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Environment Impact Assessment and Environment Management Studies for an Upcoming Multiplex - A Case Study

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Abstract: *Environmental Impact Assessment can be defined as the systematic process of identifying and evaluating the future consequences of a current or proposed action relative to the physical, chemical, biological, cultural and socioeconomic components of the environment. Any development project plan to improve the quality of life has some built-in positive and negative impacts. The development project should, thus, be planned in such a manner that it has maximum positive impacts and minimum negative impacts on the environment. The purpose of incorporating EIA approaches has been described as subjecting a proposed action to an examination of what the possible environmental impacts of that action would be and to find ways to mitigate any negative long term impacts.*

This paper highlights the importance of EIA in the sustainable development of a Construction project with a case study of an upcoming Multiplex in BalloMajra near Mohali (Punjab). The parameters covered in present work are Biological, Air, Water, Noise, Soil and Socio-Economic. A study period from January 2012 to April 2012 was selected for collection of Base Line Environmental Data. The impact of various environmental parameters, due to the proposed project has been predicted and depending on them mitigation measures have been suggested.

The 'Leopold Impact Matrix' has been used to evaluate the impacts of various parameters. With the help of 'Leopold Impact Matrix' the impact of the environmental changes, due to the project, with and without the mitigation measures has been evaluated. Finally, an Environment Impact Statement has been prepared.

Keywords*: Environment Impact Assessment, environmental pollution, Construction activities, Environmental impact of construction.*

I. Introduction

Environmental protection is an important issue throughout the world (Tse and Raymond, 2001). Compared with other industries, construction is a main source of environmental pollution (Shen et al., 2005). Building construction and operations have a massive direct and indirect effect on the environment (Levin, 1997). Pollution sources from the construction process include harmful gases, noise, dust, solid and liquid waste (Chen et al., 2000).

Enhancing the identification of the major environmental impacts of construction processes will help to improve the effectiveness of environmental management systems. Furthermore, prediction of the correlated environmental impacts of construction before the construction stage, will lead to improvements in the environmental performance of construction projects and sites. The determination of major environmental impacts will assist to consider a range of on-site measures in order to mitigate those (Gangolells et al., 2011).

Any large scale project is expected to cause environmental impacts near the project site during its construction and operational phase. The type and intensity of the impacts on the environment depends not only on the nature and size of the project but also on the geographical location. The net impact from individual project can be quantified through EIA studies for various components like air, water, land, noise, socio-economic environment prior to implementation of the project.

With rapid growth of shopping malls, multiplexes etc there is rise in living standards but this has also led to degradation of environment too. During the construction and operational phases of these malls, there is pollution of air, water, land, noise which has direct impacts on our environment.

EIA is generally viewed as a framework for considering issues regarding location, design of projects and the environment in parallel, and by that producing better designed projects having in mind both the environment and the economy. In the past decade, with increasing force during the last couple of years, new ideas about the purpose of the EIA process have sprung to life focusing on the potential benefits of the EIA process to increase acceptance of proposed projects.

II. Methodology:

The present study has been selected for an upcoming hotel, Multiplex, Offices and Shopping Mall Project. M/s Hamir Real Estate (P) Ltd is setting up a hotel, multiplex, and offices and shopping Mall project in the name of "Virsa Mall" at Ballo Majra, S.A.S Nagar at Mohali. The project has a spread of 87452.60 square metre (21.61 Acres) which falls under Mix land use as per GMADA Master Plan. The site is located on the national highway-2(NH 21, connecting Chandigarh to Ropar). Chandigarh and Mohali are located at an approximate distance of 17km and 6km respectively from the proposed site.

The project is a designated project under Schedule and falls under category B1 of the Environmental Impact Assessment Notification. In this, study of baseline environmental status has been carried out in terms of different environmental attributes. Then, the extensive EIA for the project has been prepared which includes impact predictions on identified parameters and mitigation measures have been suggested. Further, the evaluation of total impacts has been done using Leopold Matrix method, which helps in incorporating proper mitigation measures wherever necessary for preventing significant effect on the environment.

