Draft Development Plan of Gujarat Petroleum, Chemical, Petrochemical Special Investment Regional Development Authority (GPCPSIRDA)

Volume II

Development Plan Proposals

2011

Udyog Bhavan, Block No 4, 2nd Floor, Sector-11, Gandhinagar-382017

Mott MacDonald, A20, Sector 2, Noida 201301, Uttar Pradesh, India
T +91 (0)12 0254 3582 F +91 (0)12 0254 3562, www.mottmac.com

Issue and revision record

Revision	Date	Originator	Checker	Approver	Description
A	26 11 10	Anusree Ray Ajay Rana Bhargav Joshi Darshan Rathod Deepak Patel Kartik Ramu Rajnish Kumar Richa Rathi Yogesh Chalke	Madhurima Waghmare	Shoma Majumdar	Draft Development Plan Draft Report - Volume II – Development Plan Proposals
B	08.04.2011	Anusree Ray Ajay Rana Bhargav Joshi Darshan Rathod Deepak Patel Kartik Ramu Rajnish Kumar Richa Rathi Yogesh Chalke	Madhurima Waghmare	Shoma Majumdar	Draft Development Plan Draft Report - Volume II – Development Plan Proposals

Mott MacDonald, A20, Sector 2, Noida 201301, Uttar Pradesh, India
T +91 (0)12 0254 3582 F +91 (0)12 0254 3562, www.mottmac.com

Content

Tables

Figures

Abbreviation

S.No.	Abbreviations	
1	AAI	Airport Authority of India
2	AEP	Annual Exceedance Probability
3	ATF	Aviation Turbine Fuel
4	BG	Broad Gauge
5	BISAG	Bhaskaracharya Institute for Space Application and Geo-Informatics
6	BMW	Bio-Medical Waste
7	BOD	Biological Oxygen Demand
8	BRTS	Bus Rapid Transit System
9	BSNL	Bharat Sanchar Nigam Limited
10	C/W	Carriage Way
11	C4/C7/C8	Carbon Compounds
12	CETP	Common Effluent Treatment Plant
13	COD	Chemical Oxygen Demand
14	CPCB	Central Pollution Control Board
15	CPHEEO	Central Public Health and Environmental Engineering Organisation
16	CRZ	Coastal Regulation Zone
17	CWC	Central Warehousing Corporation
18	CZBT	Central Zone Bara Track
19	dBA	Decibel
20	DDP	Draft Development Plan
21	DFC	Dedicated Freight Corridor
22	DGH	Director General of Hydrocarbons
23	DGMS	Director General Mines and Safety
24	DGVCL	Dakshin Gujarat Vij Company Limited
25	DILR	District Inspector of Land Records
26	DMIC	Delhi-Mumbai Industrial Corridor
27	DO	Dissolved Oxygen
28	DP	Development Plan
29	DPR	Detailed Project Report
30	DUPL	Dahej-Uran Pipeline
31	DVPL	Dahej-Vijapur Pipeline
32	EDC	External Development Charges
33	EH	Express Highway
34	EIA	Environment Impact Assessment
35	ETP	Effluent Treatment Plant
36	EWS	Economically Weaker Section
37	FICCI	Federation of Indian Chambers of Commerce and Industry
38	FRA	Flood Risk Assessment
39	FRC	Fibre Reinforced Concrete
40	FSI	Floor Space Index
41	GACL	Gujarat Alkalies & Chemical Limited
42	GAIL	Gas Authority of India Limited

S.No.	Abbreviations	
43	GCPTCL	Gujarat Chemical Port Terminal Company Limited
44	GDCR	General Development Control Regulation
45	GEPIL	Gujarat Enviro Protection & Infrastructure Limited
46	GIDB	Gujarat Industrial Development Board
47	GIDC	Gujarat Industrial Development Corporation
48	GMB	Gujarat Maritime Board
49	GoG	Government of Gujarat
50	GOI	Government of India
51	GPCB	Gujarat Pollution Control Board
52	GPCPSIR	Gujarat Petroleum, Chemicals and Petrochemical Special Investment Region
53	GPS	Global Positioning System
54	GPSL	GPCPSIR Services Limited
55	GRAMZ	GEPIL Waste Recycling & Management Zone
56	GSI	Geological Survey of India
57	GSPC	Gujarat State Petroleum Corporation
58	GSPL	Gujarat State Petronet Limited
59	GTPS	Gujarat Town Planning Scheme
60	GWSSB	Gujarat Water Supply & Sewerage Board
61	HTL	High Tide Line
62	ICD	Inland Container Depot
63	IMD	Indian Meteorological Department
64	Ind.	Industries
65	IPCL	Indian Petrochemical Corporation Limited
66	IRC	Indian Road Congress
67	IRS	Indian Remote Sensing Satellite
68	JDI	Japan Development Institute
69	JNPT	Jawaharlal Nehru Port Trust
70	JNPT	Jawaharlal Nehru Port Trust
71	kTA	Kilo Ton per annum
72	kV	Kilo Volt
73	LNG	Liquefied Natural Gas
74	LPCD	Litres Per Capita Per Day
75	LUT	Land Utilisation
76	m	Meters
77	mcm	Million Cubic Meters
78	MDI	Methylene Diphenyl Diisocyanate
79	MDR	Major District Roads
80	Mg/l	Milligram/ litre
81	MGD	Million Gallon
82	ML	Mining Licence
83	MLD	Million Litre
84	MM	Mott MacDonald

S.No.	Abbreviations	
85	MMTPA	Million Metric Tonnes Per Annum
86	MoEF	Ministry of Environment & Forest
87	MoM	Minutes of Meeting
88	MoU's	Memorandum of Understanding
89	MSL	Mean Sea Level
90	MSME	Micro, Small and Medium Enterprises
91	MSW	Municipal Solid Waste
92	MVA	Mega Volt Ampere
93	NBSSLP	National Bureau of Soil Survey & Landuse Planning
94	NEERI	National Environment Engineering and Research Institute
95	NELP	New Exploration Licence Policy
96	NEPL	New Exploration of Petroleum Lease
97	NG	Narrow Gauge
98	NGL	Natural Ground Level
99	NH	National Highway
100	NRVY	National Railway Vikas Yojana
101	ODP	Other District Roads
102	OFC	Optical Fibre Cable
103	OISD	Oil Industry Safety Directorate
104	ONGC	Oil and Natural Gas Commission
105	OPaL	ONGC Petro additions Limited
106	OWC	Organic Waste Converter
107	PCP	Petroleum, Chemical & Petrochemical
108	PCU	Passenger Car Unit
109	PEL	Petroleum Exploration Lease
110	PLU	Proposed Landuse
111	PNGRB	Petroleum and Natural Gas Regulatory Board
112	PPP	Public-Private Partnership
113	PSU	Public Sector Unit
114	R&B	Roads & Building
115	RCC	Reinforced Cement Concrete
116	RDA	Regional Development Authority
117	RIL	Reliance Industries Limited
118	RoU	Right of Use
119	ROW	Right of Way
120	Rs/ INR	Indian Rupee
121	SEZ	Special Economic Zone
122	SH	State Highway
123	SIR Act	Special Investment Region Act
124	SoR	Schedule of Rates
125	Sq.Km	Square Kilometre
126	sqm	Square Meters

S.No.	Abbreviations	
127	SSNN	Sardar Sarovar Narmada Nigam Limited
128	STP	Sewerage Treatment Plant
129	SWD	Strom Water Drainage
130	SWM Manual	Solid Waste Management Manual
131	TDI	Toluene Diisocyanate
132	TDO	Taluka Development Office
133	TP	Town Planning
134	TP & UD Act	Town Planning & Urban Development Act
135	TTP	TertairyTreatment Plant
136	UDPFI	Urban Development Plans Formulation & Implementation Guidelines
137	V/C Ratio	Volume/Capacity Ratio
138	VGGIS	Vibrant Gujarat Global Investors Summit
139	VR	Village Roads
140	WR	Western Railway

1. Introduction

The land use and infrastructure proposals for Draft Development Plan of GPCPSIR are based on the analysis of the existing situation that has been included in *Volume I* of the DDP report. Further to that, based on various projections and planning guidelines the land use and infrastructure projection and proposals have been derived and detailed out in this report

1.1 Background

The Volume I of the Development Plan report of GPCPSIRDA included the baseline information of the delineated area, details of the base map preparation and finalisations, particulars of the various stakeholders consultation carried out for the project and a comprehensive analysis of the situation existing for GPCPSIR.

The key aspects consulted with the Government, Industries, Implementing agencies and other key stakeholders have provided the basis for proposing appropriate land use and infrastructure proposals for the GPCPSIR. This volume presents the development plan proposals for GPCPSIR. The land suitability analysis and the situation analysis have provided the basis for the land use zoning and infrastructure for the GPCPSIR area.

1.2 The Report

This Volume II of the Development Plan report includes the projections, statutory guidelines and the development plan land use and infrastructure proposals. The implementation strategy and related details are also included in this report.

Industrial, employment, population, infrastructure and other projections have been done in order to provide a systematic basis for the Development Plan proposal. The statutory guidelines and obligations related to various developments proposed in the GPCPSIR area included in this report have also provided the basis for the Development Plan proposals. Based on the practical requirements of various stakeholders, ongoing and future development plans of various implementing agencies active in this area, projections and various statutory guidelines, a comprehensive base for the proposals outlined in this report for the development plan have been worked out. Furthermore, the implementation strategy for the Development Plan has also been suggested and included in Chapter 5 of this report.

2. Vision and Future Projections

The industry sizing and employment generation for GPCPSIR has been projected on the basis of both existing situation and future growth potential, simultaneously drawing parallels from benchmarks as have been established in other parts of the state, country and abroad. Once these were ascertained, the employment generated from non processing area has been worked out. These are discussed in this chapter under subsequent sections.

2.1 Vision and Development Objectives

2.1.1 Vision

The GPCPSIR has been envisioned to be amongst India's foremost sustainable Petroleum Chemical Petrochemical Special Investment Region.

2.1.2 Development Objectives

To achieve the Vision for GPCPSIR, following development objectives have been outlined.

- Land use compatibility – suitability with existing land use, compatibility with existing physical feat.
- Environmental Sustainability – waste minimisation, natural conservation.
- Long term sustainability
- In-situ development with existing rural habitations
- Accessibility with major rail/road transportation
- Cositing of Hazardous Industries
- Provision of World Class Infrastructure (water supply, power supply, gas supply, drainage, effluent and waste disposal etc.).

2.2 Industrial Projections

The *Report of the Working Group on Chemicals and Petrochemicals - 11th five year plan (2007-08 to 2011-12), Ministry of Chemicals and Fertilizers, GoI* mentions that petrochemical industry plays a vital role in economic growth & development. Indian petrochemical industry has been one of the fastest growing sectors in the country. The downstream plastic processing sector is highly labour-intensive which currently provides employment to 3.3 million people. It has the potential to generate 3.7 million additional jobs by 2011-12. However, the petrochemical industry is technology driven and for operation of sophisticated and modern petrochemical plants, skilled manpower is required. The report (Pg. 14 Volume II) also states that polymer consumption has a strong correlation with economic growth. Gujarat is a hub of chemical industry in the country and offers immense potential for further development and growth of the industry.

2.2.1 Proposed Production Capacity

Globally, the cracker size is defined by the ethylene capacity. The global petrochemical industry has also witnessed steady increase in its capacity. During the 1990s, the trend of increasing growth in the average cracker size was also witnessed in the Indian polymer industry. The average size of ethylene crackers in India has been observed to be increasing in the following manner and is expected to attain the average capacity of 1000 kTA in the current context with the coming up of the OPaL Dual Feed Cracker.

- **0.08 MMTPA** in 1990-91
- **0.35 MMTPA** in 2004-05
- **1.2 MMTPA** in 2011-12 (of OPaL as revealed from the official interaction)

The current ethylene production capacity in India is of the order of 2.4 MMTPA and projected demand is of 7.3 MMTPA by 2012. Considering annual growth rate of 10 – 15%, there is scope of setting up dual feed crackers, having capacity more than 1 MMTPA each. Thus the coastal location of GPCPSIR at Dahej has the potential of adding 1MMTPA cracker after every 5-7 years. Studies reveal that, globally, cracker capacities are less than 5 years of age, hence taking a conservative approach; it is proposed that dual feed crackers having 1 – 2MMTPA ethylene capacity can come up in Gujarat by 2020, followed by one in 2030 and one in 2040.

2.2.2 Proposed Plan Period

In 1990, GACL had first started their operations in Dahej. By 2010, an area of 8,220 ha has been acquired, allotted and developed in Dahej. We assume that with a similar growth pattern and the kind of growth pattern applicable for the Petroleum Chemical Petrochemical (PCP) industrial chain, it would take another 30 years for development of the remaining processing area. Moreover the Government of Gujarat is now keen to develop both processing and non-processing areas of the GPCPSIR simultaneously. Thus, it is proposed that in next 30 years, the rest processing area and the entire non-processing would be developed.

2.2.3 Industrial Phasing

Within the proposed plan period of around 30 years, and the PCP industrial chain deriving out of the major units like a cracker or a refinery, it has been assumed that the development of GPCPSIR would progress as per the stages mentioned in Table 2.1

Table 2.1: Development Phases of GPCPSIR

Phases	% Total Area	Description
Immediate Phase i.e. Phase 0 (2011 – 2015)	5%	The percentage development assumed in this phase is beyond the existing, ongoing and proposed development in Dahej 1(including Dahej SEZ), Dahej II and Vilayet Estate. (Beyond the Allotments done by GIDC and MOUs signed during Vibrant Gujarat 2009). The percentage development includes mainly the future expansion of adjacent to the existing industries.
Phase 1 (2016 to 2020)	20%	Assuming that during this phase major infrastructure would be developed. The first industrial chain after the anchor tenant will also develop. Also the '% area development has been kept at a minimum since major infrastructure will also be developing
Phase 2 (2021 to 2030)	45%	During this phase, maximum area development is perceived as most of the enabling infrastructure would also be in place by then.
Phase 3 (2031 to 2040)	30%	The remaining area will be developed in the last phase.

2.2.3.1 Employment Generation and proposed industrial product mix for GPCPSIR

The upstream petrochemical plants are both capital and technology intensive while the downstream plastic processing industry is labour intensive. To calculate the proposed employment generation in GPCPSIR the following assumptions have been taken.

1. The **workers' density** of the existing industrial area within GPCPSIR (Dahej I and II) is **1.47** as per primary industrial survey conducted by Mott MacDonald study team during October 2009.
2. On the basis of *Report of the Working Group on Chemicals and Petrochemicals - 11th five year plan (2007-08 to 2011-12), Ministry of Chemicals and Fertilizers, GoI,* the **indirect employment factors** is said to be 3.75 for **downstream units**. Considering further technological advancement in the next 3 decades a factor of **2.5** has been assumed. The factor for upstream units has been considered to be **0.5** the same as what the report has stated as **upstream industries** are already technology driven and it employs less people.

Based on the Vision, Development Objectives discussed under Section 2.1 in Volume II and Industry Analysis presented in "Situation Analysis" chapter in Volume I, the following range of product mix has been finalised. The product mix has been used as the basis for projections of employment generation. This has been presented in Table 2.2.

Table 2.2: Proposed Industry Sizing

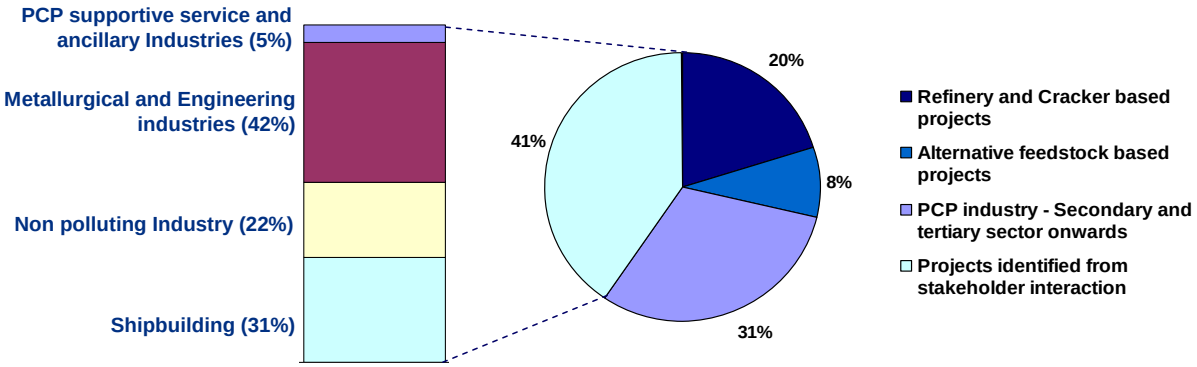
Project	Area (ha)	Direct employment	Indirect* employment	Total employment	Production capacity (MMTPA)	Number of Units
Refinery or Cracker						
a) Cracker (yr 2015) and primary intermediates	500	1200	600	1800	1.2	1
b) Refinery / Cracker (yr 2025) and primary intermediates	1000	1200	600	1800	15	1
c) Cracker (yr 2035) and primary intermediates	500	1200	600	1800	2	1
Gas-based projects						
a) Methanol, Acetic acid, Ethyl acetate	50	500	250	750	1.5	-
b) Fertilizers	400	4000	10000	14000	2.5	-
Bio refinery , Bio-degradable polymers and plastic processing	350	1000	500	1500	1	-
Large scale PCP industries (Intermediates and Final products) Product range: Cumene, Phenol, Acetone, Bisphenol , polycarbonate, C4 based, Elastomers, Engg plastics, Chloro benzens, Nitrobenzene, Aniline, Nitrochlorobenzene complex, C7, C8 extraction, Solvents separation, Purified terephthalic acid, Phthalic anhydride, Carbon black, Automotive tubes and tyres, conveyor belts, MDI, TDI, Polyurethanes, Ethyl benezene, Styrene, Polystyrene, Other Chemicals (including inorganic)	1030	4300	10750	15050	2.5	-
Medium scale PCP industries - speciality chemicals, fine chemicals, performance chemicals, manmade yarns and fibres, Industrial oils, Fatty alcohols, ethoxylates, catalysts, industrial gases, etc	1000	11000	27500	38500	-	150
Plastic processing zone (Engineering plastics and other polymers)	500	50000	125000	175000	1	1
Small chemical industries zone	500	11000	27500	38500	-	500
Metallurgical and Engineering industries - which supports chemical and petrochemical base by way of fabricating/ supplying equipments, piping, process control and instrumentation, etc, and maintenance related services, dock and terminal activities becomes	1100	20000	6000	26000	-	

Project	Area (ha)	Direct employment	Indirect* employment	Total employment	Production capacity (MMTPA)	Number of Units
an integral part of the region for the self sustainability. In turn, engineering industry shall require support from metallurgical industry						
Ancillary industries zone	100	2000	5000	7000	-	200
Service industries zone	100	2000	5000	7000	-	200
Net Industrial Area plots	7130	109400	219300	328700		

Source: Mott MacDonald Analysis

Thus almost 41% land of the GPCPSIR has been divided for various industries as per stakeholders, followed by PCP secondary and tertiary sector and refinery and cracker based projects, 31% and 8% respectively (refer Figure 2.1)

Figure 2.1: Land distribution amongst industries



Source: MM Analysis

2.2.3.2 Other land use projections

For activities like logistics parks, dedicated chemical storages, warehousing and allied activities, the following projections detailed in Table 2.3 have been considered.

Table 2.3: Area Back up calculation for warehousing and container terminal

Space Norm for Chemical and Fertiliser sector as per Central Warehousing Corporation (CWC)		
Commodity	**Unit (kg /sq.mt)**	
Chemical and Fertiliser	968	
Assumption		
Imported raw material	3months storage	
Domestic raw material	1 months storage	
Dual feed cracker - Ethylene production by	60%	Naptha cracking
	40%	NG cracking
1 ton Ethylene requires	2.66	ton Naptha
1 ton Ethylene requires	1.25	ton NG
Typical Cracker Output (Per Tonne of Ethylene)		
Product-Mix		Feedstock
	Naphtha	NGL
Ethylene	1	1
Propylene	0.55	0.07
Butadiene	0.17	0.025
Benzene	0.25	0.01
Toluene	0.04	0
Refinery Capacity per day	0.05	MMT (refinery capacity as assumed refer DDP Vol 1)
Total Cracker capacity per day	0.0216	MMT (Cracker capacity as assumed refer DDP Vol 1, and in case of naphtha received from proposed Refinery at GPCPSIR, 14% naphtha conversion rate is assumed) Cracker capacity considered including the OPaL capacity
Cracker output per day		
	from Naptha	from NG
Ethylene	0.01296	0.00864
Propylene	0.00713	0.00060
Butadiene	0.00220	0.00022
Benzene	0.00324	0.00009
Toluene	0.00052	0.00000
	0.02605	0.00955
Crude refining capacity	0.05	(refinery capacity as assumed refer DDP Vol 1)
Crude oil storage required for 90days	4.5	MMT
Naptha required per day	0.0345	MMT

Naptha storage for 90 days	3.1026	MMT
NG required per day	0.0108	MMT
NG Storage for 90 days	0.972	MMT
Total cracker out put per day	0.03560	MMT
Cracker output storage for 30 days	1.067904	MMT
Other Miscellaneous Storage including engineering goods	0.5	MMT
Total chemical storage required	10.1425	MMT
Assuming 40% of this total storage will be stacked within the various plant battery limit	4.0570	MMT
Rest will be stored at common terminal and warehousing area	6.0855	MMT
	6085516800	kg
Area required	6286691	sq.mt
	628.6691	ha

Source: MM

As can be seen from Table 2.3, for storage the area required is 629 ha. The total land use break-up is calculated in Table 2.4.

Table 2.4: Broad land use break-up of GPCPSIR

Land use	Break up
a) Storage (both liquid and solid cargo)	45%
b) Admin	1%
c) Commercial	2%
d) Utility and Ancillary zone - petrol pump, service areas, weigh bridge etc.	5%
e) Parking (idle, transit and other vehicle)	18%
f) Circulation	20%
g) Open spaces	9%

Source: MM

2.3 Population Projections

The population in GPCPSIR would be mainly generated from employment in industrial activities followed by those generated from support services/activities (such as commercial, institutional, recreational) as well as natural growth of existing population.

2.3.1 Industrial and non Industrial Employment

Industrial Employment: The industrial employment generated (both direct & indirect), by the existing GIDC estate and proposed industrial area is the basis of projection for migratory and residing population. Further the total projected industrial employment has been categorised into executive and non executive employment[1] classes as shown in Table 2.8 (rows D & E).

[1] This categorisation assumption is based on stakeholder consultation with the existing industries in GIDC industrial estate Dahej. Refer Appendix A1 for assumption.

Non Industrial Employment: Non industrial employment (such as commercial, institutional, recreational), is expected to be 3% of the total residing industrial employees. About 8 thousand people are envisaged to be employed in the non processing land use by the end of 2040 (refer Table 2.8, row F). Total industrial and non industrial employment is envisaged to be approx 6 lakhs.

Total Employment generated in GPCPSIR is about 6 lakh.

Table 2.5: GPCPSIR Total Employment (Phase wise)

Phases	Industrial Employment	Non-Industrial Employment	Total Employment (Industrial + Non industrial)
Phase 0	69097	926	70023
Phase 1	94806	1538	96344
Phase 2	258882	4200	263082
Phase 3	177190	2112	179302
Total	**599975**	**8776**	**608751**

Source: MM Analysis

2.3.2 Residential Population

Residing and Floating Employment: Out of the total employment generated, all non industrial employment and a part of industrial employment (60% executive and 80% non executive)[2] are proposed to be accommodated within the GPCPSIR.

It is assumed that a part of the gamtal population will fulfil the requirement of the non executive employment residing in GPCPSIR[3]. Hence the residing employment considers gamtal population too.

The remaining 40% of the executive class and 20% of the non executive class of the projected industrial employment are assumed to be the daily floating population.

Residential Population: Considering 3 as an average family size the total population to be housed within GPCPSIR is 9 lakhs. The average family size, as compared to the National Average family size of 5, has been considered low keeping in view the requirement for bachelor accommodation in GPCPSIR.

Projected Residential Population:

It is anticipated that the population residing in GPCPSIR in phase 0 will grow at a Natural growth rate. Till the end of phase 4 a substantial population will be added to this residing population, apart from the newly generated employees.

For the same, three cities from similar regional setting were compared to anticipate the growth trends in residential population. Surat city, Vapi city, Ankeleshwar town presented high, gradual and low growth rate respectively. One of the objectives of GPCPSIR is to restrict population explosion while accommodating an

[2] The assumptions for Floating and Residing population percentage have been detailed in Appendix A1

[3] 'Socio-economic report for 44 villages' suggested potential youth employment in PCPIR

optimal population size. Hence the gradual population growth trend has been selected for projection. The total projected household population for the year 2040 is 14, 00,659 (refer Table 2.6 and Table 2.8)

Table 2.6: Population projections (Phase wise)

Phases	Floating Employment	Residing Employment	Projected Residing Population
Phase 0	19347	31792	95376
Phase 1	26546	52798	188472
Phase 2	72487	144187	551437
Phase 3	49613	72522	565373
Total	**1,67,993**	**3,01,299**	**14,00,659**

Source: MM

2.3.3 Rural Population

In the decade 1991-2001, the rural population of the GPCPSIR has demonstrated an average annual growth rate of 1.2%. Maintaining the same growth rate we assume that the rural population in 2041 would be about 1.14 lakh. The details of the rural (hereafter referred as *Gamtal as prevalent in Gujarat State)* are elaborated below. Also refer Appendix A2.

2.3.3.1 Gamtal Population Projection

Based on census 2001 population have been calculated up to year 2041, population projections has been made using different methods as mentioned below:

- Arithmetic progression method
- Geometric progression method
- Incremental Increase method
- Graphical method

Table 2.7 shows projected gamtal population of the proposed area.

Table 2.7: Gamtal Population Projection

Population projection Methods	Projected Population					
	2010	**2011**	**2015**	**2021**	**2031**	**2041**
Arithmetic Progression	55045	55500	57890	60280	64875	69470
Geometric Progression	62415	63490	69510	75530	90555	109370
Incremental Increase	***61550***	***62500***	***69017***	***75535***	***92815***	***114335***
Graphical	51157	51634	54237	56839	62934	70084

Source: MM analysis

Considering the growth pattern of this region, the projected population figures based on Incremental increase method which was slightly higher than other methods, was selected for calculations and planning of all utilities.

2.3.4 Population projections summary

Following table tabulates the summary of the projected population including the gamtal, residing, floating population projected till 2020 for the GPCPSIR area. It also provides the summary of the employment projected for the GPCPSIR area.

