V. IDENTIFICATION, CLASSIFICATION AND ASSESSMENT OF ENVIRONMENTAL IMPACTS

V.1. INTRODUCTION

Based on the analysis performed in previous chapters (delimitation of Environmental System (SA), change events in the same, classification and analysis of the AS and Identification and analysis of the environmental diagnosis), in this chapter we identify, describe and assess adverse and beneficial environmental impacts generating interaction between the project development and its area of influence, as well as its effect in the SA.

There are several techniques to identify and assess environmental project-factors interactions; however, all environmental impact assessments should describe the action generating the impact, predict the nature and magnitude of environmental effects, interpret the results and prevent negative effects on the environment. Due to the aforementioned, we developed a methodology to guarantee the estimate of impacts caused by the execution of the project and allowing reduction of the subjectivity in detection and assessment of environmental impacts; the aforementioned derived in an analysis that allowed determining the disturbances and modifications present in environmental components of the SA delimited.

The Department, as provided in paragraph three Section 9 of the RLGEEPAMEIA, provides guidelines to facilitate the submission and delivery of the EIS, according to the type of work or activity intended to be developed, the content of EISs is in fact a guide. The content of each chapter of the EIS must conform to Chapter 13 of the RLGEEPAMEIA, and for the specific case of chapter V should contain, in accordance with fraction V of Section 13 of the Regulations, the identification, description and assessment of environmental impacts, cumulative and residual, of the SA; so even when we took as reference the guideline of the Department for the preparation of this chapter, its content conforms to the provisioned in fraction V, Section 13 of the Regulations.

Based on the latter, the structure of the methodology for identification and assessment of environmental impacts used in this study follows the procedure indicated below:

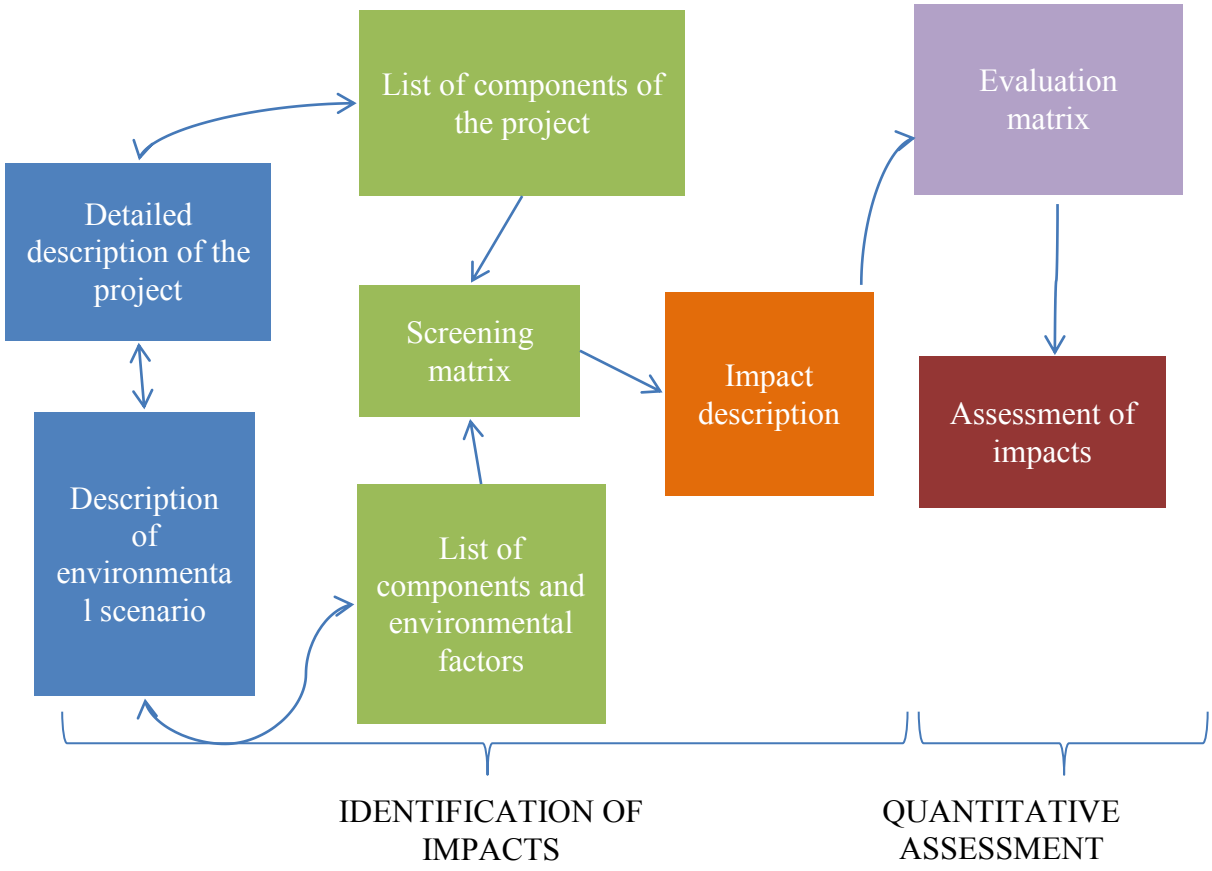

Figure V.1. Diagram of the methodology for the environmental impact assessment

V.1.1. Methodology for identification of environmental impacts

For identification of environmental impacts we used the matrix method (screening matrix), which is based on identifying and qualifying actions of the Project comparing them to natural and social environmental conditions. This is done by adding inputs to a double-entry matrix in columns and rows with information about activities of the Project which may alter the environment and features of the environment susceptible to be altered. This gives us a list of anthropomorphic actions with impacts to the environment.

The latter was carried out through the use of a cause-effect relationship matrix. We selected a modification to the Leopold Matrix, to adapt columns and rows of the original matrix to the features of the Project, which facilitated the analysis; since, otherwise, several cases would be empty due to their little or non-existent relationship in terms of environmental impact generation**.** This matrix relates through a double-entry case environmental and socioeconomic components (in the vertical axis) with activities for each stage of the project (horizontal axis), all of them selected from the list of indicators of environmental impacts. We made a list of both Project activities and environmental factors that have been or are to be disturbed.

For actions to be carried out in the execution of the Project we consider the following stages:

1. Site Preparation Stage
2. Construction Stage
3. Operation and Maintenance Stage
4. Site Abandonment Stage

V.1.2. Methodology for quantitative assessment of environmental impacts

The assessment and quantification of environmental impacts identified through the use of Leopold Matrix, implied the use as basis of **Gómez Orea (2002)** Methodology, where once impacts are identified, these will be assessed through quantitative evaluation to be finally classified.

The methodology to assess and quantify environmental impacts was based in determining the following:

- **Incidence rate:**

Incidence refers to the severity and way of alteration, which is defined by *intensity* and a series of qualitative *attributes* characterizing such alteration. After having classified the environmental impact, the *incidence rate* is calculated in four steps.

1. We establish the different attributes each impact may present and the character of each of them. For this case we established 5 attributes which are the following:

- Accumulation (simple or cumulative)
- Moment (short, medium and long-term)
- Persistence (temporary and permanent)
- Synergy (low, moderate and high)
- Reversibility (short term, medium term and non-reversible)
- Mitigability (mitigable, non-mitigable)

The last two (Reversibility and Mitigability), are only applicable to negative impacts

2. Each attribute is given a numerical code, providing a maximum value to the most unfavorable and a minimum value to the most favorable. Codes given to attributes are presented in the following Table.

Table V.1. Codes given to environmental and socioeconomic attributes to obtain the incidence rate.

Attributes	Character of attributes	Description	Code / value
Accumulation	Simple	Environmental impact shown in one environmental component and caused by one single activity	1
	Cumulative	Cumulative environmental impact is the impact that increases progressively when the action that causes it extends or when it is caused by two or more activities	3
Moment	Short	Its effect appears in the short term, that is, upon execution of the work or activity projected.	3
	Medium	Its effect appears in the medium term (one year)	2
	Long term	Its effect appears in the long term (more than one year)	1
Persistence	Specific	The environmental impact involves an alteration that disappears when the activity causing it disappears	1
	Temporary	The environmental impact involves an alteration that disappears with the time	2
	Permanent	The environmental impact involves an alteration of indefinite duration.	3
Synergy	Low	Synergy is produced when the presence of an environmental impact involves the generation of another environmental impact, which, altogether, cause a higher environmental impact than if presented in an isolated manner.	1
	Moderate		2
	High		3
Reversibility	Short term	Reversible environmental impact which may be assimilated by natural processes in the short term.	1
	Medium term	Partially reversible environmental impact which may be assimilated by natural processes in the medium term.	2
	Long term or non-reversible	Environmental impact that cannot be assimilated by natural processes, or can be assimilated very slowly, taking several years to achieve it.	3
Mitigability	Mitigable	Environmental impact that can be eliminated or mitigated with intervention of human actions	1
	Partially mitigable	Environmental impact that can be partially eliminated or mitigated with intervention of human actions	2
	Non-mitigable	Environmental impact that cannot be eliminated or mitigated with intervention of human actions	3

3. After giving values to each attribute, we make a weighted addition to obtain an incidence value (I).

4. We standardize between 0 and 1 the values obtained, through the following expression:

   Incidence rate Ii = $(I - I_{min}) / (I_{max} - I_{min})$.

