



Netherlands Commission for
Environmental Assessment

Bagan River Multipurpose Beautification Project

Final Advice on ToR for EIA

Myanmar



15 January 2015





Netherlands Commission for
Environmental Assessment

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your reference

your letter

our reference
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Date: 19 December 2014

Subject: Advice on the ToR for EIA for the Bagan multi-purpose beautification project, Myanmar

Dear Mr U Nyan Tun Aung,

Through the Ministry of Infrastructure and the Environment of the Netherlands, the Ministry of Transport of Myanmar requested the Netherlands Commission for Environmental Assessment (NCEA) to give their advice on the Terms of Reference of the EIA for the Bagan River Multi-Purpose Beautification Project (hereafter the Bagan project). The NCEA includes social impact assessment as part of EIA. Therefore, the NCEA has reviewed the Bagan project proposal and made a field visit in November 2014.

I would like to draw your attention to the following issues:

- The NCEA acknowledges the integrated character of this pilot project. Therefore, in this advisory report, the scope of the EIA will not be limited to those activities legally requiring an EIA but will include all project activities. As such, this EIA can be considered as a pilot as well.
- It is recommended to develop a vision on the development of the Bagan section of the Irrawaddy river in the EIA, that could become an example for other sections of the river. In this vision the joint development of river related services together with socio-economic land use development of the hinterland should be elaborated, taking into consideration future scenarios such as climate change.
- The NCEA has questions regarding the technical and environmental aspects of some activities, namely the water reservoir, the supply of irrigation water and the development of a new tourist resort. These questions should be addressed in the EIA. Moreover, the NCEA provides suggestions for optimisation of these activities such as compartmentalisation of the water reservoir and tourist facilities that are possibly more beneficial for the local people.

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- It is recommended to start face-to-face consultations with the relevant government authorities as well as with representatives of the stakeholders that will be affected, in order to assess the environmental and the social / gender effects of the project.

I would like to invite you to provide us with your comments on this advisory report. I hope that you will be able to provide your comments within the next three weeks because in the week of 12 January we would like to make this advisory report publicly available.

The NCEA is ready to review the draft final EIA and is more than willing to carry out this review jointly with MOECAAF.

Yours sincerely,

Professor Rudy Rabbinge



Chairman of the Working Group – Advice on the ToR for EIA for the Bagan multi-purpose beautification project, Myanmar

Bagan River Multipurpose Beautification Project Myanmar

Advice submitted to the Minister of Transport of Myanmar, by a working group of the Commission for Environmental Assessment in the Netherlands.

The technical secretary



Arend Kolhoff

The chairman



Rudy Rabbinge

Utrecht, 15 December 2014

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1. Introduction

1.1 Initiative and involvement of the NCEA

The project

This project is known as the Bagan River Multipurpose Beautification Pilot Project (hereafter the Bagan project). The project aim is primarily to improve the navigability of the Ayeyarwaddy River near the city of Bagan by means of dredging and a set of river training works. These training works guide the flow through the main channel and regulate the flow in the secondary channels to some extent. During lower river stages, the idea is to concentrate the discharge to a greater extent through the main channel, whereas the discharge through the secondary channels during highest stages is enabled to prevent significant flood water impoundment.

Implementation of the project will be based on a Public Private Partnership between the Government of Myanmar, the Government of the Netherlands and private investors.

The multipurpose character of this project is covered by contribution of the dredging and river training activities to:

- Flood protection, mainly by protecting the large island against further erosion;
- Water availability for e.g. irrigation by enlarging the present secondary channel, and if possible to 'catch' additional water in the aftermath of the seasonal flood, resulting in a temporary water reservoir;
- Sustainable energy generation by a hydropower turbine at the outlet structure;
- Recreation by beautification of the riverine area near Bagan – by the presence of the enlarged secondary channel–, as well as by a planned tourism resort at the main island in front of Bagan;
- Land development, e.g. enabling improvement of the irrigation scheme.

Involvement of the Netherlands Commission for Environmental Assessment (NCEA)

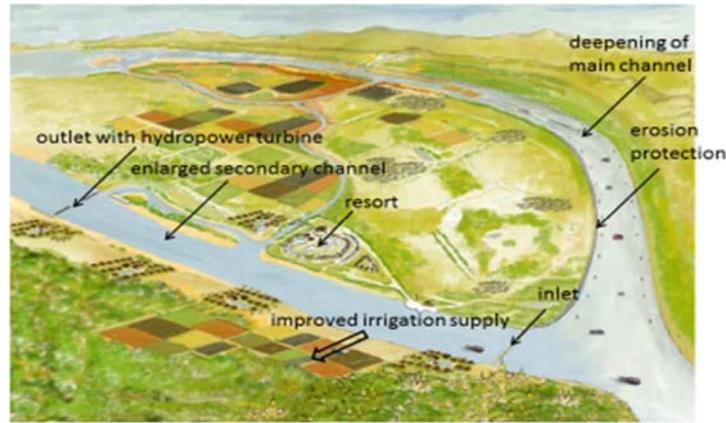
The NCEA has been asked by the Myanmar Ministry of Transport via the Netherlands Ministry of Infrastructure and the Environment to prepare an advisory report for the Terms of Reference (ToR) for the EIA for 'the Bagan project' that meets:

- The Government of Myanmar requirements for EIA, including social impact assessment as explained in the EIA guidelines prepared by MOECA, 2014.
- The IFC standards for EIA as an indicator of international good practice.

The main purpose of this advisory report is therefore to provide an advice on the ToR for the EIA of the Bagan project.

The NCEA acknowledges the integrated character of this pilot project. Therefore, in this advisory report, the scope of the EIA will not be limited to those activities legally requiring an EIA but will include all project activities. As such, this EIA can be considered as a pilot as well.

The figure below is an artist impression of the Bagan project after implementation showing the basic activities or objectives. For a map of the project area, see Appendix 1. (Source: Royal HaskoningDHV)



basic functions of Bagan River Beautification Project

The Netherlands Ministry of Foreign Affairs provided the funds for the preparation of this advisory report.

EIA process and project planning cycle

The Ministry of Transport of Myanmar is the owner of the project. A project proposal has been developed by a consortium of two Dutch companies: Van Oord and Royal HaskoningDHV (dd. 5 November, 2014). The project is in the pre-feasibility stage with a preliminary design for dredging and river training works.

According to the EIA guidelines of the Ministry of Environmental Conservation and Forestry (MOECA, 2014) Appendix 1, an EIA is required for some of the activities that will be executed by the Bagan project. A formal categorisation decision by MOECA still needs to be made, for which the proposed activities need to be defined. Therefore, in table 1 the objectives, activities and preliminary categorisation of the activities have been made.

Table 1 shows that a number of the proposed project activities probably require an EIA and other activities only require an Initial Environmental Examination (IEE). In this advisory report the NCEA provides advice on the ToR for an EIA study that has a wider scope than just for the activities that legally require an EIA. However, for one of the proposed activities, the development of the tourism resort, the NCEA would like to stress that an EIA study will not provide information that is necessary to meet the legal requirements for EIA as a condition for environmental approval by MOECA. The reason for this is that the plan for the development of the tourism resort has not yet been elaborated in detail, such as the site and the size.

It is not yet sure whether the project area is considered as an environmentally, ecologically or socio-culturally sensitive area. This might have consequences for the categorisation decision with regard to the need for IEE or SEA. In this advisory report we assumed it is not.

Implementation of the EIA study is planned in January – April 2015. The dredging and river training works – as planned in the ToR for EIA– will probably need to be reviewed and approved by MOECAAF. In parallel to the EIA study a feasibility study will be conducted. Review of the EIA study by MOECAAF (and possibly the NCEA) is planned in April 2015.