Table 2.8: GPCPSIR Population Projections summary (2040)

S. No.	Categories	Population	Description
	GPCPSIR Industrial Employment		
A	Projected Industrial employment (Direct)	2,33,115	Inputs from industrial employment
B	Projected Industrial employment (Indirect)	3,66,860	Inputs from industrial employment
C	Total Projected Industrial employment (A+B)	5,99,975	Inputs from industrial employment
	Executive/ Non Executive Class		
D	Executive workers	2,39,990	40% of Industrial employment
E	Non executive class workers	3,59,985	60% of Industrial employment
	GPCPSIR Non-Industrial Employment		
F	Non industrial projected employment	8,776	3% of the total residing industrial employees (refer row I)
	GPCPSIR Total Industrial And Non Industrial Employment		
G	Total industrial & non-industrial employment (C+F)	6,08,751	Total employment including industrial & non industrial employment
	GPCPSIR Floating/Residing Employment		
H	Floating Population	1,67,993	40% of executive & 20% of non executive industrial employment
I	Industrial residing employment	2,92,523	(Residing executive + Residing Non-executive)-employed Gamtal population
J	Total Residing Employment	3,01,299	(60% of executive & 80% of non executive industrial population + non industrial employment
	GPCPSIR Residing Population (Migrating)		
K	Household Population	9,03,897	Avg. Household size of three family members for each employee.
L	Projected Population (up till 2040)	14,00,659	Household population projected as per gradual growth rate (0.63) assumed from Vapi city decadal growth.
	Projected Rural Population		
M	Projected Rural Population	1,14,335	Incremental population projection
	Total GPCPSIR Population (Inc Floating, Residential & Rural)	16,82,987	

Source: MM analysis

2.4 Infrastructure Projections

2.4.1 Traffic Projection

The traffic census data of following three main roads was available from Roads & Building Department of Bharuch, according to which existing volume capacity ratio of these roads has been calculated as below.

Table 2.9: Bharuch - Dahej Road

Period	2007		2008		2009
	April	October	April	October	April
V/C Ratio	0.88	0.83	0.85	0.84	0.48
Average		0.85		0.85	0.48

Source: Based on data provided by R&B Department, Bharuch

Table 2.10: Muler - Dahej Road

Period	2007		2008		2009
	April	October	April	October	April
V/C Ratio	0.51	0.65	0.67	0.61	0.55
Average		0.58		0.64	0.69

Source: : Based on data provided by R&B Department, Bharuch

Table 2.11: Jolva - Pakhajan Road

Period	2007		2008		2009
	April	October	April	October	April
V/C Ratio	1.66	1.65	1.60	1.30	1.60
Average		1.66		1.45	1.60

Source: MM Analysis

The Passenger Car Unit for different roads, its traffic projections & Vehicle registration details of Bharuch District are given in Appendix B.1. The design service volume for Four-lane highways in PCUs per day is considered as 40000 from Manual of specification & standards for four laning of highways and for 6-Lane Highways, 8-Lane Highways it has been assumed as 60,000 & 80,000 PCUs respectively.

2.4.2 Water infrastructure Projections

2.4.2.1 Design Norms

The quantity of water required in the houses for drinking, bathing, cooking, washing etc is called domestic water demand and mainly depends upon the habits, social status, climatic conditions and customs of the people. As per UDPFI guidelines under normal conditions, the domestic consumption of water is about 150-200 litres/day/capita (For Population>10 lakh). But in developed countries the supply rate would be around 300- 350 litres/day/capita because of their life style.

Table 2.12: Domestic Water Needs

Sr. No.	Aspect	Population		
		Small (<50,000)	Medium (>50,000)	Large & Metro (>10,00,000)
1	Absolute Min	70 lpcd	70-100 upper limit above 100,000	135 lpcd it can be reduced up to 70 lpcd
2	Desirable	100 lpcd	130-150 lpcd	150-200 lpcd upper limit for metro cities income area standards of lpcd

Source: UDPFI Guidelines

Table 2.13: Non-Domestic Water Needs

Sr.No	Institutions	Liters Per Capita Per Day (lpcd)
1	Hospital (Including laundry)	
a.	Nos. of Bed Exceeding 100	450/Bed
b.	Nos. of Bed not Exceeding 100	340/Bed
2	Hotels	180/Bed
3	Hotels	135
4	Nurse Home & Medical quarters	135
5	Boarding school/colleges	135
6	Restaurant	70/seat
7	Air port and Sea port	70
8	Junction station and Intermediate stations where mail or express stoppage	70
9	Terminal Station	45
10	Intermediate Station (Excluding mail and express stops)	45(Could be reduced to 25 where bathing facilities are not provided)
11	Day school/Colleges	45
12	Offices	45[4]
13	Factories	45(could be reduced to 30 where no bathrooms are provided)
14	Cinema,concert halls and theatre	15

Source: CPHEEO Manual

For projecting the water demand in the proposed GPCPSIR, the following have been taken into consideration from the above stated design norms.

Water Demand Standards for Population:

- Village (Gamtal) Residential Population: 200 lpcd
- Industrial Residential Population: 200 lpcd
- Industrial Floating Population: 50 lpcd

2.4.2.2 Fire Fighting Water Demand

Fire fighting demand is considered as per formula given in CPHEEO manual: Fire demand in Kl/Day = $100 \times \sqrt{p}$, Where p= population in thousand

2.4.2.3 Projections & Demand Gap Analysis

Proposed area is to be developed as petrochemical down stream product industrial zone and required large quantum of water for processing and non processing activities. Total water demand for the whole area is categorized into:

- Domestic Water Demand
- Industrial Demand

[4] As per CPHEEO for Office population 45lpcd has to be proposed, considering fire demand, migratory population to industries, and 50 lpcd has been considered for projection.

3. **Domestic water demand considerations**
- Demand for village population covered under GPCPSIR
- Industrial Domestic water demand
- Commercial water demand

4. **Industrial Water Demand considerations**
Industrial process raw water demand has been calculated based on water required (tonne) per tonne of production as on basis of existing industrial survey of Dahej estate, similar kind of Industrial estate studies and from relevant data available on chemical technology.

2.4.2.4 Existing Water Demand

At present, **Domestic Water Demand** of the existing area is catered by GWSSB intake well close to Nand village and **Industrial Water Demand** is catered by GIDC from intake well close to Nand Village and Angareshwar Village. Following tables give details of the existing water demand as received from GIDC and other stakeholder consultations

Also Refer Appendix B.2 for details of the existing Industrial survey of Dahej Estate which has been further used as a basis for the calculation of water demand of various industrial types

Table 2.14: Existing Domestic Water Demand of GPCPSIR area

Sr. No.	Year	Population	Water Demand (MLD) (Assuming 70 lpcd)
1	2010	61,550	**4.30**
2	2011	62,500	**4.40**

Source: MM Analysis

Table 2.15: Industrial Water Demand of Dahej I & Vilayat Estate

Sr. No.	Industry Type	Water Demand (MLD)
1	Dahej Estate (Dahej-I)	279.12
2	Vilayat Estate	70.01
Total Water Demand (MLD)		**349.13**

Source: MM Analysis

2.4.2.5 Future Domestic Water Demand

For practical purposes, phase wise development is projected for the proposed GPCPSIR for processing and non processing activities. CPHEEO planning norms, UDPFI guidelines and others relevant sources of data have been considered to project future water demand for processing & non processing activities. Phase wise population of proposed area including village Gamtal, Industrial residents, Industrial floating population and corresponding water demand has been summarized below:

Table 2.16: Domestic & Commercial Water Demand For Phase-0 (Up to 2015)

Sr. No.	Population Type	Population	Water Demand (MLD)
1	Village Gamtal	69,017	13.80
2	Industrial Resident	95,376	19.08
3	Industrial Floating	19,347	0.97

Sr. No.	Population Type	Population	Water Demand (MLD)
Total Population		1,83,740	33.85
Total Water Demand			33.85
Water demand including losses 15 %			38.92
Fire Fighting Water Demand			1.36
Commercial Water Demand			0.65
Total Water Demand (MLD)			**40.92**
Total Water Demand (MGD)			**9.00**

Source: MM Analysis

Table 2.17: Domestic & Commercial Water Demand For Phase- 1 (2016 to 2020)

Sr. No.	Population Type	Population	Water Demand (MLD)
1	Village Gamtal	75,535	15.11
2	Industrial Resident	2,83,849	56.77
3	Industrial Floating	45,893	2.29
Total Population		4,05,277	74.17
Total Water Demand			74.17
Water demand including losses 15 %			85.30
Fire Fighting Water Demand			2.84
Commercial Water Demand			2.14
Total Water Demand (Cumulative Demand up to 2020)			**90.28**
Total Water Demand (MGD)			**19.86**

Source: MM Analysis

Table 2.18: Domestic & Commercial Water Demand For Phase-2 (2021 - 2030)

Sr. No.	Population Type	Population	Water Demand (MLD)
1	Village Gamtal	92,815	18.56
2	Industrial Resident	8,35,286	167.06
3	Industrial Floating	1,18,380	5.92
Total Population		10,46,481	191.54
Total Water Demand			191.54
Water demand including losses 15 %			220.27
Fire Fighting Water Demand			5.38
Commercial Water Demand			5.19
Total Water Demand (Cumulative demand up to 2030)			**230.84**
Total Water Demand (MGD)			**50.78**

Source: MM Analysis

Table 2.19: Domestic & Commercial Water Demand For Phase-3 (2031 - 2040)

Sr. No.	Population Type	Population	Water Demand (MLD)
1	Village Gamtal	1,14,335	22.87
2	Industrial Resident	14,00,659	280.13
3	Industrial Floating	1,67,993	8.40
Total Population		16,82,987	311.40

Sr. No.	Population Type	Population	Water Demand (MLD)
Total Water Demand			311.40
Water demand including losses 15 %			358.11
Fire Fighting Water Demand			7.90
Commercial Water Demand			8.99
Total Water Demand (Cumulative demand up to 2020)			**374.99**
Total Water Demand (MGD)			**82.49**

Source: MM Analysis

2.4.2.6 Future Industrial Water Demand

For Industrial water demand, petrochemical product chain has been analyzed based on Industrial survey, Feed stock availability and demand of down stream petrochemical based product. Industrial projection has been categorized in phase wise manner to develop the whole area as petrochemical and downstream petrochemical product. The industrial projections discussed in detail in situation analysis chapter of Volume I, Section 1 and the industrial survey sections of Volume II, Section 2 of the DDP report. Apart from this, details of projections for Dahej phase II water demand projected by GPCPSIR Services Limited has also been considered for projections. For the employment projections and phase wise basic distribution of the same kindly refer chapter 2 of this report. Phase wise Industrial process raw water demand has been summarized in following table:

Table 2.20: Industrial Water Demand

Sr. No.	Phasing Period	Year	Water Demand (MLD)	Water Demand (MGD)
1	Phase-0	Immediate up to 2015	612.40	134.93
2	Phase-1	2016-2020	671.55	147.94
3	Phase-2	2021-2030	914.24	201.33
4	Phase-3	2031-2040	1,010.59	222.52

Source: MM Analysis

Table 2.21: Total Water Demand of GPCPSIR

Sr. No.	Development Phase	Phase Duration	Domestic & Commercial Demand (MLD)	Industrial Demand (MLD)	Total Water Demand (MLD)	Total Water Demand (MGD)
1	Phase-0	Up to 2015	40.92	612.40	653.32	143.71
2	Phase-1	2016 to 2020	90.28	671.55	761.83	167.58
3	Phase-2	2021-2030	230.84	914.24	1,145.08	251.89
4	Phase-3	2031-2040	374.99	1,010.59	1,385.58	304.79

Source: MM Analysis

As seen in Table 2.21, a total quantity of 304.79 MGD water is projected for GPCPSIR. Apart from this, water would be required during phase wise construction of the proposed development. This water demand is one time temporary water demand hence not considered in total operational water demand calculation however proposed development is inline with total water demand of area (Constructional & Operational). Based on similar kind of project experience, it is assumed that 14 MGD of water would be required as a construction demand of the area. Refer Appendix B.2 for details of water demand calculation for GPCPSIR.

Table 2.22: Total Water Demand

Sr. No.	Development Phase	Phase Duration	Constructional Phase Water Demand (MLD)	Operational Phase Demand (MLD)	Total Water Demand (MLD)
1	Phase-0	Up to 2015	13.64	653.32	666.96
2	Phase-1	2016 to 2020	27.28	761.83	789.11
3	Phase-2	2021-2030	50.01	1,145.08	1,195.09
4	Phase-3	2031-2040	63.65	1,385.58	1,449.23
Total Water Demand (MLD)					**1,449.23**
Total Water Demand (MGD)					**318.79**

Source: MM Analysis

2.4.2.7 Demand Gap Analysis

Based on existing water demand and future water demand, demand gap analysis has been carried out by considering the existing source available within GPCPSIR. Currently, GIDC supplies 33 MGD of raw water from intake wells located at Nand Village (8 MGD) and at Angareshwar Village (25 MGD).

Table 2.23: Demand Gap Analysis

Phasing	Phase wise Water Demand		Existing Water Availability (MGD)	Short Fall (MGD)
	In MLD	In MGD		
Phase-0	666.96	146.71	33(25+8)	-113.17
Phase-1	789.11	173.58	-	-140.58
Phase-2	1,195.09	262.89	-	-140.58
Phase-3	1,449.23	318.79	-	-285.79

(-) shows deficit of water and (+) shows excess of water w.r.t. existing source of water supply.

Source: MM Analysis

2.4.3 Sewerage Infrastructure Projections

The total sewerage generation has been calculated based on the population projection of the existing Gamtal & also future migratory population up to the ultimate year for the GPCPSIR region.

As water supply augmentation has been planned simultaneously, the rate of supply is seen to be sufficient to run the sewer system to ensure the self cleaning velocity. Water requirement of 200 lpcd has been proposed for the entire GPCPSIR area for domestic requirement. Sewerage contribution has been considered as 80 % of water supply as per the CPHEEO guidelines. The industrial contribution to the system has not been considered for sewerage flow calculation since that would be disposed in the effluent disposal system. The sewerage generation of 160 lpcd which is 80% of 200 lpcd of water supply has been considered (200 lpcd x 0.8 = 160 lpcd). Refer Appendix B.3 for population wise details of sewerage demand calculation for GPCPSIR.

Table 2.24: Phase wise sewerage generation

Phasing period	2010-2015	2016-2020	2021-2030	2031-2040	Total
Migratory Sewerage Generation (MLD)	15.26	30.16	88.23	90.46	**224.11**
Sewerage Generation from Village (MLD)	8.05	2.60	2.57	4.64	**17.86**

Phasing period	2010-2015	2016-2020	2021-2030	2031-2040	Total
Non-Polluting Industries (MLD)	0.31	1.22	2.76	1.84	**6.13**
Total Sewerage Generation (MLD)	**23.62**	**33.98**	**93.56**	**96.94**	**248.10**

Source: MM Analysis

The Migratory population sewerage generation has been calculated from the migratory population projection and the rural/gamtal sewerage generation has been calculated from the villages that would be included in the phase wise expansion of the industrial area as defined in the Land use plan for the GPCPSIR area in chapter 4.

The Migratory sewerage generation has been calculated from the migratory population projection and the village sewerage generation has been calculated from the villages coming under the phases defined in the Land use map.

2.4.3.1 Design Formula

Manning's Formula has been used for designing the sewerage collection system

$V = 1/n\ r^{2/3}\ s^{1/2}$

Where, V = Velocity of flow in pipe in m/sec

n = Manning's co efficient of roughness

r = Hydraulic radius in m

s = Slope of hydraulic gradient

The 'n' value 0.011 has been used for RCC pipe with rubber ring joint for designing the sewerage collection system.

2.4.3.2 Pipe Materials

For all sewers at all depths, RCC pipes conforming to IS: 458 have been adopted. The joint for RCC pipe is S&S with rubber sealing ring gasket type. RCC pipe of class NP4 with sand bedding has been proposed for Sewer applications. Type of pipes to be used may be changed considering the localised problems and considering the tech-economic feasibility during DPR stage.

2.4.3.3 Manholes

The design of manholes depends upon the depth and diameter of the sewer. Manholes have been provided at the junction of sewers, deviations in alignments etc. apart from the ones at regular intervals to facilitate system maintenance. All manhole types considered for estimates are circular brick masonry type and RCC manholes may be used at water logging areas

2.4.4 Effluent Management Infrastructure Projections

2.4.4.1 Proposed industries effluent generation

Total effluent generated from proposed industrial cluster has been calculated based on following three assumptions.

- Effluent generated per ton of product generation
- Process involved in manufacturing of specified products
- Consideration of effluent generation pattern of Hazira, Ankleshwar Vapi GIDC estate etc.

Refer Appendix B.4 for the details of the same and for the details of effluent generation calculation for GPCPSIR.

2.4.4.2 Existing industries effluent generation

As per standard practices, 70 % of water demand for effluent generation has been considered (Since no valid data for upcoming Industrial pattern in Dahej-II and Vilayat area is available). Based on this assumption, total quantity of effluent from the industries is tabulated in Table 2.25

Table 2.25: Phasewise Effluent Generation

Sr.No	Phasing Development	Phasewise Effluent Generation (MLD)	Phase wise Effluent Generation (MGD)
1	Phase-0 (Immediate up to 2015)	428.38	94.23
2	Phase-1 (2016-2020)	40.98	9.01
3	Phase-2 (2021-2030)	121.22	26.67
4	Phase-3 (2031-2040)	57.36	12.62
Total Effluent Generation		**647.94**	**142.53**

Source: MM Analysis

2.4.5 Storm Water Drainage Infrastructure Projections

2.4.5.1 Situation Analysis

For an effective design of storm water drainage system, there are several aspects which need to be considered to arrive at effective design criteria. The entire region can be evaluated with respect to storm water on following parameters.

Topography

Topography of the particular area plays very vital role in behaviour of storm water drainage. An economic design can be achieved if natural topography followed during the design. It is therefore very important to consider topographical features of Region. With this basis,the following parameters have been decided:

- From the study of the general topography of the GPCPSIR Region it is observed that the area is almost flat or very gently slopped towards south-West.
- The total difference between the highest and lowest point in the Area is not more than 12 m.

Rainfall Pattern

Quantification of rainfall shall govern the sizing of the drains and disposal system. Effective estimation of rainfall can be achieved by studying the rainfall pattern of the particular region.

The precipitation data for the five stations located in the GPCPSIR area have been collected and analyzed. According to analysis the average rainfall intensity for the project area for the return period of 10 year and 100 year is 10 mm/hr and 20 mm /hr respectively. The average rainfall intensity of 10 mm/hr has been taken for designing of the storm water drains.

2.4.5.2 Design Criteria

The design of storm water drain depends upon the amount of flow, cross-sectional area of the water body (through which the flow has to pass), and velocity in the drain.

Run-off

Run-off is a portion of rainfall which drains over the ground surface. Estimation of such run-off reaching the storm drains is dependent on the following parameters:

- Intensity of rainfall
- Duration of rainfall
- Characteristic of tributary area
- Time of Concentration

Different methods are available for the estimation of storm water run-off. These methods are:

- Rational Method
- Hydrographical method
- Rainfall-run-off co-relation studies
- Digital Computer Models
- Inlet method of empirical formula

Use of any of the above listed methods depends upon the basic requirement. However the Rational method is the most commonly used method in practice and the same has been adopted for the estimation purposes.

$$Q = 0.0028 \times C_e \times i \times A$$

Where,

Q = run-off in m^3/s.

C_e = Co-efficient of run-off

i = Intensity of run-off in mm/hr

A = Area of catchments in hectares

The various values to be adopted for the design are as under:

Co-efficient of run-off

Some quantity of rainwater that falls on the ground is absorbed by soil and the percentage of rainwater that enters the drain is known as impermeability factor. The paved surfaces and areas occupied by covered roofs are treated as 100 percent impermeable. Exposed earth surfaces are treated as completely permeable or slightly impermeable. On these basic considerations, the value of impermeability factor according to the area is fixed and same has to be adopted for the whole GPCPSIR area.

Table 2.26: Effective impermeability coefficient, Ce

Particular	Value
Fully paved area (Industrial, commercial area, security blocks and Logistics etc)	75%
Paved area (roads, parking)	80%
Semi constructed areas (public utility blocks etc)	60%
Fully Developed Area (Big Housing Complexes, Internal Road, Ecopark etc)	60%
Non-paved areas (gardens, landscaping etc)	20%

Source: CPHEEO Manual

Intensity of Rainfall

A rainfall at a particular place can be completely described if its intensity, duration and frequency are known. The intensity of a rain is the rate at which it is falling, the duration is the time for which it is falling with that given intensity, and frequency is the number of times it falls with the same amount of intensity. It is usual practice to design the storm water drains by considering the storm occurring once in 5 years or so for residential areas and a slightly longer period i.e. once in 10 of occurrence for industrial and commercial area. Once in 10 year Rainfall intensity has been considered for the design area and it has been taken as 10 mm/hr. the total surface run-off as per the design calculations is 807 m^3/sec. Also see Appendix B.6 for details of runoff calculation.

2.4.6 Solid Waste Management Infrastructure Projections

In case of GPCPSIR, on basis of the standard data, available and past experience an average density of 400 Kg/m^3 has been adopted for calculations and projections. (CPHEEO, SWM Manual).

2.4.6.1 Solid Waste Quantification

Based on CPHEEO manual on Municipal Solid waste management and past experience, it has been observed that quantity of solid waste generation rate is less than the developed countries. The waste generation ratio normally varies between 0.2 – 0.6 kg/capita/day.

For purposes of project identification, where an indication of service level must be estimated and the following municipal refuse generation rates have been adopted as per CPHEEO, Manual

- Residential refuse: 0.3 to 0.6 kg/cap/day
- Commercial refuse: 0.1 to 0.2 kg/cap/day
- Street sweepings: 0.05 to 0.2 kg/cap/day
- Institutional refuse: 0.05 to 0.2 kg/cap/day

For our planning purpose based on population, the waste generation rate ***of 0.4 kg/capita/day*** has been assumed with **1.5 %** annual increase in waste generation for projection of future domestic waste. Phased wise domestic waste generation for the area has been given in Table 2.27. The Biomedical & Industrial waste generation has been shown in Table 2.28 & Table 2.29. Refer Appendix B.7 for details of the solid waste generation calculations

Table 2.27: Phase wise Domestic solid waste generation

Phasing Period	Waste Generated/ Capita (kg.)	Gamtal Population	Residing Employee	Total Waste Generated (TPD)	Biodegradable Waste Generated (TPD)	Landfillable Waste (TPD)
Phase-0 (Immediate up to 2015)	0.40	69,017	1,56,392	95.12	57.07	38.05
Phase-1 (2016-2020)	0.43	75,535	3,21,311	157.41	94.45	62.96
Phase-2 (2021-2030)	0.50	92,815	7,05,391	383.16	229.90	153.26
Phase-3 (2031-2040)	0.58	**1,14,335**	2,17,565	138.67	83.20	55.47
		Total	**14,00,659**	**774.36**	**464.62**	**309.74**

Source: MM Analysis

Table 2.28: Phase wise Biomedical Waste Generation

Phasing Period	Biomedical Waste Generated (TPD)
Phase-0 (Immediate up to 2015)	0.116
Phase-1 (2016-2020)	0.42
Phase-2 (2021-2030)	0.84
Phase-3 (2031-2040)	0.84
Total	**2.216**

Source: MM Analysis

Table 2.29: Phase wise Proposed Industrial Waste generation

Phase	Phasing Period	Industrial Waste Generated (TPD)
0	2010-2015	24.57
I	2016-2020	128.28
II	2021-2030	276.12
III	2031-2040	185.41
Total Waste Generated (TPD)		**614.38**

Source: MM Analysis

2.4.7 Power Supply Infrastructure Projections

2.4.7.1 Phase wise power demand calculation for Non-processing area

As detailed in the population projections sections above, it is seen that substantial floating and residential population would be attracted to this region. This would create power demand for the residential area which is designed on the basis of the following considerations.

2.4.7.2 Assumptions

- Power requirement: 150 watts per person i.e. 0.15 kW
- Members per family: 3
- Power requirement per family: 450 watts i.e. 0.45 kW

Table 2.30 details the total power demand for the non processing area for GPCPSIR. Also refer Appendix B.8 for the detailed calculations of power demand for Processing areas and non-processing areas

Table 2.30: Phase wise power demand calculation for non-processing area

Phasing Period	Total Gamtal Population	Industrial Employment		Total Population (Gamtal+Industrial Resi.+Ind. Floating)	Total Families (Nos.)	Total Power Demand (kW)	Total Power Demand (MW)
		Total Resident Population	Total Floating Population				
Phase-0 (2010-2015)	69,017	95,376	19,347	1,83,741	61,247	27,561	**28**
Phase-1 (2016-2020)	75,535	1,88,472	26,546	2,21,536	73,845	33,230	**33**
Phase-2 (2021-2030)	92,815	5,51,437	72,487	6,41,204	2,13,735	96,181	**96**
Phase-3 (2031-2040)	1,14,335	5,65,373	49,613	6,36,507	2,12,169	95,476	**95**
Total (after Yr. 2040)	**1,14,335**	**14,00,658**	**1,67,993**	**16,82,988**	**5,60,996**	**2,52,448**	**252**

Source: MM Analysis

2.4.7.3 Industrial Power requirement and stakeholder's consultation

The total power demand for industrial/processing area is projected to be around 2000 MW. This has been initially derived on the basis of the industrial sizing done for the area and the power demand ball park assumptions are based on the details collected during the primary survey. Also refer Appendix B for the detailed calculations of power demand for processing area.T he total power demand along wjth the costing for the power infrastructure has been discussed and finalised after discussing with various key stakeholders. The details of the same are given below.

Mott MacDonald study team visited the site on 29th and 30th April, 2010 for getting data regarding existing power supply network as mentioned in chapter 3 of Volume I of the development plan report. The team also met officials from GIDC, Bharuch, GETCO substations at Dahej, Vagra and Vilayat and collected data regarding power import and export at different substations.

The team had a discussion with Superintending Engineer of GIDC, Gandhinagar office for getting data. The team received the draft development plan for Dahej 2, 3 and 4.

The team had a discussion with Superintending Engineer of GETCO, Vadodara office on 2nd August 2010 to discuss points regarding power transmission and distribution within GPCPSIR region. The team prepared preliminary development plan in consultation with SE, GETCO and the suggestions and feedbacks were incorporated.

The team discussed with Superintending Engineer of GETCO, Vadodara office on 16th September 2010 to discuss draft development plan, draft report and tentative cost estimate for power within GPCPSIR region. We have revised the plan, report and cost estimates in consultation with the SE, GETCO as per their suggestions and feedbacks.

The team discussed with GETCO about need for setting up any captive power plant within GPCPSIR region. The officials at GETCO discussed the matter and it was decided that there is no need for any captive power plant looking at the adequate power availability to cater the demand for GPCPSIR for all phases. Also setting up captive power plant requires other infrastructure services to be separately provided hence it is not recommended.

The team visited Superintending Engineer of GIDC at their Gandhinagar office on 6th October 2010 for getting their final comments or suggestions on our revised planning for power transmission and distribution

for GPCPSIR. The team received GIDC map for Dahej 1 and Dahej 2 in editable format.The team received this report in compliance with comments.

3. Statutory Obligation

Development guidelines are an integral part of planning. Besides land use planning, development guidelines and planning norms indicate growth direction and help bring controlled development.

3.1 Introduction

Various features in PCPIR, especially growth nodes and restrictive uses are proposed to be controlled by PCPIR guidelines and norms. The Development controls and norms are drawn from guidelines at Central or State level legislations. Acts, rules, regulations, guidelines and notifications referred for this study are discussed in this chapter.

