MILITARY INSTITUTE OF SCIENCE AND TECHNOLOGY
COURSE CODE: EWCE 431
COURSE TITLE: ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT
SPRING 2026

Problem: A 250-acre industrial park is proposed near a river, agricultural land, and a residential area. The project includes a textile dyeing industry, wastewater treatment plant, internal road network, and power generation facilities. The Environmental Impact Assessment (EIA) identifies the following environmental components and their corresponding weights.

Environmental Component	Weight
Air Quality	0.18
Surface Water Quality	0.22
Groundwater Quality	0.15
Soil Quality	0.10
Noise Environment	0.08
Ecological Habitat	0.15
Socio-economic Environment	0.12

The predicted impact scores (before mitigation) are:

Component	Impact Score (-5 to +5)
Air Quality	-4
Surface Water Quality	-5
Groundwater Quality	-3
Soil Quality	-2
Noise Environment	-2
Ecological Habitat	-4
Socio-economic Environment	+4

Three mitigation alternatives are proposed.

Alternative A

* Install advanced wastewater treatment.

* Cost: USD 2.5 million.

* Improves Surface Water and Groundwater scores by 60%.

Alternative B

* Introduce green belts and emission control systems.

* Cost: USD 1.8 million.

* Improves Air Quality, Noise, and Ecological Habitat scores by 40%.

Alternative C

* Implement both Alternatives A and B.

* Total budget available: USD 3.5 million.

The Environmental Impact Index (EII) is defined as:

$EII = \sum W_i S_i$

Tasks

1. Calculate the Environmental Impact Index (EII) before mitigation.
2. Calculate the EII for Alternatives A, B, and C.
3. Considering the budget limitation, determine the most suitable mitigation strategy.
4. Discuss the trade-offs between environmental performance, implementation cost, and project feasibility.
5. Identify the environmental component that contributes most significantly to the overall impact and justify your answer quantitatively.
6. Prepare a final recommendation on whether the project should be approved, conditionally approved, or rejected, with engineering justification.

Solution

Weights

Environmental Component	Weight (Wi)
Air Quality	0.18
Surface Water Quality	0.22
Groundwater Quality	0.15
Soil Quality	0.10
Noise Environment	0.08
Ecological Habitat	0.15
Socio-economic Environment	0.12

Total Weight = 0.18+0.22+0.15+0.10+0.08+0.15+0.12=1.00

Initial Impact Scores

Component	Score (Si)
Air Quality	-4
Surface Water	-5
Groundwater	-3
Soil	-2
Noise	-2
Ecology	-4
Socio-economic	+4

Environmental Impact Index calculation (Before Mitigation): $EII=\sum WiSi$

Component	Wi	Si	Wi×Si
Air	0.18	-4	-0.72
Surface Water	0.22	-5	-1.10
Groundwater	0.15	-3	-0.45
Soil	0.10	-2	-0.20
Noise	0.08	-2	-0.16
Ecology	0.15	-4	-0.60
Socio-economic	0.12	+4	+0.48

Total EII=-0.72-1.10-0.45-0.20-0.16-0.60+0.48 =-2.75

Interpretation: Since EII<-2, the project is **Environmentally unacceptable.**

Alternative A

Improvement

Surface Water improves by 60%
Surface Water Original score = -5
Improvement [0.60*5=3]
New score [-5+3=-2]
Groundwater Original = -3
Improvement [0.60*3=1.8]
New score [-3+1.8=-1.2]
Other parameters remain unchanged.

New EII

Component	Wi×Si
Air	-0.72
Surface Water	0.22×(-2)=-0.44
Groundwater	0.15×(-1.2)=-0.18
Soil	-0.20
Noise	-0.16
Ecology	-0.60
Socio-economic	+0.48

Total EII_A=-1.82

Interpretation: Project still has considerable impacts but is much improved.

Alternative B

- Air, Noise, Ecology

Improves by 40%.

Air: Original [-4]

Improvement [0.4*4=1.6]
New score [-4+1.6=-2.4]

Noise: Original [-2]

Improvement [0.4*2=0.8]
New score [-2+0.8=-1.2]

Ecology: Original [-4]

Improvement [0.4*4=1.6]
New score [-4+1.6=-2.4]

New EII

Component	Wi×Si
Air	0.18×(-2.4)= -0.432
Surface Water	-1.10
Groundwater	-0.45
Soil	-0.20
Noise	0.08×(-1.2)= -0.096
Ecology	0.15×(-2.4)= -0.36
Socio-economic	+0.48

Total EII_B=-2.16

Alternative C
Alternative C combines both A and B.
Budget required, 2.5+1.8=4.3 million USD
Available budget, 3.5 million USD
Hence, **Alternative C cannot be implemented within the available budget.**

Component	Wi×Si
Air	0.18×(-2.4)= -0.432
Surface Water	0.22×(-2)=-0.44
Groundwater	0.15×(-1.2)=-0.18
Soil	-0.20
Noise	0.08×(-1.2)= -0.096
Ecology	0.15×(-2.4)= -0.36
Socio-economic	+0.48

If budget were available, Total EII_C=-1.23
which would be the best environmental option.

Best Alternative

Alternative	Cost (Million USD)	EII
No mitigation	0	-2.75
A	2.5	-1.82
B	1.8	-2.16
C	4.3	-1.23

Since only **A** and **B** satisfy the budget,
Alternative A provides the greatest reduction in environmental impact.
Hence, Alternative A is recommended

Most Critical Environmental Component: Contribution before mitigation

Component	Contribution
Surface Water	−1.10
Air	−0.72
Ecology	−0.60
Groundwater	−0.45
Soil	−0.20
Noise	−0.16
Socio-economic	+0.48

The highest negative contribution is Surface Water Quality
Therefore, wastewater management should receive highest priority.

Final Recommendation

- Among the feasible alternatives, **Alternative A** is recommended.
- The project may be **conditionally approved**.