(ACE-EIA Paper 6/2004)
For discussion

Study on Wetland Compensation – Proposed Guidelines on the Approaches for Consideration of On-site and Off-site Mitigation and Implementation of Ecological Compensation for Wetland

Purpose

This paper seeks Members' views on two proposed guidelines prepared under the Study on Wetland Compensation (the Study) on the approaches for consideration of on-site and off-site mitigation and implementation of ecological compensation for wetland.

Background

2. Black & Veatch Hong Kong Ltd. has been commissioned by the Agriculture, Fisheries and Conservation Department to carry out the Study with the main objectives of providing systematic baseline information on the status of the existing wetlands; evaluating and identifying ecological important wetlands; defining the overall impact of development on wetlands; developing a strategy and action plans for implementing mitigation measures to address loss of wetland arising from development and proposing practical schemes for wetland compensation in Hong Kong.

3. The key findings of the Study were presented to the Advisory Council on the Environment (ACE) on 7 June 2004. Members of the ACE were also informed that details of two proposed guidelines on the approaches for consideration of on-site and off-site mitigation and implementation of mitigation measures would be presented to the ACE-EIA Subcommittee.

4. The general policy and sequence for compensating impact on important habitats and wildlife stated in the Technical Memorandum on EIA Process (TM) must be strictly adhered to i.e. all appropriate and practicable steps must be undertaken to **first avoid** and **then minimize** adverse impacts to ecological resources, **prior to recommendations of compensatory measures**. Remaining unavoidable impact shall be compensated to the extent appropriate and practicable.

5. The two sets of proposed guidelines are recommended to complement existing guidelines and statutory or administrative requirements that would have implications on the wetland compensation project. Examples of existing relevant guidelines or requirements include:

- WBTC No. 13/2003 Guidelines and Procedures for Environmental Impact Assessment of Government Projects and Proposals

- WBTC No. 04/1997 Guidelines for Implementing the Policy on Off-site Ecological Mitigation Measures
- Hong Kong Planning Standards and Guidelines
- Land use zonings in the relevant zoning plans
- Town Planning Board Guidelines for Application for Developments within Deep Bay Area under Section 16 of the Town Planning Ordinance
- Deep Bay Guidelines for Dredging, Reclamation and Drainage Works

6. In order to facilitate the consideration of ecological compensation for wetland loss and preparation of mitigation/compensation proposals during the statutory EIA process, two sets of proposed guidelines prepared under the Study are presented in the following paragraphs. The first set (in para. 7 to 33) is on the **approaches of ecological compensation of wetland** in line with the TM and the second set (in para. 34 to 62) is on the **approaches for implementation of wetland mitigation/compensation and management plan proposals**. The proposed guidelines will form part of the recommendations of the Study which could later be developed into guidance notes for project proponents and EIA practitioners.

Guidelines on approaches for consideration of ecological compensation of wetland (on-site and off-site)

Purpose

7. The purpose of the guidelines is to facilitate the consideration of the on-site or off-site approaches of ecological compensation for wetland loss in line with the TM.

8. Annex 16 of the TM states that mitigation shall **preferably** be carried out **on-site rather than off-site** and that off-site compensation can only be considered when on-site measures have been exhausted. As the basic principle, on-site options are preferred as wetland functions are retained in an area and compensation is close to the area of loss allowing species to migrate from the affected area to the mitigation /compensation site.

9. The consideration process is illustrated in a flow chart at Annex 1, which included the following aspects:

- establish baseline conditions
- evaluation of impact
- identification of ecological functions
- “like for like” issue
- extent of mitigation measures
- types of compensation
- timing of compensation
- justification of compensation

Baseline conditions

10. An accurate assessment of the baseline conditions of the affected site and the mitigation/compensation site (no matter on-site or off-site) is the basis. The approach for baseline survey is described in Annex 16, Para. 5.1 of the TM. The objective is to provide sufficient and accurate ecological data to allow a complete and objective identification, predication and evaluation of the potential ecological impacts.