   Being:

   Ii = incidence rate (incidence value obtained due to an environmental impact)

   I = incidence value (Σ of attributes values)

   I_{max} = the value of the expression in case attributes appear with the highest value (in this case 18 for negative impacts and 12 for positive impacts)

   I_{min} = the value of the expression in case attributes appear with the lowest value (in this case 6 for negative impacts and 4 for positive impacts)

- **Magnitude**

The determination of the magnitude of the environmental impact is done through predicting changes triggered by an action on different environmental factors (climate, air, water, soil, etc). Therefore, we give values between 0 and 1 to each environmental factor considering the premise of "with" and "without" a certain action of the project. Value near 1 means a higher quality of the factor, while values near 0 mean a lower quality of the factor.

The magnitude of the environmental impact will be the difference between the values of the factor quality without the project minus the quality of the factor with the project. Positive values indicate an adverse impact, whereas negative values indicate a beneficial impact on the environment. If we obtain a value of 0, it will mean that the environmental impact was totally mitigated and the environmental system did not suffer any modification.

- **Value of environmental impacts.**

The value of impacts (Vi) is obtained by multiplying magnitude (M) by the incidence rate (I) of each environmental factor disturbed, according to the following formula:

Vi = M * I
Where:
Vi = Value of environmental impact.
M = Magnitude
I = Incidence rate.

- **Classification of environmental impacts.**

Finally, we need to classify environmental impacts with the purpose of providing a comprehensive and complete vision of the project. Therefore, we use the relevance value, which is between 0 an 1. For each relevance value we determine a category for classification, using the following table.

Table V.2. Categories of environmental impacts assessment.

CATEGORIES		
Low beneficial	**0 - 0.25**	Adverse low
Moderate beneficial	**0.26 - 0.50**	Adverse moderate
High beneficial	**0.51 – 0.75**	Adverse high
Relevant beneficial	**0.76 – 1.00**	Adverse relevant
O void		

- **Mitigability**

It is important to consider that for each environmental impact identified mitigability values were given indicating if an environmental impact was mitigable, partially mitigable or non-mitigable. As previously mentioned, if an environmental impact was totally mitigated, we will obtain a magnitude value of 0, which will provide an environmental impact value of 0, that is, nonexistent.

V.2. IDENTIFICATION OF IMPACTS

V.2.1. Actions of the project susceptible to produce impacts

In general, the concept of action is understood as "the active part involved in the cause-effect relation defining an environmental impact" (Gómez-Orea 2002). In order to identify the project activities that will have a direct or indirect effect on the environment we consider the following aspects:

- Actions involving emission of pollutants (air, noise and water)
- Actions involving a modification of hydrological patterns
- Actions involving a modification in the soil quality and structure
- Actions acting on the biotic environment (flora and fauna)
- Actions involving damage of the landscape
- Actions affecting infrastructure (services)
- Actions modifying the social, economic and cultural environment

Based on the previous aspects, we defined **concrete actions** in each stage of the project, which were considered as actions caused by a simple, concrete, well-defined and located cause of the impact.

Table V.3. Phases and concrete actions of the project

Phases	Actions
Site Preparation	Negotiations with owners of premises
	Delimitation of working zones
	Land clearing and clearance
	Rehabilitation, extension and construction of access roads
	Construction and/or placement of provisional facilities (building offices, machinery and equipment warehouses, concrete plant, crusher and screens)
	Transportation of consumables, equipment, materials and staff
	Storage of materials, machinery and equipment
Construction	Rocks removal and blasting activities
	Excavation, cuts, and filling-in
	Compaction and leveling
	Construction of wind turbines (foundation and assembly)
	Installation of meteorological towers
	Construction of transmission lines and substations (laying of underground line, construction of substations, laying of overhead lines)
	Operations of provisional facilities (concrete plant, crusher, offices and warehouses)
	Connection tests
	Restoration, cleaning, and signaling
	Transportation of consumables, equipment, materials and staff
	Storage of materials, machinery and equipment
Operation and Maintenance.	Wind turbines operation
	Operation of electric facilities (substations and transmission lines)
	Maintenance and Surveillance
	Transportation of consumables, equipment and staff
	Land restoration in provisional roads and temporarily disturbed areas
Site abandonment	Dismantling and demolition of structures
	Transportation of consumables, equipment, materials and staff
	Cleaning and rehabilitation

V.2.2. Factors of the environment subject to receive impacts

Environment is the part of the natural environment interacting with the project in terms of resources and raw material sources, support to physical elements and receivers of effluents through environmental vectors of air, land and water (Gómez-Orea 2002), as well as social considerations. For this project, information from Chapter IV of the EIS was taken, and next, as a result of the environment complexity and its systemic nature, it was broken down into several levels until obtaining simple and concrete factors:

Table V.4. Components and factors of the environment

Environment	Component		Factor
Abiotic	Climate		Microclimate
	Atmosphere		Air Quality
			Noise
	Land		Structure
			Quality
			Relief
	Surface water		Surface drainage (run-off patterns)
			Quality
	Groundwater		Aquifers recharge
			Quality
Biotic	Flora		Vegetable coverage
			Individuals of species within any category of NOM-059
	Fauna	Terrestrial	Habitat
			Distribution
			Species within any category of NOM-059
	Ecosystem		Biodiversity
Landscape	Landscape		Quality
Socioeconomic	Economic		Change of land use
			Jobs
			Local and Regional Development
	Services Demand		Water
			Energy
			Waste management and disposal
			Consumables

V.2.3. Identification of project-environment interactions

For the identification of interactions common techniques were used in the different stages of the project. The techniques for identification of relevant impacts compose the main part of the assessment methodology and register several proposals in specialized literature, some of them very simple and others highly structured. Impacts identification is the most important step in the EIS for "an impact which is not identified is not classified, assessed or described".

In this case, the Geographic Information System was used as the tool for application of such techniques in order to obtain environmental information generated for the property, the definition of natural units and zoning of traces, digital air photographs of the traces and information generated in work field and verification works. We used said information to classify the Environmental System (SA). The latter allowed assessing the environmental situation of the premise and the SA defined and delimited for the project, considering as context the portion of the coast area and of the natural unit to which it belongs.

Subsequently, interactions between the project and the environment were identified for each stage of the project, by using a matrix presented below.

:

Matrix 1. Identification and assessment of the Project environmental impacts during site preparation stage

	Components	Climate	Atmosphere		Land			Surface water		Groundwater		Flora		Fauna			Ecosystem	Landscape	Socioeconomic								
														Terrestrial					Economic			Services					
Stage	Actions / Factors	Microclimate	Quality	Noise	Structure	Quality	Relief	Surface drainage	Quality	Aquifers recharge	Quality	Vegetable coverage	Species within any category of NOM-059	Habitat	Distribution	Species within any category of NOM-059	Biodiversity	Quality	Change of land use	Jobs	Local and Regional Development	Water	Energy	Waste management and disposal	Consumables	Negative interactions	Positive interactions
Site Preparation	Negotiations with land owners																		IP 17		IP 19					1	1
	Delimitation of working zones																			IP 18	IP 20				IP 24	0	3
	Land clearing and clearance	IP 1	IP 2	IP 3	IP 4	IP 5		IP 7	IP 8	IP 9		IP 10	IP 11	IP 12	IP 13	IP 14	IP 15	IP 16		IP 18	IP 20	IP 21		IP 23	IP 24	17	3
	Rehabilitation, extension and construction of access roads		IP 2	IP 3	IP 4	IP 5	IP 6	IP 7	IP 8	IP 9				IP 12	IP 13			IP 16		IP 18	IP 20	IP 21		IP 23	IP 24	13	3
	Construction and/or placement of provisional facilities		IP 2	IP 3	IP 4	IP 5	IP 6	IP 7	IP 8	IP 9					IP 13			IP 16		IP 18	IP 20	IP 21	IP 22	IP 23	IP 24	13	3
	Transportation of consumables, equipment, explosives, materials and staff		IP 2	IP 3											IP 13			IP 16		IP 18	IP 20	IP 21			IP 24	5	3
	Storage of materials, machinery and equipment					IP 5			IP 8						IP 13			IP 16								4	0
	Negative interactions	1	4	4	3	4	2	3	4	3	0	1	1	2	5	1	1	5	1			4	1	3			
	Positive interactions																			5	6				5		
	Total negative interactions	53																									
	Total positive interactions	16																									

Matrix 2. Identification and assessment of the Project environmental impacts during construction stage