III. Baseline Environmental Data

Air quality:

The environmental quality status with respect to ambient air quality status was established through intensive monitoring of ambient air quality within the impact zone i.e 10km of the proposed project site. The location of AAQM stations was finalised. The parameters for AAQM study were S.P.M, SOx, NOx. The area is residential. Table below shows the four sites selected for air quality monitoring.

The location 1 that is the site of the mall is further divided into two sampling locations which are (a) near the gate and (b) near the multiplex. These sampling sites within the project area are given a location code as L1a and L1b respectively.

LOCATION	LOCATION CODE	NAME OF PLACE	DIRECTION
Location 1	L1	Ballo Majra(Site)	--
	L1a	Near the gate	
	L1b	Near the multiplex	
Location 2	L2	Sohana	SE
Location 3	L3	Atawa	E
Location 4	L4	Khanpur	W
Location 5	L5	Togan	NE

The results of Air quality sampling for the different sites is given below:

S.No	Location	SPM (µg/m3)			SOx (µg/m3)			NOx (µg/m3)		
		Max.	Min.	Avg	Max.	Min.	Avg	Max.	Min.	Avg
1.	L1a	245.65	196.34	220.99	6.84	4.13	5.48	18.80	16.01	17.40
	L1b	284.12	210.10	247.11	8.31	5.65	6.98	17.91	15.61	16.67
2.	L2	225.64	192.35	208.99	7.49	4.35	6.42	13.89	12.56	13.22
3.	L3	224.47	188.84	206.65	8.17	4.32	6.24	18.04	14.21	16.12
4.	L4	234.74	174.37	204.55	6.89	5.94	6.40	15.68	11.92	13.80
5.	L5	219.76	178.58	199.17	6.90	5.78	6.34	14.15	10.38	12.26

Inference:

SPM: The maximum value of SPM observed at all the monitoring locations was 284.12 µg/m3 which exceeds the NAAQ standards.

SO2: The monitoring was conducted at all the stations around the project site. The SO2 values are well within the permissible limits in all the locations.

NO2: The NOx values were found to be well within the permissible limits in all the locations.

Water Environment:

Ground water is the principle source of water for domestic, industrial and irrigation purposes. Ground water samples were extracted from bore wells and hand pumps and were analysed. The sampling was done at site also. Four ground water samples were collected from bore wells and hand pumps and one surface water sample was collected from canal located near Balongi village.

The water quality monitoring locations are given below:

S.NO	LOCATION	LOCATION CODE
1.	Bore well- Project site	GW1
2.	Bore well- Sohana	GW2
3.	Hand pump- Togan	GW3
4.	Hand Pump- Khanpur	GW4
5.	Surface water (near Balongi village)	SW1

The results of the analysis and their comparison with Indian standards are reported in the table below:

S. No	Test Parameter	Units	Location				IS-10500-1991
			GW1	GW2	GW3	GW4	
1.	Colour	Hazen unit	<5	<5	<5	<5	<5
2.	Odour	-	Unobjectionable	Unobjectionable	Unobjectionable	Unobjectionable	
3.	Taste	-	Agreeable	Agreeable	Agreeable	Agreeable	
4.	Turbidity	NTU	<5	<5	<5	<5	<5
5.	pH	-	7.12	7.0	7.3	7.0	6.5-8.5
6.	Total Hardness	mg/l as CaCO3	190	240	248	240	<300
7.	Iron	mg/l	0.07	0.14	0.10	0.12	<0.3
8.	Chlorides	mg/l	21.5	22	22.1	24.03	<250

Noise Environment:

Noise levels were measured at the same locations as for Air Quality Monitoring. The locations for noise monitoring at the project site were selected as below (when DG set is ON):

LOCATION	LOCATION CODE
In front of electric room	N1
Besides electric room	N2
Near batching plant	N3
Near basement area	N4
Near temporary office	N5

The measured noise levels at different locations are as follows:

LOCATION		DAY TIME
		Leq(dB(A))
L1	N1	75.2
	N2	74.8
	N3	74.9
	N4	73.5
	N5	73.8
L2		53
L3		53
L4		52

The results of daytime noise monitoring at all the locations other than the site are within the AAQS noise limits while at the project site noise level is beyond the permissible limits, when the DG sets are ON.