11. Wetland compensation consideration must be based on an adequate understanding and evaluation of the ecological values and functions of the affected site prior to disturbance and also the proposed mitigation/compensation site. In addition to the flora, fauna and habitat surveys identified in the TM and Guidance Notes, the following information should be collected at the affected site and mitigation/compensation site to characterize their functional attributes:

- Hydrological regime and topographical features
- Water quality
- Surrounding land uses at the mitigation /compensation site
- Site constraints that could affect compensation proposals

Evaluation of impact

12. Para. 5.2 and 5.3 of Annex 16 of the TM has already provided the guidelines on impact identification and prediction as well as the evaluation of impacts. The TM must be strictly adhered to when determining the impact of the project on the wetland feature, identifying residual impact and the need for mitigation (including compensation) measures.

Identification of ecological functions

13. The baseline survey of the ecological impact assessment study shall identify the type of wetland affected and the target species involved so as to define the objective and scope of compensation. It is necessary to determine the ecological functions of the site that will unavoidably be lost and replacing such loss is the key objective when proposing and defining the compensatory mitigation.

14. The habitat and species impacted both directly (such as through loss of roosting sites) and indirectly (such as foraging or breeding areas being affected) and functional impacts on wetland features due to the change in land use have to be identified to establish if the hydrology is affected that has adverse impact on wetland habitats.

15. Examples of the ecological functions to be considered are:

- Biological functions such as foraging, breeding, nesting, or spawning grounds for aquatic and terrestrial species;
- Important wildlife habitats as sanctuaries or refuges

- Natural drainage function
- Flushing characteristics
- Ground water discharge and recharge
- Significant water purification functions

"Like for like" issue

16. In general, "like for like" compensation is required. Para 5.4.5 (a) and (d) of Annex 16 of the TM has already provided guidelines that "all practicable on-site ecological mitigation measures shall be fully investigated in the EIA study and exhausted" and that "the off-site mitigation measure shall be on a "like for like" basis, to the extent that is practicable." The compensatory measures to be adopted for mitigating the residual ecological impacts should be directly related to the habitats and species to be affected, either the same kind of species or habitats of the same size or with the same kind of ecological function and capacity.

17. Assessment of the compensation requirements should also take account of the ability of the on-site mitigation areas to sustainably compensate for the loss. The issues to be addressed include levels of disturbance to the site concerned; size of the compensation area in relation to species needs; linkages to other wetland / dry-land for target species and hydrological linkage to other wetland.

18. In line with Para.5.4.3 of Annex 16 of the TM that mitigation measures for ecological impact shall preferably be carried out well in advance, and also Para. 5.4.5 (a) and (d) of Annex 16 of the TM mentioned in Para. 16 above, off-site mitigation/ compensation would be required when on-site mitigation/ compensation would be impracticable.

19. As examples, off-site mitigation/ compensation would be necessary under the following situations: on-site mitigation/ compensation is found to be inadequate to mitigate impacts to an acceptable level, mitigation/ compensation is required in advance of development work, provision of the on-site mitigation/ compensation is impracticable, or construction impact (which is on-site) is identified to be so severe that mitigation/ compensation measures have to be implemented off-site during construction phase of a project.

20. For long term sustainability, it is considered necessary to make an early assessment of the recurrent costs of maintaining the compensation area. Elements that may need to be considered include costs of restocking, pumping, staff needed to maintain water condition (with weirs and pumps facilities), vegetation management, stocking and replanting.

21. To facilitate the process of identifying off-site mitigation/ compensation area, it is suggested that wetlands on Government land under conservation-related or non-development zonings or un-zoned area to be identified as "Potential Mitigation Area"

(PMA) and to be considered as an option for off-site ecological compensation of wetland loss in respect of public works under the EIAO process.

22. Where an off-site proposal needs to be considered, the project proponent should identify details of the impacted site, loss anticipated, and habitat features desired for compensation, and consult AFCD for information on PMA.

23. The Project proponent would then identify a compensation package, to confirm its suitability for off-site mitigation and site availability from the Lands Department.

