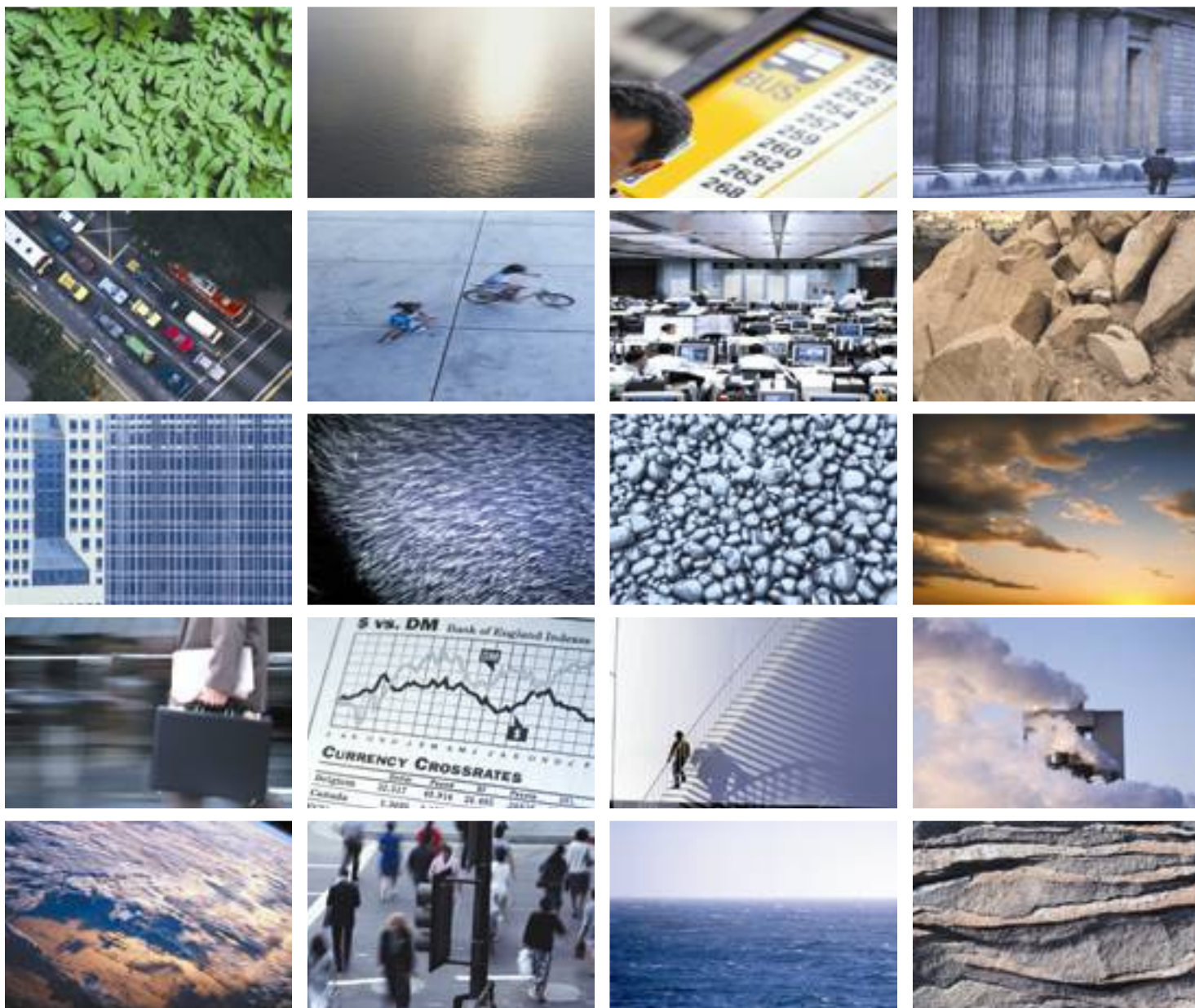


EXECUTIVE SUMMARY



BRASKEM-IDESA

Environmental and Social Impact Assessment Etileno XXI Project

EXECUTIVE SUMMARY

Project No. 123172

September 2011

1 GENERAL DETAILS REGARDING THE PROJECT, THE DEVELOPER AND OF THOSE RESPONSIBLE FOR THE ENVIRONMENTAL IMPACT ASSESSMENT.

1.1 PROJECT

1.1.1 Name of the Project

The Etileno XXI Project, comprising of preparation, construction, operation and closing of the site (hereafter referred to as “the Project”).

1.1.2 Location of the Project

The proposed site for the Project is located to the south of the Petrochemical Complex La Cangrejera, on the 3+290 km of the access road to the new toll booth No. 16 on the road between Resistol and El Chapo. It is located in the municipality of Nanchital de Lázaro Cárdenas del Río, Veracruz, Mexico. The site is located 7km southwest of the city of Coatzacoalcos and approximately 3.5 km east of the city of Nanchital de Lázaro Cárdenas del Río.

The terrain on which the Project will be developed, has a total area of 191.59 ha and is located at the following UTM coordinates, and using the center of the site as a reference: X: 1998465.37 and Y: 355171.81.

Figure 1.1 shows the geographic location of the proposed site for the Project.

In accordance with the demarcation map developed by the company Construcciones y Ecología Suristmo S.A. de C.V., a subcontractor for the Developer, the UTM coordinates for the vertices of the site are presented in Table 1.1. The demarcation map for the site is also included in Annex 1 – Plans.

TABLE 1.1. COORDINATES OF PROPOSED SITE

Vertices	UTM Coordinates	
	X	Y
200	354205.0292	1999517.4390
201	354219.2768	1999521.6544
202	354232.9578	1999523.9119
203	354243.7840	1999528.2334
204	354256.9078	19995.3203
205	354265.6189	1999545.6668
206	354271.8630	1999436.3630
207	354277.2460	1999352.9880
208	354281.0990	1999299.2470
209	354293.9480	1999098.6350
210	354380.4500	1998832.6200
211	354929.2707	1998967.6575
300	355397.1314	1999082.9129

EXECUTIVE SUMMARY

Vertices	UTM Coordinates	
	X	Y
400	355501.4500	1999108.6200
401	355567.9034	1999200.8065
402	355580.5570	1999195.9920
403	355593.5570	1999168.9920
404	355620.8976	1999147.1208
405	355686.6218	1999156.3152
406	355731.3142	1999172.0770
407	355754.9749	1999143.1804
408	355740.5156	1999112.9703
409	355777.3211	1999111.6568
410	355795.7238	1999128.7321
411	355829.9004	1999107.7164
412	355858.4339	1999090.1707
413	355895.8427	1999115.4642
414	355926.0758	1999090.5080
415	355989.3657	1999107.5685
416	356068.2347	1999110.1955
417	356123.7314	1999112.0440
418	356231.1843	1999208.1194
419	356180.8006	1999128.5479
420	356120.7087	1999051.1336
421	356080.0694	1999009.7520
422	356037.7406	1998974.6340
423	355856.5570	1998795.9920
424	355968.4728	1998637.5615
425	355922.5570	1998458.9920
426	355861.5570	1998512.9920
427	355865.5570	1998422.9920
428	355834.5570	1998289.9920
429	355828.5570	1998237.9920
430	355806.5570	1998129.9920
431	355827.5570	1998033.9920
432	355690.2100	1997894.1670
433	355643.8760	1997878.2950
434	355604.7210	1997875.3440
435	355537.7850	1997867.9830
301	355506.4056	1997863.9364
302	355470.5380	1997859.3110
303	355456.8290	1997856.8680
304	355435.0560	1997855.1260
305	355437.3780	1997906.9810
306	355438.5570	1997921.9920
307	355424.6820	1997917.1620
308	355372.4940	1997895.2300
309	355325.9380	1997875.9810
311	355264.5210	1997851.2650
312	355166.3130	1997812.0880
313	355129.9300	1997793.7250
212	355005.0233	1997767.0075
213	354909.7240	1997746.6230

EXECUTIVE SUMMARY

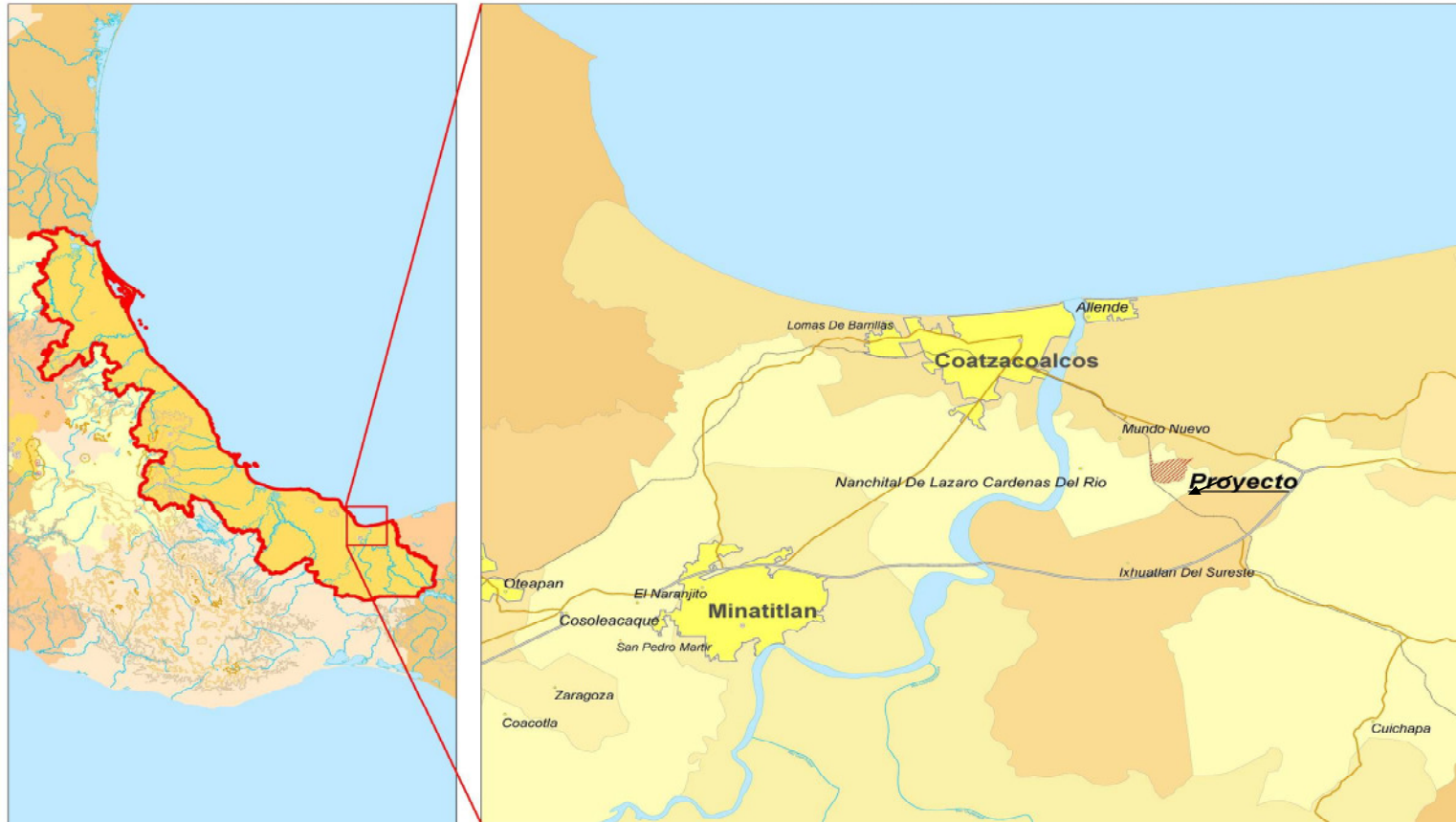
Vertices	UTM Coordinates	
	X	Y
500	354884.5795	1997716.4211
501	354866.8262	1997695.0170
502	354842.7751	1997665.0459
503	354825.8152	1997640.1170
504	354801.3146	1997609.2195
505	354781.7294	1997585.6906
506	354777.2714	1997580.3348
507	354766.5090	1997565.3466
508	354752.6226	1997544.7113
509	354731.1994	1997509.0730
510	354716.9523	1997523.1094
511	354706.6999	1997505.9371
512	354691.2340	1997523.3726
513	354649.3131	1997569.7103
514	354620.0242	1997596.7159
515	354590.6734	1997627.7391
516	354572.8669	1997645.8146
517	354549.8084	1997675.8524
518	354520.5464	1997711.1928
519	354484.2281	1997759.5782
520	354469.1420	1997781.2494
520	354460.0815	1997792.4427
521	354434.8533	1997834.2656
523	354411.6488	1997876.7302
115	354395.2051	1997909.2942
116	354393.9472	1997911.8201
117	354382.7776	1997935.3034
118	354356.9936	1997991.3971
119	354339.0490	1998039.2169
120	354327.3881	1998073.8378
121	354315.7219	1998113.5786
122	354304.3595	1998169.9314
123	354292.1147	1998236.7216
124	354288.2760	1998262.1498
125	354284.3571	1998292.5145
126	354282.2349	1998313.5119
127	354274.9092	1998415.6630
100	354274.5434	1998421.8237
225	354274.2238	1998427.2080
226	354271.8119	1998463.8583
227	354270.7144	1998481.8025
228	354269.6107	1998497.7862
229	354268.5582	1998515.7161
230	354266.9906	1998541.3597
231	354265.0561	1998571.4533
232	354221.6550	1999256.9408
233	354218.8487	1999301.4333
234	354216.7887	1999332.5036
235	354215.7838	1999348.9482
200	354205.0292	1999517.4390

1.1.3 *Lifetime of the Project*

In accordance with the calendar of activities included in Chapter 3, section 3.2.1, the Project is expected to begin with the preparation of the site, which is estimated to take 15 months. Once this phase is complete, that is to say, when the embankments have been leveled out, the construction phase will begin. This phase is scheduled for the end of 2012, and will last approximately three years. As such, operations for the project are expected to begin in 2015. The lifetime of the project is expected to be approximately 30 years from the start of operations; however it is possible this could be extended, depending on the maintenance of the site and its installations.

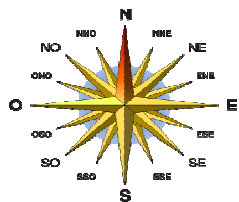
1.1.4 *Presentation of the Project's legal documents*

Currently, the company of Braskem-Idesa S. A. P. I. (hereafter referred to as "the Developer") is processing the merging of the sites with the appropriate authorities. As such, and since the Project will be carried out on a single property and under the name of a single owner, the following will refer to the area as a single site.



Km. 3+290 of the access road to the new toll both No. 16. on the road between Resistol- El Chapo, Municipality of Nanchital de Lázaro Cárdenas del Río, Veracruz.

Fuente: INEGI, 2001 y 2002



ERM-México, S.A. de C.V.

Title: Figure 1.1. Geographical location of the site of interest

Client: Braskem-Idesa

Date: Aug 2011

Project: 0123172

Report: ESIA

Drawing: IA

Design: IA

Site: Nanchital, Veracruz

Reviewed: EMO

Scale: Not to Scale

Legend:



Site of interest

1.2 DEVELOPER

1.2.1 Name or business name of the company

Braskem Idesa S.A.P.I., as established in the articles of association, No.143 434, registered in Mexico City, April 28 (see Annex 3.1).

1.2.2 Federal Taxpayer Registry number (RFC, Registro Federal de Contribuyentes)

BID100428IX6 (see Annex 3.2).

1.2.3 Name and title of the legal representative

Stefan Lanna Lepecki , General Director of the Project, according to Power of Attorney No. 145 684, registered in Mexico city by notary public number No. 151, Mr. Cecilio González Márquez, dated August 30, 2010 (see annex 3.3).

1.2.4 Address at which to receive notifications

Street and Number: Boulevard Manuel Ávila Camacho No. 36.
Neighborhood: Lomas de Chapultepec.
Delegation: Miguel Hidalgo.
State: Mexico, D.F.
Post Code: 11000.
Telephone: (55) 6234-1100.
Fax: (55) 6234-1100.
Contact: Antonio Santos Souza Galvao, Sustainability Manager.
e-mail: antonio.galvao@braskem.com.br

1.3 *THOSE RESPONSIBLE FOR THE ELABORATION OF THE ENVIRONMENTAL IMPACT ASSESMENT.*

1.3.1 *Name or business name of the company*

ERM Mexico, S.A. de C.V.
Registration in SEMARNAT: PSIA-E14/91 (4).

1.3.2 *Federal Taxpayer Registry number (RFC)*

EME-900717-GVA.

1.3.3 *Technical supervisor for the elaboration of the study*

Annex 4 includes copies of the professional licenses of the participating supervisors.

Supervisors:

Eng. Manuel Ortiz Monasterio Quintana.
General Director
ERM-Mexico, S.A. de C.V.
RFC: OIQM 680801-993.
CURP: OIQM680801HDFRNN09.
Professional License: 2028087.
manuel.ortizmonasterio@erm.com

Biol. Paola Romero Crespo.
Project Manager
ERM-Mexico, S.A. de C.V.
RFC: ROCP651108DH8.
CURP: ROCP651108MDFMRL03.
Professional License: 1614894.
paola.romero@erm.com

1.3.4 *Address of those responsible for the study*

Street: Mazatlán No. 96.
Neighborhood: Condesa.
Delegation: Cuauhtémoc.
State: Mexico, D. F.
Post code: 06140.
Telephone: 5211.0090.
Fax: 5286.9759.
e-mail: erm.mexico@erm.com

SITE SELECTION AND ACQUISITION

This chapter presents the site selection process for the Project and describes how did the site acquisition occurred once selected.

2.1

SITE SELECTION

The Project area location corresponds to a strategic location within the large existing industrial and petrochemical pole in the south of the State of Veracruz, with the advantages that this represents, as, in the foreground, the supply logistics of raw materials (in part to be supplied by the Mexican state-owned petroleum company (PEMEX, *Petróleos Mexicanos*)) and, in the background, the services availability and required infrastructure for the operation of the Project, already existing in the area.

The used criteria for the assessment of the different alternatives were mainly the following (the list is not in order of priority):

Environmental criteria

- Existing noise sources.
- Possible impacts to wildlife (bodies of water and protected natural areas).
- Presence of intermittent runoffs.
- The potential of existing contamination (PEMEX rights-of-way).
- Groundwater table.
- Vegetation.
- Area with natural vegetation.
- Seismicity.
- Winds.

Social criteria

- Land tenure.

Other criteria

- Topography.
- Area availability.
- Perimeter.
- Existence of areas ready for construction.
- Proximity to fill material banks.
- Proximity to excavation material dump sites.
- Length of water pipeline (assuming that the Cangrejera dam was the direct source).

- Possibility of differential settlements (changes in topography).
- Type of required foundations.
- Communication means.
- Railways.
- Power transmission and distribution lines.
- Presence of PEMEX rights-of-way.
- Proximity to other electrical facilities (sources of raw materials).
- Possibility to discharge wastewaters into a water body.
- Limitations on the lay out.
- Access to the site by rail.
- Factors affecting insurance.
- Availability of space for expansion.
- Requirement of additional works.
- The need to dismantle existing facilities.

Based on the above criteria, the developer conducted the assessment of all possible sites of interest for the Project location, all located in the same area of interest, since it was taken as an initial reference point the proximity to the PEMEX petrochemical complexes and other industries, for the efficient supply of raw materials.

Of a total of seven sites, (see figure 2.1), five options were assessed in detail, as follows;

- a) Ideal A (IDES A /III/ PEMEX).
- b) Ideal B (III/ PEMEX/ J. A. Hernández).
- c) Option 2.
- d) Ideal D.
- e) MEXARO Site.

These five options formed the portfolio assessment. The option e), MEXARO site, was not analyzed with equal attention, since it was declared infeasible, mainly because the following reasons:

- It is the furthest site from the Cangrejera petrochemical complex (10 km), of the water services (10.2 km) and railway line (6.7 km).
- It is located within a flood zone and prone to differentiated settlements (subsidence).
- Does not have access roads, which would lead to the construction of a dock on the river and wide access roads.
- A total of 2 070 m² are already built, more than in the other cases, which would need to be demolished.

These reasons would represent a material associated cost and would risk the feasibility of the Project, and therefore, this option was discarded.

In Annex 5.1, a complete site selection report is presented, including a comparative study that was prepared for each of the previously mentioned properties, where the characteristics of each of the assessed sites are presented.

As a result of the comparative study, the best option considered for the development of the Project was the site known as Ideal D, having the following specific characteristics that differentiate this site from the rest, according to the above listed criteria:

- Identification of existing bodies of water within the site.
- The less PEMEX-owned infrastructure was identified in this site with respect to the others; which means, that this site has the less number of rights-of-way, intersections and interconnections with the site of interest, compared to the other properties.
- The site geologic and geotechnical assessment, which resulted in a suitable area to support the required civil structures for this type of facility.
- Ideal D site is the area with the lowest susceptibility to flooding, with respect to the other options.
- This location does not involve the displacement of dwellings or businesses in the area.
- According to the analysis, there is a low possibility of new differential settlements (land subsidence), in the short and long term.
- The site has an adjoining dump site, eliminating the transportation routes to dump sites for the residual cutting and trimming material during the site preparation activities.

Other specific characteristics of the selected site are the following:

- The Project site does not share boundaries, nor is it adjacent to any Natural Protected Area (ANP, *Área Natural Protegida*). The nearest biodiversity areas of interest include: the Los Tuxtlas ANP, of Federal jurisdiction, located at approximately 300 km to the northwest of the Project site; the Jaguaroundi Ecological Park, under conservation of PEMEX, at approximately 7 km to the north of the Project site; and the Pajaritos and Cangrejera lagoon system, considered a restrictive ecological reserve, with mangroves in flood-prone areas, in charge of the National Water Commission (CONAGUA, *Comisión Nacional del Agua*), and located at approximately 6 km to the northwest of the Project site.
- The Project area is located by land at approximately 10 km to the Coatzacoalcos port, which would facilitate the resources mobilization (machinery and equipment) from other countries to be used in the Project.
- Bordered on the west by a railroad (in the section of Coatzacoalcos, Veracruz-Salina Cruz, Oaxaca), which would represent a connection to a communication mean for cargo transport. Various raw materials would be transported through this mean in rail car tankers and would have the option to ship the products by the same means.

- The region has an international airport, which would allow the easy transit of the corporate staff that would mainly come from Mexico City and Brazil.
- The site has access by primary communication land routes, which would ease the entrance and exit of personnel to the area of interest, as well as for the raw materials reception and to the products shipping through trailer trucks using these routes.
- An important aspect is its proximity to the PEMEX petrochemical complexes, established in this zone, since these will supply the main required raw materials.

2.1 *ALTERNATIVE OF NOT DEVELOPING THE PROJECT*

As detailed in chapter 3, one of the main objectives of the Project is to substitute the importation of polyethylene to Mexico, since the domestic production of this material has not increased since the mid nineties.

If the Project is not developed, this would mean that the benefits thereof for the country such as import substitution, creation of direct and indirect jobs, and other social and economical benefits, would not take place.

2.2 *SITE ACQUISITION*

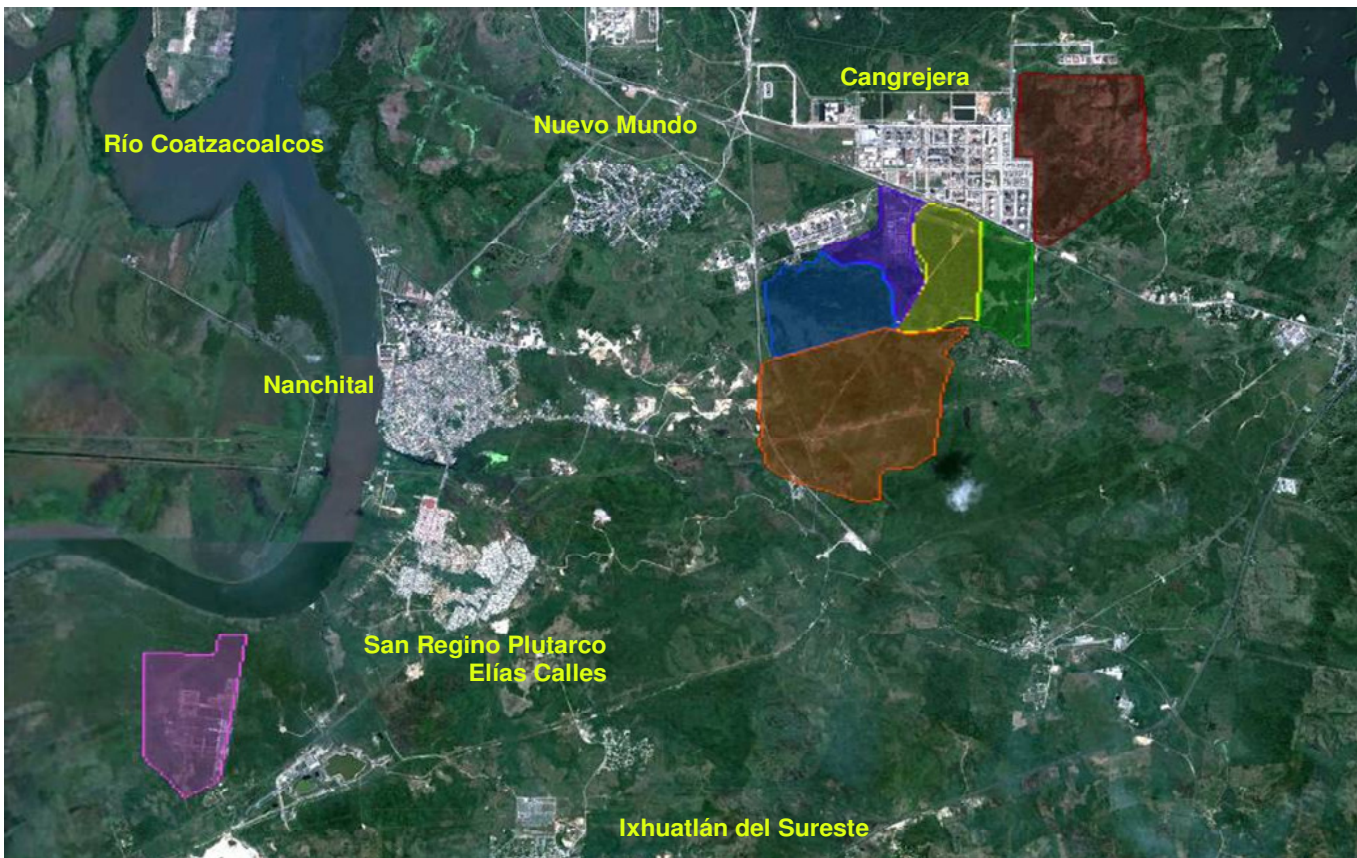
During the site selection, the site owners were approached in order to assess the acquisition costs and the alternatives that were being evaluated; quotes were obtained from the owners of the following properties:

- a) Ideal B (III/PEMEX/J. A. Hernández).
- b) Option 2.
- c) Ideal D.

The range of cost was between US \$10 to US \$12 per m². By the time this document was completed, there were still quoting for properties in the same range, even after having already acquired the Project site.

As mentioned above, the selected site was the so-called Ideal D. The site acquisition was completed through Sales Agreements between the developer and the owners, before a notary public. The site consisted of five (5) identified properties (see chapter 2).

Two dwellings were identified within the site and the owners indicated that they were uninhabited, and thus, no risk of relocation was considered.



Fuente: Google Earth.

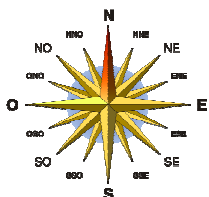
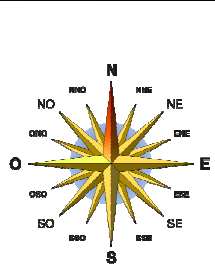
			ERM-México, S.A. de C.V.		Legend:  IDEAL D  J.A HERNANDEZ  IDESA  OPTION 2  I.I.I  MEXARO  PEMEX			
	Title: Figure 2.1. Aerial view of the proposed sites for the Project area							
	Client: Brakem - Idesa		Date: Jan 2011	Project: 0123172				
	Report: ESIA		Drawing: IA	Design: IA				
	Site: Nanchital, Veracruz		Reviewed: EMO	Scale: Not to Scale				

FIGURE 2.1 AERIAL VIEW OF THE PROPOSED SITES

Fuente: Google Earth



ERM-México, S.A. de C.V.

Title: Figure 2.2. IDEAL D site polygon, selected for the Project		
Client: Brakem - Idesa	Date: Jan 2011	Project: 0123172
Report: ESIA	Drawing: IA	Design: IA
Site: Nanchital, Veracruz	Reviewed: EMO	Scale: Not to Scale

Legend:



IDEAL D SITE POLYGON

FIGURE 2.2: IDEAL D POLYGON SITE

3. *PROJECT DESCRIPTION*

This section describes the activities related to the site preparation, construction, operation, and dismantling of the Etileno XXI Project.

3.1 *PROJECT INFORMATION*

3.1.1 *Project Nature*

Braskem-Idesa was selected by the PEMEX, by a tender process, to construct and operate a petrochemical facility, for the production of ethylene, high density polyethylene, and low density polyethylene. This Project is known as the Etileno XXI Project. The Project will consist of an ethane cracker that will produce 1 050 kilotons (kt) net of ethylene and will feed three polyethylene plants in the following way:

1. High density polyethylene (HDPE-1) Unit 1, with a capacity of 408.5 (kilotons) kt /yr, Ethylene consumption of 409 kt/yr, and comonomer requirements of 500 ton/yr of butene-1 and 6 400 ton/yr of hexene-1.
2. Low density polyethylene (LDPE-2) Unit 2, with a capacity of 341.5 kt/yr, an ethylene consumption of 338 kt/yr, and comonomer requirements of 5 300 ton/yr of butene-1 and y 5 700 ton/yr of hexene-1.
3. Low density polyethylene (LDPE) Unit, with a capacity of 300 kt/yr, net consumption of ethylene of 303 kt/yr, and a gross consumption of ethylene 313 kt/yr including 10 kt/yr of recycled ethylene from the cracking. No comonomers are required

3.1.2 *Project Location and location maps*

The site selected for the Project is located at the 3+290 km of the access path to the new toll both No. 16, stretch Resistol – El Chapo, in the Nanchital de Lázaro Cárdenas del Río municipality of Veracruz, Mexico, 3.5 km to the east of the city, approximately 2.5 km to the south of the Cangrejera Petrochemical Complex and 7 km to the southeast of Coatzacoalcos City.

3.1.3 *Required investment*

The total estimated investment will be \$ 2.5 billion USD (U.S. dollars) (approximately \$ 30 billion Mexican pesos), of which approximately \$ 500 million USD (approximately \$ 6 000 million pesos) will be designated to the implementation of impact mitigation and prevention measures , to the implementation of social and environmental protection programs, and to the actions needed for national and international environmental health and safety standards compliance, including contamination control methods.

3.1.4 Project Dimensions

The site to be used for the Project development comprises of an area of 191.59 hectares (ha) and is located in the following UTM coordinates, taking as a reference the center of the area, X: 1998465.37 Y: 355171.81. As indicated in the initial section, the area consists of five adjoining lots where the activities of top-soil and vegetation removal will take place for the embankment and platform formation. These activities will be previously authorized in accordance with the Environmental Impact Statement (MIA, *Manifestación de Impacto Ambiental*) first stage particular modality resolution, which includes only the site preparation. (see Annex 6.1).

TABLE 3.1 AREA TO BE USED FOR THE DIFFERENT PROJECT AREAS

Concept	Area (ha)	Percentage in relation to the total site area
Permanent usable area		
Top-soil and vegetation removal area for the permanent facilities (embankments and platforms) of the second stage of the Project (logistics, administration, flare, PEAD-1 y PEAD-2, PEBD and cracker).	117.73	61.45
Temporary or provisional exploitation area.		
Top-soil and vegetation removal area for the temporary facilities in the second stage of the Project.	17.25	9.00
Subtotal	134.98	70.45
Non exploited area		
PEMEX pipelines Right of Way (ROW)	26.61	13.88
Conservation area. - Section 1.- 20.41 ha - Section 2.- 6.44 ha - Section 3.- 3.14 ha	30.00	15.66
Subtotal	56.61	29.54
Total	191.59	100

TABLE 3.2 SITE VEGETATION

Activities	Area	%
Surface of the property with forest vegetation	122.1783	63.77%
Surface of the property without forest vegetation	69.4190	36.23%
Total	191.5973	100.00%

Of the total surface, the top-soil of a total area of 134.98 ha will be removed. The distribution of the surface to be impacted by vegetation type is presented in the table 3.3.

TABLE 3.3 VEGETATION TO BE AFFECTED BY THE PROJECT

Vegetation type and/or land use in the site		Surface (ha)	Percentage (%)
Forest	Medium Semi-deciduous Forest (considered as forest lands with low wood productivity, according to the land use change guide classification of the standard named the Regulation on the General Sustainable Forestry Development Law)	79.9139	41.70 %
	Palm grove	15.5786	8.13 %
	Affected forest area	95.4925	49.83%
Non Forest	Induced and cultivated grasslands (or agriculture and livestock use, according to the guide for land use change of the standard named Regulation on the General Sustainable Forestry Development Law)	39.4895	20.61 %
TOTAL AREA AFFECTED BY THE PROJECT		134.982	70.45
Existing ROW		26.616	13.90
Conservation area		30.0	15.66
Total		191.597	100.00%

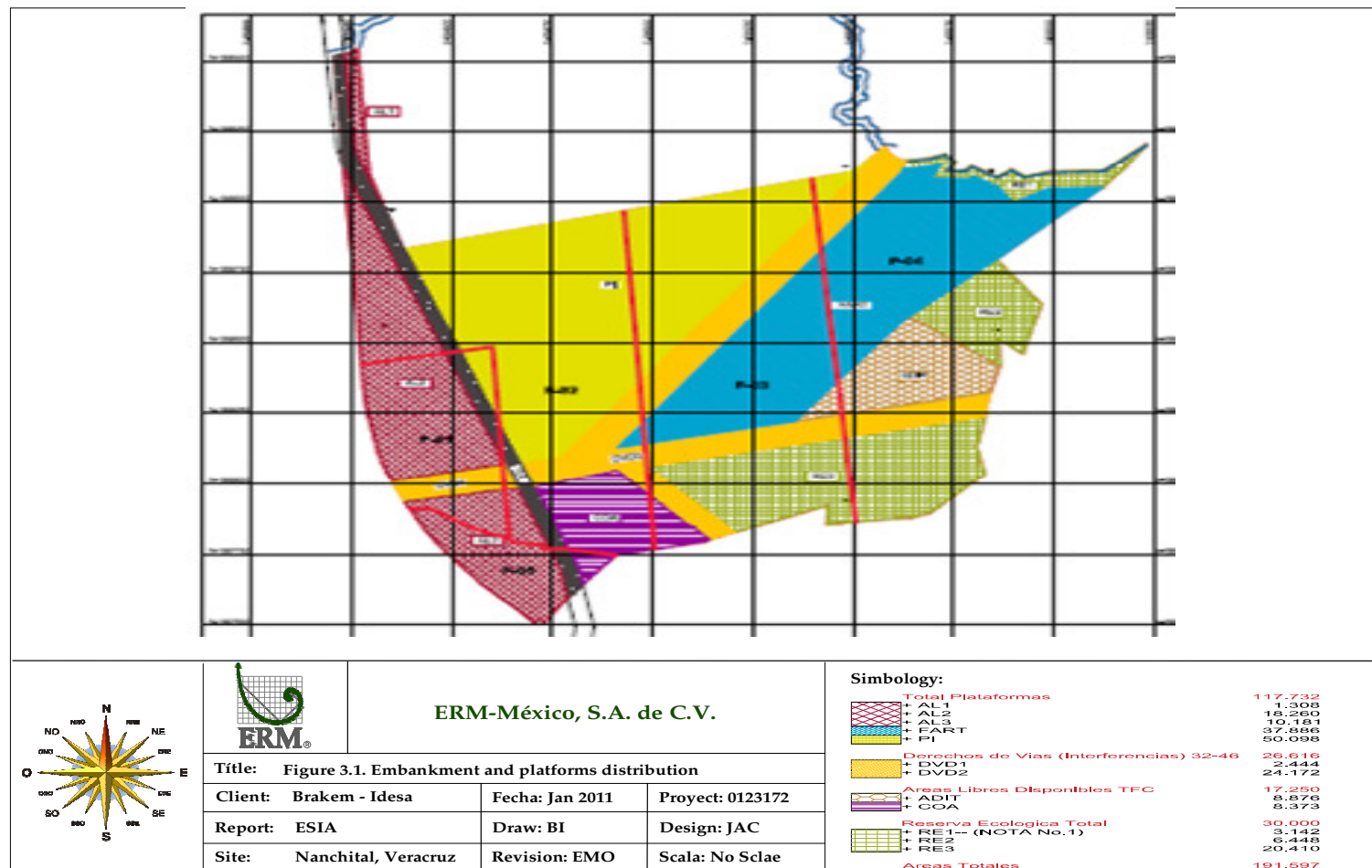


FIGURE 3.1 EMBANKMENT AND PLATFORMS DISTRIBUTION

3.1.5 Current land use description

According to the Urban Development Program (*Programa de Desarrollo Urbano*) of the urban zone of Coatzacoalcos–Nanchital de Lázaro Cárdenas del Río–Ixhuatlán del Sureste, the area of the Project is located in an area in which the predominant land use is industrial.

TABLE 3.4 BREAKDOWN OF SITE AREAS TO BE USED BY ENVIRONMENTAL MANAGEMENT UNITS (UGA, UNIDADES DE GESTIÓN AMBIENTAL)

UGA	Use Policy	Site surface in the UGA area (ha)	Land use designated by the Project	Surface affected by the Project (ha)	Affectation in relation to the total area (%)	Affectation in relation with the UGA (%)
5	Livestock	3.44	Ecological reserve	0		0
7	Industrial	134.98	Industrial	134.98	70.45	100
11	Protection	17.35	Ecological reserve	0		0
13	Flora and fauna restoration	9.2	Ecological reserve	0		0
Existing ROW	UGA 7 Industrial	26.61	N/A	N/A	N/A	N/A
Total		191.59		134.98	70.45 %	

Requested surface for the Environmental Impact Land Use change, in which works and activities for the site preparation are developed.

According to the State Environmental Agency (SEDEMA, *Secretaría de Medio Ambiente del Estado de Veracruz*), the **exploitation area** for the new industrial facilities of the Braskem-Idesa Etileno XXI Project are located entirely in the Industrial Exploitation UGA 7, in accordance with the SEDEMA zoning related with the ecological planning regulation program (POECBC, *Programa de Ordenamiento Ecológico de la Cuenca Baja del Río Coatzacoalcos*), therefore, the Braskem-Idesa Project is totally in compliance with the Cuenca Baja del Río Coatzacoalcos ecological planning regulations. For the above, the Etileno XXI Project does not contradict the Opinion on Technical Exploitation Congruence (*Opinión de Congruencia Técnica de Aprovechamiento*) issued by the authorities. The site UGA zoning is presented in the Figure 3.2.

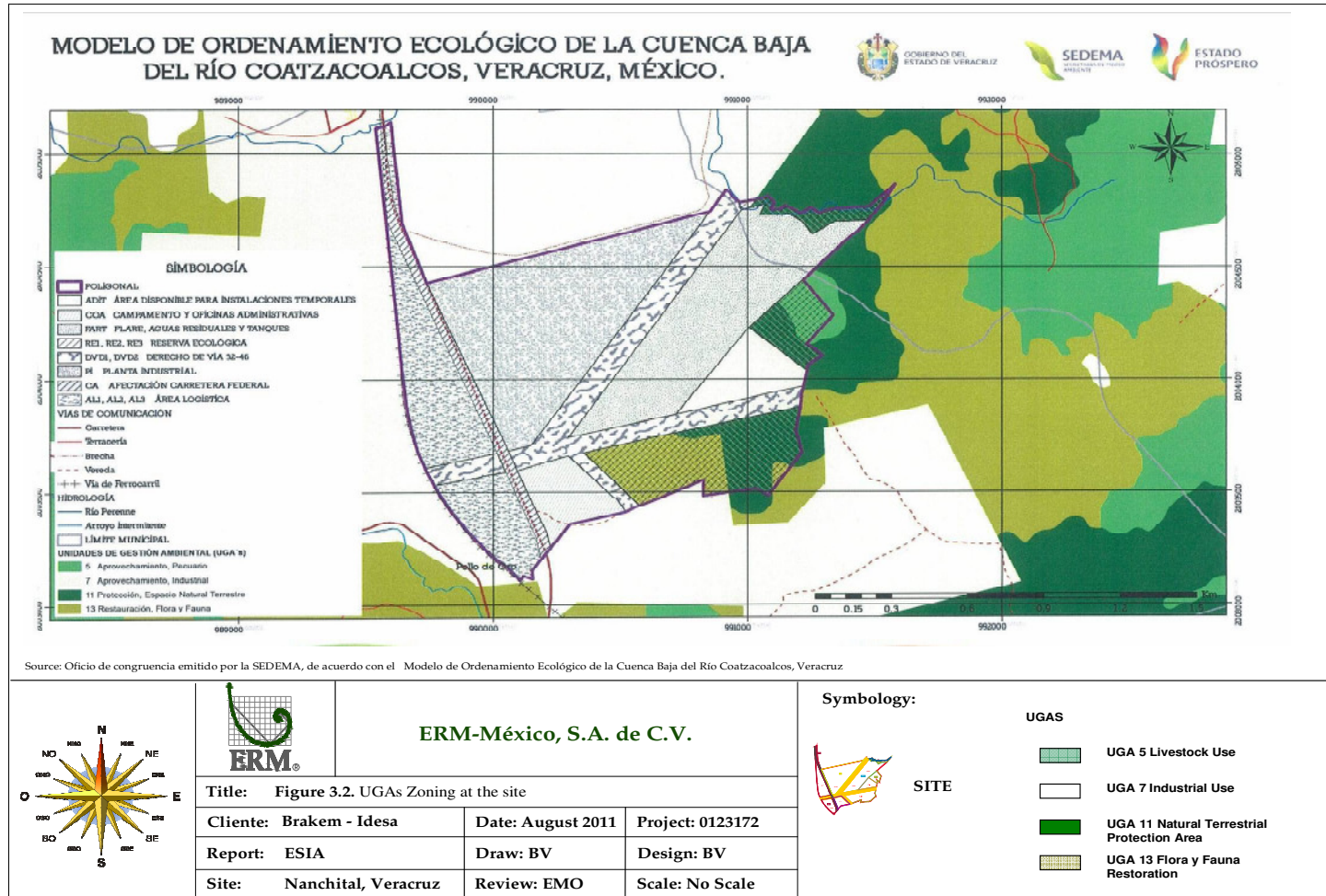


FIGURE 3.2 CURRENT LAND USE, URBAN DEVELOPMENT PROGRAM

3.1.6 *Area urbanization and description of required services*

The site has state roads and access by to federal highways:

1) Federal Highway 180 or Transísmica (that communicates with the Gulf of Mexico at the north, with the Pacific Ocean at the south, and with the Quintana Roo State at the east) and

2) Federal Highway 145 (that communicates to the Project site, at the west, with the Córdoba city and the center of the country).

The Figure 3.5 shows, in an aerial photograph, the location of the principal towns and industrial facilities surrounding the Project site.

Required Services

Below is a brief list of the required services for the different Project phases.

Water supply

Site preparation phase

The Federal Labor Agency (STPS, *Secretaría del Trabajo y Previsión Social*), establishes a water consumption per person of 3 liter (l)/day, therefore, it is estimated according to the workforce planning and considering a maximum peak of 274 people per month, a monthly consumption of 822 l/day. This estimation does not take into account the consumption by transportation staff, so that, although this demand will be covered by the transportation staff, a demand of 1000 l/day is considered as a surplus to ensure the drinking water consumption for an estimated period of 15 months. Water will be transported to the Project site, in 19-L plastic bottles, for personnel consume.

In addition, raw water will be used for various activities like, sanitary and cafeteria supply, the washing and lubrication station for vehicles, and the dampening of embankments and road irrigation. A usage of 100 000 cubic meters (m³) in a total period of 15 months is estimated to reduce the dust generated by the material movement activities derived of the excavation and deforestation.

Construction phase

A drinking water consumption of 29 400 l/day (9 800 people per 3l/day) is estimated according to the planning that considers a maximum peak of 9 800 people during the construction phase, for a period of four years.

Based in theoretical approaches, the following water consumption for the construction activities development of the construction phase, are also estimated, but must be readjusted once more precise data is available at the beginning of this phase.

• Potable water	Approx. 12 385 m ³
• Raw water for staff	Approx. 99 083 m ³
• Raw water for concrete	Approx. 22 500 m ³
• Raw water for washing and hydrostatics tests	Approx. 320 000 m ³

Operation phase

Based on technical specifications, it is estimated a maximum water consumption of 2 500 cubic meters (m³)/hour (hr), for the cracker operation and the polyethylene plants, which include the water consumption for operation, services, and sanitary use. For this, a connection feasibility was requested to the National Water Commission (CONAGUA) for the PB-3 pumping substation connection, connected to the Cangrejera dam (see Annex 6.7).

Electrical Energy

Site preparation phase

Two diesel-based 190.4 HP power generators, with a consumption of 6.5 gal/h with 75% or charge will be installed. This will be installed in areas isolated for noise and protection against lightning.

Regarding the fuel supply, three tanks for diesel storage of 15 m³ each will be installed, which will be filled by an automatic pump.

Construction phase

Depending on the National Electricity Commission (CFE, *Comisión Federal de Electricidad*) resolution, two options for the electrical energy supply are considered for this stage.

Additionally, only in the temporary offices area, the use of motor-generators as emergency equipment are being contemplated, which will connect to a double throw switch, to transfer the charge in a quick and safe manner in case of failure.

Operation phase

For the electrical energy supply during this Project phase, two options are being considered, which are being evaluated by the Electricity Federal Commission (CFE) as energy supply: the MINA II electrical substation and the Coatzacoalcos II electrical substation, both owned by CFE in a 400 kV (Kilovolts) system.

Regarding the electrical energy consumption, it is considered using a compressors of high polytrophic efficiency with a specific power consumption of approximately 622 kW / ton ethylene. Consumption per unit will be in the order of:

•  Cracking gas compressor	47 MW
---	-------

- Ethylene Refrigeration Compressor 7.8 MW
- Propylene refrigeration compressors 23 MW

The total consumption of the project is estimated in 16.7 GJ per ton of ethylene which is in the low range of the best environmental performance values published by the European Union (15-25 GJ / ton ethylene (Integrated Pollution Prevention and Control. Reference Document on Best Available Techniques in the Large Volume Organic Chemical Industry, February 2003))

Wastewater discharge

Site preparation phase

Portable toilets will be installed in the different working areas, with a distribution of a toilet each twenty workers, which will be operated and maintained by the company in charge of the site preparation activities.

Construction phase

Portable toilets that meet the Federal Labor Law (*Ley Federal del Trabajo*) and the Federal Labor Agency (STPS) health and safety standards will be installed in the different working areas, with a distribution of a latrine for each twenty workers.

Operation phase

The wastewater treatment system will be designed to catch, store, distribute, treat, reuse the treated water in the facility, and finally to discharge the non usable treated water. The main source of wastewater discharges will be the production process, given the chemical reactions that occur in the different equipments for its proper operation, either by cooling or as vapor.

Therefore, the main sources of wastewater generation in the complex will be as follows:

- Production process: cracker (ethylene) and high and low density polyethylene; this water comes from purges, de-methanization and caustic treatment process.
- Service area: cooling system effluents (cooling towers), heat exchangers condensates, rejected water from the water treatment systems, compressors purges.
- Sanitary water.
- Wastewater from the kitchen and cafeteria, administration building, etc.
- Contaminated water from the flare water trap (hydraulic seal)
- Potentially contaminated storm water from the production area, from the oil and grease elimination section, and from the regulation lagoons of the wastewater treatments.

Solid Urban Waste (SUW) Management

Site preparation phase

The SUW generated during the site preparation activities will be collected and sent to a final disposal site operated by the Nanchital municipality and authorized by the SEDEMA, through the Cleaning service of this municipality.

As a summary, the following volumes of special handling waste are estimated:

- 8 745.23 m³ from the vegetation removal.- This amount is almost entirely usable: it is estimated that a third party will be likely to participate for wooding exploitation, another third party will use it for fire wood, and the rest can be returned to the ground for the soil improvement.
- 680 000 m³ from the top-soil removal.- Will be sent to final disposal sites in the Project zone, as explained in the section 3.2.2.
- 4.5 million of m³ of excavation material.- Will be sent to final disposal sites in the Project zone, as explained in the section 3.2.2.

Construction phase

The SUW generated during the construction phase activities will be collected and sent to a final disposal site, through the Nanchital municipal cleaning service or through an authorized company. A site authorized by the SEDEMA, the authority that regulates the non –hazardous waste management, will be used for the final disposal of this waste.

The approximate volumes of construction waste generated by the Odebrecht constructor company will be:

- Insulating material waste (insulating material and aluminum plates, generating approximately 115 m³).
- Wood waste (pallets and other packages), generating approximately 157 m³.
- Other wastes, including scrap metal (steel and copper materials), packaging waste (plastics and protectors), pipe cleaning materials (sand of grit used in the *sand blast*, which will be analyzed to define its hazard characteristics with a CRETÍ (for its acronym in Spanish) analysis to confirm the waste does not present hazard characteristics, otherwise, to be treated as hazardous waste. A generation of approximately 12 410 m³ is estimated for this waste.

Operation phase

During the operation phase, the SUW generation will decrease considerably, as it will be a total of 184 workers, so a generation of non-hazardous waste of 138 kilogram (kg)/day is estimated.

A Non-hazardous Waste Management Program (presented in the Annex 8.2) will be developed and implemented for the proper management of the SUW generated during the operation phase. An authorized company by the SEDEMA will be hired for the SUW transportation and final disposal.

Hazardous Waste*Site preparation phase*

The expected hazardous waste corresponds to the intensive use of the machinery and transport units that use hydrocarbons for their operation (lubrication and maintenance). This involves the generation of spent oil, small quantities of contaminated soil due to accidental spills from the machinery, impregnated materials due the equipment and machinery cleaning operations, among others. In addition, hazardous waste will be generated due the oil and grease traps usage in the toilets, cafeteria, and washing stations, as well as a low quantity of biological-infectious waste due the temporary clinic that will be operating during this stage.

Construction phase

Hazardous waste generated during this stage will correspond mainly to the lubrication and maintenance of machinery and transport units that will use hydrocarbons for their operation, which involves the generation of:

- Spent oils.
- Small quantities of contaminated soil due accidental spills from machinery.
- Solvents and paints waste.
- Material used in pipes cleaning (*sand blast*), which will be analyzed with a CRET analysis to determine if it is a hazardous waste for its management and disposal.

The construction of the temporary hazardous waste storage area will comply with the requirements of the article 82 of the General Waste Law (LGPGIR) and IFC requirements.

Operation phase

The hazardous waste generated during the operation will be stored in proper containers in accordance to its hazardous characteristics, which will be labeled

with the generator name, waste type, CRET code (Corrosivity, Reactivity, Rxplosivity, Toxicity and Flammability) , and generation date.

3.2 *PARTICULAR PROJECT CHARACTERISTICS*

For the purpose of the current document and as mentioned at the beginning, the works and activities related with the site preparation, as well as the construction and operation activities of a petrochemical plant for the ethylene production, are described.

The activities to develop for the site preparation are:

- Execution of the flora and fauna rescue programs.
- Resources mobilization.
- Temporary infrastructure.
- Cleaning and deforestation.
- Excavation.
- Open cast rock excavation.
- Compacted gravel and rocks embankment.
- Compacted Soil embankment.
- Bank material exploitation
- Materials transportation.

3.2.1 *General Working Program*

Before starting the site preparation phase activities, two subprograms for fauna and flora rescue and recovery will be implemented. The implementation details for these subprograms are presented in the chapter 10 of the ESIA. The scheduled working programs for the preparation and construction phases are presented in the Tables 3.5 and 3.6 respectively.

TABLE 3.5 WORKING PROGRAM FOR THE SITE PREPARATION PHASE

No.	Activity	Weeks			Months														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
-	Rescue and fauna relocation program.																		
-	Transplant and relocation of vegetation program																		
1	Resources mobilization																		
2	Temporary facilities																		
3	Vegetation and top-soil removal																		
4	Strengthening of the sub grade																		
5	Excavation																		
6	Compacted gravel and rocks embankment																		
7	Compacted soil embankment																		
8	Bank material exploitation																		
9	Materials transportation																		
9.1	Vegetal material transport to the final disposal site.																		
9.2	Excavation material transportation to the final disposal site.																		
9.3	Internal transportation of backfill material.																		
9.4	Transportation of loan bank to the Project site.																		

A detailed working program for the vegetation and top-soil removal is included in the Annexes 1.4 and 1.5 respectively.

Field and desk studies

Previous surveys were conducted for this document and for Project engineering development, which are detailed described in the section 5.1 and listed below:

- Hydrological studies. This survey was developed in November 2010, with the objective of estimating the flooding risk associated with the maximum precipitation events in the area of study, considering the Arroyo Gopalapa input basin. From this data, a potential flooding risk map was generated for the site (see Annex 5.2.). Additionally, two surveys were conducted, the first one to identify the proper location for a water well construction and the other to design works to prevent the potential floods with protection and channeling elements for the storm water in the Project zone, for its posterior discharge to the Gopalapa and Nanchital streams.
- Flora and fauna baseline study. This survey was developed in November 2010, with consecutives visits in January, February, August, and September 2011, with the objective of knowing the current biodiversity status (species under any protection status by the national and international legislation, species of economic and cultural interests), through sampling campaigns and bibliographic consultation (see Annex 5.3). Additionally, in September 2011, a nine day specific survey was conducted in order to identify the *Ceratozamia miqueliana* H. Wendl. distribution in the Area of Influence (AoI) in the Nanchital and Coatzacoalcos municipalities (see Annex 5.10).

- Social baseline Study. Anonymous population, housing, and social perception questionnaires were conducted in the Coatzacoalcos, Nanchital de Lázaro Cárdenas del Río, and Ixhuatlán del Sureste municipalities in the Veracruz state from 11 to 14 January 2011. The main intention was to document the principal characteristics and living conditions of the communities of the Area of Influence of the Project. In this analysis, El Chapo, Ejido 5 de Mayo, Lázaro Cárdenas del Río, Mundo Nuevo, Nahualapa, Nanchital and Pollo de Oro communities were selected based on the closeness and vulnerability or interference with the Project (see Annex 5.4).
- Mapping and identification of the stakeholders. The purpose of this document is to show the different stakeholders that can have important roles, each at different levels, during all the Etileno XXI Project stages, which were mapped (see Annex 5.5.). This document was developed during March 2011.
- Geotechnical study. This study was conducted to learn in detail the stratigraphy of the site, by means of exploratory surveys and surveys based on indirect physical methods including seismic and electrical methods, to determine measurements to be considered during the design and construction of the Project (See Annex 5.7). This study was conducted in March 2011.
- Noise survey. An environmental noise survey was conducted in January 2011, with the objective of establishing the current noise level produced in the areas surrounding the site (see Annex 5.7).
- Phase I and II assessments. The Phase I was developed on the 4th and 5th of November 2010, with the objective of discarding the presence of hydrocarbon contamination at the site to be used for Project development.
- Air quality monitoring. A local air quality monitoring was conducted in the Project area. The monitoring was undertaken from 3 to 13 June 2011 in the Pollo de Oro community, the closest to the site, in its southwest section.
- Environmental Risk Assessment (ERA) and Accident Prevention Program (APP). A risk analysis was developed as part of the ESIA. The methodology used to identify potential risk events was the Major Hazard Analysis, which can be used in the basic engineering phase of the project. The method uses information from the process for identifying major hazards. On the other hand, the APP is an instrument requested by the SEMARNAT which disclosed the security measures in the event of accidents in which facilities are considered highly risky activities, more details of the risk study are included in Chapter 9.5.

The previous surveys results are presented in the site description and in the Area of Influence.

TABLE 3.6 WORKING PROGRAM FOR THE CONSTRUCTION PHASE

Activity	Trimester timing																			
	Year 1				Year 2				Year 3				Year 4				Year 5			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Staff transportation and hiring																				
Resources mobilization																				
Temporary facilities																				
Assembly and pre-cast of concrete structures																				
Racks for pipelines and metallic structures installation.																				
Prefabricated buildings construction																				
Roads (including pavements)																				
Electro-mechanic construction																				
Equipments installation																				
Metallic structures and pipelines preparation and assembly																				
Underground instrumentation ducts installation																				
Underground piping installation and hydrostatics tests																				
Services supply																				
Waste management and disposal																				
Temporary working areas rehabilitation																				

3.2.2 *Site preparation*

Phases:

- a) Implementation of programs for wildlife rescue
- b) Resources Mobilization
- c) Interim Facilities
- d) Cleaning and Deforestation
- e) Excavation
- f) Earthworks
- g) Exploitation of materials banks
- h) Materials transportation

Temporary *Project* works and facilities

Diverse temporary facilities are planned to be installed to carry out the required services of the Project preparation phase, with the objective of supporting the different works, with complementary services, such as material and waste storage, metallic structures and equipments assembly, electrical energy supply, cafeteria, sanitary services, among others. Following are listed the required temporary facilities for the Project.

a) Technical-administrative facilities.

- Offices
- Cafeteria
- Nursery
- Conference rooms
- Workshops
- Contractors area
- Parking lot

b) Industrial facilities.

- Warehouses
- Workshops
- Ohters

c) Industrial services:

- Reserve potable water for human consumption.
- Raw water reserve.
- Toilets.
- Mechanical workshop.
- Washing and lubrication station for vehicles and machinery.
- Diesel fueling station.
- Service networks (electric energy).
- Hazardous waste storage warehouse.

- Temporary non-hazardous waste storage warehouse.
- Dismantling of temporary facilities

3.2.3 *Construction phase*

The Project construction phase refers to the construction of the petrochemical complex. In the following text describes the activities that will be carried out for its development.

3.2.3.1 *Staff hiring*

At this stage will be the maximum staff hiring, with a peak of 9 800 workers, working a ten hour shift.

3.2.3.2 *Resources mobilization and usage*

Total estimated diesel consumption: 21 251 m³.

Total estimated oil consumption: 46 m³.

Total estimated consumption of primer paint: 22 m³.

Total estimated consumption paint finishing: 57 m³.

Total estimated solvent consumption: 15 m³.

Total estimated cement consumption: 64 031 t

Total estimated gravel consumption: 68 433 m³.

Total estimated sand consumption: 114 096 m³.

3.2.3.3 *Electro-mechanical construction (including masonry)*

The electro-mechanical construction works consists basically of the equipment piping interconnection (static and dynamics), the motors electrical energy supply, and the installation of all the instrumentation (starters, controllers, etc) that will connect the electrical signals with the equipments.

The masonry activities comprise the following services:

- Lighting installation.
- Fire system installation.
- Waterproofing application (where appropriate)
- Paint application

3.2.3.4 *Metallic structures and pipes preparation and assembly (including thermal isolation, fireproofing, and sand blasting)*

The preparation and assembly of the metallic structures and pipes will include the following activities:

- Sand blasting.
- Spools pre-assembly.

- Pipes assembly.
- Pipes isolation.
- Fireproofing of equipment and structures.

3.2.3.5 *Underground instrumentation ducts assembly*

Underground instrumentation ducts will be constructed for safety reasons in the off-site area, for the motors, equipments, and instrumentation control signals.

3.2.3.6 *Underground piping installation and hydrostatic tests*

The underground piping installation corresponds to the systems that provide the raw material to the processes (which are described in the Section 3.2.6).

Description of the ancillary project activities

3.2.3.7 *Services supply (water well, diesel, potable water, electrical energy and others)*

The required services for the construction phase are described in the Section 3.1.7. The temporary facilities that will supply the different services to the Project are detailed described in the Section 3.2.3.

3.2.3.8 *Waste management and disposal*

The description of the temporary waste (hazardous and non-hazardous) storage facilities are presented in the Section 3.2.3. The provisional facilities and its waste generation are described in the Section 3.2.8.

3.2.4 *Maintenance and operation phase*

The Etileno XXI Project will consist in ethane cracking that will produce 1 050 kilotons net of ethylene, which will feed three polyethylene plants.

The Figure 3.3 shows a block diagram and a general mass balance of the entirely complex.