3.2 Petroleum, Chemical and Petrochemicals Investment Region (PCPIR) Policy

Figure 3.1: Concept of PCPIR

Source: PCPIR policy

The Government of India has launched the policy on the promotion of Petroleum, Chemicals and Petrochemical Investment Regions (PCPIRs) in the country in the month of May 2007 after several internal deliberations within the government departments.

The policy is the basic framework for PCPIR as it provides an overall concept guideline for specifications on the minimum standards required for setting up PCPIRs.

The policy objectives are focused on the promotion of investment in the petroleum and petrochemicals sector through the provision of an efficient regulatory system and world class infrastructure. The act defines a PCPIR region as 'A Petroleum, Chemical and Petrochemicals Investment Region (PCPIR) is conceptualised as a specifically delineated investment region with an area of around 250 sq.Km planned for the establishment of manufacturing facilities for domestic and export led production in petroleum, chemicals and petrochemicals, along with the associated services and infrastructure'.

Relevant Clauses: The policy states that a PCPIR would be a combination of production units, public utilities, logistics, and environmental protection mechanisms, residential areas, where the manufacturing facilities, along with associated logistics and other services and required infrastructure will be located. Non processing area shall include residential, commercial and other social and institutional infrastructure. The minimum processing area for the PCPIR will be about 40% of the total designated area, i.e. around 100 sq km[5]. A summary of the PCPIR Policy is attached in Appendix C.1.

3.3 Special Investment Region Act

SIR ACT, 2009 states its objectives as: *"To provide for establishment, operation, regulation and management of large size Investment Regions and Industrial Areas in the State of Gujarat; and to specially*

[5] The processing may or may not be contiguous (mentioned in the policy).

enable their development as global hubs of economic activity supported by world class infrastructure, premium civic amenities, centres of excellence and proactive policy framework; and for setting up an organizational structure with that purpose and for matters connected therewith or incidental thereto."

The Gujarat Government notified "***Gujarat Petroleum Chemical & Petrochemical Special Investment Region"*** under the SIR Act on 9th June, 2009. Refer Appendix C.2.

The relevant clauses of the Act are:

- Special Investment Region Act, 2009 has been designed to provide for the establishment, operation, regulation and management of large size Investment Regions and Industrial Areas in the State of Gujarat. The following planning considerations have been clearly spelt out in the Act;

- Planning of the SIR "…..shall take into account the development plan, if any, prepared by the respective local authority for the concerned village area (*gamtal*) of the village Panchayat, Municipal area and Municipal Corporation area and the adjacent area thereof; Provided that the State Government may declare the adjacent area of a village Panchayat, Municipality or Municipal Corporation from time to time".

- It is clearly mentioned that "The area within the Special Investment Region except the village site area (*gamtal*) of a Village Panchayat, Municipal area and Municipal Corporation area shall be deemed to be an industrial township within the meaning of the provisions of clause (1) of article 243Q of the Constitution of India from the date it is so notified in the Official Gazette by the State Government".

- The Special Economic Zones falling within the Special Investment Region shall continue to be governed by the Gujarat SEZ Act, 2004.

- State Government may declare the outer area, not exceeding three kilometres on either side adjoining to a SIR, to be the periphery of the SIR and this shall be regulated by the Regional Development Authority (RDA)

- The planning shall ensure provision for sufficient civic amenities and services including hospitals and medical services, schools, fire services, public parks, markets and shopping places, play ground entertainment areas and disposal of waste and provision of drainage. The development plan must provide for disaster management and mitigation.

The SIR Act mentions the reference of **Town & Country Planning Act, 1976 for formulation of Draft Development Plan.**

The TCP Act discusses the Declaration of Development area, constitution of Development authority, control of development, use of land included in Development plan, Town Planning scheme, finance, levy and recovery of development charges in general for application in Gujarat.

The Act defines preliminary contents of a DDP, ***"which shall indicate the manner in which the use of land in the area covered by it shall be regulated and also indicate the manner in which the development therein shall be carried out"***.

As per the Act, PCPIR DDP proposal designates the use of land for residential, industrial, commercial, agricultural and recreational purpose. The proposal shall have reservations for public purposes, natural

reserves and physical infrastructure. Matters such as flood control, preservation of river pollution, conservation of natural scenery are a part of DDP as concerns of these issues are mentioned in the Act.

The Act suggested provision for controlling and regulating the use and development of land within the development area, including imposition of conditions and restrictions in regard to the open spaces to be maintained for buildings, the percentage of building area for a plot, height, density of built up area etc. Details of which will be included in the GPCPSIR Development Control Rules (GDCR).

3.3.1 Town Planning Scheme

One of the suggested development strategies for GPCPSIR Town Planning Scheme (GTPS) has been made in accordance with the TP scheme stated in the Town and Country Planning Act, 1976. The GTP scheme makes provision for the following:

- Laying out of new roads, improvement in roads, constructions;
- Allotment or reservation of land for various purposes from the total area covered under the scheme;
- Imposition of conditions and restrictions in regard to the open spaces to be maintained etc.

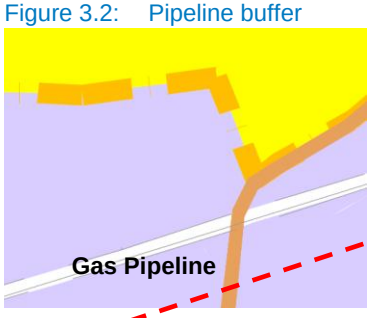
TP scheme can be referred for rules, bye-laws and regulations. For detailed GTPS refer GDCR.

3.4 Oil and Gas Infrastructure related norms

3.4.1 Pipeline network related norms

As mentioned in chapter 3, volume II elaborating on the baseline information there is presence of oil and gas infrastructure pipelines in the GPCPSIR area. Based on the reference of various regulatory agencies and especially the Petroleum and Mineral Pipelines Act, 1962 mentioned below, the network of gas pipelines across the GPCPSIR site is proposed to have restricted land use along their respective Right of Use (RoU). A buffer up to of 30 mts (ranging from 20- 21mts. on the left and 9-10 mts.[6] on the right of the direction of the flow) is mandatory and has been marked in the land use proposal.

Figure 3.2: Pipeline buffer



Source: PCPIR DDP, MM

As per the Petroleum and Mineral Pipelines Act, 1962, the owner or occupier of the ROU land is entitled to use the land for the same purpose for which it was put to use earlier, before the date of notification of ROU, provided that the occupier shall not

a. Construct any building or any structure,
b. Construct or excavate any tank, well, reservoir, dam or
c. Plant any tree

3.4.2 Oil wells & gas gathering station related norms

Petroleum and Natural Gas Rules, 1959 (as amended by rules, 2003): Under these rules, Central Government has issued instructions on the spacing of wells or gas gathering station buffer, which shall be drilled at any point within a minimum distance from the following:

- railway line,

[6] 21L-9R mts ROU marked in DUPL, GAIL pipeline already.

- pipeline or other right of way,
- surveyed roads,
- dwellings,
- industrial plants,
- aircraft runway,
- buildings for public purposes or any mine, whether active or abandoned[7]

As per the Oil Mines regulations, 1984, Director General of Mines and Safety, during operation, minimum 30 mts distance from the well shall have

d. No person other than those required for fracturing operations,
e. No naked light or any other source of ignition,
f. All electrical equipment to be de-energised, etc[8] and within 90 mts distance
g. Flame shall not be sited from any part of production or petroleum storage tank

Hence about 100mt X 100mt is proposed to be maintained as a buffer encompassing all the safety distance norms for precautions against fire.

3.5 Environment related norms

3.5.1 Coastal Zone Regulations

As per the Coastal Regulation Zone notification, issued by MoEF, dated 4th August, 2000 the GPCPSIR coastal area within 500 mts of the High tide line towards the landward side is under the development regulation of CRZ III.

The prominent land use permitted in the CRZ regulated area are-

1. Agricultural,
2. Recreational,
3. Port related,
4. Storage/ warehouse,
5. Salt manufacturing,
6. Local Architecture

Storage of the following petroleum products in the Port area

- Crude oil,
- Liquefied Petroleum Gas,
- Aviation fuel,
- High speed Diesel,
- Lubrication oil,
- Butane,
- Propane,
- Compressed Natural Gas,
- Naphtha,
- Furnace oil,

[7] Source: Petroleum and Natural Gas Rules, 1959 (as amended by rules, 2003), pg no.13.

[8] Other restrictions within a minimum distance are mentioned in Oil mines regulations, 1984 in chapter VII, section 67: Safety distance and precautions against fire. The prominent precautionary rules are mentioned here to highlight the basis of arriving at the minimum distance of the buffer for wells.

- Low Sulphur heavy Stock.

Besides this, area up to 200 metres from the HTL is to be earmarked as **'No Development Zone'**. No construction shall be permitted within this zone except for repairs of existing authorised structures

Regulations for prohibited activities in CRZ area are mentioned in the report Appendix C.3 is to be observed. Norms for development controls specifically in the CRZ[9] are included in specific in the GPCPSIR General Development Control Regulations (GDDCR).

3.6 Planning Guidelines related to Infrastructure development

The guidelines relevant for the infrastructure development have been included in the next chapter where the proposals for the infrastructure have been elaborated.

3.7 Envisaged Planning and development regulations for GPCPSIR

General Development Control Regulation (GDCR) is an effective tool for growth management and balanced development. In case of GPCPSIR, the draft GDCR (refer Volume - III) has been recommended to have homogenous and safe development within the planning area of GPCPSIR. However, the recommended GDCR may need further decadal modification in order to suit the need of a dynamic mega industrial development proposal in the GPCPSIR. The GDCRs also mention about strict adherence to the various Acts and Rules that will be applicable to a mega PCP area from the point of view of chemical and other disasters, explosions and fire possibilities. Apart from that, Town Planning schemes and integrated housing schemes are envisaged to be the preferred mechanism. Both are elaborated in Volume III of the report.

[9] Construction related norms are specifically mentioned in the CRZ notification, Sub section for CRZ III and Notification Appendix II are referred.

4. Proposed Draft Development Plan Proposals

The culmination of a Development Plan is a proposal for the development and zoning of various land use and infrastructure. This section comprises of Land use and the land use zoning proposed for GPCPSIR. All features discussed till now have been relevantly included in terms of spatial allocation of all proposed activities into a physical plan.

4.1 Proposed Land use Distribution

The proposed land use plan for GPCPSIR has been finalised out of a consultative process and on the basis of the land suitability analysis done for the area. Contemporary planning principles have also been the driving factor for the proposed land use and infrastructure proposals including aspects of transportation and logistics synergy, appropriate co-siting of industries, environment and safety issues, cohesive and safe non processing area development.

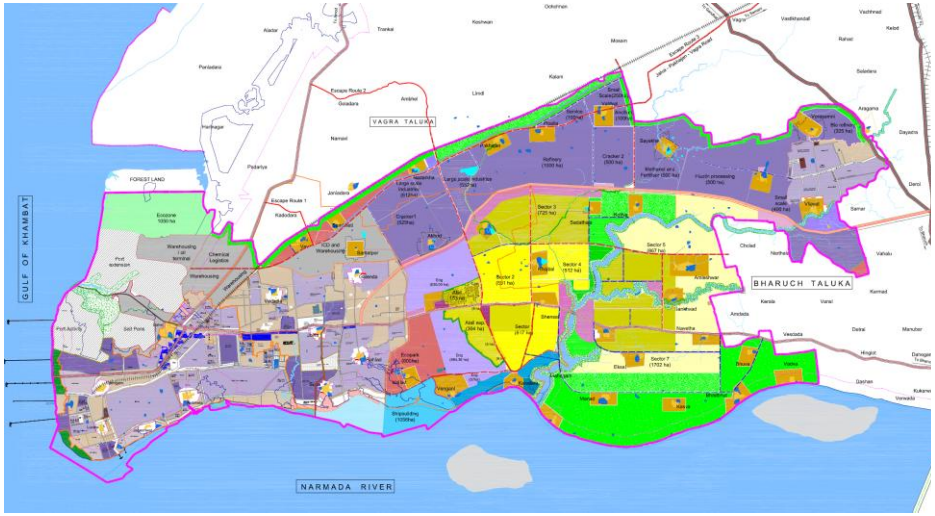
4.1.1 Consultative process

The proposed land use distribution has been decided as per the following parameters:

- Land suitability parameters as discussed in Volume I Section 5.3
- Contemporary planning principles
- Benchmarking parameters of World Class mega PCP Industrial area as discussed in Volume I Section II –GPCPSIR Studies
- Stakeholder consultative process as discussed in Volume I Section 5.2.3.

Taking all the inputs from the above four parameters, all proposed activities had been allocated spatially on the prepared base map in form of a physical plan. It included all the plans of existing active agencies and gradually through repetitive consultation process with the stakeholders (refer Figure 4.1, Figure 4.2 , Figure 4.3, Figure 4.4) the land use plan has been finalised.

Figure 4.1: Stage I - Option 1, August 2010

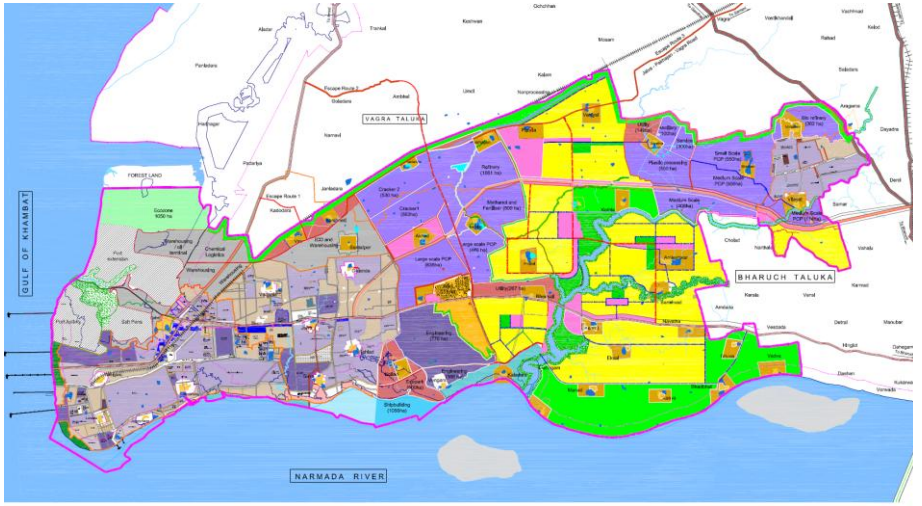


Main Features:

- Industry and Non processing zone totally segregated
- Mixed use land use proposed.
- Significant portion of Agricultural land is left as it is.

Source: MM

Figure 4.2: Stage I - Option 2, August 2010

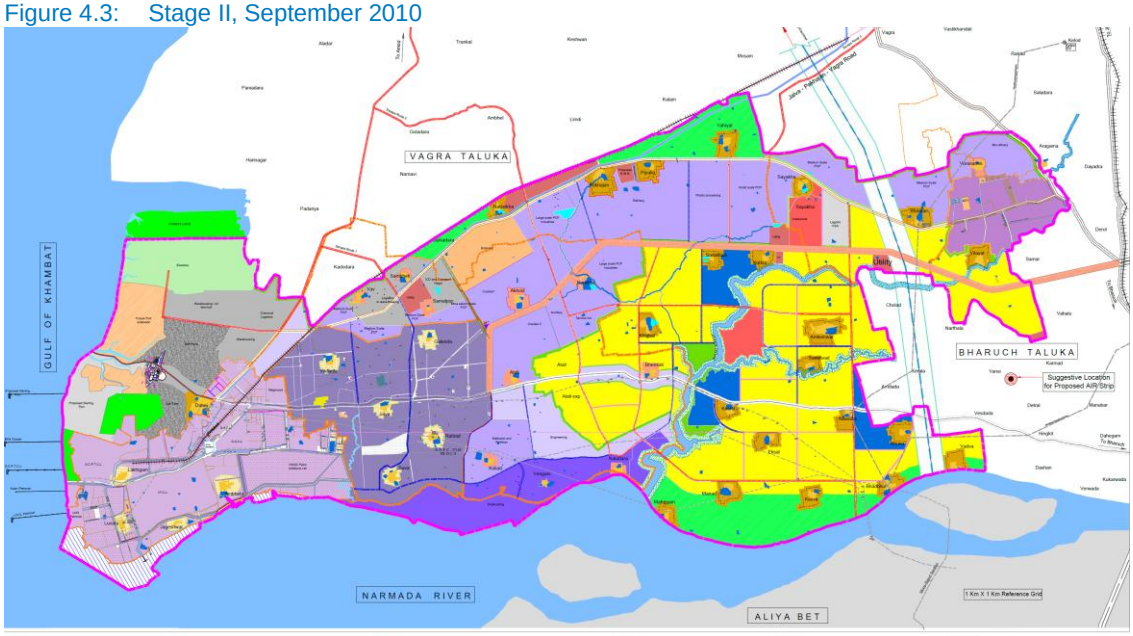


Main Features:

- Industrial zone is divided into two parts
- Existing road-network tried to be retained as much as possible.
- Mixed use land use proposed

Source: MM

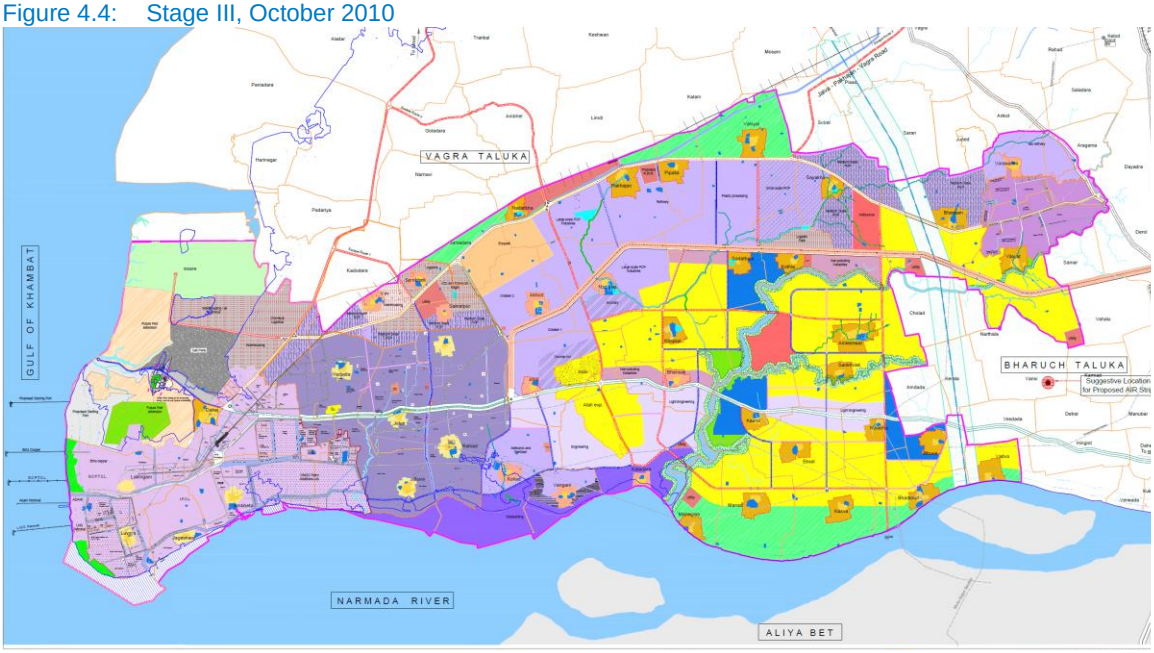
Figure 4.3: Stage II, September 2010



Source: MM

Combining both the options of Stage I, Stage II had been formed and it tried to leave the agricultural land as much as possible. And in the next stage as per discussion with Key stakeholders and requirement of the industries fraternity, non-polluting industrial zone has been added along the major linkages (Refer Figure 4.4).

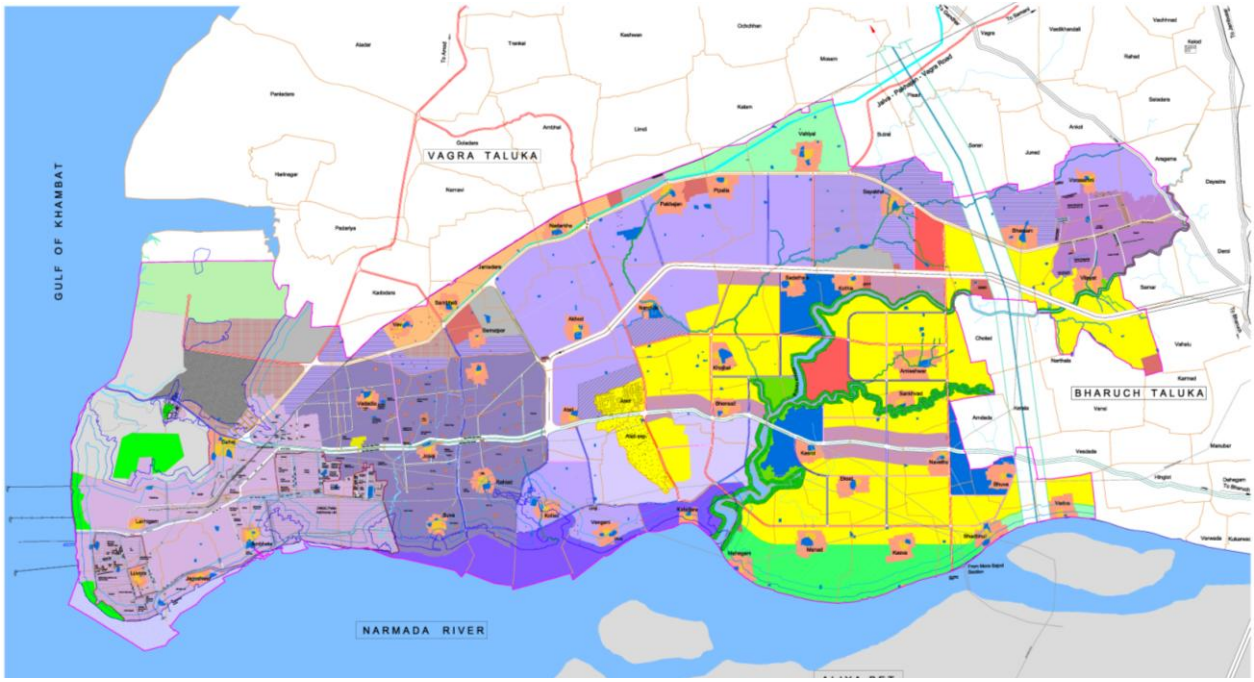
Figure 4.4: Stage III, October 2010



Source: MM

Further to that, in order to accommodate a possibility of a large petrochemical area along the proposed expressway, there has been final modification in the Landuse Plan where the Ecopark area has been included entirely to the North of the proposed 120 m road and final Land Use Plan (Figure 4.5) has been derived. A detailed map is attached in Appendix D. Also, the proposed landuse plan at the scale of 1:8000 is included in a separate Map portfolio for detailed reference.

Figure 4.5: Stage IV, November 2010



Source: MM

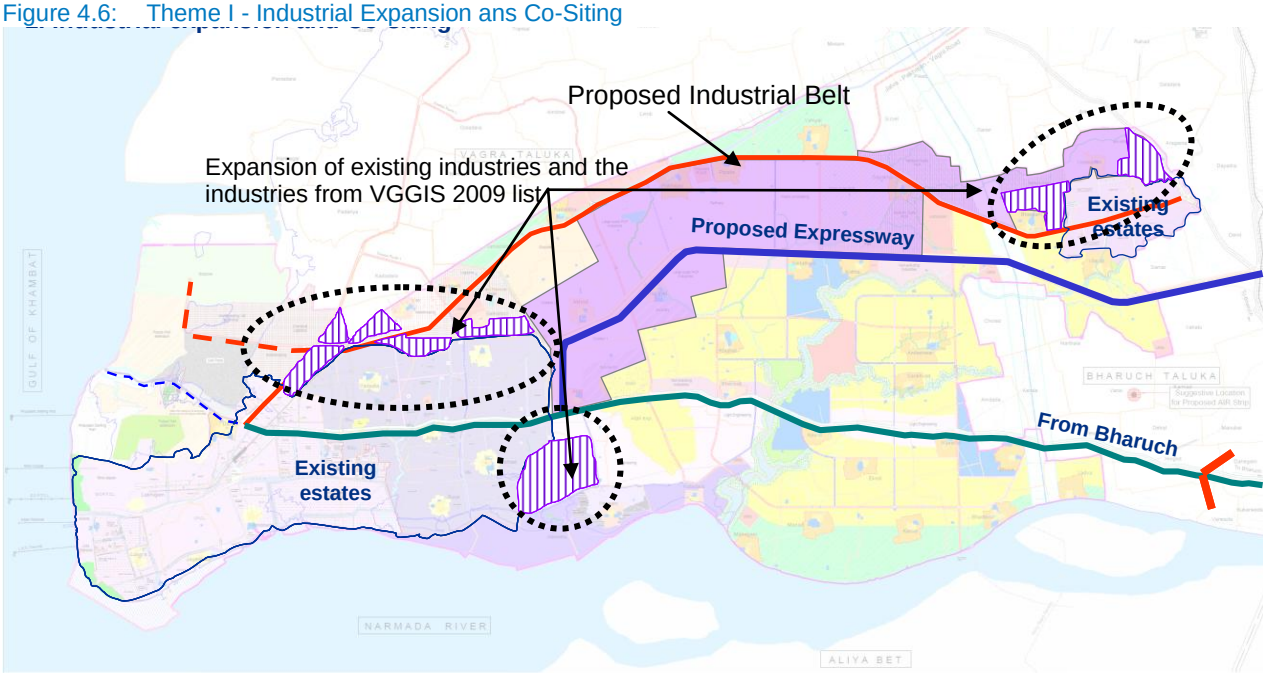
4.1.2 Main features of land use zoning

Land use zoning concepts have been derived on the basis of site geometry, basic road structure within the site and proposed linkages with the existing system. Based on the development objectives as discussed under Section 2.1.2, the zoning has been evolved around four themes as follows:

a) Industrial Expansion and Co-siting

Industrial area has been planned in a way that it can accommodate the expansion of existing industries as well as the listed industries of Vibrant Gujarat Investor Summit 2009. Proposed industrial belt has been suitably sited and grouped in such a way that they can perform better as well as it would connect the existing Industrial belt at Dahej and Vilayet.

