Urban River Basin Enhancement Methods

Indicators of Success

Work Package 10

Final Version. October 2005

Dresden University of Technology (TU Dresden) March 2005

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EVK-CT-2002-00082 Deliverable 10.1

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Dissemination Status

Public

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“No one wants to learn by mistakes, but we cannot learn enough from successes to go beyond the state of art“

(Petroski 1992, in Downs and Kondolf 2002, p. 494)

Summary

Post Implementation Assessment (PIA) is a vital component of successful river rehabilitation (Kondolf 1995, Bruce-Burgess and Skinner 2002 a. o.). Although the need for PIA has been widely acknowledged, so far there has been little effort to evaluate the success, life-span, or cost-effectiveness of river rehabilitation projects (Olson and West 1989, Hillenbrand and Liebert 2001). Reasons given include the lack of planning and legislative requirements, insufficient resources for monitoring, methodological deficits, and the fear to possibly be confronted with project failures. Yet the benefits are considerable.

A PIA will help to remove the ambivalence from river enhancement projects that have in the past been viewed to be more of an art than a science. The PIA process outlined here will pursue planners to follow a planning process with a clear statement of goals and objectives that can then be transferred into criteria to measure success. It will further require pre- and post implementation inventories of conditions, permitting a comparison, applying criteria to measure success. Only when such a comparison is made lessons can be learned, corrective actions can be taken and the state of the art be advanced. A PIA will also provide data for a substantiated documentation that can then be used in a stakeholder involvement process called for in the Water Framework Directives.

"Urban River Post Implementation Assessment (URPIA)", as outlined in the following reflects the three components of sustainability, expanding the assessment of rehabilitation of river ecology to also consider social and economic aspects. Socio-economic components including spatial planning and aesthetics especially apply to urban settings, where rivers have a role in shaping the quality of life for the city of tomorrow.

The following report first summarises theoretical requirements of a PIA to enhance common understanding and provide the basis for the proposed method. Second a comprehensive but flexible framework to conduct an indicator based Urban River Post Implementation Assessment (URPIA) is outlined. Three materials are provided to support the establishment of a project specific set of indicators, with which effects, effectiveness and efficiency can be assessed:

- Decision support chart for the establishment of a project specific set of indicators
- Hierarchies of ecological, social and economic criteria for urban river rehabilitation
- Indicator sheets, describing single indicators.

The method is to be used in an interdisciplinary setting; therefore it is open to incorporate the knowledge and methods of diverse disciplines. It is permitting adjustment to the various conditions found at sites that differ throughout Europe. Test applications of the method have been done. Results have been used to refine the procedure.

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Abbreviations

cf.	compare
c.f.	carried forward
CTV	Critical Threshold Value
e.g.	for example
et al	and others
etc.	et cetera
exp.	for example
FISRWG	Federal Interagency Stream Restoration Working Group
i.p.	in preparation
p.	page
PfAM	Polyfunctional Assessment Method
PIA	Post Implementation Assessment
SWOT	Strengths – Weaknesses – Opportunities – Threats (Analysis)
URBEM	Urban River Basin Enhancement Methods (EU Research Project)
URPIA	Urban River Post Implementation Assessment
WFD	Water Framework Directive
WP	Work Package
WQ	Water Quality

1. The Task

It has been a general experience, that river rehabilitations have been carried out with a lot of effort in terms of costs and human resources but the results achieved have not been assessed (URBEM PART B 2001). Especially in urban environments, where ecological, social and economic aspects are complexly interrelated and planning efforts have to deal with a certain level of uncertainty, the assessment and control of what has actually been achieved is vital. Post Implementation Assessments helps to identify weaknesses und unforeseen effects early on, allows for adaptive management, and may determine the efficient use of resources. The new knowledge gained in turn will bring forward the field of urban river rehabilitation and reduce uncertainty. Further positive side effects include the increased commitment to project goals and an increased transparency for all stakeholders.

Despite the positive outputs of PIA, it is widely neglected, due to missing planning and legislative requirements, a lack of funding, methodological deficits, data gaps and fear of possible ‘bad news’. The task of this research is to close the methodological gaps and to reduce the existing uncertainty surrounding the indicator based post implementation assessment of an urban river rehabilitation project.

Urban river rehabilitation has been found to be extremely context specific relating to existing ecological framework conditions, cultural understanding, financial constraints, professional abilities and preferences of stakeholders and decision makers and the public in general. Therefore a procedure needs to be set up, which can be adapted to needs of low budget projects as well as to comprehensive long term efforts. In consequence not a definitive set of indicators can be given, but moreover a comprehensive set of potential criteria and indicators needs to be defined, from which then a set can be chosen according to the project specific needs.

Criteria shall take into account the fact that we live in a changeable society and climate and therefore need to be applicable at present and also transferable to any future changed conditions. They shall consider maintenance issues, showing implementing authorities that rehabilitation is sustainable in an economic sense. To achieve sustainability in urban areas one needs to consider human needs, including social and economic aspects. Effects of rehabilitation may include economic growth, new establishment of citizen networks, increased value for recreation and amenity. Human needs may be the overriding goal of any rehabilitation effort in densely populated areas. Hence the inclusion of social and economic criteria is a must.

In addition to potential indicators, a common methodology needs to be established, to select project specific indicators, which measure and communicate the effects of rehabilitation, its effectiveness and efficiency as well as its contribution to achieve a sustainable future in the urban context.

To achieve the above described objectives following approach was taken:

- Review of findings from preceding URBEM WP’s regarding criteria and monitoring, to include WP 2 - Case Studies (Schanze et al i.p.), WP 4 Aesthetic Evaluation (Silva et al 2004), WP 5 and 9 Criteria and Decision Making (Bettes et al i.p.), WP 7 Social Appraisal (Walker et al 2000)

- In-depth literature research for indicators and methodologies used for post implementation assessment and analysis of the most advanced monitoring methods used across Europe
- A summary of the state of the art, including knowledge of relevant discipline to comply with the complexity of urban environments and interrelations between urban fabric, humans and the river itself
- Combination and enhancement of theoretical requirements to form the URPIA framework and the procedure to select the set of indicators.
- Collation and structuring of indicators to described potential positive and negative effects of any urban river rehabilitation effort, including existing and used indicators from different professional fields
- In light of test applications the suggested procedural framework as well as the list of indicators was reviewed and refined, suggested criteria and indicators were tested

This research is carried out as part of the URBEM project, lunched under the key action “City of tomorrow and cultural heritage”, which targets the improvement of urban life quality. Care was taken, to include the diverse aspects of sustainable urban city planning. This includes such overriding goals as social progress, recognising the needs of stakeholders, effective protection of the environment, prudent and efficient use of natural resources; as well as maintenance of high and stable levels of economic growth and employment.

There is a wide agreement that PIA is needed, especially to increase of efficiency and quality of river rehabilitation projects (cf. Chapter 3.2). It will force the setting of clear goals early in a project, increases transparency, establishes stakeholder participation and last not least increases manageability for decision making bodies (Nijkamp & Ouwersloot 1998). It provides a controlling function and increases commitment towards meeting project objectives (Glasson et al 1999). PIA conducted during implementation of middle- or long-term projects provides for adaptive management, which is of high importance for urban river rehabilitation projects with often fuzzy and shifting targets.

PIA will provide a systematic learning experience, on how strategies and measures impact site conditions. It will help to improve the understanding of river dynamics and socio-economic processes and lay out a scientific foundation for the prediction of the impacts of mitigation measures. This in turn will reduce uncertainties to set clear river restoration targets and helps to select measures that may be more effective than others. It will reduce subjectivity of planning and will help to bring forward a science of river restoration (Kondolf 1995).

2. THEORETICAL SCOPE OF POST IMPLEMENTATION ASSESSMENT

2.1 Terms and Understanding of Success Appraisal

Scientific literature serves with various terms related to (ex-post) project appraisal in relation to success. General terms include Project Evaluation resp. Assessment, Post Project Appraisal (Downs and Kondolf 2002), Post Project Evaluation (Kondolf and Micheli 1995, Kondolf 1998), Success Appraisal or Assessment of Success (Schmickler 1986, Heitzer 2000, Scholz 2000, Hobbs 2003, Brühl 2004), Effectiveness Monitoring (FISRWG 1998), Performance Control or Audit (Marti and Stutz 1993, Skinner 1999, Downs and Gregory 2004), or Environmental Impact Auditing (Glasson et al 1999) etc.

It will be shown below, that the actual extent of ex-post evaluation at project level can vary considerably. In this study the term “Post Implementation Assessment” (PIA) will be used. It refers to an indicator based evaluation of effects, effectiveness and efficiency of an urban river rehabilitation effort. Hereby e*ffects* are intended and unintended positive or negative outcomes of the project. Unintended effects may also be related to as ‘side effects’. *Effectiveness* describes the relation of intended effects to the planned effect and thus strongly relates to goals underlying the measures. *Efficiency* again shows the relation of intended effects and the resources spent to achieve these effects.

A rehabilitation effort may be called successful, when targets (intended effects) have been achieved with no or low negative side effects, the achievement of targets can be related to implemented measures (effectiveness) and the measures have been efficient (cf. Heitzer 2000, p 28).

Intentionally, the often used term ‘Post Project Assessment’ is not used. The term Post Implementation Assessment was chosen to emphasise the understanding, that PIA is an integral part of the project. As will be shown, assessment of outcomes is necessary for the completion of the project. The word ‘Post’ relates to the fact that final enquiries and the valuation take place after implementation. It should not mislead to the assumption that a PIA is a process subsequently following implementation. Much more it is closely related to project definition and needs to be borne in mind during time of implementation.

To ensure the measurement of effects, parameters of indicators need to be enquired at different (at least two) points of time – before and after the implementation process. Spatial and temporal resolution of assessment as well as applied enquiry methods must pay respect to the specific conditions of the project. Indicators must reflect the targets of the project as precise as possible. Their definition before project implementation is essential, since otherwise no status-quo enquiry is possible. Ex-ante parameter values of indicators are needed for the quantification of effects and subsequent determination of effectiveness and efficiency. A comparison to clear target values for indicators allows assessing if objectives have been achieved later on.

Urban river rehabilitation is closely related to issues of urban development (cf. Schanze et al i.p.). Therefore, when appraising urban river rehabilitation it is important to see the effects related not only directly to the water body but also in their urban context and in relation to urban planning.

2.2 State of Science and Current Practice

The importance of and the need for PIA's that relate to river rehabilitation is well documented in scientific literature (Olson and West 1989, Gardiner 1991a, Westman 1991, Kondolf 1995, Kondolf and Micheli 1995, FISRWG 1998, Tunstall et al 1999, Hillenbrand and Liebert 2001, Bruce-Burgess and Skinner 2002, Downs and Kondolf 2002), to urban and spatial development (Hellstern and Wollmann 1984, Schmickler 1986, Königs 1989) and in general terms (Heitzer 2000, Scholz 2000, Brühl 2004) it has been acclaimed by scientists for at least the past two decades.

Post implementation assessment is not only considered important to determine whether and to which degree a rehabilitation project has been successful. Project appraisal itself is often seen to be a vital component of successful river rehabilitation (cf. Kondolf 1995, Bruce-Burgess and Skinner 2002). Reasons are manifold. Beginning in the planning phase (cf. chapter 2.4) the layout of a PIA is an important step for the self understanding of any project. *First*, properly defined targets and corresponding performance criteria and benchmarks can set an effective approach to identify problems or opportunities (cf. Bettes et al, i.p.). *Second*, a clear and agreed target system may contribute to commitment to overall projects goals. *Third*, in an ideal case, ongoing projects would receive feedbacks on target achievements and possible side effects early on during implementation, allowing for early adaptive management, especially valuable for the usually fuzzy nature of target systems in river rehabilitation. *Fourth*, it is agreed, that for effective development of the rather new discipline of river rehabilitation, dissemination of results of previous projects is of high importance (Kondolf, 1995). To ensure such dissemination a systematic PIA needs to be conducted.

Despite much progress in river rehabilitation the latter point, remains particularly important. Kondolf (1998, p. 467) claims, that "a sanguine 'assumption' of project effectiveness is unwarranted" citing an average 50 % success rate of North American river habitat improvement projects. It turns out that sources about project effectiveness and efficiency are hardly available, illustrating the extent of the problem.

The FISRWG (1998) emphasises that assessment of success should not be seen as last and negligible step of urban river rehabilitation but as an indispensable one that allows evaluation of whether the effort does what it is meant to do and if not so caring for measures to optimise the effort. Furthermore, it emphasises that "Management of the monitoring plan is perhaps the least appreciated but one of the most important components of restoration" (FISRWG 1998, p. 6-33).

However, though the need for proper evaluation is well documented, disproportionally little effort has been made to evaluate success, life-span, or cost-effectiveness of in-stream habitat manipulations (Olson and West 1989, p. 7, cf. also Hillenbrand and Liebert 2001, p. 47). To date, only few exemplary cases of appraisal monitoring efforts are known (Marti and Stutz 1993, Hillenbrand and Liebert 2001). "The majority of river restoration and rehabilitation projects in the past has not undergone any objective evaluation" (Kondolf 1995). From nearly 100 examined restoration projects related to flood alleviation schemes in the UK only five where found to have conducted post project appraisal (Holmes 1991). Though many different appraisal methods are recognised in surveys (Bruce-Burgess 2001, Schanze et al i.p.) few projects to date appear to have adopted explicit criteria (cf. Downs and Kondolf 2002, p. 479). Schanze et al (i.p.) report that from 23 enquired urban river rehabilitation projects only three were furnished with a comprehensive, indicator based post project appraisal. Other case studies displayed some form of evaluation, but usually only considered single, predominantly ecological, aspects.

What is true for the assessment of ecological effects applies even more for social and economic effects. The integration of social and economic aspects in PIA for river rehabilitation is most often neglected. Reasons mentioned in the literature (cf. Redondo 2003) comprise the complexity, uncertainty and related difficulties of predicting socio - economic impacts and their measurement. In consequence the task has often been avoided. Findings in literature were also proven true by the case study analysis mentioned above. Most often economic and social aspects were not considered or conducted in single studies, without feedback into an overall result.

Little has changed in the past decade, despite the wide consensus for the need of a PIA among river scientists. It has been rephrased by many what has been described by Steinberg (1976, p. 208), stating that “The most complicated and most displeasing phase of the planning cycle is the control of success. Therefore it is usually omitted” (quoted by Schmickler 1986, p. 19). Reasons for lacking systematic project appraisal are manifold (Kondolf 1995, Kondolf and Micheli 1995, Bruce-Burgess 2001, Downs and Kondolf 2002):

- Lack of legal requirements to conduct appraisals
- Funding usually covers only the physical part of implementation, whereas post project appraisal is viewed as scientific work
- Complexity of the riverine system and related difficulties in measuring and predicting effects
- Fear of those responsible to be confronted with bad news
- Project appraisal is often not foreseen in the project concept (Schanze et al i.p.)

Another, not least important reason may be that despite the existing consensus about the importance of appraisals, the *knowledge about how to conduct appraisals* is not well distributed and not sufficiently developed. Most handbooks (exp.: Brookes 1996, FISRWG 1998, Rutherfurd et al 2000, RRC 2002) and major book publication (exp.: Boon 1992, Schueler 1995, Bailey et al 1998, FISRWG 1998, Waal et al 1999, Boon et al 2000) give no or only little guidance on the issue of PIA. Also Gardiner’s manual, entitled *River Projects and Conservation: A Manual for Holistic Appraisal* (1991b), devotes only a few pages explicitly to post project appraisal.

Undoubtedly, a *lack of data* limits the meaningful assessment of a project’s outcomes. The inadequacy of spatial, temporal and thematic resolution of monitored parameters hinders the development of comprehensive project specific indicator systems. Given that in most cases no funding is set aside for post implementation assessment (cf. Schanze et al i.p.), practitioners must rely on regularly enquired data if an assessment is to be conducted at all. However without sensitive data reflecting local changes along river stretches and their urban hinterland, systematic and comprehensive assessment cannot be achieved.

2.3 Existing Methods of Indicator Based Project Assessment

Following is a presentation of existing multi-criteria assessment methods appearing particularly applicable for the development of a PIA method for urban river rehabilitation.

Polyfunctional Assessment Method (PfAM, Grabaum 1996)

The PfAM is an ex-ante multi-criteria based assessment method, to determine the best land use option for a site. While the method is described for ex-ante assessment, the steps are easily transferable to the establishment of an indicator set, which can be applied for post implementation assessment. Following steps are presented by Grabaum:

- Formulation of target functions
- Determination of parameters for target function
- Weighting of parameters for each target function
- Assignment of impact function to each parameter related to the target function
- Assessment of best land use option trough the combination of parameter weight and impact function

Grabaum suggest the formulation of target functions, representing the targets to be achieved for the site (e.g. recreation, protection of a target species etc.). Each of the target functions depends upon specific parameters. Their ‘parameter value’ will determine the degree of fulfilment of the respective target function.

For the selection of parameters Grabaum uses tree-diagrams. Only those parameters which have a measurable influence on the target function are considered. Parameters are then split in sub-parameters, until they become quantifiable indicators. Those then allow measuring the degree, to which target functions can be fulfilled. Between 3 and 8 classes are suggested for the classification of indicators. The varying effects of parameters for a target function are described through assigned weights. In addition, parameters which impact the target function significantly are assigned a value greater than 1 and parameters with a minor impact are assigned a value smaller than 1.

As a next step impact functions are established, defining the relation between an indicator and certain proposed target function. Potential parameter values are related to the potential degree of target fulfilment in a matrix. Grabaum describes 7 classes of target achievement, ranging from “target function is badly fulfilled” with 1 point to “target function is completely fulfilled” with 7 points.

The final assessment on how much a certain option satisfies a proposed target function is done in two mathematical steps. First, the parameter weight and the class value of target achievement are multiplied. Second, all those products for one objective function are added. Values then determine the absolute degree of target achievement. For an applicable evaluation, values are again distributed to value classes of one to five to determine the relative degree of target achievement.

The PfAM Method constitutes a multi-criteria assessment, deemed to be a suitable approach for river rehabilitation projects. A tree-diagram breaks down overall goals into objectives and finally into measurable indicators, making the approach intelligible. A tree-diagram structured for the purpose of urban river rehabilitation offers a possible tool for future users, permitting efficient selection of indicators according to project objectives.

The weighting of parameters will depend on preferences of stakeholders and decision makers and the specific circumstances of a project. Cultural values and norms differ from region to region. Subsequently no general weights can be given but guidance provided for assigning various levels of importance to different target levels.

Grabaum provides the possibility of assigning the same parameter to different target functions through a differentiation in the impact function. This allows for the assessment of multiple cause-effect relationships (cf. chapter 2.5.3). For instance, the improvement of morphological conditions of a river, is not only likely to benefit in-stream habitats, but will also have an impact on water quality and biodiversity. The parameter ‘morphological conditions’ may be assigned to the objective function ‘Improvement of habitat’ as well as to the objective function ‘Improvement of biodiversity’. The two different impact functions express which effect a change in morphological conditions has on both of the target functions.

However, Grabaum’s approach appears rather complicated and requires great commitment as well as extensive resources. Furthermore, the current state of knowledge in urban river rehabilitation may limit the establishment of accurate impact function. For this reasons only some steps will be considered in the URBEM Method.

FLAG Method (*Nijkamp & Ouwersloot 1998*)

The FLAG Method represents a multi criteria based decision support method. Similar to the PfAM Method it is used to analyse regional sustainability based on “a [operationalised] set of minimum (or critical) conditions to be fulfilled” (Nijkamp & Ouwersloot 1998, p. 4). It considers ecological, economic or social objectives and identifies three steps for the assessment of sustainability:

- Identification of a set of measurable indicators
- Establishing normative reference values
- Development of a practical impact methodology for assessing (future) developments

Parallel to the PfAM Method a tree-like structure is suggested for the identification of a set of indicators to maintain cohesion and completeness. It is to assist in the aggregation and disaggregation of indicators, depending on communication needs. Aggregated indicators may be used for communication with public stakeholders, not familiar with detailed professional terms and data.

The establishment of reference values is based on the concept of carrying capacity, “which indicates the maximum environmental resource use that is still compatible with an ecologically sustainable economic development" (Nijkamp & Ouwersloot 1998, p. 9). The term of 'critical threshold values (CTV)' is used for the quantification of carrying capacity. For CTV's that are either ambiguous due to different expert opinion or fuzzy in nature, a special approach is developed, which will also be of relevance for urban river rehabilitation projects. A range of CTV's have been established, to include CTV_{min} standing for the minimum allowable threshold of the corresponding sustainability indicator. CTV_{max} refer to the maximum allowable value of the sustainability indicator beyond which an alarming development would start (see Figure 2.1).

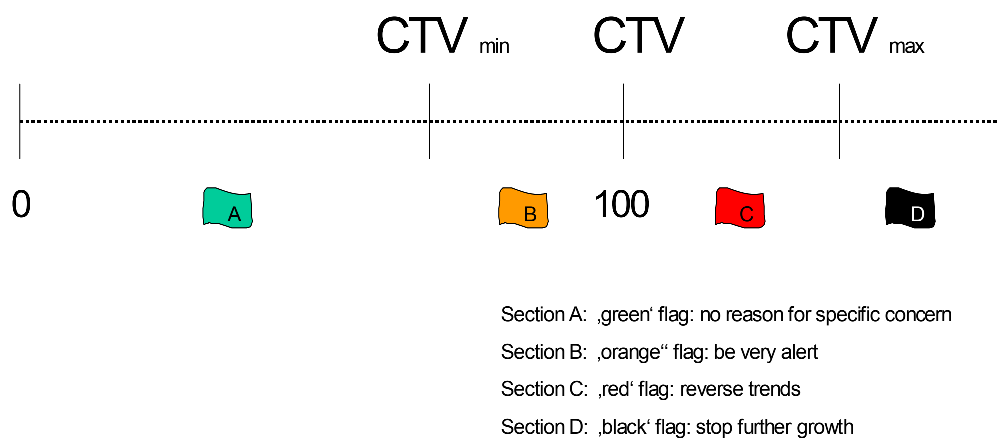

Figure 2.1: A range of Critical Threshold values for fuzzy CTV's (adopted from Nijkamp & Ouwersloot 1998, p. 10)

2.4 Relation to the Planning, Implementation and Management Process

Post Implementation Assessment needs to be seen embedded in the general planning, implementation and management process of any urban river rehabilitation effort. The monitoring of chosen effects that are to be considered in the PIA already needs to be addressed in the layout of the project and integrated into each phase of plan development (cf. Kondolf and Micheli 1995). The monitoring concept, thereby, must rest upon the defined targets of the project (Marti and Stutz 1993, p. 132), but it must also permit the identification of side effects. Only limited flexibility of targets and scales can permitted to allow for adjustments in the course of the project. As monitoring must be started before or with the implementation and will require several rounds of data enquiry, from the very beginning the concept must integrate the parameters, sampling methods, sampling conditions as well as consideration for the final analysis (Marti and Stutz 1993, p. 132). This flexibility, however, cannot be handled as free as in so called one-shot or remains (Kondolf and Micheli 1995) ex-post evaluations that usually would start after implementation (e.g. Sailer 2002, p. 67).

The close integration of PIA into the overall project planning and implementation process is emphasised by many authors (cf. Gardiner 1991a, Marti and Stutz 1993, Kondolf and Micheli 1995, Bruce-Burgess and Skinner 2002, see also figures below). An analogous assignment of success appraisal is also presented by Gardiner (1991a, p. 8 c.f.). All these structures show similar patterns in terms of the integration of PIA in the overall project management. Adapted from business economics (cf. Ossadnik 2003, Brühl 2004) PIA's cover a part of the information delivery function of evaluation in general, which is indispensable for the overall project management process.

The assessment of urban river rehabilitation projects can be based on 'formal goals' which can be either quantitative or qualitative. The assessment by indicators would be directed on both categories, but comprising only quantifiable elements of the qualitative goals (Brühl 2004, p. 18).

Within general PIA a variety of different modules are proposed. Most common seems this sequence (cf. Schmickler 1986, Marti and Stutz 1993, Heitzer 2000):

- Control of implementation (as planned / as built control)
- Identification of effects (usually limited to intended effects)
- Evaluation of goal achievement (comparison of identified effects with goals)
- Effect Analysis (why did certain effects occur / not occur).

Heitzer (2000, p. 30) additionally names Planning Control, Control of Framework Conditions and Assumptions (belonging to effectiveness control) and Control Efficiency and Adequacy as dimensions of project appraisal. In excess of these and with reference to evaluation in urban planning in general (Schmickler 1986) names Control of the Target System and the Delay of Effects and Side-Effects. An important element emphasised by all authors is the feedback of PIA to project management allowing for adjustments in the scope of adaptive management.

Volz (1980[1]) (quoted by Schmickler 1986, p. 7, Königs 1989, p. 9) sees project appraisal as an instrument of correction in the planning and decision making processes, which (ex-post) compares the state of the matter of interest at different temporal stages. It, furthermore, evaluates the reasons for effects and gives feedbacks for the planning to improve future action. The correction function proposed by Volz for spatial planning is also pronounced and emphasised by other authors with direct relation to river rehabilitation (Kondolf 1995, Kondolf and Micheli 1995, Bruce-Burgess 2001, Downs and Kondolf 2002). However, it must be borne in mind that intermediate evaluation is only sensible if project (implementation) phases last over a longer time span. Volz related this approach to programs ranging over several years.

[1] Jürgen Volz (1980): Erfolgskontrolle kommunaler Planung (Success Control of Municipal Planning), Köln, 1980.

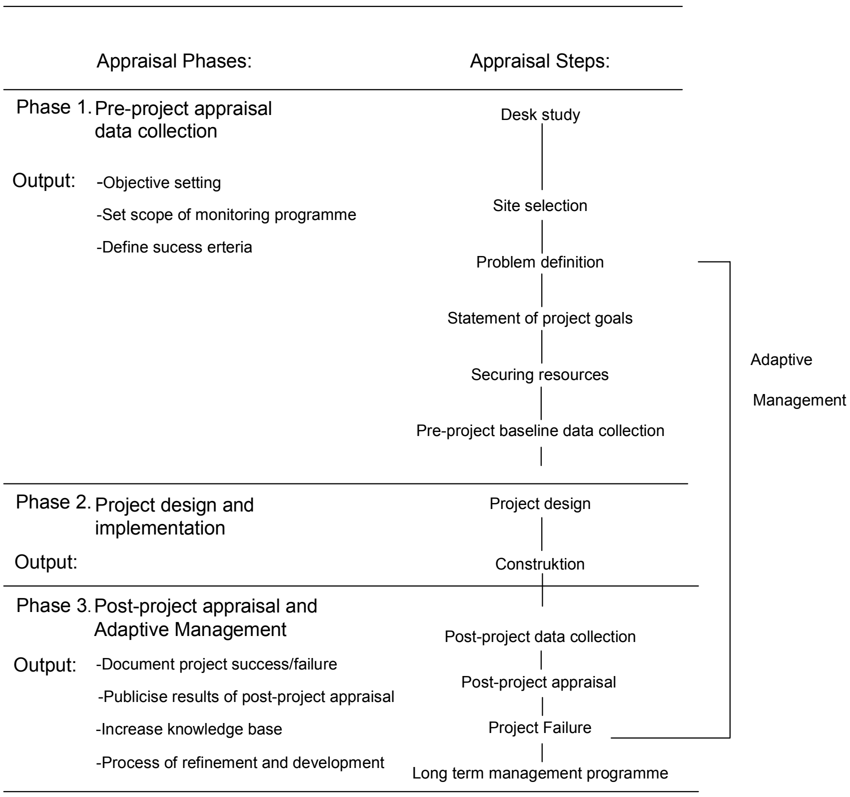

Figure 2.2: Post Project Appraisal and adaptive management (Bruce-Burgess and Skinner 2002)

A common feature is also the differentiation between plan implementation and its performance: Compliance Audit and Performance Audit (cf. e.g. Skinner 1999, Downs and Gregory 2004). Here both, implementation and success appraisal have their own management plan. With regard to the emphasis of post implementation assessment, Marti and Stutz (1993) propose the differentiation between compliance audit and performance audit (Downs and Gregory 2004, p. 230); the first targeting the assessment of physical implementation, the latter targeting the assessment of effectiveness and efficiency of the project.

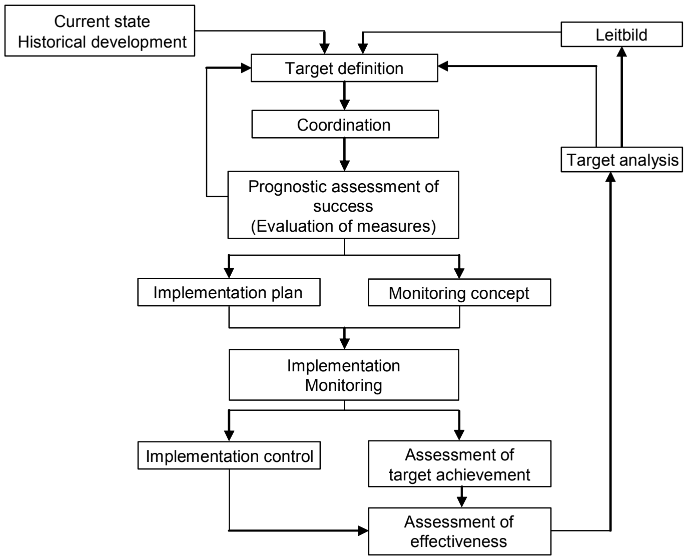

Figure 2.3: Steps of Project Assessment (translated from Marti and Stutz 1993, p. 125)

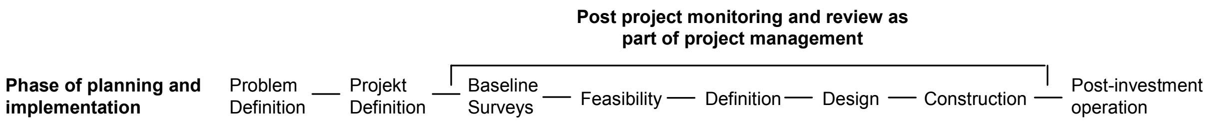

Figure 2.4: Post project monitoring and review (modified and considerably shortened from Gardiner 1991a, p. 9)

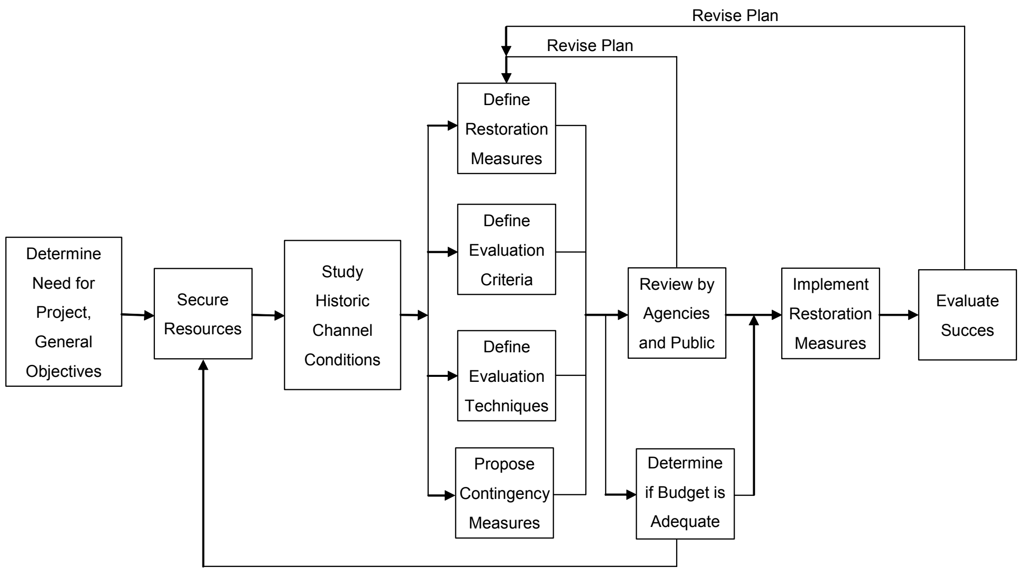

Figure 2.5: Success evaluation in the process of project realisation (Kondolf and Micheli 1995, p. 3)

2.5 Defining the Scope for Post Implementation Assessment

As shown above, post implementation assessment is a part of the overall project and is embedded into the project management. Before the URBEM Method for post implementation assessment of urban river rehabilitation can be developed, a number of issues concerning the scope of assessments shall be addressed to include:

- Clearly defined targets (chapter 2.5.1)
- Scale of assessment – programme, project, measure (chapter 2.5.2)
- The most important prerequisite for an appraisal of success is the availability of clearly defined and generally accepted targets to which achieved effects can be compared is Without sufficiently precise defined targets, the core element of post implementation assessment – the control of target achievement– will not be possible.

