahmed	
Language:	Urdu	
Preamble:	The discussion started with an introduction of the consultation team members. The community was briefed about the purpose of the meeting by providing a brief information to the attendees about the ESR and CIA studies. A comprehensive picture of the current and proposed developments at Port Qasim and briefed about the future plans of IFC for developing jetties at Port Qasim was given. At the end of the informative session, the attendees were invited to share their comments and concerns about the current and future developments at Port Qasim and provide their overview about ecosystem services (particularly those offered by their neighboring creek system) and their dependence on these ecosystem services. The consultation also focused on; identifying possible Valued Environmental and Social Components (VECs), as well as identifying any key perceptions, vulnerability and issues of these communities. The meeting minutes are documented below to provide the record.	

1. Ecosystem Services and Percentage of Community Dependent on Ecosystem Services

Ecosystem Service	*Description of Specific Service and Notes*	*Reported Percentage of Community Dependent on Ecosystem Services*
Food from crops, livestock, capture fisheries, aquaculture, and wild foods	The intertidal mudflats to the east of Port Qasim, near shrine of Shah Hasan serve as habitat for Crabs (Blue and Mud Crabs)	80
	Korangi and Phitti creeks offers fish as livelihood for local fishermen	20
Habitat	Mangrove mudflats offers ideal habitat for Crabs	100
Regulation of natural hazards	Mangrove forests of Korangi and Phitti creeks providing protection against strong currents and floods	>50
Regulation of local, regional, and/ or global climate	The variable direction of the monsoon winds in the PQ area regulates the climate and the rainfall patterns.	100

Alternative means of livelihood

The key respondents only identified daily wage labor as an alternate resource of livelihood.

2. Possible Valued Environmental and Social Components (VECs) based on discussions:

- **Marine ecosystem:** the intertidal mudflats of marine ecosystem are the ideal habitat for the Crabs. Crabs serves as the major source of livelihood for the local fishermen community. The local fishermen use long handled forks to catch Crabs. Crabs are kept in the Crab pot and brought for processing from where they are exported to Thailand, Bangkok, and China. The price of the Crab varies from 200 to 1,000 rupees depending upon the season (rates increase as winter season approaches.
- **Mangroves ecosystem:** mangroves of the intertidal mudflats not only provides living and breeding habitat to the Crabs, but also serve as the major source of essential nutrients required for the growth of the Crab. The Crabs in the mudflats are found in the ditches where they lay eggs. The young Crabs spend most of their time in these ditches during winter season and reach their maturity age towards summer season, where they are commonly found on the surface of the mudflats.

Air: sea breeze is identified as one of the major easements enjoyed by the locals of the community. Due to prevailing power outages in the country, especially in the rural areas, sea breeze serves as the main medium to ease down the scorching heat of the coastal areas.

3. Key Issues Identified and Perception

The summary of issues raised by the key respondents from the community related to the ecosystem services and the impact of current developments of Port Qasim on the ecosystem services is provided below:

1	**Access issues due to location of Port Qasim:** The eastern side of the Port Qasim, along the shoreline of the Gharo Creek is identified as the main habitat of Crabs. The community greatly depends upon the area for catching Crabs. Due to location and development of Port Qasim, the Port Qasim Authority has restricted movement of the local fishing community to take a shorter route to the Gharo Creek passing through the Port Qasim jetties and shipping lanes. This has increased their traveling cost to the Gharo Creek reducing their profit margins. In addition, the Port Qasim Area (PQA) creeks, due to their abundant fish population serve as major fishing grounds for local fishermen. The fishermen used to make trips to nearby creeks towards east of the Port Qasim. However, due to the development of Port Qasim, these fishermen are forced to fish in deep sea towards Keti Bandar increasing their fishing cost.
2	**Issues related to limited livelihood:** The local communities lack proper educational infrastructures and skill training programs. The residents are bona fied fishermen relying on fishing as their only source of income. But, the continuous increase in the fishermen of the area has limited fishing opportunities in the neighboring creeks of PQA. This has limited the fishing activities of fishermen of the community to few areas marginalizing their living conditions. Therefore, the lack of educational facilities and technical trainings, the community has no other source of income to earn livelihood and support families. These socioeconomic factors have adversely affected the living conditions of the local community.
3	**Issues related to discharge of industrial effluents from PQA:** The effluent discharge from the industries in PQA contains chemicals and other pollutants which result in the degradation of sea water of Gharo Creek. This has greatly reduced both fish and Crab population of Gharo Creek especially compromising the fishing practices of the local fisherman whose livelihood is entirely dependent on Crabs.
4	**Issue related to future developments in PQA:** The key respondents from the community reported concerns with the future development at Port Qasim. They have reservations related to the development of the jetties and industries in the PQA as they have perception that these developments will hamper their fishing activities and will not provide any employment opportunities to the local due to their lack of education and skill.
5	**Issues related to maintenance of shipping lanes:** Port Qasim shipping lanes are maintained time to time for which dredging is carried out. The dredged material is dumped carelessly in Korangi and Phitti Creeks. This dredged material blocks creeks affecting the navigation of the local fishermen through them.

Female

Stakeholder/s:	Ali M Brohi Goth	
Consultation	ESR Scoping (Identification of Ecosystem Services) ESR Perceptions and Vulnerability CIA Scoping (Identification of Possible VECs, Issues, etc.)	
Date:	June 11, 2015	
Time:	13:00 pm	
Meeting Venue:	Residence of Rehana Bengali	
Key Respondents	*Name*	*Contact Number*
	Rehana Bengali and family	03208288166
HBP Consultation Team	Dr. Anne Sweetser Sadia Khalid	
Conducted by:	Sadia Khalid	
Recorded by:	Dr. Anne Sweetser Sadia Khalid	
Language:	Urdu, Sindhi	
Preamble:	The discussion started with an introduction of the consultation team members. The community was briefed about the purpose of the meeting by providing a brief information to the attendees about the ESR and CIA studies. A comprehensive picture of the current and proposed developments at Port Qasim and briefed about the future plans of IFC for developing jetties at Port Qasim was given. At the end of the informative session, the attendees were invited to share their comments and concerns about the current and future developments at Port Qasim and provide their overview about ecosystem services (particularly those offered by their neighboring creek system) and their dependence on these ecosystem services. The consultation also focused on; identifying possible Valued Environmental and Social Components (VECs), as well as identifying any key perceptions, vulnerability and issues of these communities. The meeting minutes are documented below to provide the record.	

1. Ecosystem Services and Percentage of Community Dependent on Ecosystem Services

None

2. Key Issues Identified and Perceptions

None

3. Ecosystem service and its vulnerability status (based on Diversity of Income, Education, Health, Assets, Access to Alternative Sources of Income and Issues Raised by the Community).

Ecosystem service	*Vulnerability*
Food from crops, livestock, capture fisheries, aquaculture, and wild foods	High
Habitat	High
Regulation of natural hazards	Medium
Regulation of local, regional, and/ or global climate	High

ESR and CIA for Port Qasim

Male

Stakeholder/s:	Bakhtawar Goth	
Consultation:	ESR Scoping (Identification of Ecosystem Services) ESR Perceptions and Vulnerability CIA Scoping (Identification of Possible VECs, Issues, etc.)	
Date:	June 11, 2015	
Time:	14:30 pm	
Meeting Venue:	Baithak of Nazir Bhutto (local contractor and political and tribal leader)	
Coordinates	N 24° 49' 16.2'', E 67° 13' 41.9''	
Key Respondents:	Name	Contact Number
	Nazir Bhutto Younas	0300 260 3357 0322 293 4065
HBP Consultation Team:	Dr. Anne Sweetser Hussain Ali M Salman Ahmed Sadia Khalid Waris Ali	
Conducted by:	Hussain Ali	
Recorded by:	M Salman Ahmed	
Language:	Urdu	
Preamble:	The discussion started with an introduction of the consultation team members. The community was briefed about the purpose of the meeting by providing a brief information to the attendees about the ESR and CIA studies. A comprehensive picture of the current and proposed developments at Port Qasim and briefed about the future plans of IFC for developing jetties at Port Qasim was given. At the end of the informative session, the attendees were invited to share their comments and concerns about the current and future developments at Port Qasim and provide their overview about ecosystem services (particularly those offered by their neighboring creek system) and their dependence on these ecosystem services. The consultation also focused on; identifying possible Valued Environmental and Social Components, as well as identifying any key perceptions, vulnerability and issues of these communities. The meeting minutes are documented below to provide the record.	

1. Ecosystem Services and Percentage of Community Dependent on Ecosystem Services

Ecosystem Service	*Description of Specific Service and Notes*	*Reported Percentage of Community Dependent on Ecosystem Services*
Food from crops, livestock, capture fisheries, aquaculture, and wild foods	The PQ creeks serves as the major fishing grounds for the local fishermen Mangrove forest areas are used for wild bee farming for honey production	70
Habitat	Mangrove forests offers ideal habitat to fish fry to reach maturity Mangrove forests as an ideal habitat for wild bee farming	100
Fresh Water	The fresh water from the Indus River enters the Arabian Sea. The water provides essential components to maintain the ecological balance of marine ecosystem	100

Alternative means of livelihood

Material supply and daily wage labor are the two major alternate sources of livelihood identified by the key respondents.

2. Possible Valued Environmental and Social Components (VECs) based on discussions:

Marine ecosystem: offers the major source of livelihood to the local fishermen by proffering fish. Due to the location of the community, a huge number of residents (nearly 70%) are engaged in fishing business, as both business owners and fishing labor.

Mangrove ecosystem: The fish from the deep sea lays eggs near the shoreline. The fish frys rely on mangrove ecosystem during their maturity period. The mangrove ecosystem provides essential nutrients for the fish fry to mature.

Fresh water: water flowing into the Arabian Sea through the Indus River serves as the main factor to maintain ecological balance of the marine ecosystem providing fresh water for the growth of mangroves and bringing along nutrients for the growth of marine flora and fauna.

3. Key Issues Identified and Perception

1	**Issues related to lack of employment opportunities:** The community has limited access to employment opportunities at Landhi, Korangi and Port Qasim Industrial areas due to lack of education and skill level. This has resulted in poor living conditions and compromised socioeconomic conditions of the community. The current generation, however, is putting efforts in improving their living standards by focusing towards education.
2	**Issues related to illegal fishing activities:** The fishermen use small size nets (*Bulla Gujja*) to catch fish. The net has the capacity to catch very small size fish which not even has reached its maturity age. This practice is greatly deteriorating the fish population of the Korangi and Phitti Creeks. Fishermen Cooperation Society (FCS); an NGO working to protect fishermen rights, is currently engaged in controlling the illegal fishing activities. However, due to deep and extended network of illegal fishermen, the NGO is yet not able to identify the factors and organizational network promoting these illegal fishing activities

3	**Issue related to future developments in PQA:** The key respondents from the community reported concerns with the future development at Port Qasim. They have reservations related to the development of the jetties and industries in the PQA as they have perception that these developments will hamper their fishing activities and will not provide any employment opportunities to the local due to their lack of education and skill.
4	**Future opportunities:** The key informants also termed the future developments as "business opportunity for the local contractors". The local contractors have been involved in the development activities at Port Qasim by offering supply of raw material and labor during construction works. Therefore, they see the future developments as an important labor and business opportunity for them.
5	**Issues related to the design of the jetties at Port Qasim:** Few of the jetties at Port Qasim were developed at an alarmingly low height. During the high tides, the jetty floods with water, making it hard for the local fishermen to navigate through channels between jetties. The key respondents reported that future developments of jetties should be maintained at an optimum height after determining the water level in both low and high tides so they do not hamper movement of fishermen within the creeks.
6	**Role of fishermen rights organizations:** The key respondent from the community, Mr Nazeer Bhutto is the acting Advisor to Chairman of Fishermen Cooperative Society (FCS). During the consultations, questions were asked to inquire and establish the status of the FCS and its function in protecting the rights of the fishermen. Mr Bhutto, contrary to what was reported by the respondents of Ibrahim Hyderi, termed FCS as an organization which is actively involved in protecting the rights of the fishermen and facilitate their fishing business by providing access to market with low tax rates and supports fishing restrictions during monsoon season by supplying free ration to the fishing communities located to the west of Port Qasim.

4. Ecosystem service and its vulnerability status (based on Diversity of Income, Education, Health, Assets, Access to Alternative Sources of Income and Issues Raised by the Community).

Ecosystem service	*Vulnerability*
Food from crops, livestock, capture fisheries, aquaculture, and wild foods	High
Habitat	High
Fresh Water	High

ESR and CIA for Port Qasim

Male

Stakeholder/s:	1. Goth Karam Ali Baloch 2. Goth Ismail Katiyar 3. Ghulam Muhammad Khaskheli 4. Abdul Ghani Goth	5. M Azeem Mirbar Goth 6. Mohsin Khaskheli Goth 7. Goth Hasil Rindh Baloch
Consultation:	ESR Scoping (Identification of Ecosystem Services) ESR Perceptions and Vulnerability CIA Scoping (Identification of Possible VECs, Issues, etc.)	
Date:	June 12, 2015	
Time:	12:00 pm	
Meeting Venue:	Dera of Goth Karam Ali Baloch	
Coordinates:	N 24° 43' 03.0'', E 67° 31' 19.0''	
Key Respondents:	*Name*	*Contact Number*
	Ghulam Rasool	0321 395 8902
	Abdul Sattar	0321 733 8527
	Khamiso Khan Baloch	0321 301 6515
	Abbas Kalmati	0321 348 4705
	Muhammad Hasan	0342 258 1783
	Muhammad Yami	0322 301 6438
	Yar Muhammad Khaskheli	0323 389 1297
	Rasool Bakhsh	0322 353 4035
	Sajjad	0321 386 8835
	Sikander	0321 323 6581
	Allah Bakhsh Khaskheli	0322 253 1664
HBP Consultation Team	Hussain Ali M Salman Ahmed Waris Ali	
Conducted by:	Hussain Ali	
Recorded by:	M Salman Ahmed	
Language:	Urdu	
Preamble:	A combined consultation session for the communties located to the east of the Port Qasim was held at the Dera (community center) of Goth Karam Ali Baloch. A combined consultation session was held due to the proximity in the location of the communities and their common dependence on ecosystem services identified during the scoping visit. Representatives from the communities fully participated in the discussion and reported their views about the valuable environmental and social components (VECs), ecosystem services and shared their concerns about the existing and proposed development at Port Qasim and its	

	industrial zones The discussion started with an introduction of the consultation team members. The community was briefed about the purpose of the meeting by providing a brief information to the attendees about the ESR and CIA studies. A comprehensive picture of the current and proposed developments at Port Qasim and briefed about the future plans of IFC for developing jetties at Port Qasim was given. At the end of the informative session, the attendees were invited to share their comments and concerns about the current and future developments at Port Qasim and provide their overview about ecosystem services (particularly those offered by their neighboring creek system) and their dependence on these ecosystem services. The consultation also focused on; identifying possible Valued Environmental and Social Components, as well as identifying any key perceptions, vulnerability and issues of these communities. The meeting minutes are documented below to provide the record.

1. Ecosystem Services and Percentage of Community Dependent on Ecosystem Services

Ecosystem Service	*Description of Specific Service and Notes*	*Reported Percentage of Community Dependent on Ecosystem Services*
Food from crops, livestock, capture fisheries, aquaculture, and wild foods	Offers fishing as livelihood. Fishing is practiced in Gharo Creek, located to the east of Port Qasim	40
Regulation of soil quality	Soil fertility contributing towards agricultural practices The narrowing gap between sea water and shoreline, due to decline in flow of fresh water into the Indus Delta, affecting soil quality by degrading ground water	60
Fresh Water	The fresh water from both rain and Indus River enters the Arabian Sea pushing the saline water away from the shoreline. This water controls erosion by sea water and provide water for agriculture.	100
Water cycling	The climate change has reduced rain falls in the area and flow of fresh water into the Indus Delta reducing availability of fresh water,	100
Biological raw materials from timber and other wood products, fibers and resins, animal skins, sand, and ornamental resources	The forests of Keekar (thorny bushes) in the area serve as the main fuel source for the fishermen for cooking and heating purposes.	100

Alternative means of livelihood

None

2. Possible Valued Environmental and Social Components (VECs) based on discussions:

- **Marine ecosystem:** offers fishing as livelihood for the local fishermen. Due to the location of the community, near shoreline of Gharo Creek, nearly 40% of the communities are engaged in fishing activities.
- **Terrestrial ecosystem:** a considerable percentage of the residents (nearly 60%) is engaged in agricultural activities cultivating wheat, rice and vegetables as subsistence food. The agricultural yield is greatly dependent on the fertility of soil which is deteriorating due to decrease in fresh water sources providing sea water sufficient space to flow near the shoreline. The increasing proximity of the sea water (concentrated with salts) and the shoreline results in erosion and degradation of ground water quality.
- **Fresh water**: flow of fresh water into the Indus Delta (Gharo Creek) through the Indus River and received rain falls (very rare) serves as the main factor to maintain ecological balance of the marine ecosystem and provides fresh water to the local farmers for agricultural activities.

The climate change, experienced since 1989 has adversely altered the rainfall patterns of the area. Due to less rainfall events, the fertility of the soil is reducing at an alarming rate marginalizing the agricultural practices of the communities.

3. Key Issues Identified and Perception

The summary of issues raised by the key respondents from the communities related to the ecosystem services and the impact of current developments of Port Qasim on the ecosystem services is provided below:

1	**Issues related to the location and development of Port Qasim:** The development of Port Qasim, which started in 1970's had forced nearly 27 local communities to relocate to the eastern shoreline of the Gharo Creek. In addition, the Port Qasim Authority has restricted the movement of the local fishermen in its neighboring creeks. This in turn has affected the fishing business as now the fishermen sails to deep sea to catch fish which has increased their fishing cost reducing their profit margins. The fishermen, a couple of decades back, used to sell their fish to the whole sale dealers (mill owners) of Ibrahim Hyderi. But, due to restrictions by Port Qasim Authority to navigate in their neighboring creeks, the fishermen now sell their fish in Karachi fish market. This results in application of additional taxes in the market and increase in transportation cost from the communities to Karachi fish market.
2	**Issues related to illegal fishing activities:** The fishermen of Ibrahim Hyderi and Rehri Goth use small size nets (*Bulla Gujja*) to catch fish. The net has the capacity to catch very small size fish which not even has reached its maturity age. This practice is greatly deteriorating the fish population of the Gharo Creek as most of the fish is caught by the fishermen on the west of the Port Qasim (the fish is found in abundance in creeks located to the west of the Port Qasim, which migrates to the east hen reach maturity)
3	**Issue related to introduction of hybrid seed:** A considerable number of local residents are engaged in agricultural activities. The recent introduction of hybrid seed has greatly reduced their agricultural yield due to its chemical nature. The natural seed, adapted to their climate and soil conditions is now rarely available and the communities do not have sufficient fresh water and resources to purchase fertilizers to facilitate farming by utilizing hybrid seed.
4	**Issues related to quarrying:** Quarrying for land reclamation is commonly practiced by the industries at Port Qasim Authority. The quarrying at the Ghaghar nullah has altered the water quality of the nullah due to increase in its depth. This has resulted in mixing of ground water, with high dissolved salts, into the nullah water. The Ghaghar nullah was one of the major source of fresh water for the local communities. The deterioration in its water quality has affected the availability of fresh water to the local communities.

5	**Issues related to payments against acquired land by Port Qasim:** The respondents of consulted communities reported that 27 settlements were relocated for the development of Port Qasim in 1970's. The government acquired land from the locals committing just payments against purchase land. Till to date, no one has received compensation for the acquired land. The locals have filed cases in High Court and Supreme Court, but due to lack of political support and monetary .resources, locals are not yet able to receive any compensation for their land.
6	**Issues related to climate change**: Since last couple of decades the area has received very scanty rainfalls. This decrease in rainfall has degraded existing fresh water resources, lowering of ground water table, affecting their agricultural practices.

Female

Stakeholder/s:	1. Goth Karam Ali Baloch 2. Goth Ismail Katiyar 3. Ghulam Muhammad Khaskheli 4. Abdul Ghani Goth	5. M Azeem Mirbar Goth 6. Mohsin Khaskheli Goth 7. Goth Hasil Rindh Baloch
Consultation	ESR Scoping (Identification of Ecosystem Services) ESR Perceptions and Vulnerability CIA Scoping (Identification of Possible VECs, Issues, etc.)	
Date:	June 12, 2015	
Time:	12:00 pm	
Meeting Venue:	House of Kazbano	
Key Respondents:	*Name*	
	Kazbano Sughra Jamila Rani	
HBP Consultation Team:	Dr Anne Sweetser Sadia Khalid	
Conducted by:	Dr. Anne Sweetser Sadia Khalid	
Recorded by:	Sadia Khalid	
Language:	Urdu, Sindhi	
Preamble:	A combined consultation session for the communties located to the east of the Port Qasim was held at the Dera (community center) of Goth Karam Ali Baloch. A combined consultation session was held due to the proximity in the location of the communities and their common dependence on ecosystem services identified during the scoping visit. Representatives from the communities fully participated in the discussion and reported their views about the valuable environmental and social components (VECs), ecosystem services and shared their concerns about the existing and proposed development at Port Qasim and its industrial zones The discussion started with an introduction of the consultation team members. The community was briefed about the purpose of the meeting by providing a brief information to the attendees about the ESR and CIA studies. A comprehensive picture of the current and proposed developments at Port Qasim and briefed about the future plans of IFC for developing jetties at Port Qasim was given. At the end of the informative session, the attendees were invited to share their comments and concerns about the current and future developments at Port Qasim and provide their overview about ecosystem services (particularly those offered by their neighboring creek system) and their dependence on these ecosystem services.	

	The consultation also focused on; identifying possible Valued Environmental and Social Components, as well as identifying any key perceptions, vulnerability and issues of these communities. The meeting minutes are documented below to provide the record.

1. Ecosystem Services and Percentage of Community Dependent on Ecosystem Services

Ecosystem Service	*Description of Specific Service and Notes*	*Reported Percentage of Community Dependent on Ecosystem Services*
Women are indirectly reliant on ecosystem, however they do not participate in any economic activity related to ecosystem services.		

Alternative means of livelihood

None

2. Possible Valued Environmental and Social Components (VECs) based on discussions

None

3. Key Issues Identified and Perception

The summary of issues raised by the key respondents from the communities related to the ecosystem services and the impact of current developments of Port Qasim on the ecosystem services is provided below:

1	**Issues due to lack of health services:** Having no basic health facilities in the community, people are forced to go to nearby town of Gharo. This is usually very costly and unaffordable for them.
2	**Issues related to education services:** Mothers came up with a strong complain against unavailability of education facilities for their children.

4. Ecosystem service and its vulnerability status (based on Diversity of Income, Education, Health, Assets, Access to Alternative Sources of Income and Issues Raised by the Community).

Ecosystem service	*Vulnerability*
Food from crops, livestock, capture fisheries, aquaculture, and wild foods	Medium
Regulation of soil quality	Medium
Fresh Water	High
Water cycling	High
Biological raw materials from timber and other wood products, fibers and resins, animal skins, sand, and ornamental resources	High

ESR and CIA for Port Qasim

Male

Stakeholder/s:	Hirjna Fishing Area	
Consultation:	PESR Scoping, PESR Perceptions and Vulnerability and CIA Scoping	
Date:	June 12, 2015	
Time:	13:30 pm	
Meeting Venue:	Open Air	
Coordinates:	N 24° 44' 47.0'', E 67° 32' 05.1''	
Key Respondents:	*Name*	*Contact Number*
	Saleem	0324 322 2399
	Muhammad Hashim	0323 286 2872
	Rab Nawaz	0300 895 5246
HBP Consultation Team:	Hussain Ali M Salman Ahmed Waris Ali	
Conducted by:	Hussain Ali	
Recorded by:	M Salman Ahmed	
Language:	Urdu	
Preamble:	Hirjna fishing area provides a natural harbor for the local fishermen from where they enter the Gharo Creek for fishing. During the consultation survey, local fishermen were found. Consultation meeting was held with the representative of the contractor to inquire about the previaling fishing activities. The discussion started with an introduction of the consultation team members. The community was briefed about the purpose of the meeting by providing a brief information to the attendees about the ESR and CIA studies. A comprehensive picture of the current and proposed developments at Port Qasim and briefed about the future plans of IFC for developing jetties at Port Qasim was given. At the end of the informative session, the attendees were invited to share their comments and concerns about the current and future developments at Port Qasim and provide their overview about ecosystem services (particularly those offered by their neighboring creek system) and their dependence on these ecosystem services. The consultation also focused on; identifying possible Valued Environmental and Social Components, as well as identifying any key perceptions, vulnerability and issues of these communities. The meeting minutes are documented below to provide the record.	

1. Ecosystem Services and Percentage of Community Dependent on Ecosystem Services

Ecosystem Service	*Description of Specific Service and Notes*	*Reported Percentage of Community Dependent on Ecosystem Services*
Food from crops, livestock, capture fisheries, aquaculture, and wild foods	The fish of Gharo Creek serve as the only source of livelihood for the fishermen. The fishermen from the Ghaggar Phattak, Gharo and Dhabeji depends upon the area for livelihood	100

Alternative means of livelihood

During winter season, the water of the Gharo Creek does not proffer fish to the fishermen. The fishermen are mostly engaged in net weaving during winter season as a source of income.

2. Possible Valued Environmental and Social Components (VECs) based on discussions:

The marine ecosystem provides fishing as the only source of livelihood for fishermen of the area. The fishing activities vary from season to season. Currently, Jelly Fish is found in the creek as the major catch. The season of jelly fish starts in April and ends in September.

3. Key Issues Identified and Perception

The fishermen raised few issues related to developments at Port Qasim and shared their perception about the ecosystem services. The summary of the discussion with the fishermen is provide below:

1	**Access issues due to location of Port Qasim:** The eastern side of the Port Qasim, along the shoreline of the Gharo Creek is identified as only fishing grounds for the local fishermen. The fishermen not only fish themselves, but also provide services to the recreation fishermen. They charge around 2,000 to 3,000 rupees per trip per day. Therefore, the creek offers the only source of livelihood to the local fishermen However, due to restricted movement in Gharo Creek, the fishing business has been adversely impacted, as there are limited fishing spots in the creeks which are exhausted by excessive fishing.
2	**Issues related to limited livelihood:** The local communities lack proper educational infrastructures and skill training programs. Therefore, fishermen have no other options to adapt as alternate livelihood and improve their socioeconomic conditions.
3	**Issues related to discharge of industrial effluents from PQA:** The effluent discharge from the industries in PQA contains chemicals and other pollutants which result in the degradation of sea water of Gharo Creek. This has greatly reduced the fish population of Gharo Creek compromising fishing activities of the local fishermen.

4. Ecosystem service and its vulnerability status (based on Diversity of Income, Education, Health, Assets, Access to Alternative Sources of Income and Issues Raised by the Community).

Ecosystem service	*Vulnerability*
Food from crops, livestock, capture fisheries, aquaculture, and wild foods	High

ESR and CIA for Port Qasim

Male

Stakeholder/s:	Goth Hashim Mirbehar	
Consultation:	ESR Scoping (Identification of Ecosystem Services) ESR Perceptions and Vulnerability CIA Scoping (Identification of Possible VECs, Issues, etc.)	
Date:	June 12, 2015	
Time:	14:30 pm	
Meeting Venue:	Baithak of Muhammad Azeem	
Coordinates:	N 24° 44' 07.5'', E 67°32' 09.4''	
Attended By:	*Name*	*Contact Number*
	Muhammad Azim	0322 348 4609
	Muhammad Ayub	-
	Ghulam Rasool	0322 343 3850
	Moosa	0321 320 2767
	Peeru Muhammad	-
	Muhammad Rafique	0310 102 9018
	Mehran Ali	-
HBP Consultation Team:	Hussain Ali M Salman Ahmed Waris Ali	
Conducted by:	Hussain Ali	
Recorded by:	M Salman Ahmed	
Language:	Urdu	
Preamble:	The discussion started with an introduction of the consultation team members. The community was briefed about the purpose of the meeting by providing a brief information to the attendees about the ESR and CIA studies. A comprehensive picture of the current and proposed developments at Port Qasim and briefed about the future plans of IFC for developing jetties at Port Qasim was given. At the end of the informative session, the attendees were invited to share their comments and concerns about the current and future developments at Port Qasim and provide their overview about ecosystem services (particularly those offered by their neighboring creek system) and their dependence on these ecosystem services. The consultation also focused on; identifying possible Valued Environmental and Social Components, as well as identifying any key perceptions, vulnerability and issues of these communities. The meeting minutes are documented below to provide the record.	

1. Ecosystem Services and Percentage of Community Dependent on Ecosystem Services

Ecosystem Service	*Description of Specific Service*	*Reported Percentage of*

	and Notes	*Community Dependent on Ecosystem Services*
Food from crops, livestock, capture fisheries, aquaculture, and wild foods	Gharo creek serve as the main fishing grounds for the local fishermen	50
Production of raw material	The sea water is extracted with the help of pumping motors and is kept stored in salt panes to facilitate evaporation which in return leaves raw salt as a by product	50
Biological raw materials from timber and other wood products, fibers and resins, animal skins, sand, and ornamental resources	The *Keekar* forests in the neighboring vicinity serving as the main source of fuel wood	100

Alternative means of livelihood

None

2. Possible Valued Environmental and Social Components (VECs) based on discussions:

- **Marine ecosystem:** offers one of the major sources of livelihood to the locals. The locals are engaged in both fishing and providing services to the recreational fishermen.
- **Sea water**: the community is located near Hirjna Salt works; facility engaged in production of salt from salt lakes. The location of the community in proximity to the facility provides a major source of income to the local residents. A large number of the residents work as labor at Hirjna Salt production facility.

Terrestrial vegetation: the Keekar (thorny bushes) vegetation serves as the only source of fuel for both cooking and heating purposes.

3. Key Issues Identified and Perception

The summary of issues raised by the key respondents from the community related to the ecosystem services and the impact of current developments of Port Qasim on the ecosystem services is provided below:

1	**Issues related to increased number of fishermen due to location of Port Qasim:** The development Port Qasim has restricted the movement of local fishermen to the west of the port. Therefore, a huge number of local fishermen of the area rely on Gharo Creek for fishing, This is overburdened the creek and fish population reducing the fish population of the creek..
2	**Issues related to effluent discharge from industries at Port Qasim Industrial Zones:** The effluent discharge from the industries in PQA contains chemicals and other pollutants which result in the degradation of sea water of Gharo Creek. This has greatly reduced fish population of Gharo Creek especially compromising the fishing practices of the local fisherman whose livelihood is entirely dependent on fishing. In addition, this degradation in quality of sea water has also affected the salt production business of Hirjna Salt facility compromising the livelihood of the local community depending upon the facility.

3	**Access issues due to location of Port Qasim:** The existing jetties and their associated shipping lanes in PQA have adversely affected the movement of local fishermen and those providing services to recreational fishermen. This has greatly reduced the navigation area of the local and recreational fishermen, limiting them to the east of Gharo Creek resulting in over burdening of the fish population of Gharo Creek.

Female

Stakeholder/s:	Goth Hashim Mirbehar	
Consultation:	ESR Scoping (Identification of Ecosystem Services) ESR Perceptions and Vulnerability CIA Scoping (Identification of Possible VECs, Issues, etc.)	
Date:	June 12, 2015	
Time:	14:30 pm	
Meeting Venue:	Compound of Muhammad Azeem's Residence	
Attended By:	*Name*	*Contact Number*
	Aashaa	-
	Maklaye	-
	Zarina	-
	Saraa	-
	Halima	0322 3484 609
HBP Consultation Team:	Dr. Anne Sweetser Sadia Khalid	
Conducted by:	Sadia Khalid	
Recorded by:	Dr. Anne Sweetser Sadia Khalid	
Language:	Urdu, Sindhi	
Preamble:	The discussion started with an introduction of the consultation team members. The community was briefed about the purpose of the meeting by providing a brief information to the attendees about the ESR and CIA studies. A comprehensive picture of the current and proposed developments at Port Qasim and briefed about the future plans of IFC for developing jetties at Port Qasim was given. At the end of the informative session, the attendees were invited to share their comments and concerns about the current and future developments at Port Qasim and provide their overview about ecosystem services (particularly those offered by their neighboring creek system) and their dependence on these ecosystem services. The consultation also focused on; identifying possible Valued Environmental and Social Components, as well as identifying any key perceptions, vulnerability and issues of these communities. The meeting minutes are documented below to provide the record.	

1. Ecosystem Services and Percentage of Community Dependent on Ecosystem Services

Ecosystem Service	*Description of Specific Service and Notes*	*Reported Percentage of Community Dependent on Ecosystem Services*
Women are indirectly reliant on ecosystem, however they do not participate in any economic activity related to ecosystem services.		

Alternative means of livelihood

None

2. Possible Valued Environmental and Social Components (VECs) based on discussions:

3. Key Issues Identified and Perception

The summary of issues raised by the key respondents from the community related to the ecosystem services and the impact of current developments of Port Qasim on the ecosystem services is provided below:

1	**Issues related to increased number of fishermen due to location of Port Qasim:** The development Port Qasim has restricted the movement of local fishermen to the west of the port. Therefore, a huge number of local fishermen of the area rely on Gharo Creek for fishing, This has overburdened the creek and is reducing the fish population of the creek.
2	**Issues related to effluent discharge from industries at Port Qasim Industrial Zones:** The effluent discharge from the industries in PQA contains chemicals and other pollutants which result in the degradation of sea water of Gharo Creek. This has greatly reduced fish population of Gharo Creek especially compromising the fishing practices of the local fisherman whose livelihood is entirely dependent on fishing. In addition, this degradation in quality of sea water has also affected the salt production business of Hirjna Salt facility compromising the livelihood of the local community depending upon the facility.
3	**Access issues due to location of Port Qasim:** The existing jetties and their associated shipping lanes in PQA have adversely affected the movement of local fishermen and those providing services to recreational fishermen. This has greatly reduced the navigation area of the local and recreational fishermen, limiting them to the east of Gharo Creek resulting in over burdening of the fish population of Gharo Creek.
4	**Issues related to health facilities:** There is no health facility in the community. Women have died during pregnancy complications due to unavailability of emergency care. In case when they can afford a taxi, they go to nearest facility in Gharo.
5	**Issues due to absence of schools:** There is not a single school in the village and people cannot afford to send their children to other villages. There is a demand for a school with teachers from the villagers.

4. Ecosystem service and its vulnerability status (based on Diversity of Income, Education, Health, Assets, Access to Alternative Sources of Income and Issues Raised by the Community).

Ecosystem service	*Vulnerability*
Food from crops, livestock, capture fisheries, aquaculture, and wild foods	Medium
Production of raw material	Medium
Biological raw materials from timber and other wood products, fibers and resins, animal skins, sand, and ornamental resources	High

ESR and CIA for Port Qasim

Record of the Consultation Meeting

Male

Stakeholder/s:	1. Goth Ameen Muhammad Baloch 2. Goth Allah Dino	
Consultation:	PESR Scoping, PESR Perceptions and Vulnerability and CIA Scoping	
Date:	June 12, 2015	
Time:	16:00 pm	
Meeting Venue:	Outside Goth Ameen Baloch	
Coordinates	N 24° 49' 24.2'', E 67° 26' 24.0''	
Key Respondents:	*Name*	*Contact Number*
	Muhammad Yousaf	0343 220 6517
	Baloch	-
	Shahnawaz Baloch	0305 260 0323
HBP Consultation Team:	Hussain Ali M Salman Ahmed Waris Ali	
Conducted by:	Hussain Ali	
Recorded by:	M Salman Ahmed	
Language:	Urdu	
Meeting Outcomes:	The discussion started with an introduction of the consultation team members. Mr Ali briefed about the purpose of the meeting by providing a brief information to the attendees about the ESR and CIA studies. Mr Ali presented a comprehensive picture of the current and proposed developments at Port Qasim and briefed about the future plans of IFC for developing jetties at Port Qasim. At the end of the informative session, Mr Ali invited the attendees to share their comments and concerns about the current and future developments at Port Qasim and provide their overview about the existing ecosystem services offered by their neighboring creek system and their dependence on the ecosystem services. The key respondent refused to share any information as they have already provided information and reported their concerns to HBP during consultations held for the previous HBP project in Port Qasim Area.	
3. Ecosystem Services and Percentage of Community Dependent on Ecosystem Services		
None		
4. Key Issues Identified and Perception		
None		

ESR and CIA for Port Qasim

Male

Stakeholder/s:	1. Goth Haji Ibrahim 2. Mir Khan Baloch 3. Haji Khan Zohrani	4. Natho Tando Khoso 5. Haji Jhangi Khan 6. Goth Mayo
Consultation:	PESR Scoping, PESR Perceptions and Vulnerability and CIA Scoping	
Date:	June 13, 2015	
Time:	10:30 pm	
Meeting Venue:	Outside local market of Goth Haji Ibrahim	
Coordinates:	N 24° 50' 30.6'', E 67° 25' 51.9''	
Key Respondents	*Name*	*Contact Number*
	Abdul Ghani Baloch	0311 842 0446
	Muhammad Baloch	0311 001 9754
	Mayo Khan	
	Abdullah	0313 025 5981
	Muhammad Hussain	0311 001 9747
HBP Consultation Team:	M Salman Ahmed Waris Ali	
Conducted by:	M Salman Ahmed	
Recorded by:	M Salman Ahmed	
Language:	Urdu	
Preamble:	A combined consultation session with the non-fishing communties located to the northeast of the Port Qasim was held at the common sitting area outside the local market of Goth Haji Ibrahim. A combined consultation session was held due to the proximity in the location of the communities and their common interest and concerns associated with Port Qasim industria zones. Representatives from the communities were not willing to share much of the infomration due to their lack of interest in such surveys, as the communities have been visited by various Non-Governmental Organizations (NGOs) and consulting firms including HBP in past few years but nothing positive has yet happebed to improve their socioeconomic conditions. However, the communities, during informal discussion did share some of their concerns related to current developments. The discussion started with an introduction of the consultation team members. The community was briefed about the purpose of the meeting by providing a brief information to the attendees about the ESR and CIA studies. A comprehensive picture of the current and proposed developments at Port Qasim and briefed about the future plans of IFC for developing jetties at Port Qasim was given. At the end of the informative session, the attendees were invited to share their comments and concerns about the current and future developments	

	at Port Qasim and provide their overview about ecosystem services (particularly those offered by their neighboring creek system) and their dependence on these ecosystem services. The consultation also focused on; identifying possible Valued Environmental and Social Components, as well as identifying any key perceptions, vulnerability and issues of these communities. The meeting minutes are documented below to provide the record.

1. Ecosystem Services and Percentage of Community Dependent on Ecosystem Services

Ecosystem Service	*Description of Specific Service and Notes*	*Reported Percentage of Community Dependent on Ecosystem Services*
Fresh Water	Both surface and ground water serve as the main source of water for livestock farming	100
Air Quality (Regulation of disease)	Clean air supporting healthy life. The emission from industries in Port Qasim resulting in degradation of air quality, affecting the health of the local residents, compromising quality of living	100
Biological raw materials from timber and other wood products, fibers and resins, animal skins, sand, and ornamental resources	*Keekar* forests providing fuel wood and fodder for livestock	100
Marine Ecosystem Food from crops, livestock, capture fisheries, aquaculture, and wild foods	Gharo Creek proffers fish as a source of livelihood. A very small number of households work as fish labor with large boat owners	15

Alternative means of livelihood

Daily wage labor

2. Possible Valued Environmental and Social Components (VECs) based on discussions

- **Water:** the water from nearby nullahs serves as the only source of freshwater to the local residents. The surface water not only helps meeting the water requirements of the livestock, but also helps in maintaining the groundwater table.
- **Air:** the strong winds of the area helps cool down the temperature during summer season. The communities are adversely struck by the power outages, therefore, the clean air serves as the only source supporting life in high temperature during summer season.
- **Terrestrial Vegetation:** the communities do not have access to any natural gas transmission network. The Keekar wood is commonly used as fuel wood for both cooking and heating purposes. Keekar forests also provide fodder for the livestock.

Marine ecosystem: a very few fishermen from Goth Mayo are reliant on Gharo Creek to catch fish. Due to their minor dependence, the marine ecosystem plays a very insignificant role in determining the socioeconomic conditions of the communities.

3. Key Issues Identified and Perception	
The summary of issues raised by the key respondents from the communities related to the ecosystem services and the impact of current developments of Port Qasim on the ecosystem services is provided below:	
1	**Issues related to Fauji Fertilizer Bin Qasim Plant (FFBL) in Port Qasim Eastern Industrial Zone:** The FFBL is located nearly 1.5 km to the south of the communities. The air emissions from the plant has adversely impacted the ambient air quality resulting in a number of air borne diseases in the local including eye, skin and breathing problems. FFBL discharge liquid effluents in a designed nullah flowing to the east of the communities. The water in nullah contains a high number of dissolved chemicals. The water from the nullah is utilized by the locals to feed their livestock. Due to presence of untreated chemicals in the water, the communities have faced a huge loss of livestock in the near past.
2	**Issues related to payments against acquired land by Port Qasim:** The respondents of consulted communities reported that they were originally settled at Port Qasim area in their native Goth named Goth Ali Khan. They were forced to relocate in 1970's for the development of Port Qasim. The government acquired land from the locals committing just payments against purchase land. Till to date, no one has received sufficient compensation for the acquired land. The locals have filed cases in High Court against unjust payments made by the government, but due to lack of political support and monetary .resources, locals are not yet able to receive any compensation for their land.

Female

Stakeholder/s:	1. Goth Haji Ibrahim 2. Mir Khan Baloch 3. Hajo Khan Zohrani	4. Natho Tando Khoso 5. Haji Jhangi Khan 6. Goth Mayo
Consultation:	PESR Scoping, PESR Perceptions and Vulnerability and CIA Scoping	
Date:	June 13, 2015	
Time:	10:35 pm	
Meeting Venue:	Compound of the village	
Key Respondents:	*Name*	*Contact Number*
	Sughra Khatoon Marium Asma Zulaikha Samina	0313 201 3643
HBP Consultation Team:	Dr. Anne Sweetser Sadia Khalid	
Conducted by:	Sadia Khalid	
Recorded by:	Dr. Anne Sweetser Sadia Khalid	
Language:	Urdu, Sindhi	
Preamble:	A combined consultation session with the non-fishing communties located to the northeast of the Port Qasim was held at the common sitting area outside the local market of Goth Haji Ibrahim. A combined consultation session was held due to the proximity in the location of the communities and their common interest and concerns associated with Port Qasim industria zones. Representatives from the communities were not willing to share much of the infomration due to their lack of interest in such surveys, as the communities have been visited by various Non-Governmental Organizations (NGOs) and consulting firms including HBP in past few years but nothing positive has yet happebed to improve their socioeconomic conditions. However, the communities, during informal discussion did share some of their concerns related to current developments. The discussion started with an introduction of the consultation team members. The community was briefed about the purpose of the meeting by providing a brief information to the attendees about the ESR and CIA studies. A comprehensive picture of the current and proposed developments at Port Qasim and briefed about the future plans of IFC for developing jetties at Port Qasim was given. At the end of the informative session, the attendees were invited to share their comments and concerns about the current and future developments at Port Qasim and provide their overview about ecosystem services (particularly those offered by their neighboring creek system) and their dependence on these ecosystem services. The consultation also focused on; identifying possible Valued Environmental and Social Components, as well as identifying any key perceptions, vulnerability and issues of these communities.	

	The meeting minutes are documented below to provide the record.

1. Ecosystem Services and Percentage of Community Dependent on Ecosystem Services

Ecosystem Service	*Description of Specific Service and Notes*	*Reported Percentage of Community Dependent on Ecosystem Services*
Fresh Water	Water from Gharo nullah used for drinking and washing purposes.	100
Air Quality (Regulation of disease)	The emission from industries in Port Qasim is causing serious health issues for the community as well as the livestock.	100

Alternative means of livelihood

None

2. Possible Valued Environmental and Social Components (VECs) based on discussions:

Water: Women use water from Gharo nullah to wash clothes. This activity is done close to nullah.

Air: In the absence of electricity, wind is the only source for cooling the temperature in summer.

3. Key Issues Identified and Perception

The summary of issues raised by the key respondents from the communities related to the ecosystem services and the impact of current developments of Port Qasim on the ecosystem services is provided below:

1	**Issues related to health services:** There is no basic health service unit in community. The patient is usually taken to hospitals in Karachi or Gharo which takes a lot of time and this has been a cause of a few deaths in the community.
2	**Issue related to drinking water:** Water lines are available but they have dried since a few months. People from community fetch water from nearby nullah.
3	**Issues related to Fauji Fertilizer Bin Qasim Plant (FFBL) in Port Qasim Eastern Industrial Zone:** The FFBL is located nearly 1.5 km to the south of the communities. The air emissions from the plant has adversely impacted the ambient air quality resulting in a number of air borne diseases in the local including eye, skin and breathing problems. There are reports of livestock deaths from drinking water that has been contaminated by liquid discharge from the industry.
4	**Issues related to education services:** There is only one primary school in the village which is not in working condition. There is a strong demand for better education services in the community.

4. Ecosystem service and its vulnerability status (based on Diversity of Income, Education, Health, Assets, Access to Alternative Sources of Income and Issues Raised by the Community).

Ecosystem service	*Vulnerability*
Fresh Water	High
Air Quality (Regulation of disease)	High
Biological raw materials from timber and other wood products, fibers and resins, animal skins, sand, and ornamental resources	High
Marine Ecosystem Food from crops, livestock, capture fisheries, aquaculture, and wild foods	Low

ESR and CIA for Port Qasim

Male

Stakeholder/s:	1. Humar Khan 2. Mir Khan Baloch 3. Pir Bux	
Consultation:	PESR Scoping, PESR Perceptions and Vulnerability and CIA Scoping	
Date:	June 13, 2015	
Time:	12:00 pm	
Meeting Venue:	Dera of Muhammad Amin (notable from Mir Khan Baloch)	
Coordinates	N 24° 51' 11.3'', E 67° 26' 39.8''	
Key Respondents:	*Name*	*Contact Number*
	Muhammad Amin Nawaz Ali Baloch Sadheer Ahmed	0322 325 2639 0323 299 2636 -
HBP Consultation Team:	M Salman Ahmed Waris Ali	
Conducted by:	M Salma Ahmed	
Recorded by:	M Salman Ahmed	
Language:	Urdu	
Preamble:	The discussion started with an introduction of the consultation team members. The community was briefed about the purpose of the meeting by providing a brief information to the attendees about the ESR and CIA studies. A comprehensive picture of the current and proposed developments at Port Qasim and briefed about the future plans of IFC for developing jetties at Port Qasim was given. At the end of the informative session, the attendees were invited to share their comments and concerns about the current and future developments at Port Qasim and provide their overview about ecosystem services (particularly those offered by their neighboring creek system) and their dependence on these ecosystem services. The consultation also focused on; identifying possible Valued Environmental and Social Components, as well as identifying any key perceptions, vulnerability and issues of these communities. The meeting minutes are documented below to provide the record.	

1. Ecosystem Services and Percentage of Community Dependent on Ecosystem Services

Ecosystem Service	*Description of Specific Service and Notes*	*Reported Percentage of Community Dependent on Ecosystem Services*
Regulation of soil quality	Soil fertility contributing towards agricultural practices The narrowing gap between sea water and shoreline, due to decline in rainfall patterns, affecting soil quality by degrading ground water	50
Regulation of soil quality	Soil fertility contributing towards agricultural practices The narrowing gap between sea water and shoreline, due to decline in rainfall patterns, affecting soil quality by degrading ground water	50
Fresh Water	The fresh water from rain serving as the only source to support agriculture.	50
Water cycling	The climate change has reduced rain falls in the area and flow of fresh water into the Indus Delta reducing availability of fresh water,	80
Biological raw materials from timber and other wood products, fibers and resins, animal skins, sand, and ornamental resources	The forests of Keekar (thorny bushes) in the area serve as the main fuel source for the fishermen for cooking and heating purposes.	100

Alternative means of livelihood

Daily wage labor

2. Possible Valued Environmental and Social Components (VECs) based on discussions

- **Terrestrial ecosystem:** a considerable percentage of the residents (nearly 50%) is engaged in agricultural activities cultivating vegetables and mangoes as subsistence food. The agricultural yield is greatly dependent on the fertility of soil which is deteriorating due to decrease in rainfall patterns and use of hybrid seeds.

Fresh Water: The climate change, experienced since early 1990's has adversely altered the rainfall patterns of the area. Due to less rainfall events, the fertility of the soil is reducing at an alarming rate marginalizing the agricultural practices of the communities.

3. Key Issues Identified and Perception

The summary of issues raised by the key respondents from the communities related to the ecosystem services and the impact of current developments of Port Qasim on the ecosystem services is provided below:

1	**Issue Related to Introduction of Hybrid Seed:** Local residents are found to be engaged in agricultural activities. The recent introduction of hybrid seed has greatly reduced the agricultural yield due to its chemical nature. The natural seed, adapted to their climate and soil conditions is now rarely available and the communities do not have sufficient fresh water and resources to purchase fertilizers to facilitate farming by utilizing hybrid seed.
2	**Issues Related to Climate Change:** Since last couple of decades the area has received very scanty rainfalls. This decrease in rainfall has degraded existing fresh water resources, lowering of ground water table, affecting their agricultural practices.
3	**Issues Related to Lack of Employment Opportunities:** The communities have no access to proper educational facilities. Therefore, socioeconomic conditions of the communities are compromised as the residents do not enjoy availability of employment opportunities matching their skill level. A very few individuals are working as daily wage labor at Pakland cement and Pakistan Steel Mills. The community requested to facilitate them with a secondary level school to improve educational conditions which in turn is expected to open a number of other employment opportunities for them.

Female

Stakeholder/s:	1. Humar Khan 2. Mir Khan Baloch 3. Pir Bux	
Consultation:	PESR Scoping, PESR Perceptions and Vulnerability and CIA Scoping	
Date:	June 13, 2015	
Time:	12:00 pm	
Meeting Venue:	Residence of Nawaz Ali	
Key Respondents:	*Name*	*Contact Number*
	Saleemat Noor Khatoon Noor Bibi Niamat Hanifa Sakina Sukhan Marium	-
HBP Consultation Team:	Dr. Anne Sweetser Sadia Khalid	
Conducted by:	Sadia Khalid	
Recorded by:	Dr. Anne Sweetser Sadia Khalid	
Language:	Urdu, Sindhi	
Preamble:	The discussion started with an introduction of the consultation team members. The community was briefed about the purpose of the meeting by providing a brief information to the attendees about the ESR and CIA studies. A comprehensive picture of the current and proposed	

	developments at Port Qasim and briefed about the future plans of IFC for developing jetties at Port Qasim was given. At the end of the informative session, the attendees were invited to share their comments and concerns about the current and future developments at Port Qasim and provide their overview about ecosystem services (particularly those offered by their neighboring creek system) and their dependence on these ecosystem services. The consultation also focused on; identifying possible Valued Environmental and Social Components, as well as identifying any key perceptions, vulnerability and issues of these communities. The meeting minutes are documented below to provide the record.

1. Key Issues Identified and Perception

The summary of issues raised by the key respondents from the communities related to the ecosystem services and the impact of current developments of Port Qasim on the ecosystem services is provided below:

1	**Issues related to health services:** The respondents informed that hepatitis, allergies, cough, influenza and kidney issues are very common in the community. The community members suffer due to the unavailability of basic health services in the community.
2	**Issues related to education services:** Mothers were reporting that their male children were not getting environment suitable for learning to be a better human beings. This was mainly due to lack of educational services at any level.

2. Ecosystem service and its vulnerability status (based on Diversity of Income, Education, Health, Assets, Access to Alternative Sources of Income and Issues Raised by the Community).

Ecosystem service	*Vulnerability*
Regulation of soil quality	Medium
Fresh Water	Medium
Water cycling	High
Biological raw materials from timber and other wood products, fibers and resins, animal skins, sand, and ornamental resources	High

ESR and CIA for Port Qasim

Male

Stakeholder/s:	Gulshan-e-Hadeed	
Consultation:	PESR Scoping, PESR Perceptions and Vulnerability and CIA Scoping	
Date:	June 13, 2015	
Time:	13:30 pm	
Meeting Venue:	Residence of Makhdoom Family	
Coordinates:	N 24° 52' 10.9", E 67° 21' 17.2"	
Key Respondent:	*Name*	*Contact Number*
	Muhammad Umaiz	0345 360 2554
HBP Consultation Team:	M Salman Ahmed Waris Ali	
Conducted by:	M Salman Ahmed	
Recorded by:	M Salman Ahmed	
Language:	Urdu	
Meeting Minutes:	Gulshan-e-Hadeed is located at an altitude of 200 feet above Port Qasim. Therefore, the area does not is not affected by many of the issues likes traffic, noise and air emissions associated with the development of Port Qasim. Due to its proximity, development and a semi-urban status, the employees working in industries at Port Qasim and Pakistan Steel Mills prefers to relocated to the settlement from Karachi. This has increased the population of Gulshan-e-Hadeed from few thousand to above hundred thousand in last few years. This rapid urbanization and influx of people form Karachi city has exhausted educational and health facilities at Gulshan-e-Hadeed. The residents of the settlement are mostly educated. Therefore, Port Qasim Area and Pakistan Steel Mill offer a number of employment opportunities to the educated and skillful individuals. Gulshan-e-Hadeed has well developed water, electricity, and gas transmission networks. The area has ample number of private schools and clinics. Due to its rapid urbanization, the area has a mixed ethnic culture. Commonly found ethnic groups include various castes of Sindhis and Balochis. When Mr Umaiz was asked about the ecosystem services provided by the Port Qasim Area and the community dependence on those services, he told that due to urbanization and availability of necessities by Karachi Development Authority, the communities are not directly dependent on any ecosystem services. However, he pointed out the deteriorating air quality as an alarming situation but did not directly related it to the Port Qasim developments.	

1. Ecosystem Services and Percentage of Community Dependent on Ecosystem Services
None
2. Key Issues Identified and Perceptions
None

ESR and CIA for Port Qasim

Male

Stakeholder/s:	Morand Khan Qaiserani	
Consultation:	PESR Scoping, PESR Perceptions and Vulnerability and CIA Scoping	
Date:	June 14, 2015	
Time:	12:45 pm	
Meeting Venue:	Government Middle School	
Coordinates:	N 24° 51' 31.9'', E 67°23' 04.4''	
Key Respondents:	*Name*	*Contact Number*
	Ayaz	0322 211 2260
	Muhammad Akram	0321 254 6184
	Ali Ahmed	0321 291 2445
	Muhammad Fazal	0323 224 4109
	Ghulam Rasool	0321 737 5916
	Abdul Rehman	0344 273 0398
	Saddam Hussain	0322 247 6165
HBP Consultation Team:	M Salman Ahmed Waris Ali	
Conducted by:	M Salman Ahmed	
Recorded by:	M Salman Ahmed	
Language:	Urdu	
Preamble:	The discussion started with an introduction of the consultation team members. The community was briefed about the purpose of the meeting by providing a brief information to the attendees about the ESR and CIA studies. A comprehensive picture of the current and proposed developments at Port Qasim and briefed about the future plans of IFC for developing jetties at Port Qasim was given. At the end of the informative session, the attendees were invited to share their comments and concerns about the current and future developments at Port Qasim and provide their overview about ecosystem services (particularly those offered by their neighboring creek system) and their dependence on these ecosystem services. The consultation also focused on; identifying possible Valued Environmental and Social Components, as well as identifying any key perceptions, vulnerability and issues of these communities. The meeting minutes are documented below to provide the record.	

1. Discussion on Ecosystem Services and Percentage of Community Dependent on Ecosystem Services
During the consultation meeting, Mr Ahmed asked questions to inquire and identify the VECs and ecosystem services. The attendees only indentified air and water quality as key environmental components on which they rely. The community, due to its location, is adversely impacted by the air quality. Wind from the northeast carries emissions from Pakland cement while, while winds from southwest direction is concentrated with the pollutants from the industries in Port Qasim Authority. There is no fresh water source available for the local community to meet their daily water requirements. They either have to purchase water tanker from the hydrants, or bring water from nearby Karachi Development Authority water supply pipeline. 50% of the community members work as agriculture labor at Gharo, while remaining 50% work as daily wage labor in Gharo, Dhabeji and Ghaggar Phattak area. Only three individuals are working as permanent employee at Pakistan Steel Mills.
2. Key Issues Identified and Perception
The summary of issues raised by the key respondents from the community is provided below:

1	**Issues related to location and development of Port Qasim:** The community of Morand Khan Qaiserani was originally located in Port Qasim Authority area. For development of the port, the community was asked to relocate with a commitment that a model village would be developed for them to resettle with all necessities to support life. The community was promised that during port development, community members will be trained and permanent employment will be provided. The commitments made by the government are not yet fulfilled. No model village was developed, and the community was forced to relocate without any proper planning. Community still lacks proper social infrastructure with no access to quality health and education facilities.
2	**Issues related to lack of employment opportunities:** The key respondents reported to have no permanent source of livelihood. There are no educational facilities located near the community, and due to compromised socioeconomic conditions, the residents of the community cannot afford to send their children to schools and colleges in Gharo or Karachi city. This, in turn, has marginalized the socioeconomic development of the local residents, restricting their economic activities to earn livelihood as laborers and farmers. In addition, the community, several times, has put serious efforts to earn employment at Port Qasim matching their educational and skill level, but due to politicize management of the port, no individual has ever been able to get as positive response from the port's management.

Female

Stakeholder/s:	Morand Khan Qaiserani	
Consultation:	PESR Scoping, PESR Perceptions and Vulnerability and CIA Scoping	
Date:	June 14, 2015	
Time:	12:50 pm	
Meeting Venue:	House of Zarina	
Key Respondents:	*Name*	*Contact Number*
	Parpai Zainab Chagli Zarina Hajiani Jannat Safiyaan	
HBP Consultation Team:	Anne Sweetser Sadia Khalid	
Conducted by:	Sadia Khalid	
Recorded by:	Anne Sweetser Sadia Khalid	
Language:	Urdu, Sindhi	
Preamble:	The discussion started with an introduction of the consultation team members. The community was briefed about the purpose of the meeting by providing a brief information to the attendees about the ESR and CIA studies. A comprehensive picture of the current and proposed developments at Port Qasim and briefed about the future plans of IFC for developing jetties at Port Qasim was given. At the end of the informative session, the attendees were invited to share their comments and concerns about the current and future developments at Port Qasim and provide their overview about ecosystem services (particularly those offered by their neighboring creek system) and their dependence on these ecosystem services. The consultation also focused on; identifying possible Valued Environmental and Social Components, as well as identifying any key perceptions, vulnerability and issues of these communities. The meeting minutes are documented below to provide the record.	

1. Discussion on Ecosystem Services and Percentage of Community Dependent on Ecosystem Services

During the consultation meeting, Ms Khalid asked questions to inquire and identify the VECs and ecosystem services. The attendees only indentified air and water quality as key environmental components on which they rely.

The community, due to its location, is adversely impacted by the air quality. Wind from the northeast carries emissions from Pakland cement while, while winds from southwest direction is concentrated with the pollutants from the industries in Port Qasim Authority.

There is no fresh water source available for the local community to meet their daily water requirements. They either have to purchase water tanker from the hydrants, or bring water from nearby Karachi Development Authority water supply pipeline.

50% of the community members work as agriculture labor at Gharo, while remaining 50% work as daily wage labor in Gharo, Dhabeji and Ghaggar Phattak area. Only three individuals are working as permanent employee at Pakistan Steel Mills.

2. Ecosystem service and its vulnerability status (based on Diversity of Income, Education, Health, Assets, Access to Alternative Sources of Income and Issues Raised by the Community).

Ecosystem service	*Vulnerability*
Fresh water	High
Air quality (contributing towards regulation of air borne diseases)	High

ESR and CIA for Port Qasim

Male

Stakeholder/s:	Soomar Jokhio	
Consultation:	PESR Scoping, PESR Perceptions and Vulnerability and CIA Scoping	
Date:	June 14, 2015	
Time:	14:00 pm	
Meeting Venue:	Office of Muhammad Ilyas (local contractor and community representative)	
Coordinates:	N 24° 52' 09.4'', E 67°22' 36.0''	
Key Respondent:	*Name*	*Contact Number*
	Muhammad Ilyas	0333 326 3446
HBP Consultation Team:	M Salman Ahmed (MA), Associate Waris Ali (WA), Field Assistant	
Conducted by:	MA	
Recorded by:	MA	
Language:	Urdu	
Meeting Minutes:	Mr Ilyas was briefed about the purposed of the visit. Mr Ahmed provided an outline of ESR and CIA studies. Mr Ilyas reported to have no concerns with the current and proposed developments at Port Qasim. The summary of the meeting held with Mr Ilyas is provided below: Soomar Jokhio is located, approximately, to the north of the Port Qasim. The community was leveled by Pakistan Steel Mills (PSM) over some land ownership disputes nearly a decade ago. The notables of the community filed a case against PSM seeking for justice. After 3 years of long struggle, the community managed to acquire ownership rights for their land. The community is currently in developing processes. Nearly 40% of the community has been rebuilt with 100% masonry structures. Most of the community members are working as daily wage labor at Ghaggar Phattak, Gharo, Dhabeji and Port Qasim Authority areas. There is no permanent source of income available; neither the community has access to government schools and medical facilities. Children from the community attend private schools at Gulshan-e-Hadeed due to its proximity to the community. However, due to lack of economic resources and employment opportunities, very few families form the community can afford to send their children to the private schools. Overall, the community reported no concerns related to the developments at Port Qasim. The community reported to have no direct dependence on any ecosystem service offered by the environment in which they live.	
1. Ecosystem Services and Percentage of Community Dependent on Ecosystem Services		
None		
2. Key Issues Identified and Perceptions		
None		

Female

Stakeholder/s:	Soomar Jokhio	
Consultation:	PESR Scoping, PESR Perceptions and Vulnerability and CIA Scoping	
Date:	June 14, 2015	
Time:	14:00 pm	
Meeting Venue:	Residence of Muhammad Ilyas (local contractor and community representative)	
Key Respondent:	*Name*	*Contact Number*
	Muhammad Ilyas	0333-3263446
HBP Consultation Team:	Dr Anne Sweetser Sadia Khalid	
Conducted by:	Sadia Khalid	
Recorded by:	Dr. Anne Sweetser Sadia Khalid	
Language:	Urdu, Sindhi	
Meeting Minutes:	Community was briefed about the purposed of the visit. Ms Khalid provided an outline of ESR and CIA studies. Community reported to have no concerns with the current and proposed developments at Port Qasim. They are masons and carpenters by profession. Women in community are given liberty to visit markets and buy groceries, they also help their families financially by stitching clothes and by participating in local rotating savings and credit associations (committee). All the basic facilities like health and education services are availed at nearby Gulshan-e-Hadeed Town.	
1. Ecosystem Services and Percentage of Community Dependent on Ecosystem Services		
None		
2. Key Issues Identified and Perceptions		
None		

ESR and CIA for Port Qasim

Male

Stakeholder/s:	Fisheries Development Board	
Consultation:	Scoping Consultation	
Date:	June 22, 2015	
Time:	2pm	
Meeting Venue:	FDB Office, Karachi	
Attended By:	*Name*	*Contact Number*
	Faisal Iftikhar	0333 222 5941
HBP Representatives:	Kamran Minai (KM)	
IFC Representatives:	Sally Johnson	
Conducted by:	Sally Johnson	
Recorded by:	KM	
Language:	English	
Preamble:	Faisal Iftikhar was already aware of the Cumulative Impact Assessment and Ecosystem Services review being carried out by HBP for IFC's investment in Port Qasim from the workshop held by HBP on 17th June 2015. Sally Johnson inquired about the availability of information which can be used to assign an economic value to the environmental resources of the Port Qasim area. Faisal Iftikhar recommended meeting the Marine Fisheries Department for this information and highlighted that in recent times three research vessels have carried out research activities in the area.	

Identified VECs and Ecosystem Services

VECs identified:

1. Fishing grounds

Ecosystem Services:

1. Fish stocks for human consumption especially commercial purposes

Institution's Perception about the Ecosystem Services	
The summary of issues raised by the key respondents from the institution is provided below:	
No.	*Issue Raised*
1	**Issues Related to Implementation of a no fishing zone and the mafia:** Faisal Iftikhar described how the FDB has been campaigning for a no-fishing zone to be established in the Port Qasim area. He stated that the Port Qasim Authority has jurisdiction over ~25% of the creek area; if a no-fishing zone can be established within it then this is a start. He went on to state that reasons for establishing this can also include security and international regulations. He further stated that in the Port Qasim area fishermen are often catching fish for animal feed purposes. Faisal Iftikhar also stated that in the past there was an agreement between the various stakeholders involved in activities at the creeks to follow a ban on fishing during the months of June and July mainly because during this period young shrimp are moving out to the open sea after birth and because monsoons result in rough seas which are unsafe for fishermen. He then highlighted that this ban could not be implemented because there is pressure from local landlords to continue fishing regardless of no-fishing zones and during periods when there is agreement to ban fishing such as in June and July. He explained that there is only a projection that no-fishing zones and fishing bans during certain periods will adversely affect local fishermen and fishing communities. He also stated that fishermen from Sindh are not the only ones in the area; there are also fishermen from Khyber Pakhtoonkhwa who take a short term view of the fisheries business and are not interested in sustainability of the fisheries.

D.3 Record of Institutional Consultation, Briefing and Workshops

D.3.1 Record of Consultations and Briefings

See following pages.

ESR and CIA for Port Qasim

Male

Stakeholder/s:	World Wildlife Fund Pakistan	
Consultation:	Scoping Consultation	
Date:	June 22, 2015	
Time:	11 pm	
Meeting Venue:	WWF Office, Karachi	
Attended by:	*Name*	*Contact Number*
	Muhammad Moazzam Khan	0300 211 4066
	Umair Shahid	021 3454 4791/92
	Altaaf Hussain Sheikh	0321 824 2115
HBP Representatives:	Kamran Latif Minai (KM)	
IFC Representative:	Sally Johnson	
Conducted by:	Sally Johnson	
Recorded by:	KM	
Language:	English	
Preamble:	Sally Johnson, of the IFC, outlined the reasons for HBP carrying out a Cumulative Impact Assessment (CIA) and Ecosystem Services Review of the Port Qasim area. The two main reasons stated were the due diligence requirement by the IFC and the need for a CIA in the case of multiple investments. Moazzam Khan, of the WWF, provided a timeline of studies having been conducted of the Port Qasim area along with his extensive experience in studying the area. He referred to a baseline study carried out in 1975 stating that at the time the habitat was 'pristine'. He also referred to a study of the flora of the Indus Delta carried out in the 1920s and published in the Indian Journal of Botany. Following referencing these older studies, he highlighted that current information shows how the area has changed with time and development of human activities such as the establishment of industry and expansion of human settlements. According to him a significant concern for the ecology of this area is the increase in pollution and release of effluence into the aquatic system. Sally Johnson stressed that any information on the presence of threatened or endangered species in the Port Qasim area would be extremely valuable especially in gaining support for mitigation measures and management options for the area. Both Moazzam Khan and Umair Shahid were in agreement that there are no endangered or endemic species in the Port Qasim area. Moazzam Khan stated that human activity has influenced the environment of Port Qasim for the past 30 years. However, he stressed that the Indus Delta is a very dynamic system and that an increase in salinity to three to four times higher than sea water is a result of the natural movement of the River Indus.	

	On the issue raised by Sally Johnson regarding comparisons of the environmental performance of the Port Qasim Authority versus the Karachi Port Trust, Moazzam Khan explained that the latter is more environmentally aware and vigilant. He stated that they have taken measures including the setting up of barriers, retention of solid waste and investment of considerable funds in environmental protection measures.

Identified VECs and Ecosystem Services

VECs identified:

1. Fishing grounds for local communities
2. Recreational fishing grounds

Ecosystem Services:

1. Protection against flooding and storm surges provided by the mangroves
2. Breeding grounds for marine life including economically important species

Institution's Perception about the Ecosystem Services

The summary of issues raised by the key respondents from the institution is provided below:

No.	*Issue Raised*
1	**Issues Related to Pollution:** Moazzam Khan highlighted that when the Port Qasim area was a pristine habitat dolphins such as the Indo-Pacific humpback dolphin was common. However, with increase in pollution over the passage of time this species is no longer observed in the area because it is extremely sensitive even to low levels of pollution. Today it can only be seen in some of the less polluted creeks such as the Issaro creek where four individuals were observed in 2013. Pollution was also highlighted as a major factor keeping foraging populations away from the creeks in the Port Qasim area. The dolphin populations near the Port Qasim area were described by Moazzam Khan as vibrant. However, he explained that they remain outside the Port Qasim area because they are very sensitive to pollution. He also stated that, to some extent, fishing activity also hinders the activity of these species within this area. Moazzam Khan also described a study conducted on the Phitti creek system which demonstrated that this area's productivity is dependent on turbidity of the water as this factor controls light penetration. Therefore, turbidity was cited as a measure for determining productivity. The main forms of pollution and their sources were described as organic pollution from Bhains Colony, effluent from the Pakistan Steel Mills being noxious, waste from tanneries and thermal pollution from power plants which is very intolerable by marine animals as they cannot stand such sharp rises in the temperature of water. Furthermore, the dumping of solid waste in the sea was highlighted as being a significant form of pollution resulting in habitat alteration. Moazzam Khan also highlighted future developments of the Port Qasim area being a factor that can easily increase the level of pollution in the area, for example, developments in the hinterland of Port Qasim as well as the likelihood of more coal projects. He stressed the need for the determination of a carrying capacity and the enforcement of caps on development. The species *Lingula*, the Lampshell Brachiopod, was cited as an example of a species that has become extinct with acceleration of its rate of extinction being a result of disruption of biodiversity due to high organic matter content of effluents as well as thermal and chemical pollution.

2	**Issues Related to Species Richness and Data Collection:** Moazzam Khan stated that there have been no studies conducted exclusively on cetaceans in this area. Both he and Umair Shahid agreed that a 1 week survey would be needed to identify the presence of cetaceans. The Black Finless Porpoise was also stated as a data deficient species of the area. According to Moazzam Khan some have been observed near the outer margins of Bundal Island. Concerning green turtles Umair Shahid stated that they are a rare sighting as there are no feeding grounds for them in the Port Qasim area. Furthermore, in a 2009-10 assessment no live turtles or cetaceans were observed; only carcasses were found. In the last 40 years no turtle nesting has been observed either. Over fishing and illegal fishing practices such as use of the Estuarine Set Back Net (locally called Bulla Ghujja) were also highlighted as factors affecting species richness. Both Moazzam Khan and Umair Shahid stressed the need for zoning to protect fish populations. Furthermore, hunting of birds was also described as having adverse effects on bird populations in the area.
3	**Issues Related to The Mangroves:** In terms of Mangrove cover both Moazzam Khan and Umair Shahid stated that this has increased in Pakistan. They stated that mangroves have only been damaged in the channel area. They also highlighted that naturally occurring mangroves are flourishing whilst planted ones are suffering. Reasons for this include issues with site selection and species selection. Moazzam Khan stated that this been observed both in the Port Qasim area and at Sandspit where the Lyari River flows into the sea. Within Port Qasim they identified the eastern side has having more mangrove cover compared to the western side with the former also being healthier and of better quality. They stated that the western side has undergone more development relative to the eastern side but that the western side already has very small mangroves cover. Umair Shahid recommended the use of a pictorial timeline to observe and record changes in planted mangroves with time. Moazzam Khan highlighted that there is a lack of data on the mangrove cover with various organizations quoting different figures. He stressed the need for an investigation into the real mangrove cover in the Port Qasim area and in Pakistan. However, he reiterated that between 1992 and 2014 there has been a clear increase in mangrove density.
4	**Issues Related to Changes in Topology:** Moazzam Khan explained that land erosion mapping from 1952 to 2006 has shown that the Indus creek system is very dynamic even without human intervention. However, he further explained that some significant changes have been caused by human activity such as an increase in the depth of a large area within Port Qasim as a result of construction of the channel. The depth in this area was between five and ten meters but currently is thirty meters. He stated that this is not due to dredging but due to changes in topology as a result of extensive use of that channel for shipping purposes. Concerning dredging Moazzam Khan stated that this process can completely displace sediments and change topology as demonstrated by conditions in the Pasni Harbour in Balochistan where a former channel is now covered with sediment. He explained the need for coastal engineering to manage these issues.

ESR and CIA for Port Qasim

Male

Stakeholder/s:	Marine Fisheries Department	
Consultation:	Scoping Consultation	
Date:	June 22, 2015	
Time:	3 pm	
Meeting Venue:	MFD Office, Karachi	
Attended by:	*Name*	*Contact Number*
	Shaukat Hussain	0347 205 3608
	Muhammad Wasim Khan	–
HBP Representatives:	Kamran Minai (KM)	
IFC Representatives:	Sally Johnson	
Conducted by:	Sally Johnson	
Recorded by:	KM	
Language:	English	
Preamble:	Sally Johnson explained the purpose of HBP carrying out a Cumulative Impact Assessment and Ecosystem Services Review as part of a requirement by the IFC to invest further in the Port Qasim area. She also explained that HBP and IFC are currently trying to obtain information on aspects of biodiversity within the Port Qasim area and the associated creek system. Shaukat Hussain stated that this area is rich in terms of biodiversity with more than 150 species having been identified. He also stated that in recent times the Forest Department has carried out plantation of mangroves resulting in an increase in mangrove cover. He explained that the area is a breeding ground for various species including fish and shrimp species; the area provides nesting sites and hatcheries from where animals at the pre-adult stage move out into the open sea mainly during June and July. He went on to state that this is one of the reasons for attempts at implementing a ban on fishing during these months. Muhammad Wasim Khan stated that an extensive study of the creek area, including the Port Qasim area, has recently been carried out which includes assessment of factors such as sedimentation, water Quality, biodiversity and socioeconomics. He stated that the results of this study will be available in August 2015.	

Identified VECs and Ecosystem Services
VECs identified: 1. Fishing grounds for local communities 2. Biodiversity rich area 3. Breeding grounds for marine life Ecosystem Services identified: 1. Fish stocks for commercial purposes

Institution's Perception about the Ecosystem Services

The summary of issues raised by the key respondents from the institution is provided below:

No.	*Issue Raised*
1	**Issues Related to fishing mal-practices and over exploitation of fisheries:** Shaukat Hussain highlighted that the lack of implementation of a ban during June and July has resulted in adverse impacts on the populations of some marine animal species as animals at the pre-adult stage are killed. He also stated that fishermen trading in juvenile fish are applying pressure to stop implementation of the ban and that they continue to use the Bulla Ghujja net, the use of which is illegal.

ESR and CIA for Port Qasim

Male

Stakeholder/s:	Trust for Conservation of Coastal Resources	
Consultation:	Scoping Consultation	
Date:	June 30, 2015	
Time:	11 am	
Meeting Venue:	F11/2, Islamabad	
Attended by:	*Name*	*Contact Number*
	Zubeda Birwani	0300 251 9465
HBP Representatives:	Kamran Minai (KM)	
Conducted by:	KM	
Recorded by:	KM	
Language:	Urdu, English	
Preamble:	KM described the IFC's investment in Port Qasim and their requirement to carry out a Cumulative Impact Assessment (CIA) and Ecosystem Service Review (ESR) for their multiple investments in the area. KM also clarified HBP's role in carrying out this CIA and ESR including the consultations with various stakeholders, both institutional and community based. Zubeda Birwani highlighted that TCCR has had collaborations with numerous organizations including prominent ones such as CARE International, IUCN, WaterAid etc. She also stated that TCCR is the first organization in Pakistan combining both indigenous knowledge and scientific knowledge towards better management of Pakistan's coastal resources.	

Identified VECs and Ecosystem Services

VECs identified:

1. The mangrove ecosystem
2. Breeding habitat for marine life
3. Transport routes for local fishermen

Ecosystem Services identified:

4. Mangroves contributing to healthy air quality
5. Mangroves contributing to dust pollution mitigation
6. Mangroves providing protection against flooding and storm surges

Institution's Perception about the Ecosystem Services	
The summary of issues raised by the key respondents from the institution is provided below:	
No.	*Issue Raised*
1	**Issues Related to the Port Qasim Authority (PQA) and Karachi Port Trust (KPT):** Zubeda Birwani stated that she was displeased by the management of both PQA and KPT with respect to Karachi's coastal resources. She stressed that these organizations, including PQA, had not been successful in preventing the cutting of mangroves within the areas under their jurisdiction. The developments of concern stated by her included those associated with Fauji Fertiliser and the new jetties. In particular she was concerned about the international bulk cargo terminal, the development of which required the cutting of significant areas of mangroves. She stated that the Environmental Impact Assessment (EIA) for this was a sham. Furthermore, she stated that she had no trust in the EIAs endorsed by the Environmental Protection Agency of Pakistan. Her criticisms of the PQA included the PQA for not being truthful about the adverse impacts of mangrove cutting and the subsequent developments on the areas previously occupied by the mangroves, their lack of engagement with the community, its continued development efforts despite adverse impacts on the mangrove ecosystem, their lack of accepting responsibility for stewardship of the mangrove ecosystem and their interference to not allow planting of mangroves by the forest department (FD) and in site selection for removal of mangroves. Zubeda Birwani also highlighted that the PQA had not taken responsibility for man-made disasters and pollution such as oil from ships which is spilled onto the mangroves resulting in adverse impacts on them. She stated the occurrence of a major oil spill of this nature in 2002-2003.
2	**Issues Related to the cutting of mangroves and replantation:** Zubeda Birwani reiterated that this was a mangrove based ecosystem with the mangroves being key breeding grounds for the fish and marine life in the area. She stated that they are being cut by industries, in particular, those using them for fuel since the start of the energy crisis in Pakistan. She stressed that villagers and members of the local communities do not use mangroves for fuel and that their source of energy is primarily gas. She was of the opinion that illegal players associated with providing industries with fuel wood from the mangroves are, in part, driving removal of mangroves from the area, highlighting the Korangi creek as an example of an area where this can be observed. She stated that there is no legal agreement between industries in the area and those supplying wood from mangroves for industrial fuel use. Zubeda Birwani stated that the mangroves are very important for maintaining air quality and that cutting them has resulted in deterioration of air quality in the surrounding areas. She also stated that there has been an increase in exposure to dust as a result of mangrove removal. On the comment regarding an increase in mangrove cover in certain parts of the Port Qasim area, Zubeda Birwani agreed that there had been an increase but that this was due to re-plantation of a non-indigenous species called *Rhizofora*, not of the indigenous species *Avicennia*. She expressed her concern about the impacts of this change of species in mangroves on fish stocks and fish breeding. Furthermore, she stressed that the ratio of 1:10 for cutting to re-plantation is not a sound practice because the removal of one mangrove tree and replacement by 10 sapling does not immediately replace the ecosystem services being provided by the mature mangrove tree.