	Components	Climate	Atmosphere		Land			Surface water		Groundwater		Flora		Fauna					Socioeconomic								
															Terrestrial			Ecosystem and scape	Economic			Services					
Phases	Actions / Factors	Microclimate	Quality	Noise	Structure	Quality	Relief	Surface drainage	Quality	Aquifers recharge	Quality	Vegetable coverage	Species within any category of NOM-059	Habitat	Distribution	Species within any category of NOM-059	Biodiversity	Quality	Change of land use	Jobs	Local and Regional Development	Water	Energy	Waste management and disposal	Consumables	Negative interactions	Positive interactions
Construction	Rocks removal and blowing up		IC 1	IC 2	IC 3	IC 4	IC 5	IC 6	IC 7						IC 9			IC 10		IC 11	IC 12	IC 13		IC 15	IC 16	11	3
	Excavation, cuts, and filling-in		IC 1	IC 2	IC 3	IC 4	IC 5	IC 6	IC 7						IC 9			IC 10		IC 11	IC 12	IC 13		IC 15	IC 16	11	3
	Compaction and leveling		IC 1	IC 2	IC 3	IC 4	IC 5	IC 6	IC 7	IC 8					IC 9			IC 10		IC 11	IC 12	IC 13		IC 15	IC 16	12	3
	Wind-turbines construction		IC 1	IC 2	IC 3	IC 4		IC 6	IC 7	IC 8					IC 9			IC 10		IC 11	IC 12	IC 13	IC 14	IC 15	IC 16	12	3
	Installation of permanent meteorological towers		IC 1	IC 2	IC 3	IC 4		IC 6	IC 7						IC 9			IC 10		IC 11	IC 12	IC 13	IC 14	IC 15	IC 16	11	3
	Construction of transmission lines and substations		IC 1	IC 2	IC 3	IC 4		IC 6	IC 7	IC 8					IC 9			IC 10		IC 11	IC 12	IC 13	IC 14	IC 15	IC 16	12	3
	Operation of provisional facilities (concrete plant, crusher, offices and warehouses)		IC 1	IC 2					IC 7						IC 9			IC 10		IC 11	IC 12	IC 13	IC 14	IC 15	IC 16	8	3
	Connection tests																							IC 15	IC 16	1	1
	Restoration, cleaning, and signaling		IC 1	IC 2											IC 9					IC 11	IC 12	IC 13		IC 15	IC 16	5	3
	Transportation of consumables, equipment, materials and staff		IC 1	IC 2											IC 9					IC 11	IC 12	IC 13			IC 16	4	3
	Storage of materials and equipment					IC 4		IC 6										IC 10					IC 14			4	0
	Negative interactions		9	9	6	7	3	7	7	3	0	0	0	0	9	0	0	8	0			9	5	9			
	Positive interactions																			9	9				10		
	Total negative interactions	91																									
	Total positive interactions	28																									

Matrix 3. Identification and assessment of the Project environmental impacts during operation and maintenance stage

Phases	Components / Actions \ Factors	Climate	Atmosphere		Land			Surface water		Groundwater		Flora		Fauna			Ecosystem landscape			Socioeconomic							
														Terrestrial						Economic		Services					
		Microclimate	Quality	Noise	Structure	Quality	Relief	Surface drainage	Quality	Aquifers recharge	Quality	Vegetable coverage	Species within any category of NOM059	Habitat	Distribution	Species within any category of NOM059	Biodiversity	Quality	Change of land use	Jobs	Local and Regional Development	Water	Energy	Waste management and disposal	Consumables	Negative interactions	Positive interactions
Operation	Wind turbines operation		IO 1	IO 3										IO 6	IO 7	IO 7		IO 8			IO 10				5	2
	Operation of electric facilities																	IO 8			IO 10				1	1
	Maintenance and Surveillance		IO 2	IO 3		IO 4									IO 7			IO 8		IO 9				IO 11		6	1
	Transportation of consumables, equipment, materials and staff		IO 2																							1	
	Land restoration in provisional roads and temporarily impaired areas											IO 5															1
	Negative interactions		2	2		1								1	2	1	3							1			
	Positive interactions		1									1								1	2						
	Total negative interactions	13																									
	Total positive interactions	5																									

Matrix 4. Identification and assessment of the Project environmental impacts during abandonment stage

Phases	Components	Climate	Atmosphere		Land			Surface water		Groundwater		Flora		Fauna			Ecosystem	Landscape	Socioeconomic							
														Terrestrial					Economic		Services					
	Actions / Factors	Microclimate	Quality	Noise	Structure	Quality	Relief	Surface drainage	Quality	Aquifers recharge	Quality	Vegetable coverage	Species within any category of NOM059	Habitat	Distribution	Species within any category of NOM059	Biodiversity	Quality	Change of land use	Jobs	Local and Regional Development	Water	Energy	Waste management and disposal	Consumables	Negative interactions	Positive interactions
	Dismantling and demolition of structures		IA 1	IA 2		IA 3			IA 4	IA 5								IA 8		IA 10	IA 11	IA 12	IA 13	IA 14	IA 15	8	4
	Transportation of consumables, equipment, materials and staff		IA 1	IA 2																IA 10	IA 11	IA 12				3	2
	Cleaning and rehabilitation		IA 1	IA 2						IA 5		IA 6		IA 7				IA 9		IA 10	IA 11	IA 12		IA 14	IA 15	4	7
	Negative interactions		3	3		1			1									1				3	1	2			
	Positive interactions									2		1		1				1		3	3				2		
	Total negative interactions	15																									
	Total positive interactions	13																									

As a result of the analysis of the interaction matrix, the following table presents the description of each impact identified:

Table V.5. Impacts on the site preparation stage

Actions	Component	Factors	Impact identified
Land clearing and clearance	Climate	Microclimate	• IP 1: Alteration of local microclimate due to modification on the proportion of latent and sensible heat of radiation in deforested premises
Land clearing and clearance	Atmosphere	Air Quality	• IP 2: Emissions of combustion gas and dust resulting from the use of machinery and equipment and circulation of vehicles during site preparation.
Rehabilitation, extension and construction of access roads			
Construction and/or placement of provisional facilities			
Transportation of consumables, equipment, materials and staff			
Land clearing and clearance	Atmosphere	Noise	• IP 3. Noise emissions resulting from the use of machinery and equipment and vehicle circulation.
Rehabilitation, extension and construction of access roads			
Construction and/or placement of provisional facilities			
Transportation of consumables, equipment and materials			
Land clearing and clearance	Land	Structure	• IP 4: Land erosion due to loss of vegetable coverage and changes in its structure
Rehabilitation, extension and construction of access roads			
Construction and/or placement of provisional facilities			
Land clearing and clearance	Land	Quality	• IP 5: Land pollution due to wrong management of solid waste, as well as possible dripping of hydrocarbons from machinery and equipment, and wrong storage of oil and fuel.
Rehabilitation, extension and construction of access roads			
Construction and/or placement of provisional facilities			

Actions	Component	Factors	Impact identified
Storage of materials, machinery and equipment			
Rehabilitation, extension and construction of access roads	Land	Relief	• IP 6: Modification of geological formations
Construction and/or placement of provisional facilities			
Land clearing and clearance	Surface water	Surface drainage	• IP 7: Modification of surface hydrological pattern due to removal of vegetation and construction of provisional works and roads
Rehabilitation, extension and construction of access roads			
Construction and/or placement of provisional facilities			
Land clearing and clearance	Surface water	Quality	• IP 8: Pollution of water bodies nearby due to wrong storage and management of waste and construction materials, which may be swept by rain.
Rehabilitation, extension and construction of access roads			
Construction and/or placement of provisional facilities			
Storage of materials, machinery and equipment			
Clearing and grubbing	Groundwater	Aquifers recharge	• IP 9: Decrease in the aquifer recharge capacity due to removal of vegetation and compaction of land
Rehabilitation, extension and construction of access roads			
Construction and/or placement of provisional facilities			
Land clearing and clearance	Flora	Vegetable coverage	• IP 10: Loss of vegetable coverage in specific areas of the project.
Land clearing and clearance	Flora	Species within any category of NOM-059	• IP 11: Loss of individuals from vegetable species listed in NOM-059-SEMARNAT-2010, specifically the elephant's foot (*Beucarnea recurvata).*

Actions	Component	Factors	Impact identified
Land clearing and clearance Rehabilitation, extension and construction of access roads	Terrestrial fauna	Habitat	• IP 12: Modification and fragmentation of habitat due to loss of vegetable coverage
Land clearing and clearance Rehabilitation, extension and construction of access roads Construction and/or placement of provisional facilities Transportation of consumables, equipment, materials and staff Storage of materials, machinery and equipment	Terrestrial fauna	Distribution	• IP 13: Displacement of species due to noise, presence of machinery and equipment and presence of staff
Land clearing and clearance	Terrestrial fauna	Species within any category of NOM-059	• IP 14: Loss of individuals of animal species within any category of NOM-059-SEMARNAT-2010
Land clearing and clearance	Ecosystem	Biodiversity	• IP 15: Reduction of biodiversity due to loss of some flora and fauna individuals.
Land clearing and clearance Rehabilitation, extension and construction of access roads Construction and/or placement of provisional facilities Transportation of consumables, equipment, materials and staff	Landscape	Quality	• IP 16: Modification of original landscape due to loss of vegetable coverage and presence of machinery and equipment