The extent of mitigation measures

24. The extent of compensatory mitigation shall be basically related to the residual ecological impacts as identified in the EIA study. The extent of mitigation could be presented in form of compensation ratio, if practicable (i.e., functional/area loss against functions / area for compensation) that could be determined depending on the type of compensation adopted (which may cover restoration and enhancement), on a case-by-case basis subject to the conclusion of the EIA study concerned. The objective of compensatory mitigation is to provide at least essential functional compensation.

25. In the absence of more definitive information on the functions of the sites, compensation in terms of area of a similar wetland type may be used as a reasonable surrogate. It is important to employ an adequate safety margin in the compensation ratio to reflect the expected chance of success associated with the compensatory mitigation proposals. For instance, a higher ratio may be required for sites and wetland types that are difficult to restore. The setting and adjustment of higher compensation ratio is one of the principal tools for addressing risk and in some cases, temporal loss of habitat.

Type of compensation

26. In general, compensatory mitigation can be broadly divided into two types

- Wetland restoration and enhancement - The restoration or re-establishment of a wetland in an area where it historically existed but now performs minimal wetland function due to change in physical setting or disturbance or enhancement of wetland function of an existing wetland by modifying management practice and/or physical setting.
- Wetland creation – The construction of a wetland in an area which was not a wetland in the recent past.

27. Wetland restoration and enhancement are more preferable options as they have a higher chance of success. The approach acknowledges that there will be physical loss in wetland area but the loss of wetland function can be fully compensated. Wetland restoration or enhancement has a relatively higher chance of success than wetland creation. Wetland creation may maintain total wetland area physically but would require consideration of

resources implication in implementation and is generally of a lower chance of success.

28. The selection of the best option should be determined on a case-by-case basis taking into consideration the wetland habitat and associated functions to be affected, availability of suitable areas for carrying out the compensatory mitigation and chance of success of proposed measures.

Timing

29. From an ecological point of view, mitigation measures for ecological impact shall preferably be carried out well in advance of, or at least concurrent with, the works rather than after completion of works [Para 5.4.3 of Annex 16 of the TM]. However, whether this is practicable and absolutely justified would depend on the mitigation/ compensation approach and magnitude of impact.

30. It is important to plan the mitigation as early as possible when the need of mitigation/ compensation is identified so that options would be kept opened. On-site mitigation measures may be constrained by land availability, sites may not be available until certain aspects of works are completed i.e. it is impracticable to provide the mitigation in advance. Even when land within the works boundary is reserved for the mitigation, it may not provide the appropriate mitigation/ compensation in advance of or concurrent with the works due to disturbance during construction.

31. In case where the magnitude of construction impact is considered severe to the species affected, even taking into account temporary and reversible nature, mitigation/ compensation measures may be required in advance of or concurrent with the works. Under such circumstances, off-site approach or other measures (e.g. establishing buffer zones or restrictions on the most disturbing works activities to less sensitive locations and avoiding sensitive periods) may be required to ensure that effective functioning of mitigation measures are available during the construction stage.

Justification

32. The EIA study of the project will need to confirm that all reasonable steps have been taken to avoid and minimize impact on wetland, determine and define wetland functions that are being affected and the way that these will be mitigated through either on-site or off-site mitigation/ compensation measures.

33. If the off-site mitigation option is adopted it will be necessary to show that all practicable on-site mitigation options have been exhausted and residual impact will be addressed at a clearly defined off-site location. The objectives and location of the off-site mitigation/ compensation measures have to be defined and justified in the EIA report.

Guidelines on approaches for implementation of wetland mitigation/compensation and management plan proposals (implementation approach)

Purpose

34. This set of practical guidelines will assist project proponents in the implementation of wetland compensation packages through a five- stage process as follows and illustrated in a flow chart at Annex 2.