Table 1: Summary of objectives, activities and preliminary assessment of the need for IEE/EIA by the NCEA

Objectives	Activities	Preliminary assessment of need for IEE / EIA *
<p>Main objective:</p> <ul style="list-style-type: none"> • Increase revenue generation from increased river trade volume by improving the navigability in a sustainable way. 	<ul style="list-style-type: none"> • Dredging of the main and secondary channel; • Constructing river training works such as bank protection, groins, inlet- and outlet structures. 	<ul style="list-style-type: none"> • Likely IEE, probably EIA • Likely IEE, probably EIA
<p>Secondary objectives:</p> <ul style="list-style-type: none"> • Electricity generation by establishing a micro-hydropower installation near the outlet structure; • Improving the water availability for irrigation schemes during the dry period by creating water reservoir(s) during the dry period by enlarging the secondary channel; • Optimisation of flood protection; • Improved accessibility of the river for people and tourism; • Development of a resort for tourism. 	<ul style="list-style-type: none"> • Constructing of a micro-hydropower installation near the outlet structure; • Extracting more river water for (primary) irrigation; • Bank protection works on the northern side of the island; • No activity foreseen yet; • Construction of a tourism resort. The site and characteristics are not yet defined e.g. number of rooms and m2. 	<ul style="list-style-type: none"> • Likely IEE, probably no EIA • Probably IEE, probably no EIA • Likely IEE, probably no EIA • No IEE or EIA • Likely IEE, probably EIA (depends on nr. of rooms and acres)

*) Source, Appendix 1 of the MOECAAF procedure on EIA, English version 2013.

1.2 Expert working group and field visit

This advice has been prepared by a working group of experts acting on behalf of the NCEA¹. The group comprises expertise in the following disciplines: river hydraulics and morphology, ecology, agriculture and social/gender aspects.

For the preparation of this advice, two members of the working group visited Myanmar in the period 23 until 28 November. Part of this visit was a two-day trip to the project area of the Bagan project, and was guided by representatives of MOECAAF, Royal HaskoningDHV and the Netherlands Economic Mission. During the visit to the project area the working group worked closely together with representatives of MOECAAF and the Ministry of Agriculture and Irrigation. On the main island, the village leaders of two villages were consulted. Separately, they spoke with local women. At the site of the pumping station, irrigation officials provided information and one of the leading farmers joined the group to visit the farmlands in the Bagan agricultural irrigation scheme. Prior to and after the field visit a meeting was organised with MOECAAF in the capital of Nay Pyi Taw. Appendix 3 gives an overview of the programme and the people consulted. Appendix 5 provides a photographic impression of the project area.

1.3 Justification of the approach

The primary task of the NCEA is to prepare an advisory report providing guidance for the development of the ToR for the EIA. To that purpose, the NCEA has reviewed the project proposal as well as the following documents:

- Proposition: Bagan river multipurpose beautification project (5 November 2014);
- National IWRM Strategic Study – From “Vision to action” (December, 2014).

A summary of the main observations of the review of the project proposal is presented in section 3.2.

A draft of this advisory report was discussed with the MOECAAF on 25 November 2014. After the site visit the observations were presented verbally and discussed with the MOECAAF on 27 November 2014. On 12 January 2015 the NCEA received final comments by the Ministry of Transport on an earlier draft of this advice and we have incorporated them in this final advice.

The NCEA made use of the structure of ToR for EIA, as prescribed by the EIA guidelines (MOECAAF, 2014).

In the development of this advice the NCEA has used the following sources of information:

- MOECAAF National EIA guidelines (2014).
- The Netherlands Ministry for Infrastructure and Environment as well as the potential funding by FMO – the Dutch Development bank requires application of the IFC performance standards for EIA and SIA.
- The NCEA has used its long term experience with providing advice on EIA.

¹ Appendix 2: Information on the working group of the NCEA

2. Policy, legal and institutional framework

The purpose of describing legislation, regulations and policies is: (i) to check if the intended initiative complies with these and (ii) to get insight in the opportunities and constraints concerning the development of alternatives.

In the EIA study, legislation and existing as well as proposed policies and plans should be described to check whether the intended initiative complies with these and to get insight in the opportunities and constraints for the development of alternatives. At the very least the following policies and plans should be considered:

- Plan for improving the navigability of the Ayeyarwaddy (World Bank initiative for the whole Ayeyarwaddy as well as the Dutch-funded feasibility study upstream of Bagan).
- National plan for climate change adaptation.
- National/regional agricultural policy or plan.
- Bagan (draft) management plan for UNESCO cultural heritage.
- National/regional plan or policy for future power supply of the Bagan area.
- Myanmar Tourism Master Plan 2013–2020 that aims to strengthen the structure for regional tourism by means of conducting pilot projects. Bagan was selected as a pilot project or model for regional tourism development. See: Final Report (JICA, August 2014) the detailed planning survey on establishment of the pilot model for regional tourism development in the Republic of the Union of Myanmar.
- Community development plans (if available).
- Cross sector laws, rules and regulations should also be considered (i.e. environmental, social, tourism, water resources and labour).

The project components/activities and identified alternatives should be checked on their consistency with the relevant existing policies and plans. Such a consistency check provides insight in the way the proposed project components/alternatives are contributing towards the achievement of objectives in the approved plans and policies. If it turns out that project activities are in conflict with one of the plans or policies, the EIA study should describe how this is resolved.

3. Project description

3.1 Description of the project activities

In the EIA study, each of the project activities needs to be described, to enable the assessment of the environmental and social effects. For each of the project activities the EIA study should provide more specific information.

- Dredging and river training works. For the description of this activity use can be made of the project proposal dated 5 November 2014. In addition, the following information needs to be provided:

- Describe the functioning/operation, location, situation and height of the inlet and outlet structure. Take notice in the design of the crest level of the structures that low-lying assets may longer be flooded with increased water levels.
 - Describe the locations of capital dredging, the estimated amount of material to be dredged, the timeframe for the dredging activities and the locations of the dredge spoils.
 - Describe the anticipated order of magnitude of maintenance dredging, in the main channel as well as in the secondary channel. Associated with this description also indicate the possible timeframe and dredge spoil locations.
 - Describe the materials used for the construction of the river training works and their borrow areas as well as the transport from the borrow areas to the project site.
- Flood protection, mainly by protecting the large island against further erosion:
 - Describe which flood protection measures are expected and at which locations;
 - Describe what materials are used and the location of the borrow area(s) as well as the transport from the borrow areas to the project site.
 - Demonstrate that high flood water levels are not increased by the project interventions.
- Water availability for e.g. irrigation by enlarging the present secondary channel, and if possible to ‘catch’ additional water in the aftermath of the seasonal flood, resulting in temporary water reservoir(s):
 - Describe the expected additional amount of water that will be stored and become available for irrigation per month.
 - Describe the required supply of power for the water pumps during the dry season, and indicate best ways to secure that the expected additional water can actually be pumped to the agricultural irrigation scheme.
- Sustainable energy generation by a hydropower turbine installation at the outlet structure:
 - Describe the turbine installation details, the capacity installed and the expected amount of electricity produced per month, the measures taken to avoid siltation that may hamper the functioning and to enable passage by aquatic life.
 - Describe which specific sectors or identified user groups are intended to benefit from the generation of electricity by the hydropower installation.
- Recreation by beautification of the riverine area near Bagan, by the presence of the larger secondary channel as well as by a planned tourism resort on the main island:
 - Describe the channel enlargement details and incorporate landscaping/beautification considerations into the design.
 - Describe the proposed location(s) and possibly indicate the type of resort, the size in acres and the accommodation capacity i.e. the number of rooms available at any one time.
- Land development:
 - Provide for optimal land area and conditions in the project area of the enlarged channel, for instance winter cropping: by doing so, the reduced area for winter

cropping that is envisaged by increasing the water level and/or dredging away shallow banks, may be compensated or (preferably) over-compensated.