Actions	Component	Factors	Impact identified
Storage of materials, machinery and equipment			
Negotiations with owners of premises	Socioeconomic (Economic)	Change of land use	• IP 17: Modification of land use in premises disturbed by the project
Delimitation of working zones.	Socioeconomic (Economic)	Jobs	• IP 18: Creation of direct and indirect jobs because of hiring staff from the region
Land clearing and clearance			
Rehabilitation, extension and construction of access roads			
Construction and/or placement of provisional facilities			
Transportation of consumables, equipment, materials and staff			
Negotiations with owners of premises	Socioeconomic (Economic)	Local Development	• IP 19: Payment to owners and ejido owners for leasing their premises and compensation for change of land use on their premises.
Delimitation of working zones.	Socioeconomic (Economic)	Local and Regional Development	• IP 20: Demand of services in neighboring towns (food, accommodation, recreation, vehicles, machinery and equipment)
Land clearing and clearance			
Rehabilitation, extension and construction of access roads			
Construction and/or placement of provisional facilities			

Actions	Component	Factors	Impact identified
Transportation of consumables, equipment, materials and staff			
Land clearing and clearance	Socioeconomic (Services)	Water	• IP 21: Water demand for activities of site preparation, mainly to keep working and circulation zones moisten, thus avoiding spreading particles and dust
Rehabilitation, extension and construction of access roads			
Construction and/or placement of provisional facilities			
Transportation of consumables, equipment, materials and staff			
Construction and/or placement of provisional facilities	Socioeconomic (Services)	Energy	• IP 22: Energy demand for provisional facilities construction activities
Land clearing and clearance	Socioeconomic (Services)	Waste management and disposal	• IP 23: Both the presence of staff at the site and the tasks of site preparation stage will generate solid waste which need the use of sanitary filling or municipal dumps duly authorized
Rehabilitation, extension and construction of access roads			
Construction and/or placement of provisional facilities			
Delimitation of working zones.	Socioeconomic (Services)	Consumables	• IP 24: Demand of consumables or materials to be used for site preparation activities and to be supplied from local or regional sources
Land clearing and clearance			
Rehabilitation, extension and construction of access roads			
Construction and/or placement of provisional facilities			
Transportation of consumables, equipment, materials and staff			

Table V.6. Impacts on the construction stage

Actions	Component	Factors	Impact identified
Rocks removal and blasting activities	Atmosphere	Air Quality	• IC 1: Emissions of combustion gas and dust resulting from the use of machinery and equipment, vehicles circulation, blasting of rocks, earth moving and during operation of the concrete plant, as well as operation of portable generators.
Excavation, cuts, and filling-in			
Compaction and leveling			
Wind-turbines construction			
Installation of permanent meteorological towers			
Construction of transmission lines and substations			
Operation of provisional facilities (concrete plant, crusher, offices and warehouses)			
Restoration, cleaning, and signaling			
Transportation of consumables, equipment, materials and staff			
Rocks removal and blasting activities	Atmosphere	Noise	• IC 2. Emissions of noise resulting from the use of machinery and equipment, due to blasting of rocks and operation of turbines during tests stage
Excavation, cuts, and filling-in			
Compaction and leveling			
Wind-turbines construction			
Installation of permanent meteorological towers			
Construction of transmission lines and substations			
Operation of provisional facilities (concrete plant, crusher, offices and warehouses)			
Restoration, cleaning, and signaling			
Transportation of consumables, equipment, materials and staff			

Actions	Component	Factors	Impact identified
Rocks removal and blasting activities	Land	Structure	• IC 3: Land erosion due to loss of vegetable coverage and changes in its structure
Excavation, cuts, and filling-in			
Compaction and leveling			
Wind-turbines construction			
Installation of permanent meteorological towers			
Construction of transmission lines and substations			
Rocks removal and blasting activities	Land	Quality	• IC 4: Land pollution due to wrong management of materials and solid waste, as well as possible dripping of hydrocarbons from machinery and equipment
Excavation, cuts, and filling-in			
Compaction and leveling			
Wind-turbines construction			
Installation of permanent meteorological towers			
Construction of transmission lines and substations			
Storage of materials, machinery and equipment			
Rocks removal and blasting activities	Land	Relief	• IC 5: Modification of geological formations
Excavation, cuts, and filling-in			
Compaction and leveling			

Actions	Component	Factors	Impact identified
Rocks removal and blasting activities	Surface water	Surface drainage	• IC 6: Modification of surface hydrological pattern due to modification of geological formations and construction of elements which may block the original pattern of surface run-off.
Excavation, cuts, and filling-in			
Compaction and leveling			
Wind-turbines construction			
Installation of permanent meteorological towers			
Construction of transmission lines and substations			
Storage of materials, machinery and equipment			
Rocks removal and blasting activities	Surface water	Quality	• IC 7: Pollution of water bodies due to wrong management of materials and waste resulting from construction which may be swept by rain towards water bodies nearby.
Excavation, cuts, and filling-in			
Compaction and leveling			
Wind-turbines construction			
Construction of transmission lines and substations			
Operation of provisional facilities			
Restoration, cleaning, and signaling			
Storage of materials, machinery and equipment			
Compaction and leveling	Groundwater	Aquifers recharge	• IC 8: Decrease in aquifer recharge capacity due to land compaction and substitution of natural land for foundations and paved areas
Wind-turbines construction			
Construction of transmission lines and substations			

Actions	Component	Factors	Impact identified
Rocks removal and blasting activities	Terrestrial fauna	Distribution	• IC 9: Displacement of species due to noise, presence of machinery and equipment and of staff, including species indicated in NOM-059-SEMARNAT-2010
Excavation, cuts, and filling-in			
Compaction and leveling			
Wind-turbines construction			
Installation of permanent meteorological towers			
Construction of transmission lines and substations			
Operation of provisional facilities (concrete plant, crusher, offices and warehouses)			
Restoration, cleaning, and signaling			
Transportation of consumables, equipment, materials and staff			
Rocks removal and blasting activities	Landscape	Quality	• IC 10: Modification of original landscape due to presence of machinery and equipment during construction activities
Excavation, cuts, and filling-in			
Compaction and leveling			
Wind-turbines construction			
Installation of permanent meteorological towers			
Construction of transmission lines and substations			
Operation of provisional facilities (concrete plant, offices and warehouses)			
Storage of materials, machinery and equipment			

Actions	Component	Factors	Impact identified
Rocks removal and blasting activities	Socioeconomic (Economic)	Jobs	• IC 11. Creation of direct and indirect jobs because of hiring staff from the region
Excavation, cuts, and filling-in			
Compaction and leveling			
Wind-turbines construction			
Installation of permanent meteorological towers			
Construction of transmission lines and substations			
Operation of provisional facilities (concrete plant, crusher, offices and warehouses)			
Restoration, cleaning, and signaling			
Transportation of consumables, equipment, materials and staff			
Rocks removal and blasting activities	Socioeconomic (Economic)	Local and Regional Development	• IC 12: Demand of services in neighboring towns (food, accommodation, recreation, vehicles, machinery and equipment)
Excavation, cuts, and filling-in			
Compaction and leveling			
Wind-turbines construction			
Installation of permanent meteorological towers			
Construction of transmission lines and substations			
Operation of provisional facilities (concrete plant, offices and warehouse)			
Restoration, cleaning, and signaling			
Transportation of consumables, equipment, materials and staff			

Actions	Component	Factors	Impact identified
Rocks removal and blasting activities	Socioeconomic (Services)	Water	• IC 13: Water demand for construction activities, mainly to avoid spreading dust and particles during drilling for blasting activities, during operation of provisional facilities, during circulation of vehicles on dirt roads, and for general cleaning services at the offices.
Excavation, cuts, and filling-in			
Compaction and leveling			
Wind-turbines construction			
Installation of permanent meteorological towers			
Construction of transmission lines and substations			
Operation of provisional facilities (concrete plant, offices and warehouses)			
Restoration, cleaning, and signaling			
Transportation of consumables, equipment, materials and staff			
Wind-turbines construction	Socioeconomic (Services)	Energy	• IC 14: Demand of electric energy for construction tasks, for operation of provisional facilities and lighting of warehouses
Installation of permanent meteorological towers			
Construction of transmission lines and substations			
Operation of provisional facilities (concrete plant, offices and warehouse)			
Storage of materials and equipment			
Rocks removal and blasting activities	Socioeconomic (Services)	Waste management and disposal	• IC 15: Both the presence of staff at the site and construction tasks will generate solid waste which need the use of sanitary landfill or municipal dumps duly authorized
Excavation, cuts, and filling-in			
Compaction and leveling			
Wind-turbines construction			
Installation of permanent meteorological			

Actions	Component	Factors	Impact identified
towers			
Construction of transmission lines and substations			
Operation of provisional facilities (concrete plant, offices and warehouse)			
Connection tests			
Restoration, cleaning, and signaling			
Rocks removal and blasting activities	Socioeconomic (Services)	Consumables	• IC 16: Demand of consumables or materials to be used for construction activities and supplied from local or regional sources (fuel, sand, gravel, cement, paint, rod, wood, steel, among others)
Excavation, cuts, and filling-in			
Compaction and leveling			
Wind-turbines construction			
Installation of permanent meteorological towers			
Construction of transmission lines and substations			
Operation of provisional facilities (concrete plant, offices and warehouse)			
Restoration, cleaning, and signaling			
Transportation of consumables, equipment, material and staff			
Tests			