3	**Issues Related to the use of mangroves for fuel:** In continuing with the debate on mangrove removal, she stated that it is not economical for the local community members to use mangroves as fuel because of the relatively higher costs and labour intensive effort of mangrove removal and transport compared to the relatively inexpensive use of gas. She further stated that those villagers who use wood for fuel do not use mangroves, instead they rely on Keekar. She quoted figures stating that a 15day supply of mangrove wood collection costs an estimated PKR 2000/- to 2,500/- whereas gas costs PKR 300/- per month, thereby, making mangrove wood collection economically unfeasible for local communities. She also highlighted that mangrove wood collection is an unreliable source of fuel.
4	**Issues Related to chemical pollution:** Zubeda Birwani stressed that the sewage of local communities was not responsible for chemical pollution in the Port Qasim area. She further stated that if this was a source of pollution to the area, then it is a public health concern and needs to be addressed by the government.
6	**Issues Related to fishing practices:** Zubeda Birwani agreed that fishing practices are a concern. However, she highlighted that this problem has two separate aspects: one of those is the introduction of unsustainable fishing practices introduced by outsiders such as the use of the Estuarine Set-Back net and the other is the increase in greed due to removal of mangroves resulting in declines in fish stocks and hence in the use of poor fishing practices being adopted. In the first case she agreed that there are some local fishermen involved in using banned fishing nets but that the use is widespread amongst illegal immigrants fishing in these waters and by outsiders who are not interested in the sustainability of the fisheries. She highlighted that TCCR has been working to stop illegal fishing practices and has been part of the process of introducing a bill against them. Continuing on the topic of unsustainable fishing practices Zubeda Birwani stated that there are three areas that require focus: the first is that of coastal fishing which brings in very large catches, the second is that of the use of wenches which not only haul in much larger quantities of fish per netting but are also low in terms of employment opportunities (use of machinery in place of labour) and finally technological advances, such as satellites for detection of where fish are concentrated, being used to increase fish catches per unit time. She was very critical of outsiders, people not part of the local fishing communities, who did not have sustainable values and principles with respect to fishing practices. She also stressed that the local, traditional fishing practices were and still are sustainable. Concerning opinions on regulation of fishing activities, she stated that TCCR is in favour of this measure but are interested in having addressed the entity responsible for implementation.
6	**Issues Related to the building of the Dam:** She **a**greed that diversion of the Indus is a very significant issue. She also stated those affected downstream of the dam have not been considered let alone compensated. In line with man-made changes to hydrology, Zubeda Birwani stated that certain areas which use to be used for agricultural are now underwater due to intrusion by the sea.

7	**Issues Related to fishing communities:** In line with consideration of those affected downstream of the dam site, she highlighted that Karachi's fishing communities have had to pay a significant price for the development of Karachi's industrial area. Similarly, she stated that developments such as the D.H.A in Karachi have resulted in removal of mangroves and mud flats and restrictions in movements, thereby, impacting the fishing communities. She went on to pose the question of where fishing communities should relocate to find and continue activities for their livelihoods. On the matter of the ban on fishing in June and July, she stated that bans need to be species specific. Furthermore, it is necessary to address the concern of how members of the fishing community should make a living during the months that a ban is implemented. She insisted that she was no against development and wants to see financiers playing their role, however, not at the cost of the fishing communities and their livelihoods.
8	**Issues Related to the management approaches:** Zubeda Birwani was clear that TCCR are very much in favour of engagement especially with government authorities. However, she insisted that any management options they are invited to participate in need to consider multiple factors and be comprehensive as well as focused on sustainability. One of the most important factors she noted was of who the responsibility taker would be with respect to any management options decided on for the Port Qasim area. She was critical of the PQA in their lack of implementation of controls on current disagreeable activities in the area including the illegal cutting and transport of mangroves, health problems associated with industrial developments in the area such as the development of more coal processing plants and the bulk cargo terminal. Zubeda Birwani stated that the factors that need to be addressed in management plans must include potential health problems that may be caused by industrial developments such as air quality. Environmental management must also address the protection of mangroves and fishing grounds, measures to address mafias and illegal activities in the area and sustainable management of the coastal resources overall are also necessary.

ESR and CEA for Port Qasim

Stakeholder/s:	Industries of Port Qasim Area
Consultation:	Feedback and Mitigation Discussion
Date:	December 21, 2015
Time:	11:00 am
Meeting Venue:	Port Qasim Authority Meeting Room
Attended by:	Major Abir Yar Khan (AY), Senior Manager, Fauji Akbar Portia Marine Terminals Nader Cowasjee (NC), Senior Manager, Fauji Akbar Portia Marine Terminals Lt Col Asadullah Chugtai (AC), General Affairs and Security Manager, Lotte Chemical Pakistan Syed Qamar Alam (QA), Sustainability Manager, Lotte Chemical Pakistan Jamil Ajmal (JA), Director MS, PQA Tariq Yousufi (TY), Director Environment and Safety, PQA Farrukh Jamil (FJ), DG Finance, PQA Najaf Mirza (NM), DG Planning & Development, PQA Ikram Nabi (IN), Admin Incharge, Engro Polymer and Chemicals Ltd Muhammad Azhar Iqbal (AI), Deputy Manager Horticulture, PQA Abdur Rehman Ismail (AR), Secretary General, BQATI Major Khalid (MK), Manager, BQATI Rehan Siddiqui (RS), Manager Projects, MAPAK Edible Oils Muhammad Ibrahim Sahito (MI), Fire Fighting Officer, PQA Nadeem Esbhani (NE), Senior Business Manager, FWQ – Liquid Cargo Terminal Salman Tariq (ST), Assistant Admin, FWQ – Liquid Cargo Terminal Shahid Hafeez (SH), Manager Channel Dredging, PQA Jawaduddin Athar (JA), Director Channel Dredging, PQA Ammar Raza Zaidi (AZ), Assistant Manager, Fauji Oil Terminal and Distribution Co Ltd. Khwaja Hassan Mansur (KH), Environment and Industrial Hygiene Engineer, Engro Polymer and Chemicals Ltd
Conducted by:	Vaqar Zakaria (VZ), Managing Director, Hagler Bailly Pakistan
Recorded by:	Hussain Ali, Senior Engineer, Hagler Bailly Pakistan
Reviewed by:	Bilal Khan
Language:	English/Urdu
Preamble:	The session started by Mr Zakaria going through the findings of the Cumulative Environmental Assessment Study of Port Qasim Area (PQA). Presentations were delivered by Mr Zakaria regarding details of environmental baseline data collection, key environmental issues and proposed mitigation measures and management strategies. After the informative session, the participants were given an opportunity to provide comments and feedback on the proposed institutional and financial framework.

No.	Comments/Issues Raised	By	Response Provided
1.	Was any environmental mitigation and management plan proposed for Karachi Port and Gwadar Port? Will Port Qasim be the first marine port in Pakistan to adopt such environmental protection measures?	NC	Karachi Port is already contaminated and no environmental measures will be of much help in that area. Gwadar port is not developed yet and environmental management may be done in future there.
2.	Currently PQA does not have the institutional and technical capacity to implement such environmental management plan. It is advised that an Environmental Advisory Committee should be set up which could later be converted into an Environmental Committee.		This option will be considered in further planning.
3.	If the erosion of channels and depletion of mangroves is taking place due to unsustainable reclamation activities by DHA, why should we expected to pay for that?	AC	Erosion of channel banks also takes place due to waves generated by movement of ships and unsustainable dredging by PQA.
4.	Financial sustainability of the environmental management plan will be critical. However, contribution to the environmental fund will have to be approved by each industry's Board of Directors. PQA will have to communicate this request in writing for consideration of our Board.	AC	Currently different options of implementation are being considered and acceptance by industries is being explored. Any financial commitments by industries are not required at this stage.
5.	The federal government should fund all environmental work in PQA because this a national issue.	KH	Environmental degradation is being caused by companies who own the land and the industries that cause environmental degradation. It is a combined responsibility of the government and the industries in PQA to contribute to environmental protection. Government will definitely be involved and will be represented by Port Qasim Authority.
6.	We have spent PKR 35 million developing an effluent treatment plant and state of are labs to treat our waste. We cause minimum environmental damage and we should not be expected to pay more to the environmental fund.	AC	Environmental protection should be a shared and combined responsibility. If one industry is spending to treat their waste and others are releasing untreated waste in the sea, industrial development will not be sustainable. It is important all industries realize the importance of the environment and work together to protect and conserve the environment around PQA.

No.	Comments/Issues Raised	By	Response Provided
7.	Monitoring and protection of the environment should be the responsibility of SEPA. Why should we be expected to pay for something which is not our responsibility?	QA	Legally speaking, monitoring is the responsibility of the owner and not SEPA. SEPA's responsibility is to review monitoring reports submitted to them regularly by industries as per their environmental monitoring plan in approved EIA. SEPA may monitor in some cases where non-compliance to environmental standards is foreseen.
8.	An industry advisory committee should be set up to monitor environmental management work. Technical support will be provided by industries for better performance of the environmental management committee. Engro will contribute monetarily subject to results and improvement in environmental conditions of the area.	IN	Agreed. It is proposed that the environmental committee will be jointly formed by representatives from the industry and PQA. This will also increase technical capacity and transparency because the industries who will contribute to the environmental fund will have their own representatives in the committee that will decide where the money is spent.
9.	It is important that financial model is set up at an early stage to identify the scale of costs that will be involved in this work. Then industries will be in a better position if they will be able to become a party to this.	AC	Currently we are at strategic planning stage and once the implementation strategy is worked out in terms of institutional structure, further details on the duties and associated costs of the environmental committee can be worked out.

ESR and CEA for Port Qasim

Stakeholder/s:	Director General Finance, PQA
Consultation:	Feedback and Mitigation Discussion
Date:	December 21, 2015
Time:	01:00 pm
Meeting Venue:	DG Finance Office
Attended by:	Farrukh Jamil (FJ), DG Finance, PQA Tariq Yousufi (TY), Director Environment and Safety, PQA
Conducted by:	Vaqar Zakaria (VZ), Managing Director, Hagler Bailly Pakistan
Recorded by:	Hussain Ali, Senior Engineer, Hagler Bailly Pakistan
Reviewed by:	Bilal Khan
Language:	English/Urdu
Preamble:	The session started by Mr Zakaria going through the findings of the Cumulative Environmental Assessment Study of Port Qasim Area (PQA). After the informative session, the participants were given an opportunity to provide comments and feedback on the proposed institutional and financial framework. The discussions centered largely around the environmental committee and fund.

No.	*Summary of discussions*	*By*
1.	An Environmental Fund should be set up rather than an Account for environment in the PQA books. The beneficiary of the fund will remain PQA and the money will be managed by PQA. The Environmental Fund will act as a no profit Trust and will be relieved of all taxes.	FJ
2.	All inflows into PQA accounts are treated as income, and are subjected to corporate tax.	FJ
3.	PQA is not a profit making body so whatever we contribute to the environmental fund will have to be passed on to the industries. The recommended mechanisms are in the form of fines and/or levies.	FJ
4.	he FD shared the estimates for annual income figures for PQA with us, from shipping as well as land charges	FJ
5.	Environmental levy is a reasonable approach but should be a very small proportion of revenue so that it is easily accepted by industries. Once it is imposed, it can be increased in future years very easily on the basis of high environmental cost.	FJ
6.	We need approximate numbers for budget if environmental management. That way we can plan better where the money will come from.	FJ
7.	Shipping charges are collected regularly without delay because we do not allow the ship to leave port unless the dues are cleared. Quite a few landholders do not pay land charges and the charges are realized only when a land transaction/sale is made, so recovery from the industries is weak.	FJ
8.	A budget estimate should be prepared for one time and recurring costs.	FJ

No.	*Summary of discussions*	*By*
9.	Annual revenue from shipping revenue is approximately PKR 5 billion and from industries is PKR 600 million. If the industries pay as they are billed, the revenue can go up to PKR 1.5 billion.	FJ

ESR and CEA for Port Qasim

Stakeholder/s:	Port Qasim Authority
Consultation:	Discussion on way forward
Date:	December 2, 2015
Time:	11:00 am
Meeting Venue:	Port Qasim Authority (PQA) Meeting Room
Attended by:	Agha Jan Akhtar (AJ), Chairman, PQA Shabbir Anwar Qazi (SQ), DG Technical, PQA Farrukh Jamil (FJ), DG Finance, PQA DG (Planning & Development) Mirza Azhar Iqbal, Deputy Manager (Environment and Safety), PQA Larry Jiang (IFC) Shahid Lutfi (SL), International Finance Corporation
Conducted by:	Larry Jiang (LJ), International Finance Corporation Shahid Lutfi (SL), International Finance Corporation Bilal Khan (BK), Manager Environmental Programms, HBP
Recorded by:	Bilal Khan
Reviewed by:	Bilal Khan
Language:	English
Preamble:	The discussions centered largely around the environmental committee and fund.

No.	*Summary of discussions*
Commitment:	
PQA is ready to show their commitment on environment.	
Fund:	
1.	Fund needs to be a separate entity, and cannot be an account under PQA, as the legislation does not exist to be able to create an account, but a fund is possible. Shahid mentioned that a draft paper on the fund by PQA is important on how they propose to manage this, sources of revenue etc.
2.	There was mention that only donations by tenants, instead of regular payments, should be made to fund, and that it may be difficult to convince BQATI, in particular, to regularly contribute. Nonetheless, the Chairman said that the same approach will need to be used as with their normal charges, else a 'donation-based' approach is not sustainable and will not work.
3.	The IFC may be able to contribute to the fund, however this is if the PQA also contributes to this fund. This is the same for other banks and donors. Donors may also need specific projects under the fund to provide money, as well as a clear mechanism.
4.	HBP will come up with an indicative budget on 21 December: initial capital PQA requires (e.g. for boats) and on-going costs
5.	The approval for fund is firstly through PQA Board, and then Ministry. If Board gives approval, then Ministry approval will be relatively easy.

No.	*Summary of discussions*
Committee	
1.	PQA would not have a problem if there are community representatives “observing” the management of the fund or committee.
2.	Further discussion on the committee will be on 21 December
3.	Committee will oversee the fund, and start work on other aspects of M&M.
Strengthening departments:	
In previous meetings strengthening of the departments of hydrography, dredging and environment and safety was discussed. This includes both training and creation of new positions. A key point that PQA re-highlighted was that creating and filling positions to strengthen departments is not the best approach; new positions get filled politically and may therefore it is not the best approach. Instead that the PQA Committee will look at outsourcing monitoring and other aspects. Nonetheless, the PQA does need training to be able to deal with environmental consultants e.g. currently they have no capability of understanding sediment models. The PQA will not outsource some of the other aspects of implementation of the M&M such as setting up the necessary departmental structures, environmental management committee and the fund associated with M&M. PQA will, however, need support on this implementation.	
Additional discussions:	
The Chairman was mentioning, in Urdu to his DGs, that the PQA does not stand to benefit in terms of getting loans from IFC. Bilal Khan mentioned that the WB, and others, will be there at the main conference, and that things like wastewater treatment plants, or other auxiliary services (as with other industry parks operating in Pakistan) are possible and the PQA has opportunity to meet the lenders at the workshop in Feb. The Chairman also mentioned that wastewater treatment a service they can charge for. The DG Technical also mentioned that they need to look at solid waste management. Larry mentioned that IFC funding may be possible for ‘municipal’ projects, and that the 16 Feb workshop is also a good opportunity to meet other lenders. Later, some DGs pointed out to me their current water is not polluted (based on the HB study), but Bilal Khan said that the risk for pollution over time with increasing industries is very much there, and that the Environmental Committee once set up should evaluate and address the issues and risks as they arise and identified through monitoring (adaptive management), and they could look for funding through that forum once it is set up.	

ESR and CEA for Port Qasim

Stakeholder/s:	Port Qasim Authority
Consultation:	Feedback and Mitigation
Date:	November 27, 2015
Time:	11:00 am
Meeting Venue:	Port Qasim Authority (PQA) Meeting Room
Attended by:	Shabbir Anwar Qazi (SQ), DG Technical, PQA Captain Nouman Hassan (NH), DG Operations, PQA Farrukh Jamil (FJ), DG Finance, PQA Jamil Ajmal (JA), Director MA, PQA Tariq Iqbal Yousufi (TY), Director Environment and Safety, PQA Adeel (MA), PA Director Environment and Safety, PQA Jawaduddin Athar (JA), Director Dredging, PQA Sardar Jang (SJ), PQA Asad Abbas (AA), Deputy Manager PSP, PQA Nusrat Hussain Sangi (NS), Manager Planning, PQA
Conducted by:	Vaqar Zakaria (VZ), Managing Director, Hagler Bailly Pakistan
Recorded by:	Hussain Ali (HA), Hagler Bailly Pakistan
Reviewed by:	Bilal Khan
Language:	Urdu/English
Preamble:	The discussion started with the introduction of the team from Hagler Bailly Pakistan and Port Qasim Authority. Mr Zakaria briefed about the purpose and agenda of the meeting. Environmental management plan institutional restructuring framework was presented to the participants by Mr Zakaria. At the end of the presentation, the participants were invited to share their comments and concerns, which have been documented below.

No.	*Comments/Issues Raised*	*By*	*Response Provided*
1.	Is there any way to control NO_x emissions at PQA? What kind of controls are proposed for future?	AA	Current NO_x levels in PQA are within NEQS and further stricter controls on NO_x will push the cost for private investors which may discourage them from investing in industries in PQA. However, future NO_x goals such as restricting power generation at PQA to keep NO_x levels within acceptable limits.

No.	*Comments/Issues Raised*	*By*	*Response Provided*
2.	Many coal power projects are being shut down by Chinese courts due to harmful emissions. Should such restrictions be imposed at PQA?	JA	Coal power generation in China is of a very higher scale relative to that in Pakistan. Currently, coal potential is being developed and ambient air quality in Pakistan is not as bad is China. However, to prevent the same situation from being happening in Pakistan, zoning and planned development is recommended.
3.	Does the air modeling conducted by HBP take north winds into account?	NH	The modeling approach adopted by HBP took into annual weather data and the contours represent worst case scenario.
4.	Environmental management and protection in Port Qasim Area should not be the sole responsibility of Port Qasim Authority but a collaborative approach should be recommended in which SEPA, Sindh Wildlife Department, Marine Fisheries Department and industrialists can work together for the protection of environment.	SQ	Agreed. A similar approach is recommended by HBP for environmental protection.
5.	Which other stakeholders are on board with this study? Have industry owners in PQA, Bin Qasim Association of Trade and Industry (BQATI), and other stakeholders agreed to the proposed environmental management plan?	AA	Industry and terminal operators were consulted when this study was initiated. They will be consulted again in a workshop where the recommendations of the environmental management plan will be recommended to them.
6.	PQA act should be reviewed by HBP according to which everything in PQA is owned by Port Qasim Authority and they are responsible for activities in their notified area.	NH	PQA act will be reviewed. It is recommended to engage Forest Department and Wildlife Department during vigilance activities to reduce communal pressures on PQA and protect the brand in communities.
7.	We need coordinated efforts to decide between water for irrigation (from Kotri Barrage) and water for mangroves. No study has been conducted how much water should be released from Kotri Barrage for the protection of Indus Delta where mangroves are receding due to limited availability of flow in Indus River.	SQ	Sophisticated ecological modeling can be conducted in which environment upstream and downstream of Kotri Barrage will be assessed to model different scenarios. Modeling results and expert consultants will be able to advise the minimum environmental flow which should be released from Kotri Barrage.

No.	*Comments/Issues Raised*	*By*	*Response Provided*
8.	A presentation should be arranged by HBP for the board of PQA. Creating a new position at Board level for environment will be difficult. However, an environment committee can be created which can be associated with the Board.	SQ	A position dedicated to environment is important at Board level so that issues are heard at the top most level where decisions are taken. If creating a new position will be difficult, an existing Board member position can be dedicated to environment and a learned representative from private sector who has worked in environment can occupy that post.
9.	The environmental committee proposed should be headed by Director Environment and Safety at PQA. This will ensure that PQA interests are protected and the environment committee stays in check.	SQ	Agreed. This will be proposed in the environmental management plan.
10.	Generally induction at PQA is politically influenced and the staff recruited is not motivated. Therefore outsourcing is advisable for sophisticated environmental studies. Work can be outsourced to firms or individual consultants.	SQ	Agreed. Outsourcing jobs produce better and efficient results. Environmental management work should be contracted out to a specialized firm and, monitoring and should be contracted out to a separate independent firm.
11.	We do not have the capacity to prepare Terms of Reference for external consultants. We will need support from HBP to provide us with scope of work required from the consultants for environmental management and monitoring.	SQ	Sufficient information will be included in this study which can be used by PQA officials to prepare Terms of Reference for outsourcing consultancy jobs.
12.	Environmental department should be under Planning and Development department so that environmental aspects can be taken into account when planning for the future.	SQ	Environmental planning can relate to P&D and environmental monitoring can related to operations. It is recommended that Environment Department should be moved to Technical so that it works well with the Dredging and Hydrography Department. It will also help the Environment Department build technical expertise with regards to modeling and monitoring techniques.
13.	A segregated fund for Environment Department will not be allowed but a grant can be allocated for which the approval rules will be standard. However, the fund within the current financial framework of PQA can have simpler authorization rules to make transactions efficient and quick. The approval will be at PQA level and not Government level.	FJ	Agreed.

No.	*Comments/Issues Raised*	*By*	*Response Provided*
14.	To support the environmental fund, industrialists in PQA should also be asked to contribute. Every company has a CSR fund and if they agree to contribute in the centralized fund, efficiency of environmental protection activities will multiply. When the decision to use the fun will be made by the environment committee where industries and other institutions will have representation too, this will build confidence among industrialists to contribute.	SQ	Agreed.
15.	Regular publication should be encouraged to project a soft image of PQA among communities and other stakeholders. Environmental activities should be published in electronic and print media.	AA	Agreed.
16.	Other industries and associations should contribute by building technical capacity of PQA officers. PQA staff can be sent outside in the industry for weeklong courses or work placements in industries to train on the importance of environment and techniques to handle environmental issues.	FJ	Agreed.
17.	Staff within PQA should be posted in the environment department so that everyone is exposed to the importance of environment and later in their career they have more awareness of what is being done and how things help conserve the environment.	SQ	Agreed.
18.	Most of the staff who have worked at PQA over the years and managed the port are due to retire soon. We need to build technical capacity soon so that the new staff can be trained and handed over port responsibilities.	SQ	Agreed.

Closing Remarks:

A workshop to be arranged to brief industrialists in PQA, terminal operators, BQATI and representatives of other associations having stake in PQA, on the proposed environmental management plan and take them on board.

E&S Department to communicate list and profiles of the members of PQA Board to HBP.

ESR and CEA for Port Qasim

Stakeholder/s:	Port Qasim Authority
Consultation:	Feedback and Mitigation
Date:	November 27, 2015
Time:	01:00 pm
Meeting Venue:	Chairman's Office (PQA)
Attended by:	Agha Jan Akhtar (AJ), Chairman, PQA Shabbir Anwar Qazi (SQ), DG Technical, PQA Tariq Iqbal Yousufi (TY), Director Environment and Safety, PQA Jawaduddin Athar (JA), Director Dredging, PQA Asad Abbas (AA), Deputy Manager PSP, PQA
Conducted by:	Vaqar Zakaria (VZ), Managing Director, Hagler Bailly Pakistan
Recorded by:	Hussain Ali (HA), Hagler Bailly Pakistan
Reviewed by:	Bilal Khan
Language:	Urdu/English
Preamble:	The discussion started with the introduction of the team from Hagler Bailly Pakistan and Port Qasim Authority. Mr Zakaria briefed PQA staff on the purpose and agenda of the meeting. Environmental mitigation measures prepared by HBP were presented to the participants by Mr Zakaria.

No.	Comments/Issues Raised	By	Response Provided
1.	A letter should be sent by PQA to Wildlife Department and Forest Department informing them of the environmental damage caused by the communities around PQA.	AJ	Noted.
2.	Development of Approximately 16,000 acres of mangrove land is being planned. This will involve industrial units on islands and development of terminals along the current shipping channel. This development is being triggered by limited availability of land close to Karachi Port. How will the mangroves be affected by this?	AJ	Harvesting mangroves by communities is the most serious threat to mangroves at the moment which needs to be controlled. Future expansion should be well planned and controlled by carefully considering environmental aspects and damage it may cause. Development of terminals may not significantly harm mangroves by development of industrial units should be re-considered and alternate options like development on coastal land should be given priority. If mangroves being affected by limited fresh water in the Indus Delta can be protected, then the relative damage due to expansion of Port Qasim may not be very severe.

No.	Comments/Issues Raised	By	Response Provided
3.	Environmental zoning within PQA should be done by experts to advise us what can be done where.	AJ	Yes agreed. There are ways in which environmental conservation and development can work together simultaneously. For example, dredged material can be strategically dumped to develop bird islands to encourage bird feeding and nesting.
4.	The workshop with industry owners, terminal operators and other stakeholders will be important so that everyone is educated on the importance of environment conservation and can work together for a collective effort at PQA.	AJ	Agreed.

ESR and CEA for Port Qasim

Stakeholder/s:	Port Qasim Authority
Consultation:	Feedback and Mitigation
Date:	November 24, 2015
Time:	11:00 am
Meeting Venue:	Port Qasim Authority (PQA) Conference Room
Attended by:	Captain Noumqan Hassan (NH), DG Operations, PQA Tariq Iqbal Yousufi (TY), Director Environment and Safety, PQA Jawaduddin Athar (JA), Director Dredging, PQA Ibrahim Sehato (IS), Chief Fire Fighting Officer, PQA Aleem Shaikh (AS), Director Planning and Development, PQA Muhammad Yahya (MY), Director Finance, PQA
Conducted by:	Vaqar Zakaria (VZ), Managing Director, Hagler Bailly Pakistan Bilal Khan (BK), Manager, Hagler Bailly Pakistan
Recorded by:	Hussain Ali (HA), Hagler Bailly Pakistan
Reviewed by:	Bilal Khan
Language:	Urdu/English
Preamble:	The discussion started with the introduction of the team from Hagler Bailly Pakistan and Port Qasim Authority. Mr Zakaria briefed PQA staff on the purpose and agenda of the meeting. Environmental mitigation measures prepared by HBP were presented to the participants by Mr Zakaria and Mr Khan followed by discussion and feedback from PQA staff.

No.	*Comments/Issues Raised*	*By*	*Response Provided*
1.	What sort of modeling approach is suggested for prediction of sediment transport and effects of constructions in port and dredging?	TY	Hydrodynamic modeling is recommended for modeling of currents, sediment movement, and water quality. An extensive data collection exercise spreading over a year will be required to collect data for setting up the model. While capacity for data collection is available, modeling expertise is not available in the country.
2.	A study was conducted by National Institute of Oceanography for DHA to predict marine sedimentation and erosion impacts due to reclamation activities for the development of DHA.	JA	This study is requested to be shared with HBP.

No.	*Comments/Issues Raised*	*By*	*Response Provided*
3.	Dredging has been practiced by PQA since 1978 but till date PQA does not have a hydraulic expert to predict impacts of dredging. Many modeling studies have been conducted by consultants but due to limited technical capacity at PQA, coordination was weak and the recommendations of studies were not implemented. Staff with modeling expertise should be inducted in Dredging Department at PQA to interpret different studies and models that consultants prepare for us.	JA	Noted and will be taken into account in the report and recommendations.
4.	One of the major short comings of the Environment and Safety Department at PQA is the regular transfers at the post of Director E&S and cross department transfers for E&S Department. The hierarchy and ranks should rise within the Department and staff who have served in the E&S Department should be able to progress within.	JA	The need to retain specialist staff in the department will be addressed in the report.
5.	Standards and zones for emissions have been set for PQA but they have not been implemented. Due to limited capacity within PQA, those standards have not been enforced or monitored.	TY	Noted.
6.	Lab staff is available within PQA but they lack technical expertise and chemistry skills required. Most of the staff is politically inducted and have very limited technical training.	JA	Agreed. Induction of technically competent staff in the Dredging and Hydrography Department will be recommended.
7.	In terms of organizational structure, the Director of E&S Department should be supported by few Managers, who should be then supported by at least two Deputy Managers each. This will provide the required resources and strengthen the E&S Department.	TY	Agreed.
8.	Along with surveillance, protection at coasts is also important to check for community members transporting harvested mangroves to the shore. E&S Department should have a permanent position to monitor the coasts.	JA	Noted.

No.	*Comments/Issues Raised*	*By*	*Response Provided*
9.	One of the major hindrances in implementation of environmental policies and management plan is lack of will at the top management level.	JA	A new environmental position at the Board level is recommended. This position can be filled by someone from the private sector who has worked for and cares for the environment.
10.	Dredged material is being dumped at 4 nautical miles south from farewell buoy and 10-15 nautical miles from Khuddi Island.	JA	Noted.
11.	Reclamation activities conducted by private sector projects are not being monitored by PQA. E&S Department should be strengthened to monitor industrial development activities to ensure that environmental standards are not compromised.	JA	Noted.
12.	Erosion is also caused by fast moving ships which generate wakes and erode banks of the shipping channel. Specialists should be engaged to recommend maximum speeds for different seasons which are environmentally and technically feasible.	JA	Agreed. Technically feasible and environmentally acceptable speeds have to be worked by engaging specialist consultants and conducting relevant studies.
13.	To protect the banks of the shipping channel, geotextile material or wooden protection can be used to minimize erosion. However the economic and technical feasibility of each option has to be analyzed first.	JA	Noted.
14.	Financial sustainability of the E&S Department is important so an independent fund should be established solely for the purpose of spending on environmental protection measures. To fund this, environmental fees can be introduced for all the industries in exchange of which environmental services can be offered to private industries such as site selection and access to established environmental models for PQA.	TY	Noted.
15.	Responsibility of conducting studies should lie with the Dredging Department and monitoring the hydrodynamics of the creek should be with the Hydrography Department.	JA	Noted.

No.	*Comments/Issues Raised*	*By*	*Response Provided*
16.	Jurisdiction of each department within PQA should be clear in the environmental management plan and there should be no overlap of responsibilities.	JA	Noted.
17.	Warm water discharge from industries in the creek will be an issue in future which will significantly damage ecology of the creek.	NH	Noted.
18.	A committee for environmental management can be formed with members of PQA and private industries who can work together to preserve the environment of PQA.	NH	Noted.
19.	Development of alternate shipping lane should be encouraged to reduce the traffic pressure on the existing shipping lane to conserve mangroves in that region.	NH	Noted.

Closing Remarks:

- HBP to coordinate with PQA to determine the number and specifications of boats required for surveillance.
- HBP to prepare institutional and financial structure for Dredging and E&S Departments which need to be discussed with the Directors of each Department.
- Dredging Department to provide the following documents:
  - DHA Study conducted by National Institute of Oceanography
  - Deeping and widening of the channel study conducted by Techno Consult International
  - 10 years data of dredged materials (quantity and location of dumping sites)
  - Spoil grounds information (map)
- The following documents were provided by E&S Department:
  - Fire Contingency Plan
  - Existing equipment with the E&S Department
  - Equipment requested by the E&S Department

ESR and CEA for Port Qasim

Stakeholder/s:	Port Qasim Authority
Consultation:	Scoping
Date:	November 13, 2015
Time:	11:00 am
Meeting Venue:	Port Qasim Authority (PQA) Meeting Room
Attended by:	Shabbir Anwar Qazi (SQ), DG Technical, PQA Captain Noumqan Hassan (NH), DG Operations, PQA Muhammad Saqib (MS), Director IM, PQA Farrukh Jamil (FJ), DG Finance, PQA Tariq Iqbal Yousufi (TY), Director Environment and Safety, PQA Jawaduddin Athar (JA), Director Dredging, PQA Syed Kazim Abbas (KA), Deputy Harbor Master, PQA Aleem Shaikh (AS), Director Planning and Development, PQA Sardar Jang (SJ), PQA Shahid Hafeez (SH), Manager Dredging, PQA Asad Abbas (AA), Deputy Manager PSP, PQA Nusrat Hussain Sangi (NS), Manager Planning, PQA Shahid Lutfi (SL), International Finance Corporation
Conducted by:	Vaqar Zakaria (VZ), Managing Director, Hagler Bailly Pakistan Hidayat Hassan (HH), Divisional Manager, Hagler Bailly Pakistan
Recorded by:	Hussain Ali (HA), Hagler Bailly Pakistan
Reviewed by:	Bilal Khan
Language:	Urdu/English
Preamble:	The discussion started with the introduction of the team from Hagler Bailly Pakistan and Port Qasim Authority. Mr Zakaria briefed about the purpose and agenda of the meeting. Findings of the baseline studies and major environmental issues were presented to the participants by Mr Zakaria and Mr Hassan. Copies of the Executive Summary of Baseline Report were circulated to the participants. At the end of the presentation, the participants were invited to share their comments and concerns, which have been documented below.

No.	Comments/Issues Raised	By	Response Provided
1.	During these studies, were EIAs of other projects in PQA reviewed, particularly the cumulative impact assessment sections?	SQ	Yes, other EIAs of projects in PQA were reviewed but this cumulative impact assessment (CIA) has a different time and spatial scope relative to project specific CIAs. The scale of this CIA will be different and not limited to project related CIA but will consider PQA region as a whole.
2.	The current Study Area marked on the map does not include regions where dredging and dumping is being practiced by PQA. HBP should include those regions in their CIA Study Area.	JA	Information was requested from PQA earlier regarding locations and quantity of dredging which was not shared. Once this information is available from PQA, the Study Area can be extended. An iterative approach to this study has been adopted therefore revisions and improvisations are always possible. Dredging related data will be shared with experts at Tetra Tech who will conduct modeling to predict impacts such as erosion and deposition among others.
3.	In future, some projects may start development in PQA due to changing economical dynamics in Karachi and rest of Pakistan. Was industrial influx in PQA considered during this study?	SQ	Yes, potential developments in future were considered which were in line with Government's development policy.
4.	The outfall channel of Pakistan Steel Mill releases warm water. Will HBP cover thermal impact on sea due to this?	SQ	Yes, the experts working at Tetra Tech on this study will take this into account.
5.	What are the most important environmental aspects that are likely to be impacted due to development at PQA?	SQ	Three major environmental aspects likely to be impacted are: Air quality which directly impacts physical and social environment (health). Mangroves which directly impact ecological and social environment (livelihood). Fish which directly impacts ecological and social environment (livelihood).
6.	Which development or activity at PQA is likely to cause worse environmental damage?	NH	Dredging, dumping release of untreated effluents and accidental spillage are the major contributors to environmental damage.
7.	What are other contributors of environmental damage in this region that that does not involve PQA activities?	SQ	Mangrove cutting by communities, over grazing, mud flats being reclaimed and encroached and long term release of heavy metals by industries.

No.	Comments/Issues Raised	By	Response Provided
8.	For environmental protection and management in future, two different strategies should be developed, long term and short term. Also, a fund should be established solely for the purpose of environmental protection of PQA for the financial sustainability of the environmental management strategies.	SQ	Noted.
9.	DHA has been excluded from the Study Area whereas the major contributor to environmental damage is extensive reclamation practiced by DHA. These activities are leading to increased erosion at PQA. This region should be included in the Study Area and impact due to DHA related reclamation activities should be considered.	AA	Once data on the reclamation activities is provided by PQA, this will be included in erosion/deposition modeling that is being conducted by a team of experts at Tetra Tech.

Closing Remarks:

- Three meetings will be scheduled with PQA officials to discuss environmental management strategies. The agenda and invitees proposed for each meeting is summarized in the table below:

Code	*Attendees*	*Venue*	*Objectives*
A	HBP/IFC: Vaqar Zakaria, Sally Johnson, Hussain Ali PQA: Director Environment and Safety, DG Operations, Manager Dredging, Manager Planning and Development	PQA Meeting Room	This is aimed at educating PQA officials on suitable environmental and management options available. Potential environmental protection measures will be discussed and pointers will be provided to PQA officials for brainstorming so that they are prepared for Meeting 'C'. PQA officials will also advise HBP/IFC on institutional structure of PQA so that feasibility of each environmental management option is clear. HBP will also receive details of dredging with regards to regions and quantity during this meeting from the relevant officers.
B	HBP/IFC: Vaqar Zakaria, Sally Johnson, Hussain Ali PQA: DG Technical, DG Finance, DG Operations	PQA Meeting Room	This will be a discussion with senior officials of PQA to further discuss the points brought up at Meeting 'A'. The key objective of this meeting will be to work out the financial sustainability of the environmental management measures proposed by HBP and discussed at Meeting 'A'.

Code	*Attendees*	*Venue*	*Objectives*
C	HBP/IFC: Vaqar Zakaria, Sally Johnson, Bilal Khan, Hussain Ali PQA: DGs, Managers and other relevant officers	PQA Meeting Room	This meeting will involve a larger group from PQA. HBP will present the environmental management solutions and strategies discussed at Meeting A and B. A deeper discussion will follow to discuss the practical implementation of the environmental management options.

- Data on dredging activities by PQA and reclamation activities by DHA will be shared by PQA.
- HBP will share electronic copies of the Draft Baseline Report of the Cumulative Impact Assessment for Industrial and Port Developments at Port Qasim, Executive Summary and the presentation slides with PQA.
- PQA Chairman will briefly attend the workshop on **December 3rd 2015** organized by IFC. The workshop will also be attended by DGs, Manager PSP and Deputy Manager PSP from PQA. Other relevant stakeholders and Major Lenders will also be present at this workshop.

ESR and CIA for Port Qasim

Stakeholder/s:	International Union for Conservation of Nature and Natural Resources (IUCN)
Consultation:	Scoping Consultation for Ecosystem Services Review and Cumulative Impact Assessment
Date:	June 8, 2015
Time:	11 am
Meeting Venue:	IUCN Karachi Office
Attended by:	Name Contact Number Tahir Qureshi Ghulam Qadir
HBP Representatives:	Vaqar Zakaria (VZ), Syed Hidayat Hasan (SHH), Bilal Khan (BK), Kamran Minai (KM)
Conducted by:	VZ, BK
Recorded by:	KM
Reviewed by:	Bilal Khan
Language:	English, Urdu
Preamble:	The IUCN representatives were briefed about the International Finance Corporation's investment in projects at Port Qasim and their requirement for a Cumulative Impact Assessment (CIA) and Ecosystem Service Review (ESR) being carried out. The IUCN representatives identified four broad key areas which need to be considered in assessing the ecosystem at Port Qasim: ecological, oceanographic, hydrological and human. The IUCN representatives stated that authority of the ecosystem at Port Qasim is divided between The Port Qasim Authority (PQA), The Karachi Port Trust (KPT) and The Forest Department (FD). The Governor of Sindh has designated the jurisdiction (ownership) of the Mangrove vegetation to the FD and they are under Protected Status. They also clarified the transfer of 64,400 hectares of mangrove area to PQA and The IUCN's recommendation for it to be brought under a single authority for uniform legislation. In the view of the IUCN representatives the cutting of the mangroves by The PQA requires an NOC from the FD. The IUCN representatives highlighted the main cause of environmental degradation of the mangroves as being the diversion of the River Indus. They attributed relatively less environmental degradation to human activities (industrial development, human settlements and other activities), agreeing that the former only impacted smaller parts of the ecosystem. They referred to the development of barrages such as the Kotri barrage and the Guddu barrage as having significant adverse consequences for the ecosystem. The HBP representatives stated the organization's objectives of looking at the impact of the Port Qasim Authority on the Study Area, the impact of industries on the Study Area and the impact of various potential scenarios on the Study Area as well as carrying out systematic sampling to develop a profile of it.
	Possible VECs and Identified Ecosystem Services

VECs: Water quality and availability (flows), habitat (Migratory birds' breeding grounds on the delta)

Ecosystem Services identified include Fuel, Fodder, Seafood (Fish, Prawn, Shrimp), Food Web, Protection (Mangroves protect human infrastructure from storms), Camel Grazing (Camels used for milk, meat, export to the Middle East), Mangrove Honey (economically significant)

The summary of issues raised and suggestions provided by the key respondents from the institution is provided below

No.	*Issue Raised*
1	**Issues Related to Flooding and Associated Changes:** The diversion of the Indus River was considered the main cause of concern. The knock-on effects described by the IUCN representatives included a lack of nutrients being provided to downstream agricultural lands, the water logging of these agricultural areas, the Gharo Channel now having sea water, migrations of people caused by water shortages and other water related issues and the replacement of natural flooding with artificial flooding due to the creation of the dams. This last consequence was explained further in terms of the benefits of natural flooding bringing in more nutrients due to a gradient of intensity with which the water flows (low, medium, high, very high and mega) resulting in deposition of nutrients. The construction of dams has resulted in less nutrient deposition and the disruption of the natural processes of erosion and accretion which were regular occurrences of the Indus River. The IUCN representatives recommend the establishment of an integrated hydrological institute to provide input for policy makers.
2	**Issues Related to Pollution from Human Activity (Industry and Settlements):** As in the case of flooding, the diversion of The Indus River was highlighted as the main area of concern and of greater importance compared to industrial activity and human settlement impacts. The IUCN representatives stated that the Indus Delta is subsiding and that there is widening of the creeks. As far as pollution is concerned the fishing village known as Ibrahim Haidri has the main inputs from the industries and townships. The pollutants being released include pesticides, waste and other farming effluents. There is also thermal pollution. As a consequence of this pollution changes in environmental chemistry have been observed which in turn is causing changes in the ecosystem and marine dynamics. The pollution is causing issues such as stunted growth of plants and other adverse developmental effects. Some mangroves have adapted to changing environmental conditions resulting the development of a modified and artificial ecosystem. The process of eutrophication has been observed and is a key area of concern for the health of the ecosystem. Fish populations have been affected with evidence of heavy metals being present in fish tissue. A relatively new activity is that of camel grazing which is also having adverse impacts on the mangroves as it causes pollution. Grazing pressure is present on the Bhambor, Gharo and Korangi Creeks and economics has been identified as the major driver of continuing camel grazing. Camels have been observed accessing the mangroves by swimming to them. The National Institute of Oceanography has reported sea level rise and warned of the sea potentially intruding on human infrastructure because of this. Furthermore, the cyclone threat has increased with increasing frequency of storms being observed. Ocean upwelling has also changed to an anti-clockwise direction. IUCN representatives also pointed out that there are numerous 'invisible' impacts that we cannot yet predict and that there is backing by major, authoritative stakeholders to develop Port Qasim. The IUCN representatives stressed on the importance of industrial compliance and zoning for developments. Concerning settlements they referred to the need for regulation of farming activities upstream of the delta as this the major activity before the river flows into the sea. They were critical of organizations like WAPDA which, they state, have ignored

	agricultural communities in their reports. They stated that IUCN, on the other hand, has engaged stakeholders on the ground; people dependent on the mangrove ecosystem for their livelihoods and have witnessed success with local user groups in, for example, fodder and fuel collection. They cited the fishing village Rehry Goth as an example where this can be observed. In line with this they continued to stress stakeholder participation and buy-in along with the need to regulate and control their activities. The IUCN representatives were critical of the ratio based re-plantation rule, highlighting that it has no scientific basis. Planting more saplings than the number of mature Mangrove trees cut down does not replace the mature Mangrove trees as the contribution of saplings and mature Mangroves to the ecosystems differ. Furthermore, they also highlighted that there is a need to look at other components of the ecosystem, not just the Mangroves. An example was that of the Marho Kotri Wildlife Sanctuary located on the River Indus.

ESR and CIA for Port Qasim

Stakeholder/s:	Fauji Akbar Portia Terminals	
Consultation:	ESR Scoping Consultation, CIA Scoping Consultation	
Date:	June 8, 2015	
Time:	5 pm	
Meeting Venue:	FAP Office	
Attended by:	Name	Contact Number
	Ahmed Rana	
HBP Representatives:	Bilal Khan, Vaqar Zakaria	
Conducted by:	Vaqar Zakaria (VZ), Managing Director, Hagler Bailly Pakistan (HBP) Bilal Khan (BK), Manager Environmental Programs, HBP	
Recorded by:	Mr Bilal Khan (BK), Manager Environmental Programms, HBP	
Reviewed by:	Bilal Khan	
Language:	English	
Preamble:	FAP was briefed about the International Finance Corporation's (IFC) investment interests in Port Qasim (PQ) and Hagler Bailly Pakistan's (HBP) work on the Cumulative Impact Assessment (CIA) and an Ecosystem Services Review (ESR). HBP recognizes the FAP as a stakeholder, and particularly part of the Fauji Group that operates the FOTCO terminal and the Fauji Bin Qasim Fertilizer Complex, is planning a power plant in the Port Qasim area and has other developments in the vicinity (e.g. slaughter house).	

Possible VECs and Identified Ecosystem Services

VECs: Safety and Health associated with developments. Migratory birds.

Ecosystem Services: Mangroves reduce dredging costs, protection from cyclones and storms for infrastructure, aesthetic values, habitat.

Institution's Perception about the Ecosystem Services

The summary of issues raised and suggestions provided by the key respondents from the institution is provided below:

No.	Issue Raised
1	**Issues related to nearby developments and zoning:** PQA does not strictly follow the zoning plan. Developments such as the Engro Elengy have been allowed in areas where there is no zoning for LNG. The LNG zone is the North Western Industrial Zone where FOTCO's jetty extends out. Similarly, the coal terminal advertised may cause issues for FAP depending on its placement (due to the coal dust generated), even though this may be in the proper and planned zone. These type of zoning issues have created a number of problems between owners and developers.

2	**Issues related to capacities of PQA for regulation on environment:** The PQA is a good authority and it supports the owners and developers in operations quite a bit. Capacity within the PQA for regulation on environment within the notified PQA area is limited. It is not clear who is responsible for regulation of health, safety and environment; whether this is SEPA or PQA. Environmental Management Plans (if any) or Safety Plans for the Port Qasim area are not publically available. Similarly it is not clear who is responsible for insurance claims, or insurance, if a health, safety or environmental incident by another owner impacts others owners in the area. The capacity of the relevant PQA department to assess developer plans with respect to environment, health and safety, is also a consideration.
3	**Issues related to environmental approvals:** Environmental approvals for projects such as Elengy have gone through without proper consultation or public hearings. Typically invites are not sent for the Public Hearing by the Sindh EPA to relevant stakeholders, or these arrive too late. Where invites are sent, and a developer raises concerns on the development, they only hear back when the No Objection Certificate (NOC) by SEPA has already been issued. The PQA should take a proactive role in the EIA process, as it is the primary authority mandated to manage the Port Qasim area and is responsible for the environment within its limits, and engage with the Sindh EPA for approvals.
4	**No grievance redress mechanisms or mechanism in place are not functioning:** Formalized grievance redress mechanisms do not exist if an owner needs to raise an issue with another owner and where established, these are not functioning. Letters to other developers are typically not responded to, and developer concerns may not be addressed.

ESR and CIA for Port Qasim

Stakeholder/s:	Engro Vopak Terminal Limited	
Consultation:	Scoping Consultation for Ecosystem Services Review and Cumulative Impact Assessment	
Date:	June 9, 2015	
Time:	2 pm	
Meeting Venue:	Engro Vopak Terminal, Port Qasim	
Attended by:	Name	Contact Number
	Amir Mahmud Ammar Mohammad Fakhir	- - 0333 380 2073
HBP Representatives:	Bilal Khan (BK), Kamran Minai (KM)	
IFC Representatives:	Larry Jiang Mr Shahid Lutfi (SL), International Finance Corporation	
Conducted by:	BK, Larry Jiang	
Recorded by:	KM	
Reviewed by:	Bilal Khan	
Language:	English	
Preamble:	The Engo Vopak Terminal's (EVT) team was briefed by IFC representatives about their concerns regarding Safety, Health and Environment, in particular about EVT's measures to address the Environmental concerns of this project. EVT was also told about Hagler Bailley Pakistan's (HBP) association with IFC and the carrying out of a Cumulative Impact Assessment (CIA) and Ecosystem Services Review (ESR) for the project. Operational details of EVT's project were presented by the EVT representatives including a review of their Health and Safety Performance, with which IFC representatives were satisfied. The EVT representatives described the Environmental measures they have taken. These included quarterly reports being submitted to The Sindh Environmental Protection Agency (SEPA). It also included working in conjunction with IUCN to plant 500 hectares of mangroves following the clearing of 41 hectares of mangroves cleared by the project. EVT representatives commented that they have observed the work in progress regarding mangrove plantation including mobilization of site selection, nursery grow out and supporting initiatives, mangrove plantation and supporting initiatives and ongoing monitoring and adaptive management.	
Possible VECs and Identified Ecosystem Services		
The main possible VEC identified were the mangrove ecosystem. Ecosystem Services identified were those provided by the mangroves including being a habitat for biodiversity and value as protection against flooding and storm surges.		

ESR and CIA for Port Qasim

Stakeholder/s:	World Wildlife Fund (WWF)	
Consultation:	Scoping Consultation for Ecosystem Services Review and Cumulative Impact Assessment	
Date:	June 9, 2015	
Time:	5 pm	
Meeting Venue:	WWF Karachi Office (Bath Island Rd, Karachi)	
Attended by:	Name	Contact Number
	Rab Nawaz Umair Shahid	0307 212 6393
HBP Representatives:	Vaqar Zakaria (VZ), Syed Hidayat Hasan (SHH), Anne Sweester (AS), Bilal Khan (BK), Kamran Minai (KM)	
Conducted by:	BK	
Recorded by:	KM	
Reviewed by:	Bilal Khan	
Language:	English	
Preamble:	WWF representatives were briefed about The International Finance Corporation's (IFC) investment interests in Port Qasim (PQ) and Hagler Bailly Pakistan's (HBP) work on Environmental matters related to IFC's investments: HBP is carrying out a Cumulative Impact Assessment (CIA) and an Ecosystem Services Review (ESR). HBP recognizes The WWF as a key stakeholder. The WWF's representatives described their sampling activities and data analysis carried out over a period of one year from 2013 to 2014. They collected data on all marine animal species in 15 major creeks in Pakistan, using trawling. They also referred to the possession of this data by the Marine Fisheries Department and Karachi University having done a study on 'Effects of Heavy Metals on Mangrove Ecosystems'. The WWF representatives recommended a post-cyclone analysis.	

Possible VECs and Identified Ecosystem Services

The VECs identified were the mangroves and the marine life.

Ecosystem Services identified included the habitat for biodiversity and protection against flooding provided by the mangroves, as well as hunting and livelihood for local communities.

The summary of issues raised and suggestions provided by the key respondents from the institution is provided below

No.	*Issue Raised*
1	Issues Related to Water Quality and Pollution: Off Port Qasim water is hyper-saline which is adversely affecting the ecosystem. There is a lack of freshwater in the creeks. In places such as Ibrahim Haidri there is a lot of waste and chemical pollution which has adverse effects on biodiversity. There are no water treatment plants.

2	Issues Related to Mangrove Plantation: A recent announcement has been made by Ministry of Ports and Shipping for continuous mangrove plantation. Mangroves are increasing due to focus on them and coordination between WWF, IUCN, Sindh Environment Protection Agency (SEPA), Sindh Fisheries Department (SFD). Furthermore, mangroves are largely consumed locally and there are few, if any, land grabbing issues. But we will run out of space to plant mangroves.
3	Issues Related to Fishing Approach: The number of fishing boats has increased, the fishing effort per boat has increased, gill net trawl sizes have increased, soak times have decreased but repeat of netting has increased. Measures recommended by WWF include a no-take zone and a rotational zone. They want to see these concepts institutionalized. WWF also recommended that The Port Qasim Authority sign up to the international agreement to stop illegal fishing and that a no-take zone would aid in the identification of those fishing illegally. They also recommended the implementation of GSM based monitoring of small scale fishing vessels as a relatively inexpensive monitoring option.
4	Issues Related to Fish Stocks: Fish stocks have been adversely affected by pollution and hyper-saline conditions created in the major creeks. WWF's data shows a significant loss of fish. Crab and jellyfish, however, are abundant. A reduction in shark species (a top predator) has been observed and WWF representatives expect this to increase the number of pelagic prey species. Jellyfish blooms have been observed in summer followed by hunting of jellyfish in large numbers causing wide oscillations in their population numbers. Furthermore, changes in species composition of species being hunted have been observed, for example, in mackerel and tuna. However, WWF representatives also stated that there are still trophic levels to support good fishing, but that the Sindh coastline has been very badly affected and only Balochistan has good conditions for fishing.
5	Issues Related to Governance: The Government of Pakistan does not recognize fisheries as an industry. Furthermore, the entire Indus Delta is a world heritage site but officially there is no protection for the habitat. There is also no regulation for where dredging material should be placed. The Karachi Port Trust put forward an idea of a constructed wetland but this proposal was blocked. WWF consider this a set back as they favour the proposal. Furthermore, where there are land issues there is confusion and law and order is a concern as two mangrove activists associated with the WWF have been assassinated recently. WWF representative stated that politically this is a good time to act as there is support from major stakeholders including The Marine Fisheries Department, The Sindh Fisheries Marine Department, D.G. Fisheries and other political entities. However, they also stressed that in some cases the land mafia is a threat. WWF representatives also recommended a master plan for Karachi which integrates Port Qasim.

ESR and CIA for Port Qasim

Stakeholder/s:	Engro Vopak Terminal Limited	
Consultation:	Scoping Consultation	
Date:	June 16, 2015	
Time:	12pm	
Meeting Venue:	Engro Vopak Terminal, Port Qasim	
Attended by:	Name	Contact Number
	Mohammad Fakhir	0333 380 2073
HBP Representatives:	Bilal Khan (BK), Kamran Minai (KM)	
Conducted by:	BK	
Recorded by:	KM	
Reviewed by:	Bilal Khan	
Language:	English, Urdu	
Preamble:	The Engro Vopak Terminal representative was already familiar with HBP's involvement in the Cumulative Impact Assessment and Ecosystem Services Review for The International Finance Corporation's investment in Port Qasim based on the previous meeting held on 9th June 2015. In this meeting HBP representatives asked in detail about Engro Vopak Terminal's views of the Ecosystem Services provided by the Environmental components at Port Qasim and about their concerns regarding management and regulation of Port Qasim. In particular the Engro Vopak Terminal representative discussed waste management issues and emergency response preparations at the regulatory level.	

Possible VECs and Identified Ecosystem Services

Possible VECs identified include the mangrove ecosystem, water quality and safety.

Ecosystem services identified include medicinal value of mangroves, protective value of the mangroves in particular current mangroves plantations.

The summary of issues raised and suggestions provided by the key respondents from the institution is provided below

No.	*Issue Raised*
1	**Issues Related to Mangroves and Hydrology:** The Engro Vopak Terminal representative raised the issue of the need for studies related to hydrological impacts and assessment of underwater biota. He also suggested a study on the biology of the Mangroves in Port Qasim, especially, on the kinds of Mangrove (in terms of species) that should be planted. He referred to work carried out by The Engro Vopak Terminal in 1999 of planting Mangroves along one of their walls to prevent wall collapse that was being caused by continuous erosion. According to the representative the Mangroves planted stopped the wall from collapsing by securing the soil and sediment beneath it. Therefore, for The Engro Vopak Terminal the Mangroves are extremely important.

2	**Issues Related to Waste:** The Engro Vopak Terminal representative was concerned about the waste treatment issue at Port Qasim, in particular mentioning waste water treatment and sewage systems associated with industry at Port Qasim. He highlighted that The Engro Vopak Terminal is a zero effluent facility: releasing no effluent into the environment. He also outlined the use of some of the waste water generated at the facility being used by plantations. However, he was concerned about the plans of the Port Qasim Authority regarding waste management. He was of the opinion that sewage is not managed at Port Qasim, stating that he was not made aware of any controls required by Port Qasim over industries with respect to their waste management. He also stressed the need for a mechanism to be developed by the Sindh Environmental Protection Agency and the need for them to deliver on legislation such as the Hazardous Substance Act 2014. He also mentioned the need for a more cooperative business model in which there is common infrastructure for industries such as dumping yards, water supply and other infrastructural aspects.
3	**Issues Related to Implementation of CIA:** The Engro Vopak Terminal representative was of the opinion that the CIA being carried out by HBP needs to advise towards a Master Plan. He also stressed the need for capacity building in government authorities such as the Port Qasim Authority to move towards enforcing regulations and appointing monitors to demonstrate ownership of the CIA. The representative was also critical of the Port Qasim Authority not having any audits and that compliance has so far gone unaddressed.
4	**Issues Related to Emergency Response Planning:** The Engro Vopak Terminal representative stated that he is unaware of The Port Qasim Authority's Emergency Response Planning and that there is no preparation for crisis situations. He stressed the need for containment technologies and studies directed at managing risks such as dispersion modeling, wall surge studies, simulation etc. He also highlighted that the Port Qasim Authority is lacking a grievance redress system when dealing with the local communities as well as with institutions.

ESR and CIA for Port Qasim

Stakeholder/s:	Sindh Forest Department	
Consultation:	Scoping Consultation for Ecosystem Services Review and Cumulative Impact Assessment	
Date:	June 15, 2015	
Time:	3 pm	
Meeting Venue:	Sindh Forest Department Campus, Malir	
Attended by:	Name	Contact Number
	Agha Tahir Hussain (Project Director – Sea Intrusion Project)	0333 257 8850
	Arif Khokar (District Forest Officer – Coastal Forest Division)	0303 012 0780
HBP Representatives:	Bilal Khan (BK)	
Conducted by:	Bilal Khan	
Recorded by:	Bilal Khan	
Reviewed by:	Bilal Khan	
Language:	English	
Preamble:	The Sindh Forest Department was briefed about the International Finance Corporation's (IFC) investment interests in Port Qasim (PQ) and Hagler Bailly Pakistan's (HBP) work on the Cumulative Impact Assessment (CIA) and an Ecosystem Services Review (ESR). HBP recognizes the Sindh Forest Department as a key stakeholder as they are custodians of the protected mangrove forests. The Sindh Forest Department represents	

Possible VECs and Identified Ecosystem Services

The main possible VEC identified were the mangrove ecosystem. It was also highlighted that while the forests are legally protected, the forest is part of an ecosystem.

The main ES identified by the Sindh Forest Department include the following:

- Support sustainable fisheries including prawns and fin fish
- Carbon sequestration (carbon markets can be used for comparison on total cost; approximately 8,000 to 15,000 /hectare in Malaysia)
- Preventing erosion (and associated reduction in dredging costs)
- Good wind break, and associated protection of developments and communities
- Part of the national defense strategy as these areas are difficult to navigate
- Ecotourism (on the weekend approximately 50-100 people visit Keti Bander)
- Aesthetic values
- Lungs of Karachi (largest contiguous mangrove in Pakistan; and possibly largest arid zone mangrove)
- Private fishing (angling)
- Medicinal values
- Industrial values e.g. use of water from the system

The summary of issues raised and suggestions provided by the key respondents from the institution is provided below

No.	*Issues Raised*
1	**Issues Related** to Protection of Forests: Mangrove cutting is high in the Sindh area. There are issues related to rights of people and protection of forests. The communities have usufruct rights on these forests as they have been using them for generations.
2	**Approvals Issues**: PQA is a very strong department, and has influence. They do not include the SFD in their approvals process, and it may be difficult to approach the PQA. In replantation efforts the SFD is not always taken on board, even by NGOs.
3	**Pollution**: The pollution in the area is high. Salt pans/extraction is decreasing and the pollution is putting the industry out of business. In addition to this pollution due to industries or other urban developments in the areas may help generation of established mangrove forest but new growth is typically inhibited in these areas. Therefore, the areas close to Port Qasim or Bhains Colony may seem to have cover, but the ecosystem health and regeneration may not be there. The industrial waste from Malir River is also a very big issue. Karachi city does not have proper sewage disposal and there is sewage in the Malir River. These issues will impact replanted mangroves and also inhibit generation of saplings.
4	**Replantation Management**: Management of replanted areas after contracts with NGOs have expired are the SFDs responsibility. SFD is managing replantation carried out by NGOs in the Sindh area.
5	**Board of Revenue Issues**: A large part of mangrove forests are on government land, as opposed to protected areas or notified PQA area. The revenue department considers mangroves wastelands.
6	**Issues associated with Mangrove Removal**: Timber mafias exist within the areas, and these cannot be controlled by the SFD and there is immense extraction of wood from the protected mangrove forest.
7	**Issues related to Replantation**: the replantation carried out by the PQA does not necessarily mean that it is beneficial. It takes time for mangroves to regenerate and the ecosystem to regenerate. It is also not clear whether the entire ecosystem regenerates. The ecosystem services lost are not immediately regained elsewhere; the process takes time.
8	**Issues related to Indus**: The key issue affecting mangroves is the Indus and not necessarily localized industrial developments. The water and sediment received from the Indus has decreased significantly from 150 MAF to between 1 and 4 MAF. The Indus Water Accord appropriates 10MAF of environmental flow. However this is never released. In addition to this, Pakistan is currently in a 15 year wet cycle e.g. during floods of 2010 mangroves grew double the size they would otherwise grow each year. When this wet cycle ends, it is expected that there will be greater loss of mangroves.
9	**Management and Training is Required**: The PQA should train their staff to ensure greater protection, in the training institute. It is recommended that the PQA train people from the local areas to join the ranks of the PQA in environmental protection. This will reduce stress on natural resources, by local communities as they will now have new sources of employment, benefit the population and the PQA.
10	**Mangrove Species:** Many mangrove species have disappeared from Pakistan. In the Gharo Dhabeji area there is greater diversity of mangroves and these areas should be protected. Plantation of specific species has also been carried out by NGOs and SFD, to increase diversity.

ESR and CIA for Port Qasim

Stakeholder/s:	Multiple	
Workshop	Workshop 1 on Cumulative Impact Assessment and Ecosystem Service Review	
Date:	June 17, 2015	
Time:	12 noon to 3:30 pm	
Meeting Venue:	Arabian Sea Country Club, Port Qasim	
Attended by:	Name	Designation and Affiliation
	Shabir Anwar Kazi	Director General (Technical), PQA
	Anwar Mahtab Zaidi	Manager (Private Sector Projects, PQA
	Asad Abbas	Deputy Manager (Private Sector Projects), PQA
	Tariq Iqbal Yousufi	Director (Environment and Safety), PQA
	Mirza Azhar Iqbal	Deputy Manager (Environment and Safety), PQA
	Ahmed Rana	CEO, FAP Marine Terminals
	Hassan Sobuctageen	COO, FOTCO
	Brig Javed Mobin	Secretary, FAP Marine Terminals
	Faisal Iftikhar	CEO, Fisheries Development Board
	Syed Ghulam Qadir Shah	IUCN
	Altaaf Hussain Sheikh	WWF
	Rameez Fraz	Plant Manager, Engro Fertilizer Zarkhez
	Shujat Jamal Rizvi	Senior HSE Advisor, Engro Polymer and Chemicals
	Piyar Ali Palijo	AD, Sind Wildlife Department
	Sohail Ahmed Khoso	Field Officer, Sindh Wildlife Department
Invited and/or Apologies:	Meher Noshirwani	Trust for Conservation of Coastal Resources
	Agha Tahir	Sindh Forest Department
	Rashid Jan Mohammad	Bin Qasim Association of Trade and Industries
	Changez Niazi	DP World
	Song Zhaochun	Sinohydro Resources (Port Qasim Electric Power Company)
	Furrukh Husnain	DP World
	Javed Mehar	Sind Wildlife Department
	Rab Nawaz	WWF
	Umair Shahid	WWF
	Tahir Qureshi	IUCN
	M Fakhir	Engro Vopak
	Amir Mahmud	Engro Vopak

	Majid Tahim	Fisherfolk Forum
HBP Representatives	Vaqar Zakaria (VZ), Bilal Khan (BK), Kamran Minai (KM)	
IFC Representative	Sally Johnson	
Conducted by:	VZ, BK	
Recorded by:	BK, KM	
Language:	English	
Preamble:	Sally Johnson provided an introduction to the involvement of IFC in Port Qasim; due diligence IFC is currently carrying out, with a cumulative impact assessment and ecosystem service review for Port Qasim as part of this due diligence; and that IFC would like to see mitigation if significant cumulative impacts are identified. Vaqar Zakaria (HBP) briefed the attendees about how similar cumulative impact assessment or strategic environmental planning exercises are now being carried out, e.g. Jhelum Basin (IFC Funded work); that government agencies have to submit a Strategic Environment Assessments submitted to the Sindh Environmental Protection Agency are part of the law in Sindh, and the legal protection of mangroves in Sindh. Good planning would be helpful for everyone and IFC has been positively engaging in these efforts. A brief presentation on the methodology for the ESR and CIA were provided. Ghulam Qadir (IUCN) and Altaaf Hussain (WWF) gave presentations on the ecological importance and summary baseline of the area, and the management work the NGOs are involved in and ecosystem services that the mangroves offer.	

The summary of issues raised and advice by the are provided below:

No.	*Key Aspects and Issues Raised*
1	FAP: While IFC is carrying out this Study, IFC may not have leverage and cannot dictate the way forward in terms of addressing cumulative impacts. The developers may not have incentive to self-regulate or worry about cumulative impacts. Port Qasim Authority has responsibility of maintaining environment within the Port Qasim notified area.
2	FDB: Developments in Port Qasim by the Port Qasim Authority may affect commercial fishing businesses and livelihoods in all areas including Port Qasim notified areas and outside.
3	PQA: the PQA is mandated under the PQA Act 1973 for management of the port area. While ESIAs are prepared and are SEPA approved for projects, there is inadequate amount of monitoring of industries. The issues highlighted in the cumulative impact assessment should include assessment of these aspects and provide approaches to address these. As an example PQA does not have good collaboration and coordination with SEPA on regulation.
5	PQA: While the CIA is being carried out, it is important also to establish the mechanism of mitigation and responsibilities for mitigation.
6	Engro Zarkhez: EIAs have been conducted in the area (e.g. power plants, Sinohydro, Fauji, etc). Engro has participated in the public consultation for many of these. Previous EIAs (e.g. HBP EIA for Sinohydro) indicate that additional power plants in the area may not be possible due to ambient air limits i.e. there is not enough cushion available for additional plants. The air quality issue should be looked at in detail as part of the CIA.

8	Engro Zarkhez: Health Impact Assessments, in addition to EIAs, should also be considered as these are important and also recently gaining momentum. Health issues associated with developments may not adequately be covered by EIAs.
9	Engro Polymers: Assessment of alternative locations is not properly considered in the EIA process. As an example the PQEPC power plant for which an EIA was carried out by HBP is placed on areas where reclamation of mangroves was carried out.
10	FOTCO: EIAs tend to misjudge impacts and do not look at developments in totality. PQ has a master plan to 2050. The CIA needs to be aligned to the master plan. In addition to this, the economic aspect of development cannot be ignored and a balance needs to be struck between environment, including protection of mangroves, and development.
11	FAP: There are a number of environmental and safety concerns. With respect to safety of the Elengy terminal, it is unclear who is responsible for insurance, or if there is a blast or accident. It is also not clear whether the PQA will provide compensation or Engro Elengy. The Engro Elengy terminal is not at the location it should be and the master plan is not followed.
12	FAP: It is not clear what the outcomes of the CIA will be and whether a tangible set of mitigation and management actions will be discussed.
13	FDB: The mangrove areas provide a source of livelihood and are also important breeding grounds for commercial offshore fisheries. Industrial developments in the Port Qasim area may affect these resources. Additionally, since HBP is at the initial stages of the study, the workshop may be a waste of time. HBP should carry out its monitoring and research. The FDB has information available on fisheries.
14	Port Qasim Authority: An EIA is carried out for all developments and every developer tends to blame others. It is important that the CIA provide clear guidelines and suggestions to PQA on management. Currently, PQA is only manages the developments in a landlord concept. Every developer has to carry out their own studies, share with SEPA, and get SEPA approval. The PQA's strategic plan contains environmental considerations that need to be looked at for the CIA. Any recommendations on the PQA's strategic plan would also be very useful.
15	FAP: The master plan is not being followed.
16	PQA: Engro Elengy is specifically one development for which the plan has not been followed. However, typically the master plan is followed to the extent possible.
17	PQA: The Port Qasim Authority does not maintain full capacity for regulation of the environment. In addition to this, the Port Qasim Authority does not have a fully operational wastewater treatment plant for all industries; nonetheless there is a treatment plant that PQA operates for a smaller number of industries.
18	PQA: PQA areas include a nursery for mangroves. While dredging and reclamation is carried out, the PQA has maintained a 1:6 to 1:10 re-plantation policy on mangroves.
19	It is expected that EIAs carried out for developments in Port Qasim will improve if they are carried out considering the results of the cumulative impact assessment. The scale of development in Port Qasim is greater than what is considered in EIAs.

The summary of issues raised and suggestions provided by the key respondents from the institution is provided below

No.	*Possible Management and Approaches for the Study*
Outcomes	The environmental sections of the PQA master plan will be looked at in detail by HBP, and recommendations on the environmental sections of the strategic plan will be provided to the PQA as part of the study. It is important to evaluate PQA's capacity to ensure that recommended management and mitigation as part of the CIA can be carried out by the PQA given its current capacities. An appropriate framework will be provided in addressing significant impacts highlighted by the CIA by PQA in collaboration with other government authorities.
Management Approaches	The key environmental aspect highlighted in the workshop was the mangrove ecosystem and the potential impacts on this ecosystem due to developments. However, factors external to PQA were also highlighted, including over fishing, extraction of wood, grazing (camels), and extraction of food for fodder. It is recognized that near-shore mangrove health (cover) has been improving in the PQA notified area since the 1970s. The most likely reasons for this include greater protection (e.g. through NGO efforts), and re-plantation by PQA and other developers, among other possible reasons such as increased flow of nutrients from agricultural areas or other regional developments in the area[1].While offsets to land reclamation in mangrove areas are in place through re-plantation of mangroves, the offsets need to be evaluated properly particularly given other pressures (e.g. wood cutting, grazing) that may limit the efficacy of offsets. A cautious and clear strategy is needed to ensure offsets are working and re-plantation is going as planned. An integrated approach is needed for management of mangrove areas. Since the PQA is mandated with management within the notified PQA area, it could be a central authority, along with other government agencies and non-government agencies. It was also noted that the PQA already maintains good links with NGOs, including the IUCN on re-plantation efforts. Zone based managed was discussed as a potential approach to management. These included discussion on whether areas where no development will be carried out can be defined, and also possibly definition of no-take areas for fishermen[2].

[1] HBP is awaiting results of laboratory testing that may be used to verify whether there is greater availability of nutrients in the areas close to Port Qasim and where these nutrients may originate (e.g. Bhains Colony, rural developments in Gharo-Dhabeji area, etc).

[2] It is noted that NGOs that work with communities such as Fisherfolk Forum and Trust for Conservation of Coastal Resources, or any representation from communities that depend on the mangrove areas as a source of livelihood were not at the workshop. HBP intends to consult them separately and invite them to subsequent workshops.

ESR and CIA for Port Qasim

Stakeholder/s:	Port Qasim Authority
Briefing:	Briefing on the CIA and ESR for Port Qasim Authority
Date:	June 18, 2015
Time:	11:30 am
Meeting Venue:	Port Qasim Authority Chairmans Secretariat Building
PQA Representatives:	Shabir Anwer Kazi, Capt Nouman Hassan, M Asim Sualeh, Kazim Jatoi, Jawad Ud Din Ather, Anwar Mahtab Zaidi, Asad Abbas, Tanveer Farooqui, Tariq Yousufi, Mirza Azhar Iqbal
HBP Representatives:	Vaqar Zakaria (VZ), Bilal Khan (BK), Waris Ali (WA), Hussain Ali (HA), Sadia Khalid (SK), Kamran Minai (KM),
IFC Representative:	Sally Jonson
Conducted by:	Vaqar Zakaria, Sally Jonson, Bilal Khan
	Shabir Anwer Qazi (PQA)
Recorded by:	Kamran Minai (KM)
Reviewed by:	Bilal Khan
Language:	English
Preamble:	An introduction to the involvement of IFC and reasons IFC has funded the cumulative impact assessment and ecosystem service review for Port Qasim was provided by Sally Johnson (IFC). PQA were briefed about The International Finance Corporation's (IFC) investment interests in Port Qasim (PQ) and HaglerBailly Pakistan's (HBP) work on Environmental matters related to IFC's investments and that HBP is carrying out a Cumulative Impact Assessment (CIA) and an Ecosystem Services Review (ESR). Shabir Qazi (PQA) made a presentation on Port Qasim, focusing on the history of the PQA and its current activities, and existing and current developments within the Port Qasim land development zones and notified area. Bilal Khan (HaglerBailly Pakistan) made a presentation on the Cumulative Impact Assessment and Ecosystem Service Review. The key steps and methodologies in the studies were discussed, in addition to the benefits and overall scope of the cumulative impact assessment and ecosystem service review.

The summary of issues highlighted by the Port Qasim Authority:

No.	*Issue Highlighted*
1	**Issues Related to development of a second channel:** The Port Qasim Authority representatives displayed on the map the location being considered for development of a second channel within the Port Qasim Area. They highlighted that the development of this requires study. At this point they stressed the importance of realizing that there are ~75,000 hectares of land available in the Port Qasim Area out of which ~64,000 hectares are Mangroves with the rest being available for development. However, they also stated that the pace of development is very slow.

2	**Issues Related to future planning:** With respect to future plans for the Port Qasim area, the PQA clarified that there is uncertainty with respect to developments and that future development will depend on market demand and national need. At this point they highlighted that currently certain projects have been advertised but to date there are no concrete agreements with investors on these. Keeping this in mind they suggested that the current CIA, being carried out by HBP, should address future plans in the Port Qasim area. In response to this concern Vaqar Zakaria, of HBP, confirmed that HBP plans to work with the PQA to develop potential development scenarios. The PQA stressed that, when doing so, HBP should be aware of the land allotment policy of the PQA and its status as legally binding legislation.
3	**Issues Related to environmental regulation and it's Implementation:** The environmental representative of the PQA raised the issue of the lack of an environmental fee system in Pakistan. He recommended that this needs to be incorporated in the legislation (via a clause or law) and compliance with this needs to be ensured. He also stated that in light of recommendations to be made by HBP, there needs to be an amendment in the PQA Act to build institutional capacity for components like a monitoring mechanism. He went on to stress that the question of who is to manage increases in institutional capacity and environmental compliance needs to be addressed. A potential step suggested by him included the establishment of an agency for this purpose. Vaqar Zakaria, of HBP, suggested the idea of a joint environmental board of regulation including representation from regulators like The Sindh EPA, the PQA and developers. He also recognized the need for clarity on jurisdiction and responsibility.
4	**Issues Related to recycling:** The PQA representatives stated that they were interested in the use of the recycling industry. They suggested its use by the PQA in the Korangi Creek Channel and highlighted its benefits including the potential to create more jobs. They also stressed the need for assessment of using tidal traps and the necessity of contacting The Karachi Port Trust for this. Keeping in mind the suggested measures, Vaqar Zakaria stated that HBP was focusing on the long term scenario and considering options such as the need to look at buffer zones and impacts on the wider area.
5	**Issues Related to environmental concerns of coal:** A contemporary environmental issue of concern in Pakistan highlighted by the PQA representatives was that of environmental issues with coal and coal fields. They stated that currently there is a case in the Supreme Court regarding these specific environmental issues.