- Waste management:
 - Describe the waste management during both construction and operation phases.

The MOECAF emphasised the importance of river front development on the Bagan river bank. It is clear that this project does not intend to develop the water front. Therefore the NCEA suggests to indicate potentials and possibly make a vision as it fits into the integrated approach of this project.

As the project is aiming to contribute to the beautification of the project area, specific attention is asked for the way the following project activities will fit in, and are of added value to the landscape:

- design of the secondary channel layout, including functioning of reservoir(s);
- inlet and outlet structure (including micro-hydropower), river training works, river bank protection measures;
- tourist resort;
- Bagan water front development (voluntary, e.g. outline vision, indication of potentials).

Artist impressions need to be made to be able to assess the visual effects on the landscape.

3.2 NCEA main observations concerning the project proposal

3.2.1 EIA legal requirements

The NCEA noticed that the following three main issues are still insufficiently addressed in the present project proposal:

- problem analysis, vision and objectives;
- development of alternatives;
- consultation and disclosure.

These issues are summarised in this section. Furthermore, the NCEA provides specific guidelines to elaborate these issues in the EIA study in Chapters 4, 6 and 10 of this advisory report.

Problem analysis, vision and objectives

A challenge of this project is to promote the most desirable socio-economic developments, by developing riverine functions that are best contributing to the desirable socio-economic land-use development of the hinterland and its ecological values. In the EIA report, a vision on such developments and the link with secondary objectives of the project needs to be established.

The NCEA noticed that the analysis of the problems that underlay the proposition is insufficient. The project rationale requires more attention. In the proposal main and secondary objectives of the project are mentioned. The analysis of the main problem of

limited navigability is insufficiently justified in the proposition. In addition, a number of secondary objectives are identified but the need to define these objectives is hardly substantiated. Reference has to be made to overall opportunities and challenges identified in the region and river basin and explanation provided on the extent to which each of these challenges can be addressed through the project.

Development of alternatives

In the project proposal no alternatives have been given, and therefore alternatives that could also contribute to the achievement of the main and secondary objectives, have not been compared. Through the development of these alternatives the main and secondary objectives can possibly better be achieved as well or be optimised further.

Consultation

The NCEA noticed that a selection of formal stakeholders has been identified and consulted. However, inter-ministerial or public consultation has not been executed yet, nor is reference made in the proposition for the need for this consultation.

3.2.2 Questions on the conceptual design of the project components

The NCEA has questions regarding the conceptual design of the following project components:

- The construction of inlet and outlet structures in the secondary channel aims to create a temporary water buffer or reservoir during the dry period (November – March). The water in this reservoir is intended to be used for multiple purposes such as drinking and irrigation water, transport and as a permanent water body for tourism. The NCEA raises two questions: (i) Does this water buffer last during the dry season, because due to the highly sandy bed composition of the secondary channel the infiltration may be high, resulting in loss of surface water; (ii) The capacity of the pumping station is large and the reservoir volume is limited. Therefore it should be assessed whether the reservoir contains sufficient water for on the one hand extraction for additional irrigation and on the other hand to provide a sufficiently large water body that it is valued by tourists and that really adds to riverine beautification. If the above is not feasible, the EIA report should elaborate in how far the deepening and widening of the present secondary channel by dredging may fulfil the above objectives.
- The micro-hydropower installation that is planned to be installed near the outlet structure can only be operational during higher river stages, outside of the dry season. The EIA should therefore elaborate on the cost-effectiveness of this installation.
- The construction of a tourism facility is not yet elaborated in detail. Presently the search area for the location is on the river bank of the secondary channel on the northern part of the island opposite the hotel zones of Bagan. However, this location is vulnerable for flooding and therefore the design needs to be adaptive and the location may require erosion control works.

The NCEA requires to provide clarity about these issues in the EIA study in the section description of the project activities.

3.2.3 Suggestion for analysis

After return of the NCEA working group members to the Netherlands, three existing structures (weirs) were identified in the secondary channel on satellite images (Google Earth), south of the area that had been visited during the site survey. The structures may have a temporary function: at least one structure was shown to be installed in the winter time of last year (which was obvious from successive images). The structures seem to serve as water retaining structures during the receding river stage after the monsoon period.

Such structures may be interesting to investigate in the EIA study as they indicate the usefulness of water storage in the dry period. In addition, they may provide quantitative clues on the permeability of the subsoil of the water bodies upstream of the structures, when further explored and analysed. An impression of the existing structures as given in Appendix 4.

4. Problem analysis, vision and objectives

The purpose of describing the problem analysis and objectives is to assess if the proposed activity does solve the observed problem and to assess if the project objectives will be achieved.

Problem analysis and justification of the project

For an insight in the current and future problems it is necessary to carry out an in-depth analysis of the following problems in the defined project area, the underlying causes and the consequences for the socio-economic development of the private sector and people (women and men) living in and outside of the Bagan region.

1. Regional and inter-regional transport demand, modal split and contribution of improved navigability of the Ayeyarwaddy.
2. Loss of land and assets on the island in front of Bagan.
3. Availability of and women's and men's access to water and energy as limiting factors for irrigated agriculture in the area of Bagan.

The influence of the minimum and maximum climate change scenarios for the Ayeyarwaddy basin (upper and middle part) on these three problems needs to be described for 2050 or at the very least a broad anticipation of the potential effects of climate change.

Ad 1) The EIA study should describe:

- Actual and potential importance of the Ayeyarwaddy River for regional and inter-regional inland water transport of people and cargo (e.g. oil and coal) compared to the transport by existing and planned other modes such as pipelines, railways and roads. A brief comparative analysis is required to justify the investments to improve the navigability of the Ayeyarwaddy River. The Bagan project is considered as a pilot project that will solve the river transport bottleneck in the Ayeyarwaddy near Bagan.
- Navigational constraints, e.g. Least Available Depth (LAD) for the Ayeyarwaddy project area near Bagan and the observed tendencies over the last 20 – 30 years, as well as present longitudinal bed profile in the thalweg (if not available, from additional field measurements). In addition, the EIA should provide an indication of tendencies to be expected over the coming say 30 years, taking into account the effects of climate change (see above) and autonomous changes in sediment load.

Ad 2) Loss of land and assets: The EIA study should identify the significance and the risks (in recent years) and future (after bank stabilisation) loss of land and assets for women and men on the island located in front of Bagan and other stakeholders. The project will not only save land: some loss of land may occur by reduction of the area of riverine banks and sand bars in the secondary channel, by increasing the water volume by dredging and by ponding up of the water (when feasible). If possible, this loss of land should be quantified in the EIA study taking into account the natural variability of the secondary channel.

Ad 3) Availability of drinking-, irrigation water and energy. The following items should be addressed in the EIA study:

- Assessment of the present and future drinking water supply and demand for the Bagan area, including projections for a considerable growth of the number of tourists.
- A brief assessment of the agricultural potential and practices for the irrigation scheme of about 7200 acres located in the area of Bagan of which only a minor part presently receives surface water for irrigation from the secondary channel. In this assessment gender aspects need to be considered, by gathering sex dis-aggregated data. Presently, irrigation water and power provided by the national grid are considered to be the limiting factors to make full use of the agricultural potential. Moreover, the NCEA notices that the irrigation water could be used more efficiently. The opportunities for saving water by practicing more efficient use of water should be described in the EIA study.