Transparent evaluation of performance in relation to set targets will not be possible unless agreement about rehabilitation targets is achieved between stakeholders (preferably in open consultation with the multiple publics, see (Westman 1991). Therefore, it is indispensable that targets be defined already in the process of project planning (see chapter 2.4). This is highly beneficial to the overall project definition and supports common understanding of project attitudes. Furthermore, clearly specified targets also enable an effective selection of alternative options (cf. Marti and Stutz 1993, Bettes et al i.p.). Also, targets are prerequisites for the indispensable baseline assessment, conducted before implementation starts and conditions begin to change.

Targets need to be operationalised. Fuhrich (2001, p. 1) claims that “targets are worth as much as it is possible to assess the extent of their achievement.” Each target must be provided with at least one fully practicable indicator. Those must be related to a sensible and sensitive scale that allows the measurement of change. First, targets must give sufficient consideration to the problems identified (problem adequacy, cf. Hellstern and Wollmann 1984, p. 20). Second, they need to be chosen in a way that they can be operationalised by indicators to ensure measurability.

Marti and Stutz (1993, p. 128) name five properties, that targets should have to permit a PIA:

- Specificity (targets must reflect individual conditions)
- Measurability (measurement of targets must be reproducible. Not quantifiable targets can be measured using ordinal scales)
- Medium risk (the ambition reflected by the target should be a compromise between the minimum acceptable and the maximum achievable)
- Time specification (the time frame for the achievement of targets should be defined to allow for a timely success appraisal)
- Updatability (targets should be adjustable over time to reflect changing conditions and perception. They should not be viewed to be unamendable)

Generally, targets can be divided in: a) (strategic) goals; b) (management) objectives and c) objectives for single measures (Marti and Stutz 1993). A differentiation is necessary between their application to large and small projects. A simplification of a target set is appropriate to make an evaluation of smaller projects affordable.

Goals

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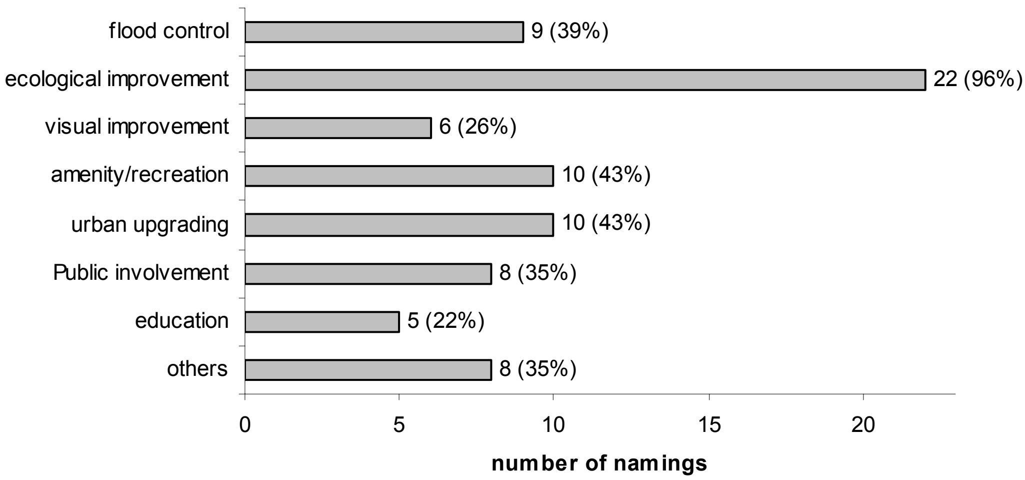


Figure 2.6: Strategic goals in urban river rehabilitation projects (Schanze et al i.p.)

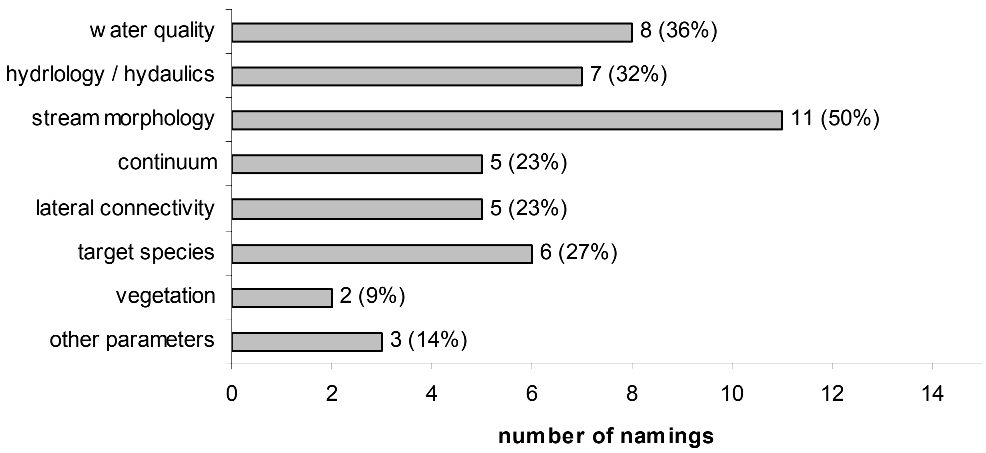


Figure 2.7: Goals of ecological improvement in urban rehabilitation projects (Schanze et al i.p.)

Objectives

At project scale general goals are usually transformed into more specific objectives. They can be organised into qualitative and operational objectives, the first describing site qualities or a “preferred state” to be achieved, while the second relates to the actual management steps (measures) to achieve quality objectives. Qualities to be achieved set the basis for control of target achievement, while operational objectives provide the basis for compliance audits that control construction implementation (cf. e.g. Skinner 1999, Downs and Gregory 2004). For the assessment of achievements both will be taken into account.

In addition and in compliance with the properties of operationalised targets by Marti and Stutz (1993, see above this chapter), Heizer (2001) describes an operationalised objective as a description of a quality for an object, stating how much of the quality should be achieved, when and where. The determination of those dimensions should be based on feasibility studies or expert judgement and involve stakeholders.

Objectives for single measures are operationalised as described above. Their assessment of achievement is most direct, as relatively clear relations between cause and effect can be established (cf. next chapter and 2.5.3)

2.5.1 Scale of Assessment – Programme, Project, Measure

Assessment may generally take place at three different scales: At the *programme scale,* at the *project scale* or at the *measure scale.* These scales correspond to goals and objectives described in different detail, from very general goals at ‘programme scale’ to very detailed and measurable objectives at ‘measure scale’. Those different scales contain different issues of evaluation.

The objectives of *programme evaluation* are river basin or administratively relevant activities promoting or supporting river rehabilitation, but not conducting those. Object of appraisal at this stage can be issues, such as the target system of the program, project selection process, effectiveness of guidance structure, funding efficiency, controlling instruments, etc. Thus, assessment at programme scale concentrates on processual issues of programme management and has only limited access to project outcomes.

Project evaluation identifies and measures intended and unintended effects of rehabilitation activities manifested in (usually physical) measures. Due to the fact that projects often are compounds of measures, project level assessment can be seen as in-between of programme and measure assessment. Projects are – in contrast to programmes - clearly spatially and temporally delimited and have clear outcomes. However, detailed effect analysis may not be feasible, while outcomes can still be identified and measured.

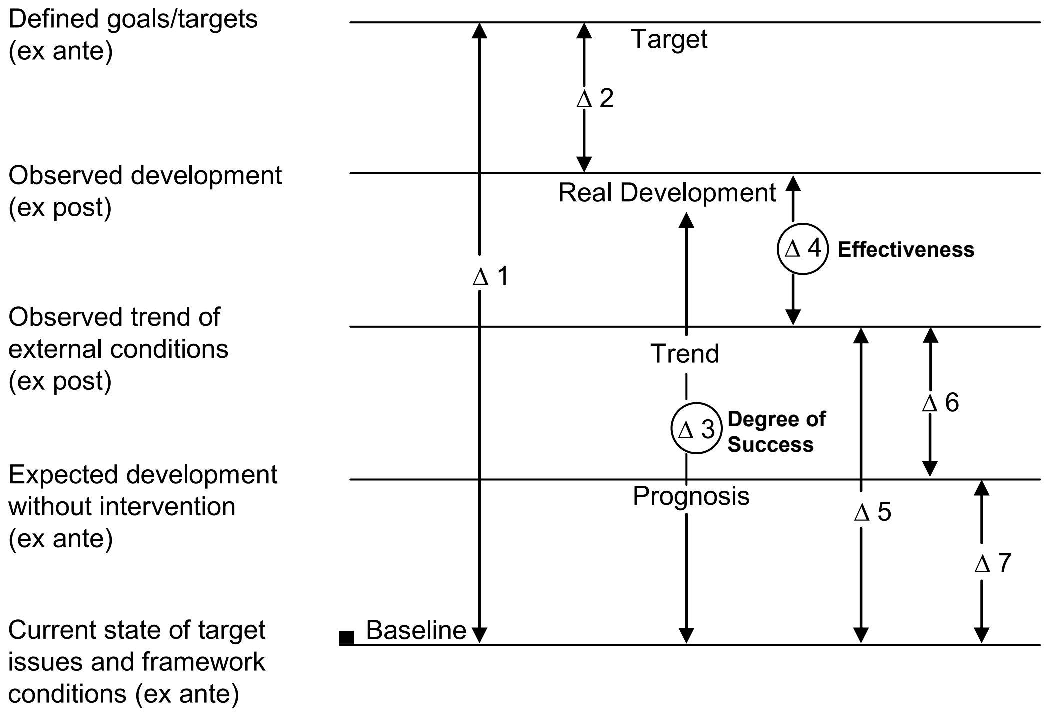
For *measure evaluation* intended and unintended effects of single rehabilitation measures are in focus. This requires detailed investigation of effect pathways and subsequent the systematic effects analysis. Results may allow the clear description of effects of one single measure.

Against this background, programme level assessment cannot be targeted by the proposed URBEM method for post project assessment. Being effect (outcome) oriented, only project and measure level assessment can be the issue of post implementation assessment of urban river rehabilitation projects.

Project level assessment in most cases will be the more appropriate abstraction, describing outcomes, but not necessarily describing why outcomes are as they are. Evaluation at measure level in the case of urban river rehabilitation appraisal may play a primary role for the establishment of relevant cause-effect relationships in order to investigate effect pathways and detailed outcomes with the aim of uncovering and explaining possible problems of implementation. However, the rather complex effect analysis is not targeted by the URBEM method.

- Units of Assessment - Effects, Effectiveness, Efficiency (chapter 2.5.3)
- Effects not only occur in reaction to measures taken in the course of urban river rehabilitation (see chapter 0). Effects also must be seen in the context of the changing societal and natural environment, which they are part of. Thus, to avoid misinterpretation of results the distinction of several information levels is proposed (based on Hellstern and Wollmann 1984). This concept formulates a framework for the assessment of effects under consideration of simultaneous development of conditions. It summarises the relation of different information levels useful for the determination and interpretation of effects, effectiveness and efficiency:
    - ❑ Baseline, representing the current state of target issues and framework conditions before implementation
    - ❑ Prognosis, being the expected development (of a parameter) without intervention, determined ex-ante by assuming a certain development of relevant framework conditions.
    - ❑ Trend, being the real development that would have occurred without intervention, determined ex-post by comparing the assumed development of related framework conditions and their real development.
    - ❑ Real development observed after the intervention.
    - ❑ Target, being the defined goal for the development (of a parameter).

Figure 2.9 shows the relationship of these five levels and illustrates different dimensions that can be described in the evaluation.



Δ 1: Target-Baseline comparison (planned development)
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Figure 2.9: Levels of information for success appraisal (translated from Hellstern and Wollmann 1984, p. 39)

Not all of these dimensions need to be established exclusively for PIA. Baseline values, Prognosis and Target values need already to be provided during the project's planning phase. Additional tasks of post implementation assessment are:

- The measurement of the Real Development and the determination of underlying trends
- The analysis of Targets with in comparison with the Real Development (Δ 2), as basis for the **target achievement** control
- Consideration of the underlying trends to determine the real extent of effects (incl. side effects) and **effectiveness related to targets** (Δ 4)
- Coupling of effectiveness with the effort needed to achieve the related effect to obtain **efficiency**

Effects, effectiveness and efficiency only describe the categories of assessment. Assessment itself needs to be carried out to enlighten the whole complexity of the issue. Especially in urban areas, the sustainability concept therefore is considered to be an appropriate scope for the definition of assessment criteria. Only by combining ecological and societal issues, success of urban river rehabilitation can be adequately described. Therefore, the URBEM indicators will cover all three dimensions defining sustainability:

- Ecological
- Social
- Economic

Thus, depending on the thematic focus of an urban river rehabilitation project a wide variety of data is required for success appraisal. It is probable that in most cases only parts of required information will be available. Therefore, to give consideration to all relevant aspects project managers must be prepared to conduct own enquiries of missing data.

- Spatial Reach of effects and requirements for data resolution (chapter 2.5.4)
- Monitoring and Temporal Delay of effects (chapter 2.5.5)

2.5.2 Clearly defined Targets

The most important prerequisite for an appraisal of success is the availability of clearly defined and generally accepted targets to which achieved effects can be compared is Without sufficiently precise defined targets, the core element of post implementation assessment – the control of target achievement– will not be possible.

Transparent evaluation of performance in relation to set targets will not be possible unless agreement about rehabilitation targets is achieved between stakeholders (preferably in open consultation with the multiple publics, see (Westman 1991). Therefore, it is indispensable that targets be defined already in the process of project planning (see chapter 2.4). This is highly beneficial to the overall project definition and supports common understanding of project attitudes. Furthermore, clearly specified targets also enable an effective selection of alternative options (cf. Marti and Stutz 1993, Bettes et al i.p.). Also, targets are prerequisites for the indispensable baseline assessment, conducted before implementation starts and conditions begin to change.

Targets need to be operationalised. Fuhrich (2001, p. 1) claims that “targets are worth as much as it is possible to assess the extent of their achievement.” Each target must be provided with at least one fully practicable indicator. Those must be related to a sensible and sensitive scale that allows the measurement of change. First, targets must give sufficient consideration to the problems identified (problem adequacy, cf. Hellstern and Wollmann 1984, p. 20). Second, they need to be chosen in a way that they can be operationalised by indicators to ensure measurability.

Marti and Stutz (1993, p. 128) name five properties, that targets should have to permit a PIA:

- Specificity (targets must reflect individual conditions)
- Measurability (measurement of targets must be reproducible. Not quantifiable targets can be measured using ordinal scales)

- Medium risk (the ambition reflected by the target should be a compromise between the minimum acceptable and the maximum achievable)
- Time specification (the time frame for the achievement of targets should be defined to allow for a timely success appraisal)
- Updatability (targets should be adjustable over time to reflect changing conditions and perception. They should not be viewed to be unamendable)

Generally, targets can be divided in: a) (strategic) goals; b) (management) objectives and c) objectives for single measures (Marti and Stutz 1993). A differentiation is necessary between their application to large and small projects. A simplification of a target set is appropriate to make an evaluation of smaller projects affordable.

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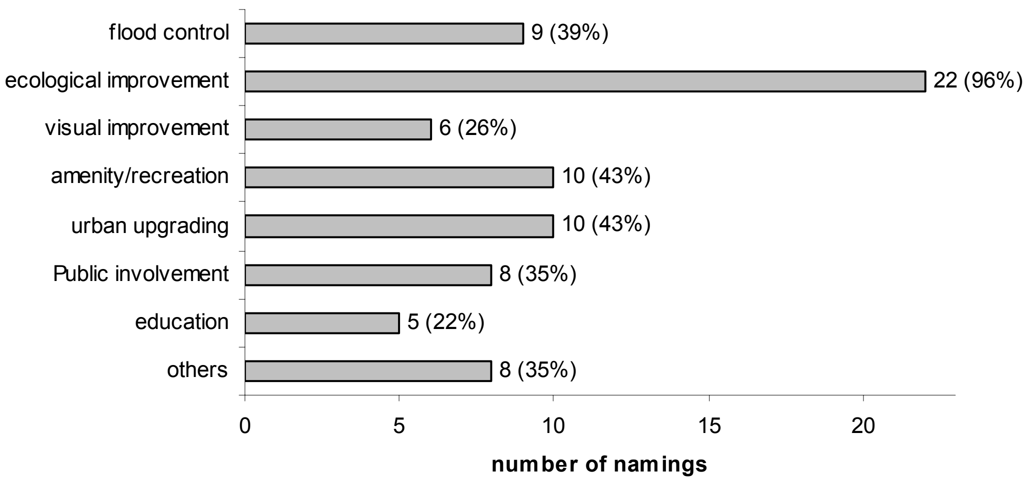

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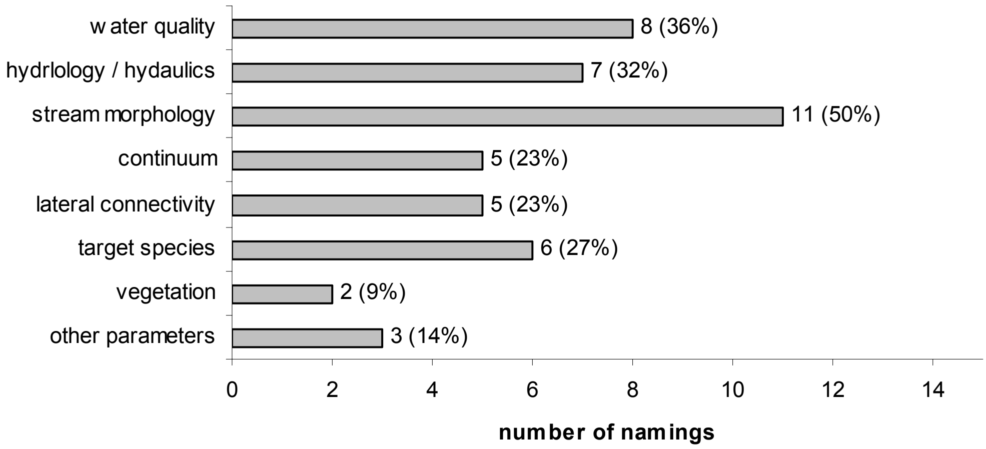

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2.5.4 Units of Assessment - Effects, Effectiveness, Efficiency

It is supposed, that rehabilitation measures cause certain intended or unintended effects. Whereas intended effects relate to targets of the rehabilitation project, unintended effects are either not wanted or unforeseen. Unintended effects can be positive or negative and may also be addressed as side-effects.

In general, two different perspectives of cause – effect relationships are important (see Figure 2.8). The first describes the single effect as a result of different causes. Causes can be one or different measures applied in course of rehabilitation, but also synergies of measures and external conditions. The second perspective describes the cause (e.g. a measure) being the source (or trigger) of one or several effects. For example, improved morphological conditions can contribute to an improved water quality as well as riverine flora and fauna in the affected reach.

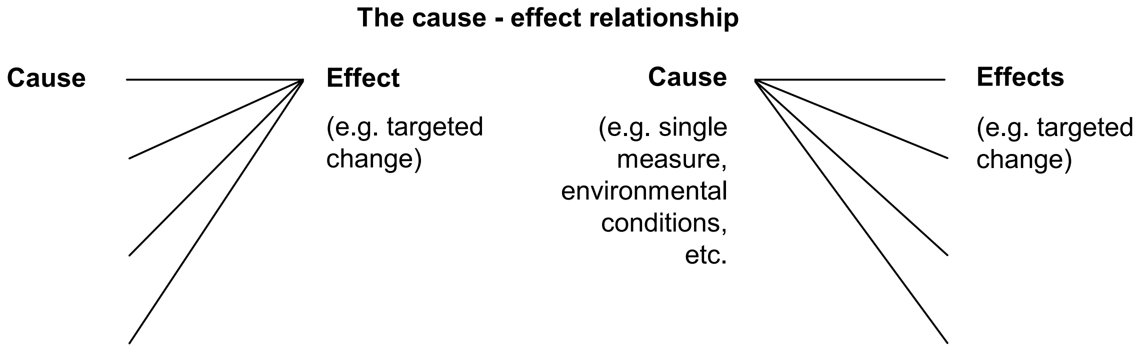

Figure 2.8: The cause-effect relationship (Hellstern and Wollmann 1984, p. 36)

In the practice of river rehabilitation effects often cannot be traced back to only one single cause respectively measure. Certain effects will often be influenced by several causes, some of which may even not always be clearly definable. Furthermore, effects can be distorted by external influences. Second, measures may have by far more effects than foreseen respectively desired. Especially undesired negative effects may limit the project’s success and may need mitigation. The other way around, unforeseen positive side effects may be overlooked.

Therefore, it is important, that not only intended effects, but also pathways of potential side effects are identified early in the project and included in the assessment plan. Otherwise, a rather narrow and unrepresentative view on a project may be offered and possible major positive and negative effects may be neglected.

In practice, a three step approach is useful to evaluate intended and unintended effects:

- Measurement of effects
- Determination of effectiveness
- Determination of efficiency

The *measurement of effects* pays general attention to the cause-effect relationship comprising both targets (intended effects) and side-effects (unintended effects). Its goal is first, to establish potential effects pathways and second, based on this, to determine relevant indicators for post implementation assessment. Full effect analysis scientifically highly complex and can not by primary goal of post implementation assessment of urban river rehabilitation. However, most relevant side effects should be revealed for evaluation.

Intended effects of rehabilitation measures and projects are of major importance for success appraisal. Therefore, *establishment of effectiveness* constitutes a core element of post implementation assessment. Effectiveness shows the ratio of observed intended effects and target values defined for the respective qualities to be achieved.

The third important part of post implementation assessment is the *determination of efficiency*. Heitzer (2000, p. 34) differentiates three levels of efficiency in success appraisal:

- Overall efficiency = desired output / (Input + undesired output)
- Output efficiency =: desired output / undesired output
- Product efficiency = desired output / Input

For practicability reasons, only ‘product efficiency’ can be issue urban river rehabilitation appraisal, whereby input relates to the resources spent to achieve the desired output.

Effects not only occur in reaction to measures taken in the course of urban river rehabilitation (see chapter 0). Effects also must be seen in the context of the changing societal and natural environment, which they are part of. Thus, to avoid misinterpretation of results the distinction of several information levels is proposed (based on Hellstern and Wollmann 1984). This concept formulates a framework for the assessment of effects under consideration of simultaneous development of conditions. It summarises the relation of different information levels useful for the determination and interpretation of effects, effectiveness and efficiency:

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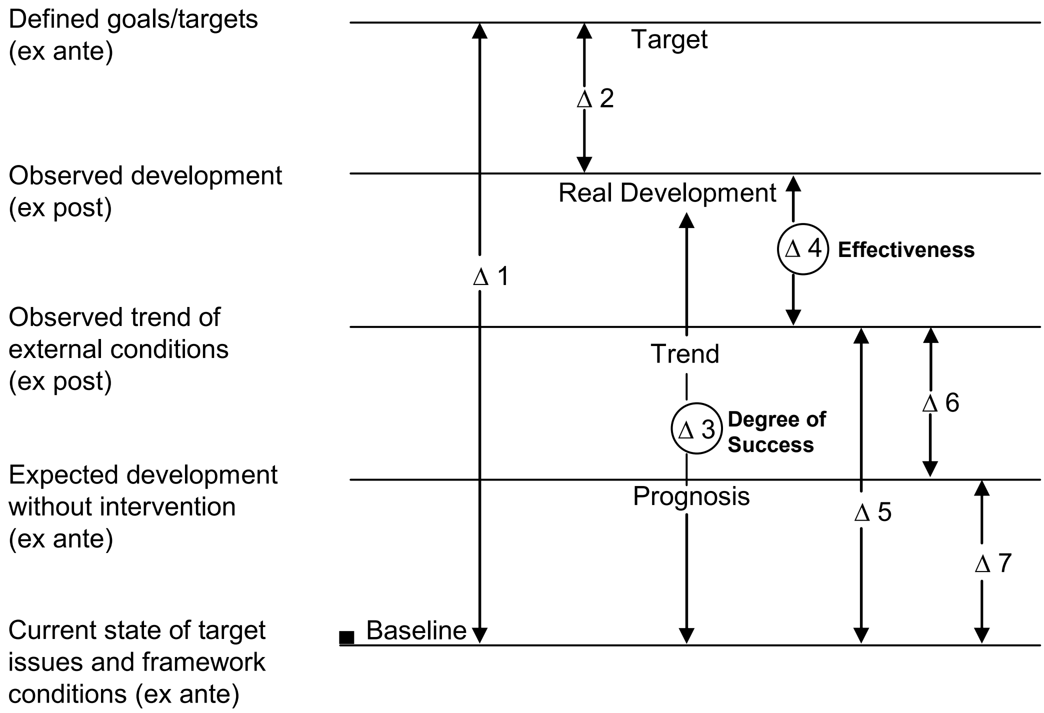

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Thus, depending on the thematic focus of an urban river rehabilitation project a wide variety of data is required for success appraisal. It is probable that in most cases only parts of required information will be available. Therefore, to give consideration to all relevant aspects project managers must be prepared to conduct own enquiries of missing data.

2.5.5 Spatial Reach of Effects and Requirements for Data Resolution

The analysis of existing case studies of URBEM found river rehabilitation projects with various spatial extensions (Schanze et al i.p.). Some were found to concentrate on in-stream measures, some on the river banks, some emphasised changes in the area along the river course, while others also made improvements in the wider catchment area. Interrelationships between those spatial dimensions must be considered. Measures taken along river banks may also improve the surrounding area as well as in-stream structures. Measures in the catchment area would usually be taken to rehabilitate water quality and quantity of the river.

While most actions of urban river rehabilitation are taken in immediate vicinity of the river, effects of the rehabilitation may, and often are intended to reach out into the surrounding urban area. Influenced by the type of effect, its reach can be very different. Depending on the spatial extent of the reach the following spatial dimensions of effects are distinguished in relation to urban river rehabilitation:

Water level: considering effects that occur directly in the water body (e.g. water quality improvements).

Stream reach level: considering effects in certain stream sections in the project area.

Hinterland: considering the urban area, where no intervention has taken place, but which is influenced by the changed conditions at the rehabilitation site. This applies especially to societal issues.

Evaluation should give consideration to these spatial dimensions by using appropriate indicators. The availability of citywide or even district related information can be important for capturing baseline and background data. However, most continuous monitoring is conducted on a rather general scale and does usually not serve with highly resolved district or even sub district scale information (cf. Fuhrich 2001, Heiland et al 2003). Resolution of statistical data varies and usually depends on reference areas of the local census. In Germany, social and economical data is usually available on district and sub-district levels. The Netherlands have a postal code related system related to every street. The USA has a census block related system, providing detailed data on social and economic conditions etc. Due to national variations, only a rough guidance can be given, where data in an appropriate resolution may be acquired.

National, regional and local differences in data quality and availability are limiting the development of a generic set of indicators of success. Therefore, the indicator system will be laid out open for integration of various data sources and data qualities, provided that the same unit of data is used. Sources for single indicators need to be selected depending on the census system, the size and shape of the effect area as well as the type of data. Nevertheless, due to the variety of issues (see chapter 2.5.2) certain data may not be available at all or may be not adequate to the spatial level. In such cases a special enquiry needs to be made.

2.5.6 Monitoring and Temporal Delay of Effects

The time, necessary to complete a post implementation assessment can vary from months to years and even decades, depending on the speed of the stream's and societal system's response to the measures applied (FISRWG 1998, p. 6-39 c.f.). Most authors see PIA as a task starting with the project definition and ending more or less close after implementation (see chapter 2.4). Kondolf (1995) suggests that the "commitment to the long term" is necessary for the project evaluation to capture delayed effects that may occur only after years. More than ten years with intervals of several years are proposed for such long term monitoring (cf. Downs and Kondolf 2002).

Delayed effects may occur in all domains of rehabilitation, incl. ecological, social and economic aspects. Perceived beauty along a river may increase with a certain maturity of plantings and a more natural river bed, shaped over years through morphological processes. Vacancy rates in a deteriorated city district may only measurable decrease years after an upgraded river section has improved the image of the districts and has led to investments into the housing infrastructure. Therefore, the detection of improved economic conditions may only be possible years after the actual rehabilitation effort. Monitoring should pay respect to this potential delay of effects.

Accordingly, data for the assessment of different targets must be enquired in intervals capable of capturing changes. Data sets updated by local authorities or in the scope of general environmental monitoring are usually enquired periodically. It can be expected, that the considered periods often may not necessarily be representative for changes induced by an urban river rehabilitation project.

Downs and Kondolf (2002) differentiate five levels of success appraisal in dependence of necessary and potentially available data: Full success appraisal (long term), Medium-Term, Short term, One-shot, and Remains. Thereby the first three pay respect to different time periods of occurring effects. "One-shot" and "Remains" refer to cases where appraisal did not start in time (at latest with start of implementation) and therefore need to be accomplished with recourse to incomplete and possibly not fully adequate data sets.