Stage 1 – Ecological assessment of the site

35. The first element of a compensation package is a reliable baseline for the site proposed for compensation. An ecological assessment will have formed part of the EIA study and will have identified and evaluated potential ecological impacts and the recommended on-site or off-site compensation package. For compensation design the ecological baseline obtained for the purpose of an EIA may not be of sufficient detail for developing a wetland compensation management plan.

36. In addition to ecological data the following are needed to characterize the mitigation /compensation site:

- Updated ecological baseline of the affected site and mitigation /compensation site (on-site or off-site)
- Hydrological regime and topographical features of the mitigation /compensation site
- Details of water source and quality
- Depth, texture and capability of the soil to retain water
- Chemical and nutrient status and organic matter levels of the soil
- Surrounding land uses at the mitigation /compensation site
- Physical cconstraints that could affect the siting, design and implementation of the compensatory wetland e.g. structures, utilities.

Stage 2 - Wetland design

37. The specific goals and objectives of compensation will have been identified in the EIA study of the project. The objective of the design is to translate the objectives and goals of compensation into a design that the ecological characteristics of the mitigation /compensation site are similar to that of the affected site. The design consideration process will include:

(a) Ecological consideration:

- Type, location and extent of wetland loss identified.
- Type, location and extent of mitigation determined.
- Type of compensation determined.

- Habitat layout and key features to be provided.
- Habitat requirements of vegetation to be established.
- Target fauna and their requirements.
- Soil and substratum.
- Ecological linkage.
- Compatibility with conservation objectives.
- Fragmentation and disturbance.

(b) Engineering and other consideration:

- Identification of site constraints (e.g. substratum stability, site and shape of the mitigation area, topography, availability of land).
- Identification of practicable construction methods.
- Identification of structures impinging on design and landscaping of the compensatory wetland.
- Accessibility of the mitigation /compensation site for personnel and machinery.
- Hydrology and water quality of the water sources and future water management requirements of the compensatory wetland. *It is more sustainable and cost effective to have a self-sustaining water regime which allows manipulation of the natural hydrological flow rather then designing a wetland requiring extensive engineering, pumping or maintenance.*
- Interface with surrounding land uses/human activities and the need for buffer or screening to protect the habitats from disturbance in the mitigation /compensation site.
- Integration with surrounding environment.
- Risk of increased flooding to adjoining land – how the mitigation area affects external sites.
- Environmental hygiene i.e. the potential issue of stagnant water and requirements for mosquito control.
- Security and access to the compensatory wetland.
- Staffing implications and responsibility for future management and monitoring of the wetland.
- Cost implications for construction, management and monitoring of the wetland.
- Timing and implementation schedule of the wetland compensation project.

<u>Stage 3 - Site preparation</u>

38. The mitigation /compensation site for a wetland compensation project should be prepared according to the engineering design, including the engineering plans and specifications, soil engineering, planting and stocking requirements. Site preparation includes three aspects: site formation, vegetation establishment and stocking (if required) as described in para. 39 to 44.

(a) Site formation

39. Issues of concern include:

- A check-list of existing and necessary infrastructure at the site.
- Avoiding or minimizing disturbance to surrounding habitats during site formation and construction works.
- Hydrological control should be in place and running properly according to the predetermined water regime.

(b) Vegetation establishment

40. Vegetation establishment works should be implemented in accordance with the specifications identified in the planting plan. Planting should be carried out in the appropriate time of the year, as far as practicable. Although watering of plants growing in wetland is usually not required (except for establishment on bunds above the water level or terrestrial planting as part of the overall design), different temperatures affect water availability and establishment and survival of vegetation. Aftercare management such as replanting of dead plants, weeding and pest control may be required.

41. Planting stock should be obtained from the affected site which if not removed would be lost to the proposed development or from commercial sources. Collection and translocation of plants from other wetland sites should not be carried out without permission from the relevant authority.

42. Use of invasive plant species such as *Wedelia trilobata*, *Lemna minor* and *Eicchornia crassipes* for vegetation establishment in the wetland should be avoided.