Vision and objectives

The NCEA welcomes the project initiative in which river development is placed in a wider context than solely the improvement of the navigability of the Ayeyarwaddy. The pilot project as proposed may become an example for promoting the further development of inland navigation projects in an environmentally and socio-economically sensitive manner. A vision on such developments and the linkage with secondary objectives of the project needs to be prepared.

It is recommended to develop a vision for the integrated development of Bagan section of the Ayeyarwaddy River taking into consideration:

- Problem analysis as indicated in the above section.
- Awareness that the project, although being a pilot with a modest spatial and functional scale, may become a pivotal starting project for sustainable development of the

present, virgin Ayeyarwaddy River and Delta system. This imposes a specific responsibility on the project and calls for a highly careful analysis.

- Review of opportunities and challenges identified in regional and basin analyses, IWRM, the inland navigation feasibility study (as far as already available) and the plan that Bagan becomes a UNESCO world heritage site (use can be made of a draft management plan).
- Socio-cultural analysis, identifying how women and men could benefit most from the pilot and sub-sequent projects, taking into account women's and men's different water-related responsibilities and realising differences in education, job opportunities, influence in decision making on project-related developments and new opportunities.
- This vision should also zoom in on the island in front of Bagan as it is vulnerable for flooding and has a rather unique position, isolated and yet so close to Bagan. The construction of the first tourist facility could be the start of (uncontrolled) tourism development with positive and negative consequences for the inhabitants of the island. This calls for a sound socio-economic embedment of such a development.

5. Description of the surrounding environment

This chapter provides guidelines to describe the autonomous development which serves as a reference situation or alternative. With the autonomous development/reference alternative we mean: the current situation in the project area without the project. This could for example mean, including the effects of other projects that are planned. The pros and cons of the reference alternative should be used to compare with the pros and cons of the two alternatives that are suggested to be developed. In Chapter 6 suggestions are provided for the development of those two alternatives. Based upon the comparison of these alternatives and the reference alternative, the preferred alternative should be selected.

Setting the study limits (demarcation of the project and study area)

The area that will directly be affected by the proposed project, consists of the following geographical or project landscape units:

- main channel (project site);
- secondary channel (project site) including Bagan river front and the river banks of the island along the secondary channel;
- agricultural irrigation scheme in the Bagan area;
- villages located on the northern and eastern part of the island in front of Bagan;
- borrow areas providing construction material and transport corridors between the borrow areas and project site.

The study area for the EIA is the area that will indirectly be affected by the proposed project and consists of:

- the sections of the Ayeyarwaddy River between the naturally stable river sections at Pakokku and Chauk that might be affected due to changes in the flow conveyance of the river and in the sediment balance;
- the main transport hubs upstream and downstream of the project site that benefit from improved navigability (mainly cargo, but possibly also people, e.g. to and from the island and the secondary channel);

- villages located in the western and southern part of the island in front of Bagan.

Main users or stakeholders

Main groups of users or stakeholders that have so far been identified and presently make use of services provided by the identified project landscape units:

- Boat owners and crew/traders: the owners and crew of boats who are responsible for transport of people and cargo in the near-Bagan area of the Ayeyarwaddy River;
- Farmers: two main groups of farmers can be distinguished. A group of farmers that owns land in the irrigation scheme of about 7200 hectare. Another group of farmers who are living on the island of Bagan where they get land allocated on a yearly basis. The diversity as regards socio-economic characteristics within those two groups of farmers is large.
- Labourers: there is group of people who do not own land or own land that cannot be irrigated at present. They generate (additional) income by providing labour to farmers or day labour (e.g. gravel mining in the riverbed during the dry season).
- Tourists: presently, the tourists who are visiting the Bagan area for a couple of days very rarely visit the island of Bagan and therefore the use of tourist boats is limited.
- Fisher folk: local people whose livelihood (partly) depends on fishing and fish product manufacturing.
- Gold-miners: this group of people is mentioned as possible users in the proposition but they were not identified as main user group by local people during the NCEA field visit. Therefore this group is not included in table 2.
- Users of the study area not yet identified: potentially there might be other users that have not yet been identified but need to be considered.

The size of each of these groups needs to be estimated and other relevant groups, if present, would need to be identified and taken into consideration in the EIA study. It is important to realise that the identified stakeholder groups may not be homogeneous groups. The scale of activities may be different for people with different socio-economic status and women and men in the same stakeholder group may undertake different tasks. Different people within the same stakeholder group may therefore be affected differently by the proposal or its alternatives.

Following the approach of the UN Millennium Ecosystem Assessment (MA, 2003 ²), the Bagan project area can be described as a landscape consisting of (four) homogeneous units providing multiple services for human well-being. Enhancing one of these services may go at the cost of other services, and may consequently affect stakeholders depending on these services negatively.

In table 2 the main services provided by the landscape units of the project area, are listed. The main user groups of the services have been identified. This list of services and users has been elaborated during a two day field visit by the NCEA and is most likely not exhaustive. The NCEA would like to emphasise that the EIA study should focus on the main services used by the different user groups that might be affected (positively or negatively) as a consequence (directly or indirectly) of the implementation of the Bagan project.

² Millennium Ecosystem Assessment (2003) Ecosystems and Human Well-being: A Framework for Assessment. Island Press. (<http://www.millenniumassessment.org/en/products.aspx>)

Transport

- **River transport:** The Ayeyarwaddy River provides the opportunity for year-round transport of people and cargo. Although during the peak flow it might become too dangerous or costly (strong current) and during the dry season it may become too shallow for large boats to pass. In the EIA study an overview should be provided of the present use of the Bagan section of the Ayeyarwaddy by different types of boats, amount and type of cargo and passenger transport.

Table 2: Preliminary assessment of the main services presently provided by the identified landscape units for the main users.

Landscape units	Main services	Project area – main users					Study area
		Farmers land owner (by sex)	Boat crew & owners	Tourists	Fisher folks (by sex)	Labourers (by sex)	Main users not identified
Main channel	-Transport - Fish - Sediment. & erosion	- - -	X - -	? - -	- X -	X - -	- ? X
Secondary channel & (river front)	- Domestic Water - Irrigation - Transport - Cultural - Food / fish - Habitat for diseases - Hydrop. *	X X X X X X ?	- - X - - - -	X - X X - X -	- - - - X X -	- - - - - X -	- - - - - - -
Irrigation scheme	- Food - Cultural	X X	- -	- X	- -	X X	- -
Island	- Food - Cultural - Sedim. (silt) /shelter	X X X	- - -	- X -	- - -	- - -	- - -
Borrow areas	Not considered as providing main services						

* Hydropower is not a present but a potential service Source: NCEA during field visit in November 2014

Food (agriculture) and water

- **Domestic water supply:** the use of water for drinking and other uses, the amount and origin of domestic water (surface water / boreholes) should be described in the EIA study.
- **Water quality:** upstream larger cities and industrial zones, potential sources of pollution, might affect the water quality. The basic water quality of the Ayeyarwaddy

needs to be assessed – by making use of measurements made – for October and November in one of the previous years, assuming that the water intake in the reservoir will be during those months. The suitability of this water needs to be assessed on the following purposes: irrigation, drinking water, swimming and bathing.