Table 2.1: Categories of success appraisal of in-stream geomorphology (modified and shortened from Downs and Kondolf 2002)

	Category of Success Appraisal				
Component	**Full**	**Component**	**Full**	**Component**	**Full**
Periodic or event driven monitoring	> 10 years	Periodic or event driven monitoring	> 10 years	Periodic or event driven monitoring	> 10 years
Success criteria	explicit	Success criteria	explicit	Success criteria	explicit
Baseline survey	thorough	Baseline survey	thorough	Baseline survey	thorough
Indication of short term performance	Yes	Indication of short term performance	Yes	Indication of short term performance	Yes
Long-term evaluation	Probable	Long-term evaluation	Probable	Long-term evaluation	Probable

Despite this rather static differentiation it can be expected that not only the length of the monitoring program, but also the chosen monitoring intervals is decisive for the expressiveness acquired data. Some effects may be achieved immediately with the end of implementation and can be assessed then (e.g. the sinuosity of a reshaped river channel) or after proving events (e.g. flood security standards). Other effects may need more time, such as aesthetic effects of mature vegetation or the stabilisation of target species.

Therefore, a definition of appropriate points in time is essential for a meaningful monitoring. Frequencies of assessment may vary for single indicators, due to different times of response as well as varying efforts for assessment. In general only long term monitoring (min. 10 years) provides sufficient data as basis for a comprehensive PIA, but may only be feasible for comprehensive rehabilitation efforts, where major effects can be expected. Monitoring frequency is a particularly important factor for the monitoring of instate parameters with often changing values, such as geomorphologic features, macrozoobenthos populations, visitor frequency, and other. Here continuous monitoring is undoubtedly the key to a correct interpretation of ongoing changes induced by implemented measures.

With reference to the selection of rehabilitation targets, it is proposed that a time frame of about 10 years monitored as a maximum for the achievement of most project targets. Nevertheless, certain (exemplary) targets may need more time, which should not lead to the abandonment of those (e.g. the stability of population of a highly specialised fish species cannot be established within ten years, though intermediate success and a possible positive trend can easily be monitored). However, the longer the final achievement takes after the actual intervention the less it will be possible to assign the effect to the measures applied.

Many parameters of urban river rehabilitation may require a special enquiry effort, which cannot be frequently repeated. These include most social and economic aspects that need an individual and costly field enquiry using time consumptive methods such as visitors surveys, household based surveys, interviews etc. (e.g. social changes in the effect area, public perception of changes and other). Compromises for assessment include the reduction of measurements to only two (or at maximum three) times – e.g. one in the planning phase, one year after implementation, and five or ten years after implementation (e.g. the indicator property values).

For some parameters a two-time monitoring (one before and one after implementation is a priori acceptable, since corresponding parameter values remain relative stable and are not subject to future development (e.g. local flood control standards).

Following assessment ranges are proposed based on the classification given in

Table 2.1.

Short term	With project implementation or within the first two years
Mid - term	Within about 5 years after realisation of the scheme
Long term	Within about 10 years after realisation of the scheme and longer

2.5.7 Conclusions for the Assessment

Even though opinions like "If it's not counted, it won't be noticed" (MacGillivray et al 1998)[2] are not seldom, quantification at all costs cannot be the sole approach of a PIA. It is out of doubt that qualities of a rehabilitated urban river are perceived by all senses. Consequently, it is not the goal but rather the ungraceful task of indicator development to translate those qualities into easily measurable (countable) figures. For this reason many of these values can only be addressed indirectly, as the word "indicator" implies. For example, the indicator "visitor frequency" measures the number of people visiting a place, but simultaneously giving information about the general appreciation of the site, which itself cannot be described in numbers. However, such an indicator would be highly aggregative and may cover many more issues than only one. Nevertheless, the fact that more or less people attend the rehabilitated river site can help to indicate whether or to which extent the project responds to public wishes or human needs in general – an issue, which particularly in urban areas cannot be overestimated.

[2] quoted by Birkmann (1999), p. 57

Post implementation assessment starts parallel to the project's definition. The steps of problem analysis, prognosis of development and the definition of targets are indispensable for both, project definition and appraisal of success. Success appraisal is to be understood as part of project management and thus of planning, implementation and overall evaluation. Especially the proper operationalisation of targets is a step highly beneficial for both, project definition and post implementation assessment.

Based on the above the following can be summarised as prerequisites for a successful PIA:

1. *The setting of rehabilitation targets (goals, objectives, etc.)*
   The determination of target achievement can only take place through a comparison of measured values and target values for an indicator. Target values should therefore be defined as early and as precise as possible. The definition of contents for post implementation assessment should be seen as part of project planning.

2. *Availability of benchmarks for targets* (qualitative and quantitative)
   Benchmarks are indispensable for the ranking of indicators and criteria. Each indicator or indicator group can have individual classification. Sources of benchmarks can be thresholds derived from different administrative levels (cf. DVWK 1996): the EC (e.g. state of water bodies), national or regional legislature (flood defence or other security standards), local planning targets, or individual specifics (e.g. local target species or district development goals).

3. *Selection of indicators*
   Performance indicators should be defined already in the course of target definition. For the detection of potential side effects additional indicators must be selected before implementation. Important effect path ways of measures should be covered to detect potential side effects. Indicators can be qualitative or quantitative measures.

4. *Establishment of baseline conditions*
   For the determination of effects the measurement of baseline conditions is essential. Only with the knowledge of status quo conditions effectiveness can be assessed. Reference sites for example upstream will help to uncover underlying trends later on.

5. *Appropriate monitoring frequency*
   Frequencies of post implementation monitoring must respond to the needs of each single indicator. It should respect the differing development times until a certain effect can materialise. Especially the timing of the final enquiry is important for significance of results. Oscillation of measured properties (damping, cf. Westman 1991) can be natural for certain systems. These effects should be considered when interpreting results. Highly instable properties may not be assessed.

6. *Spatial adequacy of data time aspect*
   Measures of urban river rehabilitation have a limited spatial impact radius. Assessment of effects must consider the spatial adequacy of data to avoid misinterpretation. This especially applies to societal impacts beyond the direct

intervention area – here an appropriate effect area needs to be defined, where data must be enquired. A spatial limitation of data also applies to the water course itself. Water related effects may not be sufficiently measurable beyond the intervention reach.

7. *Consideration of the trend without intervention*
   Condition of urban waters can change naturally or in response to impulses elsewhere (cf. Kondolf and Micheli 1995). Therefore, the success of rehabilitation is not only defined by the improvement of properties of interest. Also the real effect of measures taken is important. This is especially complicated if systems/properties in transition are concerned. Depending on the trend a drastic improvement can be as successful as an avoided decline of qualities.

2.6 Development of indicators for post implementation assessment

2.6.1 Existing indicators and indicator systems for appraisal of urban river rehabilitation

As stated before, indicators and indicator system for the specific purpose of urban river rehabilitation do practically not exist and are only seldom applied. Basically not much has changed since Holmes (1991) found that only 5 % of rehabilitation projects had some kind of appraisal. Also Bruce-Burgess (2001) states in an extended study on success appraisal that appraisal processes, if implemented at all, “appears to be ad hoc and to be governed by the availability of time and money and by individual initiative”.

A recently accomplished study on the state of the art of urban river rehabilitation in Europe (Schanze et al i.p.) identified only a few projects with systematic monitoring and post implementation appraisal. Furthermore, the extent of monitoring and the quantity and quality achieved differed a lot in dependence of project size, project design and the availability of financial resources. However, in most case studies at least some parameters were taken into account in the process of rehabilitation. Some of those appeared regularly, some only exceptionally. Most often biological indicators including fauna and flora as well as water quality aspects were monitored. Assessment of societal factors including social, aesthetic and economic aspects were performed less. In most cases those were assessed in special external studies, most without feedback to the overall success of the project.

Against this background it can be summarised, that currently there is practically no systematic post implementation assessment in urban river rehabilitation projects. Only singular attempts have been noticed, but in general are not consequently integrated in the overall project management and therefore deliver only limited value for the development of an indicator system. Therefore, only parts respectively single indicators can be integrated in the system to develop.

Ecological aspects

In terms of ecological monitoring the following parameters and indicators have been applied in the enquired case studies (Schanze et al, i.p.).

Hydrology and Hydromorphology

- Hydrological regime (incl. NQ, MQ, HQ)
- Bank full flow conditions
- Sediment balance
- Bed shear force
- Stream morphology
- Cross section

Water quality

- Chemical
- Biological
- Physico-chemical (e.g. automated dissolved oxygen)
- Different groups of pollutants
- Sediment concentrations
- Nutrient concentrations

Flora

- Shrubs
- Trees
- Perennials
- Invasive species

Fauna

- Avifauna
- Ichtiofauna
- Invertebrates
- Mammals
- Amphibians

Other

- Soil pollution (heavy metals)
- Potential for re-colonisation of river section
- Land use distribution (e.g. percentage of impervious area within the basin)

In the evaluation of biological parameters aspects such as species richness, abundance and conservation values played an important role. In reference to hydrology and water quality typical measures were used, though sampling methods and thresholds differed within countries. Only one project reported the use of the WFD systematic (Emscher case study, see Schanze et al i.p.). Indexes used were the Europe wide applied ‘Saprobic index’ and the Italian Extended Biotic Index (EBI).

In the case studies following approaches and methods were applied for monitoring:

- Hydrologic and hydraulic modelling
- Geomorphological modelling
- Rosgen morphological stream classification
- Stream habitat structure mapping (Strukturguetekartierung, D)
- EHS (Ecologische Hoofdstructuur, NL)
- Biological inventory
- Breeding experiment of brown trout fry
- Test section monitoring
- Environmental Impact Assessment
- Photo documentation of changes

Social and economic aspects

River rehabilitation in urban areas may have significant impacts on social and economic well being. Direct positive impacts potentially include a decrease of safety and health risks, an enhancement of amenity values of the site, an increased awareness and stewardship for the river site, and an increase of property values. Impacts may also be negative, such as subsequent neighbourhood segregation processes, a higher risk of flooding or noise and dust pollution during construction. Impacts will be even greater, if urban river rehabilitation comes along with river front development, neighbourhood revitalisation and stakeholder participation. In consequence for the overall success appraisal socio-economic criteria will be as important as ecological criteria. Without their consideration results of post implementation assessment may be distorted.

A lead for the assessment of socio-economic impacts can be generally drawn from the procedure of Social Impact Assessment, including “… the monitoring and managing the intended and unintended social consequences, both positive and negative, of planned interventions and any social change processes invoked by those interventions” (IAIA 2003). Despite the legal integration of the assessment of “human beings, …and cultural heritage” in the European Impact Assessment legislation (85/337/EEC), there seems to be no legislative agreement in terms of what socio-economic impact assessment should be covered (Redondo, 2003).

The literature on social criteria to be considered in an impact assessment is wide, but only a few explicit listings exist (cf. van Schooten et al 2003). In consequence the management and assessment of socio-economic impacts of interventions have been very variable to date. In fact, social impacts are rarely included in any EIA Studies (Stolp 2003, p. 231). This is also true for river rehabilitation projects since for such projects not even impact assessment itself is required in legislation (cf. María Díaz

Redondo 2003). A study of urban river rehabilitation projects (Schanze et al i. p.) has shown, that socio-economic criteria are only seldom explicitly considered and criteria is usually not operationalised. There is a missing need in doing so, since ecological improvement is anticipated to have positive social and economic impacts as well (cf. Otto et al 2003, Redondo 2003).

A very general classification of socio-economic impacts of a physical intervention, based on an extensive study of respective lists, has been attempted by van Schoeten, Vanclay and Slootweg (2003, p. 84 sqq). Table 2.2 displays an excerpt of the list. Stated impacts have been selected based on potential impacts of urban river rehabilitation related to in Literature (cf. Schanze et al i.p., Redondo 2003, Riley 1998).

Table 2.2 Socio-economic impacts of physical interventions (van Schoeten, Vanclay and Slootweg 2003), shortened in relation to urban river rehabilitation)

Impact Category	Criteria
Health and Social well being	❑ Actual physical health ❑ Mental health – feelings of stress, anxiety, depression, general self-esteem etc ❑ Feelings in relation to the project
Quality of the living environment (liveability)	❑ Quality of the living environment (actual and perceived) ❑ Leisure and recreation opportunities and facilities ❑ Environmental amenity value/aesthetic quality ❑ Availability, physical and social quality of housing (actual and perceived) ❑ Personal safety and hazard exposure (actual and perceived) ❑ Crime and violence (actual and perceived)
Economic impacts and material well-being	❑ Economic prosperity and resilience ❑ Income ❑ Property values ❑ Replacement costs of environmental functions
Cultural impacts	❑ Change in cultural values ❑ Natural and cultural heritage ❑ Cultural integrity
Family and Community impacts	❑ Social networks ❑ Community identification and connection ❑ Community cohesion (actual and perceived)
Institutional, legal, political and equity impacts	❑ Functioning of government agencies (institutional capacity) ❑ Participation in decision making and Subsidiary

The study of urban river rehabilitation projects mentioned above (Schanze et al i. p.) revealed that social and economic aspects have rarely been explicitly considered for appraisal. Following aspects were mentioned to be at least considered in some way, but seldom assessed by systematic studies:

Social

- Public perception of rivers
- Public acceptance and awareness
- Stewardship and advocacy
- Stakeholder network
- Ownership
- Built structure
- Aesthetics
- Recreational value
- Health risks

Economic

- Economic appraisal
- Property values
- Cost measurement
- Potential flood damage

Methods, applied for the assessment of social, aesthetic and economic aspects were:

- Stakeholder analysis
- User surveys
- River Landscape Assessment
- Photo documentation and
- Cost-benefit-analysis

Generally only a few of these aspects were considered by more than one case study. Often only single measurements were realised, which do not necessarily have representative character for project success.

Examples of comprehensive post project assessment were found in two North American case studies (cf. Schanze et al i. p.). The Don and Anacostia case studies both combine a large variety of relevant criteria, individual indicators as well as ecological and societal parameters. The monitoring approaches of these two projects are summarised below.

Don River (Toronto)

The entire watershed is considered by the Don River monitoring program. It was initiated by the Don Watershed Task Force and put forth in their challenging and internationally renowned "40 Steps to a New Don" (TRCA 1994). The monitoring programme is carried out and financed by the city and repeated every three years.

The monitoring programme considers the ecological state of the water body and the surrounding habitats as well as social aspects. Indicators describe quantity and quality of ecological and social parameters, and the state of measures applied to enhance the water body. There are a total of 18 indicators, accompanied by sets of targets or specific aims. The following tables summarise the contents of the "Don Watershed Report Card 2000" (cf. DWRG and MTRCA, 2000). They are headed by following themes: 'caring for water', 'caring for nature', 'caring for community', 'protect what is healthy', 'regenerate what is degraded', and 'take responsibility for the Don'.

Table A: Caring for water

Parameter	*Indicator*	*Description of measurement*
Quantity	1. Flow Pattern	Volumes of discharge, peak flows.
Quality	2. Water Quality - Human Use	Parameters include, but are not limited to bacterial count (faecal coliforms, E.coli), phosphorus, and nitrite, copper, zinc, suspended solids, ph, temperature, dissolved oxygen, ammonia, copper.
	3. Water Quality - Aquatic Habitats	Wet weather sampling of total suspended solids, aquatic invertebrates studies, young-of the-year fish monitoring, identification of persistent toxins.
	4. Storm- water Management	Percentage of watershed in quantity and quality control.

Table B: Caring for nature

Parameter	*Indicator*	*Description of measurement*
Quantity and Quality of Habitats	5. Woodlands	Percentage of watershed in woodland. Goal: 30-25% of woodland cover within a watershed is threshold for a healthy watershed.
	6. Wetlands	Percentage of area within watershed (Target 0.5 % of watershed).
	7. Meadows	Percentage of area within watershed.
	8. Riparian Habitats	Percentage of riverbank with aquatic vegetation.
	9. Frogs	Baseline data to be developed increase number and diversity.

	10. Fish	Number of removed barriers to fish migration.

Table C: Caring for community

Parameter	*Indicator*	*Description of measurement*
Appraisal and Actions	11. Public Understanding and Support	Percentage of watershed inhabitants expressing knowledge of and expectations for the river.
	12. Classroom Education	Percentage of elementary, junior high and high school classes in Toronto visiting the Don.
	13. Responsible Use and Enjoyment	Number of users.

Table D: Protect what is healthy and regenerate what is degraded

Parameter	*Indicator*	*Description of measurement*
Nature areas	14. Protect Natural Areas	Percentage of natural areas within watershed in public ownership.
	15. Regeneration Projects	Number of regeneration projects. Objective: To increase the number of regeneration projects undertaken in a three-year period from 100 to 200.

Table E: Take responsibility for the Don River

Parameter	*Indicator*	*Description of measurement*
Personal	16. Personal Stewardship	Percentage of watershed residents that volunteer time or funding.
Business	17. Business and Institutional Stewardship	Number of businesses and institutions signing an agreement of stewardship.
Municipal	18. Municipal Stewardship	Adoption and enforcement of water friendly policies, controls, and practices (e.g. reduction of salt, pesticides, fertilizer, topsoil preservation, sediment control, fill, groundwater protection, native plants).

Those indicators were evaluated using following approach of evaluation: Each indicator was presented within the so-called report card under the following questions:

- Where have we been at the last monitoring?
- What were the targets?
- Where are we now at this monitoring?
- What is the trend of development?
- Where do we want to be?
- How do we get there?
- What measures are necessary to be reaching targets?

The approach did not use a solely quantitative approach, but rather used description substantiated with numbers. This approach ensured an understandable presentation for the public and was made available via Internet (cf. DWRG and MTRCA 2000).

Figure 2.10: Case study Don River, Toronto (Schanze et al, in prep)

Anacostia (Washington D.C.)

"Anacostia Restoration Indicators and Target Project (I & T Project)"

In 1999 an agreement was reaffirmed and a new provision added to develop a set of specific, long-term restoration indicators and targets under public participation. Six fundamental goals were defined to be achieved by the year 2010. A set of 31 "Technical Indicators" and 19 "Public Awareness/ Stewardship Indicators" were established for the year 2001. A numerically based scoring system (e.g. 0-100 points total with associated verbal ranking categories) was employed to provide a more systematic and consistent method for reporting. Draft versions of a restoration progress summary sheet with a subset of 16 so-called "Leading Indicators" and a more detailed companion 'Report Card' have been developed to facilitate public understanding and dialog.

Leading indicators:

Goal 1: Reduce pollutant loads

- Total suspended solids
- Combined sewer overflows
- Faecal coliform concentration/ bacterial contamination- instream concentrations
- Dissolved oxygen
- Trash index and quantity of trash removed

Goal 2: Restore ecological integrity

- Deformities, Erosions, Lesions, Tumors (DELTs)
- Macroinvertebrate community health
- Resident fish community health
- Stream miles restored
- Percent of developed land in the watershed with storm water controls

Goal 3: Improve fish passage

- Percent historical anadromous fish spawning range open

Goal 4: Increase wetland acreage

- Created/ restored tidal wetland acreage
- Created/ restored non-tidal wetlands

Goal 5: Expand forest coverage

- Miles of created riparian forest

Goal 6: Increase public and private participation

- Number of school activities
- Number of active "Friends of" groups

Anacostia stakeholders receive a detailed annual appraisal of watershed restoration progress and a summary sheet with dashboard-like gauges intended to convey annual and overall restoration progress 'at a glance' for each of the six goals.

Monitoring program

The rehabilitation project established frameworks of watershed-wide monitoring and restoration reporting to elected officials and the public. Prior to the start of restoration work aquatic biota and water quality were evaluated. The results established a pre-restoration baseline data set and were utilised during the planning process. Vegetation monitoring efforts have been conducted in order to document the development and evolution of reconstructed wetlands over a 5-year period. Monitoring results have led to several adaptive management decisions, e.g. replanting less palatable wetland species, measures to limit invasive species such as Phragmites, installing of trash barriers. Other research and monitoring efforts included studies of the accumulation of toxins in fish, invertebrates and sediment, fish, plant, reptile, amphibian and bird surveys. (DEP and MWCG 2001)

Figure 2.11: Case Study Anacostia, Washington D.C., United States of America (Schanze et al i. p.)

2.6.2 Criteria for the choice of indicators

A central element for the choice of indicators for an indicator system is the orientation along the defined 'Leitbild' and related, more specified targets (cf. Kern 1994, Kondolf 1998, Birkmann et al 1999). When indicators lack a direct relation to the defined target system they may loose their indicative function. The selection of an indicator, therefore, should always be justified by its relation to the target system (Birkmann et al 1999, p. 58). A set of further relevant criteria for the selection of suitable indicators for any rehabilitation project are to be found in Table 2.3. (DEST 1994, ITFM 1995, Nijkamp and Ouwersloot 1998, Birkmann 1999, Lorenz 1999, Enders and Grangler 2001).

In relation to indicator sets it needs to be ensured that it is minimal, complete, mutual exclusive and operational to measure the achievements of the project (cf. Bettes et al i. p.). In general it is desirable to have a small number of indicators in an indicator set, permitting efficient monitoring and subsequent analysis of data. At the Washington D.C., U.S. case study (cf. chapter 2.6.1.) at the beginning 50 indicators were chosen, which were subsequently reduced to a set of 32. A study of sustainability indicator systems revealed, that most of them used between 20 to 30 indicators (Heiland et al 2003), which is consistent with the case study mentioned above.

Table 2.3: Criteria for an indicator system

Criteria	Description
Scientific requirements	
Theoretical soundness	The close relation of an indicator to a rehabilitation target is a prerequisite for the measurement of success. Indicators should reflect change as precise as possible and should be influenced as little as possible by other factors. It should be unambiguously linked to a target value.
Measurability	An indicator should be measurable over time, be easy quantifiable and have a defined numerical scale.
Predictability	An indicator has to be predictable relating to its development and definition of reference or target value. Only then a determination of prognosis and/or trend will be possible.
Scientific credibility	An indicator must be scientifically credible in terms of statistical validity, reproduction (methods of enquiry) and classification (transparency of scales). Enquiry methods and classification of an indicator should be either widely accepted or documented in a reproducible way.
Temporal Sensitivity	An indicator must be sensitive to changes over time.

	Ideally, the indicator should detect changes already in early implementation stages to allow for adaptive management.
Spatial Resolution	Ecological and societal aspects always relate to a certain space. Indicators of those aspects must relate to this specific space to have relevance for the aspect of interest.
Robustness	The indicator should not only apply to a certain project but be applicable with various projects in differing situations. Therefore indicators should be flexible in regard to time, space and scale.
Organisational requirements	
User and policy relevant	The indicator should be tailored towards the needs of its actual addressee's. This is important to enable addressees (e.g. decision makers or river managers) to act.
Comprehensibility and communicability	Indicators should pay respect to the easy understanding of the measured value and the attached meaning.
Efficiency and practicability	The indicators should either allow for the use of existing monitoring data or be easily acquirable. Enquiry methods should be simple and as cost-efficient as possible.
Participation	Where possible and appropriate the indicator should facilitate community involvement (e.g. by direct relation to public perception of issues)
Obligation	Where required, indicators should also contribute to the fulfilment of reporting obligations.

3. Method for Urban Rivers Post Implementation Assessment (URPIA)

Existing criteria based assessment methods have been analysed in quest of a flexible PIA procedure for urban river rehabilitation (cf. chapter 2.3.). Those included methodological approaches applicable for different evaluation tasks and specific examples of PIA for river rehabilitation. In response to identified gaps and deficits as well as theoretical requirements mentioned in the chapters above a method is proposed for a systematic and comprehensive post implementation assessment. It provides a flexible framework for the assessment of effects, effectiveness and efficiency of any urban river rehabilitation project. In relation to the overall project management process (Figure 3.1 Integration of the URPIA Method into the overall Planning Process) following steps are proposed:

- Determination of an indicator set
- Qualitative and quantitative analysis of data
- Dissemination of results

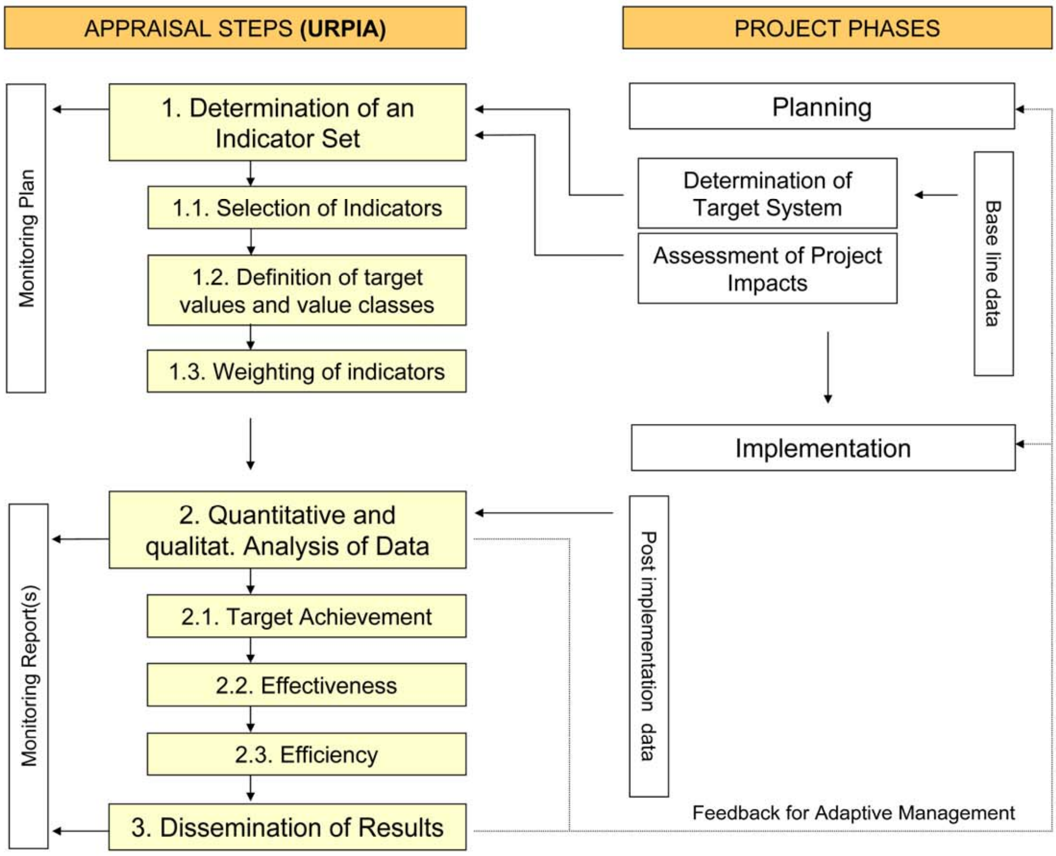


Figure 3.1: Integration of the URPIA METHOD into the overall Planning Process

The method constitutes a step by step approach to determine a project specific set of indicators and their use for the assessment of effects and effectiveness in relation to ecological, social and economic aspects. The detection and measurement of significant positive or negative side effects will constitute an integral part of the suggested approach. In addition, attention will be given to the establishment of a monitoring plan (cf. chapter 3.6) that will help to manage assessment of indicators and the dissemination of results (cf. chapter 3.5).

In order to facilitate the determination of a project specific indicator set, the following is provided with the method:

- Three hierarchies of criteria and indicators, describing the range of potential ecological, social and economic effects of a river rehabilitation project at different levels of detail (see annex 2A) to be used for aggregation purposes cf. chapter 2.6.2)
- Indicator sheets, describing the indicators in detail, including operationalisation, rational, data enquiry, and application aspects (see annex 2B and chapter 4)
- A decision support chart for the selection of indicators (see chapter 3.3.1)

Those materials are designed as flexible system, open for adaptation to specific needs of individual projects. This may include simplification of indicator selection or the integration of additional indicators. The provided compilation of potential criteria and indicators is most inclusive, though only indicators applicable to the site are to be used.

3.1 Determination of a Target System

This chapter will give a short overview for an approach to determine a target system, which can be easily disaggregated to measurable indicators. The output of this step will be a set of operationalised objectives and a corresponding set of quality elements, which potentially change their state as a result of implemented project measures and therefore reflect the effects achieved by the project. In the next step those quality elements then will be furnished with suitable indicators, which can quantify their change. For description of quality elements, other criteria and indicators, see chapter 4.

If project targets have already been established, one may use the hierarchies provided in the annex 2A and determine, which quality elements will be intentionally affected by the project. Also, it should be ensured that existing targets are operationalised as described below. One may chose to proceed directly to the next step “Determination of an Indicator Set”.

Table 3.1 Example of how to transform criteria into targets and visa versa

Level Number	Hierarchy of Criteria	Description of criteria	Hierarchy of Targets	Description of Targets
I	Theme	Success level, describing the effects within the three main components of sustainability	Mission statement	A flexible, but clear framework, describing the aimed conditions at the site in relation to ecological, social and economic aspects
	Example	Ecology, social well-being and economic well-being		Ecological state of the river in compliance with the ecological requirements of the WFD. A site offering recreational values to attract residents and visitors alike. Reduced flood risk, to attract investment to the site.
II	Category	Criteria differentiating the effects and describing the level of success within each theme	Goals	A small group of general targets, specifying the state and displaying the tendency of development
	Example	Biodiversity Existing Conditions and Quality of River and River Site Settings Project Costs and Maintenance Costs		Increase biological diversity of the river section Provision and enhancement of recreational values along the river Lowering of maintenance costs
III	Sub-Category	Criteria differentiating the effects and describing the level of success within each category (or a group of rehabilitation elements)	Objectives	Targets, which are specifying goals
	Example	Biological Quality Elements Public Accessibility to River and River Site Maintenance Costs		Improve biological status of the river section in relation to fish fauna, benthic invertebrate fauna Improve accessibility towards the river Lowering of maintenance costs
IV	Quality Element	Criteria differentiating the effects within each sub-category and aggregating effects described by indicators	Sub-Objectives	Operationalised Targets, which are specifying objectives and goals
	Example	Fish Fauna Physical access to the		Increase number of native fish species in a long term

		water Event related maintenance costs		Improve physical access to the water along one side of the river in a middle term effort Lowering of event related maintenance costs in a long term effort
V	Indicators	Measurable criteria differentiating the effects and describing the level of success within each quality element through measurement of indicators	Measurable Objectives	Targets, which are completely operationalised, including a description of what, how much, where and when something should be achieved
	Example	Abundance of fish fauna		Increase Individual desinsity of target fish species (with as little as possible variation from undisturbed conditions) by 2015
		Water Contact Zones		Provision of water contact zones including steps, low slopes and piers at least every 200 meters along one side of the river by 2010
		(Potential) Flood damage costs		Reducing potential flood damage costs for a 50 year event to about 1 Million Euro until 2015

The establishment of targets, which later can be transformed into measurable indicators, requires several steps. It may start with the formulation of a mission statement in conjunction with general goals (strategic targets) and proceeds to the establishment of more precise objectives until measurable objectives (indicators with target values) have been defined. Most often a mission statement will be developed in conjunction with goals and objectives. General targets may be refined and adapted, as more precise targets are defined.

→ Consider following general requirements for the determination of targets:

Targets should comply with sustainability requirements and especially in urban environments include ecological improvement as well as social and economic well being.