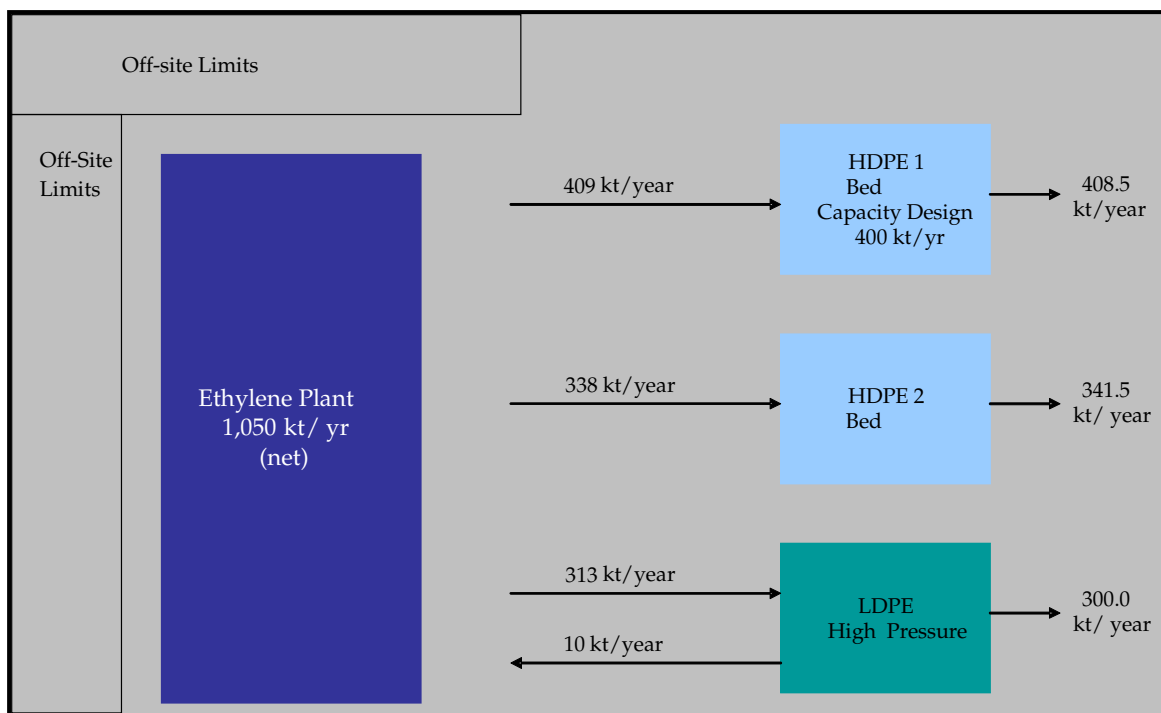


FIGURE 3.3 *DIAGRAM AND GENERAL MASS BALANCE OF THE ENTIRELY COMPLEX*

Also, is estimated a total of 184 workers, considering all levels, for the operation of the entirely petrochemical complex (see Table 3.13).

3.2.4.1 *High Density Polyethylene (HDPE)*

This plant will have an estimated annual capacity of 750 000 metric tons of high density polyethylene, that will be produced in two production units. The process has two reactors, in order to increase the productivity and prepare bi-modal products; this means, each reactor will produce HDPE with different characteristics. A simplified block diagram of the process is presented in the Figure 3.4.

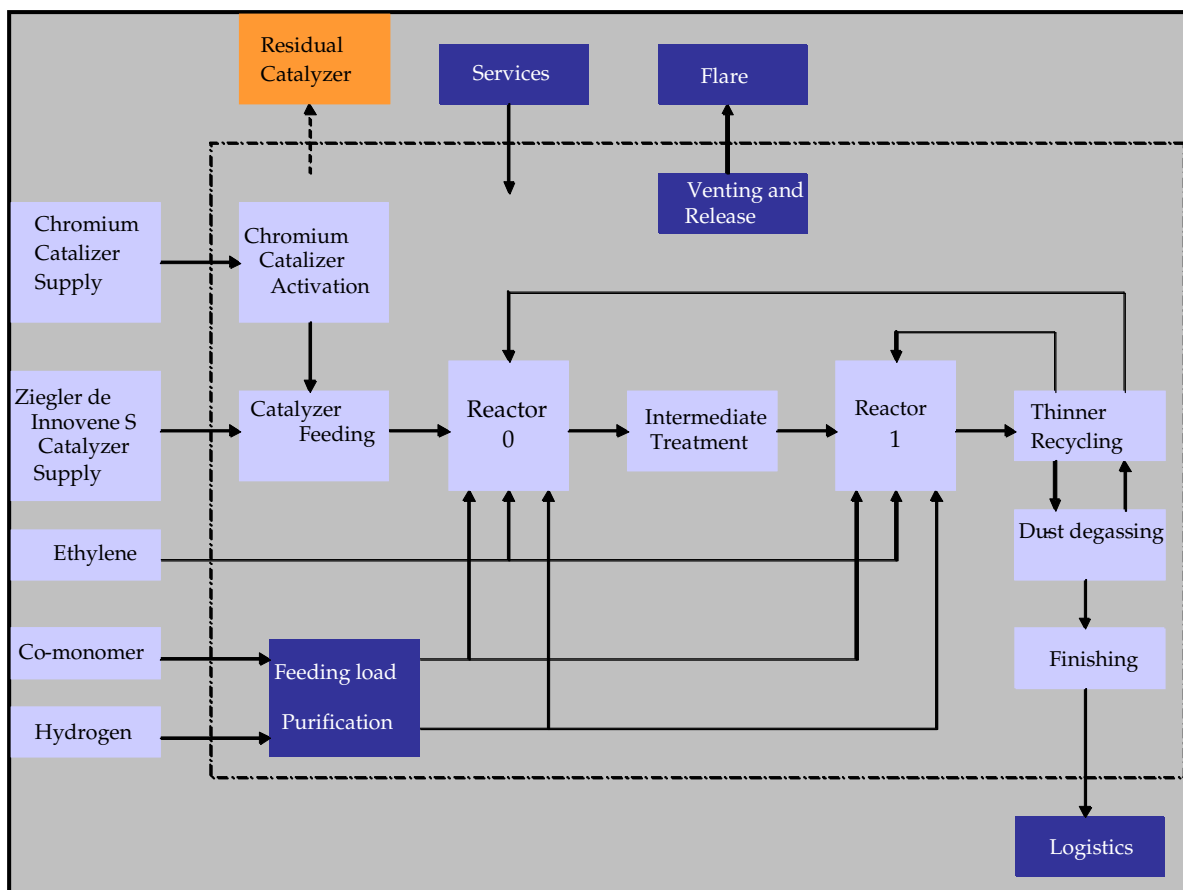


FIGURE 3.4 BLOCK DIAGRAM FOR THE HDPE PROCESS (SIMPLIFIED)

3.2.4.2 Low Density Polyethylene (LDPE)

The plant will have an estimated annual capacity of 300 000 tons of low density polyethylene. The Figure 3.5 shows a simplified block diagram of the process.

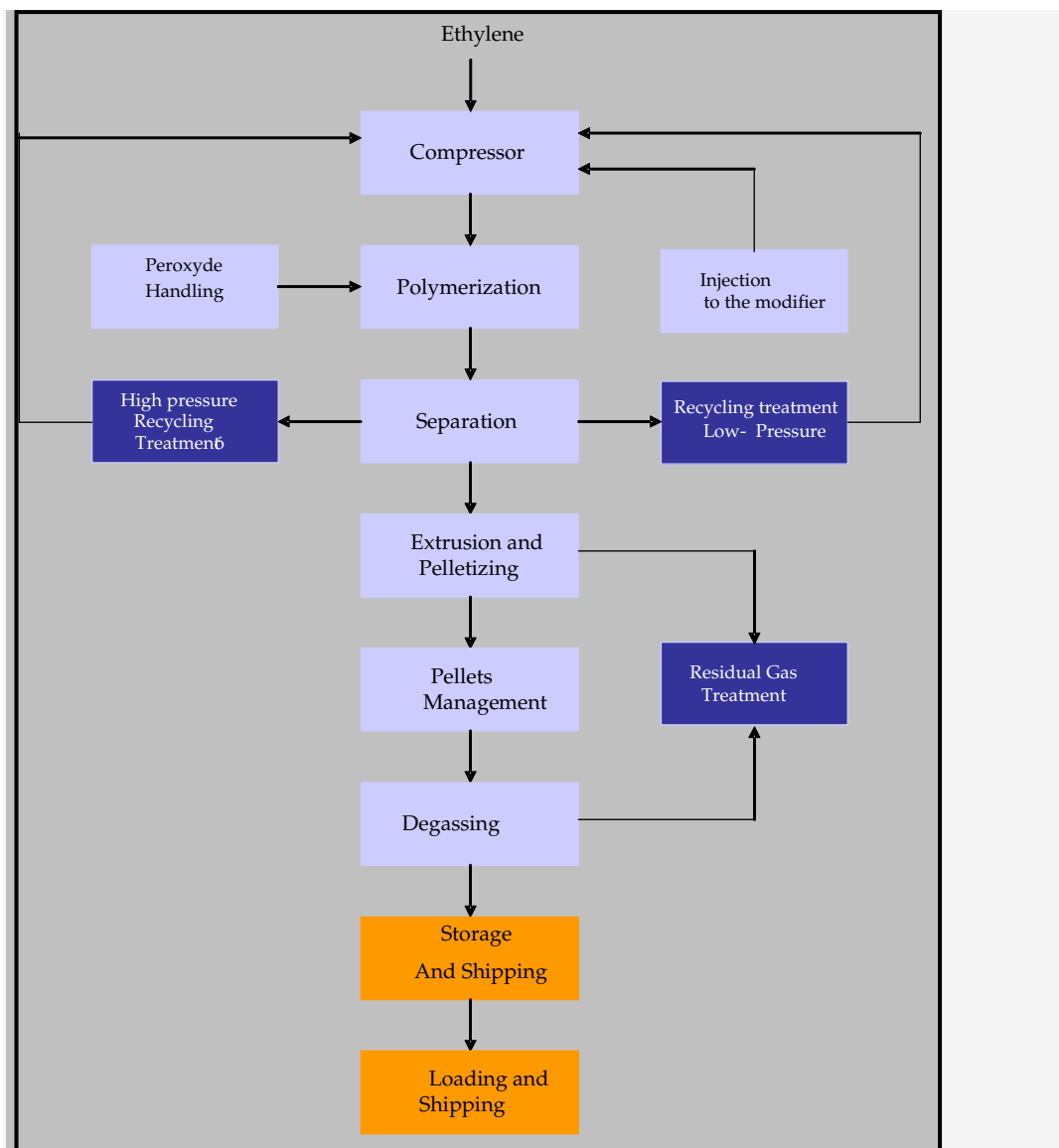


FIGURE 3.5 BLOCK DIAGRAM FOR THE LDPE PROCESS (SIMPLIFIED)

The chemical substances that will be used in the three processes are presented in the Table 3.7.

TABLE 3.7 CHEMICAL SUBSTANCES REQUIRED IN THE PRODUCTION

Process	Chemical Name	Consumption
Cracking	Ethane	
Cracking	Caustic soda 20%	1.2 ton/hr
Cracking	Sulfuric acid 98%	0.2 ton/hr
Cracking	Dimethyl bisulphide	20 kg/hr

Process	Chemical Name	Consumption
Cracking	Caustic antifouling agent	0.5 kg/hr
Cracking	Neutralizer and anticorrosive agent.	5 kg/hr
Cracking	Dispersant	1.5 kg/hr
HDPE	Ethylene	Plant 1: 409 kt/yr Plant 2: 338 kt/yr
HDPE	Isobutene	Plant 1: kt/yr Plant 2: kt/yr
HDPE	Butene-1	Plant 1: 500 ton/yr Plant 2: 338 kt/yr
HDPE	Hexene-1	Plant 1: 6 400 ton/yr Plant 2: 5 700 ton/yr
HDPE	Additives	Depends on the characteristics required by the HDPE
LDPE	Ethylene	303 kt/yr
LDPE	Modifiers	NA
LDPE	Organic peroxides	NA

The chemicals substances included in the Table 3.8 are listed in the First or Second High Risk Activities Agreements, published in the Mexican law on 29 March 1990 and 4 May 1992 respectively.

TABLE 3.8 LISTED SUBSTANCES AS HIGH RISK ACTIVITIES

Chemical substance	Report quantity and physical state
Ethylene	500 kg – gas
Hydrogen	500 kg – gas
1-Butene	500 kg – gas
1-Hexane	20 000 kg – liquid

TABLE 3.9 STORAGE

Tank number	Chemical substance	Characteristics	Code or construction standard	Maximum storage capacity (m ³)	Security devices
10-TK-1001	Ethylene	Refrigerated tank with 9% nickel steel roof dome	API 620	21,750	Pressure relief valves and vacuum. Double wall.

10-TK-1004A/B/C	Ethane	Horizontal cylindrical tank partially underground	ASME VIII	3,358 each one	Pressure relief valves. Tank covered with soil, fire totally protected
10-TK-1005	Propylene	Horizontal cylindrical tank partially underground	ASME VIII	1,470	Pressure relief valves. Tank covered with soil, fire totally protected
10-TK-1002	Pyrolysis Gasoline	Carbon steel tank dome roof	API 620	1,500	Pressure and vacuum relief valves. Concrete secondary containment 100% of tank
10-TK-1003	Pyrolysis Gasoline Mono-hydrogenated	Carbon steel tank dome roof	API 620	1,700	Pressure and vacuum relief valves. Concrete secondary containment 100% of tank

In addition to the tanks described in Table 3.19, there will be about 20 silos with capacity of 1050 m³ each, equivalent to approximately 600 tons for each silo.

In addition to the silos, there will be:

- A 20 000 m² warehouse for storage of 15,000 tons on pallets.
- Rail spur (capacity of 500 Hopper cars approximately =; 90 ton per Hopper Car)
- External patio to store product in case of saturation (more than 30.000 m² area).

3.2.5 *Description of ancillary works to the Project*

For the site preparation phase, the following ancillary works will be installed:

- Electricity generators.
- Hermetically sealed underground tanks.
- Sedimentary box.
- Ancillary works.

Works Braskem-Idesa responsible for:

- Ethylene, installation of underground ducts for ethylene, whose supplier will be PEMEX.
- Raw water from the Cangrejera dam, directed with underground piping, whose supplier will be installation of underground duct for natural gas, whose supplier will be PEMEX.

- Electrical energy, installation of an aerial electrical transmission line for electrical energy, whose supplier will be CFE.

Works PEMEX responsible for:

- Ethane conduction line.

Works Veracruz State Administration responsible for:

- Access road.

These ancillary works involve the installation of infrastructure out the site of the Project through the respectively connections, as well as the agreements management with the agencies to ensure the supply. These agreements are still in process.

It is important to mention, that the works and areas presented in this section are the available alternatives at the time of this Environmental and Social Impact Assessment (ESIA) due, to date, are still developing the preliminary support of such works and once obtained the details, the social and environmental impacts will be assessed, and establish the appropriate mitigation measures, and presented to the SEMARNAT and the CFE.



FIGURE 3.6 GENERAL VIEW OF THE OFF-SITE WORKS ASSOCIATED WITH THE PROJECT

Access roads

The Resistol–El Chapo highway runs through the area of the Project, which, according to the Veracruz State Government planes, will be relocated to the southern boundary of the site. The Veracruz State Government is completely in charged of the construction and operation of this road.

3.2.6 *Site abandonment phase*

Once completed the site preparation and construction phases, the following activities will be developed for the closure of some temporary works:

- The hydraulic, sanitary, and electrical installations, which will be dismantled. The reusable materials will be stored and the non-reusable materials will be disposed as industrial waste.
- The temporary facilities of the industrial services camp, such as the mechanical workshop, the materials warehouse, the washing and lubrication station, the diesel supplier station, and the hazardous waste temporary storage area, will remain during the construction phase. Some structures will remain even in the operation phase.

Regarding the abandonment of the site for the operation phase, the *Project* considers a 30-year useful life, which can be extended if an adequate maintenance program is maintained, involving the replacement of equipment. A specific program for these activities will be developed and will cover the decommissioning of hydraulic, sanitary, electrical, civil installations, among others. The materials may be utilized will be stored and unusable materials will be disposed as industrial waste.

Once dismantled the previously mentioned areas, the soil will be rehabilitated placing an organic material matter layer (from the top-soil removal) for its regeneration. Previous to the organic material placing, visual inspections will be realized to ensure that no residual contamination is present in the soil; in case of contamination evidence, an investigation will proceed for the contaminated area. These means will be important in the most viable zones for contamination as the fuel loading or generator areas.

3.2.7 *Generation, management, and disposal of liquid, solid, and air emission waste*

Solid Urban Waste (SUW) and waste requiring special treatment

Site preparation and construction phases

Currently the Coatzacoalcos and Nanchital municipalities have no landfills authorized by the SEDEMA, currently the SUW (domestic trash) generated in the municipalities are disposed in open air dump. The developer will hire the service from a specialized company, with authorizations from the SEMARNAT and from the Federal Transport and Communication Agency (SCT, *Secretaría de*

Comunicaciones y Transportes). This company must be obligated to dispose the SUW in some of the authorized sites (see Table 3.26), until the programmed landfills start operations. A report of the authorized companies for the waste management services is presented in the Annex 6.12.

Operation phase

According to the Federal Wastes Law (LGPGIR, *Ley General para la Prevención y Gestión Integral de los Residuos*) the site will have the classification of large generator of waste, with a total waste generation up to 10 tons per year. It is planned to have a temporary storage area for the type and volume of waste and later transport the waste to an authorized site for the final disposal.

a) Waste generated by the services

TABLE 3.10 NON-HAZARDOUS WASTE GENERATION IN THE OPERATION PHASE

Waste	Frequency	Source	Approximate average generation (tons per month)
Sanitary waste	Continue	Toilets	1
Cardboard	Intermittent	Offices, warehouse	2
Paper	Continue	Offices	1
Plastic packages	Intermittent	Offices, warehouse	10
Wood	Infrequent	Warehouse, Operation	5
Glass	Intermittent	Offices	0.1
PET	Continue	Offices	0.5
Electronic equipment	Infrequent	Offices	0.1
Food waste	Continue	Cafeteria, kitchen	3.5
Conveyor filters	Infrequent	Operation	0.1
Dust filter	Infrequent	Operation	0.2

This waste will be handled according to the Special Waste Management Plan, by hiring an authorized company.

It is estimated an annual waste generation of 282 ton/yr from the service area, offices, and plant operation activities.

b) Production Wastes

- *Residual Polymer*, main solid waste generated during the production, it is present as pellets or powder in the finished area. Mostly of these waste will be recovered and reprocessed in the production area, or will be sold as material for reuse.

It is expected that this waste generation in the extruders and conveyors systems will be 5kg each 1 000 kg of final product, therefore, a generation of 5 250 ton/yr is expected.

Hazardous Waste

Site preparation and construction phases

Hazardous waste generated at this stage is related to the equipment and machinery maintenance and lubrication activities, and the transportation units that use hydrocarbons, which involves the generation of the following waste:

- Spent oil.
- Small quantities of contaminated soil from accidental spills from the machinery.
- Paint.
- Contaminated empty containers.
- Contaminated sand and grit from the sand blast process. A CRETI analysis will be made for the sand to classify the sand as hazardous or non-hazardous waste.
- Biological-infectious waste from the medical service.

Operation phase

Hazardous waste will be generated in the following phases:

a) Production

Catalyst. Spent chromium catalyst will be generated during the High Density Polyethylene (HDPE) process. The generation will take place due to small spills during the transfer and storage activities or due to the filter cleaning. The estimated volume generated will be 400 kg/year (200 kg per plant), per each 8 000 operation hours.

- *Absorbent beds.* Absorbent packages beds will be generated that will be used in the raw material preparation unit. The waste will be generated each 3 years, approximately (the average life of columbra absorbent packages).
- *Waxes.* - Formed by hydrocarbon oligomers, will be managed as hazardous waste. A generation of 130 ton/yr is estimated.

All the hazardous waste will be handled by a contractor company authorized by the SEMARNAT and the SCT for its transport, management, and disposal in authorized sites, and to comply with the LGPGIR requirements, as indicated in the attached subprogram (see Annex 8.3).

b) Wastewater treatment

A wastewater treatment system will be installed as a part of the production process. This system will generate hazardous waste, listed below:

- *Salts.* - From the effluent demineralization process. A generation of 2.2 m³/hr is estimated.
- *Sludge.* - From the drying sludge system, that concentrates the biological sludge and the foams from the flocculators. A total generation of 0.2 m³/h of sludge is estimated.

c) Maintenance

Hazardous waste will be generated as a result of the routine maintenance and operation activities at the site (see Chapter 3 or the ESIA). This waste will be handled according to the Hazardous Waste and Materials Management Plan that will be developed by the developer. It is estimated an annual volume of 42 t/year of hazardous waste from the maintenance and operations activities at the plant.

Liquid waste

Site preparation phase

Sanitary wastewater discharges will be collected in septic tanks and will be periodically pumped by a hired company that will discharge the wastewater in the Coatzacoalcos municipality wastewater treatment utility (CMAS).

Construction phase

Portable toilets will be installed in the different working areas, toilets will be in compliance with the health and safety regulations of the STPS Federal Labor Law, with a distribution of one toilet each twenty workers.

Operation phase

The main effluents that will receive the wastewater treatment plant (WWTP) will be from the operation and the services areas. A summary of the effluents from the operative areas, indicating if the discharges are continuous or intermittent and the main contaminants is presented in the Table 3.10.

TABLE 3.11 OPERATIVE AREA EFFLUENTS

Source	Emission Type		Pollutants				
	Continue	Intermittent	HC	Organic Solvents	Salts	Particles	Suspended Solids
Process purges	X		X	X	X	X	X
Equipment drainage and maintenance		X	X	X	X	X	X
HC drainage	X		X			X	X
Tar generation		X	X	X		X	X
Caustic soda		X		X	X	X	X
Cooling tower purges	X			X	X	X	X
Clarifiers purges		X		X	X	X	X
Waste treatment system		X		X		X	X
Heater purge	X			X		X	X
Condensed waste and spills		X	X				X
Cooling tower water		X	X	X			X
Storm water		X	X	X	X	X	X
Washing of paved areas		X		X		X	X
Fire system water		X	X	X	X	X	X

a) Design baseline from the wastewater treatment system

The most strictly daily discharge limits of the Mexican standards and the International Finance Corporation (IFC) performance standards were considered for the treatment system design. The main wastewater sources are:

- Production process: cracker (ethylene) and high and low density polyethylene. This water comes from purges, de-methanization process, and caustic treatment.
- Service water: sanitary water, kitchen and cafeteria water, administration building, etc.
- Cooling towers water.
- Contaminated water from the flare water trap (hydraulic seal).
- Cooling system effluents: cooling towers.
- Heat exchangers condensates
- Storm water potentially contaminated from the production area and from

b) Wastewater treatment system characteristics

The wastewater treatment system will be composed of the following treatments:

- *Primary treatment*
- *Secondary treatment*
- *Tertiary treatment*
- *Demineralization*
- *Sludge treatment*

Discharge into body water. The treated wastewater that can not be reused in the previous mentioned processes will be finally discharged in the Gopalapa stream. An approximately volume of 100 and 150 m³/hr will be discharged. The characteristics of this effluent are described in the following section. The process wastewater and the WWTP effluent characterization is presented in the chapter 3 of the ESIA.

c) Storm water management

The Site will have separated internal drainage systems separated from process, sanitary, and storm water. The process and sanitary water, as well as the storm water collected in the process areas, will be conducted to a wastewater treatment system; however, the storm water collected in the rest of the areas will be collected and sent to a retention lagoon to be further discharged to the Gopalapa stream.

The retention lagoon will be large enough (15,000 m³) to contain the effluent generated in the firsts storm water events and will have a compartment with a pumping system to prevent overflows and direct the contaminated storm water to the secondary treatment, on to direct the clean to the water to be reused or to the sludge accumulating system. This design was done according to the hydraulic analysis of the project site, considering the maximum expenditure values obtained for a return period of 100 years, plus the application of a security percentage of intensities due to a possible change in the regime climate. The system will be able to support big storm events or to contain the fire system water during a periods of 6 hours.

Air emissions

Site preparation and construction phase

The air emissions correspond mainly to:

1. Combustion gases, produced by stationary and mobile sources, which will include the electricity generators (stationary sources), and the equipments and machinery (mobile sources); both sources operates with diesel.
2. Welding fumes, fugitive emissions in non significant quantities from the welding operations at the mechanical workshop and fuel tanks venting.
3. Dusts; suspended particles from the land movement with excavators, backhoes, and other equipments; as well as for the trucks traffic, as the

dust of the transited roads or the dust that will escape from the transported material (soil and backfill) by the dump trucks.

Operation phase

The equipments that generate air emissions are listed below:

- Flare,
- Pyrolysis ovens,
- Boilers,
- Combustion turbines, and
- Chimneys.

There will also be fugitive emissions from:

- Venting,
- Leaks,
- Valves,
- Connections,
- Flange,
- Storage tanks,
- Pumps,
- Compressors, and
- Release valves.

Emissions to the atmosphere to be more common in Etileno XXI project plants are volatile organic compounds (VOCs) from the drying, finishing and purging.

Emissions of particulate matter (ie, fine-polymer and / or additives such as release agents, etc.) are associated with the drying and packaging of polyethylene activities. Other sources of particulate matter include transportation, transfer and removal of dust from the pellets of polyethylene.

These emissions will have control devices to minimize the air emissions, which will be mentioned later.

a) Design characteristics

The project design will be made following the strictest standards to ensure compliance with air emission concentrations which provide Mexican law and the International Finance Corporation (IFC).

As part of the previous Project activities, a dispersion model was developed to establish the contaminant dispersion in the Project Area of Influence and to determine whether will be impacts in the air quality as a result of the air emissions. The air emissions used for the dispersion model were obtained in the Project basic design phase (for detailed data see Annex 5.11).

Once completed the detailed engineering design, will by modeling emission data set for final operations, to verify that the operation phase will meet the established requirements.

b) Controlled emissions

The estimated contaminants concentration that will be generated by each process or service unit is included in this section. Besides the emission sources that will operate in the process areas, the Project will have three boilers, a flare, and an ethylene tank flare. The boilers installed in the Project will be 150 cc and will operate with natural gas.

- Cracking

The main emission source or the Cracking area, will be the six pyrolysis ovens, in which five of them will be operating and one will be as a backup. The combustion gas heat excess will be recovery and reused in the convection sections from the pyrolysis oven.

- High Density Polyethylene (HDPE)

Three types of gas venting, which generates contaminant gases emissions, will be implemented in this process. The venting emissions come from the following HDPE plant processes:

- Catalysis emissions from venting.
- Hydrocarbons venting emissions.
- Flare emissions.

Direct air emissions

Extrusion units and extruder feeder: the air and nitrogen emissions can contain dust traces, the units will have specific filters that will retain a 99.9% of dust with a diameter no bigger than 5 (micrometers) μm , for the dust emissions below the standards established by the Mexican legislation and IFC criteria's. Also will be a continuous moist air emission from the pellets extractor ventilator.

- Pellets mixing unit: the air emissions from the hopper and silos venting contain pellets, as well as the venting from the dust elimination package of the pellets. The pellets dust emissions is less than 10 (milligram) mg of solid particles/ (Normal cubic meter) Nm^3 after passing through the control textile filters, less as the established by the NOM-043-SEMARNAT-1993 standard and the established levels by IFC.
- Filling tank from the sudden cold water of the reactor: continuous emission but small, which contains nitrogen and water from this tank.

Catalysis venting emissions: the operational venting that comes from the catalyzer contains fines catalysts (metals and particles) and is filtered on a catalysis transference filter to eliminate these particles before being recycled in the chromium recovering solvent.

Emissions from the hydrocarbon venting: vapor emissions (that come from the cracker) are directed to the piping network for inflammable and inert gas that goes through the flare or to the recovery system.

Flare head emissions:

- Overpressure protection: all the release devices discharges directly into the flare head, or directly into the degassing.
- Polymerization reactor emissions: the polymerization products (HDPE and LDPE) are discharged into a tank. The emissions from these tanks and from the degreasing system contain fine polyethylene dusts and are directed to the flare.
- Venting from the dust transportation: approximately 800 kg/hr of transported nitrogen contains more than 2% of hydrocarbons humid traces that are sent to the flare.
- Venting coming from the flash liquid purges which are sent to the flare container: one part of this liquid to the flash purges in the flare container is sent to the flare in gaseous state.

Low Density Polyethylene (LDPE)

The estimated emissions from the Project basic engineering phase that will be generated in the LDPE process are presented in the Chapter 3 of the ESIA:

c) Fugitive Emissions

The following gases will be generated in the Project as fugitive emissions:

- Hydrogen.
- Methane.
- Volatile Organic Compounds (VOCs), for example, ethane, ethylene, propane, polypropylene, butane, butylenes, pentane, pentene, C6-C9 alkylate, benzene, toluene, xylene, phenol, and aromatic C9.
- Polycyclic aromatic hydrocarbons.
- Inorganic gases, such as hydrogen sulfide, ammonia, carbon dioxide, carbon monoxide, etc.

These emissions will come, mainly, from venting, leaks, valves, connections, flanges, storage tanks, pumps, compressors, and release valves.

d) Flare system

A flare system will be installed to collect and dispose, on a safe manner, the remaining generated during the operation, which will include the ones generated

from the decompression activities, realized in normal and in emergency conditions. The system will collect the gaseous effluents generated in the following areas:

- Cracking area.
- High density polyethylene area.
- Low density polyethylene area.
- Storage area (localized out of the site limits).
- Fuel piping and power generation systems.

Noise

Site preparation phase y Construction phase

During the site preparation activities development, equipment and heavy machinery will be used operating between one and two shifts of 10 hours each.

Therefore, mitigation measures will be implemented for the noise reduction perceived by workers and the surrounding communities, which will be the most affected by this impact.

Operation phase

The noise generated during the operation will not exceed the Mexican Official Standard NOM-081-SEMARNAT-1994 and the established levels by IFC (see Table 3.44). In any case, the noise level generated by the Project will not increase in more than 3dB the current noise level present in the closest receptors to the site boundary.

The maximum exposure noise will not exceed the recommendations by time exposure for each machine. The maximum noise per machine, based on the developer company experience in other facilities, will be 85dB at 1m of distance, same that will be encapsulated as a mitigation measure. The machines that present this conditions are:

- Pellets dryer,
- Filters,
- Boilers,
- Extruders and pumps extruders, and
- Hydrocarbon, nitrogen, and air compressors.

In addition, the staff will use appropriate hearing protection equipment for each area.

3.3

CHANGES TO THE PROJECT DUE THE ESIA

The original Project design was modified based the recommendations from the risk assessment process realized for the Environmental Risk Assessment (ERA),

among other elements. This study lays out an arrangement which from January 2011 to date, in which, in general terms, the following was considered:

- The general elevated security flare was relocated to minimize the potential thermal radiation to which potential receptors might be exposed in the facility, and also for the protection of the equipment.
- Mounded bullets tanks were selected, instead of spheres, for the ethane and propylene storage. This represented a significantly higher investment, but brings the benefit of eliminating one of the highest risks: the boiling liquid expanding vapor explosion (BLEVE). While the spherical tanks for liquefied gas by pressure are more susceptible to this event when they are exposed to fire, the mounded bullets tanks are from the latest generation and are not subject to this eventuality, being more isolated from the fire, if necessary.

Additionally, an optimization of the overall complex lay out was performed, based on the results of the geotechnical study, in order to reduce excavation and fill material, which brings the benefit of being reduced to the area of use for the display facilities, and the relocation of conservation areas within the project area.

4. **PROJECT LINKS TO APPLICABLE ENVIRONMENTAL LEGAL SYSTEMS AND TO APPLICABLE LAND USE REGULATIONS**

The objective of this chapter is to describe the Project links to the applicable environmental legal regulations, as well as to related agreements and land use regulations. This chapter has been divided into four sections:

- Legal and regulatory instruments directly applicable to the Project.
- Existing planning and legal system of the Project subject region.
- International Finance Corporation (IFC) performance standards and environmental, health and safety guidelines.
- International agreements applicable for Mexico and directly related to the Project.

4.1 **LEGAL AND REGULATORY INSTRUMENTS**

Links between the Project and applicable environmental legal and regulatory instruments are analyzed in this section, including federal, state and municipal regulations.

4.1.1 **Legislation**

4.1.1.1 **Environmental Federal Legislation**

General Environmental Law (LGEEPA) and its regulations related to environmental impact and prevention and control of air pollution.

General Sustainable Forestry Development Law (LGDFS) and its regulation.

General Wildlife Law (LGVS) and its regulation.

Law of National Waters (LAN) and its regulation.

Federal Wastes Law (LGPGIR) and its regulation.

4.1.1.2 State Legislation

- *Law No. 62 Veracruz State Environmental Protection*
- *Law No. 847 Veracruz state Prevention and Integrated Management of Urban Solid and Special waste*
- *Law No. 59 Noise in Veracruz*
- *Law No. 21 Veracruz State Water*
- *Law No. 878 State Climate Change Mitigation and Adaptation*
- *Law No. 876 Animals Protection*
- *Law No. 555 Sustainable Forestry Development of the Veracruz state*
- *Law No. 26 Urban, Regional and Housing Development in Veracruz*

4.1.1.3 No environmental Legislation

- Federal Labor Law – Chapter 4 presents a table showing the relationship between this Law and the Performance Standard No. 2 of the IFC
- Legislation on Human Rights
 - Law of the National Commission on Human Rights (published on June 29, 1992, and last reformed on June 30, 2006)
- Laws relating to land use, land acquisition, compensation of affected lands.
- Legislation on land tenure and land acquisition
- Legislation on Compensation for affected, compared with the Performance Standard No. 5 Land Acquisition and Resettlement

4.1.2 Regulations

The Mexican Official Standards (NOM, *Normas Oficiales Mexicanas*) applicable to the Project are discussed in this section. It is also discussed proposed means to achieve compliance with applicable regulations including the following subjects: water, air, noise, hazardous and non hazardous waste, among other.

Specific performance standards, their interaction with applicable Mexican Official Standards, as well as IFC sector guides for the above mentioned subjects are showed in the following table considering the fact that the Project will require international founding from international financial institutions. It is important to note that Braskem-Idesa is engaged in be compliance with the must restrictive guidelines.

Table 4.1 ***NOM and IFC Guidelines***

Mexican Official Standard / IFC Guideline
<i>Wastewater</i>
• NOM-001-SEMARNAT-1996, establishing the maximum permissible limits of pollutants in wastewater discharges into national waters. • Corresponding IFC Sector Guides.
<i>BIOSOLIDS</i>
• NOM-004-SEMARNAT-2002, establishing sludge and bio-solid environmental procedure and specification and limits of pollutants for treatment and final disposal.

Mexican Official Standard / IFC Guideline

AIR

- *NOM-041-SEMARNAT-2006*, establishing the maximum permissible limits of emission of contaminant gases originating in the exhaust of automobiles in circulation that use gasoline as a combustible.
- *NOM-044-SEMARNAT-2003*, establishing the maximum permissible limits of emissions of total hydrocarbons, non methane hydrocarbons, carbon monoxide, nitrogen oxides, particulates and opacity of smoke originating from the exhaust of new motors that use diesel as a combustible and that will be utilized for the propulsion of new automotive vehicles, as well as for new units with gross vehicular weight greater than 3,857 kilograms equipped with this type of motors.
- *NOM-045-SEMARNAT-2006*, Environmental Protection. Vehicles in circulation that use diesel as a combustible. Maximum permissible limits of opacity, testing procedure, and technical characteristics of the measuring equipment.
- CFI Guideline related to environment, health and safety for polymers petroleum-base manufacture.
- *NOM-043-SEMARNAT-1993*, establishing the maximum permissible levels of emission to the atmosphere of solid particulates originating from fixed sources.
- *NOM-085-SEMARNAT-1994*, Atmospheric Contamination – fixed sources. For fixed sources that utilize solid, liquid, or gas combustible fossil fuels or any of their combinations, that establishes the maximum permissible levels of emission to the atmosphere of smoke, total suspended particulates, sulfur dioxides and nitrogen oxides and the requirements and conditions for the operation of the indirect heating equipment for combustion, as well as the maximum permissible levels of sulfur dioxide in the direct heating equipment for combustion.
- Related IFC Sector Guides.

NOISE

- *NOM-080-SEMARNAT-1994*, establishing the maximum permissible limits of noise originating from the exhaust of automotive vehicles, motorcycles, and motorized tricycles in circulation and the method of measurement.
- *NOM-081-SEMARNAT-1994*, establishing the maximum permissible limits of emission of noise from stationary sources and the method of measurement.
- Related IFC Sector Guides.

HAZARDOUS WASTES

- *NOM-052-SEMARNAT-2005*, establishing the characteristics, the procedure of identification, classification, and the lists of hazardous wastes.
- *NOM-053-SEMARNAT-1993*, establishing the procedure for carrying out the extraction test for determining the chemical compounds that make a waste hazardous by its toxicity to the environment.
- *NOM-054-SEMARNAT-1993*, establishing the procedure for determining the incompatibility between two or more wastes considered hazardous by the Official Mexican Standard NOM-052-SEMARNAT-1993.
- CFI Guideline related to environment, health and safety for polymers petroleum-base manufacture.

BIOLOGICAL INFECTIOUS WASTE

- *NOM-087-SEMARNAT-SSAI-2002*, Environmental Protection – Environmental Health – Biological – infectious hazardous wastes – Classification.

FOREST HARVESTING

- *NOM-060-SEMARNAT-1994*, establishing the specifications for mitigating the adverse effects caused to the soil and bodies of water from forest utilization.
 - *NOM-061-SEMARNAT-1994*, establishing the specifications for the mitigation of adverse effects to the forest flora and fauna from forest utilization.
-

4.2**PLANNING INSTRUMENTS**

Ecological planning regulation program of the low basin of the Coatzacoalcos River.

In the Ecological Planning Regulation (EPR), it establishes administrative areas with common characteristics in accordance with natural or ecological resources, Environmental Management Units (UGAs, *Unidades de Gestión Ambiental*) which the

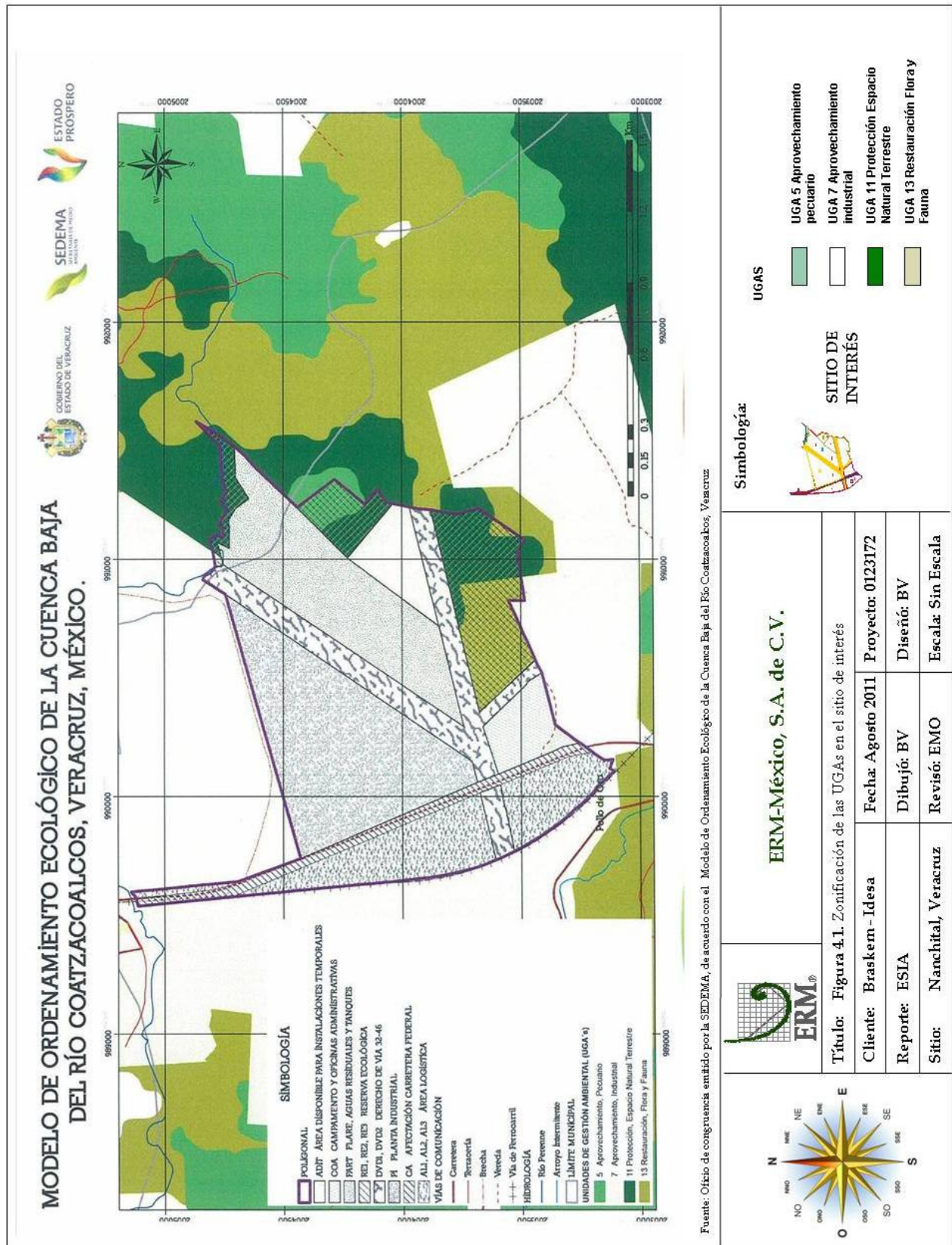
following aspects are considered: trend of environmental and economic behavior, degree of integration or political and administrative autonomy, as well as the level of development in the communication, urban and industrial infrastructures.

According to the document number 1381/A/2011 issued by the State Environmental Agency (SEDEMA) dated in Jun 11, 2011, in which this agency issued a Technical Congruence opinion with the Etileno XXI Project relative to the Ecological Planning Regulation of the down basin of the Coatzacoalcos River. The interested Site in which is expected to develop the Project possess classified sections as UGA5 (for livestock use), UGA 7 (for industrial use) and UGA 11 and 13 (for the environmental restoration and conservation, not compatible with industrial uses); however, all the works to be developed is located in the UGA 7 (see Annex 6.3)

The location of the project related to the zoning of the Ecological Planning Regulation of the low basin of the Coatzacoalcos River, are presented in the figure 4.1.

Territorial policies considered in the EPR are: use, protection, conservation and restoration as describe below:

<i>Use:</i>	applies to the areas where is allowed to use and manage renewable and non renewable resources, in a manner that it results efficient, socially useful and it does not have a negative impact and significantly to the ecological process of the region.
<i>Conservation:</i>	applies to those areas or natural elements that comply with the important ecological function. There are areas where some activities can be perform, limited to their use that allow the preservation of the natural conditions and encourage the recovery of the environmental balance.
<i>Protection:</i>	applies to those areas where, for their ecological characteristics of their ecosystems, it searches the preservation of the natural environments in order to ensure balance and the continuity of the ecological process.
<i>Restoration:</i>	applies to areas that have been subject to environmental degradation process and that, due to its original characteristics, must be restored with the objective to recover the important habitats o vital ecological process.



According to the information raised by the authorities in the document issued by the SEDEMA mentioned above, the industrial installations that Braskem-Idesa for the Ethylene Project XXI pretends to located within the totality of the UGA 7, which it potential land use, according to the zoning included in the Ecological Planning Regulation, is industrial; therefore, the Project raised by Braskem-Idesa in the Site of Interest is totally consistent with the Ecological planning regulation planning of the down basin of the Coatzacoalcos River.

In the defined areas within the Site of Interest such as Ecological Reserve Area, those together consist in a total of 30 hectares, within the property of Braskem-Idesa, there will not carry out any activity related with the Interested Project. Braskem-Idesa will leave this area as a permanent natural conservation area.

Urban Development Program (Programa de Desarrollo Urbano) of the urban zone of Coatzacoalcos–Nanchital de Lázaro Cárdenas del Río–Ixhuatlán del Sureste

According to the Urban Development Program (*Programa de Desarrollo Urbano*) of the urban zone of Coatzacoalcos–Nanchital de Lázaro Cárdenas del Río–Ixhuatlán del Sureste, the site of interest is located in two reserves, one of industrial type and the other of Productive Ecological Reserve. According to the figure 4.2 of the chapter 4, the 60% of the land use of the Interested Site, is mainly for industrial uses, while the 40% is productive ecological type.

In this subject, it is important to mention that the Veracruz Institute of Urban Development, Regional and Housing of the Government of the State of Veracruz, (INVIVIENDA, *Instituto Veracruzano de Desarrollo Urbano, Regional y Vivienda del Gobierno del Estado de Veracruz*) granted to Braskem-Idesa the Technical Opinion of Use date on 4 March 2011 (see Annex 6.5).

Therefore, the Project does not contravene the Technical Opinion of Use issued by the authority.

Protected Natural Areas (ANP, Áreas Naturales Protegidas)

The Project area is not within or adjacent to any natural protected area by the state or the federation, as can be shown in Figure 4.3 in chapter 4. Natural protected areas, state or federal, and their distances with respect to the Area of Influence and the Project area, which are specified in the Table 4.2 of this chapter.

Table 4.2 ***Protected Natural Areas***

Natural Area	Category	Distance of the Site of interest
Los Tuxtlas	Federal	41 km to the Northwest
Selva el Ocote	Federal	123 km to the South
Pantanos de Centla	Federal	167 km to the East
Predios El Bastonal, Los Chaneques y Agua Caliente	State	65 km to the Northwest
Parque Ecológico de La Chontalpa	State	83 km to the East
La Pera	State	165 km to the South

Ramsar Sites

The State of Veracruz has nine Ramsar sites; however, the Project is not located within or adjacent to any of them. The nearest Ramsar site to the Site of Interest is Laguna Sontecomapan, which is located 85 km to the Northwest of the Site.

Other important ecological zones

There are other areas that are considered important ecological reserves in the area where the Project is located; such as:

- Lake System of Pajaritos y Cangrejera, considerate as a restrictive ecological reserve, with mangrove in a flooded area of brackish water, which is located 6 km to the Northwest of the Site of Interest.
- Jaguaroundi Ecological Park, of 960 hectares, with high jungle and lagoon ecosystem, located 5 km to the northwest of Coatzacoalcos.

These sites are under area and custody of PEMEX. The Project will not have direct influence over them.

Priority areas proposed by the CONABIO

According to the information generated by the National Commission for Biodiversity (CONABIO, *Comisión Nacional para la Biodiversidad*), the Area of Influence is not located within or adjacent to any priority land region or hydrological region.

4.3 *PERFORMANCE STANDARDS ON SOCIAL AND ENVIRONMENTAL SUSTAINABILITY OF THE IFC AND THE GUIDELINES ON ENVIRONMENT, HEALTH AND SAFETY OF THE IFC*

The Etileño XXI Project is classified as Category A: project with potential social and environmental adverse significant impacts, which are diverse, irreversible or unprecedented, according to the Ecuador Principles, and with the performance standards and guidelines on environmental, health and safety of the IFC.

In the following Table 4.3, there is a brief description of the environmental performance standards on social and environmental sustainability, and how Braskem-Idesa will comply with each of them in the Etileño XXI Project. Also including in the Table 4.4 is including the guidelines on environmental, health and safety of the IFC, which Braskem-Idesa will comply.

Table 4.3 *Performance Standards on environmental and sustainability issued by the IFC and their connection with the Etileño XXI Project*

Performance Standard (PS)	Compliance of the Standard by the Etileño XXI Project
PS 1: Social and Environmental Assessment and Management Systems Objectives: - To identify and assess social and environment impacts, both adverse and beneficial, in the project's area of influence - To avoid, or where avoidance is not possible, minimize, mitigate, or compensate for adverse impacts on workers, affected communities, and the environment - To ensure that affected communities are appropriately engaged on issues that could potentially affect them - To promote improved social and environment performance of companies through the effective use of management systems Social and Environmental Management System: - Environmental and Social Assessment: It will take into account potential social and environmental risks and impacts of the project. The assessment process will be conducted based on current information, and will include an accurate project description as well as pertinent social and environmental essential data. To assess overseas (not applicable) and cumulative impacts. - Management Programs: mitigation/improvement. It will propose policies and operational practices to achieve quantifying results, success criteria, periods, resources and responsibilities. In order to achieve these requirements an action plan will be developed. - Organization capability: a structure with specific duties, responsibilities and an authority. - Training: to employees and subcontractors directly responsible, including both Mexican and IFC statutory requirements. - Community participation. - Disclosure to communities. - Consultation in case of affectation. - Complaints mechanism.	In order to comply with this Performance Standard the developer has developed the current ESIA, and also a Program of Integral Environmental Management (PIEM) will be implemented to supervise the execution of all sub-programs which meet all environmental impacts of the Project in all its phases (see Annex 8.1). The following sub-programs are derived from the PIEM and will serve to achieve the above mentioned: - Sub-program for waste management (includes hazardous, non-hazardous and special wastes). - Sub-program for conservation and protection of biodiversity. - Sub-program for noise monitoring and control. - Sub-program for environmental education. - Sub-program for preventive and corrective maintenance. - Sub-program for vehicular and pedestrian traffic control. - Sub-program for air quality monitoring and control. - Sub-program for water quality monitoring and control. - Sub-program for contingency and emergency response. There is also a Program of Integral Social Management (PISM), which is in turn to establish and reinforce the organizational structure to identify, negotiate and minimize risks and potential social impacts associated with the Project (see Annex 8.17). To comply with the above mentioned, the following sub-programs are derived from this Program: - Sub-program for Community Participation and Communication

Performance Standard (PS)	Compliance of the Standard by the Etleno XXI Project
• Supervision of management programs. • Internal and external reports regarding action plans.	(CPC). • Sub-program for Grievances and Complaints Mechanism (GCM) • Sub-program for Community Health and Safety, and Investment (CHSI). • Sub-program for Working Conditions (WC). • Sub-program for Continual Training (CT). • Participative Monitoring Program • Human Rights Policy Finally, Braskem-Idesa is developing a Comprehensive Management System (Annex 8.24) which will include all these programs and subprograms. It is expected to complete this Comprehensive System between the second and third quarter of 2012.
PS 2: Labor and Conditions Objectives: • To establish, maintain and improve the worker-management relationship • To promote the fair treatment, non-discrimination and equal opportunity of workers, and compliance with national labor and employment laws • To protect the workforce by addressing child labor and forced labor • To promote safe and healthy working conditions, and to protect and promote the health of workers The developer must attend the following issues: • Work conditions and management of labor relations. Will promote a policy of human resource management, working relations, work and employ conditions, labor organizations, no discrimination, minimization of impacts through reduction of the working force size, and mechanisms of attending complaints. • Protection of the working force: ◦ Child labor force. ◦ Forced work. • Occupational Health and safety. • Non-employed workers. • Supplies chain.	To comply with this Performance Standard the developer has developed and will implement a series of subprograms, such as: • Working conditions. (PS2) • Vehicular traffic control. • Noise monitoring and control. • Contingency and emergency response. • Cultural Protection Plan with the Protocol for fortuitous findings.(PS8) • Code of behavior. (PS1) • Training program. • Influx management plan. (PS4) • Employment policies. • Contract of employment models. • Non-discrimination policies in work environment. • Human resources policies. • Occupational Health and Safety Program. • Labor rescission management. • Patrimonial Safety Policy. Sub-program for Working Conditions (WC), which will attend those matters related with compliance of national legal statutes regarding contracts and general labor conditions within the project. Additionally, will watch compliance of international best practices (according IFC and/or the Labor International Organizational) regarding human resources, working relations, work and employment conditions, labor organizations, no-discrimination and equal opportunities, child labor force, forced work, occupational health and safety, in the project execution and through the supplies chain. Sub-program for Vehicular and Pedestrian Traffic Control, which considers the use of heavy machinery for the works that, will be developed through the diverse phase of the Project. This subprogram was developed in order to maintain the personnel safety and the communities, as well as for the environmental protection.

Performance Standard (PS)	Compliance of the Standard by the Etleno XXI Project
	Subprogram for Noise Monitoring and Control, to guarantee that noise levels generated through the different phases of the Project be kept within the maximum permissible levels according to Mexican standards and IFC guidelines on this matter. Subprogram for Contingency and Emergency Response, its purpose is to provide the tools for an adequate response in case of contingency within the site of interest, such a fire, earthquake, natural climatic event, spillage of fuel or chemical substances, among others. A Training Program was also developed, and will be implemented in order to make people more aware of the contents established in the Program of Integral Environmental Management and the Program of Integral Social Management, and encourage its comply. All these subprograms and policies are summarized in chapter 10, and are included as Annex 8. Some of the policies and procedures are taken from the company that will be in charge of the site preparation and construction (Odebrecht) and they are of internal character, in the meantime when the Braskem-Idesa complete its own policies, that must be part of the Comprehensive Management System to be completed between the second and third quarter of 2012.
PS 3: Pollution Prevention and Abatement Objectives: • To avoid or minimize adverse impacts on human health and the environment by avoiding or minimizing pollution from project activities • To promote the reduction of emissions that contribute to climate change. These objectives will be achieved through the following requirements by the developer. • General requirements: to reduce or minimize impacts to the health and the environment, by fitting to the best practices of industry. ○ Prevention of contamination, conservation of resources and energetic efficiency, control of the intensity/load of contaminants including those circumstantial, usual or fortuitous. ○ Decreasing generation of wastes including those of reuse, recuperation, treatment, destruction and disposal. ○ Minimization the use of hazardous materials and to avoid emissions. ○ Training and response for emergency situations. ○ Control and prevention of pollution through technical orientation. • Environmental considerations: to establish strategies for contaminants reduction and improvement of the environmental conditions within the Project. It should look for alternative options for project location and emissions offsets. • Greenhouse gas emissions: annual quantification and monitoring; analysis for compensation and reduction, through the carbon financing, changes on the project design, renewable sources, etc. • Pesticide use and management: must be in safe containers in order to avoid damage to other species and to comply with the FAO standards. Pesticides must be free of hazardous	In order to comply with this Performance Standard the developer has developed and will implement subprograms, such as the following: • Management of non-hazardous wastes. • Management of hazardous wastes. • Maintenance of machinery and equipment. • Control of vehicular traffic. • Noise monitoring and control. • Soil conservation and control of erosion. • Management and disposal of water. • Air quality monitoring and control. • Contingency and emergency response. All these subprograms and policies are detailed in Annex 8.

Performance Standard (PS)	Compliance of the Standard by the Etleno XXI Project
products.	
PS 4: Community Health, Safety and Security: Objectives: - To avoid or minimize risks to and impacts on the health and safety of the local community during the project life cycle from both routine and non-routine circumstances - To ensure that the safeguarding of personnel and property is carried out in a legitimate manner that avoids or minimizes risks to the community's safety and security Sections to achieve these goals: - Community health and safety requirements. - General requirements: Risks and impacts assessment through each phase of the project. Prevention standard will be preferred over reduction or minimization. For the case of risks and impacts to the community health an action plan will be disclosed. - Safety of infrastructure and equipments. Structures will be constructed according to best practices and by qualified professionals in order to avoid risks to the communities. - Safety of hazardous materials. To avoid the communities exposition to hazardous materials, including pesticides and wastes. - Environmental problems and natural resources. To reduce natural risks such as landslides, flooding and those derived from the project activities on soil, water and other natural resources. - Community exposure to illnesses. Exposure will be avoided by water and vectors. Conditions will be improved in case of endemic illnesses. - Preparation and response to emergency situations. Assessment of risks derived from project activities, promoting collaboration with local organizations as well as disclosing the action plan among the communities. - Requirements of the security personnel. The principles of proportionality will be applied according to best practices, and also the required equipment as well as appropriate training will be provided. Relative risks will be assessed and the applicable legislation will be observed.	In order to comply with this Performance Standard the developer has developed and will implement the following subprograms, additionally to those mentioned in the third Performance Standard: - Program of Integral Social Management. - Sub-program for Community Participation and Communication. - Sub-program for Grievances and Complaints Mechanism. - Sub-program of community health and safety. - Sub-program or relationship with interest groups. - Sub-program of working conditions. - Protocol for fortuitous findings. - Code of behavior. - Training program. - Influx management plan. - Contracting policies. - Contract formats. - Policies of no-discrimination in work. - Policy of human resources. - Program for occupational health and safety. - Management of labor rescission. - Policy of assets security. - Program for diseases prevention. - Human Rights Policy All these subprograms and policies are summarized in chapter 10 and are included as part of the Annex 8.
PS 5: Land Acquisition and Involuntary Resettlement Objectives: - To avoid or at least minimize involuntary resettlement wherever feasible by exploring alternative project designs - To mitigate adverse social and economic impacts from land acquisition or restrictions on affected persons' use of land by: (i) providing compensation for loss of assets at replacement cost; and (ii) ensuring that resettlement activities are implemented with appropriate disclosure of information, consultation, and the informed participation of those affected - To improve or at least restore the livelihoods and standards of living of displaced persons	In order to comply with this Standard of Performance, the acquisition of lots or properties was completed through a trade between the developer and each of the landlords of the lots (see chapter 2.2). Two vacant houses (according to the owner) were identified within the property. This acquisition was completed at a market price and according to the prices offered by the owners. Regarding the ancillary works, specifically for the ethane pipeline, PEMEX reported during the meetings with Braskem-Idesa that SEMARNAT request that all junctions of special works be completed using underground tunnels; also reported that already completed a risk assessment that includes

Performance Standard (PS)	Compliance of the Standard by the Etileno XXI Project
- To improve living conditions among displaced persons through provision of adequate housing with security of tenure at resettlement sites All previous sentences are applicable if: - Land acquisition is by means of expropriation or another mandatory way. - Failure of private negotiations with landlords provoked an expropriation. - It was not a voluntary transaction. - Impacts to the community are significantly adverse. To comply with previous sentences the following must be completed: - General requirements: - Project design: will avoid movement of persons. - Compensation and benefit to the moved persons. - To consult and to inform to the communities to be moved, as well as to those receiving communities. - Mechanism for attention to complains. - Planning and execution of the resettlement. - Movement. For persons with any right over the land. - Physical movement. - Economic reimbursement: compensations, assistance and supports. - Responsibilities of the private sector in the resettlement managed by the government: the client will work with the responsible organization by developing plans, programs and supervision works.	environmental and social factors, applying established methodologies as Montecarlo and Crystal ball. In order to manage potential social risks, in lots that cross the pipeline way, PEMEX has agents who will be attending all sections of the pipeline way as well as supervising/following to the compensations different to the land subject. Even though PEMEX is the responsible for the execution of this work and its maintenance, the pipeline will be exclusive for the ethane supply for the Etileno XXI Project as detailed in chapter 3; for this reason Braskem-Idesa will follow this process to assure that no environmental and social negative impacts will be generated due to this project. In the case of land acquisition in the trace of the PEMEX's pipeline, the sale of this will be done according to the value of the land in time of this operation will be done, there will be a fair payment for the sale and operation will the directly with the land owner.
PS 6: Biodiversity Conservation and Sustainable Natural Resource Management Objectives: - To protect and conserve biodiversity - To promote the sustainable management and use of natural resources through the adoption of practices that integrate conservation needs and development priorities Compliance requirements. - Protection and conservation of the biodiversity: by assessing the importance of impacts. Will be focused on the main threats to the biodiversity such as habitat destruction and invasion of exotic species. - Habitats: Destruction of habitats, either natural or modified, is the main threat. - Modified habitats. Precautionary measures will be taken in order to reduce its deterioration. - Natural habitats: will not be modified unless: - No other viable alternatives exist. - Benefits are superior that costs, including environmental. - Deterioration is mitigated. Mitigation measurements include the following: - Restoration of the habitats after operation. - Compensation of loss by means of creation of areas for development of biodiversity. - Compensation for direct users of biodiversity. - Critical habitats that deserve special attention for one or more of the following	In order to comply with this Performance Standard the developer has developed and will implement the following subprograms: - Environmental education. - Biodiversity. - Rescue and relocation of wild fauna. - Relocation and transplant of vegetation. - Reforestation. - Handling of surplus material from cutting and removal of vegetation. All these subprograms and policies are summarized in chapter 10 and are included as part of Annex 8.

Performance Standard (PS)	Compliance of the Standard by the Etileno XXI Project
reasons are those that have a high value of biodiversity, contain threatened species that are essentials for endemic or migratory species or for those species of key evolutionary process. • No quantifiable impacts occur. • No reduction of population occurs. • Impacts be mitigated. ○ Goals in legally protected areas: • To operate according to each area management plan. • Consulting with those involved in each area. • To implement preservation programs. ○ Invasive exotic species. No such species will be introduced unless this is done according to appropriate regulations or to risk assessment. Special attention to avoid doing by accident. • Management and exploitation of renewable natural resources: the sustainable use of these resources will be independently certified. ○ Natural woodlands and plantations for clients who works on the exploitation of natural forests. ○ Marine and freshwater systems, for clients who works on exploitation of peaces or aquatic species.	
PS 7: Indigenous Peoples Objectives: • To ensure that the development process fosters full respect for the dignity, human rights, aspirations, cultures and natural resource-based livelihoods of Indigenous Peoples • To avoid adverse impacts of projects on communities of Indigenous Peoples, or when avoidance is not feasible, to minimize, mitigate, or compensate for such impacts, and to provide opportunities for development benefits, in a culturally appropriate manner • To establish and maintain an ongoing relationship with the Indigenous Peoples affected by a project throughout the life of the project • To foster good faith negotiation with and informed participation of Indigenous Peoples when projects are to be located on traditional or customary lands under use by the Indigenous Peoples • To respect and preserve the culture, knowledge and practices of Indigenous Peoples Compliance requirements: • General requirements. ○ To avoid adverse impacts. Identify by means of a social and environmental assessment of the communities that could be affected. Minimize, mitigate and compensate these impacts if they are unavoidable. To complete a development plan of indigenous peoples. ○ Disclosure of information, consultation and informed participation. To involve and inform the communities. Facilitate manifestation of these communities on the project. • Benefits from the development. Creation of opportunities to improve life conditions regarding culture, standard of life, and livelihood of such people.	According to the baseline developed as part of this ESIA, no prominent presence of indigenous peoples has been identified within the project area of influence and for that reason the IFC Performance Standard 7 does not apply to the project (sees chapter 5.5).