- Water supply for irrigation: the irrigation scheme near Bagan with a size of approximately 7200 acres receives supplementary irrigation during the wet season. During the dry season water is pumped from the secondary channel and on average about 25% of the irrigation scheme is irrigated. Apart from limited water availability, electric power supply restricts the pumping of more water. The present agricultural production characteristics as well as the socio-economic position of the farmers/labourers need to be described in the EIA study. The minimum and maximum demand for electricity used by the water pumps as well as the supply by the grid need to be described on a monthly basis.
- Flood recession based agriculture: the island of Bagan is temporarily flooded during the wet season. As a consequence the natural sedimentation of silt provides natural nutrients to the soil. In the dry season agriculture is mainly moisture and groundwater dependent (allowing winter crops) and incidentally crops are irrigated supplementary by using shallow wells. The EIA study should describe how the present seasonal regime of the Irrawaddy influences the agricultural production. The importance of the production of winter crops on the river banks and river bed of the secondary channel should be described as well.

Sedimentation and erosion

- Natural erosion and deposition of sediment/silt: forces of erosion and deposition are strong due to the highly dynamic character of the Ayeyarwaddy River. Contributing to that dynamic character is the high sediment load and the prolonged periods of low and high river stages in the dry and monsoon periods, in which the water level may change more than 10 meters. Compared to former days with abundant forests, currently the vegetation cover is strongly reduced in the upstream catchment and as a consequence surface soil erosion is more intense at a catchment scale. Hence, considerable amounts of eroded material are fed into the Ayeyarwaddy river system by seasonal rains. Floods are still valued for the silt they bring onto the lands, thus maintaining soil fertility. It is anticipated that the high sediment load of the Ayeyarwaddy, in combination with potentially higher flood discharges, will continue to increase in future. This enhances the risk to further worsen the navigability, unless dredging and river training will be applied for the Ayeyarwaddy at a larger scale. In the EIA report the present situation should be addressed as far as relevant for the project area, including the potential effects of climate change. Furthermore the quality of the sediment that will be dredged should be assessed.

Health

- Providing habitat for disease transmitting organisms: the creation of a more or less temporary water reservoir may enhance the reproduction of freshwater related water borne diseases such as mosquitoes and bilharzia. This depends on the type of vector species and their ecology. The risk of infection greatly depends on availability and reliability of public water supply and vigilance of primary health care services. In the EIA study the present risk of water borne diseases that are likely related to the standing and receding water in the secondary channel during the dry season needs to be described.

Fisheries / biodiversity

- Influencing fisheries: the deepening of the main channel, the creation of a temporary reservoir in the secondary channel and the installation of micro-hydropower generators might influence the fisheries resources. In the EIA study the importance of the Bagan section of the Ayeyarwaddy needs to be described for the populations of important fish species (important because of commercial value or because of a threatened or protected status) and for the Irrawaddy dolphin.

Cultural

- Cultural, spiritual services: the Bagan area is known for its cultural heritage that is valued by the people living and working in the Bagan area and by national and international tourists. In addition, in the EIA study needs to be described, the occurrence and value of cultural heritage located in the project area and specifically on the Bagan river bank and on the island located in front of Bagan. A map indicating cultural heritage in the project area should be included.

6. Development, comparison and selection of alternatives

The purpose of describing the development of alternatives is to investigate any potential alternatives that may present environmentally sustainable, socially acceptable and economically feasible solutions.

It is suggested to develop and present two comprehensive alternatives in the EIA study that will be compared with the autonomous development which can be considered as a reference alternative. Those two alternatives could be considered as a continuum and aim to facilitate a debate on the pros and cons in achieving the project objectives. A comparison of the impacts of the proposed alternatives with the reference situation should provide the justification for the selection of one of the alternatives.

In the process of developing alternatives ideally representatives of the identified stakeholders should be involved.

In this section suggestions are provided for building blocks that can be used for the development of comprehensive alternatives for each of the identified project area units. Mitigating measures to prevent or reduce environmental or socio-economic impacts can be considered as building blocks as well. It is recommended to combine the building blocks in at least two comprehensive alternatives.

Building blocks for the development of alternatives, to be elaborated in the EIA study are:

- **Main channel**: in addition to the proposed river training works, the opportunities to improve the navigability in the short-term through application of "soft" guidance (fairway beaconing, update thalweg information, radar, radio-controlled guidance, GPS etc.) should be indicated, acknowledging the time-restraints for the institutional set-

up of fairway guidance systems. Outcome of this reconnaissance may be that simple guidance measures are feasible in the short-term. Such measures should then be considered as an alternative to dredging.

- Secondary channel: for the development of the river training works in the secondary channel three options should be developed:
 - Option X; optimises the navigability of the main channel by means of river training works at the entrance of the secondary channel and outlet to increase flow intensity in the main channel and avoid backflow;
 - Option Y; optimises the development of a buffer or reservoir to supply irrigation water;
 - Option Z: optimisation (by means of compartments) of buffers or reservoirs for multiple use by securing permanent water of good quality during the dry season for irrigation, recreation, the inlet structure also used as a temporary bridge and possibly creating habitat for fish.

After the development of the river training works required for the options, an optimum mix can be considered that aims at an optimum combination of functions (which is also of importance for maximising the revenues of the project).

- Secondary channel:
 - A challenge is to optimally utilise the generated electricity with the micro-hydro power installation at the outlet structure. An alternative for delivery of electricity to the grid would be to store the energy in such a way that the energy can be made available as and when required. A combination with one or more (small) reservoirs could be an option. This option also enables the direct delivery of additional water to the irrigation scheme, when properly designed. Prior to further detailing of possibilities, a realistic reconnaissance should be made on the seasonal power to be generated and on the features and potentials to delivery to the local grid.
 - The potential to introduce aquaculture needs to be investigated.
 - Fish friendly turbines, fish passages such as ladders, and the opportunity to create habitats that are beneficial for fish and other aquatic life needs to be described.
 - Land use: by proper landscaping, for example in association with using dredged materials (if clean), loss of land may be compensated. It is well thinkable that even more shallow flats may be created than are available now, for winter cropping for instance.
- Main and secondary channel:
 - The project envisages to realise interventions that limit the dredging efforts. An alternative needs to be developed for maximum re-use of the dredging spoil. In the case where not all dredging spoil can be re-used, the optional deposit sites needs to be selected, justified and described.
 - As an alternative for or addition to electricity generation by means of micro-hydro installation in the outlet structure, one could develop compact micro-hydro installations attached to multipurpose floating barges, for instance in variable positions, to be located in the secondary channel (during higher flows) as well as the primary channel (during a wide scope of flows). If such a

development is sufficiently small-scale and implemented widely, it may well be highly beneficial to small enterprises.

- Irrigation scheme: In addition to pumping more irrigation water, one can also develop more water-efficient crops and a more efficient water supply for the fields, in which case a larger area can be irrigated. An assessment of potentials for more water-efficient irrigation and crops may increase the societal revenues for improved irrigation and is recommended to be studied in the EIA.
- Island in front of Bagan:
 - In the EIA study for the protection works, at the very least the following option should be elaborated: the use of geotubes and/or geocontainers by making maximum use of local sand.
 - The development of tourist facilities is not yet elaborated in detail. Therefore, in the EIA study, alternatives need to be developed for different sites, type and size. One needs to take into consideration that tourist facilities located on the island are vulnerable to flooding and that the banks may be vulnerable to erosion. A design that is adaptive to flooding, for example on piles, floating or a non-permanent structure that can be removed during the flood season should be elaborated. Community-based tourism, when properly organised and controlled, is an alternative that might fit with the socio-economic characteristics of the people living on the island and should therefore be assessed in the EIA report.
 - In the EIA study the opportunities for maximum extension of the land area at the main island should be described. This can be done by bank realignment, as part of the bank protection works, along the presently eroding north side of the island, for instance by making use of dredge spoils.
- Bagan river front development: MOECAAF has indicated that development of the river front is desired in order to create a public space such as proper bank protections, a boulevard or the opportunity to develop jetties. River front development fits in the multipurpose character of this project that aims to contribute to the beautification of the project area. However, this activity is not foreseen in the project and therefore elaboration might be done on a voluntary basis.