(c) Stocking (if required)

43. In order to establish a compensatory wetland with ecological functions resembling the affected site, stocking of animal species may be required in the compensatory wetland at an early stage of establishment. For example, fish species may be stocked for bird feeding or mosquito control. Suitable environmental conditions, especially water quality, must be established prior to stocking e.g. suitable pH conditions that are neither too acidic nor alkaline.

44. If this is required, regular replenishment of food supply to the habitats may be necessary, with associated cost implications. It is more desirable to carry out stocking after the vegetation and the associated faunal communities have been developed.

<u>Stage 4 – Wetland management</u>

45. The compensatory wetland should be managed according to the management objectives defined at the early stage of wetland compensation and management planning.

The ultimate target for habitat management is to achieve the goals identified in the EIA for the compensatory wetland. Management of a compensatory wetland could be broadly divided into seven aspects which included hydrology, water quality, vegetation management, wildlife management, environmental hygiene, site security and staffing.

(a) Hydrology

46. The water regime of the compensatory wetland is the key factor in determining if the wetland functions are created and the wetland compensation goals can be achieved. Plant growth, survival and reproduction will respond to hydrological change, and this will affect the fauna communities established through stocking or natural succession. Management actions include maintenance of hydrological connections between the wetland and the water sources and between different habitats in the same wetland; water level control; dredging to maintain the free flow and depth of water in the wetland habitats; pumping or transfer of water between wetland zones; prevention of flood risk; and possibly periodic draw-down for bird feeding or maintenance purpose.

(b) Water quality

47. The water quality of the wetland must be maintained within the living range of the flora and fauna of the wetland. Typical water quality parameters are listed below. However, it should be noted that the parameters only serve as a general reference as each wetland may have a specific set of water quality objectives to achieve compensation requirements. Examples of parameters to be considered are: salinity, conductivity, dissolved oxygen, pH, turbidity, suspended solids, $BOD_{5,}$ ammoniacal nitrogen, TIN (total inorganic nitrogen) and total phosphate.

48. Management practices for water quality of a wetland include drain-down and refilling of the wetland with rainwater, liming or addition of organic matter to adjust pH of the water, fish stocking and inclusion of a natural filtering systems for water purification purposes. Reliance on tankering or use of raw water sources should be avoided due to the recurrent costs involved.

(c) Vegetation management

49. Establishing and maintaining a wide range of vegetation types will result in beneficial effects as habitat diversity promotes wildlife diversity. Plants in the wetland form the basis of the grazing food web that a diverse group of grazing macro-invertebrates and fish will feed on. The prompt removal of certain invasive species (e.g. water hyacinth can cover ponds very rapidly once established) will prevent loss of identified compensation requirements. However, the implications of complex vegetation cutting requirements on the ongoing management costs should not be under-estimated.

(d) Wildlife management

50. Wildlife managed in a compensatory wetland include stocked and target species. For compensation packages in Hong Kong the most commonly stocked species is likely to be fish, for insect control or as a food source. They are introduced and kept in the compensatory wetland for specific purposes including enhancing the wetland as a feeding site for water birds, control of mosquitoes and improvement of acidity of water. Regular restocking, replenishment of feed, harvesting and removal of excessive stock are management measures that may be needed for stocked species to ensure that they perform their target function in the compensation area. Again, the ongoing management costs need to be determined.

51. For target species, specific management measures may be needed to manage animals of conservation concern such as rare or target species attracted to the compensatory wetland or within a naturally colonized wetland. Supplementary stocking (if practicable) of the target species may be considered necessary when the original stock is found to be too small to establish a self-sustaining population. Provision of artificial roosting sites, vegetated rafts or nest boxes are examples that could increase the chance of target species using the wetland as their habitat.

(e) Environmental hygiene

52. Appropriate management measures are needed to ensure that the objectives of maintaining a good environmental hygiene in the wetland site are satisfied, e.g. control of mosquito and other pests, removal of rubbish and weed control.

(f) Site control and security

53. The wetland site should be managed to avoid illegal dumping, fishing, trespassing, vandalism or unauthorized development. Fencing or screening, as appropriate, should be regularly checked and maintained to control access for both security and public safety.