Table V.7. Impacts on the operation stage

Actions	Component		Impact identified
Wind turbines operation	**Atmosphere**	Quality	• IO 1: Reduction in the contribution of greenhouse gas into the atmosphere by substituting the use of fossil fuel in conventional power stations for electricity generation through harnessing a renewable energy source
Maintenance and Surveillance	**Atmosphere**	Quality	• IO 2: Emissions of combustion gas and dust resulting from the circulation of vehicles mainly during surveillance tours and from the use of machinery and equipment during maintenance activities
Wind turbines operation Maintenance and Surveillance	**Atmosphere**	Noise	• IO 3. Emissions of noise resulting from the turbines operation and the use of machinery and equipment during maintenance activities
Maintenance and Surveillance	**Land**	Quality	• IO 4: Land pollution due to wrong management of waste generated during maintenance of turbines, dripping of oil or fluids during maintenance activities, as well as possible dripping of hydrocarbons from machinery and equipment used during maintenance tasks.
Land restoration in provisional roads and temporarily disturbed areas	**Flora**	Vegetable coverage	• IO 1: Growth of natural vegetation on roads used temporarily and areas temporarily disturbed during site preparation and construction stages.
Wind turbines operation	**Fauna**	Habitat	• IO 6: Risk of mortality of birds and bats due to collision with turbines, thus impairing their population dynamics and migration
Wind turbines operation Maintenance and Surveillance	**Fauna**	Distribution	• IO 7: Displacement of species due to noise from the operation of turbines and presence of vehicles, machinery and equipment during maintenance activities, including species listed in NOM-059-SEMARNAT-2010
Wind turbines operation Operation of electric	**Landscape**	Quality	• IO 8: Modification of the original landscape mainly because of the presence of wind turbines in different areas, as well as of infrastructure

Actions	Component		Impact identified
facilities Maintenance and Surveillance			for electric conduction and substations, as well as for the presence of machinery and equipment during maintenance tasks
Maintenance and Surveillance	**Socioeconomic (Economic)**	Jobs	• IO 9: Generation of direct and indirect jobs due to labor demand during maintenance and surveillance activities
Wind turbines operation Operation of electric facilities	**Socioeconomic (Economic)**	Local and Regional Development	• IO 10: To encourage companies, activities and local and regional productive sectors considering a wider coverage of the electric power service through exploitation of a never ending resource.
Maintenance and Surveillance	**Socioeconomic (Services)**	Waste management and disposal	• IO 11: Services demand for management of waste generated during maintenance activities.

Table V.8. Impacts on the site abandonment stage

Actions	Component		Impact identified
Dismantling and demolition of structures Transportation of consumables, equipment and staff Cleaning and rehabilitation	**Atmosphere**	Quality	• IA 1: Emissions of combustion gas and dust resulting from the use of machinery and equipment for structure dismantling and demolition activities, as well as from circulation of vehicles on the area and cleaning activities
Dismantling and demolition of structures Transportation of consumables, equipment and staff Cleaning and rehabilitation	**Atmosphere**	Noise	• IA 2: : Noise emissions resulting from the use of machinery and equipment, structure demolition and circulation of vehicles on the project area
Dismantling and demolition of structures	**Land**	Quality	• IA 3: Land pollution due to wrong management of waste generated during structure dismantling and demolition, as well as possible dripping of hydrocarbons from machinery and equipment
Dismantling and demolition of structures	**Surface water**	Quality	• IA 4: Pollution of water bodies nearby due to wrong management and disposal of waste during structure dismantling and demolition
Dismantling and demolition of structures Cleaning and rehabilitation	**Groundwater**	Aquifers recharge	• IA 5: Greater recharge capacity of aquifers due to demolition of wind turbines foundations, as well as of office buildings and other paved areas
Cleaning and rehabilitation	**Flora**	Vegetable coverage	• IA 6: Growth of natural vegetation on the site after rehabilitating disturbed areas

Actions	Component		Impact identified
Cleaning and rehabilitation	**Fauna**	Habitat	• IA 7: Reincorporation of individuals from local fauna species due to rehabilitation and maintenance of disturbed areas
Dismantling and demolition of structures	**Landscape**	Quality	• IA 8: Landscape modification because of the presence of machinery and equipment during demolition and dismantling of structures.
Cleaning and rehabilitation	**Landscape**	Quality	• IA 9: Improvement of landscape quality of the area due to rehabilitation of disturbed areas and maintenance of the same.
Dismantling and demolition of structures	**Socioeconomic (Economic)**	Jobs	• IA 10: Generation of direct and indirect jobs due to labor demand during activities for dismantling and demolition of the wind farm, as well as activities related to cleaning and rehabilitation of areas
Transportation of consumables, equipment and staff			
Cleaning and rehabilitation			
Dismantling and demolition of structures	**Socioeconomic (Economic)**	Local and Regional Developme nt	• IA 11: Demand of services in neighboring towns (food, recreation, vehicles, machinery and equipment)
Transportation of consumables, equipment and staff			
Cleaning and rehabilitation			
Dismantling and demolition of structures	**Socioeconomic (Services)**	Water	• IA 12: Water demand during dismantling and demolition activities, mainly to keep working and circulation areas moisten and thus avoid spreading particles and dust in different working

Actions	Component		Impact identified
Transportation of consumables, equipment, materials and staff			areas
Cleaning and rehabilitation			
Dismantling and demolition of structures	**Socioeconomic (Services)**	Energy	• IA 13: Energy demand for the operation of some equipment used during dismantling and demolition.
Dismantling and demolition of structures	**Socioeconomic (Services)**	Waste management and disposal	• IA 14: Services demand for management of waste generated during dismantling and demolition activities.
Cleaning and rehabilitation			
Dismantling and demolition of structures	**Socioeconomic (Services)**	Consumables	• IA 15: Demand of consumables or materials to be used for site abandonment activities and supplied from local or regional sources.
Cleaning and rehabilitation			

V.2.4. Impact description

V.2.4.1. Climate

Alteration of local microclimate due to modification on the proportion of latent and sensible heat of radiation in deforested premises (IP 1)

As mentioned in chapter II, the surface of direct disturbance of the project considering the maximum occupation scenario (436 wind turbines maximum) will be 508.51 hectares as permanent surface and 398.72 hectares as temporarily disturbed surface. Considering that the total surface of the property is approximately 30,113 hectares, it is believed that the surface to be permanently cleared and grubbed represents only 1.69% of permanent works and 1.32% of temporary works.

Clearing and grubbing this surface during site preparation will cause the removal of vegetation and, therefore, there will be a modification of latent and sensible heat of radiation in disturbed areas, as well as an increase of the environment dryness. This will cause changes in temperature and humidity content at the site and consequently in the local microclimate. This is considered low impact taking into account that the surface to be cleared encompasses less than 2% of the total surface of the project. It is worth mentioning that after the construction of the wind farm, for all surface that will be temporarily cleared and grubbed a Land Restoration and Conservation Program is to be implemented with the purpose of achieving the regeneration of natural vegetation.

V.2.4.2. Atmosphere

Reduction in generation of emissions into the atmosphere within the region due to the use of a non-renewable source of energy instead of fossil fuels (IO1)

As for the operation stage, electricity will be generated through harnessing a renewable energy source, thus avoiding generating emissions equivalent to the fuel necessary to generate the same amount of electricity through conventional generating power stations. It is believed that with this project we boost the Guidelines of the Kyoto Protocol, reducing the contribution of greenhouse gas and support the Agreement for Cooperation on Research and Development of Wind Energy Generation Systems.

Emissions of combustion gas and dust (IP 2, IC1, IO2, IA1)

At the area where it is intended to develop the project there is no data on the air quality; however, there are no relevant fix sources of emission of pollutants so the air quality is deemed good.

During the activities of site preparation and construction, as well as during the abandonment stage (dismantling and demolition of facilities), the operation of machinery and equipment with internal combustion engines will be necessary, as well as of vehicles for earth moving and materials for construction. The latter will cause an increase in the emissions of combustion gas (Carbon Monoxide, Hydrocarbons, Nitrogen Oxides) and suspended particles (dust) in the Project area during working days. It is estimated that the emissions will be temporary and specific, so it is believed that they will not cause relevant impacts on the air quality within the area.

Another type of emissions generated during the construction stage is dust coming from rock blasting and operation of the concrete plant. These emissions are also specific and temporary.

As for the operation and maintenance stage, emissions of combustion gas and suspended particles will also be generated during circulation of vehicles for surveillance tours and due to the use of machinery and equipment during maintenance activities. These emissions are only present when it is necessary to visit the site for any repair or maintenance activity; therefore, they are also considered specific and temporary.

Noise emissions (IP 3, IC2, IO3, IA2).

Within the area where the wind farm will be located, there are currently no noise emissions sources, so the use of heavy machinery, equipment and combustion vehicles during site preparation, construction, operation (maintenance activities) and site abandonment stages will generate noise levels which may disturb workers at the site and fauna living nearby.

The construction stage will entail the highest levels of noise, considering the this is the stage requiring a larger amount of machinery and equipment. Moreover, this is the stage including rock blasting activities, so it is very important to supervise the use of hearing protective equipment during said activities.