Figure 4.6: Theme I - Industrial Expansion ans Co-Siting



Source: MM

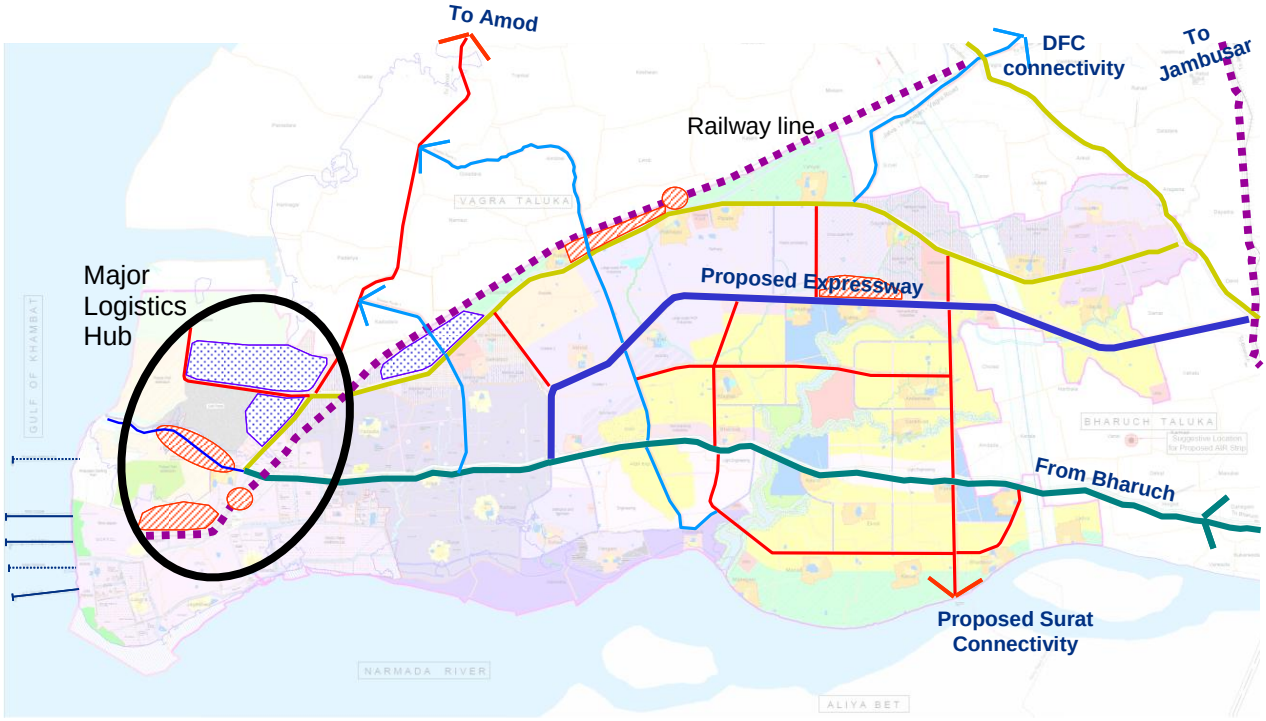
b) Transportation and logistics synergy

Major spine of the access and strategic connectivity to the national transportation corrodors was one of the major criteria for initiating the physical layout of the plan of GPCPSIR. Therefore the **Expressway** has been been proposed in addition to the existing State Highway 6 which will connect the region with DMIC corridor. Abutting, this expressway, on the northern side is the proposed industrial area. Existing stretch of Vagra-Pakhajan Road will be partially utilised in the expressway alignment and is proposed to be strengthened and upgraded for this purpose. A needed connectivity between the existing Dahej industrial area towards the west and the Vilayet and proposed industrial area towards north and east of GPCPSIR site has been proposed. Major logistics and warehousing areas are also strategically connected to the main transportation (road as well as rail) spines further getting a quick and strategic connectivity with the DFC.

With due considerations for the port infrastructure and port related activities, area has been allocated adjacent to state highway and the major freight corridor spine which is also supported with the rail route running adjacent to it. The port is expected to create a high demand for goods transportation outside the region as well as within the region. For this purpose the rail link has been extended up to the port. This junction is allocated as a major transport hub for all the activities related to the loading and unloading of the goods and parking of heavy vehicles.

These major access roads are traversed by another set of roads forming a major linkage within the region. The proposed roads are such laid that they open out or passing adjacent to the Gamtals to the surrounding areas.

Figure 4.7: Theme II - Transportation and Logistics Synergy



Source: MM

c) Environment and Safety

Another major concern of the proposed land use zoning was to balance the industrial development with appropriate green area and buffers and enhance the overall safety of the mega chemical estate. Provision of escape routes have also been kept at suitable location connecting all major industrial nodes and non processing area which will help human habitation within GPCPSIR to flee the site during any disaster. These routes are connected with all major road network system.

The CRZ, Forest areas and Agriculture lands has been proposed and preserved as much as possible. Suitable and permissible activities as per the prevalent act only have been proposed in these areas. Provision of buffer areas has been suitably provided along hazardous and Green industries to separate them from the non-processing land use. Rivers, channels and water bodies are also kept separated from the surrounding land use with green buffer.

Figure 4.8: Theme III - Environment and Safety

Source: MM

View 1

Source: MM

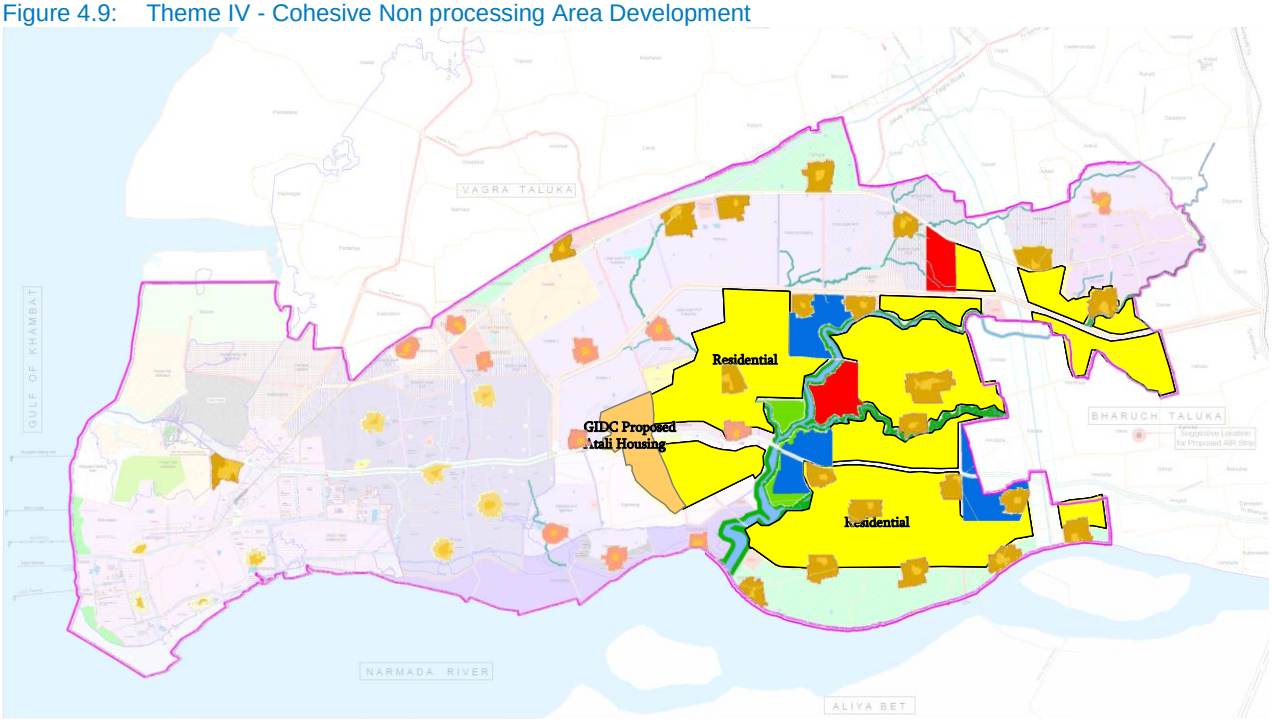
View 2

Source: MM

d) Cohesive Non processing area Development

The non-processing areas are proposed to expand and grow with the existing and proposed Atali housing area and Atali expansion. Also neighbourhood amenities, commercial, open spaces in non-processing area are suggested to be developed through Town Planning scheme for sustainable development process. A buffer of around 300 m is provided to the gamtal area as per the prevailing practice in the State. This will allow in-situ sustainable development of the existing villages. The development in these areas will be mixed land use and development as per the GDCRs included in Volume of the development plan report. Apart from these, city level nodes are also proposed for GPCPSIR area to bring in a dimension of dynamic urban space to the area.

Figure 4.9: Theme IV - Cohesive Non processing Area Development



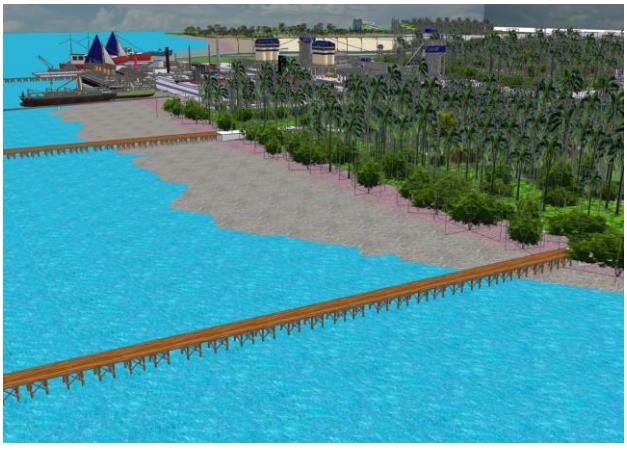
Source: MM

View 3

- Cohesive development of non processing area

Source: MM

View 4



- Development of Eco sensitive Zone

Source: MM

4.1.3 Proposed Land use Zones and Statement

The total area included in the Development Plan is 45298 hectare. Various activities described in the previous section are proposed for GPCPSIR areas have been distributed in form of following land uses. These are as follows:

1. Industrial including the existing Industrial Estates
2. Utility Services including clean technology and related Industries
3. Logistics and warehousing related
4. Residential Zone including commercial, institutional, recreational and internal road networks
5. Gamtal/Village including buffer areas.
6. Commercial
7. Institutional
8. Recreational Zone
9. Green buffer for rivers and khadis
10. Eco sensitive Zones- Protected forest, CRZ, Mangroves, Flood prone areas
11. River, Streams / canals, Water Bodies, Lakes
12. Agricultural landuse

Out of total area, gross Industrial area contributes about 55.61%. The gross non-processing area is around 44.39% of the total GPCPSIR area. Following table presents the landuse statement for the proposed GPCPSIR area.

.Table 4.1: Proposed Landuse Statement

Sl. No.	Zone	Zone / Landuse	Gross Area (ha)	Net Area (ha)	Area in Overall (%)	Remarks
	Gross Processing Zone		**25189**		**55.61**	
1	GIDC Estate (existing)	Existing industrIal area excluding 1.4 (1)	8653			Existing estates-gamtal (1.1+1.2+1.3)-1.4
1.1		Dahej-1 Estate		4000	8.83	As per GIDC records
1.2		Dahej-2 Estate		4220	9.32	As per GIDC records
1.3		Vilayat Estate		1100	2.43	As per GIDC records
1.4		Existing Gamtal with buffer area		667	1.47	From existing LU Map, Included in non-processing gross area
2	Industrial		16536		36.51	
4	Large scale PCP and Power plant & large scale PCP			5232	11.55	
4	Medium scale PCP (Secondary products)			1132	2.50	
5	Small scale PCP (Tertiary onwards)			728	1.61	
6	Service and ancillary industries			242	0.53	
7	Engineering Industries			2491	5.50	
8	Port Development			1360	3.00	
9	CRZ permitted Industries (Shipbuilding)			1300	2.87	
10	CRZ permitted Industries (Salt Pans)			814	1.80	
11	Non polluting Industry			877	1.94	
12	Warehousing, Oil terminal		1293		2.85	
13	Logistics	Logistics zone including - ICD, Transport nagar, logistics park		2360	5.21	
	Gross Non Processing Zone		**20109**		**44.39**	

14	Ecopark		600		1.32	
15	Utility	Utility area including ponds enhancement		595	1.31	
16	Residential (including village extension area)		9941		21.95	
16.1		Residential Zone including commercial, institutional, recreational and internal road networks		7678	16.95	To be developed in T P Scheme model/other development model.
16.2		Gamtal Buffer/Village buffer outside existing estates		1596	3.52	As per Norms practiced in Gujarat
16.3		Gamtal/Village including gamtal and gamtal buffer inside existing estates		667	1.47	
17	Commercial		811		1.79	
18	Institutional		527		1.16	
19	Recreational		159		0.35	
	Green areas and Water Bodies (including river front development, forest and ecozone)		5301		11.70	
20		Green buffer, other than eco sensitive zones		855	1.89	
21		Eco sensitive Zones-Protected forest, CRZ, Mangroves, Flood prone areas		2239	4.94	
22		River, Streams / canals, Water Bodies, Lakes and Lake enhancement, Wetlands, Submerged land, ROW assigned for Kalpsar Canal		2207	4.87	
23	Agricultural zone	Agriculture	2175			
		Total Area of GPCPIR	**45298**		**100.00**	

Source: MM

4.1.4 Proposed land use description

Following subsections elaborate on the various land uses proposed for the GPCPSIR area. The land use categories and the category number reger to the land use codes mentioned in GDCRS included in Volume III of the development plan report.

4.1.4.1 Industrial land use (Primary, Secondary, Tertiary)

After proposing the major road and rail network in the region, the zoning of the area was done. About 49.85% of the region is allocated for industrial purpose. Features of Industrial Zone are as follows:

- Major portion of this industrial zone is allocated on one side of the proposed Expressway.
- It is so planned that proposed area is now connecting the existing GIDC estates, Dahej I, II and Vilayet.
- The industrial area is further subdivided into following category of industries (refer Table 2.2):
  - Petroleum, Chemical and Petrochemical (PCP) Industries, Bio refinery, Fertiliser Industry, Plastic Processing and other PCP related sectors.
    - Large scale PCP (Refinery and Cracker Units, First stage products based on Building Blocks i.e. Primary petrochemicals and Secondary 1 products, Gas based Large scale PCP Units i.e. Methanol and Fertiliser related PCP, Bio refinery / Bio degradable polymers, Refer Appendix C)
    - Medium scale PCP (Secondary 2 products)
    - Small scale PCP (Tertiary onwards)
    - Service and ancillary industries related to PCP industries
  - Engineering Industry,
  - Ship building and other port related activities, port expansion
  - Salt Pans
  - Non polluting Industry including light service industries, workshops, small factories (preferable green industries), cottage industries
- Gross industrial area (including the existing) is 23774ha, which is 49.85% of the project area of 45298 ha.
- Total industrial employment including the existing industrial employment is estimated to be 5, 99,975 employees.

PCP Industrial Zone

This zone will include the Petroleum, Chemical and Petrochemical (PCP) Industries which are further sub-divided in to following zones:

- Large scale PCP (Refinery and Cracker Units, First stage products based on Building Blocks i.e. Primary petrochemicals and Secondary 1 products, Gas based Large scale PCP Units i.e. Methanol and Fertiliser related PCP, Bio refinery / Bio degradable polymers, Refer Appendix C of Volume III)
- Medium scale PCP (Secondary 2 products)
- Small scale PCP (Tertiary onwards)
- Service and ancillary industries related to PCP industries

Expressway is one of the major USPs of GPCPSIR. Hence PCP industries are given priority position to be located here. As this I-1 zone will contain industries of obnoxious and hazardous category, it will have a special 100m buffer zone of green areas with plantations along the roadside. Housing for industrial workers will not be encouraged in the proximity of this industrial zone or within this zone.

Engineering Industrial Zone

This zone is identified as Engineering Industrial zone. Engineering industry which supports chemical and petrochemical base by way of fabricating/ supplying equipments, piping, process control and instrumentation, etc, and maintenance related services, dock and terminal activities becomes an integral part of the region for the self sustainability. Major portion of this zone has been kept at the southern portion of the state highway.

Ship Building Industrial Zone

Being a coastal zone, shipbuilding activity can be encouraged here as a substantial area of GPCPSIR is coming under CRZ. Approximately 2660 ha area has been considered for shipbuilding.

Port Based Development Zone

Port infrastructure is one of the key infrastructure requirements for GPCPSIR. Therefore for expansion of port and related infrastructure there is a zone demarcated in the proposed landuse plan. The proposed sterling port nad its expansion plans as received from Gujarat Maratime Board have been included in this planning

Salt Pan Industries

A substantial amount of Industrial area (1.8%) is under Saltpans. These are saline ecosystem from which crude salt is extracted. Salt making has been a traditional occupation in Coastal area. Saltpans get inundated by tidal waters and monsoonal runoff and are found in Dahej adjacent to sea. The salt is used locally for domestic consumption as fertilizer, soil conditioner, termite repellent, fermenting agent for salting green mangoes in pickles, in ice plants and for curing dry fish etc.

Non–Polluting Industrial Zone

Almost 2% area has been allocated to Non polluting Industry including light service industries, workshops, small factories (preferable green industries), and cottage industries as discussed with stakeholders along the major linkages.

4.1.4.2 Residential Zone

Residential Zone in GPCPSIR has been proposed based on the land suitability analysis. The suitable areas have been identified by considering safety parameters, flexibility to construction, soil characteristics, flood risk analysis etc. This area is completely segregated from Industrial zones. And type of development permitted here will be as per GDCR. These are primarily residential area including commercial, institutional, recreational and internal road networks.

The Main Features of the Residential Zone are

- Density: around 150 persons per hectare.
- Maximum Permitted Building Height: as mentioned in General Development Control Regulations (GDCR)
- FSI permitted: as mentioned in GDCR

The Draft Development Plan has provided the residential zone necessary network for their development. These areas will be developed with proper road network with hierarchical order, integrating each one of the residential localities with required facilities and amenities for sustainable urban system and these will be developed under the micro level plans of Town Planning Schemes.

Beside these, there are areas for Gamtal Buffer/Village buffer outside existing estates and Gamtal/Village including gamtal and gamtal buffer inside existing estates. Almost 5.64% falls under these land use category. Total 300m buffer has been given around these Gamtals for their future expansion and required

buffer from the GPCPSIR urban area. But these Gamtals will be properly integrated with the DP level roads.

4.1.4.3 City level nodes

In order to be able to drive the development of city level activity hubs for commercial, institutional and recreational activities such city level land use are also a part of the proposed land use plan for GPCPSIR. Following sub sections discuss on the same. Minimum areas ranging around 1000 ha are proposed for the city level nodes point of view of TPS development.

Commercial Land use

City level commercial land use has been provided in selected areas with proper road networks. These will be developed under the micro level plans of Town Planning Schemes.

Institutional Land use

City level Institutional land use has been provided in selected areas with proper road networks. These will be further developed under the micro level plans of Town Planning Schemes.

Recreational Land use

City level recreational land use has been provided in selected areas with proper road networks. These will be further developed under the micro level plans of Town Planning Schemes.

4.1.4.4 Logistics and Warehousing and Oil Terminal Zone

As revealed from the primary survey, there is a great requirement for warehousing, logistics, Transport Nagar, Inland container terminal areas. This land use has been provided in selected areas with proper road networks. These will be developed under the micro level plans as described in GDCR.

This land use has been provided in selected areas with proper road networks and located on main corridor of Goods movements (rail, road and good proximity to port areas). Strategically they are also located on fringe of developed lands. These areas will be developed under the micro level plans as described in GDCR. An exercise has been done to derive area requirement for the warehousing and logistics. It shows that requirement is coming up approximately 1400 ha.

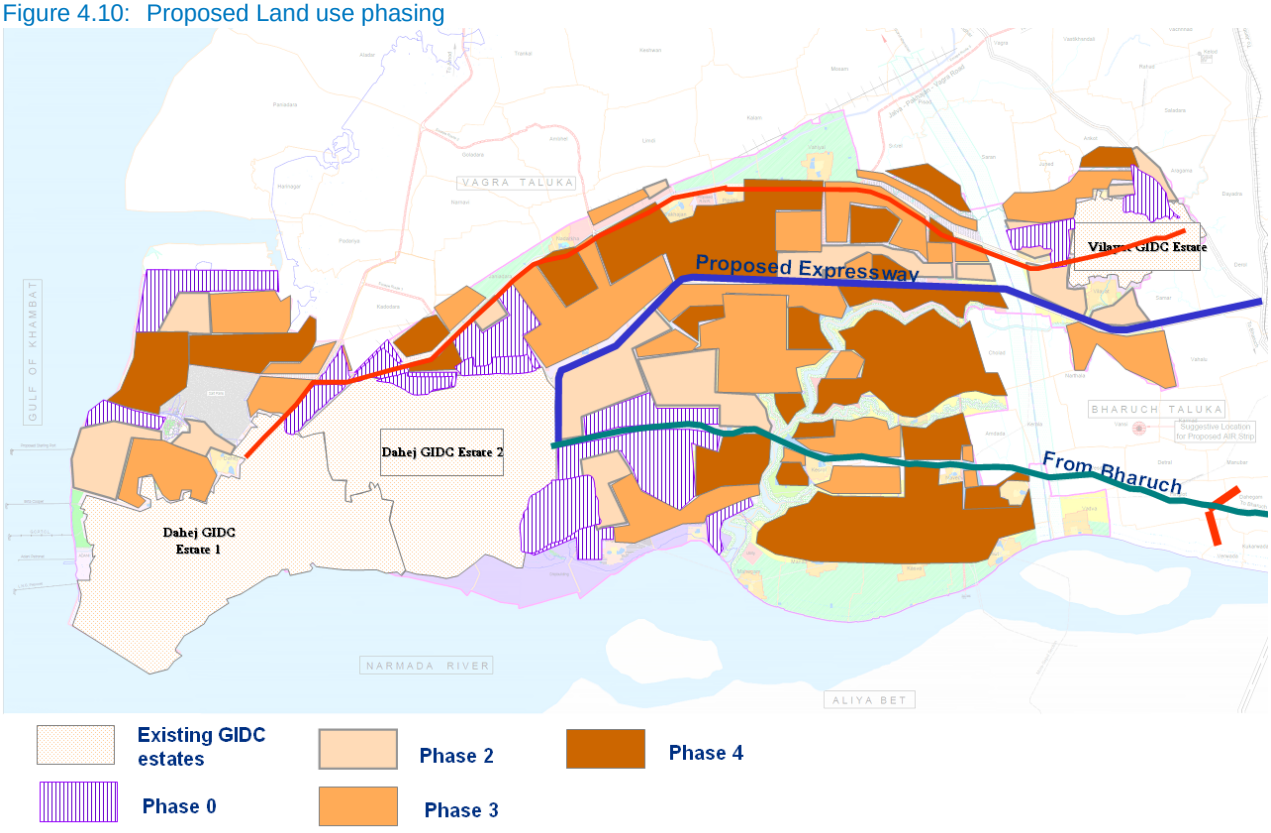
4.1.4.5 Agricultural Land use

5.1% land of GPCPSIR has been left as the Agricultural Zone. It comprises the area which is primarily double cropped in nature. Primarily the area along the bank of Narmada which is also the area prone to fluvial floods as per the FRA study and the area in the extreme north along a part of the railway link is demarcated for agricultural land use looking into all the aspects of land suitability analysis. In this zone traditional agricultural and allied activities would be allowed. The nature of use would primarily be agricultural fields & rural landscape. Certain agro-based activities including orchard, vegetable farm, cold storage, green houses can be permitted.

4.1.5 Phasing of Development Plan

Since the scale of the proposal development is massive, it would be prudent to develop a basis for the phased development of the whole area. As primarily this is an industrial area, land use development is suggested to be developed as per industrial phasing as discussed under Section 2.2.3. Existing developed industrial areas, Atali housing, the future growth drivers including the proposed expressway and the Bharuch-Dahej State Highway and natural features like the Bhukhi Khadi are the determining factors for the proposed phasing of the land use plan as depicted in the figure below.

Figure 4.10: Proposed Land use phasing



Source: MM

4.2 Proposed Infrastructure

The details of the proposed infrastructure for GPCPSIR are elaborated in the sub section below. Section 2.4 above provides the projection details for the proposed infrastructure where the demand and generations aspects of various infrastructure and utilities have been included. Also refer Appendix B for the cost related details and Appendix E for the infrastructure plan information.

4.2.1 Proposed Road Infrastructure

The proposed region is the focal point of India's pilot global investment. Different kinds of industries will be established in the GPCPSIR area including petroleum, chemicals, petrochemicals, engineering and ancillary industries of different types & scales. These industries during & after its establishment will require

road infrastructure for transportation of its construction material, its raw & manufactured products as envisaged from proposed land use. From the available data it is analysed that the existing condition of road infrastructure is very poor i.e. majority (57.5%) of VR, MDR & ODR are damaged at present which are not capable to bear the expected traffic movement of heavy to very heavy vehicles on it. To cater future needs of the region based on traffic volume projections, proposed utilities following proposal have been made for different Right of Way roads.

4.2.1.1 Expressway Highway within GPCPSIR

From the point of view of future traffic problems of the fast developing areas between Mumbai & Ahmedabad, NHAI has proposed Vadodara Mumbai Express Highway the alignment of which is collected from Bharuch National Highway Division, Bharuch which will be running in between Bharuch Vadodara & Bharuch Jambusar railway lines which is shown in the drawing no 245268/PI/001-A in Appendix E.

In order to provide a direct link to this proposed expressway, the expressway has been proposed keeping in view of the development of the region, easy traffic movement and to overcome traffic problems which is expected to generate due to heavy vehicles.

As per alignment given by NHAI, Express Highway has been proposed within GPCPSIR starting from Rahiyad Cross Road to the proposed Mumbai-Vadodara Express Highway. I.e. junction of Bharuch Jambusar & Bharuch Derol State Highways. The ROW of Proposed Express highway within region is 250m.

Right of Way for the proposed express highway is planned for 250m which can accommodate Utilities corridor for proposed HT line(HT line shall run on 52m width corridor), raw water transmission /treated waste water pipe lines from processing industries, Gas pipe lines etc. Refer Appendix E.1.1 for the cross section of the road.

Implementation Model suggested for this road is through the public private partnership (PPP) mode in consultation with the key stakeholders. Also, keeping in view of the developers commercial interest, 50m wide land has been considered within the proposed 250m Right of Way which can be utilised for commercial/industrial establishments in synergy with the adjacent land uses

The suggestive phasing and costing of this road is detailed in Appendix no. B. However it is subject to changes as per actual traffic generation & its upcoming demand as would be seen progressively

The alignment of the express highway has been proposed in such a way that it passes through major industrial processing zone & non-processing zone dividing both for ease of operation and clustered industrial activities.

Entry & exit has been proposed at two point's i.e. entry between cracker 1-2 and exit at junction of Bharuch-Derol, Bharuch-Jambusar state highway & proposed express highway. One intermediate entry can also be proposed in between these two points for processing & non processing zone during detail designing & planning of the road on need basis.

4.2.1.2 150m Row Road

For the existing Bharuch Dahej State Highway no. 6, 150m Right of Way has been proposed. Kindly refer Appendix E.1.1 for the plan and section details

Incorporating the land use plan & traffic projection from traffic census this road has been proposed for 6 lane widening in the year 2019 & for 8 lane widening in the year 2025 as per appendix C-2(1), which shall be rephrased as per upcoming traffic demand. Separate BRTS to facilitate easy public movement by public/common transport has been proposed along southern side of the road which includes cycle track & pedestrian path. Along some strategic locations paid parking facilities shall be provided, near engineering zone & commercial zone which can be taken up during detail engineering stage. As per the Dahej Phase II map GIDC has planned for utility corridor of 100m & 85m on north & south side of this road on which proposed Row of the road is overlapped for proposal however as per the availability of land proposed carriage way can be aligned.

Provision of 50m utility corridor has been considered and planned within the proposed Row for power transmission & other utility lines.