ESR and CIA for Port Qasim

Stakeholder/s:	International Union for Conservation of Nature and Natural Resources	
Consultation:	Scoping Consultation	
Date:	June 19, 2015	
Time:	12 pm	
Meeting Venue:	IUCN Office, Karachi	
Attended by:	Name	Contact Number
	Mahmood Akhtar Cheema Ghulam Qadir Shah Muhammad Tahir Qureshi Danish Rashdi	
HBP Representatives:	Hussain Ali (HA), Kamran Minai (KM)	
IFC Representatives:	Sally Johnson	
Conducted by:	Sally Johnson, Hussain Ali (HA)	
Recorded by:	Hussain Ali (HA), Kamran Minai (KM)	
Reviewed by:	Bilal Khan	
Language:	English	
Preamble:	The IUCN representatives presented background information and details of various projects and initiatives carried out by their organization including The Business and Biodiversity Programme of the IUCN, The Turtle Conservation Project, The Pakistan Water Programme, Water Challenges in Pakistan's Federally Administered Tribal Areas (FATA), Pakistan Sustainable Transport (PAKSTRAN) and The Murree Biodiversity Park. The IUCN representatives also stressed that an important emerging area is the requirement for Strategic Environmental Assessments by environmental regulators in Sindh and Balochistan. The IFC representative noted that, following her surveys, she identified numerous issues with critically dependent fisheries especially small fisheries. However, she stated that the IFC recognizes that it needs to be realistic about the changes it wants to see, therefore, inquired about the key, major areas that the IUCN representatives would like to address. In terms of IFC's contribution and role, the IUCN representatives highlighted two areas; the regulatory level to ensure compliance and continuing support to initiatives even after the end of the investment. In this regard the IFC representative recognized the need for an annual monitoring report and regular visits by IFC representatives with agreement of communicating this message to the IFC. The IUCN stressed the need for a competent organization for monitoring activities and an initiative involving other investors being important. They also highlighted that the IUCN can bring international resources for conservation purposes. Concerning biodiversity the IFC representative stressed the need for awareness regarding endangered species in the port area. The IUCN	

	confirmed the presence of turtles and marine mammals and their use of the creeks for travel. They also highlighted a decrease in the diversity of migratory birds in the Port Qasim area. The IFC representative made it clear that information on species of high concern in the area will be of high importance for sequestering conservation resources. The IFC representative stated that information on economic valuations of natural resources in the Port Qasim area and the ability to put 'dollar values' on them would be contributory to conservation efforts. The IUCN representatives highlighted ongoing studies at the Institute for Business Administration as well as information by the United Nations Environment Program. The IUCN representatives highlighted four key areas which need to be addressed: The Port Qasim Authority Master Plan needs revisiting Proper implementation is needed with involvement of institutions and local communities Third party monitoring is required with checks on compliance Sustainable financing is required (including measures such as user charges)
Possible VECs and Identified Ecosystem Services	
VECs:Turtles and marine mammals. Breeding grounds for migratory birds. Ecosystem Services: The protective cover of the mangroves is a key Ecosystem Service, fisheries for livelihood of local communities.	
Institution's Perception about the Ecosystem Services	
The summary of issues raised by the key respondents from the institution is provided below:	
No.	Issue Raised
1	**Issues related to the bigger picture and assessment of measures:** The IUCN representatives stressed the need to look at the bigger picture. Keeping this in mind they highlighted that although the Indus Delta is the 5th largest delta in the world, ~80% of it is now dead as a result of environmental degradation. The ecosystem has become saline and since the creation of Pakistan, development in the area has resulted in migration of people from the delta. Keeping this in perspective, the IUCN is pushing for sustainable development. To achieve this the IUCN wants institutional capacity building of organizations like the Pakistan Fisher Folk Forum and they want to see an increased focus on the Mangroves as they are a key part of this ecosystem, for example, being breeding grounds for marine life. To achieve the focus on Mangroves the IUCN has taken measures including the raising of Mangrove plantations, experimentation with a number of Mangrove species (including foreign species) to determine those most adaptable to the conditions in the Indus Delta, the preparation and circulation of technical reports to relevant government departments and the carrying out of community awareness programs with the introduction of concepts such as rotational cutting and grazing and training of local people. The IUCN has observed success in conservation with these measures and in view of this stress that conservation, protection, rotational use of resources and political will for their implementation need to work together. The IUCN has requested the EngroVopak Terminal to replicate these measures and hence success in conserving the Mangroves. The IUCN representatives stated that as a result of conservation measures protection for fish populations has increased and there are increases in crab and shrimp catches. They highlighted that local people have indigenous knowledge about the value and conservation of Mangroves and will support and contribute to their protection to protect

	their fisheries.
2	**Issues related to governance:** The governments of Sindh and Balochistan have made SEA a mandatory requirement but institutional capacity building at the government level is required to achieve it.Furthermore, Environmental Management Plans at the government level are often ignored. Decision makers often view the environment as a threat rather than as an opportunity. At the government level attention needs to be paid to recent environmental disasters and understanding needs to be built up. In this regard dialogue with political parties has been useful in improving awareness of environmental concerns and there is now less opposition. The IUCN representatives also highlighted that the government uproots local people from their lands once they decide to develop it. This insensitivity by the government results in unsustainable use of natural resources by local peoples, thereby, causing issues related to offsets.
3	**Issues related to offsets:** In response to the issue of offsets raised by the IFC representative, the IUCN highlighted the importance of regulating the activities of local populations: the cordoning off of young trees and the provision of old trees for use by local people.
4	**Issues related to sustainable fishing:** Concerning sustainable fishing the IUCN representatives reiterated the need for zoning and setting of limits along with the establishment of fishing safe zones and sanctuaries.

ESR and CIA for Port Qasim

Stakeholder/s:	Bin Qasim Association of Trade & Industry (BQATI)
Consultation	Feedback and Mitigation
Date:	Feb 24, 2016
Time:	03:00 pm
Meeting Venue:	Office of BQATI
Attended by:	Shakil Ashfaq (SA), President, BQATI Mian Muhammad Ahmed (MA), Patron-in-chief/Founder President, BQATI Abdul Rehman Punjwani (AP), Member Managing Committee, BQATI Amin Dawood (AD), Chairman, Dawood Meat Company (Pvt.) Ltd Wajid Bux Siddiqui (WB), Manager Production Control & Logistics, Indus Motors Khalil ul llah Malik (KH), Assistant Manager Production, Indus Motors Abdur Rehman Ismail (AI), General Secretary, BQATI Salim Dada (SD), Member Managing Committee Ibrahim Saeed (IS), Port Qasim Environment Director. Azhar (AZ), Port Qasim Authority Iftikhar (IF), Port Qasim Authority
Conducted by:	Hussain Ali
Recorded by:	Hussain Ali
Reviewed by:	Bilal Khan
Language:	English, Urdu
Preamble:	The discussion started with the introduction of HBP, International Finance Cooperation (IFC) and the team working on the CEA of the developments at PQA. Mr Ali briefed the purpose of the meeting and gave a comprehensive description of how the studies carried out for CEA and the proposed strategies for mitigation of adverse environmental impacts. At the end of the informative session, Mr Ali invited the participants to share their comments and concerns, which have been documented below. The participants were assured that their concerns and comments would be communicated to the Project proponent for their consideration and action.

No.	Comments/Issues Raised	*By*	*Response Provided*
1.	How will the air quality be managed?	SD	An air dispersion model was developed that kept using extensive baseline data for analyzing impact on air quality. This model can also be used as a tool for other industries to assess impacts on air quality due to their activities.

No.	Comments/Issues Raised	*By*	*Response Provided*
2.	How will the solid and liquid waste produced in the area be managed?	SD	The waste produced by the industries in Port Qasim will be managed through the environmental management plan but the waste from Bhains Colony and Korangi sewerage do not come under Port Qasim Authority.

ESR and CIA for Port Qasim

Stakeholder/s:	Karachi Port Trust (KPT)
Consultation:	Feedback and Mitigation
Date:	Feb 24, 2016
Time:	12:00 pm
Meeting Venue:	Office of KPT.
Attended by:	Muhammad Fayaaz. (MF), Karachi Port Trust. Arshad Hussain (AH), Karachi Port Trust.
HBP Representatives:	Hussain Ali
Conducted by:	Hussain Ali
Recorded by:	Hussain Ali
Reviewed by:	Bilal Khan
Language:	English, Urdu
Preamble:	The discussion started with the introduction of HBP, International Finance Cooperation (IFC) and the team working on the CEA of the developments at PQA. Mr Ali briefed the purpose of the meeting and gave a comprehensive description of how the studies carried out for CEA and the proposed strategies for mitigation of adverse environmental impacts. At the end of the informative session, Mr Ali invited the participants to share their comments and concerns, which have been documented below. The participants were assured that their concerns and comments would be communicated to the Project proponent for their consideration and action.

No.	Comments/Issues Raised	*By*	*Response Provided*
1.	A marine pollution control (MPC) department already exists at Port Qasim.	MF	There have been several interactions with PQ Authorities but there was no mention of the MPC department.
2.	The members of the MPC department at Port Qasim have been trained by KPT.	MF	Noted
3.	The MPC department came into existence under the leadership of Lt .Javed who was trained by KPT and also sent to Thailand for further training.	MF	Noted.
4.	The PQA transferred Lt. Javed to a different department as soon as he returned from Thailand after training.	MF	Noted
5.	The PQ is a young port and all necessary measures should be taken to prevent it from pollution.	MF	Noted

No.	Comments/Issues Raised	*By*	*Response Provided*
6.	KPT board has given a lot of powers to MPC to take action against environmental non-compliances.	MF	Noted
7.	Port Qasim Area is divided into four zones so trained members will be required for each zone.	MF	Noted
8.	The Chairman of PQA should be contacted for immediate responses.	MF	The chairman is on board with this study.
9.	A proper assurance from the chairman must be taken that the trained members will be in position long enough to bring revival in the MPC at PQA.	MF	Noted
10.	MPC at KPT has manpower of 18 members and 32 EHS coordinators are working to ensure the KPT act is followed properly.	AH	Noted
11.	IFC should request PQ to bring Lt.Javed back to his original position as the Director of the MPC.	MF	Noted

Notes:
At the end of the meeting, Organogram and Inventory list of MPC at KPT were shared by MF.





ESR and CIA for Port Qasim

Stakeholder/s:	Sindh Fisheries Department.
Consultation:	Feedback and Mitigation
Date:	Mar 2, 2016
Time:	3:00 pm
Meeting Venue:	Sindh Fisheries Department Office
Attended by:	Rukhsana Azhar Chaudhary (RA), Director Sindh Fisheries. Nawaz Ali Jat (NA), NGO Haider Ali Channa (HA), NGO
Conducted by:	Hussain Ali,
Recorded by:	Hussain Ali
Reviewed by:	Bilal Khan
Language:	English, Urdu
Preamble:	The discussion started with the introduction of HBP, International Finance Cooperation (IFC) and the team working on the CEA of the developments at PQA. Mr Ali briefed the purpose of the meeting and gave a comprehensive description of how the studies carried out for CEA and the proposed strategies for mitigation of adverse environmental impacts. At the end of the informative session, Mr Ali invited the participants to share their comments and concerns, which have been documented below. The participants were assured that their concerns and comments would be communicated to the Project proponent for their consideration and action.

No.	*Issues/ Comments*	*By*	*Response Provided*
12.	The marine data collected over the course of this project should be shared with Sindh Fisheries.	RA	Noted
13.	The community fishermen lack resources and should be helped to uplift their standard of living.	NA	Noted
14.	The Sindh Fisheries has the expertise regarding fishing control patrol but lack the resources to properly implement it.	RA	Noted
15.	The Sindh Fisheries should be strengthened as part of the project so it could be of better assistance to PQA.	HA	Noted
16.	The Department will extend their support in every possible way to PQA.	RA	Noted

D.3.2 February Workshop Report and Logs

See following pages.

Hagler Bailly Pakistan

Industrial and Port Developments at Port Qasim, Pakistan

Cumulative Impact Assessment

Workshop Report

HBP Ref.: Z6WS1CIA

March 15, 2016

International Finance Corporation (IFC)

Washington DC

Contents

1. Introduction.....1-1

2. Objectives and Agenda.....2-1

3. Attendees and Apologies 3-1

4. Materials and Presentations.....4-1

5. Key Issues, Concerns and Feedback 5-1

Appendices:

Appendix A: Presentation on CIA for Port and Industrial Developments

Appendix B: Executive Summary

Appendix C: Log of Baseline and Impact, and Mitigation and Management Sessions

Exhibits

Exhibit 2.1: Workshop Programme **2-1**

Exhibit 3.1: Attendees and Apologies **3-1**
Exhibit 3.2: Presentation Session **3-8**
Exhibit 3.3: Discussion Sessions on Management, Baseline and Impacts **3-9**

1. Introduction

Port Qasim in Sindh, Pakistan was established in early 1980s as an alternate to Karachi Port with the added feature of an associated industrial area. The International Finance Corporation (IFC), the private sector arm of the World Bank Group (WBG), has invested in four port terminals and one industrial project in Port Qasim. As Port Qasim Authority (PQA), the federal government agency mandated to manage the port and associated industrial developments, has plans to develop the port further, the IFC may invest in these.

Environmental and social impacts from existing developments combined with the incremental impacts resulting from proposed future developments, may result in significant cumulative impacts that would not be expected in the case of a stand-alone development, IFC has acquired the services of Hagler Bailly Pakistan (Pvt) Ltd (HBP) to conduct an Ecosystem Service Review (ESR) and a Cumulative Impacts Assessment (CIA) for the existing and planned developments at Port Qasim.

The PQA undertook a strategic environmental assessment as part of the strategic planning study in 2001.[1] Since the completion of the study, developments have taken place in Port Qasim area and in surrounding areas. The present Study augments the previous PQA study.

The Study was initiated in March, 2015. Consultations and briefings with the PQA and other stakeholders were carried out from March through December, 2015, and the Workshop was held in February, 2016.

This document presents a summary of the Workshop carried out in February, 2016.

[1] Engineering Consultants International (Pvt.) Ltd., Strategic Planning Study for Port Qasim, Volume 5, Strategic Environmental Assessment, June 2001.

2. Objectives and Agenda

The objectives of the workshop were to:

- Communicate the potential impacts of development in Port Qasim and corresponding mitigation measures
- Share perspectives on possible roles and responsibilities of different stakeholders to implement mitigation measures
- Consider the capacity of stakeholders to support implementation of mitigation measures and explore possible partnerships and areas for collaborative action to support the sustainability of Priority Ecosystem Services in PQA

The workshop programme is provided in **Exhibit 2.1**.

Exhibit 2.1: Workshop Programme

Time	*Topic*	*Presenter/Moderator*
09:30 am	**Registration Opens**	
10:00 am	Welcome, introduction, background and rationale for the Study.	Nadim A. Siddiqui and Larry Jiang, IFC
10:15 am	Workshop contents and structure	Vaqar Zakaria, HBP
10:20 am	Overview of Port Qasim environment and development plans	Shabir Kazi, DG PQA
10:40 am	Objectives and key findings of the Study on Cumulative Impact Assessment and Ecosystem Service Review	Sally Johnson, IFC Bilal Khan, HBP Hidayat Hasan, HBP
11:10 am	**Tea Break**	
11:30 am	Key findings of the Study on Cumulative Impact Assessment and Ecosystem Service Review	Continued..
11:50 am	Suggested preventive actions and management measures Proposed institutional and financial framework for management	Vaqar Zakaria, HBP
12:45 pm	**Lunch**	

Time	*Topic*	*Presenter/Moderator*
1:30 pm	**Discussion Session I – One Hour** Theme: Review of Impact Assessment Focus of discussion: ▶ Key environmental values and threats ▶ Priority areas and actions for implementation ▶ Stakeholders' role in sustainability of Priority Ecosystem Services ▶ Synergies for way forward	Introduction by Sally Johnson, IFC Moderated by WWF-P
1:30 pm	**Discussion Session II – One Hour** Theme: Review of Management Framework Focus of discussion: ▶ Capacity of stakeholders to implement mitigation measure ▶ Institutional arrangements for implementation and roles and responsibilities ▶ Financial model to support environmental management	Introduction by Vaqar Zakaria, HBP Moderated by Port Qasim Authority
2:30 pm	**Tea Break**	
2:45 pm	Summary of Discussion and Recommendations for Way Forward	Sally Johnson and Vaqar Zakaria
3:00 pm	Closing Remarks and Way Forward	Larry Jiang, IFC

3. Attendees and Apologies

The complete list of the stakeholders who were invited has been provided in **Exhibit 3.1** divided into those that attended and those that apologized.

Exhibit 3.1: Attendees and Apologies

No	*Name*	*Designation and Affiliation*	*Attended*
1.	Larry Jiang	Principal Environmental Specialist, IFC	✓
2.	Sally Johnson	Consultant, IFC	✓
3.	Nadeem A. Siddiqui	Pakistan Country Manager, IFC	✓
4.	Samir Besirevic	Senior Environmental Specialist, IFC	✓
5.	Shahid Lutfi	Consultant, IFC	✓
6.	Gulen Miten	Social Development Specialist, IFC	✓
7.	Timothy Moore	Dy Director, Office of Energy, USAID-Pakistan	✓
8.	Eric Florimon-Reed	Dy Director, Office of Energy, USAID-Pakistan	✓
9.	Shabir Anwar Kazi	DG Technical, PQA	✓
10.	Mr Najaf Quli Mirza	DG P&D, PQA	✓
11.	Jawad ud din Athar	Director Dredging, PQA	✓
12.	Tariq Iqbal	Director Environment &Safety, PQA	✓
13.	Rizwan Ghauri	Harbor Master, PQA	✓
14.	Anwar Mehtab Zaidi	Manager PSP, PQA	✓
15.	Asad Abbas	Deputy Manger PSP, PQA	✓
16.	Mirza Azhar Iqbal	Deputy Manager (Environment and Safety), PQA	✓
17.	Eng. Shaukat Shah	Dy Manager, Port Qasim Authority	✓
18.	Capt. Farrukh Husnain	Manager QHSE&T, DP World	✓
19.	Ahmad Rana	CEO, FAP Terminals	✓
20.	Mohammad Fakhir	SHE & Training Head, Engro Vopak and Elengy Terminal	✓
21.	Nadeem Esbhani	EHS Manager, FWQ/Liquid Cargo Terminal	✓
22.	Song Zhaochun	Project Director, SinoHydro	✓
23.	Rameez Afraz	Manager, Engro Zarkhaiz	✓
24.	Lt Col Asad ullah Chughtai	Co-Chairman, Lotte Chemical Pakistan Ltd	✓
25.	S Qamar Alam	Plant Manager, Lotte Chemical Pakistan Ltd	✓

No	*Name*	*Designation and Affiliation*	*Attended*
26.	Dr Ghulam Qadir	NRM Coordinator, IUCN	✓
27.	Tahir Qureshi	Programme Director - Coastal Ecosystem Unit, IUCN	✓
28.	Rab Nawaz	WWF Director (Sindh Region), WWF	✓
29.	Umair Shahid	WWF Coastal Manager, WWF	✓
30.	Brig. Zubair Ahmed	Administrator, Defence Officers Housing Authority (DHA)	✓
31.	Rashida Qari	Director, Institute of Marine Sciences	✓
32.	Dr. Qadeer Mohammad Ali	In Charge, Marine Reference Collection and Research Center	✓
33.	Syed Masood Ahmed	Consultant, Partner of ERM in CIA study of Windfarms	✓
34.	Naeem Mughal	Director General, EPA	✓
35.	Syed Mohammad Tarique	Managing Director, Korangi Fisheries Harbor Authority	✓
36.	Ahmed Raza	Pakistan International Bulk Terminal	✓
37.	Naila Haq	Deputy Director – Environment, P&D	✓
38.	Sultan Mahmood	Unit Manager, Fauji Fertilizer, Bin Qasim Limited	✓
39.	Shabbir Khurshid Hussain	Business development Manager, Lotte Chemical Pakistan Ltd	✓
40.	Khalid Mahmood	Manager, Fisheries Development Board	✓
41.	Dr. Ehsan Elahi Valeem	Institute of Marine Sciences	✓
42.	Dr. Nuzhat Afsar	Institute of Marine Sciences	✓
43.	Prof. Dr. Omme Hany	Institute of Marine Sciences	✓
44.	Dr. Nafisa Shoaib	Assistant Professor, Centre of Excellence in Marine Biology (CEMB)	✓
45.	Dr. Shahnaz Rashid	Assistant Professor, Centre of Excellence in Marine Biology (CEMB)	✓
46.	Syed Imtiaz Shamsi	Pakistan Steel Mills	✓
47.	Hamed Saeed Anjum	Pakistan Steel Mills	✓
48.	M. Shamail Haider	Pakistan Steel Mills	✓
49.	Syed Shujat Hussain	Manager operation, Fauji Oil Terminal & Distribution Co. Ltd (FOTCO)	✓
50.	Danish Murtaza	Deputy Manager operation, Fauji Oil Terminal & Distribution Co. Ltd (FOTCO)	✓
51.	Dr Hina Saeed Baig	Senior Research Officer, National institute of oceanography	✓

No	*Name*	*Designation and Affiliation*	*Attended*
52.	S. Shujat Jamal	Senior HSE advisor, Engro Polymer & Chemical Ltd	✓
53.	Capt Rafi Qadir	GM ENGG, Qasim International Container Terminal (QICT)	✓
54.	Khurram Noor	CFO, Defence Housing Authority (DHA)	✓
55.	Hussain Ali	Senior Engineer, HBP	✓
56.	Mansoor Ahmed	XEN, Karachi Port Trust (KPT)	✓
57.	Shakaib Arif	Chief operating officer, National Foods	✓
58.	Basim Zafar	Consultant, Tekcellent Pvt Ltd	✓
59.	Ali Dehlavi	Economist, WWF Pakistan	✓
60.	Dr. Shaukat Hayat Khan	Marine Ecology Consultant	✓
61.	Rukhsana Asghar Chaudhary	Director Marine, Sindh Fisheries	✓
62.	Nawaz Ali	President, Sea Friend Pakistan	✓
63.	Zeeshan Liaqat	Manager, Pakistan International Bulk Terminal (PIBT) Limited	✓
64.	Syed Azhar Sultan	Anti-Pollution Officer, Karachi Port Trust (KPT)	✓
65.	Arshad Hussain	Environmental Specialist, Karachi Port Trust (KPT)	✓
66.	Nouman Shaikh	Assistant Manager Environmental, ECS	✓
67.	Mansoor A. Bhutto	Karachi Port Trust (KPT)	✓
68.	Dr. M. Shoaib Kiani	Assistant professor, Institute of Marine Sciences	✓
69.	Hidayat Hasan	Divisional Manager, Hagler Bailly Pakistan	✓
70.	Bilal Khan	Environment Engineer, Hagler Bailly Pakistan	✓
71.	Ghulam Hyder Chaman	General Secretary, Sea Friend Pakistan	✓
72.	Zaheer A Ather	Environmental Specialist, ECS	✓
73.	Imran Sabir	Deputy Director, SEPA	✓
74.	Shaharyar A Kazi	Deputy Director (Eng), Sindh Coastal Development Authority, PZDD	✓
75.	Dr. A. D. Khan	Groundwater Expert, Pakistan Council of Research in Water Resources, Islamabad	✓
76.	Farrukh Husnain	Safety Manager, DP World	✓
77.	Deniz Baharoglu	Manager, Transactional Risk Solutions, IFC	
78.	Samina Mussarat Islam	Consultant, IFC	

No	*Name*	*Designation and Affiliation*	*Attended*
79.	Mona Abou El Yazeed Fahm Darweesh	Investment Analyst, IFC	
80.	Zeeshan Ahmed Sheikh	Investment Officer , IFC	
81.	Javaid Afzal	Senior Environmental Specialist, World Bank	
82.	Hassan Afzal Zaidi	Transport Specialist - GTIDR, World Bank	
83.	Babar Naseem Khan	World Bank	
84.	Ernesto Sanchez-Triana	Lead Environmental Specialist, World Bank	
85.	Hammad Raza	World Bank	
86.	Mosuf Ali	World Bank	
87.	Kseniya Lvovsky	World Bank	
88.	Zia Aljalaly	World Bank	
89.	Akiko Nakagawa	World Bank	
90.	Rafik Hirji	World Bank	
91.	Tapas Paul	World Bank	
92.	Dan Biller	World Bank	
93.	Peter Webster	World Bank	
94.	John Pethick	World Bank	
95.	Santiago Enriquez	Lead Environmental Specialist, World Bank	
96.	Jacqueline C. Schumacher	Deputy Director, Karachi Provincial Office , USAID-Pakistan	
97.	Ross E. Hagan	Director, Office of Energy, USAID-Pakistan	
98.	Safia Shafeeq	Environment Specialist, ADB, Islamabad	
99.	Jocelyn Erlinda S. Munsayac	Senior Safeguards Specialist, ADB, Manila	
100.	Jose Frazier P. Gomez	ADB - Private Sector Operations Department	
101.	Werner Liepach	Head , ADB, Pak Residence Mission	
102.	Karin Nunan	Senior Social Consultant, ERM	
103.	Agha Jan Akhtar	Chairman, PQA	
104.	Capt Nouman Hassan	DG Operations, PQA	
105.	Mr Farukh Jamil	DG Finance, PQA	
106.	Dr Kazim Hussain Jatoi	DG Admin, PQA	
107.	Mr Aleem Shaikh,	Director P&D , PQA	
108.	Mr Muhammad Saqib	Director IM, PQA	
109.	Sardar Jang	Chief Hydrographer, PQA	
110.	Mr Shahid Hafeez	Manager Dredging , PQA	

No	*Name*	*Designation and Affiliation*	*Attended*
111.	Musaddaq Zulqarnain	Board Member, PQA	
112.	Nadeem Babar	Board Member, PQA	
113.	Muhammad Adrees	Board Member, PQA	
114.	Muhammad Zubair	Board Member, PQA	
115.	Babar Badat	Board Member, PQA	
116.	Changez Niazi	CEO, DP World	
117.	Hasan Sobuctageen	COO, Fauji Oil Terminal & Distribution Co. Ltd (FOTCO)	
118.	Ammar Raza Zaidi	Assistant Manager Business Development, Fauji Oil Terminal & Distribution Co. Ltd (FOTCO)	
119.	Brig Javed Mobin	COO, Fauji Abkar Portia Terminals	
120.	Syed Muhammad Ali	CEO, Engro Vopak and Elengy Terminal	
121.	Amir Mahmud	Terminal Manager, Engro Vopak and Elengy Terminal	
122.	Rasheed Jan Mohammad	CEO, FWQ/Liquid Cargo Terminal	
123.	Salman Tariq	Administration Officer, FWQ/Liquid Cargo Terminal	
124.	Sharique Siddiqui	CEO, Pakistan International Bulk Terminal (PIBT)	
125.	Mia Ahmed	President, Bin Qasim Association of Trade and Industries (BQATI)	
126.	Rashid Jan Mohammad	Vice President, Bin Qasim Association of Trade and Industries (BQATI)	
127.	A Rehman Ismail	Secretary General, Bin Qasim Association of Trade and Industries (BQATI)	
128.	Maj. Khalid	Bin Qasim Association of Trade and Industries (BQATI)	
129.	Intezar Haqqi	CEO, Lucky Power Plant	
130.	Ruhail Muhammad	CEO, Engro Zarkhaiz	
131.	Khalid Siraj Subhani	CEO, Engro Polymer & Chemical Ltd	
132.	Shujaat Rizvi	Manager, Engro Polymer & Chemical Ltd	
133.	Ikram Naqi	Engro Polymer & Chemical Ltd	
134.	Khawaja Hassan Mansur	Environment and Industrial Hygiene Engineer, Engro Polymer & Chemical Ltd	
135.	M Hamidullah	Chief Engineer, MAPAK Edible Oil Refinery	
136.	Rehan Siddiqui	Manager Projects, MAPAK Edible Oil Refinery	

No	*Name*	*Designation and Affiliation*	*Attended*
137.	Brig. (R.) Sami Akhtar	Divisional Residence Manager, Fauji Fertilizer Bin Qasim Limited	
138.	Humair Ijaz	CEO, Lotte Chemical Pakistan Ltd	
139.	Maj. General (R.) Zaheer Ahmed Khan	CEO, Pakistan Steel Mills	
140.	Tariq Rafi	CEO, Siddiqsons Energy	
141.	Irshad Ali	Director, K-Electric Bin Qasim Power Station-1	
142.	Syed Medhi Ali	General Manager, K-Electric BBQPS-II, Combined Cycle PP	
143.	Majid Thahim	Pakistan FisherFolk Forum	
144.	Muhammad Ali Shah/ M. Saeed Baloch	Chairman/Contact Person, Pakistan FisherFolk Forum	
145.	Meher Noshirwani	Technical Advisor, Trust for Conservation of Coastal Resources	
146.	Zubeda Birwani	Director, Trust for Conservation of Coastal Resources	
147.	Rafiul Haq	Founder & Ecologist, Costal Restoration Alliance for Bio Diversity (CRAP)	
148.	Syed Aziz Agha	Country Representative, International Game Fish Association	
149.	Dr. Pirzada Jamaluddin Ahmed Siddiqui	Director, Centre of Excellence in Marine Biology (CEMB)	
150.	Mr Asif Shaikh	Chairman, Environmental Engineering Dept., NED University of Eng. & Tech.	
151.	Dr. Tariq Masood Ali Khan	Director, Institute of Environmental Studies	
152.	Dr Shahid Amjad	Expert in Coastal Ecology, Independent Consultant	
153.	Dr M Rafique	Director, Pakistan Museum of Natural History and HBP Consultant	
154.	Dr. Syed Shahid Alam	Expert in Marine Structures, Independent Consultant	
155.	Rizwan Memon	Secretary, Forest, Environment, Wildlife Department, Sindh	
156.	Saeed Akhtar Baloch	Conservator of Wildlife, Sindh Wildlife Department	
157.	Javed Mehar	Conservator Wildlife, Sindh Wildlife Department	
158.	Agha Tahir Hussain	Conservator - Mangroves, Sindh Forest Department	

No	*Name*	*Designation and Affiliation*	*Attended*
159.	Iqbal Nafees	Director General, Coastal Development Authority	
160.	Mohammad Ramzan Awan	Secretary , Fisheries & Livestock Department	
161.	Mohammad Ramzan Awan	Managing Director, Karachi Fisher Harbor Authority	
162.	Faisal Iftikhar	CEO, Fisheries Development Board (FDB)	
163.	Israr Ahmed	Director-General, Marine Fisheries Department (MFD)	
164.	Muhammad Wasim Khan	Director (Research & Assessment), Marine Fisheries Department	
165.	Dr. Asif Inam	Director General, National Institute of Oceanography	
166.	Mr Ajaz Ahmed Khan	Additional Chief Secretary (Development) & Chairman Provincial Climate Change Policy Implementation Committee, Planning and Development Department/Climate Change	
167.	Rehana Ghulam Ali Memon	Secretary Development, Planning and Development Department	
168.	Khalid Rehman	MD, SSGC (Sui Southern Gas Company)	
169.	Arsalan I. Khan	Chief Financial Officer, Marine Group of Companies (MRGC)	
170.	Aamir Fayyaz Khan	K-Electric Limited	
171.	Zahid Faqir	Deputy General Manager HSEQ, K-Electric Limited	
172.	Jahangir Waheed	General Manager, Manufacturing, Engro Polymer & Chemicals Limited	
173.	Col. Mansoor Ahmed	Coastal Development Authority	
174.	Khurram	Coastal Development Authority	
175.	Mr. Qaisar Abbas	Institute of Marine Sciences	
176.	Arif Ahmed Siddiqui	Deputy Director, K-Electric Bin Qasim Power Station-1	
177.	Dara Muneer Qazi	Assistant Conservator Technical, Sindh Wildlife Department	

Photographs from the presentation session are provided in **Exhibit 3.2** and from the discussion session in **Exhibit 3.3**.

Exhibit 3.2: Presentation Session





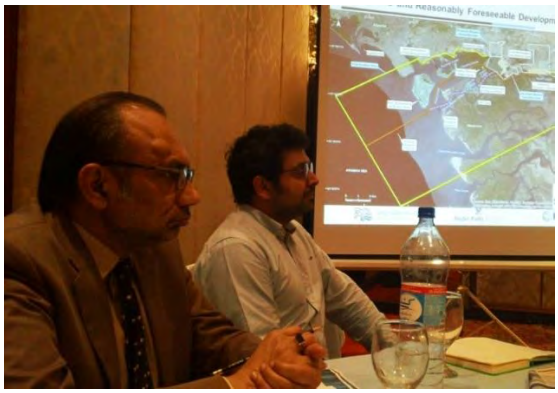








Exhibit 3.3: Discussion Sessions on Management, Baseline and Impacts




Management Session




Baseline and Impacts Session

4. Materials and Presentations

A draft executive summary of the CIA was shared with invited stakeholders before the workshop. The presentation detailing the CIA Study is attached as **Appendix A**.

An updated summary on the basis of the recommendations and feedback (see **Section 5**) has been provided as **Appendix B**.

5. Key Issues, Concerns and Feedback

The key issues which emerged during the discussion sessions on baseline and impacts and management are summarized as follows and further detail is provided in **Appendix C**.

Baseline and Impacts Session

- **Evidence for the presence of dolphins:** Evidence for the presence of dolphins in the Study Area was provided by representatives from Karachi University, with reference to a study and published research paper in which Karachi University has been involved. They highlighted the presence of relatively large groups of dolphins in the Study Area as well as the rich biodiversity within it.[2]
- **Welfare and mobility of local fishermen:** The welfare of the local fishermen was highlighted as being of high importance by representatives from the Sindh Fisheries Department, especially with respect to their mobility. It was stated that industrial infrastructure associated with FOTCO and the LPG terminal was impeding their movement. The industry representatives noted the concerns and said that this issue has to be addressed in consultation with PQA who are responsible for regulation of the shipping traffic. PQA responded by stating that these concerns would be addressed using proper planning.
- **Cutting of mangroves for developments:** The representatives from the Sindh Fisheries Department stated that mangroves have been cut for developments but replantation has not been carried out. This point was noted by the developers who highlighted that they are supporting plantations and making efforts to improve their success.
- **An ecological baseline for the mouth of the shipping channel:** An ecological baseline study was recommended by representatives from the National Institute of Oceanography (NIO), justifying the recommendation by the relatively high level of shipping traffic that moves through this area and emptying of ballast tanks here. It was noted that the present study (CIA) identified the mangrove ecosystem as the prioritized VEC and that ecology at the mouth of the shipping channel could be considered as part of further investigations. It was recommended that PQA and NIO collaborate to discuss the feasibility and requirements of such as investigation, after the initial and prioritized mitigation and management steps have been taken, including the institutional and financial management frameworks recommended as part of the CIA.
- **Air pollution:** Air pollution from the development of the conveyer belt for coal transport was highlighted as a concern by representatives from the food industry present in the area, such as Karachi Grains. HBP representatives stated that this was the subject of an EIA being conducted for the coal conveyor system and

[2] Subsequent to the workshop, marine mammals have been added as VEC in the CIA

although the design for the conveyer belt is not yet finalized it is likely to be closed/covered design, and that there is a need to address zoning in the area.

- **Illegal land reclamation:** Illegal land reclamation activities were highlighted as a concern by representatives from the Institute of Marine Science. They stated that there are multiple illegal land reclamation activities being carried out along the Port Qasim Notified Area by other entities and individuals. They indicated DHA as being one such entity and stated that the mangroves removed for this purpose have not been re-planted under any program. It was agreed that the Environmental Committee (if set up) needs to tackle the issue of un-regulated land reclamation. This may be possible through the land use planning recommended as part of the CIA.
- **Disagreements on strategies for replantation of mangroves:** Numerous stakeholders including the Institute of Marine Sciences, the Sindh Fisheries Department and the WWF expressed concerns associated with mangroves including disagreements on replantation strategies and practices, enforcement of regulations to protect and preserve the mangroves and the use of a number of conservation strategies. The main concerns were the replantation ratio of 1:5 being ineffective, the time lag between clearing and replantation as mature trees are removed and saplings planted. The Sindh Fisheries Department stated that the plantations need to be carried out in advance as loss of mature trees cannot be compensated for by planting of seedlings. Some of the other measures suggested included better protection, raising awareness, regulation of mangrove cutting, and efforts to cover as much mudflat area as possible.
- **Further developments:** Concerns about further industrial and commercial development in the area were expressed mainly by representatives from Karachi University. They stated that industrial development has been making this relatively rich ecosystem increasingly fragile. It was also stated that the locals and their livelihoods need to be given highest priority. It was noted by the developers that the IFC has high standards of environmental protection and that industries should aim to meet these at least in part. The IFC highlighted that they have leverage with the organizations they invest in but not with others.

Management Session

- **Consideration of legal issues:** The need for legal issues to be taken on board was highlighted as being very important in developing an environmental management plan. In particular the evaluation of the applicability of environmental legislation and the need for taking on board other stakeholders.
- **Recognition of the need for an environmental committee:** The recognition of the need for an Environmental Committee and decision on the share to be paid by industries for environmental management were highlighted as important areas that need to be addressed. The need for the Committee to be representative of all stakeholders was emphasized. QICT stated that they had invested relatively large sums towards environmental management since 2008 and improved their environmental performance.

- **Environmental fee:** It was noted that the PQA already charges ships an environmental fee under the current laws. PQA representatives recommended that no additional charge be imposed on the ships, as it would be counter to financial competitiveness.
- **Expenditure planning:** It was emphasized that a plan of expenditure is needed for any money collected for the purpose of environmental management. Representatives from the IUCN stated that a setup similar to that in India needs to be put in place where companies pay 2% of their profits towards environmental protection, as part of their CSR.
- **Future developments, centralizing protection and funding:** In light of concern expressed about possible environmental deterioration from future developments, it was suggested that centralized protection is important. In line with this approach funds need to be collected by PQA. The PQA highlighted that they are willing to lead the collection of funds but are not ready to increase tariffs as they want to remain financially competitive. Instead it was recommended that under each company's CSR, funds be contributed toward environmental protection. It was also recommended that, in line with international practices, environmental funds should be contributed by consumers.
- **Focus on the mangrove ecosystem:** The mangrove ecosystem was recognized as being important, therefore, requiring protection on priority. PQA made a note of this recommendation.
- **Early recognition of the importance of environmental protection:** The importance of recognizing the value of environmental protection as early as possible, especially for Port Qasim, was highlighted. Representative from KPT stated that resources should be developed in PQA such as nurseries for mangroves, environmental laboratory, environmental managers, and pollution control officers. As PQA is a relatively young port, addressing these areas at this stage was stated as being advisable.

Appendix A: Presentation on CIA for Port and Industrial Developments

See following pages.

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Cumulative Effects Assessment (CEA) for Port Qasim

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Rationale for Study

- IFC an investor in five jetty and one manufacturing project in PQA: Engro Elengy Terminal most recently
- Impetus for Cumulative Effects Assessment (CEA) stems from expectation set by IFC Board in anticipation of potential future investments (April 2015)
- Concerns over lack of CEA raised during Sindh EPA's public hearings in 2014 on Sinohydro's proposed investment in two 660-megawatt coal-fired power units
- Opportunity for PQA to move from piecemeal approach to a strategic approach







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Workshop Contents and Structure





OVERVIEW OF PORT QASIM

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Regional Setting of Port Qasim



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Port Qasim Authority

- Port Qasim Authority (PQA) functions under the Port Qasim Authority Act, 1973
- PQA, under landlord concept, encourages Private Sector to establish Terminal on BOT, industrial and commercial activities
- Large vessels having 13 meter draught are handled for bulk cargo – PQA caters Country's 40% seaborne cargo at present
- Direct access to National Highway, Super Highway and Railway Network for upcountry transportation
- Largest industrial estate, 273 units under operation, 233 under construction
- Away from city population, traffic congestion and environment friendly atmosphere
- 45 km long navigational channel provides opportunity of expansion of port activities

Port Qasim

The land under the jurisdiction of the Port Qasim Authority (PQA) comprises three industrial and commercial zones and the Notified Port Area. The three industrial and commercial zones are:

- **Southwestern Industrial Zone** including Port Operations and Commercial Areas
- **Northwestern Industrial Zone**
- **Eastern Industrial Zone**

In addition to this an LNG Zone has been demarcated by the Port Qasim Authority.

The Port is being developed largely according to the PQA Strategic Plan (2000-2050) developed in 2001 and keeping in view more recent requirements of Pakistan.

Port Qasim Notified Limits and Zones

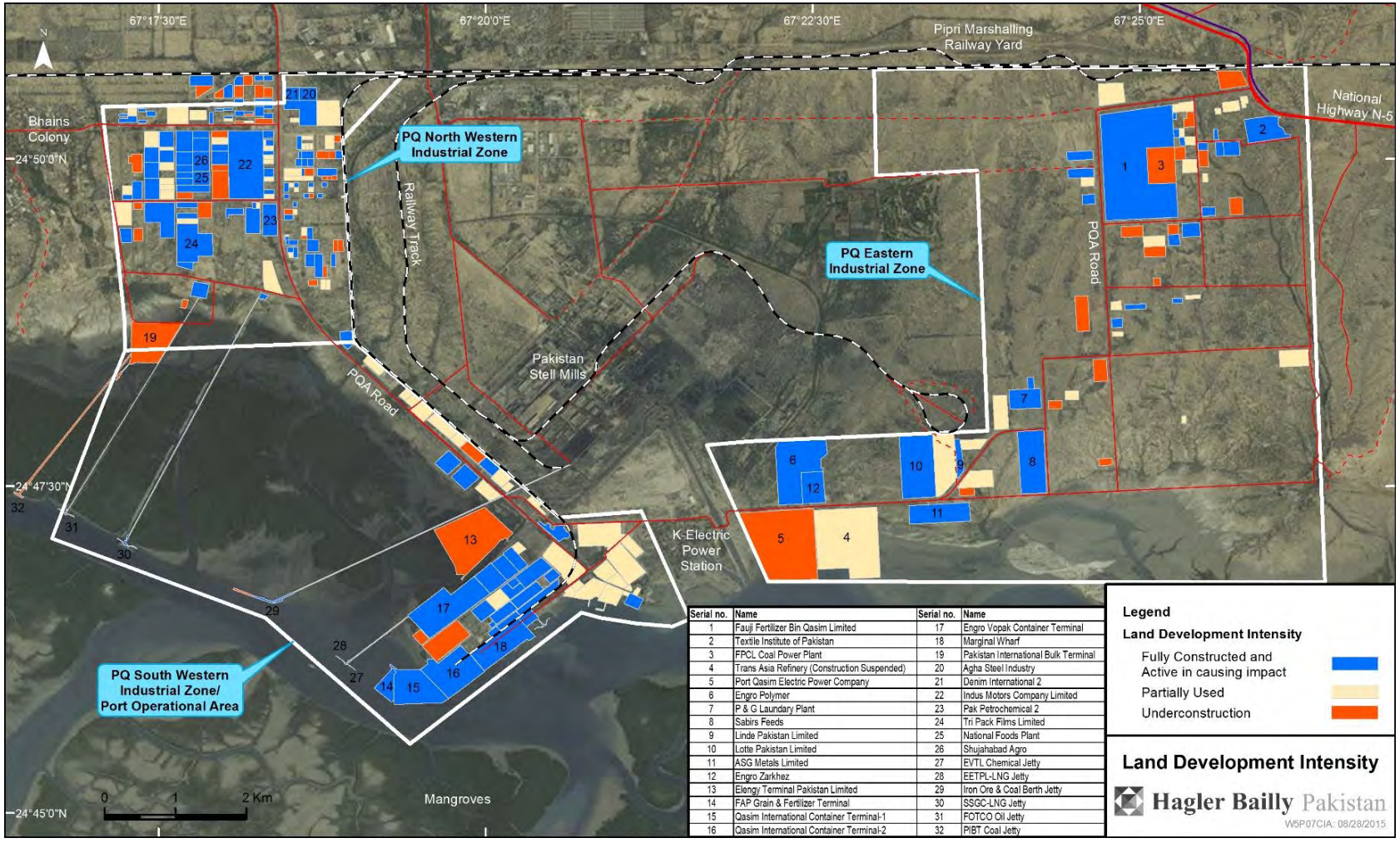


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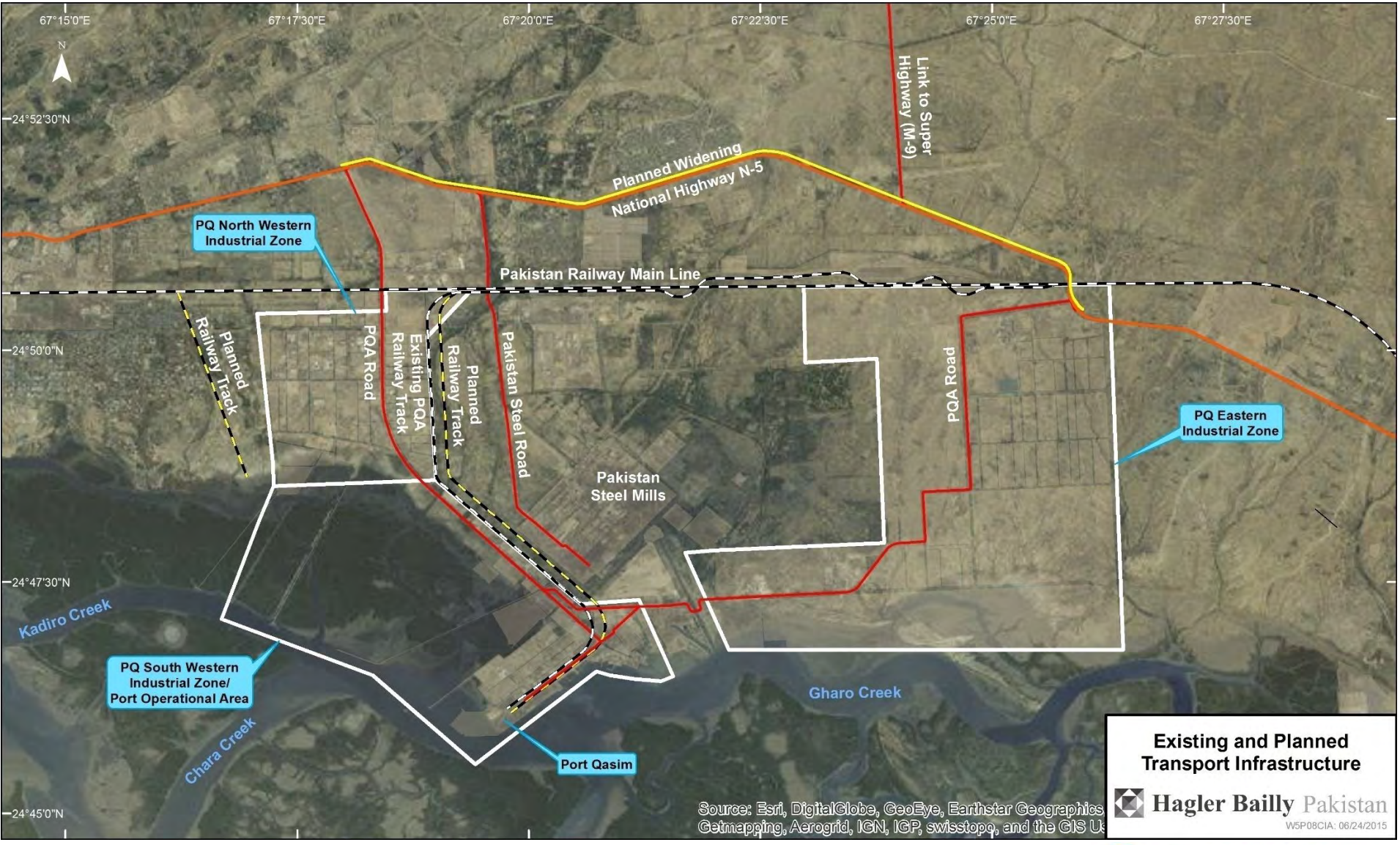
Current Development Intensity



Serial no.	Name	Serial no.	Name
1	Fauji Fertilizer Bin Qasim Limited	17	Engro Vopak Container Terminal
2	Textile Institute of Pakistan	18	Marginal Wharf
3	FPCL Coal Power Plant	19	Pakistan International Bulk Terminal
4	Trans Asia Refinery (Construction Suspended)	20	Agha Steel Industry
5	Port Qasim Electric Power Company	21	Denim International 2
6	Engro Polymer	22	Indus Motors Company Limited
7	P & G Laundary Plant	23	Pak Petrochemical 2
8	Sabirs Feeds	24	Tri Pack Films Limited
9	Linde Pakistan Limited	25	National Foods Plant
10	Lotte Pakistan Limited	26	Shujahabad Agro
11	ASG Metals Limited	27	EVTL Chemical Jetty
12	Engro Zarkhez	28	EETPL-LNG Jetty
13	Elengy Terminal Pakistan Limited	29	Iron Ore & Coal Berth Jetty
14	FAP Grain & Fertilizer Terminal	30	SSGC-LNG Jetty
15	Qasim International Container Terminal-1	31	FOTCO Oil Jetty
16	Qasim International Container Terminal-2	32	PIBT Coal Jetty

Approximately 273 projects are operational within the Port Qasim Northwestern, Southwestern and Eastern Zones, with another 233 under construction

Existing and Planned Infrastructure: Road and Railway

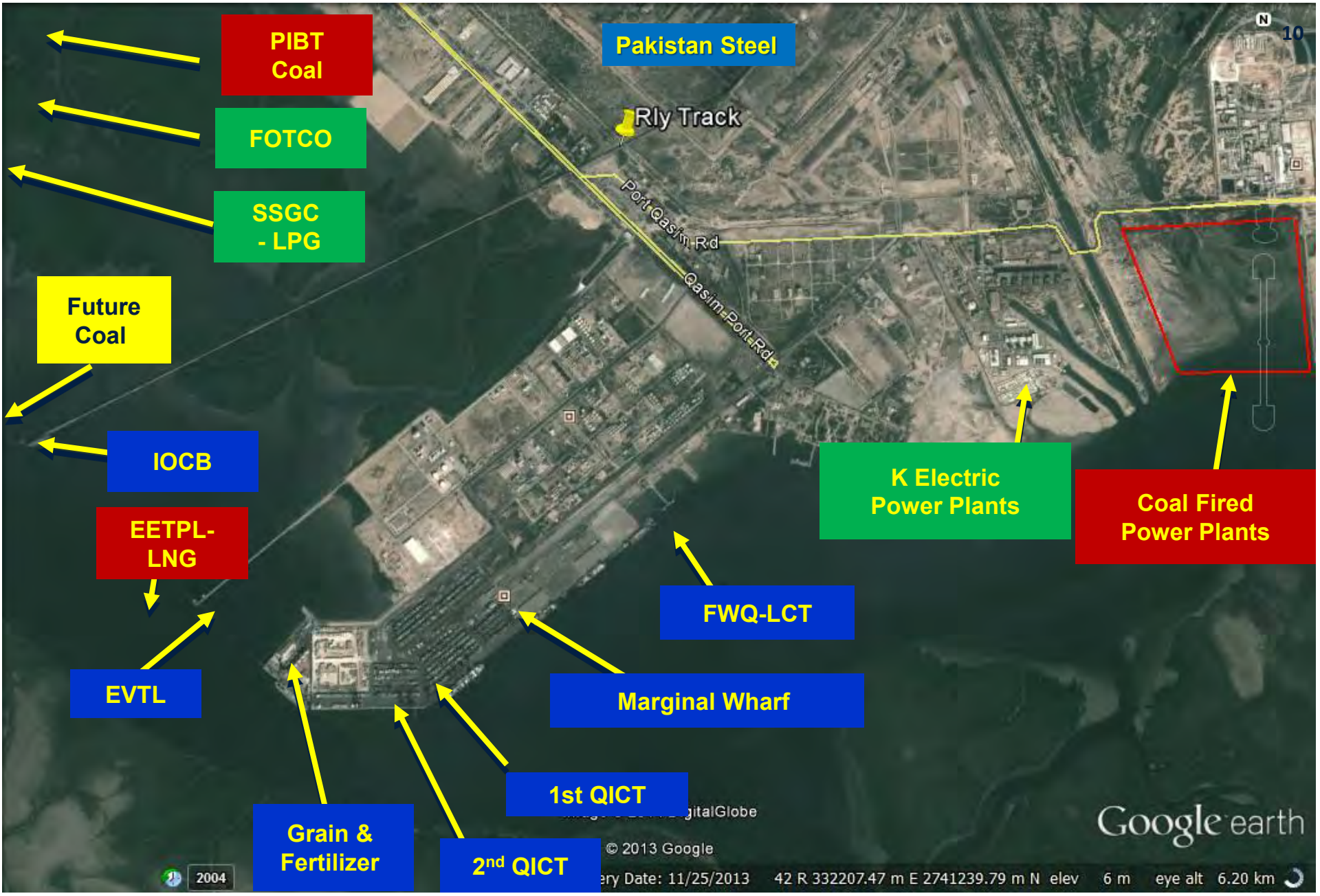


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Port Operational Complex



Port Operational Complex

Terminal	Basis	Berths/ Terminal	Annual Capacity million tonnes	Cost (million)	Year of Operation
Iron Ore & Coal Berth (IOCB)	Public Sector	1	3.0	Rs. 415	1980
Marginal Wharf		4	6-7	Rs.1362	1983
Fauji Oil Terminal (FOTCO)	Private Sector	1	9.0	US$ 97	1995
Qasim International Container Terminal (QICT)		2	0.850 TEUs	US$ 100	1997
Liquid Chemical Terminal (EVTL)		1	4.0	US$ 76	1998
SSGC LPG Terminal		1	2.0	US$ 50	2007
Liquid Cargo Terminal (LCT)		1	4.0	US$ 25	2009
Grain & Fertilizer Terminal (FAP)		1	4.0	US$ 135	2010
2nd Container Terminal		2	1.175 TEUs	US$ 300	2010
Fast track LNG By EETPL		1	400 mmsfd	US$135	March 2015

Pakistan International Bulk Terminal



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Pakistan International Bulk Terminal

Name of Company	Pakistan International Bulk Terminal (PIBT)
Jetty Size	30m x 460 m
Trestle	Width 9m, Length 2.5 Km
Capacity	8 million ton / annum (Original Plan - 4 m each) Enhanced to 16 million ton / annum (12 m Coal, 4 m Clinker/Cement)
Vessel Handling Size	55,000 - 75,000 DWT
Cost	US$ 250 Million
Completion	December 2016

Anticipated Developments

Anticipated developments at Port Qasim.

Widening, Deepening & Straightening of existing Navigational Channels and Commissioning of alternate channel:

- Deepening, Widening & Straightening of the existing Navigation Channel (along Phitti and Kadiro Creeks) for all-weather 14 meter draught
- Extension of the existing Navigation Channel upto Port Qasim Electric Power Company Power Plant
- Commissioning of new alternate navigation channel (along Chara, Rakhal and Chhan Wado Creeks)

Construction of additional Port terminals:

- Coal Terminal(s)
- LNG Terminal(s)

Anticipated Developments *(contd…)*

Development of industrial and power generation units within the Northwestern Zone and Eastern Zone, including the following:

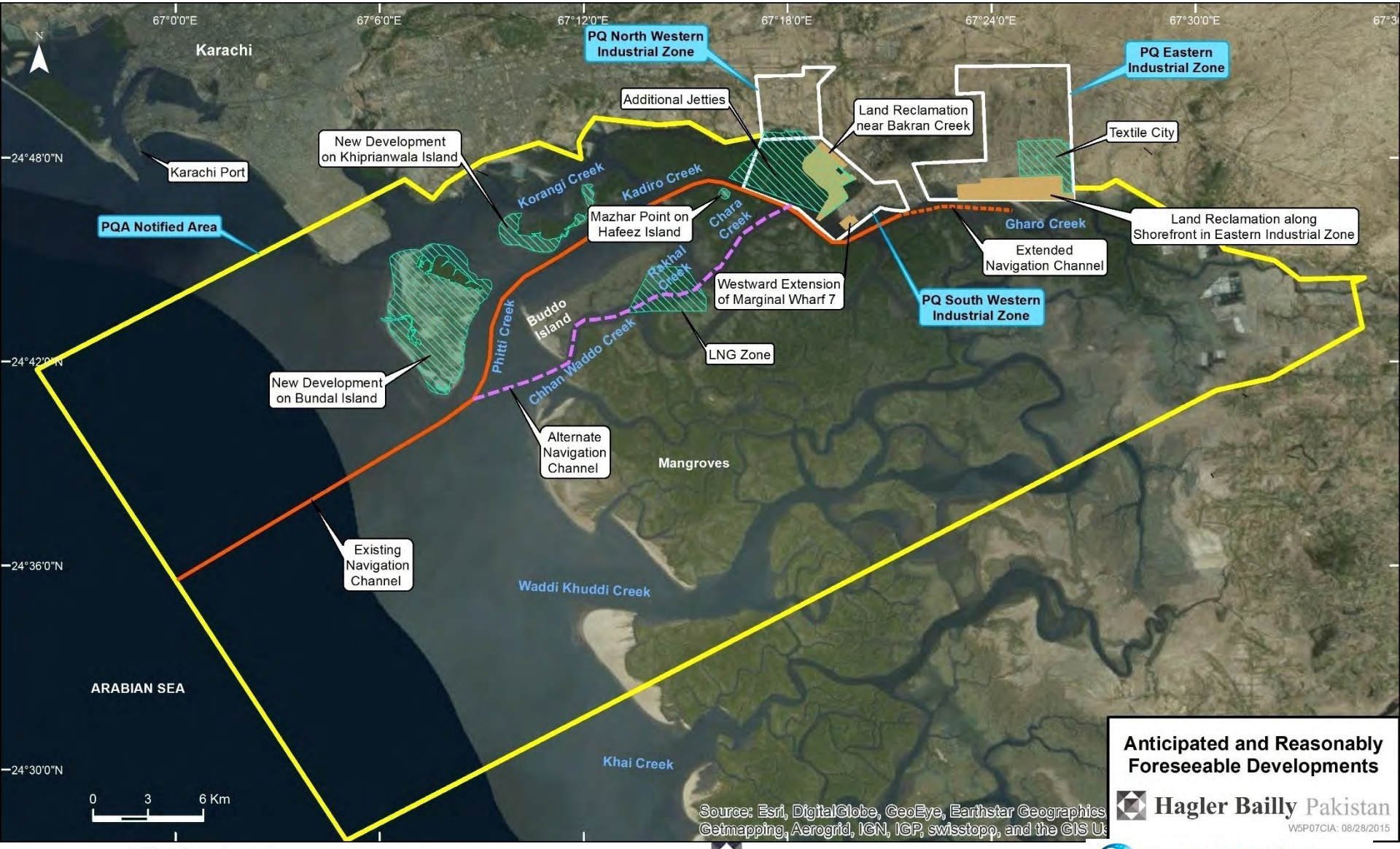
- Textile City
- Siddique Sons Limited, 350 MW Coal-fired Power Plant
- K-Electric, 1400 MW Coal Fired Power Plant
- 150 MW FFBL Coal Fired Power Plant

Reasonably Forseable Developments

Reasonably foreseeable developments exist largely outside the current land development zones and include:

- Dredging for a new, alternate navigation channel (along Chara, Rakhal and Chhan Wado Creeks)
- Development of LNG terminals within the LNG Zone and adjoining creeks of alternate navigation channel.
- Developments at Bundal and Khiprianwala Islands (e.g. recreational developments or deep water berths for liquid bulk, dry bulk and container ships and related industrial development) and Ziarat Shah Islands.
- Developments at Mazhar Point on Hafeez Island (across Gharo Creek from the South Western Zone).
- Land acquisition (non-shorefront) along eastern edge of Eastern Industrial Zone, approximately 485 hectares (1,200 acres).
- Land reclamation in other areas identified in the PQA Strategic Plan (2000-2050) for Port Qasim including Bakran Creek.

Anticipated and Reasonably Foreseeable Developments









KEY FINDINGS OF CEA

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Port Qasim



Objectives of CEA

- ESIA's fail to capture cumulative effects additive or interactive
- Ensure cumulative effects of developments don't compromise the sustainability of ecosystems and related services
- Ensure the value of PQA and feasibility of future development not limited by cumulative effects
- Support the establishment of appropriate governance structures for managing impacts and decision-making





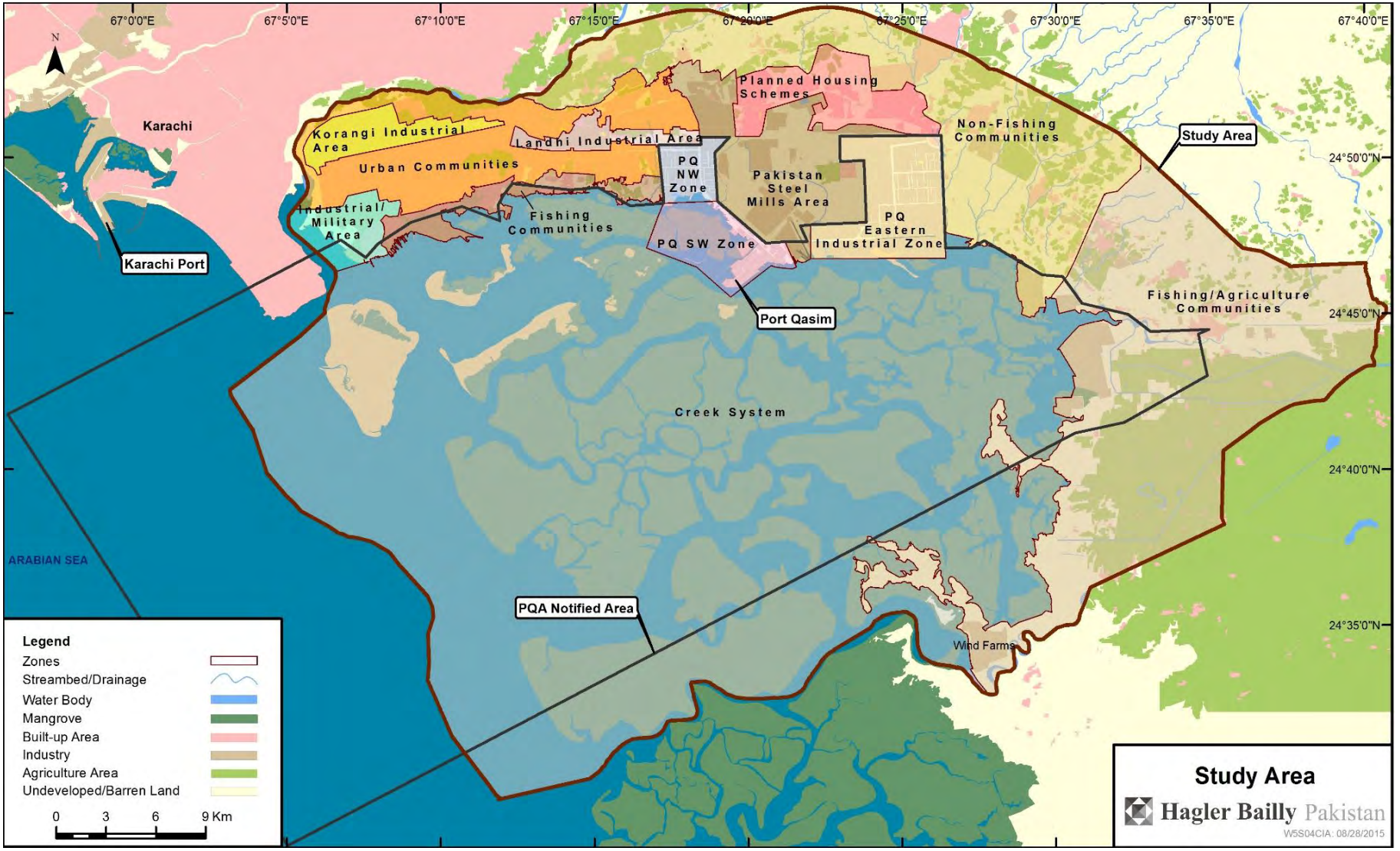


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The study area for the CEA

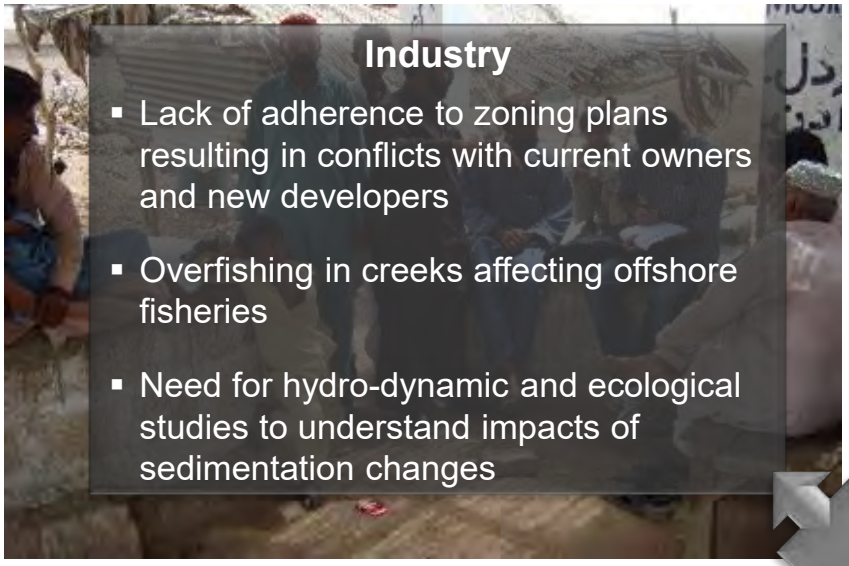


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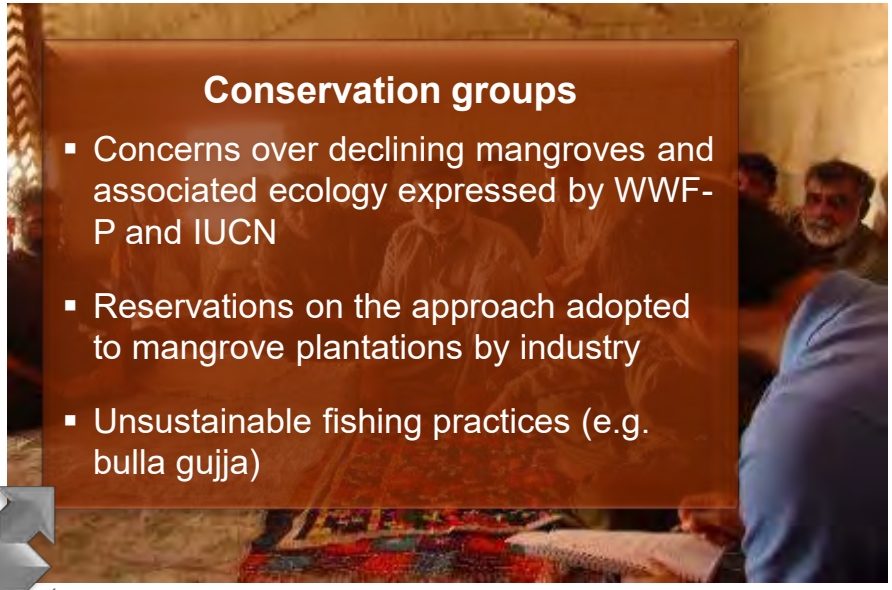
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Concerns expressed in stakeholder consultations



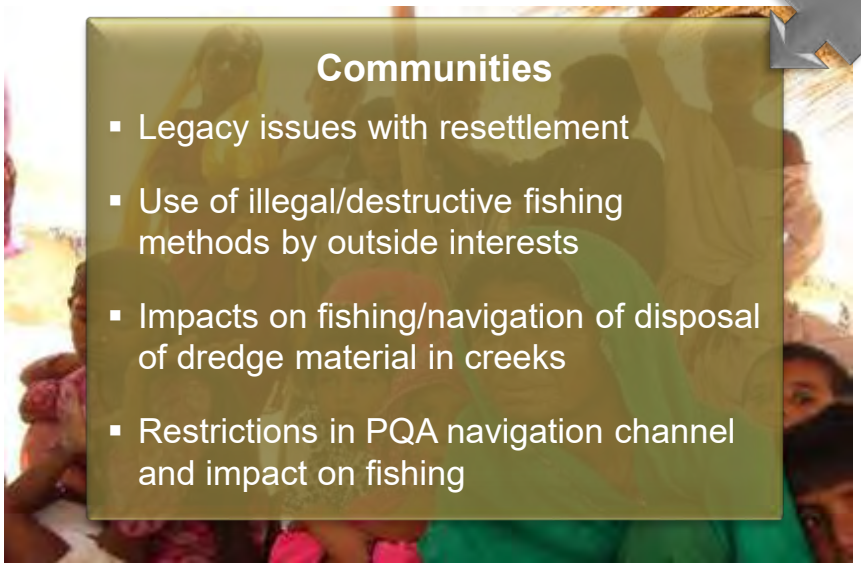
Industry

- Lack of adherence to zoning plans resulting in conflicts with current owners and new developers
- Overfishing in creeks affecting offshore fisheries
- Need for hydro-dynamic and ecological studies to understand impacts of sedimentation changes



Conservation groups

- Concerns over declining mangroves and associated ecology expressed by WWF-P and IUCN
- Reservations on the approach adopted to mangrove plantations by industry
- Unsustainable fishing practices (e.g. bulla gujja)



Communities

- Legacy issues with resettlement
- Use of illegal/destructive fishing methods by outside interests
- Impacts on fishing/navigation of disposal of dredge material in creeks
- Restrictions in PQA navigation channel and impact on fishing



Shared concerns

- Communities, industry and NGOs concerned by discharge of untreated effluent
- Communities and industry concerned about impacts of ambient air quality on human health

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Ecological Baseline

- The Indus Delta (Ramsar site) -5th largest delta in the world
- Consists of creeks, estuaries, mud, sand, salt flats, mangrove habitat, marshes, sea bays, and straits
- Very Important economically and ecologically
- It is a Ramsar site and Key Biodiversity Area (KBA)-supports more then 60,000 migratory and congregatory species including threatened species
- The Mangrove ecosystem meets the IFC and the Asian Development Bank's criteria for Critical Habitat.