7. Impact and risk assessment

Starting point for impact assessment are the services that are listed and described in chapter 5. Impacts on these ecosystem services due to the project, need to be quantified for the alternatives as much as possible, following a three-steps approach:

7.1 Step 1: Changes in ecosystem services

Describe and quantify the actual services provided as well as the expected change under two alternatives. Suggestions for the way in which services can be expressed for each of the identified landscape units in the project area are provided below:

A. Main channel

- **Transport**
 - Expected change in the intensity of inland water transport for cargo (size of boats and cargo specified per type) and passenger transport in the study area.
 - Describe the risks of accidents (safety of small boats and passenger transport) and the risks and consequences of spills of hazardous substances (oil, fuel, cement, other).

- **Fish / biodiversity**
 - Describe the impacts of dredging and the noise and vibrations from sheet piling (where relevant) and whether and to what extent it influences the viability of populations of fish and other valuable species.

- **Sediment**
 - Describe the expected qualitative change in sedimentation and erosion for the section downstream and upstream of the project area, and the potential risk of hampering navigation in those sections.
 - Describe the expected change as a result of dredging on the river bottom on water quality, turbidity and aquatic life. The chemical quality of the dredge spoils needs to be determined to know if pollutants from upstream sources have accumulated here.

- **Water**
 - It should be noted that deepening of the main channel could result in a decrease of the water level on the upstream side of the works and this might influence the groundwater level in the project areas as well. Describe both effects and take into consideration that the planned works in the secondary channel will most likely compensate those effect to a certain extent.

- **Mining**
 - In case small-scale gold mining by means of sieves takes place at or near the project location, it should be described how dredging and changes in sediment balance will affect the livelihood of these miners.

B. Secondary channel / water reservoirs

- **Water**
 - Describe to what extent the water quality might be changed when the water will be more isolated due to the construction and operation of inlet- and outlet structures or compartments, in particular the consequences for the quality of drinking water.
 - The improved availability of irrigation water will enhance agricultural production. Especially in the dry season more water will become available, generating the potential to introduce more crops per year or to increase the irrigated area. When the water becomes available at a fair price to small farmers it can support

poverty alleviation. However, when only large-scale commercial farmers will benefit from the water reservoir, this may threaten small farmers livelihood and create more competition over irrigation water.

- **Food / Agriculture**
 - During the dry season, immediately after the receding flood waters, farmers are making use of the river banks and river bed to practice moisture based cropping. The development of a water reservoir may lead to loss of land used for this type of cropping and the effects need to be described.
- **Transport**
 - Describe the change in transport opportunities by water due to the construction of the reservoir and/or the change in use of the inlet structure for pedestrians and/or motor bikes during the dry season.
- **Sedimentation / erosion**
 - Assess to what extent the lifetime and the storage capacity of the enlarged secondary channel / reservoir might be affected / will change due to sedimentation and to what extent the inlet and outlet structure and their operational regime (including the micro turbine installation) have an impact on this lifetime and storage capacity.
 - Describe the change as a result of dredging of the river bottom on water quality, turbidity and aquatic life. The chemical quality of the dredge spoils needs to be determined to know if pollutants from upstream sources have accumulated here.
 - With the sedimentation in the water reservoir the sediment load of the river downstream of the reservoirs will decrease. Potentially this may generate increased erosion of bed and banks. This should be described in the EIA study.
- **Health**
 - Describe the potential change in the occurrence of water-related diseases like bilharzia, malaria and dengue.
- **Fish / biodiversity**
 - Fish migration will be blocked by the reservoir and will, outside of the flood season, only be possible through the main channel. Effect on aquatic life of this change in migration needs to be described.
 - With the construction of the reservoirs, small pools of water, which serve as spawning and nursery ground for fish may disappear. This potential change needs to be described in the EIA study.
 - Maintaining biodiversity: change in habitat of species with internationally recognised status such as the Ayeyarwaddy Dolphins (Critically Endangered) with a population of about 50 individuals in the Ayeyarwaddy River (2003 measurements³). A protected zone is located upstream of Mandalay but is not affected by the project. However, this species is also observed in the project area and the effects of the project on these mammals need to be described.
 - Impact of turbines on mortality of fish and other aquatic life needs to be described.
 - Safety risks of turbines, electricity storage and distribution needs to be described for the local population and fishermen fishing close to the turbines.

- **Hydropower**
 - The EIA study should describe to what extent the beneficiaries of the electricity generated by the hydropower installations i.e. which specific sectors benefit in economic and social terms.

C. Irrigation scheme

- **Food /agriculture**
 - Assess the following possible changes on the agricultural production opportunities and expected gender specific socio-economic changes for the farmers and labourers of: (i) the additional supply of irrigation water; (ii) more efficient use of irrigation water and better cropping and (iii) risk of leaching (due to absence of drainage).

D. Island in front of Bagan

- **Livelihood**
 - Due to the isolated character of the island in front of Bagan, the EIA study should assess the following possible changes (positive and negative) on the livelihood system of the people (economic aspects, social aspect such as social cohesion and cultural identity) living on this island in terms of: (i) availability of surface water during (part of) the dry season; (ii) decreased risk of loss of land, cultural heritage and assets due to stabilisation of the island; (iii) improved access to and from the Bagan area; (IV) tourism facilities on the river banks of the island or inland.
- **Tourism**
 - The EIA study should describe a change in risk of uncontrolled tourism development on the island in front of Bagan as the island belongs to another jurisdiction as Bagan and it is not considered in the Bagan pilot model for regional tourism development. This might be a serious risk.

E. Borrow areas

- Existing borrow areas: as long as existing borrow areas such as quarries and sustainable managed forests are used for the extraction or recycled construction materials (e.g. wood, gravel, cement) no extensive assessment needs to be made assuming that these borrow areas have their own environmental label (e.g. Forest Steward Council), environmental permit and/or environmental management plan.
- New borrow areas: in the case where new borrow areas need to be opened or developed it should be checked whether an EIA or IEE is required.

7.2 Step 2: Affected stakeholders

Description of the (groups of) users or stakeholders affected by or making use of these services. Define for the main services the area of influence. Different services may have

different areas of influence. In addition to the direct users of the services that have been identified in Chapter 5, one could also think of the following groups of stakeholders:

- government for its national policies or international obligations concerning cultural heritage protection, tourism development or biodiversity conservation;
- non-governmental organisations representing biodiversity conservation.

7.3 Step 3: Social and economic assessment

The NCEA recommends to make use of a Multi Criteria Analysis (MCA) to value the changes of services. An MCA is designed to make quantitative comparisons between such varying expressions of values and is very useful when impacts cannot easily be expressed in financial terms. The changes in ecosystem services are expressed in terms of changes in social and economic values for stakeholders. Values can be expressed in their own terms, such as number of employed people, agricultural production, number of people served by public water supply, number of threatened species being affected, contribution to gross regional product. The NCEA advises to make use of interviews with experts and key resource persons, reinforced by consultation of (representatives, gender specific of) the farmers/labourers from the irrigation scheme and from the island to describe the importance of the different changes.

8. Cumulative impacts

This project is a pilot project. If this pilot is considered to be a success more of this type of projects may be implemented, creating cumulative impacts.