4.2.1.3 120m Row Road

This road has been proposed at north side of the GPCPSIR region along its boundary so as to provide transportation for industries of processing zones & to divide traffic of proposed service road side by proposed express highway. Also this road will provide connectivity for the villages & area on north side of GPCPSIR boundary. Provision of 50m utility corridor has been considered and provided within the proposed Row for power transmission & other utility lines. On north side of the road separate divided BRTS is proposed with foot path for easy & fast movement of workers by common/public transport mode. The construction of this road is phased according to traffic projection of Vagra Pakhajan road traffic census as per appendix B

4.2.1.4 80m Row Road

This road has been proposed to connect proposed express highway, ICD & Transport Nagar & Logistics Ware housing to give direct access of vehicle movement. It also connects Bharuch Dahej state highway directly to transport agar. Phasing of this road for construction has been proposed in line with proposed express highway.

4.2.1.5 Arterial Road (60 m Row), Sub Arterial Roads (45m Row), Collector Street (30m Row)

- ***60m Row Road:*** These roads have been proposed of 60m ROW of 6 lanes for Dahej- Muler-Amod, and for the escape routes connecting to the coastal highway from the PCPI region. It also acts as circular route for the proposed non processing areas. This road of 6 lanes consists of service road on both sides with cycle track & pedestrian path.
- ***45m Row Road:*** These roads have been proposed of 45m ROW, which can be converted to 6 lanes along with cyclist track & foot path on both sides at later stage.
- Collector Street: These roads have been proposed of 30m ROW to take up to 6 lanes widening at later stage. Proposed road length is as per below table.

The phasing of these roads is planned tentatively as per appendix no. B. However it can be rephrased as per actual traffic generation & its upcoming demand in line with land use development.

Internal roads shall be planned & designed in such a way that maximum of existing alignment of VR, MDR, ODR category roads get utilised while preparing Town Planning schemes for GPCPSIR or during detail planning of the region.

Table 4.2: Length of Proposed Road

Type of Road	Right of Way (ROW)m	Length in Kms.
Express Highway (EH)	250	34.65
Dahej Bharuch State Highway	150	42.70
Vilayat Pakhajan Vav Dahej road.	120	37.86
Transport Nagar to EH	80	3.86
Dahej Muler Amod Coastal Highway & Arterial roads	60	130.33
Sub Arterial Roads	45	74.42
Collector Roads	30	22.30
	Total Proposed Road Length (Km.)	**346.13**

Source: Drawing no. 245268/PI/001-A

4.2.1.6 Cross Drainage Works

All along the proposed roads, careful consideration has been given to planning of cross drainage works, which are vital for any road projects and also for its longevity. Along express highway, at every kilometre length of the road, a box culvert of sufficient size has been proposed. Minor bridges and Major bridges have been considered at river crossing along the express highway. Pipe culverts, minor bridges have been considered for other roads at suitable intervals as per standard requirements.

Types of bridges & culverts shall be worked out during detail engineering based on detail soil investigation, hydraulic requirements, performance requirement, and techno-economic feasibility as per prevailing/related standard codes of practices.

The length of these proposed roads & area requirement in detail are stated in Appendix D. The alignments of different ROW roads are shown in road network Drawing No. 245268/PI/001-A which is proposed, utilising existing alignments as much as possible, and avoiding crossing of village Gamtals and minimum crossing of water bodies. The details of conceptualised and proposed different ROW Cross Sections are shown in Drawing No. 245268/PI/001-B.

Set back distances as per IRC 73-1980 Page no.6, table 4 should be considered while detailed planning & design of roads. Traffic Modelling of the proposed area shall be done during detail designing period. The detail proposal for roads shall be developed in accordance with MORTH guide lines and IRC/IS codes. For the curvature of roads at junctions following assumptions are considered.

Table 4.3: IRC Code

As per IRC 73 Table 2 & 16.		
Road Classification		Design Speed (Km./Hr.)
Proposed ROW (m)		Plain Terrain
	Minimum Design Speed	Absolute Minimum Radius
250,150,120,80	80	230
60,45,30	65	155

Location of Toll plaza has also been planned & considered according to Manual of specifications & standards for six laning of National Highway through PPP of Ministry of Shipping, Road Transport & Highways of Year 2008.

4.2.2 Proposed Road Infrastructure Costing

The roads are proposed for different ROW including service roads, foot path & dedicated bus route. The estimation is done according to traffic projection & phased accordingly for different component constructions in different years during project span. For different roads different finished levels are considered so as to avoid flooding on the roads and easy movement of vehicles. Looking to the soil characteristics major soil is loamy sand so tentatively average 0.5m cutting is considered for all roads.

Also as majority of roads are damaged & looking to the possibility of heavy vehicle movement all the roads are proposed as new except Bharuch Dahej widening & Amod Dahej road widening.

For the estimation purpose of Express highway the finished level has been considered 2.5m above NPGL, and at every kilometre 1no of box culvert is considered, and at every 4 kilometre one over bridge or under bridge is considered for internal road crossings. However based on the final alignment there may be variation. For service road the finished road level is considered 1.5m above NGL with 1m divider. Cost for Major bridges has been considered for Express highway at railway crossing, Bhukhi river crossing & at junction of proposed Mumbai Vadodara express highway & one proposed for GPCPSIR region.

For Bharuch Dahej Road (SH-6), the average finished level has been considered as 1.5m above NGL and for dedicated bus corridor it shall be 1.0m above NGL. For all other types of road average finished level is considered 1.00m above NGL. The pavement composition for all the major roads has been defined in the Table 4.4

Table 4.4: Details of pavement components

Details of Layer	Thickness in mm
Granular Sub Base	460
Wet Mix Macadam	250
Dense Bituminous Macadam	195
Bituminous Concrete	50

For estimation purpose, it is considered that source for Bitumen and aggregates for construction would be made available from Koyali refinery near Vadodara & Kadvali village near Rajpipala.

As discussed with Talati of Dahej, agricultural land acquisition cost considered for estimation is Rs. 7 Lakh per acre. Estimates for road component have been done based on the SOR of State highway & National highway division for the Year 2009-10 respectively. 10% escalation has been considered per year for phasing. Refer Appendix B. for detail cost estimation including phasing of road components.

Table 4.5: Phasewise cost estimation details

Proposed Road Planning for GPCPSIR Gujarat Area

	Existing		Proposed		Total Length in Km	Phase-0 (2011-15)	Phase-1 (2016-20)	Phase-2 (2021-30)	Phase -3 (2031-40)	Forecasted PCU	Capacity after completion	V/C ration for LOS B	Remarks	Proposed Lanes	Cost as per SOR 2009-10 (` Crores)	Round Up to 0.05 (` Crores)	Cost for Phase-0 (2011-15) (` Crores)	Cost for Phase-1 (2016-20) (` Crores)	Cost for Phase-2 (2021-30) (` Crores)	Cost for Phase-3 (2031-40) (` Crores)	Total Cost (` Crores)
	C/W	ROW	C/W	ROW																	
Proposed Express Highway	5.50	24	14	250	34.65	2015				Four Lane express highway Proposed in Year 2015 for the Marketing of GPCPSIR Region as well Traffic Diversion from other Roads i.e. Dahej Bharuch & Vagra Pakhajan Jolva Road				4 Laning	13.34	13.35	693.96				1017.98
			21	250			2020							6 laning	3.66	3.70		256.45			
			28	250				2030						8 Laning	0.62	0.65			67.58		
SH 6 Bharuch Dahej	14.00	45	21	150	42.70		2019			39314	60000	0.66	End Point of Extended Length is Bharuch	6 laning	6.67	6.70		543.57			1093.33
			28	150				2025		60674	80000	0.76		8 Laning	5.11	5.15			549.76		
Dahej Amod Coastal Highway(SH)	7.00	45	14	60	22.00	2015				14634	40000	0.37	Dahej Muler	4 Laning	1.42	1.45	47.85				185.57
			21	60				2028		37468	60000	0.62	Dahej Muler	6 Laning	0.47	0.50			30.80		
			14	60	24.00		2019			13827	40000	0.35	Muler Amod	4 Laning	1.42	1.45		66.12			
			21	60					2034	40914	60000	0.68	Muler Amod	6 Laning	0.47	0.5				40.80	
Vagra Pakhajan(SH)	5.50	24	7	120	37.86	2012				8525	13800	0.62		2 Laning	3.18	3.20	145.37				652.84
			14	120			2019			14143	40000	0.35		4 Laning	4.41	4.45		320.08			
Pakhajan Vav(MDR)	3.75	18	21	120					2033	38927	60000	0.65		6 laning	1.50	1.50				187.39	
80m RoW Road	5.50	18	7	80	3.86	2015				Phasing In line with Express Highway				2 Laning	3.12	3.15	18.24				48.93
			14	80			2020							4 Laning	1.63	1.65		12.74			
			21	80				2030						6 Laning	1.54	1.55			17.95		
Arterial road	3.75	18	7	60	84.33	2013								2 Laning	3.13	3.15	345.35				1749.52
			14	60			2020							4 Laning	1.46	1.5		253.00			
			21	60				2025	2035					6 Laning	4.55	4.55			479.65	671.51	
Sub Arterial Road	3.75	18	7	45	74.42	2013								2 Laning	3.13	3.15	304.75				788.48
			14	45			2020							4 Laning	1.45	1.45		215.82			
			21	45				2025	2035					6 Laning	1.15	1.2			111.63	156.28	
Collector Streets	3.75	18	7	30	22.30	2013								2 Laning	2.75	2.75	79.71				168.90
			14	30			2020	2030						4 Laning	1.59	1.6		35.68	53.51		
			Total Km.		346.12								Total				1635.24	1703.45	1310.88	1055.99	5705.56
																Cost for Land	1167.57				1167.57
																Cost of Bridges for phasing	260.00		177.00		437.00
																Total Cost of Proposed Roads	3062.81	1703.45	1487.88	1055.99	7310.13
																				Say (` Crores)	7310.00

Note : For all roads construction should start two year prior to the phased year to make it operational as calculated.

Priority of road construction should be in line with actual land use development.

Table 4.6: Proposed road Infrastructure costing estimate

Type of Road	Length (Km.)	Total Component wise Cost (` Crores)
Express Highway (EH)	34.65	1017.98
Dahej Bharuch State Highway	42.70	1093.33
Dahej Muler Amod Coastal Highway	46	185.57
Vilayat Pakhajan Vav Dahej road.	37.86	652.84
Transport Nagar to EH	3.86	48.93
Arterial roads	84.33	1749.52
Sub Arterial Roads	74.42	788.48
Collector Roads	22.30	168.90
Initial Land Acquisition Cost		1167.57
Cost of Bridges		437.00
Total Estimated Cost (` Crores)		7310.00

4.2.3 Proposed Water Supply Infrastructure

As discussed in earlier section, presently raw water is being served by GIDC to Industrial area from intake well located at Nand & Angareshwar village to Vilayat Industrial Estate & Dahej Industrial Estate.

From analysis it is found that there is huge demand in future and the present source of water supply will not be sufficient to cater requirement for the whole planning area. Various alternatives have been considered for water supply to proposed GPCPSIR area. The possible best scenario has been described below which will be beneficial while selecting the best techno economic option select the best way to supply water for the demand areas of GPCPSIR.

- Augmentation of Existing Water Supply Source of GIDC
- Design of New water supply network in phase wise development utilizing the existing infrastructure

4.2.3.1 Augmentation of Existing GIDC Water Supply Source

Presently GIDC is supplying 33 MGD (8 MGD +25 MGD) water from Narmada River near Nand and Angareshwar village to Industrial Estate of Dahej & Vilayat. GIDC has planned to augment their water supply source up to 47 MGD. The proposed area comprises of different kind of Industrial & commercial clusters which are planned in phased manner for processing & non processing activities, the total water demand for the ultimate year is estimated around 1449.24 MLD. It is found that augmentation of the existing system to cater the current & future needs would not be a cost effective solution, hence new source of water to cater the demand would be required for this area, utilising the existing Infrastructure where as possible.

4.2.3.2 Design of new water supply system

The necessity for new water supply scheme in the GPCPSIR area is due to the following reasons:

- Development of 450 sq.km area of Bharuch and Vagra taluka including 44 villages.
- Huge water demand for process and non process activities.

- Total water demand of proposed area has been projected up to 318.79 MGD and total availability of water supplied by GIDC is 33 MGD hence additional 285.79 MGD of water would be required to cater water demand of proposed area up to the year 2040.

4.2.3.3 Development Strategy & Stakeholder Consultation

There are several agencies involved in development of utility services in GPCPSIR area. GIDC has signed MoU with Multi ManTech International Pvt. Ltd and formed GPCPSIR Services Pvt Ltd (GSPL). GPCPSIR Services are responsible for planning water supply for this area. Proposed development plan is in line with GPCPSIR development plan which has been considered in the overall projection for water demand.

Proposed development plan of water supply comprises:

- Identification of Feasible water supply source
- Design of new raw water reservoir
- Design of conventional WTP for domestic use and also design of New water supply network in line with GWSSB augmentation programme
- Design of New Industrial water supply network (Untreated raw water) and utilization of GIDC Existing Industrial water supply network

4.2.3.4 Identification of Feasible source of Water Supply

At present GIDC is the regulating authority for supplying Industrial process raw water and GWSSB for Domestic water. Demand analysis has revealed that existing source of water supply is not sufficient to meet future water requirement.

After stakeholder consultation with different agencies, it has been informed that the distributory (Luvara Branch canal) of Narmada Main canal which is passing thru the proposed planning area can cater partially the future demand which is required for the planning area in addition to the irrigational needs of the area. Government has already sanctioned 35 MGD of water from Luvara branch canal for the GPCPSIR area.

A feasible option in future shall be drawing the required demand from Bhadbhut barrage with Kalpasar link canal. In case Kalpasar link canal project does not arise, then other option would be to build Bhadbhut barrage across Narmada River near Bhadbhut village to cater for the regional needs, but policy for reservation shall have to be conceived by State Planning commission considering the demand.

Table 4.7: Feasible Source of Water Supply

Sr.No	Phasing period	Source of water Supply	Water Demand in MGD(Cumulative)
1	Phase 0 (Immediate up to 2015)	GIDC Existing Water Supply / Luvara Branch Canal/New Intake well on Narmada	146.71
2	Phase I (2016 to 2020)	Kalpasar Link Canal/ Bhadbhut barrage/ New Intake well on Narmada	173.58
3	Phase II (2021 to 2030)	Kalpasar Link Canal/ Bhadbhut barrage/ New Intake well on Narmada	262.89
4	Phase III (2031 to 2040)	Kalpasar Link Canal/ Bhadbhut barrage/ New Intake well on Narmada	318.79

Another feasible option is to construct new Intake well on upstream of Narmada River (up stream of Nand village or near by Angareshwar village and is dependent on Hydrological survey at particular location) of

229 MGD capacity. Water transmission from 60-70 kms would not be cost effective option to cater to the whole area demand even though it may be technically feasible.

Desalination is also one option for the water supply of the proposed area but considering the huge capital cost and operation cost, this would not be cost effective solution for catering the needs of GPCPSIR. The desalination cost has been worked out only for reference on the basis of data & market survey cost of desalination has found ` 35-40 per litre, which include

- 38 % of Capital cost
- 20 % of Energy Cost
- 21 % of Labour cost
- 16 % of Maintenance cost
- 5 % of Chemical cost

4.2.3.5 Design of Raw Water Reservoir

Luvara branch canal, Kalpasar link Canal (Bhadbhut reservoir) and New intake well on Narmada river (upstream of Narmada 70 Kms away) is the only feasible and sustainable source of water supply for the proposed project area for processing & non processing industries. Three raw water reservoirs has been planned to cater the water demand of whole area at three different locations in consultation with GPCPSIR services pvt ltd. ltd. Ltd.

Table 4.8: Proposed Raw Water Reservoir

Sr.No	Raw Water Reservoir(RWR) Location	Area of RWR in Ha	Source of Water
1	Near Sambheti Village	100	Luvara Branch Canal (Tail End)
2	Between Pakhajan and Pipaliya Village	30	Bhadbhut barrage/ Kalpasar Link Canal/ New Intake on Narmada River
3	Near Kothia Village	40	Bhadbhut barrage/ Kalpasar Link Canal/ New Intake on Narmada River

Source: MM

4.2.3.6 Development Plan for Domestic Water Supply

Domestic water is being served by GWSSB under Central zone Bara track water supply scheme. Three conventional WTP has been planned in phase wise manner to cater domestic demand of GPCPSIR area.

At present, treated water is pumped to Pakhajan and Vilayat head works from Sudi Aura Head works by GWSSB to cater the domestic needs of the villages in the region. The existing system can be utilised while designing along with new infrastructure including augmentation scheme which is proposed by GWSSB. The New water supply scheme for the future demand includes raw water reservoir, water treatment plant, distribution systems etc.

Table 4.9: Domestic Water Supply Plan

Sr.No	Proposed WTP Location	Capacity in MGD	Area in Ha (with HW)	Source of Water
1	Near Pakhajan Village	18.70 (85 MLD)	12	New Intake on Narmada

Sr.No	Proposed WTP Location	Capacity in MGD	Area in Ha (with HW)	Source of Water
				River/GWSSB existing source
2	Vilayat Village (Near GWSSB Existing HW)	18.70 (85 MLD)	12	Bhadbhut barrage/ Kalpasar Link Canal/ New Intake on Narmada River
3	Near Kothia Village	45.00 (205 MLD)	28	Bhadbhut barrage/ Kalpasar Link Canal/ New Intake on Narmada River

Source: MM

During Phase 0-I, the domestic water demand has been projected as 85 MLD which can be met by providing conventional WTP near at Pakhajan village along with the proposed raw water reservoir. The raw water from the reservoir shall be pumped to WTP for treatment. The treated water shall be transferred to the existing GWSSB head works for final distribution by providing new water supply network.

During Phase-II development, domestic water demand has been projected as 140.29 MLD which can be met by providing conventional WTP near at Vilayat & Kothia village along with the proposed raw water reservoir at Kothia. The WTP capacity of these proposed plants shall be 85 MLD & 60 MLD respectively. The treated water shall be transferred to the existing GWSSB head works for final distribution by providing new water supply network.

During Phase-III development domestic water demand has been projected as 105.03 MLD, which can be met by augmenting the 60 MLD WTP at Kothia to 205 MLD in future. Final treated water from Kothia WTP shall be transferred to the already proposed water supply network of Pakhajan and Vilayat which would have been executed in Phase-1 & Phase-2. Refer Drawing No.245268/PI/002 for proposed water supply development.

Table 4.10: Proposed WTP

Phasing Period	Water Demand in MGD at Pakhajan (Phase wise individual demand)	Water Demand in MGD at Vilayat (Phase wise individual demand)	Development Plan
Phase 0	6.84	0.58	Catered by Existing Water GWSSB Network
Phase I	11.86	0.58	Catered by proposed WTP of 18.70 MGD (85 MLD) at Pakhajan Village
Phase II	13.19	17.67	Catered by proposed WTP of 18.70 MGD (85 MLD) at Vilayat Village
Phase III	0.81	30.90	Catered by proposed WTP of 45 MGD (205 MLD) at Kothia Village (After augmentation of Kothia WTP from 60 to 205 MLD)

Source: MM

Conventional treatment plant has been considered for treating the raw water. The type of treatment process usually depends on the quality of raw water & required quality after treatment which should be as Class C as per CPCB. The following table shows the different treatment units & its process for any conventional water treatment plants.

Table 4.11: Treatment units & process of WTP

Operation	Impurities Removed
Intake work structure	Raw water from the source for treatment
Cascade Aerator	Dissolved gases,CO2,H2S etc

Operation	Impurities Removed
	Dissolved minerals like iron, magnesium and manganese, Dissolved organic matter causing bad taste and odour.
Screening	Floating matters
Sedimentation	
a. Plain	Larger and heavier solids
b. Aided with coagulation	Smaller and lighter suspended solids
Filtration (Rapid, Sand, Pressure)	Fine suspended and colloidal matter and some living organism including bacteria
Chemical house / Chlorination units	Killing of living pathogenic organism i.eprotoza, bacteria, virus etc.
Clear water reservoir/Pumping Station/ESR with HW for Distribution	To Store treated water and distribution for the use

Source: MM

4.2.3.7 Development Plan for Industrial Water Supply

At present key industrial player in this region are chemical and petrochemical based industries. The leading among them are IPCL, GACL, BASF, Birla Copper and Welspun. Proposed development caters to petrochemical and chemicals from downstream of petrochemical building blocks. It has estimated there would huge water demand for their process water and other uses. The existing water supply system of GIDC cannot meet the current demand.

For Phase-0 & to cater for the existing Industrial demand, 100 ha area for raw water reservoir has been proposed near Sambheti Village near the tail end of Luvara branch canal. During this phase which is up to 2015, the projected industrial water demand is 134.93 MGD. This would be met by providing additional 35MGD of raw water from tail end of Luvara branch canal near Sambheti village, including the existing functional water supply scheme of GIDC & design of new Intake well on upstream of Narmada River. Raw water from this reservoir is planned to be pumped to the existing GIDC reservoir at Dahej, which shall cater to Industrial demand thru the existing GIDC water supply network. Total length of proposed water transmission line from proposed reservoir to GIDC existing reservoir at Dahej is around 9.85 kms**.** As discussed with GPCPSIR Services Ltd (GPSL) & GIDC, for immediate phase (2015) water supply planning, they have planed to provide 100 Ha of reservoir near Vav village at tail end of Luvara branch canal. Based on base map received and situation analysis, near Vav village there are nos. of ONGC oil wells on site and design of new reservoir at Vav village is not feasible therefore location of proposed reservoir has been shifted near Sambheti village.

Also, GPCPSIR services have suggested two nos. of reservoir at Vav village and Rahiyad village water supply. As per their development plan had suggested *100 Ha* area for raw water reservoir at tail end of Luvara branch canal near Vav (Dahej existing, Dahej-II & SEZ-I & II) and another reservoir of 50 ha area at Rahiyad village. It was proposed to transfer the raw water from Sambheti to Rahiyad reservoir and from Rahiyad to Dahej reservoir. The feasibility of having two reservoirs needs to resolve by the development authority at later stage. Refer Drawing No.245268/PI/002 of Appendix E.1.2 for proposed water supply development.

Table 4.12: Present Proposal

Sr.No	Stake Holder/ Consulting Agency
1	**GPCPSIR Services Ltd.**
	Proposed Raw water reservoir of 100 ha at tail end of Luvara Branch Canal near Vav Village

Sr.No	Stake Holder/ Consulting Agency
	Design of another Raw Water reservoir at Rahiyad Village
	Two Stage Pumping between source & Dahej Raw Water reservoir
	Total length of proposed transmission pipeline is 24.91 KM
2	**Present Proposal**
	Proposed Raw water reservoir of 100 ha at tail end of Luvara Branch Canal near Sambheti Village
	One Stage Pumping between source & Dahej Raw Water reservoir
	Total length of proposed transmission pipeline is 9.85 KM

Source: MM

For Phase I, II & III total water demand of proposed area is 81.81 MGD and this shall be met from the proposed reservoir at various phases near Pakhajan and Kothia villages. New raw water transmission pipe line from these proposed reservoirs has been planned to cater the needs of the industrial demand of the proposed planning area.

Table 4.13: Development plan for Industrial water supply

Phasing Period	Water Demand in MGD (Phase wise individual demand)	Development Plan
Phase 0	134.93	Use of Luvara Branch Canal and transferred to GIDC Existing Dahej reservoir by Pumping Use of GIDC Existing Industrial raw water supply Design of New Intake on Narmada River
Phase I	13.01	Design of new raw water supply distribution network from proposed raw water reservoir at Pakhajan Bhadbhut Barrage/Design of New Intake on Narmada River
Phase II	53.39	Design of new raw water supply distribution network from proposed raw water reservoir at Pakhajan and Kothia village Design of New Intake on Narmada River
Phase III	21.19	Design of new raw water supply distribution network from proposed raw water reservoir at Kothia village Bhadbhut Barrage/Design of New Intake on Narmada River

Source: MM

4.2.3.8 Recommendations

- Desalination of water can also be lloked as an option to cater to water requirement needs
- Provision of storage of rainwater of Bhukhi Khadi
- Water audit for existing GIDC industrial water supply network
- Design of new water supply network should be inline with GWSSB augmentation programme
- There should be only one agency in GPCPSIR to supply water for villages and industries with equitable norms. So villages in GPCPSIR should be served by GIDC instead of GWSSB if it is possible
- After commencement of whole area and Bhadbhut barrage ,complete water demand including proposed and existing GWSSB water demand, ONGC & GIDC can be switched over to Bhadbhut barrage and existing arrangement should be stopped to save O&M
- Considering the water demand for the planned GPCPSIR up to the ultimate year of 2040, several options has been discussed for sustainable source for supply of water like drawing water from proposed Kalpasar link canal, Bhadbhut barrage reservoirs etc, which is likely to involve huge capital and

operating costs. It is projected that the demand of water for the planned area would be around 318.79 MGD, by considering the reuse of waste water for industrial purposes; around 15% -20% of the water demand would be reduced approximately. Since the works related to waste water would be taken up in phase, it would be very difficult to predict the capacity, location and operational period of any reuse water plant (Tertiary Treatment plant).It is envisaged that this aspect of reuse of water to be taken up during detailed engineering phase as and when the industries are set up in the region.

4.2.4 Proposed Water Supply Infrastructure Costing

Total estimated cost of proposed water supply is ` 3,518.75 Crores. It includes design of new Domestic and Industrial water supply networks, Water treatment plants with head works for domestic water supply & raw water storage reservoirs and new Intake well on Narmada River with water transmission line from source to reservoir (70 Kms). Refer Appendix B.2.2 for detailed cost estimation.

Table 4.14: Proposed Water Supply Infrastructure Cost Estimate

Description	Component Cost (`)	Component Cost (` Crores)
Immediate Phase up to 2015		
Proposed New Intake well on Narmada River	21,15,67,67,076.92	2,115.68
Domestic Water Supply WTP with HW & Trunk main only)	1,32,90,15,664.04	132.90
Industrial Water Supply(Proposed RWR & Trunk main only)	3,28,05,74,728.76	328.06
Total Cost	**25,76,63,57,469.72**	**2,576.64**
Phase II (2021)		
Domestic Water Supply(WTP with HW & Trunk main only)	5,67,46,38,649.19	567.46
Industrial Water Supply(Proposed RWR & Trunk main only)	3,74,64,84,437.77	374.65
Total Cost	**9,42,11,23,086.96**	**942.11**
Total Cost of Water Supply	**35,18,74,80,556.68**	**3,518.75**

If Kalpasar link canal does not arise, Bhadbhut barrage would be built as a part of GPCPSIR development and cost of Bhadbhut barrage would be added in proportionate of water usages.

4.2.5 Proposed Sewerage Infrastructure

At present there is no underground sewerage system in the GPCPSIR area. There is general practice of on site disposal through either soak-pit or release in open drains leading to contamination of ground water and the environment. The proposed development is likely to generate huge quantity of sewerage which should be treated before disposal as per regulatory requirements.

Due to lack of integrated sewerage system, unsanitary conditions prevails in the area, which necessitates the need for proper integrated under ground drainage system and safe disposal after treatment as per CPHEEO norms.

Characterisation of sewerage is essential for an effective and economical wastewater management programme. It helps in the choice of treatment methods, deciding the extent of treatment, assessing the

beneficial uses of wastewater and utilising the wastewater. For initial stage planning data from other similar cities can be adopted in which the BOD level of 250-300 mg/l is considered. The various parameters as pH, Solids, Nitrogen, Phosphorus, Chlorides, BOD, COD needs to be analysed.