Performance Standard (PS)	Compliance of the Standard by the Etileno XXI Project
- Special requirements. - Impacts on in-use historic or traditional lands. Avoid the use of lands used for specific purpose of these people, determine such use with support of an expert; information regarding its rights will be given and an appropriate compensation in lands more than money. - Relocation of indigenous peoples outside their historic and traditional lands. This will be done only when strictly unavoidable. - Cultural resources. Important only in case of use of cultural knowledge of these people by the project.	
PS 8: Cultural Heritage Objectives: - To protect cultural heritage from the adverse impacts of project activities and support its preservation - To promote the equitable sharing of benefits from the use of cultural heritage in business activities Compliance requirements: - Protection of the cultural heritage in the design and execution of the project. - Internationally recognized practices. Put into practice appropriate international agreements. - Chance find procedures. They must be practiced when the project is developed in a zone where is expected to find cultural heritage elements. - Consultation. Consult with affected communities and national organizations in case of affectation of cultural heritage, in order to determine the significance. - Removal of cultural heritage. No such movements unless: - No technical or financial alternative exists. - General benefits are greater, including the cost of heritage loss. - Removal is conducted with the best available techniques. - Critical cultural heritage. Damage or removal will be avoided except in scarce exceptions. - Use of cultural heritage by the Project.	As detailed in chapter 5.5.8, the Nanchital municipality does not have registered archeological zones. However, a formal request to the National Institute of Anthropology and History (INAH, <i>Instituto Nacional de Antropología e Historia</i>) was performed in order to verify in its data base the presence or absence of sites of archeological interest within the Site of Interest (see Annex 7.1). The INAH Office confirmed the absence of archeological registers for the Site of Interest in its data base (see Annex 7.2). Subsequently, in order to assure that the Project does not put risks for the integrity of archeological vestiges, the developer completed a formal request into INAH to visit the Site of Interest to verify the non-existence of archeological vestiges (see Annex 7.3). After a visual inspection of the Site of Interest completed by various archeologists from INAH, in which the property was divided into several sections for better analysis, the INAH response was that the non-existence of archeological vestiges could not be determined in a precise manner due to difficulties imposed by vegetation high density on the inspection (see Annexes 7.4, 7.5 and 7.6). Once clearing activities are in a more advanced phase, INAH will need to complete a second inspection to the Site of Interest. Moreover, Braskem-Idesa has prepared a Cultural Protection plan with fortuitous finding plan which will be implemented by Odebrecht under the supervision of Braskem-Idesa to assure that works are stopped and pertinent notifications are completed in case of archeological vestiges are encountered (see Annex 8.23.1).

Table 4.4 **General Guideline for Environmental, Health and Safety (EHS) of the IFC that Braskem-Idesa will comply in the Etileno XXI Project**

Issue	Recommendations of guidelines to comply with and/or to observe by Braskem-Idesa
EHS regarding the particulate emissions control	- Optimization of the dryer design. - The use of gas closed circuits. - Reduction in origin (example: the transference systems of granulation) and catchment through facilities of elutriation.

Issue	Recommendations of guidelines to comply with and/or to observe by Braskem-Idesa
	• Installation of electrostatic precipitators, filtration bags or humid depuration. • Installation of automatic systems of bagging and efficient ventilation during packing operations. • Appropriate service operations. • Guarantee that levels of emissions comply with values in the reference guidelines (see Table 4.1.4., "Air" section).
EHS on requirements for the blowing and burning torch control	• The aired ethylene from the plants of polyethylene of high pressure and low density (PEBD) and lineal propylene of low density (PELBD) cannot be transported to the torch due to the opening of the security discs of the high pressure reactor, but must be aired at the atmosphere through a chimney after diluted with vapor and cooled by means of depuration with water in order to minimize the risks of explosive clouds. It will be used systems specifically designed and operated through detonation detectors. • In the polymerization plants, pressure security valves (PSV) will be used to reduce the quantity of chemical substances released through the activation of a mechanism overpressure/purge, discharging directly to the atmosphere. • Considering the possibility of the conduits blockage produced by the polymers formation, it is recommended the use of security systems redundant subject to frequent inspections. The PSV lines will be protected upstream by means PSD to avoid loss and blockages. Connections that allow verification of the security systems will be provided during plant operation. • Specific instrumentation of control for the feeding conditions and the operation of the reactor. • System of chemical inhibition to stop the reaction. • Capacity of emergency cooler of reactor. • Emergency electric supply for the reactor agitation. • In case of foam production during the emergency aeration, this foam will be reduced through addition of defoamers to avoid the blockage of the aeration system. • During the emergency aeration, the reactor content will be discharged in a depressurization tank, and will be stripped with vapor before its discharge.
EHS regarding air emissions control to the atmosphere from combustion sources	The following options of efficiency improvement in process with furnaces and blast furnaces, and with auxiliary services systems such as boilers and fluid heaters, must be examined: • To conduct routine inspections of the CO, oxygen and CO₂ content of the combustions fumes, in order to verify that combustions systems use the air excess minimum volumes. • To consider the combustion process automation by means of controls which activate by oxygen. • Minimize the number of boilers or heaters used for loads. In general is more efficient to keep one single boiler up to 90% capacity instead of two at 45%. Minimize also the number of stand-by boilers. • To use regulators for combustions fumes in order to eliminate ventilation loss in those boilers in stand-by. • Keep clean those surfaces of heat transference; in boilers combustion fumes must not be more than 20 km above the vapor temperature. • In systems of vapor boiler to use economizers that allow to recover heat from combustion fumes and apply it to the feeding water or to the combustion air which have not been heated yet. • To consider the reverse osmosis or electrodialysis as the treatment for the feeding water, in order to reduce in the extent of possible the need of use the mechanism of extraction from boiler. • To adopt an automatic mechanism of extraction in boilers. • Recover heat from the extraction systems by reusing vapor of rapid expansion or by preheating feeding water. • Not to feed the dearator with excessive quantities of vapor. • When furnaces of direct fire are used, to consider the possibility of recover heat and apply to the combustion air using systems of regenerator burners. • In those systems which operate along extensive periods (more than 6,000 hours per year), the combined generation of electric energy, heat and/or refrigeration allow costs saving.

Issue	Recommendations of guidelines to comply with and/or to observe by Braskem-Idesa
EHS regarding acid gases control	• Oxygen and fuel burners (<i>Oxy-Fuel</i>). • Enrichment by oxygen injection. • Use of turbulators in burners. • Adjustment to the design and use of multiple boilers for different load configurations. • Quality control of fuel/fuel mix. • Guarantee that levels of emissions comply with reference values (see Table 4.1.4., “Air” section).
EHS regarding dioxins and furans control	• Operation of incineration facilities according to technical standards internationally recognized. • To keep appropriate operative conditions such as incineration temperatures high enough and combustion gas to avoid the dioxins and furans formation. • Guarantee that emissions levels comply with reference values indicated in Annex I.
EHS regarding wastewater management	The maximum permissible limits of water discharge are included in table 4.14, “Water” section. The design team is taking into account the following strategies recommended for management of waste water applicable for the project. • Wastewaters containing volatile monomers in the process (for example MVC, styrene, acrylnitrile, ester acrylics, vinyl acetate, caprolactam) and/or polymerization solvents (for example condensed from stripping with suspension vapor, or condensed latex from the removal of solvents, or wastewater generated during maintenance of equipments) will be recycled; or will be treated through instant distillation or the equivalent division to extract the VOCs before their transport to the wastewater treatment system of the facilities. • Organic substances will be separated and recycled in the process as possible, or will be incinerated. • The non-recyclable contaminated streams will be catalytic or thermally incinerated. • The aids for the emulsion and suspension polymerization will be selected considering how biodegradable they are once enter into the wastewater stream during the polymer recuperation. • When low biodegradable or non-biodegradable aids are used for the polymerization, a unity specifically designed for a previous treatment of water prior its discharge into the wastewater treatment system of the facilities. • Wastewater generated during the polymers recuperation, after the ionic polymerization, which contain metal ions from catalyzes of polymerization (for example Li, Ni, Co, V, etc.) will be previously treated, when necessary, before its discharge into the wastewater treatment system in the facilities. • Used reagent solutions will be sent to a treatment specialized unity for discharge. • Acid and caustic effluents from demineralized water preparation will be treated by means of neutralization prior their discharge into the wastewater treatment system in the facilities. • Contaminated water from regular cleaning activities during cleaning of the facilities will be tested and treated in the wastewater treatment system in the facilities. • Oily effluents such as process leaks will be collected in closed sumps, decanting and discharging into the wastewater treatment system in the facilities. • The facilities will complete and implement a hazardous waste management program, including specific prevention plans and dumping control. • Sufficient capacity for process fluids dilution will be arranged to avoid process liquids discharge into the oily water drainage system and to maximize recovery in the process.
EHS regarding	An appropriate management of in situ used catalyzers will include a water immersion of the pyroforic catalyzers used during their temporary storage, until their transport to the place where definite treatment will be completed in order to avoid non controlled exothermic reactions.

Issue	Recommendations of guidelines to comply with and/or to observe by Braskem-Idesa
used catalyzers	Return to the manufacturer for regeneration of external management of used catalyzers by specialized companies includes heavy or precious metals recovery through recovery and recycling processes. Catalyzers that could contain platinum or palladium must be sent to a noble metals recovery center.
EHS regarding saturated filtration beds	- Recycle or reuse waste streams suitable for reuse or recycling instead of discharge. Potential recycling options include paraffin selling to the wax industry. - The necessary treatment to extract and recover separately the VOCs (for example, through stripping with vapor). - Segregation and storage in a safety place. - Some polymer wastes (for example those polymers subject to heat or shear strain produced during drying and finish equipments start up or shut-off operations, rusty polymers recovered during maintenance of dryers, coatings from the process plant without antioxidants, and wastes from aging polymers) can be instable and disposed to heating and spontaneous burning. These waste will be stored in a secure manner and will be eliminated (incineration for example) as soon as possible.
EHS regarding controls and measures of air emissions prevention for the production of olefins	- Implementation of and advanced multi-variable control and on line optimization, with incorporation of on line analyzers, performance controls and restriction controls. - Recycling and reuse of hydrocarbons wastes for heat and vapor generation. - Minimize coke formation through processes optimization. - Use of cyclone or depuration recovery systems to eliminate emissions of solid particulates. - Avoid to the maximum possible torch burning during start up phase (start up without burning). - Reduce to the minimum torch burning during operations. - Collection of emissions produced by process flues and other sources located in a closed system, directing them to an appropriate purge system for fume recovery, or to the torch. - Adoption of sampling systems of closed cycle. - The hydrogen sulfur generated in a treatment with acid gas must convert in sulfur dioxide through combustion, or in sulfur through a Claus unity. - Installation of permanent gas monitors, video surveillance and machine supervision (such as vibration monitoring on line) to guarantee early detection and warning of any unusual condition. - Implementation of periodic inspections and instruments monitoring to detect leaks and fugitive emissions to the atmosphere, or Leak Detection and Repair Program (LDAR).
EHS regarding volatile organic compounds (VOCs)	The recommended measures to control VOCs are as follows: - The downstream separation and purification of polymers to the reactor. - The instantaneous separation of solvents and monomers. - The stripping with vapor or hot nitrogen. - The degassing phases in extruders, normally vacuum. - The VOCs condensation at low temperatures or in absorption beds before venting the exhaust air. The drying process will recycle the exhaust air of the nitrogen with the condensation of the VOCs. - Ensure that the air emission levels comply with the reference values indicated in Table 4.14. In the process purges: - The VOCs from the finishing sections and the reactor vents will be treated by catalytic incineration techniques prior to their emission into the atmosphere. - The process steam purges will be recovered through the compression or cooling and the condensation of liquefiable components or be sent to a highly efficient flame that can guarantee an efficient destruction.

Issue	Recommendations of guidelines to comply with and/or to observe by Braskem-Idesa
- The non-condensable gases will be supplied to a flaring system, specifically designed to ensure complete combustion with low emissions and to prevent the formation of dioxins and furans. Fugitive emissions - In the manufacture of polyethylene, the monomer leakage from the alternative compressors used in the high-density polyethylene plants will be recovered and recycled in the suction phase at low pressure. There are other requirements for polyester production, alkyd resins, polyolefins, PVC, polystyrene, polyamide, and phenolic resins, but that are not applicable to the Project.	- The steam flow purges (normally 10% of the total steam flow of the used dilution for preventing the accumulation of pollutants) must be neutralized by a pH adjustment and must be treated through an oil/water separator and pressurized dissolved air flotation or other system giving the same or better results prior to their discharge to the wastewater treatment system of the facility. - The exhausted caustic solutions, if not reused to recover the hydrogen sulfide contained or cresol, should be treated by a combination of the following steps: - Washing with solvents or liquid-liquid extraction to remove polymers or polymer precursors. - Sedimentation and/or liquid-liquid coalescence for the removal and recycling in the process of the free phase of liquid gasoline. - Separation with steam or methane to remove the hydrocarbons. - Neutralization with a strong acid, which results in a gaseous current of H₂S /CO₂ that is burned in a flare or incinerator for acid gases. - Oxidation (with moist air, or catalytic oxidation with moist air, or ozone) to oxidize the carbon and sulfides/mercaptanes before neutralizing (to reduce or eliminate the generation of H₂S). - A current of resulting products from C2 polymerization, called “anthracene oil”, which is produced in the catalytic hydrogenation of acetylene to produce ethylene and ethane and that contains polycyclic aromatic hydrocarbons, such as anthracene, chrysene and carbazole. This stream must be recycled in the process (in the principal separator, for example, for its recovery as fuel oil components), or burned for heat recovery.

Recommendations for common environmental approaches to the Organization for Economic Cooperation and Development (OCDE)

Below are the most relevant aspects of these recommendations and how Braskem-Idesa is addressing the recommendations in the Etileno XXI Project.

Recommendation Aspect	How it is addressed
Operations are classified in three categories: Category A: operations with possible environmental adverse impacts (sensitive sectors/areas). May affect larger areas than the Project location. For these projects, the Members will require an Environmental Impact Assessment. Category B: projects with a potential environmental impact less adverse than those from Category A, usually confined to the Project area. For these projects, the Members will require the needed information to have a clear idea regarding the potential environmental impacts of the Project, according to its nature. Category C: projects that are not expected to have any adverse environmental impact or that this is minimal. No further action is required.	The Etileno XXI Project is classified as Category A, and thus an Environmental Impact Assessment was submitted to SEMARNAT for the first phase (site preparation). In addition, the Project design has been included and considered by the World Bank Operational Policies, the eight Performance Standards of the IFC and the Environmental, Health and Safety General Guidelines.
Regarding the dissemination of environmental information shall: Publish the principles governing its environmental policy and procedures. Exchange of information with other Members on co-financed projects, with the aim to achieve common positions. For Category A projects, publicly disclose information regarding the project (name, location, description and available environmental information) and make publicly available the environmental information of the project of at least 30 days before the final compromise on the coverage of the operation. Publish at least annually information regarding issued policies, with respect to Category A and B projects.	The Project has developed and implemented a Sub-program of Community Participation and Communication and a Sub-program of Relationship with Interest Groups (Annexes 8.16 and 8.21). A summary of the first activities and their results are included in the Annexes 5.15 and 5.17. In addition, according to the establish environmental impact procedure of the Federal Environmental Law (LGEEPA, <i>Ley General del Equilibrio Ecológico y la Protección al Ambiente</i>), and its Regulation on the Environmental Impact Assessment, once the evaluation process by SEMARNAT has started, the Project was publicly available on the SEMARNAT webpage.

According to these instructions, the environmental analysis of the projects will be based on the following principles:

- Credit insurance is a tool to support exports.
- The environmental analysis of the projects will be an integral part of the global risk analysis.
- Among the environmental considerations, it should be taken into account not only the potential benefit or damaging of the project, but also the ecological characteristics of their location.
- Complete respect to the legislation of the beneficiary country.
- The exporter must provide sufficient information to assess the environmental effect of the project.

- The confidential information provided by the exporter must be respect.

Additionally, the structure complies with the Impacts Assessment referred in the Recommendations of the Common Approaches of the OCDE. This document cover with the requirements to have a legal, administrative and politic framework, to present the Project description, evaluate the baseline information, identify and evaluate the environmental impacts, analyze the project alternatives, to have a Management Plan, and record the consultation process. Therefore, it is in complete compliance with the established in the Recommendations of the Common Approaches of the OCDE.

4.4

INTERNATIONAL AGREEMENTS APPLICABLE IN MEXICO

Mexico is a part of several environmental International agreements. Some of them since 1946 and other are currently being confirmed for its implementation. Mexico has a consistent record of support for the International environmental agreements and consistent confirmation for them. The following agreements have the national legal application by the Federal Government, with the possibility of national sanctions in case of not compliance.

Agreements are listed below:

- *Convention on Biological Diversity.*
- *Convention on International Trade in Endanger Species of Wild Fauna and Flora (CITES, Convención sobre el Comercio Internacional de Especies Amenazadas de Flora y Fauna Silvestre).*
- *United Nations Convention to Combat Desertification.*
- *United Nations Framework Convention on Climate Change.*
- *Kyoto Protocol.*
- *Vienna Convention for the Protection of the Ozone Layer.*
- *Montreal Protocol.*
- *Basel Convention on the Control of Transboundary Movements of Hazardous Waste and their disposal.*
- *Rotterdam Convention.*
- *Stockholm Convention*
- *Convention 169 of the International Labor Organization - Indigenous and Tribal Peoples in Independent Countries.*
- *Convention on the Rights of the Child*
- *Universal Declaration of Human Rights.*
- *International Labor Convention No. 155 on Safety and Health of Workers and Working Environment.*
- *International Labor Convention No. 182 on the prohibition of the Worst Forms of Child Labor and Immediate Action for the Elimination*

- *International Labor Convention No. 29 concerning Forced or Compulsory Labor*

International agreements applicable to Mexico that do not involve legal obligations:

- *Declaration of the United Nations Conference on the Human Environment.*
- *Rio Declaration on Environment and Development.*
- *Johannesburg Declaration on Sustainable Development.*

5 DESCRIPTION OF THE AREA OF INFLUENCE OF THE PROJECT AND INDICATION OF THE DETECTED ENVIRONMENTAL ISSUES

5.1 DELINEATION OF THE STUDY AREA

The Etileno XXI Project is located in the Municipality of Nanchital de Lázaro de Cárdenas del Río, State of Veracruz, as established in the title deed, included in Annex 2.1, and the land use ratification issued by the Municipality of Nanchital de Lázaro de Cárdenas del Río, included in Annex 6.4.

In this section, the other used Areas of Influence are described, the Direct Area of Influence (DAoI) and the Indirect Area of Influence (IAoI). The Direct Area of Influence establishes the geographic space that will be affected directly by the operations of the Project, including the polygon that constitutes the Project site; while the Indirect Area of Influence establishes the geographic space that will be affected by the Project in a major scale of interaction, as a result of a series of affectations and interactions between the different biotic and abiotic components of the Project. Overall, the DAoI and the IAoI are the Area of Influence (AoI) of the Project.

For the delineation of the Direct Area of Influence (DAoI), the arguments in order to establish the geographic spaces that will interact directly with the Project operations are presented as follows:

- a) Flora and Fauna. It is considered that the Jaguaroundi Ecological Park is within the DAoI, since most of the individuals of the flora and fauna species will be relocated in this site, considered as suitable as it maintains similar natural characteristics to those that will be affected by the preparation activities of the site of interest.
- b) Water. The Gopalapa and Nanchital streams are considered within the DAoI, which will be the water bodies where the treated wastewater and the collected storm water of the petrochemical complex will be discharged into, during the operation phase.
- c) Air. The intersections between the Resistol-El Chapo road and the Federal highway 180 (Coatzacoalcos-Villahermosa), and the Resistol-El Chapo road with the El Chapo residential area, are considered within the DAoI due to the points of dust generation caused by the increased vehicular flow for the transportation of materials and wastes.
- d) Soil. Once the authorized material dump sites are defined for the disposition of the special wastes, as well as the temporary sites for the fill operations in the Project site, these sites will be included within the DAoI since their characteristics will be affected directly by the Etileno XXI Project.

For the delineation of the IAoI, a preliminary analysis was conducted of the following aspects:

- e) Territorial analysis. The biotic and abiotic elements were identified and localized in the property through the access of primary information sources (studies of vegetation and fauna, geophysical, geohydrological, topographic, and hydrological surveys, among others, including expert opinions) and secondary sources such as existing and edited maps by the National Institute of Statistics and Geography (INEGI, *Instituto Nacional de Estadística y Geografía*) (scales 1:250,000 and 1:50,000), aerial photograph (Google Earth, CONAGUA) and official information regarding legal and environmental issues, applicable to the Project area and to the type of Project. Based on such information, a zoning was conducted.
- f) Functional Analysis. Based on the information of the biotic and abiotic elements and from the territory interpretation, a functional analysis was required in order to identify expressions and evidence of natural processes and cycles.
- g) Analysis of development trends and deterioration of the region. Event and effects scenarios are proposed from the results of the preceding subsections e) and f), particularly from the environmental and socioeconomic information crossing with the provisions of the applicable legal instruments and with the development policies in the region. In this sense, the interaction of the Project on air emission within the airshed of the region according to the preliminary exercises conducted by the National Institute of Ecology (INE, *Instituto Nacional de Ecología*). It is worth mentioning that it does not exist a single methodology to determine the airshed characteristics, so the extension can vary from region to region. In this case, the airshed includes the entire region of Coatzacoalcos, due to the high accumulation of industries and urban areas in the zone.

Considering the above, the process used to determine the IaOI is described next in each of the above mentioned topics:

- Geographic maps published by INEGI, relating to topography, geology, edaphology, surface and groundwater hydrology, were used as follows:
 - Topography: Coatzacoalcos E15A85 scale 1:50 000 (1998), Agua Dulce E-15 A-86-76, scale 1:50 000 (2000).
 - Edaphology: Coatzacoalcos E-15-1-4, scale 1:250 000 (1984).
 - Geology: Coatzacoalcos E-15-1-4, scale 1:250 000 (1983).
 - Groundwater Hydrology: Coatzacoalcos E-15-1-4, scale 1:250 000 (2000).
 - Surface Hydrology: Coatzacoalcos E-15-1-4, scale 1:250 000 (2003).
 - Edaphology: Coatzacoalcos E-15-1-4, scale 1:250 000 (1984).
 - Land Use and Vegetation: Coatzacoalcos E-15-1-4, scale 1:250 000 (1984).
- Hydrological aspects: The presence or absence of permanent or intermittent rivers and streams, present water bodies, the basin and sub-basin delineation, specifically, the microbasins. This information was

complemented with the execution of specific studies in the area such as the geohydrological, geophysical, hydrological and the groundwater supply feasibility in the area. Based on this, the Project is located in the Coatzacoalcos Hydrological Region No. 29 (part of the Coatzacoalcos river basin) and, in particular, in three microbasins that have direct influence on the Project. The Project is located in the watershed of two microbasins, the Gopalapa stream and a stream south of the Project site that crosses the Nanchital locality (see figure 5.1).

- Ecological Planning Programs were enacted in the region. The Regional Ecological Planning Regulation of the Low Basin of the Coatzacoalcos river, the Urban Planning of the Metropolitan Area of Coatzacoalcos – Nanchital de Lázaro Cárdenas del Río–Ixhuatlán del Sureste; in which the Environmental Management Units (UGAs, for its acronym in Spanish) characteristics were defined for the area where the Project is located.
- Land use and vegetation: The vegetation types delineation was used, such as the degree of perturbation of the same, the undustrial, agricultural, and livestock uses to have a framework of reference of the existing vegetation.
- Dispersion of pollutants: Another factor to consider were the results of the atmospheric dispersion study of the particulate matter of less than 10 microns (PM₁₀), Sulfur Dioxide (SO₂), Nitrogen Dioxide (NO₂), Carbon Monoxide (CO) issued by the main fixed sources of the Project during the operation phase. The plumes of higher concentration are located adjoining to the site proximities, within a radius of 400 meters approximately, and therefore, the definition of the AoI should cover at least this radius surrounding the Project site.
- Infrastructure: The roads that surround the UGAs were initially identified for the IAoI and, in turn, led to the localities defined as those that would have more influence on the Project. The reason for doing such delineation is due to that the roads and highways, which are connections that fragment the environmental conditions of the study area, a situation that already exists in the AoI, not only by the presence of the Federal Highway No. 180 Coatzacoalcos – Villahermosa, the State Highway Nanchital – Guillermo Prieto, the Resistol – El Chapo roads, but by the presence of industrial activities in the region represented by the Cangrejera, Morelos and Pajaritos petrochemical complexes, and industries as Celanese, Resirene, Quimir, Verapas, Praxair, Productos Olefínicos de Mexico, among others.
- Social (population centers). From the social point of view the populations of Coatzacoalcos, Nanchital de Lázaro Cárdenas del Río as main seats, being direct and important contribution of labor (in the different phases of the Project). However, as a result of the baseline study, the localities in the vicinity of the Project such as Pollo de Oro, el Ejido Lázaro Cárdenas, Nahualapa, el Ejido Cinco de Mayo, El Chapo, Mundo Nuevo and Nanchital, were determined to be within the direct Area of Influence, of which particular description will be included in the section 5.5 of socioeconomic aspects of this document.

Protected Natural Areas (ANPs): A fundamental aspect that was considered for the delineation of the AoI was the location of the ANPs and/or the Ramsar sites in the area where the Project is located, and that potentially could be impacted. It is worth mentioning that the Project is not located within or adjacent to any State or Federal ANPs, or with any Ramsar site (see figures 3.3., 3.4 and 3.5 of chapter 3).

According to the above mentioned, the most important criteria used in the delineation of the IAoI, considering the rainfall in the region and the topographic conditions where the Project is located, in which it is possible to identify a soft hill, was the concept of hydrological basin.

In this sense, three microbasins are located within the AoI. The Project is located within the watershed of two of them: the Gopalapa stream and a stream south of the Project site, known as the Nanchital stream.

In figure 5.1 the defined DAoI and the IAoI for the Project are presented.

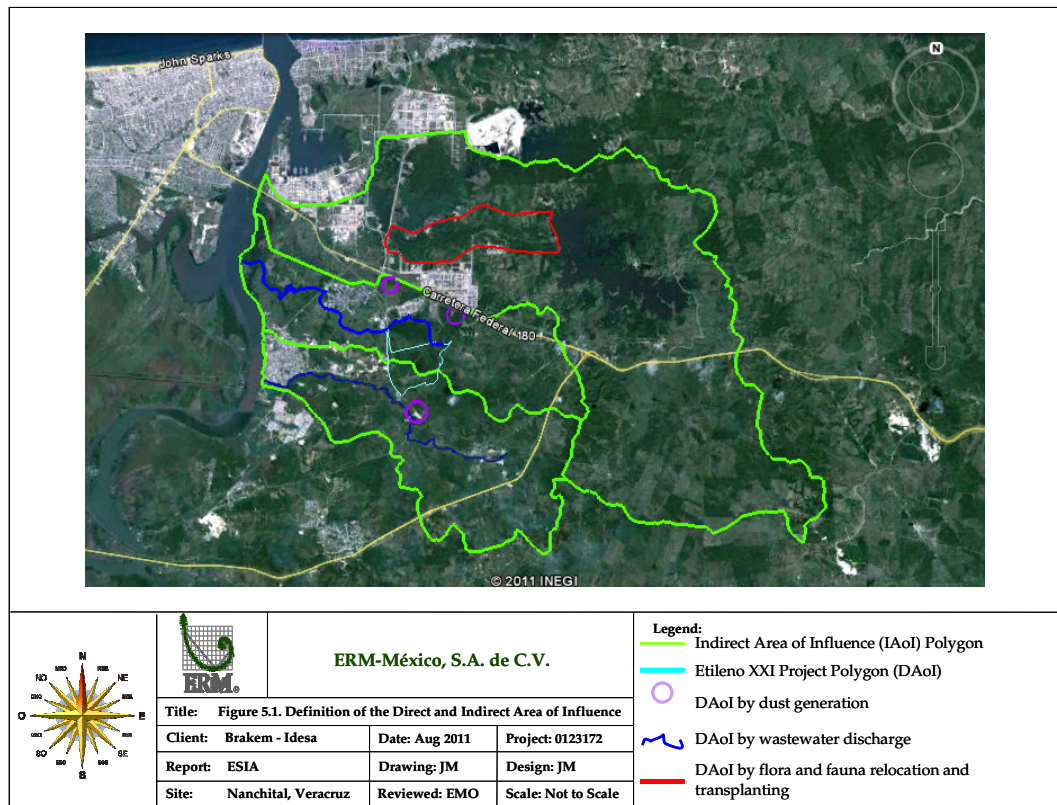


FIGURE 5.1 DEFINITION OF THE DIRECT AND INDIRECT AREA OF INFLUENCE

For the above, the delineation of the AoI for the purposes of this ESIA, is shown in figure 5.2, with an area of 15 160 ha.

5.2 ABIOTIC ASPECTS

5.2.1 Climate

- *Type of climate*

According to the Köppen classification, modified by E. García (1981) for Mexico, the AoI is immersed in the climatic unit belonging to the Am (f) type warm humid climate with rain throughout the year. The average annual temperature is 25 °C; the coldest month is January, with 22 °C.

The total annual rainfall is between the 2,300 and the 2,800 mm, the rainfall regime is intermediate since it rains all year round, although rainfall is concentrated between June and November. The percentage of winter rainfall is 9%. The relative humidity is high, being the annual average of 79%. The normal monthly precipitation in the Nanchital region ranges between 40.7 and 462.2 mm.

- *Average temperature*

The closest climate station of the National Meteorological Service (NMS) of the AoI is called Nanchital, located in the geographical coordinates 18°04'20" N latitude and 094°24'35" W longitude. The record of such station has precipitation, temperature, evaporation, fog, hail and storm data (see figure 5.3). The climate station is located in the climate unit Am (f), which is described at the beginning of this section.

Based on the records of the maximum, mean, and minimum temperature for the period from 1971 to 2000 in the Nanchital station, it is observed that the maximum temperature was recorded in May with a value of 35.6° C. According to the data recorded in the meteorological station in March 1973, daily maximum temperatures reached 42°C in March and May. The average monthly minimum temperature reaches the 18.1° C, with daily minimum temperatures recorded of up to 11°C in January and February (see table 5.1).

GRAPH 5.1 BEHAVIOR OF NORMAL TEMPERATURE (MEAN, MAXIMUM, AND MINIMUM) IN THE NANCHITAL STATION

- *Average rainfall and evaporation*

In the Nanchital station, the record of the annual precipitation for the period from 1971 to 2000 was 2,778.9 mm, with normal maximum values of 462.2 mm during September. In September 1982, a maximum rainfall value was recorded in 1 075 mm. A total of 127.4 days of the year with rain have been registered, being its main inflow during the period from August to October (see table 5.2).

On the other hand, the annual evaporation in the Nanchital station was 1 115.2 mm.

GRAPH 5.2 RAINFALL AND EVAPORATION DATA REGISTERED IN THE NANCHITAL STATION

- *Weather Phenomena*

Frequency of Frosts, snowfalls and hurricanes

Weather records of the Nanchital station do not indicate the presence of frosts neither snowfalls; however, winds from north are registered, reaching maximum speeds between October and March months, with a wind of 9.45 m/s and a dominant wind of 27.10 m/s.

Air quality

In the industrial corridor “Coatzacoalcos-Minatitlán” there is not a monitoring system of the air quality which could to provide information about the suspended particles (CO₂, SO₂, CH₄, etc.). Some research institutions as the Ecodevelopment Center of Veracruz, the Ecology Institute and the Organization for Economic Cooperation and Development (OCDE), have made researches about the problem of the air quality in the industrial zone; unfortunately, such researches are not recent (see chapter 5).

Monitoring on air quality in the Project area

A monitoring was made about the local air quality in the Project area. The monitoring was conducted from 03rd to 13th in June 2011 in the Pollo de Oro population, which is closer to the site of interest and is even contiguous with it and its southwest section. It was conducted in the monitoring mobile station in 18°03'40.98" N y 94°22'25" O coordinates.

The objective of the study was to evaluate the concentration of Nitrogen Dioxide (NO₂), Sulfur Dioxide (SO₂), Carbon Monoxide (CO), Ozone (O₃), Total Suspended Particles (PST), PM₁₀, PM_{2.5}, and Lead (Pb) in the area where the Project will be using originally official Mexican standards for these pollutants. These standards were taken as a reference basing on the General Guidelines about Environment, Health and Safety (EHS) of the International Finance Corporation (IFC), which establishes the emissions should not produce pollutants concentrations that equal or exceed the permitted ones bt the standards and guides about environment quality in application of the national legislation or, otherwise, from the Air Quality actual Guides from the World Health Organization (WHO). The result was that all parameters and values established in the general guidelines about EHS and IFC, as well as with the limits of the Mexican Offical Standards mentioned during the sampling period.

In the specific case of sulphur dioxide, the monitoring results where well below the guidelines (50 µg/m³), however these are timely results so air quality monitoring will continue and expand throughout the Proyect Area of Influence (for the paramiters , see annex8.15 Subprogram for the Monitoring and Control of Air Quality).

The results of the dispersion model (see Annex 5.11) indicate that in the area of with the highest concentration of sulphur dioxide, it will increase to 5.24 mg/m³ (10 ppm) or by 5.24 mg/m³ (10 ppm) over a period of 24 hours, with which it

will still not surpass the guidelines. The addition of dimethyl ether will generate hydrogen sulphide, which will be removed by means of a chemical wash including caustic soda and will not produce SO₂.

Noise level

Relating to this topic, there is not information from the industrial corridor Coatzacoalcos-Minatitlán, in the state of Veracruz.

ERM, through an accredited subcontractor before the Mexican Accreditation Entity (EMA, *Entidad Mexicana de Acreditación*), conducted a monitoring of peripheral noise in January 2011 (see Annex 5.7).

The monitoring of the peripheral noise considered five points in the proximities of the site of interest considering the fixed source and the closeness of the potential receptors, for this purpose bottom and source measurements were taken in each of the sampling points. The samplings considered the punctual data capture during the daytime since 08:00 hours, and during the evening hours since 16:00 hours.

TABLE 5.1 **NOISE LEVELS IN THE AREA OF INFLUENCE SURROUNDING THE SITE OF INTEREST**

Shift	Sampling site	Noise emission dB (A)	Maximum level permitted * dB (A)
Evening	Pollo de Oro	56.48	65
Daytime		53.13	68
Evening	Resistol	64.34	65
Daytime		67.71	68
Evening	Poblado Lázaro Cárdenas	58.90	65
Daytime		52.57	68
Evening	Planta La Cangrejera	82.45	65
Daytime		67.62	68
Evening	Celanese	73.79	65
Daytime		70.21	68

* According to the NOM-081-SEMARNAT-1994.

According to the results of environmental noise previously mentioned, the Pollo de Oro and Ejido Lázaro Cárdenas populations are the potential receivers closer to the site of interest, which the noise levels are under the maximum limits permissible that establishes the NOM-081-SEMARNAT-1994.

5.2.2 *Geology and geomorphology*

- *Litologic characteristics of the area*

The AoI is located in the physiographic province called Southern Gulf Coastal Plain, particularly in the subprovince Flood Prone Coastal Plain. The topographic

characteristics are valleys, valleys with plains, hills and mountain chain (INEGI, 2009).

The Gulf of Mexico Coastal Plain, particularly in its south and southeast region, is extended in a stripe form roughly parallel to the Gulf of Mexico, since the north the Veracruz city to the Tonalá river, where it continues through tabasqueño territory. Its geomorphologic action only is being expressed through relief alterations produced by human activities, as the oil deposits in cretaceous rocks and the associated ones with salt domes and miocene rocks, to the south (in Minatitlán).

According to the Coatzacoalcos E-15 1-4 Escala 1:250,000 geological map (INEGI, 2003), in the AoI two types of well-differentiated rocks are emerged, which belong to two different environments, bringing together by the age and origin. Accordingly, in the AoI a unit of fluvial origin of the quaternary with deposits is identified (Q) and the unit with sediments of Miocene (Tm) along with Jurassic sediments (J).

- *Geomorphological characteristics*

According to the Geographic Synthesis of the state of Veracruz edited by the INEGI, the AoI is located in the Southern Gulf Coastal Plain, specifically in the coastal plain subprovince of Veracruz. In it they are located: the lower basin of the Papaloapan River, located in the northeast and central part; and the basin of the Coatzacoalcos River in the southeast. These rivers are permanente but erratic, with strong floods in the summer months. The annual medium spills of their basins are of 39 175 y 22 395 million m³ respectively.

- *Presence of failures and fractures*

According to the Coatzacoalcos geological map E 15-1-4 escala 1:250,000 (INEGI, 2003), with the AoI there is a fracture inferred located for about 2 km to the south of the Project polygon (see figure 5.5 of chapter 5).

- *Susceptibility to environmental risks*

According to the document called "Hazards diagnosis and disaster risk identification in Mexico", published by the Mexican National Center for Disaster Prevention (CENAPRED, 2005), AoI is located in an area where the annual precipitation fluctuates between 2 000 and 3 000 mm/year. Based on this document, AoI is located in an area with a flood medium risk to low, and a medium probability relating to the incidence of cyclones.

According to the CENAPRED, in the AoI area there is not a risk because of a volcanic activity. Pico de Orizaba and San Martín Tuxpan are the volcanos closest to the AoI, located approximately 342 km and 98 km to the northwest of the AoI, respectively.

At present there are not reports about affects or registers about damages because of the earthquakes in the area where the AoI is.

Geological aspects

In the Project area there are two geologic formations of the upper tertiary. The Paraje Solo formation is the oldest, and the Central Formation is discordantly and irregularly overlying. In the most important streams channels there are some quaternary alluvial deposits.

The Paraje Solo formation has a wide distribution in the north and central of the area, forming low height hills and a slight slope; the surveys detected this formation up to the 40 m of depth. However, it is known it has a thickness higher than 200 m.

The Cedral formation is distributed to the south part of the Project area, covering unconformably to the F. Paraje Solo, forming hills elevated and larged from East to West. The thickness of this unit in the study area is not known.

Geomorphology

The study area is characterized by the presence of two well-defined geomorphologic zones:

The first one is in the highest areas, where the hills and have rounded forms reaching a height up to 150 msnm (meters above the sea level) and formed by folding structures with outcrops constituted by sandy sediments.

The second one, belongs to a flat topography zone where there are marshy areas corresponding to the low parts where the surface drainage is difficult.

Types of soils

Particularly in the site of interest, it can be identified that the Bf+LP+Lo/2 (99%) soil predominates, ferralic cambisols with plinthic luvisols and ortic luvisol, of médium texture and, in lower proportion, to the north of the site of interest the type of soil is the Gm + Ge/2 (1%), molic gleysol with eutric gleysol of a moderate texture.

- *Soil quality*

Phase I Environmental Site Assessment

ERM-Mexico conducted a Phase I Environmental Site Assessment in the site of interest, located in the km 3+ 290 of the Resistol– El Chapo road, in the Municipality of Nanchital de Lázaro de Cárdenas del Río, Veracruz, Mexico. The assessment and report were made according o the considerations contained in the Practical Standard ASTM E 1527-05 for the Environmental Site Assessment (ESA):

Based on information and data obtained during this research, ERM identified in the site the next Recognized Environmental Conditions (RECs):

- Filthy water was observed (it seems rainwater) with an oil layer under a PEMEX duct crossing the center of the area. The water surface was of approximately 4 m².
- In the central part of the site, geomembranes remains were observed. The surface which covers the geomembrane remains is of approximately 300 m².
- Adjacent to the northeast limit of the area there is the Gopalapa stream. This stream receives municipal and industrial discharges. The closest companies to the site are Celanese, Resirene and Quimir, approximately 600 m and 400 m to the north of the site, respectively, downstream.

Historical recognized environmental conditions

Based on the information and data obtained during this research, ERM did not identified recognized environmental conditions historically in the site.

De minimis conditions and other findings

The *minimis* conditions are the ones without presenting a threat to health or the environment and generally should not be subject to an Action of Fulfillment drawing attention of the proper authorities. ERM did not identified *minimis* conditions in the site.

In the Annex 5.8 it is presented the detail of the Phase I conducted for the site of interest.

Phase II Environmental Site Assessment

ERM personnel performed field activities associated with the Phase II Environmental Site Assessment from 10 to 19 January 2010, it was about 35 soil samplings collection in 12 survey points and the installation of two monitoring Wells for groundwater, as well as five water samplings collection, in five potential areas of concern (PAOCs).

Based on the laboratory results it was identified that:

Soil

- Concentrations were not detected, above the detection limits of laboratory, of Total Petroleum Hydrocarbons (TPH), light, médium and heavy fraction, Volatile Organic Compunds (VOCs), Semivolatile Organic Compounds (SVOCs), Polycyclic Aromatic Hydrocarbons (PAHs), Pesticides, and Herbicides, in any of the analized samplings.
- Metals concentrations were detected, but all under the comparison criteria (industrial) of the Mexican Official Standard.

Water

- Concentrations were not detected, above the detection limits of laboratory, of Total Petroleum Hydrocarbons (TPH), light, medium and heavy fraction, VOCs, SVOCs, PAHs, Metals and Pesticides, in any of the analyzed samplings.

In the Annex 5.9, the Phase II is presented for the site of interest, which includes the location of the potential areas of concern and sampling sites.

5.2.3

Surface and groundwater hydrology

- *Continental bodies of water*

According to the surface hydrology chart Coatzacoalcos E 15 1-4 Scale 1:250,000 (INEGI, 1984) the AoI is located in the Coatzacoalcos Hydrological Region No. 29, within the Coatzacoalcos river “B” basin, and in the “A” sub-basin, named Coatzacoalcos river. In figure 5.14 of chapter 5, the AoI location with respect to the Hydrological Region No. 29 (see figure 5.2 of the Executive Summary).

The Coatzacoalcos Hydrological Region No. 29 presents high hydrological dynamics, as the nearby water bodies are related to the largest rivers of Mexico, such as the Coatzacoalcos and the Tonalá Rivers.

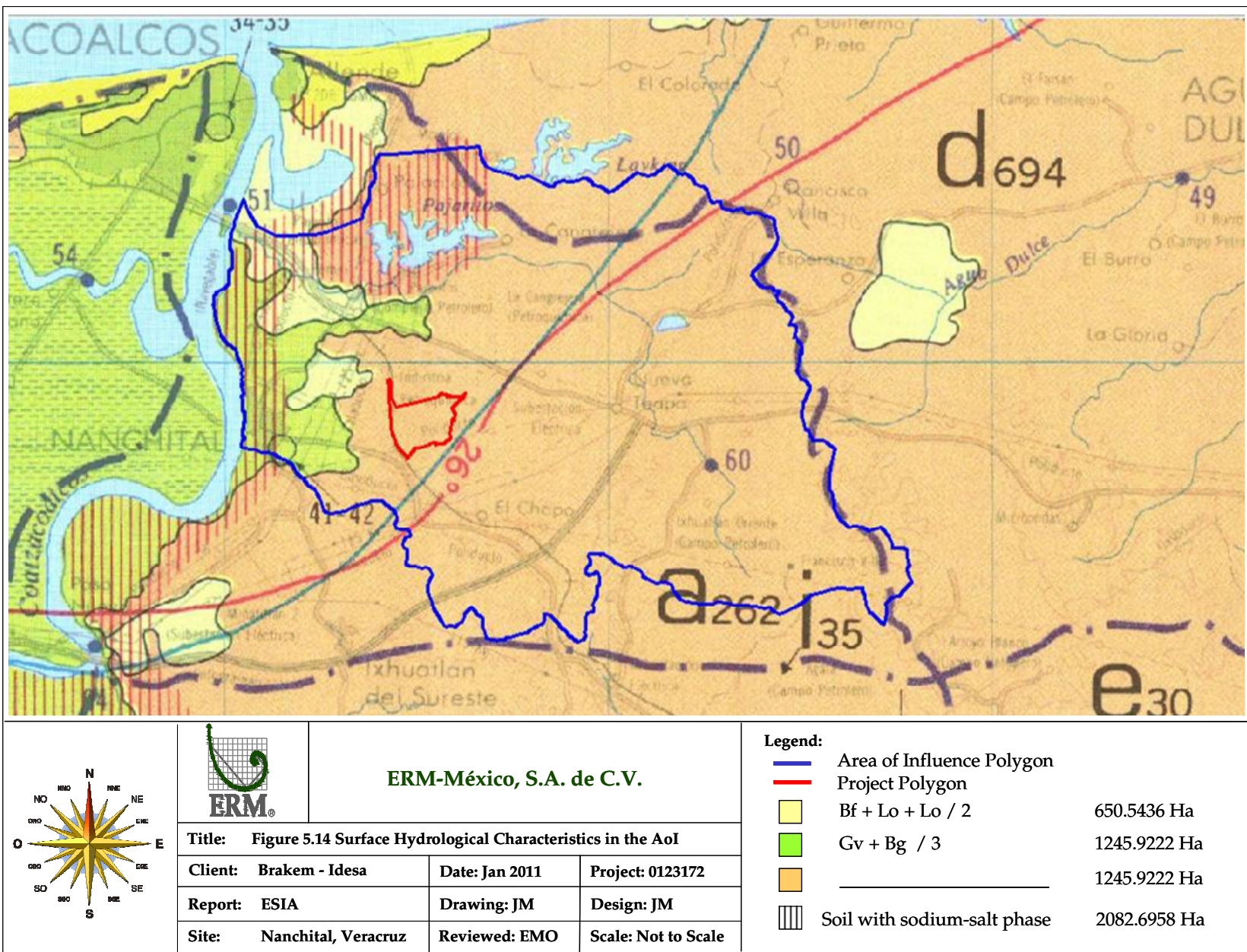


FIGURE 5.2 SURFACE HYDROLOGICAL CHARACTERISTICS IN THE AOI

The site of interest is part of the Coatzacoalcos Hydrological Region No. 29, in the basin of the Coatzacoalcos River. Within the site of interest there is a watershed of two microbasins, the one of the Gopalapa and a stream, whose name is unknown, and crosses the Nanchital community, by the northeast limit of the site of interest, in the cross with the PEMEX right-of-way crossing Gopalapa stream.

According to the hydrological study of the Gopalapa stream, this is an intermittent stream and discharges in the Coatzacoalcos River. It begins from the stemflows of a little mountain range located in the study zone. The lifting of the mountain range is approximately 100 msnm.

The length of the main stream, upstream of the study site is approximately 5 300 m and downstream is of 18 200 m.

- *Water quality analysis*

The basin of the Coatzacoalcos River concentrates the most important petrochemical facilities from Mexico: the Lázaro Cárdenas plants, Morelos, Cangrejera, Cosoloacaque and Pajaritos, discharging in the most southern point from the Gulf of Mexico, next to the population and the port, which have the same name.

The Coatzacoalcos river and its basin (including wetlands and lagoons systems, the floodable low evergreen forest, mangroves, popals, beaches and dunes, according to Pronatura, A.C., 2006), have strong problems of pollution between Minatitlán and its mouth (Coatzacoalcos), due to the industrial activity of the petrochemical facilities and chemical industries in the region as wells as the traffic of oil tankers in the Coatzacoalcos port.

In addition, the “Classification declaratory of the Coatzacoalcos River, its tributaries (Calzadas River, Gopalapa stream and Teapa stream) and the Pajaritos lagoon”, published by Federal Environmental Agency (SEMARNAT) on 6 February 2008, reports the pollutants charge the Gopalapa stream receives and, although this information does not represent the water quality of the stream, it contributes to understand what kind of pollutants are discharged and how many (see Table 5.2).

TABLE 5.2 POLLUTANTS CHARGE IN THE GOPALAPA STREAM

Parameter	Gopalapa (kg/day)
Greases and oils	2
Total suspended solids	18
Biochemical oxygen demand (5 days)	26
Total Nitrogen	30.7
Total Phosphorus	3.3
Methylene blue active substances (MBAS)	0.5
Biochemical oxygen demand	178
Arsenic	0
Cadmium	0.02
Copper	0.14
Chromium	0.02
Mercury	0
Nickel	1.04
Lead	0.21
Zinc	0.16
Cyanides	0.21
Ammoniacal Nitrogen	5.87
Phenols	0.04
Sulphates	417
Iron	3.28
Benzene	0
Toluene	0
Ethylbencene	0
Xylene	0
Polychlorinated biphenyls	0
Polycyclic aromatic hydrocarbons	0

As a conclusion, there is not information collected in field neither bibliographic about the quality of the Gopalapa and Nanchital streams; however, as part of the general framework of the follow-up and monitoring plan, the baseline measures of both streams will be made through the water samplings for analysis by an accredited laboratory by EMA.

5.2.4 Groundwater hydrology

According to the data published in the Federal Official Gazette (FOG, 2003) related to the water availability in the Coastal Aquifer of Coatzacoalcas, State of Veracruz, the AoI is located in the Coastal Aquifer of Coatzacoalcas (code 3012).

The Gopalapa stream microbasin is located in the Coastal Aquifer of Coatzacoalcas, which covers an approximate surface of 2 600 km² and that it is located in the southeastern portion of the State of Veracruz. To the north is the Gulf of Mexico; to the south is the parallel 17° 53'; to the east is the Tonalá river, which serves as a Boundary with the State of Tabasco; and to the west is an imaginary line which substantially coincides with the meridian that passess through the San Martín hill, of the Los Tuxtlas volcanic massif, and the Jáltipan de Morelos town.

Shallow aquifers formed by alluvial deposits have thicknesses from 40 to 50 meters and work as unconfined aquifers, receiving a vertical feed by infiltration of storm water, possibly the most important component of the total recharge.

Although the regional Coastal Aquifer of Coatzacoalcos is considered as underexploited, there are strong local overexploitation issues due to the concentration of wells, which following the trend of their drilling, can cause a saline intrusion. According to the data published in the FOG, the aquifer has a mean annual recharge of 172 millions of m³, a committed natural extraction of 9.7 millions of m³ and a total extraction for different uses of 72.8 millions of m³, which reports a mean annual availability of 125.5 millions of m³ (see Table 5.10). However, for their geohydrological conditions and proximity to the sea, it is an aquifer that is reported with problems of saline intrusion (Water Statistics, INEGI, 2004). This situation limits, of course, any increase in groundwater exploitation.

The groundwater hydrology of the AoI is shown in figure 5.15 of chapter 5 (see chapter 5.3 of the Executive Summary).

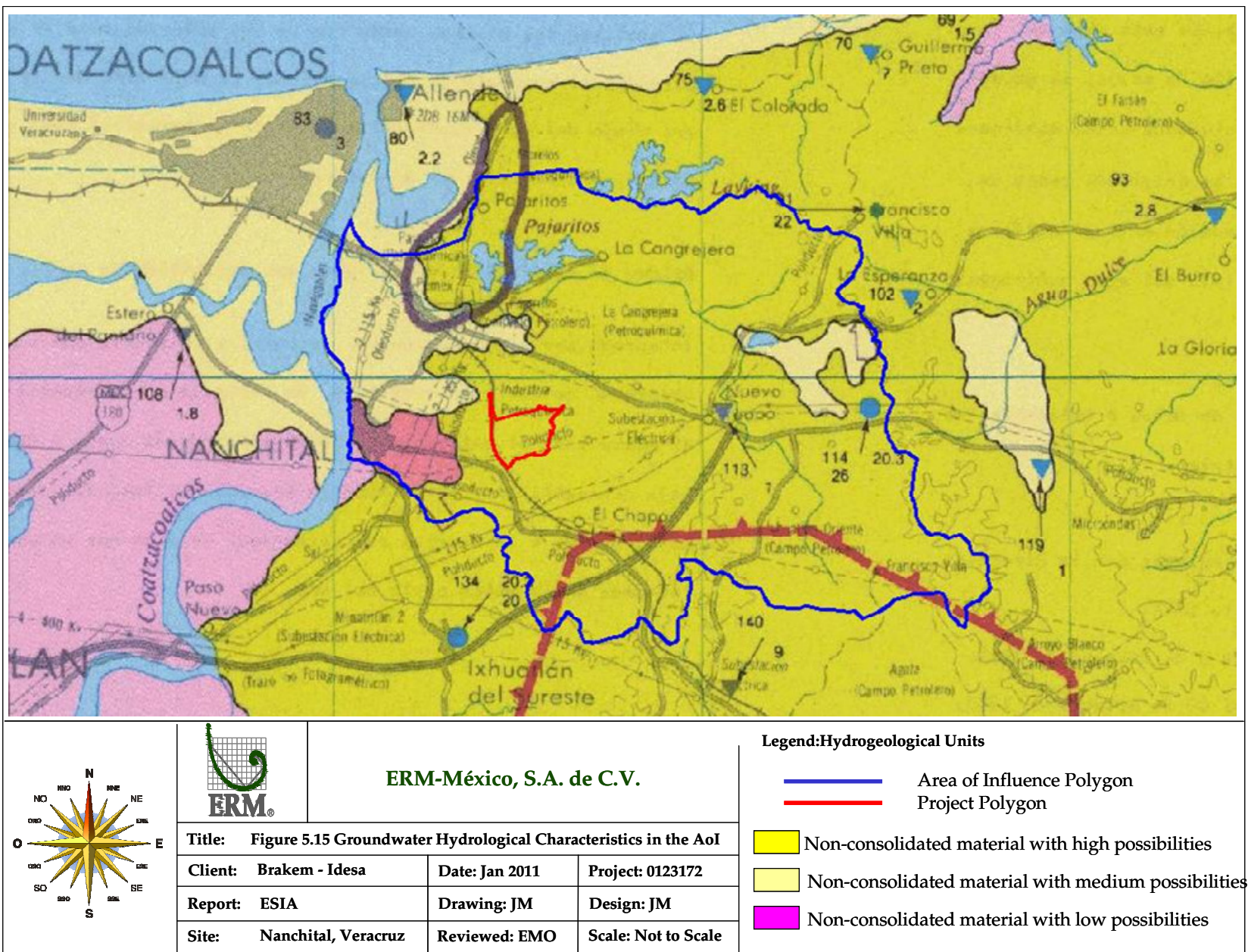


FIGURE 5.3 GROUNDWATER HYDROLOGICAL CHARACTERISTICS IN THE AOI

Water Quality Analysis

In the ground water of the Costera Zone of the Coatzacoalcos River, there are issues regarding:

- Operative impacts as a result of local overexploitation, due to the reduced weight of the water tables and the subsequent difficulty to recuperate pump levels.
- The flow of fine silt in the water of some intakes
- Sea water intrusion, due to the constant weight of the water- located as the northern boundary of the water table – together with the abatement cones in the intakes close to said boundary.

Additional hydrological Studies for the Baseline

For the proper design of the Project, two additional hydrological studies were conducted with the following objectives:

- Identify the site for the well development for the 100% of water to be supplied during the construction phase, and that will be maintained to support the raw water pipeline that is planned to be installed to supply the water demand for the operation phase.
- Design of the works aimed to prevent potential flood events through elements of storm water protection and channeling in the Project area for its subsequent discharge to the Gopalapa and Nanchital streams.

1. Hydrological study for the well advancement

The main objective of this study was to assess the potentiality of the area aquifer, as well as to establish the feasibility to construct a groundwater abstraction well, and to determine the potential flow that could be supplied.

The specific objectives that were covered with the conduction of this study were as follows:

- Establish the geologic and hydrogeologic conceptual models in the zone, so that, based on these, the more suitable sites for the groundwater abstraction well drilling were identified.
- Assess the aquifer potentiality in the area where the wells will be drilled.
- Estimate the approximate flow that the wells may give depending on the nearby wells production, drilled in sites with similar hydrogeological characteristics to the area of interest.
- Estimate the quality that could be expected from the area groundwater, based on the results obtained through the chemical analyses conducted in wells near the area.
- Establish the preliminary design of the well to be drilled.

The area in which the studies are conducted are with an area of 40 km² (4 000 ha).

The complete hydrological studies that were conducted are included in Annex 5.13.

2. *Hydrological study for the design of the protection works against flood events*

The study aimed to conduct the hydrological analysis in order to determine the growing design criteria that were assign to return periods (Tr) of; 2, 5, 25, 50 and 100 years. However, the analysis was extended up to a Tr of 1 000 years; to design the protection and channeling of the Project zone, which is located in the vicinities of the petrochemical pole of the coastal city of Coatzacoalcos, Veracruz. The complete hydrological studies that were conducted are included in Annex 5.14.

5.3. *BIOTIC ASPECTS*

5.3.1. *Terrestrial Vegetation*

- *Characteristic Vegetation of the Area of Influence*

The region of the Veracruzano tropic, as well as the diversity of vegetation types that is home, constitutes the most northern geographic limit of the evergreen high forest distribution in the American continent (Dirzo and Miranda, 1992). It is here where the species of tropical and temperate environments converge, resulting in a floristic richness and endemisms important center, both on individuals' number by area and on the species diversity.

In the Coatzacoalcos region, there are four types of vegetation: the semi evergreen medium forests, the grasslands, (savannahs, induced and floodable grasslands), the palm groves and the consequent secondary vegetation as a consequence of the human-induced activities in the zone.

The study zone is located in the borders of the natural vegetation with the petrochemical complex of the region, such as Celanese, Resirene and Cangrejera. Moreover, these lands have been used several years ago as feeding areas for the bovine cattle, that's why the degree of disturbance and fragmentation is important. However, and due to the high degree of disturbance in the entire region, there are small marks of the medium semi evergreen forest distributed within this petrochemical area, as well as in different parts of the AoI and the region (see figure 5.19).

This type of vegetation is represented, in its natural form, within the protected natural areas located in this region, known as Jaguaroundi Ecological Park and Los Tuxtlas Biosphere Reserve. These ecosystems mean wildlife refuges, with some species of both flora and fauna, referred within the protection and conservation lists of both national and International, reason which produced the legal base to get the protection to such natural areas expressed above, and ensuring the existence of such intact ecosystems within this interest area.

In the figure 5.4 the vegetation map of the Area of Influence is showed.

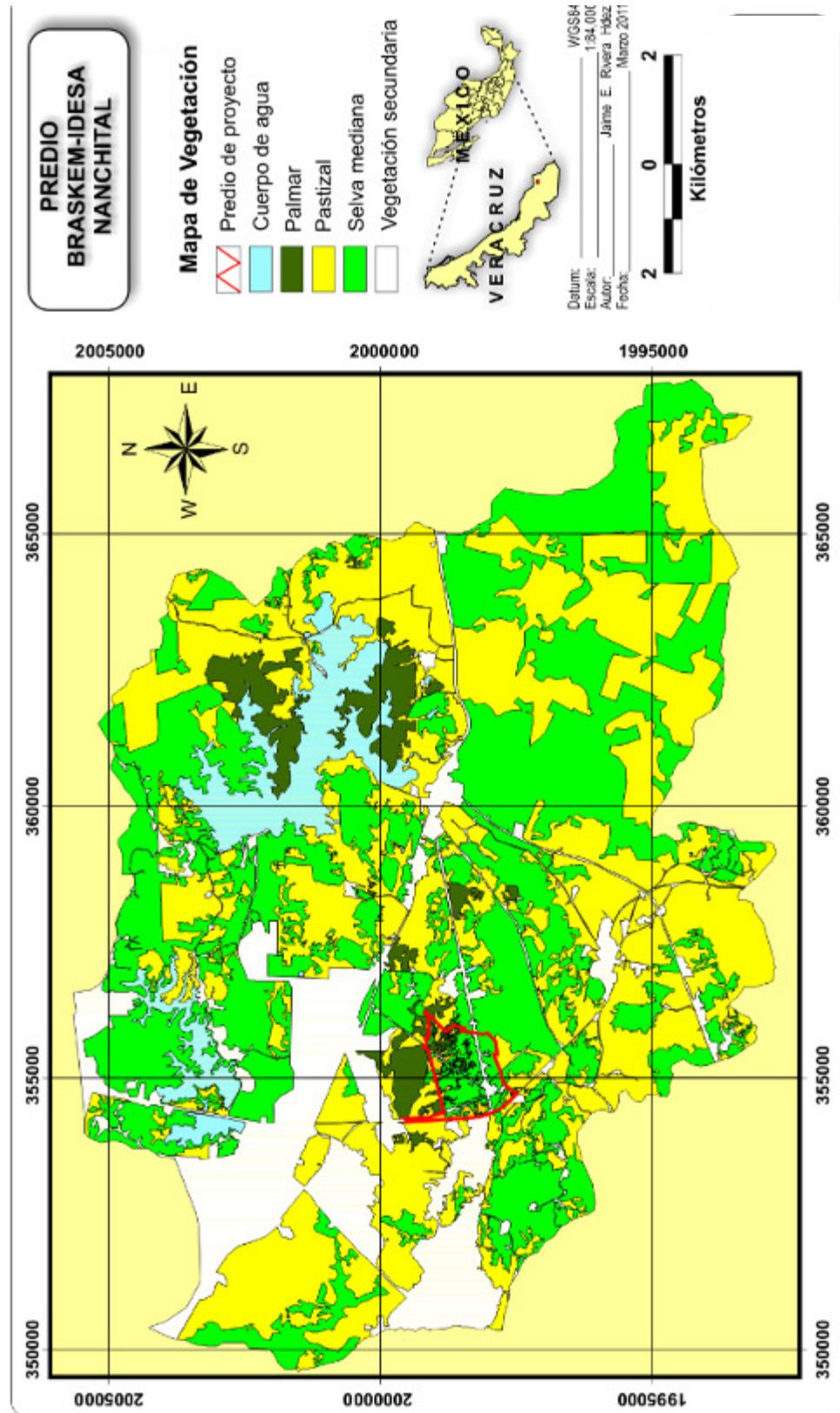


FIGURE 5.4 AOI VEGETATION MAP

- *Characteristic vegetation in the site of interest*

The Coatzacoalcos region in the state of Veracruz can be defined in landscape terms as an ecosystems mosaic whose focal point is the high evergreen forest. However, there are other ecosystems represented in an embedded distribution, such as the medium forest, forest with Holm Oaks, mangroves, aquatic communities and a diversity of human-induced communities. This reveals the Geographic importance of the region because of its wildlife peculiarities and exuberance. For the Coatzacoalcos area would be expected within the low impact areas, a kind of marks that is a floristic richness similar to Los Tuxtlas, in the area as noted above, which is compatible because of the sharing of vegetal communities, besides being scientifically the most studied tropical area within the country. In such region 3,700 species of vascular plants are reported. While it is true that there is this richness regarding to the diversity in the Coatzacoalcos area, it is important to consider that due to petrochemical industry establishment within the region, there is a disturbance and fragmentation degree, which have provoked the gradual loss of an important contingent of species, the reason why there is a great care in the natural conservation of the Jaguaroundi Ecological Park and Los Tuxtlas Biosphere Reserve areas.