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Priority Ecosystem Services

- Mangroves are the main nursery grounds for fish/shellfish – subsistence and economic importance for both off shore and in creek fisheries and associated livelihoods
- Meets fuel wood and fodder requirements of local communities
- Erosion control
- Water purification-absorb heavy metals
- Barrier to cyclones and typhoons







Fish diversity

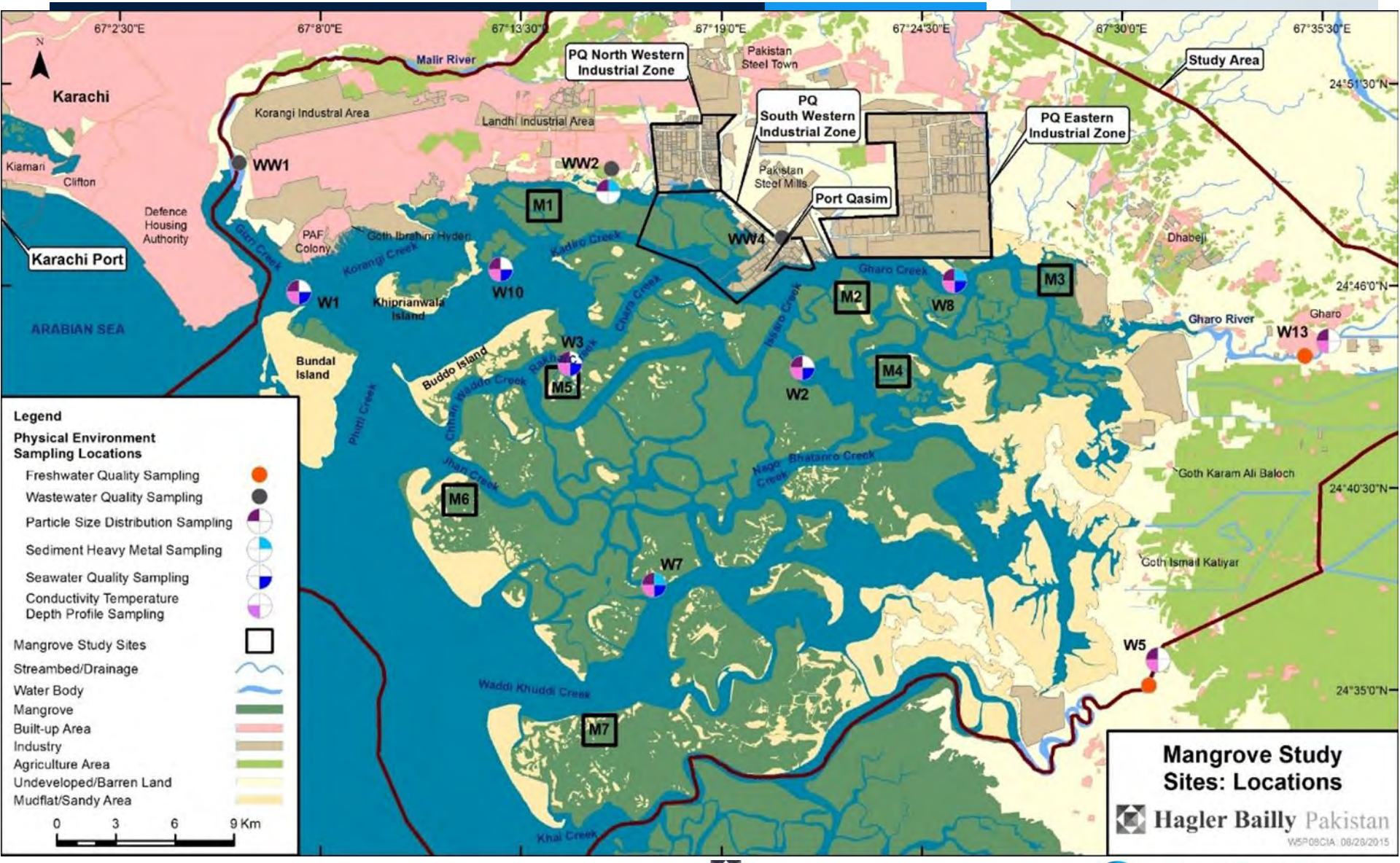
- High diversity of fish - 126 marine species found at Keti Bandar in a recent study (also expected in Study Area)
- 66 species observed during limited sampling at PQ
- Anecdotal reports indicate presence of 180 fish species
- Fish diversity lower near PQ closer to the shoreline, and improved within creeks moving away from the shoreline
- Possible reasons are over fishing closer to the mainland, and higher levels of pollution
- 4 fish species expected in Study Area are listed as Near Threatened in the IUCN Red List. One species has a restricted range







Mangroves Study Sites



Mangroves

- Mangroves cover an area of 129,000 ha (97% of mangroves in Pakistan) -24% under PQA
- Mangrove cover has declined significantly due to multiple stresses, 1/3rd of what it was in 1980 (1/5th of 1932)-recent trends since 2003, however, show a slight increase
- Changes in distribution and extent mainly due to reductions in fresh-water inflows
- Healthy mangroves largely along the banks of the creeks
- Mangroves closer to PQ and areas that receive municipal and industrial effluents are healthier
- Unhealthy mangroves more common further from PQ- possibly due to lower delivery of nutrients, water and sediment from the Indus and less protection from fodder and fuel wood extraction







Impacts on Mangroves/Biodiversity (PQA)

- 0.3% of the mangrove area has been lost to development of PQ to date
- The loss will expand to 2.1% of mangrove in the Study Area by 2050 if all planned developments proceed, which is minor in terms of area impacted
- However, as mangroves in the Indus Delta qualify as Critical Habitat, the impact would be significant requiring credible remedial measures
- There is a risk of further damage to mangroves due to unregulated dumping of dredge materials, particularly from dredging the second channel
- The impact of accidental releases of oil and other toxic materials from tankers and other ships and on marine life is a potential concern



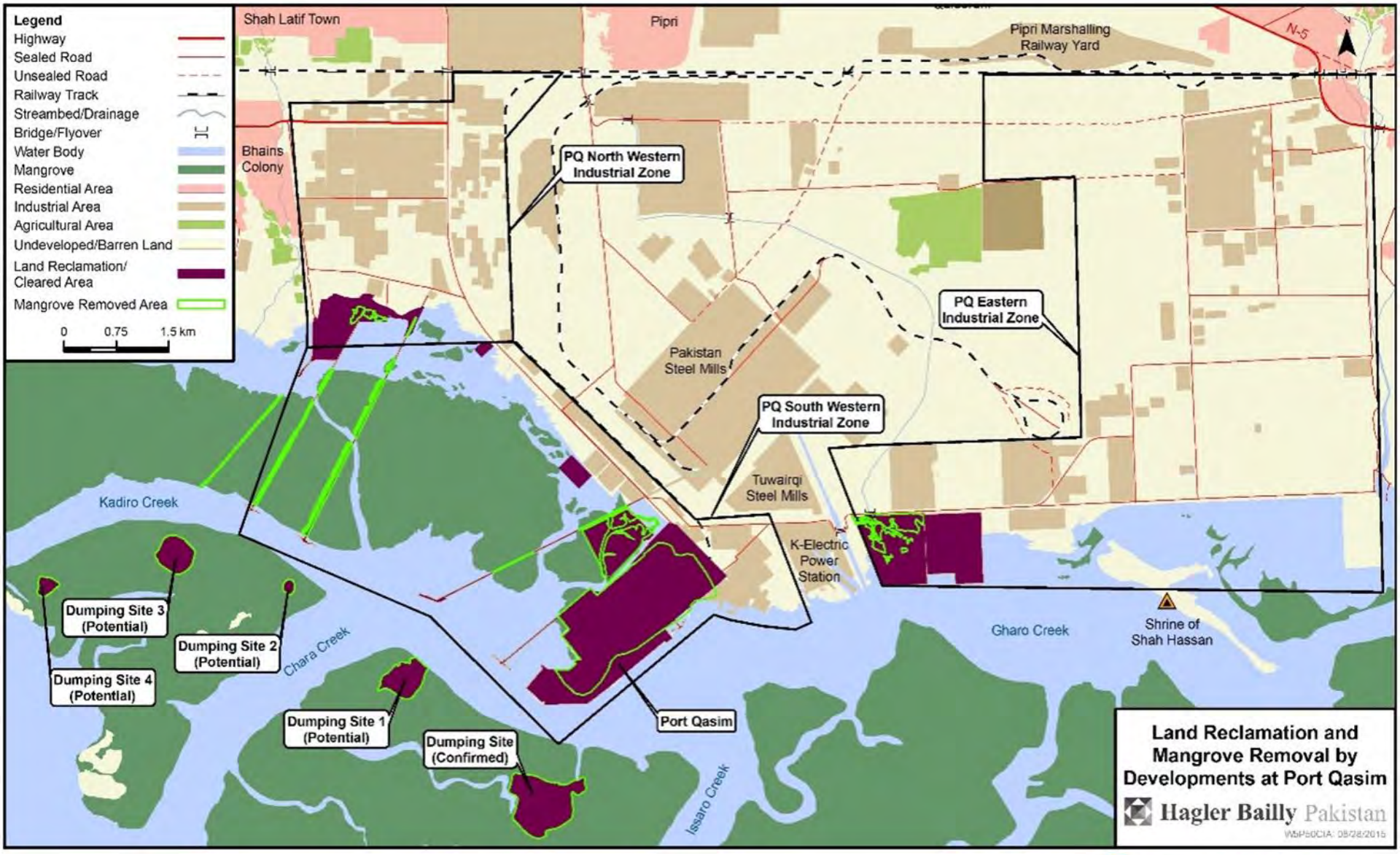


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Land Reclamation and Mangroves removal



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Dumping site at Port Qasim



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Time Series Analysis for confirmed dumping site at Port Qasim









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Dumped Sites along Jetties



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Impacts on Mangroves/Biodiversity (others)

- Lack of fresh water from the Indus will lead to further loss/deterioration of mangroves ecosystem
- Harvesting pressures by local communities are expected to remain high unless proper controls are implemented
- Mudflats in the Study Area provide feeding areas for resident and migratory birds, and offer potential for mangrove replantation. Mudflats face risks similar to those for mangroves
- Continued release of untreated industrial effluent could result accumulation of heavy metals in the sediments. This will impact marine biodiversity as well as their suitability for human consumption







Socioeconomic profile

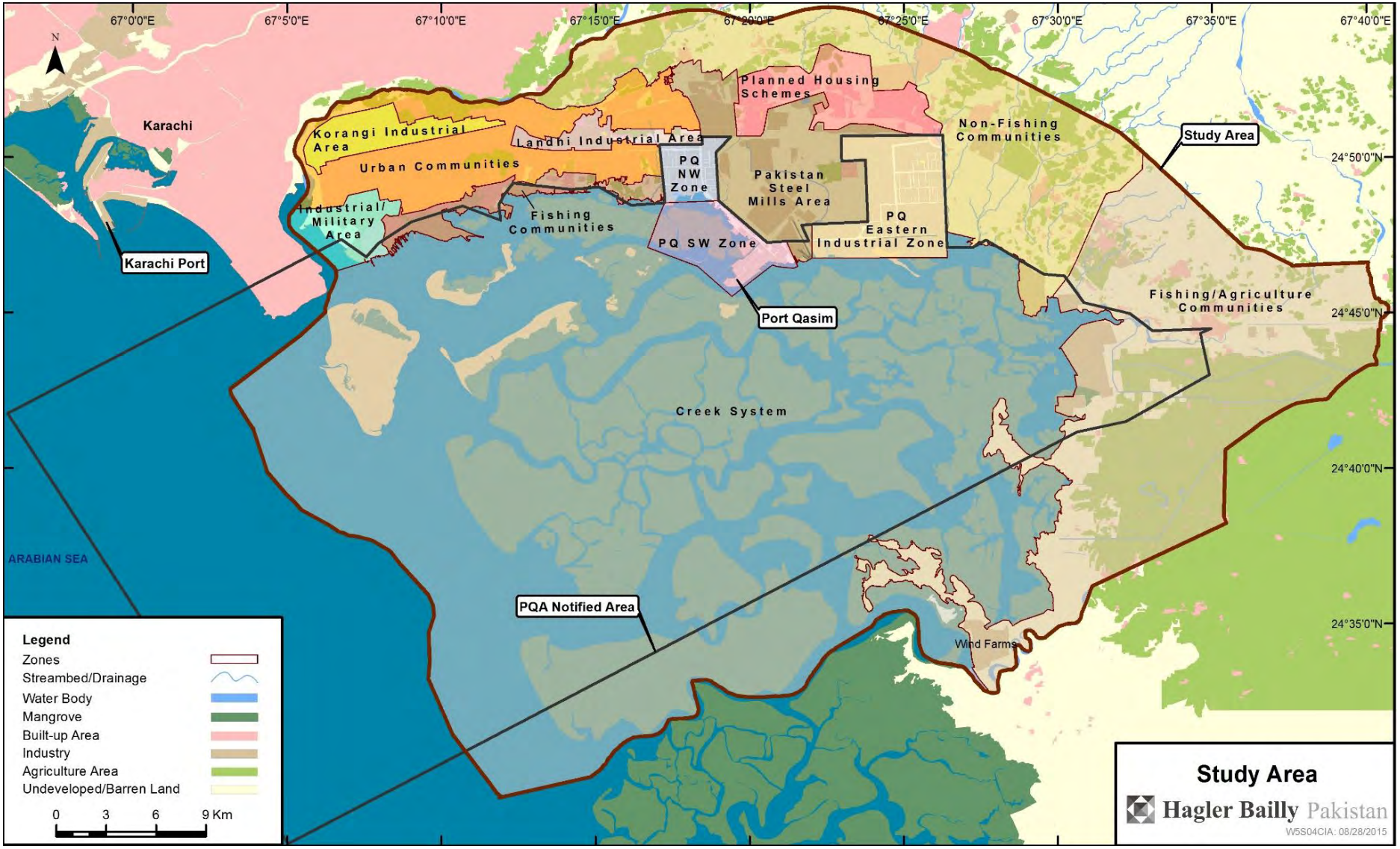
- Fishing Communities
- Non-fishing Communities
- Urban Communities
- Planned Housing Schemes
- Fishing/Agriculture Communities







Socioeconomic zones in study area



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Sources of livelihoods

Livelihood	Fishing Communities	Non-Fishing Communities	Fishing/Agriculture Communities	Planned Housing Schemes
Fishing (own boats)	4%	-	2%	-
Fishing (labor)	68%	-	38%	-
Boat Building/Repair	4%	-	-	-
Non-Fishing Wage Labor	24%	65%	32%	54%
Employment in PQA and Pakistan Steel Mill	-	16%	-	46%
Government Employment	-	1%	-	-
Small Business (Hotel/Shop)	-	18%	-	-
Farm Labor	-	-	29%	-
Total	100%	100%	100%	100%

Estimated fish catch by location

Originating Site	Fishing Location	Fish Catch (in metric tons)	% of Fish Catch
Ibrahim Hyderi	Mangrove	20,301	29
	Open Sea	19,565	28
Rehri	Mangrove	14,599	21
	Open Sea	14,599	21
Bhambore	Mangrove	1,045	1
	Open Sea	0	0
Total		70,110	100

Vulnerability of different groups

Zone	Resilience or vulnerability based on number of criteria							
	Access to Social Services	Out Migration	Economic Opportunities	Access to Credit	Assets	Mobility	Disaster Preparedness and Response	Overall Vulnerability Level
Fishing Communities	Moderately Resilient	Resilient	Moderately Vulnerable	Moderately Vulnerable	Highly Vulnerable	Vulnerable	Critically Vulnerable	Vulnerable
Non Fishing Communities	Highly Vulnerable	Moderately Resilient	Critically Vulnerable	Moderately Vulnerable	Highly Vulnerable	Critically Vulnerable	Critically Vulnerable	Highly Vulnerable
Fishing/ Agriculture Communities	Highly Vulnerable	Moderately Resilient	Vulnerable	Moderately Vulnerable	Vulnerable	Critically Vulnerable	Highly Vulnerable	Vulnerable
Planned Housing Schemes	Moderately Resilient	Moderately Vulnerable	Critically Vulnerable	Resilient	Vulnerable	Moderately Resilient	Moderately Vulnerable	Moderately Vulnerable

Resilient	Moderately resilient	Moderately vulnerable	Vulnerable	Highly vulnerable	Critically vulnerable

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Impacts on mangrove-related livelihoods (PQA):

Incomes from fish, shrimp and crabs

- Fishing and related activities (e.g. boat building and repair) is a principal source of livelihood for a large population, many poor and vulnerable
- The operation of PQ has hindered access to preferred fishing areas, particularly for small boats
- The dredging and operation of a new shipping lane as planned by PQA will further restrict their access
- PQA has limited leverage over non-sustainable fishing practices which fall in the mandate of the Marine Fisheries Department







Impacts on mangrove-related livelihoods (others):

Incomes from fish, shrimp and crabs

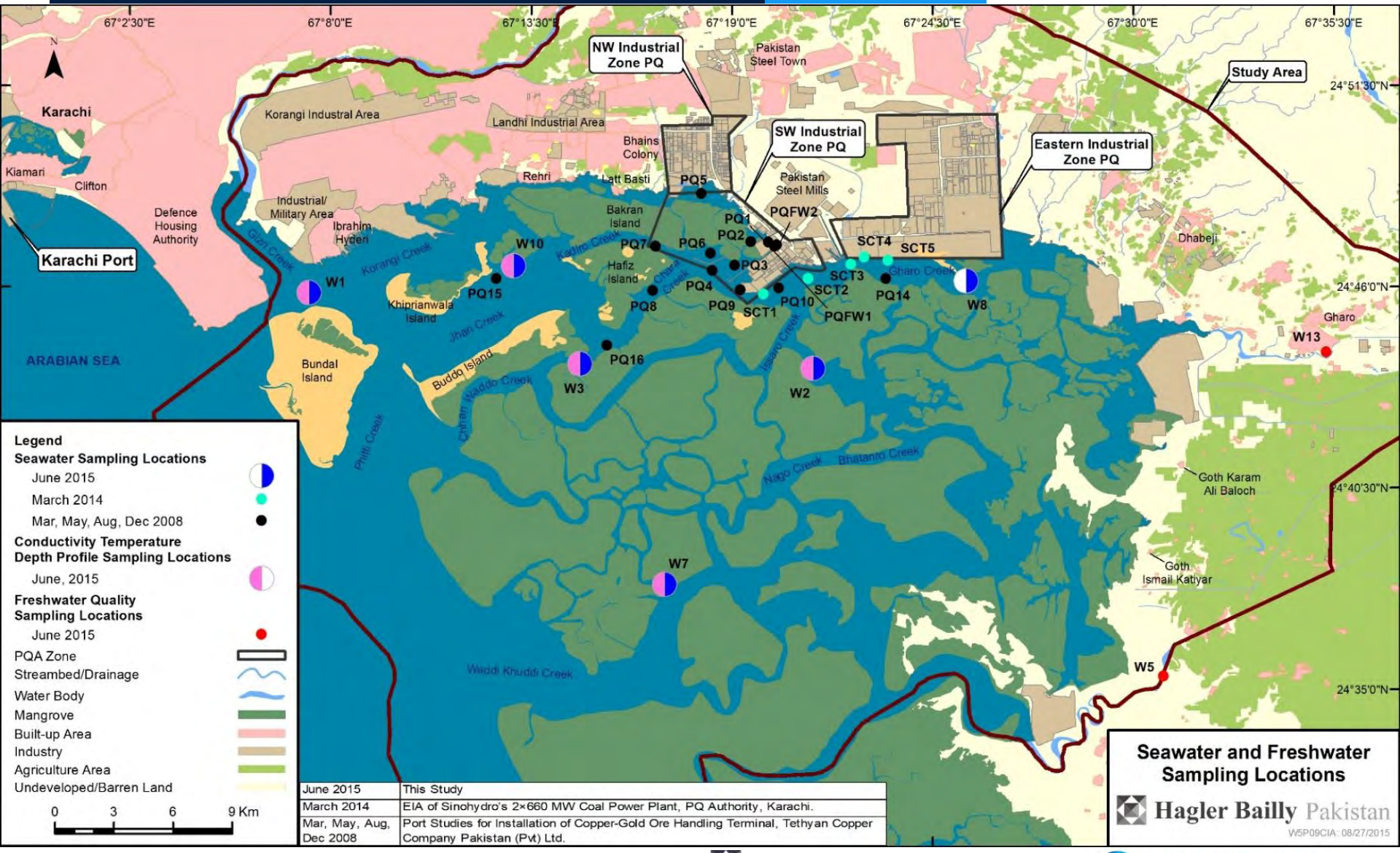
- Non-sustainable fishing practices by the local community including use of prohibited fine mesh nets are a principle threat to the diversity and abundance of fish in the Study Area
- The total fish catch 2014 declined by as much as 63% of the peak level in 1993
- If non-sustainable fishing practices and overfishing continue, fish catches and corresponding incomes could decline to 33% of current levels in 15 years







Seawater and freshwater sampling locations

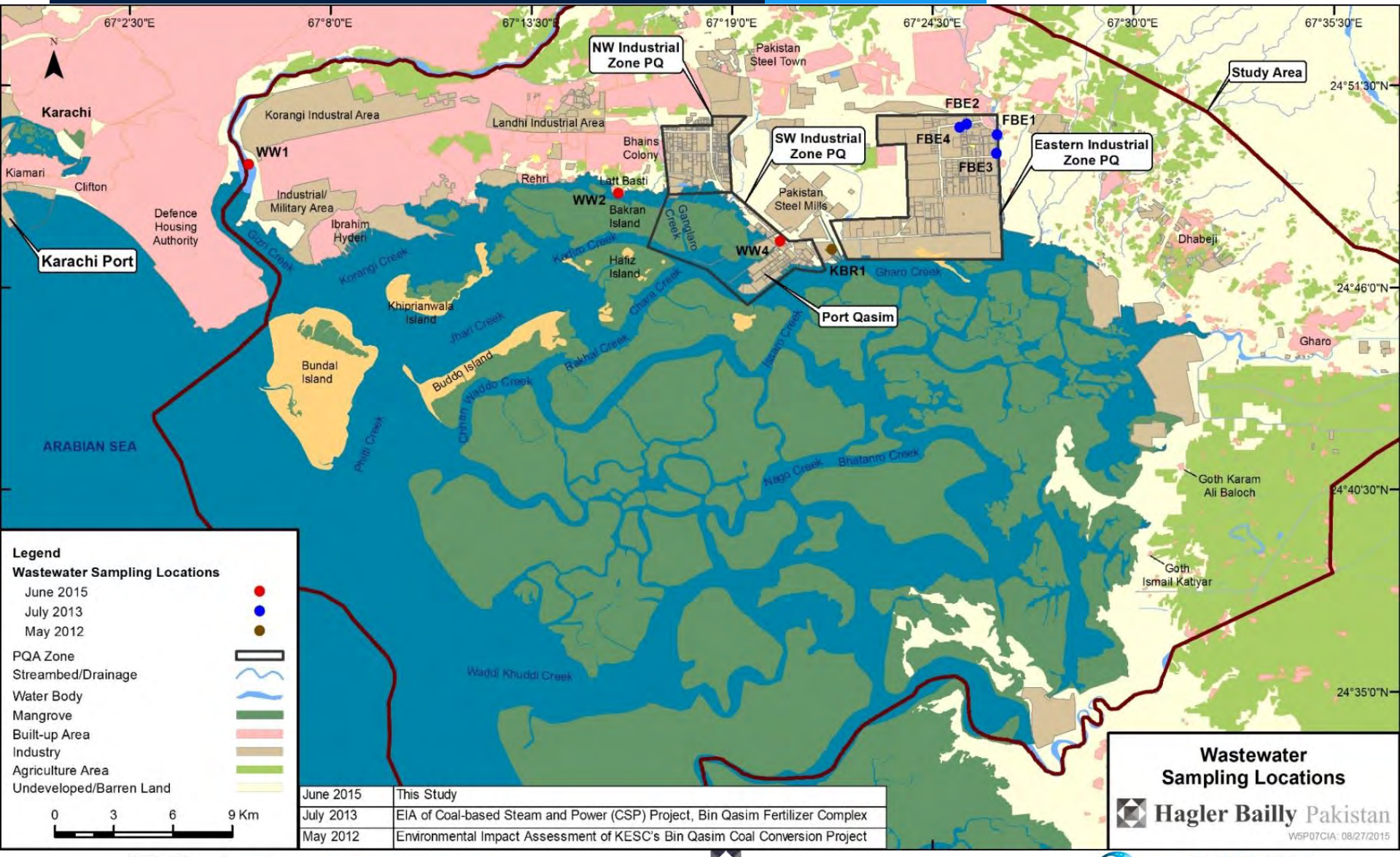


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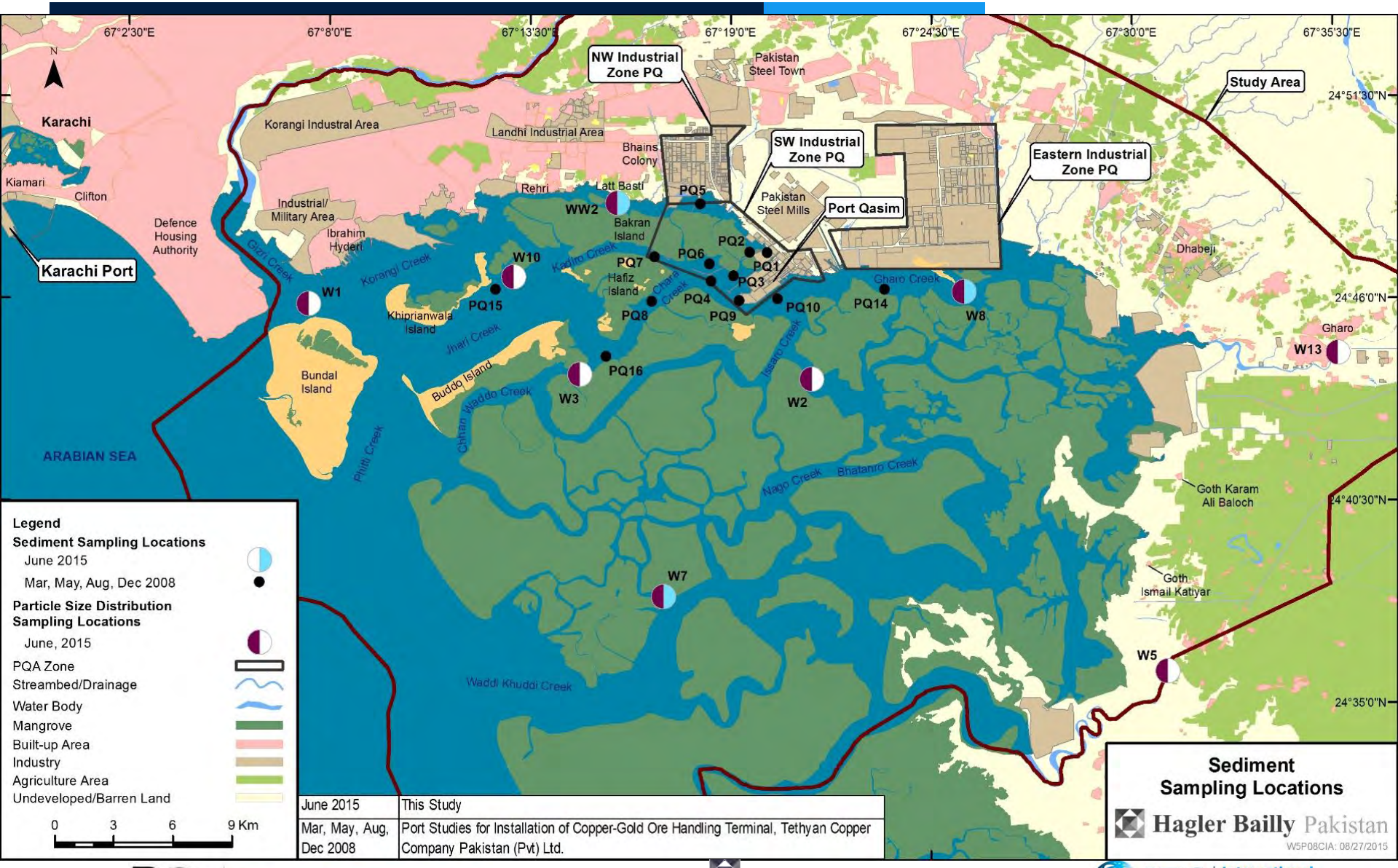
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Wastewater sampling locations



Sediment sampling locations



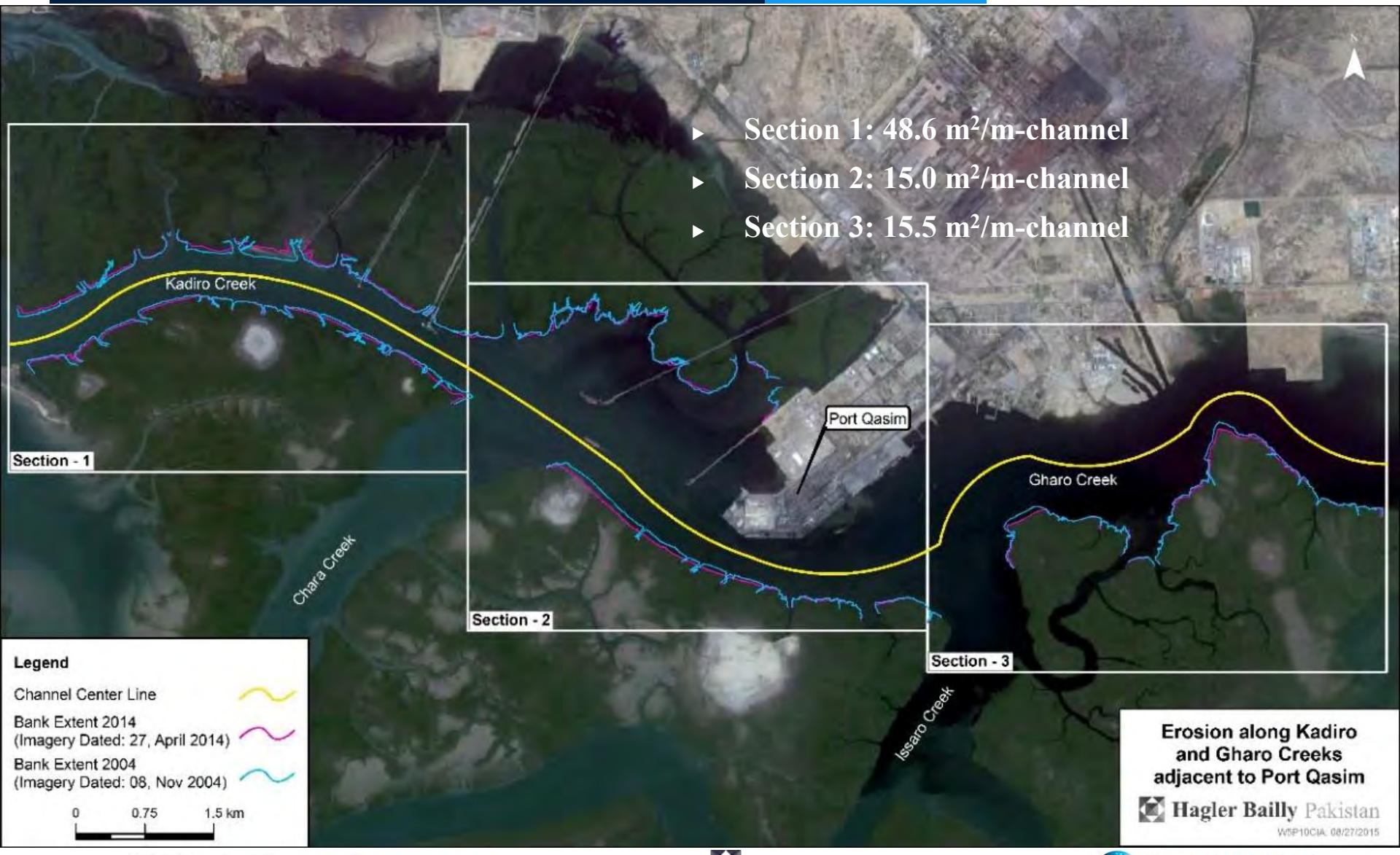
Heavy metal analysis - fish, shrimp and crab

- 2015 data. Arsenic was found to be very slightly above the prescribed FAO limit in two out of five fish, shrimp and crab tissue samples. Copper, Lead, Mercury and Zinc, were below the prescribed limits.
- 2014 data. Levels of arsenic, copper and zinc in edible tissue were above the prescribed limit
- 2008: At Keti Bandar arsenic (2.33 mg/kg) in fish liver was above the prescribed limit. At Port Qasim arsenic (2.50 mg/kg), cadmium (2.49 mg/kg) and zinc (134.0 mg/kg) were above the prescribed limits in liver tissue. All samples at Keti Bunder were lower than PQA. Similar for fish tissue.





Erosion in the vicinity of Port Qasim *(1 of 2)*

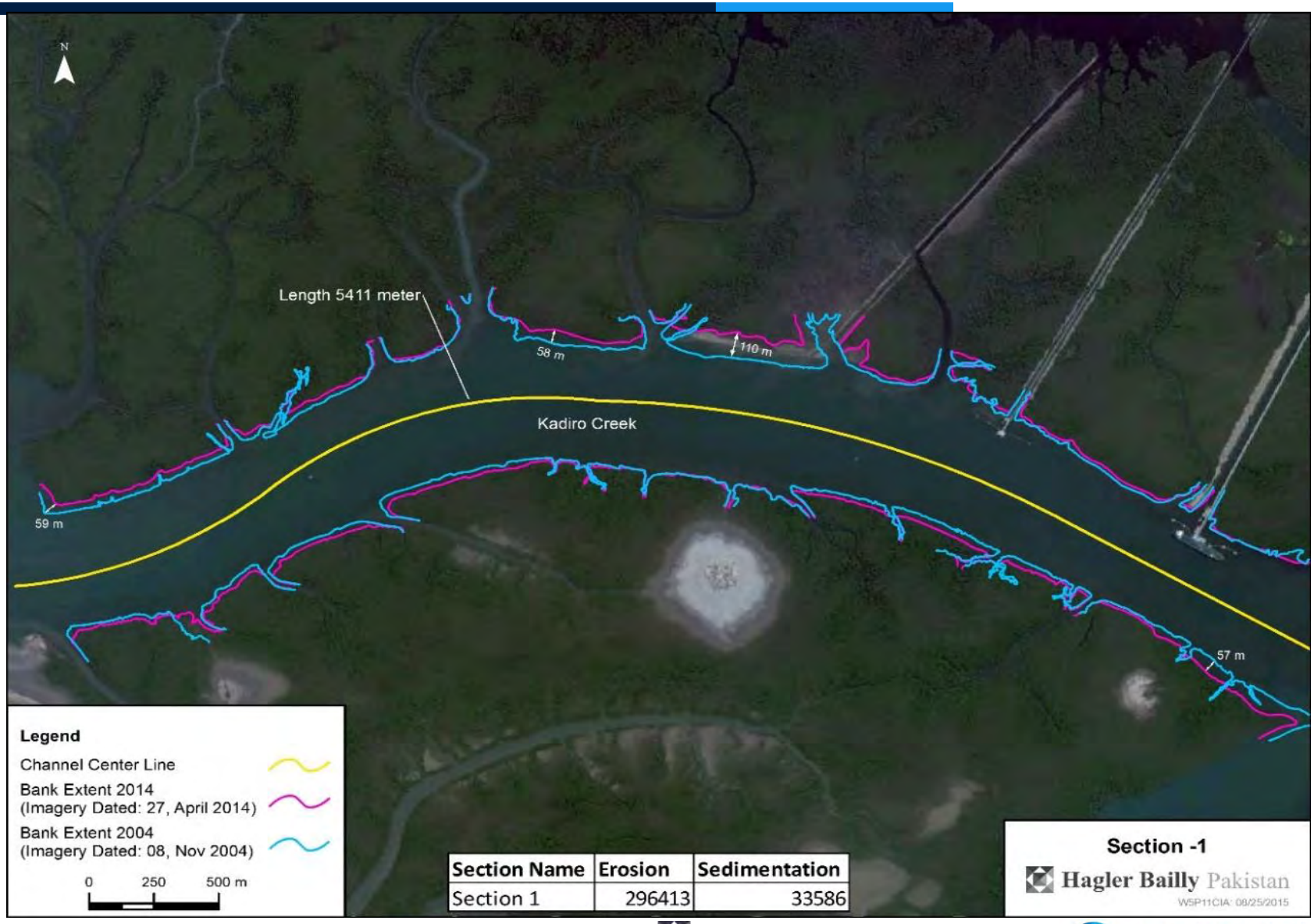


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Erosion in the vicinity of Port Qasim *(2 of 2)*

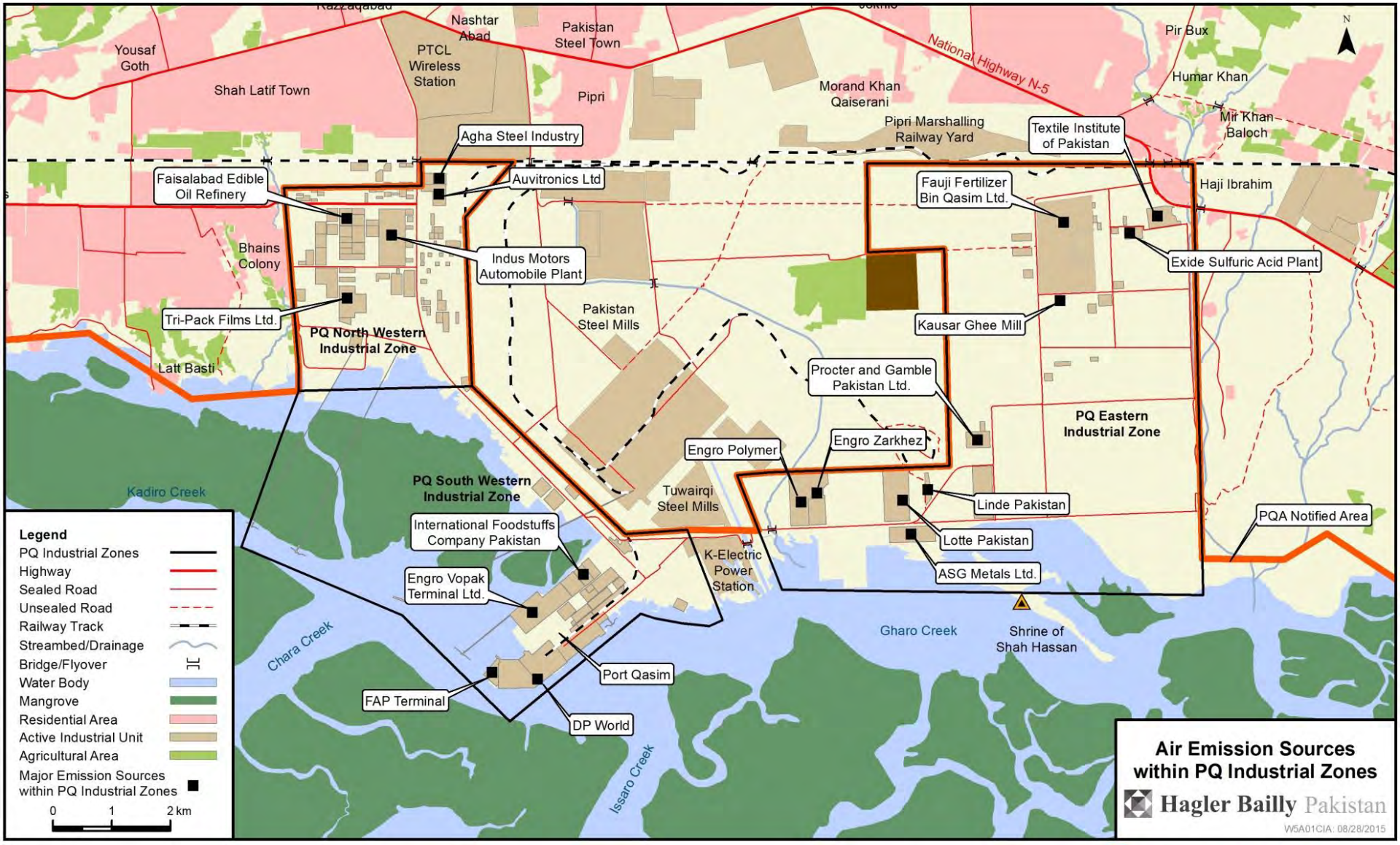


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Air emissions sources



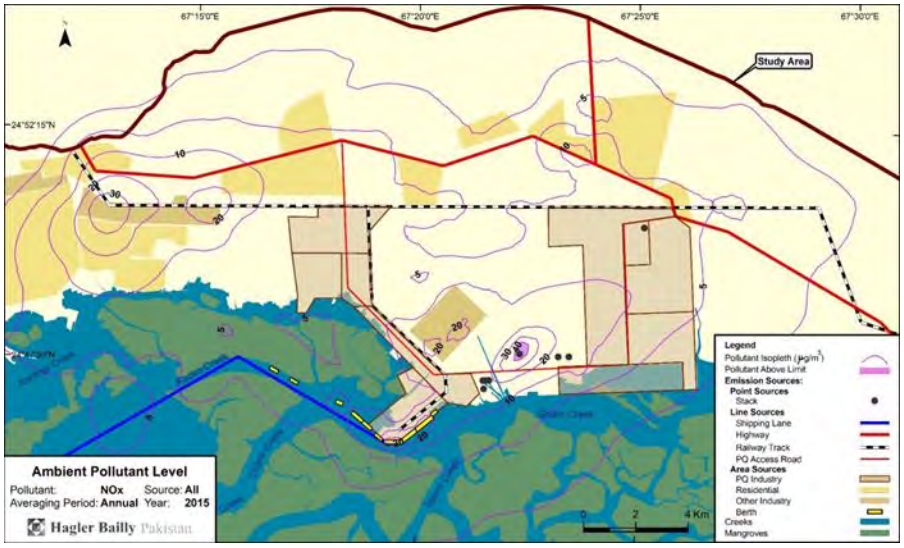
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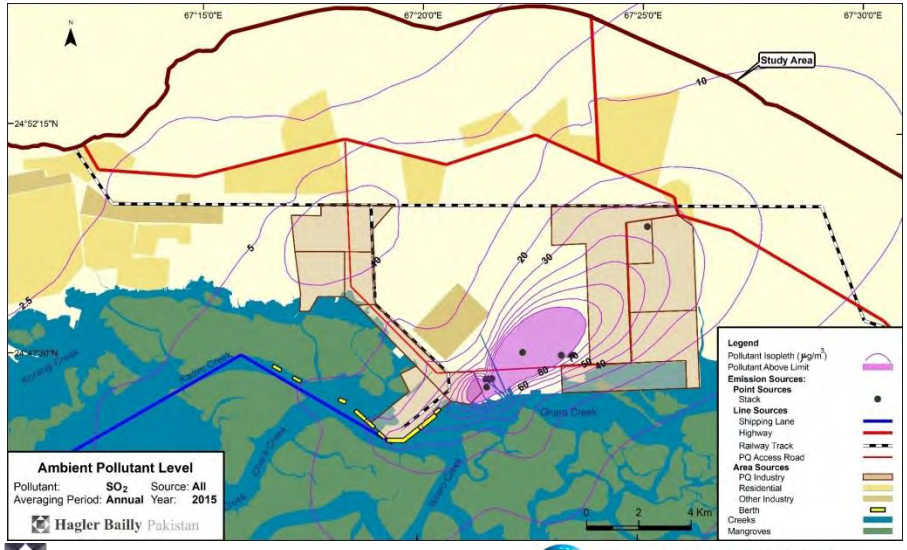
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Air Quality

- The concentration of pollutants at all locations sampled is below the limits prescribed by Sindh Environmental Quality Standards (SEQS) and International Finance Corporation Guidelines (IFC).
- Modelling shows that small areas are likely to be above limits (even though not picked up in the sampling)





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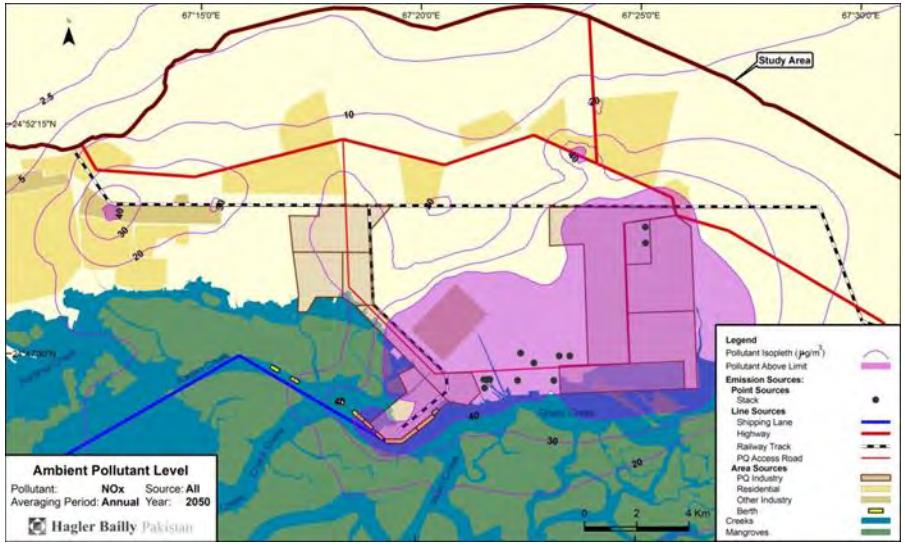
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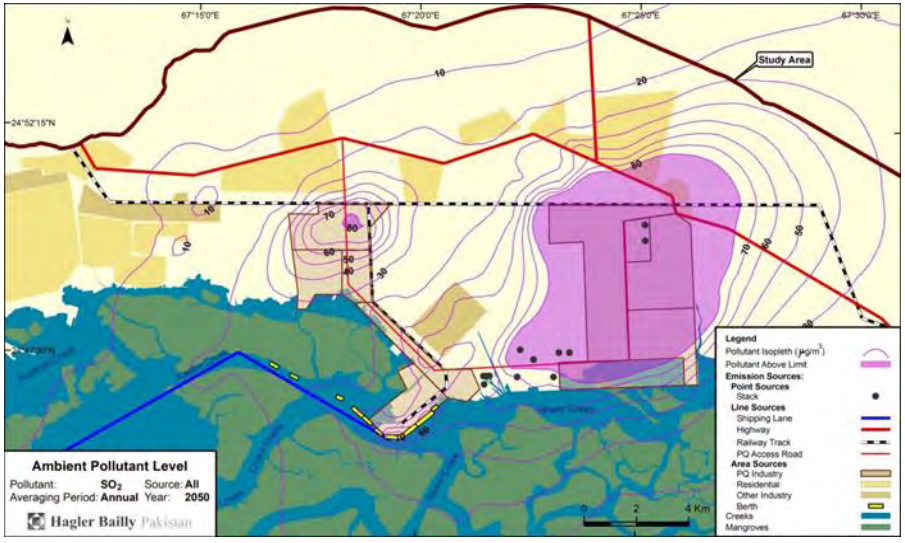
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Impacts on Air Quality

- With the anticipated development of PQA industrial zones, the impact zone and intensity of both pollutants will increase significantly
- By 2050, air quality in several communities north and northwest of PQA will by severely affected
- Particulate matter (PM_{10} and $PM_{2.5}$) are not likely to be a concern from PQA activities







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MANAGEMENT AND MITIGATION

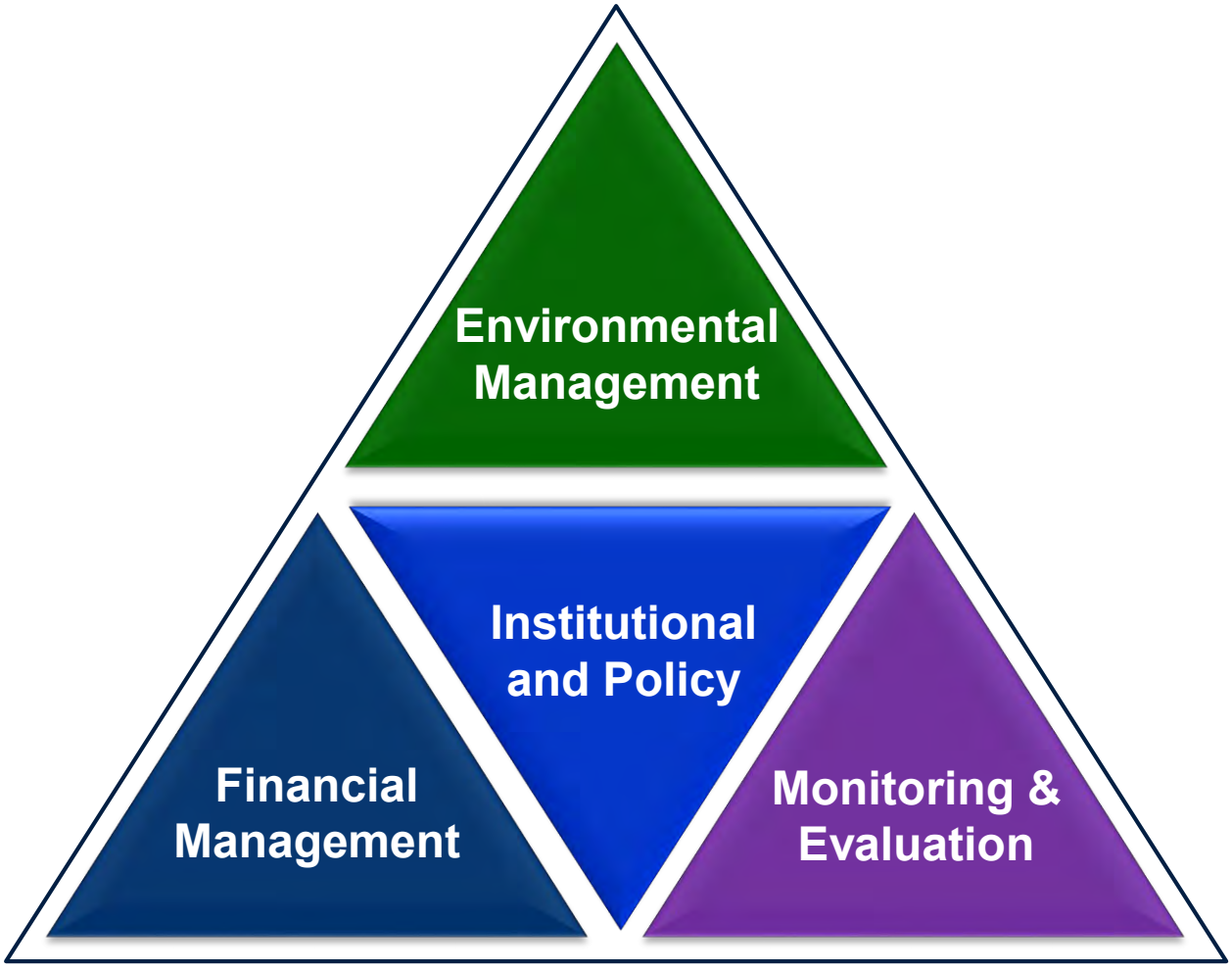
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From ‘Business as Usual’ to ‘Collaborative Management’:

Management approach involving four frameworks



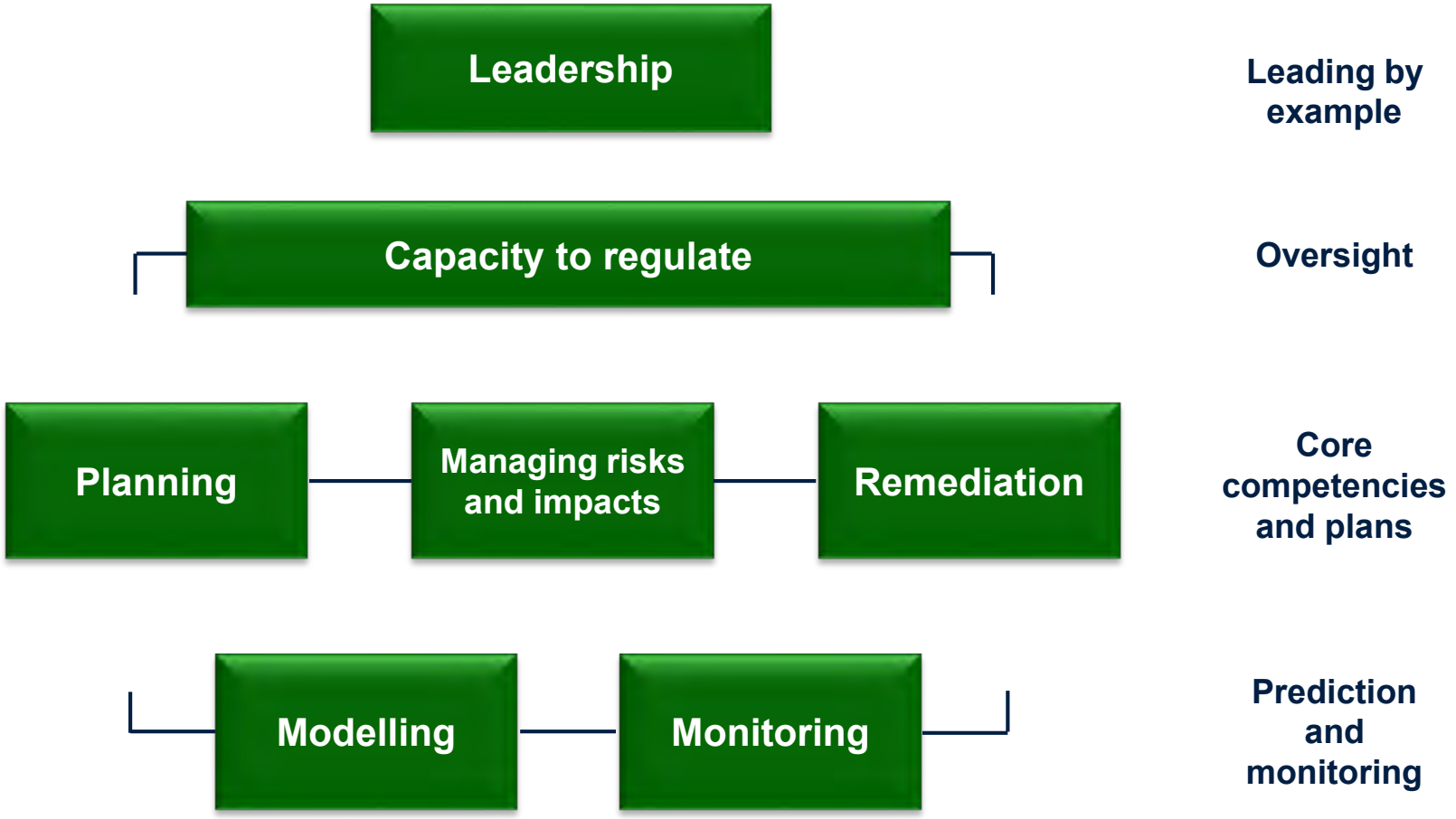
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Environmental Management Framework

Role and responsibilities of PQA



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Environmental Management Framework

Principal actions and measures by PQA

1. Planning

Environmental Zoning Plan for PQA Notified Area

Guidelines to support Zoning Plan covering mangroves, erosion and sediment management, dredge disposal, air quality, and safety

2. Regulating

Implement Zoning Plan and guidelines

Limit ship speeds in critical areas

Review EIAs of projects and advise developers and SEPA

Ensure plantations are sustained

3. Policing

Improve patrolling of mangroves

Work with industry to enforce NEQS for water and air quality

4. Research/Studies

Develop hydrodynamic and sediment models

Develop air quality model

Monitor water quality and air quality

Review spill contingency and safety plans

Environmental Management Framework

Principal actions and measures by others with PQA participation

1. Planning

Environmental Zoning Plan for areas west of the PQA Notified Area

2. Regulating

Monitor fishing activities by local communities in collaboration with responsible authorities and introducing sustainable fishing practices



3. Policing

Patrolling and ensuring regulatory pressure to prevent fodder and fuel wood extraction from mangroves at unsustainable levels

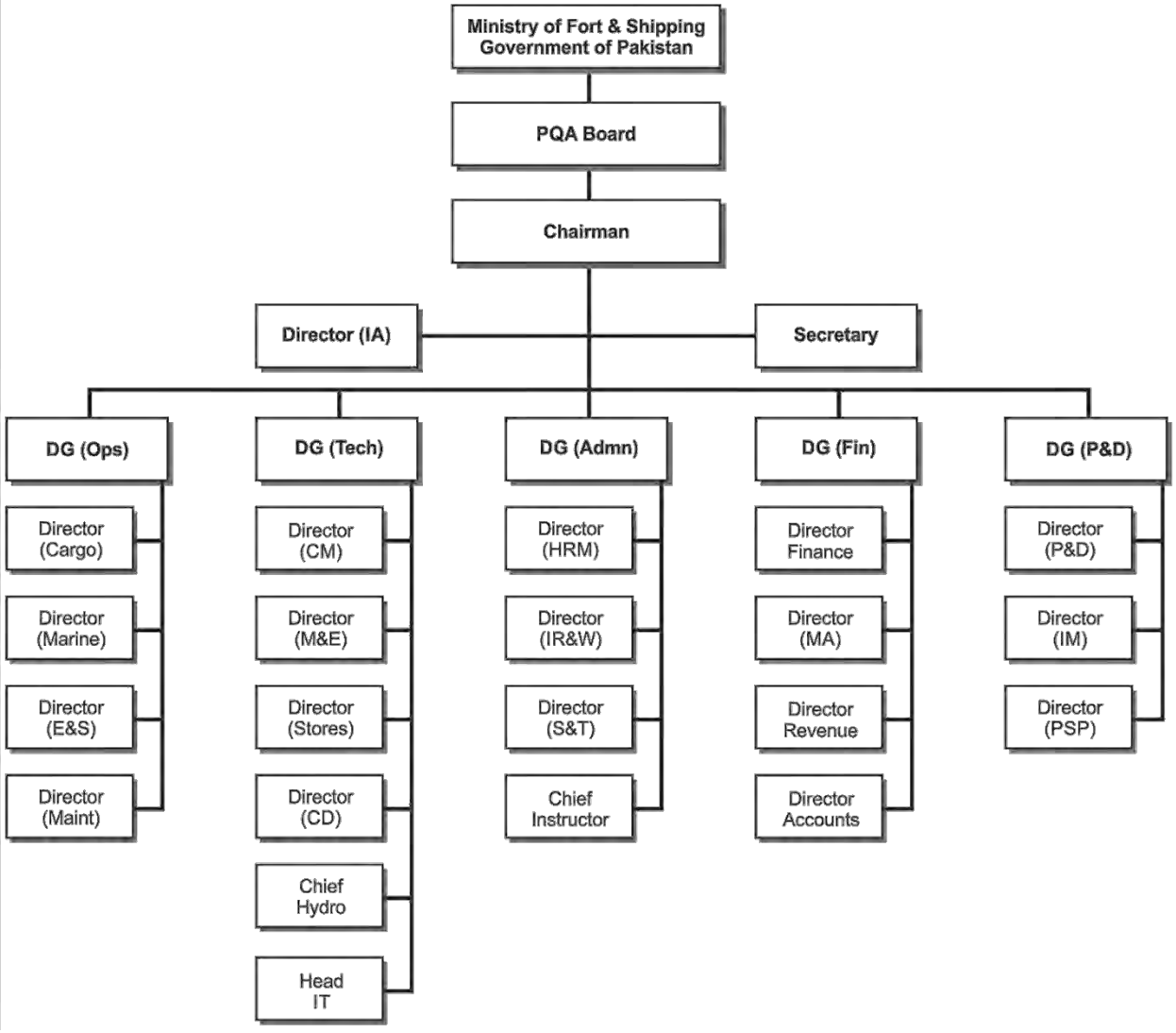
4. Research/Studies

Research on mangrove ecosystems to help develop management strategies, and on flows from Kotri Barrage to balance competing demands of users

Indicative budget for environmental management

	One Time	Recurring
Hydrodynamic Modeling		
Data Collection and Setting up the Model	1,000,000	
Ongoing Data Collection		150,000
Air Quality		
Setting up the Regional Air Quality Model	20,000	
Air Quality Monitoring		10,000
Water Quality Monitoring		12,000
Mangroves and Ecological Monitoring		15,000
Monitoring and Surveillance of Mangrove Areas		
Low Draft Boats, 4	60,000	
Annual Operating Cost of Boats		26,000
Floating Checkpoint for Monitoring	20,000	
Floating Buoys for Cordoning off of Prime Fish Breeding Areas	100,000	
Community Education and Awareness		5,000
Miscellaneous Monitoring Equipment	30,000	
Special Studies and Training		75,000
Total	1,230,000	293,000

Institutional Structure of PQA

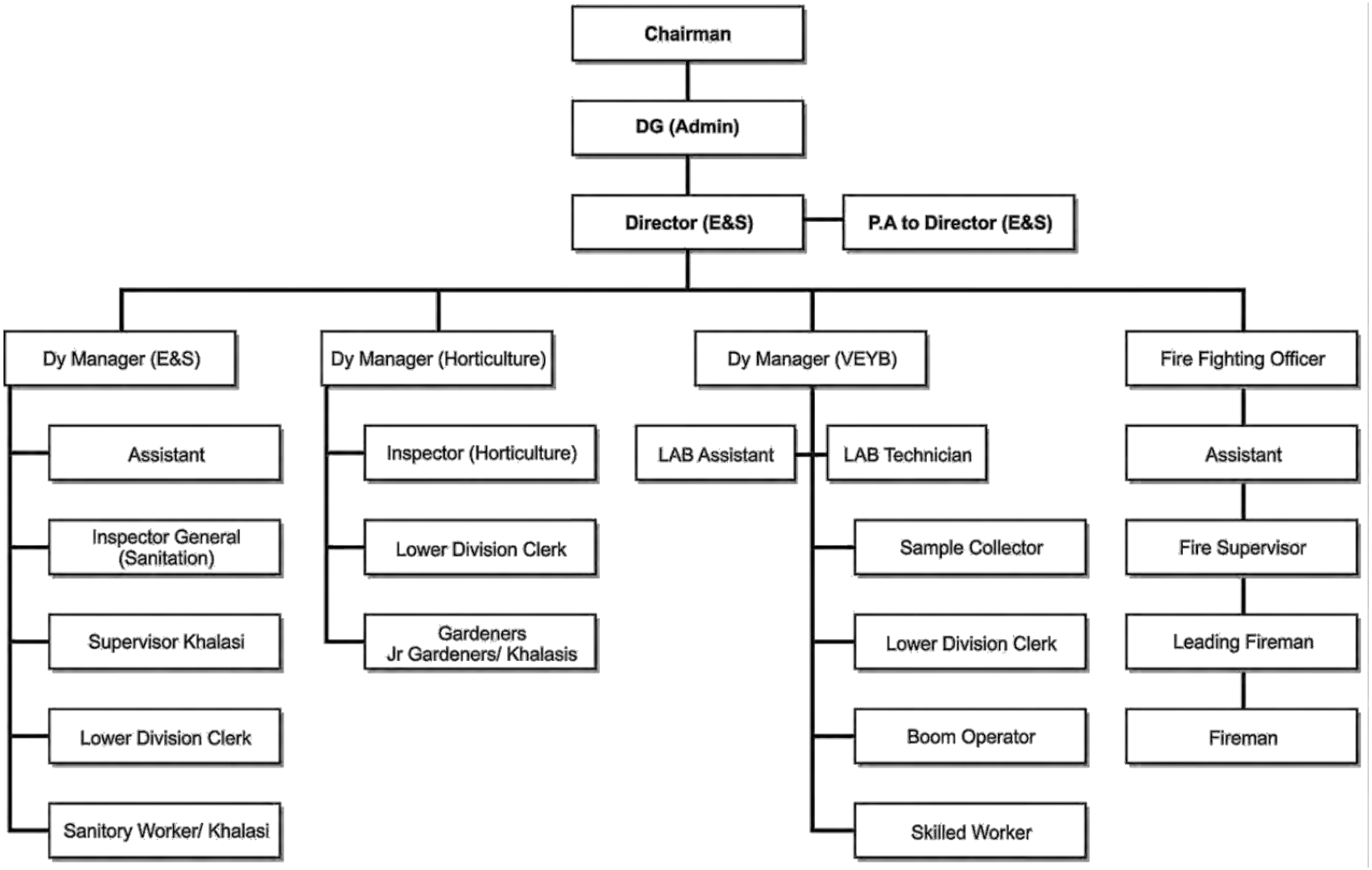


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Present Structure of E&S Department



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Suggested Roles and Responsibilities

- **Leadership:** PQA and Bin Qasim Association of Trade and Industry
- **Implementation:** PQA E&S Department with support from Hydrography Section, Dredging Section, and Planning and Development
- **Capacity Building and Management Support:** IFC, WWF, IUCN, and possibly TCCR
- **Enforcement and Management Support:** SEPA, Sindh Forest Department, Sindh Fisheries Department, SWD, MFD, OPSW
- **Research:** NIO, Center of Excellence Marine Biology
- **Observation and Management Support:** LATI, KATI, FDB

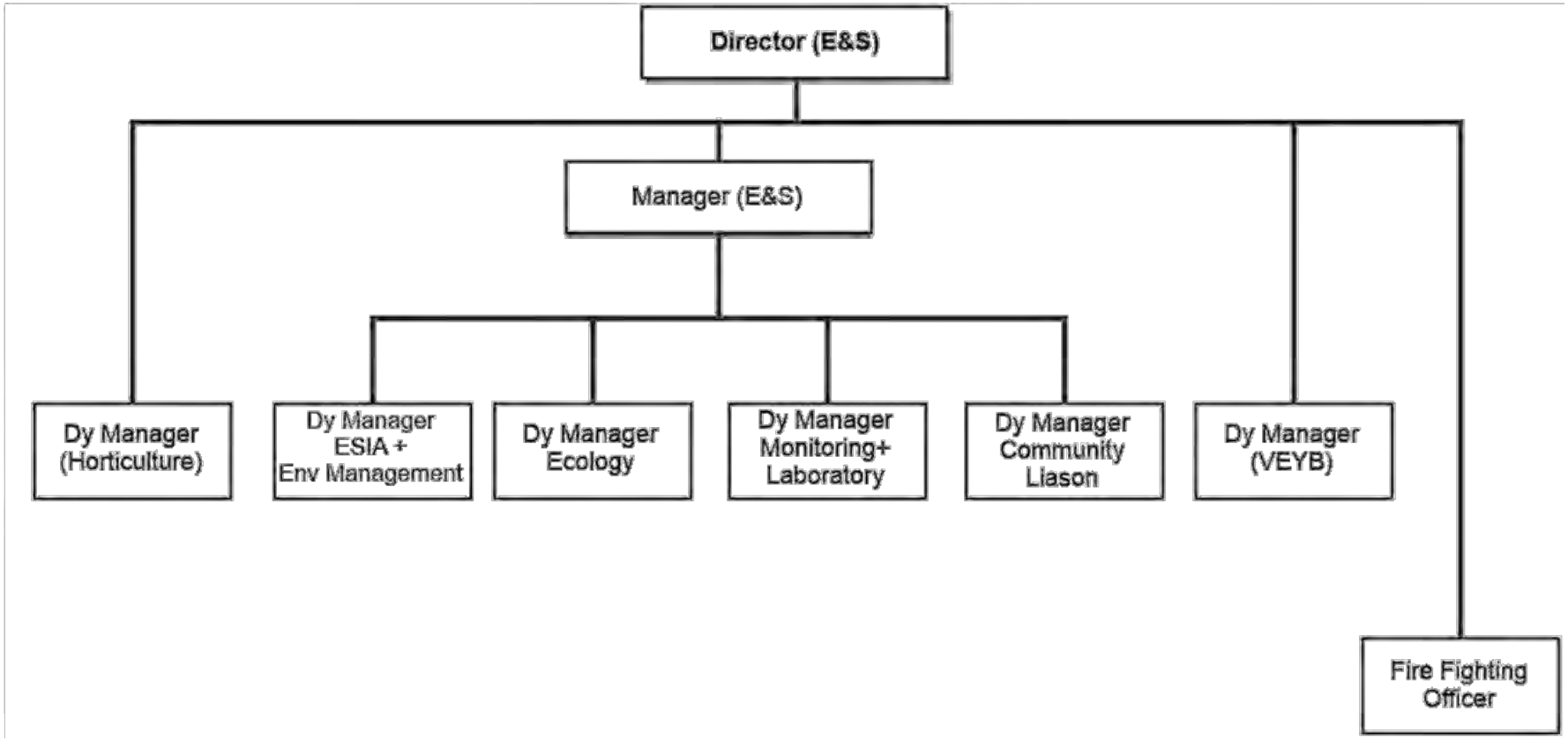
Institutional and Policy Framework *(1 of 2)*

- **Identification or addition of a Member Environment in the Board of PQA** to strengthen the oversight and supervision capacity of the PQA Board on environmental matters
- **Formation of an Environmental Committee in PQA:** The Environmental Committee will report directly to the Chairman, and will have representation from the industry and DGs Technical, Operations, and Planning
- **Environment and Safety Department:** Strengthening capacity to manage physical, ecological and socioeconomic aspects of environment, environmental monitoring, review of ESIAs, and coordination with industry in PQA and external stakeholders.
- **Hydrography Section in the Technical Division:** Strengthening capacity to manage and supervise collection of hydrography data in and around the port area.

Institutional and Policy Framework *(2 of 2)*

- **Dredging Section:** Strengthening capacity to manage development of hydrodynamic and sediment transport models and to operate and interpret the results for predicting changes in sedimentation and erosion patterns
- **Restructuring of Environment Department:**
  - A position of Manager Environment to manage and coordinate the functions for which respective Deputy Managers will be engaged
  - Deputy Managers proposed for ESIAs and Environmental Management, Ecology, Monitoring and Laboratory, and Community Liaison.
- **Placement of E&S Department under the DG - Technical:** This is recommended to maintain coordination among the functions of environment, hydrography, and dredging for the reasons listed above.

Proposed Structure of E&S Department

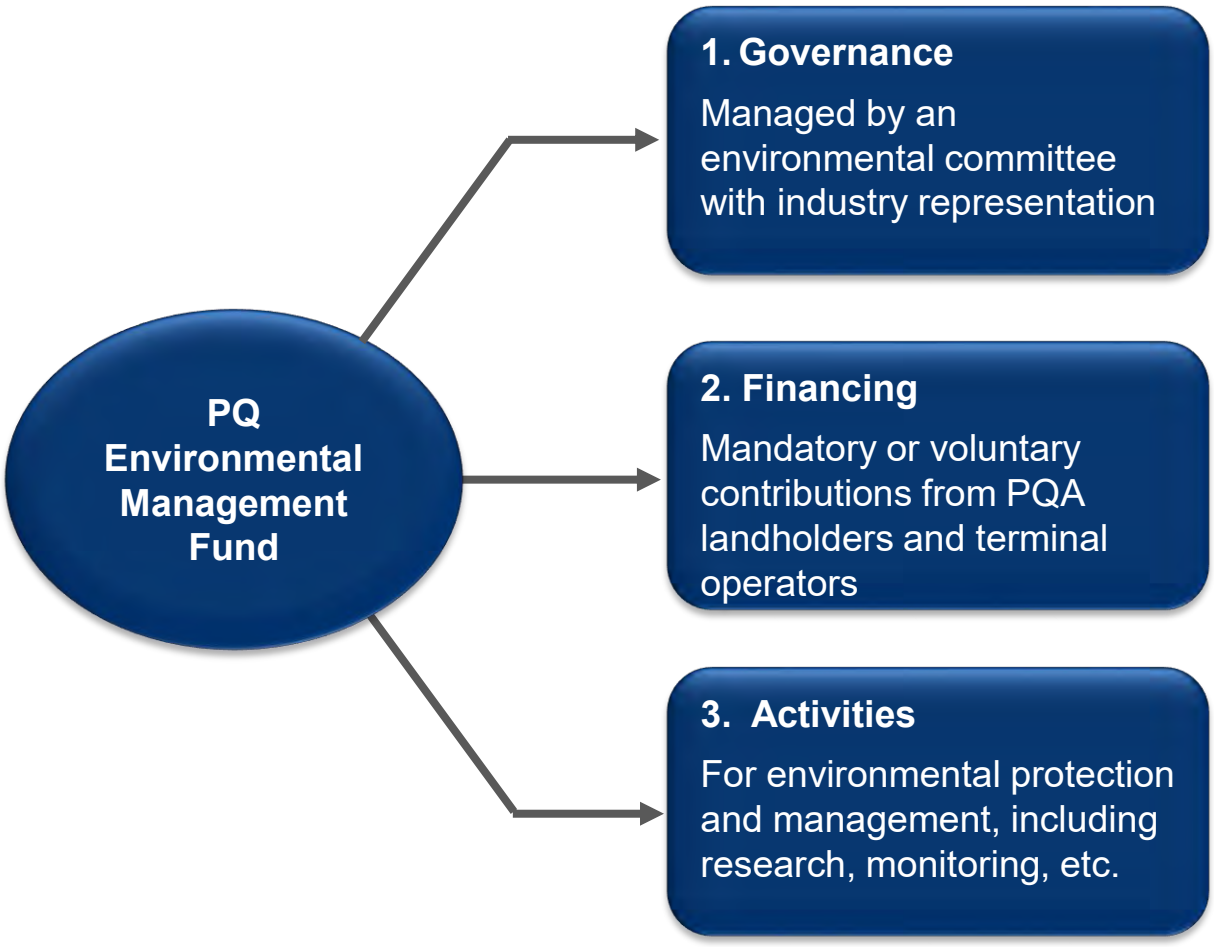


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Financial Management Framework



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Financial Management Framework

- A separate Account for environmental management titled Port Qasim Environmental Management Account can be opened with appropriate legal cover under the rules of the PQA.
- The Account can be managed by the Environmental Committee with representation from industry.
- Inflows into the Account can include mandatory or voluntary contributions from the land holders in PQA on the basis of defined fees or incremental land charges, fines and penalties collected by PQA on account of environment, pollution charges, and contributions from donors.
- The amounts in the Account can be used to support activities for implementation of protection and management of environment such as protection and patrolling, research and monitoring, community engagement, effluent treatment, clean-ups, and restoration.

Appendix B: Executive Summary

See following pages.

Cumulative Impact Assessment for Industrial and Port Developments at Port Qasim

Executive Summary

1. Introduction

Port Qasim in Sindh, Pakistan was established in early 1980s as an alternate to Karachi Port with the added feature of an associated industrial area. The International Finance Corporation (IFC), the private sector arm of the World Bank Group (WBG), has invested in four port terminals and one industrial project in Port Qasim. As Port Qasim Authority (PQA), the federal government agency mandated to manage the port and associated industrial developments, has plans to develop the port further, and the IFC may invest in these.

Environmental and social impacts from existing developments combined with the incremental impacts resulting from proposed future developments, may result in significant cumulative impacts that would not be expected in the case of a stand-alone development, IFC has acquired the services of Hagler Bailly Pakistan (Pvt) Ltd (HBP) to conduct an Ecosystem Service Review (ESR) and a Cumulative Impact Assessment (CIA) for the existing and planned developments at Port Qasim.

The PQA undertook a strategic environmental assessment as part of the strategic planning study in 2001.[1] Since the completion of the study, developments have taken place in Port Qasim area and in surrounding areas. The present Study will thus augment the previous PQA study.

This document provides a summary of the CIA of the planned developments at Port Qasim up to 2050.

1.1 Objectives and Limitations of the CIA

Environmental and social impact assessment (ESIA) is now an established tool, a mandatory requirement in almost all the countries in the world, for assessing the environmental and social impacts of development projects. The emphasis of ESIA is on the impacts of a single project. Even if all the projects in a geographical location are studied through their respective ESIA studies, they fail to adequately capture the how these individual projects collectively change the environment. Cumulative effects can be additive, or interactive and can result in exceedances of environmental thresholds. The overall objectives of a cumulative impact assessment studies are as follows:

- Ensure that the cumulative effects of future developments do not exceed a threshold that could compromise the sustainability of Valued Environmental and Social Components (VECs).

[1] Engineering Consultants International (Pvt.) Ltd., Strategic Planning Study for Port Qasim, Volume 5, Strategic Environmental Assessment, June 2001.

- Ensure that the value of Port Qasim and feasibility of future developments are not limited by cumulative social and environmental effects.
- Support the development of regional governance structures for decision making and managing cumulative effects.

The aim of a CIA study is not to assess all impacts of all Projects. The project EIAs address all impacts of a specific Projects. Under Good International Industry Practice Guidelines (GIIP) such as the IFC GPH on CIA a VEC-centered approach is utilized for CIA where impacts on prioritized VECs are considered and addressed. The prioritized VECs include the following:

- Mangrove Ecosystem and Biodiversity (Mangrove and Mudflat Habitat, Fish, Shrimp, Crab, and Marine Mammals)
- Livelihood Associated with Mangrove Ecosystem
- Air Quality

Baselines as part of CIA are limited to determining the status of a VEC, and are typically on the basis of previous baseline studies already carried out. Data in previous baselines did not completely or uniformly characterize the PQA Notified Area, and in some cases quality control information was not available (e.g. for water quality). IFC funded limited field sampling to fill the major gaps and ensure a coordinated data collection methodology. While sampling was limited, the result of the exercise is a more comprehensive and coordinated baseline for the Port Qasim area, compared to previous EIA studies at or close to Port Qasim.

The Study time was originally limited to 4 months, and due to some limitations, the Study was initiated just before start of the Summer Monsoon. The scope of analysis, did not also, then allow collection of seasonal data, temporal data and other aspects, such as bird surveys. Access to areas within the intertidal delta (including, and particular, to the islands) was also limited initially. However, the study time was extended to incorporate sampling of mangroves. Study times were also extended to cater for multiple important meetings and discussions with the Port Qasim Authority, the key stakeholder, on the management and mitigation of impacts.

1.2 Port Qasim and Regional Developments

Cumulative effects are those that result from the incremental impact of a project or *developments* when assessed in combination with other *existing* and *reasonably foreseeable future developments* or other activities in a rationally set geographical and temporal scale.

Exhibit 1 shows the layout of the 'Study Area' selected for this study. The land under the jurisdiction of PQA comprises three industrial and commercial zones (Northwestern, Southwestern and Eastern Zones), the Port Area and a recently demarcated LNG Zone. The total area of these zones is in excess of 7,200 hectares. The term *Developments* is used for "the existing, anticipated and reasonably foreseeable developments in the Notified Port Area and PQA Industrial Zones." Where existing refers to fully constructed industrial facilities in PQA, anticipated includes under construction or planned developments, and reasonably foreseeable developments includes developments that has

been discussed in policy documents, strategies, or development plans and are plausible and likely.

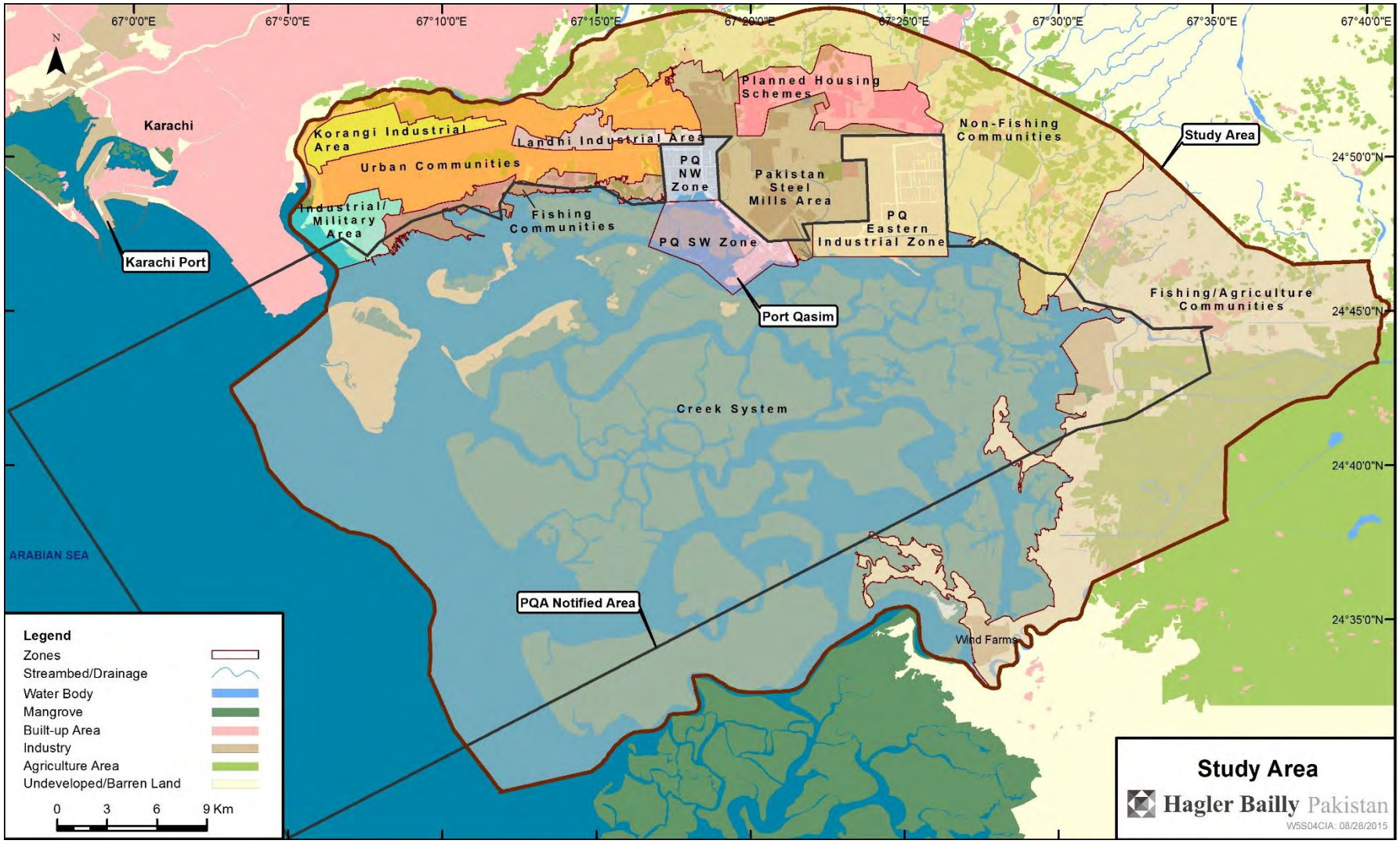
According to the PQA, all the available plots in the land development zones have been acquired by various investors. Approximately 273 projects are operational within the Port Qasim, with another 233 under construction. These include development of a textile city and new power plants.

The current industrial activities within the three zones include production of downstream steel products, textiles, petrochemicals, food products, fertilizer, and automobiles. Other activities include grain, fertilizer, bulk, liquid, LPG, and container terminals. A 1,320 MW power plant that will utilize imported coal offloaded at Port Qasim is under construction.

There are plans to expand the port facilities to accommodate larger vessels and increase the cargo handling capacity of the port. These include widening and deepening of existing channels and construction of additional floating terminals.

Reasonably foreseeable developments exist largely outside the current land development zones and include development of a new alternate channel, development of LNG terminals; developments at Bundal and Khiprianwala Islands; land acquisition for additional industrial units; and land reclamation.

Exhibit 1: Study Area



Major projects in the vicinity of the PQA industrial zones, which are not located on land under the jurisdiction of PQA but share resources or infrastructure include Pakistan Steel Mills, K-Electric Power Station, Landhi and Korangi Industrial Areas, and Pipri Railway marshaling yard. The anticipated projects in the vicinity of the PQA industrial zones include Lucky Cement Coal-fired Power Plant, partial conversion of K-Electric Power Station to coal, and wind farms located south of Port Qasim (**Exhibit 1**).

1.3 Development Scenario

The CIA, development scenario considered for the CIA is summarized below. The Port Qasim Strategic Plan outlines the plan for development of Port Qasim till 2050. Year 2050 has been selected as the time horizon for the CIA.

1.3.1 Port Qasim

The PQA has achieved many of the targets set in the Strategic Plan for 2010. It is therefore assumed that in 2050, development of PQA will be largely in line with what has been outlined in the Strategic Plan. However, there have been some recent deviations from the Strategic Plan to cater for market demand and pressures. Some of the limiting factors in the development at the Port include:

- Development of Gwadar Port and expansion plans at Karachi Port will compete with Port Qasim.
- Additional coal import facilities are unlikely to be developed at Port Qasim due to development of the Thar Coalfields.

Given the addition of an LNG terminal at the Port, there is requirement for an additional navigational channel. The additional navigational channel is likely to be economically feasible and a requirement for Port operations and management of ship traffic in the future.

1.3.2 Regional Developments

Port Qasim is in the backdrop of Karachi city. Karachi has seen rapid population growth since the 1947. The city has seen development of land at a proportional rate. While rural communities around PQA have been incorporated in the city, new housing societies are developing or are planned north of Port Qasim. It is assumed that by 2050, all the undeveloped land in the housing societies will be occupied and further societies will be developed to the northeast of the PQA.

National Highway N-5 is currently a dual-carriage 4-lane highway. There is room for additional lanes on both sides of the highway. However, it is assumed that the principal highway connecting Karachi with upcountry will be the Motorway M-9. Therefore, N-5 is unlikely to expand by the same rate as the M-9.

2. Stakeholder Consultations

Scoping consultations and surveys were conducted from June 10 to 14, 2015, along with multiple ad-hoc scoping and management and mitigation consultations between July, 2015 and December 2016. The consultations included two key workshops where

feedback on scoping, baselines and impact assessment, management and mitigation were provided by stakeholders:

- Preliminary Workshop in June, 2015
- Main Workshop in February, 2015

Key institutional stakeholders consulted during separate consultations and/or during consultative workshops included the Port Qasim Authority, selected industries at Port Qasim, Bin Qasim Association of Trade and Industry (BQATI), WWF-P, IUCN, Marine Fisheries Department (MFD), Sindh Fisheries Department, Sindh Wildlife Department (SWD) and the Sindh Forest Department (SFD).

The discussions with the community members (particularly Fishing Communities and Fishing/Agriculture Communities) focused on determining the perceptions of the local communities on the Developments and their dependence ecosystem services in Study Area. The community stakeholder consultations were conducted within settlements to ensure, encourage, facilitate, and maximize participation. A summary of issues raised by stakeholders is provided below:

- Issues raised by the industry included lack of strict adherence to zoning plans by PQA which has resulted in conflicts between present owners and new developers; limited environmental management capacity in PQA particularly with respect to implementation of recommendations of the CIA study; weaknesses in EIA review and approval process followed by the Sindh Environmental Protection Agency (SEPA); limited involvement of PQA in the EIA review and approvals, and absence of a grievance redress system to resolve conflicts among owners, and between owners and PQA.
- Industry and universities also expressed the need for conducting hydrodynamic and ecological studies to understand the impacts of changing sedimentation patterns on the depth of port channels and on the ecology of the mangroves.
- WWF-P and IUCN highlighted the importance of the mangrove ecosystems in terms of biodiversity and their ecosystems services, and expressed serious concern on the overall decline in mangrove ecosystems in Sindh associated with decline of freshwater flows and sediments into the Indus Delta. WWF-P cited studies which have shown a decline in diversity of fish in the mangrove areas, particularly shark species, and in mangrove species due to hyper saline conditions and increasing pollution. These institutions also pointed out the absence of well-defined institutional responsibilities and mechanisms for management of the mangrove ecosystems, and limited availability of land suitable for plantations.
- Both WWF-P and IUCN expressed reservations on the approach adopted towards mangrove plantations by the industry to compensate for loss of mangroves.
- Stakeholders said that plantations are not a replacement of functioning ecosystems and that mangrove plantations, as offsets, could be carried out on an on-going basis and planted in advance before removal of mangroves.

- Significant legacy issues persist associated with PQA's perceived mishandling of relocations between 1972 and 1982, in relation to restoration of housing and livelihood when Port Qasim was established.
- The Fishing/Agriculture Communities located east of Port Qasim complained of use of illegal and destructive fishing methods by the fishermen coming in to fish from west of the Study Area. Conflicts between the two communities have resulted in an incidence of loss of human life.
- The communities, the industry, and the NGOs believe that discharge of untreated effluents from PQA and other areas results in degradation of the seawater leading to declines in fish population in creeks, which in turn affects the livelihood of the local fishermen.
- The fishing community stated that PQA disposes the dredged material in the creeks, away from their shipping lanes, resulting in increase in sea water turbidity, affecting fish population and consequently the livelihoods of fishing communities. They also stated that disposal of dredged material in the creeks reduces depth, and makes navigation difficult for the fishermen.
- The fishing community stated that PQA has restricted their movement in the main PQA navigation channel and declared the shipping channel a formal exclusion zone where fishing is prohibited, thus limiting their livelihoods.
- The fishing community stated that the jetties within Korangi Creek inhibit access to fishing grounds, along the eastern edge of Korangi Creek.
- Key respondents from all the consulted communities identified poor educational infrastructure as the major cause of their poor socioeconomic conditions.
- Both the communities and the industry expressed the concern that the development of PQA industrial zones has greatly affected the ambient air quality due to pollutants released in the air by the industries, affecting health of the communities.