Targets should be based on a preceding problem analysis, resulting in the determination of rehabilitation needs and an identification of opportunities (e.g. scenario technique, SWOT analysis), to ensure specificity of targets for the site and problem adequacy (cf. chapter 2.5.1).

Targets should take into account superior programmes as well as legislative requirements and commonly accepted standards (cf. Bruce-Burgess and Skinner 2002) and pay attention to ongoing and future developments in the basin.

It is the task of mission statements to provide a clear framework of qualities the river and the surrounding urban area should provide for in future and which functions it should fulfil. This statement should be flexible to allow adaptation under changing framework conditions. In addition to the formulation of a first mission statement, it is recommended that a ‘feasible mission statement’ be formulated. Based on feasibility considerations, it will express, what can be done under the applicable local or organisational constraints.

→ Formulate a mission statement, describing which ecological, social and economic qualities you want to achieve at the site. Record the reasoning that led to the mission statement as well as to a feasible mission statement, to ensure transparency of the planning process.

The hierarchies of criteria (Annex 2A) provide a guideline for the definition of goals and objectives. The predefined criteria may be transformed into those, by operationalising the criteria and complementing them with a description of what, how much, when and where should be achieved (cf. Table 3.1 for examples). If one proceeds from Level I to Level V information becomes more specific. The hierarchy will, therefore, guide the user from a very general statement at first to a very precise description of what should to be achieved at which point of time by project. The hierarchy ensures a clear structure of targets as well as that each goal is provided with at least one or more objective, each objective with at least one sub-objective and so on.

Goals should express desired qualities and functions for the river rehabilitation site in common. Due to their general character, their number should be as low as possible. For example, for the rehabilitation of the Anacostia River in Washington D.C., U.S. only six goals were chosen. Each of those was supplemented with several objectives clarifying what was to be achieved. Later on objectives were linked to indicators (cf. chapter 2.6.1). Goals themselves may not be completely operationalised as they are usually defining statements for the whole project site and give an overall direction.

→ In conjunction with the mission statement, define a low number of very general goals. You may use the categories provided in the hierarchy of criteria as a guide to define your goals. Include ecological, social and economic aspects.

An operationalised objective describes a quality for a site element (object), stating how much of this quality should be achieved when and where (see Table 3.2). The dimensions of an objective shown in Table 3.2 should be understood as follows (based on Heizer 2001):

Object: A physically existing element, whose quality respectively conditions are to be changed

Quality: Description of the condition, which is to be changed through implementation of measures. Quality elements of the hierarchy trees reflect this dimension.

Quantity: Description of how much should be achieved for a specific condition. This dimension is to be specified in each project individually or rely upon existing norms and standards. It will establish the basis for a later control of target achievement and effectiveness. For non-quantifiable objectives an ordinal scale may be established. For guidance on the establishment of the quantitative dimension see 3.3.2.

Space: Project objectives can refer to a stream in its entirety (e.g. ecological continuity), or to defined stream sections, it may relate to the river itself, the river site or its hinterland. Spatial dimensions for each objective are to be set, before meaningful measurements can take place (cf. 2.5.4)

Time: Some objectives will be met right after implementation of measures, while others will take years to be achieved (e.g. establishment of certain target species). To set a feasible time dimension a prognosis of development should be made. Any change in the project framework may result in delayed or accelerated achievement of goals (cf. 2.5.5).

Table 3.2: Examples of operationalised objectives

Dimension	Object	Quality	Quantity	Space	Time
Leading question	What are objectives bound to?	What should be achieved?	How much should be achieved?	Where should the objective be achieved?	When should the objective be achieved?
Example 1	River channel and banks	Ecological longitudinal continuity	Full longitudinal continuity within the project reach	River reach 1	Until 2005
				River reach 2	Until 2006
Example 2	River corridor	Accessibility of river	Continuous accessibility	One side of river	Until 2006

The definition of the above described dimensions should be based on feasibility studies or expert judgement and involve stakeholders. If objectives have been established in the described way, they can be easily linked to affected quality elements and visa versa. Once quality elements are chosen, whose conditions will intentionally change in course of measure implementation, one can proceed to the next step, where quality elements will be furnished with indicators. With the information provided through the operationalisation of objectives, the definition of indicators is well prepared.

The hierarchies provided in annex 2A may not be suitable for smaller projects. In this case the structure can be simplified to fewer levels in the hierarchy. If hierarchical aggregation is not needed for an overall determination of success, only quality elements that relate to objectives may be selected.

→ Specify defined goals through objectives and sub-objectives. You may use the hierarchy of criteria provided in annex 2A as a guide. Make sure objectives are operationalised completely as described in Table 3.2, as this will simplify the selection of indicators. Define the set of quality elements, which will be intentionally effected by the project.

3.2 Assessment of Project Impacts

Besides the intended effects, defined in the target system, side effects may occur caused by the measures taken in scope of a project. Those side effects may be positive or negative, and in consequence reducing or enhancing the actual effects caused by the project. In consequence, most likely further quality elements have to be chosen in addition to the ones already defined.

Depending on the complexity of the project, different methods used for this impact assessment may be applicable. Most of them will establish effect pathways, determining what side effects may occur, and which mitigation measures have to be taken for negative ones.

As there is a wide variety of impact assessment methods and approaches, differing from country to country, and project to project no further specification will be undertaken here. In most cases expert opinions will be sufficient to determine side effects and respective quality elements laid out in the provided hierarchies (annex 2A). Side effects, too, may be subject to delay and displacement. For instance, rehabilitation of morphological structures may not only improve the habitat quality, but through improved visual appearance and ecological value finally an increased public appreciation may be achieved. While the latter effect does not need to be intended it is worthwhile identifying.

→ Determine quality elements, which will reflect significant negative or positive side effects. You may define target values for those quality elements for a later comparison during the assessment of effectiveness or you may just monitor those side effects with appropriate indicator parameters.

3.3 Determination of an indicator set

3.3.1 Selection of Indicators

It will be virtually impossible to define an unambiguous set of indicators for urban river rehabilitation projects. Even for one project different sets of indicators may be established, but may be more or less appropriate to determine effects, effectiveness and efficiency. In order to allow an efficient selection of a project specific set of indicators, a flow-chart is proposed, functioning as a decision support for planners (Figure 3.2). It is to enable the systematic compilation of a set of indicators covering intended and unintended effects by guiding the user through criteria which should be fulfilled for indicators as well as the indicator set.

Most important for the selection of an indicator is not only whether it has been defined as target value, but whether the intervention is likely to cause a respective effect on quality elements. Those have been determined during the previous two steps and include quality elements, which will be intentionally impacted and quality elements, which are most likely to be affected as a result of implemented measures, but are not a part of the target system (side effects).

Examples of indicators described in indicator sheets are provided in the annex 2B. The indictors described are not at all attempting to provide a complete set. Instead it is providing those, which where most often found during the case study or literature research. Undoubtedly, further criteria and indicators useful to specify effects of the project can and should be included. For more information on criteria and indicators please refer to chapter 4.

Table 3.3 Example for decision matrix

QUALITY ELEMENT (QE)	A)Is the QE part of my target system?	B) Is the QE likely to be significantly impacted?	INDICATOR	C) Are there existing Target values for this indicator?	D) Can plausible benchmarks be establised?	E) Does appropriate data exist for the assessment of this indicator?	F) Is the collection of new data (ex ante and ex post) feasible?	SELECTED INIDCTAORS	G) Do(es) the selected indicator(s) represent the QE adequately?	I) Are all the chosen indicators critical in defining the effects of the project?	J) Are the indicators operational (for experts)?
	y			y		y		y	y	y	y
				y		n	y	y		y	y
				n	y	n	y	y		n	
				n	n			n			
	n	y		n	y	n	n	n	y		
				y		n	y	y		y	n
	n	n	-					n	n		

In the following, the decision support chart, based on a set of leading questions, is explained. To track answers to the questions a matrix is proposed (see Table 3.3). The matrix facilitates the selection process and increases its transparency.

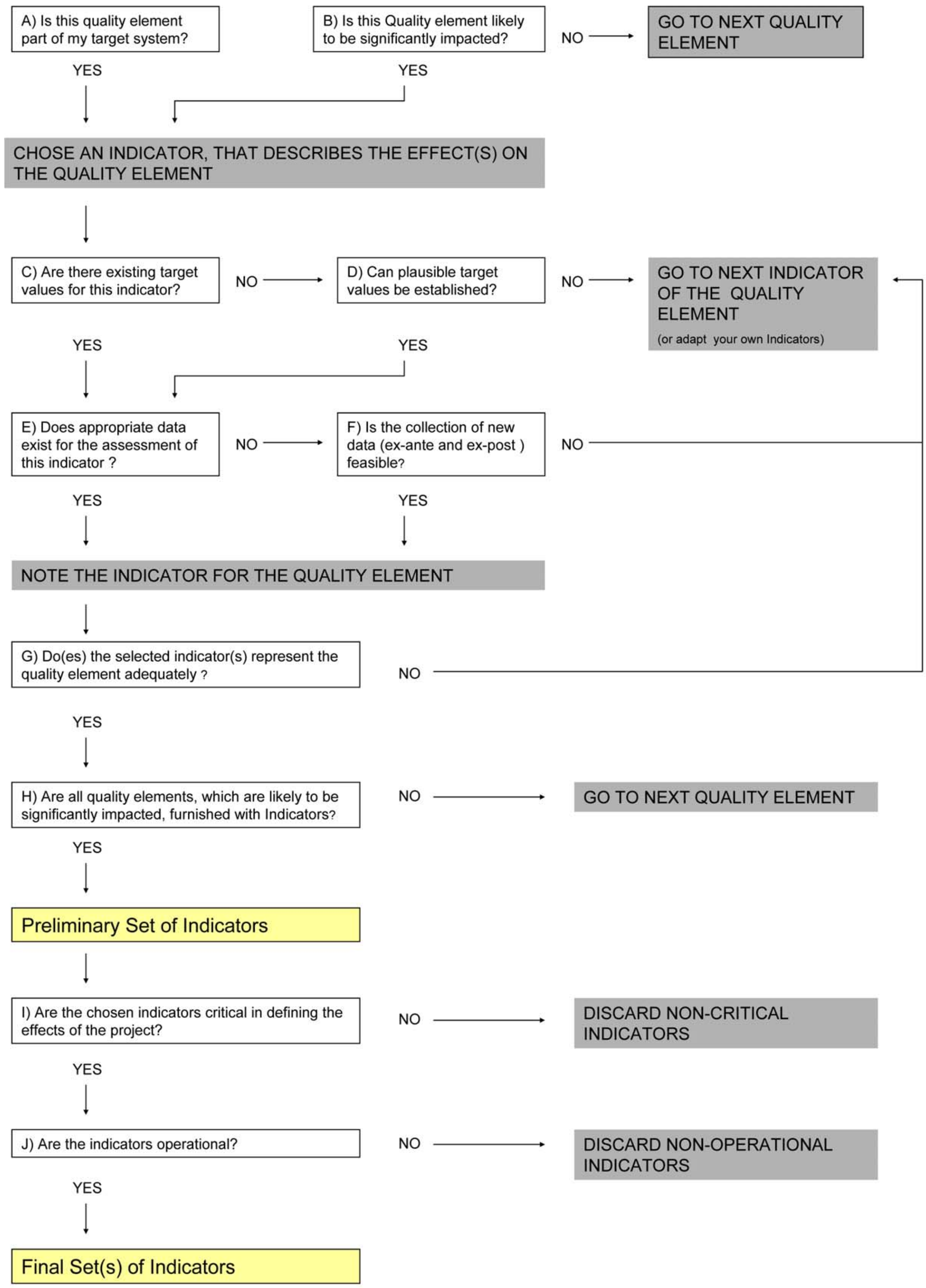


Figure 3.2: Decision support chart for selection of an indicator set

A) Is this quality element part of my target system?

The selection of quality elements is to be seen as an in-between step to foster the linkage between target system and selected indicators. There are two ways to approach this question.

→ A1. You may use the proposed matrix (Table 3.3) already during the determination of quality elements, which are part of the target system. Therefore note all quality elements provided in the hierarchies of criteria (Annex 2A) into the column “Quality Elements”. Include any additional qualitative elements, which are not included in the hierarchies, but may be needed for the assessment of project effects on your site. Fill in the column with above question with YES or NO as you approach the quality elements.

→ A2. If you already have determined the quality elements for your target system as described in chapter 3.1., note those in the matrix column “Quality elements” (c.f. Table 3.3). Check the column with the above question with YES for the quality elements of your target system. Proceed to the next question.

B) Is this quality element likely to be significantly impacted?

Here you want to determine any quality elements, which may be potentially affected through side effects. If significant side effects have been determined trough some form of impact assessment, then quality elements should be included, troug which those side effect can be monitored. Check especially upon those quality elements not yet included as a part of the target system. As for the previous question there are two ways to approach this question (B1 and B2).

→ B1. If you have not yet chosen quality elements representing side effects, follow guidance in A1 for quality elements, describing side effects. Use only those quality elements which are not yet part of your target system (marked with YES in Column A of the matrix). Proceed to B3.

→ B2. If you already have determined the quality elements for side effects as described in chapter 3.2., note those in the column “Quality elements”. Check the column with the above question with YES. Proceed to B3.

→ B3. If you have determined and noted all the quality elements that are affected by your project, you may start the selection of indicators. Use the indicator sheets provided in Annex 2B to furnish your quality elements with indicators. Choose indicators, which are most directly linked to your targets. If needed, you may add your own indicators. Prepare your own indicator sheets for easier replication later on. With the selected indicator proceed to C.

C) Are there existing target values for this indicator?

The availability of either qualitative or quantitative described target values is a prerequisite to each meaningful indicator. Ideally target values and their classification follow widely accepted benchmarks or objectives at appropriate levels. Examples are: EU benchmarks (e.g. water quality; national or regional benchmarks (flood defence or other security standards); individual specifics (local, site or water body level: e.g. local target species or district development goals). Sources of benchmarks can also be thresholds defined by European, national or regional legislature, regional or local planning targets or individually defined goals (cf. DVWK 1996). Rationale for these benchmarks should be explored, to ensure coherence with the locally defined goals. Guidance on potential target values, respectively where to find reference values is given in the indicator sheets under “Benchmarks” and “Tendency”.

The enquiry for target values relates to the question for existing value classifications. Wherever possible existing international, national or regional scales (e.g. Gewässerstrukturgütekartierung in Germany) should be used, to increase the chance for comparability with other projects (robustness of indicators see table 2.3). Sometimes values may require added refinement to comply with the site specific needs of the project. Guidance on classification is given in the indicator sheets under “Potential classification”.

→ If existing benchmarks can be used, mark the column with the above question with YES and proceed to Question E. If there are no existing benchmarks, mark the column with NO and proceed to Question D.

D) Can plausible target values be established?

In some cases there may be no existing target values and they have to be established for the respective indicator. The indicator sheet gives guidance in which direction the existing condition should normally change under “Tendency”. Also guidance for “Potential classification” can be found on the indicator sheets. For further guidance on the establishment of target values and respective classification see chapter 3.3.2.

→ Indicate YES in the column with the above question, if plausible target values can be established. Proceed to Question E. If target values cannot be established, indicate NO. Then the indicator cannot be used and must be discarded (cf. Predictability in table 2.3.). Select a new indicator for the quality element and go back to Question C.

E) Does appropriate data exist for the assessment of this indicator?

Indicators should utilise existing data, whenever possible. “Potential sources of data” for each potential indicator are to be found on the indicator sheets. Data is appropriate, if the spatial resolution and temporal sensitivity of data will reflect the effects of the project. Therefore existing data has to be checked upon those for project needs (cf. table 2.3).

Spatial resolution may be too low, in which case change may not be displayed. This may be the case for water quality data, which in many European countries is regularly assessed, but on a rather broad scale. Small projects may encounter the problem, that there are no or only a few gauging stations near the project site. In this case new monitoring may be needed. For socio-economic indicators, data routinely collected by government or NGO’s can often be adapted for appraisal purposes without a great deal of more work. Nevertheless data on the neighbourhood level is not easily obtainable, since information tends to be aggregated at least on a city wide level (Wagner et al 2003).

A more explicit problem may be the time sensitivity of data, which needs to relate to time of monitoring, even during implementation, to allow for adaptive management. Especially social and economic data is usually accessed in intervals of one to ten years (e.g. property values), due to comprehensive enquiry methods. Changes detected may not be a result of the rehabilitation scheme, but of many other external influences and processes. In general it applies, that the shorter the project and the greater the monitoring intervals, the less effects can be attributed to the scheme itself.

It should be noticed, that parameters with a high temporal and spatial resolution are more sensitive to display even small changes. At the end, project size and sensitivity have to correspond. If sensitivity is too low, the value of the information derived will be limited. If sensitivity is too high, resources will be wasted for limited information gains.

The usability of the data is limited, when just one of the aspects - spatial and temporal validity or the existence of a traceable assessment method - cannot be fulfilled. Then new monitoring needs to be conducted. As resources for additional monitoring are usually limited, exiting data may be used, but its existing limitations should be explicitly expressed in the appraisal.

→ Indicate YES in the column with the above question, if the existing data fulfils above described requirements. Proceed to Question G. If no appropriate data exists, indicate NO. Then the collection of new data must be considered. Proceed to Question F.

F) Is the collection of new data (ex-ante and ex-post) feasible?

Enquiry methods should be as simple and as cost efficient as possible (cf. table 2.3.). Expensive enquiries run the risk to be dropped to make financial short cuts. Enquiry methods that do not require expert knowledge and may be done by volunteers should be considered. For some indicators it may be possible to do one shot assessments (e.g. public preferences and values). Nevertheless a comparison of real ex-ante and post-ante assessments will be most meaningful and bear the smaller risk of subjective distortion of results.

For an assessment of target achievement and effectiveness a comparison of baseline values and target values has to be conducted. In order to achieve comparable values, the same assessment methods have to be used. Enquiry methods should be either widely acknowledged or documented in a repeatable manner to ensure scientific creditability (cf. table 2.3.). Especially, if existing baseline data is used, it should be made certain, that ex-ante and ex-post datasets are comparable. If assessment procedures cannot be reproduced, existing data should be refined using an assessment method, which can later on be repeated. If this is not possible either, new data should be inquired or the indicator discarded. A listing of standard methods, project specific considerations and a description of project specific methods should be included in the monitoring plan (cf. chapter 3.6). Guidance on

“Enquiry Methods”, “Temporal Scope” and “Spatial Scope” are to be found at each indicator sheet.

→ If data collection is determined to be feasible for the indicator, mark it in the column “Selected indictors” with YES. Proceed to question G. If it is determined to be not feasible, discard the indicator and mark the Column with NO. Select a new indicator for the quality element and go back to Question C.

G) Do(es) the selected indicator(s) represent the quality element adequately?

Since the quality element represents an aggregated target, there may be several aspects, which need to be fulfilled to be successful. Therefore the question aims to review the completeness of selected indicators to reflect all effects on the quality element adequately.

→ Look at all the indicators selected for the respective quality element. If any significant effects are not covered by the indicators yet, choose another indicator and go back to question C. If all effects on the quality element are adequately represented, proceed to question H.

H) Are all quality elements, which are likely to be significantly impacted, furnished with indicators?

The question aims to review all significantly impacted quality elements and if they have been adequately furnished with indicators. Despite the need of having as few indicators as possible, all important criteria, which will be relevant for the evaluation of project achievements, should be represented in the set. The omission of significant criteria may distort the final result. This also may be the case if significant side effects have not been considered (cf. Bettes et al i.p.). It is advised to include indicators for potential significant side effects. The monitoring of those may reveal positive as well as negative side effects and an eventual problem shift. This is to ensure the completeness of an indicator set (cf. Bettes et al i.p.).

→ Look at the column with the question “G) Do(es) the selected indicator(s) represent the quality element adequately?”. If all quality elements are indicated with YES in that column, the Preliminary set of indictors is complete. This set needs to be reviewed in order to fulfil further requirements, which will ensure a higher practicability of the set of indicators.

I) Are the chosen indicators critical in defining the effects of the project?

At the end of the selection process it should be re-evaluated, weather indicators are critical for the assessment of the projects success, in order to keep the indicator set as small as possible. Especially indicators which are very closely related to each other should be reviewed and minimized. Guidance is given on the indicator sheets under “Relation to other indicators” and under “Application and Applicability”.

→ Review all indicators. Omit indicators, which do not display a major impact or which are closely related to another indicator. Indicators with a minor impact, which cannot be omitted, should be given a respective importance during the weighting process (cf. chapter 3.3.3). In the column with the above question, note YES for indicators which are critical and NO for dismissed indicators. For the indicators marked with YES proceed to question J.

J) Are the indicators operational?

Indicators selected should be tailored towards the needs of target groups including decision makers, professionals and the public (cf. table 2.3). The main purpose will be communication of what has been achieved to provide a foundation for decision making. Some indicators may be meaningful and comprehensible to certain groups, others may not (cf. table 2.3). Indicators have to be selected accordingly. Guidance on “Application and applicability” is given at the indicator sheets.

Professionals will generally be able to handle specific and raw monitoring data. For public information of monitoring results though data should be aggregated for increased communicability. This may be done in choosing a smaller subset or through aggregation of criteria (cf. chapter 3.3.3).

→ Review the indicators for comprehensibility and communicability to the target group of the post implementation assessment. You may create different set of indicators for different target groups as described above.

When a set of indicators has been selected, one should proceed to the definition of target values and value classifications as well as the weighting of indicators. Some of these tasks have already been fulfilled during previous steps. For instance, many target values should have been set during the establishment of objectives.

3.3.2 Definition of target values and classification of values

Target values

Targets enable the evaluation of measured results. If no existing target values are available, they may be derived from:

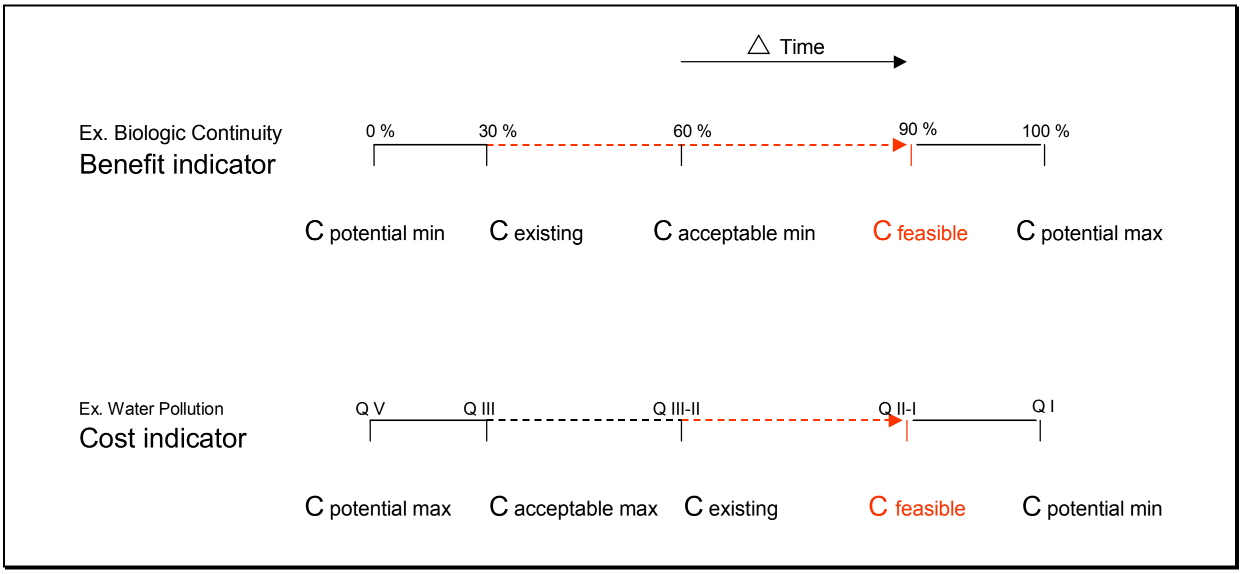
- reference conditions (e.g. for ecological indicators other stream section with similar site conditions, for social and economic indicators other neighbourhoods or city average)
- values based on preferences or experience of stakeholders (objectives, which have been agreed on, e.g. enhancement of recreational values through establishment of more playgrounds)

Guidance for each indicator is given in the indicator sheets under “benchmarks” and “tendency”.

First of all the potential value range of a parameter needs to be determined. This is also most important for the establishment of value classes. Hereby maximum and minimum potential values are determined, representing the range of values a parameter can have. For benefit indicators a minimum acceptable value may be determined, which represents the value below which the described condition is not acceptable and would need to be changed.

In order to comply with the requirement of "medium risk" for targets (cf. chapter 2.5.1) the target value should be defined within the range of the minimum acceptable value and the potential maximum values for benefit indicators (Figure 3.3). Feasible target values represent those values, which can be potentially achieved at a certain point in time under consideration of constraints and possible external impacts. In general it will be true, that the more constraints exist for achievement of a target value, the more the target value will tend towards the minimum acceptable for benefit indicators. Respective considerations can be made for cost indicators.

Furthermore targets of urban river rehabilitation are often not installed but rather induced by the project measures. Indented effects need time to become evident and to mature. For the determination of feasible target values it needs to be taken into account, when effects will be measured and what can be achieved until then. This again will depend on a wide variety of conditions, ranging from type and quality of interventions to external constraints. In consequence any target value should be related to a certain point in time, which allows for a timely monitoring.



C_{existing} = baseline value

C_{feasible} = feasible target value

$C_{\text{ac. min/max}}$ = minimum/maximum acceptable value

$C_{\text{pot. max/min}}$ = maximum/minimum potential value

Figure 3.3: Example for establishing target values

River rehabilitations tend to carry a large uncertainty in predicting responses to interventions. This is true for ecological as well as for socio-economic responses. In consequence many target values for indicators may not be unambiguous. Options to handle ambiguous target values are existent, depending on the accuracy of statement, which needs to be achieved. First a range of values may represent an objective. Second, if no prediction of a target value can be made, then at least a tendency of development should be stated, such as "increase of visitor frequency". In both cases ordinal scales may be used for a later classification.

In general the information content of an indicator will decrease from targets with unambiguous values, to target with ambiguous values and targets defined through a trend of development.

→ If no target value exists for the indicator, start to define the potential minimum and potential maximum value for it. Next, define the target values and feasible target values in relation to a point in time. Depending on the nature of the indicator you also may define a maximum or minimum acceptable value (see Figure 3.3: Example for establishing target values).

Classification of values

For a ranking of measured values a classification of values needs to be established. Each indicator may have an individual classification responding to the characteristics of accessed data. Nevertheless for the purpose of later aggregation indicators need to have a comparable scale. This may already be considered during the establishment of classification. If this is not the case normalisation of scales needs to be acquired.

Once potential maximum and minimum values have been established for an indicator, value classes can be determined. A total of five classes is suggested here, but also 3 or 7 classes may be chosen according to project specific needs. Following mathematical procedure (Figure 3.4) may be applied to establish equal classes:

$CL = (C_{pot.\ max} – C_{pot.\ min})/n$

The classes are defined as follows:

CL_i (i=1, …, n) = $[C_{pot.\ min} + (i -1); C_{pot.\ min} + i*CL)$*

CL_n = $[C_{pot.\ min} + (n -1); C_{pot.\ max}]$**

CL = class interval, n = number of classes

* ( ) → open interval, limit value is not included

** [] → closed interval, limit value is included

Figure 3.4: Determination of equal value classes

→ Use the potential maximum and minimum values to determine your value ranges for classes. For the establishment of equal classes apply the mathematical procedure described in Figure 3.4. Equal classes will not be applicable for all indicators. Other classification types may be used.

3.3.3 Weighting of Indicators

It is anticipated, that for most river rehabilitation schemes single targets will have different priority. For example, safety may be chosen to be of higher concern than ecology or recreation. In consequence, decision makers may assign weights to targets and to indicators, to reflect the importance of targets relative to each other.

In the following the Weighted Sum Method is presented as an approach, which seems most practicable for river rehabilitation projects (cf. Bettes et al i. p.). It is a simple, quantitative method for screening and ranking single criteria within a set of criteria. Other weighting methods may be applied and have been described in Bettes et al i.p.

According to the attempted statement of the PIA, different issues can be weighted. For the target achievement control and determination of effectiveness only indicators describing goals and objectives need to be weighted. Single weights of indicators and criteria can be summed up to describe target achievement at the following levels:

The weighting process may be conducted at following aggregation levels (also see chapter 4.1):

Level II: Theme

Level III: Category

Level VI: Sub-Category

Level V: Quality Element

Level VI: Indicators

An absolute scale (points) or a relative scale (percentages) may be used for the assignment of weights. A relative scale will increase comparability to other projects and may also be easier understood. Weights are assigned as percentages. The sum of all weights within one level of aggregation must equal 100%. The sum of weight for all indicators describing one quality element must equal the weight of the quality element. This applies for all other aggregation levels (cf. figure 3.5 for an example). If a decision on weights cannot be taken, a lower level of aggregation (higher number) may be used. Subsequent, weights will be added for the respective criteria of the higher level (lower number).

If absolute weights are assigned, one starts at a lower level of targets (see Figure 3.5). A scale for ranking the quality elements relating to their importance has to be established. A five-point or three-point scale, with higher values reflecting a greater priority, can serve this purpose. If all weights have been assigned for one criterion, the total sum of those will establish the weight value for the respective criteria on the higher level. This has to be done for all levels of aggregation respectively. If one decides to start at a higher level of aggregation, the weight value of one goal needs to be split for all related objectives etc. An absolute scale may be transferred into a relative scale at the end (see Figure 3.5).

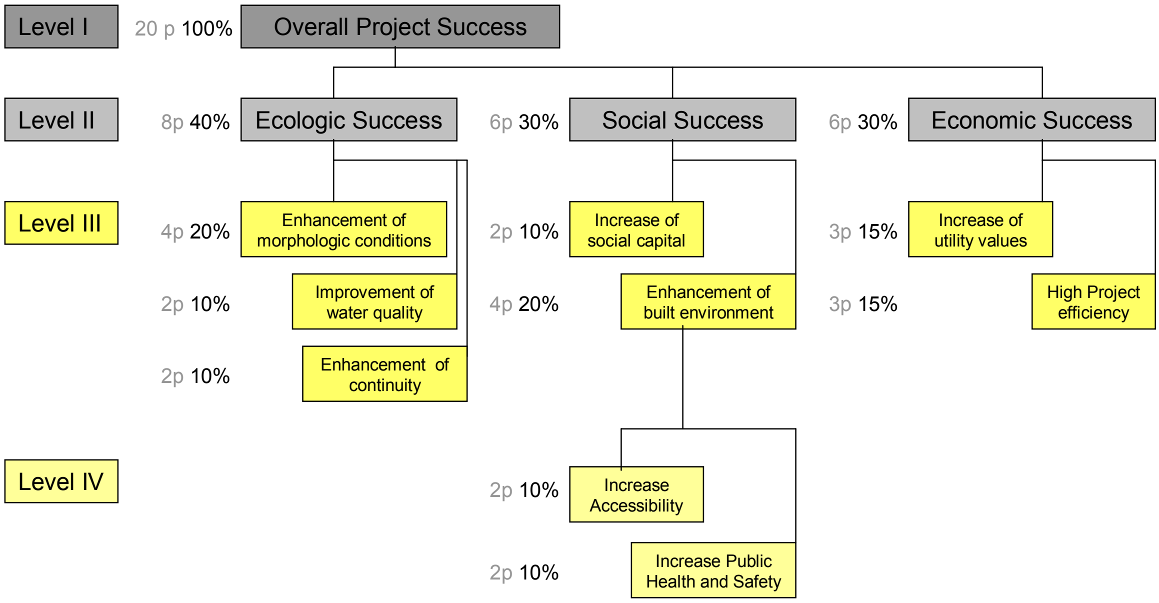


Figure 3.5: Example for assigned weights at different levels of aggregation

Corresponding to the hierarchy of weights, target achievement can be presented at different levels of aggregation. Which one will be most suitable will depend upon the target group, for which the PIA is being done. In holds generally true that the higher the aggregation level is, the less accurate but the easier the presented information is to understand. While establishing a set of indicators, the final level of aggregation should be considered, since a classification of aggregated values may be needed.