To know about the floristic richness of the Project area, walkthroughs were made through the study area, in four biological surveys made in December 2010, August and September 2011, one of three days, two of one day and the last one of four days working in field. During these visits, notes were written and some photos were obtained from the species found, collecting those important ones because of its protection status or the ones with doubts about their identity. The resulting floristic list was submitted to a rigorous taxonomic revision so that the synonymy is not included; this taxonomic revision was conducted based on the different fascicles of the Veracruz Flora, as well as the W3 Tropics data base of the *Missouri Botanical Garden*.

Keeping on the classification of the vegetation types reported by Rzedowski (1978), inside the polygon of the site of interest there are four different types of vegetation (see Figure 5.59):

- a. Medium semi evergreen forest.
- b. Palm grove.
- c. Grassland.
- d. Secondary vegetation.

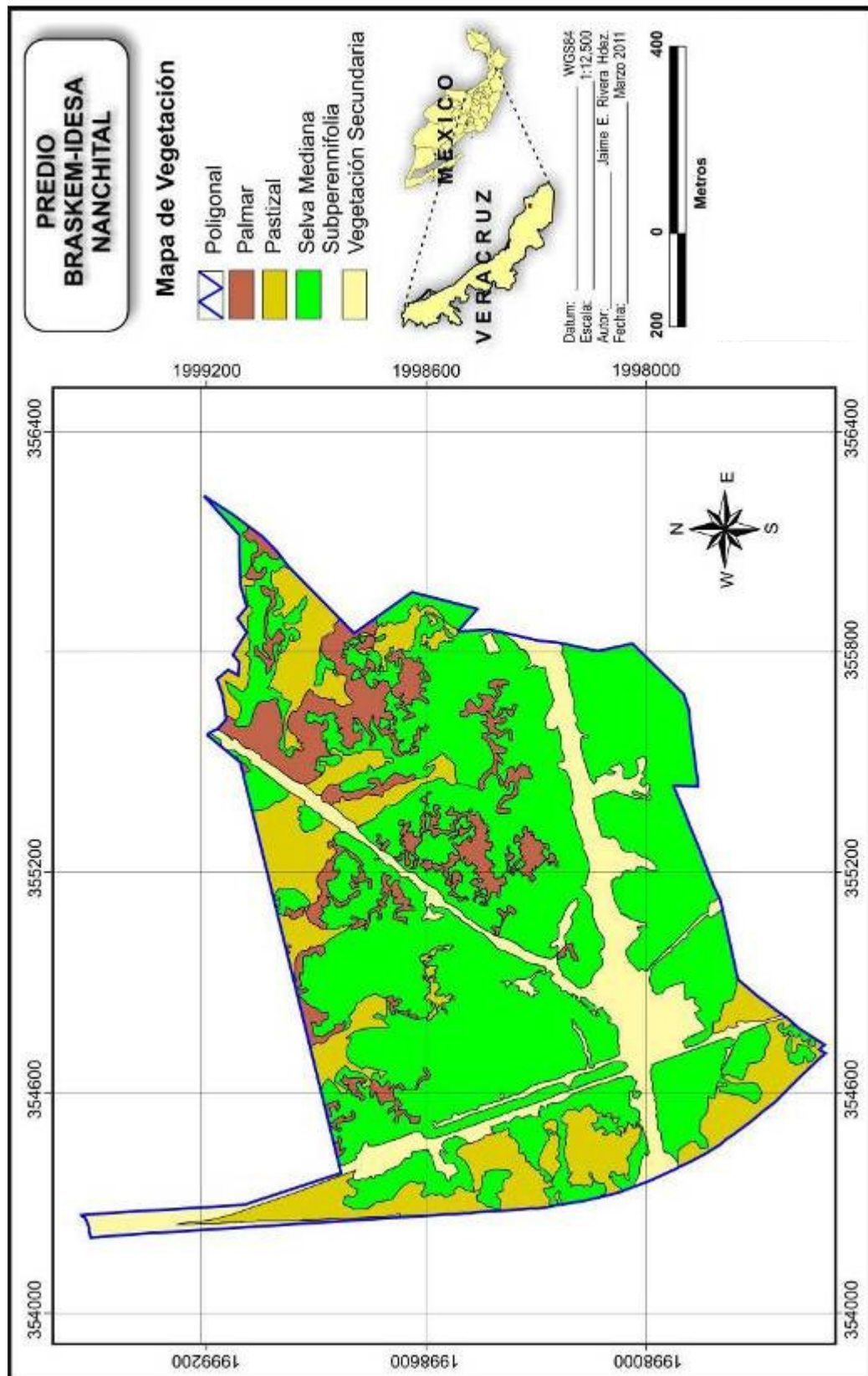


FIGURE 5.5 **VEGETATION MAP OF THE SITE OF INTEREST**

Then, the main vegetation units are described and their subdivisions are identified in the site of interest.

❖ **Medium semi evergreen forest.**

This forest is grouped by Rzedowski (1978) inside the tropical evergreen forest, along with the rest of the tropical rainforests, and therefore, it is preferable to use the term of Miranda and Hernández X. (1963), to be more specific and better describe this vegetation unit (see Photo 5.1).



PHOTO 5.1 **VEGETATION REPRESENTATION OF MEDIUM FOREST INSIDE THE PLOT**

This vegetation unit predominates in the site of interest area where the Project is to be conducted, representing the original vegetation of the site before it could be impacted, at present, such research takes 37.01% from the total area that constitutes the AoI; however, the presence of some species are part of the disturbed high evergreen forests, which could be interpreted as if the origin was due to high evergreen forest disturbance, established on a poorer soil, with a different microclimate.

❖ **Palm grove.**

This vegetation unit is present in a discontinuous way within the site of interest and in different chances it is adjacent to the floodable grasslands and other bodies of water within the AoI, constituting a total percentage of 3.62% of the total area occupied by the AoI. This type of vegetal community, even when it is supported by impacts such as floods, as well as the forest fires, it results very important ecologically, because it provides ecological niches very different and they are specific for the wildlife, remaining possible to find restricted species to this type of vegetation (see Photo 5.2).



PHOTO 5.2 PANORAMIC VIEW OF THE PALM GROVE PRESENT IN THE SITE OF INTEREST

This vegetation unit is characterized by the dominance in the high stratum of a unique species, the “corozo” (*Attalea liebmanni*), a palm grove of up to 12 m. This palm in other regions can measure up to 40 m; however, its small stature in the zone can be due to limiting factors, as the soil richness and the impact of strong winds.

- **Grassland**

The grasslands inside the Project zone have compositions and different origins; however, in this study they are grouped within the same category, mainly by two reasons; the first and the most important one is that, they all are mixed and there are not well-defined borders between them; the second one is a consequence from the first one, because of this reason it is very difficult to distinguish them from the aerial photos; therefore, in the vegetation map they were grouped within the same category. However, each one is described. The grasslands take a total percentage of 38.28% from the total area occupied by the AoI.

- **Floodable grasslands**

These grasslands are very common in the site of interest and they are of considerable dimensions. Their floristic composition is based on different species of grasses, among which we can find “grama de caballo” (*Eleusine indica*), “pan caliente” (*Eragrostis hypnoides*), *Paspalum virgatum* y *Brachiaria fasciculata*, as well as different species of cyperaceae, like the “tuxpata” (*Cyperus odoratus*) and the “zacate de agua” (*Eleocharis elegans*). Because of their characteristics relating to water, they are the habitat of a lot of water birds (see Photo 5.3)

PHOTO 5.3 VIEW OF A FLOODABLE GRASSLAND IN THE SITE OF INTEREST



- **Savannah**

They are small prairies of grasses, where also flourish in a very dispersed way, some small sized trees, mainly “nance” (*Byrsonima crassifolia*), “tlachicón” (*Curatella americana*), “guava” (*Psidium guajava*), “uvero” (*Coccoloba barbadensis*) y “holm oak” (*Quercus oleoides*). They are found in the grasslands and also in the borders of the medium forests, indicating in both cases a human-induced disturbance. They are all established on the soil with an enough drainage, which becomes muddy in rainy days, while in the dry season it is strongly dry and hard, finally reaching the cracking.

- **Secondary grasslands**

They are the result of farming activities and are induced grasslands, also called “potreros”, which have replaced to the native forests. A lot of them already have savannah elements, as part of their natural succession. In these grasslands, the dominance of grasses is absolute, in many of the cases, the “pasto kikuyo” is found (*Pennisetum clandestinum*), which is a great invader and non-native species from Mexico. In the same way, in different moments some arboreal elements can be established, like the palm groves and “uveros”, among others, (see Photo 5.4).

PHOTO 5.4

VIEW OF A SECONDARY GRASSLAND IN THE SITE OF INTEREST



- **Water vegetation**

This vegetation unit is restricted talking about its spatial distribution, to the borders of the temporal and small water bodies existent in the site of interest, very close to the Gopalapa stream, located in the northwest limit of the site of interest, and it is mixed with the vegetation from the floodable grasslands. All the water bodies present in this area are not located because some of them are relatively small and intermittent; however, considering the occupied water by the water bodies within the site of interest, it is estimated this vegetation takes 5.83% of the total surface.

- **Secondary vegetation**

It is about zones where the original vegetation has been removed for the infrastructure construction, such as houses, roads and earth roads. In these areas the proper species of disturbed forests flourish, such as the “jonote” (*Heliocarpus appendiculatus*), “chancarro” (*Cecropia obtusifolia*), “pasto kikuyo” (*Pennisetum clandestinum*), “quiebramuelas” (*Asclepias curassavica*), “achiotillo” (*Vismia camparaguey*), “majahuilla” (*Helicteres* sp.) and “patastillo” (*Luehea speciosa*).

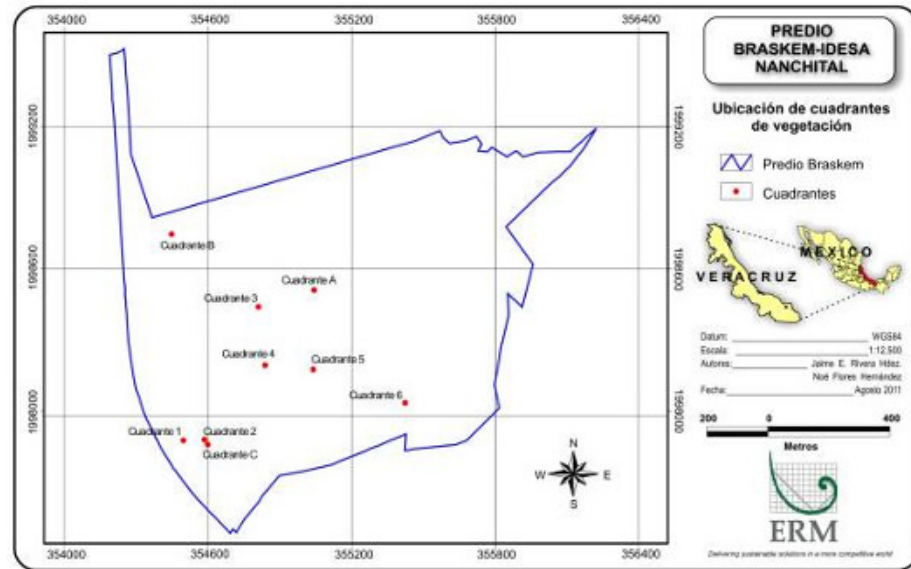
PHOTO 5.5. VIEW OF A SECONDARY VEGETATION IN THE SITE OF INTEREST



Method

The field work consisted in random samplings (selection of sampling units at random) because each population unit has equal probability to be part of the sampling. Initially, three 25 m² quadrants were established (A, B and C), and then, six 40 m² were included (1 to 6), for the purpose of obtaining a greater representativeness of area. The nine sampling sites were located inside the fragments of medium semi evergreen forest with different disturbance grades in the grassland. In the Figure 5.6 the spatial location is showed within the Project area.

FIGURE 5.6 LOCATION MAP OF SAMPLING SITES IN THE PROJECT AREA



Results

As a result of the second collection of vegetation data and taking into account 9 quadrants as a total, a total of 504 individuals belonging to 129 species is registered; from which 55 have low abundance. The species were found distributed in 40 families and 65 genders. With the new quadrants, it emphasizes the fact that the *Fabaceae* family was the best represented. With seven species, then comes the *Rubiaceae* family, with five (see Graph 5.1).

GRAPH 5.1 NUMBER OF SPECIES REGISTERED BY FAMILY, IT IS COMPLEMENTED WITH THE 9 QUADRANTS

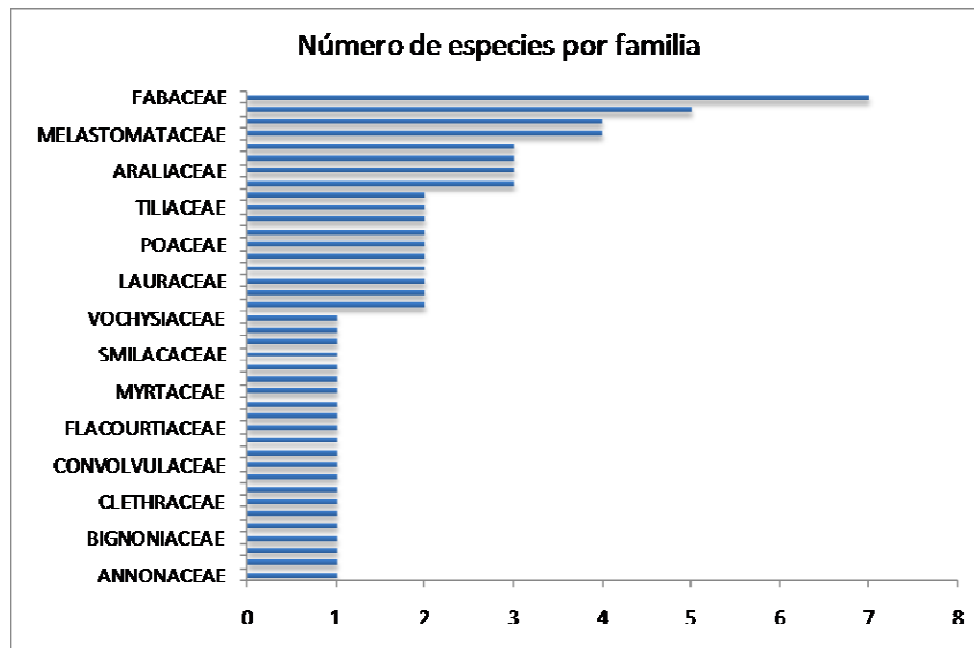


TABLE 5.3 LIST OF ENDANGERED SPECIES

Scientific name	Common name	NOM	CITES	IUCN
CYCADOPHYTA				
ZAMIACEAE				
<i>Ceratozamia miqueliana</i> H. Wendl*	"amendaui"	Threatened with extinction		Critically endangered
<i>Zamia loddigesii</i> Miq.	"palmilla"	Endangered		Near threatened
CLUSIACEAE				
<i>Calophyllum brasiliense</i> Cambess	"bariz"	Endangered		
ORCHIDACEAE				
<i>Myrmecophila grandiflora</i>	"orchid"		Appendix II	
<i>Tanacetum integerrimum</i>	"orchid"		Appendix II	

Ceratozamia miqueliana

It is a species belonging to the *Zamiaceae* family, a group of plants also called cicadas. This species belongs to a complex sharing common characteristics, including: *C. euryphyllidia*, *C. zoquorum* y *C. becerrae*, all of them with distribution in the southeast of Mexico. The known distribution of this species is restricted to the Veracruz states, in the southeast portion, Tabasco and north of Chiapas, it is always in an ecosystem of tropical evergreen forest (high and medium evergreen and semi evergreen), and although in Veracruz, its presence is also reported in the cloud forest.

The known distribution in the state of Veracruz can be observed in the next figure (Gómez-Pompa et al., 2010).

FIGURE 5.7 KNOWN DISTRIBUTION OF CERATOZAMIA MIQUELIANA IN THE STATE OF VERACRUZ.



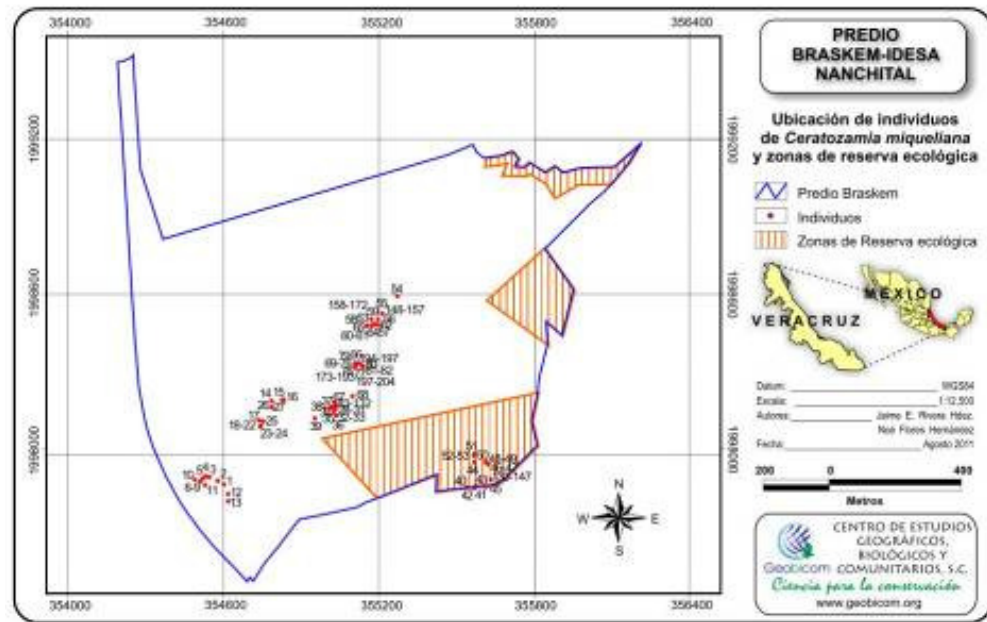
In the survey conducted in the Project site, during walkthroughs and visual searches for four days, a well established population of around 204 individuals was located, they were geo-located, measured and marked with marking tapes for an easy location in future Works of rescue and relocation. It is important to mention that from the total number of individuals, 122 were seedlings, because there were seven individuals with seedlings around them, that is, they were the mother plants.

Relating to the individuals distribution by height and coverage ranges, the individuals lower than 50 cm and a lower coverage of 1 m are highlighted, belonging to the seedling. It is also observed that the rest of the individuals are adult plants of 1 m and with coverages higher than a 1 m. These numbers indicate the *Ceratozamia miqueliana* population is well established, with the pollinators and the necessary environmental conditions for its reproduction and with an important recruiting (see the corresponding chapter of ESIA).

This way, in the map of the figure 5.8 the distribution of the individuals is presented, they are identified in the area, indicating the areas will not be affected by the Project; however, for the rescue and relocation subprogram of these plants, it should be considered at least a 50% percent more than the total of the

individuals found. That is, it is calculated a minimum total of 300 individuals in the zone, from which, at least 200 will be adults and/or young people.

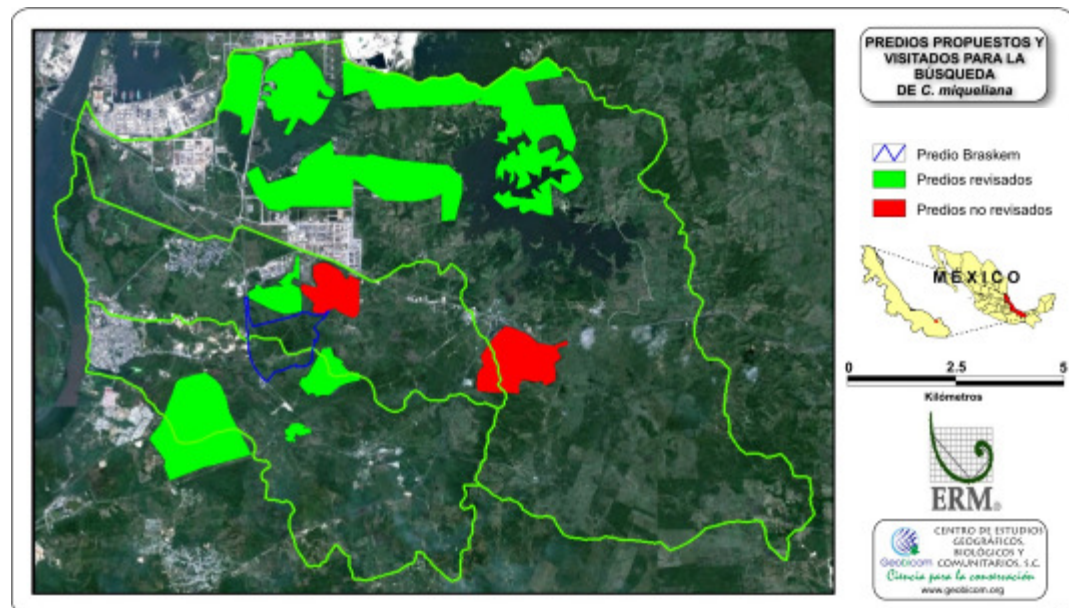
FIGURE 5.8 *LOCATION OF THE INDIVIDUALS FOUND OF CERATOSAMIA MIQUELIANA IN THE INTEREST AREA AND LOCATION OF THE ZONES DESTINED FOR ECOLOGICAL RESERVE WITHIN THE SAME AREA*



The Project contemplates the search conduct of *Ceratozamia miqueliana* in accessible areas within the Area of Influence with the following results:

Walkthroughs were made in area with potential characteristics for the finding of this species (see Figure 5.9), in a total of 8 checked areas; two of them were not checked because of access restrictions.

FIGURE 5.9 *AREAS VISITED WITHIN THE AREA OF INFLUENCE*



As a result of the search made, *Ceratozamia Miqueliana* populations were located, according to the summary presented in the next table:

TABLE 5.4 SUMMARY OF THE POPULATIONS AND INDIVIDUALS LOCATED

Area	Number of individuals registered	Populations number
Jaguaroundi Ecological Park	1 333	55
Rincón Grande	7	5
Reserva 100 ha Celanese	7	3
Rancho el 34	32	2
Complejos (2 areas)	0	0
Rancho Los Cocos	0	0
Predio Marlboro	0	0
TOTAL	1 379	65

The complete report of this search is included as an annex 5.10.

Zamia loddigesii

It is a species pertaining *Zamiaceae* family or cicadas family. It is about the species with the largest distribution of the entire gender, due to it is distributed in a variety of disturbed habitats, acahuales, low and medium forests, potreros, cultivations and ruderal vegetation next to highways and chasms. *Zamia loddigesii* is distributed along the coastal plain from the Gulf of Mexico on the tropical evergreen forest, it should be emphasized generally associated to altered vegetation, and there are a few locations with a vegetation in good conservation and a populations register of this species.

Orchids

The presence of the *Oeceoclades maculata* orchid in the site of interest is due to an invasion made in the region, it is about a native species from the tropical Africa that now is very common in the entire Neotropics mainly expanding in disturbed vegetation resulting from tropical rain forests, that's why it is considered as a disruption indicator.

In the site of interest, it is about a species very abundant , and recent studies show that where this species abounds, other species are sorely lacking (Cohen and Ackerman, 2009), that is, the native species of orchids are displaced, such as it occurs in the Project area, where it is observed an abundance of this species of over 20 000 individuals in the site of interest, only two additional individuals were found of the other two orchids species (*Myrmecophila grandiflora* and *Tanacetum integerrimum*). Because of the small size of these species, it will be easy to reach their rescue and relocation.

5.3.2. Fauna

Amphibians and reptiles

The state of Veracruz is considered as one of the richest in herpetofauna, with 537 amphibians and reptiles species, representing the 21% of the national herpetofauna (Ochoa-Ochoa and Flores-Villela, 2006).

Work field

There were random samplings, trying to cover the different type of vegetation, microhabitats (as buttress of the trees, barks of trunks, litter fall, beneath rocks, fallen trunks, roots, shrubs, palms, water bodies, etc.) and disturbance grades. The capture of the examples was direct and according to the characteristics of each group.

To know the conservation state of the species, the information was compared with the documents, which classify them in accordance with their extinction risk: Mexican Official Standard NOM-059-SEMARNAT-2010 (SEMARNAT, 2010), appendixes CITES and the IUCN Red List (IUCN, 2011).

Twenty-six herpetozoos species were registered (see Annex 5.3), from which 10 corresponded to amphibians and 16 to reptiles. The amphibians species were found distributed in six families and seven genders, while the reptiles corresponded to 13 genders, contained in nine families (see Table 5.5).

TABLE 5.5 AMPHIBIANS AND REPTILES COMPOSITON OF THE STUDY AREA

Groups	Families	Genders	Species	% from total
<i>Anura</i>	7	8	10	39
<i>Lacertilia</i>	6	8	11	42
<i>Serpentes</i>	2	4	4	15
<i>Testudines</i>	1	1	1	4
Total	15	20	26	100

From the 26 registered species, five are included in the category subject to a special protection of the NOM-059- SEMARNAT-2010.

Relating to the IUCN Red List, 12 species in the category of least concern (PM), one of them appears as vulnerable and other one with insufficient data. Just the green iguana (*Iguana iguana*) is in the Appendix II of CITES (see Annex 5.3).

The two species of registered iguanas in the study area are protected by the NOM-059- SEMARNAT-2010.

In the annex 5.3, it is a brief description of the species found in a status of protection.

TABLE 5.6 SPECIES OF ENDANGERED AMPHIBIANS

Scientific name	Common	CITES	IUCN	NOM
Type Amphibia				
Order Anura				
<i>Craugastoridae</i> family				
<i>Craugastor laticeps</i> (Duméril, 1853)	Ranita		Near threatened	Non-endemic (Pr)
<i>Craugastor rhodopis</i> (Cope, 1867)	Ranita		Vulnerable	
<i>Microhylidae</i> family				
<i>Gastrophryne usta</i> (Cope, 1866)	Sapito		Least concern	Non-endemic (Pr)
<i>Iguanidae</i> family				
<i>Ctenosaura acanthura</i> (Shaw, 1802)	Garrobo			Endemic (Pr)
<i>Iguana iguana</i> (Linnaeus, 1758)	Iguana	II		Non-endemic (Pr)
<i>Kinosternidae</i> family				
<i>Kinosternon leucostomum</i> (Duméril and Bribon 1851)	Pochitoque			Non-endemic (Pr)

It should be emphasized that in addition the species are protected by the NOM-059-SEMARNAT-2010, the Project impact would be low, due to these species have a wide geographical distribution. Given that the Project activities consider the total remove of the habitat from different amphibians and reptiles species, it is proposed the Subprogram for Rescue and Relocation of Wild Fauna (see Annex

8.7) in order to move reptiles and amphibians catalogued with conservation problems.

Birds

Work field

For the birdlife study, transects were made along the highways and chasms covering all area to conduct direct observations and auditive registers, which started since 7:00 am until sunset, and one night until 10:30 pm. The registers were made with binoculars (8X40, high-resolution, Swift Gran Prix Mk I) and the species were determined with the field guides use Howell y Webb (1995), *National Geographic* (1996) and Van Perlo (2006).

In this study, 86 resident species were registered, 26 winter visitors species and one transitory species.

Endangered species

According to the risk categories, 17 species registered in the site of interest are in a category of NOM-059-SEMARNAT-2010, reporting three species threatened with extinction, eight subject to a special protection and six as endangered. According to the CITES, 24 species are within the Appendix II and just the *Amazona oratrix* species appears in the Appendix I.

Additionally, one species is considered as vulnerable according to the Red List of the IUCN, the pheasant (*Crax rubra*). The yellow-headed parrot (*Amazona oratrix*) and the golden-cheeked warbler (*Dendroica chrysoparia*) are also in the IUCN list as species threatened with extinction, (see Table 5.7), whose distribution is detailed in the Annex 5.3.

TABLE 5.7 REPORTED SPECIES WITHIN THE NOM-059-SEMARNAT-2010, CITES AND THE RED LIST OF IUCN.

SCIENTIFIC NAME	COMMON NAME	NOM	CITES	IUCN
GALLIFORMES				
CRACIDAE				
<i>Ortalis vetula</i>	Plain chachalaca			
<i>Crax rubra</i>	Pheasant	A	AIII	Vulnerable
PELECANIFORMES				
ARDEIDAE				
<i>Tigrisoma mexicanum</i>	Mexican tiger-heron	Pr		
ACCIPITRIDAE				
<i>Accipiter striatus</i>	Sharp-shinned hawk	Pr	AII	
<i>Buteo magnirostris</i>	Roadsie hawk		AII	
<i>Buteo albonotatus</i>	Zone-tailed hawk	Pr	AII	
FALCONIDAE				

SCIENTIFIC NAME	COMMON NAME	NOM	CITES	IUCN
<i>Caracara cheriway</i>	Crested caracara		AII	
<i>Herpetotheres cachinnans</i>	Cowbird		AII	
<i>Falco femoralis</i>	Falcon aplomado	A	AII	
<i>Falco ruficularis</i>	Dwarf falcon		AII	
PSITTACIDAE				
<i>Aratinga holochlora</i>	Mexican parakeet	A	AII	
<i>Aratinga nana</i>	Olive-throated parakeet	Pr	AII	
<i>Amazona autumnalis</i>	Yellow cheeked parrot		AII	
<i>Amazona farinosa</i>	mealy amazon	P	AII	
<i>Amazona oratrix</i>	Yellow headed amazon	P	AI	Endangered
STRIGIFORMES				
STRIGIDAE				
<i>Megascops guatemalae</i>	Vermiculite tecolote		AII	
<i>Pulsatrix perspicillata</i>	Glasses owl	A	AII	
<i>Glaucidium brasilianum</i>	Ferruginous Pygmy owl		AII	
<i>Pseudoscops clamator</i>	Striped owl	A	AII	
TROCHILIDAE				
<i>Amazilia candida</i>	White bellied emerald		AII	
<i>Amazilia yucatanensis</i>	Buff-bellied hummingbird		AII	
<i>Archilochus colubris</i>	Ruby-throated hummingbird		AII	
PICIFORMES				
RAMPHASTIDAE				
<i>Pteroglossus torquatus</i>	keel billed toucan	Pr	AII	
<i>Ramphastos sulfuratus</i>	Toco Toucan	A	AII	
PICIDAE				
<i>Campephilus guatemalensis</i>	Pale-billed woodpecker	Pr		
VIREONIDAE				
<i>Hylophilus decurtatus</i>	Lesser greenlet	Pr		
PARULIDAE				
<i>Dendroica chrysoparia</i>	Golden-cheeked warbler	P		Endangered
ICTERIDAE				
<i>Psarocolius</i>	Montezuma	Pr		

SCIENTIFIC NAME	COMMON NAME	NOM	CITES	IUCN
<i>montezuma</i>	oropendola			

A description of the species found with a protection status is presented in the Annex 5.3.

Due to the ecological fragmentation caused by the human-induced activity, particularly, the Industrial activities (mainly the effect of the great petrochemicals facilities in the zone), the agricultural activities, at present the Coatzacoalcos zone shows a notorious but limited presence of biodiversity reservoir in the region. It is inferred from the observations made in some zones of the study area. Mainly, the present marks of the forest work as little biodiversity reservoirs, the same for the resident birds as for the ones crossing Coatzacoalcos in their migratory route to the south of Mexico or America. Due to the above, the acquisition land is considered within the region, with similar characteristics to the site of interest, as a compensation measure to ensure through fauna rescue and relocation actions, the conservations of these present species in the area to be impacted.

The “golden cheeked warbler” register (*Dendroica chrysoparia*) highlights in importance, because it is a migratory species from the EEUU visiting Mexico in its migratory route to the south of America, where the distribution area is very restricted. This species requires vegetation patches in a good conservation state, which are used as islands to continue advancing to the site where the winter will remain. The conservation of most of the vegetation patches is important, so it should be secured to leave conservation areas inside the Braskem-Idesa ground, such as the Project is contemplated.

The works to be conducted inside the Braskem-Idesa ground will consider, if possible, respecting the conservation areas, living priority to the forest remnant marks and focusing on the points considered as high and medium conservation state, so that these biodiversity remnants can help to maintain the birds diversity and fauna in general; from this Coatzacoalcos zone, because it not only allows resident species but receive each year to a considerable number of migratory winter, and surely of summer. On the other hand, the fact that the area has been registered 14 birds species found in the NOM-059, as the “yellow headed amazon” (*Amazona oratrix*) and the “mealy amazon” (*Amazona farinosa*), supports the conservation politics of an area within the interest ground, as it is established in the Project.

In the Annex 5.3, the species found are detailed within the site of interest showing a protection status.

Mammals

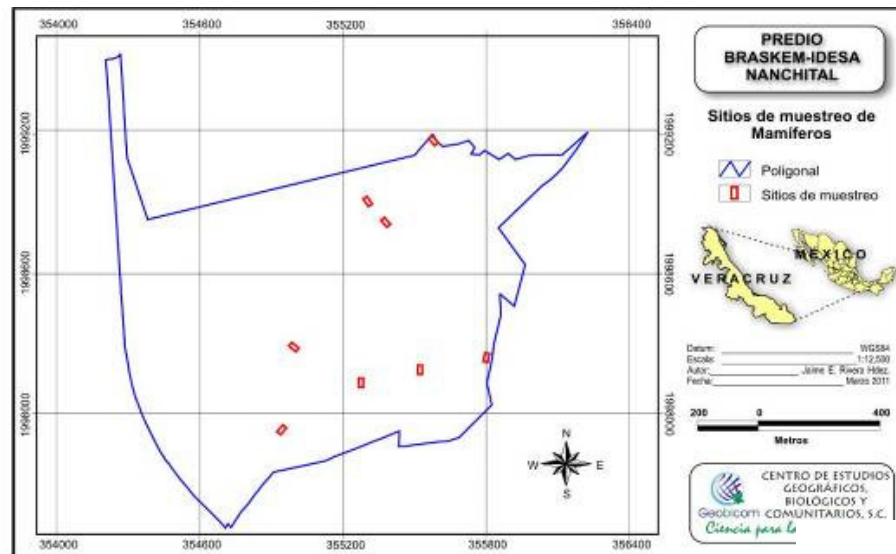
Method

As a first step to conduct a mastofauna sampling of the zone, a bibliographic revision based on Aranda (2000), Villa and Cervantes (2003), Ceballos and Oliva (2005), Herrera *et al.* (2008), Morales-Mávil and Suárez-Domínguez (2010), for the purpose of having a base list of mammals species with a potential distribution for

the area, to have a reference framework and to have a correct species determination occurring in the AoI. For this, the appropriate guide fields were used, for example, for visual observations, evidences, footprints of Aranda (2000) and Reed (1997); and for bats, the one of Medellín *et al* (2008).

To evaluate the presence and abundance of the mammals species present in the area, appropriate samplings were designed, for each of the groups (terrestrial and flying). Hereafter, the used methods are described.

FIGURE 5.10 *DISTRIBUTION OF THE SAMPLING QUADRANTS FOR RODENTS AND NETS FOR BATS*



Relevant aspects from mammals

Nineteen mammal species were registered in the 8 sampling stations. Most of the part of the registered species is tolerant to the disturbance (see annex 5.3). In fact, 10 species are habitat generalists; this indicates they could be found in a wide variety of different environments.

Two species are in the NOM-059-SEMARNAT-2001 and in the CITES catalogued as Endangered (E) (*Puma jagouaroundi* and *Lontra longicaudis*), and a highest species in the CITES appendix (*Nasua narica*), and two more are registered as least concern (PM) (*Puma yagouaroundi* y *Nasua narica*).

TABLE 5.8 SPECIES REPORTED IN THE NOM-059-SEMARNAT-2010, CITES AND THE IUCN LIST.

Species	Common name	NOM-059	CITES	IUCN
FELIDAE FAMILY				
FELIANE SUBFAMILY				
<i>Puma yagouaroundi</i>	Jaguaroundi	A	I	Least concern
MUSTELIDAE FAMILY				
LUTRINAE SUBFAMILY				
<i>Lontra longicaudis</i>	River otter or giant otter	A	IV	Insufficient data
PROCYONIDAE FAMILY				
PROCYONINAE SUBFAMILY				
<i>Nasua narica</i>	Coati, badger		III*	Least concern

Habitat importance

The habitats evaluated have a low richness due to they are vegetation fragments with different states of disturbance; this would allow to infer the relieved habitats and more sensitive to the presence and human activities.

Habitat connectivity

The habitat from the study area has different grades of disturbance, and potentially it would have a diversity of mammal species equally variable. Moreover, our registers and the effort made just allow us to indicate that, for most of the species, this is an habitat being time-space used, gradually, by some species, as the bats and some carnivores, who could use it as a feeding site, so those environments with the best conservation state and with characteristics that allow the interconnection with other vegetation patches with the same habitat quality, could be appropriate for the species conservation.

c) Aquatic biodiversity in the streams located in the study area.

There are two streams in the study area: the Gopalapa and the Nanchital.

Gopalapa stream

General characteristics

In the Northeastern extreme of the Project area, there is the Gopalapa stream, which is one of the polygon limits where the Project will be installed. To know the biotic and abiotic characteristics of this stream the way restricting the area around 200m was covered; outside the area limits was covered, 100m to the west and 100m to the north, resulting in 400m evaluated of length.

PHOTO 5.6 **GOPALAPA STREAM VIEW**



Vegetation found in the channel borders was of two types: in the north side, corresponding to an outside area of AoI, vegetation is practically a 100% of grassland with few arboreal elements and of secondary status, with species as *Cecropia obtusifolia* and *Guazuma ulmifolia*.

In the south, within the Project area, vegetation is a combination by sections: starting from the west extreme of the studied section, with a medium semi evergreen forest (or acahual), with secondary trees up to 15 m high, as *Cecropia obtusifolia*, and with some elements of the palm species *Attalea liebmännii*, of 10 and 15 m high. It is important to mention of the side of the area, with a width of 10 and 15 m, the dominant vegetation is abandoned grassland, because previously the area was used for farming. In brief, the vegetation in both stream borders is of a secondary type in a 100%.

Vegetation, flora and fauna

Relating to the fauna, small fishes were found in the water relatively crystalline due to the ground that is in solution in this rainy time. At present, specialists are conducting monitoring efforts related to the capture of these examples in order to perform an identification of the species represented by these individuals. This presence shows the water contamination is not severe. This group of fishes can be an indicator to follow the conservation state of this water body.

Along the Gopalapa stream the next bird species were registered: *Euphonia affinis*, *Dryocopus lineatus*, *Psarocolius montezuma*, *Campylorhynchus zonatus*, *Myiopagis viridicata* and *Oncostoma cinereigulare*. These species are in the Least Concern category (PM) according to the IUCN Red List; the *Psarocolius montezuma* is in the Special Protection category according to the NOM-059-SEMARNAT-2010.

Nanchital stream*General characteristics*

In the southwestern extreme of the Project area, but outside, there is a Nanchital stream section, next to the Pollo de Oro community, which discharges its waste water directly to the channel.

The road that connects the highway to Villahermosa with the accesses to different industrial facilities crosses over this stream, that's why it was built a sewer not to prevent its flow. To know about the characteristics of this stream, 500 linear meters were covered and the vegetation was observed among other characteristics.

The Nanchital stream, in the evaluated section, has a channel with a width of 3 and 5 m, and an actual depth (August 2011) of 40 cm and 1.5 m; coloration and marks were detected in the ground of the walls and riversides of both margins, which indicate that their maximum depth reached recently would have raised around 1 or 2 m above the actual depth observed.

In addition, the black sewage discharge was observed without the Pollo de Oro treatment, so the channel is contaminated since this point. It is important to mention, before this point, it has a yellowish-brown color that seems to be unnatural.

PHOTO 5.7 NANCHITAL STREAM VIEW



Vegetation, flora and fauna

In the margins of this stream, a secondary vegetation was found, such as little marks of disturbed forests and induced grasslands. The dominant species were the typical of the secondary vegetation (*Cecropia obtusifolia*, *Heliocarpus appendiculatus*, etc.), with some remnant elements of the forest and of the gallery vegetation, just like *Inga* sp. In general, the conservation state of the vegetation would seem low.

Relating to the big and medium mammals, it was just found the old trace of an excrete, but because of its deterioration it could not be recognized. There were not fresh footprints or excretes that could indicate the presence of this fauna group along the channel, neither fishes presence was observed in the channel.

The Nanchital stream is bordered, in most of the section covered, by the vegetation of a disturbed acahual, secondary vegetation and grassland. In those types of vegetation some birds were observed, like *Pitangus sulphuratus* and *Miozetetes similis* flycatchers, *Psilorhinus morio* Brown Jays, *Melanerpes aurifrons* woodpecker and *Turdus grayi* Clay-colored Robin, which are tolerant to the disturbance, and other birds not so tolerant to the same one, which use this type of vegetation as biological corridors, like the warbler *Dendroica coronata*, *Mniotilta varia*, *Dendroica petechia*, *Dendroica magnolia* and *Setophaga ruticilla*. These species are in the least concern category (PM) according to the IUCN Red List, and the *Dendroica coronata* is in the endangered category according to the NOM-059-SEMARNAT-2010.

Conclusion and general considerations

After studying extensively the vegetation, flora and fauna of the Project area, as well as to cover and characterize the surrounding areas at the same, where it could generate an indirect affectation to the Project, two general conclusions were reached:

1. The sites of interest to be occupied by the Project, as well as its surrounding areas, are disturbed for decades.
2. Notwithstanding above, and because of the biological richness of the region where the site is, there are some rare or protected species, and due to the low density they are in the site of interest, their rescue and relocation are completely manageable. In this case, there are the completely described orchids and cycads, which can be relocated through the Sub-program of vegetation relocation and transplantation (see Annex 8.8). In the case of two protected mammals, they can be captured for a further relocation, if they are within the site of interest. In the case of the birds, they will move to places not to be disturbed; however, an effort will be conducted in order to help nesting and sling bars. It is explained and detailed in the Sub-program of biodiversity (see Annex 8.6), whose actions are summarized below:

Rescue of native species

It is important to define part of the Project area as reservoir or conservation zone. Such zone will have 3 polygons containing 30 ha, and native flora and fauna examples will be rescued.

In the case of the flora examples, the procedure will be the transplant of all the protected species, as the cycads, which already were searched and counted getting a total of 201, they were marked and located by GPS.

For the terrestrial vertebrates, mainly mammals, amphibians and reptiles, the captures will be made with the appropriate methods: traps for the small and medium mammals, and direct capture for amphibians and reptiles.

According to the total quantities of the captured flora and fauna examples, it will be distributed in the mentioned polygons already defines for conservation. If they do not have the enough resources for a space or appropriate conditions for survivor, other areas will be needed to complete the relocation.

To prevent this, the Jaguaroundi Ecological Park was an option, property of PEMEX Petroquímica, and managed by the Biology Institute of the National Autonomous University of Mexico since October 2009 through a collaboration agreement. This park is located to the north of the Project area in the same region, approximately 4 km in a straight line from the destined area to the building of the Ethylene plant.

In August 10th 2011, there was a meeting in the Jaguaroundi Ecological Park with the Director of such reservoir, the biologist Víctor Peña Ramírez, for consulting if

there are conditions and availability to receive flora and fauna examples of relocation. The response was affirmative and the biologist Peña Ramírez offered the examples donation of native species of the high evergreen forest in the nurseries of such ecological park.

So, with the support of the Jaguaroundi Ecological Park, it is considered to conduct transplant activities and flora relocation, as well as the wildlife rescue and relocation. The personnel and materials to perform the relocation of such species will be provided by the developer. Moreover, the personnel park will be used as guides and they are going to define the points of fauna release and the replant within the ecological park. It will be a continuous access to the transplant point for monitoring and maintaining the flora individuals transplanted in the best conditions.

Collaboration will be present with the Park in other aspects, as the germplasm procurement and vegetal material, to subsequently be transplanted to the conservation zones destined in the ground to be occupied by the Project and the germplasm donation from the developer to the Park.

Accordingly, the rescue is secured from the examples of protected native species in the work transplant area, which is planned to perform other actions of biodiversity conservation. It will also possible to conduct possible collaborations with the Park personnel.

Also, it is important to mention that the Jaguaroundi Ecological Park manager have been keeping Couch with students from the Ecology Institute A.C of Xalapa (INECOL) since June, looping for the support or collaboration in activities of both restoration and identification (with Dr. Javier Laborde) of protected species, particularly the ones of the *Zamiaceae* family (with Dr. Andrew Vovides).

As well as in the park, it is only necessary to formalize the collaboration among institutions.

About the *Ceratozamia miqueliana*, species listed as Critically Endangered according to the IUCN Red List, as a result of the obtained results alter the exhaustive monitoring campaigns performed in the interest area but also in the Area of Influence of the Project, taking as a reference the Performance Standard No. 6 of the IFC about Diversity Conservation and the Sustainable Management of Natural Resources and the Guidance Note G17 about such standard, it can conclude saying that the site of interest to be occupied by the Project is classified as a Critical Habitat, taking into account the criteria of such Performance Standard, which asks for “the presence of species from which it is known they are in extreme danger or threatened with extinction. It is well known that the *Ceratozamia miqueliana* is under the next grade of protection: Critically Endangered (PC).

It is important to consider that according to sections G19 y G20 from the Guidance Note of such Performance Standard, which establishes that a project can be conducted within an area classified as critical habitat only if it possible to demonstrate there won't be an adverse quantifiable impact about the capacity of the critical habitat, and populations of any species recognized as endangered or

critically endangered should not be reduced (according to the Red List of UICN and any other national list). Then, there are some arguments and actions which will secure the accomplishment with the established constraints by the IFC for this type of habitats:

- According to the field observations, the *Ceratozamia miquelania* species is well represented in the Jaguaroundi Ecological Park, just as the monitoring campaign showed it in this Ecological Park, with more than 1 000 individuals of such species, of different ages and still counting with some individuals in a reproductive way.
- Within the site of interest, the Developer will leave a total area of conservation without any alteration of 30 ha within the area, according to the monitoring campaign in this zone, it is well known there are 80 individuals of such species besides the conservation of such area, there will be maintenance actions, conservation and permanent monitoring, carried out by the personnel of the developer.
- It is considered the relocation and transplant of the 100% of individuals identified in the survey conducted in the site through the Vegetation Relocation and Transplant Subprogram (see Annex 8.8). The best practices of transplant will be considered to increase the survival of the interest species, which will be transplanted within the same conservation area located inside the site of interest (30 ha), as well as inside the Ecological Park. These actions will be conducted through the support of the National Institute of Ecology (INE) and Jaguaroundi Ecological Park personnel.
- Finally, it is considered to perform a continuous following and monitoring of the survival percentage from transplanted individuals, both in conservation area of the site of interest and in the Jaguaroundi Ecological Park.

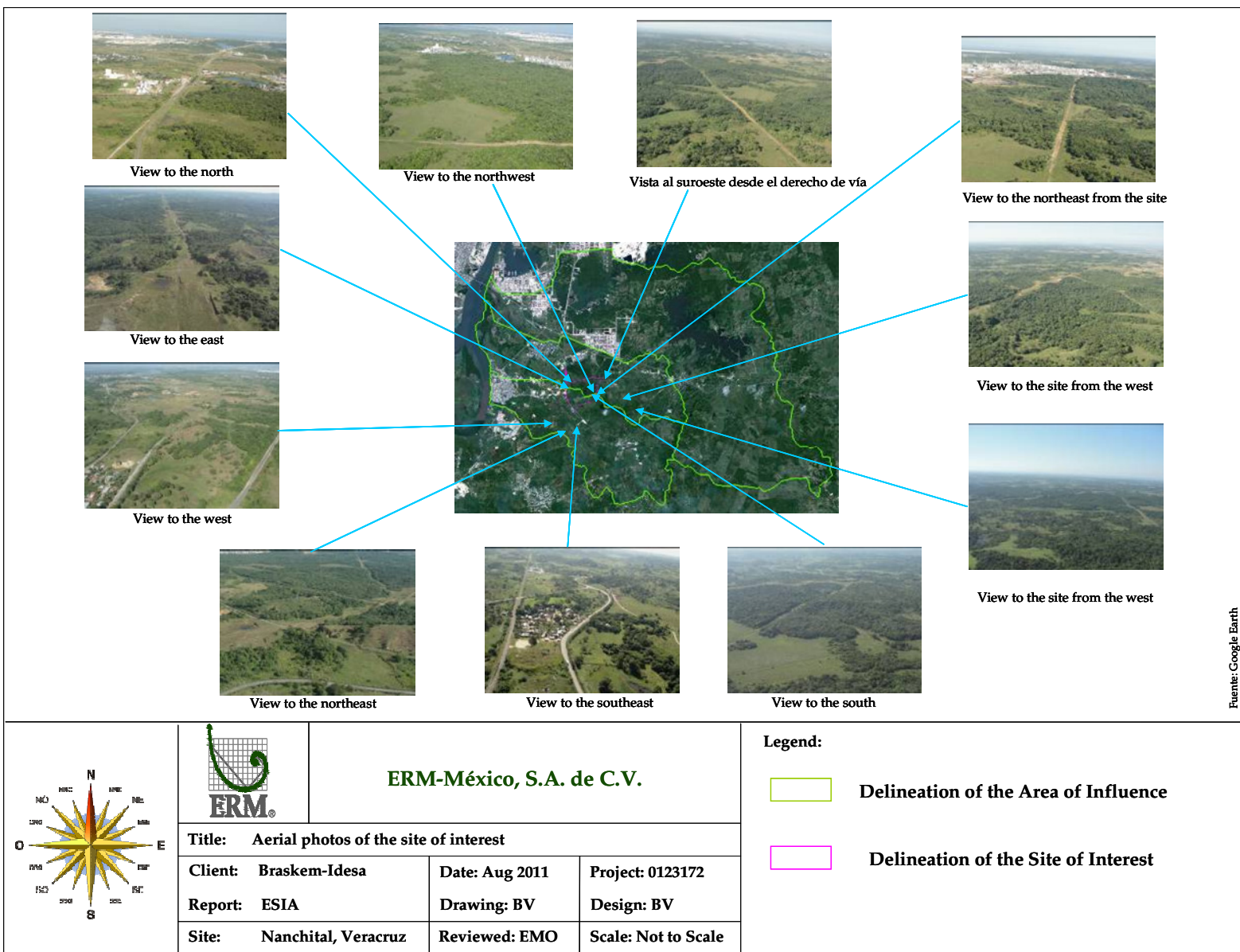
5.4. *LANDSCAPE*

The landscape attributes were evaluated into the Area of Influence (AoI) of the Project, following the next Landscape Units (LU)¹:

- Urban Zones.
- Rural Zones.
- Industrial Zones.
- Permanent water bodies (rivers, lagoons, costal zones).
- Intermittent water bodies (runoffs).
- Elevations (hills).
- Coconut grove.
- Grasslands.
- Medium rainforest.
- Secondary vegetation.

In Figure 5.11 are presented the panoramic photographs of the Project area.

¹ Ecogeographical areas with some degree of homogeneity biophysics.



The LUs location inside AoI is presented in the Figure 5.12

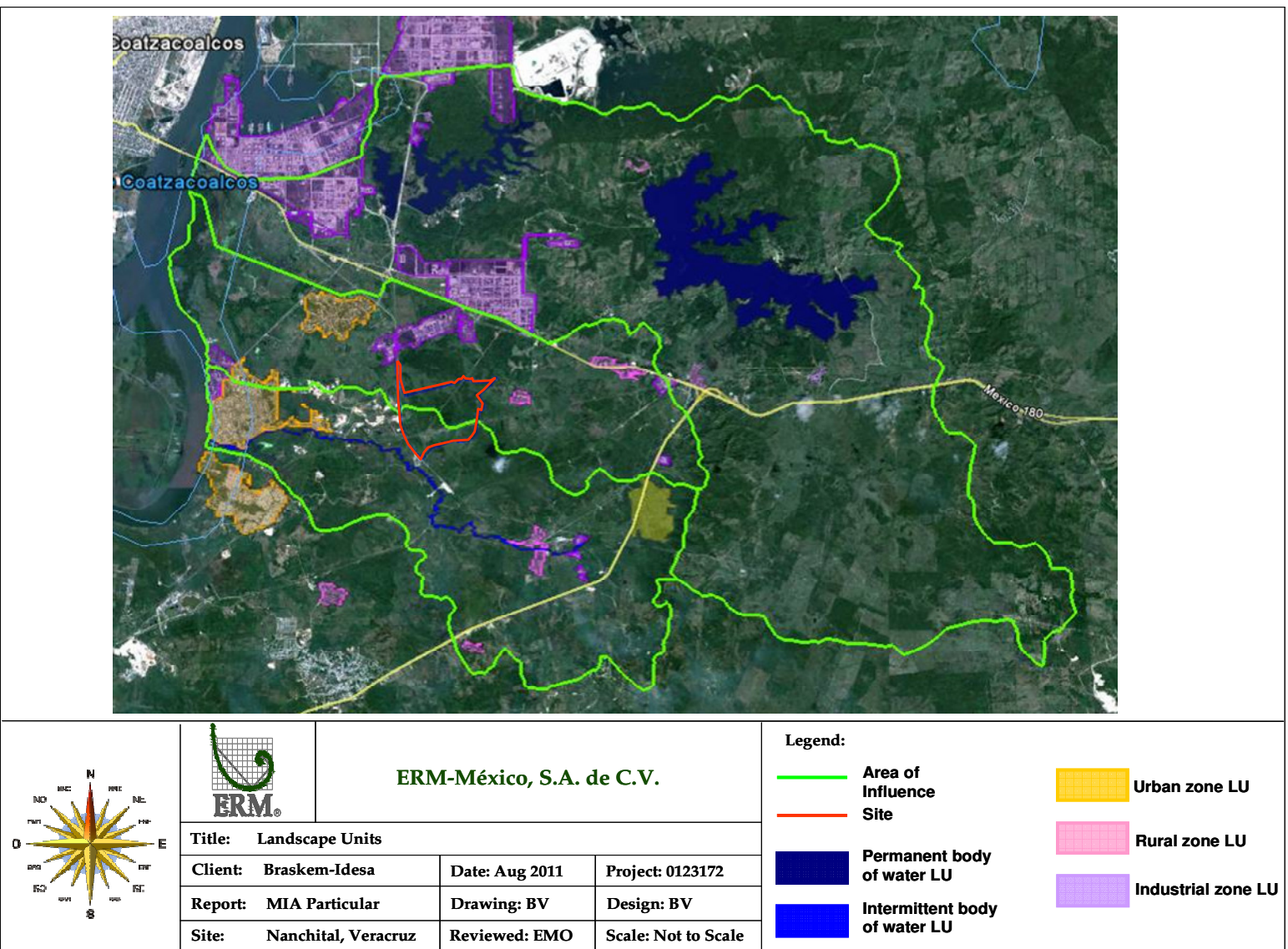


FIGURE 5.12 LANDSCAPE UNITS INSIDE THE AREA OF INFLUENCE

Figure 5.13 shows the LUs, identifying the vegetation distribution and other natural and anthropogenic elements inside the AoI.

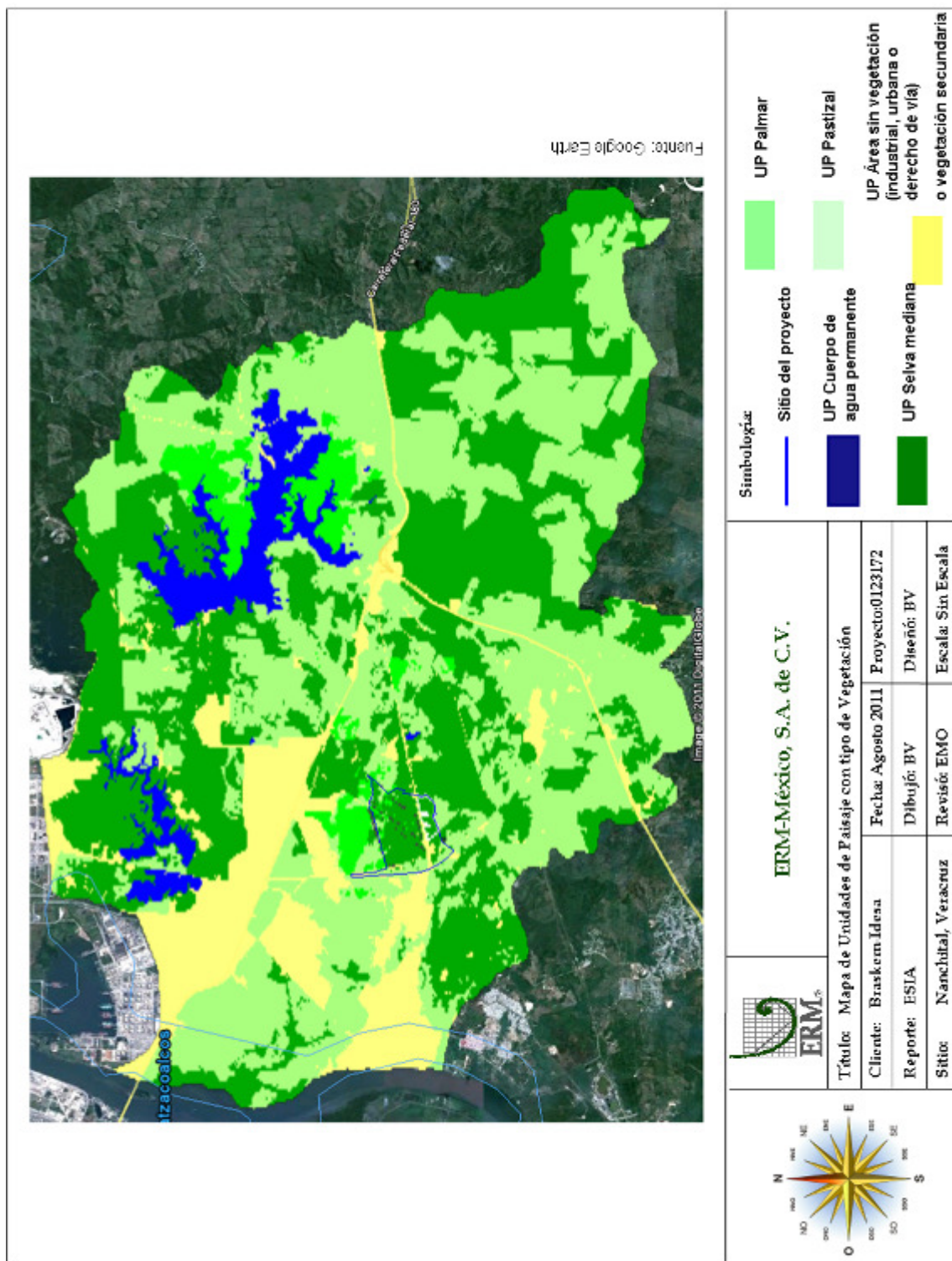


FIGURE 5.13 MAP OF LANDSCAPE UNITS WITH TYPE OF VEGETATION

Each of the Landscape Units located in the AoI were assessed, according to the following variables:

Visual Quality (VQ)	Aesthetic and ecological value of the degree of alteration of an area and the visual importance or value of it.
Visual Fragility (VF)	Landscape susceptibility to change when an activity is carried on it. Its role in response to varying gradients of topography, vegetation, temperature, humidity and soil. An additional factor to this variable is imposed by disturbances, biotic interactions and land use.
Visibility (V)	Is the susceptibility of an area or scene to be seen and is determined from the view shed and towns, and is a function of distance.

Source: Montoya *et al.*, 2002; Turner *et al.*, 1991; Martínez, 2003.