3. Environmental Baseline

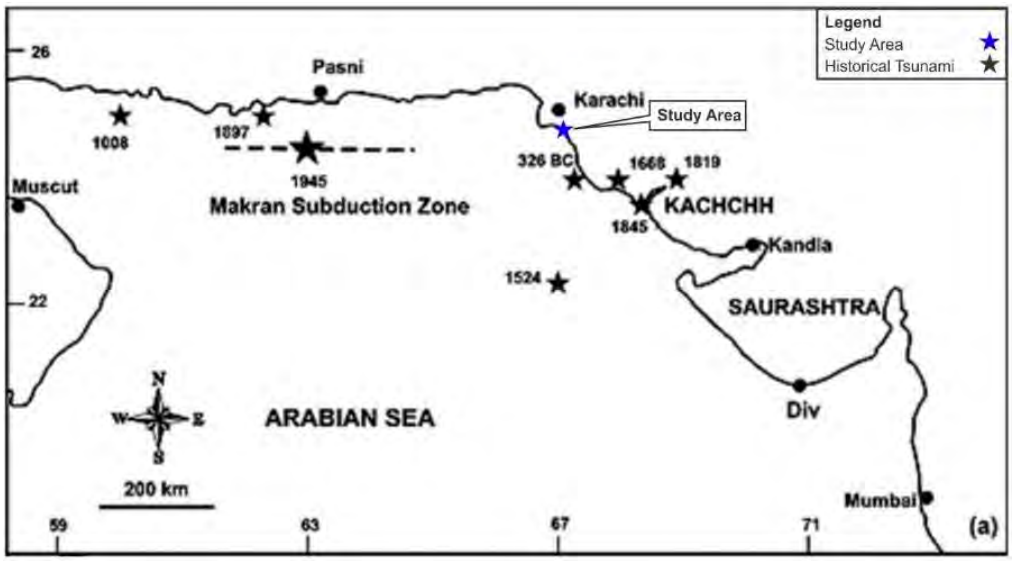
3.1 Physical Baseline

The baseline study relied on review of literature, previous ESIA reports prepared for projects in the Study Area, and sampling surveys conducted as a part of this study. Port Qasim is located on the northwestern fringe of the Indus Delta system. It is the fifth largest delta of the world, formed by the river Indus and tidal creeks. The majority (29%) of the Study Area is occupied by channels and creeks. Mangroves and mudflats/beaches occupy 19% and 10% of the Study Area respectively, while 19% is barren land. Agricultural areas occupy 9% of the Study Area, whereas 6% and 7% of the Study Area comprises industrial and commercial areas (including Port Qasim) and built-up residential areas, respectively.

3.1.1 Tsunamis

The coast of Pakistan is in an area of potential tsunami. While large tsunami genetic earthquakes have been relatively rare, there is potential for a tsunami associated with the Makran Subduction Zone (MSZ) or smaller localised tsunamis associated with several smaller thrust faults around Karachi (see **Exhibit 2**). The relatively recent tsunami generated along the MSZ in 1945 was responsible for 4,000 deaths, and destruction along the sparsely populated coast of Pakistan.

Exhibit 2: Historical Tsunamis Generated in the Region (up to 1945)[2]



3.1.2 Storms and Cyclones

Severe storms and cyclones seldom cross the coast of Pakistan. The main cyclonic activity in the Study Area takes place in the month of June. All the cyclonic storms that emerge in the Arabian Sea either curve sharply into the Gulf of Kutch or cross the Arabian Sea from East to West and end up at the coast of the Arabian Peninsula. When the cyclones cross the coast they are accompanied by storm surges, generally known as storm tides. The cyclones that cross the coast in the month of June generate winds of approximately 15-18 m/s.

3.1.3 Air Quality

The current air quality is influenced by a number of factors. These include industrial activities in PQA; activities outside the PQA Area, such has the Pakistan Steel Mill, the K-Electric Bin Qasim Power Plant; road traffic particularly the National Highway N-5; industrial emissions from Korangi and Landhi; domestic emissions from homes using biomass as fuel and natural wind-blown dust.

The air quality baseline study relied on analysis of secondary data and modeling of emission sources. There was insufficient time to collect primary data as this would have

[2] Shukla et al. “Coastal Geomorphology and tsunami hazard scenario along the Kachchi coast, western India” (2010)

required a year round baseline study. The number of active industrial units within PQA Industrial Zones is estimated to be about 168.[3] Fuel combustion is the predominant source of emission in these units. Residual Fuel Oil (RFO), natural gas and diesel are the main fuels used. Emissions include oxides of nitrogen (NO_x), sulfur dioxide (SO_2) and particulate matter (TSP, PM_{10} and $PM_{2.5}$).[4] The available historic data spanned a period of 2004-2015 and consisted of short-term (mostly one-day) measurements at 34 locations across the PQA. Results of the analysis are summarized below.

- The concentration of pollutants at all locations sampled is below the limits prescribed by national and international guidelines and standards including the Sindh Environmental Quality Standards (SEQS) and those of the International Finance Corporation (IFC).
- The reported concentration of all pollutants (NO_X, SO_2, PM_{10} and $PM_{2.5}$) along the coast is higher in 2004-2010 as compared to 2011-2015. The reason for the decrease in the amount of pollutant is not clear and needs further research.
- The concentration of key pollutants including (NO_X, SO_2, PM_{10} and $PM_{2.5}$) along the sea coast is higher than the eastern and western industrial zones of PQA Area. This is because of the major port operational activities are taking place along this sampling site.
- The concentration of particulate matter is nearly same in all data sets. Elevated concentrations of PM is a common occurrence all over Pakistan and is attributed to dry conditions and natural wind-blown dust.

As part of the impact assessment, all the existing sources of gaseous emission in PQA and vicinity were modelled. The simulation of the current emissions largely confirmed the results of the analysis of the historic sampling data. However, the model also suggested that the concentration of NOx and SO_2 in the ambient air may already be exceeding the target limits (IFC ambient air quality guidelines in this case as it is more stringent than the SEQS for ambient air). The area in which the limits are exceeded is relatively small, which also explains why it has not been captured in any measurement.

3.1.4 Seawater Results and Analysis

The conductivity-temperature-depth data shows that there is little variation along the profile at each site. While this indicates a well-mixed tide dominated system, the salinities are all above 35 practical salinity units (psu) showing that this is primarily seawater with little or no freshwater input.

The levels of arsenic show a spatial trend. Concentration of arsenic at a reference site located further away from Port Qasim was 1.9 micrograms per litre (µg/L) compared to locations closer to the areas where industrial and municipal wastewater is discharged into the creeks where it ranged from 2.4 to 3.7 µg/L. The average concentration of arsenic,

[3] For the purpose of gaseous emission, *active* units are defined as process industrial unit that are emitting gaseous pollutants. The information is based on satellite image analysis and field verification.

[4] The particulate matter is classified on the basis of particle size as follows: total suspended matter (TSP) contains particles of all sizes; course respirable particulate matter containing particles of diameter 10 microns or less (PM_{10}), and fine respirable particulate matter containing particles of diameter 2.5 microns or less (PM_{10}).

copper and zinc in the 2015 conducted for this study and sampling conducted by HBP as a part of another EIA were all higher than the concentration at the reference site of 2015. This corresponds to the higher concentration of the heavy metals found in the fish liver and tissue samples compared to permissible limits and the reference site for analysis of fish tissue. Oil and grease, TPH and CN were not detected in any sample. No major differences were found in the analyzed samples for the pH, turbidity, alkalinity, nitrates (except higher at one location), nitrites, phosphorus, phosphate, sulfate, bromide, fluoride and chlorides.

Total coliforms were detected too numerous for count in the seawater samples. However, Faecal E. *coli* and Faecal *Streptococci*/*Enterococci* were not seen in the analyzed samples.

The relatively good quality of the ambient seawater is likely because of the following:

- the locations are east of Phitti, Gharo and Korangi Creeks
- the tidal prism within the Study Area is very large, particularly compared to wastewater flows, therefore diluting the wastewater
- enhanced mixing and, therefore, dilution of wastewater discharges due to Summer Monsoon winds[5] when sampling was carried out

Regardless of the good mixing and dilution within the estuary, at least during Summer Monsoon, heavy metal contamination is evident within fish tissue and liver (see **Section 3.2.5**).

3.1.5 Wastewater Results and Analysis

Sampling conducted by HBP in 2014 for drains carrying effluent from the Eastern Industrial Zone of PQA where bulk of the PQA heavy industry is located showed that all the parameters were within the Sindh Environmental Quality Standards (SEQS) limit and IFC General Environmental, Health and Safety Guideline indicative values for treated sewage discharges (IFC EHS guideline), which is indicative of the pollution levels in wastewater discharged by the industry in the PQA Area.

Sampling carried out for this study in 2015 showed that the total dissolved solids (TDS) were highest in K-Electric drain[6]. TDS were recorded at 41,790 milligrams per litre (mg/L), which does not exceed the SEQS limit of 3,500 mg/L above the concentration of the seawater source. The TDS concentration in wastewater carried by major freshwater streams draining effluents from the other industrial and residential areas located west of Port Qasim exceeded the SEQS limit of 3,500 mg/L. However, the TDS levels were below those of the ambient seawater where the wastewater is discharged.

The maximum value of turbidity was observed at Bhains Colony drain, where it exceeded the SEQS. The concentration of all the nutrients was the highest at Bhains Colony with concentration of nitrate as 64.26 mg/L, nitrite as 8.74 mg/L, total phosphorous as

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5 Turbulent boundary layer likely to be penetrating along depth due to high winds, as well during tides.

6 Pakistan Steel Mills does not discharge into this drain, and largely reuses and recycles water on site, with some wastewater, including runoff, draining into Badal Nullah and Gharo Creeks during the wet season.

394.68 mg/L, orthophosphate as 174.25 mg/L and ammonia 1.89 mg/L, with the exception of sulfate which was higher at K-electric drain.

Cyanide concentration in Malir River, Bhains Colony drain, and K-electric drain were below the level of reporting. The bromide and fluoride concentrations were the highest at the Bhains Colony drain whereas the highest chloride concentration was observed at Pakistan Steel Mills drain. Water quality at all locations west of Port Qasim exceeded the SEQS limit for bromide and fluoride. For the Bhains Colony drain and Malir River, the total suspended solids (TSS) were 55 mg/L and 584 mg/L respectively, and above the IFC EHS Guideline of 50 mg/L. The total phosphorous at Bhains Colony was 395 mg/L compared to the IFC EHS Guideline of 2 mg/L.

The heavy metals that are of major concern on the basis of their toxicity even at lower concentrations are arsenic, cadmium, lead and nickel. The concentration of lead and nickel was in compliance with the SEQS at locations where sampling was carried out for heavy metals. The concentration of arsenic and cadmium was highest at the Bhains Colony drain. The concentration of cadmium exceeded the SEQS limit. The level of arsenic, cadmium, copper and zinc in Malir River and Bhains Colony drain were significantly higher compared to freshwater and seawater in the Study Area. This is of consequence, as the arsenic, cadmium, copper and zinc levels in fish tissue and liver were also observed to be elevated (see **Section 3.2.5**).

3.1.6 Ocean Currents and Tides

Currents along the Indus Delta (based on measurements near Karachi) are bimodal. The current switches from south-westerly during the summer monsoon (May to September) to north-easterly during the winter monsoon (October to April). The tides in the area are semidiurnal, with tidal ranges in the area of about 2.7 m.

3.1.7 Waves

The wave regime on the coast varies with seasons. During the winter season, when winds are around 5 m/s, the coastal waters are almost calm and the wave height is less than 1 m. During the southwest monsoons of the summer months, the winds are around 13 m/s and the waves on the coast are more than 3 m high and vary according to the nearshore depths and locations. In other months the waves are between 1.5 to 2.5 m.

3.1.8 Wave Induced Currents

The longshore current is the littoral current in the breaker zone which moves essentially parallel to the shore. The current is usually generated by waves breaking at an angle to the shoreline. The value of longshore current in the Indus Deltaic region is about 1.0 meter per second.

3.1.9 Erosion and Sedimentation

The abandoned channels of the Indus Delta have been reworked, through erosion and sedimentation by tides, into dendritic tidal creeks. The tidal creek network is most extensive and mature east of the present Indus mouths (Khobar and Ghaghiar creeks). In comparison, the deltaic coast closer to Karachi is dense and a less mature channel network. The stronger wave influence along this part is suggested by occurrence of

drumstick-shaped barrier islands typical of island systems significantly influenced by both waves and tides *e.g.* Khiprianwala Island.

In comparison to the shoreline along Phitti, Khuddi and Khai creeks, there are different dynamics within the creeks of the Study area. In addition to influence by waves and tides on erosion and sedimentation along the coast, erosion related to Developments at Port Qasim and ship wake associated with Port Qasim has been reported by the PQA. A comparison of mangrove extent along the banks of the current navigation channel and proposed extension using aerial imagery from 2014 and 2004 indicates the following:

- Along Kadiro Creek, where the channel is narrow, the net erosion per unit channel-length is 48.6 m^2/m-channel. There is up to 100 m of erosion of mangroves along the banks of this creek[7].
- In front of the main Port Qasim bulk terminals where the channel is wider, the net erosion per unit channel-length is 15.0 m^2/m-channel.
- The channel is again wider moving eastwards where port extension is proposed, the net erosion per unit channel-length is 15.5 m^2/m-channel.

Lower net erosion is evident where the channel is wider. The channel in Kadiro Creek is narrow, where greater impact of ship wake is observed.

3.1.10 Sediment Quality Sampling and Analysis

A total of nine sediment quality samples were collected from June 4, 2015 to June 8, 2015. The sampling locations were chosen considering marine ecosystem, port activities and wastewater inflows from the on-shore industry. All samples were taken from the channel bed, as access to islands (with mangroves) was not possible given conditions due to the prevalence of the Summer Monsoon. Total metals were analyzed in three samples from the Study Area. The observations from the results are as follows:

- Manganese and Strontium were detected at concentrations higher than three times its average crustal abundance in all samples and exceeded the sediment quality guidelines, target values and standards.
- Values of all other analyzed metals were below the reported guidelines or target values.

3.2 Ecological Baseline

The baseline study relied on review of literature, previous ESIA reports prepared for projects in the Study Area, and sampling surveys conducted as a part of this study for mangroves, fish, and shrimp.

3.2.1 Mangroves

Port Qasim is located on the northwestern fringe of the Indus Delta system, which is the fifth largest delta of the world. The area covered by mangroves in the Indus Delta is about 129,000 ha, which is about 97% of the total mangrove area in Pakistan. Of this, approximately 31,000 ha of mangroves are under the Port Qasim Authority, which is

[7] The aerial imagery does not include area recently reclaimed by PIBT

approximately a quarter of the entire mangrove area in the country. A number of protected areas designated by the Sindh Wildlife Department are located in the proximity of the Study Area, of which the nearest and adjacent is the Keti Bandar North Wildlife Sanctuary located at a distance of approximately 22 km from the Study Area. The Indus Delta Ramsar Site also lies adjacent to the Study Area.

Historical records indicate that the distribution and extent of mangroves in the Indus Delta has changed significantly over the past several hundred years as the river has shifted its position. In more recent times, the reduction in fresh water flows due to diversions of water for agriculture is the main factor responsible for the extent and change in mangrove distribution. One source estimates that the mangroves in the Indus Delta have declined from approximately 600,000 ha in 1932 to just over 100,000 ha in 2010. Another estimates that over the three decades from 1980 to 2010, the rate of loss of mangroves in Pakistan has been over 2% per year, which is amongst the highest in South Asian countries. This is expected to threaten the long term sustainability of mangroves in the Indus Delta. Others factors affecting mangroves include pollution from industrial and municipal areas, dredging, felling of mangroves, encroachments of settlements around Karachi's mangroves, sea intrusion caused by sea level rise, dumping of waste, and over-exploitation of mangroves for fuel, fodder and grazing by camels. The dense mangrove cover in Pakistan has declined significantly due to multiple stresses since 1932. Recent trends since 2003, however, show a slight increase. There is greater persistence and regeneration of mangroves in the northwestern part of the Indus Delta -within the Study Area -compared to other parts of the Indus Delta. Possible reasons are low salinity and nutrient rich wastewater, as well as monsoon floods, flowing into the tidal creeks from from the Malir River catchment. Mangrove cover in Pakistan has changed the most as compared to the other countries, and mangroves in Pakistan remain critically threatened. The perception amongst policy makers and developers in Pakistan of mangroves as wastelands has resulted in large areas of mangroves being cleared.

Initiatives to restore up to 100,000 ha of mangrove forests have been taken in 2012 involving the Sindh Forest Department and the IUCN. However, it is unclear to what extent these initiatives have been successful. Mangroves enjoy a special legal status under the Forest Act of 1927, however for all practical purposes, the right of PQA to develop the mangrove area under its jurisdiction is recognized.

Based on a simplified approach, mangroves in the Study Area were classified as Healthy Mangroves with trees in good health and dense cover, Unhealthy Mangroves with generally reasonable health but sparse canopy, and Mangroves with Die Back with poor condition and very open canopy cover. Spatial and temporal analysis conducted on the basis of Google Earth™ satellite imagery and field sampling indicated the following:

- Healthy Mangroves are largely present along the banks of the creeks, whereas mangroves inland and further away from the banks tend to be Unhealthy Mangroves.
- Mangroves along the coast, closer to Port Qasim and to the areas that receive municipal and industrial effluents are healthier, possibly due to presence of fresh wastewater, fertilization by nutrients and better protection.

- Proportion of Unhealthy Mangroves is higher at Study Sites distal from Port Qasim. This could possibly be due to lower delivery of nutrients, a decline in both fresh water flows and sediment from the Indus Delta, and lower level of protection from fodder and fuel wood extraction.
- The mangroves in proximity to the Port Qasim and areas where municipal and industrial effluents are discharged into the sea have shown an improvement over time. This temporal trend reverses moving away from the coast towards the open sea.

Damage due to anthropogenic activities including collection of fodder and fuel wood was observed at all locations sampled in September 2015, but was higher at locations closer to the mainland. Evidence of insect and disease attack was observed at all locations sampled. Some of the observed harmful insects have the potential to cause damage to relatively large areas of mangrove forests. Seedling density was highest in Healthy Mangroves closer to Port Qasim, where abundance of snails was also observed. Analysis of Google Earth images from January 2011 to June 2015 show that dumping of dredged material resulted in the destruction of a significantly large area that was once covered by Healthy Mangroves.

The Study Area includes 35,546 ha (355 km^2) of mangroves. To date loss of mangroves due to clearing and land reclamation is estimated at 448 ha (4.48 km^2). In addition to this loss of mangroves due to erosion along Kadiro Creek over the last 10 years has been estimated as 44 ha. Mangroves covering about 120 ha (1.2 km^2) have been buried under disposed dredging material. An additional 1,324 ha (13.2 km^2) is planned to be cleared by 2050 as per PQA plans.

3.2.2 Marine Benthic Invertebrates (MBI)

MBI organisms are a good indicator of ecological disturbances. While a clear link between sediment heavy metal and MBIs cannot be established, overall the Port Qasim Area creeks are a disturbed area, and therefore both species diversity and species richness are relatively low. Based on information available in previous ESIAs and secondary liteature, none of the marine invertebrates species reported from the Study Area are threatened or included in the IUCN Red List of Threatened Species. Moreover, their distribution is not limited to any specific site or habitat type and is widespread.

3.2.3 Fish Diversity and Abundance

The area supports a high diversity of fish species. A total of 126 marine species found at Keti Bandar in a recent study are expected to be present in the Study Area. A total of 66 species were observed during limited sampling within the Study Area for this study. Anecdotal reports (WWF-P and Marine Fisheries Department) indicate the presence of 180 fish species in the Port Qasim area. The two species that occur in brackish water at Keti Bandar are unlikely to occur in the Study Area as the brackish water zone has been much reduced due to a reduction in inflows of fresh water. Fish diversity was observed to be lower near Port Qasim closer to the shoreline, and improved within the creeks moving away from the shoreline. Possible reasons for this pattern are over fishing closer to the mainland, and higher levels of pollution from waste waters discharged into the sea.

3.2.4 Shrimp and Crab

Mud crabs were observed during low tide in the mudflats in June 2015. In addition, three species of crabs were collected in the sampling exercise carried out in September 2015 in the creeks in the Study Area. Three shrimp species were also collected during the same exercise.

3.2.5 Heavy Metal Contamination in Fish, Crab, and Shrimp

Based on studies carried out by HBP in 2008 at Port Qasim, arsenic (2.50 mg/kg) as well as cadmium (2.49 mg/kg) and zinc (134.0 mg/kg) were above limits prescribed by the FAO. In the case of fish tissue samples, only the concentrations of the arsenic were above the prescribed limit at both Keti Bandar and Port Qasim (1.29 mg/kg and 1.50 mg/kg respectively). Comparisons of the two sites indicated that levels of heavy metals at the Keti Bandar site were lower in the case of almost all heavy metals, for both liver and tissue samples. This was with the exception of silver in liver samples and mercury in tissue samples. The results indicate that the Keti Bandar site had comparatively lower heavy metal pollution as compared to the Port Qasim site. Based on sampling and analysis carried out in 2015 as part of this study, arsenic was found to be slightly above the prescribed limit in one out of three fish tissue samples and above the prescribed limit in a crab sample. The results indicate that the fish tissue and liver contamination has occurred and there is bioaccumulation of heavy metals in the fish in the Study Area.

3.2.6 Marine Mammals and Reptiles

Fishermen interviewed in June 2015 during the ecology field surveys conducted for this study reported that they have seen turtles in the Study Area; however the evidence is anecdotal. Although there have been rare sightings of turtles of conservation importance in the Study Area, preliminary investigations show that these turtles do not use the Study Area for breeding or nesting.

Three cetacean species (Indian Ocean Humpback Dolphin *Sousa plumbea*, Bottle-nosed Dolphin *Tursiops truncatus,* and Finless Porpoise *Neophocaena asiaeorientalis*) have been reported from the Indus Delta. Kiani and Waerebeek (2015)[8] have recorded the presence of an important population of the Indian Ocean Humpback Dolphin *Sousa plumbea* in a number of creeks in the Indus Delta creek system including within the Study Area. The sightings have been reported from November 2005 and May 2009 (see **Section 5.6** of the **Ecological Baseline**). The Finless Porpoise is listed in the IUCN Red List as Vulnerable. While the Indian Ocean Humpback Dolphin has not yet been assessed by the IUCN, given the threats it faces its status is likely to be Vulnerable.

3.2.7 Avifauna

The mangrove habitats provide abundant food and shelter to a number of species of resident and migratory birds. The Ramsar site which is continuous with the PQA Study Area regularly supports more than 60,000 migratory waterfowl including some

[8] Muhammad Shoaib Kiani and Koen Van Waerebeek, A Review of the Status of the Indian Ocean Humpback Dolphin (*Sousa plumbea*) in Pakistan. Advances in Marine Biology, Vol. 72, pp 201-228, Oxford: Academic Press, 2015,

threatened species like the Greater Knot *Calidris tenuirostris*, the Dalmatian pelican *Pelecanus crispus* and Marbled Teal *Marmaronetta angustirostris* all of which are listed as Vulnerable in IUCN Red List and the Painted Stork *Mycteria leucocephala* and Cinereous Vulture *Aegypius monachus* which are listed as Near Threatened. Other species include the Greater flamingo *Phoenicopterus rubber*, the Lesser Flamingo *Phoenicopterus minor*, the Wigeon *Anas phenelope*, Black tailed Godwit *limosa limosa*, Pochard *Aythya farina* and Common coot *Fluca atra.* Of the birds reported from the Korangi-Phitti Creek System, three are included in the IUCN Red List and listed as Near Threatened. These are Painted Stork *Mycteria leucocephala*, Black Tailed Godwit *Limosa limosa*, and Eurasian Curlew *Numenius arquata*..

3.2.8 Critical Habitat Assessment

Critical Habitats are areas with high biodiversity value. The Mangrove and associated mudflats and creeks within the Study Area qualifies as Critical Habitat in alignment with IFC Performance Standard 6 on Biodiversity Conservation and Sustainable Management of Living Natural Resources on two criteria:

- Criterion 3: (Tier 2) The presence of Migratory and/or congregatory species.
- Criterion 4: Highly threatened and/or unique ecosystems. This ecosystem is both unique and critically endangered.

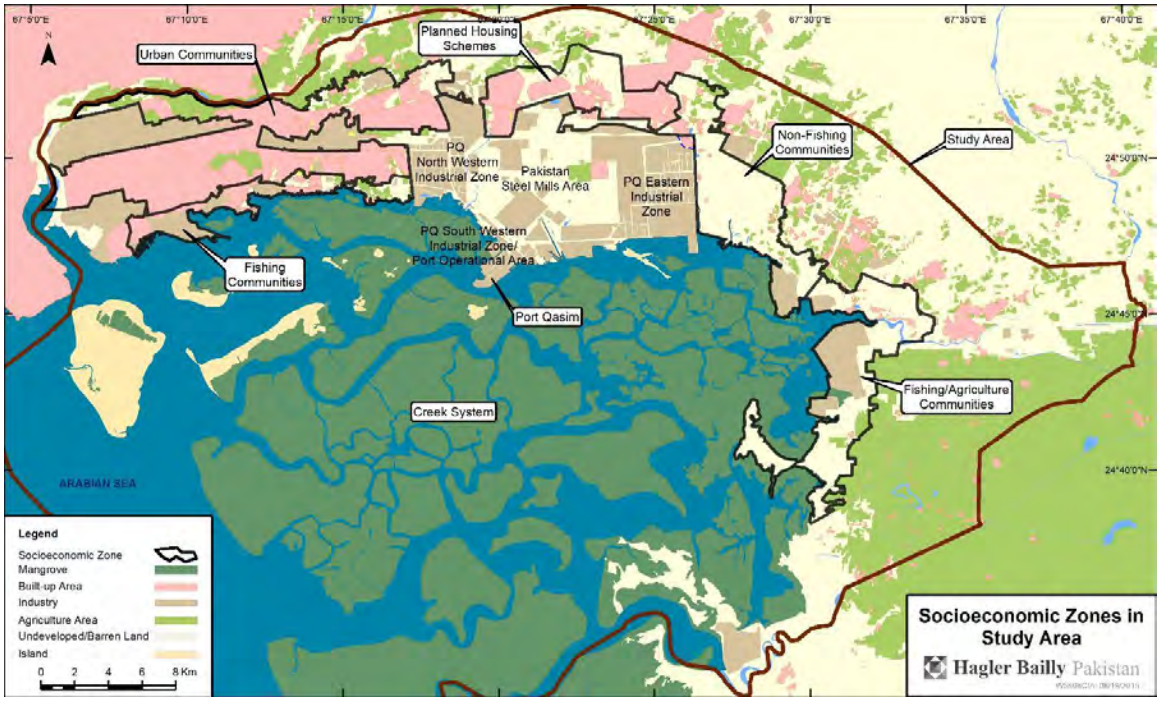
It also meets the criteria of Critical Habitat according to the Asian Development Bank's (ADB) Safeguard Policies as the area is of significant economic importance to local communities.

3.3 Socioeconomic Baseline

The baseline study relied primarily on information collected through surveys conducted by HBP in the communities as a part of this study. Information from secondary sources consisting mainly of previous ESIAs done by HBP, and others as well as published reports, and literature was also consulted. The Study Area was divided into the following Socioeconomic Zones (see **Exhibit 3**):

- Fishing Communities
- Non-fishing Communities
- Urban Communities
- Planned Housing Schemes
- Fishing/Agricultural Communities

Exhibit 3: Socioeconomic Zones in the Study Area



Almost 90% of the residents of the **Fishing Communities**, mainly Ibrahim Hyderi and Rehri Goth, are directly or indirectly connected to the fishing business as a source of livelihood including fishing in creeks/mangroves of PQA Area and in open sea, fish processing, ship building and net making, and providing recreational fishing and tourism services to the visitors from Karachi. The infrastructure in the Fishing Communities zone is poorly developed with limited health and educational facilities, below par road networks and poorly maintained electricity transmission lines.

Non-Fishing Communities are located in the northeast of the Study Area with most of the population concentrated near Ghaghar Phattak. Their livelihood is mainly daily wage labor in the industries located in PQA industrial and commercial zones, towns of Gharo and Dhabeji, and Karachi city. The lack of economic resources and permanent sources of income has resulted in compromised socioeconomic conditions of these communities resulting in poor health and low level of education, and an overall reduction in the quality of life.

Planned Housing Schemes located in the north of the Study Area include densely populated settlements having relatively well-developed infrastructure. Two urban (Gulshan-e-Hadeed and Pakistan Steel Town) and one semi-urban (Pipri) settlements fall in this zone. Pakistan Steel Town is equipped with all the basic facilities which include drainage and sanitation system, police station, electricity and natural gas transmission infrastructure, and a 100-bed hospital. Pipri is a less developed, with poor infrastructure. Electricity and gas transmission networks exist.

Fishing/Agriculture Communities in the east of the Study Area are located at a distance of 60 km from Karachi city on Bhambore road leading to Mipur Sakro. The livelihoods

of these communities are dependent on fishing in the Gharo and Bhambore creeks and farm labor.

3.3.1 Socioeconomic Profile

The population of the surveyed clusters of the Socioeconomic Zones is estimated at 396,395. The majority of the population (96%–97%) residing in and around the Study Area are Muslim. Castes represented within the PQA Area include Mirbehar, Jat, Khaskheli, Syed, Baloch, Brohi, Larak, Musani, Punjwani, Waryani, Qasimani, Malkani, Shah, Kalmati, Khosa and Zohrani. The two commonly spoken languages in the Socioeconomic Zones are Sindhi and Urdu. Due to existence of a few Pakhtoon and Baloch settlements, a small number of people speak Pashtu and Balochi as well.

Housing and Utilities

Most of the houses (nearly 62%) of the rural settlements in both Fishing Communities and Non-Fishing Communities are masonry structures, while the remaining are wood and straw huts. The huts are in a very poor condition and need repairs, especially after seasonal rains in the area. The housing in the Planned Housing Schemes comprises masonry construction only. In the Fishing Communities, 88% of the households reported access to natural gas, while remaining 12% of the households reported reliance on mangrove wood for cooking and heating purposes. In addition, commercial sale of mangrove wood was also reported. The Non-Fishing and Fishing/Agriculture Communities do not have access to natural gas supply. They collect wood form mesquite forests and other vegetation in their surroundings to meet their heating and cooking requirements.

Water Supply

During the socioeconomic survey, it was noted that the water to the Fishing Communities, Planned Housing Schemes and the only settlement of Haji Ibrahim in Non-Fishing Communities is supplied by the Karachi Development Authority (KDA) through its supply system. The other source of water in the Socioeconomic Zones is groundwater, which is mostly brackish and not fit for drinking and mainly used for washing, bathing and cooking purposes.

Health and Education

The settlements of Ibrahim Hyderi and Steel Town are the only settlements having separate government girls' and boys' colleges (up to 14th grade) providing higher education. The two major settlements in Fishing Communities, Ibrahim Hyderi and Rehri Goth have girls' and boys' primary and secondary schools. The residents of the villages in the nearby surroundings of Rehri Goth visit colleges of either Ibrahim Hyderi or Karachi city located at an approximate distance of 5 km and 15 km form these villages. Education facilities in the surveyed Non-Fishing Communities include primary, middle and secondary schools run by the provincial Education Department, Human Development Foundation (HDF), Fauji Fertilizer Bin Qasim Ltd. (FFBL) and Sindh Education Foundation (SEF). The government provided educational facilities in the surveyed settlements comprise of six primary, two middle and two high schools. FFBL has also established a girl's elementary school in Haji Jhangi Khan, where education up to class eight is provided to girls.

Health facilities are reported to be inadequate and lack of technical medical staff and absence of doctors from duty has resulted in poor health status of the communities. The health centers of the Fishing Communities are limited to Ibrahim Hyderi and Rehri Goth with only government and private health centers functioning in the area. The residents of these communities visit health centers including public and private hospitals located in Karachi city at a distance of about 15 km.

Livelihood and Assets

The primary sources of livelihood (for the residents of communities located in the Socioeconomic Zones are as follows:

Primary Sources of Livelihood (% of Households)

Livelihood	*Fishing Communities*	*Non-Fishing Communities*	*Fishing/Agriculture Communities*	*Planned Housing Schemes*
Fishing (own boats)	4%	-	2%	-
Fishing (labor)	68%	-	38%	-
Boat Building/Repair	4%	-	-	-
Non-Fishing Wage Labor	24%	65%	32%	54%
Employment in PQA and Pakistan Steel Mill	-	16%	-	46%
Government Employment	-	1%	-	-
Small Business (Hotel/Shop)	-	18%	-	-
Farm Labor	-	-	29%	-
Total	**100%**	**100%**	**100%**	**100%**

The household survey conducted as part of this assessment shows that the average income of households engaged in fishing ranges from PKR 7,000 to PKR 20,000 per month, depending upon the size of boat, boat ownership and fish catch. There is a general sharing arrangement, whereby half of the total catch goes to the boat owner while the income generated from the other half is equally divided among the fishing labor. Average crew size is 20 persons on a 24 ft boat and 45 persons on boats exceeding 32 ft. Average income of the households providing wage labor is PKR 10,000 per month. The per capita income for the communities is estimated to be PKR 2,551 per month.

Almost all the fishermen are working as fishing labor, with only a small number of fishermen owning boats, as a result, the fishermen have low income levels. The total commercial fish catch in Sindh increased from 1947 onwards, this was followed by a decreasing trend after 1993. The decrease is attributed a reduction in the quantity of fin fish caught. Estimated fish catch and its distribution, given some assumptions, for the Study Area is summarized below:

Estimated Fish Catch by Fishing Locations[9]

Landing Site	*Fishing Location*	*Annual Fish Catch (in metric tons)*	*% of Fish Catch*
Ibrahim Hyderi	Mangrove	20,301	29
	Open Sea	19,565	28
Rehri	Mangrove	14,599	21
	Open Sea	14,599	21
Bhambore	Mangrove	1,045	1
	Open Sea	0	
Total		**70,110**	**100**

Distribution of Fish Caught by Communities Living in Study Area on the Basis of Boat Sizes

Fishing Location	*% age of Catch*
Mangroves	51
Open Sea	49

The total fish catch from the Socioeconomic Zones, including fish for food and trash fish (fish mesh used in manufacturing process of dairy and poultry feed), is estimated to be 61,026 metric tons in 2014. Applying the market rates for these categories of fish, the annual market value of the fish caught in the Study Area is estimated at PKR 7,332 million.

Reliable data could not be collected for shrimp catch through the socioeconomic survey or otherwise. Applying an average market rate of PKR 787/kg[10] for the total of 4,413 metric tons of shrimp estimated on the basis of MFD data for three types of shrimp reported, annual market value of shrimp catch is estimated at PKR 3,473 million. Crab catch is estimated at 34,131 kg as calculated from the data recorded during the socioeconomic survey. The annual market value of crab catch is estimated at PKR 7.8 million.

Korangi and Landhi Industrial Areas are home to Pakistan's' largest textiles, pharmaceutical, cosmetic, steel, chemical, automobile and flour mill industries. These industries provide multifaceted job opportunities to the residents of the communities located in their immediate vicinity.

[9] There are a number of limitations in the analysis carried out. However, the estimated incomes on the basis of the estimated fish catch generally correspond with the per capita incomes calculated on the basis of separate socioeconomic surveys carried out within the Study Area. Further monitoring of the fish catch, most of which goes unreported, is recommended to establish a better state of the "pressure" on the "ecosystem" due to factors external and outside the control of the Port Qasim Authority.

[10] Market rate varies from PKR 300 to PKR 1,200 per kg depending on the size and quality of shrimp.

3.3.2 Overview of Community Dependence on Ecological Resources

The mangrove forests in Pakistan provide important ecosystem services. The livelihoods of the Fishing Communities are almost entirely dependent (75% of households) on fishing and fishing related activities, with little diversification of income sources. About 51% of the fish catch in these communities comes from the creeks and mangrove areas. In the Fishing/Agriculture Communities, 40% of the households are dependent entirely on fishing in the creeks and mangrove areas. In the Fishing Communities, a small number of households in Rehri Goth collect fodder from the mangroves for their livestock and 12% of the households are dependent on wood collected from the mangroves for fuel use.

3.3.3 Absolute Vulnerability

To ascertain the absolute vulnerability status of the communities, a vulnerability matrix was filled in discussion with key informants at each settlement as a part the settlement level socioeconomic survey. Socioeconomic zones within the Study Area were ranked based on their current status for vulnerability. The results of the vulnerability survey are summarized below.

Vulnerability Levels in Study Area

Zone	*Vulnerability Level*							
	Access to Social Services	*Out Migration*	*Economic Opportunities*	*Access to Credit*	*Assets*	*Mobility*	*Disaster Preparedness and Response*	*Overall Vulnerability Level*
Fishing Communities	Moderately Resilient	Resilient	Moderately Vulnerable	Moderately Vulnerable	Highly Vulnerable	Vulnerable	Critically Vulnerable	Vulnerable
Non Fishing Communities	Highly Vulnerable	Moderately Resilient	Critically Vulnerable	Moderately Vulnerable	Highly Vulnerable	Critically Vulnerable	Critically Vulnerable	Highly Vulnerable
Fishing/Agriculture Communities	Highly Vulnerable	Moderately Resilient	Vulnerable	Moderately Vulnerable	Vulnerable	Critically Vulnerable	Highly Vulnerable	Vulnerable
Planned Housing Schemes	Moderately Resilient	Moderately Vulnerable	Critically Vulnerable	Resilient	Vulnerable	Moderately Resilient	Moderately Vulnerable	Moderately Vulnerable

Color Coding: Red – Critically Vulnerable, Brown – Highly Vulnerable, Yellow - Vulnerable

The highest levels of vulnerability were observed in the Non-Fishing Communities, followed by the Fishing Communities and Fishing/Agriculture Communities. The Planned Housing Schemes have relatively lower level of vulnerability in comparison to populations in other Socioeconomic Zones studied.

4. Impact Assessment

The impact assessment carried out for this study assumed a 'Business as Usual' scenario, assuming continuation of current practices and trends in environmental management of the Study Area, as evidenced by general lack of proactive environmental management in the past.

4.1 Air Quality

As stated earlier, the concentration of NO_x and SO_2 in the ambient air may already be exceeding the target limits (IFC ambient air quality guidelines in this case as it is more stringent than the SEQS for ambient air). The impact zone—the area in which the target limits are exceeded—is currently relatively small. The zone falls over an area which is presently either unoccupied or is covered by industrial units. However, this situation will change in future. With the anticipated development of PQA industrial zones, installation of power plants, increase in shipping, road and rail traffic, the impact zone as well as the impact intensity of these two pollutants will increase significantly under the business-as-usual scenario of emission controls. **Although, currently no communities are affected, it is predicted that by 2050 air quality in several communities in the north and northwest of the PQA will by severely affected.**

Particulate matter (PM_{10} and $PM_{2.5}$) are not likely to be a concern from PQA activities. However, it may be noted that the concentration of these pollutants are already high due to natural sources and to some extent due to air-borne dust from traffic movement.

4.2 Mangrove Ecosystem and Biodiversity

Impacts due to Developments in PQA Area

1. Mangroves in Indus Delta constitute a 'Critical Habitat' under the IFC Performance Standards. About 0.3% of the existing mangrove area has been lost to development of Port Qasim, directly, in past. The direct loss will expand to 2.1% of the existing mangrove in the Study Area by 2050 if all the planned Developments take place, which is relatively small. However, **considering the classification of mangroves in the Indus Delta as Critical Habitat, the impact would be significant requiring a net gain in habitat (credible offsets) to comply with the IFC Performance Standard 6 and ADB Safeguard policies**.
2. PQA presently does not have a well-defined policy or guidelines for dumping of dredge material. While the mangrove area already lost to dumping of dredge material to date is relatively small, **there is a risk of additional damage to mangroves due to unregulated dumping of dredge materials in future, particularly from dredging of the second channel** to accommodate future port traffic.

3. The Study Area includes habitat for cetaceans, including the Indian Ocean Humpback Dolphin *Sousa plumbea* and Finless porpoise *Neophocaena asiaeorientalis* which are of conservation importance. The degradation of the near-shore habitats due to increased pollution, shipping activity and developments, could therefore result in adverse impacts on the population of these species. Collisions between ships and cetaceans has also been reported to be a serious issue. Noise during construction in the port from piling and drilling operations can also cause disturbance and harm to the cetaceans.
4. Impact of **accidental releases of oil and other toxic products** from tankers and other ships delivering cargo to Port Qasim and consequential impact on abundance of marine life is a potential concern.

Impacts Due to Others

1. Given the established practice of harvesting mangroves for fodder in the local communities, expanding populations in the coastal area, and high cost of commercial fuels, the harvesting pressures are expected to remain high. **The loss of mangroves due to harvesting by local communities could intensify if proper controls are not maintained on a continuous basis**.
2. Mudflats the Study Area are feeding areas for both resident and migratory birds, and are potential areas for replantation of mangroves. **Mudflat habitats in the Study Area are likely to face risks similar to those for mangroves, particularly from urban developments by organizations and institutions other than PQA.**
3. In the long term, if the release of industrial effluent into the creek systems remains unchecked and unregulated, and if the industrial activity in the catchment of Malir River multiplies, **accumulation of heavy metals in the sediments is likely impact marine fauna as well as affecting their suitability for human consumption**.
4. **Clearing of mangroves and deposition of toxic metals in the creeks will impact the abundance of fish and crabs, and consequently the livelihoods of local communities.** The significance of these impacts will increase over time if effective regulatory regimes to control land use and flow of toxic pollutants into creeks are not established.
5. **The loss of freshwater into this part of the delta will affect the long term sustainability of the entire mangrove ecosystem.**

4.3 Livelihoods Related to Mangroves - Income from Fish, Shrimp and Crab

Impacts due to Developments in PQA Area

1. **Operation of Port Qasim has hindered the access of fishing communities, particularly those that use small fishing boats, to the preferred fishing areas. The dredging and operation of a new shipping lane as planned by PQA will further restrict their access**.

Impacts Due to Others

1. **Non-sustainable fishing practices by the local community including use of prohibited fine mesh nets are the principle threat to the diversity and abundance of fish in the Study Area**. Total fish catch has declined to as much as 63% of peak level in 1993 by 2014.
2. Fishery and associated activities such as boat building and repair is a principal source of livelihood for a large population in the Study Area, which includes poor and vulnerable households. **If non-sustainable fishing practices and overfishing continue, the fish catch and the corresponding incomes could decline to 33% of present day level in 15 years**. PQA has limited leverage over non-sustainable fishing practices which fall in the mandate of the Marine Fisheries Department.

5. Mitigation Actions and Management Measures

As opposed to a 'Business as Usual' scenario for impact assessment discussed above, a 'Collaborative Management' scenario was assumed for development of mitigation and management measures. This scenario assumes proactive environmental management by PQA in its zone of influence, combined with collaboration with other institutions that have an influence over the Study Area and/or impact its environment. The long term outcome of this scenario in terms of ecosystem services and environment will be maintenance and possibly enhancement of coastal ecosystem functions and services, and sustainable livelihoods.

The following management approach is proposed to achieve a transition from the 'Business as Usual' scenario to the 'Collaborative Management' scenario:

An **environmental management framework** consisting of a set of mitigation actions and management measures including environmental zoning of the Study Area

An **institutional and policy framework** that purposes strengthening of key departments in PQA and defines the roles, responsibilities and mandates of participating institutions in environmental management of the Study Area

A **financial management framework** that generates and provides funds for environmental management and defines mechanisms for transparent and effective utilization of an account

A **monitoring and evaluation framework** that relies on continuous professional, scientific and independent monitoring of the extent to which the environmental management objectives are being achieved and identifies of causes of poor performance or failure

5.1 Environmental Management Framework

Principal Actions and Measures by PQA

- Preparation and implementation of an Environmental Zoning Plan for PQA Notified Area
- Preparation and implementation of guidelines for disposal of dredge materials

- Assessment of risk to cetacean populations due to collisions with ships and from noise from construction activities in the port, and if required preparation and implementation of guidelines for management of these risks
- Preparation and implementation of spill contingency plans for the port
- Regular monitoring of air quality, water quality, and health of mangroves in the Study Area
- Setting an example for other polluters outside the Notified Area including industries and residential areas by achieving compliance with SEQS, and applying pressure on them through regulators and stakeholders to discourage them from discharging effluents and gaseous emissions into the Study Area
- Setting up hydrodynamic and sediment models for prediction of impact of proposed developments and operations on circulation, sedimentation and erosion, and consequentially on ecosystems and ecosystem services
- Continuation of plantation of mangroves to offset clearing to address land use change as a driver for ecosystem change, although a proper replantation strategy and planning is need to ensure offsets are sustainable e.g. through secondary management.
- Building up environmental management capacity to regulate the port operations and businesses operating in the Notified Area to manage environmental impacts on an individual and collective basis.

Principal Actions and Measures by Others with Participation from PQA

- Preparation and implementation of an Environmental Zoning Plan for areas west of the PQA Notified Area where residential and other developments are being considered
- Regulating fishing activities by local communities in collaboration with the concerned government departments and sustainable harvesting practices are introduced and established
- Active watch and ward (patrolling) and regulatory pressure is applied on communities to either stop fodder and fuel wood extraction from mangroves or maintain harvesting at sustainable levels
- Conducting research on mangrove ecosystems to support development of appropriate management strategies
- Conducting studies on release of environmental flows from Kotri Barrage to achieve a balance between the ecology in the Indus Delta and the needs of the communities living in the delta, and the agriculture in the upstream areas.

5.2 Institutional and Policy Framework

Principal actions proposed are:

Addition of a Member Environment in the Board of PQA through prescribed procedures to strengthen the oversight and supervision capacity of the PQA Board on

environmental matters. The person should ideally have a private sector background with longstanding experience in environmental policy and management in a large corporation.

Formation of an Environmental Committee in PQA: The Environmental Committee will report directly to the Chairman, and will have representation from the industry and terminals operators in PQA and DGs Technical, Operations, and Planning. The Chairperson of the Committee can be taken from the private sector to enhance participation and involvement of the industry.

Outsourcing of Specialized Technical Functions: Due to various constraints, it is difficult to engage and maintain high level technical expertise required for achieving the long term objectives of the Collaborative Management scenario on regular payroll of PQA. Outsourcing of specific tasks in specialized areas such as hydrography, hydrodynamic and sediment modeling, air quality modeling, ecological management, laboratory services, and community liaison is proposed.

Strengthening and capacity building of the following departments and sections in PQA:

Environment and Safety Department: Capacity to manage physical, ecological and socioeconomic aspects of environment, environmental monitoring, review of ESIAS, and coordination with industry in PQA and external stakeholders.

Hydrography Section in the Technical Division: Capacity to manage and supervise collection of hydrography data in and around the port area.

Dredging Department: Capacity to manage development of hydrodynamic and sediment transport models and to operate and interpret the results for predicting changes in sedimentation and erosion patterns, and providing advice on design of new facilities.

Restructuring of Environment Department: A position of Manager Environment is proposed, who will manage and coordinate the following functions for which one or more Deputy Managers will be engaged: ESIAs and Environmental Management, Ecology, Monitoring and Laboratory, and Community Liaison.

Placement of E&S Department under the DG - Technical: This is recommended to maintain coordination among the functions of environment, hydrography, and dredging for the reasons listed above.

5.3 Financial Management Framework

Principal actions proposed are:

- **A separate Account for environmental management** titled Port Qasim Environmental Management Account can be established with appropriate legal cover under the rules of the PQA.
- **The Account will be managed by the Environmental Committee** with representation from industry as discussed in the previous section.
- **Inflows into the Account can include mandatory or voluntary contributions from the land holders in PQA** on the basis of defined fees or incremental land charges, fines and penalties collected by PQA on account of environment, pollution charges, and contributions from donors.

- **The amounts in the Account can be used to support activities for implementation of protection and management of environment** such as outsourcing of specialized technical functions, protection and patrolling, research and monitoring, community engagement, effluent treatment, clean-ups, and restoration.

Budgetary Implications for Implementing the Recommendations

Major items in one-time and capital costs for environmental management include setting up and calibrating the hydrodynamic and sedimentation model, setting up air quality model, purchase of low draft patrolling boats, and installation of buoys for cordoning of sensitive fish breeding areas. The indicative budgetary requirement for these is estimated at USD 1.23 million.

Major items for annual recurring costs include hydrodynamic and sediment flow monitoring, air and water quality monitoring, ecological monitoring, surveillance to control illegal and non-sustainable fishing and harvesting of mangroves, awareness and education of local communities, and special studies for environmental management. Annual indicative budgetary requirement for these is estimated at USD 293,000[11].

Given a current revenue base of PQA from shipping as well as land charges of about USD 57 million, the capital or one-time costs for environmental management are estimated 2.2% of the PQA revenues, while the recurring costs correspond to 0.5% of the annual PQA revenues.

[11] Excluding additional PQA staff costs.

Appendix C: Log of Baseline and Impact Session, and Management and Mitigation Session

Appendix C: Log of Discussion

See following pages.

Exhibit C.1: Log of Discussion on Baselines and Impact Assessment

Workshop Session:	Discussion on Baselines and Impact Assessment
Date:	16 February 2016
Time:	9 30 am to 5 pm
Meeting Venue:	Avari Hotel, Karachi
HBP Representatives:	Bilal Khan, Hidayat Hassan, Kamran Minai
IFC Representative:	Sally Johnson
Conducted by:	Sally Johnson (IFC), Rab Nawaz (WWF-P)
Recorded by:	Kamran Minai
Reviewed by:	Bilal Khan
Language:	English
Preamble:	The importance of Port areas and the importance of considering the interests of various stakeholders in development of Port Areas was highlighted as the key issue in considering impacts on the area

No.	*Issues, Comments and Suggestions*	*By*	*Responses and Explanations*
1	**Baseline for the mouth of the Channel:** Representatives from the National Institute of Oceanography (NIO) stated that baseline studies are required for the mouth of the shipping channel where there is a lot of shipping traffic and emptying of ballast tanks. They stated that the ecology here needs to be considered.	National Institute of Oceanography	The approach for CIA is VEC-centered. A CIA does not aim to address all impacts (see relevant IFC Good Practice Handbook on Cumulative Impact Assessment). The impact on the marine side of the shipping channel is important, however ecology at the mouth of was not specifically identified as VEC, especially when compared to the mangrove ecosystem. The consideration of marine ecology is important, as this is also linked with the mangroves. The approach recommended is that this aspect is considered as part of further investigations. However, a key aspect of this is that the institutional structures of PQA are built, and the PQA has started co-management of the PQA notified area with other stakeholders, before expanding the management and mitigation to the marine areas. In particular with respect to the CIA, the VEC approach also considers leverage of PQA in addressing overall impacts of all developments and activities. With respect to the marine area and shipping channel, there are many additional factors that will impact that area, e.g. fishing in nearby areas, ships to other Ports, possibly pollution from Karachi, etc and these are aspects that are not under control of PQA. The major area of leverage, and importance, particularly with respect to ecosystem services is the mangroves and the mangrove ecology. It is recommended that the NIO and PQA discuss this aspect, and once PQA has established structures recommended as part of this Study, determine or find financial resources for marine baseline investigations, and specifically the 'impact assessment' of Port Qasim activities instead of cumulative impact assessment of all activities..
2	**Hydrodynamic modelling:** Representatives from the NIO stated that they are currently working on hydrodynamic modelling for some of the creeks in the Indus Delta and are open to discussion on modelling efforts. The WWF stated that there is a lot of potential for hydrodynamic modeling and that this needs to be related to the productivity of the system.	National Institute of Oceanography, WWF-P	Noted

No.	*Issues, Comments and Suggestions*	*By*	*Responses and Explanations*
3	**Mobility of fishermen:** Ghulam Hussain Channa, from the Sindh Fisheries Department, stated that the local fishermen from Lath Basti and Rehri Goth are facing problems due to the development of industrial infrastructure pertaining to FOTCO and the LPG terminal. They stated that the movement of approximately 1500 boats is being hindered due to the building of bridges. They also stated that dumping and dredging are adversely affecting the local communities. In addition to this they highlighted that the smaller boats are facing problems due to the traffic of larger ships and container vessels. With respect to the mangroves they stated that these have been cut for the building of three bridges and no replantation has been done to their knowledge.	Sindh Fisheries Department	The FOTCO representative stated that FOTCO has a mangrove farm. However, the Sindh Fisheries Department was concerned that the mangroves being planted are not successful. Rab Nawaz representative, stated that there needs to be a system for regulating the planted mangroves, and there was general agreement on this within the stakeholders.
4	**Air Pollution:** The Engro representative expressed concern on the ash storage and disposal related issues at Port Qasim given a number of upcoming power plant developments.	Engro	HBP representatives highlighted that this is an issue that needs to be addressed as part of the project-specific EIA. They also highlighted that the issue of ash disposal, given Government policy to introduce coal-fired power plants in Pakistan, needs to be addressed at the strategic level through SEPA; this aspect is specifically outside the scope of the CIA.
5	**Land reclamation:** The representative from the Institute of Marine Sciences stated that certain authorities, namely DHA, are involved in land reclamation and that clearing of mangroves for this purpose has not been compensated for by the strategy of replantation, by any ratio (typically 1:5).	Institute of Marine Sciences	The issue of land reclamation has been highlighted by multiple stakeholders. The Environmental Committee (if set up) and collaborate management proposed as part of the Study can be used to tackle the issue of unregulated land reclamation.

No.	*Issues, Comments and Suggestions*	*By*	*Responses and Explanations*
6	**Disagreements with the replantation strategy:** A number of stakeholders including the Institute of Marine Science and the Sindh Fisheries Department and the WWF were of the opinion that the current replantation strategy of planting 5 mangroves for every 1 cut down is ineffective. In particular they highlighted that the time lag to functioning of the replanted mangroves as a proper ecosystem. This led to the suggestion by the Sindh Fisheries Department that the plantations need to carried out in advance as the loss of mature trees cannot be compensated for by the presence of seedlings.	Institute of Marine Sciences, Sindh Fisheries Department, WWF	**Summary of suggested conservation measures for mangroves:** The conservation measures for mangroves were discussed among the stakeholders and summarized as follows: • Preservation of mangrove forests • 1:5 Plantations • Transparency is required • Effort to cover as much empty mud flat habitat as possible • More legal regulation for mangrove cutting • The need to find compensation measures and take productivity of the mangroves into consideration • The need for planting to be done in advance • The raising of awareness is important • Industrialists need to be compelled to establish water treatment plants so that polluted water is not released into the mangrove ecosystem
7	**Other issues with mangroves:** Representatives from the Institute of Marine Sciences were concerned that there is no enforcement of a punishment for the cutting down of mangroves.	Institute of Marine Sciences	Noted
8	**Involvement in studies:** Representatives from academic institutions stated that academia need to be involved in the studies being carried out on the ecosystem and its components.	Institute of Marine Sciences	Noted

No.	*Issues, Comments and Suggestions*	*By*	*Responses and Explanations*
9	**Dredging, Accretion and the need for Coastal Engineering:** Dredging and accretion were highlighted as major issues by the Institute of Marine Sciences. The WWF representative suggested the need for coastal engineering. WWF representatives also highlighted that the impact of shipping on marine fauna is an area that requires further study.	WWF	The aspect of hydrodynamic modelling is already recommended in the CIA. With respect to the marine fauna, this was not identified as VEC for the Port Qasim Study for a number of reasons (see No 1).
10	**Planned conveyer belt:** Representatives of the food industry, namely Karachi Grains, were concerned about the planned conveyer belt for coal transportation between PIBT and the railway mainline. They stated the possibility of pollution of food products is a very serious risk. HBP representatives stated that the design of this conveyer belt is not yet finalized. However, it is likely that it will be closed. HBP representatives also stated that the zoning plan in PQA needs to be addressed further.	PIBT	Specific project aspects are not part of a CIA, as this is VEC-centered. A separate meeting was also set up with Karachi Grains.

No.	*Issues, Comments and Suggestions*	*By*	*Responses and Explanations*
11	**Development related concerns:** The representatives of Karachi University stated that in view of the development being carried out, academia need to produce research and other material in order to have some beneficial effects for the area. He stated that this ecosystem was once very rich but has become increasingly fragile since industrial development. He highlighted that highest priority needs to be given to the locals and their livelihoods. The representative from Karachi University was of the opinion that the results of fish surveys carried out by the FAO are unlikely to show positive results with respect to ecology. He further stated that he had observed dolphins in the area on numerous occasions and in relatively large groups. He also highlighted that there is marine life in the area that has not yet been explored. Finally he stated the all developers should adopt best practices, build capacity for regulation and be involved in green branding. The release of chromium from tanneries was highlighted as an important issue.	Karachi University	The representative from Engro stated that the International Finance Corporation (IFC) has relatively high standards for environmental protection and that developers in the area should aim to achieve at least partial compliance with these standards. The IFC representative stated that the organization only has leverage with companies it invests in, not in the other organizations.
12	**Vulnerability Indices:** It was suggested the vulnerability indices, like that used in the social assessment, also be used for assessing ecology and physical factors.	Institute of Marine Sciences	This is carried out as part of the CIA study, as it does target VECs, however with respect to those aspects that are vulnerable to activities by PQA, such as water quality and air quality, or other ecological aspects such as species of concern.

Exhibit C.2: Log of Discussion on Management

Workshop Session	Discussion on Management Measures
Date:	16 February 2016
Time:	9 30 am to 5 pm
Meeting Venue:	Avari Hotel, Karachi
HBP Representatives	Vaqar Zakaria, Hussain Ali
IFC Representative	Larry Jiang
PQA Representative	Shabbir Qazi
Conducted by:	Vaqar Zakaria, Shabbir Qazi
Recorded by:	Hussain Ali
Reviewed by:	Bilal Khan
Language:	English

No.	*Issues, Comments and Suggestions*	*By*	*Responses and Explanations*
1.	Administration of proposed Environmental Management Plan is fine but legal issues have to be evaluated so other stakeholders need to be on board too.	PQA	
2.	The recognition of the environmental committee needs to be clarified in this session. How much money will be involved and the share industries are willing to pay?	HBP	QICT mentioned that they are already investing too much since 2008. They have reduced our carbon footprint by 15% by modifying our engines and are going on solar power.
3.	PQA is already charging the ships therefore we cannot impose any additional charges on ships as environmental fees. PQA needs to bring in legislative change and then we will be able to implement it.	QICT	PQA said that they do not recommend per ship increment with regards to financial competitiveness. The charge needs to be in some other form which needs to be discussed.
4.	I need a plan of expenditures that will be presented to the board of directors which will clarify how much money is needed and where it will be spent.	QICT	IUCN mentioned that in India (IUCN) all companies working in coastal areas give their 2% profit to CSR. This should be implemented in Pakistan too.
5.	Were these proposals discussed in PQA board of directors?	Engro	PQA mentioned that this forum is held to prepare a proposal to be submitted to PQA board. HBP mentioned that this was discussed in detail with the PQA Chairman and he is happy with PQA environmental improvement.
6.	The current environment is not deteriorating but it may spoil in future due to the prospects of new projects. We have treated our effluents to keep the environment clean so why should we pay for future developments?	QICT	HBP mentioned that port related issues cannot be addressed by industries so a centralized protection approach is important. The charges should be collected by PQA, the impact on land charges will be very small and major portion of the charge will go to shipping charges.
7.	Pooling in centralized fund will vary from company to company. The simplest idea is a small proportional increase in terminal handling charges.	QICT	PQA mentioned that they will lead the funds but cannot increase the tariffs to stay financially competitive. Industries can contribute by sharing a portion of their CSR to raise the environmental fund. We have been asked by the federal government to reduce the tariff. Increment of tariff will not be allowed by the federal government.

No.	*Issues, Comments and Suggestions*	*By*	*Responses and Explanations*
8.	Gulpur Hydropower Project had environmental cost added in their NEPRA tariff. 0.3% tariff was increased and environmental cost was transferred to consumers. Government wanted to take it out of the company's profit but was refused by the company.	HBP	HBP mentioned that internationally environmental funds come out of consumers. KPT and Gwadar should also have similar environmental charges.
9.	A large financial value of the ecosystem is provided by the mangroves, so protecting them is important. A biogas fuel plant can be set up to recycle the waste from Bhains Colony.	WWF	Suggestion documented for PQA.
10.	We were not properly consulted for this project. PQA has not been audited properly for the past 5 years, the finances are not clear and they have been charging us double. We do not trust PQA to handle finances of the environmental fund.	BQATI	HBP mentioned that a dedicated session on management for industries and BQATI was arranged and BQATI did attend a consultation session for this. Industries will have representation in the environmental committee which will decide where the money will be spent.
			PQA said that BQATI have this opportunity to make decisions with PQA and share accounts with PQA and that planning can be done together.
11.	If a terminal operates and BQATI wants to constitute a committee, we are happy to do it. We have a marine pollution control department at KPT and PQA should also make something similar. We have certifications of quality, we have nursery of mangroves, labs, departmental managers pollution control officers etc. We have fines at KPT for those who violate and cause marine pollution. We are compromising trade for the betterment of the environment.	KPT	HBP said that KPT is 125 years old and realized importance of the environment when it was quite late. PQA is a young port and they should realize the importance of environment at an earlier stage.
12.	Port Qasim has been damaging local communities since many years. FOTCO jetty and bridge have obstructed fishing routes. They had given us assurances that alternate path will be given to us but nothing like this has ever happened. FOTCO oil has leaked and the fish population was damaged.	Sindh Fisheries	PQA said that specific issues will be resolved through proper planning.

No.	*Issues, Comments and Suggestions*	*By*	*Responses and Explanations*
13.	A workable solution should be developed and a way to move forward should be worked out. We have 80% edible oil industries in PQA and the construction of coal conveyor belt will be harmful for us so we are concerned about this project.	Karachi Grains	HBP mentioned that conveyor belt will be constructed as per JICA guidelines. Therefore, international standards will be placed. Capacity needs to be built at PQA to analyze EIAs and protect the environment.

D.4 Socioeconomic Survey Plan

A socioeconomic survey will be conducted to develop socioeconomic baseline of the Socioeconomic Study Area. The Socioeconomic Study Area with administrative boundaries (Union Councils[3]) is shown in **Exhibit D.1** below.

The Socioeconomic Study Area includes:

- Communities that could be impacted by the Developments at Port Qasim, or
- Communities that could be impacted by changes to the mangrove ecosystem within the Port Qasim Notified Area as a result of the Developments.

The Socioeconomic Study Area is divided into the following general Socioeconomic Zones[4] (see **Exhibit D.1**).

- Fishing communities
- Non-fishing communities
- Urban communities
- Planned housing schemes
- Fishing/Agriculture Communities

Specifically with respect to the Ecosystem Service Review (ESR), the communities that are considered most vulnerable and to have high dependence on ecosystem services derived from the mangrove ecosystem include:

- Fishing communities (e.g. Ibrahim Hyderi, Rehri Goth, Latt Basti)
- Communities of Gharo-Dhabeji-Area

With respect to development related changes to demographics, dependence on PQA area for employment, reliance on ecosystem services offered by PQA creeks and possible deterioration in health and safety of the communities due to development related changes in air and water quality, the following zones are of relevance:

- Urban communities
- Planned housing schemes

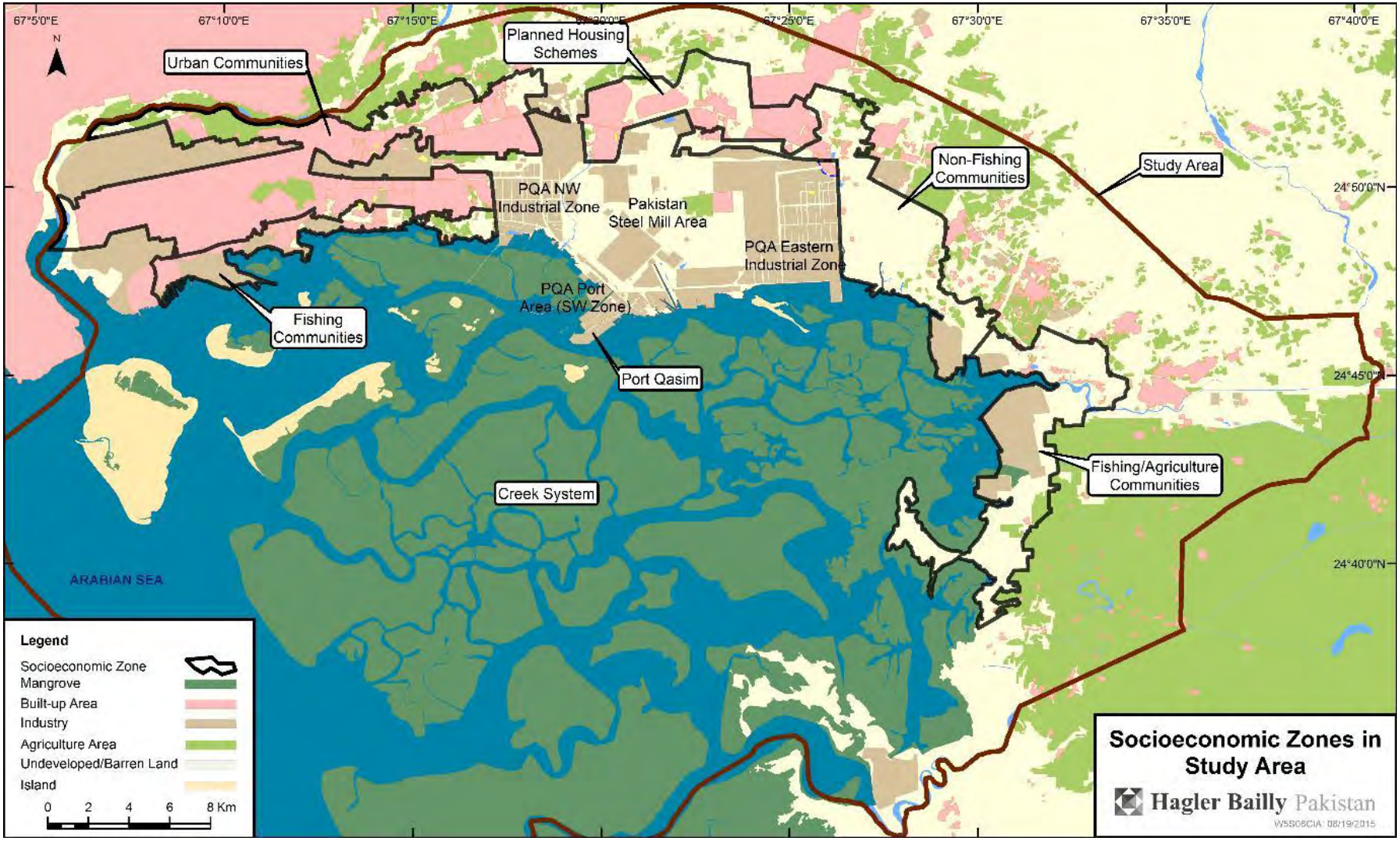
With respect to additional communities that may be impacted by the Development at Port Qasim, and have reliance on Port Qasim industrial and commercial zones as source of livelihood (wage labor or permanent employment), the "**non-fishing communities"** are of relevance.

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[3] A sherwan or union council in Pakistan is an elected local government body consisting of 21 councilors, and headed by a nazim (which is equivalent to a mayor) and a naib nazim (deputy). Union councils are the fifth tier of government in Pakistan and are often known as village councils in rural areas, the territory represented by a village council usually comprises a large village and surrounding areas, often including nearby small villages.

[4] Note that some overlap between zones occurs; however these are defined for convenience.

Exhibit D.1: Socioeconomic Study Area



D.4.1 Objectives

The objectives of the socioeconomic surveys are to:

- Strengthen the socioeconomic profile[5] for the Study Area as they act as a key tool to understand and determine the exiting socioeconomic conditions of the communities residing in the Study Area.Gather information on the community dependence on ecosystem services and their vulnerability to change in ecosystem services. This will be utilized to strengthen the Ecosystem Service Review.
- Verify information, obtained using focus group discussions, on the perception of Beneficiaries towards ecosystem services and changes to it.
- Gather information on the baseline status of livelihoods associated with ecosystem services that have been identified as a Valued Environmental and Social Component (VEC) (see **Section 5.3.1** for details). These baseline status act as a benchmark for the monitoring of biophysical environment in PQA Area during developmental activities

D.4.2 Methodology

The socioeconomic survey will be conducted to collect settlement and household level data on the prevailing socioeconomic conditions of the Socioeconomic Study Area. The findings of the survey will be used to develop a socioeconomic baseline as well as to assess the vulnerability of the subject population.

D.4.2.1 Settlement Level Socioeconomic Surveys

The survey will be conducted at two different levels, including household and settlement-level. The household level surveys will help identifying the household level incomes, allied sources of income in households, household expenditures and household level income and debt rations, while the settlement. The settlement level survey will be implemented in demarcated settlement clusters in the Socioeconomic Study Area. The demarcated settlement clusters within the Socioeconomic Study Area are presented on a map provided in **Exhibit D.2**, while list of the settlements within each cluster is provided in **Exhibit D.3**.

The settlement clusters have been demarcated on the basis of the following:

- Population and size of settlements;
- Union council boundaries;
- Proximity of villages;
- Dependence on ecosystem services; and
- Zoning shown in **Exhibit D.1**.

[5] The socioeconomic profile (see **Section 6**) was developed using information HBP has collected for ESIAs for developments in Port Qasim as well as secondary literature.

The scope of the surveys will include:

- Characterization of the type of jobs related to the ecosystem service
- Characterization of natural resource use (e.g. fish, crab, prawn, fodder, fuel wood) and the percentages sold commercially and used for subsistence.
- Determination of sources of income, and variations to incomes (seasonal as well as the difference between good and bad years), and alternative incomes
- Characterization of "absolute vulnerability" through survey on 'diversity of income', 'access to healthcare', ' access to education', 'dependence on wage labor', 'debt and loans" and access to facilities', 'assets (including typical changes and temporal variations)
- Perceptions and vulnerability to changes in ecosystem services

HBP intends to include between 4 and 5 key informants in settlement-level surveys for each of the 15 settlement clusters (see **Survey Plan** for details). These will include, where possible, the following:

- Union Council heads
- Educated persons (with Higher School Certificate as minimum level of education attained)
- School teachers
- Tribal leaders
- Fishermen
- Local government representatives

D.4.2.2 Household Surveys

- Within the settlements that have reliance on ecosystem services ("Fishing Communities" and "Communities of Gharo–Dhabeji Area") derived from the mangrove ecosystem household level surveys will be conducted to corroborate and cross check information obtained from key informants at the settlement level.
- Within the "non-fishing" communities both settlement and household level surveys will be carried out. While the characterization of incomes and sources will be the same as for "Fishing and Fishing/Agriculture Communities", any impact on these communities associated with the developments at Port Qasim or other associated developments will be of relevance.
- Within the settlements that are related to Port Qasim, i.e. "Urban Communities" and "Planned Housing Schemes" for employment or ecological ecological resource use purposes, characterize the general socioeconomic profile including the population, sources of income, diversity of income, and dependence on ecosystem services. Since these communities are not considered vulnerable, or are found to be dependent on Port Qasim for either employment or ecosystem services a field assessment during surveys will be made to determine whether a household level survey is needed in these areas.

- The household survey will cover 3–5 households per cluster depending upon the size and population of marked cluster. Given budget and time limitations, and the size of the area being covered in the socioeconomic surveys, HBP does not intend to carry out statistically representative sampling of households. Nonetheless, random household sampling and surveys will be conducted for a limited number of households before carrying out the settlement-level surveys to corroborate and cross check information obtained from key informants.

D.4.2.3 Survey Plan

Household and settlement-level surveys will be conducted in the Socioeconomic Zones of the Study Area (see **Exhibit D.1**). The household survey will be conducted prior to the settlement survey. The information collected during household survey will be validated during the settlement survey. Survey questionnaires for both these are attached as **Appendix D.4** and **Appendix D.5** of the main report respectively.

A pilot survey will be conducted before implementing formal socioeconomic surveys for the study to help ensure the forms are correctly designed and include sufficient socioeconomic aspects to establish the socioeconomic profile and conduct vulnerability assessment for the Study Area.

Settlement clusters numbers 5–8 (Urban Communities), (see **Exhibit D.2** and **Exhibit D.3**) and Bengalis SO Quarters from cluster 1a will not be surveyed due to security issues. In addition, the residents of these clusters, during scoping consultations, were reported to be not dependent upon PQA area for employment or ecological resource use purposes. These Urban Communities of the Study Area are reliant upon Korangi and Landhi Industrial Areas, Karachi city and Export Processing Zone for employment.

Also, socioeconomic data of settlements clusters 2d and 2e will not be recorded as respondents from these refused to be communicate with the survey team during stakeholder consultation carried out for preliminary ESR.

The tentative schedule for the surveys is the last week of July and first week of August (July 30 to August 08, 2015). The survey schedule along with the zone, cluster number, settlement name, and household sample size for each cluster is provided in **Exhibit D.4**. The surveys will be conducted by HBP. The activities along with assigned responsibilities to each team member are provided in **Exhibit D.5**.