The total sewerage output for GPCPSIR area would be around 250 MLD for which Sewerage treatment facilities would be required. It has been planned to have 5 numbers of STP at different locations and the Gamtals covers in proposed STP (Table 4.16) including tentative localised pumping stations to cover whole GPCPSIR area. Location of STP has been decided based on topography and coverage of maximum nos. of villages/residential area. Sewerage lifting /pumping stations have been proposed wherever the invert level of sewer crosses more than 6m. Refer Drawing no. 245268/PI/003 in Appendix E.1.3.

Table 4.15: Proposed STPs

Sr.No	Location	Capacity in MLD
1	Luvara	16
2	Vengani	14
3	Vilayat	38
4	Kasva	72
5	Atali	110

Source: MM

Table 4.16: Villges covered in Proposed STPs

Villages covered in Proposed STP				
Luvara (15 MLD)	Vilayat (14 MLD)	Atali (33 MLD)	Kasva (81 MLD)	Vengani (52 MLD)
Dahej	Vorasamni	Nandida	Vadva	Kaladara
Jageshwar	Bhersam	Akhod	Bhuva	Koliad
Lakhigam		Khojbal	Bhadbhut	Sadathala
Ambheta		Bhensali	Navetha	Pipalia
Suva		Nadarkha	Mahegam	Kothia
Jolva		Pakhajan	Eksal	Sayakha
Vadadla			Manad	Vahiyal
Galenda			Kesrol	
Samatpor			Amleshwar	
Sambheti			Sankhwad	
Vav			Rahiad	

Source: MM

4.2.5.1 Reuse of Treated Sewerage

The increasing scarcity of water in the world along with rapid population increase in urban areas gives reason for concern and the need for appropriate water management practices. Very little investment has been made in the past on sewerage treatment facilities. Only water supply has often received more priority than wastewater collection & treatment. However, due to the trends in urban development, wastewater treatment deserves greater emphasis. Currently there is a growing awareness of the impact of sewerage contamination on rivers and lakes; wastewater treatment is now receiving greater attention from the World Bank and government regulatory bodies.

Treated sewerage can be reused for agriculture, aquifer recharge, aquaculture, fire fighting, industrial cooling, floor washing, flushing, parks, golf courses, formation of wetlands for wildlife habitats, recreational impoundments, and essentially for several other non-potable requirements etc.

Reuse is also practiced as a method of water resources management. For example, depleted aquifers may be “topped-up” by injection of highly treated water, thus restoring aquifer yields or preventing saltwater intrusion (in coastal zones).

Potential reuses of wastewater depend on the hydraulic and biochemical characteristics of wastewater, which determine the methods and degree of treatment required. BOD and COD levels are brought down to the required standards based on the end use required.

Depending on the capacity Tertiary treatment plant could be provided after secondary treatment plant for recycling the treated water to some industrial use for their process water. The capacity would ultimately depend on the requirement of process water of such industries and their consensus. Rest of the water can be used for general purposes like maintaining public gardens, etc, or can be also be supplied to nearby villages for irrigation, also thus bringing down the demand of water requirement in this region due to proposed developments.

Digested sludge from the treatment plants has higher calorific value, rich in mineral contents which can be used as manure after drying. The commercial aspects of marketing this manure at Agro Markets can be thought off at later stage to generate revenue.

Considering the water demand for the planned GPCPSIR up to the ultimate year of 2040, several options has been discussed for sustainable source for supply of water like drawing water from proposed Kalpasar link canal, Bhadbhut barrage reservoirs etc, which is likely to involve huge capital and operating costs. Since the works related to waste water would be taken up in phase, precisely the capacity, location, operational period of any reuse water plant (Tertiary Treatment plant) can be finalised during Detailed Engineering stage. However the whole scheme cost has been considered including provision of TTP for reuse at all Sewerage treatment plant. It is projected that the demand of water for the planned area would be around 318.79 MGD, by considering the reuse of waste water for industrial purposes, it is anticipated around 15% -20 % of the water demand would be reduced approximately.

4.2.6 Proposed Sewerage Infrastructure Costing

The total cost of sewerage system including trunk lines, sewerage treatment plants, localised sewerage pumping stations and lifts stations, manholes , TTP, disposal line etc, has been estimated based on GWSSB SOR, market rates and relevant references. Cost of entire system is around ` **444.32** crores, which excludes internal collection systems with Gamtals and industrial areas, road restoration works. Refer Appendix B.3.2 for detailed cost estimation. For the cost summary and tentative phase wise cost estimation refer Table 4.17 & Table 4.18

Table 4.17: Proposed Sewerage Infrastructure Cost Estimate

Sr. No.	Description	Vilayat	Luvara	Kasva	Atali	Vengani	Amount (`)
1	Cost of Trunk main network	63,709,198.88	131,075,058	431,653,987	145,350,451	243,039,420.73	1,014,828,115.61
2	Cost of STP	140,000,000	160,000,000	1,100,000,000	380,000,000	720,000,000	2,500,000,000.00

Sr. No.	Description	Vilayat	Luvara	Kasva	Atali	Vengani	Amount (`)
3	Miscellaneous works (Includes cross drainage works, road crossings, treated sewerage disposal line, Safety items etc.)					L.S	40,000,000.00
7	Sub Total 1						3,554,828,115.60
8	10% Price escalation						355,482,811.56
9	Sub Total 2						3,910,310,927.18
10	10 % contingencies						391,031,092.72
11	Total cost						4,301,342,020.00
12	Tentative land cost	79,88,750	87,72,500	2,96,03,750	1,88,51,250	4,63,65,000	141,831,250.00
	Say						4,443,173,270.00
						Estimated Cost (` Crores)	**4,44.32**

Table 4.18: Tentative Phasewise Cost Estimate

Phase	STP Location	Total Cost (` Crores)
Phase-0 (2010-15)	Vilayat & Luvara	63.5
Phase-1 (2016-20)	Atali	66.7
Phase-2 (2021-30)	Vengani	121.6
Phase-3 (2031-40)	Kasva	192.5
Total Estimated Cost (` Crores)		444.32

4.2.7 Proposed Effluent Management Infrastructure

Based on site visits and consultation with Industries, existing large scale units in Dahej-I estate have their own effluent treatment plant and treated effluent and disposed into sea as per regulatory norms via effluent disposal system of GIDC. After proposed development of Petrochemical industrial cluster, there will be extensive generation of effluent and present effluent disposal system of GIDC is not sufficient to carry the additional load of effluent.

As stated in earlier section regarding effluent projections, the total effluent quantity of 648 MLD would be generated, which was calculated by considering cluster of large, medium and small scale Industries. Generally for small & medium scale industries do not have individual effluent treatment facility because of the scale of operations/lack of space/technical manpower. Therefore it becomes necessary to have a common effluent treatment plant (CETP) for a group of small & medium scale industries where the combined effluent from these industries are treated and disposed off. Four nos of CETP & Four nos. of treated effluent collection sump has been planned to treat their effluent as per regulatory norms for marine disposal

Table 4.19: Proposed CETP & Treated Effluent Collectiion Sump (TECS)

Sr.No	CETP Location	CETP Capacity (MLD)	Treated Effluent Collection Sump (TECS) Capacity (MLD)
1	Vilayat Estate	80	80
2	Near Proposed Express Highway (Northern side of Kothia Village)	50	180
3	Dahej-II	150	380
4	Dahej Estate	700	558

Source: MM

At present total carrying capacity of GIDC effluent conveyance line is 90 MLD. In addition to the GIDC existing effluent disposal line, another proposed effluent conveyance line of 558 MLD has been planned to manage effluent generation of proposed area. (It is presumed that effluent generate from large scale units are treated within their premises & connected to the proposed effluent disposal line parallel to the proposed express highway on northern side). Refer Drawing No: 245268/PI/004 in Appendix E.1.4 for proposed effluent disposal system. The feasibility of splitting the line can be envisaged during detailed engineering stage for the ease of operation.

4.2.7.1 Studies required for Marine outfall

It is obvious that the treated effluent would be discharged finally into sea coast using marine outfall system. Considering the Environmental aspects and effects of such disposal into sea environment, special studies would be required to determine the point of disposal within the sea. It would be mandatory to take environmental clearance from MoEF & CRZ. The general objective of the marine outfall is to safely disperse treated effluent from landfall point to outfall inside sea at a safe distance offshore. To find out the safe disposal distance, design of Marine Outfall using dispersion/dilution model would be required along with Marine Geophysical and Geological surveys. The disposal of treated effluent via a designed diffuser array at a distance offshore offers the best security to inshore water quality during diurnal and seasonal flow and load variations. The outfall will disperse the treated effluent collected from this region at a safe distance from the shore via a dispersion array confirming regulatory standards at specified distance from the foreshore. The position and length of the diffuser array will be determined by water quality modelling of the far-field dispersion using MIKE21/ CORMIXI models or any other models. These aspects are not envisaged currently but would be required to be taken up during design and implementation stage.

4.2.8 Proposed Effluent Management Infrastructure Costing

The total estimated cost for Effluent management is ` **787.42 Crores**. It includes Common Effluent Treatment Plant, Treated effluent collection sump, Effluent disposal line parallel to proposed express highway including marine disposal system. Estimates are prepared based on GWSSB SOR and market rates (Refer Appendix- B.4.2).

Table 4.20: Proposed Effluent Infrastructure Cost Estimate

Sr. No.	Details	Cost (` Crores)
1	Proposed Treated Effluent Disposal of 550 MLD (Parallel to proposed express highway on Northern side)	
a.	Pipeline Cost	253.19
b.	Pumping station & machinery cost	10.48

Sr. No.	Details	Cost (` Crores)
2	Common Effluent Treatment Plants (CETP) Cost (340 MLD) including land cost	443.10
3	Proposed Collection sump	5.65
4	Marine outfall with Diffuser (5 Kms)	75.00
	Total Estimated Cost (` Crores)	**7,87.42**

4.2.9 Proposed Storm Water Drainage (SWD) Infrastructure

4.2.9.1 SWD Network Design

The SWD network design has been done on the basis of the following parameters:

- Estimating rainfall at each plot based on type of plot.
- Estimating runoff accumulation at each road level.
- Design flow pattern i.e. flow direction with topography as governing factor.
- Design of drain section size depending on the flow to be handled.
- Consideration of natural drains for disposal wherever possible.
- Harmonizing different section so as to make ease in construction.

The design of storm water drain network has been undertaken by the rational method. Different sections has been planned to carry the storm water run-off from different planned roads and contributing areas. Different sections have been worked out as per the total storm water contribution from its adjacent area.

The storm water drains has been planned to start at 2012-2013 and follow phasing of the road network for its completion. The storm water drain has provided on either side of all the roads from technical point of view. Small storm water drain has been designed as circular section and large as rectangular sections from economy point of view, which also facilitates the construction activities. As per design different diameter has been worked out. Designed diameter ranging from 500 mm -2000 mm has been provided. In case of rectangular sections different sections of 2.1-3.9 m top width has been planned. Refer AppendixB.5 for design purpose.

RCC pipes up to internal diameter 2000 mm has been provided along the roads. For remaining drains which has large cross sectional area, Rectangular type drain section with R.C.C. side Wall, top and bottom slab has been provided on both the side of road. Cleaning chambers are provided at every 50m distance for cleaning purpose and to take storm of surrounding area. Also the cross manholes are provided at opposite side for to drain off storm of relevant area. Catch pits are provided at 30 m distance with perforated FRC covers in wider road to collect rain water of adjoining area and connected to respective drains and manholes by using 300 mm diameter RCC pipes. For rectangular drain pre-cast covers in slab at every 10m are provided for cleaning purpose of post and pre monsoon activities.

4.2.9.2 Constraints

While planning of storm water drains major areas and major access roads are considered & cross sections of the SWD have been worked out. Accordingly drain size can be reduced while detail planning of internal access roads and considering small areas around internal roads to match the width for drain provision by the major roads.

4.2.9.3 Disposal point

The direction of flow/route of the designed storm water drain will follow the road network and topography of the region. As the study area is huge about 453 Sq.Km. Most natural drains are considered for disposal of Surface runoff. Especially drains from Sayakha-Sadathala-Khojbal and Pakhajan-Nandida-Khojbal have been considered as disposal stream. The section of natural drains mentioned above has been modified to take discharged storm water and given in Appendix B. The storm water drainage system has been designed in zone wise pattern. Total 27 different disposal & connection points have been proposed for Strom water drainage line in the GPCPSIR Region. All proposed disposal and connection points, channel improvements, & network of paved drains has been depicted in the network Drawing No. 245268/PI/005 in Appendix E.1.5.

4.2.10 Proposed Storm Water Drainage Infrastructure Costing

The estimate of storm water drains has been planned for 2012-13 as per the Road Phasing. The estimates have been worked out based on GWSSB SOR 2008-09, SOR R&B 2009, other relevant SOR including market items for Non SOR items. Tentative capital cost for Storm drainage for the planned GPCPSIR has been given the table below.

Table 4.21: Proposed Storm Water Drainage Infrastructure Cost Estimate

Sr. No.	Components	Cost (` Crores)
A.]	**Storm Water Drain**	
1	Rectangular Drain	601.58
2	Circular Drain	197.33
3	Sub-total Cost	798.91
4	Add Escalation at 30% (for Yr. 2012-13)	239.67
5	Total Cost (` Crores) (A)	1,038.58
B.]	**Interlinked Drain**	
1	Soil Excavation	23.48
2	Providing and Laying Dry rubble Pitching	4.90
3	Sub-total Cost	28.38
4	Add Escalation at 30% (for Yr. 2012-13)	8.51
5	Total Cost (` Crores) (B)	36.90
Total Estimated Cost (` Crores) (A+B)		**1,075.48**

4.2.11 Proposal for flood mitigation

On the basis of the flood risk analysis elaborately discussed in chapter 5 of Volume I, Section 1 and chapter 2 of Volume I, Section 2 the following flood mitigation measures are proposed for the GPCPSIR area. Kindly note that these are broad measures and the costing provided is preliminary in nature which is bound to vary during detailed stage of engineering with availability of more accurate data. Various flood mitigation measures are suggested for GPCPSIR area are elaborated below

4.2.11.1 Ponds enhancement

GPCPSIR has many existing ponds. As flood mitigation measure following ponds are suggested for enhancement and the details of the same are tabulated in table 4.22

Table 4.22: Probable Pond Extension and its cpacity

Sr.No	Location of Pond	Surface area (m^2)
1	Sadathala	34998
2	Khojbal	63122
3	Kothia	16052
4	Nadarkha	22143
5	Nandida	39506
6	Wasteland (Between Nadarkha & Pakhajan)	209994
7	Right side of Sambheti & above Samatpor	35927
8	Left side of Nadarkha	15586
9	Near west of Khojbal	770125
10	Sayakha	29464
11	Sayakha top	7144
12	Sayakha bottom-1	9617
13	Sayakha bottom-2	4868
14	Sayakha bottom-3	5332
15	Total Area	1263877.57
16	Total volume (Assuming 3 m depth) (m3)	3791632.71
17	Total Volume (Million m3)	3.79

4.2.11.2 Rain Water Harvesting

The total study area is about 453 sq.km,t of which considering only 5% as covered area, it would be about 22.65 sq.km. If roof water harvesting structures are installed on this area, about 10.82 mcm water can be saved which is a saving of approximately ` 2164.84 lakhs. This is a considerable saving considering that the area is in coastal area with salinity problem which would ultimately reduce the water demand of the region and also increase the quality of the ground water. The brief details are given Table 4.23.

Table 4.23: Roof Rain water harvesting Potential of GPCPSIR

Water Harvesting of Rainwater in Vagra-Bharuch	
Area (sq.km)	22.65
Area(sqm)	22650000
Rainfall of Vagra-Bharuch(mm)	682.7
Total Rainfall (cum)	15463155
Water That can be caught from roof (70%)(cum)	10824209
Water That can be caught from roof (70%)(mcm)	10.82
Cost of supplying of one cum of water (`/cum)	20
Water Saved (`)	216484170
Water Saved (` Lakhs)	2164.84

Roof Rain Water Harvesting Model

Table 4.24: Estimation of water Availability from roof top water harvesting structure

Estimation of Water Availability from Roof Top Water Harvesting Structure								
Vagra-Bharuch			Results					
Area of the catchment (sqm)	Total annual Consumption (cum)	Maximum Tank Capacity (Based on Rainfall) Available (cum)	Maximum Balance of water that can be stored- after monthly use (cum)	Optimum capacity of the tank (cum)	Depth of the tank(m)	Inner Diameter of the tank (m)	Cost of the Tank (`)	Water is Adequate
100	36.50	47.79	34.79	34.79	3.00	3.84	66110	
Month	Rainfall (mm)		Rainfall that can be caught (m)	Total water caught based on area of roof (cum)	Cumulative water caught (cum)	consumption / Month (cum)	Balance of water after use (cum)	Over flow(cum)
June	89.20		0.06	6.24	6.24	3.00	3.24	0.00
July	201.00		0.14	14.07	20.31	3.10	14.21	0.00
August	263.30		0.18	18.43	38.75	3.10	29.55	0.00
September	117.80		0.08	8.25	46.99	3.00	34.79	0.00
October	11.40		0.01	0.80	47.79	3.10	32.49	0.00
November	0.00		0.00	0.00	47.79	3.00	29.49	0.00
December	0.00		0.00	0.00	47.79	3.10	26.39	0.00
January	0.00		0.00	0.00	47.79	3.10	23.29	0.00
February	0.00		0.00	0.00	47.79	2.80	20.49	0.00
March	0.00		0.00	0.00	47.79	3.10	17.39	0.00
April	0.00		0.00	0.00	47.79	3.00	14.39	0.00
May	0.00		0.00	0.00	47.79	3.10	11.29	0.00
Total	682.70		0.48	47.79		36.50		0.00
Max	263.30		0.18	18.43	47.79	3.10	34.79	0.00

4.2.12 Other Flood Mitigation Measures

4.2.12.1 Flood Embankment

To confine flooding due to river Narmada and high tides, it is proposed to provide counterfort wall along the north bank of river Narmada starting from Bhadbhut to Suva.

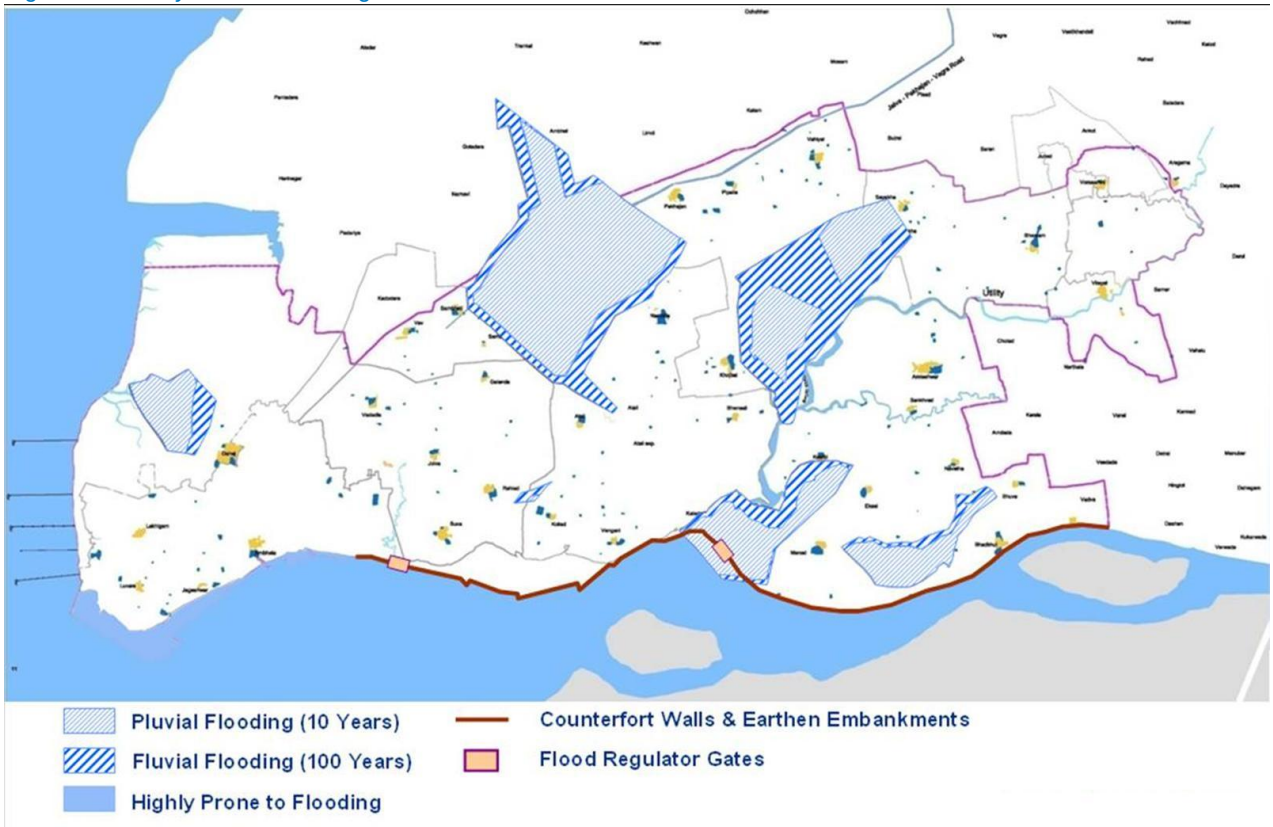
In fact the roads along right bank of SSNL canal are to be designed with top level at or above RL 15.6m. If to raise road levels are uneconomic then alignment should be along sea side from Suva to Dahej, its intersection with Jolva Pakhajan-Vagra road, It is further aligned along the northern side of the existing SSNL Canal till it encounters higher ground at RL 16m near Vahiyal. The layout of embankment is shown in Figure 4.11.

Adequate drainage culverts need to be provided below the roads and/or inlets into the SSNL canal. The embankment/roads on Narmada side/sea side are to be provided with 0.60m thick stone/CC blocks pitching with 1.5m deep toe wall. (Top level of the embankment, the thickness of stone/CC blocks pitching and toe wall dimensions are tentative for rough estimate. The detailed designs are to be made at DPR stage). Total length of the embankment considered is about 60km.

4.2.12.2 Drainage

Gated regulators with automatic shutters so as to close once the Narmada River is in spate or during time of high tides in the sea and open when water level on country side is higher to allow for the drainage of the protected area has to be provided. Pumps of adequate capacity are to be provided to drain the storm water during period the drainage is blocked during the period of high flood in Narmada/high tide in the sea. Alternatively sufficient buffer is to be provided along the natural drains. Tentatively provision of `10 crores for the regulator at outfall of Bhuki Khadi and ` 5 crores at outfall of drainage area C and ` 50 lakhs for the pumps has been made. The Figure 4.11 shows the location of gated regulators at outfalls of Bhuki Khadi drainage channel of drainage sub-basin C along with layout of Flood Embankment. It also shows the areas which can be saved from flooding after implementation of proposed flood Mitigation measures.

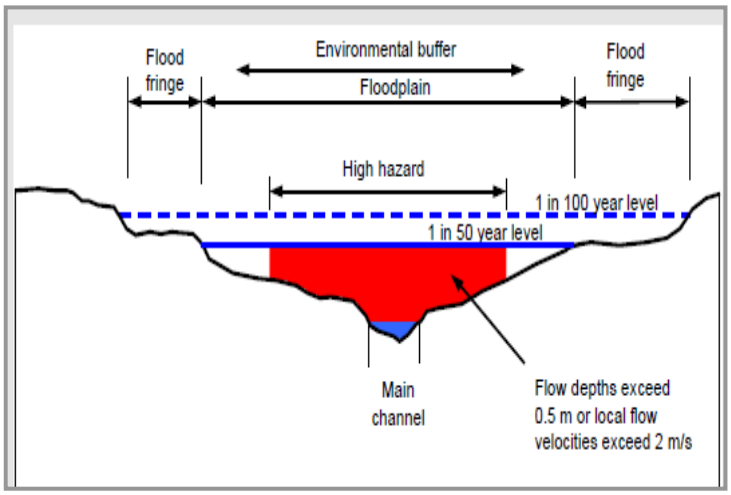
Figure 4.11: Layout of Flood Mitigation Measures



4.2.12.3 Land Use Zoning for Flood Safety

The following definitions of flood plain etc are important for designing suitable land use zoning and flood mitigation strategies.

Figure 4.12: Floodplain and Flood Fringe



The floodplain is defined as the area susceptible to inundation by the 1 in 50 year flood; the flood fringe is defined as the area between 1 in 50 year and 1 in 100 year flood envelope.

Every city needs some open area like park, play ground and gardens etc. In one way it will be possible to develop such areas by restricting any building activity in Flood prone areas.

On the same analogy, certain area on either side of existing and proposed drains should be declared as green belts where no building or other activities should be allowed. In this case buffer area (Floodplain with flood fringe) has been estimated based on data available considering 1 in 100 year's recurrence. Table 4.25 shows the buffer width at various locations. This will not only facilitate improvement of these drains in future but will also help in minimizing the damage due to drainage congestion.

Table 4.25: Environmental Buffer along Bhiki Khadi (Distance from centre to Bank)

Sr. No.	Remark	Environmental Buffer (From Centre) m
1	Out side study area up to Vilayat village	50
2	Vilayat village to Kothia village	160
3	Kothia village to Check Dam	225
4	Check Dam to Culvert on SH-6	225
5	Culvert to Narmada and Bhuki meeting point	250

4.2.13 Cost estimates for Flood Mitigation

Based on the above study, to mitigate the floods due to pluvial and fluvial floods including localized drainage problems, certain measure has been tentatively formulated based on the study made for the region with the available data. Accordingly Embankments, retaining walls, gated regulators, pumps, etc, has been estimated tentatively taking reference of different SOR for costing purpose. The costing provided in table 4.26 is preliminary and is bound to vary during detailed stage of engineering with availability of more accurate data. Refer appendix B.6.2 for detailed estimation.

Table 4.26: Tentative Cost Estimate

Description	Cost (` Crores)
Earthen Embankment	81.34
Counter fort Wall	155.45
Regulator at outfall of bhuki Khadi	10.00
Regulator outfall of drainage area C	5.00
Pumps	0.50
Total	252.29
Add 30 % for 2011-12	75.69
Grand Total (` Crores)	**327.98**

4.2.14 Proposed Solid Waste Management (SWM) Infrastructure

4.2.14.1 Facet of SWM

The following aspects have been considered for planning for solid waste management in GPCPSIR area

- Household segregation (organic and inorganic: Recyclables/Non recyclables.)
- Household Storage (In separate plastic containers for Biodegradable and non biodegradable waste)
- Containerized collection (House to house)
- Transportation (Pedal Tricycle / Handcart / other types)
- Transfer or recyclables / recycling
- Treatment and disposal.