Land Environment:

The soil in the area is classified into reddish chestnut soil and tropical arid brown soil. The soils are generally deficient in nitrogen and responds to nitrogen application. Soil samples have been collected from the depth of 1 feet from the project site.

The results of soil sample (project site) analysis are given below:

S.No	Parameter	Results
1.	pH	7.11
2.	Soil moisture content	30.12%
3.	Bulk Density	1.10 g/cm3
4.	Nitrogen	0.20ppm
5.	Sodium	0.13 mg/100g
6.	Potassium	0.07 mg/100g

IV. Biological Environment:

Forests:

The recorded forest area in the Punjab state is 3,058 square kilometres which is 6.12% of the geographical area of the state. Reserved forests constitute 1.43%, protected forests 36.87% and un-classed forests constitute 61.70%.

Wildlife:

The project site has no protected areas located within the study site. Besides, the proposed project area is not located within an existing or any proposed ecologically sensitive zone known for providing habitat and movement corridor for any kind of animals. Hence the impact of the project on the wildlife is not expected. There is little evidence of small mammals, reptiles and birds on the site.

Flora:

The principal crops are wheat, paddy, potato, tomato, cauliflower, cabbage and all type of pulses.

The major species found in this area are

1. Achyranthus aspera
2. Argemone Mexicana
3. Aristida hystrix
4. Cassia tora
5. Chloris Montana
6. Cynodon dactylon
7. Mimos sp.
8. Parthenium sp.
9. Phragmites karlea
10. Saccharum munja
11. Saccharum spontaneum
12. Tribulus terrestris
13. Tridax procumbens

Source: forest department, Punjab

Fauna:

No wild mammalian species was directly in the study area. The different bird species found in the study area are:

S.No	English Name	Scientific Name
1.	Pariah kite	Milvus migrans
2.	Red- wattled lapwing	Vanellus indicus
3.	Spotted dove	Streptopelia chinensis
4.	Large Indian parakeet	Psittaculla eupatoria
5.	White breasted king fisher	Haleyon smyrensis
6.	Indian roller	Coracias benhalensis
7.	Indian hoopoe	Upupa epops
8.	Common green bee eater	Merops orientalis
9.	Common myna	Acridotheres tristis
10.	Black Drongo	Dicrurus adsimilis
11.	Coucal	Centropus sinensis

Source: forest department, Punjab

Socio-Economic Environment:

Punjab is situated in the north western corner of the country. It is bounded on the north by the Indian state of Jammu & Kashmir and east by Himachal Pradesh and the union territory of Chandigarh, on south by Haryana and Rajasthan and on west by Pakistan.

The rural population of Punjab has decreased from 66.08 to 62.51 from 2001 to 2011. The city of Sahibzada Ajit Singh Nagar, popularly known as S.A.S Nagar was declared as 18th district of Punjab on 14th April, 2006. Its population in 2011 census was 986,147, out of which 442,112 is rural and 544,035 urban.

The study area for socioeconomic assessment was defined as an area within ten kilometre radius around the project site.

Demographic Structure:

A detailed breakup of population (urban and rural & sex wise) compared with state average is given below

AREA	POPULATION				MALE FEMALE RATIO			
	2001		2011		2001		2011	
	Rural%	Urban%	Rural%	Urban%	Rural	Urban	Rural	Urban
S.A.S Nagar	61.67	38.33	44.83	55.17	832	858	868	887
Punjab State	66.08	33.92	62.51	37.49	890	849	906	872

Source: Director of Census Operations, Punjab

Literacy:

The average literacy rate of Punjab is 76.7% and that for S.A.S Nagar is 84.9. The summary for literacy rate is given below:

AREA	LITERACY RATE(MALES)				LITERACY RATE(FEMALES)			
	2001		2011		2001		2011	
	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban
S.A.S Nagar	79.66	89.38	85.37	92.28	65.65	80.62	73.65	85.10
Punjab State	71.05	83.05	77.92	87.28	57.72	74.49	66.47	79.62

Source: Director of Census Operations, Punjab

V. Identification Of Pollution Sources And Its Quantification

1) Air emissions: From vehicular exhaust
Dust during construction
From D.G sets

Pollutant	Emission Rate
SPM	0.30
SO2	0.70
NO2	5.50

2) Noise emissions: From various construction equipments
From air compressors
From D.G sets
From vehicles

The construction equipments and other sources will generate noise within the range of 70 to 120 dB (A) within the vicinity of construction site.