Exhibit D.2: Settlement Clusters in Socioeconomic Zones

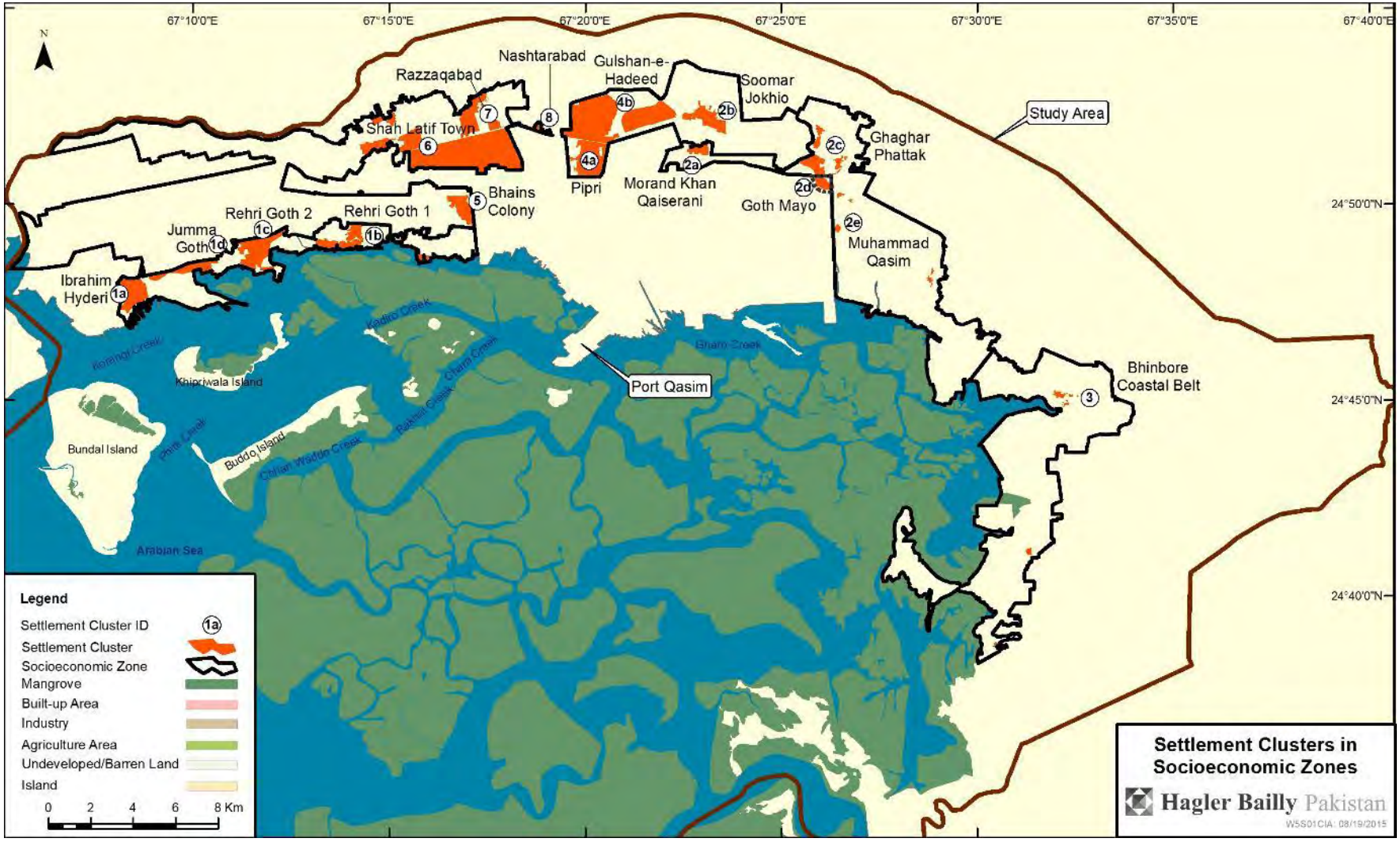


Exhibit D.3: Clusters and their Associated Settlements

Zone	*Cluster Number*	*Cluster Name*	*Settlements within Cluster*	*Union Council*
Fishing Communities	1a	Ibrahim Hyderi	Ibrahim Hyderi	UC 1 - Ibrahim Hyderi
			Charan Para	UC 1 - Ibrahim Hyderi
			Bangalies (SO Quarters)	UC 1 - Ibrahim Hyderi
	1b	Rehri Goth 1	Bakhtwar Goth	UC 2 - Rehri Miani
			Rehri Goth	UC 2 - Rehri Miani
			Latt Basti	UC 2 - Rehri Miani
	1c	Rehri Goth 2	Chasma Goth	UC 1 - Ibrahim Hyderi
			Ali M Brohi Goth	UC 1 - Ibrahim Hyderi
			Ali M Khaskheli Goth	UC 1 - Ibrahim Hyderi
	1d	Juma Goth	Juma Goth	UC 1 - Ibrahim Hyderi
Non-Fishing Communities	2a	Morand Khan Qaiserani	Morand Khan Qaiserani	UC 6 - Gulshan - Hadeed
	2b	Soomar Jokhio	Soomar Jokhio	UC 6 - Gulshan - Hadeed
	2c	Ghaghar Phattak	Haji Ghulam Muhammad	UC Dhabjei
			Mir Khan Baloch	UC 7 - Ghaggar
			Pir Bukhsh	UC 7 - Ghaggar
			Humar Khan	UC 7 - Ghaggar
			Haji Jhangi Khan	UC 7 - Ghaggar
			Haji Ibrahim Goth	UC 7 - Ghaggar
			Haji Khan Zohrani	UC 7 - Ghaggar
	2d	Goth Mayo	Goth Mayo	UC 7 - Ghaggar
	2e	Muhammad Qasim	Muhammad Qasim	UC Dhabjei
			Ameen Muhammad Baloch	UC Dhabjei
			Allah Dino	UC Dhabeji
Fishing/Agriculture Communities	3	Bhambore Coastal Belt (Gharo-Dhabeji Area)	Goth Karam Ali Baloch	UC Dhabjei
			Goth Ismail Katiyar	UC Dhabjei
			Goth Allah Dino Sheikh	UC Dhabjei
			Goth Haji Natho	UC Dhabjei
			Goth Mohsin Khaskheli	UC Dhabjei
			Goth Abdul Ghani Baloch	UC Dhabjei
			Hashim Mirbehar	UC Dhabjei
Planned Housing Schemes	4a	Pipri	Shahnawaz Goth	UC 6 - Gulshan - Hadeed
			New Allah Bakhsh Goth	UC 6 - Gulshan - Hadeed
			Mureed Gabol Goth	UC 6 - Gulshan - Hadeed
			Khuda Bakhsh Goth	UC 6 - Gulshan - Hadeed
			Ali Muhammad Jokhio	UC 6 - Gulshan - Hadeed

Zone	*Cluster Number*	*Cluster Name*	*Settlements within Cluster*	*Union Council*
			Goth	
			Ali Bakhsh Baloch Goth	UC 6 - Gulshan - Hadeed
			Suffan Gabol Goth	UC 6 - Gulshan - Hadeed
			Dur Muhammad Goth	UC 6 - Gulshan - Hadeed
			Muhammadi Colony	UC 6 - Gulshan - Hadeed
			Pathan Goth	UC 6 - Gulshan - Hadeed
			Naseerabad	UC 6 - Gulshan - Hadeed
			Allah Bakhsh Goth	UC 6 - Gulshan - Hadeed
	4b	Gulshan-e-Hadeed	Gulshan-e-Hadeed	UC 6 - Gulshan - Hadeed
			Steel Town	UC 6 - Gulshan - Hadeed
Urban Communities	5	Bhains Colony	Bhains Colony	UC 3 - Cattle Colony
	6	Shah Latif Town	Shah Latif Town	UC 5 - Landhi
			Goth Shafi Muhammad	UC 4 - Qaidabad
			Yousaf Goth	UC 5 - Landhi
			Saleh Muhammad	UC 4 - Qaidabad
			Abdullah Goth	UC 5 - Landhi
	7	Razzaqabad	Razzaqabad	UC 5 - Landhi
	8	Nashtarabad	Nashtarabad	UC 5 - Landhi

Exhibit D.4: Survey Schedule

Zone	*Cluster Number*	*Cluster Name*	*Settlements within Cluster*	*Planned Survey Date*
Fishing Communities	1b	Rehri Goth 1	Pilot Survey	July 30, 2015
Fishing Communities	1a	Ibrahim Hyderi	Ibrahim Hyderi	July 31, 2015
			Charan Para	
			Bangalies (SO Quarters)	
	1b	Rehri Goth 1	Bakhtwar Goth	August 01, 2015
			Rehri Goth	
			Latt Basti	
	1c	Rehri Goth 2	Chasma Goth	
			Ali M Brohi Goth	
			Ali M Khaskheli Goth	
	1d	Juma Goth	Juma Goth	August 02, 2015

Zone	*Cluster Number*	*Cluster Name*	*Settlements within Cluster*	*Planned Survey Date*
Non-Fishing Communities	2a	Morand Khan Qaiserani	Morand Khan Qaiserani	
	2b	Soomar Jokhio	Soomar Jokhio	August 03, 2015
	2c	Ghaghar Phattak	Haji Ghulam Muhammad	August 04, 2015
			Mir Khan Baloch	
			Pir Bukhsh	
			Humar Khan	
			Haji Jhangi Khan	
			Haji Ibrahim Goth	
			Haji Khan Zohrani	
Fishing/Agriculture Communities	3	Bhambore Coastal Belt (Gharo-Dhabeji Area)	Goth Karam Ali Baloch	August 05, 2015
			Goth Ismail Katiyar	
			Goth Allah Dino Sheikh	
			Goth Haji Natho	
			Goth Mohsin Khaskheli	
			Goth Abdul Ghani Baloch	
			Hashim Mirbehar	
Planned Housing Schemes	4a	Pipri	Shahnawaz Goth	August 06, 2015
			New Allah Bakhsh Goth	
			Mureed Gabol Goth	
			Khuda Bakhsh Goth	
			Ali Muhammad Jokhio Goth	
			Ali Bakhsh Baloch Goth	
			Suffan Gabol Goth	
			Dur Muhammad Goth	
			Muhammadi Colony	
			Pathan Goth	
			Naseerabad	
			Allah Bakhsh Goth	
	4b	Gulshan-e-Hadeed	Gulshan-e-Hadeed	August 07, 2015
			Steel Town	

Exhibit D.5: Activities and Responsibilities

Activity	*Responsibility*
Coordination	M Salman Ahmed
	Waris Ali
Pilot survey	Bilal Khan
	M Salman Ahmed
Data collection	M Salman Ahmed
	Waris Ali
Female consultations (additional) and family profiles	Mehrunisa Malik
Data entry	M Salman Ahmed
	Waris Ali
Data Q/C	Mehrunisa Malik
Field and logistic assistance	Waris Ali

D.4.3 Household Questionnaire

Investigator		Settlement	
Coordinates			
Head of Household (HoH)		Respondent	
Relation of Respondent to HoH			
Contact number			

Tenurial Status Owner ☐ Tenant ☐

Codes

Household	A household may be either a single person or a multi-person household. Household members may be related or unrelated and essentially include people who make common provisions for food and other essentials of living and have no usual place of residence elsewhere		
Gender	**M** = Male	**F** = Female	
Marital Status	**MR** = Married	**UM** = Unmarried	
Education Grade or Level	**UE** = Uneducated **SE** = Secondary (6 to 10) **MA** = Masters (15 and 16)	**MD** = Madrassah **IN** = Intermediate (10 to 12) **AM** = Above Masters	**PR** = Primary (1 to 5) **CL** = College (13 and 14)
Employment Status	**E** = Employed **N** = Non-employed willingly. Is a jobless person not seeking job **S** = Student	**U** = Unemployed is a person seeking job since a month and is unable to find it	
Employment Type	**G** = Government servant	**P** = Private or non-governmental	**O** = Working overseas

Types of Occupations	
FIS	Catch and sale of fish, crabs or shrimp
FIL	Labor services for catching and selling of fish
FIP	Processing of fish, crab or shrimp
BBR	Boat building/repair
FNM	Fishing net making/repair
HON	Honey making and selling
PQA	Employed in PQA area
FOD	Selling fodder
FOR	Cutting and selling wood
TOU	If a person earns by providing tourism related services, such as, tourist's guide in mangroves, fishing guide. **Specify tourist service.**
FAR	Farmer who is land owner, is farming on his own land and earning income by selling farm produce
FAL	Farm labor is paid wages for helping the farmer
FAS	Sharecropper has a share in the crop in return for services on the farm
LIV	Livestock farmer who is owner of livestock and is earning income by selling livestock produce or animal
OLB	Other daily wage labor such as well digger, bricklayer. **Specify type of labor work.**
TRB	If a person earns through trade business. **Mention type of goods traded**
ART	Artisan makes and/or sells handicrafts, such as, carpet weaving, clothes
BUS	Business Owner
SHK	Shopkeeper
SER	If a person is providing a service against a type of skill such as drivers, electricians, plumbers, mechanics, office peons, military, police, teacher. **Specify type of service.**
OTH	Other. **Specify type of work.**
Non-Income Generating Activities (Subsistence)	
S-FAR	Farmer is farming on his own land for the consumption of his own household
S-LIV	Livestock farmer is rearing livestock for the consumption of his own household
S-FIS	Catching fish for the consumption of his own household.

Household Profile

Use multiple rows where a household members has multiple occupations

No.	Relation to Head of Household	Age	Gender (M/F)	Marital Status (MR/UM)	Education		Income Earning Activities					Indicate if member also engaged in any subsistence activity – provide code from list
					Attending school (Yes/No)	Grade or Level Attained	Employment Status (E, U, N, R, S)	Employment Type (G, P, O)	Type of occupation – provide code from list	Income (PKR) *specify if daily, monthly or annual*	Work duration (days, months) *to calculate total annual income*	

No.	Relation to Head of Household	Age	Gender (M/F)	Marital Status (MR/UM)	Education		Income Earning Activities					Indicate if member also engaged in any subsistence activity – provide code from list
					Attending school (Yes/No)	Grade or Level Attained	Employment Status (E, U, N, R, S)	Employment Type (G, P, O)	Type of occupation – provide code from list	Income (PKR) *specify if daily, monthly or annual*	Work duration (days, months) *to calculate total annual income*	

If any household member(s) is involved in fishing (fish, crab, shrimp) for subsistence purposes or as a source of income, please provide the below information

Provide distribution of catch by fish/crab/shrimp species

In Mangroves

Fishing days per month _____

Species	*Peak Season (Months)*	*Total Catch Per Day in Peak Season (Kg)*	*Unit Price of Catch in Peak Season (Rs/Kg)*	*Total Catch Per Day in Off Season (Kg)*	*Unit Price of Catch in Off Season (Rs/Kg*	*Total Catch Per Year*

In Open Sea

Fishing days in month _____

Species	*Peak Season Month*	*Total Catch Per Day in Peak Season (Kg)*	*Unit Price of Catch in Peak Season (Rs/Kg)*	*Total Catch Per Day in Off Season (Kg)*	*Unit Price of Catch in Off Season (Rs/Kg*	*Total Catch Per Year*

If you sell fish/crab/shrimp, then specify business (hotel/market) and its location:

Sold To (hotel, market, etc.)	*Location*	*Specify: Fish, Crab or Shrimp*	*Distance (from landing point) km*	Mode of Transport (suzuki pick-up, personal transport)

Provide information about the equipment you use for fishing (boats, nets, ice-boxes, rods etc.). Specify if it is yours, rented or shared, and how much of its use is for fishing against other activities. Specify how long does it last and what is its present cost to replace.

Equipment	*Number*	*Ownership*	*Equipment use for fishing (%)*	*Durability (years)*	*Cost of New*

If any household member(s) is involved in processing of fish, crab or shrimp as a source of income, please provide the below information

Specify: Fish/Shrimp/Crab	*Activity*	*kg/month*	*Price/kg*	*Selling to (Market, Hotel, Other)*

If any household member(s) is involved in boat making/repair as a source of income, please provide the below information

Type of boat	*Activity (Making, Repair)*	*No. of boats made/repaired annually*	*Average income/boat*
Fishing			
Recreational			
Other			

If any household member(s) is involved in fishing net making/repair as a source of income, please provide the below information

Activity	*No. of nets made/repaired annually*	*Average income/net*
Net Making		
Net Repair		

If any household member(s) is employed in tourism activities (fishing guide for tourists, tourist visits to mangroves), then please provide the below information for the last year

	Summer	*Winter*
Number of tourists taken		
Number of days guiding		
Income per day		
Expenditure per day		

If any household member(s) is involved in wood cutting for household use or selling as a source of income, please provide the below information

Type of wood cut	*Season*	*WWood cut/month (kg)*	*Proportion self consumed (%)*	*Price/KG*	*Wood sold to (market, houses, other)*
Mangrove					
Mesquite					
Other					

Please specify if mangrove wood is purchased from market Yes/No

If yes, please provide details (rates, seasons etc.) _____

If any household member(s) is involved in fodder collection for subsistence or selling as a source of income, please provide the below information

Source	*Collection /month (kg)*	*Proportion self consumed (%)*	*Price/KG*	*Fodder sold to (market, houses, other)*
Mangrove				
Mesquite				
Other				

Please specify if mangrove is purchased as fodder from market Yes/No

If yes, please provide details (rates, seasons etc.) _____

If any household member(s) is involved in honey making and selling a source of income, please provide the below information

Source	*Production/month (kg)*	*Season (months when honey is produced)*	*Price/kg*
Mangrove (wild)			
Bee farm			
Other			

If any household member(s) is involved in wage labour as a source of income, please provide the below information

Household Member (self, son, wife etc.)	*Duration*	*Location*
	☐ Daily ☐ Weekly ☐ Monthly	☐ Inside Village ☐ In PQA Area ☐ Outside PQA Area
	☐ Daily ☐ Weekly ☐ Monthly	☐ Inside Village ☐ In PQA Area ☐ Outside PQA Area
	☐ Daily ☐ Weekly ☐ Monthly	☐ Inside Village ☐ In PQA Area ☐ Outside PQA Area
	☐ Daily ☐ Weekly ☐ Monthly	☐ Inside Village ☐ In PQA Area ☐ Outside PQA Area

If any household member(s) has identified themselves as a farmer (income or subsistence), please provide the below information

Total land cultivated (specify unit): _____

Is the land: ☐ Self-Owned ☐ Sharecropping

What proportion is cultivated in a year? _____

Provide information on cultivated land by crop type (for last one year):

Crop name	*Season (Summer/ Winter)*	*Production (specify unit)*	*Unit price (PKR)*	*Self Consumption (%)*

If any livestock is owned by the household, please provide the below information

Items	*No. Owned*	*Value per unit (PKR)*
Bullock/Buffalo		
Cow		
Goat		
Sheep		
Donkey		
Horse		
Camel		
Poultry		
Other, specify below		
_____		
_____		
_____		

What is the source of fodder for the livestock?

☐ Mangroves ☐ Bought from market ☐ Other _____

Please provide the cost if purchased from market (per unit price) _____

Please provide the cost if mangroves is purchased as fodder from market (per unit price) _____

Do you practice open grazing for the livestock? ☐ Yes ☐ No

Location ☐ Mangroves ☐ Other _____

Household Expenditures and Savings

Major Household expenditures in the last year

Expenditure Heads	*Total Expenditure per Month (in PKR)*	*Comments*
Food		
Health		
Education		
Transportation		
Rent, if any		
Electricity		
Gas		
Others		

Have you obtained any loans during the last year? ☐ Yes ☐ No

Source	*Amount (PKR)*	*Amount Paid Back (PKR)*	*Purpose*	*Comments, if any*
Outstanding debt				
1. Institutional (e.g. ADBP)				
2. Friends/relatives				
3. Moneylender				
4. Shopkeeper				
5. Others _____				

Do you have any savings? ☐ Yes ☐ No

Source	*Value*
Monetary savings	
Jewelry	

Fuel

What type of fuel do you use for cooking and heating?

☐ Wood ☐ LPG ☐ Piped Gas Supply ☐ Electricity ☐ Other

If using wood, please provide the below information

Source	*Method obtained (cut directly, bought from market)*	*Usage/month (KG)*	*Per Unit Price (PKR)*
Mangrove			
Mesquite			
Other			

Vulnerability Matrix

Based on the information collected above and additional information where required, classify the household on the vulnerability matrix

	Vulnerability Assessment at Household Level					
	Level 1	*Level 2*	*Level 3*	*Level 4*	*Level 5*	*Level 6*
Wage labor	Does labor work round the year / gets employment for only 5-10 days / month	Does labor work for 8-10 months / gets employment for 15 days / month	Does labor work 5-6 months/ gets employment for 20 days/ month	Does labor work 2-3 months/ gets employment for 25 days / month	May do labor work for 1-2 months in a year, when they require it.	No need for them to do wage labor, rather they hire others
Fishing Activities	Fish catch not sufficient even for household consumption	Fish catch sufficient only for household consumption	Sells 25% of the fish catch, rest consumed by household	Sells 50% of the fish catch, rest consumed by household	Sells 75% of the fish catch, rest consumed by household	Sells more than 90% of the fish catch, rest consumed by household
Allied sources of income	No knowledge	Only fishing/ wage labor	Fishing/ wage labor & some livestock/agriculture-based income generating activities	Good Fishing, and wage labor	Good fishing & own business	Hires out boats; Owns fishing/other business that employs others
Child Labor	Boys as well as girls above the age of 8 work outside	All boys above the age of 8 work outside	The oldest boy child (<15 yrs) works outside	Boy works at distance from home and daughter who is 15+ works close to home	No child labor	Daughter works as a teacher/nurse/ beauty parlor helper because she wants to
Percentage of Income Divided by Loan	Below 10%	Between 10% to 20%	Between 20% to 30%	Between 30% to 40%	Between 40% to 50%	More than 50%
Debt/Loan facility	No one gives them loan	Continuously in debt from local money lender who lends at very high interest rate	Frequesnt borrowing from moneylender at high interest rate;	Occasional borrowing from moneylender at high interest rate;.	Gets loan easily from relatives/ shopkeeper at 0% interest p.a.	No need for loan, in fact give loan to others
Saving	No knowledge	No saving	Savings spent	Saved some money	Save small amounts on a regular basis	Savings placed in bank account for safe keeping
Jewellery	No jewellery	Sold jewellery	Some silver jewellery	More silver jewellery (medium sized)	Plenty silver jewellery (heavy sized)	Owns silver and gold jewellery

	Vulnerability Assessment at Household Level					
	Level 1	*Level 2*	*Level 3*	*Level 4*	*Level 5*	*Level 6*
Household assets	No appliances	One fan	Several fans	TV	TV and washing machine	TV, washing machine, and refrigerator
Transportation	Almost always use public transport; cannot afford hiring private transport	Occasionally use rented transport (taxi, car)	Use rented transport about 25% of the time	Use rented transport about 50% of the time during emergency and need	Have motorbike and use rented vehicles during emergency and need	Have own transport such as motorbike or can which can be used during emergency and need

D.4.4 Settlement Level Questionnaire

Investigator		Settlement	
Coordinates			
Village Represented			
Key Informant 1		Contact No.	
Key Informant 2		Contact No.	
Key Informant 3		Contact No.	
Key Informant 4		Contact No.	
Key Informant 5		Contact No.	

Codes

Household	A household may be either a single person or a multi-person household. Household members may be related or unrelated and essentially include people who make common provisions for food and other essentials of living and have no usual place of residence elsewhere		
Gender	**M** = Male	**F** = Female	
Marital Status	**MR** = Married	**UM** = Unmarried	
Education Grade or Level	**UE** = Uneducated **SE** = Secondary (6 to 10) **MA** = Masters (15 and 16)	**MD** = Madrassah **IN** = Intermediate (10 to 12) **AM** = Above Masters	**PR** = Primary (1 to 5) **CL** = College (13 and 14)
Employment Status	**E** = Employed **N** = Non-employed willingly. Is a jobless person not seeking job **S** = Student	**U** = Unemployed is a person seeking job since a month and is unable to find it	
Employment Type	**G** = Government servant	**P** = Private or non-governmental	**O** = Working overseas

Types of Occupations	
FIS	Catch and sale of fish, crabs or shrimp
FIL	Labor services for catching and selling of fish
FIP	Processing of fish, crab or shrimp
BBR	Boat building/repair
FNM	Fishing net making/repair
HON	Honey making and selling
PQA	Employed in PQA area
FOD	Selling fodder
FOR	Cutting and selling wood
TOU	If a person earns by providing tourism related services, such as, tourist's guide in mangroves, fishing guide. **Specify tourist service.**
FAR	Farmer who is land owner, is farming on his own land and earning income by selling farm produce
FAL	Farm labor is paid wages for helping the farmer
FAS	Sharecropper has a share in the crop in return for services on the farm
LIV	Livestock farmer who is owner of livestock and is earning income by selling livestock produce or animal
OLB	Other daily wage labor such as well digger, bricklayer. **Specify type of labor work.**
TRB	If a person earns through trade business. **Mention type of goods traded**
ART	Artisan makes and/or sells handicrafts, such as, carpet weaving, clothes
BUS	Business Owner

SHK	Shopkeeper
SER	If a person is providing a service against a type of skill such as drivers, electricians, plumbers, mechanics, office peons, military, police, teacher. **Specify type of service.**
OTH	Other. **Specify type of work.**
Non-Income Generating Activities (Subsistence)	
S-FAR	Farmer is farming on his own land for the consumption of his own household
S-LIV	Livestock farmer is rearing livestock for the consumption of his own household
S-FIS	Catching fish for the consumption of his own household.

Key Informants

Name	*Village*	*Main Source of Income/Occupation*	*Monthly Income (PKR)*

Settlement Profile

Total Number of Households in the Settlement _____

Average Household size _____

What proportion of the households would you classify as poor (below poverty line[6])? _____%

Main sources of household income

Please provide the below information to identify the primary sources of household income in the settlement

Income source	*% of Households Primarily[7] Dependent*	*% of Households Involved*
Total Number of Households Involved in Fishing		
• Fishing (own boats) – Fish, Crab and Shrimp		
• Fishing (labour) – Fish, Crab and Shrimp		
Processing of fish, crab or shrimp		
Boat Building/Repair		
Tourism/Recreation in Mangroves		

6 Poverty line is defined as the per capita estimated minimum level of income needed to secure basic necessities of life. The World Bank poverty line currently lies at 1.25 Dollars ($) per capita per day.

7 More than 60% dependent

Income source	*% of Households Primarily[7] Dependent*	*% of Households Involved*
Net Making/Repair		
Wood cutting and selling		
Non-Fishing Wage labour		
Employment in PQA		

For fishing (fish, crab, shrimp), please provide the following information

Provide distribution of catch by fish/crab/shrimp species

In Mangroves

Fishing days in month _____

Species	*Peak Season Month*	*Total Catch Per Day in Peak Season (Kg)*	*Unit Price of Catch in Peak Season (Rs/Kg)*	*Total Catch Per Day in Off Season (Kg)*	*Unit Price of Catch in Off Season (Rs/Kg*	*Total Catch Per Year (Kg)*

In Open Sea

Fishing days in month _____

Species	*Peak Season Month*	*Total Catch Per Day in Peak Season (Kg)*	*Unit Price of Catch in Peak Season (Rs/Kg)*	*Total Catch Per Day in Off Season (Kg)*	*Unit Price of Catch in Off Season (Rs/Kg*	*Total Catch Per Year (Kg)*

Species	*Peak Season Month*	*Total Catch Per Day in Peak Season (Kg)*	*Unit Price of Catch in Peak Season (Rs/Kg)*	*Total Catch Per Day in Off Season (Kg)*	*Unit Price of Catch in Off Season (Rs/Kg*	*Total Catch Per Year (Kg)*

Fishing Area/Location frequented by fishermen from the settlement	*Distance from Settlement (km)*	*Specify Period when Fishing is not Carried out at the Location Identified*

Has there been any change in the fishing areas over the past 5 years? ☐ Yes ☐ No

If yes, give reasons: Tick all that apply

☐ Development of PQA ☐ Decrease in number of fish ☐ Other _____

Has there been any change in the fish catch over the past 5 years?

☐ Increased ☐ Decreased ☐ No Change

If decreased, give reasons why you think this has happened:

_____

Where is the fish, crab and shrimp catch sold commercially?

Sold To (hotel, market, etc.)	*Location*	*Specify: Fish, Crab or Shrimp*	*Distance (from settlement) km*

Has the catch being sold commercially changed in the past 5 years?

☐ Increased ☐ Decreased ☐ No Change

If it has increased or decreased, give reasons (eg. Less/more demand, prices etc.) _____

If any households are involved in non-fishing wage labour as their main source of income, please provide the below information

What type of non-fishing labour is provided?

Type of Labour	*Proportion of HHs Providing Wage Labour %*
Daily	
Weekly	
Monthly	

Where is the non-fishing labour provided?

Location	*Proportion of HHs Providing Wage Labour %*
Inside the settlement	
In PQA areas	
Outside PQA but in Karachi	
Outside Karachi	

Businesses in the Settlement

Please provide the below information on businesses in the settlement

Type of Business	*Total Number in Settlement*
Fishing (boat owners hiring labour)	
Lending	
Fish Brokering	
Hotel Owners	
Shop Owners	
Tourism/ Recreational Fishing	
Boat Making	
Net Making	
Selling of Wood	
Other Busninesses	

Basic Facilities

Health

List the locations of the following nearest health facilities in/to the settlement:

Nearest Health Facility	*Location*
Government Health Center/ BHU	☐ Inside Settlement ☐ Outside Settlement Distance if outside ____ km
Government Hospital	☐ Inside Settlement ☐ Outside Settlement Distance if outside ____ km
Community Run Health Center	☐ Inside Settlement ☐ Outside Settlement Distance if outside ____ km
Private Health Center/Clinic	☐ Inside Settlement ☐ Outside Settlement Distance if outside ____ km
Private Hospital	☐ Inside Settlement ☐ Outside Settlement Distance if outside ____ km

List the three most common diseases/health problems in the settlement:

_____

_____

_____

_____

Education

List the locations of the following nearest education facilities in the settlement:

Specify number of males above age 18 who have passed matriculation _____

Specify number of females above age 18 who have passed matriculation _____

Nearest Educational Facility	*Locations*
Government Primary School (girls/co-ed)	☐ Inside Settlement ☐ Outside Settlement Distance if outside ____ km
Government Primary School (boys)	☐ Inside Settlement ☐ Outside Settlement Distance if outside ____ km

Nearest Educational Facility	*Locations*
Government Secondary School (girls/co-ed)	☐ Inside Settlement ☐ Outside Settlement Distance if outside ____ km
Government Secondary School (boys)	☐ Inside Settlement ☐ Outside Settlement Distance if outside ____ km
Government College (girls/co-ed)	☐ Inside Settlement ☐ Outside Settlement Distance if outside ____ km
Government College (boys)	☐ Inside Settlement ☐ Outside Settlement Distance if outside ____ km
Private Primary School (girls/co-ed)	☐ Inside Settlement ☐ Outside Settlement Distance if outside ____ km
Private Primary School (boys)	☐ Inside Settlement ☐ Outside Settlement Distance if outside ____ km
Private Secondary School (girls/co-ed)	☐ Inside Settlement ☐ Outside Settlement Distance if outside ____ km
Private Secondary School (boys)	☐ Inside Settlement ☐ Outside Settlement Distance if outside ____ km

Water Supply

What is the source of water supply in the settlement? Tick all that apply

☐ Groundwater well ☐ Directly from nullah ☐ Buying from tankers ☐ Piped water supply

☐ Other: _____

Are there ever any issues with water quality not being good enough for domestic use?

☐ Yes ☐ No

Assets

Community Structures

Number of community structures in the settlement

Structure	*Total Number*
Mosques/ Churches/ Mandirs	
Community Centers	
Other	

Boats

How many boats do the households in the settlement own? _____

Livestock

What is the approximate number of livestock in the settlement?

Items	*No. Owned*	*Value per unit (PKR)*
Camel		
Bullock/Buffalo		
Cow		
Goat		
Sheep		
Donkey		
Horse		

What is the main source of fodder for the livestock?

☐ Open grazing in mangroves ☐ Open grazing in other areas ☐ Collection from mangroves

☐ Collection from other areas ☐ Buying from the market

☐ Other _____

Access to Finance

What is the level of borrowing (loans) in the settlement? ☐ High ☐ Medium ☐ Very Seldom

What are the sources of finance/loans available to the community? Tick all that apply

☐ Institutional (banks etc.) ☐ Moneylenders ☐ Shopkeepers

☐ Other _____

Fuel Use

What type of fuels are used for cooking and heating?

Fuel	*Proportion of Households %*
Wood	
LNG	
Piped Gas Supply	
Electricity	
Other	

If wood is being used, where is it sourced from?

☐ Mangroves ☐ Mesquite ☐ Other _____

Natural Hazards

Have there been any of the following natural disasters in the last 5 years?

Rainfall/Floods ☐ Yes ☐ No

Frequency in last 5 years _____

Damage Caused (tick all that apply)

☐ Damage to houses and community structures due to flooding

☐ Damage to houses and community structures due to breakage

☐ Loss of livestock ☐ Damage to fishing boats and equipment ☐ Loss of fishing time

How did the community cope at the time of the disaster?

☐ Self-help/ self-response ☐ Help from government emergency response institutions

☐ Help from NGOs ☐ Other _____

Does the community have any insurance for loss from natural disasters? ☐ Yes ☐ No

In your opinion, do the mangroves provide protection from this hazard? ☐ Yes ☐ No

Cyclones/Ocean Storms ☐ Yes ☐ No

Frequency in last 5 years _____

Damage (tick all that apply)

☐ Damage to houses and community structures due to flooding

☐ Damage to houses and community structures due to breakage

☐ Loss of livestock ☐ Damage to fishing boats and equipment ☐ Loss of fishing time

How did the community cope at the time of the disaster?

☐ Self-help/ self-response ☐ Help from government emergency response institutions

☐ Help from NGOs ☐ Other _____

Does the community have any insurance for loss from natural disasters? ☐ Yes ☐ No

In your opinion, do the mangroves provide protection from this hazard? ☐ Yes ☐ No

Earthquakes/Tsunamis ☐ Yes ☐ No

Frequency in last 5 years _____

Damage (tick all that apply)

☐ Damage to houses and community structures due to flooding

☐ Damage to houses and community structures due to breakage

☐ Loss of livestock ☐ Damage to fishing boats and equipment ☐ Loss of fishing time

How did the community cope at the time of the disaster?

☐ Self-help/ self-response ☐ Help from government emergency response institutions

☐ Help from NGOs ☐ Other _____

Does the community have any insurance for loss from natural disasters? ☐ Yes ☐ No

In your opinion, do the mangroves provide protection from this hazard? ☐ Yes ☐ No

Other _____ ☐ Yes ☐ No

Frequency in last 5 years _____

Damage (tick all that apply)

☐ Damage to houses and community structures due to flooding

☐ Damage to houses and community structures due to breakage

☐ Loss of livestock ☐ Damage to fishing boats and equipment ☐ Loss of fishing time

How did the community cope at the time of the disaster?

☐ Self-help/ self-response ☐ Help from government emergency response institutions

☐ Help from NGOs ☐ Other _____

Does the community have any insurance for loss from natural disasters? ☐ Yes ☐ No

In your opinion, do the mangroves provide protection from this hazard? ☐ Yes ☐ No

Migration Patterns

What proportion of the households have migrated **into** the settlement in the last 10 years?: _____ %

What are the reasons for in-migration: ☐ Employment in PQA ☐ Fishing

☐ Other (specify) _____

What proportion of the households who migrated for fishing were fisherment by profession? _____ %

Where did the households migrate from? ☐ Other Areas in Karachi ☐ Outside Karachi but within Pakistan

☐ Outside Pakistan ☐ Other (specify) _____

What proportion of the households have migrated **out** of the settlement in the last 10 years?: _____ %

What are the reasons for out-migration: ☐ Better employment/Jobs ☐ Decrease in income from fishing

☐ Other (specify) _____

Mangrove-related Recreational Activities

To what extent does the community's recreational activities rely on the mangroves as a location?

☐ none at all ☐ less than 25% ☐ 25% ☐ 25 to 50%

☐ 50% ☐ 50 to 75% ☐ 75% to 100% ☐ _____ %

What recreational activities, if any, does the community engage in at the mangroves? Tick all that apply

☐ Fishing ☐ Boating ☐ Relaxing ☐ Picnic ☐ Other _____

Would the mangrove recreational activities be affected by a change in the water quality of the mangroves?

☐ Yes, negatively ☐ Not significantly ☐ Yes, positively

If yes, please explain how.

_____

_____

_____

Vulnerability Matrix

Based on the information collected above and additional information where required, classify the community on the vulnerability matrix[8]

	Vulnerability Assessment at Community/Settlement Level					
	Level 1	*Level 2*	*Level 3*	*Level 4*	*Level 5*	*Level 6*
Health	No facility in the settlement	Local untrained *dai* and *hakim* available	BHU/ government dispensary/NGO health facility in the vicinity, EPI team visited and immunized children	Public/private health facility available, trained midwife/LHV, medication available at health facility	Government hospital at a distance of 10 km or less	Government hospital at a distance of 2 km or less
Education	No facility in the settlement	Madrassa (for boys and girls).	Public or private primary school (for boys as well as for girls)	Secondary school (for boys)	Secondary school (for girls)	English medium primary and secondary schools (for boys as well as for girls)
Migration	70% of the population migrated here in the last decade	50% of the population migrated here in the last decade	40% of the population migrated here in the last decade	30% of the population migrated here in the last decade	20% of the population migrated here in the last decade	Nobody migrated here in the last decade (0%)
Wage labor	75% of the households are primarily dependent on wage labour all year round	50% of the households are primarily dependent on wage labour all year round	More than 50% of the households are primarily dependent on wage labour for up to 3 months of the year	Less than 50% of the households are primarily dependent on wage labour for up to 3 months of the year	50% or more of the households are involved in some wage labour	Less than 25% of the households are involved in any wage labour

[8] To be asked from Phase 6 backwards (starting from the most resilient)

	Vulnerability Assessment at Community/Settlement Level					
	Level 1	*Level 2*	*Level 3*	*Level 4*	*Level 5*	*Level 6*
Fishing Activities (in season)	Fish catch is consumed by the community (only subsistence fishing)	Majority of the fish catch is consumed by the community	Majority of the fishermen work as labour on boats; fish catch is sold to middle men	Majority of the fishermen work as labour on boats; fish catch is sold commercially (directly in market or to businesses)	Majority of the fishermen are boat owners; fish catch is sold to middle men/broker	Majority of the fishermen are boat owners; fish catch is sold commercially (directly in market or to businesses)
Debt/Loan facility	No loans available	Most of the households borrow from local money lenders	About 50% the households borrow from local money lenders	About 25% the households borrow from local money lenders	Borrowing mostly from friends and families	Have access to lending institutions such as commercial and microfinance banks
Boats	No boats owned by households in the settlement	Less than 10% of the households own one boat	10 to 20% of the households own one boat or more	20% to 30% of the households own at least one boat	30% to 40% of the households own at least one boat	40% or more of the households own at least one boat
Livestock	No livestock owned by households in the settlement	Less than 10% of the households own some livestock	50% of the households own one goat	50% of the households own only small livestock (goats, sheep)	50% or more of the households own up to 2 camels or cows/buffaloes	75% or more of the households own 5 or more camels or cows/buffaloes
Transportation	Less than 10% of the households own transport	Between 10% to 20% of the households own transport	Between 20% to 30% of the households own transport	Between 30% to 40% of the households own transport	Between 40% to 50% of the households own transport	More than 50% of the households own transport
Disaster [9] Preparedness and Response	No community, government or NGO contingency planning for any type of disaster	Community contingency plan exists for at least one natural disaster like cyclone	Community contingency plan supported and developed by NGOs for natural disasters	Contingency planning with joint government and community roles exercised for all types of disasters	Government Response Teams and disaster early recovery mechanisms in place for all sorts of disasters	Joint government and community based early warning systems, response teams, evacuation plans, rescue procedures and early recovery mechanisms in place for all sorts of disasters

[9] Perceived disasters at this stage are likely to be Cyclones, Storm Surge, Earthquake, Tsunami, Oil Spill/Contamination, Fires, terrorism, infectious epidemic etc.

Sustainable Fishing Practices

Specify Number of households using *Bulla Gujja Net* _____

Specify number of households using *Thukri Net* _____

Specify estimated number of boats fishing in PQA Area _____

Any other unsustainable fishing practices? Provide details if any.

_____

_____

_____

_____

_____

D.5 Socioeconomic Survey Results Summary

See following pages.

D.5.1 Household Level Data

Socioeconomic Zone	*Surveyed Number of Households*
Fishing Communities	14
Non-Fishing Communities	8
Fishing/Agriculture Communities	10
Total HHs Surveyed	32

Respondents	*Number*	*Proportion*
Male	24	75%
Female	8	25%

Average HH Size 8

Unemployment

Number of Persons	*Proportion of Adults*
9	7%

Employment

Types of Employment	*Number of Persons*	*Proportion of Total*
Farming Labor (FAL)	5	10%
Farming (FAR)	1	2%
Fishing Labor (FIL)	15	31%
Cutting and Selling Wood (FOR)	1	2%
Wage Labor (OLB)	6	13%
Other (OTH)	1	2%
Employment in PQA	1	2%
Service (SER)	15*	31%
Shopkeeper (SHK)	2	4%
Trade (TRB)	1	2%
Total	**48**	**100%**

3 of these are in the PQA area

Average Income (by occupation)

Source of Livelihood	*Average Annual Income*	*Average Monthly Income*
Fishing (labor)	124,831	10,403
Wage labor	120,000	10,000
Service	170,000	14,166

Total HH 32

Average Household Income10

Zone	*Average HH Income (annual)*	*Average HH Income (monthly)*
Fishing Communities	181,571	15,131
Non-Fishing Communities	177,750	14,813
Fishing/Agriculture Communities	217,717	18,143
Total HHs Surveyed	**192,346**	**16,029**

Average per Capita Income

Zone	*Average Monthly Income*	*Per Capita Income*
Fishing Communities	15,131	2,380
Non-Fishing Communities	14,813	2,330
Fishing/Agriculture Communities	18,143	2,853
Average (for all)	**16,029**	**2,521**

Education levels

Age	*Total Persons in Surveyed HHs*	*Persons who have/are attending school*	*Proportion (%)*
Adults (18 yrs and above)	131	27	21%
Children (5- 18 yrs)	101	49	49%

Expenses

Type of Expense	*Average/month (all respondents)*
Health	2,827
Education	1,253
Electricity	924
Food	10,339
Gas	710
Transportation	2,709

[10] No households from Planned Housing Schemes were covered.

Allied Sources of Income

Zone	*Total HHs*	*No. with more than one income source*	*Proportion of Total*
Fishing Communities	14	2	14%
Non-Fishing	8	2	25%
Fishing/Agriculture	10	3	30%
Total	**32**	**7**	**22%**

Debt

Zone	*No. of HHs with debt*	*Proportion (%)*	*Average Debt*
Fishing	13	93%	571,071
Non-Fishing	6	75%	132,167
Fishing/Agriculture	6	60%	84,133

Savings

Zone	*Monetary Savings*	*Proportion of Total HHs (%)*	*Jewelry*	*Proportion (%)*
Fishing	2	14%	1	7%
Non-Fishing	1	13%	2	25%
Fishing/Agriculture	1	10%	2	20%
Total	**4**	**13%**	**5**	**16%**

Type of Fuel Used for Cooking

Zone	*Piped Gas Supply (no.)*	*Piped Gas Supply (%)*	*Wood (no.)*	*Wood (%)*
Fishing	11	79%	3	21%
Non-Fishing	0	0%	7	88%
Fishing/Agriculture	0	0%	10	100%
Total	**11**	**34%**	**20**	**63%**

Wood Source	*No. of HHs*	*Proportion of Total (%)*
Mangroves	18	90%
Mesquite	2	10%
Total	**20**	**100%**

Wood Use per Month (kg) 308

Livestock Owned

Zone	*Bullock/Buffalo*	*Cow*	*Goat*	*Sheep*
Fishing	1	4	1	0
Non-Fishing	0	0	9	0
Fishing/Agriculture	0	10	7	9
Total	**1**	**14**	**17**	**9**

Vulnerability Matrix

Zone	*Wage Labor*	*Fishing Activities*	*Allied sources of income*	*Child labor*	*% Income/ Loan*	*Debt/ Loan facility*	*Saving*	*Jewellery*	*Household assets*	*Transportation*
Fishing	2	5	2	5	3	3	2	2	3	3
Non-Fishing	2		3	5	4	3	3	2	2	3
Fishing/ Agriculture	3	4	3	5	4	3	2	2	1	2
Total	**2**	**5**	**3**	**5**	**4**	**3**	**2**	**2**	**2**	**3**

Vulnerability Matrix Summary

Zone	*Overall Vulnerability*	*Economic Opportunities*	*Child Labor*	*Access to Credit (loan facility)*	*Household Savings*	*Household Assets*	*Transport ation*
Fishing	3	3	5	3	2	3	3
Non-Fishing	3	2	5	3	3	2	3
Fishing/ Agriculture	3	4	5	3	2	1	2
Total	**3**	**3**	**5**	**3**	**2**	**2**	**3**

Vulnerability Matrix Summary

Zone	*Overall Vulnerability*	*Economic Opportunities*	*Child Labor*	*Access to Credit (loan facility)*	*Household Savings*	*Household Assets*	*Transportation*
Fishing	Vulnerable	Vulnerable	Moderately Resilient	Vulnerable	Highly Vulnerable	Vulnerable	Vulnerable
Non-Fishing	Vulnerable	Highly Vulnerable	Moderately Resilient	Vulnerable	Vulnerable	Highly Vulnerable	Vulnerable
Fishing/ Agriculture	Vulnerable	Moderately Vulnerable	Moderately Resilient	Vulnerable	Highly Vulnerable	Critically Vulnerable	Highly Vulnerable
Total	Vulnerable	Vulnerable	Moderately Resilient	Vulnerable	Highly Vulnerable	Highly Vulnerable	Vulnerable

Fishing Communities

Ibrahim Hyderi

Samina is a resident of Ibrahim Hyderi, the largest fishing village along the coast of Karachi. Living in one of the more impoverished parts of the village, Samina's nine-person strong household is dependent on income from fishing and wage labor. The household consists of her four children, her mother-in-law, father-in-law and brother-in-law. Her husband and brother-in-law provide labor on fishing boats for six months of the year, earning around PKR 20,000 a month. This income fluctuates during the remaining months, when her husband works as wage labor in the village, earning up to PKR 7500 per month. The monthly household expenditures of almost PKR 22,000 every month are just barely met during fishing season. During the non-fishing months, the expenses are met by taking loans from the local money-lender at high interest rates. Samina's household is part of the more vulnerable part of the population that makes up about 60% of Ibrahim Hyderi. The only asset that they own is a cow that Samina bought after taking a micro-loan from the Local Support Organization. They do not have any savings or jewelry and do not own a motorcycle or car. They cannot afford a piped gas connection and spend about PKR 1200 a month buying mangroves wood from the market for cooking. Samina and her children only venture out of the village when they have to visit a hospital. Due to the lack of public transport facilities, they rent a car at high rates for such an activity.



Rehri

Ayesha Muhammad Hassan lives in Rehri Goth with her disabled son and his six year old daughter. Her son, the breadwinner for the family, used to be a fisherman, working as

labor on fishing boats and earning enough income to provide food and basic necessities for his family. An unfortunate road accident left him disabled and in a wheelchair, unable to work and earn any income. This also spurred his wife to separate from him, leaving their daughter behind in his care. Ayesha's husband and other son, both deceased, were heroin addicts. To fuel their addiction, they spent all the savings the family had and sold part of their house for a paltry sum, along with leaving her with a crippling debt. Ayesha's only source of income is her two daughters who work as wage labor in factories in the Karachi Export Processing Zone. Together, they give her PKR 6000 every month, enough for basic expenses. Her brother, who lives close by, also supports her by sending her household one meal every day. Almost half of the money given by her daughters is spent on her son's medicines and visits to the doctor every month. They are desperate for him to be well enough to earn even a small amount of money. Ayesha's household is critically vulnerable. They have no source of personal income, no savings, a large debt, and are turned down for loans even from friends and family. Even a small shock to her family or that of her daughters' will result in her, her disabled son and young granddaughter to be deprived of even the barest necessities.







Rehri

Ghulam Mustafa, from Siddiqu Khaskheli Goth is a fisherman who catches Red Crabs in shallow creeks and mangroves. His household is extremely large, comprising of 20 persons including his parents, his wife, two daughters, three brothers, their wives and their nine children. All four brothers contribute to the household income, earning around PKR 70,000 for the nine-months of the crab catching season. For the remaining part of the year, they buy necessities on credit from local shopkeepers and borrow money from moneylenders at high rates. Ghulam Mustafa's household is highly vulnerable, dependent entirely on catching crabs, with the brothers often working on the same boat. They have no savings, no jewelry and no assets. Their house, located in an impoverished part of the

village has no electricity and no gas supply. They cut almost 20kg of wood from mesquites every day for cooking and heating.



Rehri

Muhammad, a resident of Rehri is a fisherman who fishes on his relative's small boat in the mangrove areas. He mainly catches shrimp and Bohi fish, earning around PKR 6000 each month. His father, who lives with him, makes nets, earning PKR 5000 per month. Muhammad's main income comes from catching shrimp. His boat catches almost 100kg per day in June and July, and 25kg per day in the remaining 10 months of the year. In December and February, they also catche around 35kg of Bohi every day. The shrimp is caught using Gujja net, and the Bohi is caught using Thukri net. They store their catch in an ice-box provided free of cost by the Fisherfolk Forum. The prawn catch is handed over the moneylender who finances their trips at the Rehri Jetty where they land. They sell the fish themselves at the local market in Rehri Goth.





Rehri

Abbas lives in a small two bedroom structure in Latt Basti with his wife, four sons, a daughter-in-law and two grandchildren. The family's source of income is only for six months of the year when him and his two sons work as fishing labor on small boats. During this time, they earn a total of PKR 8000 per month, a fraction of the PKR 22,000 expenses they have. Abbas reports that over the past few years their income has decreased, as they are not catching as much fish as they used to. He thinks it's because of the increasing pollution in the creeks. The expenses include PKR 15000 on food and another PKR 5000 on health. His wife and the 2 younger sons are consistently sick, suffering from seizures and autism. They have to visit the hospital for treatment frequently, being forced to use the only mode of transport available, rented private cars, for PKR 1200 each time. Abbas himself suffers from a skin disease caused by the highly polluted water of the creeks close to Latt Basti. Abbas's family is heavily in debt from

family, shopkeepers and moneylenders. He does not have a record of how much he owes to whom, but estimates that the total debt is over PKR 200,000. He cannot remember a time when his family was not in debt. Barely earning enough to feed his ailing family, Abbas's household is one of the most vulnerable in the village.



Non-Fishing Communities

Morand Khan Qaisarani

Ghulam Rasul lives in the small village of Morand Khan Qaisarani, located half way between Karachi and Gharo, Thatta. Morand Khan Qaisarani, comprising of only 80 households is one of the poorest communities in the Study Area. The households are all dependent on wage labor provided at close by industrial areas. Almost 80% of the households are under the poverty line, living in small huts made of straw and wood. They have no electricity or gas supply. The children in the village suffer from severe malnutrition with many having stunted growth. Ghulam Rasul's nine child aged 3 to 17 also suffer from malnutrition. He attributes this to the poor diet of the family. Like most other households, he can only afford to buy adultered white flour with little nutritional value on his income of PKR 10,000 per month as a wage laborer. They can seldom afford to buy vegetables and can never afford to buy meat. In addition to this, the community is often forced to buy water from tankers that is not fit for consumption. Despite the bare minimum spending, Ghulam Rasul spends almost PKR 18,000 each month on food for his large family, which also includes his wife, daughter-in-law and infant grandson. Ghulam Rasul buys food on credit every month from the local shopkeeper to cover the expense. Another PKR 8000 is spent every month on health expenses to treat kidney disorders his wife and two children are suffering from. The closest government hospital is 40km away in Karachi and is too far for the community to travel to. A government dispensary is nearby, but only provides medicines for basic illnesses (flu, diarrhea etc.).

For more complicated illnesses, they are forced to visit the nearest private hospital in Gulshan-e-Hadeed, which charges hefty sums. Previously, Ghulam Rasul lost three children during his wife's pregnancies and during childbirth, and two children in infancy. Health care bills from these pregnancies combined with ongoing treatment for his wife and children's illnesses have burdened him with a debt of over PKR 300,000 that he has taken from family and friends.



Fishing/Agriculture Communities

Goth Azim Mirbehar

Goth Azim Mirbehar is a small community in Dhabeji dependent on fishing in the creeks and providing farm labor. Similar to other neighboring communities, they have no gas or electricity, cutting mesquite wood for cooking purposes. The houses are mostly structures made of straw and wood, with the more well of households using larger quantities of wood to build these huts on elevated platforms to avoid damage from floods caused by rains every year.





Esma Mallah Hassan lives with her husband and three sons in Goth Azim Mirbehar village. She works as farm labor in fields close to the village, and is often supported by her husband who divides his time between farm labor and fishing. Her eldest son who is 15 years old also accompanies his father on fishing trips. Her other sons are of school going age but do not attend school as there is no facility at an accessible distance from the village. Her husband and son do not fish on boats, instead wading into the shallow creeks with nets to catch shrimp and small fish. They sell their catch at the local market in Gharo town. Together the fishing and farm labor brings in just enough income to cover food, transport and fishing equipment expenses. However, the farming is dependent on rainfall, and the income varies every year. This year there was a bad yield of vegetables planted due to no rainfall causing a loss to the farmer. Along with not getting their share in the produce, Esma and her husband were not even paid their labor wages. In times like these and to cover expenses for medical treatment, Esma is forced to borrow money from the landowner who she works for at high interest. Till now she has accumulated a debt of PRK 150,000.



Basra Punjo also from Azim Mirbehar village is from one of the poorest and most vulnerable families in the village. She is a widow who lives with her daughter and three granddaughters in a basic one bedroom hut made of only straw. During storms and rainfall it often suffers damage, which the other villagers help her fix. Basra and her family are provided basic food rations by a group of relatively better off families in the village. For other essential expenses such as health care, Basra is also dependent on handouts from the community that is already financially stressed and barely making ends meets.





Saif Salt Colony

Abdul Rehman lives in a tiny village called Goth Nathu Sudai in the Gharo-Dhabeji area of Thatta. The 15 household strong village is part of the Saif Salt Colony providing labor to the nearby salt extraction factory. All households work in salt extraction in this village. Abul Rehman lives in a small one room straw and wood structure with his wife and son, who also works at the salt factory. They provide wage labor for 6 days each week, earning up to PKR 180 per day, depending on the type of work they get. They provide manual labor such as shoveling salt and loading trucks. Together they earn PKR 9000 each month. His wife also contributes to the household income, PKR 800 every month by cutting and selling wood from mesquites in the village. The income is enough to cover the household expenses. Water is provided through tankers by the salt factory. The factory also provides transport to the nearest town through regular buses. They have a

small amount of debt with the local shopkeeper. Since the village is a small informal settlement, there is no gas or electricity.



D.5.2 Fish Catch Analysis

The summary of the results providing estimates for fish catch and its economic value from the findings of the socioeconomic survey are provided in **Exhibit D.**6 to **Exhibit D**.11. It should be noted that these estimates for fish differ from those derived from MFD data as reported in **Section 6** of the main report. Data for shrimp catch collected through the socioeconomic survey was discarded. The estimates reported for shrimp in this appendix are derived from MFD data and are same as those reported in **Section 6**.

Exhibit D.6: Estimated Fish and Shrimp Catch per Year per Landing Site

Specie	*Landing Sites (all values in metric tons)*			*Total (in metric tons)*
	Ibrahim Hyderi	*Rehri*	*Bhambore*	
Shrimp	7,797	5,794	225	**13,816**
Ghissar	1,683	1,246	33	**2,963**
Heera	1,637	1,206	32	**2,875**
Danthi	1,086	800	26	**1,912**
Dangri	1,719	1,268	32	**3,019**
Aal	5,765	4,302	-	**10,066**
Gorr	4,118	3,073	-	**7,190**
Fish for Food (total)[11]	16,007	11,895	124	**28,025**
Trash Fish	32,940	24,580	-	**57,520**
Total Fish catch in the Study Area	**56,744**	**42,268**	**348**	**99,360**

To determine the dependence of the fishermen of the Socioeconomic Study Area on different fishing locations, the key respondents were asked about their fishing grounds with respect to the size of the boat. The respondents reported that the boat size exceeding 24 feet (ft) make trips to the open sea for fishing. Rest of the boats (size below 24 ft) are totally reliant on creeks/mangroves for fishing (see **Section 6.5.1** for boats in the Socioeconomic Study Area).

The boats with sizes exceeding 24 ft are taken to the open sea for fishing for 10 months in a year (August to May), whereas, the boats smaller than 24 ft fish round the year in creeks of PQA area with peak fishing months stretched from August to November and March to May.

Exhibit D.7: Fish and Shrimp Catch Division for Mangroves and Open Sea

Landing Site	*Total Catch (in metric tons)*	*Catch from Creeks/Mangroves (in metric tons)*	*Catch From Open Sea (in metric tons)*
Ibrahim Hyderi	56,774	12,122	46,623
Rehri	42,268	8,844	33,424
Bhinbore	348	348	
Total	**99,360**	**21,314**	**78,046**

[11] Fish for Food includes Ghissar, Heera, Danthi, Dangri, Aal and Gorr.

Exhibit D.8: Percentage Division of Catch (by weight) for each Landing Site by Fishing Locations

Landing Site	*%age of Catch from Mangroves*	*%age of Catch from Open Sea*	*Total*
Ibrahim Hyderi	21	79	**100%**
Rehri	21	79	**100%**
Bhinbore	100	0	**100%**
Whole Study Area	47	53	**100%**

D.5.2.1 Economic Valuation

To estimate the total value of the fish catch form the Study Area, average market prices for shrimp, fish for food and trash fish were approximate. The prices vary depending upon the size and specie of the catch. The average market value for the catch are provided in **Exhibit D**.9. On the basis of the access to the fishing locations (creeks/mangroves or open sea), dependent on the size of boat, the division of fish catch for each landing site with respect to the fishing locations and their respective economic value was estimated (**Exhibit D**.10 and **Exhibit D**.11)

Exhibit D.9: Average Market Value of Fish and Shrimp Catch

Species	*Market Rate, Rs/kg*
Shrimp	468
Fish for Food	787
Trash Fish	16

Exhibit D.10: Annual Economic Value of Total Catch for each Landing Site

Landing Site	*Shrimp (value in Million PKR)*	*Fish for Food (value in Million PKR)*	*Trash Fish (value in Million PKR)*	*Total Catch Value from per Landing Site*	*% age Share of Total Catch Value by Landing Site*
Ibrahim Hyderi	3,649	12,597	527	16,773	57
Rehri	2,711	9,360	393	12,465	42
Bhambore	105	97	0	202	1
Total	**6,465**	**22,055**	**920**	**29,441**	**100**

Exhibit D.11: Total Value of Fish and Shrimp Catch by fishing

Landing Site	*Total Value (in Million PKR)*	*Value of Catch from Mangroves (in Million PKR)*	*Value of Catch from Open Sea (in Million PKR)*
Ibrahim Hyderi	16,773	3,522	13,251
Rehri	12,465	2,617	9,847
Bhinbore	202	202	0
Total	**29,442**	**6,342 (22%)**	**23,099 (78%)**

The results show that 22% of the total income from fishing is generated through the fish catch of creeks/mangrove area, while 78% of the fishing income comes from the fish caught in open sea.

D.5.3 Vulnerability Matrix

See following pages.

Vulnerability Matrix

	Vulnerability Assessment at Community/Settlement Level					
	Phase 1 – Critically Vulnerable	*Phase 2 – Highly Vulnerable*	*Phase 3 - Vulnerable*	*Phase 4 – Moderately Vulnerability*	*Phase 5 – Moderately Resilient*	*Phase 6 - Resilient*
Health	No facility in the settlement	Local untrained *dai* and *hakim* available	BHU/ government dispensary/NGO health facility in the vicinity, EPI team visited and immunized children	Public/private health facility available, trained midwife/LHV, medication available at health facility	Government hospital at a distance of 10 km or less	Government hospital at a distance of 2 km or less
Education	No facility in the settlement	Madrassa (for boys and girls).	Public or private primary school (for boys as well as for girls)	Secondary school (for boys)	Secondary school (for girls)	English medium primary and secondary schools (for boys as well as for girls)
Migration	70% of the population migrated here in the last decade	50% of the population migrated here in the last decade	40% of the population migrated here in the last decade	30% of the population migrated here in the last decade	20% of the population migrated here in the last decade	Nobody migrated here in the last decade (0%)
Wage labor	75% of the households are primarily dependent on wage labor all year round	50% of the households are primarily dependent on wage labor all year round	More than 50% of the households are primarily dependent on wage labor for up to 3 months of the year	Less than 50% of the households are primarily dependent on wage labor for up to 3 months of the year	50% or more of the households are involved in some wage labor	Less than 25% of the households are involved in any wage labor
Fishing Activities (in season)	Fish catch is consumed by the community (only subsistence fishing)	Majority of the fish catch is consumed by the community	Majority of the fishermen work as labour on boats; fish catch is sold to middle men	Majority of the fishermen work as labour on boats; fish catch is sold commercially (directly in market or to businesses)	Majority of the fishermen are boat owners; fish catch is sold to middle men/broker	Majority of the fishermen are boat owners; fish catch is sold commercially (directly in market or to businesses)
Debt/Loan facility	No loans available	Most of the households borrow from local money lenders	About 50% the households borrow from local money lenders	About 25% the households borrow from local money lenders	Borrowing mostly from friends and families	Have access to lending institutions such as commercial and microfinance banks

	Vulnerability Assessment at Community/Settlement Level					
	Phase 1 – Critically Vulnerable	*Phase 2 – Highly Vulnerable*	*Phase 3 - Vulnerable*	*Phase 4 – Moderately Vulnerability*	*Phase 5 – Moderately Resilient*	*Phase 6 - Resilient*
Boats	No boats owned by households in the settlement	Less than 10% of the households own one boat	10 to 20% of the households own one boat or more	20% to 30% of the households own at least one boat	30% to 40% of the households own at least one boat	40% or more of the households own at least one boat
Livestock	No livestock owned by households in the settlement	Less than 10% of the households own some livestock	50% of the households own one goat	50% of the households own only small livestock (goats, sheep)	50% or more of the households own up to 2 camels or cows/buffaloes	75% or more of the households own 5 or more camels or cows/buffaloes
Transportation	Less than 10% of the households own transport	Between 10% to 20% of the households own transport	Between 20% to 30% of the households own transport	Between 30% to 40% of the households own transport	Between 40% to 50% of the households own transport	More than 50% of the households own transport
Disaster [12] Preparedness and Response	No community, government or NGO contingency planning for any type of disaster	Community contingency plan exists for at least one natural disaster like cyclone	Community contingency plan supported and developed by NGOs for natural disasters	Contingency planning with joint government and community roles exercised for all types of disasters	Government Response Teams and disaster early recovery mechanisms in place for all sorts of disasters	Joint government and community based early warning systems, response teams, evacuation plans, rescue procedures and early recovery mechanisms in place for all sorts of disasters

[12] Perceived disasters at this stage are likely to be Cyclones, Storm Surge, Earthquake, Tsunami, Oil Spill/Contamination, Fires, terrorism, infectious epidemic etc.

Vulnerability Rankings

Community Zones	*Settlement*	*Access to Social Services*		*Migration*	*Economic Opportunities*		*Access to Credit*	*Assets*		*Mobility*	*Disaster Preparedness and Response*	*Overall Vulnerability*
		Health	*Education*		*Wage labor*	*Fishing Activities (in season)*	*Debt/Loan facility*	*Boats*	*Livestock*	*Transportation*		
Fishing	Ibrahim Hyderi	Moderately Resilient	Moderately Resilient	Resilient	Resilient	Moderately Vulnerable	Resilient	Highly Vulnerable	Highly Vulnerable	Vulnerable	Highly Vulnerable	Moderately Vulnerable
	Rehri/ Bakhtawar	Moderately Vulnerable	Moderately Resilient	Moderately Resilient	Vulnerable	Vulnerable	Highly Vulnerable	Vulnerable	Highly Vulnerable	Highly Vulnerable	Critically Vulnerable	Vulnerable
	Chashma/Khaskheli	Moderately Resilient	Vulnerable	Resilient	Moderately Resilient	Vulnerable	Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Critically Vulnerable	Vulnerable
	Juma Goth	Moderately Vulnerable	Moderately Resilient	Moderately Resilient	Critically Vulnerable	Moderately Vulnerable	Resilient	Highly Vulnerable	Highly Vulnerable	Vulnerable	Critically Vulnerable	Vulnerable
Non-Fishing	Morand Khan Qaiserani	Critically Vulnerable	Vulnerable	Resilient	Critically Vulnerable		Highly Vulnerable		Highly Vulnerable	Critically Vulnerable	Critically Vulnerable	Highly Vulnerable
	Haji Ghulam Muhammad	Vulnerable	Moderately Vulnerable	Moderately Vulnerable	Highly Vulnerable		Moderately Vulnerable		Vulnerable	Highly Vulnerable	Critically Vulnerable	Vulnerable
	Ghaghar Phattak	Critically Vulnerable	Vulnerable	Resilient	Critically Vulnerable		Moderately Vulnerable		Highly Vulnerable	Critically Vulnerable	Critically Vulnerable	Highly Vulnerable
	Soomar Jokhio	Critically Vulnerable	Critically Vulnerable	Moderately Resilient	Critically Vulnerable		Moderately Vulnerable		Highly Vulnerable	Critically Vulnerable	Critically Vulnerable	Highly Vulnerable
Fishing/ Agriculture	Goth Karam Ali Baloch	Critically Vulnerable	Vulnerable	Moderately Vulnerable	Critically Vulnerable	Vulnerable	Resilient	Critically Vulnerable	Moderately Vulnerable	Critically Vulnerable	Critically Vulnerable	Vulnerable
	Coastal Belt of Dhabeji	Highly Vulnerable	Vulnerable	Resilient	Moderately Vulnerable	Moderately Vulnerable	Vulnerable	Highly Vulnerable	Moderately Vulnerable	Critically Vulnerable	Highly Vulnerable	Vulnerable
	Hashim Mirbehar	Critically Vulnerable	Vulnerable	Moderately Resilient	Critically Vulnerable	Moderately Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Critically Vulnerable	Vulnerable	Highly Vulnerable
Planned Housing schemes	Pipri	Moderately Vulnerable	Moderately Resilient	Resilient	Critically Vulnerable		Resilient		Moderately Vulnerable	Moderately Vulnerable	Vulnerable	Moderately Vulnerable
	Gulshan-e-Hadeed	Vulnerable	Resilient	Highly Vulnerable	Critically Vulnerable		Resilient		Highly Vulnerable	Moderately Resilient	Moderately Vulnerable	Moderately Vulnerable

D.6 Resettlement Investigation Questionnaire

See following pages.

D.6.1 Resettlement Investigation Questionnaire (Template)

Date _____ Name of the Respondent _____

Age _____ Contact Number _____

Gender Male ☐ Female ☐

Did your village in which you were originally living experience resettlement due to development of Port Qasim?

☐ Yes ☐ No

1. If yes, what was the name of the village? _____

2. Where it was located? (Provide approximate location w.r.t location of the industry currently located in PQA area) _____

3. Estimated number of households of the resettled village _____

4. Estimated population of the village at the time of resettlement _____

5. When it was resettled? (provide year) _____

6. Where it was resettled or where did the residents shift to? (provide current location or locations) _____

7. What were the primary sources of income of the residents of the village?

i. _____

ii. _____

iii. _____

iv. _____

8. Was any compensation paid to the resettled households?

☐ Yes ☐ No

If yes, what type of compensation was paid or provided (tick all applicable)?

i. ☐ Alternate land

ii. ☐ Monetary compensation for land and built property

iii. ☐ Alternate source of income

iv. ☐ Model village

v. ☐ None of the above

vi. Other _____

9. What are the current primary sources of income for the residents of the village?

i. _____

ii. _____

iii. _____

iv. _____

10. Was any commitment made by the Government of Sindh or Port Qasim Authority to ensure security of livelihood of the resettled communities?

☐ Yes ☐ No

If yes, what commitments were made?

_____

_____

_____

11. Is there any legal case your village has filed relating to the resettlement?

☐ Yes ☐ No

If yes, please provide details of the case:

i. Why the case was filed? _____

ii. When it was filed? _____

iii. Where it was filed? _____

iv. Case number? _____

Please share the legal documents as evidence.

12. Has any decision given by the court in the case?

☐ Yes ☐ No

If yes, do you have any copy of the decision?

☐ Yes ☐ No

If yes, please share the copy of the decision.

13. Please share your grievances relating to the resettlement.

_____

_____

_____

14. Do you know any of the current land acquisition issues? If yes, please provide details such as the cause of issue and what action community is planning to take against it?

_____

_____

_____

15. Additional comments and observations

_____

_____

_____

D.6.2 Resettlement Investigation Questionnaire (Filled)

Date	4/11/2015	Name of the Respondent	Gul Sher
Age	58	Contact Number	0340 029 5390
Gender		Male ☑	Female ☐

Did your village in which you were originally living experience resettlement due to development of Port Qasim?

☑ Yes ☐ No

1. If yes, what was the name of the village? Ali Khan Goth

2. Where it was located? (Provide approximate location w.r.t location of the industry currently located in PQA area) East Industrial Zone

3. Estimated number of households of the resettled village 60

4. Estimated population of the village at the time of resettlement 420

5. When it was resettled? (provide year) 1974

6. Where it was resettled or where did the residents shift to? (provide current location or locations) Khan Muhammad Goth

7. What were the primary sources of income of the residents of the village?

i. Agriculture

ii. Livestock

8. Was any compensation paid to the resettled households?

☑ Yes ☐ No

If yes, what type of compensation was paid or provided (tick all applicable)?

i. ☐ Alternate land
ii. ☑ Monetary compensation for land and built property
iii. ☐ Alternate source of income
iv. ☐ Model village
v. ☐ None of the above
vi. Other _____

9. What are the current primary sources of income for the residents of the village?

i. Daily wage labour

10. Was any commitment made by the Government of Sindh or Port Qasim Authority to ensure security of livelihood of the resettled communities?

☑ Yes ☐ No

If yes, what commitments were made?

Congo commission was established in the past who gave some recommendations to solve pending acquisition related issues. But recommendations were never implemented.

11. Is there any legal case your village has filed relating to the resettlement?

☑ Yes ☐ No

If yes, please provide details of the case:

i. Why the case was filed? Inadequate Compensation

ii. When it was filed? Not sure

iii. Where it was filed? High Court

iv. Case number? Not available

Please share the legal documents as evidence.

12. Has any decision given by the court in the case?

☐ Yes ☑ No

If yes, do you have any copy of the decision?

☐ Yes ☑ No

If yes, please share the copy of the decision.

13. Please share your grievances relating to the resettlement.

Adequate compensation was not provided at the time of acquisition.

14. Do you know any of the current land acquisition issues? If yes, please provide details such as the cause of issue and what action community is planning to take against it?

Community is preparing to take peaceful legal action against pending land acquisition issues.

15. Additional comments and observations

No additional comments

Date	4/11/2015	Name of the Respondent	Wasand
Age	50	Contact Number	
Gender		Male [Male] Female [ ]	

Did your village in which you were originally living experience resettlement due to development of Port Qasim?

☑ Yes ☐ No

1. If yes, what was the name of the village? Muhammad Suleman Goth

2. Where it was located? (Provide approximate location w.r.t location of the industry currently located in PQA area) East Industrial Zone

3. Estimated number of households of the resettled village 40

4. Estimated population of the village at the time of resettlement 280

5. When it was resettled? (provide year) 1975

6. Where it was resettled or where did the residents shift to? (provide current location or locations) Peeranu Goth/Haji Ibrahim

7. What were the primary sources of income of the residents of the village?

i. Agriculture

ii. Livestock

8. Was any compensation paid to the resettled households?

☑ Yes ☐ No

If yes, what type of compensation was paid or provided (tick all applicable)?

i. ☐ Alternate land
ii. ☑ Monetary compensation for land and built property
iii. ☐ Alternate source of income
iv. ☐ Model village
v. ☐ None of the above
vi. Other _____

9. What are the current primary sources of income for the residents of the village?

i. Daily wage labour

10. Was any commitment made by the Government of Sindh or Port Qasim Authority to ensure security of livelihood of the resettled communities?

☑ Yes ☐ No

If yes, what commitments were made?

Yes. Jobs, monetary compensation, alternate houses and infrastructure was promised.

11. Is there any legal case your village has filed relating to the resettlement?

☑ Yes ☐ No

If yes, please provide details of the case:

i. Why the case was filed? Inadequate Compensation nd non provision of jobs

ii. When it was filed? Not sure

iii. Where it was filed? High Court

iv. Case number? Not available

Please share the legal documents as evidence.

12. Has any decision given by the court in the case?

☐ Yes ☑ No

If yes, do you have any copy of the decision?

☐ Yes ☑ No

If yes, please share the copy of the decision.

13. Please share your grievances relating to the resettlement.

Adequate compensation was not provided at the time of acquisition.

14. Do you know any of the current land acquisition issues? If yes, please provide details such as the cause of issue and what action community is planning to take against it?

Community is preparing to take peaceful legal action against pending land acquisition issues.

15. Additional comments and observations

Only Rs 19,000/acre was provided for surveyed land. As we were mainly living and practicing agriculture on un-surveyed land, we did not receive any compensation and the landlords made lots of money.

Date	4/11/2015	Name of the Respondent	Shahnwaz
Age	56	Contact Number	0314 503 5048
Gender		Male ☒	Female ☐

Did your village in which you were originally living experience resettlement due to development of Port Qasim?

☑ Yes ☐ No

1. If yes, what was the name of the village? Saleh Muhammad Goth

2. Where it was located? (Provide approximate location w.r.t location of the industry currently located in PQA area) East Industrial Zone

3. Estimated number of households of the resettled village 50

4. Estimated population of the village at the time of resettlement 350

5. When it was resettled? (provide year) 1976

6. Where it was resettled or where did the residents shift to? (provide current location or locations) Haji Ibrahim

7. What were the primary sources of income of the residents of the village?

i. Agriculture

ii. Livestock

8. Was any compensation paid to the resettled households?

☑ Yes ☐ No

If yes, what type of compensation was paid or provided (tick all applicable)?

i. ☐ Alternate land
ii. ☑ Monetary compensation for land and built property
iii. ☐ Alternate source of income
iv. ☐ Model village
v. ☐ None of the above
vi. Other _____

9. What are the current primary sources of income for the residents of the village?

i. Daily wage labour

10. Was any commitment made by the Government of Sindh or Port Qasim Authority to ensure security of livelihood of the resettled communities?

☑ Yes ☐ No

If yes, what commitments were made?

Bhutto committed all infrastructure facilities and utilities to the affectees of Port Qasim acquisition but no commitments were implemented during Zia's government after that. After Benazir came to power, the case of acquisition was re-opened and in 1989 Congo

Commission was formed. The committee members included Chief Minister and other provincial secretaries. Three recommendations were made: Compensation of Rs 100,000 to each affected household, allotment of 50 acres of land for settlement of affectees and development of housing authority for master planning and provision of infrastructure at the allotted land. The land allotted is now known as Haji Ibrahim and has very poor infrastructure. The monetary compensation allotted as part of the recommendations was never provided to the affectees.

11. Is there any legal case your village has filed relating to the resettlement?

☑ Yes ☐ No

If yes, please provide details of the case:

i. Why the case was filed? Inadequate Compensation
ii. When it was filed? 1986
iii. Where it was filed? High Court
iv. Case number? Not available

Please share the legal documents as evidence.

12. Has any decision given by the court in the case?

☐ Yes ☑ No

If yes, do you have any copy of the decision?

☐ Yes ☑ No

If yes, please share the copy of the decision.

13. Please share your grievances relating to the resettlement.

Adequate compensation was not provided at the time of acquisition.

14. Do you know any of the current land acquisition issues? If yes, please provide details such as the cause of issue and what action community is planning to take against it?

Community is preparing to take peaceful legal action against pending land acquisition issues.

15. Additional comments and observations

A committee was formed in 2004 by Chief Secretary to investigate resettlement concerns. PQA backed out and never showed up at the meeting.

Date	4/11/2015	Name of the Respondent	Najam Ali
Age	70	Contact Number	0321 254 3155
Gender		Male ☐ Male	Female ☐

Did your village in which you were originally living experience resettlement due to development of Port Qasim?

☑ Yes ☐ No

1. If yes, what was the name of the village? Qadir Baksh Goth

2. Where it was located? (Provide approximate location w.r.t location of the industry currently located in PQA area) East Industrial Zone

3. Estimated number of households of the resettled village 60

4. Estimated population of the village at the time of resettlement 420

5. When it was resettled? (provide year) 1978

6. Where it was resettled or where did the residents shift to? (provide current location or locations) Haji Ibrahim

7. What were the primary sources of income of the residents of the village?

i. Agriculture

ii. Livestock

8. Was any compensation paid to the resettled households?

☑ Yes ☐ No

If yes, what type of compensation was paid or provided (tick all applicable)?

vii. ☐ Alternate land

iii. ☑ Monetary compensation for land and built property

ix. ☐ Alternate source of income

x. ☐ Model village

xi. ☐ None of the above

xii. Other _____

9. What are the current primary sources of income for the residents of the village?

i. Daily wage labour

10. Was any commitment made by the Government of Sindh or Port Qasim Authority to ensure security of livelihood of the resettled communities?

☑ Yes ☐ No

If yes, what commitments were made?

Congo commission was established in the past who gave some recommendations to solve pending acquisition related issues. But recommendations were never implemented. We were told that we should compromise for country's development which we did.

11. Is there any legal case your village has filed relating to the resettlement?

☑ Yes ☐ No

If yes, please provide details of the case:

i. Why the case was filed? Inadequate Compensation

ii. When it was filed? 1974

iii. Where it was filed? High Court

iv. Case number? Not available

Please share the legal documents as evidence.

12. Has any decision given by the court in the case?

☐ Yes ☑ No

If yes, do you have any copy of the decision?

☐ Yes ☑ No

If yes, please share the copy of the decision.

13. Please share your grievances relating to the resettlement.

Commitments made were not fulfilled and we had to settle at properties of our relatives on the basis of good will. PQA did not help us settle in.

14. Do you know any of the current land acquisition issues? If yes, please provide details such as the cause of issue and what action community is planning to take against it?

We will take legal means to fight it. No violent action is planned against these issues as we have sacrificed for our country.

15. Additional comments and observations

Wherever the affectees are settled, they don't have any legal rights and documentations. They are allowed to stay at good will due to personal relations or on PQA allotted land at Haji Ibrahim. The current legal land rights in Haji Ibrahim are not clear, as no one has any documentation which has lead to encroachment and growth of land mafia in the settlement. Different government agencies harass the locals and try to claims rights. We are helpless as we do not have any legal ownership of the land we live on.

Date	5/11/2015	Name of the Respondent	Sajan Baloch
Age	100	Contact Number	0324 289 5922
Gender		Male ☐ Male	Female ☐

Did your village in which you were originally living experience resettlement due to development of Port Qasim?

☑ Yes ☐ No

1. If yes, what was the name of the village? Goth Morand Chakkar

2. Where it was located? (Provide approximate location w.r.t location of the industry currently located in PQA area) East Industrial Zone

3. Estimated number of households of the resettled village 50

4. Estimated population of the village at the time of resettlement 350

5. When it was resettled? (provide year) 1974

6. Where it was resettled or where did the residents shift to? (provide current location or locations) Morand Khan Qaisrani

7. What were the primary sources of income of the residents of the village?

i. Agriculture

ii. Livestock

8. Was any compensation paid to the resettled households?

☐ Yes ☑ No

If yes, what type of compensation was paid or provided (tick all applicable)?

i. ☐ Alternate land
ii. ☐ Monetary compensation for land and built property
iii. ☐ Alternate source of income
iv. ☐ Model village
v. ☐ None of the above
vi. Other _____

9. What are the current primary sources of income for the residents of the village?

i. Daily wage labour

10. Was any commitment made by the Government of Sindh or Port Qasim Authority to ensure security of livelihood of the resettled communities?

☑ Yes ☐ No

If yes, what commitments were made?

We were promised jobs and land compensation.

11. Is there any legal case your village has filed relating to the resettlement?

☑ Yes ☐ No

If yes, please provide details of the case:

i. Why the case was filed? Inadequate Compensation and non-provision of jobs

ii. When it was filed? Not sure

iii. Where it was filed? High Court

iv. Case number? Not available

Please share the legal documents as evidence.

12. Has any decision given by the court in the case?

☐ Yes ☑ No

If yes, do you have any copy of the decision?

☐ Yes ☑ No

If yes, please share the copy of the decision.

13. Please share your grievances relating to the resettlement.

We were not given any compensation and our livelihood was lost as were dependent upon agriculture for living. We owned livestock and used our land for grazing purposes. No we don't have anything left.

14. Do you know any of the current land acquisition issues? If yes, please provide details such as the cause of issue and what action community is planning to take against it?

We have filed cases in the court of law since many years but no verdict has been announced. We plan to raise awareness through print media about the unfair treatment we are facing.

15. Additional comments and observations

No additional comments

Date	5/11/2015	Name of the Respondent	Nur Muhammad Qaisrani
Age	60	Contact Number	0300 705 6731
Gender		Male ☐ Male	Female ☐

Did your village in which you were originally living experience resettlement due to development of Port Qasim?

☑ Yes ☐ No

1. If yes, what was the name of the village? Abdul Razzaq Goth

2. Where it was located? (Provide approximate location w.r.t location of the industry currently located in PQA area) East Industrial Zone

3. Estimated number of households of the resettled village 30

4. Estimated population of the village at the time of resettlement 210

5. When it was resettled? (provide year) 1977

6. Where it was resettled or where did the residents shift to? (provide current location or locations) Mehmood Qaisrani

7. What were the primary sources of income of the residents of the village?

i. Agriculture

ii. Livestock

8. Was any compensation paid to the resettled households?

☐ Yes ☑ No

If yes, what type of compensation was paid or provided (tick all applicable)?

i. ☐ Alternate land
ii. ☐ Monetary compensation for land and built property
iii. ☐ Alternate source of income
iv. ☐ Model village
v. ☐ None of the above
vi. Other _____

9. What are the current primary sources of income for the residents of the village?

i. Daily wage labour

10. Was any commitment made by the Government of Sindh or Port Qasim Authority to ensure security of livelihood of the resettled communities?

☑ Yes ☐ No

If yes, what commitments were made?

We were promised jobs and land compensation.