Based on the aforementioned variables; was determined visual vulnerable quality (VVQ), considered specifically as a comprehensive *indicator of landscape sensitivity to changes produced by the Project* (Carabelli, 2002).

a) Landscape Visual Quality Evaluation

This assessment was performed by assigning to each landscape unit identified in the AoI a category based on its visual quality. This assessment included ecological and aesthetic criteria.

Visual Quality Landscape Evaluation

The criteria used (see chapter 5.4) were scored by assigning a value of 1 to 6, the final scores were obtained from the averaged of the assigned values, and were obtained the visual quality of each landscape unit delimited.

The scale of values used is presented in the full document.

Table 5.9 is a summary of the visual quality values obtained for each landscape unit.

TABLE 5.9 VISUAL QUALITY VALUES FOR THE LANDSCAPE UNITS

Landscape Units	Visual Quality	Visual Quality Type
Urban zones	1.0	Low
Rural Zones	2.1	Medium
Industrial Zones	0.5	Low
Permanent Water Bodies	5.0	High
Intermittent Water Bodies	2.1	Medium
Elevations (Hills)	4.1	High
Coconut Grove	5.0	High
Grassland	4.0	Medium
Medium Rainforest	6.0	High
Secondary Vegetation	2.0	Low
Average	3.2	Medium

b) Landscape visual fragility evaluation

This indicator is very important in the assessment of environmental impacts, due that based on this is feasible determine if the Project is located in an area of high visual fragility, where its impact will be significant for the environmental component.

For this assessment, the following criteria were used to assess the fragility of the landscape in accordance with Turner et al. (2001):

- Vegetation coverage.
- Topography of the zone where it is located.
- Project susceptibility to be observed from the different LU.

The fragility scale used is presented in the Table 5.10.

TABLE 5.10 VISUAL FRAGILITY VALUES FOR LANDSCAPE UNIT

Landscape Units	Visual Fragility Value	Visual Fragility Type
Urban zones	3.0	Medium
Rural Zones	3.0	Medium
Industrial Zones	6.0	High
Permanent Water Bodies	3.0	Medium
Intermittent Water Bodies	5.0	High
Elevations (Hills)	2.1	Medium
Coconut Grove	3.5	Medium
Grassland	2.5	Medium
Medium Rainforest	2.0	Low
Secondary Vegetation	1.0	Low
Average	3.1	Medium

c) Landscape Visibility Evaluation

The evaluation of visibility is performed based on the view shed seen from the LU located within the AoI, to the property, taking the distance and type of vegetation as a weighting factor.

Table 5.11 presents the results of visibility for the study area.

TABLE 5.11 LANDSCAPE VISIBILITY VALUES

Landscape Units	Visibility Value	Visibility Type
Urban zones	4.0	Low
Rural Zones	1.0	High
Industrial Zones	1.0	High
Permanent Water Bodies	4.0	Low
Intermittent Water Bodies	3.1	Low
Elevations (Hills)	3.5	Low
Coconut Grove	3.1	Low
Grassland	2.0	Medium
Medium Rainforest	3.1	Low
Secondary Vegetation	3.1	Low
Average	2.8	Medium

d) Vulnerable Visual Quality

As stated at the beginning of this section, the assessment of visual quality, visual fragility and visibility, was used to calculate the vulnerable visual quality (VVQ) of the landscape, which serves as an integral indicator of the sensitivity of the landscape to the changes by the Project (Carabelli, 2002).

To determine the VVQ, we used the following equation:

$$VVQ = VQ + (VF * V)$$

Where:

- VVQ = Vulnerable visual quality.
- CV = Visual quality.
- FV = Visual fragility.
- V = Visibility.

Table 5.12, is a summary of the values obtained for each criterion evaluated, and the results of Landscape Unit VVQ.

TABLE 5.12 VVQ RESULTS

Landscape Units	Vulnerable Visual Quality	
	Value	Category
Urban zones	13.0	High
Rural Zones	5.1	Low
Industrial Zones	6.5	Medium
Permanent Water Bodies	17.0	High
Intermittent Water Bodies	17.6	High
Elevations (Hills)	11.5	Medium
Coconut Grove	15.9	High
Grassland	9.0	Medium
Medium Rainforest	12.2	High
Secondary Vegetation	5.1	Low
Average	11.3	Medium

Conclusions

According to the analysis presented above, the LU of *permanent water bodies*, *elevation*, *coconut grove* and *medium rainforest* are those with higher visual quality. This does not mean they are undisturbed areas, but even when they have already a degree of alteration according to the study of vegetation of all LU identified are those with greater aesthetic value.

Urban and industrial zones, and *secondary vegetation* zones are the most impacted of all the LU identified, thus shows the values of lower visual quality, which means they are areas considered less aesthetic and ecological value.

For the visual fragility, due to its proximity to the site of interest, the LU of *industrial zones* and *intermittent water bodies* present the highest rates, since these areas show greater susceptibility to changes related to activities to be conducted at the site of interest.

On average, the landscape visibility classification of all identified LU is medium, due to although there are *urban*, *rural* and *industrial zones* permanently transited by observers, the AoI topography and vegetation coverage allow that activities in the project area are not readily observable.

Evaluation al the data of visual quality, visual fragility and landscape visibility is concluded that the AoI is located within an area that presents a vulnerable visual quality *moderately sensitive* to changes that will produce the project. This means that the landscape will not be significantly altered, and being able to implement management measures that contribute to the Project harmonization with the existing LU inside the AoI.

5.5. SOCIOECONOMIC ASPECTS

The Coatzacoalcos-Manatitlán region, to the southeast of the state of Veracruz, to the north of the Isthmus of Tehuantepec, includes the municipalities of Coatzacoalcos, Minatitlán, Moloacán Nanchital de Lázaro Cárdenas del Río and Ixhuatlán del Sureste. Each municipality is administered by a town council, elected by popular vote, and has a municipal capital, a city from which the municipal president governs. It is important to note that a municipal president are not subordinate to a governor at a state level. Detailed information regarding demographic, social and economic data for the municipalities can be found in section 5.5.5 of this same document. Historical information regarding the two most important municipalities for this Project, are explained in greater detail below.

Coatzacoalcos is the third most important city in the state, after the cities of Veracruz and Xalapa, and the most developed city in the south of the state. It is the capital of the municipality of the same name, and is one of the largest and most important municipalities in the region. The city has always been important to the zone, as before the Spanish Conquest, it was considered to be the capital of the province. In 1881, the municipality of Coatzacoalcos was founded with the city of the same name as its head. Its current importance in the state began with the construction of a commercial port, and in recent years, with the petrol industry. It is the later that has substantially increased migration to the zone, as lack of employment opportunities in other sectors attract individuals with the possibility of employment in the petrochemical industry. This subject will be discussed in greater detail in section 5.5.6 of this same document.

The city of Minatitlán, the capitol of the municipality of the same name, is the sixth most important city in the state. It is located on the banks of the Coatzacoalcos River, where an important PEMEX refinery is also located. The city also has a commercial port.

The Area of Influence (AI) of a project assists in drawing borders of interaction between a project and the communities that surround it, or will be affected by it. The IA of the Project sits in found municipalities: Coatzacoalcos, Ixhuatlán del Sureste, Moloacán and Nanchital, and the analysis of the present section will focus on the demographic, cultural and socioeconomic trends of the communities located within these same municipalities. The employment, education, organization, health and social service data for the same municipalities can be found in the Baseline Study (see annex 5.4).

Within the AI, there are two subtypes: the direct AI and the Indirect AI, and the distinction between these two will determine the priority the community represents for the Project. The direct IA establishes a geographic space which will be directly affected by the Project's operations: dust, noise, visual impact, logistical activities, employment and traffic amongst others. As such, the communities within the direct AI also have a higher likelihood of being impacted or benefited by the Project, and as such, will be prioritized in the Project's decision making. The indirect AI established a geographic space which will be influenced by the Project but indirectly, as a result of a series of impacts and/or

benefits that may not be directly caused by the Project, such as economic benefits as a result of contractors' supply chain for instance.

Depending on the configuration of a given project, the AI may take different forms, and could even be located in different zones. Moreover, on the understanding that all communities are different, the level and type of impact can take different forms.

Taking as a base the limits described below, it has been determined that there are nine communities in the direct AI: the Ejido Cinco de Mayo, Mundo Nuevo, La Verónica, Cangrejera Dos, El Chapo, Lázaro Cárdenas del Río, Nahualapa, Nanchital and Pollo de Oro. The limits established in order to establish that said communities were located in the direct AI were: physical proximity to the project, potential interaction with the Project and the socio-political composition of the community (the municipality in which the community finds itself and its social characteristics). The foundation which was established to identify said communities is presented below.

As discussed earlier in this chapter, the Area of Influence (AoI) is located in four municipalities: Coatzacoalcos, Ixhuatlán del Sureste, Moloacán and Nanchital. Analyzes in this section is focused on demographic, cultural and socioeconomic general information from the communities located within the AOI. Subject to be explained more fully below, it is important to mention that exist two subtypes of AoI: Direct AoI and Indirect AoI. The AoI was determined based on subjective limits that help to define the boundaries of interaction between the Project and surrounding or to be affected communities. Additionally, it should be noted that the data for the employment, education, organization, health and social services used to identified the characteristics of communities are summarized in section C of this report, and in full detail and relevant in the social baseline study (see Annex 5.4).

The direct AoI sets the geographic space that will be directly affected by Project operations: dust generation, noise generation, visual impact, logistics activities, employment, transit, among others. The indirect AoI sets the geographical space that will be affected by the Project in an indirect way, as a result of a series of disruption and / or benefits may not be directly related with the Project, for example, the product of economic flow supply chains of contractors.

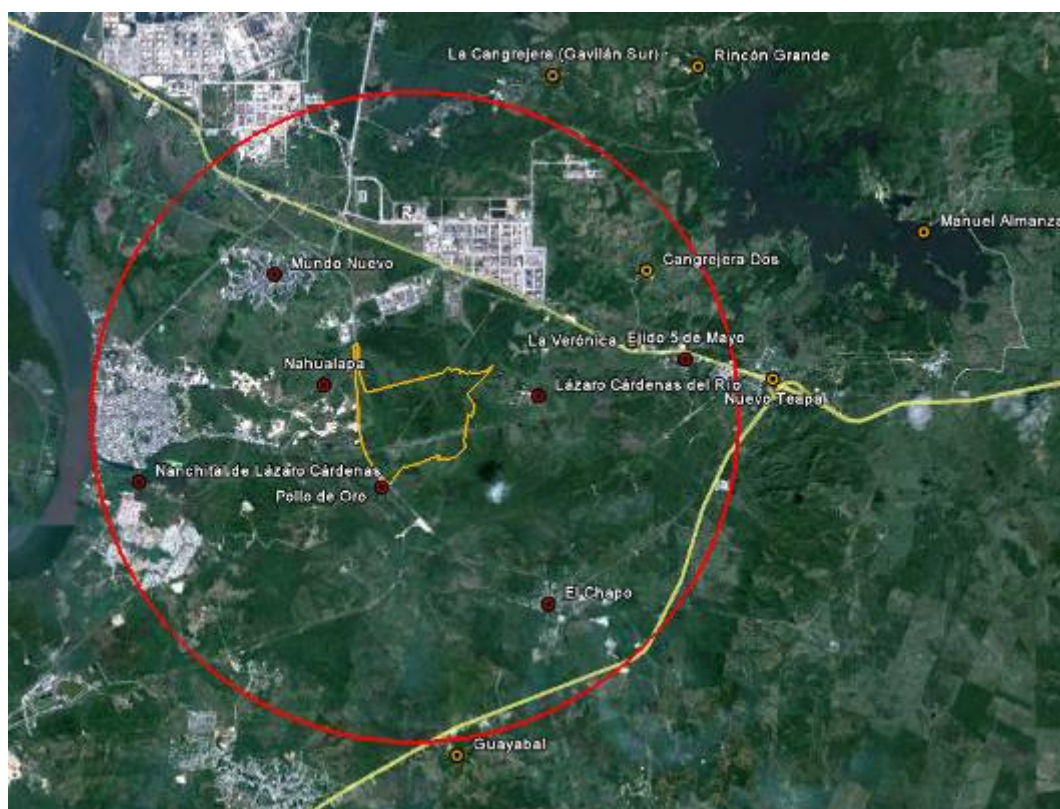
It is important to note the definition and distinction between direct and indirect AoI due, although there are communities within the two boundaries (direct and indirect), the fact that were located in one or other, set the priority that the community represents to the Project. Based on the understanding that all communities are different, this priority will dictate how the communities may be affected and / or benefited by it. So, the communities within the direct AoI will have a greater potential to be affected and / or benefited by the Project, and therefore will be a priority for making project decisions. Depending on the configuration of any project, the areas of influence can take many forms, and even be geographically located in different areas. As detailed below, the setup of the Ethylene XXI project allows the AoI to be identified and be arranged in a radial manner, as shown in Figure 5.29.

Based on the delineation of the limits described below, has determined that there are seven communities identified within the direct AoI: the Ejido Cinco de Mayo, Mundo Nuevo, El Chapo, Lázaro Cárdenas del Río, Nahualapa, Nanchital and Pollo de Oro. The limits used to determine that these communities are within the direct AoI were: physical proximity with respect to the Project, potential interaction with the Project and the social and political composition (from the municipality where the community is and its social characteristics). In the next section are presented the bases used to locate such communities.

5.5.1. Physical Proximity

The first criterion used was the physical proximity to the site of interest and its activities, since the most affected communities will be those that are inherently nearby. The fixed radius was 5 km, because this distance is reasonable to include communities that are far enough away to be directly affected by the Project, as it is unlikely that beyond this distance will exist visual, noise and logistics impacts that contrast with the present forms of community life. Figure 5.12 shows the communities identified within this radius.

FIGURE 5.12 IDENTIFICATION OF THE COMMUNITIES INSIDE THE PROJECT AOI AND THE DIRECT AOI



Source: Google Earth (2011), based on INEGI y completed with ERM information.

Figure 5.29 identifies the communities: Ejido Cinco de Mayo, Mundo Nuevo, El Chapo, Lázaro Cárdenas del Río, Nahualapa, Nanchital, Pollo de Oro, La Verónica y Cangrejera Dos. Due that the inclusion of the communities inside the AoI depends from the combination of all the criteria used, some communities will

be excluded from the direct AoI, and will be classified inside the indirect AoI.

Note:

In spite of the physical proximity to the roads that will be used to transport equipment or personnel, the routes of off-site facilities (off-site), also considered as a factor in the AoI, currently there is no sufficient information to determine the impact degree or the precise location of the routes or sites that could impact more communities. The professional opinion of ERM considers that none critical impacts to communities will occur that have not been identified in this study. As a preventive method was determined in this case an independent evaluation, where facilities and off-site works will have an impact and influence areas identification. In this study, taking into account the available information, and the most conservative professional considerations and estimations are shown the results of these interactions.

5.5.2. Project Potential Interaction

The potential interaction with the Project is defined as the level of benefits and / or affectations that communities can have on health issues as a result of Project operations. The project represents a great opportunity for economic development, which significantly benefit to the communities in the area. The project, however, is a major industrial development that will generate confrontations among stakeholders in the perception of inherent contamination and the effects on health that could happen. Both aspects will determine the potential that communities have to interact with the project in a directly proportional relationship. That is, the more you can benefit or be affected, will have more potential for interaction, and therefore, highest priority will be for the Project.

5.5.3. Socio-cultural Composition

According to assessments made in the Social Baseline Study (see Annex 5.4) on the identification and mapping of stakeholders (see Annex 5.5), and subsequent interactions (see Annexes 5.15 to 5.17) was determined and reinforced the assignment of the AoI with respect to the socio-cultural communities composition and their potential for adaptation. In this sense, were identified concerns at the population level, education and service access levels to detect possible obstacles of adaptation that should be addressed. Then, taking in consideration the existence of religious groups in the area, was determined more attention to the communication with stakeholders with the Sub-program of relationships of interest groups, or RIG (*see Annex 4 8.18*). Considering the socio-cultural factors, the potential adaptability of communities, it will be important to monitor those with cultural groups such as minorities.

5.5.4. *Socio-Political Composition*

The last criterion to be used in combination with the previous three is the geopolitical location of the Community with regards to the site of interest. Geopolitical location is defined by the political profile of the community in the municipality in which you are. The site of interest is located within the municipality of Nanchital and has a lower portion located on the border with the municipality of Coatzacoalcos, with a high level of political influence in the project, due that has a political weight as a result of its history of industrial development. For these two reasons it was determined that would be preferred communities placed within these two municipalities.

Based on an field analysis of the area and prior knowledge of the region, we designed three categories. The communities that are within the characteristics of these categories would be those located within the direct AoI. Communities, for one reason or another were not considered as belonging to the direct AoI but indirectly will be affected by the Project for being in the AoI and/or region, are considered within the indirect AoI.

In the next paragraphs is presented a brief explanation of the characteristics of the different categories that were the basis on which defined the Project direct AoI. Note that within 5 km radius determined for the application of AoI, there are subdivisions that will be presented below.

Category I

The Category I communities will be those that are within a radius of 1 to 2 km away from the site of interest and belonging to the Municipality of Nanchital. The physical proximity to the site of interest involves a high degree of interaction with the project should not be overlooked. In this category are the communities of Lázaro Cárdenas del Río, Nahualapa and Pollo de Oro.

Category II

The Category II communities will be those that have a population of between 400 and 1 000 inhabitants, and are within a radius of 2 to 3 km away from the site of interest. The communities identified in this category are: The Ejido Cinco de Mayo, El Chapo, Veronica and Cangrejera Dos. As the communities of La Veronica, Cangrejera Dos and Ejido Cinco de Mayo, are located within 1 km of distance between them and are very homogeneous in its configuration, it was considered therefore that the Ejido Cinco de Mayo is a proper representative of the three communities, not only by the consistency of the configuration also by the potential for similar interactions defined by shared physical proximity between them and with the project. In this way, the analysis of the three communities is limited to that of the representative community.

Category III

Communities in the Category III are those that have populations of more than 2 000 inhabitants, are located within 3 to 5 km around the site of interest, and belonging to the municipalities of Coatzacoalcos and Nanchital. Even though

Guayabal community is in the limits of the radius of influence, belongs to the Ixhuatlán del Sureste municipality. For this reason was included in the indirect AoI. In this sense the Category III communities within the direct AoI are Nanchital and Nuevo Mundo, the municipal seat with the same name. Both populations are larger and more diverse than the others and varied social characteristics in terms of public perception, social management and human development.

Even though strictly the city of Coatzacoalcos should be discarded from the AoI, based on the parameters described, it has been located, exceptionally, in the indirect AoI because some characteristics do not allow the exclusion:

1. It is the largest municipal region in terms of political influence in the industrial development of the area.
2. It has important opinion leaders about the project and industrial development.

However, it is important note that although it is a location within the indirect AoI, no specific studies have been conducted within the town, as was done for other communities. The reason is that the city of Coatzacoalcos is a totally urbanized area whose residents are accustomed to petrochemical industrial development in the area. However, for its population density and political importance, it was considered relevant conduct information dissemination activities, which are being detailed in the summary of the first episode of the Public Participation Program (see Annex 5.15).

Table 5.13 summarizes the categorization of communities located within the AoI and within the Project direct AoI.

TABLE 5.13 IDENTIFICATION OF COMMUNITIES WITHIN THE PROJECT AOI AND DIRECT AOI

No.	Municipality	Location	IA	Direct AoI	Category
1	Coatzacoalcos	Cinco de Mayo	X	X	II
2	Coatzacoalcos	La Cangrejera Dos	X	-	-
3	Coatzacoalcos	La Cangrejera (Gavilán Sur)	X	-	-
4	Coatzacoalcos	La Verónica	X		-
5	Coatzacoalcos	Mundo Nuevo	X	X	III
6	Coatzacoalcos	Rincón Grande	X	-	-
7	Ixhuatlán del Sureste	El Chapo	X	X	II
8	Ixhuatlán del Sureste	Guayabal	X	-	-
9	Moloacán	Manuel Almanza	X	-	-
10	Moloacán	Nuevo Teapa	X	-	-
11	Moloacán	Nuevo Teapa Santa Cecilia	X	-	-
12	Nanchital de Lázaro Cárdenas del Río	Lázaro Cárdenas del Río	X	X	I
13	Nanchital de Lázaro Cárdenas del Río	Nahualapa	X	X	I
14	Nanchital de Lázaro Cárdenas del Río	Nanchital de Lázaro Cárdenas	X	X	III
15	Nanchital de Lázaro Cárdenas del Río	Pollo de Oro	X	X	I

5.5.5. General Information of the Region

Coatzacoalcos recorded 305 260 residents, of whom 147 962 (48.47%) were men and 157 298 (51.53%) were women. Ixhuatlán del Sureste presented a population of 14 903 residents, of which 7 361 were men (52.15%) and 7 542 were women (47.85%). Moloacán municipality had a total population of 16 120, of which 7 851 were males (48.70%) and 8 269 were females (51.30%). Finally, Nanchital reported 27 094 inhabitants, of which 12 978 (47.90%) were men and 14 116 (52.10%) were women. This places the region in a context of important population. Is not a vulnerable region in population numeric terms.

Chapter 5.5 presents detailed information on the communities included in the AoI, including the Economically Active Population by municipality and by sector, birth and death rates, access to medical services, general information regarding AI, migration data, income and other socio-cultural factors.

Environmental and Social Performance Standard 7 of IFC, recognizes the presence of indigenous groups as long as they meet the following conditions:

1. *Existence of indigenous self-identified as such as well as their identification as such by others.* There is no identified, in the communities within the areas of influence, groups of people who self-identify as such.
2. *A collective attachment to geographically defined habitats or to ancestral territories in the Project area, as well as to natural resources in said habitats or territories.* There are no groups that self-identify as indigenous that are attached to specific zones or to natural resources in the area.
3. *Widespread and frequent use of a language other than the official language of the area or country.* . This condition is not met because, as mentioned above, although some residents know some indigenous language, it is not their main language. Additionally, based on INEGI statistics, although the 2.55% of the residents of the areas of influence know any Indian language, such data is not a generalization.
4. *Cultural economic, social, political institutions, historically different from those of the dominant society or culture.* None of the communities within the areas of influence have political or legal systems that differ from those established at the national level.

Archeological Zones

According to existing data from the National Institute of Anthropology and History (INAH), the most important archeological zones in the state of Veracruz are located far away from the Project Site location. The largest archaeological sites closest to the site of interest are:

- Tres Zapotes: Located approximately at 120 km to the northwest of the site of interest;
- San Lorenzo Tenochtitlan: Located approximately 53 km to the southwest of the site of interest, and
- La Venta: Located approximately at 33 km to the east of the site of interest.

The municipalities of Ixhuatlán del Sureste and Nanchital have no registered archaeological sites. However, ERM made a formal request to the INAH to verify their database in relation to the presence or absence of archaeological sites within AoI (see Annex 7.1). The INAH confirmed the absence of archaeological records for the site of interest in its database (see Annex 7.2). Subsequently to this, to ensure that the project does not presents risks to the integrity of archaeological vestiges, the promoter made a formal request to the INAH to visit the site of interest to corroborate the absence of archaeological vestiges (see Annex 7.3). After a visual inspection of the site of interest made by INAH archaeologists, in which the property was divided into several sections for better analysis, INAH response was that the absence of archaeological vestiges could not be precisely

determined by the difficulties that the density of vegetation imposed during the inspection (see Annexes 7.4, 7.5 and 7.6). Once the clearing activities are in a more advanced stage, INAH will have to make a second inspection of the site of interest.

5.6. ENVIRONMENTAL ANALYSIS

The Project environmental system consists on a complex structure due to the different elements making up the system. Later in this section it is presented the situational analysis of the Area of Influence (AoI) and specifically of the subject site, with the aim of identifying those relevant and/or critical aspects or resources affecting the system. The current environmental quality is also presented in this section. The aspects or resources are evaluated taking into consideration their interaction with the AoI and subject site natural process of deterioration and conservation status.

TABLE 5.14 CURRENT STATUS OF ENVIRONMENTAL AND SOCIAL ASPECTS

Environment al or social aspect	Factor	Aspect current situational analysis
Air	Climate	Based on the Nanchital station records of the maximum, medium and minimal temperature, it is observed that the maximum temperature is registered in may with 35.6° C; the minimal monthly average temperature reached 18.1° C, with minimal daily values of 11° C in January and February. Annual precipitation has been of 2 778.9 mm, with maximum of 462.2 mm registered in September. A total of 127.4 days of rain per year are registered, with a peak period between August and October. Due to its geographical location, the AoI could potentially be subject of threatening onslaughts of hurricanes.
	Air quality	No air quality monitoring system is installed in the industrial corridor “Coatzacoalcos-Minatitlán” in order to obtain pollutant concentrations on air (i.e. suspended solids, CO ₂ , SO ₂ , CH ₄ , etc.). An air quality monitoring was conducted locally by using a mobile station located in the Pollo de Oro community. This community is the nearest residential receptor. The objective of the air monitoring survey was to evaluate the Nitrogen Dioxide (NO ₂), Sulfur Dioxide (SO ₂), Carbon Monoxide (CO), Ozone (O ₃), total suspended solids (PST), particles less than ten microns in size (PM10), particles less than 2.5 microns in size (PM2.5), and Lead (Pb). All detected values were observed to be compliant with limits established in the Official Mexican Standards (referred in chapter 5.1) and with those established in the IFC. It could be concluded that the subject area has a satisfactory air quality.
	Noise level	Results of a fence-line noise survey conducted in January 2011 in which fixed sources and potential receptors were considered, vary between 52.57 dB to 58.90 dB in communities Pollo de Oro and Lázaro Cárdenas, and from 64.34 dB to 82.45 dB in the oil and gas industries installed in the subject areas, being the Cangrejera complex where the highest noise levels were detected. Base line monitoring will be conducted before starting the site preparation activities at Nahualapa and in the most important transport routes in points referred in chapter 8.
Soil	Lithology	The subject area is located within the geological province “Cuenca Deltaica de Veracruz”, consisting in tertiary age marine sedimentary features, covered in the lower parts by quaternary period alluvial, fluvial and paludal deposits. Two geological formations are present in the site, one of the upper Tertiary, the oldest known as Paraje Solo formation underlined by the irregular formation Formación Cedral; additionally, quaternary alluvial deposits are present in the most important streams banks.

Environment al or social aspect	Factor	Aspect current situational analysis
	Geomorphology	The subject area is characterized by the presence of two geomorphologic areas: The first is located in the upper areas, where the hills present round shapes, with an altitude up to 150 m above mean sea level and fold structures with formations consisting in sandy sediments. The second consist of a flat topography where flooded areas corresponding to the lowest parts are present and make surface drainage difficult.
	Fault and Fractures	An inferred fracture is located in the AoI at approximately 2 km south of the Project subject area as per the information contained in the Coatzacoalcos geological chart E 15-1-4 scale 1:250,000 (INEGI, 2003).
	Risks exposure	The AoI is located in an area presenting a low to moderate flooding risk and a medium probability of cyclone occurrence. The area is classified as Zone B for earthquake meaning less occurrence. There is no risk for volcanic activity.
	Soil conditions	Ferralsols Cambisols with plinthic and orthic luvisols are identified in the subject site having medium texture (99%). Molic gleysol with eutric gleysol are present at lower rate to the north of the subject site with medium texture (1%).
Water	Surface water hydrology	The subject site is part of the Hydrological region No. 29 Coatzacoalcos, having an important hydrological dynamic since the nearest water streams are related with the main effluents of the country as the Coatzacoalcos and Tonalá. Important fluvial activity is present in the extent of the land from right border of the Coatzacoalcos river to the left border of the Tonalá river. Topographic conditions permit the presence of flooding lands and this is reflected in surface hydrological conditions. Two micro-basins converge within the subject site being one of the Gopalapa stream and the other the Nanchital stream. These is at the northeastern limit of the site at the cross line of the PEMEX right-of-way trough the Gopalapa stream.
	Underground hydrology	The AoI is located in the Coastal Aquifer of Coatzacoalcos covering an approximate area of 2 600 km ² at the southeastern portion of the Veracruz state. Groundwater flow direction is southeast – northeast at the AoI, presenting a flow direction change before reaching the coast line of the Gulf of Mexico. It is important to note that a land sinking has been created due to the presence of several groundwater extraction wells located at the southern limit of the AoI; water quality in these aquifers vary from fresh to tolerable. Even that the Coatzacoalcos coastal local aquifer is considered to be underexploited (annual medium availability is reported to be of 125.5 millions m ³), several over-exploitation issues are registered in the local area due to the high number of wells and saltwater intrusion. This can represent a limit for exploitation capacity; however, this situation is presented in the urbane area of Coatzacoalcos so no risk of depilation is expected in the Project area.

Environment al or social aspect	Factor	Aspect current situational analysis
	Water use	An hydrological survey was conducted onsite, water quality results were compared against the Mexican Official Standard NOM-127-SSA-1994, establishing the water quality for human consumption. Some parameters in some of the samples were observed to exceed allowable concentration of pollutants for human consumption including iron, manganese and chlorides. Groundwater will not be used for human consumption or for industrial purposes during the site preparation activities; it would only be used for irrigation so no water purification system will be required. As per the information resulting from the hydrological survey (refer to chapter 5.1), groundwater deep vary from 80 and 150 m, prevailing those around 120 m deep; current extraction rate vary from 10 to 32 l/s, prevailing 16 l/s. Hydric resources are mainly profitable at the Coatzacoalcos region for communities supply, as well as for industrial purposes comprising mainly the petrochemical complex Pajaritos, Cangrejera and Morelos. Industrial wastewater discharge is mainly conducted to the Gopalapa and Nanchital streams, being this a source of contamination between Minatitlán and the mouth of the Coatzacoalcos river.
	Water Quality	The Coatzacoalcos river and its basin show pollution concentration problems between Minatitlán and the mouth of the Coatzacoalcos river, this is mainly related to the petrochemical industrial activities preformed at the region, as well as oil tankers at the Coatzacoalcos port. Pollutants present at the area mainly include high hydrocarbons and metals concentrations as indicated in local water quality investigations available. Water quality base line studies are currently being conducted for the Gopalapa and Nanchital streams, once this information became available, this section of the report will be updated.
Vegetation	Abundance, wealth and endemic or protected species distribution	Four types of vegetation are present in the AoI including medium semi-deciduous forest, grazing lands (savannah, induced pasture and flooded wetlands), palm groves and secondary vegetation. As a result of the anthropic activities conducted at the area, the area is impacted and present ecosystems fragmentation. A second data collection campaign considering 9 quadrants resulted in identifying a total of 504 individual belonging to 129 species of which 55 presented low abundance. The subject area has been impacted during the last decades for human activities, mainly for grazing and the industrial activities. However, even that the vegetation present in the subject area and in the northern portions of the site is not the original vegetation, the AoI is covered with important quantities of vegetation. The most important species registered include “amendaui” (<i>Ceratozamia miqueliana</i>), labeled as in Risk of Extinction and the “palmilla” (<i>Zamia loddigesii</i>), labeled as Threatened in the IUCN Red List. The two above mentioned species along with the “baríz” (<i>Calophyllum brasiliense</i>), labeled as Threatened are mentioned in the Mexican Official Standard NOM-059-SEMARNAT-2010 (SEMARNAT, 2010). Finally two species of orchids are reported in the CITES Appendix II.

Environment al or social aspect	Factor	Aspect current situational analysis
Fauna	Abundance, wealth and endemic or protected species distribution	Fauna wealth consists in 170 individual of different species, playing a prominent role the fowl, followed by reptiles, amphibians and mammals. These species are strongly related between them. Amphibians and reptiles: out of the 26 registered species, five are included in the category Subject of Special Protection (Pr) established in the Mexican Official Standard NOM-059-SEMARNAT-2010. Twelve (12) species are included in the International Union for Conservation of Nature (IUCN) Red List labeled as Least Concern (LC), one is labeled as Vulnerable (VU) and one as Data Deficient (DD). Only the green iguanas (<i>Iguana iguana</i>) is included in the CITES Appendix II. The two iguanas species identified in the subject area are protected by the NOM-059- SEMARNAT-2010. Fowl: as per the risk categories, 17 species are included in the NOM-059-SEMARNAT-2010, including three species in Risk of Extinction (P), eight as Subject of Special Protection (Pr) and six as Threatened (A). According to the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES, <i>Convención sobre el Comercio Internacional de Especies Amenazadas de Flora y Fauna Silvestre</i>), 20 species are included in the Appendix II and only one <i>Amazona oratrix</i> is included in Appendix I. Additionally, one specie is considered as Vulnerable as per the IUCN, being the Great Curassow (<i>Crax rubra</i>). The Yellow-headed Amazon (<i>Amazona oratrix</i>) and the Golden-cheeked Warbler (<i>Dendroica chrysoparia</i>) are also included in the IUCN List as threatened with extinction (refer to Table 5.15); its distribution is detailed in Annex 1. Mammals: two species are included in NOM-059-SEMARNAT-2010 and in the CITES labeled as Threatened (A) (<i>Puma jaguarundi</i> and <i>Lontra longicaudis</i>), and one specie is included in the CITES appendix (<i>Nasua narica</i>), two are labeled as Least Concern (LC) (<i>Puma yagouaroundi</i> and <i>Nasua narica</i>). Additionally other 16 species are labeled as Least Concern. As per the fauna survey results, one endemic mammal and seven endemic amphibians and reptiles specie were identified in the AoI. Shannon-Wiener diversity index classify the subject area as 2.6, being lower classification compared with other areas of México, this can be due to the property characteristics and the human impact to vegetation composition and structure.
		The following landscape units (LUs) were considered to conduct an evaluation of the values of landscape at the AoI: urban areas; rural areas; industrial areas; permanent water bodies (rivers, lagoons, coastal areas); intermittent water bodies (streams); elevations (hills); palms; grasslands; middle rain forest; and secondary vegetation. Considering all visual quality data, visual fragility and landscape visibility, it is concluded that the AoI is located in an area presenting a Vulnerable Visual Quality moderately sensible to changes generated by the Project. Landscape will not be significantly modified allowing the implementation of management measures to make the Project harmonize with existing UP.

Environment al or social aspect	Factor	Aspect current situational analysis
Social	Economic Activities	The AoI is part of four municipalities: Coatzacoalcos, Ixhuatlán del Sureste, Moloacán and Nanchital de Lázaro Cárdenas del Río. Additionally seven communities were identified within the AoI which were subject of a Social Base Line study. Half of the community within the AoI earns between \$2 000 and \$4 999 per month. The second most significant sector, above 25%, earns between \$2 000 and \$1 999 per month, and finally, less than 15% earns more than \$5 000 per month. Almost 30% of the people are below or close to the minimal wage (without revenues or earning between \$1 and 1, 999 pesos). Most of the population located with the AoI have stop conducting primary sector activities and mainly dedicates to industry or services.
	Cultural aspects	The 55.2% of the homes mentioned to have participated or had organized neighborhood council to solve or discuss on collective issues. In few communities a predominant leader role was identified. The following answers were obtained identifying main population social concerns: • <i>Minimal concern:</i> gender equity, peace and safety, migration. • <i>Medium concern:</i> corruption, Government trust, drugs / alcohol. • <i>Maximum concern:</i> environmental pollution. No archeological areas are registered in Nanchital de Lázaro Cárdenas and Ixhuatlán del Sureste. Even that there are archeological registries near the Pajaritos Lagoon (5 km from the subject site), these are not located in any cross way of the Project. No archeological risk has been identified for the Project. There are historic monuments in the four municipalities, Coatzacoalcos houses most of them and is followed by Nanchital, Moloacán and Ixhuatlán del Sureste respectively.
	Demographic processes	Within the communities potentially affected by the Project, a total of 13 communities are identified with population from 15 to 970 inhabitants with the exception of Nanchital de Lázaro Cárdenas with 25 289 inhabitants and Mundo Nuevo with 8 420 inhabitants. Veracruz is classified as the second state presenting high levels of inter-state migration; however, the southeaster area (Minatitlán and Coatzacoalcos) of the state is recipient due to its important industrial activity of the last years. The AoI population pyramid comprises 19% children, 13% teenagers, 57% adults and 11% older adults. This situation generates a large spectrum of communities characteristics with respect to health and education requirements, until 30% of the population (children and older adults) are comprised in a very vulnerable sector.

Environment al or social aspect	Factor	Aspect current situational analysis
	Human health	Availability of potable water, drainage and waste collection was considered to be deficient in most communities subject of the Social Base Line survey (refer to Annex 5.4). Most of the population has a health service installation near to the community. However, it is relevant that communities Nahualapa and Lázaro Cárdenas are constantly isolated of any service.
		Most relevant disease included in the first place respiratory diseases followed by heart and circulatory diseases and by digestive troubles.
	Special Dynamic	Most of the communities located in the AoI subject of the social base line survey present different access and land communication situations, as well as community social mobility customs and practices. Communities as Nahualapa or Lázaro Cárdenas are totally isolated of land access when flooding. Most of the communities are dependent of availability of land pedestrian access and public transportation. Physical conditions of most of the ways are poor and there are adverse traffic conditions for public health. Moreover, a significant concern is the lack of property titles of homes located in the AoI. Answer obtained related to accessibility of public services can be summarized as follow: • <i>Very easy access</i>: churches and public street lighting. • <i>Easy access</i>: schools, hospitals, doctors, medical drugs and newspapers. • <i>Difficult access</i>: Government offices, public security.

Influence Area relevant and/or critical aspects will be identified by assessing each of the aspects. Analysis results will allow ranking the aspects in accordance with process of change magnitude and importance as well as establishing the identification of parameters to be used to build scenarios with the potential to occur with or without the presence or the Project.

As indicated by the CONABIO, the ecological integrity of an area is related to the degradation rate produced by human activities resulting in the lost or transformation of its functional characteristics. The ecological integrity is considered to be low when the presence of native vegetation and wild mammalian herbivores is limited, as well as when the natural processes of ecological succession have been significantly modified. A medium ecological integrity is considered when a reduced number of native vegetation and fauna, including wild mammalian herbivores of medium size and vertebrate predators are present at the area. Finally, a high ecological integrity is reached when complete native vegetation and animals (including large predators) are present and natural ecological processes occur.

Based on the above mentioned ecological integrity parameters, the subject area are considered as having a low ecological integrity. This is due to the modifications and anthropogenic existing characteristics, since the area is already impacted by industrial activities, agricultural areas, PEMEX pipelines right of ways, and roads among others. Existing infrastructure and the distance between the site and key potential suppliers are an important factor for the Project site location choice.

6 GREENHOUSE GASES

6.1 OBJECTIVE

This section aims to present the magnitude of the greenhouse gas (GHG) emissions, both direct and indirect, generated by the Project of construction and operation of the Etileno XXI Braskem-Idesa Plant in the region of Coatzacoalcos, in the Mexican State of Veracruz.

The implementation of the industrial plant is divided into two phases: site preparation, which will last 15 months, and construction of the plant, which will last three years. The data used to calculate GHG emissions was based on information available of the use of machinery and vehicles at this stage as well as changes in the amount of organic material (vegetation) to occur as a result of site preparation and construction.

GHG Emissions from the stage of operation have been calculated based on IPCC emission factors, the estimated power consumption of the entire complex and the ethylene production capacity. The detailed information will be obtained after completion of the basic design phase that will be completed by the end of 2011.

The Project, is being developed with advanced technology in all of its operations, including process and control equipment, and services, which will be reflected in the energy efficiency of the equipment. Once the detailed equipment engineering is defined, a realistic comparison can be calculated of the emissions that will be avoided through the use of this leading edge equipment.

6.2 LIMITS SETTLING

The approach for calculating GHG is based on the Intergovernmental Panel on Climate Change (IPCC), in which all sources of emissions, both direct and indirect, were considered significant in the Project site (direct emissions are those controlled or owned by the developer of the Project, and indirect emissions are those that are related with the Project activities but that will be beyond the developer control).

The Corporate Accounting and Reporting Standard (revised version) and the 2006 IPCC, "Guidelines for National GHG Inventories", establish three reporting categories for the emissions:

- Scope 1 (direct emissions): those that are directly emitted within the company or controlled by it (stationary combustion and process emissions).

- Scope 2 (indirect emissions from electricity or heating): emissions related to the generation of electricity or heating.
- Scope 3 (other indirect emissions): those from the Project activities that are not controlled by the company¹.

Scope 1: direct emissions of identified sources:

- *Combustion sources.*

Fixed sources: Power and portable generators.

Mobile sources: Heavy machines and vehicles (tractors, graders, excavators, compactors, smooth compactors, trucks, heavy vehicles).

- *Emissions from deforestation.*

Scope 2: GHG indirect emissions from electricity:

- *Electricity from the local network.*

6.2.1 *Equivalent Carbon Dioxide (CO₂e)*

The aspects that will determine the GHG for the Project include stationary combustion, combustion from mobile sources and deforestation, since these are the activities that will generate GHG in the Project (See Table 6.1).

TABLE 6.1 ACTIVITIES THAT WILL GENERATE GHG

¹ Scope 3 is an optional category and, due to the current stage of the project implementation and the absence of detailed data, this scope was not considered.

Emission - Scope	Project Stage	Source of the emission	
Direct emissions (Scope 1)	Site preparation	Fixed sources combustion	
		Mobile sources combustion	
		Land use change (deforestation)	Biomass removal
			Lifeless organic matter
			Soil carbon
	Construction of the facility	Fuels combustion	
Indirect emissions (Scope 2)	Construction of the facility	Energy acquisition	
Estimate of direct emissions	Operation of the facility	Emissions from the production of ethylene	

6.2.2 *Methods of accounting*

Combustion

Emissions calculated according to Level 1 (*default* method by sector, general level of detail) of the IPCC methodology, based on an estimated consumption of fuel and basic emission factors.

Considering the sectoral approach (from top to bottom) and the inventory of Level 1, is a good practice to distinguish combustion according to its origin (fixed or mobile) and its industrial sector (energy industries, manufacturing and construction industries, and other sectors). In order to clearly state the method of calculation; the calculations are presented according to the type of emission.

Fixed combustion

Refers to the burning of fuels in stationary equipment, such as boilers, furnaces, burners, turbines, incinerators, engines, flares, etc.

For Level 1 inventory, the emissions factors for fixed sources of each greenhouse gas depend on the fuel type and sector of activity.

During the early stages of site preparation and construction, diesel will be used as fuel (approximately 19,000 m³ during site preparation and 21,250 m³ during construction). No other fuels will be used at these stages.

Combustion by mobile sources and mobile sources that do not travel on roads

Refers to the burning of fuels in transportations devices, such as cars, trucks, amongst others, which will be used during the site preparation and construction phases.

Acquisition of electricity

The indirect emissions associated with the consumption of purchased electricity must be calculated for the Project as a Corporate Standard of the GHG Protocol. The acquired electricity is defined as the electricity that is purchased or brought by other means (such as, for example, through a distribution network) to the limits of the company.

6.2.3 *Land use change. Deforestation*

In order to calculate GHG emissions due to the land use change from forest land to settlements, three main GHG sources must be assessed: changes in biomass,

lifeless organic matter and soil organic carbon.

6.2.4 *Organica matter degradation emissions*

Most of the biomass production (NPP) contained in live plant material is eventually transferred to the pile of dead organic matter (MOM).

6.2.5 *Soil carbon emissions*

The conversion of land for human settlement occurs with the development and expansion of cities and towns in ancient woodlands, croplands, grasslands, wetlands and other lands. These conversions change carbon storage in soil due to mechanical disturbance, excavation or gathering during development, the type and amount of vegetation, and the new management regime, particularly with regard to the application of nutrients and water.

6.3 EMISSIONS FROM THE ETHYLENE PRODUCTION

Carbon dioxide equivalent emissions for the production of ethylene are calculated by mass balance.

6.4 RESULTS

The Project GHG emissions can be divided in three phases, which differ in nature, period, and data availability. For each phase, a correlation between data quality and the phase start can be noted. The more distant is the beginning of a phase, the less information or less detail in the information is available. This impacts the uncertainty and the data availability.

Project GHG emissions can be divided into three phases. The first stage (Site Preparation), has the best quality of data while the construction phase has overall estimate of diesel but not by type of vehicle or machinery and the estimated consumption of electricity, and the operation phase is also estimated because the detailed design is still in process.

a) Emissions of the site preparation

The calculations for this stage are based on the following premises: (a) diesel will be widely used in equipment, machinery and vehicles, (b). The fuel used is separated either for fixed sources or mobile sources which gives a better estimate of GHG emissions, (c) no consumption of electricity from the grid, (d) all electricity used on the site during this stage will be provided by generators, (e) the main emission source is related to the change in land use (biomass removal).

TABLE 6.2 SUMMARY OF THE LAND PREPARATION EMISSIONS

Scope	Emission sources		Emission (CO ₂ e)
Direct emission (Scope 1)	Fixed combustion		670
	Mobile combustion		52,176
	Land use change (deforestation)	Biomass removal	41,238
		Lifeless organic matter	930
		Soil carbon	1,890
	Total – Scope 1		96,904
Indirect emission (Scope 2)	Network electricity		0
	Total Scope 2		0

b) Emissions of the site construction

For the construction phase it was considered (conservative approach) that (a) all diesel consumed during the construction would be aimed at all-terrain vehicles, increasing GHG emissions, (b) the electricity is estimated taking into account the installed capacity of electric substation, (c) it has not been considered the buildings design.

TABLE 6.3 SUMMARY OF THE CONSTRUCTION EMISSIONS

Scope	Emission sources	Emission (CO ₂ e)
Direct emission (Scope 1)	Diesel combustion <i>Total – Scope 1</i>	63,750
Indirect emission (Scope 2)	Network electricity <i>Total – Scope 2</i>	7,315

c) Emissions during the operation (production of ethylene)

The production of polyethylene and polypropylene is not as intensive in the generation of carbon emissions as the ethylene production is, because the production of polyethylene and polypropylene does not consume as much energy as required by ethylene in the cracking process. Therefore, in order to estimate the magnitude of GHG emissions from the Ethylene XXI Project operations, only the emissions from the ethylene production operations were considered.

TABLE 6.4 SUMMARY OF THE OPERATION EMISSIONS IN COMPARISON WITH OTHER BRASKEM UNITS

Scope	Emission sources	Emission (CO ₂ e)/year		
		EXXI	UNIB 1 BA ¹	UNIB 2 RS ²
Direct emissions estimate (Scope 1)	Emissions for the ethylene production	1.183.600,00	3.282.152	2.940.573
Indirect emissions estimate (Scope 2)	Electricity grid	7,315	57.455	3.352

Notes:

1: Braskem unit.- Cracker based on Naphtha located in Bahía, Brasil, with an installed capacity of 1.2 times the projected capacity of Etileno XXI

2: Braskem unit.- Cracker based on Naphtha located in Rio Grande do Sul, Brasil, with an installed capacity of 1.2 times the projected capacity of Etileno XXI.

TABLE 6.5 EMISSION COMPARISON OF TECHNOLOGY IN ETHYLENE PRODUCTION

Ethylene Cracking Technology	GHG emission increase
Raw material	
Naphtha	167%
Oil gas	219%
Ethane	100%
Propane	103%
Butane	105%
Otthers	167%
Source: PICC	

6.5 PROPOSED IMPROVEMENTS

The GHG inventory quality is related with the data availability. An improved description of the operation stage of the Project is required, as well as the reforestation activities. Therefore, the GHG calculation will be estimated again during the second quarter of 2012 using information such as:

Reforestation:

- Precise region, area and type of forest that will be reforested;
- Species of trees to be planted;
- The climate of the area;
- The current land use of the area to restore and
- The density of individuals per hectare (trees / ha).

Operation of the Project:

- Consumption of all fuels;
- Electricity produced / consumed;
- The steam produced / consumed;
- Consumption of raw materials;
- Number of processed products / manufactured - to determine emissions in each of the processes;
- Number of employees - for the calculation of emissions associated with

wastewater treatment;

- Description of wastewater treatment (stream, type, depth)
- Description of waste disposal.

7. IDENTIFICATION, DESCRIPTION AND EVALUATION OF IMPACTS

7.1. INTRODUCTION

The impacts of the Project have been evaluated based on the requirements established in Mexican Environmental Legislation and General Guidelines on Environmental Health and Safety and International Finance Corporation (IFC) Performance Standards (PS) as well as on the Recommendation on Common Approaches to Environment, developed by the Organization for Economic Cooperation and Development (OECD) and the Inter-American Development Bank (IDB) Operational Directives (OD).

In the case of this Project, the Social Area of Influence falls within the boundaries of the Environmental Area of Influence.

The environmental and social factors analyzed in the Area of Influence (AoI) are each evaluated based on their respective parameters and criteria; that said, both share the same system.

The term “impact” refers to the change that occurs in human activities and their relationship with their “environment”. “Environment” should be understood to mean the part of the system (both environmental and social) that is affected by its interaction with the activity.

The methodology used to evaluate the Project’s impacts was based on the following:

Phases	Description
<i>Phase 1</i>	Identification of the phases and activities of the Project in order to predict potential impacts and analyze the environmental and social characteristics of the same on the AoI. Identification of relevant legislation and other regulations (see Chapters 3.4 and 5).
<i>Phase 2</i>	Identification of the activities that could cause impacts (sources of impact), as well as the environmental and social factors that could be impacted. (See Chapter 3).
<i>Phase 3</i>	Identification of impacts generated, using a Leopold Matrix and the quantitative analysis of the impacts identified in the previous phase by means of the Bojorquez-Tapia (1998) methodology. In the case of social impacts, the criteria used to measure them will be based on International best-practices and standards, which are generally considered to be stricter than national regulations or legislation.
<i>Phase 4</i>	Presentation of the results by means of a Calculation report, and finally, a description of the most significant environmental and social impacts.

For more details regarding the methodology, see chapter 7.

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Environmental Component					
	Factor	Environmental Factor			
	FA20 Source of cultural interest	PS1 Land Acquisition	PS2 Personnel recruitment and transportation (administration, operations, labor amongst others)	PS3 Mobilization of resources (equipment, materials, fuel amongst others)	PS4 Rescue and relocation of organisms (flora and fauna)
Fauna	FA21 Abundance				
	FA22 Bitness				
	FA23 Distribution				
	FA24 Endemic Species				
	FA25 Protected Species				
	FA26 Species of cultural and/or economic interest				
	FA27 Quality of the view				
	FA28 Visual Fragility				
Landscape	FA29 Visibility				
		Site Preparation			
		PS5 Removal or topsoil and vegetation			
		PS6 Rehabilitation and opening of access paths			
		PS7 Temporary Structures (Camps for administrative and industrial service staff, latrines, amongst others)			
		PS8 Excavation			
		PS9 Filling and compacting embankments and platforms			
		PS10 Transport and Disposal of Materials (topsoil removal and soil cutting)			
		PS11 Definition of boundaries of conservation areas.			
		Associated Works (off site)			
		OFS1 Land acquisition and /or right-of-way			
		OFS2 Preparation and opening of trenches for the installation of pipelines			
		OFS3 Construction of electricity towers and running of cables			
		OFS4 Installation of underground lines and hydrostatic tests (gas lines, water pipes etc)			
		OFS5 Pipeline Maintenance (natural gas, water, ethylene) and power line			
		OFS6 Site Closure and Restoration			
		Construction Phase			
		C1 Personnel recruitment and transportation (administration, operations, labor amongst others)			
		C2 Mobilization of resources (equipment, materials, fuel amongst others)			
		C3 Temporary Structures (Camps for administrative and industrial service staff, latrines, amongst others)			
		C4 Casting and Construction of Concrete forms			
		C5 Installation of Racks for pipes and other metallic structures			
		C6 Construction of Prefabricated Buildings			
		C7 Roads (including sidewalks and paving)			
		C8 Electro-mechanic construction (including finishing, painting and brickwork)			
		C9 Equipment Installation (both static and Mobile)			
		C10 Preparation and Installation of pipes and mechanical structures (including thermal installation, fire proofing, sand Blasting etc.)			
		C11 Installation of underground pipelines (on site)			
		C12 Provision of services (well water, gas, electricity, potable water amongst others)			
		C13 Waste Management and disposal (urban waste, construction waste, hazardous waste amongst others).			
		C14 Contract Termination			
		C15 Dismantling of temporary structures			
		C16 Rehabilitation of locations on which temporary structures were built.			
		Operations and Maintenance Phase			
		O1 Personnel recruitment and transportation (administration, operations, labor amongst others)			
		O2 Logistical operations (Management of raw materials and finished products).			
		O3 General services (cafeteria, medical services, amongst others)			
		O4 Use of services by way of secondary infrastructure (potable water, water used in processing, electrical lines, cooling towers amongst others).			
		O5 Cracker Operations			
		O6 High Density Polyethylene Operations (HDPE)			
		O7 Low Density Polyethylene Operations (LDPE)			
		O8 Flare Operations			
		O9 Management and treatment of waste water			
		O10 Management and treatment of rain water			
		O11 Maintenance of equipment and machinery			
		O12 Management and disposal of waste (solid, urban, industrial special or hazardous wastes amongst others)			
		Closing Phase			
		A1 Termination of Contracts			
		A2 Dismantling of equipment and machinery			
		A3 Demolishing of structures			
		A4 Management and disposal of waste			
		A5 Cleaning and reorganization of site			
		A6 Environmental rehabilitation of the site			

7.3.1 Identification and assessment of social impacts

Social impacts are identified and evaluated in the same way as environmental impacts, that is to say, in accordance with international standards such as the IFC Performance Standards, the United Nations Millennium Development Goals and the standards used by the Inter-American Development Bank. Social Impact Assessments are an essential element in the identification and characterization of any impacts caused by the Project.

Chapter 7 is comprised of a social impact assessment conducted using the same methodology as the environmental impact assessment. The additional evaluation criteria included (that is to say, criteria that went beyond the focus of the Bojórquez-Tapia methodology) will be described below. Moreover, it is important to note that the basis on which the analysis has been conducted – the Social Baseline Study (SBL)- has been included in Annex 5.4, along with interest groups lists and primary concerns amongst the interest groups. The latter includes what interest groups have identified as their understanding or opinion of the Project as well as what they consider to be their needs, as stated during interviews with key informants (see Annexes 5.16 and 5.17).

- *Qualitative Assessment (matrix of potential interactions)*

With the goal of providing a standardized analysis methodology for both environmental and social impacts, the following table will cross-reference the sources of impacts identified in Chapter 7, section 7.2 (see Table 7.1) with the social factors designated by the impacts (see Table 7.3). Whenever a social factor intersects with the source of an impact, the impacts themselves and their potential effect are analyzed and where they are identified as negative, the corresponding cell is marked.

It is important to note that the identification of those social factors subject to change as a result of the sources of impacts, was determined by focusing on the five principal areas of social interest. That is:

- Economic activities,
- Cultural aspects,
- Demographic processes
- Human and community health and
- Spatial dynamics.

This is due to the need to separate those environmental factors subject to change from the social factors subject to the same. Although in some cases the factor can be a part of both social and environmental evaluations (for example, the condition of the soil can also have an impact on a source of income for a community), the focus of the social factors is their capacity to impact communities in a specifically anthropocentric way, and not so much on the environmental consequences of the same.

As such, changes to the landscape and view can, on the one hand have an environmental impact, including on the fauna of the location, while the same change can have a very specific affect on human populations, such as shifts in identity regarding a group's surroundings, or possible impacts on species of cultural or economic value or interest.

Notes relevant to the analysis:

Additionally, it is important to note that interactions can result both in impacts and in latent social risks. The former is particularly relevant as the following chapters will deal exclusively with social impacts, while the later will be considered to be mitigated and prevented by means of the Social Management Subprograms (see annexes 8.17 to 8.22), which will be described in detail below. As such, in this chapter, both risks and impacts will be evaluated and described, while in following chapters and action plans, only impacts will be considered. As any potential risks are expected to be prevented by the mitigation measures, it can be understood that the Project will only generate the stated impacts.

7.2. PRESENTATION OF THE RESULTS AND HIERARCHY OF IMPACTS

Table 7.3 shows a summary of the quantitative evaluation of the social and environmental impacts identified by means of the Bojórquez-Tapia methodology.

TABLE 7.3 RESULTS OF THE CUANTATIVE EVALUATION OF SOCIAL AND ENVIRONMENTAL IMPACTS

		Nature of Preventable risk or impact		
Phase	Significance	Negative	Positive	Total
Site Preparation	High Significance	1	5	6
	Significant	28	1	29
	Low Significance	9	1	10
	No Significance	3	1	4
Total Site Preparation		41	7	48
Off-sites	High Significance	0	3	3
	Significant	9	1	10

	Low Significance	13	0	13
	No Significance	1	0	1
Total Associated Works		23	4	27
Construction	High Significance	0	4	4
	Significant	20	0	20
	Low Significance	12	1	13
	No Significance	2	0	2
Total Construction		34	5	49
Operation	High Significance	0	4	4
	Significant	20	1	21
	Low Significance	8	2	9
	No Significance	3	1	4
Total Operation		31	8	39
Closure	High Significance	0	5	5
	Significant	3	3	6
	Low Significance	9	2	11
	No Significance	1	0	1
Total Closure		13	10	23
Grand total		142	34	176

7.4.1 *Description of generated social and environmental impacts*

Based on the results of the previous table, it should be noted that the proposed categories correspond to those established in the definition of significant impact as stated in the Regulation on the Federal Environmental Law on the subject of Environmental Impact Assessments, in section IX of Article 3, which states:

Relevant or significant environmental impact: that which is man made or the result of the environment, which cause changes in the ecosystem and its natural resources or health, impeding the existence and development of human communities and other living organisms, as well as the ongoing nature of natural processes.

Chapter 7 describes the most significant social and environmental impacts as identified using the Bojorquez-Tapia *et al.* methodology. This method defines the impacts into either very significant (only used for positive impacts), significant and of little significance (see Tables 7.31 to 7.35 for environmental impacts and 7.36 to 7.40 for social impacts).

Below is a round up of the most significant impacts (to see the full text of the impacts and the mitigation measures, see chapters 7 and 10).