3) Waste: From construction activities
From labour camps
From Sewage treatment plant (STP)
From other sources

Solid waste generation taking into account 18221 persons @ 0.15 kg/day is 2733.15kd/day.

The waste generated during operational phase is categorised as biodegradable, recyclable, inert/ recyclable and hazardous. Out of the total waste generated 50% of it would be biodegradable, 20% of the waste would be recyclable, 30% would be inert and it is assumed that a small quantity (0.3%s) of it would be hazardous waste.

4) Waste water: From construction activities
From sewage
From commercial activities
From other sources

It has been assumed that 80% of the water supplied would be discharged as wastewater. Hence approximately 717KLD of waste water would be generated.

VI. Identification Of Impacts Of Other Aspects:

1) **On Water:** Abundant water would be available for this project and supply would be met through deep bore wells. Water demand during operation phase is 19, 94,418 litres/day. 717 m3/day of treated waste water would be generated from sewage treatment plant that would be used for flushing, horticulture and other activities.
2) **On Air**: There would be no significant impact on the air environment from the project development after the implementation of proposed control techniques. The impacts of climatic, seasonal factors would be more significant on overall air environment than construction activity.
3) **On Noise:** There would be no adverse impact on area from activities of construction project when proper shields and other control measures are adopted.
4) **On soil:** There would be no adverse impact since the treated waste water would be reused for the construction activities or for watering the plants.
5) **On Socio- Economy:** There will be noticeable indirect employment and significant direct employment, therefore economic distribution to the area and alternate income & employment to population dependent on agriculture and land based occupations.

VII. Evaluation Of Impacts: Presentation In Matrix Form

The impact prediction is represented in the form of a Matrix. A derivative of 'Leopold and Interaction form of matrices' has been used. Scoring of the impact ranges from -10 to 10. These scorings are represented below:

Effect	Impact	Score
No effect	No impact	0 to 1
Short term	Slight impact	2
Occasionally reversible	Appreciable	4
Long term	Considerable	6
Permanent	Permanent	8
Drastic	Immediate	10

The activity impact matrix has been evaluated and prepared. The significance of weighted score evaluated is as:

- Upto 2500 no appreciable impact on environment
- 2500-5000 appreciable impact and appropriate measures required
- 5000-7500 significant impact; major environmental control required
- 7500-10000 major impact; project site to be reviewed
- >10000 not suitable; alternate site to be considered.

Nomenclature Used

W: Weight
B: Solid Waste
D: gas emissions
F: Transport
H: Plantation
S: Scores
A: plant activity
C: liquid effluent
E: Community Development
G: Institution
NE: Net Effect
EP: Environment Parameter

Source: Larry,W. Canter; Environment Impact Assessment; "Simple Methods for Impact Identification- Matrices, Networks and Checklists"; Chapter 3, (8)

The impact Matrix of the project is shown in the table below

EP	W	A	B	C	D	E	F	G	H	NE	S
Land	**100**	-3	-6	-6	0	2	1	2	4	-6	-600
Biotic Envt	**100**	-3	-3	-3	-4	0	0	0	4	-9	-900
Air Quality	**150**	-3	0	0	-6	-1	-2	-1	2	-11	-1650
Ground Water	**150**	-3	-6	-6	0	-1	0	0	2	-10	-1500
Health	**100**	-2	-3	-3	-6	-1	-1	0	2	-14	-

											1400
Noise	**100**	-4	0	0	0	0	-1	-1	0	-6	-600
Employ	**100**	4	1	1	1	4	2	2	0	15	1500
Literacy	**50**	1	0	0	0	3	1	4	0	9	450
Safety	**150**	-2	-5	-4	-6	-1	-1	0	1	-18	-2700
Aesthetics	**50**	-1	-2	-2	-2	1	-1	1	4	0	0

Net total = -7400

The project, without the mitigative measures scores -7400 points. This indicates that there is a significant impact and major environmental control measures are required.