11. Is there any legal case your village has filed relating to the resettlement?

☑ Yes ☐ No

If yes, please provide details of the case:

i. Why the case was filed? Inadequate Compensation and non provision of jobs

ii. When it was filed? Not sure

iii. Where it was filed? High Court

iv. Case number? Not available

Please share the legal documents as evidence.

12. Has any decision given by the court in the case?

☐ Yes ☑ No

If yes, do you have any copy of the decision?

☐ Yes ☑ No

If yes, please share the copy of the decision.

13. Please share your grievances relating to the resettlement.

The whole process was unfair and we were forced to relocate. In 1975, our access to water and land was blocked and life was made difficult for us to build pressure. Then in 1977, we were forced to leave and moved to other settlements where our family and friends lived.

14. Do you know any of the current land acquisition issues? If yes, please provide details such as the cause of issue and what action community is planning to take against it?

Jobs are not being provided nor any compensation for loss of land/house has been provided. We have resorted to legal action but cases are pending in courts since many years.

15. Additional comments and observations

No additional comments

Date	5/11/2015	Name of the Respondent	Ramazan Baloch
Age	50	Contact Number	
Gender		Male ☑	Female ☐

Did your village in which you were originally living experience resettlement due to development of Port Qasim?

☑ Yes ☐ No

1. If yes, what was the name of the village? Wasand Khan Goth

2. Where it was located? (Provide approximate location w.r.t location of the industry currently located in PQA area) East Industrial Zone

3. Estimated number of households of the resettled village 40

4. Estimated population of the village at the time of resettlement 280

5. When it was resettled? (provide year) 1985

6. Where it was resettled or where did the residents shift to? (provide current location or locations) Port Qasim Goth

7. What were the primary sources of income of the residents of the village?

i. Agriculture

ii. Livestock

iii. Fishing

8. Was any compensation paid to the resettled households?

☐ Yes ☑ No

If yes, what type of compensation was paid or provided (tick all applicable)?

i. ☐ Alternate land
ii. ☐ Monetary compensation for land and built property
iii. ☐ Alternate source of income
iv. ☐ Model village
v. ☐ None of the above
vi. Other _____

9. What are the current primary sources of income for the residents of the village?

i. Daily wage labour

10. Was any commitment made by the Government of Sindh or Port Qasim Authority to ensure security of livelihood of the resettled communities?

☑ Yes ☐ No

If yes, what commitments were made?

We were promised jobs, monetary compensation and alternate land.

11. Is there any legal case your village has filed relating to the resettlement?

☑ Yes ☐ No

If yes, please provide details of the case:

i. Why the case was filed? Inadequate Compensation and non-provision of jobs

ii. When it was filed? Not sure

iii. Where it was filed? High Court

iv. Case number? Not available

Please share the legal documents as evidence.

12. Has any decision given by the court in the case?

☐ Yes ☑ No

If yes, do you have any copy of the decision?

☐ Yes ☑ No

If yes, please share the copy of the decision.

13. Please share your grievances relating to the resettlement.

We are not happy with how we were treated. We lost everything.

14. Do you know any of the current land acquisition issues? If yes, please provide details such as the cause of issue and what action community is planning to take against it?

There are many issues. Our tribal elders are handling the process of legal proceedings against Port Qasim Authority.

15. Additional comments and observations

No additional comments

Date	5/11/2015	Name of the Respondent	Muhammad Hanif
Age	55	Contact Number	0303 250 0591
Gender		Male ☐ Male	Female ☐

Did your village in which you were originally living experience resettlement due to development of Port Qasim?

☑ Yes ☐ No

1. If yes, what was the name of the village? Muhammad Khan Gabol Goth

2. Where it was located? (Provide approximate location w.r.t location of the industry currently located in PQA area) North Western Zone

3. Estimated number of households of the resettled village 70

4. Estimated population of the village at the time of resettlement 490

5. When it was resettled? (provide year) 1975

6. Where it was resettled or where did the residents shift to? (provide current location or locations) Razzaqabad

7. What were the primary sources of income of the residents of the village?

i. Agriculture

ii. Livestock

iii. Fishing

8. Was any compensation paid to the resettled households?

☐ Yes ☑ No

If yes, what type of compensation was paid or provided (tick all applicable)?

i. ☐ Alternate land
ii. ☐ Monetary compensation for land and built property
iii. ☐ Alternate source of income
iv. ☐ Model village
v. ☐ None of the above
vi. Other _____

9. What are the current primary sources of income for the residents of the village?

i. Daily wage labour

10. Was any commitment made by the Government of Sindh or Port Qasim Authority to ensure security of livelihood of the resettled communities?

☑ Yes ☐ No

If yes, what commitments were made?

Jobs/Compensation/Alternate Housing

11. Is there any legal case your village has filed relating to the resettlement?

☑ Yes ☐ No

If yes, please provide details of the case:

i. Why the case was filed? Inadequate Compensation and non provision of jobs

ii. When it was filed? Not sure

iii. Where it was filed? High Court

iv. Case number? Not available

Please share the legal documents as evidence.

12. Has any decision given by the court in the case?

☐ Yes ☑ No

If yes, do you have any copy of the decision?

☐ Yes ☑ No

If yes, please share the copy of the decision.

13. Please share your grievances relating to the resettlement.

Not happy. We have serious concerns on non-provision of jobs and compensation. Monetary compensation was provided only against surveyed land and as most of our land was un-surveyed we did not get anything. This was unfair.

14. Do you know any of the current land acquisition issues? If yes, please provide details such as the cause of issue and what action community is planning to take against it?

Legal action.

15. Additional comments and observations

No additional comments

Date	5/11/2015	Name of the Respondent	Ali Muhammad Baloch
Age	55	Contact Number	0300 346 4926
Gender		Male [Male]	Female [ ]

Did your village in which you were originally living experience resettlement due to development of Port Qasim?

☑ Yes ☐ No

1. If yes, what was the name of the village? Mehmood Qaisrani

2. Where it was located? (Provide approximate location w.r.t location of the industry currently located in PQA area) Pakistan Steel Town

3. Estimated number of households of the resettled village 40

4. Estimated population of the village at the time of resettlement 280

5. When it was resettled? (provide year) 1975

6. Where it was resettled or where did the residents shift to? (provide current location or locations) Razzaqabad

7. What were the primary sources of income of the residents of the village?

i. Agriculture

ii. Livestock

8. Was any compensation paid to the resettled households?

☑ Yes ☐ No

If yes, what type of compensation was paid or provided (tick all applicable)?

i. ☐ Alternate land
ii. ☑ Monetary compensation for land and built property
iii. ☐ Alternate source of income
iv. ☐ Model village
v. ☐ None of the above
vi. Other _____

9. What are the current primary sources of income for the residents of the village?

ii. Daily wage labour

10. Was any commitment made by the Government of Sindh or Port Qasim Authority to ensure security of livelihood of the resettled communities?

☑ Yes ☐ No

If yes, what commitments were made?

We were promised jobs and land compensation.

11. Is there any legal case your village has filed relating to the resettlement?

☑ Yes ☐ No

If yes, please provide details of the case:

i. Why the case was filed? Inadequate Compensation and non-provision of jobs

ii. When it was filed? Not sure

iii. Where it was filed? High court

iv. Case number? Not available

Please share the legal documents as evidence.

12. Has any decision given by the court in the case?

☐ Yes ☑ No

If yes, do you have any copy of the decision?

☐ Yes ☑ No

If yes, please share the copy of the decision.

13. Please share your grievances relating to the resettlement.

Locals are being denied of job opportunities that were promised at the time of acquisition. Our cases are pending in the court of law since many years

14. Do you know any of the current land acquisition issues? If yes, please provide details such as the cause of issue and what action community is planning to take against it?

Legal action.

15. Additional comments and observations

No additional comments

Appendix E: Air Quality Assessment

The air quality assessment has been discussed in **Section 4** (*Physical Baseline*) and in **Section 8** (*Impact Assessment*). This appendix provides the details of the model developed for the assessment if impacts on ambient air quality. It includes discussion of the sources of gaseous emission, emission factors, level of activities, and total emissions from each source.

The United States Environmental Protection Agency approved regulatory air quality model AERMOD[1] was used. Weather data was taken from the Karachi weather station for 2011.

E.1 Baseline 2015

The baseline for 2015 was set up considering both anthropogenic and natural sources.

E.1.1 Air Emissions from Anthropogenic Sources

E.1.1.1 PQA Sources and Activities

PQA sources include shipping, loading and unloading at berths, traffic generated at roads and railways due to the port and PQ Industrial Zones, as well as the various industries present within the PQA industrial zones.

Shipping

The Export General Manifest[2] contains the names of ships that arrive at Port Qasim every month. Ships that arrived at Port Qasim in the months of February 2015 and June 2014 were used as reference winter and summer months. Certain ships from the PQ daily shipping reports were selected and considered as representative ships. The Deadweight Tonnage (DWT), type and manufacturing year of these oceangoing vessels[3] were looked up online[4]. The time at berth for these vessels was calculated based on the reported berthing and cast off dates as reported in the PQ Daily Shipping Reports[5].

It was estimated that in the financial year 2014-2015, 1,372 ships will use Port Qasim, calculated using a linear fit to reported data from 1997 to 2014. It was assumed that the distribution—size in DWT and vessel type (container ships, tankers, and bulk carriers)—followed the same profile of ships that used Port Qasim in February 2015 and June 2014.

Man Diesel & Turbo have compiled propulsion trends of container ships, tankers and bulk carriers based on their DWT. These documents provide average design speed and

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1 US Environmental Protection Agency, “Support Center for Regulatory Atmospheric Modeling, Recommended Models,” last modified on April 8, 2015, http://www.epa.gov/scram001/dispersion_prefrec.htm.

2 "Export General Manifest." Federal Board of Revenue. Accessed October 17, 2015. http://o.fbr.gov.pk/newcu/egm/egm.asp.

3 The terms ships and vessels are used interchangeably in this document.

4 "Instant Search" FleetMon.com. Accessed October 17, 2015.

5 http://www.pqa.gov.pk/reports.php

speed dependent power demand for each vessel type corresponding to their DWT. The catalogued ships were divided into above mentioned three categories based on the Man Diesel classifications which created a yearly profile of ships that use Port Qasim. Emission factors for channel emissions were taken from Entec[6] reports. Berth emissions were calculated based on National Pollutant Inventory methodology.[7]

Railway

There are two railroad segments on which goods are transported from PQ. The first (T07-T10, **Exhibit E.1**) carries freight from the port to the mainline. It was assumed that all freight by rail was carried up country (T03-T06, **Exhibit E.1**) and that goods destined for Karachi, land at Karachi port.

It was estimated that railways will transport 2,449,000 tonnes of cargo in 2015. This estimation was based on the projections given in Strategic Planning Study for Port Qasim[8] (SPSPQ) which were adjusted to the actual number of ships using the port from 2000 to 2014.

Pakistan Railways used only high speed diesel for locomotive purposes in 2013-14.[9]It was assumed that the current fuel efficiency of freight carried by rail is 91 tonne per km per liter. The US fleet average in 1980[10] was used as a proxy for this figure.

Sulfur content in the fuel was taken to be 0.5% which determined the SO_2 emission factor. US average fleet emission factors for Large Line haul in 2006 for NO_X and PM_{10} are 180 g/gal and 6.4 g/gal, respectively.[11] These factors were used were used in this analysis.

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6 "Quantification of ship emissions", Entec, July 2002

7 National Pollutant Inventory, "Emission estimation technique manual for Maritime operations Version 2.1, Commonwealth of Australia, July 2012,

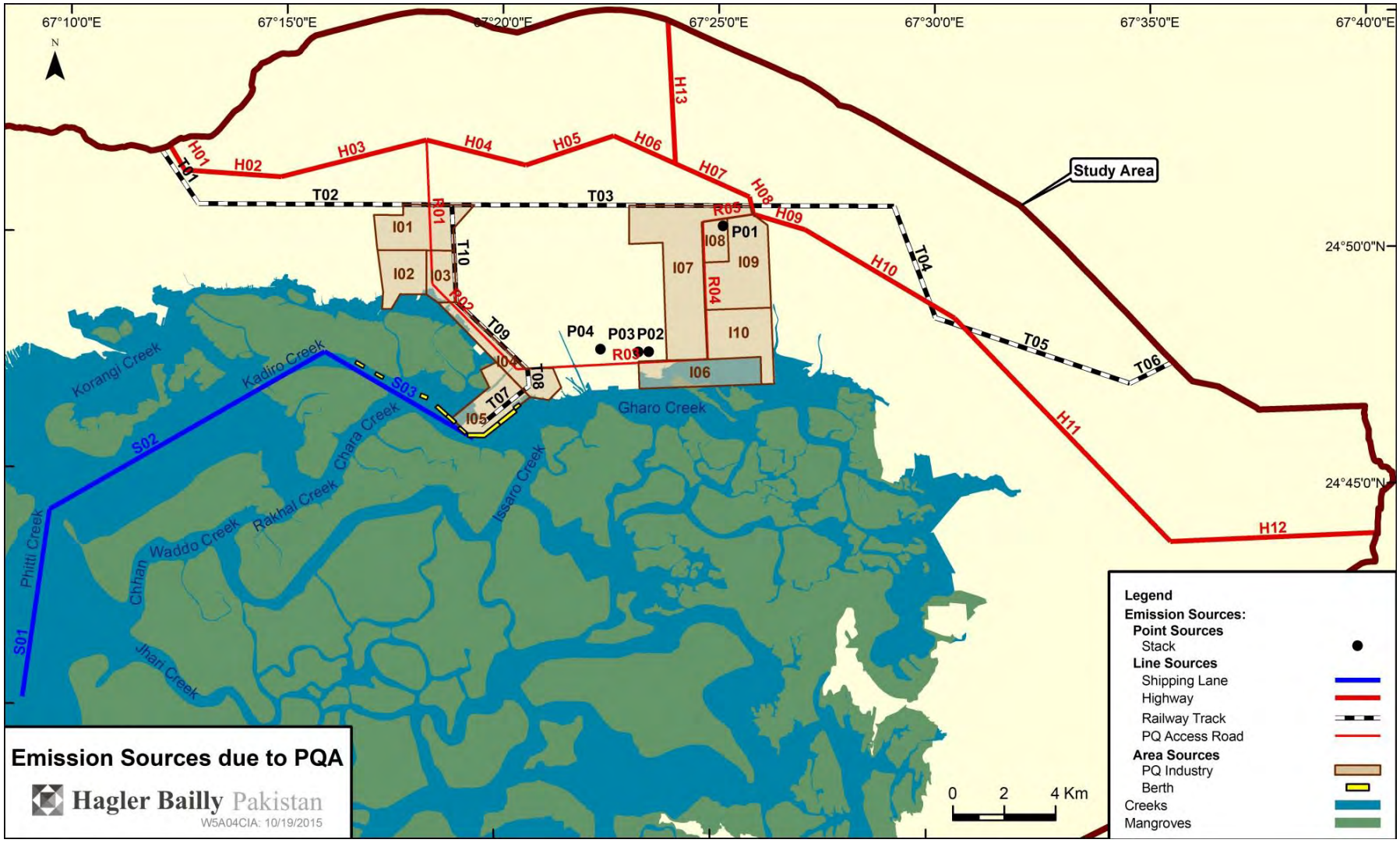
8 Engineering Consultants International Pvt. Ltd, Strategic Planning Study for Port Qasim, Port Qasim Authority, June 2001

9 "Principle Statistics", Pakistan Railways, 2014

10 "The Environmental Benefits of Moving Freight by Rail", Association of American Railroads. August 2015

11 Office of Transportation and Air Quality, "Emission Factors for Locomotives**",** United States Environmental Protection Agency, April 2009

Exhibit E.1: Emission Sources due to PQA



Road

There are two access roads that connect PQ to the national highway N-5, the main access road (R01-R02, **Exhibit E.1**) and the eastern access road (R03-R05, **Exhibit E.1**). It was estimated that 84% of trips were on the main access road and the remainder on the eastern access road. Of the traffic leaving PQA, 65% heads west towards Karachi; 12% heads east towards Thatta; and 23% heads towards the Motorway M-9 (Super Highway).

Based on projections in the SPSPQ, it was estimated that there will be 5,380 freight trips per day and 12,360 general traffic trips per day on PQ access roads. 84% of trips will be on the main access road and the remainder on the eastern access road. SPSPQ also contained the breakdown of general traffic by vehicle type (cars, motorcycles, pickups, auto rickshaws, buses, trucks) on each of the two access roads in 2001 and it was assumed that this profile will stay the same in 2015. Emission factors due to internal combustion were based on vehicle type.[12]

As vehicle moves on the road, due to friction between vehicle's tyre and road, the dust particles comes in suspension which causes dust (PM_{10} and $PM_{2.5}$) emissions. The ratio of $PM_{2.5}/PM_{10}$ is 0.15 for paved and unpaved roads. Emission factors for paved and unpaved roads were taken from AP-42 documentation.[13] For emissions estimation from roads in PQA only the two main access roads were taken into modeling.

Point Industrial Sources

Major Emission sources within PQA industrial zones were treated as point sources and are listed in **Exhibit E.2** and shown in **Exhibit E.1**. The modeling parameters for each point source were obtained from their EIAs.

Exhibit E.2: Point Sources within PQA Industrial Zones

ID	*Stack Description*
P01	Fauji Fertilizer Bin Qasim, Fertilizer Plant[14]
P02	Lotte Chemicals, Power Plant[15]
P03	Lotte Chemicals, Chemical Plant[16]
P04	Engro Polymers, Chemical Plant[17]

[12] "Emission Factor development for Indian Vehicles", The Automotive Research Association of India ,August, 2007

[13] This include AP-42, chapter 13-Miscellenous Sources, "Section 13.2.1 for Paved Roads"; http://www3.epa.gov/ttnchie1/ap42/ch13/final/c13s0201.pdf and "Section 13.2.2 for Unpaved Roads", http://www3.epa.gov/ttnchie1/ap42/ch13/final/c13s0202.pdf.

[14] HaglerBailly Pakistan, "Environmental Impact Assessment of Coal Power Plant (CPP) Project Fauji Fertilizer Bin Qasim Complex", Fauji Fertilizer Bin Qasim Ltd., Karachi, February, 2014.

[15] Hagler Bailly Pakistan. "Initial Environmental Examination of PPTA Cogeneration Power Plant", Pakistan PTA Ltd., Karachi, May, 2007.

[16] Ibid.

[17] Hagler Bailly Pakistan. "Environmental Impact Assessment of Engro Asahi Polymer Chemical Ltd. Expansion Project", EAPCL Karachi, February, 2009.

Area Industrial Sources

Port Qasim has three industrial zones: North Western Industrial Zone (NWIZ), Southwestern Industrial Zone (SWIZ) and Eastern Industrial Zone (EIZ). Only Fully Active (FA) industrial units were included in emissions modeling for 2015.

Using web searches, Google Earth and an on ground survey, business types of most industrial units were identified. Industries were then grouped together into similar blocks numbered (**I01-I10**) based on the type of industries currently present and zoning as per the PQA master plan. These zones are shown in **Exhibit E.1.**

Industrial units were distributed into broad categories: storage, chemical, edible oil, pharmaceutical, food processing (mills), incineration, automotive, textile, and heavy industry. Selected industrial units in conjunction with relevant AP-42 documentation[18] and other sources[19] were used to develop estimates for per unit area emission factors for each of these categories.

Total emissions from each block were calculated by multiplying the fraction of the area in each category by the emission factor developed for that category. Each block was modeled as a single area source.

E.1.1.2 Impact of PQA on Air Quality

Results of the modeling exercise of the emission sources due to PQA, for NO_x, SO_2, PM_{10} and $PM_{2.5}$ are shown in **Exhibit E.3** to **Exhibit E.6**. As can be n in these exhibits the emissions from PQA are focused around PQA and concentrations are low near the end of the 18 km study area. Therefore, this scale of study for the air quality impacts is deemed suitable. However, receptors affected by PQA are also affected by other developments in the Study Area not directly related to PQA activities. Therefore, it was considered important to discuss the emission potential of these other developments to gauge whether the cumulative pollution is within air quality limits or not.

E.1.1.3 Other Developments Outside of PQA

Developments outside of PQA that are also affecting the receptors affected by PQA activities are discussed below.

Railway

The main bulk of rail traffic was due to passenger trains on the main Pakistan Railway line (T01 – T06, **Exhibit E.7**). According to the Karachi Cantonment Station train timetable[20] there were 23 up trains (from Karachi to up country) and 23 down trains (from up country to Karachi) scheduled per day in 2015.

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[18] These include Chapters: 6.13 Pharmaceuticals Production, 13.2.4 Aggregate Handling And Storage Piles, 1.1 Bituminous And Subbituminous Coal Combustion, 9.9.1 Grain Elevators And Processes, 9.11.1 Vegetable Oil Processing, 2.2 Sewage Sludge Incineration, and 8.10 Sulfuric Acid.

[19] Textile emission factors were based on estimated natural gas consumption as in the EIA of PQ Textile City. Heavy industry EFs were calculated based on the average of the existing and proposed heavy industries and power plants at the south west of the PQ EIZ.

[20] "Pakistan Railway Time Table. "Karachi Cant Train Timings. Accessed October 19, 2015. http://www.railpk.com/karachi-cant.html.

Exhibit E.3: NO_x Annual Emissions due to PQA – 2015

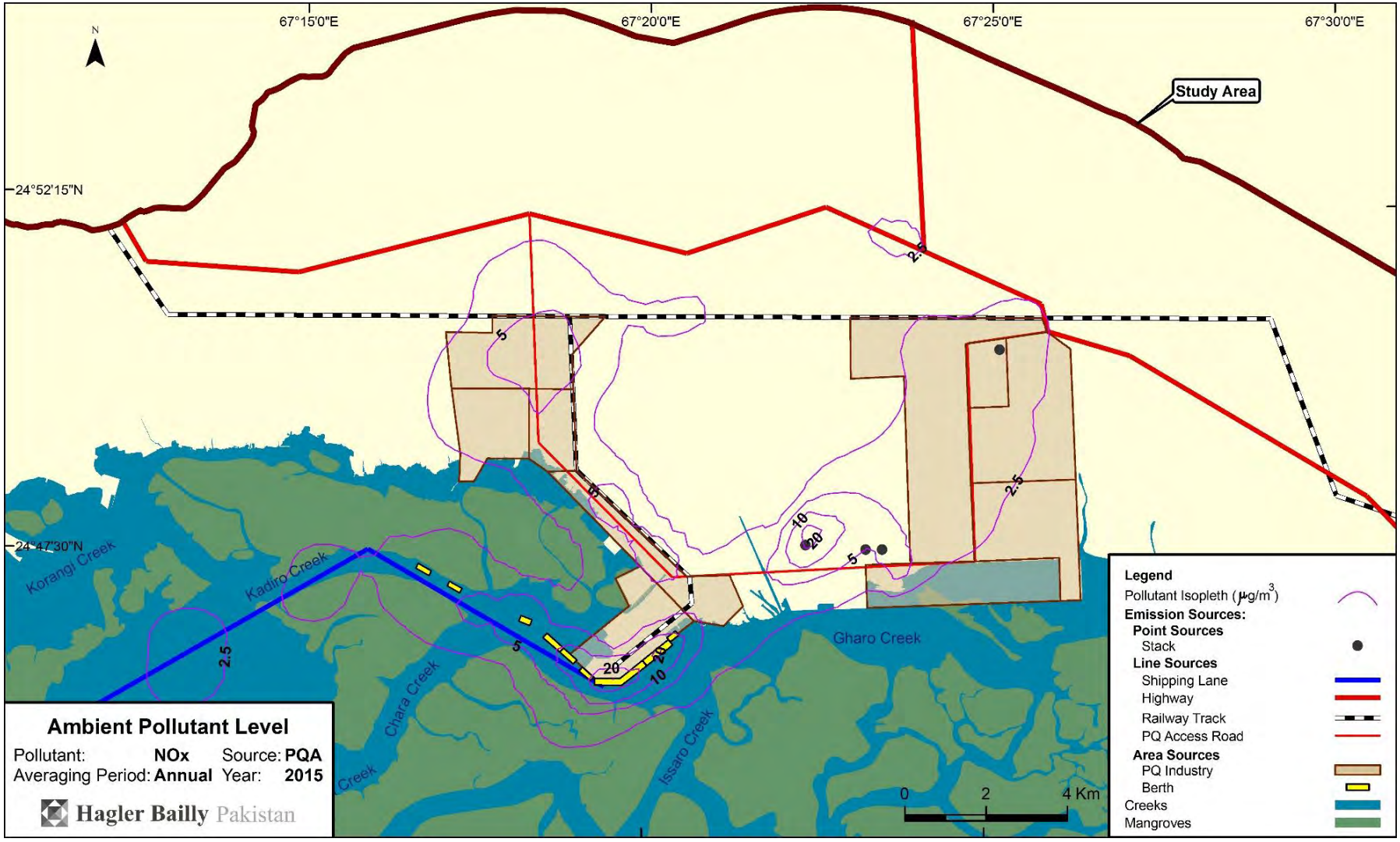


Exhibit E.4: SO_2 Annual Emissions due to PQA – 2015

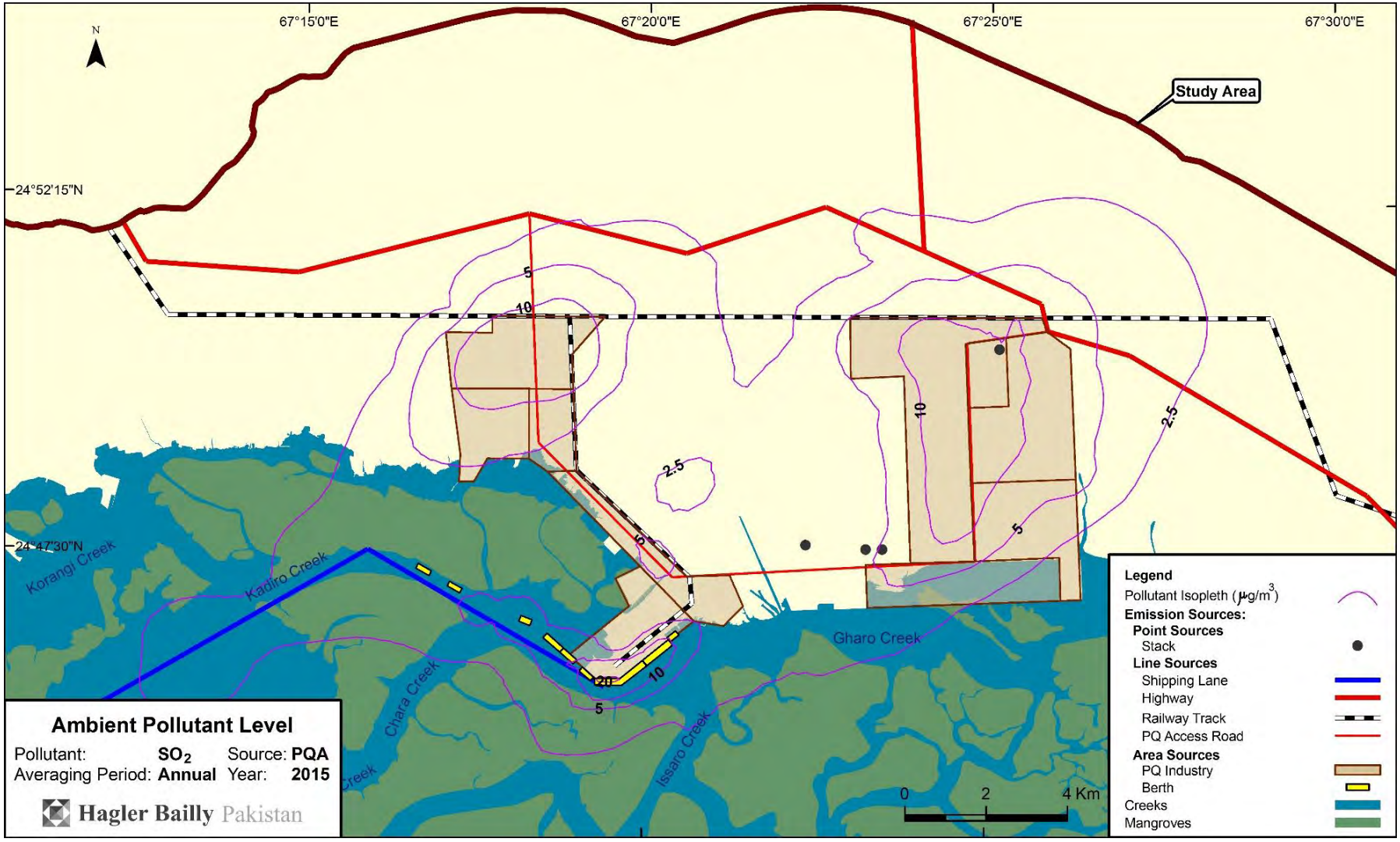


Exhibit E.5: PM_{10} Annual Emissions due to PQA- 2015

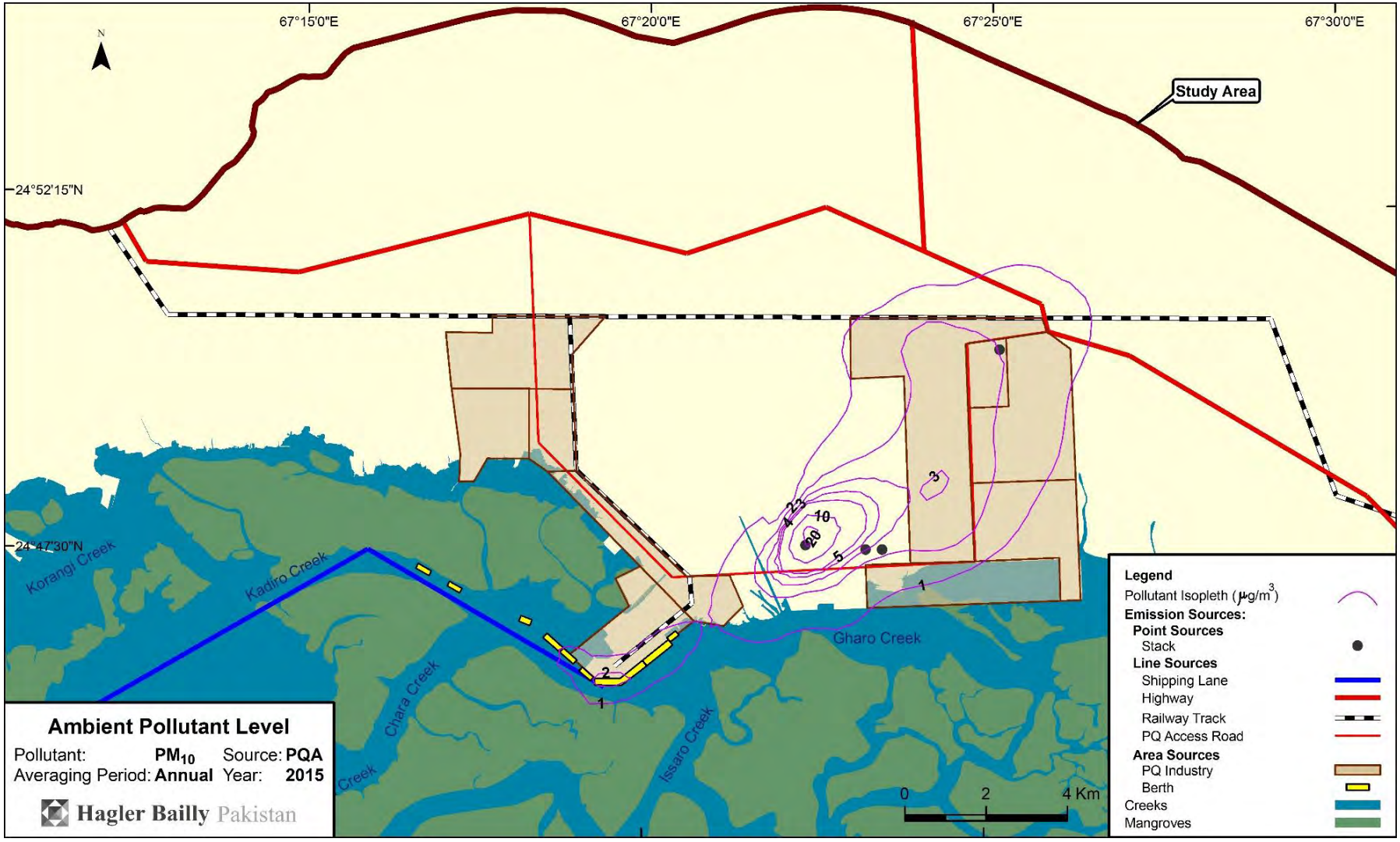


Exhibit E.6: $PM_{2.5}$ Annual Emissions due to PQA- 2015

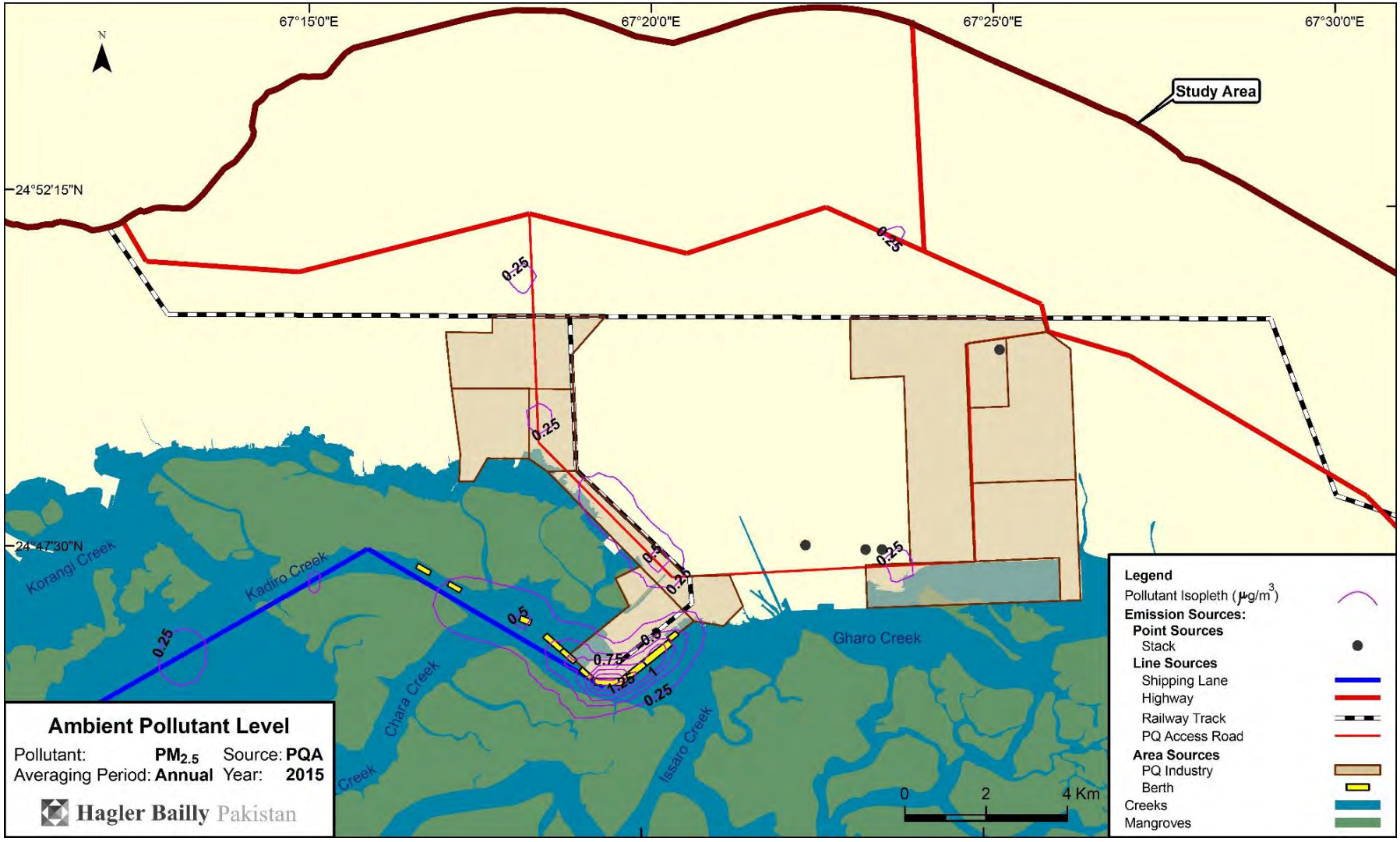
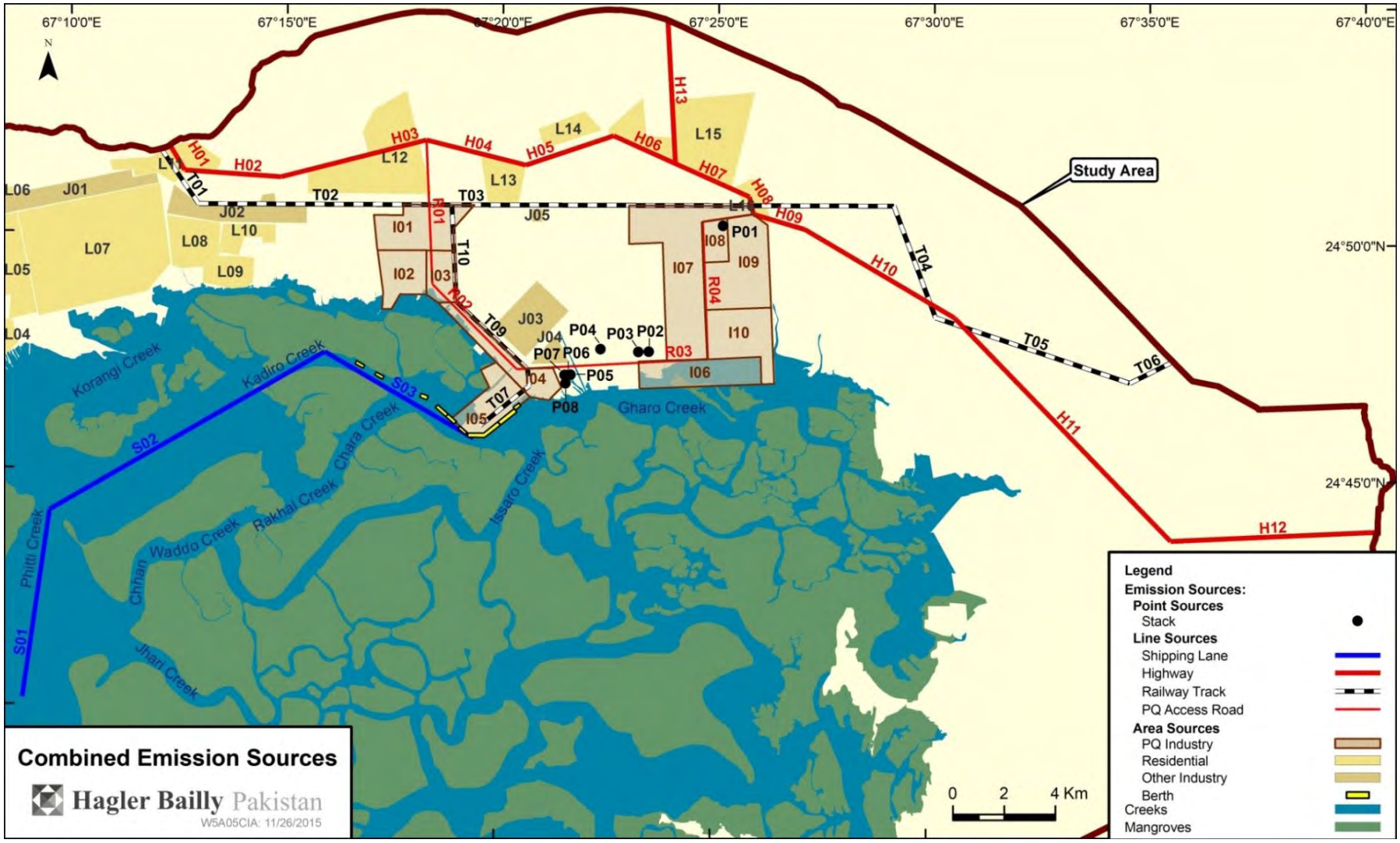


Exhibit E.7: Combined Emission Sources



Fuel efficiency for passenger trains was calculated to be 4.1 liters per km, using total kilometers travelled and High Speed Diesel (HSD) consumed for locomotive purposes in 2012-13 and 2013-14 by the Pakistan Railways.[21] Emission factors were taken to be the same as those for freight discussed earlier.

Road

The N-5 passes through the Study Area, is one of the main highways that connect Karachi to Northern Sindh and Punjab (H01-H11, **Exhibit E.7)**.Therefore, it is a major source of vehicular traffic in the Study Area. The vehicular traffic estimates on the N-5[22] is given in **Exhibit E.8**. Emission factors for paved and unpaved roads were taken from AP-42 documentation[23]. For emissions estimation only N-5 was taken into modeling and other smaller roads were ignored.

Exhibit E.8: Daily Vehicular Traffic on the N-5

Category	*% by vehicle*	*Daily no of vehicles*
Cars	32%	9,998
Motorcycles	46%	14,482
Pickups	13%	4,149
Auto rickshaws	9%	2,970
Buses	16%	1,360
Trucks	84%	7,140

Point Industrial Sources

Currently the major emission source outside of PQA is limited to the K-Electric power plant. Its different plants were modeled separately and are listed in **Exhibit E.9** and shown in **Exhibit E.7**.

Exhibit E.9: Point sources outside of PQA

ID	*Stack Description*[24]
P05	K-electric, 420 MW Gas Power Plant
P06	K-electric, 420 MW HSFO Power Plant
P07	K-electric, 420 MW HSFO Power Plant
P08	K-electric, 570 MW Gas Power Plant

21 "Principle Statistics", Pakistan Railways, 2014

22 Hagler Bailly Pakistan.Environmental Impact Assessment of Coal Transportation between Qasim and Lakhra by Railway for Lakhra Coal-fired Thermal Power Plant, Japan International Cooperation Agency Survey Team, August, 2015.

23 This include AP-42, chapter 13-Miscellenous Sources, "Section 13.2.1 for Paved Roads"; http://www3.epa.gov/ttnchie1/ap42/ch13/final/c13s0201.pdf and "Section 13.2.2 for Unpaved Roads", http://www3.epa.gov/ttnchie1/ap42/ch13/final/c13s0202.pdf.

24 Hagler Bailly Pakistan. "Environmental Impact Assessment of Bin Qasim Coal Conversion Project", K-Energy (Pvt.) Ltd., Karachi, September, 2013.

Area Industrial Sources

There are several major industrial areas outside of PQA that may affect the pre-identified receptors. These include Aisha, Tuwairqi and Pakistan Steel Mills and Landhi and Korangi Industrial Areas (J01 – J05, **Exhibit E.7**). The Aisha and Tuwairqi Steel Mills are integrated steel manufacturers. The production capacity of Aisha Steel Mill is 2, 20,000 tonnes per year. The Tuwairqi Steel Mill is currently not operational and therefore not included in modeling, but its production capacity before shutdown was 1,280,000 tonnes per year.The Pakistan Steel Mill (PSM) was reported to have consumed 1,200,000 tonnes of coal[25] in 2008-09, the highest consumption value in the last 7 years. This highest consumption was based on the assumption that the mill was running at its 100% capacity. It was assumed that PSM is currently running at its10% capacity and therefore consumed 10% of the coal it did in 2008-09. Korangi Industrial Area was not modeled due to the large number of unidentified industries present and its large distance from the focus of the air modeling study area. It was assumed that Landhi is mostly composed of textile units with the remaining area as roads, shops and open areas.

Residential Areas

Residential areas within the Study Area were divided into similar blocks based on the type of construction, number of storey in houses and planning of houses demarcated as L01 – L17[26] (**Exhibit E.7)**.Fuel consumption was estimated by surveyingrepresentative transects of each of the residential blocks. Most blocks used natural gas for domestic purposes with two depending on wood. Space heating is not a requirement in the area. Emission factors used to calculate residential emissions were based on AP-42 documentation.[27]

E.1.1.4 Cumulative Model Baseline

A cumulative air quality baseline was set up by adding the emissions due to PQA and other developments outside of PQA. The combined[28] results are shows in **Exhibit E.10** to **Exhibit E.13**.

[25] "Pakistan Energy Yearbook 2014", Ministry of Petroleum and Natural Resources, Government of Pakitan, May 2015.

[26] Some of these areas are not displayed in the map as they are to the east of the frame. They all lie within the Study Area.

[27] AP 42, Fifth Edition, Volume I Chapter 1: External Combustion Sources

[28] Combined include emissions from anthropogenic sources from PQA and other developments outside PQA.

Exhibit E.10: Combined Annual NO_X Concentrations- 2015

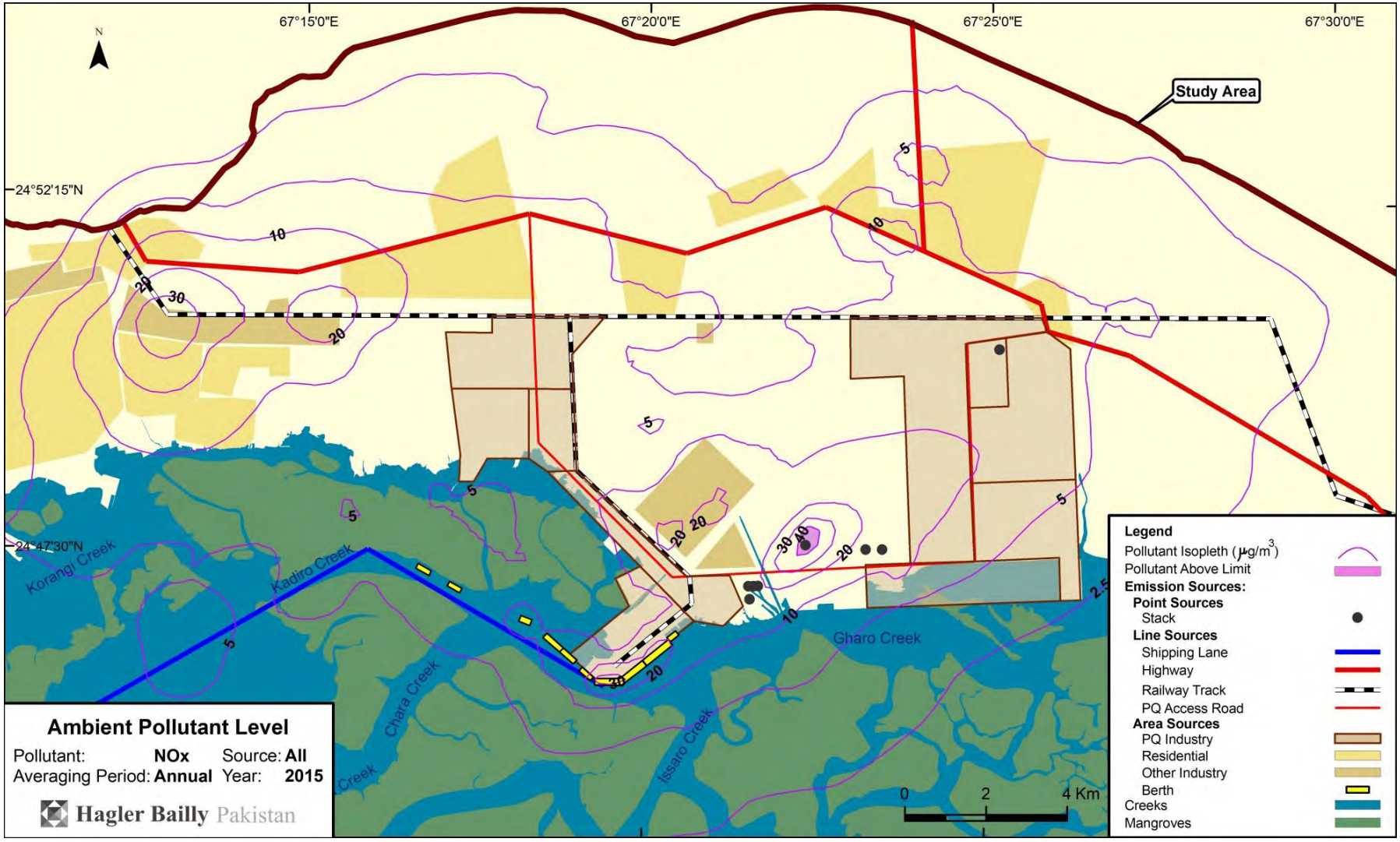


Exhibit E.11: Combined Annual SO_2 Concentrations- 2015

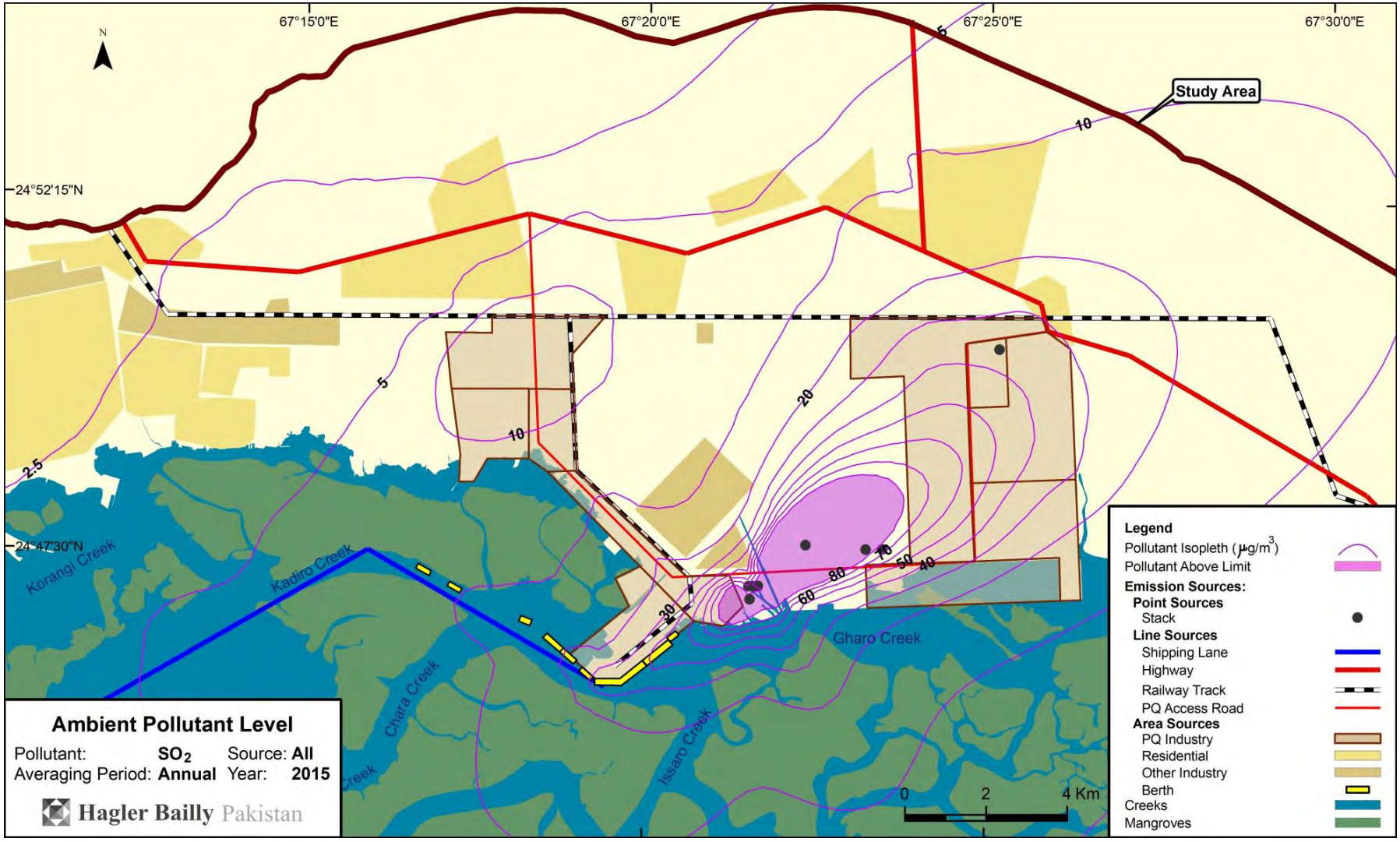


Exhibit E.12: Combined Annual PM_{10} Concentrations- 2015

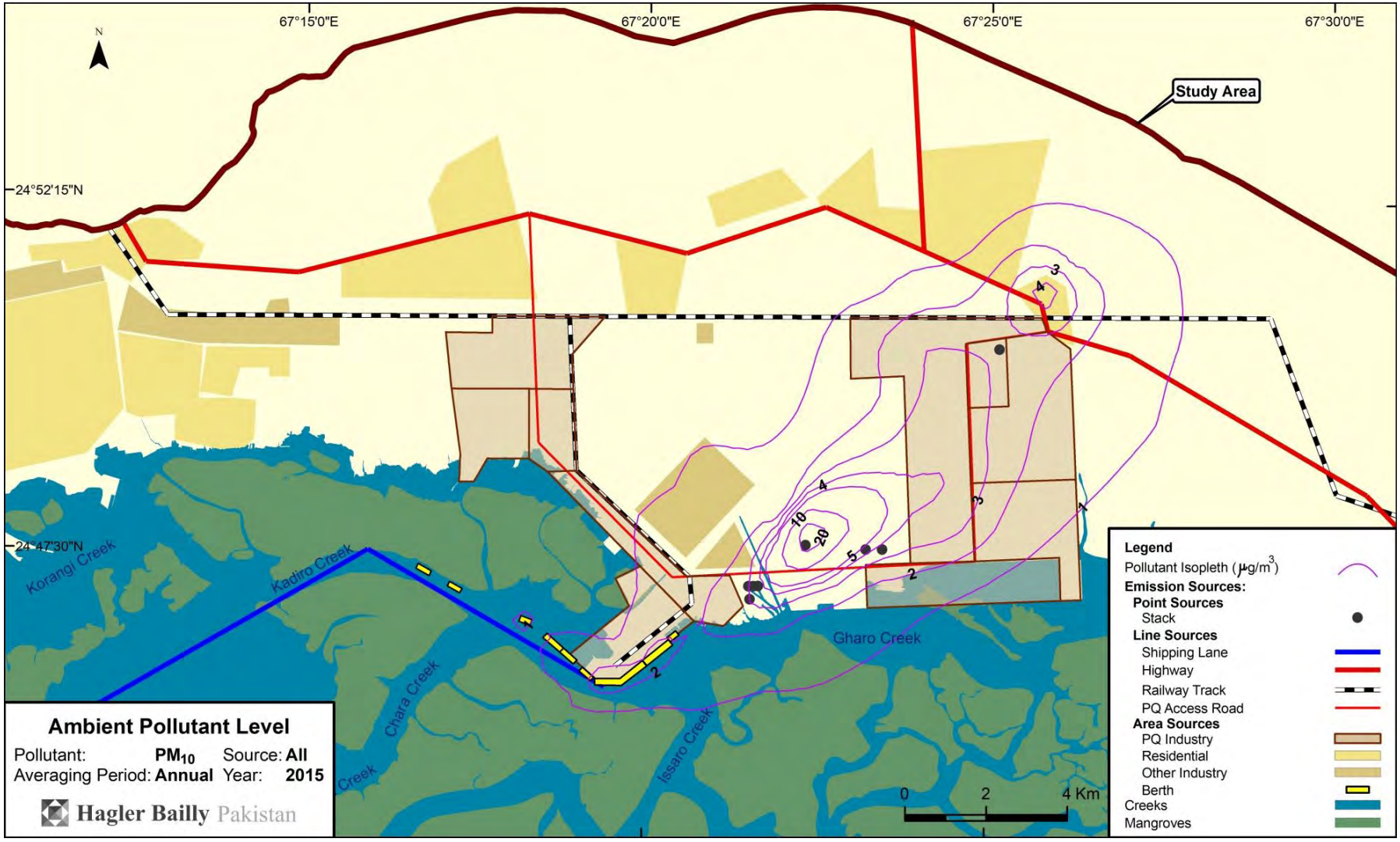
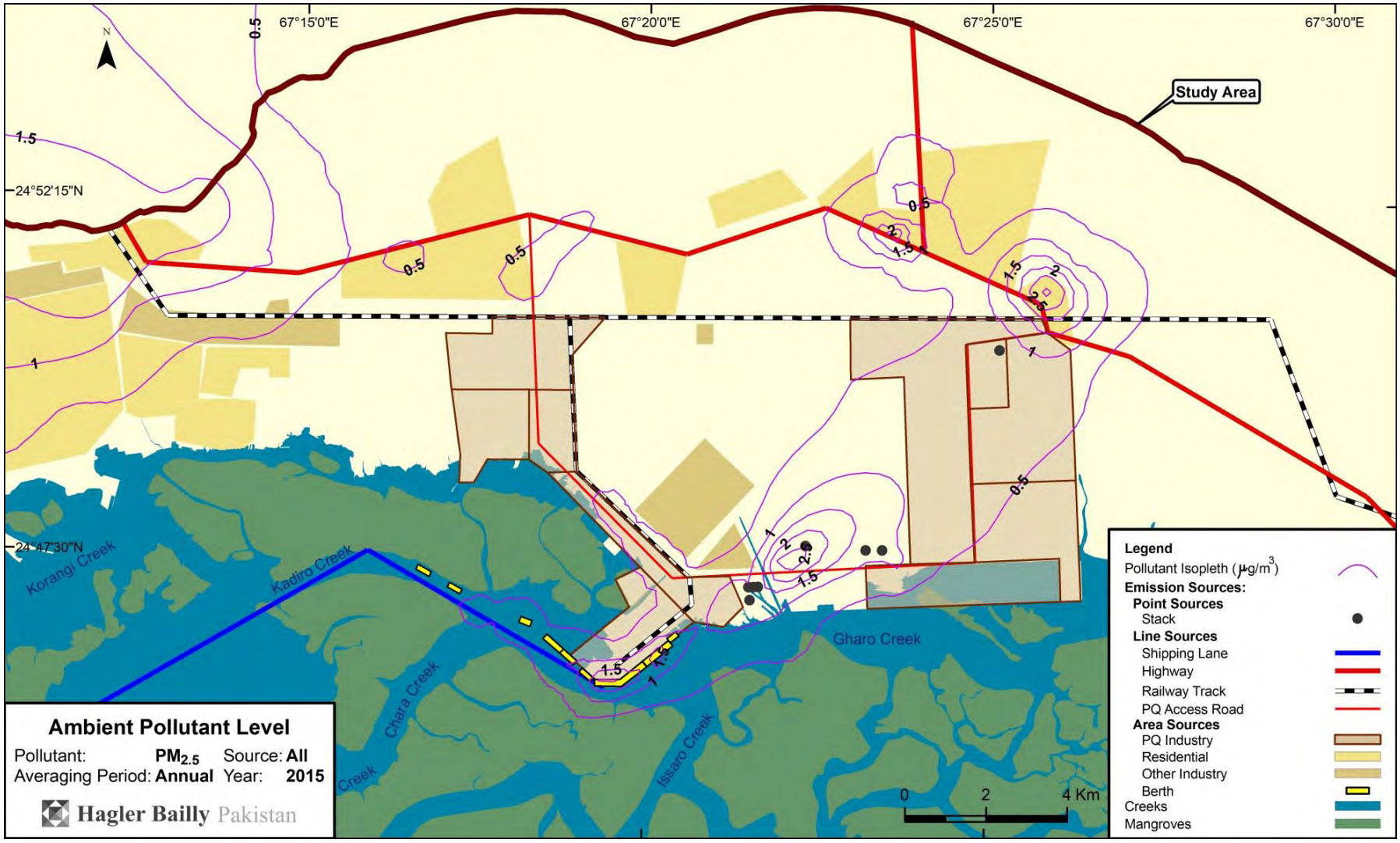


Exhibit E.13: Combined Annual $PM_{2.5}$ Concentrations- 2015



E.1.2 Air Emissions from Natural Sources

Windblown dust is the major source of particulate matter in the ambient air. The analysis shows that anthropogenic sources have negligible emissions as compared to natural sources. To estimate the concentration of dust in the ambient air due to natural sources, the Study Area was divided into 12 blocks on the basis of dominant land use. Land use in each block was categorized as follows: active agriculture, inactive agriculture, barren, and constructed land. The percentage coverage of each land category can be seen in **Exhibit E.**14 and the blocks are shown in **Exhibit E.**15**.** The emission factor for each land category was taken from methodology developed by Maricopa County in Arizona.[29]

Exhibit E.14: Land Use Estimate in Each Block – 2015

Block Number	*Active Agriculture*	*Inactive Agriculture*	*Constructed*	*Barren*
1	15.4%	23.1%	23.6%	37.9%
2	3.2%	3.2%	74.2%	19.4%
3	0.0%	0.0%	34.6%	65.4%
4	3.7%	1.6%	83.5%	11.2%
5	11.5%	2.9%	7.4%	78.2%
6	1.1%	0.3%	64.0%	34.7%
7	1.3%	1.3%	24.6%	72.7%
8	0.0%	0.0%	38.4%	61.6%
9	0.0%	0.0%	18.1%	81.9%
10	0.0%	0.0%	40.0%	59.9%
11	2.7%	24.1%	21.0%	52.3%
12	0.5%	4.4%	1.7%	90.4%

The dust emissions from natural sources are shown in **Exhibit E.16** and **Exhibit E.17**. Areas that were exceeding limits have been shaded.

[29] "Windblown Dust Emission Estimation Methodology Document", https://www.maricopa.gov/aq/divisions/planning_analysis/docs/Reports/2008/App4_WindblownDust.pdf

Exhibit E.15: Blocks Used for Open Area Emission Modeling

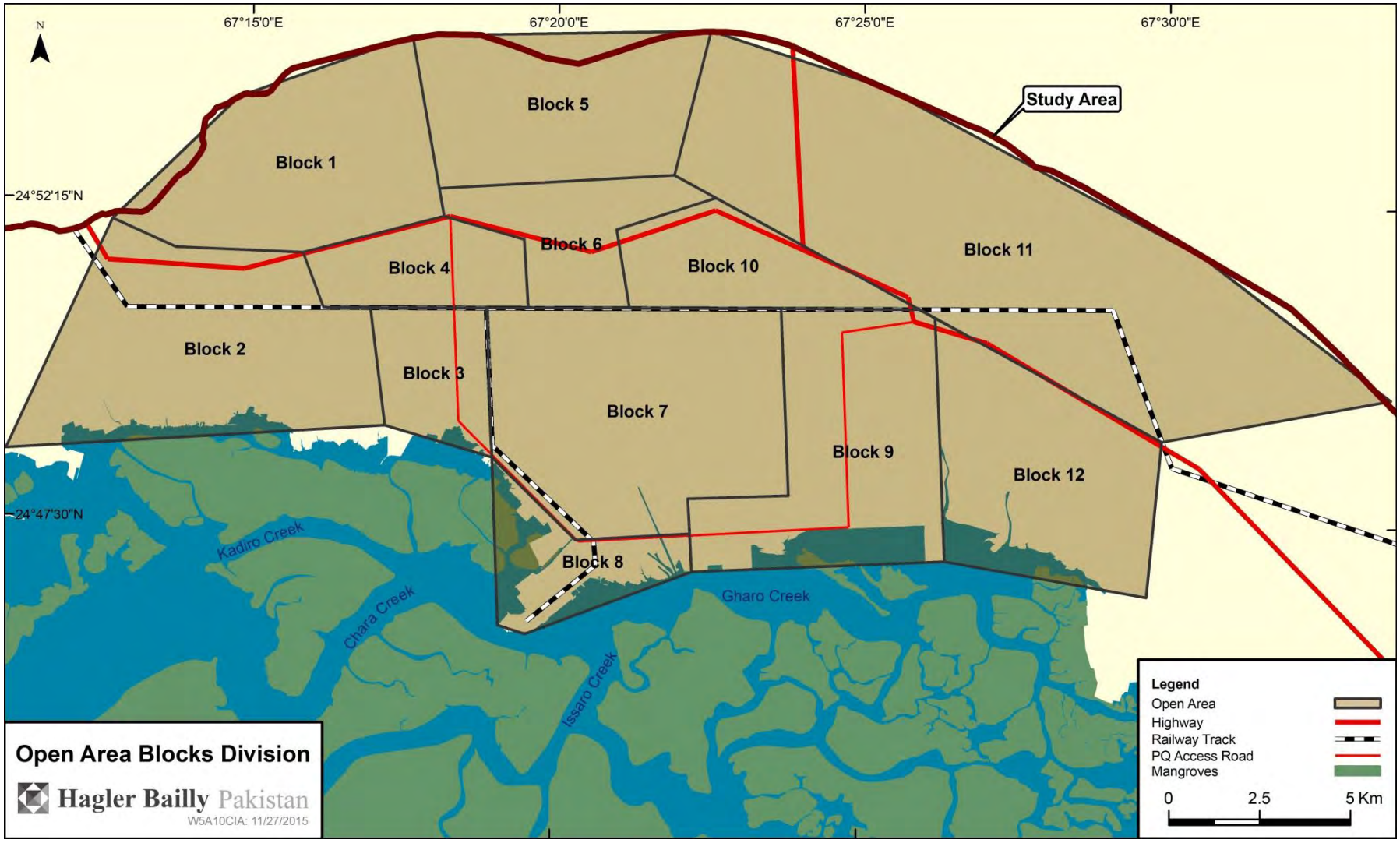


Exhibit E.16: Open areas Annual PM_{10} Concentrations- 2015

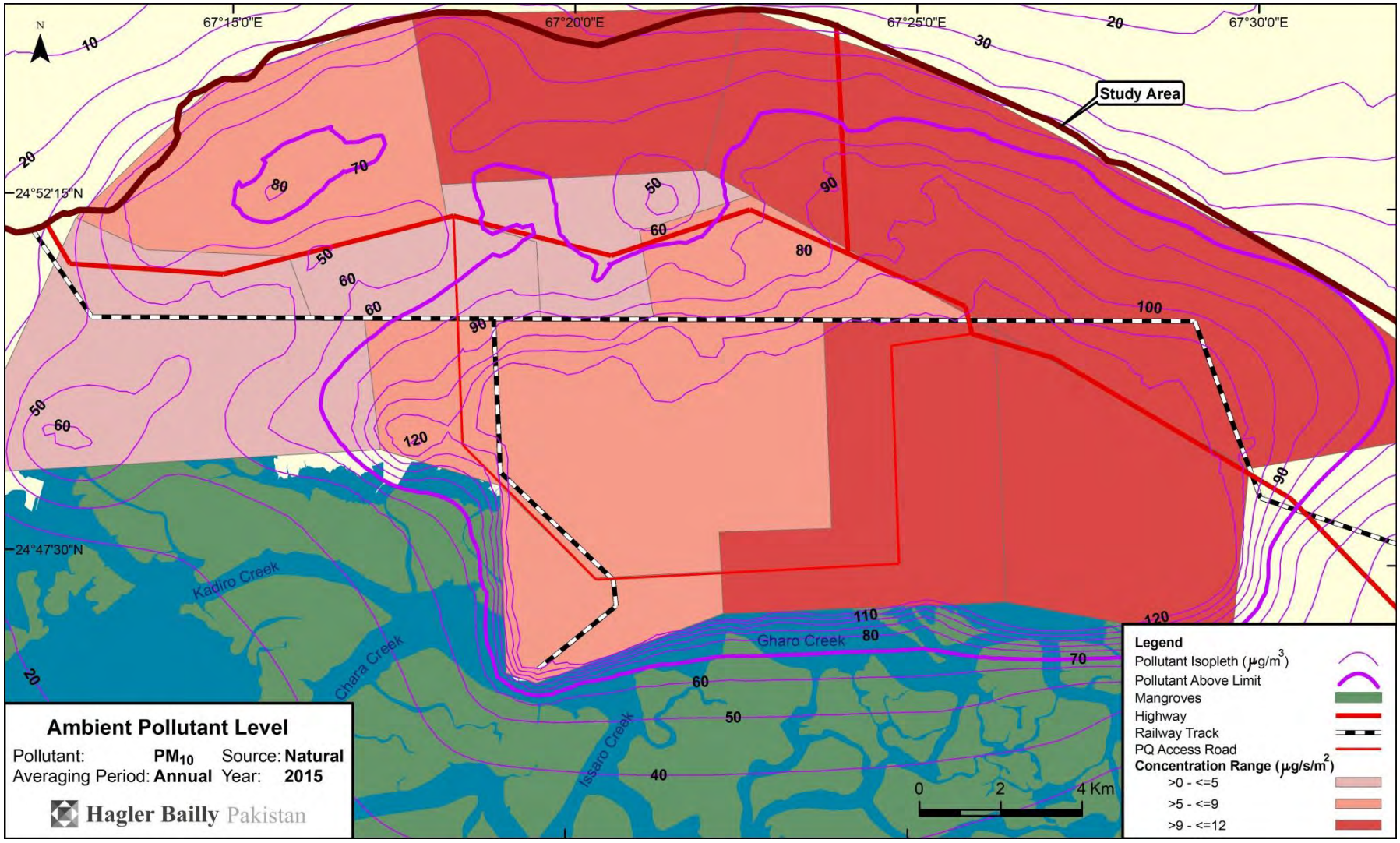
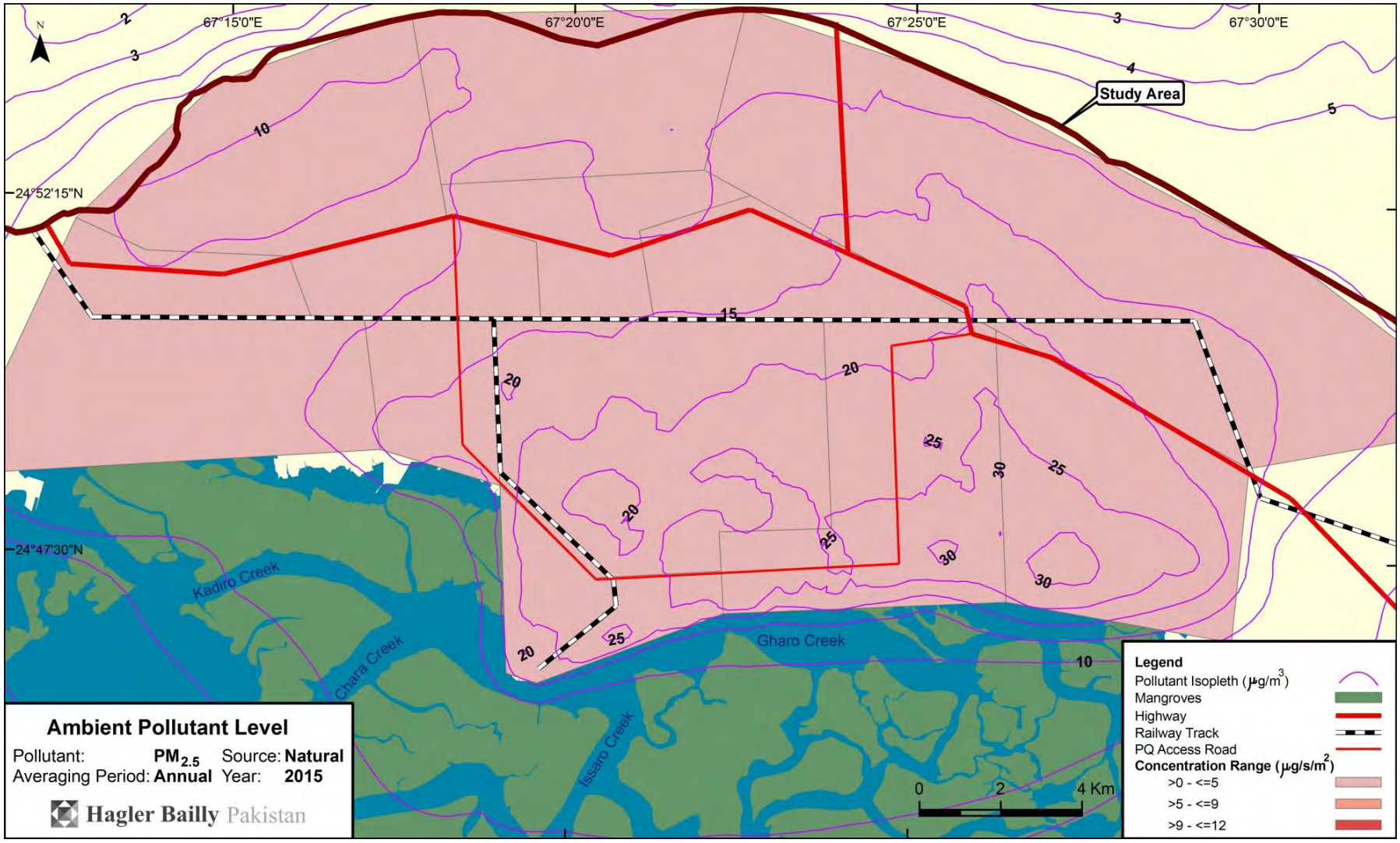


Exhibit E.17: Open areas Annual $PM_{2.5}$ Concentrations- 2015



E.1.3 Observed Data on Ambient Air Quality

The available data on ambient air quality is analyzed and the major emission sources are identified in this section.

E.1.3.1 Emission Sources

Industrial Emission in PQA Industrial Zones

The number of active industrial units within PQA Industrial Zones is estimated to be about 154. Using the available information, on the size of the plants and the nature of industrial processes, major emission sources have been identified and shown in **Exhibit E.**18**.** The list of the industrial units is provided in **Exhibit E.19.** Fuel combustion is the predominant source of emission in these units. Residual Fuel Oil (RFO), natural gas and diesel are the main fuels used in these plants. Thus emissions from these sources mainly include oxides of nitrogen (NO_x), sulfur dioxide (SO_2) and particulate matter (TSP[30], PM_{10}[31] and $PM_{2.5}$[32]).

Industrial Emission Outside PQA Industrial Zones

The industrial emission sources outside PQA Industrial Zones, but within the Study Areas, are discussed below.

Pakistan Steel Mills

Pakistan Steel Mill, spread over an area of 7,551 ha (18,660 acres) with 4,200 ha (10,390 acres) for the main plant, 3,265 ha (8,070 acres) for the township and 81 ha (200 acres) for the water reservoir Pakistan Steel is Pakistan's largest industrial complex, comprising component units numbering more than 20. PSM specializes in the production of flat steel products including, billets, slabs, hot rolled coils, cold rolled coils, galvanized iron products and corrugated sheets. PSM has a production capacity of 1.1 million ton of steel per annum. The plant was commissioned in mid 1980s.

K-Electric Bin Qasim Power Plant

K-Electric operates 1,260 MW Bin Qasim Power Station 1 (BQPS-1) and 560 MW Bin Qasim Power Station 2 (BQPS-2). Both power stations are located within the same premises, a 70.8 ha (175 acres) property owned by K-Electric. BQPS-1 comprises six dual-fired (oil and gas) units each with installed power generating capacity of 210 MW whereas BQPS-2 is a natural gas fired power plant based on gas and steam turbines.

Landhi Industrial Area

Landhi Industrial Trading Estate (LITE) is located west of the PQA Industrial Zone. LITE covers about 4,452 ha (11,000 acres) and houses about 1,100 industrial units[33] producing textiles, heavy machinery, automobiles, chemicals, pharmaceuticals, and ceramics. With 125 units, textiles constitute a major proportion of the economic activity in the LITE area.

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30 TSP indicates total suspended matter having diameter of all sizes.

31 PM_{10} indicates particulate matter having diameter less than 10 microns.

32 $PM_{2.5}$ indicates particulate matter having diameter less than 2.5microns.

33 Website of Landhi Association of Trade and Industry (http://landhi.org/aboutus/landhifacts.php, Accessed August 2015)

Korangi Industrial Area

Korangi Industrial Area (KIA) is situated to the west of PQA Industrial Zone, adjacent to LITE. With an area of over 3,440 ha (8500 acres) and an estimated 4,500 industrial, commercial, and service concerns, it claims to be one of the largest industrial estate in Pakistan. It is estimated that the number of industrial units in KIA is about 1,500. Major industrial units operating in the KIA include the Pakistan Refinery Limited, the National Refinery Limited, leather tanneries, and more than 350 textile units. Other units include jute, wool, leather, pharmaceuticals, cosmetics, sanitary, chemicals, engineering, rubber products, paint, food and automobiles industry.[34]

Traffic

Traffic on the National Highway N-5 and the traffic originating or terminating at PQA industrial zones is a major source of emission in the Study Area. The Average Daily Traffic (ADT) for light vehicles (motor cycles, cars and pickups) and heavy vehicles (buses and trucks), in both direction are as follows:[35]

- Between Karachi and Port Qasim: 9,700 light; 6,600 heavy (16,300 total)
- Between Port Qasim and location to the east: 1,800 light; 2,400 heavy (4,200 total)
- On N-5: 31,600 light; 8,500 heavy (40,100 total)

Therefore, well over 60,000 vehicles pass through or near Port Qasim Industrial Zone every day.

[34] Korangi Industrial Estate website (http://www.kati.pk/, accessed August 2015)

[35] Environmental Impact Assessment of Bin Qasim Coal Conversion Project. September 2013.