In order to aggregate results of all indicators belonging to one quality element scales of indicators need to be comparable. For approaches of normalisation see Bettes et al (i.p.). Aggregation is done from the lower level to the higher level of criteria. The total absolute or relative score of a quality element equals the sum of normalised values for each indicator multiplied by the assigned indicator weight (see Figure 3.6).

On the following Figure 3.6 and Figure 3.7 the aggregation of measured values is done from level 1 to level 2. The same procedure can be applied to other levels respectively.

$$S = \sum_{j=1}^{k} W\, V$$

S aggregated value of criteria

k number of indicators for one criteria

W weight of indicator for the achievement of the criteria

V achieved value of indicator

Figure 3.6: Aggregation of measured values to a higher level.

For a classification for the aggregated values multiply the maximal and the minimal potential value for each indicator with the assigned weight. Results for the maxima of all indictors of one quality element are summed up as well as those for the minima (see Figure 3.7). The difference of these sums defines the range, which may be divided in equal classes (see Figure 3.4).

$CL = (S_{max} – S_{min})/n$

The classes are defined as follows:

$CL_i\,(i=1, \dots, n) =$ $[S_{min} + (i -1); S_{min} + i*CL)$*

$CL_n =$ $[S_{min} + (n -1); S_{max}]$**

CL = class interval, n = number of classes

* ( ) → open interval, limit value is not included

** [] → closed interval, limit value is included

$$S_{max} = \sum_{j=1}^{k} \text{(maximal potential values x indicator weight)}$$

$$S_{min} = \sum_{j=1}^{k} \text{(minimal potential values x indicator weight)}$$

K = number of indicators assigned to quality element

Figure 3.7: Establishing classification for aggregated values (cf. IOER 2003)

3.4 Qualitative and quantitative analysis of data

3.4.1 Target Achievement Control

During the planning process baseline values and target values are determined and a prognosis is given for future development as part of the problem definition (see chapter 2.5.3). As defined, effects are understood as quantitative change of indicator parameters. These are considered for each parameter individually. Where possible, effects can be classified to obtain valued information.

When achieved effects have been measured (see chapter 3.6) the achievement of targets can be conducted. For this purpose, measured values are compared to the target values for the parameters of interest. Result of the comparison is a *yes/no statement*, which only details, whether the target has been achieved respectively exceeded or whether it has not been achieved.

The result of comparison can be threefold:

- Target is achieved
- Target is not achieved
- Target is more than achieved (value exceeded)]

3.4.2 Effectiveness

Effectiveness – how effective measures have been in achieving targets – is expressed by the ratio of the ex-post measured effects to the intended effects for the respective criterion or indicator (Figure 3.8, also see chapter 2.5.3). Hereby intended effects are represented by the change of condition between baseline value and target value.

External conditions are likely to influence the intended effects. For an exact interpretation of effectiveness those need to be taken into account. For purposes of minimizing the need of assessment, underlying trends should only be considered, if a significant distortion of effects measured is to be expected (see also chapter 2.5.3). Nevertheless for the determination of actual effectiveness – that is, what actually has been achieved by the project measures – knowledge of underlying trends is essential. The equation stated in Figure 3.8 should be used for the assessment of actual effectiveness for a certain criterion. Criteria need to be normalised and use the same classifications in order to use this equation (see Bettes et al i.p. for further information on normalisation).

Figure 3.9 shows three simplified examples of how actual efficiency can be determined. In this case water quality (WQ) was chosen as a criterion. Underlying trends in water quality in many cases will be measurable at a reference site directly upstream of the project site. An absolute point scale from 1 to 6 was chosen to express effectiveness. In case 1 the underlying trend enhances the effects of the project and therefore appears greater than the actual effectiveness of the project, which is only 50%. In case 2 no underlying trend exists. Here the appearance of effectiveness and actual effectiveness equal. In case 3 the underlying trend distorts the actual effectiveness of the measures in a negative way. The apparent effectiveness is lower, than the actual effectiveness. Such measurement of effectiveness can be done for any criterion on various aggregation levels, providing that a numerical scale has been set up.

$$\text{Effectiveness (In Percentage)} = \frac{R_D - B}{T_{AR} - B} \times 100$$

$$\text{Actual Effectiveness (In Percentage)} = \frac{(R_D - B) - (T_{RE} - B)}{T_{AR} - B} \times 100 = \frac{R_D - T_{RE}}{T_{AR} - B} \times 100$$

R_D	= Real Development = ex-post measured or achieved value
B	= Ex-ante existing conditions = baseline value
T_{RE}	= Development without intervention = ex post measured reference value
T_{AR}	= Target conditions = target value to be achieved through measures

Figure 3.8: Determination of effectiveness and actual effectiveness for a criterion

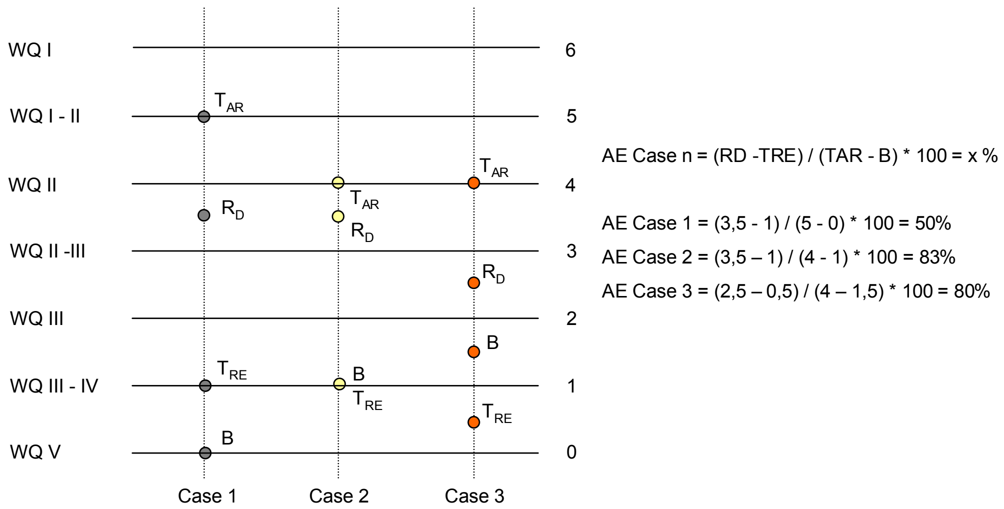


Figure 3.9: Simplified example for the determination of actual effectiveness (AE) for one criterion

3.4.3 Efficiency

When effectiveness is coupled with the efforts needed to achieve the desired effects, efficiency is attained. Chapter 2.5.3 points out that only 'product efficiency' is considered for urban river rehabilitation. Product efficiency expresses the relation of 'desired output' to 'input'. Thereby, 'desired output' is described by the set of quality elements describing indented effects. Input relates to those resources spent to achieve the desired output.

In order to describe outputs in numerical terms, measured values of indicator parameters are aggregated at a level chosen for the determination of efficiency. If 'product efficiency' of the overall project shell be determined, achieved outputs need to be aggregated on the project level. The sub-category "Project cost" can be used to determine the input of resources. Comparisons of effectiveness from one project to another can only be made, when an identical set of indicators with the same classification system has been used.

Since the determination of effectiveness is highly complex, no further specification will be given here and the reader is directed to the scientific literature (see references).

3.5 Dissemination and Presentation of Results

Results of post implementation assessments will be of interest to various audiences. Communication must be assembled to reach target groups ranging from involved scientists and professionals to the interested public and its policy makers. Feedback is not only important for adaptive management, but also a motivation for stakeholder participation and future action. Last but not least feed back is indispensable for the development of future river rehabilitation projects in urban areas. Additionally, a measurement of success may increase commitment towards the achievement of targets and may lead to funding of future projects. Thus form and frequency of reporting should be decided on early on (cf. Bettes et al i.p.). A post implementation report may contain

- A short summary of the rehabilitation effort (past. present, future),
- Overview of criteria
- Results of monitoring
- A short guide, how to read the report

A clear documentation will provide an opportunity to transfer experiences to projects in similar settings. Reports may be displayed in public institutions, offices of NGO's and interest groups, and community centres. They may also be accessible over the Internet to be displayed on the websites of the institutions involved. A public presentation of the monitoring results should be considered in addition to the preparation of a written report.

A graphical presentation of examples and their respective application is given below.

Line graphs

The graphic presentation of a trend is best suited for middle to long-term monitoring, particularly when more than one post implementation assessment is being done. It has been shown that line graphs are suited best for understanding trend development. A diagram may be combined with a coloured presentation of value classes. In reference to the FLAG method (see chapter 2.3) they could be related to an operational instruction, using orange for "improve conditions", yellow for "monitor" and green for "no need to act". The line graph may be used to present at a single indicator or aggregated criteria.

The line graph may not be appropriate for parameters, which are only assessed once or twice against a baseline. In this case symbols may be used for a graphical presentation of developments, as applied trough the so called report cards for the Don River in Toronto (cf. DWRC and MTRCA 2000).

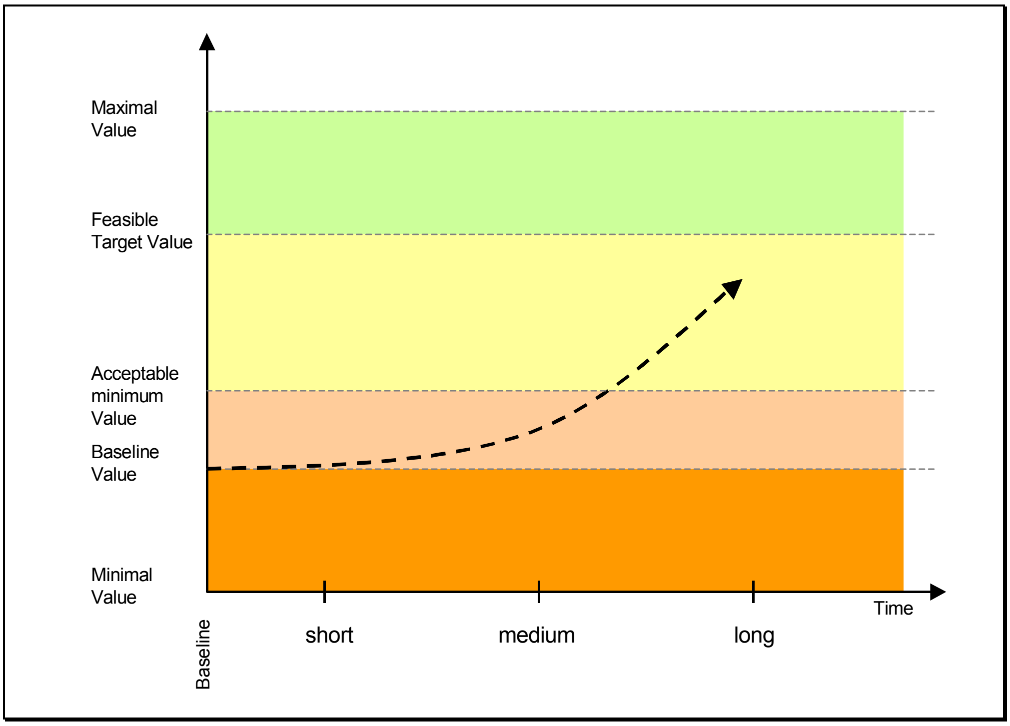


Figure 3.10: Example for a presentation of a line graph for a benefit indicator

Spider diagrams

The spider diagram may be used for a comparative, simple but expressive illustration of different aggregated criteria results. Spider diagrams are often used in multi-criteria evaluations in environmental science (Knoetschke and Thres 2002, Wirth and Schanze i.p.). They may be applied to display overall project success as shown in Figure 3.11, or may be used for one aggregated criteria and its related lower level criteria. For the display of developments at two different points in time, a diagram with two overlapping layers may be used.

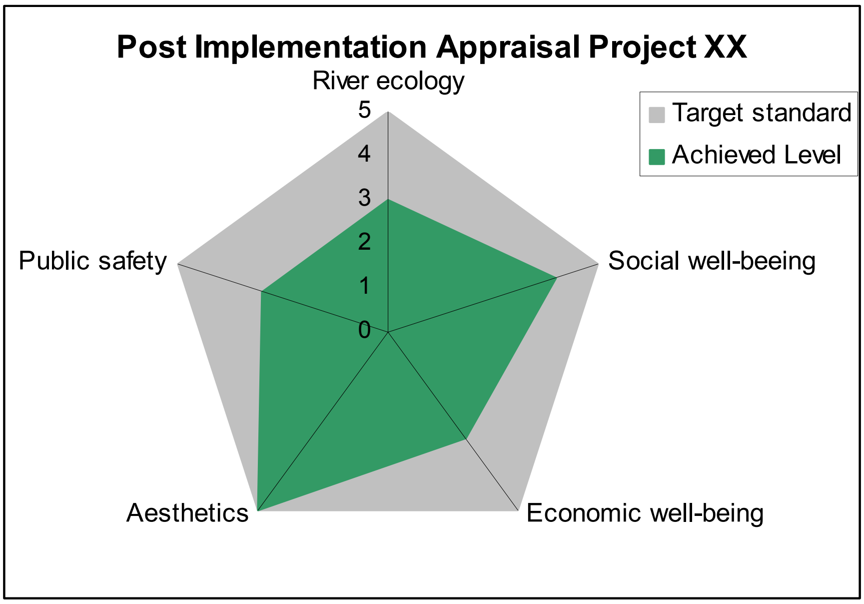


Figure 3.11: Example for a Spider diagram

Performance meter

The performance meter is an additional way to effectively display results in a public report. When baseline conditions are included in the graphic a development can be shown. This can be seen in Figure 3.12 providing an easily comprehendible illustration of the results, displaying clearly to which degree targets have been achieved.

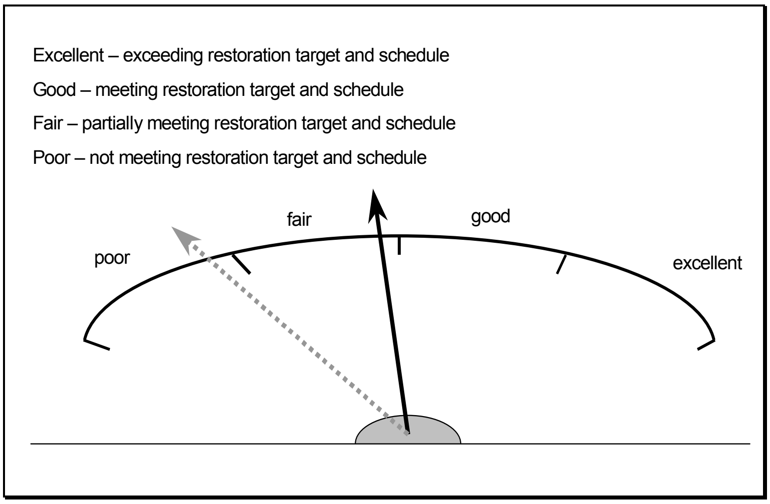


Figure 3.12: Presentation of monitoring results to the public in the Anacostia project (adapted from DEP- MWCG 2001)

Picture sequence

For small projects and projects with limited budgets a visual comparison of ex-ante and post project photographs can clearly display implementation achievements (see

Figure 3.13). It may be used in connection with a description of target achievements, but will not replace any of the above mentioned graphical presentations.

Figure 3.13: Chinbrook Meadows (London), Quaggy River before and after rehabilitation. (Photos: before LB Lewisham / after A. Olfert, IOER)

3.6 Establishing a Monitoring plan

Monitoring before, during and after an urban river rehabilitation project provides the basis for continuous project assessment. It provides information to assess the scheme's performance relative to targets and will help to correct unpredicted and unwanted developments. It also enables feedback to the public, may increase commitment to meet projects objectives and helps to convince tax payers that their funds are producing results.

The monitoring task should be outlined at the beginning of a project in conjunction with the development of goals and objectives. A written report, the monitoring plan, should include a description of goals, objectives, criteria and indicators as well as an outline of the monitoring procedure. Following aspects should be incorporated (adapted from Glasson et al 1999, FISRWG 1998; DEP-MWCG 2001):

- **Monitoring Statement**: Overview of project background, short version of mission statement, goals and objectives, participants and procedures
- **List of Indicators**: Set of measurable indicators and their description as well as potential sub-sets of indicators
- **Monitoring Matrix**: when, where and how to measure (assessment methods), potential alternatives, Statement of adequate duration for post implementation assessment
- **List of Responsibilities**: for assessment, evaluation and reporting
- **Report Statement**: Form and Frequency of public reporting
- **Cost Statement**: Funding needs and potential sources

A "**Monitoring Statement**", a short description of the project and monitoring background, should introduce the monitoring plan. This may include the objectives of monitoring, a short overview on visions, goals and objectives, the procedure of establishing and selecting objectives, project specific indicators and a definition of its participants. In addition conceptual models that were used for establishing a link between objectives and criteria or indicators, may be described. In the URPIA METHOD the hierarchies of criteria (cf. annex 2A) will take on this part of logical reasoning. It may be refined to reflect particular needs of different projects.

Indicators selected should be presented in a "**List of Indicators**". You may use the decision matrix (cf. Table 3.3). There may be different sets of indicators, the set of indicators selected on a first basis as well as a refined and minimized set of indicators. From the latter a more aggregated version may be set up for public communication. The refined list of indicators should be presented in correlation with their related targets. Information about indicators should include their name, the parameter, target values, assessment methods as well as unacceptable results and potential contingencies for addressing those. The list of indicators may be presented as a table (cf. Table 3.4).

Table 3.4: Example for a description of chosen indicators (excerpt, adapted from SFW and DEPMWCG 2001)

goal	name of indicator	parameter	short description and background information, considerations and target value
Reduce pollutant loads to the tidal river Anacostia	Total suspended solids	Annual load of suspended sediments to the Anacostia	A turbidity "total maximum daily load" (TMDL) is going to be set for the river. Work is currently being done to identify, what that TMDL will be. The recommended 2010 restoration target for TSS should be proportional to the TMDL set for turbidity. The recommended interims TSS for the tidal river should be less than 80 mg/l with a gaol of supporting underwater grasses
	Combined sewer overflows	Frequency, and/or volume of overflow	EPA Policy defines a "presumptive" approach to meeting WQ criteria for CSO's. That is, collection systems should capture 85% of the Combined sewage on an average annual basis or have no more than four overflows per year. Further revision is panned base on a modelling project.
	Total phosphorus and total nitrogen	Annual load to the river	for the 2010 target, 40% nutrient reduction consistent with the Chesapeake Bay agreement is recommended

In addition to the list of indicators a "**Monitoring Matrix**" for the timely conduction of monitoring is needed. It should state where, when, and how (method) to assess indicators and who will be responsible for it. Indicators may be assessed at the entire site (e.g. public preferences) or at selected spots (e.g. water quality), depending on the size of the rehabilitation scheme as well as the preferred spatial resolution of the indicator.

Indicators require different frequencies and durations of assessment. Some are monitored frequently (e.g. water quality, target species), some once or twice a year, while others are only assessed once or twice at all after project implementation (e.g. visitor frequency). In most cases parameters should be monitored until the target is achieved. Variations may depend on the cause effect relationship between implemented measure and final target. In some cases monitoring will be appropriate right after implementation of a project (e.g. morphological structures). In other cases it will take decades (e.g. certain target species). The expected duration of post implementation assessments should be clearly stated. Long-term monitoring will be more meaningful than short term monitoring (cf. chapter 2.5.5).

Assessments that are conducted while rehabilitation is ongoing are relevant for long-term projects that last for several years and for projects with an experimental character such as "pilot projects". The first assessment should be conducted promptly after implementation. At this time an implementation control should be conducted in addition to the measurement of parameters monitored. Not all changes will be visible onsite. For this purpose "As build drawings" should be prepared in conjunction with construction protocols.

The monitoring matrix should contain a link to the method used for assessing an indicator's parameter. Established methods should be used wherever possible, as they do not need to be explicitly described. For any assessment procedure that is not well known, an explicit description needs to be given. It will assure the reproducibility of data collection and the comparability of data, even with a change of personal. This will be especially relevant for long-term monitoring programmes. If this cannot be assured, comparison and evaluation of target achievements will be limited. Guidance on when, where and how to measure an indicator is given in the indicator sheets (cf. annex 2B). A monitoring matrix adapted to local conditions can be established with this help. It will coordinate the monitoring effort and efficiently arrange personal and financial resources.

Continuous public feedback on results should be provided for any rehabilitation scheme, especially those with public participation. This will not only be relevant for the justification of spent resources, but it will also provide ground for decision making on maintenance measures and adaptive management needed. Therefore a monitoring report should contain a "**Report Statement**", assigning form and frequency of public reporting. Annual, biannual or 5 year reports may be considered. This will vary, depending on the schemes objectives, its size and duration. Reporting may take the form of a "report card" for each criteria or indicator. Its form will be determined by the potential target group to be reached.

Responsibilities for assessment, evaluation and reporting may be well outlined in the monitoring plan. Nevertheless a "**List of Responsibilities**", with an allocation of responsibilities and relevant contact dates will facilitate efficient communication. Frequencies of organisational meetings and meeting places may be announced. A website may be established for purposes of organisation and communication.

As long as post implementation monitoring is not a legal requirement and not anchored in the project planning procedure, allocation of resources will be a challenging task. Despite this situation, early consideration of a post implementation assessment will increase the chances of allocating sufficient resources through local, regional or national institutions. Funding needs and potential sources should be shown in a "**Cost Statement".** Financial resources are needed to develop the monitoring plan itself, give quality assurance through an independent party, and pay for data collection, management, interpretation, analysis, report production as well as the presentation of results. The need for the above will vary, depending on size and complexity of a project. Cost may be reduced through stakeholder participation for data collection.

3.7 Application considerations

The URBEM method for appraisal of success described above (see chapter 3.1 to 3.4) is meant to be adapted, to project types, project size, available budget and needs for decision making. For complex, large scale projects additional methods (cf. annex 1) may be incorporated into the appraisal procedure and different supporting tools may be used. Geographic information systems (GIS) provide a powerful tool to manage multi-layered information. GIS may also provide a useful basis for a graphic presentation of appraisal results. A simplification of the procedure may be undertaken for small projects.

The URPIA method focuses on the control of target achievements and also provides the basis for the assessment of effectiveness and efficiency. For further analysis of why targets have or have not been achieved, control of framework conditions and objective system, planning control and implementation control may lead to clarification. Especially in long term projects framework conditions and objectives may change. In intervals they should be controlled and targets may eventually need to be adjusted.

Reasons for not meeting targets may be revealed trough an implementation control. It ensures that a rehabilitation scheme was constructed as designed. A simple comparison between binding construction plans and the construction on site may reveal deficiencies and management needs.

3.8 Framework for irregular Post Implementation Assessment

The concept of post implementation assessment for urban river rehabilitation projects outlined above requires a precise procedure, which doubtlessly is not yet widely practised. The outlined steps should be conducted to ensure a meaningful post implementation assessment. Undoubtedly there are many reasons why projects are not accompanied by an appraisal. It will be reasoned that monitoring data (incl. baseline) are missing or incomplete, that target definitions are none existent or that there are simply no public founds. Thus site conditions before and after implementation will not be inventoried and comparisons for a performance control will be limited. Despite missing data post implementation assessment will be possible to some degree, but will never produce the significant results a project integrated procedure would. It will require an ex-post collection of project related data and a more interpretative comparison of before and after conditions. An attempted comparison of ex-post assessment is presented by (Schanze et al i.p.).

The following particular problems may occur:

- Imprecise definition of targets, missing indicators
- zero-option for prognosis/trend is missing
- Missing baseline data
- Assessment procedures for indicators cannot be reproduced

These problems may be addressed in various ways. An evaluation of measured parameters for example will only be possible in comparison with well defined targets.

The less precise a targets system is defined the more complicated a post implementation appraisal will be. This may include missing statements on how much, when and where a target should be achieved. Some information may exist on an informal basis. Interviews with participating experts, analysis of existing project documents, meeting protocols etc. may help to acquire additional information. Also, general established or reference values (similar projects, established norms etc) may be adapted retro-respectively to make criteria operational. Problems occur when post-project operationalised targets are distorted due to a subjectivity factor incremental to interpretation.

In addition to a missing operationalisation of targets, a weighting of targets may not have been considered explicitly. Despite that, there will be targets of different priority in almost every case. Within urban areas flood control and recreational enhancement often are more important than ecological values. An approximate ex-post weighting may be done with the help of experts. Not only target values, but also general trends of measured parameters will be important for the right interpretation and evaluation of measured parameters. External factors potentially distorting measured parameters have to be detected. The prediction of their impacts is though limited (see chapter 2.5.3). An ex-post estimation of trends may be done with the help of reference sites, where no measures have been implemented. It will assist the interpretation of results.

Baseline data as well as post-project data is needed for an assessment of quantitative change. An ex-post base line assessment (Hellstern and Wollmann 1984 p. 38) can be done based on literature and document analysis, public enquiry and expert interviews (Angler and fisheries association, passionate private nature observers, local entrepreneurs, local historians, city or district administration, project managers etc.). Nevertheless it will always suffer from inadequacy of data quality (enquiry methods, spatial resolution, temporal sensitivity, etc.) and data quantity (certain data may not be acquirable ex-post). Due to this, any quantitative precision of ex post base line assessments may be of reduced reliability. Despite that, at least a qualitative statement will be possible. For some criteria (e.g. public appreciation) and indicators it may be even sufficient, to conduct only an ex-post one-shot assessment.

Conditions before, during and after implementation should be assessed using the same assessment procedure, to ensure a comparison of values. However, in some cases, personal turn over, limited budget, incomplete description of method, or even just subjectivity factors may cause incomparable data sets. A quantification of achievements will often be difficult, though a qualitative evaluation is feasible.

4. Description of Criteria and Indicators

4.1 Hierarchy of Criteria and Indicators

For the selection of indicators three hierarchies of criteria for ecological, social and economic aspects, ordered in different levels of aggregation (cf. Table 4.1: Structure of the proposed criteria system and Annex 2A), have been established. Criteria constitute an "explicit statement of project objectives in terms of expected outcomes from which it is possible to make a rational judgement about the scheme performance" (Kondolf 2002, p 479). Criteria on the lowest hierarchical level will be presented by measurable indicators. If needed, those can be aggregated, until an overall statement of project success can be given.

This hierarchy has two major functions. First, the overview of criteria shall systematically lead the planner to those criteria and indicators, which will potentially describe the change of qualities (effects) in a measurable way. Second, the hierarchy will help to express the achievements of the projects on different level of aggregation, which will satisfy different needs of communication. On the one hand it offers the possibility to make general (aggregated) statements about the success used for communication to the public. On the other hand, a more differentiated level invites to make statements as differentiated as possible, useful to communicate amongst experts and to discuss single areas of rehabilitation. Methods of aggregation are described in chapter 3.3.3.

Table 4.1: Structure of the proposed criteria system

Level I	Overall project success level expressing the overall success of the rehabilitation project
Level II (Theme)	Success level, describing the achievement of the three main components of sustainability: ecology, social well-being and economic well-being
Level III (Category)	Success level, differentiating the achievement of each theme
Level IV (Sub- Category)	Success level, differentiating the achievement of each category (or a group of rehabilitation elements)
Level V (Quality Element)	Success level, differentiating the achievement of each sub-category (or single rehabilitation elements)
Level VI (Indicators)	Success level, differentiating the achievement of each quality element through measurement of indicators

At the Theme Level (II) criteria are thematically differentiated into the three basic areas of effects:

- River Ecology
- Social Well-being
- Economic Well-being

This system has been chosen to best possible reflect the individual aspects of the specific task of urban river rehabilitation. In this respect also the categorisation in River, City, People (cf. Silva et al, 2004) was discussed as basis. It was fund that it insufficiently summarises effect areas of urban river rehabilitation project. Therefore, the accepted sustainability based categorisation was chosen.

It is anticipated, that each project that is to be evaluated should be able to select relevant indicators. The selection clearly must go beyond intended effects (targets) and must include potential significant side effects, as they are as important in the evaluation of success. It is not to the aim to produce a similar number of indicators for each quality element. The weight of criteria categories and single elements of assessment can be assigned to those in an extra process – ideally already in the planning stage of the project (cf. Bettes et al, i.p., also see chapter 2.4).

4.2 Criteria and Indicators of Ecology

Contemporary water management in Europe, including river rehabilitation in urban areas, is heavily influenced by the European Water Framework Directive (cf. EC 2000, Schanze et al. i.p.). The overall aim of the WFD for surface waters is to achieve "*good ecological status*" and "good surface water chemical status" in all bodies of surface water by 2015. Under certain conditions the WFD (Article 4(3)) permits the designation of so called artificial water bodies (AWB) and heavily modified water bodies (HMWB). Here the principal environmental objective for is "*good ecological potential*" (GEP) and "good surface water chemical status", which both also have to be achieved by 2015 (ECOSTAT 2003).

Criteria of ecological effects are based on the framework introduced by the WFD. By applying the directive's systematic, consideration is given to a comprehensive and accepted system. Furthermore, the obligation for all European member states to implement the WFD monitoring system ensures the distribution of knowledge of proposed criteria and the availability of assessment methods (cf. CIS Working Group '2.4' 2002, CIS Working Group '2.3' 2003, ECOSTAT 2003). Given this, the European wide applicability of the ecological criteria is guaranteed. In excess of criteria already provided by the WFD, the system of ecological criteria is extended by few additional water related and terrestrial criteria. The indicator system stands not least in ordinary of a European wide comparativeness of results for rivers of different size and in different eco-regions.