(g) Staffing

54. Staffing for the management of the compensatory wetland should be identified in the planning phase of the project. Suitably qualified personnel with relevant experiences in wetland habitat management or equivalent, if available, should be involved in all phases of the management process. The agents responsible for the management and maintenance of the wetland should be identified as early as possible. A matrix of management and maintenance responsibility should be provided.

<u>Stage 5 – Monitoring, performance evaluation and adaptive management</u>

55. The compensation scheme will be monitored to confirm acceptable environmental performance. The ecological process, such as succession pattern and trends under development at the mitigation/ compensation site, if detectable, should also be

monitored for determining the environmental performance. The monitoring will be evaluated against performance requirements and where there is a shortfall in performance a corrective system will be initiated in the form of adaptive management. It would be desirable to engage an independent agency or professional body or consultants, as far as possible, to conduct the monitoring and audit programme.

(a) Monitoring

56. Monitoring of the wetland habitats is the key to a successful wetland compensation project and are an essential part of the adaptive management process. It starts with the baseline surveys of the ecological assessment stage in which ecological baselines of the impact and mitigation /compensation site are collected as a reference points to develop the action/limit levels and performance targets. Once the wetland is under management, habitat monitoring confirms if the wetland is performing as planned according to the management objectives and allows day-to-day decisions to be made about adaptive management of the wetland.

57. The ecological baseline also acts as the reference point in developing action/limit levels and performance targets. Performance standards for the mitigation /compensation site should be defined relative to the level of resources present at the reference sites.

58. The commonly used monitoring attributes include:

- Hydrological regime – surface water level, surface water supply, flow rate etc.
- Water quality – salinity, conductivity, pH, nutrients, temperature, dissolved oxygen, turbidity, suspended solids, BOD5, pollutants etc.
- Vegetation – percentage coverage, species richness, health status, invasive/exotic species etc.
- Target fauna – species diversity of stocked fauna and translocated species, species richness and/or abundance of freshwater macro-invertebrates, dragonflies, butterflies, amphibians, reptiles, birds, mammals; observations of activities such as roosting and breeding etc.
- Other relevant parameters – any other monitoring requirements specifically relevant to the particular wetland's monitoring objectives should be included.

(b) Evaluation and adaptive management

59. Performance evaluation in wetland compensation project basically involves interpreting the monitoring data in relation to the management objectives. It would help to determine if the management objectives have been achieved and refine the management of the wetland to meet the objectives. Based on the management objectives, a set performance targets for the monitoring parameters should be developed. The performance of the wetland can then be objectively evaluated against these targets.

60. When monitoring data indicate that the compensatory wetland cannot meet the

goals and objectives within an acceptable timeframe without further intervention, remedial actions should be taken to correct the design, management measures or implementation schedule. However, it should be noted that evaluating the results of monitoring can sometimes be difficult. Care must be taken not to measure short-term responses against long-term goals.

61. It can take years of management to observe the types of habitat responses or attract the target species to the wetland. Sudden or drastic changes of the management in such cases may not be beneficial. If, after some time, the objectives are still not achieved, it would be necessary to seek advice of relevant authority to review the approaches of management and objective in the management of the wetland. In this regard, the expertise advice from ecologist, academics or interested group experienced in habitat management may be sought. In some cases, it may be necessary to change or adjust the management or monitoring objectives and the target levels, which may need to be considered by the relevant authority before such changes are made.

Cost of implementation / funding

62. The cost implications of the wetland compensation project include one-off construction cost and recurrent management costs have to be determined. Funding arrangements and management/ maintenance responsibilities, as appropriate, must be clearly defined and agreed among relevant parties at the earliest opportunity.