Exhibit E.18: Air Emission Sources

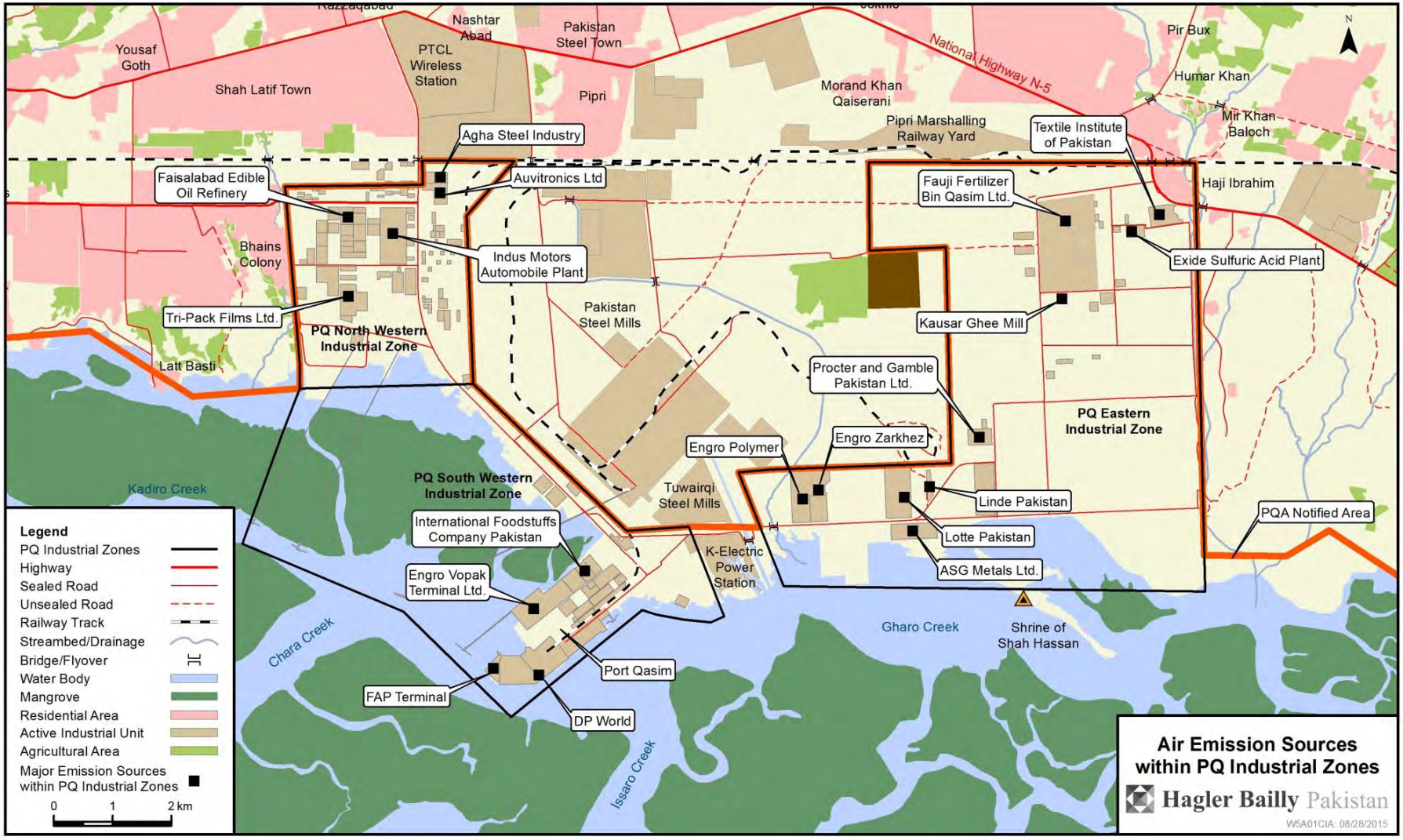


Exhibit E.19: Potential Sources of Air Emissions within Industrial Zones of Notified PQA Area

Industrial unit	*Type of Industrial unit*	*Area covered (acres)*
Eastern Industrial Zone		
ASG Metals Ltd. (manufacturing plant)	Steel unit	50
Engro Zarkhez (NPK[36] plant)	Fertilizer unit	31
Engro Polymer (PVC[37] plant)	Chemical unit	103
Exide Pakistan Ltd. (Sulphuric Acid Plant)	Chemical unit	10
Fauji Fertilizer Bin Qasim Ltd.	Fertilizer unit	310
Kausar Ghee Mill	Edible oil unit	10
Linde Pakistan (Hydrogen and Carbon dioxide plant)	Gas unit	10
Lotte Chemicals Pakistan (Purified Terephthalic Acid plant)	Chemical unit	95
Procter and Gamble Pakistan Ltd. (Ariel plant)	Chemical unit	27
Textile Institute of Pakistan	Textile unit	38
Northwestern Industrial Zone		
Agha Steel Ltd.	Steel unit	10
Auvitronics Ltd. (manufacturing plant)	Automotive unit	25
Faisalabad Edible Oil Refinery Ltd.	Edible oil unit	15
Indus Motors Automobile Plant	Automotive unit	107
Tri-pack Films Ltd. (production plant).	Chemical unit	51
Southwestern Industrial Zone		
International Foodstuffs Company Pakistan	Edible oil unit	12
Terminals in Southwestern Industrial Zone		
DP World (Qasim International Container Terminal 1 and 2)	Terminal	202
Engro Vopak Terminal Ltd.	Terminal	23
Fauji Akbar Portia Terminals	Terminal	202

E.1.3.2 Sources of Air Quality Data and Locations

The ambient air quality data was collected from various published environmental impact assessment reports of industrial developments in the industrial zones of PQA Area and literature. The data from these secondary sources is presented as a compiled table in **Appendix B.2** shows the sampling locations, sampling durations and concentration of

[36] NPK indicates macro nutrients nitrogen, phosphorous and potassium

[37] PVC indicates polymer poly-vinyl chloride

pollutants at all sampling locations. The pollutants considered for analysis are SO_2, NO_2, NO, TSP, PM_{10} and $PM_{2.5}$. Carbon Monoxide (CO) and ozone (O_3) are not listed as there is little baseline, and predicted, information available on these. The sampling locations are shown in **Exhibit E.20**.

E.1.3.3 Data Analysis

Temporal and spatial analysis has been carried out on the data.

Temporal Divisions and Spatial Averaging

For analysis of temporal variation data was separated for two divisions:

1. 2004-2010
2. 2011-2015

For analysis of spatial variation, the area was divided into five zones:

1. Eastern industrial zone of notified PQ area (2011-2015)
2. Northwestern industrial zone of notified PQ area (2011-2015)
3. Along the coast (2004-2010)
4. Along the coast (2011-2015)
5. Reference point taken at Gharo, which is distant to Port Qasim and has relatively good air quality.

A sampling point along Gharo (see **Exhibit E.20**) was taken as reference to compare it with the areas having extensive industrial activities.

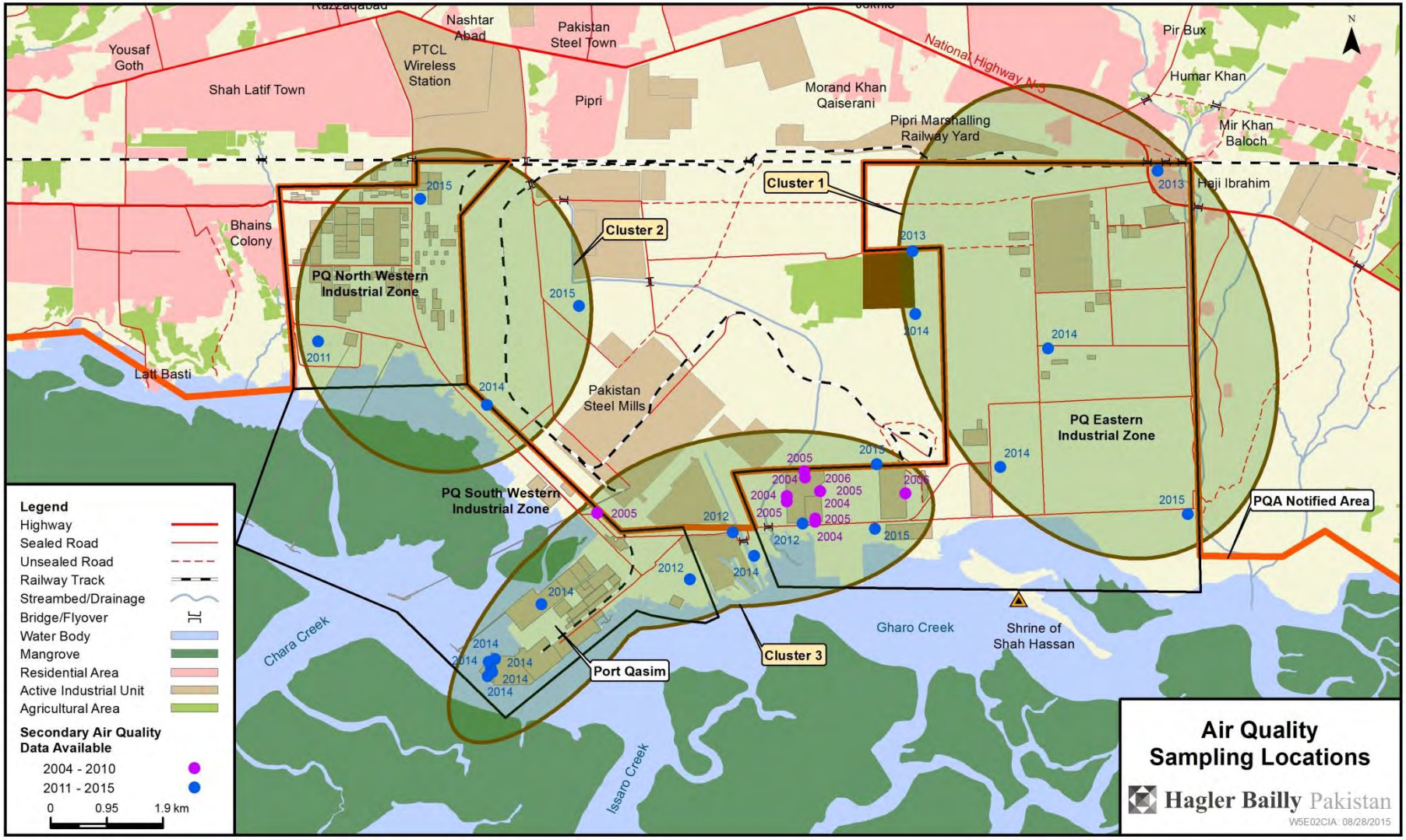
Calculation of Weighted Average for Each Zone and Temporal Division

Since the duration of sampling is not provided, or varies, for the sampling locations, duration-weighted averages were calculated using the following formula:

$$Concentration\ (in\ zone) \quad = \frac{\sum_i^n k_i c_i}{\sum k}, where\ k = duration\ of\ each\ concentration$$

The duration weighted averaging ensures that longer sampling durations are given greater weightage in calculating the average.

Exhibit E.20: Sampling Locations for Baseline Air Quality



Results and Discussion

1. The reported concentration of pollutants along the coast (Cluster 3) is higher in 2004-2010 as compared to 2011-2015. The reason for the decrease in the amount of pollutant is not clear and needs further research. Probable causes include:
    a. Bias (in averaging) due to a smaller amount of information available in the years from 2004-2010 compared to 2011-2015.
    b. Reported decrease in the production of Pakistan Steel Mill (PSM). The production data of PSM is not available. PSM consumes imported coal annual consumption data for which is available and can be used as an indicator. The average consumption of coal between 2005-06 and 2009-10 (5 years) was 594,290 tonnes whereas the consumption for three subsequent years, the period for which data is available, was 322,707 tonnes. A corresponding reduction in emission is therefore expected. The situation has not improved this year as it has been reported[38] that the average production in the month of March 2015 and April 2015 stood at 41% and 35% of the production capacity, respectively.
2. The concentration of key pollutants including (NO_X, SO_2, PM_{10} and $PM_{2.5}$) along the sea coast (Cluster 3) is higher than the eastern and western industrial zones of PQA Area. This is because of the major port operational activities are taking place along this sampling site.
3. The concentration of particulate matter is nearly same in all data sets. This high concentration of PM is common occurrence all over Pakistan and is attributed to dry conditions and natural wind-blown dust.

The above results are considered representative of the industrial zones. Some of the sampling points in Clusters 1 and 2 are likely to capture traffic emission, however, given the predominant wind direction, the sampling points in Cluster 3 are unlikely to receive emissions from Korangi, Landhi, or the N-5 traffic in any significant amount. This data can then be used to calibrate the baseline data that will be developed in the second part of the study through dispersion modeling.

E.1.4 Comparison of Observed and Modeled Data

For comparison of baseline with this observed data, the nearest modeled point to the observation coordinates was selected and its pollutant concentration was compared to the observed concentration. Factors that may influence this comparison include:

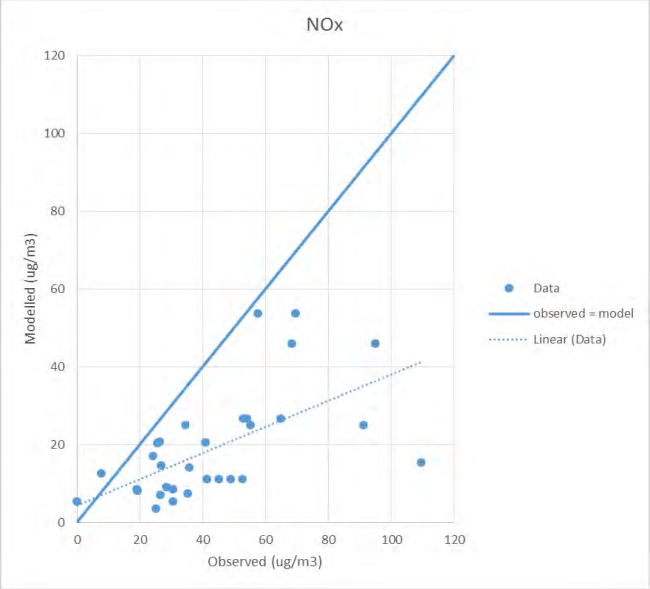
- Observed values were24 hour averages, whereas modeled values were annual averages
- Observed values were obtained over a ten year period (between 2004 and 2015) whereas the model was run for one year period (2015).

[38] The News International, “Stricken Pakistan Steel Mills look to govt to ease financial crunch” May 14, 2015

NO_x

Observed NOx concentrations were estimated by adding observed values for NO_2 and 1.5 times NO, based on balanced chemical equation for oxidation of NO. The comparison is shown in **Exhibit E.21**. It is noted that the model underestimates NO_x concentrations.

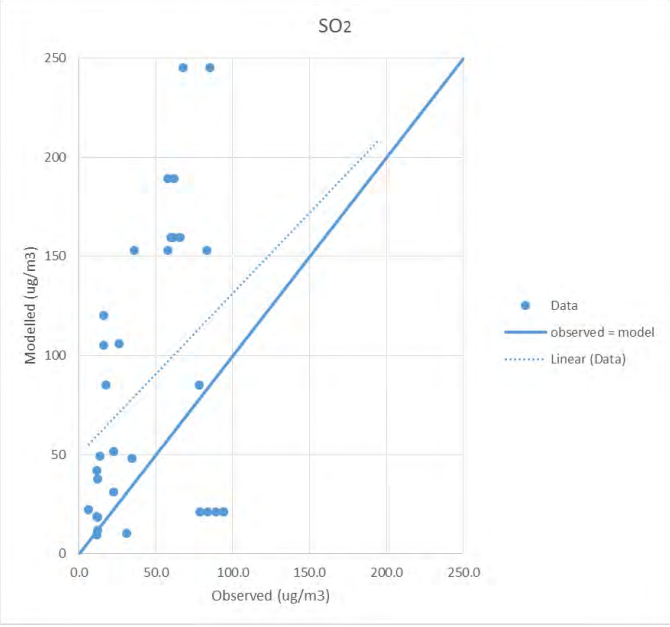
Exhibit E.21: NO_x Observed vs Modeled Concentrations



SO_2

The comparison between observed and modeled SO_2 concentrations is shown in **Exhibit E**.22. It is noted that the model overestimates SO_2 concentrations.

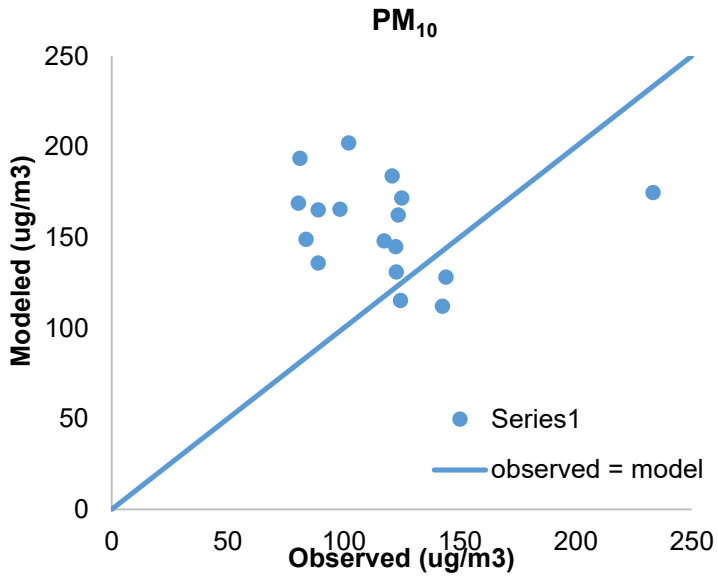
Exhibit E.22: SO_2Observed vs Modeled Concentrations



PM_{10}

A significant proportion of PM_{10} concentration is due to the natural source when windblown from the open areas present in the Study Area. All sources of PM_{10} were included in the modeling. The modeled values shows a reasonable match with the observed values as seen in **Exhibit E.23**.

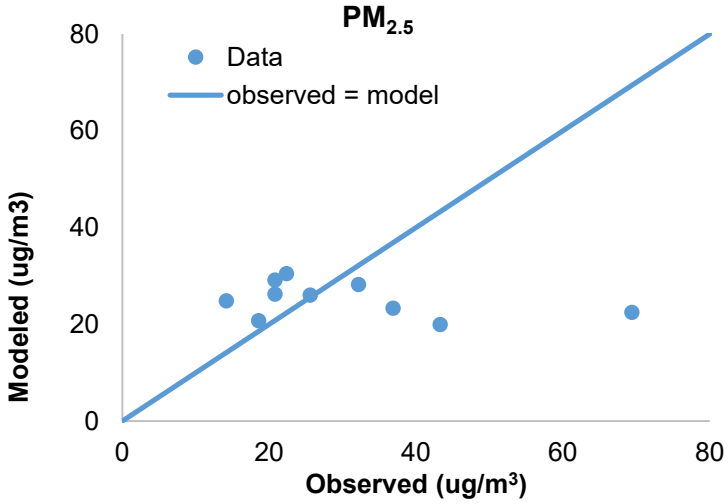
Exhibit E.23: PM_{10} Observed vs Modeled Concentrations



$PM_{2.5}$

There are only 11 $PM_{2.5}$ readings as compared to 35 NO_X and 33 SO_2 readings. The comparison is shown in **Exhibit E.24**. It can be seen that modeled and observed $PM_{2.5}$ values coordinate with each other with one outlier where model underestimates the observed values.

Exhibit E.24: $PM_{2.5}$ Observed vs Modeled Concentrations



E.1.5 Comparison with Air Quality Standards

The comparison of modeled results with SEQS and IFC EHS Guidelines are given in **Exhibit E.25**. The key takeaways are:

- Under business as usual scenario, NO_x concentrations exceed the target limit in 2015, when all the sources within Study Area are considered. The area exceeding target limit is 27 ha.
- Under business as usual scenario, SO_2 concentrations exceed the target limit in 2015, when all the sources within Study Area are considered. This is mainly due to the high Sulfur content of the fuel oil used by the K-electric power station. The area where the SO_2 concentration is exceeding is 770 ha.
- For 2015, the predicted contribution of anthropogenic sources in PM_{10} levels in the ambient air is small compared to the target limit. However, combined with the concentration due to the natural sources, the total concentration exceeds the target limit. The area exceeding the target limit due to natural sources is 26,400 ha.
- For 2015, the predicted contribution of anthropogenic sources in $PM_{2.5}$ levels in the ambient air is small compared to the target limit. When combined with the concentration due to the natural sources, the total concentration is expected to exceed the target limit. Therefore, it is expected that in 2015, the natural sources will become the major contributor to the $PM_{2.5}$ concentration in the ambient air.

Exhibit E.25: Comparison of Annual Pollutant Concentrations to Air Quality Standards ($\mu g/m^3$)

Pollutant	*Source*	*Category*	*2015*	*SEQS*	*IFC*	*Target Limit*
NO_x	Anthropogenic	PQ	33	100	40	40
		Combined	54			
SO_2	Anthropogenic	PQ	24	80	-	80
		Combined	245			
PM_{10}	Anthropogenic	PQ	31	120	70	70
		Combined	34			
	Natural	Open areas	218			
$PM_{2.5}$	Anthropogenic	PQ	2	40	35	35
		Combined	4			
	Natural	Open areas	33			

E.2 Projections for 2050

The projections for future growth in Port Qasim and other developments such as PSM are discussed below. It draws heavily from the SPSQS.

E.2.1 Projected Level of Emissions from Anthropogenic Sources

E.2.1.1 PQA Activities

The SPSPQ gives projected volumes for ship, road and rail for 2050. However, these projections were made in 2001. The number of ships that used Port Qasim between 2001 and 2014 were available and the SPSPQ estimates were corrected based on this data.[39]As freight transport through truck and rail is dependent on ship traffic, the road and rail estimates were also adjusted accordingly. The total number of ships was distributed by the type and size profile developed earlier. The SPSPQ projections and the adjusted estimates used in the modeling for projected emissions are given in **Exhibit E.26**.

Exhibit E.26: Transport Volume Projections per year

	2050		
	Number of Ships	*Tonnes transported by Rail*	*Vehicles on Access roads*
SPSPQ	2,991	5,532,500	76,920
Adjusted	3,008	5,564,700	77,370

E.2.1.2 Other Developments Outside of PQA

It was estimated that the current N-5 can handle a 25% increase in traffic before it reaches capacity and that the lanes will be doubled in 2050. It was assumed that the highways operate at maximum capacity in 2050 as a worst case scenario. Therefore traffic will be 2.5 times more in 2050 than it was in 2015. It was also assumed that the railway line will operate at its maximum capacity of 90 trains in 2050.[40] Linear growth between 2015 and 2050 were obtained by interpolating between the two time frames.

E.2.2 Projected Level of Emissions from Natural Sources

It was assumed that the land use within Study Area will change in 2050. The large area that was barren in 2015 will convert to constructed area (either residential or industrial) that will result in the reduction of PM_{10} and $PM_{2.5}$ emissions. It was assumed that agricultural area (active and inactive) will remain the same. The percentage coverage of each land category in each block is in **Exhibit E.**27.

[39] For example, the SPSPQ projection for 2020 is 1256 ships at PQ, whereas PQ handled 1280 ships in 2014.

[40] Hagler Bailly Pakistan.Environmental Impact Assessment of Coal Transportation between Qasim and Lakhra by Railway for Lakhra Coal-fired Thermal Power Plant, Japan International Cooperation Agency Survey Team, August, 2015.

Exhibit E.27: Land Use Estimate in Each Block - 2050

Block Number	*Active Agriculture*	*Inactive Agriculture*	*Constructed*	*Barren*
1	15.4%	23.1%	52.0%	9.5%
2	3.2%	3.2%	91.6%	1.9%
3	0.0%	0.0%	93.5%	6.5%
4	3.7%	1.6%	91.9%	2.8%
5	11.5%	2.9%	46.5%	39.1%
6	1.1%	0.3%	95.2%	3.5%
7	1.3%	1.3%	90.1%	7.3%
8	0.0%	0.0%	93.8%	6.2%
9	0.0%	0.0%	91.8%	8.2%
10	0.0%	0.0%	85.0%	15.0%
11	2.7%	24.1%	47.1%	26.1%
12	0.5%	4.4%	49.9%	45.2%

The results of modeling can be seen in **Exhibit E.28** and **Exhibit E.29**.

Exhibit E.28: Open area Annual $PM_{2.5}$Concentrations – 2050

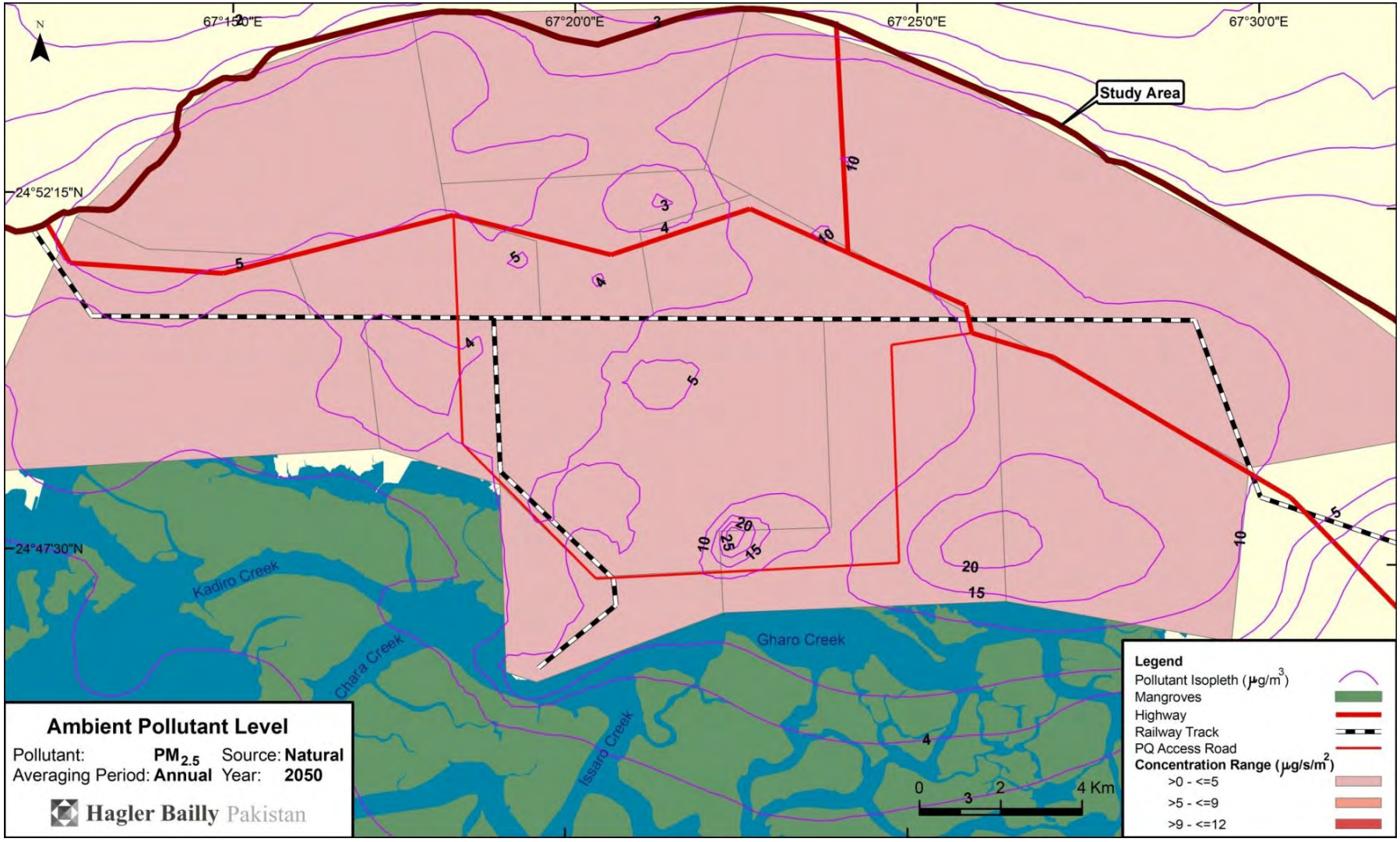
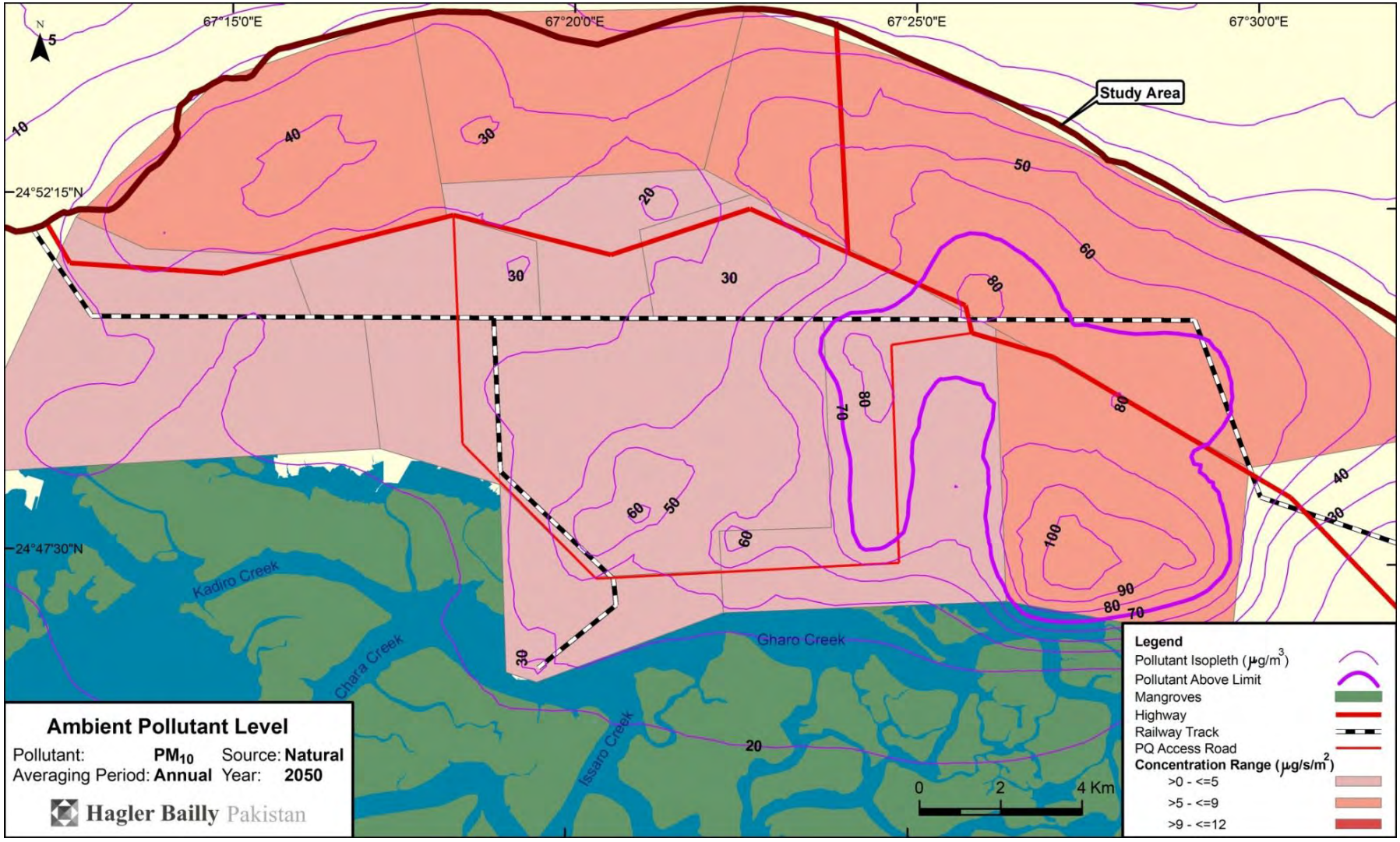


Exhibit E.29: Open area Annual PM_{10} Concentrations – 2050



E.2.3 Projected Change in Emission Controls

The change in emission controls for each source is discussed below**.**

E.2.3.1 Railways

It was estimated that the SO_2 emissions will improve because of adoption of Euro–2 standards in 2050[41]. It was estimated that NO_X and PM_{10} emission factors will improve due to the induction of new engines into the Pakistan Railways fleet. For example, 55 GE locomotives are expected to be delivered by 2017.[42] Fuel efficiency was also expected to increase due to the retirement of old engines and addition of new engines. The US average fuel efficiency of 160 tonne km per liter from 2005[43] was used in this analysis.

E.2.3.2 Road

It was assumed that Euro–2 diesel will be adopted in 2050 which will reduce the SO_2 emission factors for trucks and buses. The remaining emission factors were kept constant.

E.2.3.3 Shipping

The Entec document provides different NO_x emission factors for ships constructed pre 2000 and post 2000.[44] It was assumed that all ships using PQ in the year 2050 will be constructed after 2000.

E.2.3.4 Industries as Point Sources

Major industrial developments as point sources that are expected to take place in the future are presented in

Exhibit E.30. Their source parameters were obtained from their respective EIAs. These points are displayed in **Exhibit E.31.**

41 "Ministry plans to put off marketing of Euro II diesel" Dawn, July 30, 2012.

42 "PR inks accord with GE to procure 55 locos", Pakistan Today, June 21, 2015.

43 “The Environmental Benefits of Moving Freight by Rail”, Association of American Railroads. August 2015

44 “Quantification of ship emissions”, Entec, July 2002

Exhibit E.30: Expected Industrial Developments in the Study Area

ID	*Description of Development*
P06	K-electric; Conversion from HSFO to Coal of 420 MW Power Plant[45]
P07	K-electric; Conversion from HSFO to Coal of 420 MW Power Plant [46]
P09	Sino Hydro; 2x660 MW Coal Power plant[47]
P10	Engro Powergen CCPP , 450 MW RLNG Power Plant[48]
P11	Siddique sons, 350 MW Coal Power Plant [49]
P12	Fauji Fertilizer Bin Qasim Complex; 21 MW Coal Power Plant[50]
P13	Lucky Electric Power Company; 660 MW Coal Power Plant

45 Hagler Bailly Pakistan, "Environmental Impact Assessment of Bin Qasim Coal Conversion Project", K-Energy (Pvt.) Ltd., Karachi, September 2013.

46 Ibid.

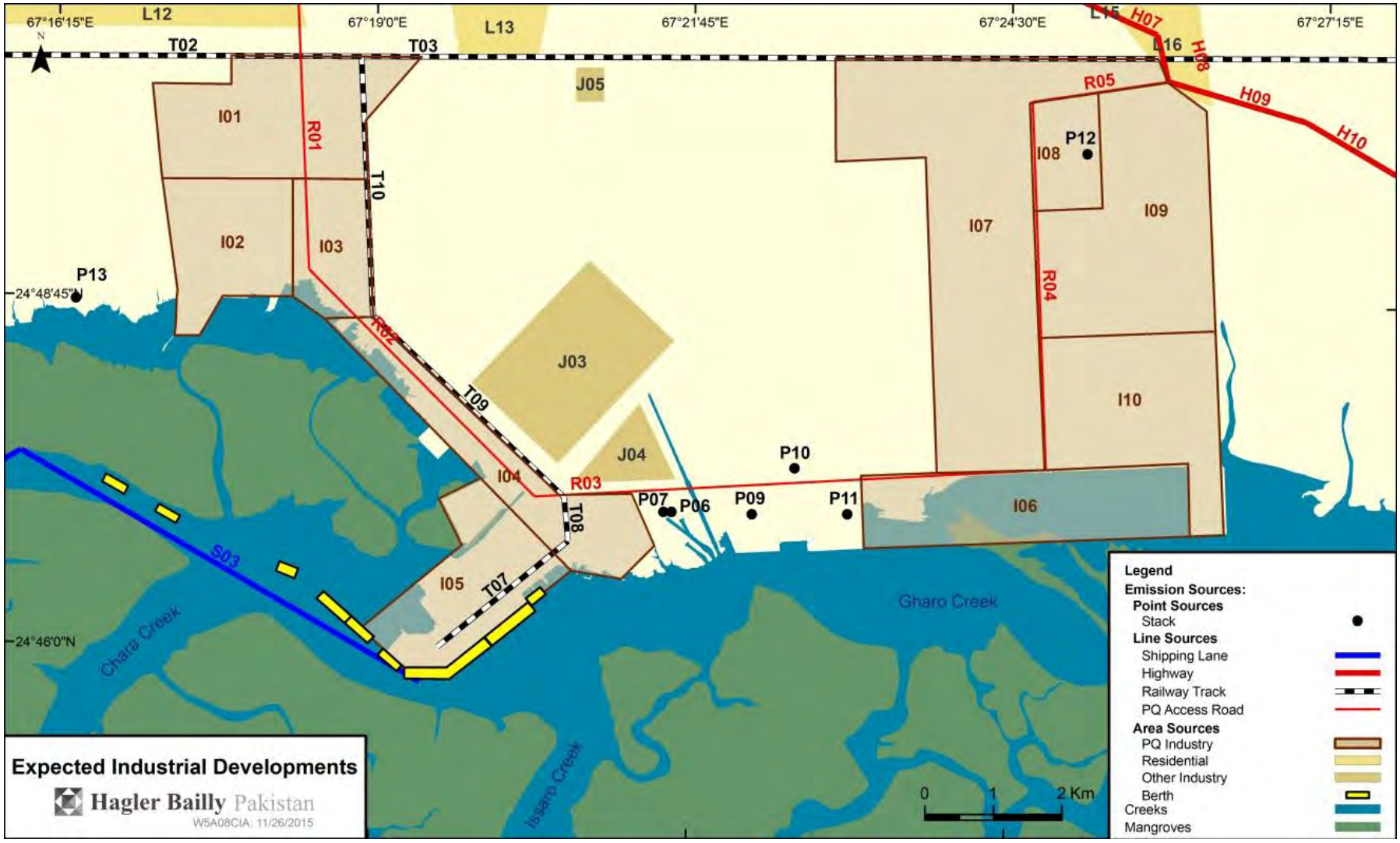
47 Hagler Bailly Pakistan. "Environmental Impact Assessment of Sinohydro's 2×660 MW Coal Power Plant, Bin Qasim, Karachi", Sinohydro Holding Ltd., Hong Kong, March, 2014.

48 Hagler Bailly Pakistan. "Environmental Impact Assessment of EngroPowergen Limited 225 MW RLNG CCPP Port Qasim Authority, Karachi", EngroPowergen (Pvt) Ltd., Karachi, July, 2015.

49 Environmental Management Consultants "Environmental Impact Assessment of 350 MW Imported Coal Power Project at Port Qasim, Sindh", Siddiqsons Energy Ltd., Karachi, March, 2015.

50 Hagler Bailly Pakistan. "Environmental Impact Assessment of Coal Power Plant (CPP) Project Fauji Fertilizer Bin Qasim Complex", Fauji Fertilizer Bin Qasim Ltd., Karachi, February, 2014.

Exhibit E.31: Expected Industrial Developments in the Study Area



E.2.3.5 Industries as Area Sources

Plots within the PQA Industrial zones have been classified as: Fully Active (FA) on which construction and activity is observable in Google Earth, Under Construction (UC) on which either construction was seen to be under way or if a boundary wall had been constructed and Open Plots (OP) which are contiguous pieces of open land not demarcated by a boundary nor have any construction or activity on them. Google Earth observations were supported by a field survey.

The following development scenario was adopted:

1. 2015: Only FA plots contribute to emissions
2. 2050: Complete development in PQA industrial zones- FA, UC, and OP contribute to emissions

It was expected that the development will follow a similar pattern to existing industries in the PQA industrial zones. The entire area of each of the block was taken as an area emission source. The emission factor was then weighted by the extent of development as given in **Exhibit E.32**.

Exhibit E.32: Extent of Development in Demarcated Blocks in PQA Industrial Zones

ID	*2015*	*2050*
	FA units	*FA + UC + OP[a]*
I01	36%	81%
I02	16%	86%
I03	12%	63%
I04	10%	66%
I05	48%	73%
I06	4%	94%
I07	88%	88%
I08	5%	82%
I09	0%	60%
I10	0%	100%

Note: FA + UC + OP does not always add up to 1, due to the presence of roads, amenities and other open areas between plots which will not be used for industrial development.

It was assumed that PSM was operating at 10% of its 1.1 million ton total capacity during 2015.In 2050, however, it is expected that PSM will have undergone privatization and its capacity will be upgraded to 3.5 million ton and it will run at 100% of its capacity. It was also assumed that Tuwairqi will also become operational in 2050.

E.2.4 Projected Air Quality Comparison of Results with Standards

Contour maps of pollutant concentrations are presented in **Exhibit E.33** to **Exhibit E.40**. Areas that exceed limits have been shaded to show pollutant hotspots.

Exhibit E.33: Annual NO_x Concentrations due to PQA – 2050

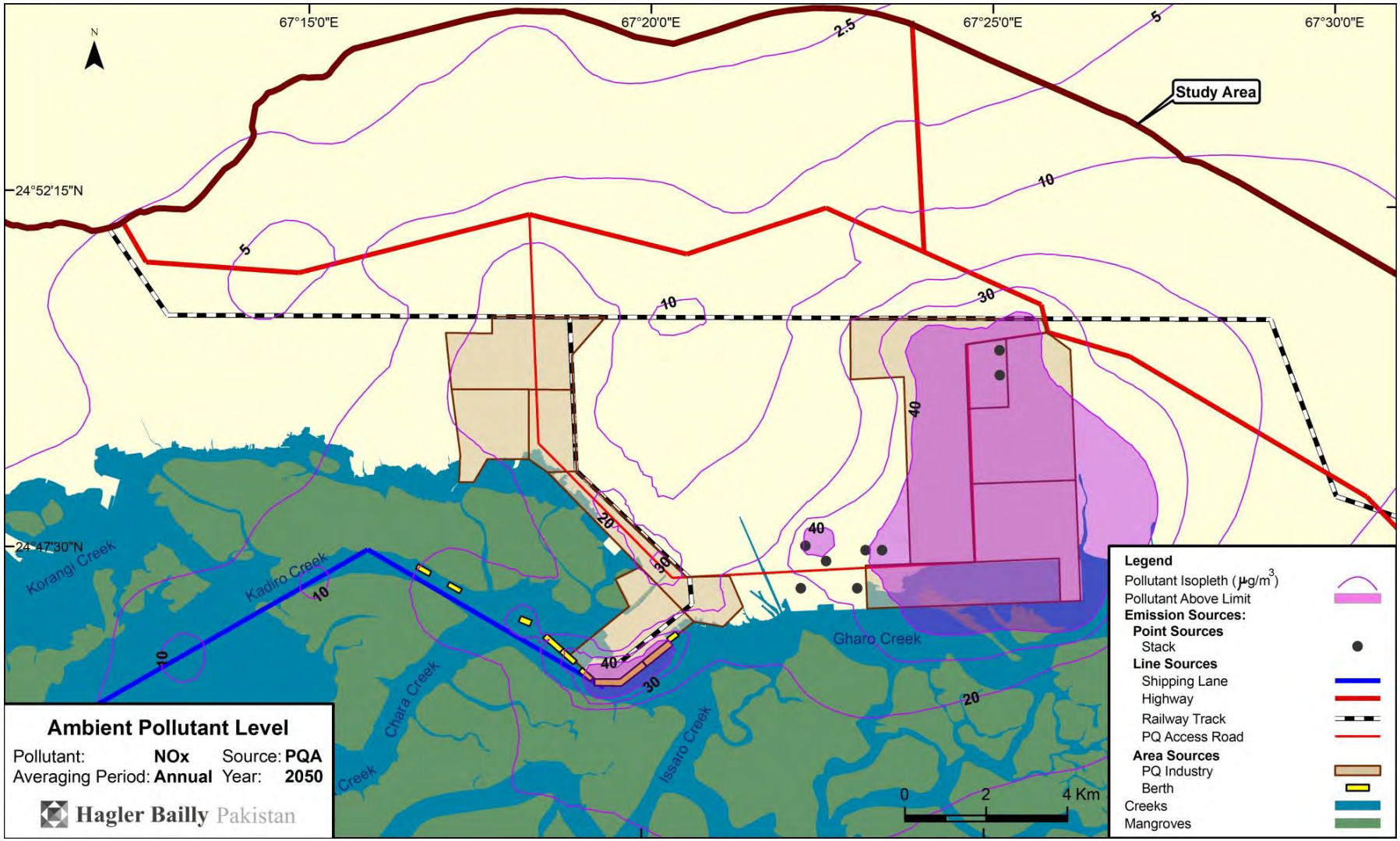


Exhibit E.34: Annual SO_2 Concentrations due to PQA – 2050

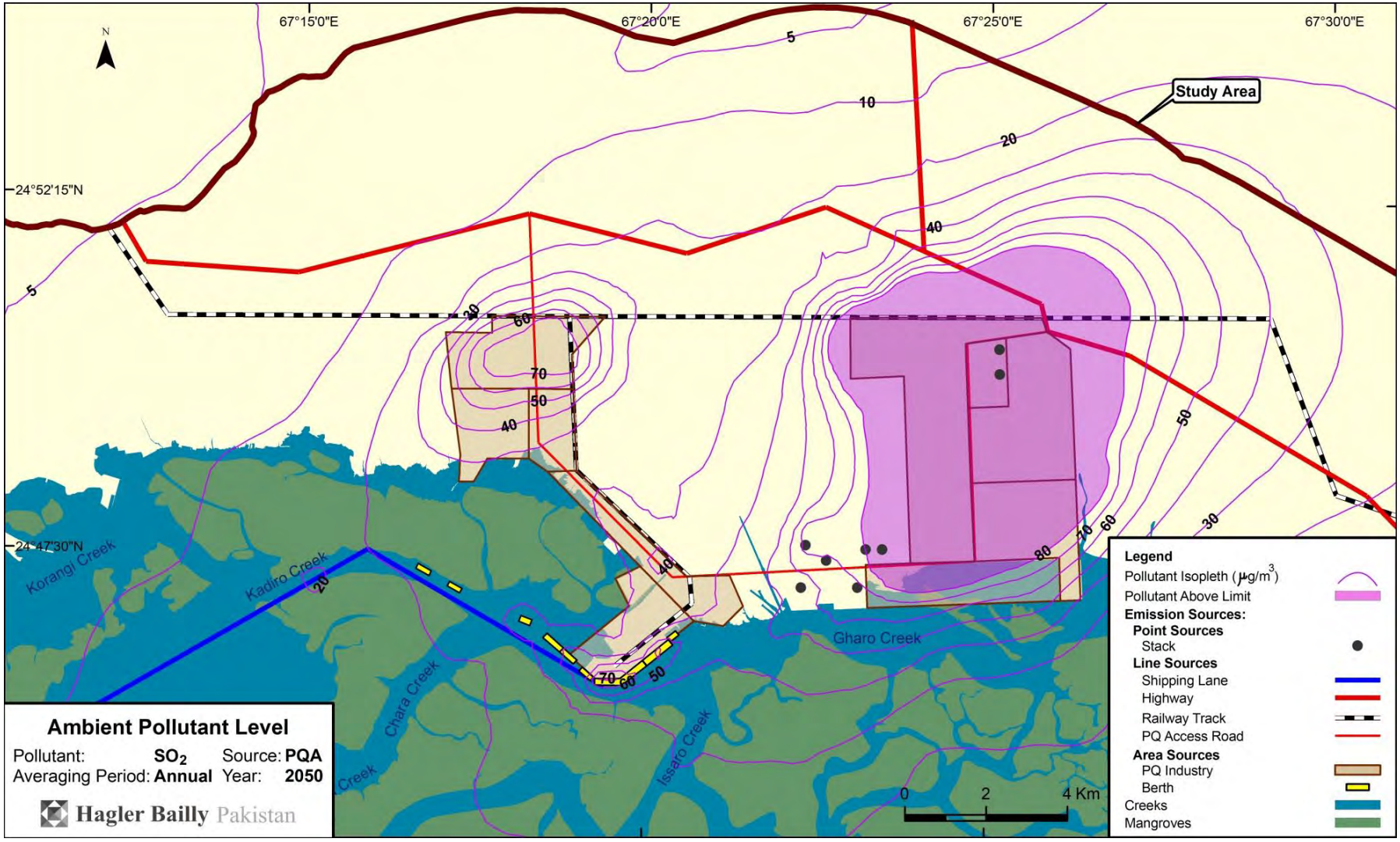


Exhibit E.35: Annual PM_{10}Concentrations due to PQA – 2050

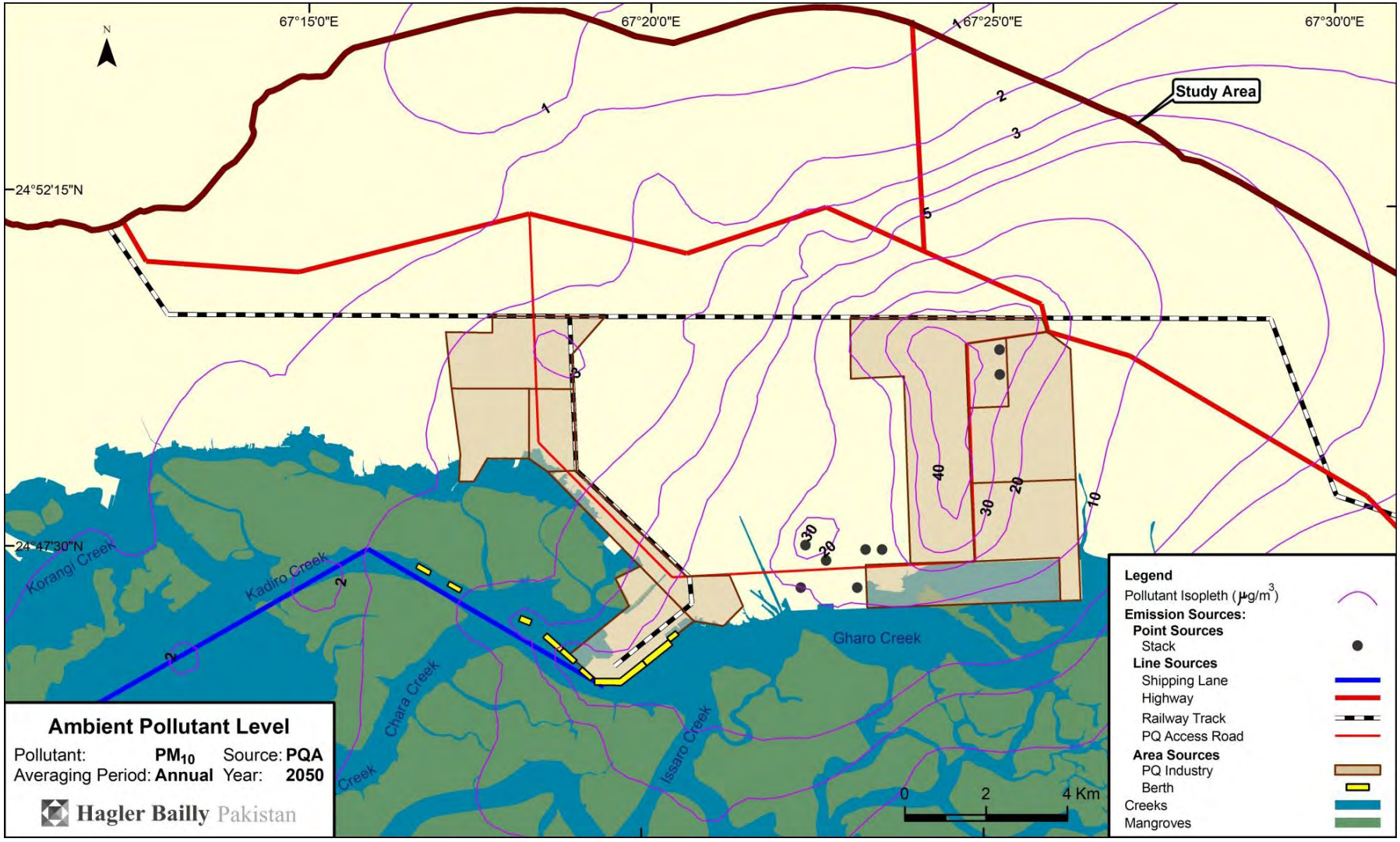


Exhibit E.36: Annual $PM_{2.5}$ Concentrations due to PQA – 2050

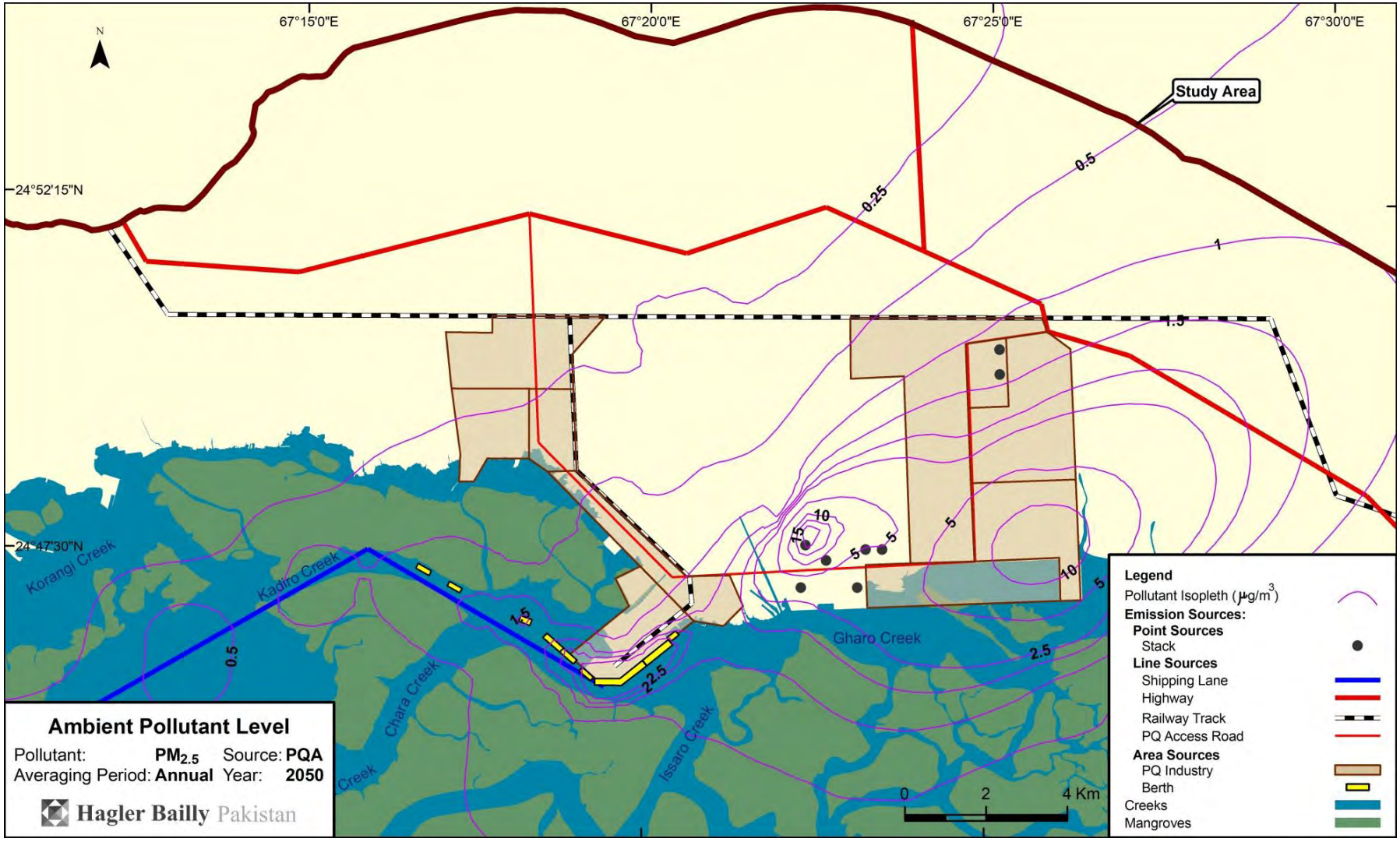


Exhibit E.37: Combined Annual NO_X Concentrations – 2050

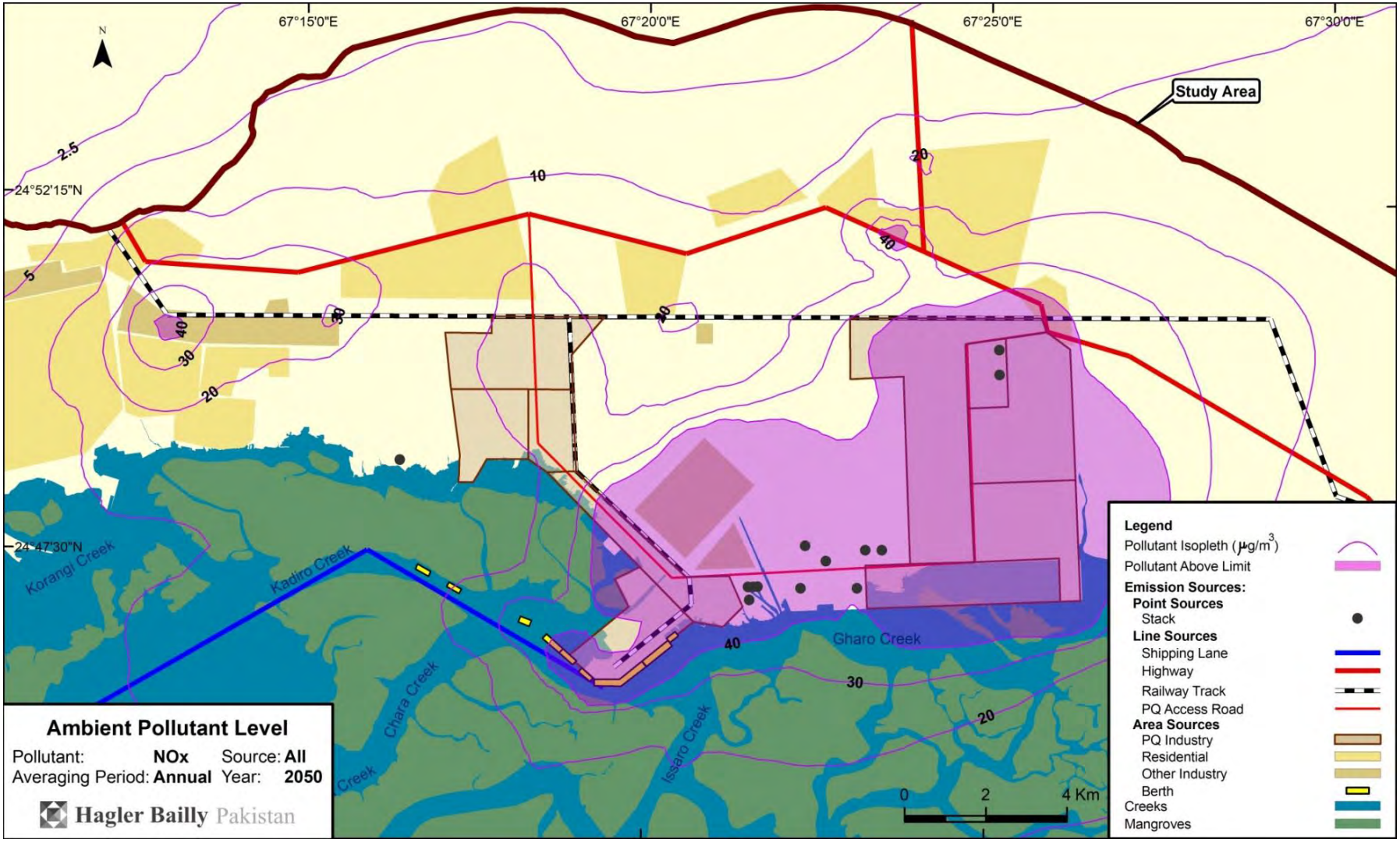


Exhibit E.38: Combined Annual SO_2 Concentrations – 2050

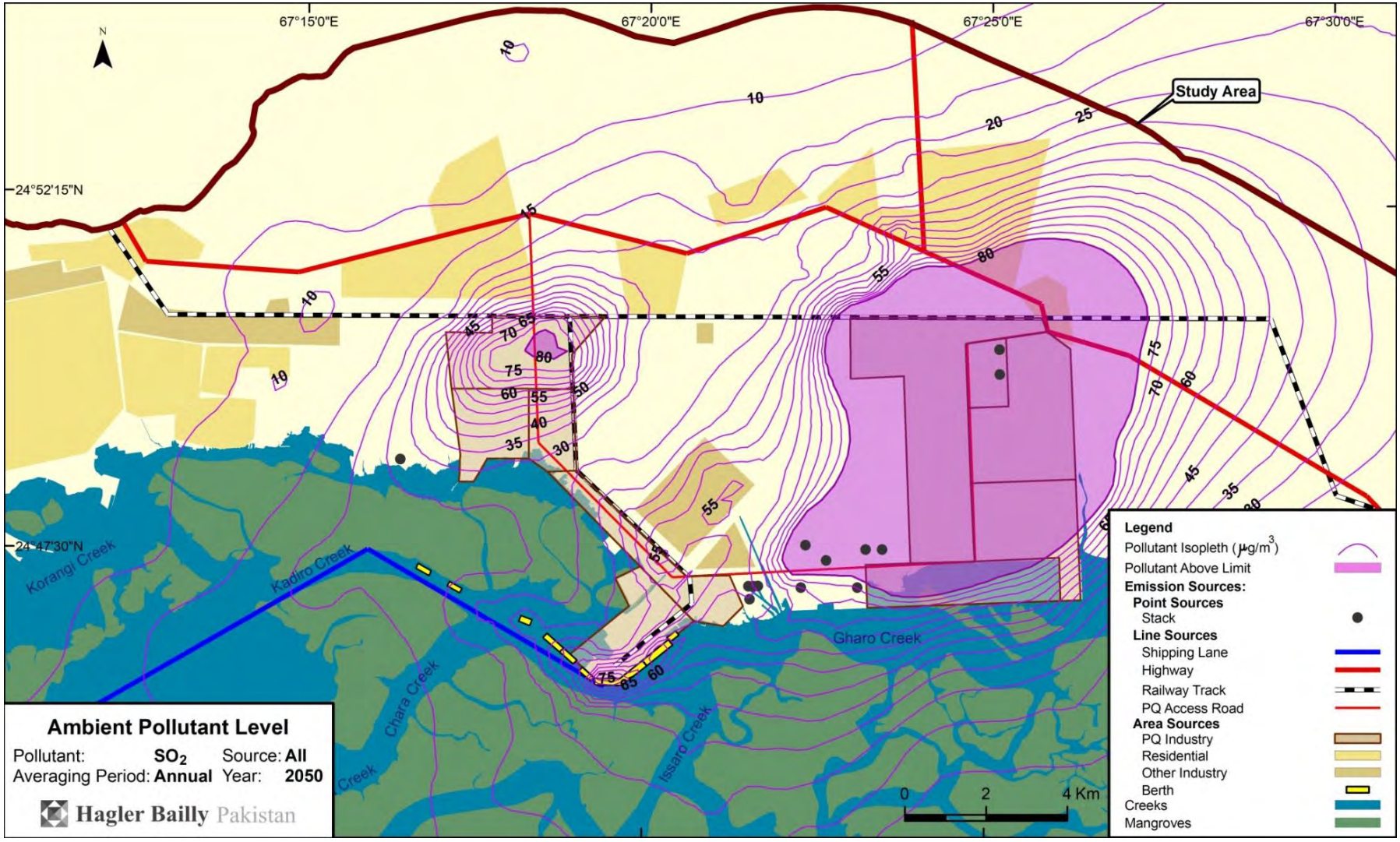


Exhibit E.39: Combined Annual PM_{10} Concentrations – 2050

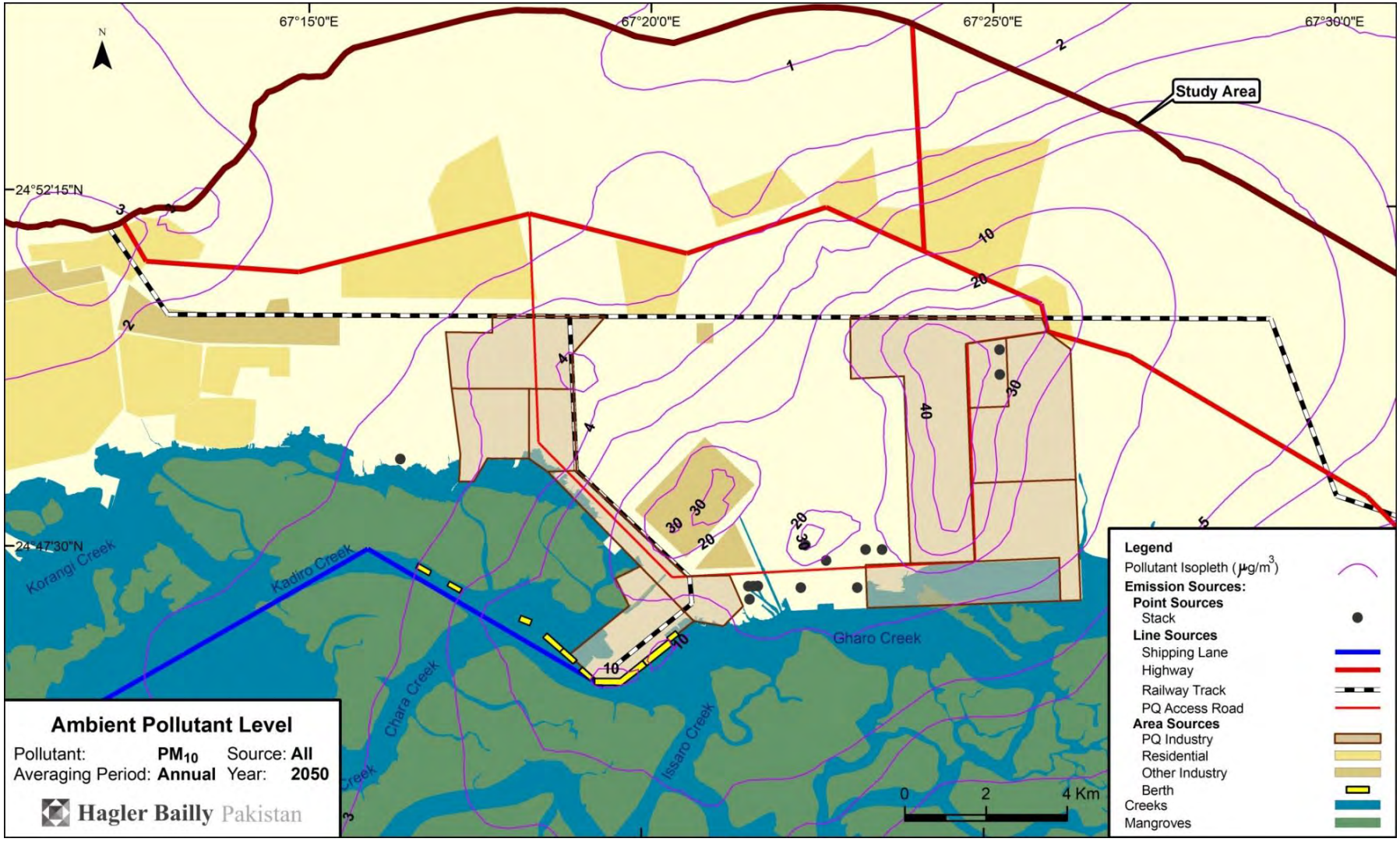
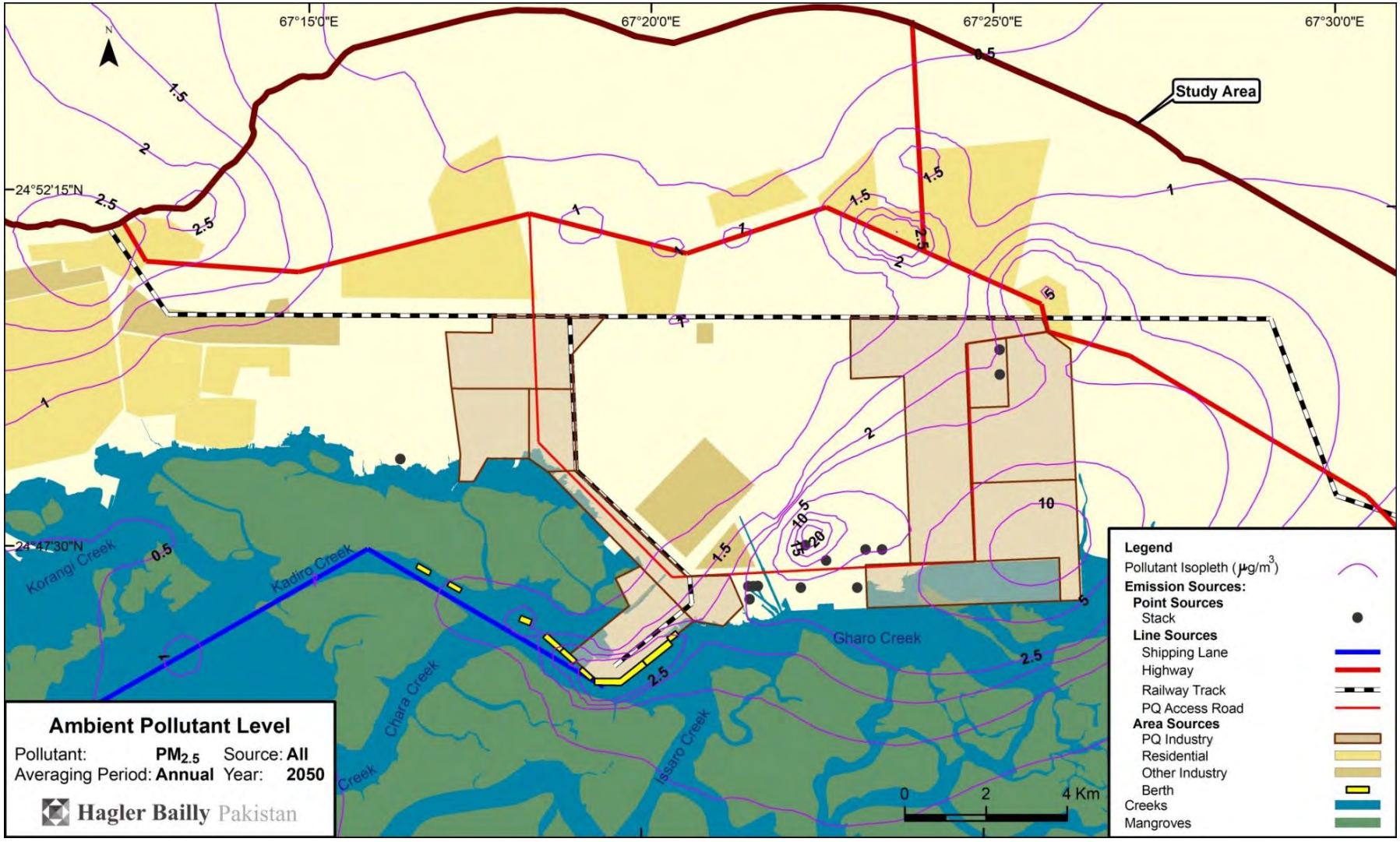


Exhibit E.40: Combined Annual $PM_{2.5}$Concentrations – 2050



Comparison of modeled emissions to air quality standards are given in **Exhibit E.41**.

Exhibit E.41: Comparison of Modeled Maximum Annual Concentrations to Air Quality Standards ($\mu g/m^3$)

Pollutant	*Source*	*Category*	*2015*	*2050*	*SEQS*	*IFC*	*Target Limit*
NO_x	Anthropogenic	PQ	33	220	100	40	40
		Combined	54	227			
SO_2	Anthropogenic	PQ	24	276	80	-	80
		Combined	245	289			
PM_{10}	Anthropogenic	PQ	31	46	120	70	70
		Combined	34	48			
	Natural	Open area	218	105			
$PM_{2.5}$	Anthropogenic	PQ	2	32	40	35	35
		Combined	4	33			
	Natural	Open area	33	16			

- Under business as usual scenario, NO_x concentrations exceed the target limit in 2050. This is not due to any single factor but is a result of cumulative emission increase in industries in PQ, production at PSM and the emission from power plants. The area exceeding target limit when only PQA activities are considered is 4,100 ha, whereas when all the sources within Study Area are considered the area exceeding target limit is 8,850 ha.
- Under business as usual scenario, SO_2 concentrations exceed the target limit in 2050. This is mainly due to the increase in industrial development in PQ Industrial zones especially in EIZ. The area exceeding the limit when only PQA activities are considered is 4,735 ha whereas when all the sources within Study Area are considered it is 5,650 ha. The major producers of SO_2 in this zone are incineration plants and coal fired power plants. Incineration plants, although fewer in number, can have significant emission. Other significant sources of SO_2 emission are the K-electric thermal power station and the PSM.
- For 2050, the predicted contribution of anthropogenic sources in PM_{10} levels in the ambient air is small compared to the target limit. However, combined with the concentration due to the natural sources, the total concentration exceeds the target limit. This is despite the fact that in 2050 the concentration of PM_{10} due to natural sources is expected to reduce to half to that in 2015. This reduction is mainly due to the expected conversion of large areas within and outside the PQA Area to constructed and built-up area by 2050. The area exceeding the target limit due to the natural sources is 5,580 ha.
- For 2050, the predicted contribution of anthropogenic sources in $PM_{2.5}$ levels in the ambient air is comparable to the target limit. When combined with the concentration due to the natural sources, the total concentration is expected to exceed the target limit. Therefore, it is expected that in 2050, the anthropogenic sources will become the major contributor to the $PM_{2.5}$ concentration in the ambient air.

Appendix F: Recommended Approach for Hydrodynamic and Water Quality Modelling

To develop a hydrodynamic, water quality and sediment transport model for the Port Qasim Authority within the current and proposed shipping channel, the best approach is to use a linked watershed to receiving water model. The Loading Simulation Program C++ (LSPC) could be used for the watershed model and the Environmental Fluid Dynamics Code (EFDC) for the receiving water model. The advantages of the EFDC are that it will allow the model to be utilized by developers within Port Qasim and the Port Qasim Authority following the model development, since the model is free of cost. It is also the industry standard for physical modelling of such systems.

In view of this key members of the Port Qasim Authortiy, Dredging and Hydrography Team, should be included as part of associated hydrodynamic surveys and water baseline surveys and modelling efforts, and in any proposals on the modelling, such that capacity building is carried out within the Port Qasim Authority as recommended in the Cumulative Impact Assessment.

An in depth baseline study to collect data on hydrodynanmics and water quality extending over at least 1 year is needed to be able to calibrate the model, and gather required information. In addition to this, water quality and quantity information from the Malir River, and other sewage outfalls along the coast are necessary. This report (Cumulative Impact Assessment for Industrial and Port Developments at Port Qasim) proposes collection of information on water quality by the Port Qasim Authority for this purpose. It is recommended that the baseline studies are carried out in conjunction with a local consultant.

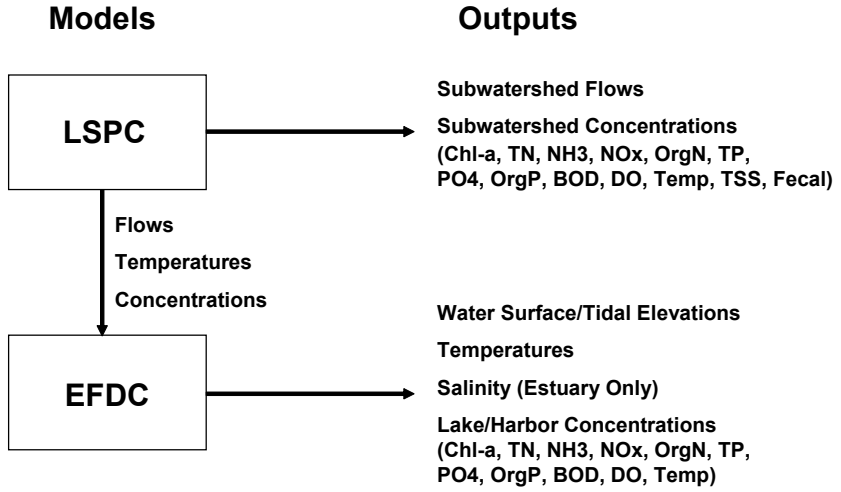
F.1 LSPC Watershed Model

The Loading Simulation Program C++ (LSPC) is recommended to be used to represent the hydrological and water quality conditions in the Lower Indus River watershed. LSPC is a watershed modeling system that includes HSPF[1] algorithms for simulating watershed hydrology, erosion, and water quality processes, as well as in-stream transport processes (http://www.epa.gov/athens/wwqtsc/html/lspc.html). LSPC integrates a geographical information system (GIS), comprehensive data storage and management capabilities, the original HSPF algorithms, and a data analysis/post-processing system into a convenient, PC-based, Windows interface. LSPC's algorithms are identical to a subset of those in the HSPF model. LSPC is freely distributed by EPA's Office of Research and Development, and is a component of EPA's National TMDL Toolbox (http://www.epa.gov/athens/wwqtsc/index.html).

[1] Hydrological Simultion Program – Fortran, United States Gelogical Survey (USGS)

A key advantage of LSPC over HSPF and other watershed models is a data management feature that uses a Microsoft Access database to manage model data and weather files for driving the simulation. This provides great flexibility for data transfer and manipulation, which is critical for complex watershed studies. LSPC was designed specifically to handle large-scale watershed and receiving water modeling applications at a high resolution. The model has been successfully used to model watershed systems composed of well over 1,000 sub-watersheds and at least as many individual stream elements. The highly adaptable design and programming architecture allows for future modular additions based on specific project needs. Furthermore, the entire system is designed to simplify model sharing. LSPC will be integrated with the EFDC as shown below.

Exhibit F.1: Linkage between LSPC and other Models



F.2 EFDC Receiving Water Model

The Environmental Fluid Dynamics Code (EFDC) is recommended to be used to represent the hydrodynamic and water quality conditions within the Study Area. EFDC is a hydrodynamic and water quality modeling package for simulating one-dimensional, two-dimensional, and three-dimensional flow and transport in surface water systems including: rivers, lakes, estuaries, reservoirs, wetlands, and nearshore to shelf scale coastal regions. The EFDC model was originally developed at the Virginia Institute of Marine Science for estuarine and coastal applications and is considered public domain software (Hamrick, 1992). It has been applied to over 200 waterbodies worldwide, including over 150 estuaries.

The EFDC model developed for Port Qasim will be able to do the following::

- Simulate flow and transport information through control structures (e.g. culverts, bridges);
- Simulate salinity and other ecological and hydrodynamic parameters;
- Simulate sediment transport (including that associated with Port developments); and

- Simulate temporal and spatial variation of temperature, salinity, nutrients and, applicable, metals, trace organic pollutants such as chlorinated pesticides and PCBs, and semi-volatile organic compounds

F.3 Experience Needed

The team working on the baseline and modelling is recommended to include/have:

- Strong team leader with at least 20 years international experience, and preferably local, in hydrodynamics and water quality on developments of similar scale and size
- Sub team leader with at least 20 years local experience on environmental impact assessment and cumulative impact assessment.
- Sub team leader with experience in physical field surveys and environmental monitoring (e.g. through use of automatic in situ loggers)
- Team members with experience on water quality modelling, hydrodynamic modelling and environmental impact assessment
- Key members from the Port Qasim Authority to support baseline development as well as model development, such that capacity building in the institution is carried out.