As for the operation stage, in general wind turbines generate wide broadband noise as a result of the blades rotation (aerodynamic noise) and of the operation of the mechanism of the generator and the transmission hub within the nacelle (mechanic noise).

Commonly, the amplitude of sound is from 90 to 105 dB at a distance of 40 meters and from 35 to 45 dB at a distance of 300 meters approximately, whereas frequencies are higher than 100 Hz in broadband noise and lower than 100 Hz in low-frequency noise. But it is noteworthy that the noise issue has been reduced considerably with the design of modern turbines, for its design minimizes the aerodynamic effect, and nacelles have sound isolation devices. According to the British Wind

Energy Association "properly designed wind turbines are quiet during operation, and in comparison to the noise of traffic on the road, trains, planes and construction activities, to mention a few, the noise of wind turbines is very low. Outside the closest houses, at least at 300 meters of distance, and sometimes ever more, the sound of a wind turbine generating electricity is likely to be approximately the same level of noise than water flowing at 50-100 meters of distance or the noise of fallen leaves during soft breeze[1]

On the other hand, the wind farm is located at a considerable distance from the closest population, which is a small town called San Francisco, at the east border of the project polygon of disturbance, but at a distance of approximately 3 km from the closest wind turbine. To the southwest of the polygon the town Llera de Canales (county seat) is located, but the distance to the nearest wind turbine is more than 4 km. Considering the above mentioned, it is believed that the noise perceived in the limit of the area where the wind farm will be operated is practically imperceptible.

V.2.4.3. Land

Possible erosive processes due to loss of vegetable coverage and changes in its structure (IP 4, IC3,)

As previously mentioned, the surface of direct disturbance of the project considering the maximum occupation scenario (436 wind turbines maximum) will be 508.51 hectares as permanent surface and 398.72 hectares as temporarily disturbed surface. The clearing of these surfaces will modify the land structure due to the removal of vegetable coverage and of surface layers of the land. This removal may expose the land to erosive processes due to wind and rain.

Likewise, construction activities will take place at sites already lacking vegetation, so these activities will also cause erosive processes and changes in the land structure.

It is important to mention that for all surface to be cleared and grubbed a Land Restoration and Conservation Program will be implemented so as to avoid erosion issues to the fullest extent possible. This program considers the temporary storage of the soil fertile layer, and after concluding the preparation and construction activities, it will be reincorporated into the site so as to enable the regeneration of the soil and of natural vegetation.

Land pollution due to wrong management of liquid and solid waste, turbines maintenance activities, as well as possible dripping of hydrocarbons from machinery and equipment (IP 5, IC 4, IO 4, IA 3)

[1] http://www.frbb.utn.edu.ar/utec/38/n6.html

Most of the equipment or machinery to be used during site preparation and construction will use diesel (loaders, graders, backhoes, excavators, compactors, trenchers, cranes, dump trucks, haul trucks) and it will be purchased at the closest gas stations and transported to the site through the use of pipes. There will be ground tanks for storage in the area of construction offices and storage area of machinery and equipment. Storage tanks should have dikes and all necessary safety devices. All fuel storage areas will be preferably located at a paved site, with trays and trenches for containing spills and applicable safety measures.

During the activities to be developed in all project stages there will be risks of soil pollution. This risk is caused by storage of fuel, as well as by the use of machinery and equipment, possible oil and fluids leaks during the stage of maintenance, and possible dripping of hydrocarbons to the land coming from machinery and equipment in bad conditions. In addition, the wrong management of solid and liquid waste could generate soil pollution, when storing them at sites without the appropriate controls.

During the operation and maintenance stage, the risk will be much lower than for the rest of the stages, because the period of time for maintenance activities would be limited. Actually, the operation of the wind farm does not represent a risk of land pollution.

Modification of geological formations (IP 6, IC 5)

In general, the specific areas where wind turbines are to be located are flat areas; however, there are some areas, mainly areas where there will be rehabilitation and extension of roads, where provisional works will be installed and the topography is slightly irregular; therefore, it will be necessary to make some cuts and leveling. During these activities, as well as during blasting activities, geological formations are modified due mainly to earth moving and readjustment. However, it is estimated that all material removed will be used for filling and leveling, seeking to recover to the extent possible the original topographic conditions.

V.2.4.4. Hydrology

Surface water

Modification of surface hydrological pattern in the area (IP 7, IC 6)

During the stage of site preparation, mainly during clearing, rehabilitation and road extension activities, as well as activities of construction of provisional works, there might be alterations in the patters of surface run-off, causing modifications in the specific hydrological pattern. In the construction stage, mainly in activities related to blasting activities and all the civil work (infrastructure construction, opening of ditches for wiring, excavations and leveling, etc), the appearance of alterations in run-off patterns is possible.

It is noteworthy that within the project polygonal there is no permanent water body, so the run-off patterns which may be disturbed would only be temporary run-off during heavy rain. It is also important to consider that the rain pattern in the area is very low, hence it is considered that this impact would be of very low magnitude.

During site preparation and construction stages necessary works will take place so as to avoid puddles or other issues due to alteration of the above mentioned patterns. This includes construction of ditches or temporary sewers, as well as extraction of accumulated water in excavated areas, through pumping or any alternative method where necessary.

Said patterns will be regularized to the fullest extent possible after finishing the construction of the wind farm.

Pollution of water bodies due to wrong management of waste and/or spills or leaks of hydrocarbons (IP 8, IC 7, IA 4)

During the different stages of the project there will be volumes of dirt and vegetable waste, as well as all types of domestic and industrial waste which, if not stored or disposed of in areas prepared for that purpose, may be swept to the channels of the closest streams causing modifications in the water quality. In addition, the presence of machinery and equipment may cause accidental dripping and spills of hydrocarbons which may be swept towards such water bodies. It is important to mention that within the polygon there are no permanent water bodies, the only water bodies near the site are those located on the lower section of the borders of the plateaus; however, since the wind turbines will be possibly located on the borders of the plateaus, it is important not to leave aside this possible impact.

With respect to the operation stage and during maintenance and surveillance activities, small volumes of waste will be generated and it is likely to present dripping or spills of oil or fluids, which, although it does not represent a relevant risk, if it is not properly managed and disposed of at proper sites they may cause pollution of water bodies nearby.

Underground hydrology

Decrease of recharge capacity of aquifers (IP 9, IC 8)

The loss of vegetation due to clearing is considered to cause a decrease in the recharge capacity of aquifers. In addition to this, rehabilitation and extension of access roads as well as construction of provisional works will cause the compaction of land reducing the aquifer recharge capacity.

As for the construction stage, the compaction and leveling activity of the land will modify the permeability of the land and, hence the aquifers recharge capacity will be reduced. In addition to

this, the basis of the foundations for each wind turbine as well as the provisional works will cause loss of the permeable surface of the land, thus reducing the aquifers recharge capacity.

It is important to consider that for both the access roads as the foundations of wind turbines and provisional works, it is contemplated that water will run off towards sites with natural soil or towards absorption wells, where water will be infiltrated naturally towards the aquifer.

Increase of recharge capacity of aquifers (IA 5)

For the abandonment stage it is estimated that with the demolition of the basis and foundations of wind turbines, as well as the dismantling of buildings and other paved areas the land will return to its original state, thus allowing the growth of natural vegetation and increasing the recharge capacity of aquifers.

V.2.4.5. Flora

Loss of vegetable coverage (IP 10)

Clearing and grubbing activities involve permanent removal of vegetation in 508.51 hectares, considering the maximum occupation scenario (436 wind turbines maximum), and temporary removal in 398.72 hectares, considering the worst-case scenario. Approximately 68.93% of the polygon where the project will be located is covered by submontane scrub, 7.81% by deciduous lowland forest, 4.51% by tropical mezquital and 3.35% by low thorny deciduous forest.

The data of percentage of different types of vegetation on each disturbed surface is presented in chapter IV.

Rehabilitation of disturbed areas (IO 5, IA 6)

It is noted that after the construction of the wind farm, a Land Restoration and Conservation Program will be implemented, contemplating land restoration activities for roads used on a provisional basis during previous stages and temporarily disturbed areas which may be rehabilitated. These activities seek to regenerate the land and grow natural vegetation, with special care in avoiding species which roots may damage underground lines of electrical conduction and data wiring (optic fiber).

On the other hand, during the site abandonment stage, the actions necessary for restoration of the land with the consequent growth of natural vegetation in areas disturbed by the project will be carried out; always considering their subsequent use. Through the implementation of these actions it is also intended to maintain the productive capacity for the largest part of the disturbed area, considering that after finishing the project lifespan these premises will return to their original purpose, thus seeking not to affect the owners or family of the same.

Loss of vegetable species individuals listed in NOM-059 (IP 11)

Clearing and grubbing activities involve the removal of some vegetable species which may be listed in NOM-059-SEMARNAT-2010. In particular, in the study area only one species was identified found in the category of "special protection". This species is the (*Beucarnea recurvata*) or commonly called elephant's foot, which is under the classification of endemic and threatened.

It should be mentioned that we will consider at all times the vegetable species rescue and relocation activities, according to the Subprogram of Rescue and Relocation of Flora.