From the framework provided by the WFD only those applicable with any type of rivers are selected (extracted from Olfert 2005). It is the task of the evaluators in each single case to identify the indicators which describe related issues of the affected type of water body. In addition to WFD indicators, the system is open to additional indicators addressing most individual aspects of rehabilitation projects. These can be related ecological issues with rather specific interest of certain cases, or which go beyond the water body and are not covered by the WFD system.

Table 4.2: Structure of indicators of ecological state (from Olfert 2005)

Level V	Level IV	Level IV	Level V
Theme	Category	Sub-Category	Quality Element
River Ecology	Biology	Biological quality elements	Phytoplankton Microphytes and phytobenthos Benthic invertebrate fauna Fish fauna
	Hydromorphology and continuity	Hydromorphological quality elements supporting the biological elements	Hydrological regime River Continuity Floodplain connectivity (additional to WFD) Morphological conditions
	Water quality	Chemical and physico-chemical elements supporting the biological elements	General conditions Specific synthetic pollutants Specific non-synthetic pollutants Ecological functioning (additional to WFD)
	Nature conservation	Nature conservation	Nature conservation value

4.3 Criteria and Indicators of Social Well-being

Parallel to the hierarchy of ecological criteria, hierarchies for social as well as economic criteria are proposed, which are open to be adapted to the local conditions in which a river rehabilitation project takes place. To help interdisciplinary teams with the selection of indicators the rational background for categories, subcategories and quality elements is outlined in the following chapter. A description of selected indicators relates to quality elements found in the annex 2B. Nevertheless expert knowledge may be needed to choose the most efficient indicators and to make project specific adaptations (for selection of indicator see chapter 3.3.1).

The social well-being hierarchy (**Error! Reference source not found.**) contains the three categories “Conditions and Quality of River and River Site Settings”, “Public Appreciation and Utilization of River and River Sites”, and “Social Relations and Social Organisation”. The division of social well-being in those three categories establishes a framework, which not only assesses the functional qualities the site provides for humans, but also integrates the actual response of humans to the river site and the potential influence a river rehabilitation project may have on social organisation and social relations within a community or neighbourhood. These categories are chosen in recognition of the fact that a close interaction exists between humans and the environment that provides the physical setting for human activities of habitation, working and recreation. People choose to live and recreate in an environment because of social amenities and the quality of life an area has to offer. In turn people shape their environment through their values, beliefs, uses and preferences. This is especially apparent in urban environments.

Table 4.3 Structure of Social Criteria for Urban River Rehabilitation (from Gersdorf)

Level II Theme	Level III Category	Level IV Sub-Category	Level V Quality Element
Social Well-being	Conditions and Quality of River and River Site Settings	Public Accessibility to River and River Site	Access From City to Site Physical Access to the Water Access from River to Site River Crossings
		Open Space Extend and Quality	Extend of Open Space Spatial Qualities of Open Space Sensorial Qualities of Open Space
		Quality and Extend of Recreational and Cultural Facilities	Quality and Amount of Recreational Facilities Cultural Events Quality and Amount of Natural and Cultural Heritage Sites Provision for Environmental Education and Awareness
		Public Health and Safety, Related Incidents and Installations	Flood Damage Control Provisions for Public Health and Safety Accidents and Health Related Incidents Type and Quantity of Crime at River Site
		Quality and Density of Land Uses	Quality and Density of Housing Quality and Density of Commercial, Industrial and Utility Uses
	Public Appreciation and Utilization of River and River Sites	Public Appreciation of River and River Sites	Perception of Public Health and Safety Sensory Perceptions Perception of Place Identity Perception of Restorative Capacity
		Recreational Use and User groups	Recreational User Groups Amount and Diversity of Recreational Activities
		Residential Use and Social Structure of Residents	Social Structure of Community Quality of Residential Use
	Social Relations and Social Organisation	Neighbourhood Relations and Neighbourhood Cohesion	Quality and Size of Neighbourhood Networks Trust in Neighbourhood
		Relations between Institutions and Residents/Stakeholders	Public Trust in Institutions and Organisations Level of Stakeholder participation

4.3.1 Conditions and Quality of River and River Site Settings

This category contains criteria and indicators, which describe the state of liveability and quality of the environmental setting at the river and the river site. In this context quality is understood in terms of physical elements that may fulfil desires and needs of residents or visitors at the river site. Criteria will reflect, to which degree the physical layout provides a nurturing environment or is able to contribute to social well-being. Depending on its settings it may promote social interaction, a sense of safety, a sense of identity and fulfil recreational functions.

Criteria and indicators will concentrate on the river and the adjacent river site, including qualitative and quantitative aspects. The river site itself may include the adjacent neighbourhoods with access to the river, as those constitute a functional and visual ensemble with the river. In this sense river rehabilitation may come along and with neighbourhood revitalisation, for which criteria concerning the latter will be suggested and may be included in the indicator set. The sub-categories for the assessment of ‘Conditions and Quality of River and River Site Settings’ include:

- Public accessibility to river and river site

- Open space extend and quality
- Quality and extend of recreational and cultural facilities
- Incidents and provisions related to public health and safety
- Quality and density of land uses

Public Accessibility to River and River Site

Public access is of paramount importance in any urban river rehabilitation project and should be analysed in any urban river rehabilitation project. In past times public access to rivers has often been limited, due to industrial uses or concentration of infrastructure lines, such as arterial roads and secondary roads or railroad tracks. Private property rights often limit access to rivers, making access an act of illegal trespass. Physical access of the water itself has often been limited through canalisation and steep banks.

Urban river sites have a great potential to satisfy different recreational needs, including active recreation such as biking and passive recreation including nature observation. Public accessibility is the major prerequisite to use this potential. Some comparative studies suggest that accessibility holds a higher value than ecological diversity (cf. Edward-Jones et. al, 1995). It is reasoned, that accessible river sites not only provide recreational functions, but in turn increase public awareness and personal attachment (cf. Otto et. al., 2003). Also, accessibility may not only be of value to reach the river site and the water, but also to leave the river corridor in case of flooding or other emergencies (cf. Schanze et al, i.p.). For navigable rivers accessibility from the river to a site may play a role. River crossings may be analysed, if better connections are required for river neighbourhoods. Crossings also play a role for a sensory experience of the river. Accessibility should be viewed in light of different user groups and their mobility needs, especially those with limited mobility capabilities, to include elderly, mothers with children and disabled people.

The sub-category of accessibility may include the following quality elements:

- Access from city to site
- Physical access to the water
- Access from river to site
- River crossings

<u>Access from City to Site</u>

Depending on distance travelled to access the river site, people will use either soft modes, such as pedestrian or bike access or public transportation respectively their car. The main catchment area for pedestrians is about 500 meters or 10 minutes walking distance to the site (cf. IOER, 2003). The more attractive the site is, distances to access the site will increase and with that the use of public transportation or car. Frequent public transportation stops and an appropriate number of parking lots needs to be offered. The following indicators may be used, alone or in combination, other indicators may be added.

Potential Indicators:

- Soft mode access barriers
- Parking lots
- Public transportation stops
- Access points for soft modes

Physical Access to the Water

Access from the site to the river refers to physical contact with the water itself. Physical contact implies an intense sensorial contact, including visibility, audibility, and being able to touch the water. Elements that permit access to the water include steps, accessible slopes, pathways and others. Pedestrian bridges and low catwalks may be considered in this sub-category. Further descriptions on the shapes of contact points can be found under Silva et. al 2003.

Potential Indicators:

- Water contact zones

Access from River to Site

Once waterways led to the founding of many cities and provided main pathways to get around a city. During the last century the transport of people and goods on water ways has declined. Today rivers gain importance for leisure activities as their water quality is increasing. In the last two decades many navigable rivers have seen an increase of recreational traffic, on a commercial or private basis. Accessibility from the river to a site, e.g. by water taxi may be of importance.

Potential Indicators:

- Anchorage points
- Passenger boat capacity

River Crossings

Rivers can be a connecting or dividing feature for a community. The dividing character of the river will increase with river width and a decreasing number of crossing opportunities. This may be counteracted by high use and good accessibility, setting the river up as a central meeting point and a place of community identity. For streams and rivers linking can be provided by ferries and bridges or even tunnels. For creeks and small rivers stepping stones may be provided. Those as well as pedestrian bridges and – ferries, concentrate mobility streams to a certain point. Therefore they can be considered as activity nodes, providing for social interaction as well as sensory contact with the water.

Potential Indicators:

- River crossings

Open Space Extend and Quality

Open space includes public as well as private and semi-public areas. Open space is an important resource for outdoor recreation (Lynch, 1998) and a place, where stress can be relieved particularly in densely populated urban areas. Public open space provides for social activities and may provide an informal meeting place for the community. Greenways along rivers are linear access routes and separate incompatible uses, while they also have an ecological function.

Open space is a valuable asset, if it is green, quite and peaceful, as for instance stated by respondents to a survey at the Ravensbourne River, London (Tapsell 1995). There has been evidence, that people’s enjoyment is higher when a river environment is more natural (Tapsell 1995).

The following quality elements are suggested

- Extend of open space
- Spatial qualities of open space
- Sensorial qualities of open space

<u>Extend of Open Space</u>

Rivers will have a very strong attraction, whereto people gravitate (Lynch, 1998). To avoid unpleasant experience and ecological degradation of river and river site one should consider carrying capacity. This refers to the number of people or the intensity of use a natural area can carry to renew itself or maintain its state. Especially in urban areas, with a low amount of green open space and therefore a high recreational pressure, this capacity may be exceeded. There are guidelines for the extend of open space. In Germany there is a recommendation to provide 6 square meter of public green open space per inhabitant of urban areas (IOER, 2003).

Potential Indicators

- Public utility of river site (Silva et. al, 2003)
- Carrying capacity of public open space

<u>Spatial Qualities of Open Space</u>

In regard to social well being open space quality depends upon the quality of human experience: free choice of activity, release from exacting urban stimuli, chances to become actively engaged, to exhibit mastery, opportunity to learn about the non-human world, ability to meet new people, and experiment with new ways (Lynch, 1998). Subsequently open space should provide a variety of spaces to fulfil those needs. Visual relations depend on the spatial organization of a site. They determine the way it is experienced and how much the sites support orientation. Those qualities are a basis for the recreational use. A study of river rehabilitation projects has shown that visual and spatial aspects have been important and considered in most cases of river rehabilitation, while methodological approaches and in consequence indicators have often been missing (Schanze et al, i.p.).

Visual qualities can be expressed in terms of viewpoints and visual connections to focal points or landmarks. Viewpoints are those locations, from where the site is actually experienced. This may include belvederes and public spaces that offer views and pathways along a river, from where a sequence of views can be experienced. Visual connections guide the user trough a site and provide orientation. They make river scenery or a landmark very memorable. Greater viewing distances can provide for dramatic views. Visual connections depend on topography as well as vegetation. Focal points are important landscape architectonic elements attracting the visitor's attention. River rehabilitation projects can make the river itself a focal point of its surroundings.

An effectively designed river site and recreation area should contain a variety of spaces with different character and sizes (Lynch, 1998). Those may include hidden and easily accessible spaces, natural- or designed areas, crowded or serene places, offering opportunities to relax from the urban stress. It should be realised that the river itself and the river site provide a valuable asset for leisure and recreation. Spaces respond to local cultural customs and traditions. Social activity nodes like cafés and bier gardens and traditional meeting spaces like dance- and concert sites make places memorable and contribute to the attraction of riverfront sites.

Potential Indictors

- Landmarks
- Viewpoints

<u>Sensorial Qualities of Open Space</u>

Sensorial qualities of open space include sound, smell, pollution and bio-climatic conditions of the site. Besides the visual and spatial qualities of the site, those conditions may influence the experience of the site tremendously. Aversion experience connected to noise pollution is especially relevant for urban rivers, as many of them are bordered by traffic corridors. Low nuisance and disruption through noise, odour, dust and excess of light contributes to a high functional quality and an improved restorative capacity and recreational quality. Comfortable micro climate enhanced with green and shade contributes to a pleasant site experience.

Potential Indicators

- Noise pollution
- Width of river site

Quality and Extend of Recreational and Cultural Facilities

The before mentioned study of urban river rehabilitation showed that active and passive recreation as well as educational aspects played an important role in many projects. Historical and environmental education was found to be in demand. Commercial activities turned out to be of marginal interest at the sites surveyed (Schanze et al, i.p.).

Many rivers and river sites provide great opportunities for recreation and leisure time use. In addition to passive recreational and restorative uses a river site often offers recreational infrastructure, such as sport facilities, playgrounds, and bicycle routes Investment into social and cultural infrastructure enhances recreational usability as well as aesthetic experiences. The potential of sites to fulfil such demands can be measured through the quality and quantity of cultural and recreational facilities including:

- Quality and amount of recreational facilities
- Cultural events
- Quality and amount of natural and cultural heritage sites
- Provisions for environmental education and awareness

Quality and Amount of Recreational Facilities

A diversity of facilities will provide recreational opportunities for different interests and different social user groups. Punctual elements are either related to the river, including anchorage places, pears, angling places or related to the river site, including sport facilities, playgrounds, etc. Linear elements for recreational purposes include bike paths, hiking and jogging trails, riding trails etc. Also, it should be kept in mind that water and the river site by itself provides a resource for leisure and passive recreation. Even an extensively maintained river site allows many different activities. It may constitute a natural playground, encourage nature watching and permit relaxation.

Potential Indicators

- Recreational facilities
- Recreational paths

Sites of Cultural Events

Sites of frequent events such as boat races, angling competitions, exhibitions or occasional events, such as annual celebration of a historic occurrence are included in the category of recreational and cultural facilities. Those events promote awareness and personal identification with the river and its surroundings. They also function as a meeting place for the community and foster social networks and community cohesion. This quality element may only of importance for larger rivers and long-term rehabilitation schemes.

Potential Indicators

- Cultural events

Quality and Amount of Natural and Cultural Heritage Sites

Cities often developed in the vicinity of waterways and were depended upon it for their existence. As a result heritage sites are particularly abundant along rivers. Heritage sites and cultural assets are valuable historic documents, which carry on beliefs, values and traditions of past generations (Zube et. al. 1975). This may include single buildings or built ensembles, open spaces and artefacts with historical, religious, cultural, and aesthetically values. The value of a site is usually reflected by its official monument conservation status, rating it of local, regional, national or international importance. Riverfront developments should – and many have done so already - conserve and integrate heritage sites into their design for the benefit of local visitors and tourists, adding character and identity and enhancing the special genius loci of a place. This holds also true for sites of natural heritage such as oxbows of rivers, wetlands and remnants of floodplain forests may be of particular interest in an urban environment. In parallel to the indicator 'Integration of cultural heritage and cultural assets' an indicator for 'Integration of natural heritage sites' may be established.

Potential Indictors

- Integration of cultural heritage and cultural assets

Provisions for Environmental Education and Awareness

Nature preservation laws in most countries include provisions for nature education. An educated constituency is a pre-requisite for a meaningful public participation in decision-making. This applies to both, natural and cultural heritage. A rivers natural and cultural history can be reflected in riverfront features, public art and interpretive signs. Guided tours may stimulate an interactive learning process. Indicators are not described in the indicator sheets but may include the qualitative description of 'Provisions for environmental education related to cultural heritage', and 'Provisions for environmental education related to natural heritage'.

Incidents and Provisions related to Public Health and Safety

Over the past decades European cities have been experiencing an ever increasing frequency of flooding with affiliated losses. Flood damage to structures and flood related threats to public health and safety are a limiting factor in urban stream rehabilitation. Problems include public health threats during and in the aftermath of flooding through the spread of diseases, contaminated water supplies and through fumes from heating oil soaked masonry. Also, the recreational use of the river and river site bears the risk of accidents as well as the potential of health problems caused through contact with contaminated water.

Riverfront sites to be rehabilitated often consist of derelict land and abandoned land in rundown neighbourhoods. Here crime may occur and cause serious limitations to recreational and residential functions. Related are acts of vandalism that can seriously stain the image of a neighbourhood including the river and the river site.

In relation to the evaluation of health and safety the perception of risk may be accessed, which may differ from the expert assessment and provide additional information to decision makers.

Quality elements include:

- Provisions for public health and safety
- Accidents and health related incidents
- Type and quantity of crime

Provisions for Public Health and Safety

Provisions for public health and safety may include installations for flood damage control, safety measures for recreational use and measures for crime prevention. Especially flood damage control will have a paramount priority for urban river rehabilitation. This applies to all types of construction in areas subject to flooding. Flood plain zoning may be in place differentiating uses for the „Open floodway district“ and the „Flood fringe area“. In the latter area pounding can be best controlled through structural flood proofing. Levies and floodwalls have been a standard flood damage control remedy, though they may merely transfer problems to other locations, increasing depth and velocity of flooding downstream.

People may come to bodily harm through contact with water, may it be during flood events or through diseases spread through water. Water pollution spread through flooding can be reduced by waterproofing manholes to sewer lines and by preventing floatation of oil tanks. In flood prone neighbourhoods, such as the currently developed ‘Hafencity Hamburg’, provisions are being made to reach buildings on access roads for emergency vehicles and to permit evacuation through raised catwalks.

Liability against accidents is considered the responsibility of property owners accountable for banisters, guardrails and railings along the water’s edge. This is particularly important after overall improvements have been made, attracting the public to a site. Drops and steep river banks may be reduced trough preventive measures, such as grading and under water safety ledges, of particular concern in parks, kinder gardens and schools.

Physical improvements, such as night time lighting, visual transparency and easy access are generally deemed to be a provision for crime control.

Potential Indicators

- Flood Risk

Accidents and Health Related Incidents

Accidents and health related incidents on a site may be inventoried to be able to show trends and monitor changes. People may come to harm not only through floods, but also through incautious recreational use of the water, such as swimming in turbulent water or by not being able to scale steep banks (Riley 2003, p 106).

Recreational accidents may increase with an increased use of river and the river site, if no provisions to educate the public about potential risks are undertaken.

Health problems caused through the contact with water are directly related to the water quality. As water quality improves, the potential of health problems and the number of health incidences will decrease. Data on health problems and diseases caused by water contact will only seldom be available on a site specific scale. Water quality may be used as proxy indicator.

Potential Indicators

- Accidents

Type and Quantity of Crime

Abandoned or derelict river sites and sites in neighbourhoods with economic and social problems tend to attract crime. Crime rates and even the fear of crime contribute to dissatisfaction of residents and site users, reducing quality of life. Crime rates may decrease through rehabilitation of river sites. Site design reducing the potential of crime follows the concept of „Crime Prevention through Environmental Design”. It includes night time lightning, appropriate visibility through transparent vegetation and improved accessibility.

Potential Indicators

- Crime rate (type of crime)

Quality and Density of Land Uses

Type, quality, and density of land uses that abut an urban river improvement site are bound to change, especially at sites where abandoned industrial, commercial or utility uses with low densities and derelict residential sites exist. Those run down areas along the water tend to have a high potential for riverfront improvement, hence may face a tremendous change in quality and density of land use. To monitor potential, even indirect effects of the river rehabilitation, the following quality elements may be considered:

- Quality and density of housing
- Quality and density of commercial, industrial and utility uses

Quality and density of housing

Residential development that abuts open space and water is known to be more desirable and have a higher value than similar development elsewhere. Well known examples are Central Park in New York City and the inner harbour in Baltimore. As a result residential development adjacent to parks and waterfronts tend to be of high density, maximizing benefits of frontage. Most urban river improvements combine both, waterfront benefits and open space protection. An inventory of pre- and post development conditions helps to quantify improvements. No specific indicators have been defined in indicator sheets, but potential indicators may include ‘Distribution of residential uses', 'Quality of residential uses (value per sqm)' or 'Density of residential uses'.

Quality and density of commercial, industrial and utility uses

As a consequence of rehabilitation, former industrial and utility uses may be reduced and transformed. Heavy industry that required rivers for cooling water and the transport of coal and utilities like railroad yards transferring goods from barges have lost their role on the waterfront. They now offer opportunities for secondary uses. Some utilities, such as sewer interceptor lines flowing by gravity tend to parallel waterfronts and offer an opportunity for open space uses, such as greenways in their right-off-way. Commercial uses add life to riverfront sites. An example is the core of the Hafencity Hamburg development, where a mix of 50% residential and 50% storefront and commercial use has been prescribed for the core of this waterfront development. No specific indicators have been defined in indicator sheets, but potential indicators may include 'Distribution of commercial, industrial and utility uses', 'Quality of commercial, industrial and utility (value per sqm)' or 'Density of commercial, industrial and utility uses'.

4.3.2 Public Appreciation and Utilization of River and River Sites

Surveys of public appreciation reflect how much a river and a river site is appreciated and how it is perceived, by measuring values people attach to a place. The perception and values people hold may vary from expert opinions and should therefore be assessed and used in decision making (Stolp 2003, p. 231). Uses by residents and particularly recreational uses may play a role, in rehabilitation projects. In many cases river rehabilitation initiates neighbourhood revitalisation, changing the social structure of the residents and their quality of life.

The category will included following aspects:

- Public Appreciation of River and River Sites
- Recreational Use and User groups
- Residential Use and Social Structure of Residents

Public Appreciation of River and River Sites

Alongside the assessment of existing physical conditions the values of people, their perception and attitudes toward the pre- and post project environment should be included in any audit of residents or user groups (cf. Stolp, 2003). More detailed this may cover values in regard to the river and the river site, perception of safety, restorative rapacity and perception of place identity. Personal knowledge relating to a site may lead to a nurturing personal attachment and relation to the river. For example, this has been expressed with the maxim "To love the river, you need to know the river" as stated by the Friends of the Chicago River" (Otto, McCormick, Leccese, 2004, p. 131).

The “Citizen Value Assessment Method” can be used for assessing values, which people assign to the environment. Further details on this method can be found at Stolp, 2003. Quality elements to be assessed may include:

- Perception of public health and safety
- Sensory perception
- Perception of place identity
- Perception of restorative capacity

Perception of Public Health and Safety

Fear of crime is far more prevalent than experience of crime (Long, Hutchins, 2003). The same may hold true for the fear of flooding. Perception of risk influences public opinion and the willingness of people to locate in an area. Actual levels of crime and flood potential has already been addressed under the category “Existing conditions and quality of river and river site settings” and may be assessed in comparison to their public perception.

Potential Indicators

- Fear of crime
- Fear of hazardous floods

Sensory Perceptions

Sensory perception of a place can be substantially improved by a river enhancement project. An attraction occurs when a scene is made memorable by vivid, intense stimuli that focus our attention. Visual distraction which focuses attention elsewhere, disillusionment where an attraction is anticipated but not realized and aversion that occurs when an object appears that we have tagged unacceptable are negative sensory perceptions that a project could reduce or eliminate. Bad water odour and water colouration are usually connected with bad water quality or industrial emissions. This also applies to noise pollution causing stress and aversion. No specific indicators have been defined in indicator sheets, but potential indicators may include ‘Visual perception – attractions, distraction, disillusionment, aversion’, ‘Perception of odour ‘, ‘Noise pollution’ or ‘Perception of watercolour’.

Perceptions of Place Identity

Place identity assesses how observers relate to places. This perception will depend upon awareness and knowledge of a site, its environmental qualities, amenities and usability. The greater the opportunity to experience a site the greater the personal attachment will be. Studies have shown that a positive and strong place identity will reduce negative perceptions of environmental problems that may be present (Silva et. al., 2003).

Silva et al (2003) refereeing to Breakwell’s model of place identity identifies distinctiveness, continuity, self-esteem and self-efficacy as potential indicators to be measured. These four features are interrelated. As one aspect is increasingly experienced, other factors will increase too. In consequence analysis of one indicator may stand as proxy indicator for the quality element. The perception of place identity will depend on qualities, such as cultural and natural heritage and their level of importance as well as the existence of distinct features such as landmarks.

Potential Indicators

- Distinctiveness
- Continuity
- Self-esteem
- Self-Efficacy

Perception of Restorative Capacity (based on Silva et al, 2003)

Research has shown, that natural environments, particularly in relation with water reduce stress, promote positive moods, and feelings and regenerate energy and health. These effects on humans have been termed "restorative capacity" (Silva et. al., 2003). The assessment of restorative capacity presented here is based on attention restorative theory and includes the aspects being away, fascination, extent, and compatibility. The perception of restorative capacity will depend on physical qualities of open space and may be assessed in addition or as proxy indicator for restorative capacity.

Potential Indicators

- Being away
- Fascination
- Extent
- Compatibility

Recreational Use and User groups

Existing conditions of a site influence its suitability for uses by different population groups. Some multifunctional sites are suitable for many user groups and their diverse desired activities. Well designed open space provides freedom of choice, social equity and social sustainability, goals put forth for instance by F. L. Olmstead when he laid out Central Park in New York City. Which recreational needs a site can fulfil and how well it is accepted by visitors or residents determines by whom, how, and how much it is being used. To assess potential effects and changes in use, quality elements to monitor may include:

- Recreational user groups
- Amount and diversity of recreational activities

Recreational User Groups

Recreational user groups can be analysed according to where they are coming from and what social groups they are belonging to. How much effort users spent to access a site reflects its value for recreation, which has also economical implications and may be assessed at the same time (e.g. travel cost). Social tensions in a neighbourhood between different social groups will have implications on who is using a site. Through rehabilitation and gentrification certain social groups that have used the use a site may be displaced and new user groups may be attracted.

Potential Indicators

- User catchment area
- Access by users
- Social structure of recreational user groups

Amount and Diversity of Recreational Activities

The assessment of the actual recreational use, diversity of activities, as well as frequency of use will reflect public acceptance and appreciation of a site. The analysis of recreational elements may serve as proxy indicators for how well the site fulfils recreational functions. Actual perceived recreational activities may actually be used as proxy indicator for appreciation of the site. No specific indicators have been defined in indicator sheets, but potential indicators may include recreational activities and Visitor frequency seen and determined by experts.

Residential Use and Social Structure of Residents

Due to their amenities, river sites are highly desirable for residential use (Wagner et al, 2003). Urban river rehabilitation, depending on its size and accompanying neighbourhood revitalisation, may have a significant impact on existing and future residents. This sub-category particularly may be monitored in rehabilitation schemes that bring about significant change in urban quality and residential use.

- Social structure of community
- Quality of residential Use

Social Structure of Community

People choose their place of living based upon personal preferences and needs, physical quality of the environment and infrastructure provided. Degraded environments with polluted rivers are often located in poor neighbourhoods, characterised by a high percentage of minority groups. Floodplains also tend to be inhabited by low income people, due to low land prices (Riley, 1998). Therefore river rehabilitation usually relates to socio-economic problems.

In poorer neighbourhoods revitalisation and enhancement of environmental qualities often lead to increased property values and rental prices, displacing the low-income residents, while higher income residents move in. This gentrification (Wagner et al 2000) may destroy community networks and disturb community cohesion und should therefore be prevented. In contrast Wagner mentions ‘incumbent economical and social upgrading’, which is more socially acceptable and retains the social composition of the neighbourhood while permitting improvements to take place. For projects, where significant effects on the social structure can be expected it should be monitored. Proxy indicators of gentrification include increased property values, increased per capita income, and residential loans. No specific indicators have been defined in indicator sheets, but potential indicators may include ‘Age structure’, ‘Household Income’ or ‘Minority groups/Racial composition’.

Quality of Residential Use

The quality of residential use can be anticipated to increase with the demand for housing in this area. As river rehabilitation usually increases the amenity values available to near by residents, demand for housing may increase. Significant effects may only occur if river rehabilitation comes along with neighborhood revitalization, upgrading the quality of housing itself, such as upgrading the standards of facilities and enhancing infrastructure. Rising demands for housing will have positive economic implications as property values, and rental prices may increase. Those economic effects may be assessed analogous. Besides the two indicators described in the indicator sheets also ‘Population Density‘ and ‘Vacancies of residential units’ may be used.

Potential Indicators

- Migration balance
- Dwelling satisfaction

4.3.3 Social Relations and Social Organisation

Projects of participative nature often have a significant impact on social relations of stakeholders and may result in greater community cohesion and in a greater trust in institutions. Those relations are described by the term “Social capital”, which includes the description of existing networks, shared values and norms, reciprocity and trust. All four elements rely on and nurture the other (Walker et. al, 2000). Social capital makes cooperative action possible and describes the capacity of the community to act together to improve their quality of life (Barclays Site Savers, 2001). It may be pictured as the time and energy spend by individuals establishing organized relationships with others (Zosiak 2003).

Networks are groups of people linked either by strong ties (as between friends), by weak ties (as between acquaintances) or community and political ties (as relations with institutions or units of government). Trust is the expectation that other members of a community will be honest and co-operative. Norms cover standards of behaviour creating expectations that others will be trustworthy and will take part in activities that benefit the group. Reciprocity here means that one is prepared to help someone when he need it because the one knows that someone else will help him in his hour of need (Walker et. al, 2000).

In context of river rehabilitation, social capital helps a community to more effectively pursue enhancement objectives based on shared values and interests. This is especially true for projects with high levels of public participation, projects of high controversy and long term projects. Projects that are conducted in favour of stakeholders and that incorporate their interests will enjoy a greater acceptance and trust in institutions. Acceptance of a design option increases through participative processes promoting understanding and stakeholder input. In contrast, institutional ignorance of stakeholder interest is bound to result in a decrease of trust in institutions. In consequence river rehabilitation projects may have a lasting impact on the social relations of people among each other, and the relation between people and institutions, and the political process in town.

It has been shown, that an increase in trust among the community leads to an increase of other social well-being components. This may include an increase in job placements, an improved social integration, better health, falls in crime, even a higher economic growth, which may be assessed parallel to following sub-categories:

- Neighbourhood Relations and Neighbourhood Cohesion
- Relations between Institutions/Organisations and Residents/Stakeholders

Neighbourhood Relations and Neighbourhood Cohesion

Residents living in a certain area tend to establish relations with the people living around them and sharing their interests. Over time those ties tend to become stronger. Neighbourhood relations can be accessed through a resident survey. Following quality elements may be considered

- Quality and size of neighbourhood networks
- Trust in neighbourhood

<u>Quality and Size of Neighbourhood Networks</u>
This quality element measures the impact of a project on social interaction of household members with other people in the neighbourhood. The amount and strength of relationships and the general feeling of inclusion and availability of social and economic opportunities contribute to neighbourhoods that are being viewed as being better off. This includes ‘strong ties’ and ‘weak ties’. Acquaintances are bound to be important sources social and economic opportunities, such as finding work. Friendships and family though will provide for emotional support. It is argued that both forms are needed (Walker et. al., 2000). Participative river rehabilitation projects can provide a platform to get to know new people from different backgrounds and create new opportunities for participants. No indicators have been described in indicator sheets, but ‘Density of Acquaintanceships’ or ‘Density of Friendships’ may be used as potential indicators.

<u>Trust in Neighbourhood</u>
The development of neighbourhood trust requires neighbours to come together, participate, communicate, and cooperage. Issues and prospects of problematic changes are the glue that brings them together. Neighbourhood associations may

provide a framework for cooperative action. The existence of those and their level of activity may be used as proxy indicators for trust in neighbourhood. No indicators have been described in indicator sheets, but ‘Level of trust’ or ‘Membership in neighbourhood associations’ may be used as potential indicators.