Advice Sought

63. Members are invited to provide comments on the two set of proposed guidelines in para. 7 to 62.

Agriculture, Fisheries and Conservation Department
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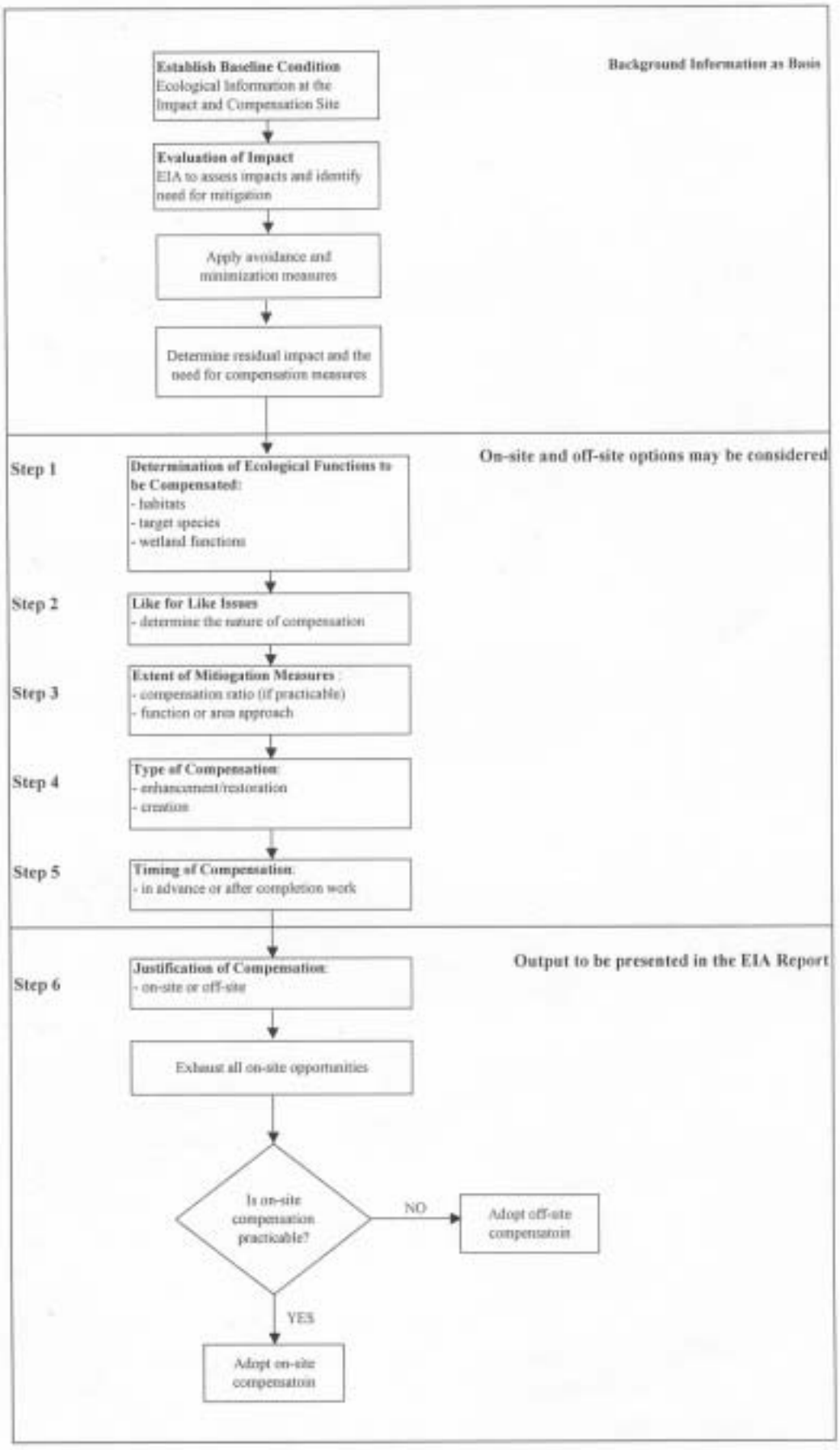
Annex 1: Flow Chart on Proposed Approaches of Ecological Compensation of Wetland



Annex 2: Flow Chart on Proposed Approaches for Implementation of Wetland Compensation Proposal