V.2.4.6. Terrestrial fauna

Habitat modification and fragmentation (IP 12, IO 6)

With the removal of vegetation during clearance of the land, the habitat of fauna species living in the area will be modified, mainly terrestrial fauna. Among the species affected we can find the felines (jaguar, ocelot, linx and oncilla). These felines are territorial animals and generally solitary. Upon the modification of their habitat they will have to move to the surrounding area and take up new territories.

With regards to the impact during the operation stage, it refers essentially to risk of mortality of birds and bats due to collision with turbines, thus affecting their population dynamics, as well as their migratory patterns. Likewise, the possible impact of wind turbines on monarch butterflies was also assessed. In order to assess the impacts on these species, field work and modeling of the possible routes of monarch butterflies were carried out, which are presented in Chapter III and a brief summary is presented below.

- Birds and bats

According to several studies performed, in general, mortality of birds due to collision with turbines is irrelevant. Studies carried out in Europe state that the rate of birds dead because of this type of turbines is very low. At offshore stations of 160 MW of Horns Rev, in Denmark, radar measurements show that most birds avoid the park, changing their routes some kilometers before, so as to fly around it and not above it. However, other human activities may have a more sensitive effect; for example, it has been observed that high tension lines are less visible for birds than turbines and may cause a higher rate of mortality.

As for bats, several studies have highlighted the following issues:

- Destruction and disturbance of their foraging habitat, as well as corridors nearby (so their activity area is restricted).
- Damage or destruction of their perching or shelters.
- Increase of the collision risk possibility during flight [the origin is unknown, with hypothesis such as turbulence, lack of hazard perception from rotation of blades, high concentration of bugs around the structure, alteration of their places due to ultrasonic sounds, even when it is known that the sound emission levels of all the new designs of wind turbines tend to follow the same values. It seems that the sound is not the main problem (Danish Wind Industry Association, 2003), however it does infer on their influence].

In order to know and monitor the main ecological parameters such as composition, richness, and abundance of birds and bats prior to the construction stage, and thus have a base line, the services of the Highly Specialized Professional Services Unit of the Instituto de Ecología A.C. (INECOL) were hired to carry out a monitoring campaign. This monitoring campaign began in spring 2013 and will continue throughout the rest of the year. It is important to mention that two SM2BAT (Wildlife Acoustics) detectors are installed at the site, in order to estimate the form in which bats use the air space of the premises and estimate the foraging activity of each species

The main objectives of this campaign are:

- To determine potential resident and migratory birds in the region.
- To monitor resident and migratory birds within the premises where the wind farm is intended to be installed.
- To describe the flight patterns of birds present within the property.
- To determine the migratory flow
- To describe the composition of species of resident and migratory bats through ultra-acoustics detection systems.
- To search for shelters within the wind farm.

Preliminary results of the monitoring campaign demonstrate that the diversity and species with higher abundance include resident and terrestrial species not flying above the canopy and migratory species flying outside the mesas or at heights above 125 meters.

With respect to migratory birds, it is important to consider that most of them were found flying at heights above 125 meters, therefore it is estimated that the effect of construction of the wind farm on resident birds is likely to be related to the fragmentation of the habitat more than with the operation of the wind turbines.

There is currently no field data on bats. Global results obtained in the monitoring campaign prior to the construction of the farm will be an integrating part of the Environmental Quality Follow-up Program (PSCA). The results set in the Environmental Impact Statement are preliminary and related to the monitoring of birds carried out in spring during March and April.

- Monarch butterfly (*D. Plexippus*)

Considering that the Project is located in the state of Tamaulipas, two potential distribution models were applied to determine if the Project Area is located in the migratory route of monarch butterflies, for there are currently no sufficient data available to determine so.

According to the results obtained from the models applied, MaxEnt and BIOCLIM, it is considered that within the Project Area it would be expected that the incidence of monarch butterflies during both migrations (spring and autumn) be minimum due to low levels of climatic affinity. Although precipitations agree with the general pattern of the species, this is not the case for the dominant condition of warm temperatures. However, it should be mentioned that the areas adjacent to the SA presenting a certain degree of affinity and adaptation were the Sierra Madre Oriental and Sierra de Tamaulipas representing a series of climatic conditions favorable for the potential distribution during migrations of *D. Plexippus*.

Reincorporation of fauna into the region due to rehabilitation of disturbed areas (IA 7)

Finally, during the site abandonment stage, the impact on the fauna will be beneficial, considering that the rehabilitation of disturbed areas and maintenance of the same would enable that the type of fauna displaced during previous stages may come back to find a place to live in this area .

Displacement of species (IP 13, IC 9, IO 7,)

Species displacement will be the result of most activities of the project, especially clearing and grubbing, blasting activities, and the presence of machinery, equipment and staff on the area during site preparation, construction and maintenance activities. All works will be performed gradually, which will enable species to migrate towards neighboring sites.

On the other hand, during the operation stage, the displacement of species will be due mainly to generation of noise because of the operation of wind turbines and caused by the habitat fragmentation.

Loss of individuals of animal species within any category of NOM-059 (IP 14)

With the removal of vegetable coverage some fauna species could be disturbed, including those listed in NOM-059-SEMARNAT-2010.

101 species of fauna were detected in total, under conservation status as per the NOM-059-SEMARNAT-2010, of which 8 are endangered species, 29 are threatened and 63 under special protection. The group with the highest number of species is birds, followed by reptiles, terrestrial mammals, amphibians and bats (chiroptera).

As part of the activities of the project it has been considered to carry out animal species rescue and relocation activities, through focused displacement and intimidation techniques, according to the Flora and Fauna Rescue and Relocation Subprogram.

Loss of biodiversity in terms of individuals (IP 15)

The removal of vegetable coverage in the areas to be occupied by the different elements of the project directly impairs the biodiversity of the site in terms of individuals both of flora and fauna. On the other hand, it is considered that this impact is mitigable if taking into account the mitigation and compensation measures included in the Flora and Fauna Comprehensive Management Program.

V.2.4.7. Landscape

Modification of original landscape (IP 16, IC 10, IO 8, IA 8)

It is important to mention that the plateaus where the project would be located are at an altitude of 400 m above sea level, so they may be observed both from the highest parts of the Sierra Madre Oriental and the sierra de Tamaulipas, and from their lowest parts. The landscape quality is high because most of the surface is covered by natural vegetation.

The landscape will be disturbed during the site preparation and construction stages, mainly due to clearing, presence of machinery and equipment and construction activities. However, it is estimated that machinery and equipment may not be seen from spots of greater visibility of the project, which would be roads and adjacent paths.

During the operation stage, there will also be a visual impact because of the presence of machinery and equipment during maintenance activities. However, the most notorious visual impact will be the presence of wind turbines, which will be at an approximate height of 180 meters, depending on the technology available during the project development. In order to harness the wind maximum potential, wind turbines will be located at the highest areas of the plateaus, and will be visible from considerable distances.

Likewise, during the site abandonment stage, the adverse visual impact will be mainly due to the presence of machinery and equipment during demolition and dismantling of structures.

Next we present some landscape simulations considering some spots where it is estimated that there will be more human presence, corresponding to roads and adjacent paths.