VIII. Mitigation Measures

Different mitigation measures to be adopted for different environmental parameters are as follows:

S.No	Parameter	Control through EMP	
1.	Groundwater	Construction Phase	• Septic tank
		Operational Phase	• Rain water harvesting • Storm water storage • Sewage sludge to be used as manure
2.	Air quality	Construction Phase	• On site dust control measures • Emission control particle filters on construction equipments
		Operational Phase	• Plantation of specific species will reduce SPM concentration.
3.	Noise environment	Construction Phase	• Equipments fitted with silencers • Providing noise shields near heavy construction
		Operational Phase	• On site plantation • Acoustic enclosures to be provided
4.	Land environment	Construction Phase	• Construction debris will be collected and used on site as per construction • Waste management plan
		Operational Phase	• On site waste collection, segregation and treatment.
5.	Biological environment	Operational Phase	• Suitable plantation will be done
6.	Socio-economic environment	Operational Phase	• Enhanced commercial & economic activities
7.	Traffic pattern	Construction Phase	• Heavy vehicular movement only at site
		Operational Phase	• NH21 has adequate capacity to accommodate additional traffic from the project

Based on above mitigation measures an activity matrix has been developed .The criteria adopted is same as per in formulation of Matrix above.

EP	W	A	B	C	D	E	F	G	H	NE	S
Land	100	**-3**	**0**	**0**	**0**	**1**	**1**	**2**	**4**	**5**	**500**
Biotic Envt	100	**-1**	**0**	**0**	**-2**	**0**	**0**	**0**	**4**	**1**	**100**
Air Quality	150	**-2**	**0**	**0**	**-2**	**-1**	**-1**	**-1**	**2**	**-5**	**-750**
Ground Water	150	**-2**	**0**	**-2**	**0**	**-1**	**0**	**0**	**2**	**-3**	**-450**
Health	100	**-1**	**-1**	**-1**	**-2**	**-1**	**-1**	**0**	**2**	**-5**	**-500**
Noise	100	**-2**	**0**	**0**	**0**	**0**	**0**	**-1**	**0**	**-3**	**-300**
Employ	100	**4**	**1**	**1**	**1**	**3**	**2**	**2**	**0**	**14**	**1400**
Literacy	50	**1**	**0**	**0**	**0**	**3**	**1**	**4**	**0**	**9**	**450**
Safety	150	**-1**	**-1**	**-2**	**-2**	**-1**	**-1**	**0**	**1**	**-7**	**-1050**
Aesthetics	50	1	**-1**	**-1**	**-1**	**1**	**1**	**1**	**4**	**5**	**250**

Net total = -350

The project scored -350 points with mitigation measure. This indicates that there would not be appreciable impact on the environment with appropriate environmental control measures.

IX. Environment Impact Statement:

Compromises have to be made so that an adversity on one hand is offset by benefits on other. The Ministry of environment and Forests, through Central Pollution Control Board has quantified degree of compromise, by fixing permissible limits of discharge of common pollutants. A company, willing to set up a project has only to ensure that these guidelines are met, in addition to selecting an approved site.

The development project of a Multiplex would not have any significant adverse impact on the environment. Adequate measures are proposed to minimise the effect of various pollutants.

The activity impact Matrix for the upcoming mall cum multiplex, has been evaluated for two cases: one without the mitigation measures and other with the mitigation measures. The development project scored -7400 points without the implementation of mitigation measures. This indicates that there would be significant impact on the environment and major environmental control measures are required.

With the implementation of environmental mitigation measures the development project scored -350points. This indicates that there would not be appreciable impact on the environment with appropriate and suitable control measures.

Impact on Air Environment will not be significant since installing appropriate devices and adopting techniques to control pollution.

Waste water will be released after treatment, through an efficient system as sewage treatment plant, will have negligible concentration of pollutants.

For handling solid waste, an elaborate and efficient plan has been proposed to ensure that it is not released in the environment.

Impact during construction phase would be confined to the site premises only. The project scored -350 points, after it implements proposed pollution control measures. Thus, the project can be classified, as having insignificant & negligible impact on environment.

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