TABLE 7.4 DESCRIPTION OF THE MOST SIGNIFICANT ENVIRONMENTAL IMPACTS DURING SITE PREPARATION

Environmental Component	Identified Impact	Description of Impact
Soil	Change in the Relief of the land	The property is located on a low hill, which will be directly altered as a result of cutting, excavation and leveling activities on the land in order to create permanent embankments and in order to build temporary structures including administrative and industrial service encampments. According to the design specifications, the embankments are expected to fall within a range of 20 to 30 meters above sea level, meaning that the Project intends to form consistent horizontal terraces at different levels, leaving some areas – such as the logistics area – at the current height of the Resistol- El Chapo path, which crosses the site from north to south. In this sense, taking into account information regarding the plans of the Project, approximately 128.98 hectares of the site (66% of the site) will undergo a complete change in its natural state, leaving this surface at approximately between 18 and 35 meters above sea level. Twenty percent of the surface (37.6 hectares) is currently in use as the Resistol-El Chapo path, and current right-of-way will continue unchanged. The rest of the surface area, 30 hectares (15%), will be kept as conservation areas, and will not undergo any changes either.
Water Quality	Change in quality of surface water	Inadequate disposal of the excavation material has the potential to contaminate surface water (primarily due to increased turbidity) by temporary run off into the site due to the sloping nature of its location. One of the alternatives for supplying water for dampening compacted areas and embankments is the use of well water. The water will be accessed by means of a submersible pump, once appropriate authorization has been obtained from CONAGUA. Any spill by the spray tanker or the water pump due to a lack of appropriate maintenance could contaminate surface water. This impact has been identified as significant due primarily to its latent risk, since as this phase is scheduled to last approximately 15 months, mitigation measures should be implemented on an ongoing basis during this time.
Landscape	Change in the original landscape (perception of what is natural)	With the removal of topsoil and vegetation and the cutting of embankments on site, the original landscape of the site, which in turn implies, not only the elimination of 95.49 hectares of secondary vegetation, but also a shift in the topography of the site as the embankments will be consistently dug to a level of between 18 and 20 meters above sea level. The areas that will be most altered will be the zone where the permanent embankments will be located, as well as the area where temporary installations will be located, which will be built at the level of the current Resistol-El Chapo path. Another cause of change in the quality of the landscape, is the movement of soil that has been leveled out or compacted, the equipment of the camp sites and the use of heavy machinery and equipment. Approximately 323 pieces of heavy equipment will be distributed throughout the site on different projects, including dump trucks, tractors, motor graders, spray tankers and compactors. Moreover, the presence of personnel could produce indirect impacts on the view, taking into account that the site will host approximately 274 workers at any given time. The presence of both employees and equipment could alter the quality of the landscape. That said, the developments are located in an areas that has already been heavily impacted by a strong industrial presence in the region dating back over three decades. As such, the impact from the project has been identified as cumulative. Based on what has been previously mentioned, this impact is considered to be very significant, permanent, local, irreversible, cumulative and residual.
Endemic or Protected Species (Fauna)	Loss of members of a protected or endemic species	A number of activities associated with the preparation and development of the site imply a change in the specific structure of the local habitat, and, as such, a loss in members of certain species, particularly those species with slow growth. These activities include: the removal of topsoil and vegetation, the preparation of areas for temporary installations, the creation of permanent embankments, and the constant presence of employment in the zone. The impact on the local habitat impacts those animals with limited mobility such as small mammals, reptiles, amphibians and small birds with limited territories the most. This could manifest itself in a local reduction in bio-diversity. That said, it is important to note that a study of fauna on the site shows that the area has a relatively low incidence of mammals due to the current deteriorated state of the habitat, compared to the numbers reported in the Jaguaroundi Ecological Park and the Tuxtlas area in general. Moreover, the area of study has been found to be noticeably fragmented, preventing the settlement of other important species, and, of the ones currently present, even amongst the most likely to be found in pristine sites, can be found in areas that have been disturbed, showing the adaptability of said species. The decrease in the composition of the habitat and diversity of endemic and/or protected species as defined by NOM-059-SEMARNAT-2010 and the IUCN, as well as their habitats have resulted in the loss of plant cover in the site during the phase of site preparation. This could mean that together with the removal of topsoil and vegetation, the presence of heavy machinery as well as of employees could negatively impact the composition and diversity of species.
Endemic or Protected Species (Flora)	Loss of members of a protected or endemic species.	A number of activities associated with the preparation and development of the site imply a change in the specific structure of the local habitat, and, as such, a loss in members of certain species, particularly those species with slow growth. These activities include: the removal of topsoil and vegetation, the preparation of areas for temporary installations, the creation of permanent embankments, and the constant presence of employment in the zone. This could result in a reduction in the local bio-diversity. That said, it is important to note that the study of flora in the site shows that in the zone covering the Environmental AoI, there is already substantial pressure on the ecosystems as a result of the PEMEX complexes, which have been located in the area for more than three decades. As such, the original vegetation of the area has already suffered a number of important changes and challenges. Currently there is a variety of types of vegetation in the area. The loss of individual members of endemic and/or protected species as defined by NOM-059-SEMARNAT-2010, as well as the loss of habitat as a result of the change and loss of plant cover in the site amongst other activities, could result in the loss of composition and diversity of species. It is important to note that in this sense, when speaking of the loss of members of a species of plant, including when said species falls under the protection of NOM-059-SEMARNAT-2010, that the project will in no way be causing the loss of an entire species, only of individual plants of any given species. As such, the developer will implement management measures described in chapter 10 of this document, by which the developer intends to prevent, mitigate and compensate for the impact of the loss of vegetation in the area.
Abundance, richness and distribution (flora)	Loss of vegetative coverage	The gradual loss of natural vegetation in the Environmental AoI as a result of industrial activities, particularly those associated with oil and gas and agriculture sectors in the zone, as well as human use including occupation of abandoned lots for urbanization, have cause the formation of small patches of vegetation which have in turn contributed to the fragmentation of the habitat of land based fauna that live in the area. The location of these patches next to federal highways, pipelines and railways, all which exist in the Environmental AoI of the project, could become a barrier to the diffusion of small mammals, amphibians and reptiles. Moreover, it is important to note that PEMEX owns the right-of-way on the site. In this sense, the activities that could impact the environment in the region are relatively low proportional to the changes in land use that the area has experienced in recent years. The surface of the area that will have its topsoil removed will include land used for raising permanent embankments and the temporary buildings used during the site preparation phase, is equivalent to 134.9 hectares, approximately 66% of the total surface area on the site. Of the area from which topsoil will be removed, the surface with forest vegetation is equivalent to 95.49 hectares, comprising mostly of medium perennial forest and palm trees. Taking into account the area that will need to have topsoil and vegetation removed in order to construct embankments, paths, workshops, temporary and service camps amongst others, the resulting loss of vegetation will cause important changes in the current microhabitats of the area.
Abundance, richness and distribution (fauna)	Loss or reduction of habitat	In the Environmental AoI, changes in use of land from forest to agriculture and pasture lands, as well as to industrial or urban regions, have not only affected the traditional vegetative coverage in the area, but have also resulted in the Reduction of spaces for the growth and increase in number of native fauna. This has resulted in a number of species having to migrate to areas that have been less impacted by human development while many others have become threatened. This is especially noticeable on site in the areas where PEMEX holds right-of-way for a number of their pipelines. The removal of 95.49 hectares of vegetation from the site is expected to cause a decrease in the habitat of amphibians, reptiles, birds and mammals, and due to the mobility of said fauna, it is expected that the activity will displace members of species that are of economic or cultural importance as well as of endemic or protected species. This has been identified as a negative, cumulative impact due to the pressure that human activities placing on the Environmental Area of Interest. The impact is considered to be significant and it has been determined that compensatory measures must be taken, as described in chapter 10.
Abundance, richness and distribution (fauna)	Loss of biodiversity	The loss of natural vegetation as a result of industrial or agricultural activities has stimulated the creation of patches of habitat, and this fragmentation can become a barrier to the movement of small mammal, amphibian and reptilian species, which act as a filter for the migration of species. In the area of study, 26 species of fauna, adaptable to disturbed habitats, have been identified. These species include <i>Sceloporus variabilis</i> , or exotic species such as the lizard <i>Hemidactylus frenatus</i> and the toad <i>Rhinella marina</i> , species that are abundant in areas of high human influence, and to which changes in habitat could cause both positive and negative impacts. In accordance with the results of the floral and faunal characterization in the site, the following can be concluded. In accordance with the results of the Shannon-Wiener diversity index, the diversity of the site is of 2.6, which is low compared to the diversity found in other Mexican rainforests. This could be due to the specific characteristics of the land including land use, human disturbances, soil composition and vegetation, which are primarily the result of livestock-raising in the area of study.

Environmental Component	Identified Impact	Description of Impact
		- The diversity index shows relatively low mammalian diversity due to a deterioration of the species' habitat. The species identified in the area of study totaled to 11 species, compared to those registered in the Jaguaroundi Park (14 species) or in the Tuxtla area (41 species). - Regarding amphibians and reptiles, 26 species with the capacity to adapt to disrupted habitats were identified. That said, the fragments of habitat and the populations of both amphibians and reptiles in the area have all been affected due to the numbers of species found to be scarce in the area. Canseco-Márquez (1996) stated that the presence of some species of amphibians in the area depend directly on the humidity of their microhabitat, as well as the vegetation with which they are associated. - Regarding mammals, 19 species of medium and large mammals as well as one species of flying mammal. The species are grouped in 16 orders, 13 families, and 15 genus, of which <i>Dasyprocta Mexicana</i> stands out as an endemic species (see Annex 5.3). During the field visits, 11 species were identified and confirmed by means of tracks and sightings, and the rest by means of information shared by local informants and bibliographic research. The orders with the highest representation of species included <i>Carnivora</i>, <i>Rodentia</i> and <i>Didelphimorphia</i> (see figure 14). The number of registered species in the area of study (11) is lower than the 14 species of land and tree dwelling mammals reported by Herrera <i>et al.</i> (2008) for the Jaguaroundi Park. The park is located in the municipality of Coatzacoalcos, Veracruz and consists of 961 hectares plus approximately 57 hectares of bodies of water. - One hundred and thirteen species of birds were identified, of which some require relatively undisturbed or pristine habitats, such as the "yellow headed parrot" (<i>Amazona oratrix</i>) and in general, the entire order of <i>Psittaciformes</i>, the "Mexican Tiger-Stork" (<i>Tigrisoma Mexicanum</i>) the "bloody tanager" (<i>Ramphocelus sanguinolentus</i>) the "canoe beaked toucan" (<i>Ramphastos sulfuratus</i>) and the pheasant (<i>Crax rubra</i>) which indicates that the habitats studied maintain sufficient biotic and a biotic characteristics in order to sustain these bird populations, despite being surrounded by large industrial complexes. It is important to note that a large number of termite mounds were identified in the area, particularly in areas where medium evergreen forest was predominant, which is used for nesting by both <i>Psittaciformes</i> and <i>Trogoniformes</i>, making it extremely important to preserve all the remaining forest possible within the site. Moreover, the locations where species have low populations, limited migration or are specialized to that particular habitat which find themselves at most risk of local extinction due to the fact that these species cannot take advantage of viable secondary habitats that exist nearby.
Natural Dynamics	Change in run-off tendencies	The site has a hilly configuration which, based on the topography of the site, there is a strong tendency towards surface run-offs without forming formal, permanent or temporary streams. As was previously mentioned, the topography of the site slopes towards the northeast, meaning that the natural run-off from the site runs into the Gopalapa stream. That said, the section of the property where the proposed logistics area will be located (to the west of the property) the run-offs flow towards the south-west of the site, draining into the Nanchital stream, located to the south of the Project. As such, the removal of vegetation and topsoil, the excavation, cutting, filling and formation of embankments, will change the natural topography of the land, and as such the tendencies for run-off. Taking advantage of these natural tendencies, a series of channels will be built in order to guide the run-off in the ditches, particularly of rain water, towards the Gopalapa Stream. According to the Preliminary Temporary Construction Storm Water Draining Study, once the embankments have been evened out, the site will have the following drainage plan during the remainder of the construction phase.: - The zone proposed for the industrial area (cracker, high and low density polyethylene) will be built to include a watershed in such a way so that storm water run-off runs into two trenches on the edges of the building that will flow to the north-east. - The zone where the industrial plan itself will be located will be built with both mesh and watershed to guide the run-off towards a principal drainage trench which will be located parallel to the right-of-way (ROW) 046, flowing northeast, in order to run into the Gopalapa stream. - The Logistics 2 area will be built with a watershed running north-south down the middle of the area, draining into two trenches, one parallel to the Resistol-El Chapo path, and the other parallel with the edges of the property. - The logistics 3 area will run off to the west, where it will join a trench located on the edge of the property, which will run south, finally joining Nanchital Stream. - The northern part of the zone to be used as a camp site and for administrative offices will include a trench located parallel to the Resistol-El Chapo highway which runs towards the Nanchital stream, while the southern part of the area will drain towards the trench on the edges of the property and will run eat, towards the trench located parallel to the Resistol-El Chapo highway.
Erosion	Acceleration of erosive processes in areas that have had top soil removed slopes and areas with no construction.	At the beginning of the ground works and topographic studies, teams were needed to complete the studies, making it necessary to remove vegetation to allow machinery and equipment to pass. As such, the areas that remained without ground cover during the study period could result in the acceleration of soil erosion. On the other hand, one of the situations that can speed up soil erosion is the increase in vehicle traffic in order to transport materials to different areas of the site. During a peak month of the study period, there could be up to 483 vehicles on the site at any time. During removal of topsoil and vegetation, particularly soil removal for construction of temporary buildings and permanent embankments, soil erosion increases, affecting the geomorphology of the site. Leaving areas open to the elements without topsoil or vegetation is likely to accelerate erosion in an area where the geomorphology is already particularly erodible. The project expects to extract approximately 4.5 million cubic meters of soil during the 15 month period, directly related to soil and rock cutting. Said material, due to its structural characteristics, cannot be reused to level out the embankments, meaning that it will have to be disposed of off site. In order to do this, the developer has established agreements of intention with several organizations, both public and private, to relieve the material, in order to ensure the adequate and safe disposal of the material. These include: the municipality of Nanchital, a current soil bank in El Polvorin and El Pinolillo, as well as IDESA's installations. This material will be used in order to improve rural paths or roadways, or areas that need to be leveled out.
Water Quality	Change in quality of groundwater	The temporary support buildings include the portable toilets- that will be used by the workforce during the site preparation phase- the camp site and the workshop amongst others. These will generate grey water and residual waste that could possibly contaminate ground water on the site. That said, as was indicated in chapter 3, the portable toilets are hermetically sealed and will receive periodic maintenance through a subcontractor, who will collect waste and treat them appropriately offsite. As such, it is not expected that there will be any waste discharge on site. The water table is found at an average depth of 25m, however, the excavations will only reach a level of 30 meters above sea level. As such, it is expected that even once excavations have been completed, there will still remain between 5 and 10 meters of soil above the water table. With these conditions met, it is not expected that there will be any change to the quality of ground water in the area caused by waste discharges. In case of any accidental spill of fuel, or in the area of gas storage or workshop, it is not expected that any surface water will be contaminated, or that any spill reach the Gopalapa stream.
Land relief	Loss of horizon of organic vegetative soil.	Due to activities associated specifically with removal of topsoil or vegetation, excavation, filling or leveling, the volume of organic soil that will be removed is likely to be of approximately 680 000 m³. That said, these areas are located in the intersection between the natural forest and urban areas, and is under a lot of pressure from urban growth.
Natural Dynamics (surface water)	Reduction in surface infiltration	Space for filtration on the surface of the site will be reduced and limited due to the removal of vegetation, soil compacting and the areas set aside to make embankments which will later be used for structures needed in the second phase of the project. In order to mitigate this impact, the developer will implement a sub program of water management and disposal (see chapter 10).
Noise	Changes to the noise level	In the area surrounding the site, there are a number of industrial installations, including: Quimir, Resirene, Grupo Celanese and a number of PEMEX petrochemical complexes including La Cangrejera, Morelos and Pajaritos all with ROW. There are also a number of complementary installations which indicate the importance of heavy industry in the region. It is important to note that railroads pass through the Aol, meaning there is already an important source of occasional noise. The tracks are adjacent to the western limits of the property. The machinery and equipment required for the Project will increase the noise level, remaining within the limits of 60dB (A) to 94dB (A), and could surpass 100dB (A) according to bibliographic reports. On the other hand, the monitored ambient noise levels adjacent to the site (see chapter 2), the potential receptors are the community members in Pollo de Oro and the township of Lázaro Cárdenas del Río where the noise levels will found to be 58dB (A) and 65dB (A) respectively. An increase is expected in the amount of noise cause by vehicular traffic which will transport both employees and material on the access roads to the site. These access roads have been identified as the federal highway Coatzacoalcos-Villahermosa and the Resistol-El Chapo path. The impact on the potential receptors such as Pollo de Oro, Nahualapa or the township of Lázaro Cárdenas del Río will be evaluated in the Social Impacts section. The existing noise levels in the area and the expected noise levels on the site are based on the fifth month of this phase when approximately 231 trucks will be in use. It is estimated that the noise levels will be of

Environmental Component	Identified Impact	Description of Impact
		approximately 95dB(A), which will dissipate to an imperceptible level at distances. As such, the significant adverse impacts on the Area of Direct Influence and noise will also differ relative to the distance. The impact has been identified as adverse, of low significance, temporary and local to specific sites in which heavy machinery and vehicles will be working, and will be easily managed with mitigation measures.
Air Quality	Changes in air quality due to increase in dust particles	Other impacts on air quality can include dust and exhaust emissions on the Project site and its AoI. The former will be caused by the movement of materials to and from the site, both bringing raw material and employees, and moving waste for its safe disposal. That said, said impacts will be temporary and only during the site preparation phase, and will be mitigated automatically by the location of the area and the strong winds in the region. The principal groups that could be affected by emissions are the workers themselves and the inhabitants of the communities in the AoI, since they will be directly exposed to emissions during the work day. These impacts have been identified as low to medium, adverse, mitigable, local, temporary, of low significance and reversible.
Soil Quality	Ground pollution (oil and gas spills, inappropriate disposal of both liquid and solid waste)	During this phase, other than the operation of heavy equipment, there will also be an industrial camp complete with warehousing for materials, offices, workshops, a vehicle washing and lubricating station and gas station. As such the use of the land during the site preparation phase corresponds to eventual spills of hydrocarbon, lubricant and other chemicals produced during the use of vehicles, equipment camp sites. In this case, the inadequate disposal of hazardous solid and liquid waste generated by the mechanic shop could alter the quality of the soil.
Odors	Presence of odors (organic decomposition of the vegetation removed as a result of topsoil removal)	The Project includes the removal of topsoil which will consist of the removal of a layer of the topsoil (an organic layer of approximately 40cm), of approximately 680 000 cubic meters, containing important organic material, humus and seeds. It is also estimated that as part of the removal of the topsoil, another approximately 8 745.23 cubic meters of wood supply will be removed. This layer is made up of woody plants whose diameter and height allows for easy inventory, and that make up part of the medium evergreen rainforest (secondary vegetation) and palms. Considering the volume of organic material that will be created by this phase of the Project, inappropriate disposal of this material in areas close to water or run-off zones could accelerate the decomposition of organic matter causing strong odors which affect not only the local population but also the work force on site.
Air Quality	Change in air quality due to increase in combustible gas	The air quality during this phase will be affected by contaminating emissions coming from the heavy machinery and equipment necessary for the proposed works, particularly during the cutting, filling, excavation, transportation and operations activities amongst others. Gas emissions including Nitrogen Oxide (NOX), Carbon Monoxide (CO), unburned hydrocarbons (HC) and Sulfur Dioxide (SO ₂), of which NOX and SO ₂ are the most important compounds that cause change in the composition of the air. Taking into account that during this phase between 102 (in the first month) and 236 pieces of heavy equipment (in the fifth month) will be operating, the levels of these compounds are expected to increase. That said, given the quality of the air shed, which is already affected by other industrial activities in the area, specifically heavy industry, it is expected that the impact caused directly by the project will be of little significance. Other factors that will affect this impact, the site and its AoI, will be the movement of materials to and from the site, as well as to its final disposal location off site. That said, said impacts will be temporary during the site preparation phases, and will be tempered by the size of the site as well as the strong winds in the region.
Natural dynamics of ground water flow.	Possible abatement of the groundwater table.	For the site preparation activities, the Project requires approximately 100 000 cubic meters of fresh water during the 15 months it will last, to be used to keep the embankments moist and to keep the dust down on the paths. In this sense, and based on the conclusions of the studies of groundwater availability, there is substantial availability, allowing for four different proposed locations for the wells. The water requirements for this phase on the Project are not expected to cause significant impacts on the water table, and neither the site nor the AoI has been identified as drought zones.
Current use of surface water	Change in the flow rate	For the site preparation activities, the Project requires approximately 100 000 cubic meters of fresh water during the 15 months it will last, to be used to keep the embankments moist and to keep the dust down on the paths. In this sense, and based on the conclusions of the studies of groundwater availability, there is substantial availability, allowing for four different proposed locations for the wells.

TABLE 7.5 DESCRIPTION OF SIGNIFICANT ENVIRONMENTAL IMPACTS CAUSED BY ASSOCIATED WORKS (OFF SITE)

Environmental Component	Identified Impact	Description of Impact
Soil Quality	Ground pollution (oil and gas spills, inappropriate disposal of both liquid and solid waste)	During this stage, the Developer will be providing a series of support services to the construction of its industrial complex within its site. There will be a storage facility for materials, offices, a workshop, a vehicle wash and a gas station, all of which could impact the soil. As such the use of the land during the site preparation stage corresponds to eventual spills of hydrocarbon, lubricant and other chemicals produced during the use of vehicles, equipment camp sites. In this case, the inadequate disposal of hazardous solid and liquid waste generated by the mechanic shop could alter the quality of the soil. In locations where pipelines are being excavated and installed, impacts are thought to be unlikely. In this case, the inadequate disposal of hazardous solid or liquid waste generated either by domestic activities or by the workshop could affect the quality of the soil, but not as a direct result of the work area. On the other hand, the inadequate disposal of excavation material on the way to the ethylene, water and gas pipelines, as well as in the running of electric cables could end up contaminated by hazardous liquid waste such as oils which could alter the quality of the soil if not managed correctly. During construction, spills of materials such as lubricants, gasoline and chemicals generated by vehicles or machinery is of low risk due to the mitigation measures in place, and as a result of the management and disposal of the materials will take place within the Braskem-Idesa installations. The management plans developed by the developer for the site preparation and construction stages will be applied in the same manner. During the operation stage, it is unlikely that a leak in the tubes could affect water quality, or that either natural gas or ethylene could dissolve in the water, as they would first dissolve in the air.
Land use	Permanent modification of land use	As it was mentioned, the construction of the ethylene and natural gas pipelines, will be performed across an existing right of way, which currently the Resistol-El Chapo path. According to the Ecological Planning Regulation, this zone is classified as in "industrial use", and, due to the associated constructions on the same right of way, it is prohibited to change the land use, or being permanently modified. In the case of laying power lines, it will prevent a permanent modification in the potential use of the current land existing all over the way of the electrical line. According to the Ecological Planning Regulation of the basin down river of the Coatzacoalcos river, the electrical line cross by some categorize land use as industrial use, flora and fauna use and agricultural and livestock use. In conjunction with the right of way, the impact surface will be 42 meters wide, according to the Standard NRG 014 CFE 2004. The impact is due to the permanent modification of the land use throughout trajectory of the power line in the environmental aspect (vegetation removal) as in the social aspect, will be detailed once the specific assessments are performed across the trajectory route, as well as with the specific micro-route that will be performed, to redefine the location of the towers if any sensitive ecosystem is found or any potential receptor is likely to be affected.
Flora and fauna	Loss of vegetation cover/loss of habitat	The gradual loss of natural vegetation in the Environmental AoI by the industrial-oil companies activities and agricultural and livestock activities existing in the zone, as well as man made source by the use of free spaces for urbanization, joined to the presence of the federal roads, gas pipelines and oil pipelines already existed on the region property of PEMEX, and the train way existed in the Environmental AoI that has cause the fragmentation of the existing habitat of the flora and fauna in the Manchones region, that has already cause some barriers for the dispersion and free transit of the small mammal species, amphibious and reptiles in this zone. In this way, the construction of the pipelines will cause a loss of secondary vegetation just in the trajectory of the natural gas pipeline to be permanently installed, because the right-of-way must be free of vegetation during the lifetime of the mentioned pipeline, this is due to the frequent maintenance activities that will be perform to the pipelines. In the other hand, in the electrical line, a vegetation removal will be required throughout the right-of-way for the towers assembly as well as in the maneuvering areas; however, this route is not already define, it is unknown the magnitude of the impact due to that the biotic categorization that will be impacted in the site, has not been performed. However, it could be say, that when the electrical laying started operations, the permanent impacted area by the loss of vegetation and the habitat of the local fauna, will be only the towers foundation, and in the remain trajectory of the electrical line it is expected a recovery of the flora and fauna.
Landscape	Modification of the original landscape (perception of what is natural)	Landscape susceptibility depends on it quality, conditions and inherent capacities to adjust to changes and any other specific value (such as Landscape signaling) that may be used. On the other hand, the susceptibility of viewers depends on the opportunities of the observation and whether they are residents, roads users or people located at the right of way. A substantial impact will occur where both sensitivities of the Landscape or viewer and the magnitude of the impact are high. - The Landscape along the pipelines trajectory (water, natural gas and ethylene) will be very uniform in all this cases, in case of the patterns that create and are concerned, and that this will be located in an area already impacted by the presence of the established industry in this region for over 50 years and the presence of secondary vegetation already impacted, moreover that the region is characterized to have a flat relative topography. According to simple field observations, there are not identified sensitive areas along the road of Resistol-El Chapo as a Landscape is concern and the constructions related with excavations along the trajectory will have a impact to the existing Landscape in just one base; however, it is necessary to perform a field work with more detail to precise exactly the fragility of the existing Landscape in this area, because in the long terms, once they finish burying the pipe, a reintegration will be perform with the existing Landscapes in the surrounding area. - The mail impacts of the existing Landscape will begin with the started of the site preparation activities to bury the pipelines, along with the movement of trucks, cranes and diggers and (possible) temporary lighting associated con the construction. The impact associated with vehicles movements will be temporary, with a relative importance in comparison with the impacts on the Landscape of the area. As for the laying of the electrical lines, the impacts above Landscape are permanent. In the short term, the temporary impacts during the construction of the electrical line, and the natural gas pipeline will result from: - Cleaning and removal of vegetation along the excavation area for the case of the pipelines and cleaning along the right-of-way of the electrical laying. - Removal and temporary storage of surface soil along de work area, creating a longitudinal corridor in the Landscape, whose visibility will depend of the characteristics of the local Landscape. - Change of land use permanent in the stroke of the electrical line and its right-of-way.
Water Quality	Change in quality of surface water	The improper disposal of excavation material could generated the temporary drain contamination existing in the site of interest, specially at junctions with the streams Gopalapa and Nanchital, causing pollution in the surface water (by the increasing of the turbidity). Other impacts that can be identified on this attribute is the possible discharge of the hydrostatic testing of the piping that will be perform in the phase after being installed. The discharge of wastewater could generate physical impacts from the release of large volume of water with flows of fast speed and the quality of discharge water. Water quality may perhaps be affected by metal and rust particles. In the case of pipelines, it will have an epoxy lining to reduce the amount of metal particles and the rust accumulated in the water when the testing is performed. However, it is contemplated that for this time, the wastewater treatment plant is already installed at the industrial complex and, hence, the discharge of such tests will be conducted in the treatment system. Considering that the water and ethylene pipelines cross the stream Gopalapa and, in the case of the natural gas pipeline, cross the stream Nanchital, the works that are performed specifically

Environmental Component	Identified Impact	Description of Impact
		in this cross to pass the pipelines under the streams, can cause an impact in the water quality. The impacts on groundwater are unlikely, and are considered minor. During the installation it will not be necessary the trenches drainage at the crossing of water (by the pipelines of water, ethylene and natural gas); therefore, it is not contemplated the use of this resource during the installation of the associated works for the operation of the same.
Erosion	Acceleration of the erosion process in areas that have had top soil removed slopes and areas with no construction	Potential impacts on soil will begin during the installation, and the duration of these impacts will depend on the success of the restoration and reinstatement measures of the ecological system to be impacted. The most important potential impact is the physical erosion of unstable soils. In addition, there is a potential degradation in the soil quality and its structure as result of the compaction and their ineffective replacement. The potential for soil erosion and frequency which this happens will depend on rainfall in the area. Soils in the Project area very friable clay with little accumulation of clay (see chapter 5), which means they are susceptible eolic erosion. For the preparation of the trenches and the installation of the pipelines, it is required to remove the vegetation and, therefore, the organic layer of the soil, so considering the type of present soil in the area where it is intend to develop additional works of gas, water, ethylene and electrical line, that can generate erosion process in the medium and long term.
Noise	Change in Noise Levels	In this area, around the Site of interest, there are different industrial facilities that are in the area for over 50 years, such as: Quimir, Resirene, Grupo Celanese and the petrochemical complex of PEMEX La Cagrejera, Morelos and Pajaritos, all of them have piping (right-of-ways), among other complementary installations, so that the industrial use in the region where the Braskem-Idesa Project will be located is obviously of heavy industry. It is also important to note, that in the Site of interest there is already a source of noise that it is the train, whose ways are on the west boundary of the property. The construction of the pipelines, whether if they are from ethylene, gas or water, and even the laying electrical line, including the activities that generated noise, such as: preparation of the right-of-way and removal of surface soil, trenches preparation, skewer, welding and installation of the pipelines and filling, laying of the posts. The operation of the required machinery and equipment will cause an increase in the noise level within the maximum levels of 60 dB (A) to 94 dB (A) and can exceed 100 dB (A), taking as reference the information reported in the bibliography. On the other hand, the monitored environmental noise levels in the adjoining area to the site of interest (See chapter 5), the potential receptors are the people of the congregation Pollo de Oro and the Ejido de Lázaro Cárdenas del Río, where noise levels were 58 dB (A) and 65 dB (A), respectively. Considering the existing noise levels in the area and the noise levels that are estimated to be taken at the Site of interest and assuming that the complementary works will be located far from the potential receptors, this will reach a detectable level; that's why the develop of these works may be lower. However, being these locations in the area of direct influence, vehicle traffic for the movements and transportation of machinery, equipment and material, could have negative impacts on these potential receptors, it would be in the main roads of communication that surround the site of interest.
Air Quality	Change in air quality due to flue gas and dust	Emissions generated during the installation and operation of the associated works to the air includes emissions from construction vehicles. Other impacts to the quality of the air will be the dust and gas emissions in the site of the Project and its influence area, the above mentioned derivative of the material movements to the site of interest and outside of it for their final disposal and the vehicles transit; however, these impacts will be temporary during the preparation phase of the site, naturally attenuated by the dispersion of the area and the predominant winds in the region. The main affected by these emissions are those workers of the road construction and the inhabitants of the surrounding communities to the Project, due to they are directly exposed during the working day; also, the dust emitted during construction can affect the close receptors; however, along the proposed routes are only industrial facilities. There is no potential receptor, such as village or town, near the proposed line for the associated works. This impact on workers is described in detail in the section of social impact.
Water Quality	Change in groundwater quality	An alternative of the water supply for the humidification activities, is to use the groundwater, therefore Braskem-Idesa requested to CONAGUA the authorization to drill well to extract water from it. Water is used for the humidification of the work areas. The acquisition of this resource will be performing after obtaining the authorization from CONAGUA. A possible fuel spill from the truck or the pump from the supply system due to a lack of maintenance of the equipment, can cause soil contamination, but not surface water. The water table is located at an average depth of 25 meter; however, excavation will reach an elevation of 20 meter above sea level, therefore, to generate an impact, it will affect first the soil. Under these conditions, it is prevented to affect the groundwater quality for the possible direct dumping or the fuel dragging, an accidental fuel spill from the machinery and/or equipment in poor operation conditions, or from the fuel storage area and from the maintenance workshop.

Table 7.6 Description of the most significant environmental impacts during construction

Environmental Component	Identified Impact	Description of Impact
Air Quality	Change in air quality (increase in gas exhaust, smoldering fumes).	One of the impacts on air quality likely to be generated during this phase is emissions from dust and smoke associated with soldering, both within the Project site, and the AoI. Even though activities associated with filling or removal of soil, there will still be a substantial flow of vehicular traffic due to the following activities: • Circulation of vehicles for the transportation of construction materials (assuming the truck beds do not have tarps covering them) • Circulation of vehicles for the transportation of materials, equipment and employees, as the vehicles will use temporary access roads that will be unpaved • Welding of tubes and racks during installation These impacts will continue throughout the construction phase, as laid out in the work timeline, and will have a duration of approximately 3.5 years. Those that will be most directly impacted by the generation of dust and smoke will be personnel working on roads or as welders on the Project site or associated works. Said personnel, along with the villages adjacent to the Project and along the transport route for materials will be directly exposed to this impact during the normal work day. These impacts are described in greater detail in the Environmental section of this chapter.
Air Quality	Change in air quality (increase in exhaust as a result of the operation of machinery or equipment, Vehicle traffic and greenhouse emissions).	Air quality in this phase will be affected by pollutant emissions coming from the machinery and equipment necessary for the construction and development of the proposed works, particularly during the stages of construction and casting of structures, construction of prefabricated buildings, electromechanical constructions, mounting of equipment and movement of resources (both human and construction materials) amongst others. Emissions from fuel include Nitrogen Oxide (NO_x), Carbon Monoxide (CO), unburned hydrocarbons (HC) and Sulfur Dioxide (SO₂). Of these, NO_x and SO₂ are the most important composites, as they cause changes in the composition of the air itself. As there are expected to be a large number of machinery and trucks being used during the entire 3.5 year period, the levels of these compounds are expected to increase. That said, considering the current air quality in the area, in which there are already a large number of heavy industry-associated activities taking place, it is expected that the impact of the project will be of little significance, especially when taking into account the mitigation and management plans in place. Other factors that will impact the situation, the site and the AoI, is the movement of materials to and from the site for final disposal. That said, said impacts will be temporary during the site preparation phase, and will be limited naturally by the dispersal throughout the zone due to the strong winds in the region. The majority of the Greenhouse Gas Emissions (GGE) associated with the production of Polyethylene comes from combustion units. In this sense, the Carbon Dioxide (CO₂) is the primary GGE for the Project. That said, trace amounts of methane (CH₄) and nitrous oxide (N₂O), are also emitted by these units and contribute to the increase of the GGE Effect.
Noise	Changes in Noise Level	In the area surrounding the Project site, there are a number of industrial sites that have been in the area over 50 years. These sites include: Quimir, Resirene, Grupo Celanese and PEMEX's petrochemical complexes: La Cangrejera, Morelos and Pajaritos. The latter have right-of-way (ROW) for pipelines between the sites and secondary installations. As such, it can be said that heavy industry is extremely important in the region. All of the aforementioned sites use the rail road tracks as a primary form of transport for raw materials or finished products, such that there already exists an important source of intermittent noise pollution. The tracks are located adjacent to the western limits of the site. The machinery and equipment required for the Project will increase the noise level, remaining within the limits of 60dB (A) to 94dB (A), and could surpass 100dB (A) according to bibliographic reports. On the other hand, the monitored ambient noise levels adjacent to the site (see chapter 2), the potential receptors are the community members in Pollo de Oro and the township of Lázaro Cárdenas del Río where the noise levels will found to be 58dB (A) and 65dB (A) respectively according to the noise studies completed by Laboratorio Microecol, SA de CV, a company certified by the Mexican Accrediting Body. In this sense, the potential receptors are the workers themselves, who Braskem-Idesa will ensure have the personal protection equipment necessary. This potential impact on employees will be described in further detail in the section covering Social Impacts. The populations in Pollo de Oro and Lázaro Cárdenas will not feel perceptible noise impacts from the operation. It is important to note that normal noise levels (base level) will return to 55dB (A) as determined in the Baseline report, once construction is completed. That said, the construction phase is expected to last approximately 3.5 years as has been mentioned previously. It can be concluded that the impact will not be permanent in the Area of Interest, but rather will only last for the duration of construction.
Soil Quality	Ground pollution (oil and gas spills, inappropriate disposal of both liquid and solid waste)	During the construction phase, apart from operation machinery and equipment, there will also be a maintenance area within the temporary installations, within which there will be storage, offices, a mechanical workshop, a vehicle washing and lubricating station and a small gas station, all of which can affect the soil quality. This impact is due to the risk of hydrocarbon, oil, lubricant or other chemical product spills, or due to mismanagement of waste in storage areas. Inadequate disposal of domestic liquid effluents and hazardous solid waste generated by the workshop could alter the quality of the soil.
Natural dynamics of groundwater flow.	Possible abatement of groundwater tables.	For site preparation activities, the Project requires approximately 392 000 cubic meters of freshwater, for which the Developer is considering the possibility of digging a well on site. Braskem-Idesa has begun the process to gain authorization from CONAGUA for the well, which if approved, will also provide the water needed during the construction phase. According to the "Report updating the annual availability of ground water in the table (3012) Costera de Coatzacoalcos, Veracruz State" (Diario Oficial de la Federación, 28 August, 2009) there is approximately 125,553,379 meters cubed of water available annually, meaning that due to the comparatively low volume of water required for the project, there is not expected to be any significant impact on the groundwater tables. Moreover, the Project site and corresponding AoI are not considered to be drought zones. It is important to note however, that the communities located close to the site like Pollo de Oro, El Chapo, Lázaro Cárdenas del Río and Nahuallapa all use well water, so it is important to do an evaluation of the possibility of the Project having negative effects on groundwater table levels.
Water Quality	Change in quality of surface water	A spill caused by a spray tanker or a supply pump due to lack of maintenance has the potential to contaminate the ground but not surface water. It is important to note that if the water used for hydrostatic testing is not disposed of appropriately, and is disposed directly into the Gopalapa stream without being treated first, could contaminate the stream.
Flora	Change in the quality of the habitat in areas of the property that have been designated ecological reserves and areas adjacent to the property.	As was mentioned in Chapter 3 of this document, Braskem-Idesa has designated an area of 30 hectares of the property, divided into three areas, for ecological conservation. One area is located to the south, another to the east and one more on the edge of the Gopalapa stream on the northeastern border of the property. This area will be maintained without any change from the site preparation phase, through construction and operations of the Project. As such, although the sites are not located in areas where there is a large amount of installations, the flora and fauna there are potential receptors, and adequate measures must be put in place to ensure employees do not invade the sites. • As a mitigation measure, Braskem-Idesa will implement an Environmental Education Subprogram for employees and subcontracts with the goal of ensuring these personnel comply with minimum standards of care in said areas.
Landscape	Change in original landscape (perception of what is natural)	With the removal of topsoil, vegetation, cutting and creation of embankments, the original formation of the soil relief, this implies not only the elimination of 95.49 hectares of secondary vegetation, but also the leveling of the embankments to between 18 and 20 m above sea level. This will particularly affect the zone where the permanent embankments and temporary structures are located, as these will be made level with the current Resistol-El Chapo road. Another point that could change the quality of the landscape, is the movement of soil (both leveled and compacted) as a result of the use of a total of 323 pieces of heavy machinery and equipment throughout the site including dump trucks, tractors, spray tankers and compactors amongst others. There will also be a substantial increase in the number of people in the area (the site will average approximately 274 workers) which can also affect the landscape. It is important to note that while these impacts are possible, the work is taking place in an area that has already felt a strong impact due to preexisting industrial activity over the last three decades, and as such, this impact is considered to be cumulative.

TABLE 7.7 DESCRIPTION OF MOST SIGNIFICANT ENVIRONMENTAL IMPACTS DURING OPERATIONS

Environmental Component	Identified Impact	Description of Impact														
Natural dynamics (run-offs)	Minimization of natural flooding in low lying zones in the sites of interest and surrounding areas.	As indicated in the bibliographic and historical antecedents of flooding in the region, the properties adjacent to the Project tend to flood during rainy season due to the overflowing of the Gopalapa stream. These properties, excluding Lázaro Cárdenas del Río are currently privately owned and are, as yet undeveloped. That said, Braskem-Idesa has considered applying mitigation measures to minimize the likelihood of flooding during the operation that could damage both the installations themselves, and any adjacent properties. These measures (see Chapter 3) have been taken into account in the design of the drainage system and the internal management of effluents, as well as the management of vents, and as such the likelihood of the lower areas of the site or any adjacent properties, flooding naturally, is likely to be minimum														
Air	Change in air quality (VOCs, exhaust, specific fugitive emissions amongst others)	The most common emissions into the atmosphere emitted by polymer plants are those comprising of Organic Volatile Compounds (VOCs) which come from the drying, finishing processes, as well as purges and fugitive emissions at different points in the process. The purges that happen during the process are associated with the purification of raw materials and the filling and emptying of reactors and other pieces of equipment as well as the extraction of byproducts as a result of the reaction of the polycondensates and the pumps that empty and depressurize the deposits. The fugitive emissions in the installations that manufacture polymers are principally associated with the releasing of OVC originating in pipe leaks, valves, connections, joints, packaging, open lines, storage tanks with floating roofs, pump joints, gas transportation systems, compressor joints, security valves, operations for offloading raw materials and chemical substances, the preparation and mixing of chemical substances, and waste water treatment operations. The emissions of particulate material (that is to say, thin polymer and/or additives such as barrier agents, etc.) are associated with polymer packing and drying activities. Other sources of particulate material include the transport, transferring and extraction of pellet dust. The design of the Braskem-Idesa installations have been carried out by Technip following the strictest standards regarding air quality established by Mexican legislation and by the IFC. These include the standards mentioned in chapters 3 and 5 of this document as well as the IFC's guide on environmental health and safety for the manufacturing of polymers derived from petroleum. According to the results derived from the air quality assessment in the area included in chapter 5.1 (which evaluates the presence of CO, PST, PM 2.5, PM 10, O ₃ , NO _x , SO ₂ and Pb), the expected air quality in the area complies with the guidelines established by the IFC. On the other hand, the results of the dispersion study on the contaminant plume for each monitored parameter (see Annex 5.11) suggest that the plumes with the greatest concentration are located within the site, within a radius of approximately 400 meters. The one exception emits the maximum amounts of CO, NO ₂ y SO ₂ . That said, it is important to point out that for all composites, the estimated concentrations are less than the limits imposed both by the IFC and by Mexican regulations regarding air quality. As such, no short or long term impact on air quality is expected. In conclusion, air quality expected by the operations of the project comply with the general focus and medium-term objectives 1 and 2 in the Table of guiding principles.														
Air	Increase in greenhouse effects (CO ₂ , N ₂ O, emissions and possible traces of CH ₄ , amongst others)	The majority of Greenhouse Gas Emissions (GGE) associated with the production of polyethylene are as the result of combustion units. In this sense, carbon dioxide (CO₂) is the primary GGE for the Project. That said, trace amounts of methane (CH₄) and nitrous oxide (N₂O) are also emitted by these units and contribute to the increase in the Greenhouse Gas effect. Based on the previous information, below is a breakdown of the areas that could potentially generate GGE. It is important to note that this review is a general guideline based on the information that has been received by Braskem-Idesa regarding the Project. <table><tr><th>Activity or area</th><th>Emissions Expected</th></tr><tr><td>Transportation of raw material, of the finished product, diesel and various waste products for their final disposal.</td><td>CO₂ + N₂O + CH₄ due to burning of used fossil fuel</td></tr><tr><td>Power for operations (includes consumption of fossil fuels and electricity) for the generation and distribution of power</td><td>CO₂ + N₂O + CH₄ due to burning of used fossil fuel</td></tr><tr><td>Operations</td><td>CO₂ + N₂O + CH₄ due to the burning of used fossil fuels for the operation of the cracker, the HDPE plant, the LDPE plant, the burner, and any additional equipment and machinery necessary for the operation.</td></tr><tr><td>Fugitive emissions from various sources</td><td>Various fugitive emissions during operations</td></tr><tr><td>Management and disposal of waste (general services)</td><td>CO₂ + CH₄ due to decomposition of organic material</td></tr><tr><td>Waste water treatment plant.</td><td>CO₂ + CH₄ due to decomposition of organic material</td></tr></table>	Activity or area	Emissions Expected	Transportation of raw material, of the finished product, diesel and various waste products for their final disposal.	CO ₂ + N ₂ O + CH ₄ due to burning of used fossil fuel	Power for operations (includes consumption of fossil fuels and electricity) for the generation and distribution of power	CO ₂ + N ₂ O + CH ₄ due to burning of used fossil fuel	Operations	CO ₂ + N ₂ O + CH ₄ due to the burning of used fossil fuels for the operation of the cracker, the HDPE plant, the LDPE plant, the burner, and any additional equipment and machinery necessary for the operation.	Fugitive emissions from various sources	Various fugitive emissions during operations	Management and disposal of waste (general services)	CO ₂ + CH ₄ due to decomposition of organic material	Waste water treatment plant.	CO ₂ + CH ₄ due to decomposition of organic material
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Waste water treatment plant.	CO ₂ + CH ₄ due to decomposition of organic material															
Noise	Change in Noise Levels (increase in train traffic)	Given that at this time the Project is still in the design phase, it does not yet have an expected volume of GGE, and as such, the Project should plan measures for its management (see chapter 10). The noise level to be generated during the operations will not exceed the environmental noise levels established in Mexican Legislation (NOM-081-SEMARNAT- 1994) and the IDC (the amounts will be included in the following table) according to the design specifications. In any case, the noise level generated by the Project will not increase more than 3dB, that is, the current noise level that the closest receptors (for instance the inhabitants of Pollo de Oro) already experience. The maximum noise that is expected to be generated by the operating machinery will be of 85dB at 1meter of distance from said machine. Braskem-Idesa has considered isolating these machines by means of enclosing them. The machines that generate these noise levels are the following: • Pellet dryer. • Filters. • Extruders and their pumps. • Hydrocarbon, nitrogen and air compressors.														

Environmental Component	Identified Impact	Description of Impact
		On the other hand, it is important to mention that all personnel who will be exposed to noise levels above those allowed by the applicable regulations published by the Secretary of Labor (that is, over 90dB in 8 hours) will be provided with protective equipment, based on the results of the noise monitoring in the work environment which will take place once operations start. Taking this into account, along with the location of populations near to the existing rail road tracks, such as Pollo de Oro which is adjacent to the tracks, or Nahualapa, which is located approximately 350m west of the tracks, the impact due to increased noise as a result of increased use of the train tracks will be significant.
Surface hydrology	Change in surface water quality (Discharges from the WWTP in the direction of the Gopalapa stream).	During operations, waste water discharge is expected as a result of: • Production process: Cracker (ethylene), polyethylene extruders for both high and low density, water involved in purges, the de-ethanization process and the caustic treatment. • Service waters: Water from the toilets, from the kitchen and cafeteria and administrative buildings • Water from the cooling towers • Contaminated water from the water trap (hydraulic seal) from the burner • Effluents from the cooling systems: cooling towers • Condensates from heat exchangers • Rain and storm water that has potentially been polluted as a result of production and coming from the defatting of the regulating pool. Braskem-Idesa will have a waste water treatment plant which in general terms will consist of the following: • Primary treatment. This will include a mechanical skimmer. • Secondary treatment. This will involve a biological treatment which will consist of a biological oxidation phase with a capacity of 1,230meters cubed, followed by the water being pumped into an ultrafiltration unit (bioreactor membrane). • Tertiary treatment. The residues will be disinfected by sodium hypochlorite, following which it will be sent to a demineralizing treatment. In emergency cases such as: maximum hourly rain or the use of fire prevention water, the water will be pumped through activated carbon filters in order to obtain the best quality water before it being discharged into the Gopalapa stream or recirculated to the equalizer tanks for recirculation. The activated carbon system consists of four filters in two parallel lines (not detailed in the flow chart). • Demineralization: With the goal to reuse the treated water in the Project process or as water for cooling, demineralization of the water is an important phase. The purges of the cooling towers and the water generated in the High and Low Density Polyethylene plants (HDPE and LDPE) will be stored in a tank which will later be sent for ultrafiltration treatment, and the water that has completed tertiary treatment will be sent back to flotation tanks for aeration (DAF type). The water that succeeds in permeating the ultrafiltration will be sent to a primary reverse osmosis treatment. • Sludge treatment. Oily sludge coming from the waste water treatment will be pumped to thickening wells. The thickened sludge will then be sent to a drying unit. This unit will comprise of centrifuging equipment, poly-electrolyte storage, a dosing system and an elevator for transporting dry sludge to a storage tank. The centrifuges in this phase give sludge with 20% solids. The sludge will be sent to be disposed of as hazardous waste. As such, sludge treatment comprises of thickening and drying units. As was indicated in Chapter 3, the Project is designed to keep separate the discharges from two Systems: • Rain and storm water, • Waste water from sanitary systems, processing areas and the washing of processing areas, or areas where storage tanks are kept. Rain and storm water that could become contaminated by grease and oils will be captured in an area for first water in the regulation pool (1 500 cubic meters). This compartment has a grease trap, the effluent will be sent by means of a pump system to secondary treatment at the water plant. On the other hand, during rainy season when rain water is in the containment dams, the dams will be monitored for contaminants before it is released towards the regulation pools, to determine if those waters need added treatment. It is expected that sludge and oil can be recuperated and treated later, in the secondary treatment system.
Aquatic Flora and Fauna	Change in the aquatic habitat in the Gopalapa and Nanchital streams	According to the baseline survey for vegetation and aquatic fauna performed in the Gopalapa and the Nanchital streams, the dominant vegetation is abandoned grassland, due previously the site was dedicated to livestock. In summary, the vegetation found on both banks of the Gopalapa steam located to the North of the property is almost 100% of secondary type. Regarding fauna were found some species of Gobiomorus dormitor Lacepede fish, a native of the Atlantic rivers, lakes and estuaries tropics and subtropics, which is distributed from southern United States (southern Florida and Texas) to eastern Brazil, crossing through Central America and the Caribbean. This species is not under any status of environmental protection. Relatively crystalline water was observed due turbidity of the rainy season. Regarding the Nanchital stream located in the extreme south-west of the site project, but outside it, is a part of the "Nanchital" stream next to a village which is called "Pollo de Oro" which discharges their sewage directly the channel, due that the channel is heavily polluted from this point. (See section 5.3 of chapter 5) Considering the water quality parameters of the final discharge is estimated to bring the following contaminants: pH, total suspended solids, free oil, chemical and, biochemical oxygen demand, nitrogen, total dissolved solids, discharged water volume, and the discharge will be permanent, the impact of greater magnitude would be associated directly to an operational failure of the treatment system, as this would cause damage to the environmental quality of streams (physicochemical, the existing biota). In this case it is important to mention that during the operation of the project will be operate a wastewater treatment plant, it was designed considering the guideline values of CFI and the requirements of the standar NOM - 001-SEMARNAT-2001 and the declaration of water quality for Coatzacoalcos River. The treatment plant is designed to treat all effluents from both process area and sanitary and storm water to potential contamination. Thus, given the parameters of water quality of the final discharge is estimated to bring the following contaminants: pH, total suspended solids, free oil, chemical oxygen demand, biochemical oxygen demand, total nitrogen, total dissolved solids. The impact of greater magnitude would be associated directly to an operational failure of the treatment system, as this would cause damage to the environmental quality of streams (physicochemical, the existing biota).

Environmental Component	Identified Impact	Description of Impact
		Considering the above, Braskem, Idesa will implement a series of mitigation measures included in Chapter 10 as a Sub-program of water Management and Disposal.
Air	Increase in greenhouse effects (CO ₂ , N ₂ O, emissions and possible traces of CH ₄ , amongst others)	The majority of Greenhouse Gas Emissions (GGE) associated with the production of polyethylene are as the result of combustion units. In this sense, carbon dioxide (CO₂) is the primary GGE for the Project. That said, trace amounts of methane (CH₄) and nitrous oxide (N₂O) are also emitted by these units and contribute to the increase in the Greenhouse Gas effect. Given that at this time, the Project is still in its design phase, the expected GGE cannot yet be estimated. As such the following precautions will be taken: • Create an inventory and with detailed quantities of equipment and activities that could potentially generate GGE. • Based on the findings, specific mitigation strategies will be recommended, on the basis that forming them based on concrete data, they will be more effective. • Ensure constant monitoring to identify and repair sources of fugitive emissions. • Separate wastes and promote taking full advantage of organic material, as well as consider investing in landfills to generate power through use of CH₄. • Consider investing in PTAR so that cleaning processes would be more efficient and effective • Investment in renewable energy projects to mitigate the generation of GGE.
Soil	Soil contamination	During the operation, it is estimated that both industrial and hazardous waste will be generated (see chapter 3) The waste that is not deemed hazardous will be managed according to the Management Plan for Non-Hazardous waste, through the contracting of an authorized company. It is estimated that approximately 282tons per year of waste from service, office and plant operating activities will be generated. The hazardous waste will be managed according to the Management Plan for Hazardous waste which will be established by the developer (see chapter 10 and chapter 8.3). It is estimated that approximately 42 tons per year of hazardous waste will be generated, primarily by the maintenance and operational activities in the plant. Moreover, it is suggested that there be an area for temporary storage adequate for the type and quantity of waste generated before to its transportation to an authorized site for final disposal. The management of waste, from its internal collection until its storage, will be the responsibility of the environmental manager for each contracted company. Considering the volume of waste generated and specifically the volume of hazardous waste generated during operations, the inadequate management of said waste can cause soil contamination.
Air	Change in level of thermal radiation (flare operations)	As part of the Project, a security system known as a burner or <i>flare</i> will be installed in the polymer manufacturing installations to guarantee the safe elimination of all gasses originating during storage and the processing units in case safety valves or disks are opened, there is a failure of power or equipment, or there are any other altered conditions on the site. Emergency discharges coming from the reactors or other equipment critical to the process will be transported to the depressurization tanks, where the reactive material will be retrieved (for example by means of vapor stripping) before the treated waste is emptied. Another option is by means of venting and high efficiency burning. The system that will be installed will collect emissions generated in the following areas: • Cracking area • Low Density Poly Ethylene area • High Density Poly Ethylene area • Storage area (located outside the battery limits) • Pipelines and power generating systems Within the battery limits (processing area), all remains will be sent to a container, and after passing through a sub-header will go directly to the burner's vapor collection systems. The systems were designed taking into account the following prevention and control measures for atmospheric emission generated during its operations: • Efficient use of the mouth of the burner and optimization of the size of the system • Maximization of the efficiency of the combustion system by means of the vapor supply, in order to lower the temperature of the flame and minimize smoke. • Minimization of the purge burning, without compromising the security of the Project, by means of the installation of devices that reduce the volume of said purges (appropriate seals). • Minimization of risk that the pilot light will go out, ensuring that the speed of the fuel will be sufficient and will be protected against drafts. • Use of a trustworthy ignition system. Moreover, the system design will include inspection and maintenance units, as well as independent shut-off valves in the battery limits of each Project process or unit. This will prevent various operations from being affected, in case intervention is necessary in a single area of the system. Regarding thermal radiation emanating from the burner and its effects on plants and animals, there is few or no information on the effects on vegetation and wildlife. However, according to the knowledge of the conditions of the area, and regardless of security measures that will be comply by standards for the protection of workers in the plant, the following alternatives are considered to the boundaries with wilderness areas such as the conservation area (REC2). Currently, there are some aspects that are at the design phase, once completed it will be established the most appropriate method for this mitigation measure, these alternatives are: Regarding the subject of thermal radiation that would emanate from the burner and its subsequent effects on plants and animals, there is little or no information regarding its possible effect on flora and fauna. That said, based on the knowledge of conditions in the zone and independently from the security measures that will be put in place for the protection of plant workers, the following general recommendations can be made, to be implemented on the edges of wild areas, like those of conservation area REC2: 1) Limit the burner to such as a distance that it does not surpass approximately 40 degrees Centigrade, as for both the region as a whole and the high moist evergreen rainforest, this is a temperature that is likely to occur naturally, and as such, both flora and fauna can tolerate it. This can be supported by information regarding temperatures in the area. Faced with a temperature above 40 degrees Centigrade (a smaller distance) some foliage could dry out, and therefore, the plants and animals could experience an increase in tension ("stress"). This is not ensured, but can be estimated as the temperature would be an extreme for the region. 2) It is suggested that the height of the fencing should be of at least 5 meters to ensure that no animals or people cross into the property. 3) That the fence not be made of mesh as it allows for radiation to pass through, as well as allowing for animals to hold on, hang from or climb it. It could be a combination of a 3m wall and the two remaining meters being made of a lighter material.

The significant impacts in the closing phase of the site are similar to those identified in the construction phase; that said, the closure of an industrial site can bring about positive environmental changes, while at the same time bringing about potentially negative socio-economic changes. In this regard, taking into account the Etleno XXI Project is current in the design and planning phases, and that it is expected to have a lifespan of at least 30 years, the evaluation of environmental impacts during the closure phase have been developed under the premise that the land use that will be set aside will differ from that of industry, and as such, the impacts in this phase have been calculated qualitatively and superficially. At an appropriate juncture, Braskem-Idesa will develop plans regarding the closure, cleaning and dismantling of the site based on best practices, which will include the restoration of habitat and support in the relocation of the work force.

TABLE 7.8 DESCRIPTION OF MOST SIGNIFICANT ENVIRONMENTAL IMPACTS DURING CLOSURE

Environmental Component	Identified Impact	Description of Impact
Flora and Fauna	Possible reintegration of the property to the natural ecosystem.	The implementation of cleaning and restorative actions will be required, including: - Remediation of green areas that could become contaminated, for which Braskem-Idesa will have to develop a remediation plan and implement it with the prior approval of environmental authorities and in accordance with the most current environmental legislation at that time. - Environmental restoration of the property areas where industrial operations took place. Considering the fact that the area that would have been used for industrial installations would be of 134 hectares according to the distribution plan presented in the manifestation of environmental impacts, it is assumed that the rehabilitation and reintegration of the surface area to the ecosystem as vegetation will be a positive impact on the area.
Landscape	Possible reintegration of the aesthetic quality of the site.	With the change from industrial activity on the site and the reincorporation of this land to the area's ecosystem, the impact due to the reintegration of the visual-aesthetic quality is considered to be positive. That said, the impact will not be immediate, rather it will progress slowly and will take a number of years for the positive impacts to be felt. As such, for the time being, only the change can be assured, but not its magnitude or the extent of its positive impact.
Land Use	Possible change in the use of industrial land to another use.	One of the significant positive impacts is the possible modification in the change in land use. Although Braskem-Idesa still does not know the use of the property in the future, the most likely to be more compatible with a non-industrial activity.
Surface hydrology	Change in the quality of surface water.	With the dismantling activities, the management of liquids and fuel is important, as inadequate management of the equipment that could contain oil or grease could contaminate the Gopalapa stream if run-offs are channeled towards it.
Air /Quality	Soil Contamination	This phase of dismantling activities will including the following activities amongst others: - Demolition of structures and installations, - Removal of construction material, machinery and equipment amongst others, - Removal of fuel storage tanks, - Removal of pipelines and racks ads well as mobile and aesthetic equipment, - Removal of power substation, - Removal and dismantling of waste storage (both hazardous and non hazardous) - Removal and dismantling of maintenance workshops. - Removal of equipment from general services (waste and raw water treatment plants) With the dismantling, and removal of the former, a large amount of solid and liquid waste (both hazardous and non hazardous), the amount of which cannot be estimated at this time. That said, it is possible to list the types of waste that will be generated, among which are the following: - Waste derived from the construction and the dismantling of the structures, of which large volumes are expected to be managed as special waste as defined by the Federal Wastes Law (LGPGIR, <i>Ley General para la Prevención y Gestión Integral de los Resíduos</i>). At the appropriate juncture, it will be necessary to ensure accordance with the most current environmental legislation and international best practices. - Waste from insulation material (insulation and aluminum plaques) - Waste from wood (platforms and other packaging) - Waste from pieces of pipe of different materials, - Scrap metal (steel and copper) - Waste from packaging (plastics and protectors) - Pipe cleaning material - Hazardous waste (used oil, small quantities of soil contaminated by accidental spills, materials impregnated by cleaning fluids amongst others) Management and temporary storage outside the specifications of the LGEPGIR and its regulations, as well as any other Mexican legislation for the management of hazardous waste could contaminate the soil. In this sense, as the dismantling of the site will require the participation of subcontractors, inadequate management of this time of waste on site can cause accidental spills, which should be dealt with according to the safety guidelines for the management of this type of activity. One way the ground can be impacted during this phase is the likelihood of hydrocarbon, lubricant or other chemical spills that may occur, or by the mismanagement of waste in the area used for fuel storage. These impacts can be managed and mitigated with the implementation of programs that will be designed and defined at the time of site closure, such as: - A Site Closure Program that specifies actions, deadlines, timelines, cleaning activities, final disposal amongst others; - A Program for the Management of Non Hazardous Waste and Plan for the Management of Hazardous Waste (see Annexes 8.2 and 8.3). - A Program for Site Restoration.
Air/Noise	Change in Noise Level	The dismantling activities imply an increase in vehicular traffic due to the movement of waste in genera, which can generate an increase in the levels of noise similar to those generated during the site preparation phase. In this sense, it is expected that the noise levels will increase to a maximum of between 60 dB (A) and 94 dB (A) and could surpass 100 dB (A), using bibliographic information as a reference. This level of noise however will

Environmental Component	Identified Impact	Description of Impact
		diminish as its point of emission moves away from the potential receptor. Considering the ambient noise levels monitored in the zone adjacent to the site (see chapter 5) the potential receptors are the inhabitants of Pollo de Oro and the Lázaro Cárdenas del Río townships, in which the noise levels were determined to be of 58 dB (A) and 65 dB (A) respectively. Taking into account the existing noise levels in the zone and the noise levels that are expected during the phase, and as additional works are located away from potential receptors, the impact is expected to be negligible, meaning that the impact as a result of the development of these works is likely to be minor. That said, as these locations are still within the Area of Direct Influence, the vehicular traffic as a result of the transportation of machinery, equipment and material could have negative impacts on these potential receptors, as the increase would be felt on the principal communication routes near the site. Moreover, it is important to consider that the normal noise levels (base level) will return once the dismantling work is done. At this time there is no estimate as to how long this phase will take. The impact will not be permanent through the closure of works, as the developer will implement a Noise Monitoring and Control Plan, to avoid an increase in the noise level, particularly during the night, as these could directly impact nearby inhabitants as potential receptors (see chapter 10).
Air/ Quality	Change in air quality (increase in gas exhaust, smoldering fumes).	As has been indicated throughout this document, the region in which the site is located is an area of intense heavy industry as of the 80s, where PEMEX and other heavy industries have a strong presence. Dismantling activities imply the generation of dust particles, although at a lesser degree than during the site preparation phase. For example, there will be fuel emissions caused by the movement of the vehicles that will be used for the vacation of construction materials, waste, and removal of equipment amongst others. Those that will be principally affected by these emissions are the workers themselves, as they will find themselves directly exposed during the work day. In the same way, the dust that is emitted during the dismantling, can affect nearby receptors. That said, the impact on workers will be touched on in greater detail in the Social Impact Section. It is possible that some receptors at a distance of 100m from the site might experience some occasional discomfort due to dust, however mitigation measures will be implemented according to best practices, with the goal of reducing dust caused by dismantling activities. In this sense, the closest potential receptor to the site is Pollo de Oro. Amongst the proposed management measures for the prevention and mitigation of this impact which will be detailed in chapter 7, are the following measure: • The implementation of a Machinery and Equipment Management Program • The implementation of different work fronts so as not to concentrate equipment in a single location at once • The placing of dust sources in less sensitive areas, or areas at a greater distance from potential receptors.