Relations between Institutions/Organisations and Residents/Stakeholders

Quality and organisation of relations between institutions and organisations on one side and residents and stakeholders on the other side will influence a projects outcome. High trust in institutions to act and decide in accordance with the community values, participative planning and decision making will increase social sustainability of any environmental project.

In the past government financed river rehabilitation projects were guided by centralized agencies that would hold authority and control, working from the top down in a linear process. Public participation was limited to an information period after the planning process was completed. In 1998 the Aarhus Convention was passed to guarantee the rights of access to information, public participation in decision-making, and access to justice in environmental matters. Also, the WFD contains explicit requirements for stakeholder participation (WFD, 2000, §14(1). Implications are shared responsibilities, collaborative, cooperative and interactive processes fostering long range solutions recognizing the interconnectedness of river basins. New information- and communication technologies make access to information no longer the privilege of government agencies. Residents and stakeholder can expect that institutions responsible for planning projects define clear goals, explore alternatives, evaluate options and make selections that can be evaluated in a transparent process.

Levels of involvement may vary from plain information to active involvement, arbitration and codetermination. It can be anticipated, that higher levels of active involvement will nurture institutional trust best. Increased trust and cooperation may increase efficiency of project planning and implementation. In turn participative planning can only succeed, if institutional trust exits. Following quality elements may be assessed:

- Stakeholder participation
- Public trust in institutions and organisations

Stakeholder Participation

Participation by stakeholders is important to sustain human as well as physical and biological settings (Kondolf and Downs, 1996). Stakeholders are those persons, who are affected by a public project or are interested in it. Representatives may include residents, property owners, businesses, NGO’s, and interest groups. Especially non governmental organizations are of increasing importance. Many government agencies have learned that it is poor practice to ignore them. Business involvement may increase resources of founding. Residents provide a valuable source of local knowledge.

Public participation will foster awareness, sense of stewardship, responsibility and attachment to the site. It will also influence relationships to institutions and even neighbours, new relations may be established and trust may increase. Public participation provides human resources for planning, implementation and monitoring. Economical benefits may result through volunteering. The quality element will assess the quantity and quality of involvement at the beginning and at the end of the project.

Potential Indicators

- Advocacy and stewardship groups
- Volunteers, Volunteer hours spent
- Business coalitions

Public trust in institutions and organisations

Trust in institutions and organisations engaged in river rehabilitation will be facilitated trough equal opportunities in participation, transparency of community decisions and an efficient institutional project organisation. Particularly for larger projects it is essential that interdisciplinary and inter-institutional committees be formed to involve all stakeholders, regulatory agencies as well as public representatives. Those committees provide for short ways of communication and a representation of diverse interest. Further the level of offered codetermination and the transparency of decision making will affect the trust in institutions and therefore may be assessed as proxy indicators. No indicators have been described in indicator sheets, but ‘Public trust in institutions and organisations’ and ‘The level of codetermination’ may for instance be used as potential indicators.

4.4 Criteria and Indicators of Economic Sustainability

Rehabilitation of urban rivers will attract visitors and residents, but can also attract new business to the site and upgrade economically depressed sites. River rehabilitation can result in a range of economic benefits, including (Otto et. al, 2004):

- Reduce costs of drinking water treatment due to improved water quality
- Curb flood damage and lower cost of flood control
- Decrease storm water management cost
- Revitalise riverfronts with new opportunities for housing, offices and commercial services that attract new residents, business and visitors
- Provide new jobs for residents in construction and commercial business
- Offer recreational opportunities, open space and park amenities
- Raise property values and generate new tax revenues
- Attract state and federal founding, new volunteers and broad financial support

Those economic benefits are often indirect implications, which materialize over extended time periods and are usually not measured in conjunction with river rehabilitation projects. An enquiry of urban river rehabilitation projects received only few responses concerning effects on employment, housing costs, and property values (Schanze et al, i.p.). This may be due to the fact, that analysis of economic benefits requires elaborated assessment methods over extended time periods as well as expert knowledge and therefore is only of limited applicability in conjunction with river rehabilitation projects. Those assessments of economic benefits found were conducted for large scale river rehabilitation projects or in conjunction with special research tasks (cf. Otto et al, 2004, p. 98 et c.f.). In addition, economic use of the river and the river site varies largely.

Due to the lack of established criteria, a structure of economic criteria for river rehabilitation is attempted on base of a structure of general acknowledged economic criteria attributed to environmental assets, which will provide a flexible framework, to be adapted to project conditions. The following two categories and four sub-categories are adapted from OECD, 1995 and Schläpfer, w.y.:

Table 4.4 Economic criteria

Categorie	Production values	Utility values
Subcategory	**Water Resources and Energy Supply**	**Use Values** Such as recreational use, economic activities, shipping, employment, property values and tax revenue values.
Subcategory	**Drainage and Waste Disposal** Transport of drainage water and wastewater (point	**Non-use values** such as values attached to

	source and non-point source pollutants)	endangered species, or an aesthetically pleasing view

The two categories, production values and utility values, describe the change of economical values attached to the site and therefore may describe the economic benefits achieved. Those categories have been complemented by the category "Project costs and maintenance costs". The first two categories in combination with criteria from the latter category will provide a basis for an analysis of efficiency (cost benefit analysis) (see Table 4.5).

Table 4.5 Structure of Economic Criteria for Urban River Rehabilitation

Level II Theme	Level III Category	Level IV Sub-Category	Level V Quality Element
Economic Well-being	Production Values	Water Resources and Energy Supply	Drinking Water Supply Water Energy Supply
		Drainage and Waste Disposal	Carrying Capacity for Pollutants
	Utility Values	Use Values	Property Values and Taxes Recreation and Amenity values Economic activities and Employment
		Non - Use Values	
	Project Costs and Maintenance Costs	Project Costs	Planning Costs Construction Costs Real Estate Costs
		Maintenance Costs	Regular Maintenance Costs Event Related Maintenance

Due to the complexity of economic analysis and the methods overlapping for diverse quality elements, just few selected indicators, which have been repeatedly found in case studies and literature will be provided. In addition a short overview of economic assessment methods applicable for various quality elements will be given in annex 1.

4.4.1 Production Values

The WFD places special emphasis on economic aspects of urban river uses through the paragraphs concerning "Heavily Modified Waterbodies", recognizing the values of rivers for shipping, water power, water supply, storm water drainage and waste disposal. Special emphasis of this project is to recognize these economic values and multiple uses of urban rivers, but to reason that this does not preclude urban river enhancement. Sub- categories to assess production values include

- Water Resources and Energy Supply
- Drainage and Waste Disposal

Water Resources and Energy Supply

In the past urban rivers used to be a source of drinking water for most cities. Recently this has declined, as bigger urban rivers tend to be too polluted to permit their use for drinking water purposes. For example, the U.S Environmental Protection Agency estimates that 140 billion dollars are needed in the next two decades to make drinking water safe (Otto et. al., 2004). An improved water quality will decrease those cost for purification. Measures targeting the self purification functions of rivers, to include restored wetlands, riparian buffers and forests, have been proven to be usually more cost effective, than cleaning polluted rivers (Otto et. al., 2004, p. 99).

Following quality elements may be considered:

- Drinking water supply
- Water energy supply

Drainage and Waste Disposal

Throughout history rivers have been used as drainage channels and for waste water disposal. The self purification functions of rivers as well as the storage capacity for storm water was reduced through canalisation and the loss of wetland. Resulting floods cause damages with high cost for repair and replacement.

Engineered flood control measures can be as expensive as damages caused by flooding and require massive investments in infrastructure and maintenance (Otto et. al., 2004). The rehabilitation of wetlands and floodplains may reduce the cost for engineered flood control. Also, cost effective installations for retention and filtering of storm water include sustainable urban drainage systems (SUDS)" (Otto et. al., 2004, p. 105). These systems use on-site detention to control flood peaks as well as constructed wetlands and surface conveyance to improve the quality of runoff and lower flood peaks and therefore reduce needed capacities of engineered storm drain systems. For example, the city of Zurich found the day-lighting of streams to be more cost effective than reconditioning and maintaining the existing combined sewer system (Schanze et al, i.p.).

Following Quality elements may be considered:

- Storage capacity for pollutants (OECD, 1995)
- Flood storage capacity

4.4.2 Utility Values

The value of a river and its setting can be divided into use values and non-use values. Use values relate to use of land- and water areas for housing, recreation, commerce and utilities. Non-use values may include a view of a site or a sites natural condition. While those are seem not to offer an immediate monetary value, they can be economical valued with the help of certain economical valuation methods (cf. Annex 1).

- Direct Use Values
- Non-Use Use Values

Direct Use Values

Land and water areas along rivers offer various opportunities for economic gain. They do however suffer the “tragedy of the commons”, having been a free for all in waste disposal. Water quality improvement of rivers came at a cost, born by the public in improving sewage treatment. As a benefit river sites have become attractive for housing and leisure time uses. It may include following quality elements:

- Property values and taxes
- Recreation and amenity values
- Economic activities and employment

Property values and taxes

River rehabilitation resulting in improved ecological and recreational conditions tends to boost real estate values increasing the community’s tax revenues (Otto et.al., 2004). A ripple effect occurs when additional development is attracted to the periphery of such sites, with newly emerging housing, offices, restaurants, hotels. Peripheral uses, attracted trough improved amenities, will further increase tax base. Several studies in the U.S. have proven such increases in property values but quantification of increase of property values remains a problem and may differ widely (cf. Otto et al, 2004). People have a preference for locations that have a view of water which is reflected in Property values. A survey of realtors has shown that waterfront units may sell at a 50 percent higher price than units that are removed from the water, and units that have a water view but no frontage sell for 20 to 30 percent higher, depending on how far away they are (Tourbier, Westmacott, 1992). Potential indicators, though not specified in indicator sheets may include, ‘Median property value (Hedonic Pricing Method)’, Rental prices, and ‘Amount of Investments in the area’.

Recreation and Amenity Values

River rehabilitation may attract visitors from a wider area, particularly when new leisure time activities are offered. This tends also to attract economic activities, such as cafés, restaurants, angler shops and other peripheral uses.

Visitor days have been used for example by the US National Park Service as a measure that relates to the direct and secondary expenses that occur to a person who is visiting a park. For example, for a fisherman this includes expenses for bait and tackle, travel expenses and accommodations that all benefit the local economy. The economic values of amenity and recreation are also reflected in real estate values. ‘Visitor days’ and ‘Travel costs’ may be used as indicators (see annex 1 for methods).

Economic Activities and Employment

At run down river sites, there are low levels of economic activities and a low number of local jobs. The creation of more economic activities and more job opportunities for local residents may be a primary or secondary goal of a project. Economic development improves access to local services and goods trough increased retail activity and will also offer employment opportunities. A higher variety of services and products to choose from increases the attractiveness of a place (Wagner et al 2000) A higher economic well-being may then increase the ability of a community to address concerns and desires of its residents. This category is particularly relevant for long term project and river rehabilitation projects including neighbourhood revitalisation. Though not specified in indicator sheets following may be considered for assessment before and after the project: ‘Commercial/Retail space’, ‘Number of Hotels/Cafés/Restaurant/Bars’, ‘Rate of Unemployment’ or ‘Activities to create income’.

Non-Use Values

Nature preserves set up to protect species abundance and diversity without offering public access provides no direct economic gain, though they offer long range benefits to humanity. Life forms are expected to hold answers that may assist human survival and they are protected on ethical grounds. Natural areas offer micro climatic benefits, provide water resources and have other non-use values of no immediate economic gain. No-use values may be accessed for their economic value, but quantification requires elaborate methods and expert knowledge. Therefore, as it will be only of limited applicability, no further detailing will be undertaken.

4.4.3 Project Costs and Maintenance costs

The category project cost and maintenance cost has been included to enable the assessment of efficiency (cost benefit ratio), whereas successful projects will have a favourable cost-benefit ratio. Nevertheless, this should not be interpreted to favour inexpensive planning and construction but to act efficiently within the constraints set by funds provided and budgets allocated.

Project costs

River rehabilitation projects incur costs for planning, construction and real estate purchase. Values in this subcategory will only be assessed ex-post and will be used to determine efficiency of the project. Following quality elements should be considered for the assessment of project cost:

- Planning costs
- Construction costs
- Real estate Purchase

<u>Planning Costs</u>

Planning of a project occurs in stages, ranging from a survey of existing conditions to pre-design planning, design planning, permit planning, execution of planning, to specifications for construction and construction observation. For participative projects it may include respective costs, covering public information, presentations, work shop and others. Potential indicators to assess include ‘Planning cost (€/m2)’ and ‘Cost of public information and participation (€/year)’.

Construction Costs

Construction implements a design for a site, set forth through drawings developed during the planning stage and supported by specifications for construction that contain quantities and unit prices for work elements.

Many EU countries have developed guidelines for the assignment of construction contracts and their implementation considering type and dimension of services, compensation, specifications, construction, deadlines, delays, cancellations, liabilities, deficiencies, invoicing and compensation, security payments, and disputes. Poorely planned projects that involve so called “Change orders” from agreed contracts tend to be highly expensive. The parameter ‘Construction costs (€/m2)’ may be assessed for the establishment of project efficiency.

Real Estate Purchase

For the implementation of river rehabilitation measures a purchase of real estate may be needed, for instance for the establishment of wetlands. It may cause substantial costs to be considered and determined in advance. Depending on the project and local existing ownerships those cost can vary tremendously (cf. Schanze et al, in prep). The parameter ‘Real estate purchase costs (€/m2)’ may be assessed for the establishment of project efficiency.

Maintenance costs

A successful cost-effective river rehabilitation project will not only consider planning and construction cost, but also “operating costs” after the project has been implemented. A self sustaining ecological equilibrium of the river is most likely to keep annual maintenance costs as low as possible. Maintenance cost can be divided in the following quality elements:

- Annual maintenance costs
- Event related maintenance cost

Annual Maintenance Costs

Annual maintenance costs can vary widely and are dependent upon project goals. For example, standard maintenance along straightened and canalised streams includes regular weed control, involving the mowing of stream banks at considerable costs to prevent establishment of woody vegetation. Along smaller streams a more cost effective alternative for weed control could be provided through tree shading of streambeds. When soil-bioengineering techniques are being used to stabilise stream banks alternative maintenance comes into play, such as cut back of woody vegetation. Riparian forest buffers” have a minimum of maintenance. Maintenance costs vary accordingly.

Potential indicators:

- Annual maintenance costs

Event Related Maintenance

Event related maintenance may consider repairs after flood events and maintenance costs after special cultural events. Flooding may require the replacement and repair of structures. The highest cost of urban flooding has long been proved to be the removal of mud, sediments and debris. Though not specified in indicator sheets following indicators may be considered to assess this quality element: '(Potential) Flood damage cost (€/m2)' and '(Real) Replacement costs for flood damage (€/m2)'.

4.5 Describing indicators

Indicators are systematically presented in indicator sheets. The single categories of the sheets are explained in the following.

No:	Number of the indicator as registered in the data bank
Name of indicator:	Giving the name of the indicator. The name does not necessarily contain the full information of the measured element
Category:	Detailing the category under which the indicator is proposed. See annex 2A for the categories, which occur.
Subcategory:	Detailing the subcategory under which the indicator is proposed. See annex 2A for the subcategories, which occur.
Quality element:	Detailing the subcategory under which the indicator is proposed. See annex 2A for the quality elements, which occur.
Measured parameter:	Defines the parameter, which is measured to obtain results for the indicator.
Unit:	Defines the unit, which is used to express the value of the parameter.
Benchmarks:	If possible, proposes possible benchmarks for the indicator.
Tendency:	Describes the development which indicator values should take. For cost indicators that tendency should decrease, for benefit indicators increase.
Classification:	Gives an example for a potential classification for the indicator.
Temporal scope:	Classifies the indicator in classes of short, middle, or long term, related to the temporal scope in which intended effects are likely to occur.
Spatial scope:	Classifies the indicator in classes of river, reach, intervention area, social effect area and hydrological effect area.

Rational: Heading, under which the motivation for the indicator is described and background information is given.

References: Gives examples of published sources containing information of the indicator respectively the parameter or their measurements. The sources are not necessarily directly related to the text above.

Enquiry method: Names or describes methods which can or should be used for inquiry of the indicator.

Potential data sources: Gives examples for typical sources where already enquired data on the indicator might be available.

Relation to other indicators: Even though measured by different parameters, one indicator might express similar issues. In such cases indicators are not necessarily congruent, but may have divergence in other means.

Example: Heading, under which, if available, an example of the application of the indicator is given.

4.6 List of Indicators

ECOLOGICAL STATE INDICATORS	
EL 1	Taxonomic composition of phytoplankton
EL 2	Average abundance of phytoplankton
EL 3	Frequency and intensity of planctonic blooms
EL 4	Taxonomic composition of macrophytes and phytobenthos
EL 5	Average abundance of macrophytes
EL 6	Average abundance of phytobenthos
EL 7	Taxonomic composition of benthic invertebrate fauna
EL 8	Average abundance of benthic invertebrate fauna
EL 9	Ratio of disturbance sensitive taxa to insensitive taxa
EL 10	Level of diversity of invertebrate taxa
EL 11	Species composition of fish fauna
EL 12	Abundance of fish fauna
EL 13	Presence of disturbance-sensitive fish species
EL 14	Age structure of fish communities
EL 15	Reproduction and development of particular fish species
EL 16	Quantity of water flow
EL 17	Dynamics of water flow
EL 18	Connection to groundwaters
EL 19	Upstream and downstream continuity of river for fish
EL 20	Downstream and upstream continuity of river for benthic invertebrate fauna
EL 21	Continuity of river for river sediments
EL 22	Flooded floodplain ratio

EL 23	Natural floodplain ratio
EL 24	Channel patterns
EL 25	Width variation
EL 26	Depth variation
EL 27	Flow velocities
EL 28	Substrate conditions
EL 29	Degradation / aggradation of river or coastal bed (additional)
EL 30	Structure and condition of the riparian zone
EL 31	Nutrient conditions
EL 32	Level of salinity
EL 33	Acidification status (Alkalinity)
EL 34	Oxygenation conditions
EL 35	Acid neutralising capacity (ANC)
EL 36	Transparency
EL 37	Thermal condition
EL 38	Concentrations of hazardous synthetic substances
EL 39	Concentrations of hazardous non-synthetic pollutants
EL 40	Self-cleaning capacity
EL 41	Nature conservation value
SOCIAL STATE INDICATORS	
S 1	Soft mode access barriers
S 2	Parking lots
S 3	Public transportation stops (PTS)
S 4	Access points for soft modes
S 5	Water contact zones

S 6	Anchorage points
S 7	Passenger boat capacity
S 8	River crossings
S 9	Public utility of river site
S 10	Carrying capacity of public open space
S 11	Landmarks
S 12	Viewpoints
S 13	Noise pollution
S 14	Width of river site
S 15	Recreational facilities
S 16	Recreational paths
S 17	Cultural events
S 18	Integration of cultural heritage and cultural assets
S 19	Accidents
S 20	Flood risk
S 21	Crime rate
S 22	Vandalism
S 23	Fear of crime
S 24	Fear of hazardous floods
S 25	Self efficacy
S 26	Distinctiveness
S 27	Continuity
S 28	Self-esteem
S 29	Being away
S 30	Fascination
S 31	Extent

S 32	Compatibility
S 33	User catchment area
S 34	Access by users
S 35	Social structure of recreational user groups
S 36	Visitor frequency
S 37	Recreational activities
S 38	Educational use trough schools
S 39	Dwelling satisfaction
S 40	Migration balance
S 41	Advocacy and stewardship groups
S 42	Volunteers
S 43	Business coalitions

ECONOMIC STATE INDICATORS	
EN 1	Median Property value
EN 2	Unemployment
EN 3	Activities to create income
EN 4	Maintenance costs
EN 5	Replacement cost related to vandalism
EN 6	(Potential) Flood damage cost
EN 7	(Real) Replacement costs for flood damage

5. Discussion and Conclusions

A post implementation assessment should be a component of any urban river rehabilitation project. This report has been written to increase knowledge, acceptance and application of meaningful and comprehensive post implementation assessments. With its application, it is hoped, that as a result of experiences improvements be made that be passed on to make urban river rehabilitation more effective and efficient and to increase the quality of projects.

The URPIA method provides a flexible framework, in order to comply with the needs of specific projects that vary in size, problematic and resources available. This flexibility leaves many decisions open to project participants. This includes the actual selection of indicators, as well as the definition of target values and the weighting of criteria. The hierarchies (Annex 2A) as well as questions in the selection procedure (Figure 3.2) were established to minimize subjective influence. A definition of target values, classification and weighting should be conducted in a participative way, by including stakeholders. Nevertheless in any case lower level criteria (e.g. Quality elements or indicators) will provide the most objective results and more detailed information on what has been achieved.

The method requires an ex-ante actions for the establishment of the needed baseline values. This requires that appropriate founds need to be provided for from the beginning. In some cases the method may be applied only ex-post, in which case baseline values have to be interpreted. Without pre- and post implementation data results will be of limited usefulness (see chapter 3.8).

The suggested approach has been reviewed and tested at different urban river rehabilitation projects, though due to time and resource limitations as an ex-post application only. There have been valuable comments that were used to improve the method. Nevertheless further refinements will be needed to streamline the process and to make it more user friendly. Many indicators have been provided. Applications and adjustments twill help to establish robust, comprehendable and easily applicable indicators, useful to achieve transferable, comparable results. Experiences made through PIA's need to be passed on to get a better understanding of the complex interrelationships between ecological, social and economic effects of urban river rehabilitations.

It is hoped that the suggested framework will contribute to better and more transparent urban decision making and therefore contribute to a democratic decision making process and to a better quality of life in urban areas. There should be an increase in knowledge about methodologies, a wider utilization of PIA's, and more legal and administrative support. Government agencies and foundations who fund projects should insist that proof be provided that there have been results and that funds have been used wisely.

6. Acknowledgements

The research has been part of the “Urban River Basin Enhancement Methods” EU-Project, founded by the European Commission under the 5th framework Programme. We would like to thank our Partners from the

- Portuguese National Civil Engineering Laboratory, Lisbon (LNEC),
- Instituto Superior Tecnico - Centro De Sistemas Urbanos e Regionais, Lisbon (CESUR),
- HR Wallingford
- New Economics Foundation, London
- Universität für Bodenkultur, Department Wasser - Atmosphäre – Umwelt, Institut für Wasserwirtschaft, Hydrologie und konstruktiver Wasserbau (IWHW)

for their critical contributions and their feedback.

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Glossary

Achievable Maximum or Minimum values are those values, which can be achieved to a certain point in time at a specific location, considering existing constraints

Benefit indicators 'The higher the better' (Nijkamp, Ouwersloot, 1998).

Cost indicators follow the correlation 'The lower the better' (Nijkamp, Ouwersloot, 1998).

Criteria describing the quality of an element at various aggregation levels

Indicator measurable criteria, specified with a parameter for measuring

Parameter related to an indictor, tells how to measure the indicator

Effect describes the consequences of the intervention on different levels of examination. These consequences can be intended (goals) or unintended (side-effects)

Effectiveness (target effectiveness) describes the quantified effect of the intervention referred to benchmarks of initially defined goals respectively effects (degree of goal achievement)

Efficiency describes the quantified effect of the intervention related to the effort taken to achieve this effect. Efforts can be any kind of input invested to achieve the desired effect (e.g. financial resources).

Index aggregated indicators

Isochrones are lines of same (travel) time in relation to the same point of departure resp. arrival (Voigt 2002, p. 21)

Operationalisation of a theoretical construct (e.g. of a term) is realised by the instruction how issues defining the construct are to be measured. Exp.: The social position of a person can be operationalised by the question for the professional status (= indicator). Beyond the naming of the indicator, operationalisation comprises the specification of the enquiry method, the enquiry instrument, the parts of the instrument delivering the empirical information (the Question) as well as the definition of the data processing in terms of the final analysis (e.g. the combination of single 'answers' to one indicator about the issue of interest). Furthermore, the level of measurement (spatial, temporal etc.) is important (advanced from Andreß 2001)

Target Values are those agreed values, which are to be achieved for a certain indicator, to a certain point in time, at a certain location

Post Implementation Assessment refers to an indicator based evaluation of effects, effectiveness and efficiency

Potential Maximum or Minimum values are those values, which can be achieved for an indicator at a certain location, not considering actual constraints

Annexes

Annex 1: Sources of data and methods of enquiry

Sources of data

- Existing updated data sets at City and District level (statistical information)
- Literature (possible benchmarks, further indicators)
- Legal acts etc. (e.g. official benchmarks)

Enquiry methods:

- Expert interview (Experteninterview) (e.g. real estate agents)
- Expert estimation (Experteneinschätzung)
- Anonymous standardised enquiries via postal service (defined area) – should be supported by city (inform)
- Anonymous standardised enquiries onsite (oral) – should be supported by city through information
- Inhaltsanalyse Content Analysis (Mayring 1997, Merten 1995 - bestellt)
- Measurement of directly measurable parameters (noise, other pollution, etc.))
- Onsite census of parameters (visitor frequency, number of passing/parking vehicles, spatial or temporal concentration of certain aspects, etc.)
- Analysis of maps / aerial photographs
- Analysis of press articles (daily, periodic: targets: number of articles addressing theme, emplacement and size of articles, diction/word choice – electronic services)
- Onsite inspections
- Mapping
- Household based surveys Kommunale Bürgerumfrage (e.g. Rent advisor enquiry and other)
- Observation (incl. participating observation)
- Environmental Impact Assessment
- Risk Assessment
- Rosgen classification
- Habitat structure based assessments. E.g.:
  - Instream structure mapping (Germany, Strukturgütekartierung)
  - River Habitat Survey (UK)
  - River Habitat Survey (UK)
  - Stream reconnaissance (UK)
- Methods addressing water quality
  - Saprobic Index
  - Other biological and chemical analysis methods (see WFD, Annex V)
- Visual
  - Site photographs
  - Aerial photographs
  - Video records

Economic Enquiry Methods:

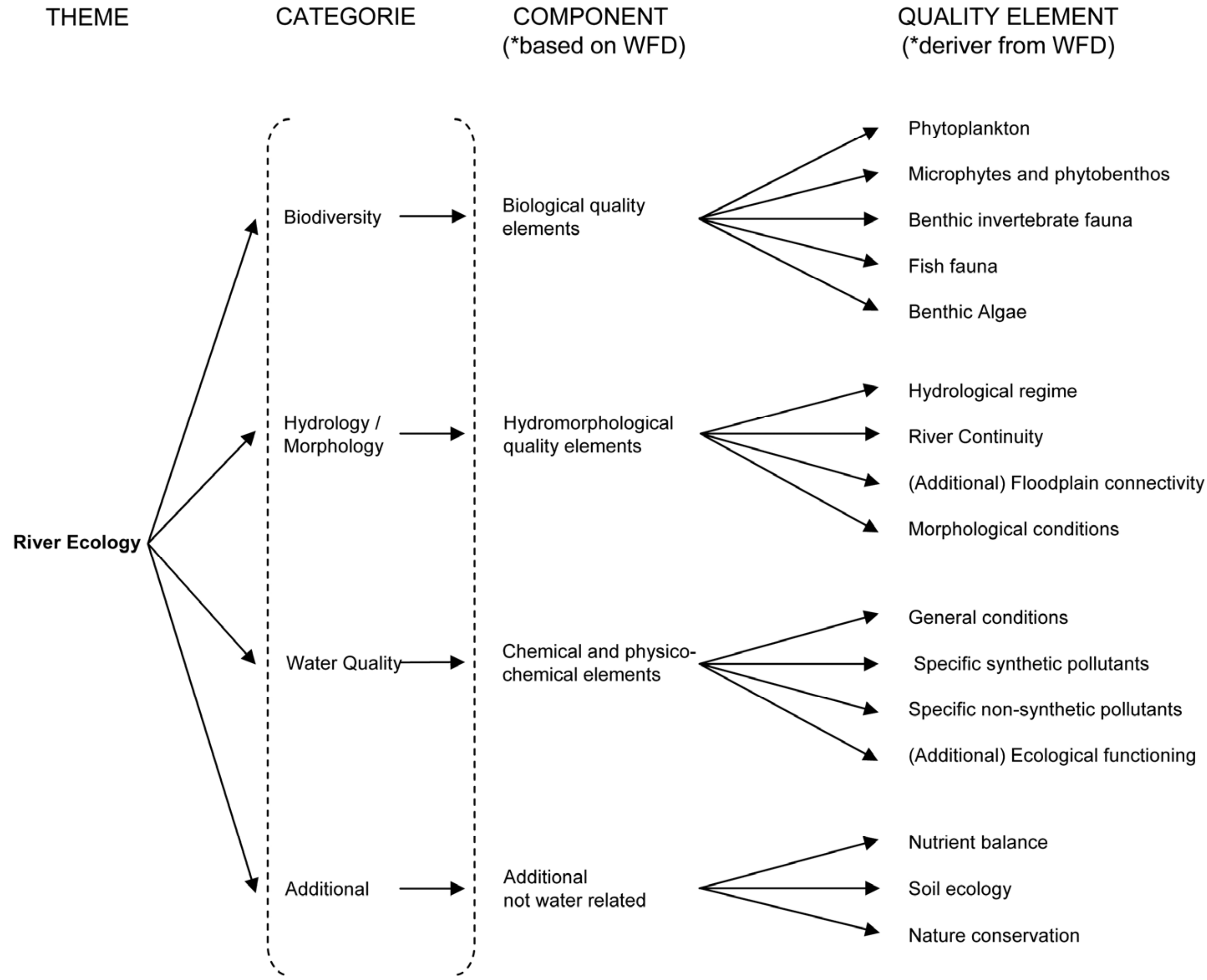
- **Replacement cost** Replacement cost referrers to a full reconstitution of conditions prior to damage. This may involve an estimate of the costs which the injured parties incurred in putting the harm right, either by observing what victims actually spent or by consulting experts (OECD, 1995). In terms of river rehabilitation this may for example be applied in flood damage compensation.