4.2.14.2 Storage & Segregation

Two bags collection system is suggested to enhance the separation of different kind of waste at source and to facilitate the workers involved in solid waste collection. The Biodegradable waste (Food waste, other kitchen waste etc.) shall be collected in Yellow coloured Bag / Non corrosive bin with lid (cover) clearly marked “BIODEGRADABLE WASTE” and non biodegradable and recyclable waste will be collected in Black coloured Bag (without lid) clearly marked with “RECYCLABLE WASTE / NON BIODEGRADABLE WASTE”

4.2.14.3 Collection & Transportation of Solid Waste

Solid waste from source i.e. from Houses, offices, utility buildings and other commercial establishments shall be collected on day-to-day basis and has to be transported to the waste processing site or common waste storage site or transfer station within Landfill site or outside. Truck mounted refuse compactor shall have to be used, which minimises the volume of waste to be handled.

4.2.14.4 Solid Waste Treatment System

According to the present scenario, the carrying capacity of the disposal sites may go on decreasing which may directly affect the Solid Waste Management System. The increasing industrialization, urbanization and changes in the pattern of life, which accompany the process of economic growth, give rise to generation of increasing quantities of wastes leading to increased threats to the environment

In recent years, technologies have been developed that not only help in generating substantial quantity of decentralized energy but also helps in reducing the quantity of waste for its safe disposal.

4.2.14.5 Technology Options

Selection of Most Suitable Technology

While identifying and selecting the technologies for GPCPSIR, following considerations have been kept as paramount:

- The technology should suitable to treat the waste characteristics of GPCPSIR, in an environmentally sustainable manner;
- The technology should meets the regulatory requirements (i.e., confirms to the MSW Rules, 2000 requirements) and is socially acceptable with minimum impacts to the environment and citizens; and
- The technology is economical and commercially available.

Technology Screening Criteria

Three main screening criteria have been used to identify potential technologies that could meet the GPCPSIR objectives.

The following technology screening criteria / filters has to be considered.

Technology Reliability Criteria

Technologies which are proven internationally for large scale application for SWM could be considered for GPCPSIR.

Environmental and Social Acceptability Criteria

A technology with minimum environmental and social impacts, and conforms to the regulatory requirements (MSW Rules, 2000) has been considered.

Waste Suitability Criteria

Suitable technology based on SWM characteristics of GPCPSIR.

4.2.14.6 Proposals

From the analysis of the existing data, it may be concluded that the domestic waste generation can be treated as per MSW management norms and sanitary landfill method can be adopted. Out of total waste generated (630 TPD), after neglecting the inert and recyclable waste, the quantity of waste 378 TPD would reach the processing site, where compositing of the waste shall be done and rejects from this process along with inert would finally reach the landfill site for final disposal.

Composting process has less environmental problems amongst waste processing/ treatment technologies. Compost is considered as a slow release fertilizer where nutrients are released slowly and over the years

which can be marketed as manure for agriculture. Though composting is proposed, but taking into consideration the land constraints and recommendation made in MoEF Proposal, use of compact Organic waste converter can be proposed to minimize time required for treatment.

The leachate generated would be collected through proper leachate collection system, which shall be collected and disposed off after proper treatment, thus preventing any ground water contamination threat. The treated water could be used as recycle water for normal landfill operation during daily cover process of waste and also for buffer zone maintenance.

The landfill gas having calorific value can be utilised either directly to local industry after removal of impurities or by connecting to the electricity grid. For generating gas energy through landfill power plant high capital investment will be required. Estimation of actual quantities of gas generated and its viability is to be studied in detail before finalising the option of gas utilisation.

Proper compost yard, vehicles for daily operation, water, internal lighting, administrative office, test bore wells, secured boundary, vehicle parking area, rest rooms, testing laboratory, top soil for daily cover, wash areas, staff for O & M have to be considered.

Biomedical Waste (BMW) and industrial waste will be managed through service provider recognised and registered under CPCB, since some of these waste also fall under the Hazardous Waste Management category.

Domestic Solid Waste

Composting has been found to be the most feasible waste processing technology for the Solid Waste of GPCPSIR. The establishment of a successful composting facility depends on making correct choices between environmental and economic aspects. All activities associated with composting operations need careful selection of design and control to produce good quality product while minimizing environmental impacts

Bio-mechanical Process:

It is well known that composting requires substantial time for maturation. For which biomechanical process can be used to minimise time required for maturation. Further large area is required for normal composting, use of Organic Waste Converter (OWC) can be proposed which will be a packaged unit based on Bio-mechanical process.

Furthermore, the rejects of the compost plant will have to be disposed in scientific manner, and therefore, sanitary landfill will form a necessary and integral part of the solid waste management solution for GPCPSIR. Total land required for land filling and composting is shown in Table 4.27.

Table 4.27: Land Requirement for landfilling & Composting

Phasing	Gamtal Population	Residing Employee Population	Biodegradable Waste (TPD)	Compost (TPD)	Land Required for Composting (Ha.) Up to 2040	Land Required For Land filling (Ha.) Up to 2040
Phase-0 (2010-15)	69,017	1,56,392	57.07	23	0.62	5.15

Phasing	Gamtal Population	Residing Employee Population	Biodegradable Waste (TPD)	Compost (TPD)	Land Required for Composting (Ha.) Up to 2040	Land Required For Land filling (Ha.) Up to 2040
Phase-1 (2016-20)	75,535	3,21,311	94.45	38	1.02	5.02
Phase-2 (2021-30)	92,815	7,05,391	229.90	92	2.48	6.18
Phase-3 (2031-40)	**1,14,335**	2,17,565	83.20	33	0.90	0.36
	Total	**14,00,659**	**464.62**	**186**	**5.02**	**16.71**

Source: MM

Bio Medical Waste

Medical care is vital for our life, health and well being. But the waste generated from medical activities can be hazardous, toxic and even lethal because of their high potential for diseases transmission. The hazardous and toxic part of waste from health care establishments comprising infectious, bio-medical and radio-active material as well as sharps (hypodermic needles, knives, scalpels etc.) constitute a grave risk, if these are not properly treated/disposed or is allowed to get mixed with other municipal waste. Table 6.3 shows the Phase wise details of number health care facilities and Bio-medical waste likely to be generated in GCPIR region. The waste generation from phase II would be sufficient to run the incineration facility at economic viability and till that duration, the bio-medical waste, generated in phase 0 and phase I, would transferred to nearby private incineration facility.

Proposed Treatment and disposal of biomedical waste may contain the following:

- Incinerator (preferably with a standby), compatible with the new emission norms, capacity 30-35 kg. /hr., to be run in 3 shifts – for anatomical /pathological waste and cyto-toxic drugs.
- Autoclave/hydroclave/micro-wave equipment, compatible with the rules, capacity 30-35 kg./hr., to be run in 2-3 shifts – for soiled waste, solid waste, waste sharps and microbiology /biotechnology waste. A shredder may be installed with hydroclave for Sanitary landfill for incinerator ash, treated material from autoclave/ hydroclave and other waste material which are not contaminated /infected.
- Secured pits for sharps.

Industrial Solid Waste

It has been projected that around 1081 TPD (including existing industries) industrial waste would be generated in the ultimate year from the proposed industries in the region. Out of total Industrial Waste, about 20-25 % waste is assumed to be reused and recycled, so around 811 TPD (75 %) waste shall be considered for processing and disposal. Depending upon the characteristics of the wastes, different types of disposal methods can be used for hazardous and non-hazardous industrial wastes. The most predominant and widely practised methods for wastes disposal are:

a. Landfill
b. Incineration
c. Composting

Depending upon the characteristics of the waste (Calorific value, moisture content), Incineration facility with proper pollution control measures and also depending on the characteristics of the waste, the landfill system with leachate collection system shall have to be proposed. More emphasis should be on following parameters during detailed planning stage,

- Opportunities for waste reduction (Reduce, recovery , recycle, & reuse)
- Rate of waste generation
- Whether or not the waste is hazardous
- Suitability of the waste for Landfilling
- Physical and Chemical properties as they relate to suitability for Landfilling
- Estimation of leachate characteristics
- Suitability of the waste for incineration
- Estimation of characteristics of stack emissions
- Estimation of requirement for auxiliary fuel
- Estimation of characteristics of ash
- Suitability of the waste for composting

Constraints

In current scenario, based on the data made available and also considering similar projects elsewhere and our experience, the forecast for Solid waste sector has been made. The planning for the GPCPSIR has been done based on the population, industries future projections, amount of rejects, biodegradable materials, biomedical waste based on hospital data provided, as a whole to identify the quantum of domestic waste, industrial waste, bio medical waste. The area required has been calculated based on the above criteria.

The block estimates for the Scientific landfill area, collection system including vehicles & equipments, incinerators, cost for civil works, electro mechanical works have been calculated based on the data collected from similar kind of project. The integrity of each component can be analysed and detailed only when all characteristics with quantity are done, which can be taken up at detailed planning stage.

4.2.14.7 Stakeholder Consultation

GIDC has signed MoU with Gujarat Enviro Protection and infrastructure Limited and formed GEPIL Waste Recycling & Management Zone (GRAMZ). GRAMZ will be not only responsible for planning of the solid waste management for GPCPSIR but also for waste management in some of the state industrial estates and Municipal Corporation within Gujarat state.

GEPIL Waste Recycling & Management Zone (GRAMZ)

Two Memorandum of Understanding (Two MoUs) were signed last year between GOG, represented by Gujarat Industrial Development Corporation (GIDC), Gujarat Enviro Protection & Infrastructure Ltd. (GEPIL) and Japan Development Institute (JDI), Japan for Solid waste management for Gujarat state. For sustaining the tremendous industrial growth within Gujarat State in economically and environmentally sound manner, the concept of Eco Recycling Park is planned to be developed, which would primarily aim at Resource, Recovery and Recycling including disposal infrastructure.

The following are the proposed Infrastructure to be developed under GRAMZ

- Alternate Fuel Resource Facility
- Solvent Recovery Units
- Acid Recovery unit
- Common Hazardous wastes Incineration Plant with Power Generation
- MSW Processing and Disposal Facility
- Oil Recovery units (incl. Transformer oil)
- Metal Recycling units (Cu, Zn, Cd, As, Pb, Hg)

- Gypsum, Iron Sludge, Slag, brine sludge utilization units
- Stabilization and solidification plant
- Secured Landfill Facility
- CoE and Waste Exchange Bank
- Supporting Infrastructure

4.2.14.8 Landfill Sites

Potential Landfill Site Identification

Location criteria given in guidelines developed for the Management of Municipal waste was used to select the site on prima facie as the first step of site assessment and investigation. Accordingly, after stake holder consultation, a site has been identified for proposed landfill site, which shall include area for engineered landfill operations, compost plant including segregation area and buffer zone. The description of the site is as under:

- Location: Southern most side of Vilayat village.
- Survey No: 1013-1024.
- Total land area (Domestic + Industrial) = 41 Hectare.

Site Proposed by GEPIL

Total land identified by GRAMZ for solid waste processing and disposal purposed is about 110 Ha (272 Acres) near Aladar and Janiadara village. The site would utilised for facilities like recycle and reuse along with full fledged treatment and disposal infrastructure in the form of HW TSDF, CETP, STP, MSW processing and disposal.

It is also envisaged that GRAMZ under GEPIL would be part of the system in GPCPSIR managing the Solid waste Management for Domestic and Industrial waste generated. The key is to form a board or MOM with GEPIL to work collaboratively for managing the waste generated in this region in near future.

Site proposed by GIDC

Total 54.38 Ha land has been proposed by GIDC for solid waste management near Dahej Village (Plot no 43). However, the landfill site proposed in point number 1 is suggested for GPCPSIR area as it is a scientifically appropriate in terms of the water table in the area and possibilities of its contamination.

4.2.15 Proposed Solid Waste Management Infrastructure Costing

Total tentative estimated cost of proposed solid waste management is around ` **455.21 Crores**, which includes collection storage, transportation, treatment and disposal facilities along with infrastructure cost. Estimates for proposed Solid waste management facilities in phase wise manner are given in Table 4.28. The detailed cost estimates have been given in Appendix B.7.2.

Table 4.28: Proposed Solid Waste Management Infrastructure Cost Estimate

Phasing Period	Estimated Cost (` Crores)			Total Cost (` Crores)
	Domestic Waste	Industrial Waste	Bio-medical Waste	
Phase-0 (2010-15)	43.80	77.60	-	**120.86**

Phasing Period	Estimated Cost (` Crores)			Total Cost (` Crores)
	Domestic Waste	Industrial Waste	Bio-medical Waste	
Phase-1 (2016-20)	36.17	16.94	-	**53.11**
Phase-2 (2021-30)	97.70	66.69	1.05	**165.44**
Phase-3 (2031-40)	55.27	60.53	-	**115.80**
Total Cost (` Crores)	**232.93**	**221.23**	**1.05**	**455.21**

4.2.16 Proposed Power Supply Infrastructure

4.2.16.1 400 kV substations

As per the industrial utility projection, the total power requirement of around 1800 MW for industrial and around 200 MW for residential set up has been envisaged for all phases. From the total of 2000 MW power requirement, initially during Phase 0 (up to 2015) we have envisaged power requirement of 1000 MW (consisting of one cracker, some gas based projects, some large, medium and small scale PCP industries, plastic processing, engineering and logistics industries and industrial utility). As per the stakeholder's consultation, for 1000 MW power requirement, there shall be 1 nos. 400/220 kV substation considering redundancy of power and outage of any transformer in case of fault or maintenance. We have proposed this substation to be commissioned near Akhod. This substation shall be tapped with two double circuit transmission lines from the nearest 400 kV transmission line. GETCO will make necessary arrangement for tapping of power at 400 kV. The installed capacity and number of transformer shall be 4 nos. 315 MVA (1260 MVA, 1008 MW). As per the stakeholder's consultation, this substation can accommodate 220 kV substations within the same premises by constructing 3 nos. 220 kV line bays. However, the land requirement for setting up this substation will be 30 hectare. It may take approximately 60 months for setting up and putting in operation for one such substation. The width of power corridor shall be 46 mt. Please note that in the power map we have shown power transmission lines running along the respective roads. The width of respective power corridors has been included in Row as planned in road network map. Power corridors wherever not provided in road network map, shall be provided separately along the respective roads as per transmission line routing and voltage level.

During Phase 1 (from 2016 to 2020), Phase 2 (from 2021 to 2030) and Phase 3 (from 2031 to 2040) we have envisaged power requirement of 1000 MW (consisting of one refinery or cracker, fertilizer industries, some large, medium and small scale PCP industries, ancillary and service industries, engineering and logistics industries, industrial utility, ship building industries and Ecopark). To cater these industries, there shall be 1 no. 400/220 kV substation considering redundancy of power and outage of any transformer in case of fault or maintenance. We have proposed this substation to be commissioned at utility corridor near Kothia. This substation shall be tapped with two double circuit transmission lines from the nearest 400 kV transmission line. GETCO will make necessary arrangement for tapping of power at 400 kV. The installed capacity and number of transformer shall be 4 nos. 315 MVA (1260 MVA, 1008 MW). As per the stakeholder's consultation, this substation can accommodate 220 kV substations within the same premises by constructing 3 nos. 220 kV line bays. However, the land requirement for setting up this substation will be 30 hectare. It may take approximately 60 months for setting up and putting in operation for one such substation. The width of power corridor shall be 46 mt. The width of respective power corridors has been included in Row as planned in road network map. Power corridors wherever not provided in road network map, shall be provided separately along the respective roads as per transmission line routing and voltage level.

4.2.16.2 220 kV substations

During Phase 0 (up to 2015) outgoing power at 220 kV from 400/220/66 kV Akhod substation shall be transmitted to 3 nos. 220/66 kV substations near Sambheti, Pakhajan and Vengani. These substations shall be tapped with a double circuit transmission line from 400/220/66 kV Akhod substation and another either from existing 220 kV line or from 400/220 kV substation nearby. This shall be done considering redundancy of power and outage of any transformer in case of any fault or maintenance. GETCO will make necessary arrangement for tapping of power at 220 kV. The installed capacity and number of transformer shall be 3 nos. 100 MVA (300 MVA, 240 MW) in each substation. As per the stakeholder's consultation, it may take approximately 36 months for setting up and putting in operation for one 220 kV substation. The land requirement for setting up one 220 kV substation is 10 hectare. The width of power corridor shall be 35 mt. The width of respective power corridors has been included in Row as planned in road network map. Power corridors wherever not provided in road network map, shall be provided separately along the respective roads as per transmission line routing and voltage level.

During Phase 1 (from 2016 to 2020), Phase 2 (from 2021 to 2030) and Phase 3 (from 2031 to 2040) outgoing power at 220 kV from 400/22066 kV Kothia substation shall be transmitted to 3 nos. 220/66 kV substations at Pipalia, Vorasamni and Navetha. These substations shall be tapped with a double circuit transmission line from 400/220/66 kV Kothia substation and another either from existing 220 kV line or from 400/220 kV substation nearby. This shall be done considering redundancy of power and outage of any transformer in case of fault or maintenance. GETCO will make necessary arrangement for tapping of power at 220 kV. The installed capacity and number of transformer shall be 3 nos. 100 MVA (300 MVA, 240 MW) in each substation. As per the stakeholder's consultation, it may take approximately 36 months for setting up and putting in operation for one 220 kV substation. The land requirement for setting up one 220 kV substation is 10 hectare. The width of power corridor shall be 35 mt. The width of respective power corridors has been included in Row as planned in road network map. Power corridors wherever not provided in road network map, shall be provided separately along the respective roads as per transmission line routing and voltage level.

4.2.16.3 66 kV substations (Industrial)

As per the stakeholder's consultation, considering 5 nos. 10 MVA (50 MVA, 40 MW) transformer in each 66 kV substation, to cater industrial power demand of 1000 MW during Phase 0 (up to 2015) we need to set up 25 nos. 66 kV substation. However, considering industries consuming power at 220 kV or 66 kV through express feeder's number of 66 kV substations may reduce. In view of this we have envisaged 7 nos. 66/11 kV substations.

Similarly, during Phase 1 (from 2016 to 2020), Phase 2(from 2021 to 2030) and Phase 3 (from 2031 to 2040) to cater industrial power demand we have envisaged 7 nos. 66/11 kV substations.

During Phase 0 (up to 2015) outgoing power at 66 kV from 220/66 kV substations at Akhod, Sambheti, Pakhajan and Vengani shall be transmitted to 66/11 kV substations located at Samatpor, Koliad, Utility corridor near Atali, Nandida, Nadarkha, Kaladara, Bhensali. These substations shall be tapped with 220/66 kV substations at different locations through a single circuit transmission line. This shall be done considering redundancy of power and outage of any transformer in case of fault or maintenance. Each 66/11 kV substation shall have the installed capacity and number of transformer as 5 nos. 10 MVA. As per the stakeholder's consultation, it may take approximately 18 months for setting up and putting in operation for one 66 kV substation. The land requirement for setting up one 66 kV substation is 1 hectare. The width of power corridor shall be 18 mt. The width of respective power corridors has been included in Row as

planned in road network map. Power corridors wherever not provided in road network map, shall be provided separately along the respective roads as per transmission line routing and voltage level.

4.2.16.4 66 kV substations (Residential)

For residential power demand of 200 MW for all phases we have envisaged 5 nos. 66/11 kV substations with 5 nos 10 MVA transformer in each substation. These substations are shown separately in residential areas (refer map for power network).

Residential power demand during Phase 0, Phase 1, Phase 2 and Phase 3 outgoing power at 66 kV from 220/66 kV substations at Vengani and Navetha shall be transmitted to 66/11 kV substations located at Kesrol, Khojbal, Amleshwar, Bhuva and Narthala. These substations shall be tapped with 220/66 kV substations at different locations through a single circuit transmission line. This shall be done considering redundancy of power and outage of any transformer in case of fault or maintenance. Each 66/11 kV substation shall have the installed capacity and number of transformer as 5 nos. 10 MVA. As per the stakeholder's consultation, it may take approximately 18 months for setting up and putting in operation for one 66 kV substation. The land requirement for setting up one 66 kV substation is 1 hectare. The width of power corridor shall be 18 m. The width of respective power corridors has been included in Row as planned in road network map. Power corridors wherever not provided in road network map, shall be provided separately along the respective roads as per transmission line routing and voltage level.

4.2.17 Proposed Power Supply Infrastructure Costing

The total estimated cost of proposed power supply is ` **1371.72 Crores**. Please refer Appendix B.8.2 for cost calculations.

Sr.No.	Phasing Period	Cost (` Crores)
1	Phase-0 (2010-15)	651.87
2	Phase-1 (2016-20)	593.48
3	Phase-2 (2021-30)	
4	Phase-3 (2031-40)	126.37
Total Cost (` Crores)		**1371.72**

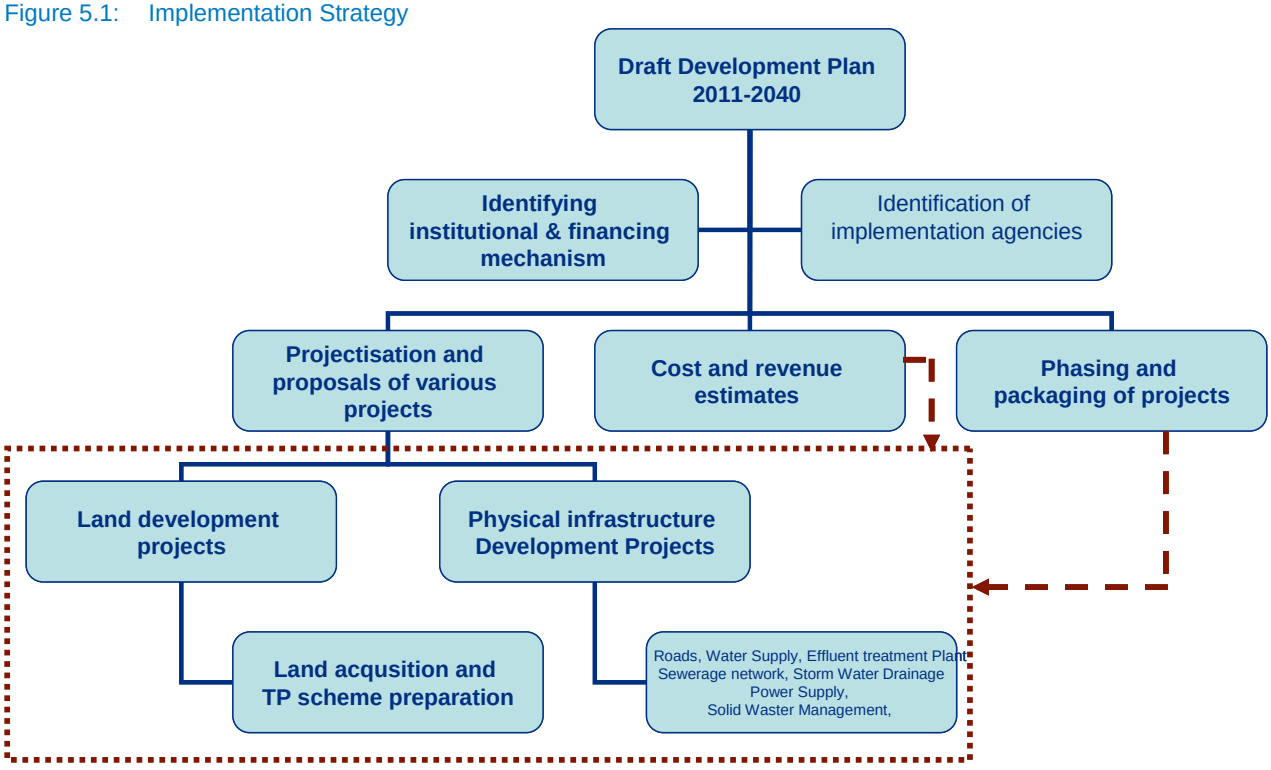
5. Plan Implementation

For any Development Plan to be implemented effectively, a good implementation strategy is essential. This chapter outlines the implementation strategy suggested for GPCPSIR. The strategy is proposed on the basis of actions plans already in discussion by the implementing authority and is in lines with the existing mechanism adopted by GIDC which has already developed a few industrial estates there. This makes the proposed strategy practically grounded in turn making it easier and quicker to implement.

5.1 Introduction

The Draft Development Plan of GPCPSIR envisages the future growth of GPCPSIR area in a planned manner by the Competent Authority. In this comprehensive development strategy, this has been segregated into a number of projects which could be implemented. As a working document the costs provided here are indicative to give an idea of the financial implications of the Development Plan. Each project will require a DPR to be prepared for implementation. Hence the comprehensive strategy includes the following steps as presented in Figure 5.1.

Figure 5.1: Implementation Strategy



Source: MM

5.2 Project Implementing Agency

In order to develop and utilize space with help of infrastructure and amenities, a new authority has been recommended by the core group looking into the aspect. The new Regional Development Authority i.e. ***Gujarat Petroleum, Chemicals and Petrochemicals Special Investment Regional Development Authority (GPCPSIRDA),*** which has been formed to exercise powers conferred by subsection (1) of sections 8,9,10, and 15 of the Gujarat Special Investment Region Act, 2009 will be responsible for planning, developing and operation-management of key/trunk infrastructure facilities, proposed for GPCPSIR. This newly formed Authority comprises the following members, namely (also attached in Appendix F):

Table 5.1: Members of GPCPSIRDA

Members	Position
Chief Secretary	Ex-officio Chairperson
Principal Secretary, Industry and Mines department	Ex-officio, Member
Chief Executive Officer, Gujarat Infrastructure Development Board	Member
Vice Chairman and Managing director, Gujarat Industrial Development Corporation	Member
District Development Officer, Bharuch	Member
Director, School of Planning, Centre for Environmental Planning and Technology, Ahmedabad	Member
(Shri U Mehta) Retired Town Planner	Member
Chief Engineer, Gujarat Industrial Development Corporation	Member secretary

Source: GIDC

5.3 Project Development Strategies

It is suggested that any one of the following development model can be adopted, with varying degrees of public-private interface. These could be articulated as **Limited Acquisition of land by public agency**, primarily for development of trunk infrastructure, nodal amenities and the Industrial area as it has been developed in the existing estates of Dahej and Vilayet. The other model for development is through **Town Planning Scheme (TPS).** Here the land acquisition related socio-economic issues of the existing stakeholders' are minimized. However, the cost of development needs to be recovered through complex mechanism of ***betterment levies or external development charges*** as elaborated below:

- A ***betterment levy***, is known as special assessment, may be made on owners of property when the value of their holdings appreciate due to public schemes such as construction of roads, drainage etc. Government, by this levy, may take a share of appreciation in value or recover a part of the cost of development made at public expense. In this case GPCPSIRDA may plan to recover premium from builders and developers for the sale of additional floor space index.
- ***External Development Charges (EDC)*** is also a kind of self-financing mechanism for urban infrastructure, which is to be funded by property owne` EDC will be collected by GPCPSIRDA. The External Development or services include the following:
    i. Water supply
    ii. Sewerage
    iii. Storm water drainage
    iv. Roads
    v. Street lighting
    vi. Community buildings

vii. Horticulture
viii. Public health maintenance
ix. Road maintenance
x. Street lighting maintenance

The proceeds of such levies and charges would be contributed for the creation of a separate ***GPCPSIR Development Fund (GPCPSIRDF)*** which would be mainly utilised for various infrastructure projects within GPCPSIR.