TABLE 7.9 DESCRIPTION OF MOST SIGNIFICANT SOCIAL IMPACTS DURING SITE PREPARATION

Social Factor	Impact	Description
Quality of the landscape's visual aesthetic	Decrease of the quality of the landscape's visual aesthetic.	It is important to note that although the study site has been modified previously by industrial activity in the region, the removal of topsoil could allow local communities a view of the site preparation, which is likely to impact the landscape. This is particularly important to note in communities directly adjacent to the site, such as Nahualapa and Pollo de Oro.
Social Mobility	Change in capacity and custom of social mobility	Impacts on the mobility of local community members include deterioration of the paths, lack of access to shortcuts through the property and increased transit times due to traffic. Pedestrian traffic patterns and habits will have to change once Project activities start. Increase in the flow of heavy machinery through local roads could quicken its deterioration, which would impact local communities by making it more difficult for public transport to reach communities.
Migration	Changes in migration flows and demographic trends.	Employment opportunities offered by the Project could interrupt the natural migratory flow in rural areas (young people looping for employment in urban zones for instance), or accelerate migration in the case of community members who feel insecure as a result of the development. Local and regional immigration could also alter the social patterns due to a disproportionate presence of single men in the area compared to demographic trends. This will be dealt with in greater detail in the Influx Management Plan.
Identity based on surroundings and environment	Reduction of areas of social and cultural interest.	The inhabitants of the AoI have placed great value on 200 hectares of green space that will be affected by topsoil and vegetation removal and site preparation, as well as reducing spaces of public interest amongst village members in the area. The value that they have placed on the space is not entirely commercial, and also includes great cultural, recreational, identity-based, or daily-to-day value. This will be highly risky, particularly for communities who perceive operations visually, olfactory or audibly. Changes to communities' cultural space can have important ramifications on the social perception of the Project and its processes, as well as their social license to operate.
Social Factor	Preventable Risk	Description
Incidents of community illness or morbidity	Increase in community morbidity	Increase in the likelihood of community illnesses due to site preparation activities including cutting, filling, soil transportation and transport of heavy equipment. The project will also have impact on the levels of run-off however, that would normally affect communities, since in rainy season or during adverse climactic events, bodies of water flood their banks and can flood local streets and homes. Due to the vulnerability of some communities in cases of extreme weather, Project activities that could help mitigate this risk could be highly relevant. Moreover, the illnesses that communities are exposed to, including respiratory illnesses as mentioned in the Health Impact Analysis (see chapter 9) could also be mitigated.
Peace and Security	Decrease in the feeling of security as a result of the increased flow of migrant workers arriving by train.	Expectation of new employment opportunities could increase the flow of immigrants to the area. The Social Base Line study which included an evaluation of local media and interviews with interest groups, identified human trafficking of Central Americans as an issue, which could increase the perception of insecurity in local communities, which in turn can exacerbate the incidences of trafficking, as well as informal businesses. Unlike the migratory process mentioned earlier, Peace and Safety can worsen the longer immigrants remain in the area. There is a current impact on the presence of undocumented immigrants in the Project area, particularly due to the presence of the railroad, which is often used to illegally ferry Central American immigrants on their way to the United States. The communities have expressed a concern at the presence of immigrants despite the fact that their search for work or opportunities in the AoI is temporary in most cases. The increase in employment opportunities in the Project area could provide an incentive for these individuals to remain in the area longer.
Traffic flows	Increase in accidents and collisions	As vehicular traffic and use of heavy machinery increase in the area, so does the risk of accidents or vehicle-pedestrian collisions with members of local communities. Some communities do not have access to public transport, so their situation during emergencies becomes acute when the only access paths for ambulances or police vehicles deteriorate. The influx of more than 200 trucks in constant motion can increase the rate of accidents, which is of grave concern.
Informal Labor Force	Increase in security risks as a result of informal businesses.	Migration due to employment can bring with it an increase in trade in illegal substances and human trafficking for sexual exploitation. In some communities, this social factor is already evident (for example, the presence of an hourly-rated motel on the road between the Project and Pollo de Oro, and problems with substance abuse, drug and alcohol addiction and petty theft in communities close to the project, such as Mundo Nuevo).
Labor Rights	Hiring of workers that don't comply with legal labor standards (under age workers, undocumented workers, vulnerable groups amongst others).	The hiring of short term workers can lack formal contracts, where both parts know and understand the stipulations (in a common language or with provided translations), that both the employer and the employee agree to, as indicated by the employee's labor rights. This could have a particularly important impact on ethnic minorities where translations, labor rights and other factors must be adequately managed. In cases where there are diverse ethnic groups, all rights must be taken into account and respected, although in the Project's AoI, there are few ethnic minorities. It is important to note that the indigenous population located in the AoI of the Project does not self identify as such (according to the information collected during Baseline interviews), nor is there any particular management on the part of local government on behalf of any indigenous community. No generalized indigenous language or traditions have been identified, and no communities have established authority or autonomy, directing the possibility of impact on indigenous groups or cultures to be considered significant. On the other hand, it is possible that contractors, with or without previous knowledge, will have access to and will be in a position to hire people under the age of 18, the legal minimum age to work on site preparation without parental consent. Currently, national legislation does not fulfill international standards regarding child labor, as it allows for children over the age of 14 to work with written parental consent. This however, is not permitted under International standards, and as such, the Project will take 18 years of age as the minimum age.
Access to working opportunities	Lack of equal employment opportunities in local businesses.	Heavy physical activity is usually done by men with certain physiological features. That said, this should not be a reason or incentive for there to be discriminatory practices in the employee recruitment and selection process, either directly through the company, subcontractors or external partners. Any adverts announcing vacancies or employment opportunities can contain allusions to a specific gender, or prohibit certain physiological conditions (avoiding hiring pregnant women), which will prevent a candidate from being considered for the task at hand. These conditions would apply to both men and women based on gender as well as limiting the field to people with special needs, or who are disabled.

Worry and social unrest.	Possibility of strikes or demonstrations, as well as blockades by opposing groups.	As soon as local community members or other entities see the beginning of site preparation activities, there is a strong possibility that they will block the roads leading to the site. This is especially likely for organizations that have identified themselves against the Project (National Petroleum Alliance- ANP- and National Petroleum Movement- MNP) as well as a number of NGOs that belong to the State Assembly of Environmentally Affected of Veracruz. The community's objections have previously driven them to meet up, denounce, and demand the closure of industrial activities that were affecting them. The characteristics of this impact show the latent risk that must be managed and mitigated according to the needs of the other impacts.
Archaeological finds and areas of historic value.	Loss of cultural material through chance findings.	Although it is unlikely that there are any archaeological remains, based on the resolutions of the INAH regarding the site, it is possible that as the region was previously inhabited by Olmec and Mayan cultures, that during the preparation phase of the site, archaeological remains could be found. If there is not an appropriate management of any chance finds, it could result in the damage or loss of regional cultural heritage.
Peace and Safety	Decrease in feeling of safety as a result of presence of security forces and the military.	Although the possibility of an increase in military presence and security forces in the Area of Direct Influence of the Project could occur independently of the Project, the developer should identify their possible contribution to the impact, and look to mitigate its influence. On the other hand, increase in the use of federal communication routes (highways, ports and railroads) could drive the developer to ask for an increase in military presence in order to protect the Project's activities (machinery, equipment, infrastructure, etc) while they are transported by means of said federal communication routes.
Incidents of illness or community morbidity	Increase in accidents due to lack of planning or preparation for climatologically emergencies.	Due to the region the Project is located in, it is probable that certain weather adverse weather conditions may present themselves (storms or hurricanes for example), which, if not properly prepared for, could result in high incidents of accidents in the work force or in the local communities. The principal risk to keep in mind is the increased risk of flooding in the AoI. Although this impact can be considered a risk, it is considered to be latent, and although the likelihood of becoming an impact remains and, as such, needs to be respectively mitigated and managed. In the subsequent Project phases (particularly in the operations and maintenance phase), the risk of flooding in Pollo de Oro will diminish due to the restructuring of the storm water run-off mentioned earlier, which could be a strong benefit in this situation.
Occupational Health and Safety	Increase in illnesses due to labor conditions.	The working conditions and the information provided is a determining factor in the health of employees and of the local communities, since an important factor in the contracting of certain illnesses are hygiene conditions. Illnesses that are transmitted through contract, including sexual contact, or through inadequate waste disposal on site can all contribute to this. The state of temporary installations for employees, is a critical point in the health of employees

TABLE 7.10 DESCRIPTION OF MOST SIGNIFICANT SOCIAL IMPACTS DURING ASSOCIATED WORKS

Social Factors	Identified Impact	Description
Aesthetic quality of the community landscape	Decrease in the quality of the landscape	Although subterranean lines don't create a significant impact beyond the installation phase, power and overhead lines will be very visible from nearby communities. This will generate a decrease in the quality of the landscape, in turn affecting the visual-aesthetic quality and identification with one's social environment. Said changes could only be seen along the current right-of-way for the highway, although can be perceived by the communities. With this situation, there could be greater impacts on community perception of the Project, as the new site would be evident as a result of the changes in landscape.
Social Mobility	Temporary change in traffic routes or access due to the installation of pipelines.	During the installation of associated works (the laying of power lines, underground pipelines etc.) that provide services to the site, there could be impacts that affect the nature of Social Mobility. Specifically, there could be a noted change in the routes usually used by the population to access their communities or places of employment. In the case of certain associated works, these would be located along an existing highway in order to take advantage of the right-of-way. Moreover, it could affect vehicular and pedestrian circulation in areas that intersect with the works mentioned above. These impacts will be noticeable primarily during the installation and closure phases of the Project. Once the works have been installed, and during their lifecycle, they should not cause any major changes.
Traffic Conditions	Temporary increase in traffic during the installation of pipelines.	The installation of pipelines requires heavy machinery and equipment to transport materials and to complete installation. During these operations, there could be an impact on vehicular traffic due to works that use the right-of-way. Taking into account the size of the equipment required to complete the installation, it is possible that a number of highway lanes may be needed on a short term basis, to transport the equipment, causing an even greater impact on circulation.
Social Factor	Preventable Risk	Description
Labor Rights	Hiring of individuals under the age of 18.	As in subsequent descriptions of impacts, one of the most important social risks is the possibility of employing children less than 18 years of age for Project activities. In this case, activities associated with transportation, installation, maintenance and dismantling associated works could cause a situation where subcontractors could invite their own children or young relatives to work with them. In a country where it is not unusual to see a child working with their parents, it would be important to be careful that this would not create the opportunity that a child could participate in any Project work. Currently, national legislation does not coincide with international standards, permitting children as young as 14 to work with written parental consent. In order to comply with international standards however, this cannot be allowed to happen, and as such all Project activities have a minimum age of 18.
Ownership and use of land	Conflicts as a result of land acquisition.	As there is currently no efficient or transparent communication between developers and communities, it is possible that a hostile environment could develop against the installation and all associated works. Currently there is insufficient information to determine the origin of the properties, either private or collective. That said, a lack of an appropriate relationship with the communities could increase the discontent and generate problems in land acquisition.

Social Factors	Identified Impact	Description
Labor Rights	Hiring of workers that do not fulfill legal standards.	Hiring employees could have repercussions on the impact of non compliance with national standards. This could happen by means of employing individuals through subcontractors who are able to complete their work without complying with the Occupational Health and Safety plans and programs, including fulfilling requirements. Examples of non-compliance include a lack of a formal contract, a lack of understanding of the requirements or clauses therein, amongst others.
Concern and social unrest.	Possibility of strikes or demonstrations, as well as blockades by opposing groups.	The main difference between this impact in the other phases of the Project and in this phase, is that the associated works have a different geographical reach, and generate a different set of perceptions than the site. This means that the demonstrations, complaints and blockades associated with the project will take place on the site itself, and are unlikely to affect associated works. During the installation of the pipelines and supply lines, it is possible that opposing groups such as unions could present themselves. That said, if they understood they belong to the same Project, mitigation measures for both could be implemented at once. Once the pipelines are buried, there is no subsequent impact that would require the presence of opposing groups in said locations.
Occupational Health and Safety	Increase in labor related accidents or deaths	Accidents during the opening of trenches for the installation of pipelines could happen if employees do not have access to or are unaware of the Occupational Health and Safety Risk Prevention Manual. In the same way, potential risks to employees working at altitudes could be relevant when laying power lines if the personnel is not qualified and certified to do so. Fatalities in these areas are easily preventable and mitigable, although they cannot be discarded, identifying them place focus on them, and help draw attention to necessary and simple preventative measures.
Occupational Health and Safety	Increase in illnesses as a result of labor conditions.	Installation and dismantling of associated Works could bring with it an increase in illnesses if working conditions are not up to the standards established by the site. The location of possible underground pipelines could place workers in remote areas, with difficult access and without nearby medical facilities. Moreover, it is possible for employees to be exposed to harmful flora or fauna, and so personnel would have to take additional precautions. Any illnesses that can be passed on through physical contact can also spread during the anticipated associated works.
Incidences of community illness or morbidity.	Possibility of accidents caused by spills or leaks in the installations.	There is an ongoing risk of leaks or faults in the installations, although this risk is heightened during the maintenance phase of the Project or when initial testing is done of the associated works (pipelines). In the case of power lines, this could mean faults or electric discharges. This impact should be of high priority during installation and initial testing. During maintenance of the pipelines and power lines, any impacts could be as severe as fatalities if due care and attention is not paid and the procedures laid out in the maintenance manual are not followed.
Access to employment opportunities	Lack of equal employment opportunities in local businesses.	Recruitment for installation, maintenance and closing activities for the associated works can bring with them negative impacts. Lack of equity in the hiring process can include geographical, skills based or even gender inequality amongst employment candidates.
Access to public services	Increase in the perception of a lack of access to public services (particularly power lines)	The associated works with the greatest capacity to capture the attention of nearby communities are power lines. They have both strong visual impact and could lead communities to mistakenly expect said lines to provide them with electrical power which could in turn lead to an increase in expectations as to the level of social investment the Project could provide. This can lead to misunderstandings caused principally by lack of anticipatory communication regarding the function and use of the power lines. This impact could extend to other parts of the installation process, particularly of any involving basic services (water, power, gas etc.) for the communities. Even when the communities are clear on the purpose and use of these services, it is possible that the local population could infer that since the infrastructure has been installed, that they could benefit from those services in the future.
Labor Relations	Increase in conflicts between the Developer and labor unions.	If clear and effective communication is not established with local communities regarding employment opportunities and the awarding criteria of the same, it is possible for the process to be misinterpreted and conflict caused, particularly between unions and the developer. If there is a lack of transparency in the selection process for employees, this impact and subsequent conflict could escalate between groups and employee guilds amongst the local work force.

TABLE 7.11 DESCRIPTION OF MOST SIGNIFICANT SOCIAL IMPACTS DURING CONSTRUCTION

Social Factor	Identified Impact	Description
Incidents of community illness and morbidity	Increase in community morbidity.	Increase in the likelihood of community illness based on construction activities. Operations that begin at this phase include the movement and transportation of heavy machinery and equipment, which does not only generate noise, but also an increase in atmospheric emissions that could cause respiratory difficulties in nearby populations. The use of heavy machinery will also be used in community areas during installation, and the presence of workers in the zone could bring with it an added risk of infection to nearby communities.
Social Mobility	Change in access to social mobility.	Changes in the mobility of local community members due to the deterioration of the condition of paths, consistent use of said paths by trucks and heavy machinery, decrease in available access to public transport due to increase in use by Project employees, and increase in commute time. The increase in flow of heavy machinery through local paths and roads could cause their rapid deterioration, which could cause members of local communities to have their capacity to move around the zone impeded. This is due both to the limited public transport which would now be able to reach said communities.
Migration	Change in migration flows and demographic trends.	The employment opportunities offered by the Project could interrupt the natural migratory flow of rural zones (young people looking for employment in urban areas) or could accelerate it if local inhabitants do not feel safe in their home communities due to sudden growth or influx of people from outside the area. Migration could also alter local level demographic trends due to a disproportionate increase in single men in the area. Over the long term, temporary work-based migration could become permanent migration which would alter demographic tendencies and birth rates nearby communities. This will be particularly evident in communities with less than 300-400 members, such as Pollo de Oro, Nahualapa and the 5 de Mayo township. The flow of immigration will be disproportionate to the norm which could impact homes and services in the area. The propagation of venereal diseases could increase if there is no strong Community Health and Safety plan in place and adequately promoted, and associated with other impacts previously mentioned.
Peace and Safety	Change in noise level and social discomfort	During construction activities, heavy machinery and vehicles will be used which will alter the noise level for inhabitants. Currently the railroad and trains cause severe discomfort to Pollo de Oro, and an increase in the frequency of the train or movement of machinery could add to this discomfort. This will require effective communication and prevention/mitigation measures to avoid an increase in discomfort along with the increase in machine use.

Social Factor	Identified Impact	Description
Aesthetic quality of the community landscape.	Decrease in aesthetic quality of the landscape and change in association with the land.	From the moment of site preparation activities, the environment has already been negatively influenced and the visual-aesthetic quality of the site has been affected. That said, this impact will greatly increase during the construction phase as it will require the construction of temporary buildings and structures, the laying of lines and tubes and various other activities that could also cause visual pollution. This is particularly crucial in communities in the immediate vicinity of the site such as Nahualapa and Pollo de Oro. Although community identification with the environment has already been discussed, construction operations will result in easily perceived and highly significant changes in these communities.
Labor Rights	Termination of contracts at the closure of the site.	Once construction has been completed and before operations have begun, there will be a series of contract terminations associated with the end of the phase. This has the capacity to cause discontent if it is not managed in an open and transparent manner. It can also generate uncontrolled migration away from the Project site. The labor rights of workers may be affected if they are not respected or do not fulfill national norms or international best practices. The migratory flow plan (see Annex 8.23.10) will help mitigate the effects of the contract terminations and as such, will allow effective supervision of the processes directly associated with well planned and controlled downsizing and subsequent economic support throughout the transitional phases of the Project. This includes plans to mitigate the effects of the Reduction of migration of the construction and operations phases which also impact and damage local formal and informal businesses.
Social Factor	Preventable Risk	Description
Land ownership and use.	Increase in perception of impact as a result of vibrations emitted from the property.	The communities close to the Project site could perceive that vibrations cause by heavy machinery and construction operations could be damaging their homes or cracking their walls. During the first phase of the Community Engagement Program, this concern was mentioned as relevant in Pollo de Oro. As such, it will be important to ensure that any operations will include a baseline evaluation of the state of nearby homes in order to allow for proper evaluation.
Relationship with vulnerable groups.	Lack of culturally appropriate relationships with minority populations.	In order to prevent high expectations on the part of community members that cannot be met by the Project, and to ensure participation on the part of interest groups in the development and dissemination of Project information, it is important to ensure appropriate and accessible communication with local communities and other interest groups. In the case of religious minorities, there could be a strong impact if communication is not culturally appropriate. Currently there is no registered presence of any indigenous minorities in the area, but the risk of not having an appropriate plan if any emerge is latent. Moreover, it should be mentioned that there are a number of vulnerable groups in the area, such as Alcoholics Anonymous who should be contacted in order to determine the possibility of any consequences to increased social risks.
Relationship with communities and interest groups.	Lack of communication and inadequate relationships with the communities.	There could be a lack of effective communication with interest groups. This could involve a lack of concrete information and the generation of negative expectations regarding the development of the Project. The relationship with the communities could suffer or be limited if this topic is not appropriately addressed for. Examples of poor communication strategies could include one-sided communication by the Community Relations Team, or the lack of public participation to strengthen decision making regarding the Project. Communication should therefore also include the creation of internal and external sustainability reports that would make the development process more transparent. Lack of said procedures or policies could prevent the goal of integral social management from being achieved.
Labor Rights	Hiring of children less than 18 years of age.	It is likely that contractors, with or without previous knowledge, will be exposed to the opportunity to either directly or indirectly hire individuals less than 18 years of age for activities associated with site preparation. Currently national legislation does not comply with international standards as it allows for people from the age of 14 years old onwards to work so long as they have written parental consent. This cannot be permitted on site as international standards and as such, Project policy states the minimum working age to be 18 years old.
Concern and social unrest	Possibility of strikes, complaints or road blocks by groups opposing the Project.	Due to the politicization of Project activities and the possible adversity of opposing groups, there is a chance that there will be demonstrations, strikes, complaints or blockades intended to interrupt said activities. That said, due to the relationship with interest groups built since before the site preparation phase, it is hoped that the complaints or concerns of opposing groups will be well attended to and communicated to the Project developers, to prevent misunderstandings which could increase the risks mentioned above.
Migration	Increase in the Lumber of undocumented workers remaining in the AoI.	Expectations regarding new opportunities may increase the flow of immigrants and as such, according to the Social Baseline, local interviews and evaluations of the local media, there is likely to be concerns regarding migration and illegal trafficking of Central American nationals throughout the zone which could impact the sense of security in the area. Changes in migratory flows would aggravate illegal trafficking and informal businesses. Unlike the migratory flow discussed earlier, the impact on peace and safety in the communities can continue worsening the longer the immigrants remain in the area. There is already an important impact as a result of undocumented immigrants in the Project zone, due primarily to the presence of a railway which is often used for the illegal transportation of Central American immigrants to the United States. The local communities have expressed concern regarding the presence of the immigrants although their search for employment or opportunities in the zone is most often temporary in nature. New employment opportunities provided by the Project could provide a strong incentive to these individuals to remain in the area, and could result in an increased presence of undocumented immigrants.
Labor Rights	Hiring of workers in a manner that does not comply with legal regulations.	The recruitment of temporary personnel could result in a lack of any formal contracts that would indicate if all parties had read and understood the terms, conditions, requirements, expectations and labor rights (in a common language or by means of translation as necessary), that has been agreed to by both the employer and the employee. This could become a greater impact if the individual being contracted belongs to an ethnic minority, where translations, rights and any other considerations must be adequately managed.
Traffic Conditions	Increase in accidents and pedestrian-vehicle collisions.	When vehicular traffic in the zone increases, so does the risk of accidents or vehicle-pedestrian collisions of bystanders in local communities. Certain communities do not have access to public transport meaning that emergency situations become more critical when the only access roads for police or ambulances are in a bad state of repair. The flow of trucks and heavy equipment has the potential to increase accident rates, which is a serious concern. Roads in the Area of Direct Influence do not currently have adequate signage.
Occupational Health and Safety	Increase in work related accidents and fatalities.	Operations during the construction phase can generate work related risks such as exposure to noise levels higher than official standards, as well as risks to those working at heights. Taking into account this situation, it is important to state that an Occupational Health and Safety Plan must be put in place and implemented. Moreover, due to the location of the site, it is likely that the area may be faced with extreme weather conditions (including storms and hurricanes) which could result in high incidences of accidents both amongst the work force and amongst the local communities without adequate planning. The principal risk to keep in mind is the possibility of flooding in the AoI. Although this impact can be considered a latent risk, it must be mitigated and managed in case it happens.

Social Factor	Identified Impact	Description
Occupational Health and Safety	Increase in illnesses related to working conditions.	Work conditions and information shared are determining factors in the health of both Project personnel and the local community, as hygiene conditions can propagate certain illnesses including physically and sexually transmitted diseases in areas of inadequate cleanliness or disposal of sanitary waste. The conditions in the temporary installations are of particular concern for occupational health.
Access to employment opportunities	Lack of equal employment opportunities in local businesses.	Heavy physical activity is usually done by men with certain physiological features. That said, this should not be a reason or incentive for there to be discriminatory practices in the employee recruitment and selection process, either directly through the company, subcontractors or external partners. Any adverts announcing vacancies or employment opportunities can contain allusions to a specific gender, or prohibit certain physiological conditions (avoiding hiring pregnant women), which will prevent a candidate from being considered for the task at hand. These conditions would apply to both men and women based on gender as well as limiting the field to people with special needs, or who are disabled.
Informal work force	Increase in security risks as a result of informal businesses	Migration due to employment can bring with it an increase in trade in illegal substances and human trafficking for sexual exploitation. In some communities, this social factor is already evident (for example, the presence of an hourly-rated motel on the road between the Project and Pollo de Oro, and problems with substance abuse, drug and alcohol addiction and petty theft in communities close to the project, such as Mundo Nuevo).
Land ownership and use	Possible conflicts associated with right of way.	Impacts can happen during the acquisition process for land rights for the ROW associated with pipelines and power lines in order to provide the site with basic services. The proposed lines for the ROW are currently estimations and will need to involve anticipatory and consistent communication and interaction with the owners and users of the land. In order to do this effectively, it is important to take into account what type of land (fallow, pasture, crops) and type of ownership (public or private). It is important to be extremely cautious with community property and these circumstances should be analyzed ahead of time.
Archaeological finds and areas of historic value.	Loss of cultural material during possible archaeological finds.	According to the INAH, there are currently no reported indices of cultural material in the Project area. However, it is important to take into account that during drilling activities, lying of underground pipes and off site pipelines, it is possible that there may be chance finds. If these are not managed appropriately, it could result in the loss of cultural heritage.
Access to public services	Increase in the perceived need for access to public services.	Installation of basic services on site could indirectly generate an increased need for access to communities who were previously isolated. For example, the community of Nahualapa does not have any type of public services, and so there could be an increase in community expectations regarding benefits, due to their new proximity. The social conditions identified in chapter 4 and the enclosed Social Baseline, lack of access to any services is a real concern for communities.
Labor Relations	Increase in conflicts between unions and workers	This impact can cause animosity amongst regional unions. Different groups can maintain expectations for employment opportunities once construction starts on the site. The unions can establish consistent communication with the developer to ensure that there are no misunderstandings or lack of openness or transparency in the organization of activities or in the employment opportunities made available.
Labor Relations	Increase in conflicts between Developer and unions	This impact was identified during the previous site preparation phase, but it is important to evaluate it once more given that the number of employees needed during the previous phase and the construction phase differ greatly. The number of personnel needed for the construction phase will increase greatly. The impacts that this can generate due to lack of transparency or ongoing relationships between unions and the developer can continue beyond the first phase of the Project. It is expected that this impact will be appropriately mitigated during site preparation and should not be of great concern during construction.
Peace and Safety	Increase in the period of time that undocumented workers remain in the area/ heightened feeling of insecurity due to the presence of the military.	Although the possibility of an increase in military presence and security forces in the Area of Direct Influence of the Project could occur independently of the Project, the developer should identify their possible contribution to the impact, and look to mitigate its influence. The general security situation at the national and regional levels due to drug trafficking and the flow of undocumented immigrants throughout the region are key factors that, on their own, could cause the presence of military and security forces in the area. On the other hand, increase in the use of federal communication routes (highways, ports and railroads) could drive the developer to ask for an increase in military presence in order to protect the Project's activities (machinery, equipment, infrastructure, etc) while they are transported by means of said federal communication routes. The increase in military presence in the area, added to the increase in private security firms for the protection of site installations, can cause a perceived imbalance for the inhabitants of nearby communities. The imbalance could be either positive or negative: positive in the sense that a greater number of security personnel could cause a perception of increased security; negative in that the presence of these same security guards could provoke increased anxiety and lack of confidence in the area. As mentioned in the Baseline study, the inhabitants in the AoI have not reported concerns regarding insecurity in the area. As such, it is much more likely that the increased military presence will have a negative impact. Said anxiety and perceptions of insecurity could at some point become related to perceived impacts on human rights at the hands of the armed forces at the federal level and, although it is important to note that this is not a major impact, it is an issue that must be taken into account.

TABLE 7.12 DESCRIPTION OF MOST SIGNIFICANT SOCIAL IMPACTS DURING OPERATIONS

Social Factor	Impact Identified	Description
Peace and Safety	Change in noise level and social unrest.	The operation of the plant and constant use of different means of transport (such as train, trucks etc) will increase the noise levels in the area, which could cause discomfort to local inhabitants. Currently, the inhabitants of Pollo de Oro have already reported disturbances caused by the train (two or three times a day). Increase in the use of the train could increase the disturbances.
Aesthetic quality of the landscape	Decrease in the aesthetic quality of the landscape	The visibility of the emissions (for example the smoke stacks for the burners) and possible residues (such as coke) diminish the quality of the community landscape.

Social Factor	Impact Identified	Description
Social Mobility	Impact on the mobility of local residents due to an increase in traffic on existing roads	Increase in the traffic cause by service provides transporting material or trucks transporting employees can reduce, or possibly alter and modify transportation routes taken by local inhabitants.
Possible Social Impacts		
Social Factor	Preventable Risk	Description
Labor Rights	Hiring of children under the age of 18 years old.	Although there is a lower likelihood, there is still the possibility that children under 18 years of age may be contracted to fulfill tasks during operations. This can happen with or without the knowledge of contractors and subcontractors. Currently, national legislation does not conform with international standards prohibiting the recruitment or hiring of a child under 18 years of age, as it allows children as young as 14 to work with written parental consent. This however, is strictly forbidden on site, and the minimum wage will remain 18 years of age.
Labor Rights	Hiring of workers in a manner that does not comply with legal regulations.	International standards demand that all workers fulfill all legal requirements and that all workers understand their rights and obligations (such as salary, holidays, work hours etc.)
Incidences of community illness and morbidity.	Increase in community morbidity.	Emissions into the atmosphere and the consequences thereof on bodies of water can increase the incidences of morbidity in the communities.
Access to employment opportunities	Lack of employment equality in local businesses	Based on the assumption that there are people in the area with the skill set and capacity to fill the employment positions during the phase of operations, it is considered to be lack of equity to prevent individuals from other locations from having the same opportunities to become a part of Project activities. This is likely to be a sensitive matter as lack of employment in the area accentuates the need for local hiring.
Concern and social unrest	Possibility of strikes, complaints or blockades by opponents of the Project.	There is always the possibility that opposing groups or members of the local communities could disagree with the Project. Some causes for this could include: the way in which the site operates, the poor management of local expectations or the execution of the work itself. These points of issue have brought communities to gather, denounce the project and to demand its closure due to the impact it is having on them and their lives. The characteristics of this impact show the latent risk that needs to be successfully managed.
Occupational Health and Safety	Increase in work related accidents and fatalities.	Some activities that can cause increase in workplace accidents or deaths are: working at heights, working in confined spaces, contact with hazardous substances, exposure to explosions or fires, work with reactors, work in electric installations and work with heavy machinery and equipment.
Relationships with communities and other interest groups	Lack of Communications and poor relationships with the communities	There is a lack of communication that could provoke high expectations or promises that cannot be kept with the communities and interest groups.
Traffic Conditions	Increase in accidents and pedestrian-vehicle collisions	Increase in the flow of traffic, train and vehicular, could increase the numbers of collisions and accidents in the zone.
Occupational Health and Safety	Increase in illnesses due to general services and working conditions	If it is not properly maintained, the services (toilets, cafeteria and medical installations) and work conditions could be the focus of outbreaks of illnesses amongst both workers and administrative personnel. In the same way, prolonged exposure to loud noise levels could damage hearing in the long run.
Migration	Possibility of increased sense of security due to limited influx of migrant population	Reduction in migratory flow of workers to the zone could increase the feeling of security amongst local inhabitants.
Peace and Safety	Increase in disagreement by the inhabitants of the area due to the behavior of security personnel.	Security forces, if not appropriately trained in the use of force could intentionally commit physical, psychological or verbal assault towards community members or personnel.
Land ownership and use.	Increase in the perception of impacts as a result of vibrations emanating from the property.	The operation of the Project can cause vibrations on the ground which, if they are perceived by the inhabitants of nearby communities, could increase the perception of impact on property (for example, homes, rooms etc).
Labor Relations	Increase in conflicts between the Developer and unions	Preferential treatment of any of the unions could cause conflicts between the developer and unions that feel they are not being treated equally.
Labor Relations	Increase in conflicts between unions and workers	Given the recurring interest on the part of the local unions to be included in the Project, the possibility that conflicts between unions will continue cannot be ignored.

Social Factor	Impact Identified	Description
Incidents of community illness and morbidity.	Increase in accidents cause by explosions during operations or transport of the finished product.	There is an ongoing latent risk of explosions during the operation of the plant. As the product is combustible, the risk of fire during its transportation must also be kept in mind.

TABLE 7.13 DESCRIPTION OF MOST SIGNIFICANT SOCIAL IMPACTS DURING CLOSURE

Social Factors	Impact Identified	Description of Impact
Social Factor	Preventable Risk	Description
Occupational Health and Safety	Increase in accidents or risks during closure.	There may be a lack of specific procedures for the dismantling of the site that could cause accidents during the closing phase of the Project. Said risks will mostly be mitigated by the closure plans that are designed for that phase. There is insufficient evidence regarding closure to make concrete estimations.
Human Development	Lack of sustainable social development without the support of the company.	While the communities associated with the Project are dependent on its existence, there could be a decrease in the Human Development Index in the communities if their self reliance and sustainability has not been firmly established before Project closure. This could cause major conflicts and dependence on industrial investment in the area in order to maintain the standard of living in these communities.
Migration	Emigration of temporary workers to areas with more available employment.	Once access to employment opportunities and income has fallen, the Economically Active Population (EAP) in the closing phase will look to migrate to areas with more opportunities. Subsequently, there will be new migratory flows which may take members of the EAP with them, although it is expected that balance to the migratory demographics will return after the flow has stopped
Relationship with communities and other interest groups.	Community dependency on the existence of the Project.	If the Project does not succeed in formalizing the community independence in a sustainable manner, it runs the risk of creating an economic dependence on the Project. Once the Project is closed, this can cause an imbalance and tremendous economic impact on the region, which could be mitigated by the existence of local businesses during the life of the project that could continue independently.
Labor Rights	Hiring children under the age of 18 years old.	Closure activities could be another phase where there could be a risk of hiring children under the age of 18 years old. This can happen with or without the knowledge of contractors and subcontractors. Currently, national legislation does not conform with international standards prohibiting the recruitment or hiring of a child under 18 years of age, as it allows children as young as 14 to work with written parental consent. This however, is strictly forbidden on site, and the minimum wage will remain 18 years of age.
Labor Rights	Incompliance with the clauses referring to the termination of contracts.	Once construction has been completed and before operations have begun, there will be a series of contract terminations associated with the end of the phase. There is currently insufficient evidence to determine with accuracy the extent of this impact, although it is likely that there could be a lack of compliance with contract clauses preventing adequate termination.
Relationship with vulnerable groups	Termination of contracts with vulnerable groups.	The downsizing mentioned earlier can impact vulnerable groups as their rights are more extensive, particularly when vulnerable groups are ethnic minorities.
Occupational Health and Safety	Increase in illnesses associated with working conditions.	Working conditions during the dismantling of the Project can cause injuries amongst the work force if management of waste does not proceed properly. Exposure to both hazardous and non hazardous waste should be considered.
Labor Rights	Hiring of workers in a manner that does not comply with legal regulations.	Recruitment and hiring of temporary workers during the closing phase may cause incompliance with legal requirements if formal contracts are not respected, and said contracts do not explain the benefits, expectations, and rights of the employee

*

8 ANALYSIS OF ACUMULATED IMPACTS

8.1 OBJECTIVES

The objective of the accumulated impacts assessment is to determine the combined effect of the increasing impact of the Project added to other existing projects and planned for an area and a specific period of time.

8.2 EVALUATION METHODOLOGY

This assessment was developed in accordance with the guidelines established by the Canadian Environmental Assessment Agency (CEAA) in the guide entitled “Cumulative Effects Assessment Practitioners Guide” (February 1999).

It is important to note that this methodology refers only to the environmental effects and not the social effects.

8.3 SCOPE OF THE ACUMULATED IMPACTS

This section defines the temporal and spatial scope of the accumulated potential impacts; identifies other existing activities, or activities with acceptable possibilities of occurring within the selected time frame, and analyzes the potential affected environmental components.

8.3.1 Temporal and spatial scope

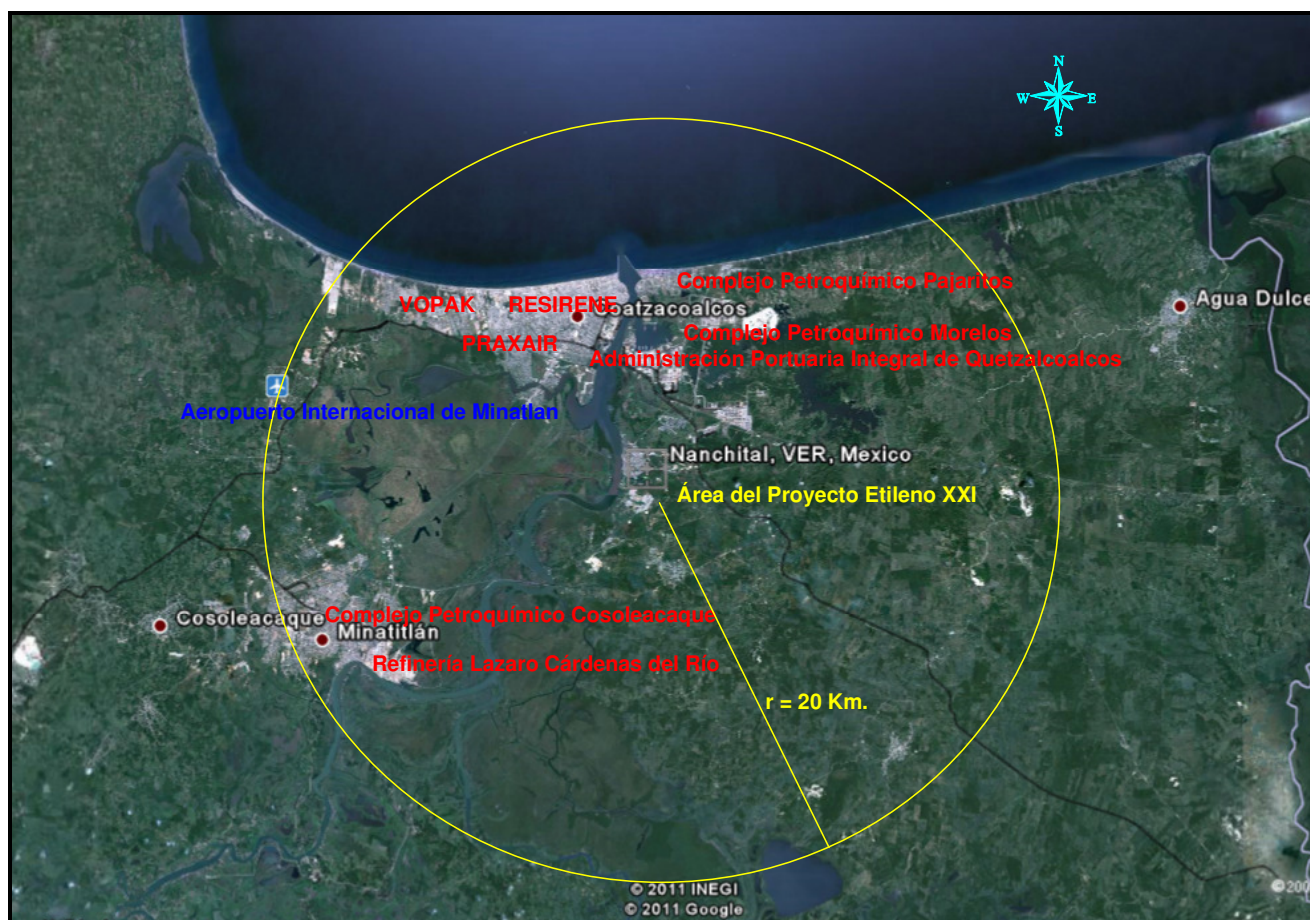
The spatial and temporal considerations for the accumulated impacts analysis involve two basic elements:

1. Identification of a geographic area includes the resources or environmental matrices potentially affected by the project, and the inclusion of neighboring sectors (when the combined effects of these and other factors in the area so warrant).
2. Identification of a temporal scope which includes the Project Lifetime, as well as the expected potential impacts.

8.3.1.1 Spatial environment

Given the nature of the proposed Project area (petrochemical industry for polyethylene production in an industrial zone with capacity for the heavy industry development), the spatial framework should include those industries which are distributed in at least a 20 km radius, taking the center as the property midpoint for the proposed Project.

FIGURE 8. 1 DIAGRAM OF THE PROJECT POTENTIAL RELATIONS



Source: Google Earth and Industrial, Commercial and Services Catalog (Coatzacoalcos Region), 2008.

8.3.1.2 Time frame

The time frame for the complex must include the period prior the construction process, the duration of the construction and the useful life of the Project.

TABLE 8.1 ELEMENTS INCLUDED IN THE PROJECT TIME FRAME

Phase	Start-up	End
Site preparation	2011	First year of the construction phase
Construction of petrochemical complex	Year 1	Year 5
Operation of petrochemical complex	Year 5 of the construction phase	Estimated year 30

8.3.1.3 Other existing projects and/or activities within the area of influence to be analyzed

- Natural resources preservation (Jaguaroundi Ecological Park, under PEMEX, and the Pajaritos and Cangrejera Lagoon System).
- Agriculture, extensive livestock production (grassland cultivation).
- Industry.
 - Manufacturing, storage, and commercialization of chemical products in general (Vopak, Oxiteno, MI Drilling Fluids, Celanese, Resirene, Quimir, Praxair, CYDSA Sales del Istmo, Grupo INFRA, Mexichem, among others).
 - Gas emissions.
 - Wastewater.
 - Surface and/or groundwater consumption.
 - Petrochemical industry (Morelos, Cosoleacaque, Cangrejera and Pajaritos, Grupo IDESA Petroquímica, Alpek Petroquímicos, and Grupo Petroquímico Beta petrochemical facilities).
 - Air emissions.
 - Noise emissions.
 - Wastewater.

- Surface and/or groundwater consumption.
- Oil industry (PEMEX).
 - Air emissions.
 - Noise emissions.
 - Wastewater.
 - Surface and groundwater consumption.
- Food processing and storage industry (Grupo Gruma, Bachoco, Minsa, Oleosur, Grupo Trimex).
 - Air emissions.
 - Wastewater.
 - Surface and groundwater consumption.
- Non-metallic mineral mining (Cemex, Minerales y Arcillas S.A. de C.V.).
 - Air emissions (particulate matter).
 - Wastewater.
 - Surface and groundwater consumption.
 - Soil quality.
- Port activity (Administración Portuaria Integral de Coatzacoalcos, terminales Transgolfo, Transferencias Graneleras del Istmo, Compañía Marítima Mexicana, Petrosub Sureste).
 - Air emissions.
 - Wastewater.
 - Surface and groundwater consumption.

8.3.1.4 *Relevant environmental components*

Relevant environmental components selected for this evaluation, are represented by environmental matrices that could be affected by the Project activities not only in terms of individual impacts, but as potential cumulative effects that could be generated by the sum of the effects caused by individual impacts on the same environmental matrix.

It is worth mentioning that according to the guide entitled "Cumulative Effects Assessment Practitioners Guide" (February 1999), "cumulative impacts are not necessarily very different from the effects assessed in the EIA, and may in fact be the same"

- Surface water quality and availability (wetlands, estuaries, Pajaritos and Cangrejera lagoon systems, Mecalapa lagoon, Coatzacoalcos River, Uxpanapa River, Gopalapa and Nanchital streams).
- Groundwater quality and availability.
- Air quality.
- Environmental noise quality.
- Soil quality.
- Abundant flora and fauna and biodiversity.

8.4 *ACUMULATED EFFECTS*

This section of the analysis considers the cumulative effects of property area and its surroundings resulting from the combined activities of the Project with the actions generated by the other activities identified previously (see section 8.3.1.3). This section includes the presentation of methodology, test results and a summary of the cumulative effects identified through the analysis.

8.5 *IMPACT ANALYSIS*

The preliminary analysis identifies nine activities in the area (besides the Project) that generate effects that can be related to each other. The observed effects are divided in two levels: six of first-order, which can potentially be generated by the

identified activities themselves, and two of a second order, whose generation is associated with combined impacts but not necessarily with the activities.

Considering the above, in Figure 8.2 the existing relationship within the levels can be appreciated, taking into account the new groups of industries mentioned above, like the petroleum, petrochemical and chemical industries, evaluating separately the Etileno XXI Project, which was taken as the basis for the selection criteria of the environmental effects that are generated by the impacts evaluated in chapter 7 of this study.

The final analysis, (the previous groupings by activity), identifies six activities (besides the Project) that generate effects that impact each other in the area. The observed effects are divided in two levels: six of first-order, which can potentially be generated by the identified activities, and two second order, whose generation is associated with the combination of other effects and not necessarily with the activities. At least one effect is identified (the surface water and groundwater availability) with potential waste characteristics, and four effects (surface water and groundwater availability, air quality and noise quality, and biodiversity) with cumulative potential.

Table 8.2 summarizes the value of the relationships indicated as well as the residual and cumulative assessment of the observed effects. Of the 44 identified relationships, 41 are significant, 2 of those, positive.

A cumulative effect is identified only if a residual effect exists, that is to say, that despite the proposed mitigation or control measures, the impact persists and can be added to other identified activity effects.

Another, if limited source are the records from the Mexican Contaminants Emission and Transfer Register (RETC, *Registro de emisión y transferencia de contaminantes de Mexico*) (<http://app1.semarnat.gob.mx/retc/retc/index.php>).

FIGURE 8. 2 DIAGRAM OF THE POTENTIAL PROJECT RELATIONSHIPS

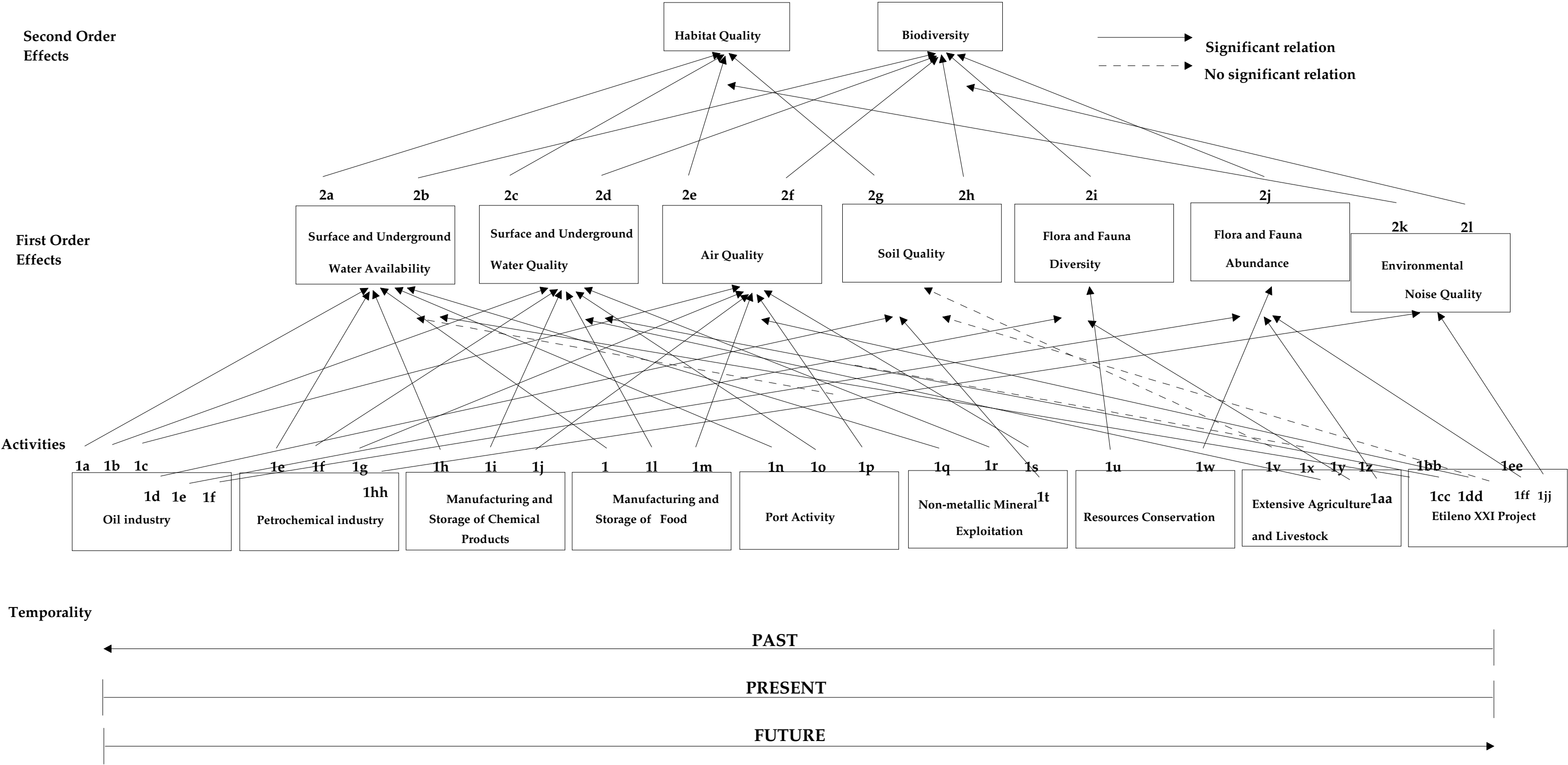
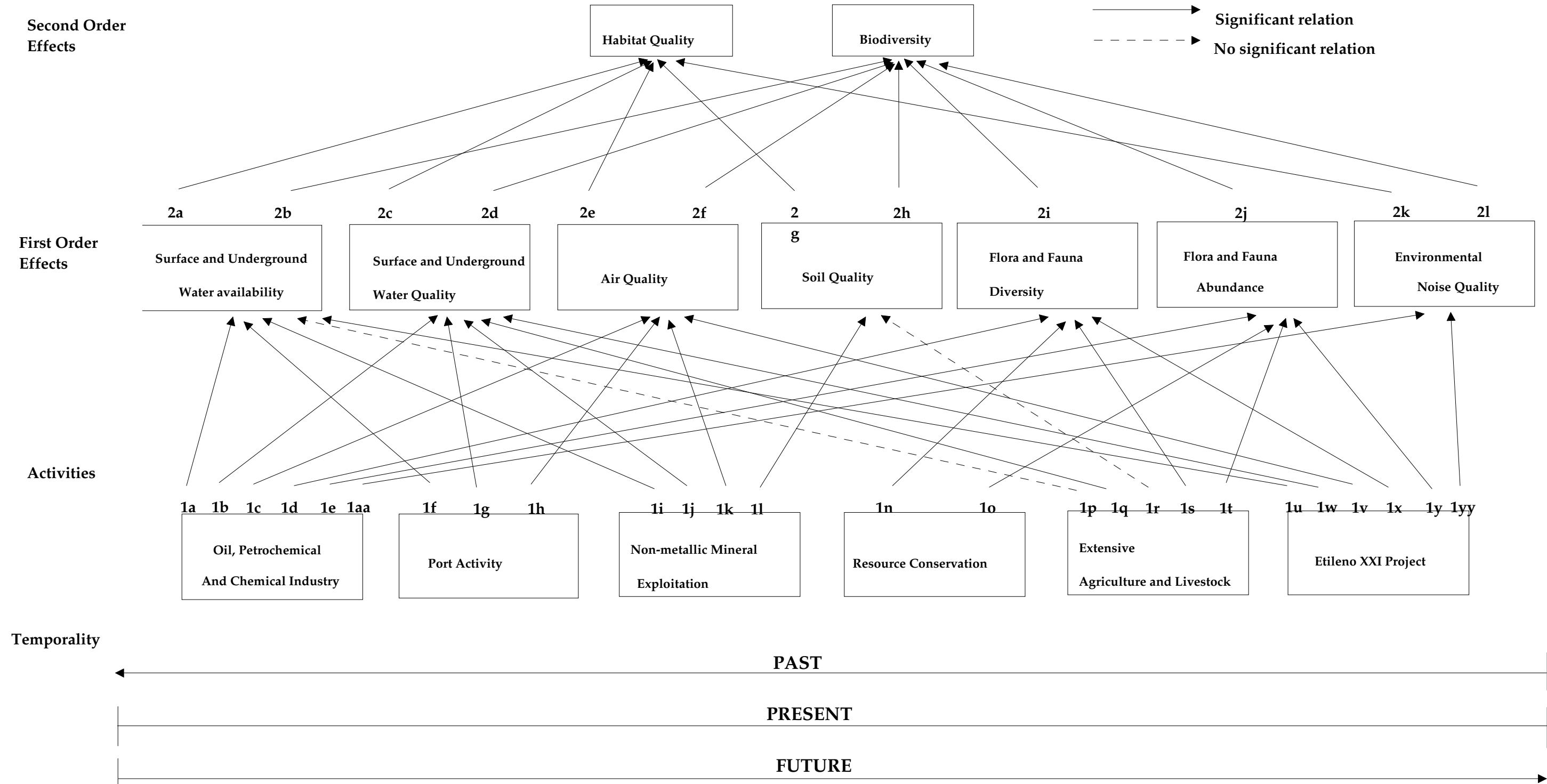


FIGURE 8.3 DIAGRAM OF POTENTIAL PROJECT RELATIONSHIPS GROUPED INTO ACTIVITIES



8.5.1 Assessment of Significance

To determine if a relationship (and its consequent effects) is cumulative, it is necessary for the magnitude of this original effect to be significantly increased when combined with other relationships of the same effect. It is important to note that, in case of this analysis, it is necessary to complete an exhaustive assessment in order to quantify this point as the totality of the impact has to be measured, from their starting point in the past, through today, and there is a high probability that they will continue in the future, making it likely that its effects will be, at least in part, cumulative.

As a result of the cumulative effects analysis, three potential cumulative effects were identified:

- Groundwater and surface water availability.
- Groundwater and surface water quality.
- Air quality.

Each of these effects is described below.

Surface and groundwater availability

The surface and groundwater availability is affected by activities associated with the petrochemical industry, refineries, the chemical manufacturing, extensive farming activities, hydro-biological resource preservation, population use, as well as the Etileno XXI Project's own actions.

Four of the five identified relationships were significant and negative, so it is understood that the activities that generate those effects would be generating some impact level to the water resource availability. Such relationships would be caused by:

- The oil, petrochemical and chemical industry on the surface and groundwater availability.
- The port activity on the surface and groundwater availability.
- Non-metallic mining on the surface and groundwater availability.
- The Etileno XXI Project on the surface and groundwater availability.

While it is true that there are activities and areas that have a high demand on this resource such as: the Pollo de Oro, Nahualpa, Lázaro Cárdenas del Río, Ejido 5 de Mayo, El Chapo, Mundo Nuevo, Nanchital de Lázaro Cárdenas del Río, Ixhuatlán del Sureste, Minatitlán, Coatzacoalcas, Allende y Nueva Pajaritos communities that use wells and Sotepan Systems to access water supplies, these activities will not be affected by those of the Project.

Surface and groundwater quality

The groundwater and surface water quality is affected by industrial activities, the wastewater discharges associated with the industrial use, the use of pesticides and agrochemicals, port activities, and human use, in addition to the Etileno XXI Project activities. No other activities that could affect this resource are identified. The five identified relationships were significant and negative, that means that these activities will generate some impact level on the resource.

Wastewater discharges generated by the Project will be directed to a wastewater treatment plant (WWTP), the daily maximum permissible limits for discharge established by the Mexican Standards and the IFC were considered for the treatment design.

Air quality

The air quality will be affected by the activities associated with chemical and petrochemical products manufacturing, the process of refining hydrocarbons, port activity and the generation of particulate materials as a result of non-metallic mineral processing as well as the Project's own activities. The four relationships identified for this effect were significant and negative, meaning it is expected they will have some level of impact on air quality.

It is worth mentioning that the project design has been made, based on the latest technology that includes all the improvements that have been made over the past decades in terms of energy efficiency and emissions to the atmosphere, and following the most stringent standards of air quality established by Mexican law and IFC performances standards and guidelines.

As part of the baseline studies conducted for this ESIA, a study on local air quality was conducted as there are no records of air quality in the region, given that local authorities still do not monitor air quality in this region. Monitoring results reported at the time of sampling all values were within the limits established in the IFC EHS Guidelines, concluding that air quality in the study area was satisfactory.

In order to determine quantitatively the potential cumulative effect of existing air emissions (air quality baseline conditions in the presence of industrial activities) and the contributions of Ethylene XXI project, a study of atmospheric dispersion (model) was prepared, considering Particulate Matter (PM10), Sulfur Dioxide (SO₂), Nitrogen Dioxide (NO₂), Carbon Monoxide (CO), emitted by the point sources of BRASKEM-IDESIA.

The air dispersion model that was designed for the operations phase of the Project, allowed for 60 discreet receptors which included the residences located in Lázaro Cárdenas del Río, La Verónica, Ejido 5 de Mayo, Cangrejera 2, Manuel Almanza, Nuevo Teapa (Santa Cecilia), Pollo de Oro, El Chapo, Guayabal, Ixhuatlán, Moloacán, Cuichapa, Colonia Los Cocos, Nanchital, Minatitlán-Tecoteno, Mundo Nuevo, Coatzacoalcos, Allende, Gavilán de Allende and Las Palmitas. The results of the dispersion study indicate that the plumes with the highest concentrations are located within the limits of the site, within a radius of approximately 400 meters, without having any effect on the communities mentioned earlier. Regarding the parameters established for NO₂ and SO₂, concentrations within the radius of 4 500m comply with the limits established by the IFC and Mexican legislation.

While the model results are below the limits set by the IFC and the Mexican Standard, it is clear that these results were obtained based on specific concentration levels of air quality. Therefore, a sampling network will be designed, as well as a monitoring air quality program within the Área of Influence for all parameters, which is expected to be operational in June 2012.

With this information it would be re-evaluated the cumulative impacts of the project on air quality in the area of influence. However, it stresses that no adverse impacts are anticipated as the average wind speeds are typically higher than those used in the dispersion model and the project is designed to operate with the best technologies available that will have emissions control equipment and will reduce energy consumption. In any case, Braskem Idesa is committed to create

the necessary measures to ensure that environmental conditions are not adversely affected.

Other potential cumulative effects

Noise levels

During the construction phase, heavy machinery and equipment will be used, operating between one and two shifts of 10 hours each. In Table 8.6, the equipment prototypes to be used in cutting, filling and formation of platforms and embankments will be listed.

Despite the fact that the machinery and equipment listed above is planned, due to the nature of the works and the size of the property, noise accumulation cannot be measured from a single location, nor can all the equipment be expected to be located in the same area at the same time. As such, it is estimated that based on the number of machines expected to be working in a certain area at any given time that noise level generated will be of between 85 and 110dB in the areas being worked on.

The current noise level which is evident in the receptors closest to the property limits continue to fall within the maximum permissible standards as defined by NOM-081-SEMARNAT-1994, possibly increasing the levels of the receptors closest to the Project by 3 dB, causing a cumulative effect of Project activities together with other base noise levels which now surpasses the limits established by the IFC. As such, the environmental management plan and the Project engineers will contemplate the implementation of control measures (sound monitoring) and noise reduction (encapsulation) to be implemented during operations.

Taking into account the expected control and mitigation measures, it is estimated that the potential cumulated impact, relative to noise levels, will be of low significance.

Diversity of Flora and Fauna

According to the flora species criteria for environmental protection as per NOM-059-SEMARNAT-2010, the International Union for Conservation of Nature and criteria established by the Convention on International Trade and Endangered Species of Wild Fauna and Flora (CITES), the significant impacts on the diversity of the flora will take place during the construction phase, principally due to the right-of-way (ROW) of a section of the natural gas pipelines and power lines. This is due to the need for clearing scrub from specified areas for the installation of towers, which requires foundations.

8.6 MITIGATION MEASURES FOR THE IDENTIFIED CUMULATIVE EFFECTS

The current analysis of cumulative effects evaluates the cumulative potential of the proposed activities during the construction and operation of the Etileno XXI Project, and other related works in the Area of Influence. This section will identify the measures for monitoring, control, prevention, mitigation and /or management that should be implemented to prevent and/or mitigate the adverse environmental risks and impacts that the Project could cause to the environment.

In total, eight activities other than the Project were identified, with eight possible impacts (see Figure 8.2). Thirty-two relationships were established, of which 33 proved to be significant, and one of which proved to be positive. These effects can be found amongst those described in the previous section.

It is important to note that the results of the evaluation, as well as the control, prevention and/or mitigation measures planned, take into account that the Etileno XXI Project will implement the effluent and emissions treatment activities mentioned in chapter 5 of this study. These measures will include, together with the water treatment plan, the processes necessary to ensure compliance with national legislation, together with the highest international standards, as determined by the IFC, as well as equipment to control atmospheric emissions, such as filters, a burner, dust collectors and separators amongst other.

In accordance with what was previously mentioned, the measures to be adopted as part of the Project environmental management plans, based on the accumulated impact assessment for areas outside of the Project, should include monitoring and control subprograms in such a way that the various parameters (including superficial and ground water and air quality) be monitored. These, could serve as management tools for Project decision making. The proposed control measures are established in chapter 10 of the current ESIA, and the mitigation measures are addressed in a series of programs and subprograms, each of which include implementation timetables and a breakdown of the costs associated with it.

HEALTH AND SAFETY**9.1 OCCUPATIONAL EXPOSURE TO THE PROJECT IMPACTS DURING THE SITE PREPARATION AND CONSTRUCTION**

The developer or petitioner shall supervise the implementation of the Contractor's Occupational Health and Safety (OHS) program during the site preparation and construction (referred to, as a whole as construction) to ensure compliance with the requirements established by the developer (see Annex 8.23.9).

The OHS program is based on Mexican law and on the international and industrial best practices. In addition, a number of critical success factors have been identified, which have also been incorporated and will be considered and taken into account in the OHS program for the construction activities.

9.1.1 Potential hazards identified for the Site Preparation and Constructions phases

The main potential hazards that may affect these phases have been identified:

1. Exposure to adverse weather events including hurricanes, torrential rains, flooding and high temperatures.
2. Exposure to fire.
3. Exposure to poor sanitary conditions of the services provided to staff, including health and cafeteria.
4. Exposure to an inadequate quality of drinking water and raw water.
5. Exposure to physical damage, theft, threats, damage to facilities and other safety aspects.
6. Exposure to vehicular traffic.
7. Inappropriate access of staff to the project site
8. Injuries requiring first aid application and / or assistance from a medical service.
9. Perform work at heights
10. Performing hot work (cutting and welding)
11. Management of hazardous substances and their health effects
12. Inappropriate use of personal protective equipment
13. Exposure to high noise levels
14. Inhalation of contaminants in the work environment
15. Improper handling of machinery
16. Heavy manual loads

9.1.2 Mitigation Measures

The Contractor shall develop and carry out specific mitigation measures for each of the potential hazards identified. In Chapter 9 of the ESIA outlined

general mitigation measures proposed by Braskem, Ideas to minimize the hazards identified as potential in these stages of the project.