In this EIA report in particular the potential cumulative upstream and downstream impacts needs to be described for:

- Risk of changes in the upstream and downstream river dynamics, such as sedimentation and erosion patterns;
- Extraction of surface water for irrigation during the dry period. Cumulative increased irrigation may have impacts on the Delta in terms of reduced low water discharge in the dry period as well as increased risk of salinisation.

The assessment of this pilot should take place in the context of the related developments in the whole catchment, i.e. with the Integrated Water Resources Management (IWRM) 'building blocks' study. In addition, the Management Project (P146482) of the World Bank may be a good general basis for this.

9. Environmental management plan

This project is considered to be a pilot project and therefore adequate monitoring of the effects of the execution of the dredging and construction of river training works is important.

In line with this monitoring, for instance adaptation of the dredging, of the river training and of the secondary channel operations should be considered. In the final design stage, a comprehensive monitoring plan needs to be made that takes into account the monitoring itself, as well as adaptation measures based on identified risks, data to be monitored and mitigation of adverse effects. An outline plan for functional and environmental monitoring and feasible adaptations of the interventions to mitigate adverse effects and other risks should be part of the EIA.

10. Consultation and disclosure

In Chapter 5 of this advisory report the primary stakeholders or users relying on the main services have been identified. These stakeholders might directly be affected by the project. Public consultation with these stakeholders serves to ensure that the project has the intended impact on them and avoids unintended (negative) consequences. Village meetings are important, which further need to ensure that perspectives from women and men are taken into account. It is important to realise that not all community members (women/men; ethnicity; wealth; age) may have equal voice. Local community and women's groups and local and (inter)national NGOs may complement findings from community consultation. Direct stakeholder consultation furthermore is an important tool to encourage project collaboration, to prepare people for anticipated changes and to raise realistic expectations.

Other stakeholders include government authorities. Consultation with these stakeholders serves to ensure coherency between and alignment with other government policies and plans. As part of the EIA report inter-ministerial consultations need to take place. Apart from the Ministry of Transport and the Ministry of Agriculture and Irrigation and the Bagan Authorities, ministries or departments such as Tourism, Livestock-Fisheries, Health and Social Welfare may bring relevant perspectives for a coherent intervention.

For the particular interventions within the Bagan Project, consultation with private sector partners is important. One could think of the following stakeholders:

- Potential Myanmar SME developers and investors;
- Myanmar fleet operators and tourism industry;
- FMO Dutch development bank;
- Dutch project initiators.

APPENDICES

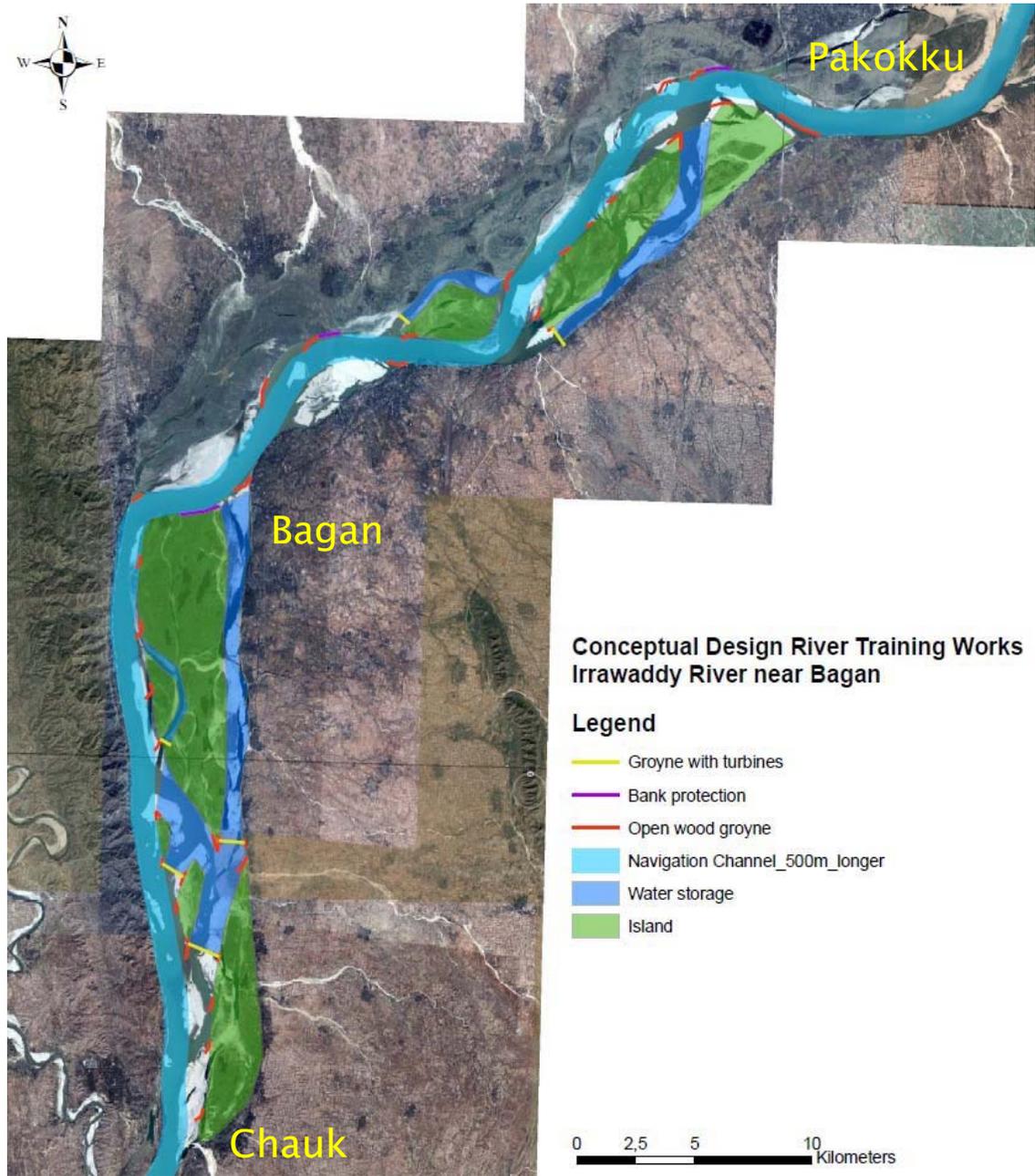
with the Bagan River Multipurpose Beautification
Project – Myanmar

Advice for ToR for EIA

(Appendices 1 to 5)

Appendix 1

Map of the project area



Conceptual design of the river training works, including channel stabilization works, bank protection and turbine groins (source Bagan River Multi-Purpose Beautification Pilot Project 5 November 2014)

APPENDIX 2

Project information

Proposed activity: This project is known as the Bagan River Multi-Purpose Beautification Pilot Project (hereafter the Bagan project). This project initiative concerns primarily to improve the navigability of the Irrawaddy river near the city of Bagan through dredging and a set of river training works. These training works guide the flow through the main channel and regulate the flow in the secondary channels to some extent. During lower river stages, the idea is to concentrate the discharge more through the main channel, whereas the discharge through the secondary channels during highest stages is enabled, in order to prevent significant water impoundment

The multipurpose approach is covered by contribution of the dredging and river training activities to:

- Flood protection, mainly by protecting the large island against further erosion.
- Water availability for e.g. irrigation by enlarging the present secondary channel, and if possible to 'catch' additional water in the aftermath of the seasonal flood.
- Sustainable energy generation by a hydropower turbine at the outlet structure.
- Recreation by beautification of the riverine area near Bagan – by the presence of the larger secondary channel-, as well as by a planned resort at the main island.
- Land development, e.g. enabling improvement of the irrigation scheme.