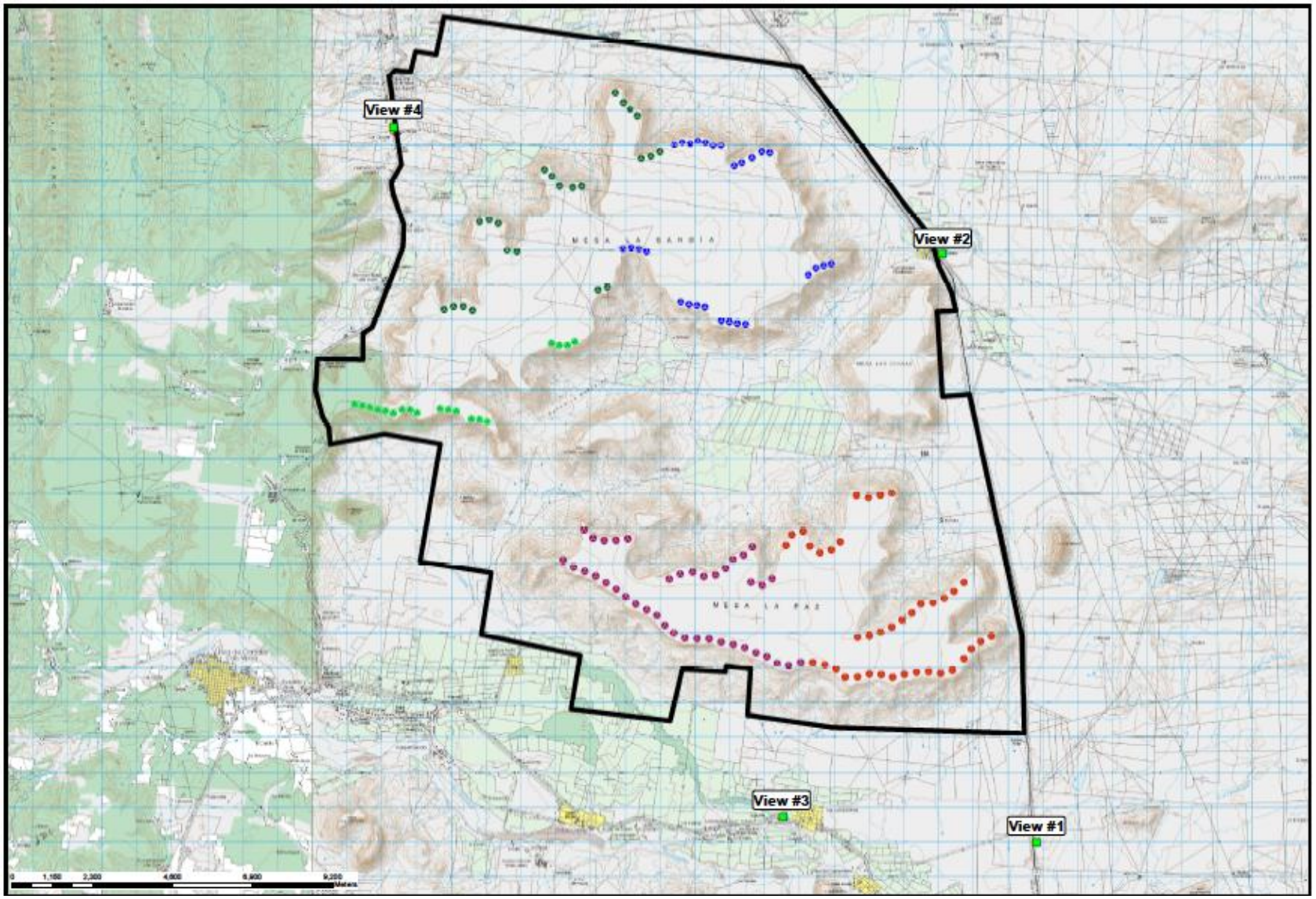

Figure V.2. Location of panoramic views of the project

Figure V.3. View 1.

Figure V.4. View 2.

Figure V.5. View 3.

Figure V.6. View 4.

Rehabilitation of disturbed areas (IA 9)

During the site abandonment stage, with the rehabilitation of disturbed areas and maintenance of the same, the landscape quality of the disturbed area will be improved again, depending on the subsequent use considered for the affected site.

V.2.4.8. Socioeconomic

Change of land use (IP17)

The modification of the land use in the areas where wind turbines and all additional elements of the project (roads, offices, storage areas, etc.) would be located, will cause that agricultural and farming tasks may not be developed on these portions of the land, or else to continue using them for the tasks to which they were destined. Nevertheless, it is important to mention the fact that most premises are covered by natural vegetation (84.6%) and are not useful at all, whereas only 15.4% are used for agricultural and/or farming purposes, thus impairing the local and regional development in these productive sectors.

It is also noteworthy that only after the wind farm is in operation, the owners of the land may use their premises for farming or agriculture, for the operation of wind turbines does not interfere with these activities; just as shown in this wind farm in the State of Oaxaca, where farming is an activity that coexists with wind energy generation.

Figure V.7. Wind farm which premises are still used for farming activities.

Figure V.8. Wind farm which premises are still used for agricultural activities.

Creation of direct and indirect jobs (IP 18, IC 11, IO 9, IA 10)

During the activities performed in site preparation and construction stages, an important staff team will be required. In particular, qualified staff with experience in construction of wind farms will be required for construction of wind turbines. Nevertheless, for the activities of clearing and opening of roads local staff living in the area will be hired so as to contribute to the creation of temporary jobs in the region. During the wind farm operation stage, specialized labor will be required specifically for maintenance and wind turbine operation tasks. However, in offices and warehouses, as well as for surveillance tasks, local staff with experience and specific skills may be hired.

According to a Study of the Electrical Research Institute, the human capital required for the construction and operation of a wind farm is composed mainly by 30% of low-skilled workers who will be trained on the field, 12% of workers in commercial tasks, 36% of specialized workers, 8% of professionals (managers and lawyers) and 14% of engineers and specialized scientists. In this study it is also estimated that 240 direct jobs are created for every 100 MW[2]. It is worth mentioning that these data are only an example of the number of jobs that could be created during the construction of a wind farm.

Local and regional development due to lease of premises (IP 19)

[2]Speech "Specialized Human Capital, Essential Link in the Wind Supply Chain". Non-Conventional Energy Unit of the Electrical Research Institute. Forum "Wind Energy, a Reality in Mexico" hosted by Mexico Wind Power in January 2013.

According to the Marginalization Rate of 2010, both the municipality of Casas and de Llera suffer medium marginalization. The marginalization rate is a measure-summary that enables to differentiate municipalities and communities according to the global impact of needs suffered by the village and measures its space intensity as percentage of population not enjoying the benefits of goods and services essential for developing their basic skills. One of the main indicators of social marginalization is economic income.

The payment of lease for the premises to be used for the project, as well as the payment of an amount on the profits during the operation of the wind farm imply an economic benefit for all owners of the premises and ejido properties, thus boosting local and regional development.

In addition to this, the rehabilitation of roads within the entire polygon of the project will give owners better and easier access to their land, enabling them to better develop their activities.

Local and regional development due to services demand (IP 20, IC 12, IA 11)

The staff demand during the different stages of the project will cause direct and indirect jobs, which shall demand services from communities nearby such as accommodation, food, recreation, vehicles, machinery and equipment, thus triggering the local and regional economy.

Local and regional development due to increase of coverage of electric energy service in the region (IO 10)

With the development of this project, it is intended to generate clean and renewable energy for the internal market of the region in order to meet the needs of individuals and corporations. In addition to this benefit for different sectors, having this type of projects in Mexico means an incentive for investors interested in implementing projects for harnessing non-polluting alternative energy.

V.2.4.9. Services

Water demand (IP 21, IC 13, IA 12)

During the different activities of site preparation, construction and abandonment, there will be water demand mainly to keep working zones and circulation areas moisten in order to avoid dispersion of dust and particles.

Likewise, during the wind farm construction stage, water will be used for drilling during blasting activities, for the concrete plant and for operation of provisional facilities.

Energy demand (IP 22, IC 14, IA 13)

During the construction stage, portable diesel generators of 5 to 100 kV will be used. Once the wind farm is in the operation stage, energy will be taken directly from the same, mainly for Operation and Maintenance Offices.

After concluding the operation of the wind farm, during the abandonment stage, the connection to some local transmission line will be necessary again for the operation of provisional facilities and functioning of some equipment.

Waste management services demand (IP 23, IC 15, IO 11, IA 14)

All waste generated during the different site preparation and construction activities, as well as during operation, will need to be sent to a proper site for their final disposal. Therefore, it will be necessary to locate a site (municipal dump or sanitary landfill) duly authorized which capacity hasn't been exceeded and may meet the demand generated by the project.

Companies for recycling and/or reuse of solid waste will be contracted as part of the Program for Comprehensive Management of Waste. On the other hand, hazardous waste generated will be disposed of or confined to specialized and authorized areas.

As for the site abandonment stage, an Abandonment Program will be prepared including assessment of elements which may be reused or recycled and those which have to be eliminated in a controlled manner. It is noteworthy that a second-hand wind resale market with emerging economies as major customers, where many of these components for this type of projects that drive the development of their economies and, at the same time, do not generate meaningful adverse environmental impacts, already exist.

Consumables demand (IP 24, IC 16, IA 15)

Consumables will be required for the different stages of the project, for staff working at the site, as well as materials, equipment and machinery which will be obtained from towns nearby if possible, causing an economic boost within the region.

V.2.5. Quantification of impacts

After having identified and described all impacts, the quantification and classification process was carried out. Appendix V.1 presents the impacts quantification matrix which, as mentioned before, was prepared taking into consideration the methodology of Gómez Orea (2002).

Based on the impacts quantification and classification matrix, information is extracted on the classification of impacts for each of the project stages summarized in the following tables.

Table V.6. Summary of classification of adverse impacts

STAGE	ADVERSE IMPACT				TOTAL
	LOW	MODERATE	HIGH	IMPORTANT	
Preparation	18	2	-	-	20
Construction	13	-	-	-	13
Operation	6	1	-	-	7
Abandonment	8	-	-	-	8
TOTAL	**45**	**3**	**-**	**-**	**48**

Table V.7. Summary of classification of beneficial impacts

STAGE	BENEFICIAL IMPACT				TOTAL
	LOW	MODERATE	HIGH	IMPORTANT	
Preparation	3	1	-	-	4
Construction	3	-	-	-	3
Operation	2	2	-	-	4
Abandonment	7	-	-	-	7
TOTAL	**15**	**3**	**-**	**-**	**18**

As you can see in the tables above, and taking into account the impacts quantification matrix, a total of 66 impacts were identified, of which 48 are adverse and 18 are beneficial.

During the site preparation stage 24 impacts were detected, of which 18 are adverse low, 2 adverse moderate, 3 beneficial low and 1 beneficial moderate. During the construction stage, 16 impacts were identified, of which 13 are adverse low and 3 are beneficial low. During the operation and maintenance stage 11 impacts were identified, of which 6 are considered adverse low, 1 adverse moderate, 2 beneficial low and 2 beneficial moderate. Finally, during the abandonment stage, 15 impacts were identified, of which 8 are adverse low and 7 are beneficial low.