The OHS program is included in the Annex 8.23.9, which requires a risk assessment for each activity to be developed.

9.1.3 *Exposure to disease*

Braskem-Idesa recognizes that the project location is conducive for transmission of various diseases such as dengue and others. In addition the number of workers can also cause the generation of infectious and contagious diseases. Therefore a program of prevention of tropical diseases and infectious has been developed whose guidelines are detailed in Sub-Program of Disease Prevention (Annex 8.25.)

9.1.4 *Personal Protective Equipment*

The personal protective equipment will be identified and selected according to the Program of Health and Safety and risk analysis results specific to each task.

9.1.5 *Communication and training*

According to the identified impacts and risks, a training program has been developed (see Annex 8.23.5) which will be implemented in the site during the construction phase. This program includes the development and delivery of various courses or training talks for different categories of workers.

9.2 *OCCUPATIONAL EXPOSURE TO THE PROJECT IMPACTS DURING THE OPERATION PHASE*

Following is the general framework of the impacts and risks to health and safety of workers during the operation phase. The detailed identification of impacts and risks and the specific program to be implemented during the operational phase of the project will be developed by Braskem-Idesa prior to the start of the operation of the plant.

9.2.1 *Potential risks identified during the Operation phase*

The following potential risks that may affect the activities to be carried out during the operational phase have been identified:

1. Exposure to adverse weather events including hurricanes, torrential rains, flooding and high temperatures.
2. Exposure to fire.

3. Exposure to physical damage, theft, threats, damage to facilities and other safety aspects.
4. Injuries requiring first aid application and / or assistance from a medical service.
5. Management of hazardous substances and their health effects
6. Inappropriate use of personal protective equipment
7. Exposure to high noise levels
8. Improper handling of machinery
9. Heavy manual loads

Additionally, we have identified potential risks that may occur mostly in maintenance activities, such as:

10. Perform work at heights
11. Performing hot work (cutting and welding)
12. Performing works with electricity
13. Confined Space Entry

9.2.2 *Mitigation measures*

Braskem-Idesa will develop in detail and carry out specific mitigation measures for each of the potential hazards identified before the start of operations, for which will produce an analysis of risks in the workplace prior to the start operations. In Chapter 9 of the ESIA is outlined the general mitigation measures proposed by Braskem-Idesa for the hazards identified as potential in the operation stage.

9.2.3 *Personal Protective Equipment*

The personal protective equipment will be identified and selected according to the program of health and safety and risk analysis results specific to each task.

9.2.4 *Communication and training*

Braskem-Idesa will develop a training program before starting operations. This program will cover the requirements for training required by the Federal Ministry of Labour and Social Welfare and the IFC.

9.3 *PROCESS SAFETY*

Below are general elements that Braskem-Idesa will implement to ensure process safety, to prevent major accidents and protect workers and damage to facilities. Process safety will be applied mainly in the management of the following substances:

- Ethane
- Ethylene
- Propylene
- Any other amounts which exceed the quantities listed in the Mexican Standards and applicable IFC guidelines.

Braskem-Idesa will implement a system to:

1. Information management
2. Risk management
3. Mechanical integrity
4. Change management

This system will be developed and implemented before the start of operations of the plant.

9.4 *COMMUNITY HEALTH AND SAFETY FOR THE PROJECT ETILENO XXI*

9.4.1 *Introduction*

Development projects can create great benefits for surrounding communities, as well as present risks and impacts to these communities. This section discusses potential impacts to community health and presents measures to address these impacts.

9.4.2 *Local Public Health Context*

Communities in the Area of Influence (AI) are in a semi - industrial area, provided that industrial complexes exist within what is considered a peri-urban area. A survey intended to document the main characteristics and living conditions of communities in the AI was realized and the following characteristics were identified:

- Lack of access to, and lack of quality public services are the most common problems identified in the AI, especially in communities with fewer than 400 inhabitants;
- Forty-four (44%) percent of the AI communities have access to potable water.
- Only 36% have easy access to medical services (doctors and medicines), and 64% have a latrine.
- The most common diseases in populations are respiratory diseases and chronic diseases (eg heart / circulatory). This indicates that communities may face a "double burden" of disease, as many countries of low and

middle income, which means that while still dealing with infectious disease problems are also experiencing a surge in non-chronic diseases such as obesity.

- Ninety percent (90%) of respondents in the AI, report concerns about environmental pollution, including sources of water and land due to industrial complexes.
- Seventy-one percent (61%) of respondents expressed a concern for current social risks in the area (drug use, alcohol and sexual exploitation), who fear that it will increase with growth and immigration.

9.4.3 *Main Impacts to Community Health and Safety*

Table 9.1 provides a summary of main impacts on public health related to the project. Overall impacts are presented for each phase of the project: Site Preparation, Construction, Operation and Abandonment.

TABLE 9.1 MAIN IMPACTS TO COMMUNITY HEALTH AND SAFETY

Identified impacts	Phase 1: Site Preparation, Construction and support facilities	Phase 2: Operations	Phase 3: Abandonment
Increase of traffic and accidents	(-) impact	(-) impact	(-) impact
Dust, emissions, and respiratory health	(-) impact	(-) impact	(-) impact
Handling of wastes and disease risk	(-) impact	(-) impact	(-) impact
Immigration and increase of social risks	(-) impact	(-) impact	(-) impact
Increase in workers and spread of disease and pregnancy	(-) impact	(-) impact	(-) impact
Impacts to the quality of life and housing by vibration	(-) impact	N/A	N/A
Altered noise level and social unrest	(-) impact	(-) impact	(-) impact
Increase on benefit expectations with respect to public services and potential conflict	(-) impact	(-) impact	N/A
Impact to water resources	(-) impact	N/A	N/A

(-) Negative Impact

The mitigation of potential impacts identified in Table 9.1 are described in detail in Chapter 9 of the ESIA.

9.4.4 *Mechanisms for protecting Community Health and Safety*

The Comprehensive Social Management Program (PGSI) established for the Project is composed by Sub-programs, which provide mechanisms to prevent occurrence of accidents and potential diseases related to the stages of the Project.

A key principle for the management of health and safety is to focus on preventing the impact because in some cases health impacts could be irreversible. If the impact can not be mitigated through avoidance to an

acceptable level, additional mitigation measures are necessary to minimize adverse effects.

Among all sub-programs, there are four that specifically address potential impacts to the Health and Safety in the AI communities, and serve as common guidelines, always applied together with the other Sub-programs for each phase of the project.

Subprogram of Grievances and Complaints (GCM) Section 8.19

- It will serve as a mechanism able to collect, record and find solutions to grievances, complaints, concerns or questions from stakeholders of the project. The application of sub MAQ will complement the rest of the Sub-programs as a key measure of performance of the sub-programs.

Subprogram of Community Health and Safety (CHS) Section 8.20

- It will attend various identified impacts and needs of the project to the communities and will establish the necessary mechanisms to prevent occurrence of accidents and potential diseases associated with each phase of the project. This sub-program will serve as a complementary mechanism to the other specific sub-programs attending Community Health and Safety.

Influx Management Plan Section 8.23.4

- The Plan contains measures to be implemented in the phases of site preparation and construction of the Project, in order to prevent, mitigate and compensate for social and environmental impacts in the communities identified as a result of the migration of labor.

Property Security Program (PSP) Section 8.23.11

- Braskem-Idesa will prepare a Property Security Sub program in early 2012 to establish the necessary mechanisms to protect facilities and employees of income for unauthorized personnel to the facilities, during site preparation, construction and operation. It will also include mechanisms for raising security forces associated with the project (which shall be private) to prevent the abuse of human rights. The subprogram will include background checks of security personnel, the prohibition of the use of firearms, instructions to act in case of strikes, acts of crime and social instability. The program will be based on the Voluntary Principles on Security and Human Rights.

In Chapter 9 of the ESIA there is a table detailing the relationship between other related Sub-programs with Community Health and Safety, as well as future activities to improve such management.

9.5

EMERGENCY PREPAREDNESS AND RESPONSE

A contingency plan for site preparation and construction has been prepared, the guidelines of which are presented in Annex 8.16. Moreover, as part of the

Environmental Risk Assessment, Braskem-Idesa has prepared an Accident Prevention Plan (APP), the principal elements of which are included in section 9.5.3. No emergencies likely to cause an impact beyond the site boundaries are anticipated during the site preparation and construction phases, except any that might occur during the transportation of fuel to the site. The contingency plan includes response measures for this event.

In order to determine the emergency response needs in the operations phase as well as the impacts that these could have in neighboring communities, a Risk Assessment has been developed that is summarized in the following section. Moreover, Braskem-Idesa has hired the company DNV in order to develop a broader Risk Assessment, including reputational and financial risks. DNV's reports will be available by the end of November 2011.

Risk Assessment

A risk analysis was completed as part of the Environmental and Social Impact Assessment. The Analysis of Major Risks was used as the methodology to identify possible risk events, , which can be used during the Project's basic engineering phase. This technique does not require specific quantitative methods or extensive planning. The method uses process information to identify the principal risks.

The Analysis of Major Risks (AMR) was the precursor of other, more complete analysis methods. It is preferably used for the identification of risks during the design phase prior to the new installations in order to anticipate the principal risks or to deepen understanding of risks in the final design.

The Contingency and Emergency Response plan for the operations phase will be detailed prior to the start of plant operations.

Accident prevention for the transport of oversized or hazardous materials.

During the site construction phase, processing equipment will be brought on site, much of which, due to its characteristics, could be oversized compared to normal cargo. Similarly, during the operations phase, hazardous materials will be transported both by road and by rail.

A program for the transportation of oversized or hazardous materials will be prepared.

Accident Prevention Program (APP)

The APP is an instrument by SEMANART in which states the security measure in case of accidents within the installations, in activities which are considered to be highly dangerous.

The general guidelines for the APP as prepared by Braskem-Idesa include:

- The security measures that will be implemented during operations
- The levels of response in case of emergency
- The organization, structure, functions and responsibilities of the brigades on which the company depends: The Spill Response or HAZMAT Brigade, Fire Brigade, Evacuation Brigade, First Aid Brigade.
- Specific response procedures classified, where possible, within the response levels. The specific procedures developed are:
 - Communication
 - Evacuation
 - Response to Natural and Social Phenomena
 - Fire prevention
 - Spill response
 - Leak response
 - Declaration of the End of the Emergency
- The functional structure that will be applied in case of emergencies
- The specific procedures for emergency response when the level of impact surpass the limits of the Project property.

10 PREVENTIVE AND MITIGATION MEASURES TO THE SOCIAL AND ENVIRONMENTAL IMPACTS

10.1 DESCRIPTION OF THE MEASURE OR PROGRAM OF MEASURES FOR PREVENTION, MITIGATION, OR COMPENSATION FOR THE SOCIAL AND ENVIRONMENTAL COMPONENT

The preventive and mitigation measures of the social and environmental impacts considered the general guidelines of environment, health, and safety (EHS) and the Performance Standards (PS) of the International Finance Corporation (IFC), as well as the recommendations regarding common approaches (CA) on the environment of the Organization for Economic Cooperation and Development (OECD) and the operational directives (OD) of the Inter-American Development Bank (IDB). The relationship of compliance with the following preventive measures may be complemented with the information of the application presented in chapter 4, where the legal framework of the Project is shown together with the international standards aforementioned. Below are the mentioned measures and their application in the identified impacts in previous chapters.

The actions of which together are known as management measures are those that can be applied to reduce the negative impacts caused to the environment or to any environmental condition.

According to the used procedure in chapter 7, where a clear and robust division between the environmental and the social impacts, and in order to give the same level of importance, this chapter is divided into the same two categories.

10.1.1 *Description of the management measures per environmental component*

All management measures for this Project fall into two comprehensive programs, the Program of Integral Environment Management and the Program of Integral Social Management, which in turn have sub-programs that address different aspects and that have different specific objectives focused on environmental or social components, as appropriate.

In addition, Braskem-Idesa has a specific Integrated Management System on Quality, Health, Safety, Environmental Protection, and Social Responsibility for the Etileno XXI Project, which will provide support to the mentioned programs, since it establishes general guidelines and directives for the management and supervision of the social and environmental sub-programs (see Annex 8, where all the described programs are included).

In the following table 10.1, the Program of Integral Environment Management and its sub-programs are described, which include all the management measures, prevention (P), mitigation (M) and compensation (C), proposals for the identified impacts in the site preparation, construction, operation, and abandonment

phases, of the off-sites and associated works to the Project, as well as the identified impacts for the activities of the Project in chapter 7.

Subsequently, in section 10.2, a general description of the Program of Integral Environment Management is included. In Annex 8, these sub-programs are presented in the level of development that so far is possible.

TABLE 10.1 PROPOSED SUB-PROGRAMS FOR THE IDENTIFIED ENVIRONMENTAL IMPACTS IN THE SITE PREPARATION, CONSTRUCTION, OPERATION, AND ABANDONMENT PHASES, OFF-SITES, AND ASSOCIATED WORKS

Proposed measure and operational directive (OD) that the IDB addresses	IFC Performance standard that addresses	Environmental Impacts that addresses	Type of measure for each phase			
			Preparation	Construction	Operation	Abandonment
Program of Integral Environmental Management (PIEM)	PS1	The PIEM serves as the guiding principle of environmental sub-programs presented in this chapter; therefore, this program addresses indirectly all identified environmental impacts.				
	PS3		P	P	P	P
	PS4		M	M	M	M
	PS6		C	C	C	C
Sub-program of non-hazardous waste management (Annex 8.2) /IDB OD B-11	PS1	Soil contamination.	P, M	P, M	P, M	P, M
	PS3	Alteration of surface water quality.	P	P	P	P
	PS4	Potential alteration of groundwater quality.	P	P	P	P
Sub-program of hazardous materials and waste management (Annex 8.3) /IDB OD B-11 y B-10	PS1	Soil contamination.	P, M	P, M	P, M	P, M
	PS3	Alteration of surface water quality.	P	P	P	P
	PS4	Potential alteration of groundwater quality.	P	P	P	P
		Pollution of nearby areas and transportation routes.	P	P	P	P
Sub-program of maintenance of machinery and equipment (Annex 8.4) / IDB OD B-	PS1	Alteration of air quality.	P, M	P, M	P, M	P, M
	PS2	Soil contamination.	P	P	P	P
	PS3	Alteration of surface water quality.	P	P	P	P

Proposed measure and operational directive (OD) that the IDB addresses	IFC Performance standard that addresses	Environmental Impacts that addresses	Type of measure for each phase			
			Preparation	Construction	Operation	Abandonment
11	PS4	Alteration of groundwater quality.	P	P	P	P
		Alteration in noise levels.	P	P	P	P
		Affectation of the natural habitat in the conservation and adjoining areas.		P		P
Sub-program of environmental education (Annex 8.5)	PS1 PS2 PS4	Alteration of surface water quality.	P	P	P	P
		Alteration of groundwater quality.	P	P	P	P
		Soil contamination.	P	P	P	P
		Loss of vegetation cover.	P	P	P	P
Sub-program of biodiversity (Annex 8.6) / IDB OD B-9	PS1 PS6	Loss of biodiversity.	M	M	M	
		Loss and/or reduction of the natural habitat.	M, C			
		Loss of individuals of protected and/or endemic species.	P	P, C	P, C	P, C
		Loss of vegetation cover.	M			
		Alteration of the ecosystem quality in the adjoining, conservation, and compensation areas.	P	P, C	P, C	P, M
		Original landscape modification.		M	M	M

Proposed measure and operational directive (OD) that the IDB addresses	IFC Performance standard that addresses	Environmental Impacts that addresses	Type of measure for each phase			
			Preparation	Construction	Operation	Abandonment
		Alteration in the vegetation due to an increase of heat radiation.		M	M	
		Loss of organic topsoil horizon.	M			
Sub-program of rescue and relocation of wildlife (Annex 8.7) / IDB OD B-9	PS1 PS6	Loss of individuals of protected and/or endemic species.	P, C	M	M	
		Loss of biodiversity.	P, C	M	M	
		Reduction of the natural habitat.	P	M	M	
Sub-program of vegetation relocation and transplanting (Annex 8.8) / IDB OD B-9	PS1 PS6	Loss of individuals of protected and/or endemic species.	P, M	M	M	
		Loss of organic topsoil horizon.	M	M	M	
		Loss of biodiversity.	M	M	M	
		Loss of vegetation cover.	M	M	M	
		Loss and/or reduction of the natural habitat.	M	M	M	
Sub-program of reforestation (Annex 8.9) / IDB OD	PS1 PS6	Relief modification.	M, C	M	M	
		Original landscape modification.	C	M	M	C
		Loss of individuals of protected and/or endemic species.	M, C	M	M, C	

Proposed measure and operational directive (OD) that the IDB addresses	IFC Performance standard that addresses	Environmental Impacts that addresses	Type of measure for each phase			
			Preparation	Construction	Operation	Abandonment
B-9		Loss of vegetation cover.	C			
		Loss and/or reduction of the natural habitat.	M, C			
		Loss of biodiversity.	M, C	M	M	C
		Change of the run-off pattern.	M, C			
		Acceleration of erosive processes in cleared or sloped areas and areas free of construction.	M	M		
		Loss or organic topsoil horizon.	M, C			
		Loss of surface infiltration.	M, C	C	C	
		Reintegration of acquired areas for the ecosystem compensation.	C	C		
Sub-program of cutting and removal of vegetation (Annex 8.10) /IDB OD B-9	PS1	Relief modification.	P			
	PS4	Original landscape modification.	M			
	PS6	Change of the run-off pattern.	P			
		Acceleration of erosive processes in cleared or sloped areas and areas free of construction.	P			
		Loss of surface infiltration.	M			

Proposed measure and operational directive (OD) that the IDB addresses	IFC Performance standard that addresses	Environmental Impacts that addresses	Type of measure for each phase			
			Preparation	Construction	Operation	Abandonment
		Presence of odors (organic decomposition of the plant material from site clearance and trimming activities).	M			
		Wastage of the organic topsoil layer.	C			
Sub-program of vehicular and pedestrian traffic control (Annex 8.11) /IDB OD B-11	PS1	Alteration of air quality.	P, M	P, M	M	M
	PS2	Vehicle accidents outside of the workplace.	P	P	P	P
	PS3		P, M	P, M	P, M	P, M
	PS4	Alteration in noise levels and social unrest.	P, M	P, M	P, M	P, M
Sub-program of noise monitoring and control (Annex 8.12) /IDB OD B-11 y B-7	PS1	Alteration in noise levels.				
	PS2		P, M	P, M	P, M	P, M
	PS3					
	PS4					
Sub-program of soil conservation and erosion control (Annex 8.13) /IDB OD B-11	PS1 PS3	Acceleration of erosive processes in cleared or sloped areas and areas free of construction.	P			
		Change of the run-off pattern.	M			
		Relief modification.	M			
		Revegetation of the areas free of construction.	C	C		
		Reintegration of restored areas.	C	C		
Sub-program of water	PS1	Alteration of surface water quality and aquatic habitat.	P	P, M	P, M	P, M

Proposed measure and operational directive (OD) that the IDB addresses	IFC Performance standard that addresses	Environmental Impacts that addresses	Type of measure for each phase			
			Preparation	Construction	Operation	Abandonment
management and disposal (Annex 8.14) /IDB OD B-11	PS3	Change of the run-off pattern.	P, M	P, M	P, M	P, M
		Minimization of natural flooding in low topographic areas of the site.	P, M	P, M	P, M	P, M
		Loss of surface infiltration.	C	C	C	C
		Potential cone of depression of the groundwater table, due to the installation of one or more groundwater abstraction wells.	M	M	M, C	C
		Alteration of flow regime (alternative streams for water supply).	P, M	P, M	P, M, C	P, M
		Potential alteration of groundwater quality.	P	P	P, M	P, M
		Alteration of groundwater quality by sanitary sludge or wastewater discharges.	P	P	P	P
Sub-program of air quality monitoring and control (Annex 8.15) /IDB OD B-11	PS1	Alteration of air quality (VOC, HC, SO _x , PM, NO _x , CO, water vapor, fugitive emissions).	P, M	P, M	P, M	P, M
	PS3	Affection of the natural habitat quality in the conservation and adjoining areas.	P, M	P, M	P, M	P, M
	PS4	Increase of the greenhouse effect.	P	P	P, M	P, M
Contingency and Emergency Response	PS1	Alteration of groundwater quality.	P, M	P, M	P, M,	P

Proposed measure and operational directive (OD) that the IDB addresses	IFC Performance standard that addresses	Environmental Impacts that addresses	Type of measure for each phase			
			Preparation	Construction	Operation	Abandonment
Plan (Annex 8.16) /IDB OD B-11	PS2	Site and/or adjoining areas contamination.	P, M	P, M	P, M,	P
	PS3					
	PS4	Air pollution.	P, M	P, M	P, M,	P
		Alteration to the biodiversity (flora and fauna).	P, M	P, M	P, M,	P

Note:

Types of measures: P: prevention; M: mitigation; C: compensation. The methodology to address the IFC Performance Standards on Social and Environmental Sustainability, is specified in Annex 8.

As shown on the table above, the OECD CA are covered with the implementation of the programs, sub-programs and submitted plans; and thus, they are not listed particularly, as in the case of the IFC PS and the IDB OD.

10.1.2 *Description of the management measures for the social component*

In the table 10.2, all proposed sub-programs for the social impacts are related to each other during all phases of the Project. It is worth mentioning that particular activities will be developed as they progress, from both the site area and the Project site itself.

TABLE 10.2 PROPOSED SUB-PROGRAMS FOR THE IDENTIFIED SOCIAL IMPACTS DURING THE PHASES.

Proposed measures	IFC Performance Standard that addresses	Social Impacts that addresses	Type of measure for each phase			
			Preparation	Construction	Operation	Abandonment
Program of Integral Social Management (PISM) - /IDB OD B-5 y OD B-9	PS1 PS2 PS4 PS8	Alteration of migration flows and demographic trends.	P, M	P, M	P	
		Increase in the value of surrounding lands.	P	M		
		Affection to species of economic value due to emissions and effluents.	P, C	P, M	P, C	
		Increase of community morbidity.	P, M	P, M	M	C
		Migration of temporary workers to areas with more jobs during the abandonment phase (discussed in chapter 7).			M	P, M, C
		Reduction in the value of surrounding lands.				M
Sub-program of relationships with the interest groups (RIG) - /IDB OD B-5	PS1 PS2 PS4	Alteration in the ability for social mobility.	P, M	P, M	P, M	
		Reduction of economic benefits to formal and informal businesses due to migratory flow reduction.			P	P, M
		Termination of employment contracts with vulnerable groups (as defined in chapter 7).	P, M	P, M	P, M	P
		Alteration in noise levels and social unrest.	P, M, C	P, M,	P, M, C	P
Sub-program of grievances and complaints mechanisms (GCM) - /IDB OD B-5	PS1 PS8	Reduction of the visual-aesthetic quality and disturbance to the identity of the site setting.	P, M, C	M, C		
		Vehicle accidents outside of the workplace.	P	P	P	p
		Alteration in noise levels and social unrest.	P, M	P, M	M, C	

Proposed measures	IFC Performance Standard that addresses	Social Impacts that addresses	Type of measure for each phase			
			Preparation	Construction	Operation	Abandonment
		Increase of community morbidity.	P, M	P, M, C	P	
Sub-program of community health and safety (CHS) - /IDB OD B-5	PS1 PS4	Affectation to species of economic value due to emissions and effluents.			M	
		Decreasing of the landscape quality.	P, M	P, M	P, M, C	
		Alteration in noise levels and social unrest.	P, M	P, M	M, C	
		Reduction of economic benefits to formal and informal businesses due to migratory flow reduction.			M	P, M
		Affectation on the mobility of the residents due to the increase of traffic in existing roads.	P, M		C	
Sub-program of working conditions (WC) - /IDB OD B-5	PS1 PS2	Termination of employment contracts at the end of activities.	P, M	P, M, C	P, M	P, M
		Alteration in noise levels and social unrest.	P, M	P, M, C	P, M	P
Sub-program of continuous training (CT) - /IDB OD B-5	PS1 PS2	Reduction of job opportunities in the region.				P, M

Notes:

- The identified potential risks (discussed in chapter 7) are mitigated with the social sub-programs described in Appendices 8.17 – 8.22. This table only mentions the impacts, not the risks, which are prevented and mitigated by the sub-programs.

- Due to the reasons established in chapters 5.4 and 7, the indigenous people issue is not addressed in the above list. The following is presented as explanation (referred to chapter 5.4): “it is concluded that: there are no indigenous communities in the areas of influence and, hence, the affectation of the Project with respect to indigenous communities and lifestyle is totally null.”

As shown on the table above, the OECD CA are covered with the implementation of the programs, sub-programs and submitted plans; and thus, they are not listed particularly, as in the case of the IFC PS and the IDB OD.

10.2 *PROPOSED PROGRAMS FOR THE IMPLEMENTATION OF THE MANAGEMENT MEASURES*

This section provides a description of the proposed programs and sub-programs as management measures, which in turn, group precise measures for both social and environmental impacts.

10.2.1 *Program of Integral Environmental Management (PIEM)*

The PIEM is the guiding program that will supervise the execution of all sub-programs that address all environmental impacts of the Project in all of its phases.

Being the core program in environmental matters, it is responsible for ensuring an organizational structure with both technical and administrative capabilities to fulfill the set objectives in each sub-program, as well as for providing the required resources for their planning, execution, and monitoring.

The environmental sub-programs are listed below, which form the PIEM. These sub-programs are included in the Annex 8:

1. Sub-program of non-hazardous waste management (see Annex 8.2).
2. Sub-program of hazardous materials and waste management (see Annex 8.3).
3. Sub-program of maintenance of machinery and equipment (see Annex 8.4).
4. Sub-program of environmental education (see Annex 8.5).
5. Sub-program of biodiversity (see Annex 8.6).
6. Sub-program of rescue and relocation of wildlife (see Annex 8.7).
7. Sub-program of vegetation relocation and transplanting (see Annex 8.8).
8. Sub-program of reforestation (see Annex 8.9).
9. Sub-program of cutting and removal of vegetation (see Annex 8.10).
10. Sub-program of vehicular and pedestrian traffic control (see Annex 8.11).
11. Sub-program of noise monitoring and control (see Annex 8.12).
12. Sub-program of soil conservation and erosion control (see Annex 8.13).
13. Sub-program of water management and disposal (see Annex 8.14).
14. Sub-program of air quality monitoring and control (see Annex 8.15).
15. Contingency and Emergency Response Plan (see Annex 8.16).

10.2.2 *Program of Integral Social Management (PISM)*

The identified social impacts in chapter 5 shall be managed and supervised by a general guiding program, called the Program of Integral Social Management (PISM), which will be described in the following section. In addition, it will

contain the following sub-programs that shall be dedicated to address specific impacts:

1. Sub-program of relationships with the interest groups (RIG).
2. Sub-program of grievances and complaints mechanisms (GCM).
3. Sub-program of community health and safety (CHS).
4. Sub-program of working conditions (WC).
5. Sub-program of continuous training (CT).
6. In addition, the Immigrants Management Plan will be indirectly considered (see Annex 8.23.4) and the Protocol of Fortuitous Findings (see Annex 8.23.1).

11. GENERAL FRAMEWORK OF THE FOLLOW-UP AND MONITORING PLAN

This chapter generally describes the aspects including the follow-up and monitoring plan of the social and environmental impacts identified in previous chapters, as well as the monitoring of the various components for each program and sub-program. This plan will be ready before the start of the construction and operation phase and will include performance indicators at the required frequencies to ensure that the implementation complies with the SEMARNAT and IFC requirements, as well as other International Institutions. However, the following tables present the follow up and monitoring plan for the Site Preparation phase as well.

The following general framework of the follow-up and monitoring plan was prepared based on the general guidelines of environment, health, and safety (EHS) and the Performance Standards (PS) of the International Finance Corporation (IFC), as well as the recommendations regarding common approaches (CA) on the environment of the Organization for Economic Cooperation and Development (OECD) and the operational directives (OD) of the Inter-American Development Bank (IDB).

The specific objectives of the follow-up and monitoring plan are:

- Assessment of the status of the different social and environmental components that will be affected by the Project through indicators that allows the identification of their modifications (positive or negative).
- Timely and effective compliance verification of the prevention, mitigation and/or compensation measures established in the programs and sub-program that will be applied during and after the useful life of the Project in order to minimize the social and environmental impacts.
- Effectiveness testing of the implemented measures so that, when considered unsatisfactory, the causes are determined and the appropriate actions are carried out.
- Detection of unforeseen impacts to implement additional measures.

As a result of the follow-up and monitoring plan, several types of reports will be generated at different times, including those required by the applicable laws, those required by financing institutions of the Project, reports to the neighboring communities, the extraordinary reports are issued when there is some unforeseen affectation that requires immediate attention and periodic reports regarding the program compliance level and the status of the social and environmental aspects in the site of interest.

In the following tables, a general framework of the programs, sub-programs, indicators, and social and environmental monitoring that will be considered are presented, in order to assess their compliance during all phases of the Project. This monitoring support the integral social and environmental programs management, in coordination with the sub-programs under their responsibility (discussed in chapter 10). This general framework will be applied to the site preparation phase and will be adjusted and previously details to the Project construction and operation phases, using the lessons learned from the implementation of the initial stage.

Tables 11.1 and 11.4 from chapter 11 present the air emission, ambient air quality, noise and wastewater discharges permissible limits. When a same parameter is regulated by the Mexican standards and the sectorial guides in comparable criteria (e.g. maximum concentration in a same period of time), the most restrictive value has been marked as underlined, which will be the one to be complied in the Project.

The following tables summarize the follow-up and monitoring plan for each of the proposed programs and sub-programs.

TABLE 11.1 *PROGRAM OF INTEGRAL ENVIRONMENTAL MANAGEMENT (PIEM) – ANNEX 8.1*

Management measure	Indicator	Frequency	Threshold analysis time	Information to report	Responsible
Program of Integral Environmental Management (PIEM).	Progress of the involved environmental sub-programs.	Monthly.	Below the 85% of the compliance level in the period.	Sustainability reports for international organisms and external audit groups.	CSS PARS Manager, Area of Environmental Protection. Support in the Occupational Health and Safety, Social and Quality Responsibility areas.
	Budgetary control.	Quarterly.	Below or above the 10% of the established budget per each sub- program.		
	Indicator of legal compliance.	Monthly.	Identification of findings that pose a risk to the Project.		
	Complaints registered in the MAQ of the PIEM related with environmental impacts and aspects.	Monthly.	One complaint.		

These performance indicators provide a framework for the Monitoring Plan at all the stages involved in the Etleno XXI project.

TABLE 11.2 SUB-PROGRAM OF NON-HAZARDOUS WASTE MANAGEMENT – ANNEX 8.2

Management measure	Indicator	Frequency	Threshold analysis time	Information to report	Responsible
Sub-program of non-hazardous waste management. (During all the project phases)	Recordkeeping and control of the generated waste volumes and destination, per type of waste.	Recordkeeping of each waste shipping to the temporary storage and dump sites.	Incomplete reports.	Special waste generation logbooks.	CSS PARS Manager, Area of Environmental Protection.
	Level of compliance of the activities established in the sub-program.	Monthly.	Less than 85%.	N/A	
	• Kg of generated wastes per employee. • Kg of shipped wastes to landfill per employee. • Kg of shipped wastes to recycling companies per kg of generated waste. • Kg of wastes per area (maintenance, operations, administration). • Kg of wastes per employee per area.	Quarterly.	Increase of 5% quarterly Failure to comply with the specific established goals per waste type.	N/A	

TABLE 11.3 SUB-PROGRAM OF HAZARDOUS MATERIALS AND WASTE MANAGEMENT – ANNEX 8.3

Management measure	Indicator	Recommended frequency	Threshold analysis time	Information to report	Responsible
Sub-program of hazardous materials and waste management. (during all the project phases)	Recordkeeping and control of the generated wastes, per type of waste.	Monthly.	N/A	In accordance with the established in the environmental impact authorization.	CSS PARS Manager, Area of Environmental Protection. Waste haulers and final disposal companies.
	Recordkeeping and vigilance regarding the compliance of the final disposal companies.	Yearly.	Non-compliance issue.	Hazardous wastes shipping and receipt manifests.	
	Level of compliance of the activities of the established sub-program.	Monthly.	80%.	Hazardous waste report sent to final disposal in the Annual Operation Report.	
	Compliance inspection of the used transportation means, which must comply with the applicable standards and the annual registries before SEMARNAT.	Per shipment.	Non-compliance issue.		
	• Kg per type of hazardous waste. • Kg per type of hazardous waste per employee. • Kg of hazardous wastes per area (maintenance, operations, administration). • Kg of hazardous wastes per employee per area. • Kg of hazardous waste that cannot be recycled per employee.	Quarterly.	The values exceed the results of the previous period or those specific established goals per waste type.		
	Authorized and current hazardous waste management plans.	Yearly.	Expired or outdated plans with all the operations of the facility.	Management plans in the established format by SEMARNAT.	

TABLE 11.4 SUB-PROGRAM OF MAINTENANCE OF MACHINERY AND EQUIPMENT – ANNEX 8.4

Management measure	Indicator	Recommended frequency	Threshold analysis time	Information to report	Responsible
Sub-program of maintenance of machinery and equipment. (during all the project phases)	Program compliance regarding the transportation units.	Monthly.	Non-compliance issue of the programmed activities.	N/A	CSS PARS Manager, Area of Environmental Protection.
	Program compliance regarding the maintenance of the process equipment and infrastructure.		Unusual mechanical failure.		Waste haulers.
	Control of air emissions, unburned HC (ppm), CO, NO (ppm), according to the state vehicular verification program.	According to the program.	Determined by the program and within the permissible limits.		Maintenance equipment.
	Ambient air quality in the Project area perimeter and transportation routes identified as critical according to the available alternative disposal or dump sites.	See table 11.22.	See table 11.21		
	- Monthly percentage of machinery, equipment or vehicles with detected leaks. - Percentage of vehicles that were not approved on the first emissions verification test. - Monthly average of time required between the reporting of a leak and its repair. - Kg of absorbent materials with oils or fluids monthly generated.	Monthly.	The values exceed the results of the last month or specific established goals.		

TABLE 11.5 *SU-PROGRAM OF ENVIRONMENTAL EDUCATION – ANNEX 8.5*

Management measure	Indicator	Recommended frequency	Threshold analysis time	Information to report	Responsible
Sub-program of environmental education. (during all the project phases)	Percentage of completion of the program performance.	Quarterly.	Non-compliance issues of the programmed activities.	N/A	CSS PARS Manager, Area of Environmental Protection.
	Results of the tests given to the participants.	Per event.	N/A		Hired subcontractors.

TABLE 11.6 *SUB-PROGRAM OF BIODIVERSITY – ANNEX 8.6*

Management measure	Indicator	Recommended frequency	Threshold analysis time	Information to report	Responsible
Sub-program of biodiversity.	Census of individuals.	Yearly, the first 5 years, and every 5 years thereafter. (site preparation, construction and operation)	Not conducting the census.	Report to SEMARNAT and PROFEPA according to the issued resolution.	CSS PARS Manager, Area of Environmental Protection. With support from a specialized consultant.
	Development of a detailed biological survey that includes an initial diagnosis of the conservation status of the proposed areas for conservation.	Every 5 years. (construction and operation)	N/A		
	Monitoring and Supervision of the abiotic conditions of the habitat, so it can be appropriate to the purposes of conservation and species abundance and richness	Every 2 years. (construction and operation)	N/A		
	Monitoring of the surrounding habitat and the conservation parks in abundance and diversity.	Monthly, the first year during the preparation site, Every two years for the next 6 years and every 5 years thereafter.	Loss of flora species, by the lack of records.		

Management measure	Indicator	Recommended frequency	Threshold analysis time	Information to report	Responsible
	Abundance of individuals per species (compared to baseline).	The first year, and then, every 5 years, during the following 20 years.	Established decrease as critical in the sub-program.		

TABLE 11.7 SUB-PROGRAM OF RESCUE AND RELOCATION OF WILDLIFE – ANNEX 8.7

Management measure	Indicator	Recommended frequency	Threshold analysis time	Information to report	Responsible
Sub-program of rescue and relocation of wildlife.	Percentage of completion of the program performance.	Monthly (site preparation)	N/A	Pursuant to the established in the environmental impact authorization and the applicable Mexican Official Standard (NOM).	CSS PARS Manager, Area of Environmental Protection. With support from a specialized consultant.
	Fauna species composition in the Project area.	Yearly (site preparation and construction)	N/A		
	Follow-up to the marked specimens.	Semiannually (site preparation)	N/A		
	Abundance of individuals per species.	Semiannually the first year (site preparation), and then, every 5 years, during the following 20 years (construction and operation).	Record of population decrease.		

TABLE 11.8 SUB-PROGRAM OF VEGETATION RELOCATION AND TRANSPLANTING – ANNEX 8.8

Management measure	Indicator	Recommended frequency	Threshold analysis time	Information to report	Responsible
Sub-program of vegetation relocation and transplanting.	Percentage of completion of the relocation activities of the sub-program.	Monthly, during the first 12 months (site preparation)	N/A	According to the established in the environmental impact authorization and the	CSS PARS Manager, Area of Environmental Protection.

Management measure	Indicator	Recommended frequency	Threshold analysis time	Information to report	Responsible
	Vegetation species composition in the Project area and Conservation area	Yearly during the construction phase and every 3 years for the operation phase	N/A	applicable NOM.	With support from a specialized consultant.
	Survival and abundance rates of the transplanted individuals. Note: Special attention will be paid to relocated protected species.	Semiannually, the first year. Every two years from the second year, during the following 20 years. (construction and operation)	Record of population decrease.		

TABLE 11.9 SUB-PROGRAM OF REFORESTATION – ANNEX 8.9

Management measure	Indicator	Recommended frequency	Threshold analysis time	Information to report	Responsible
Sub-program of reforestation.	Survival rate of the species.	Semiannually (Site preparation)	95%.	According to the established in the environmental impact authorization and the applicable NOM.	CSS PARS Manager, Area of Environmental Protection. With support from a specialized consultant.
	Percentage of rescued individuals and of authorized nurseries.	At the end of the site preparation phase	N/A		
	Percentage of species with stunted growth.	Yearly (site preparation and construction)	Less than 5%.		
	Mortality rate.	Yearly (site preparation and construction)	Less than 10%.		
	Measurement of height.	Yearly (site preparation and construction)	N/A		

TABLE 11.10 SUB-PROGRAM OF CUTTING AND REMOVAL OF VEGETATION – ANNEX 8.10

Management measure	Indicator	Recommended frequency	Threshold analysis time	Information to report	Responsible
Sub-program of cutting and removal of vegetation, during the site preparation phase.	Recordkeeping and control of the generated waste volumes and destination, per type of waste.	Per shipment.	N/A	N/A	CSS PARS Manager, Area of Environmental Protection. Contractors.
	Percentage of recovered waste (recycling or reuse), specially as a soil improver in new areas of infiltration.	Monthly.	N/A		
	Level of compliance with the slope reduction measures.	Quarterly.	N/A		

TABLE 11.11 SUB-PROGRAM OF VEHICULAR AND PEDESTRIAN TRAFFIC CONTROL – ANNEX 8.11

Management measure	Indicator	Recommended frequency	Threshold analysis time	Information to report	Responsible
Sub-program of vehicular and pedestrian traffic control, during all the phases of the project	Recordkeeping and control of the number of trips, routes, and destinations.	Daily.	N/A	N/A	CSS PARS Manager, Area of Environmental Protection. Occupational Safety Area.
	Physical condition of the used roads.	Monthly (site preparation and construction)	In case of damage caused by the activities of the Project.	SEDEMA	
	Compliance with the risk activities in roads and zones of high generation of dust or sensitive areas.	Daily. (site preparation)	Volatilization of dusts.	N/A	
	Ambient air quality in the Project area periphery and in the critical transportation routes	See Table 11.22	See Table 11.21	N/A	
	Speed reports within the Project area	Monthly	Any Increase from the last record	N/A	
	Records of incidents or traffic accidents within the site.	Quarterly	Accidents	N/A	
	Results from the Adequate use of roads from both pedestrians and vehicles Report	Monthly	Inadequate use of roads	N/A	
	Recordkeeping of verifications, maintenance and emission control measures of the vehicles.	Semiannually	Records with values above the norm	N/A	

TABLE 11.12 SUB-PROGRAM OF NOISE MONITORING AND CONTROL – ANNEX 8.12

Management measure	Indicator	Recommended frequency	Threshold analysis time	Information to report	Responsible
Sub-program of noise monitoring and control.	Noise measurements in sensitive zones, such as neighboring communities and vehicular traffic areas.	See table 11.7 and figure 11.1.	When the noise level increases in 3 dB (A) or more in any of the receptors. Whenever the Mexican permissible limits are exceeded (see table 11.4) in the property fence line.	Have the evidence available on-site.	CSS PARS Manager, Area of Environmental Protection. With support from a specialized consultant.
	Report of complaints by neighbors in the MAQ.	Monthly.	One complaint.	N/A	
	Level of compliance with the measurements established in the sub-program (e.g., day work programs, personal protection equipment, buffer strip, workers' schedules, barriers of isolation).	Monthly.	Detected non-compliance issues in the inspections.	Have the evidence available on-site.	
	Measurement of noise level in adjoining communities, as well as those communities in the material transportation routes.	See table 11.7 and figure 11.1. in Chapter 11.	When the noise level increases in 3 dB (A) or more in any of the receptors. Whenever the Mexican permissible limits are exceeded (see table 11.4) in the property fence line.	Have the evidence available on-site.	
	Monitoring records	See table 11.7 and figure 11.1. in Chapter 11.	Above permissible limits	N / A	

TABLE 11.13 NOISE LEVELS MONITORING

Characteristic	Project Phase		
	Site preparation	Construction	Operation
Parameters	Day and night noise levels in dB (A)*		
Sampling points	Cinco de Mayo, Mundo Nuevo (will be surveyed when the permanent loan sites are selected, being within the potential material transportation routes), outer area of the	Nahualapa. Pollo de Oro. Ejido Lázaro Cárdenas del Río. Resirene. Once in operation, the fence line noise survey will be conducted. .	

	municipal seat (near the Stevanatos dump site), plus the sampling points from the construction and operation phases (see figure 11.1 of chapter 11).		
Frequency	Monthly.	Quarterly.	Yearly.
Observations	First monitoring in all sampling points already defined; will be conducted prior to the start of site preparation activities. Results will be compared to the initial results in order to ensure that there is no increase of more than 3 dB (A) in the receptors. During the operation, besides the property fence line permissible limit, the IFC limits will also be met in the areas where there are adjoining residential areas and from those established in the Mexican Official Standard ((NOM-081-SEMARNAT-1994), being the strictest.		
Responsibilities	It is the responsibility of the sustainability manager to determine the actions that will be required in case that increases of more than 3 dB (A) are detected in the nearest receptors to the site.		

TABLE 11.14 SUB-PROGRAM OF SOIL CONSERVATION AND EROSION CONTROL – ANNEX 8.13

Management measure	Indicator	Recommended frequency	Threshold analysis time	Information to report	Responsible
Sub-program of soil conservation and erosion control.	Percentage of the level of compliance regarding the erosion control and mitigation measurements defined in the sub-program.	Monthly.	N/A	According to the established in the environmental impact authorization.	CSS PARS Manager, Area of Environmental Protection. Contractors.

TABLE 11.15 SUB-PROGRAM OF WATER MANAGEMENT AND DISPOSAL – ANNEX 8.14

Management measure	Indicator	Recommended frequency	Threshold analysis time	Information to report	Responsible
Sub-program of water management and disposal.	Obtaining of concession titles for the groundwater abstraction and wastewater discharge through irrigation.	Prior to its exploitation and discharge, the title must be granted. (site preparation)	Start of activities without having the required CONAGUA authorizations.	Water demand requirements and location and justification of the groundwater well.	CSS PARS Manager, Area of Environmental Protection. With support from a specialized consultant.
	Recordkeeping and control of the extracted and discharged volume.	Daily. (site preparation and construction)	Incomplete records.	Volumes of abstraction and soil irrigation.	
	Periodic quantification of the level of compliance to drinking water standards.	Quarterly. (operation)	Above the maximum permissible limits established in the NOM-127-SSA-1994.	N/A	
	Measurement of the groundwater table level. (average level of the aquifer with respect of mean sea level)	Monthly. (site preparation and construction)	Fall for three consecutive months.	N/A	
	Surface water quality in the Project zone.	See table 11.20 and figure 11.2. (all the phases)	Changes in downstream water quality (investigation whether they are attributable to the Project and, if confirmed, take action). Non seasonal changes in the quality of streams.	Monitoring results.	

Management measure	Indicator	Recommended frequency	Threshold analysis time	Information to report	Responsible
	Compliance with the maintenance of the wastewater discharges facilities (septic pits, toilets, grease traps).	Monthly for the maintenance. (operation)	Non-compliance issues of the program.	N/A	
	Wastewater collection on time.	Twice a week. (site preparation and construction)	Non-compliance issues at the times of wastewater collection activities.	NA	
	Federal zones delineation and signaling (Gopalapa stream).	Monthly. (preparation)	Wastes disposed in federal zones during inspections.	N/A	
	Physical condition of the storm water canals.	Monthly. (operation)	Blocked canals or in poor condition during inspections.	N/A	
	Wastewater quality in the point of discharge (operation phase).	Quarterly or more often if determined by CONAGUA.	Whenever the limits included in table 11.1 are exceeded.	Monitoring results.	

TABLE 11.16 SURFACE WATER QUALITY MONITORING

Characteristic	Project Phase		
	Site preparation	Construction	Operation
Parameters	• Temperature (°C). • Oils and greases. • Floating matter. • Settleable solids (ml/l). • Total suspended solids. • Biochemical Oxygen Demand (5 days). • Total nitrogen. • Total phosphorus. • pH. • Methylene blue active substances (MBAS). • Chemical Oxygen Demand • Color (Pt-Co). • Arsenic. • Cadmium. • Copper. • Chrome. • Mercury. • Nickel.	• Lead. • Zinc. • Cyanides. • Ammonia nitrogen. • Phenols. • Sulfates. • Fecal coliforms (NMP/100ml). • Iron. • Acute toxicity (toxicity units).* • Benzene. • Polycyclic Aromatic Hydrocarbons. • Sulfides. • Phenol. • Vinyl chloride. • Absorbable organic halogens. • 1,2 Dichloroethane.	

Sampling points	Upstream and downstream Project areas (between 10 and 50 m of the property limit or point of discharge, depending on the access) of the Gopalapa and Nanchital streams (see figure 11.2 in chapter 11).		
Frequency	Monthly, the first year. Quarterly, alter first year.	Quarterly.	Semiannually.
Observations	The first sampling will be conducted prior to the site preparation initial activities. The downstream results will be compared with those upstream results. Seasonal changes are expected in the water quality due to dilution during rain season.		
Responsibilities	It is the responsibility of the sustainability manager to determine the actions that will be required in case that impacts are detected in a downstream Project area.		

	<i>Project Phase</i>		
	Site preparation	Construction	Operation
Surface water parameters	• Temperature (°C). • Oils and greases. • Floating matter. • Settleable solids (ml/l). • Total suspended solids. • Biochemical Oxygen Demand (5 days). • Total nitrogen. • Total phosphorus. • pH. • Methylene blue active substances (MBAS). • Chemical Oxygen Demand • Color (Pt-Co). • Arsenic. • Cadmium. • Copper. • Chrome. • Mercury. • Nickel.	• Lead. • Zinc. • Cyanides. • Ammonia nitrogen. • Phenols. • Sulfates. • Fecal coliforms (NMP/100ml). • Iron. • Acute toxicity (toxicity units).* • Benzene. • Polycyclic Aromatic Hydrocarbons. • Sulfides. • Phenol. • Vinyl chloride. • Absorbable organic halogens. • 1,2 Dichloroethane.	
Underground water parameters	• Aluminum • Arsenic • Barium • Cadmium • Cyanides • Residual chloride • Chloride • Copper • Total cromium • Total hardness (such as CaCO3) • Phenols • Iron	• Fluoride (F-) • Manganese • Mercury • Nitrates • Nitrites • Amoniactal nitrógeno • PH • Aldrin and Diendrin (pesticidas) • Clordane • DDT • Gamma-HCH (lindane) • Hexaclorinebenzene	• Heptachlorine • Metoxichlorine • Lead • Sodium • Total dissolved solids • Sulfates • Active substances to blue methylene • Total Trihalometanes • Zinc • Coliforms • Total Coliforms

	• Water Colour • Water Odour • Water taste • Turbiedad		
Surface water Sampling points	Upstream and downstream Project areas (between 10 and 50 m of the property limit or point of discharge, depending on the access) of the Gopalapa and Nanchital streams (see figure 11.2 in chapter 11).		
Underground water sampling points	Al menos un pozo en Pollo de Oro, al menos uno en Nahualapa, y al menos uno en Lazaro Cardenas At least one deep well in Pollo de Oro, one in Nahualapa and one in Lázaro Cárdenas		
Frequency	Monthly, the first year. Quarterly, alter first year.	Quarterly.	Semiannually.
Observations	The first sampling will be conducted prior to the site preparation initial activities. The downstream results will be compared with those upstream results. Seasonal changes are expected in the water quality due to dilution during rain season.		
Responsibilities	It is the responsibility of the sustainability manager to determine the actions that will be required in case that impacts are detected in a downstream Project area or in a deep well in neighboring communities.		

TABLE 11.17 SUB-PROGRAM OF AIR QUALITY MONITORING AND CONTROL – ANNEX 8.15

Management measure	Indicator	Recommended frequency	Threshold analysis time	Information to report	Responsible
Sub-program of air quality monitoring and control. (during all the project phases)	Recordkeeping and control of the preventive maintenance of the machinery and equipment.	Monthly.	Incomplete records.	Records presentation.	CSS PARS Manager, Area of Environmental Protection. With support from a specialized consultant.
	Review of the suppliers checking that the local selection criteria are met and/or incorporation of energy efficiency in their processes.	Yearly.	Non-compliance issues in the suppliers.	Presentation of the suppliers authorizations, accreditations or registries.	
	Fixed sources emissions monitoring, VOCs, HC, SOx, PM, NOx, CO, water vapor, fugitive emissions and greenhouse gases emissions	Yearly.	Results above the maximum permissible limits according to the Mexican regulations and the IFC standards.	Monitoring results through the Annual Operation Report.	
	Ambient air quality monitoring (VOCs, HC, SOx, PM, NOx, CO).	See table 11.22 and figure 11.3.	Whenever the limits included in table 11.3 are exceeded.	Monitoring results.	

TABLE 11.18 AMBIENT AIR QUALITY MONITORING

Characteristic	Project Phase		
	Site preparation	Construction	Operation
Parameters	Carbon monoxide (CO). Total suspended particles (PST). PM 2.5. PM 10.	Ozone (O ₃). Nitrogen oxides (NO _x). Sulfur dioxide (SO ₂). Lead (Pb).	
Sampling points	Cinco de Mayo, Mundo Nuevo Congregación Cangrejera, plus the sampling points from the construction and operation phases (see figure 11.3 in chapter 11).	Considering the baseline studies and dispersion modeling, the most sensitive points regarding air quality are: Nahualapa. Pollo de Oro. Ejido Lázaro Cárdenas del Río. Resirene El Chapo.	
Frequency	Monthly.	Semiannually.	Yearly.
Observations	The monitoring will be conducted according to the established analytical methods by the Mexican relevant authorities, considering that these analytical methods are accredited and available in Mexican laboratories. The first monitoring will be conducted prior to the site preparation initial activities. The results will be compared to the IFC limits. The following sampling points were selected since they are in or near the potential transportation routes: Cinco de Mayo and Mundo Nuevo. Congregación Cangrejera was selected since it is closed to a potential dump site. The following sampling points were selected based on the results of the emissions modeling: Pollo de Oro and El Chapo. While the NO₂ plume does not reach El Chapo, no safety conditions would be available and the vehicular traffic would be blocked if the highway is used instead. The following sampling points were selected due to their proximity to the Project: Nahualpa (which in addition is closed to a potential dump site), Ejido Lázaro Cárdenas del Río and Resirene. The monitoring during the site preparation phase will be subject especially to safety conditions on the monitoring equipment. The team members will have the authority to suspend the monitoring activities if they consider that there are no adequate or sufficient safety conditions.		
Responsibilities	It is the responsibility of the sustainability manager to determine the actions that will be required in case that the limits are exceeded.		

TABLE 11.19 CONTINGENCY AND EMERGENCY RESPONSE PLAN – ANNEX 8.16

Management measure	Indicator	Recommended frequency	Threshold analysis time	Information to report	Responsible
Contingency and Emergency Response Plan.	Periodic review of the plan (includes fire drill results).	Semiannually.	Non-compliance issue on the established schedule for the revision and/or drills. Failure to implement recommended actions of previous drills	Fire fighters and Civil Protection through internal programs. Verification records to show in case they are required by the Federal Labor Agency (STPS).	CSS PARS Manager, Area of Environmental Protection. Occupational Safety Area.

Management measure	Indicator	Recommended frequency	Threshold analysis time	Information to report	Responsible
	Recordkeeping of the personnel training.	Prior to the start of activities and to each new member of the fire brigade.	Non-compliance issue of the training program.	N/A	
	Fire fighting equipment verification and inspection (fire extinguishers, water pumps, among others).	According to the schedule established by the equipment supplier (semiannually). Review during inspections.	Non-compliance issues on the records according to the schedule established by the supplier.	N/A	
	Recordkeeping of occurred emergencies and their classification.	Per event. Review during inspections.	Incomplete records.	N/A	
	Verification and testing of equipment to attend chemical spills Verification and testing of equipment to prevent unscheduled gas emissions (flare)	According to the equipment supplier, semiannually	Records of non compliance according to the schedule	N / A	

TABLE 11.20 PROGRAM OF INTEGRAL SOCIAL MANAGEMENT (PISM) – ANNEX 8.17

Management measure	Indicator	Recommended frequency	Threshold analysis time	Information to report	Responsible
Program of Integral Social Management (PISM).	Progress on the involved social sub-programs.	Constant, daily, and continuous Management of the PISM.	Prior to the start of activities.	Sustainability reports for international organisms and external audit groups.	Integral Social Management team in charge of the execution of all sub-programs.
	Transparency on the use of resources assigned to each social sub-program.	Annual accountability for internal and external audiences.	Prior to the start of activities.	Sustainability reports for international organisms and external audit groups.	PISM Social affairs manager.

TABLE 11.21 SUB-PROGRAM OF RELATIONSHIPS WITH THE INTEREST GROUPS (RIG) – ANNEX 8.18

Management measure	Indicator	Recommended frequency	Threshold analysis time	Information to report	Responsible
Sub-program of relationships with the interest groups (RIG).	Number of meetings or community communication events and level of comprehension of the covered topics.	After each update of the Project that includes changes to public information.	Lack of meetings with neighboring communities	PISM Internal sustainability reports (not local authority).	Community relations team (CRT).
	Positive and negative feedback regarding the topics of interests and number of registered persons in the people participation activities.	Each time the external sustainability reports are published.	Lack of meetings with neighboring communities	PISM Internal sustainability reports (not local authority).	Community relations team (CRT).

TABLE 11.22 SUB-PROGRAM OF GRIEVANCES AND COMPLAINTS MECHANISMS (GCM) – ANNEX 8.19

Management measure	Indicator	Recommended frequency	Threshold analysis time	Information to report	Responsible
Sub-program of grievances and complaints mechanisms (GCM).	Number of registered grievances and complaints and levels of recidivism of issues after being already addressed.	Each time a record is presented in the different access media to the mechanism.	Increase with respect to previous records	Monthly reports of grievances and complaints registries, as well as their resolution.	Community relations team (CRT).
	Resolution time of grievances and complaints and PISM transparency monitoring results.	Monthly review regarding the resolution process.	Response time over 4 weeks or increase with respect to previous records	Monthly reports of grievances and complaints registries, as well as their resolution.	Community relations team (CRT).
	Number of grievances and complaints after 30 and 60 days.		Lack or records or evidence of communication	Annual reports that include feedback.	Community relations team (CRT).

TABLE 11.23 SUB-PROGRAM OF COMMUNITY HEALTH AND SAFETY (CHS) – ANNEX 8.20

Management measure	Indicator	Recommended frequency	Threshold analysis time	Information to report	Responsible
Sub-program of community health and safety (CHS).	Morbidity indexes, road and health incidents in the area of interest.	Semiannual review regarding local indexes.	Increase with respect to previous records	PISM Internal sustainability reports (not local authority).	CHS sub-program team.
	Social perception regarding safety matters, and the number of safety incident reports.	Annual surveys regarding changes in social perception.	Decrease in the quality of the received responses, with respect to previous records	PISM Internal sustainability reports (not local authority).	CHS sub-program team.
	Quantity and destination of social investment in crucial topics, and transparent use of resources.	Annual reports of PISM information.	Lack of records	PISM Internal sustainability reports (not local authority).	CHS social issues manager.

TABLE 11.24 SUB-PROGRAM OF WORKING CONDITIONS (WC) – ANNEX 8.21

Management measure	Indicator	Recommended frequency	Threshold analysis time	Information to report	Responsible
Sub-program of working conditions (WC).	Legal compliance in employment contracts.	Monthly reviews regarding new hires.	Non compliance in contracts	PISM Internal sustainability reports (not local authority).	WC sub-program team.
	Recruitment notices (revision of equity terms and access to opportunities).	Bimonthly reviews from media announcements.	Lack of records or lack of communication	PISM Internal sustainability reports (not local authority).	WC sub-program team.
	Accident rates and work incidents. (Types, tendencies, etc.)	Monthly reviews of incidents.	Increase with respect of previous records	PISM Internal sustainability reports (not local authority).	WC sub-program team.
	Reports from the health care service provider.	Quarterly reviews of health care provider reports.	10% increase in health services visits with respect of previous quarter	PISM Internal sustainability reports (not local authority).	WC sub-program team.

TABLE 11.25 SUB-PROGRAM OF CONTINUOUS TRAINING (CT) – ANNEX 8.22

Management measure	Indicator	Recommended frequency	Threshold analysis time	Information to report	Responsible
Sub-program of continuous training (CT).	Number of trained personnel.	Monthly reviews of those attending to the training courses.	Less than 80% of the total employees	PISM Internal sustainability reports (not local authority).	WC sub-program team.
	Proportion of people entering and leaving the courses.	Semiannual reviews.	Less than 75%	PISM Internal sustainability reports (not local authority).	WC sub-program team.
	Proportion between people leaving the courses and recidivists.	Annual reviews.	Above than 75%	PISM Internal sustainability reports (not local authority).	WC sub-program team.
	Prior and subsequent performance to the courses.	Semiannual reviews of performance.	Decrease or lack of evidence of the training effectiveness	PISM Internal sustainability reports (not local authority).	WC sub-program team.

TABLE 11.26 SUB-PROGRAM OF WORK ENVIRONMENT MONITORING (WE) – ANNEX 8.26

Management measure	Indicator	Recommended frequency	Threshold analysis time	Information to report	Responsible
Sub-program of work environment monitoring (WE)	Monitoring of labour and working conditions with regards to the following aspects: noise, emissions, luminosity, temperature, etc.	Periodicity established by Mexican Official Norms	When monitoring is done less times than established	Monitoring results.	Braskem-Idesa health and safety team.
	Medical check-ups at recruitment of personnel and periodically (general check-ups and activity-specific) check-ups.	Every time there is a new recruit	NA	Report of conducted check-ups.	

Management measure	Indicator	Recommended frequency	Threshold analysis time	Information to report	Responsible
	Registry of achieved working permits.	As required	Absence of registries	NA	
	Registry of compliance with permissible limits in accordance with the Secretariat of Labour and the IFC Environment, Health and Safety Guidelines.	Weekly	When there is non-compliance	Compliance report	
	Number of times staff attended the doctor.	Monthly	Increase of 5% with respect to previous month	Frequency report and cause of doctor visit	
	Registry of sanctions for non-compliance with safety norms.	Monthly	Increase of 5% with respect to previous month	Sanction report	
	Registry of reviews done to the observed conditions of all the areas of the process, as well as to machinery and equipment.	Monthly	Increase of unsafe conditions	Findings of unsafe conditions	

TABLE 11.27 *PLAN FOR THE PROTECTION OF CULTURAL HERITAGE THROUGH A CHANCE FINDS PROTOCOL– ANNEX 8.23.1*

Management measure	Indicator	Recommended frequency	Threshold analysis time	Information to report	Responsible
Plan for the Protection of Cultural Heritage through a Chance Finds Protocol	Number of vestiges found	Permanent during site preparation phase	Findings of vestiges in the period	Internal sustainability reports to PSGI (not local authority)	PSGI team
	Number of vestiges properly handled	Permanent during site preparation phase	Findings inadequately handled	Internal sustainability reports to PSGI (not local authority)	PSGI team
	People trained to identify archaeological vestiges	Permanent during site preparation phase	Lack of training to identify archaeological vestiges	Internal sustainability reports to PSGI (not local authority)	PSGI team