A working group of experts of the Commission for Environmental Assessment (the NCEA) has been asked by the Minister of Transport of Myanmar through the Ministry of Infrastructure and Environment of the Netherlands to provide an advice for the Terms of Reference for the Environmental Impact Assessment (EIA) for the Bagan River Multi-purpose 'beautification' project. On behalf of the working group Mr. Akkerman and Mr Kolhoff have visited the project area and have met (representatives of) the people that will most likely be affected.

The NCEA will make the final advice on ToR for EIA for this project publicly available after the advice has been presented to the Ministry of Transport in Myanmar.

DAC/CRS purpose codes categories:

- 41050 – flood prevention/control
- 31140 – Infrastructure-focused integrated river basin projects and related institutional activities; river flow control; dams and reservoirs (excluding dams) primarily for irrigation
- 23065 – hydropower
- 33210 – tourism policy and administrative management
- 21040 – activities related to river transport

Project numbers: OS25-101

Progress:

- Advice for ToR for EIA, submitted December 2014
- Approval of ToR for EIA (planned December 2014)
- EIA prepared (planned January -March 2015)
- Review of draft EIA (planned in March - April 2015)

Composition of the working group of the Commission for EIA:

- Mr G.J Akkerman (Gert Jan) -River morphology and water management
- Ms S.P.W. (Saskia) Ivens - Social aspects and gender equality

Technical secretary: Arend Kolhoff (Environmental sciences)

Chair: prof. Rudy Rabbinge (Agriculture)

APPENDIX 3

Programme of the site visit

Visit of working group Bagan project of the Netherlands Commission for Environmental Assessment to Myanmar, 23 – 29 November 2014

Date	Activities
1 st Day Sunday 23 November	<ul style="list-style-type: none"> - 15.00 Arrival of working group members Mr. Akkerman and Mr. Kolhoff in Yangon - 20.00 Briefing with Ms Carola Baller and Ms Olga van Leeuwen (Economic mission) and Mr Harrie Laboyrie (Haskoning/DHV) -
2 nd Day Monday 24 November	<ul style="list-style-type: none"> - 09.00 – 10.00 Visit environ – consultancy firm - 12.00 – 13.00 Visit NEPS consultancy firm and representative of Water expert group - 16.00 – 17.00 EU country office
3 rd Day Tuesday 25 November	<ul style="list-style-type: none"> - 04.00 Departure by car to NPT - 11.00 – 12.30 Briefing at MOECAAF in NPT - 13.00 Lunch meeting with ADB consultant supporting MOECAAF - 14.00 – 19.00 Travel by car NPT to Bagan
4 th Day Wednesday 26 November	<ul style="list-style-type: none"> - 08.00 -18.00 Site visit , including visit to pumping station, boat trip on the Irrawaddy and visit to the main island in front of Bagan.
5 th Day Thursday 27 November	<ul style="list-style-type: none"> - 09.00 – 12.00 Site visit of the irrigation scheme - 12.00 Tourism office - 13.00 -18.00 Travel Bagan to NPT - 18.00 – 20.00 Debriefing at MOECAAF in NPT
6 th Day Friday 28 November	<ul style="list-style-type: none"> - 08.00 - 09.00 Flight NPT to Yangoon - 12.00 - 13.00 Ministry of Transport - 15.00 - 16.00 Ms Vicky Bowman – director Myanmar Centre for Responsible Business
7 th Day 29 November	<ul style="list-style-type: none"> - 06.00 Departure to Netherlands - 12.00 De-briefing Mr Harrie Laboyrie (HaskoningDHV) at Bangkok airport

Appendix 4

Present small weir structures in the secondary channel

From satellite images (Google Earth) it can be observed that approximately one year ago during the low water period, three small structures were present in the downstream part of the secondary channel (south of the project area for the Bagan Project). These structures have obviously been installed to retain the water of isolated upstream secondary channel sections. This is shown in the figure below.



Small weir structures that retain water in the upstream isolated water bodies of the secondary channel during low water period

During the site visit, the NCEA team was not aware of these structures (the visit was too short to allow for further inspection of these structures). As a consequence, the team has to rely on the satellite observations. During subsequent times at which the images were available one year ago, some changes can be seen. For example: for structure 1 the image of 21 December 2014 shows that the structure is about 100 m wide, whereas at 31 December 2014 approximately 50 m remains. Obviously the flat

banks of the sand islands on both sides of the constricted channel have been emerged in the meantime and the cultivated pattern indicates winter cropping at those emerged zones. At the last image of 26 January 2014, sand dams have been installed on both sides of the weir, probably for the purpose of access of the sand bars. Another example is structure 3, which is visible at the image of 26 January 2014, but it is absent at 21 December 2014 and under construction 31 December 2014.

Obviously these structures aim to retain the water in the upstream 'reservoirs' during the final stage of depletion.

The proposed structures in the secondary channel for the Bagan Project are much larger (wider and higher, although only indicatively known at this moment). Moreover, the water retaining function for the secondary channel in the Bagan Project is aimed to be active in an earlier stage during the tail of the seasonal flood.

The presence of the small weir structures give an indication on the possible feasibility of storing water inside isolated water bodies of the secondary channel. Moreover, further analysis on-site may give a quantitative clue on the permeability of the bed at the three indicated locations. The project site is farther upstream, so a definite proof of the feasibility cannot be expected, but the analysis can give a better justification of retaining measures in the secondary channel during the depletion phase of the Irrawaddy.

APPENDIX 5

Bagan project location

Photos by Olga van Leeuwen and Arend Kolhoff



Erosion: Northern tip of Island, located in front of Bagan



Erosion: Northern tip of Island, located in front of Bagan



Small scale gravel extraction from main channel



Riverbed of secondary channel in the dry period



View on entrance of secondary channel and Bagan



Interview with women on the island located in front of Bagan



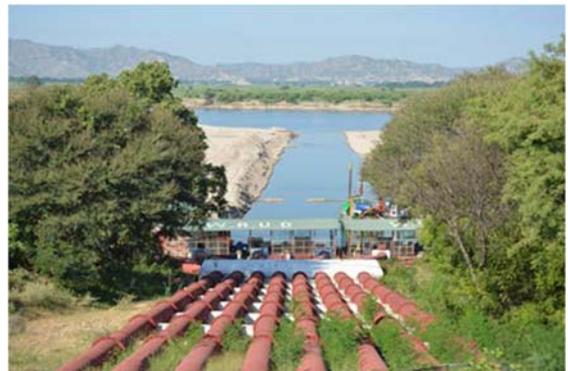
Houses on island adapted to temporarily flooding



Average water level during a flood



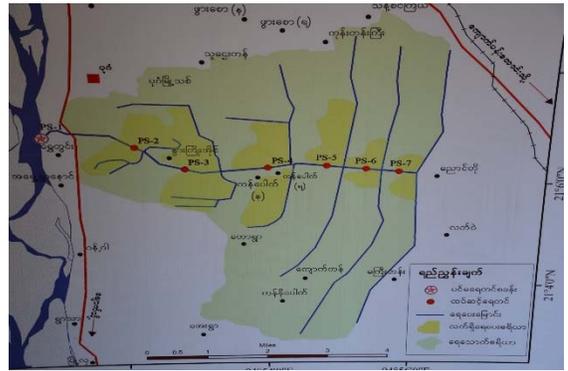
Bagan river front



Water pumping station – view on secondary channel



Water pumping station



Irrigation scheme of Bagan



Cultural heritage at the edge of the irrigation scheme



Irrigation scheme: no irrigation in dry period



Irrigation scheme, supplementary flooding dry period



Debriefing at MOECF