The town planning scheme development strategy also known as the **land pooling and readjustment strategy** is elaborated below:

Figure 5.2: Spatial example of TP scheme

Source: IMM

Under this model, as per Gujarat TP & UD Act 1976, the designated GPCPSIRDA will "pool" land, organize it, develop infrastructure and deduct 15% of the land towards cost recovery. The allotment of land from the total area covered under the scheme, to the extent of –

- 15% for roads
- 5% for parks , play grounds gardens and open space
- 5% for social infrastructure such as school, dispensary, fire brigade, public utility place as earmarked in the Draft Town Planning Scheme and,
- 15% for sale by GPCPSIRDA for residential commercial and industrial use depending upon the nature of development.

5.4 Phasing, Estimated Cost and Source of Funding

5.4.1 Phasing

The **Zero Phase (Phase 0)** of the development will be very important where development shall take place in Dahej 1 (including Dahej SEZ), Dahej 2 and Vilayet Estate, as per the allotment done by GIDC and MOUs signed during VGGIS 2009. This shall also include future expansion of the existing industries.

The development shall be from 2011 to 2015. The development would be comprehensive in nature will total amenities in the selected regions. This constitutes 5% of the total development planned for processing area. Simultaneous comprehensive development of the non-processing area has been planned along with the processing zone in the same phase and in the order of same development ratio of 5%. Thus, the cost

for Phase 0 would account for total development of Dahej 1& 2 and the extension of existing industries and also a portion of non processing area.

The **First Phase (Phase 1)**, from 2016 to 2020, of the development shall be devoted to construct the infrastructure for the Processing Zone and this would constitute 20% of the total development. Simultaneous comprehensive development of the non-processing area has been planned along with the processing zone in the same phase and in the order of same development ratio of 20%.

Thus, the cost for Phase 1 would be direct implication of the expenditure towards establishment for infrastructure in the processing zone and corresponding developments in the non- processing area.

The **Second Phase (Phase 2)**, is the longest phase from 2021 to 2030, where the civil works would be completed in the processing area. This phase is the most critical phase and constitutes 45% of the total development. Simultaneous comprehensive development of the non-processing area has been planned along with the processing zone in the same phase and in the order of same development ratio of 45%.

Thus, the cost for Phase 2 would have direct implication of the expenditure towards civil works in the processing zone and corresponding developments in the non- processing area.

The **Third Phase (Phase 3)**, is the last phase from 2031 to 2040, where the remaining areas would be completed in the processing area. This phase is also the critical phase and constitutes 30% of the total development. Simultaneous comprehensive development of the non-processing area has been planned along with the processing zone in the same phase and in the order of same development ratio of 30%.

Thus, the cost for Phase 3 would have direct implication on the expenditure towards completion of remaining infrastructure and civil works in the processing zone and corresponding developments in the non- processing area.

5.4.2 Various Projects, Estimated Cost and Sources of Funding

The development proposals under the Draft Development plan of GPCPSIR have been hinged on “Land as a resource” concept. Land would be the main tool for development of all the facilities in GPCPSIR as estimated in the table below. Thus, it is important to look into the overall land-use area statement from sale-ability point of view. The details of total development and saleable areas are given in the following table:

5.4.2.1 Land Development Projects

Land acquisition

10341 ha (refer Table 5.2) land may be acquired for industrial development. The land development mechanism as decided by the RDA is suggested to be developed in phase wise manner. External Urban Planning Consultants may be engaged by RDA to prepare development planning model to be sanctioned by RDA. This will cost around `1809 crores. It includes only the compensation rate as received from the Jantri Department, Bharuch and GIDC. The following may be some of the defined scope of work for land development work:

- Preparation of Base Map using physical surveys, indicating existing development
- Collation of land records, i.e. plot areas, land ownership and tenure of each plot, reconcililiation of land record with site conditions
- Declaration of intention

- Preparation of land use study, land price analysis, analysis of sale deeds
- Preparation of plan according to decided development model (i.e. TP scheme / master plan)
- Road network including all physical infrastructures planning of the selected zone.
- Computation of compensation and betterment levies, legal and administrative costs, financial structuring and other related matte`
- Consultation with potential stakeholders

Table 5.2: Land acquisition cost

Acquisition cost	Area (ha)	Compensation rate (` per Ha)	Total Cost (`)
Dahej III	1,458	17,50,000	2,55,15,00,000
Dahej IV	5,869	17,50,000	10,27,07,50,000
Atali Expansion	293	17,50,000	51,27,50,000
Vilayet expansion I	387	17,50,000	67,72,50,000
Vilayet Expansion II	2,334	17,50,000	4,08,45,00,000
			1,80,96,750,000
Total	**10341**		**18,096.75 million**
			1,809.675 crores

Town Planning Scheme and Implementation

Town planning scheme is the oldest method of bringing about planned development by reconstitution of large agricultural plots into serviced urban plots with minimum compulsory acquisition. Through TP schemes (TPS), a complete service network of roads and streetlights, water supply, sewerage and storm water networks are to be provided.

Each TP scheme should be developed as complete self financed project, with detailed phasing of infrastructure works, cost revenue estimations, cash flow analysis and a financial strategy worked out. This would ensure that revenues from one TP scheme pay for the cost of preparation and implementation of that TP scheme.

The cost of implementing TPS comprises the following components:

- Cost of preparing TP scheme
- Cost of compensation in lieu of land deduction
- Cost of providing Infrastructure in the TPS
  - Construction and development of DP level roads
  - TP scheme level roads
  - Streetlights
  - Water distribution network
  - Branch Sewerage
  - Branch storm water network
  - Open space development

The TP Scheme area is a gross area considered. It has been derived after deducting the proposed expansion area of the estates in the GPCPSIR mentioned in Table 5.2 and the existing area of the estate from the total area of GPCPSIR. The cost of TP Scheme preparation is elaborated in Table 5.3

Table 5.3: Cost of TP scheme preparation

Acquisition cost	Area (ha)	Rate (` per Ha)	Total Cost (`)
Area to be developed through TP scheme	**24,970**		
Assuming area of one TP scheme	2,000		
Number of TP scheme	About 13 Nos		
a) Preparation of Draft TP scheme			
Cost of physical surveys		600	1,49,82,000
Cost of consultancy services		6,000	14,98,20,000
RDA's in-house expenditure		800	1,99,76,000
Total Cost of preparing Draft TPS for the area of concern			**18,47,78,000**
			184.78 million
			18.48 crores
b) Preparation of one Final TP scheme			
Cost of publication at various stages			2,50,000
Compensation for any damage, loss misery resulting from any action of the development authority			1,50,000
Compensation for any property or right injuriously affected by the scheme			1,50,000
Legal expenses incurred by the authority for preparation and execution of the scheme, cost of demarcation, salaries of TPO and the Board of appeal			7,50,000
Cost of preparing one final TP Scheme			13,00,000
Cost of preparing 13 final TP Schemes			1,69,00,000
			16.9 million
			1.69 crores
Total cost for TP Scheme Preparation			**201.68 million**
			20.17 crores

5.4.2.2 Infrastructure Development Projects

This has been already discussed in details under Section 4.2 with their cost implication. Various projects under infrastructure development are as follows:

1. **Road development projects**

The DDP proposes to strengthen identified existing regional roads, roads that bypass the villages and proposes to develop new roads in the new urbanisable area of GPCPSIR. The roads shown in the Maps are the Development Plan (DP) level roads. Width of these roads varies from 30 M to 250M. After these,

there will be TP / Master plan level, community level, sector level, and cluster level roads which will be of width as mentioned in GDCR of GPCPSIR. The project will include the following components:

- Physical ground survey, subsurface preparation of roads, surfacing and carpeting, road dividers, laying of curb stones, plantations along dividers, road markings, development of bus stops, development of paving, development of lay-byes / rest areas, landscaping / plantations along the service lane, development of signage, traffic signalling as major junction / roundabouts, development / improvement junctions

- Invitation of bids from Planning consultants for the preparation of road development strategy and design details

- Conceptual Road development strategy and design detailing following approval from GPCPSIRDA.

- Invitation of tenders from construction management firms

- Preparation of construction management contract

- Construction and project management.

2. Water Supply

There are several agencies involved in development of utility services in GPCPSIR area. GIDC has signed MoU with Multi ManTech International Pvt. Ltd and formed ***GPCPSIR Services Pvt Ltd (GPSL)***. GPCPSIR Services are responsible for planning water supply for this area. The proposed development plan is in line with GPCPSIR development plan which has been considered in our overall projection for water demand.

The proposed development plan of water supply comprises:

- Identification of Feasible water supply source

- Design of new raw water reservoir

- Design of conventional WTP for domestic use and also design of New water supply network in line with GWSSB augmentation programme

- Design of New Industrial water supply network (Untreated Raw Water) and also utilization of GIDC Existing Industrial water supply network

3. Sewerage Network

The total sewage output for GPCPSIR area is around 131 MLD for which Sewage treatment facilities would be required. It has been planned to have 5 numbers of STP at different locations including localised pumping stations to cover whole GPCPSIR area. Location of STP has been decided based on topography and coverage of maximum number of villages / residential area. Sewage lifting /pumping stations have been proposed wherever the invert level of sewer crosses more than 6m.

4. Effluent Network

As stated in earlier section regarding effluent projections, the total effluent quantity of 336 MLD would be generated, which has been estimated considering cluster of large, medium and small scale Industries. Generally small scale industries do not have individual effluent treatment facility because of the scale of operations/lack of space/technical manpower. Therefore, it becomes necessary to have a common effluent treatment plant (CETP) for a group of small scale industries where the combined effluent from these industries are treated and disposed off.

5. Storm Water Network

The design of storm water drain network has been undertaken by the rational method. Four different sections have been planned to carry the storm water run-off from different planned roads and contributing areas. Different sections have been worked out as per the total storm water contribution from its adjacent area.

The direction of flow/route of the designed storm water drain will follow the road network and topography of the region. As the study area is huge of about 453 Sq.Km, most natural drains are considered for disposal of surface runoff. Especially drains from Sayakha-Sadathala-Khojbal and Pakhajan-Nandida-Khojbal have been considered as disposal stream. The storm water drainage system has been designed in zone wise pattern. A total of 27 different disposal & connection points have been proposed for Storm water drainage line in the GPCPSIR Region.

6. Solid Waste Management

Out of total waste generated (614.5 TPD), after neglecting the inert and recyclable waste, the quantity of waste of 364 TPD would reach the processing site, where compositing of the waste shall be done and rejects from this process (241.2 TPD) would finally reach the land fill site for final disposal. The following are the aspects of SWM plan:

- Household segregation (organic and inorganic: Recyclables/Non recyclables.)
- Household Storage (In separate plastic containers for Biodegradable and non biodegradable waste)
- Containerized collection (House to house)
- Transportation (Pedal Tricycle / Handcart / other types)
- Transfer or recyclables / recycling
- Treatment and disposal.

7. Flood risk Management

As per Flood Risk assessment (FRA) study all types of flood risks have been estimated and suitable recommendations have been made for flood mitigation strategies.

5.4.2.3 Broad Cost estimation of the projects

Adequate infrastructure is the base for better living, economic growth and overall development of a region. In order to implement successfully any Development Plan, providing quality infrastructure- Water Supply, Sewerage, Roads, Traffic Management, Solid Waste Management, and flood risk management has been considered. The estimated costs of the projects are depicted in Table 5.4 below. Suggestive land development model, implementing agency and revenue sources are also indicated for an overall broad idea.

5.4.2.4 Revenue stream

The main sources of revenue for GPCPSIRDA for implementing the development plan projects are the following:

- Grants and aids from Central Government
- Grants and aids from State Government
- Sale of land obtained through TPS - Land as a resource
    - Utilising development Rights as a resource / grant of premium i.e. additional FSI
    - Development Charges
    - Sewerage charges
    - SWM charges
    - Service and amenities fees
    - Betterment charges / Incremental fees – which is to be paid by the land owners to the extent of 50% of the increase in land values after development through TPS
    - Revenue from sale of land – besides the incremental contribution, RDA can derive significant revenue from 10% of land that it sells as developed plots to develope` This should be utilised for capital city level projects. (Gujarat TP and UD Act 1976 states 15% of TPS land to be sold at market rates as developed plots by the Authority to raise revenues, the total land deduction is proposed to be 40%, out of which 15% will go for roads, 5% for open spaces, parks and playgrounds, 5% for creation and social amenities, and 10% for sale by the DA and 5% will go for EWS Housing)
    - Scrutiny Fees
    - Security Deposit
    - Advertisement Revenues
    - Parking Fees

Table 5.4: Broad cost estimate

Projects	Main Components	Broad cost estimate					Implementing agency	Revenue Sources
		Phase-0 (2011-2015)	Phase-I (2015-2020)	Phase-II (2021-2030)	Phase- III (2031-2040)	Total (` Crores.)		
1	**Land Development**							
1.1	Land acquisition	90.48	361.94	814.35	542.90	1809.68	RDA	
1.2	TP scheme preparation	1.01	4.03	9.08	6.05	20.17	RDA	10% land selling by RDA, incremental charges, selling premium FSI
2	**Physical Infrastructure Development Projects**							
2.1	Trunk Roads	3062.81	1,703.45	1,487.88	1,055.99	7,310.13	Central govt, State govt, PPP	Advertising rights, parking, Road toll Tax
2.2	Water Supply Distribution network (Trunk)	2,576.64	-	942.11	-	3,518.75	State govt, (PPP)	User charges
2.3	Storm Water Drainage	1,075.48	-	-	-	1,075.48	RDA, (PPP)	User charges
2.4	Sewerage Network Trunk	63.54	192.52	66.70	121.56	444.32	RDA, (PPP)	User charges
2.5	Trunk Effluent Collection System	787.42				787.42	RDA, (PPP)	User charges
2.6	Solid waste management	120.86	53.11	165.44	115.80	455.21	RDA, (PPP)	User charges
2.7	Power Supply Network	651.87	593.48		126.37	1,371.72	RDA	User charges
2.8	Flood Risk Management	327.98				327.98	RDA	User charges
	Total	**8,666.60**	**2,542.56**	**2,662.13**	**1,419.72**	**15,291.01**		
	Total Outlay					**17,120.86**		

Source: MM

6. Conclusions and Recommendations

The Draft Development Plan for GPCPSIR aims at providing a comprehensive development plan with the proposed land use zoning and infrastructure to realize the vision of a modern industrial region. This chapter summarises the conclusions of the Draft Development Plan report and provides way forward with the recommendations

6.1 Inferences

Chapter 2 of this report details the industry sizing and estimates the employment generation for GPCPSIR. It has been projected on the basis of both existing situation and future growth potential, simultaneously drawing parallels from benchmarks as have been established nationally and internationally. Once these were ascertained, the employment that can be generated from non processing area has been estimated. The population for GPCPSIR has been estimated at 16, 82,987 numbe` This includes the residing population, rural population and also the floating population. The projections for the demand of various infrastructure are included in this chapter including road, water, effluent, sewerage, solid waste and power supply.

The next chapter on statutory obligations elaborates the various policies, Acts, guidelines applicable for GPCPSIR. These have been incorporated in the proposals for the land use and infrastructure planning for the area. The chapter refers to an important part of development regulations viz. General Development Control Regulations applicable for GPCPSIR. The GDCRs are included in the *Volume III* of the Development Plan report as a standard practice

Chapter 4 elaborates on the proposed land use and infrastructure proposals for the development plan. The consultative process that has gone into the finalisation of the land use and infrastructure process has been discussed here. The proposed land use plan for GPCPSIR is elaborated based on four themes including transportation and logistics synergy, appropriate co-siting of industries, environment and safety issues, cohesive and safe non processing area development. The proposed land use based on the details has been estimated for the total area of around 45298 hectares (453 sq km) which has been tabulated in this chapter. The proposed phasing of the land use is discussed mainly on the concept of expansion away from the existing activity nodes and the growth facto` The infrastructure proposals are elaborated for the various sectors in this chapter.

The final chapter is on the implementation plan and strategy for the GPCPSIR development plan. The broad indicative costs for the land and infrastructure development are included in this chapter. However, the costs are indicative and provides an idea of the main financial implications based on the Development Plan. For each infrastructure component, the detailed DPRs will have to be taken up in the subsequent stage. Since the Regional Development Authority for the GPCPSIR is already in place, the implementation strategy refers to the same in this chapter. The Development mechanisms including limited acquisition and Town Planning scheme (TPS) are suggested for the GPCPSIR which have been provided in due consultation with the client.

6.2 Way forward

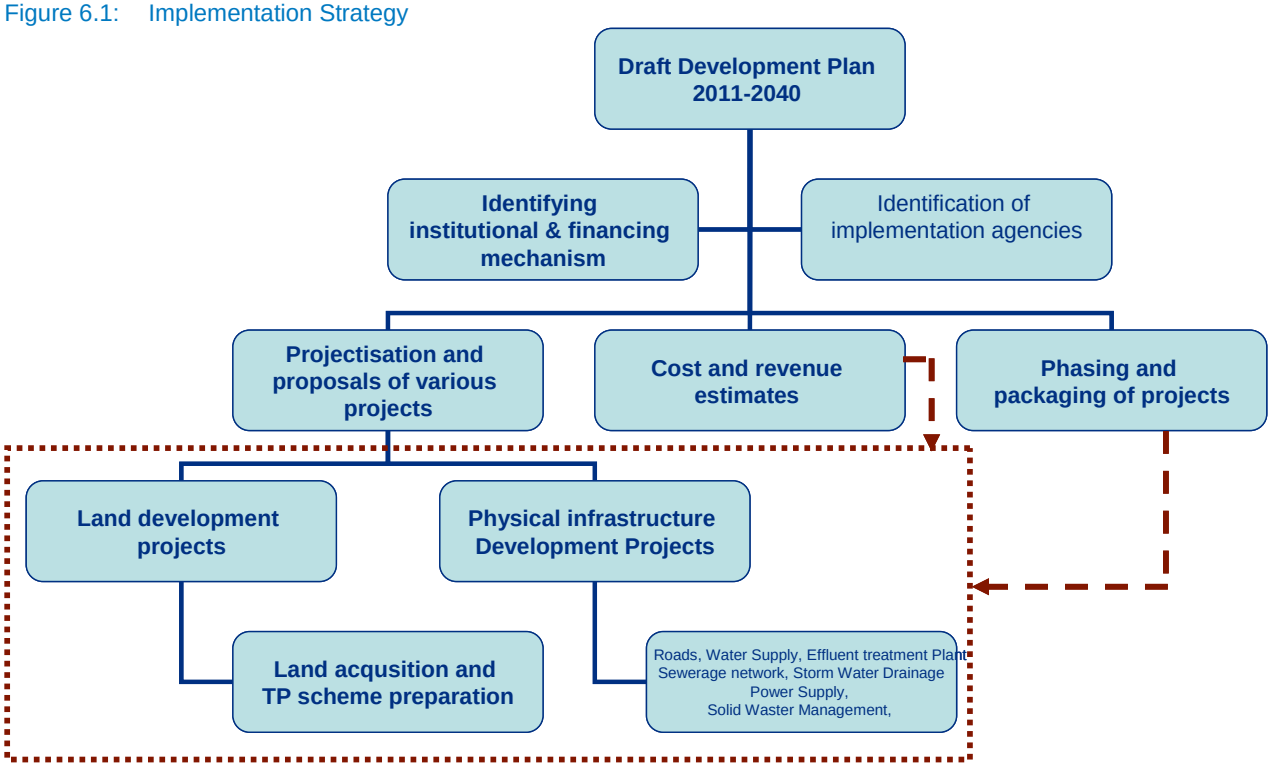
The Draft Development Plan for GPCPSIR will go through the standard procedure from the stage of the draft to its finalisation. Following is a stage wise elaboration of the envisaged finalisation process for the Draft Development Plan for GPCPSIR:

- ***Stage 1:*** Approval of the Draft Development Plan (DDP) by the Regional Development Authority (RDA) Board.
- ***Stage 2****:* Publishing of the DDP by the RDA and invitation for public objections and suggestions. The DDP will have to be made available for objections and suggestions in the public domain for a period of around two months
- ***Stage3****:* The objections and suggestions received from various stakeholders including the Government will be screened by the RDA Board and recommendations for changes, if any, will be made.
- ***Stage 4****:* Incorporation of the final recommendations, if any, and revision of the Draft Development Plan
- ***Stage 5****:* Publishing of the final Development Plan along with the GDCRs for GPCPSIR.

Apart from the standard stages of final publication of the DDP, as per the implementation strategy depicted in the Figure 4.1 the implementation of DDP would require a very high degree of co-ordination as well as co-operation amongst Central, State, Para-state, local administration and the industries. Besides the creation of the RDA which has already been completed, a series of preparatory activities need to be initiated as early as possible including the following:

1. Formulation and establishment of the RDA core and working team membes
2. Projects finalisation and prioritisation of the projects
3. Identification of Implementing and financing agencies and mechanisms
4. Coordination with the implementing and financing agencies to initiate the projects
5. Preparatory work for the implementation of projects including carrying out studies, surveys and preparation of DPRs

Figure 6.1: Implementation Strategy



Source: MM

sd/	**sd/**	**sd/**
Chairman, GPCPSIRDA	**Member Secretary, GPCPSIRDA**	**Chief Town Planner, GPCPSIRDA**

Appendices

Appendix A. Population Projection

A.1. Population Assumption

Population Assumption

Section	Assumption	Reason Base
Executive: non executive employment	40:60	Stakeholder consultation with the existing industries in GIDC industrial estate Dahej
Non-Industrial employment	3% of the Industrial Employment	Dahej Commercial Establishments Survey & Ankeleshwar Industrial area survey
Residing : Floating population		
Executive employment	40:60	Stakeholder consultation with the existing industries in GIDC industrial estate Dahej
Non-Executive employment	20:80	
Gamtal employment	50% of the Industrial non executive employment	Socio-Economic Report for 44 villages of GPCPSIR and Existing Gamtal workers
Average Family Size	3 persons	The average family size has been considered low keeping in view the requirement for bachelor accommodation in GPCPSIR
Growth rate of similar Industrial townships	Growth rate/ decade	
Ankleshwar town	0.36 – Slow growth	Data for calculation from Census 1951-2000.
Vapi town	0.63 – Medium growth	Growth rate calculated for G.R. comparison between townships in the region.
Surat town	0.71 – Fast growth	

A.2. Rural Population

Appendix B. Proposed Infrastructure Estimations

B.1. Road Infrastructure

B.1.1. Road Infrastructure – Road Traffic Calculations

B.1.1.1. Bharuch – Dahej Road Traffic Calculations

B.1.1.2. Amod – Muler Road Traffic Calculations

B.1.1.3. Muler – Dahej Road Traffic Calculations

B.1.1.4. Jolva – Pakhajan Road Traffic Calculations

B.1.1.5. Bharuch – Dahej Road Capacity Analysis

B.1.1.6. Amod – Muler Road Road Capacity Analysis

B.1.1.7. Muler – Dahej Road Capacity Analysis

B.1.1.8. GPCPSIR Proposed Roads ROW, Lengths & Area Requirement

B.1.1.9. GPCPSIR Proposed Roads ROW wise Node Lengths

B.1.2. Road Infrastructure – Cost Estimates

B.1.2.1. Proposed Roads Cost Estimation with Phasing

B.1.2.2. Proposed Bridges Cost Estimation with Land Requirement

B.1.2.3. Cost Estimation with Phasing for Construction

B.2. Water Supply Infrastructure

B.2.1. Water Supply - Demand Analysis

B.2.2. Water Supply – Cost Estimations

B.3. Sewerage Management Infrastructure

B.3.1. Sewerage Management – Generation

B.3.1.1. Sewerage Generation

B.3.1.2. Phasewise Sewerage Generation & STP Proposal

B.3.2. Sewerage Management – Cost Estimation

B.3.2.1. Cost Estimation of Vilayat STP (14 MLD)

B.3.2.2. Cost Estimation of Luvara STP (16 MLD)

B.3.2.3. Cost Estimation of Atali STP (38 MLD)

B.3.2.4. Cost Estimation of Vengani STP (72 MLD)

B.3.2.5. Cost Estimation of Kasva STP (110 STP)

B.3.2.6. Cost Estimation of Sewerage System (Trunk Sewer and STPs)

B.4. Effluent Management Infrastructure

B.4.1. Effluent Management – Generation

B.4.1.1. Effluent Generation

B.4.2. Effluent Management – Cost Estimation

B.4.2.1. Cost Estimation of Proposed Effluent Management

B.4.2.2. Cost Estimation of Proposed Effluent Disposal Line

B.4.2.3. Cost Estimation of Proposed CETP

B.4.2.4. Cost Estimation of Collection Sump

B.4.2.5. Cost Estimation of Effluent Pumping Machinery

B.5. Storm Water Drainage Infrastructure

B.5.1. Storm Water Drainage – Design Analysis

B.5.1.1. Storm Water Drainage Design Assumptions

B.5.1.2. Surface Run-off Calculations

B.5.1.3. Storm Water Drainage Design

B.5.1.4. Storm Water Drain Size Calculations

B.5.2. Storm Water Drainage – Cost Estimations

B.5.2.1. Cost Estimations of Interlinked Nallah

B.5.2.2. Cost Estimations of Proposed Storm Water Drain

B.6. Flood Risk Mitigation Infrastructure

B.6.1. Flood Risk Mitigation – Design Analysis

B.6.1.1. Bhukhi Khadi Buffer Estimations

B.6.1.2. Pond Details

B.6.2. Flood risk Mitigation – Cost Estimations

B.6.2.1. Cost Estimations of Earthen Embankments and Counterfort Wall

B.7. Solid Waste Management Infrastructure

B.7.1. Solid Waste Management – Waste Generation Analysis

B.7.1.1. Phase-wise Landfill Site Area Requirement

B.7.1.2. Solid Waste Management – Land Requirement

B.7.1.3. Biodegradable Waste Generation Analysis

B.7.1.4. Waste to Energy Analysis

B.7.1.5. Total Solid Waste to Gasification Analysis

B.7.1.6. Bio-Medical Waste Generation Analysis

B.7.1.7. Industrial Solid Waste Generation Analysis

B.7.2. Solid Waste Management – Cost Estimations

B.7.2.1. Cost Estimation of Solid Waste Management

B.8. Power Supply Infrastructure

B.8.1. Power Supply – Demand Analysis in Industrial Development

B.8.1.1. Power Demand in Industrial Development

B.8.1.2. Power Demand in Residential Setup

B.8.2. Power Supply – Cost Estimations

B.8.2.1. Cost Estimations for Power Supply – Phase-0

B.8.2.2. Cost Estimations for Power Supply – Phase-1, 2 & 3

B.8.2.3. Cost Estimations for Power Supply – Residential

B.8.2.4. Cost Estimations for Power Supply in Proposed GPCPSIR

Appendix C. Statutary Obligations

C.1. Petroleum, Chemical and Petrochemicals Investment Region (PCPIR) Policy- Summary

C.2. Special Investment Region Act, 2009

C.3. Coastal Regulation Zone Notification, 2000

Appendix D. Proposed Landuse Map

Appendix E. Proposed Infrastructure maps

E.1.1. Proposed Road Infrastructure Map

E.1.2. Proposed Water Supply Infrastructure Map

E.1.3. Proposed Sewerage & Solid Waste Management Infrastructure Map

E.1.4. Proposed Effluent Management Infrastructure Map

E.1.5. Proposed Storm Water Drainage Infrastructure Map

E.1.6. Proposed Power Supply Infrastructure Map

Appendix F. RDA Formation