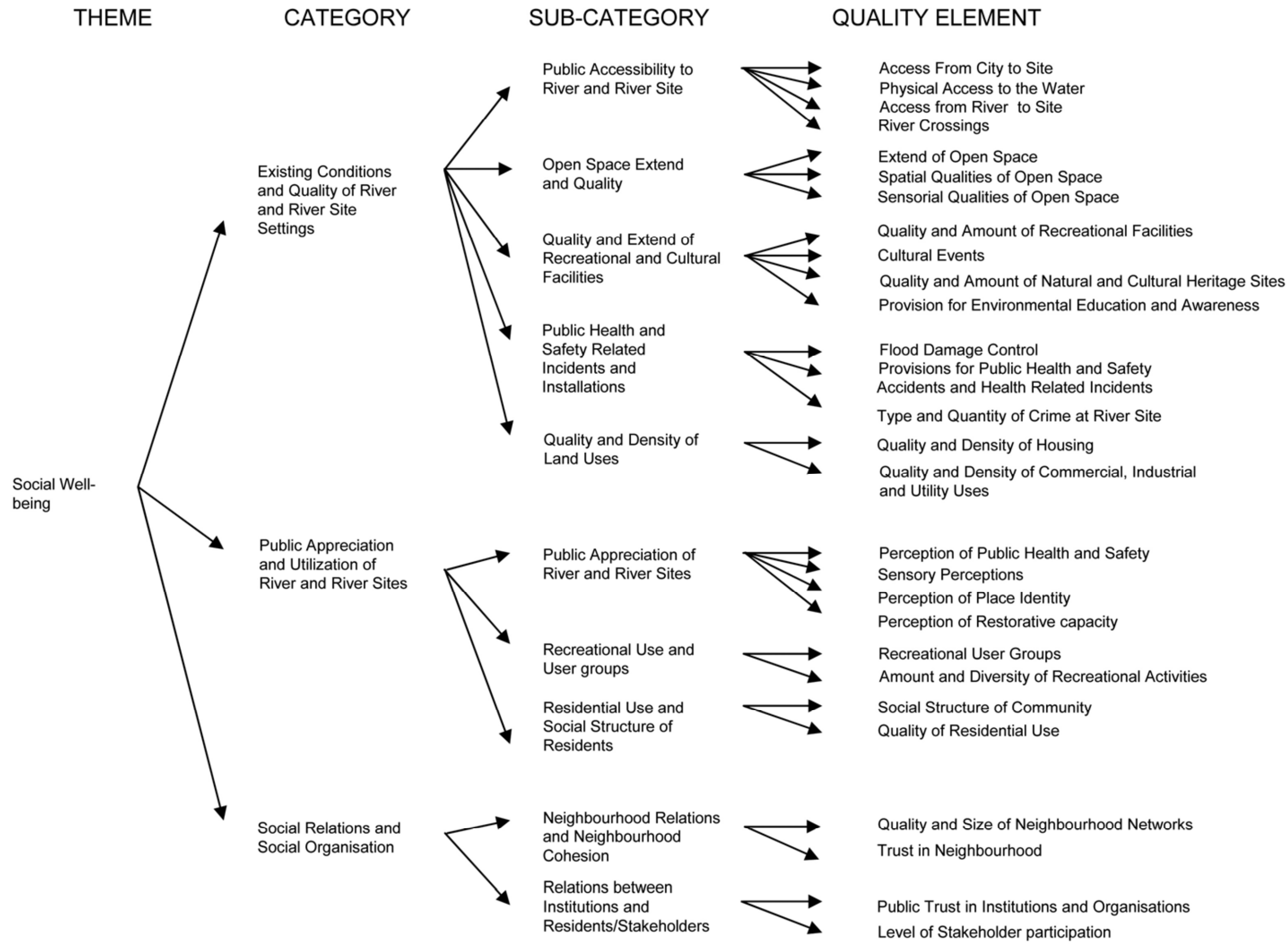
- **Contingent valuation (CV)** is an approach, which has been used for the economic assessment of non market goods. This may include use values, e.g. water quality, viewing wild life, enjoying views or non-use values, for example preservation of rare species or bio-diversity for its own sake. The technique is essentially based on public surveys, where people state their preferences. In river rehabilitation the “Willingness to pay for a good” (WTP) may be used. . A high rating will not reflect an economical benefit but merely a high economical valuation of the environmental improvements. CV surveys are usually divided into three parts, starting with an explanation of the theme in question, to proceed to actual questions on WTP and the inquiry of socio-economic data. The last part is used for the interpretation of the WTP answers. The process of CVM remains contentious (Edward-Jones et. al., 1995). Critics point to the distortion of results through the inability of respondents to translate their values into monetary terms, as well as misunderstanding of the nature of the enquiry, or unconscious biases (OECD, 1995). A reduction of those potential distortions can be achieved by eliminating clearly implausible answers from the sample. All together it is a data intensive method that requires careful sampling, training of enumerators, extensive time for preparation and analysis. For further information, an example questionnaire and references see OECD, 1995.

- **Travel Cost (TCM)** In comparison to the CV, where stated preferences of people are analysed, the travel cost method analyses revealed preferences of people. It is based on the assumption that goods are demanded less as prices goes up. Analogue, the number of visits to a site would be inversely related to the size of travel costs. Therefore cost and time people spent to come to a site can be used as a proxy measure for an entrance fee (OECD, 1995). For post project assessments an increase in travel costs spent to access the site, will reflect its value. It is an opportunity to discover the potential for levying charges. TCM is a well established method for estimating the demand for recreational facilities. It will be applicable for river sites with recreational use or amenity value. For the use of the method a site has to be accessible, no entry charge must exist and people must have to spend significant time and costs to reach the site. In urban areas those prerequisites may not be fulfilled. Here a site visit may overlap with other purposes of the trip, whereby costs cannot be completely assigned to the site visit itself. Urban travel costs also tend to be fairly small. For further information see OECD, 1995.

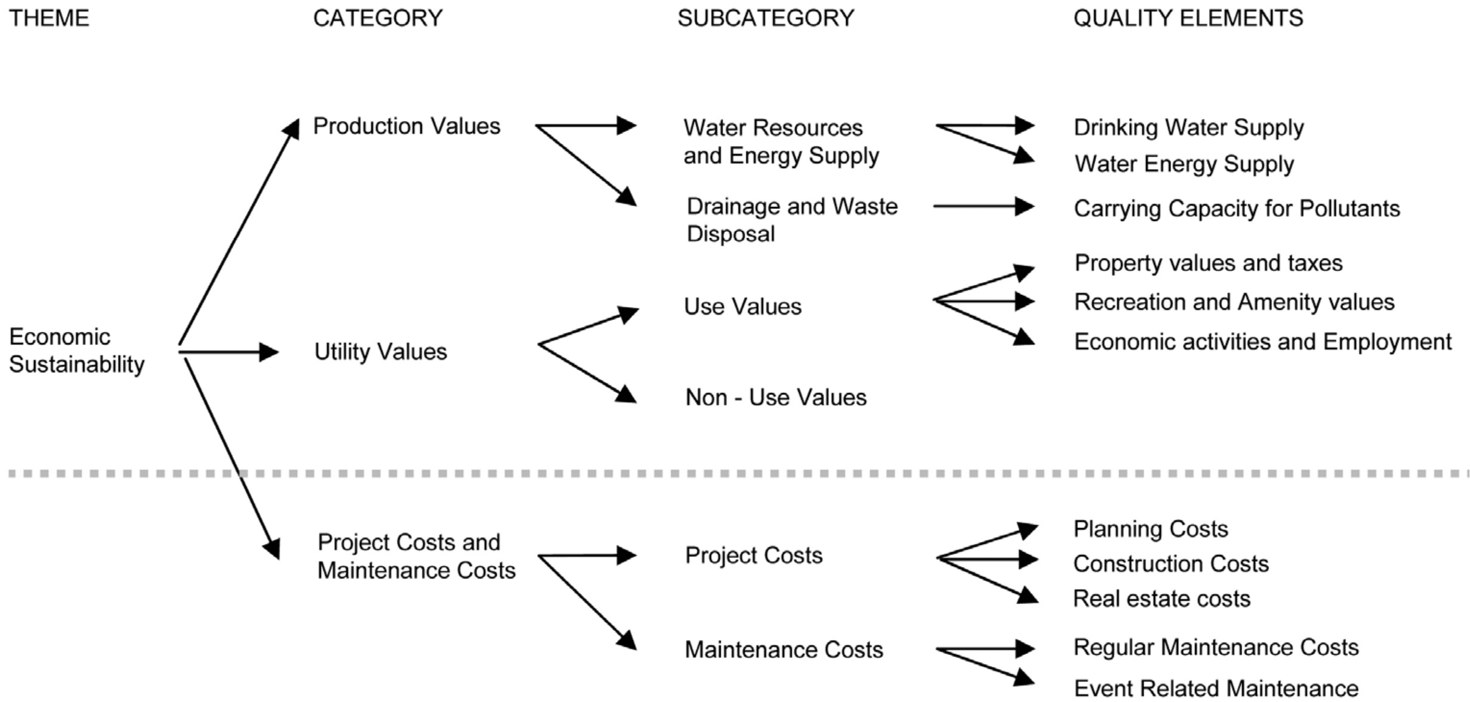
- **Hedonic Pricing Method (HP)** The Hedonic Pricing is based upon the thesis, that the values people place on environmental quality can be related to their willingness to pay for goods that incorporate environmental attributes. For this method property prices are used. Variations of property price are correlated with key property features such as size, age, condition and locality. The remaining “unexplained” difference in price account for the environmental benefits a property has to offer. The method is the most data intensive of all economical valuation methods (OECD, 1995). It relies on the collection of data on the characteristics of the property. Therefore HP should only be undertaken, where relevant data is available and when sufficient resources are available to conduct the survey. Its methodological approach requires high skills in statistics and econometry. It also requires a transparent and well functioning property market, where environmental values are clearly appreciated by property owners (OECD, 1995). In consequence HP may only be applicable for large scale impact studies. For further information see OECD, 1995.

Annex 2A: Hierarchies of Ecologic, Social and Economic Criteria for Post Implementation Assessment


THEME
CATEGORIE
COMPONENT
(*based on WFD)
QUALITY ELEMENT
(*deriver from WFD)
River Ecology
Biodiversity
Hydrology /
Morphology
Water Quality
Additional
Biological quality
elements
Hydromorphological
quality elements
Chemical and physico-
chemical elements
Additional
not water related
Phytoplankton
Microphytes and phytobenthos
Benthic invertebrate fauna
Fish fauna
Benthic Algae
Hydrological regime
River Continuity
(Additional) Floodplain connectivity
Morphological conditions
General conditions
Specific synthetic pollutants
Specific non-synthetic pollutants
(Additional) Ecological functioning
Nutrient balance
Soil ecology
Nature conservation



THEME
CATEGORY
SUB-CATEGORY
QUALITY ELEMENT
Social Well-being
Existing Conditions and Quality of River and River Site Settings
Public Appreciation and Utilization of River and River Sites
Social Relations and Social Organisation
Public Accessibility to River and River Site
Open Space Extend and Quality
Quality and Extend of Recreational and Cultural Facilities
Public Health and Safety Related Incidents and Installations
Quality and Density of Land Uses
Public Appreciation of River and River Sites
Recreational Use and User groups
Residential Use and Social Structure of Residents
Neighbourhood Relations and Neighbourhood Cohesion
Relations between Institutions and Residents/Stakeholders
Access From City to Site
Physical Access to the Water
Access from River to Site
River Crossings
Extend of Open Space
Spatial Qualities of Open Space
Sensorial Qualities of Open Space
Quality and Amount of Recreational Facilities
Cultural Events
Quality and Amount of Natural and Cultural Heritage Sites
Provision for Environmental Education and Awareness
Flood Damage Control
Provisions for Public Health and Safety
Accidents and Health Related Incidents
Type and Quantity of Crime at River Site
Quality and Density of Housing
Quality and Density of Commercial, Industrial and Utility Uses
Perception of Public Health and Safety
Sensory Perceptions
Perception of Place Identity
Perception of Restorative capacity
Recreational User Groups
Amount and Diversity of Recreational Activities
Social Structure of Community
Quality of Residential Use
Quality and Size of Neighbourhood Networks
Trust in Neighbourhood
Public Trust in Institutions and Organisations
Level of Stakeholder participation


THEME
CATEGORY
SUBCATEGORY
QUALITY ELEMENTS
Economic Sustainability
Production Values
Utility Values
Project Costs and Maintenance Costs
Water Resources and Energy Supply
Drainage and Waste Disposal
Use Values
Non - Use Values
Project Costs
Maintenance Costs
Drinking Water Supply
Water Energy Supply
Carrying Capacity for Pollutants
Property values and taxes
Recreation and Amenity values
Economic activities and Employment
Planning Costs
Construction Costs
Real estate costs
Regular Maintenance Costs
Event Related Maintenance

Annex 1b: Indicator sheets

See files URPIA_EcolIn.pdf URPIA_SoIn.pdf and URPIA_EconIn.pdf

<table>
<tr><td colspan="2">Category
Subcategory</td><td colspan="2">Biology
Biological quality elements</td><td rowspan="2">ECOLOGICAL</td></tr>
<tr><td colspan="2">Quality Element</td><td colspan="2">Phytoplankton</td></tr>
<tr><td colspan="2">Name of indicator:</td><td colspan="2">Taxonomic composition of phytoplankton</td><td>NO
EL 1</td></tr>
<tr><td rowspan="3">Operationalisation</td><td colspan="2">Measured parameter:
Species density
Biomass</td><td colspan="2">Unit:
Individuals/area
kg/area</td></tr>
<tr><td colspan="2">Benchmarks:
type specific
Tendency:
as little as possible variation from undisturbed conditions</td><td colspan="2" rowspan="2">Potential classification:
see WFD Annex V</td></tr>
<tr><td colspan="2">Temporal scope:
individual
Spatial scope:
individual</td></tr>
<tr><td>Rational</td><td colspan="4">Rational:
rational to come
References:
CIS Working Group '2.7' (2003), p. 40f; p. 48f</td></tr>
<tr><td>Data enquiry</td><td colspan="4">Enquiry method:
Integrated sample (3-4m), depth sampler; Integrated or discrete samples in the water column 1-5 sites per lake. A number of sampling gears are commonly used such as hand-held bottles or flexible hose.
Potential sources of data:
Monitoring programs, inquiery</td></tr>
</table>

Category Subcategory	Biology Biological quality elements	ECOLOGICAL
Quality Element	**Phytoplankton**	
Name of indicator:	**Average abundance of phytoplankton**	NO **EL 2**

<table>
<tr><td rowspan="3">Operationalisation</td><td>Measured parameter:
Individual density of aquatic flora or of particular species
Biomass</td><td>Unit:
Individuals/area
kg/area</td></tr>
<tr><td>Benchmarks:
type specific
Tendency:
as little as possible variation from undisturbed conditions</td><td rowspan="2">Potential classification:
see WFD Annex V</td></tr>
<tr><td>Temporal scope:
individual
Spatial scope:
individual</td></tr>
<tr><td>Rational</td><td colspan="2">Rational:
rational to come
References:
CIS Working Group '2.7' (2003), p. 40f; p. 48f</td></tr>
<tr><td>Data enquiry</td><td colspan="2">Enquiry method:
Integrated sample (3-4m), depth sampler; Integrated or discrete samples in the water column 1-5 sites per lake. A number of sampling gears are commonly used such as hand-held bottles or flexible hose.
Potential sources of data:
Monitoring programs, inquiery</td></tr>
</table>

Category Subcategory	Biology Biological quality elements	ECOLOGICAL
Quality Element	**Phytoplankton**	
Name of indicator:	**Frequency and intensity of planctonic blooms**	NO **EL 3**

Operationalisation	**Measured parameter:** Frequency and intensity of planctonic blooms	**Unit:** -
	Benchmarks: type specific **Tendency:** as little as possible variation from undisturbed conditions	**Potential classification:** see WFD Annex V
	Temporal scope: individual **Spatial scope:** individual	
Rational	**Rational:** rational to come **References:** CIS Working Group '2.7' (2003), p. 40f; p. 48f	
Data enquiry	**Enquiry method:** Integrated sample (3-4m), depth sampler; Integrated or discrete samples in the water column 1-5 sites per lake. A number of sampling gears are commonly used such as hand-held bottles or flexible hose. **Potential sources of data:** Monitoring programs, inquiery	

Category Subcategory	Biology Biological quality elements	ECOLOGICAL
Quality Element	**Microphytes and phytobenthos**	
Name of indicator:	**Taxonomic composition of macrophytes and phytobenthos**	NO **EL 4**

Operationalisation	**Measured parameter:** Species density Biomass	**Unit:** Individuals/area kg/area
	Benchmarks: type specific **Tendency:** as little as possible variation from undisturbed conditions	**Potential classification:** see WFD Annex V
	Temporal scope: individual **Spatial scope:** individual	
Rational	**Rational:** rational to come **References:** CIS Working Group '2.7' (2003), p. 40f	
Data enquiry	**Enquiry method:** CEN-standard under development **Potential sources of data:** Monitoring programs, inquiery	

Category Subcategory	Biology Biological quality elements	ECOLOGICAL
Quality Element	**Microphytes and phytobenthos**	
Name of indicator:	**Average abundance of macrophytes**	NO **EL 5**

Operationalisation	**Measured parameter:** Species density of macrophytes or of particular species Biomass	**Unit:** Individuals/area kg/area
	Benchmarks: type specific **Tendency:** as little as possible variation from undisturbed conditions	**Potential classification:** see WFD Annex V
	Temporal scope: individual **Spatial scope:** individual	
Rational	**Rational:** rational to come **References:** CIS Working Group '2.7' (2003), p. 40f	
Data enquiry	**Enquiry method:** CEN-standard under development **Potential sources of data:** Monitoring programs, inquiery	

Category Subcategory	Biology Biological quality elements	ECOLOGICAL
Quality Element	**Microphytes and phytobenthos**	
Name of indicator:	**Average abundance of phytobenthos**	NO **EL 6**

Operationalisation	**Measured parameter:** Species density of phytobenthos or of particular species Biomass	**Unit:** Individuals/area kg/area
	Benchmarks: type specific **Tendency:** as little as possible variation from undisturbed conditions **Temporal scope:** individual **Spatial scope:** individual	**Potential classification:** see WFD Annex V
Rational	**Rational:** rational to come **References:** CIS Working Group '2.7' (2003), p. 40f	
Data enquiry	**Enquiry method:** CEN-standard under development **Potential sources of data:** Monitoring programs, inquiery	

<table>
<tr><td colspan="2">Category
Subcategory</td><td colspan="2">Biology
Biological quality elements</td><td rowspan="2">ECOLOGICAL</td></tr>
<tr><td colspan="2">Quality Element</td><td colspan="2">Bentic invertebrate fauna</td></tr>
<tr><td colspan="2">Name of indicator:</td><td colspan="2">Taxonomic composition of benthic invertebrate fauna</td><td>NO
EL 7</td></tr>
<tr><td rowspan="3">Operationalisation</td><td colspan="2">Measured parameter:
Number and diversity of benthic invertebrate fauna taxa</td><td colspan="2">Unit:
-</td></tr>
<tr><td colspan="2">Benchmarks:
type specific
Tendency:
as little as possible variation from undisturbed conditions</td><td colspan="2" rowspan="2">Potential classification:
see WFD Annex V</td></tr>
<tr><td colspan="2">Temporal scope:
individual
Spatial scope:
individual</td></tr>
<tr><td>Rational</td><td colspan="4">Rational:
rational to come
References:
CIS Working Group '2.7' (2003), p. 40f</td></tr>
<tr><td>Data enquiry</td><td colspan="4">Enquiry method:
ISO 8265, 7828, 9391 (surber sampler, handnet, grab)
Potential sources of data:
Monitoring programs, inquiery</td></tr>
</table>

Category Subcategory	Biology Biological quality elements	ECOLOGICAL
Quality Element	**Bentic invertebrate fauna**	
Name of indicator:	**Average abundance of benthic invertebrate fauna**	NO **EL 8**

Operationalisation

Measured parameter:

Average abundance of benthic invertebrate fauna or of particular species

Biomass

Unit:

Individuals/area

kg/area

Benchmarks:

type specific

Tendency:

as little as possible variation from undisturbed conditions

Potential classification:

see WFD Annex V

Temporal scope:

individual

Spatial scope:

individual

Rational

Rational:

rational to come

References:

CIS Working Group '2.7' (2003), p. 40f

Data enquiry

Enquiry method:

ISO 8265, 7828, 9391 (surber sampler, handnet, grab)

Potential sources of data:

Monitoring programs, inquiery

Category Subcategory	Biology Biological quality elements	ECOLOGICAL
Quality Element	**Bentic invertebrate fauna**	
Name of indicator:	**Ratio of disturbance sensitive taxa to insensitive taxa**	NO **EL 9**

Operationalisation	**Measured parameter:** Ratio of disturbance sensitive taxa to insensitive taxa	**Unit:** -
	Benchmarks: type specific **Tendency:** as little as possible variation from undisturbed conditions	**Potential classification:** see WFD Annex V
	Temporal scope: individual **Spatial scope:** individual	
Rational	**Rational:** rational to come **References:** CIS Working Group '2.7' (2003), p. 40f	
Data enquiry	**Enquiry method:** ISO 8265, 7828, 9391 (surber sampler, handnet, grab) **Potential sources of data:** Monitoring programs, inquiery	

<table>
<tr><td>Category
Subcategory</td><td>Biology
Biological quality elements</td><td rowspan="2">ECOLOGICAL</td></tr>
<tr><td>Quality Element</td><td>Bentic invertebrate fauna</td></tr>
<tr><td>Name of indicator:</td><td>Level of diversity of invertebrate taxa</td><td>NO
EL 10</td></tr>
</table>

<table>
<tr><td rowspan="3">Operationalisation</td><td colspan="2">Measured parameter:
Number of taxa</td><td>Unit:
-</td></tr>
<tr><td colspan="2">Benchmarks:
type specific
Tendency:
as little as possible variation from undisturbed conditions</td><td rowspan="2">Potential classification:
see WFD Annex V</td></tr>
<tr><td colspan="2">Temporal scope:
individual
Spatial scope:
individual</td></tr>
<tr><td>Rational</td><td colspan="3">Rational:
rational to come
References:
CIS Working Group '2.7' (2003), p. 40f</td></tr>
<tr><td>Data enquiry</td><td colspan="3">Enquiry method:
ISO 8265, 7828, 9391 (surber sampler, handnet, grab)
Potential sources of data:
Monitoring programs, inquiery</td></tr>
</table>

Category Subcategory	Biology Biological quality elements	ECOLOGICAL
Quality Element	**Fish fauna**	
Name of indicator:	**Species composition of fish fauna**	NO **EL 11**

Operationalisation	**Measured parameter:** Species composition of fish fauna	**Unit:** -
	Benchmarks: type specific **Tendency:** as little as possible variation from undisturbed conditions	**Potential classification:** see WFD Annex V
	Temporal scope: individual **Spatial scope:** individual	
Rational	**Rational:** rational to come **References:** CIS Working Group '2.7' (2003), p. 40f Dußling et al. 2005	
Data enquiry	**Enquiry method:** Nets, electrofisher - depending on habitats **Potential sources of data:** Monitoring programs, inquiery	

Category Subcategory	Biology Biological quality elements	ECOLOGICAL
Quality Element	**Fish fauna**	
Name of indicator:	**Abundance of fish fauna**	NO **EL 12**

Operationalisation	**Measured parameter:** Individual desinsity of fish fauna or of particular species Biomass	**Unit:** Individuals/area kg/area
	Benchmarks: type specific **Tendency:** as little as possible variation from undisturbed conditions	**Potential classification:** see WFD Annex V
	Temporal scope: individual **Spatial scope:** individual	
Rational	**Rational:** rational to come **References:** CIS Working Group '2.7' (2003), p. 40f Dußling et al. 2005	
Data enquiry	**Enquiry method:** Nets, electrofisher - depending on habitats **Potential sources of data:** Monitoring programs, inquiery	

Category Subcategory	Biology Biological quality elements	ECOLOGICAL
Quality Element	**Fish fauna**	
Name of indicator:	**Presence of disturbance-sensitive fish species**	NO **EL 13**

<table>
<tr><td rowspan="3">Operationalisation</td><td>Measured parameter:
Certain type specific or locally specific species</td><td>Unit:
-</td></tr>
<tr><td>Benchmarks:
type specific
Tendency:
as little as possible variation from undisturbed conditions</td><td rowspan="2">Potential classification:
see WFD Annex V</td></tr>
<tr><td>Temporal scope:
individual
Spatial scope:
individual</td></tr>
<tr><td>Rational</td><td colspan="2">Rational:
rational to come
References:
CIS Working Group '2.7' (2003), p. 40f</td></tr>
<tr><td>Data enquiry</td><td colspan="2">Enquiry method:
Nets, electrofisher - depending on habitats
Potential sources of data:
Monitoring programs, inquiery</td></tr>
</table>

Category Subcategory	Biology Biological quality elements	ECOLOGICAL
Quality Element	**Fish fauna**	
Name of indicator:	**Age structure of fish communities**	NO **EL 14**

Operationalisation	**Measured parameter:** Age class distribution in fish communities	**Unit:** -
	Benchmarks: type specific **Tendency:** as little as possible variation from undisturbed conditions	**Potential classification:** see WFD Annex V
	Temporal scope: individual **Spatial scope:** individual	
Rational	**Rational:** rational to come **References:** CIS Working Group '2.7' (2003), p. 40f Dußling et al. 2005	
Data enquiry	**Enquiry method:** Nets, electrofisher - depending on habitats **Potential sources of data:** Monitoring programs, inquiery	

<table>
<tr><td colspan="2">Category
Subcategory</td><td colspan="2">Biology
Biological quality elements</td><td rowspan="2">ECOLOGICAL</td></tr>
<tr><td colspan="2">Quality Element</td><td colspan="2">Fish fauna</td></tr>
<tr><td colspan="2">Name of indicator:</td><td colspan="2">Reproduction and development of particular fish species</td><td>NO
EL 15</td></tr>
<tr><td rowspan="3">Operationalisation</td><td colspan="2">Measured parameter:
Certain life stages of selected species</td><td colspan="2">Unit:
-</td></tr>
<tr><td colspan="2">Benchmarks:
type specific
Tendency:
as little as possible variation from undisturbed conditions</td><td colspan="2" rowspan="2">Potential classification:
see WFD Annex V</td></tr>
<tr><td colspan="2">Temporal scope:
individual
Spatial scope:
individual</td></tr>
<tr><td>Rational</td><td colspan="4">Rational:
rational to come
References:
CIS Working Group '2.7' (2003), p. 40f</td></tr>
<tr><td>Data enquiry</td><td colspan="4">Enquiry method:
e.g. Breeding experiments
Potential sources of data:
Monitoring programs, inquiery</td></tr>
</table>

Category Subcategory	Hydromorphology and continuity Hydromorphological quality elements supporting the biological elements	ECOLOGICAL
Quality Element	**Hydrological regime**	
Name of indicator:	**Quantity of water flow**	NO **EL 16**

Operationalisation	**Measured parameter:** Quantity of water flow	**Unit:** m3/s
	Benchmarks: type specific **Tendency:** as little as possible variation from undisturbed conditions	**Potential classification:** see WFD Annex V
	Temporal scope: individual **Spatial scope:** individual	
Rational	**Rational:** rational to come **References:** CIS Working Group '2.7' (2003), p. 52f	
Data enquiry	**Enquiry method:** Gaging **Potential sources of data:** Monitoring programs, inquiery	

<table>
<tr><td colspan="2">Category
Subcategory</td><td colspan="2">Hydromorphology and continuity
Hydromorphological quality elements supporting the biological elements</td><td rowspan="2">ECOLOGICAL</td></tr>
<tr><td colspan="2">Quality Element</td><td colspan="2">Hydrological regime</td></tr>
<tr><td colspan="2">Name of indicator:</td><td colspan="2">Dynamics of water flow</td><td>NO
EL 17</td></tr>
<tr><td rowspan="3">Operationalisation</td><td colspan="2">Measured parameter:
Fequency and character of discharge and water level change</td><td colspan="2">Unit:
-</td></tr>
<tr><td colspan="2">Benchmarks:
type specific
Tendency:
as little as possible variation from undisturbed conditions</td><td colspan="2" rowspan="2">Potential classification:
see WFD Annex V</td></tr>
<tr><td colspan="2">Temporal scope:
individual
Spatial scope:
individual</td></tr>
<tr><td>Rational</td><td colspan="4">Rational:
rational to come
References:
CIS Working Group '2.7' (2003), p. 43f</td></tr>
<tr><td>Data enquiry</td><td colspan="4">Enquiry method:
CEN-standard under development, no common method, Expert hudgement
Potential sources of data:
Monitoring programs, inquiery</td></tr>
</table>

Category Subcategory	Hydromorphology and continuity Hydromorphological quality elements supporting the biological elements	ECOLOGICAL
Quality Element	**Hydrological regime**	
Name of indicator:	**Connection to groundwaters**	NO **EL 18**

Operationalisation	**Measured parameter:** Water table height Surface water discharge	**Unit:** m/cm under surface m3/s
	Benchmarks: type specific **Tendency:** as little as possible variation from undisturbed conditions	**Potential classification:** see WFD Annex V
	Temporal scope: individual **Spatial scope:** individual	
Rational	**Rational:** rational to come **References:** CIS Working Group '2.7' (2003), p. 43f, p. 52	
Data enquiry	**Enquiry method:** Depth-volume curves, hypsographic curves, Water level gauge But, no common methodology **Potential sources of data:** Monitoring programs, inquiery	

<table>
<tr><td colspan="2">Category
Subcategory</td><td colspan="2">Hydromorphology and continuity
Hydromorphological quality elements supporting the biological elements</td><td rowspan="2">ECOLOGICAL</td></tr>
<tr><td colspan="2">Quality Element</td><td colspan="2">River Continuity</td></tr>
<tr><td colspan="2">Name of indicator:</td><td colspan="2">Upstream and downstream continuity of river for fish</td><td>NO
EL 19</td></tr>
<tr><td rowspan="3">Operationalisation</td><td colspan="2">Measured parameter:
Number of structural migration barriers
Continuity of single migration barriers
Length of obstructed river sections</td><td colspan="2">Unit:
-
individual
m/km</td></tr>
<tr><td colspan="2">Benchmarks:
Tendency:
as little as possible variation from undisturbed conditions</td><td colspan="2" rowspan="2">Potential classification:
individual</td></tr>
<tr><td colspan="2">Temporal scope:
individual
Spatial scope:
individual</td></tr>
<tr><td>Rational</td><td colspan="4">Rational:
rational to come
References:
-</td></tr>
<tr><td>Data enquiry</td><td colspan="4">Enquiry method:
Counting / mapping
Observation / expert judgement
Mapping
Potential sources of data:
Individual</td></tr>
</table>

Category Subcategory	Hydromorphology and continuity Hydromorphological quality elements supporting the biological elements	ECOLOGICAL
Quality Element	**River Continuity**	
Name of indicator:	**Downstream and upstream continuity of river for benthic invertebrate fauna**	NO **EL 20**

Operationalisation	**Measured parameter:** Number of structural migration barriers Continuity of single migration barriers Length of obstructed river sections	**Unit:** - individual m/km
	Benchmarks: **Tendency:** as little as possible variation from undisturbed conditions	**Potential classification:** individual
	Temporal scope: individual **Spatial scope:** individual	
Rational	**Rational:** rational to come **References:** -	
Data enquiry	**Enquiry method:** Counting / mapping Observation / expert judgement Mapping **Potential sources of data:** Individual	

Category Subcategory	Hydromorphology and continuity Hydromorphological quality elements supporting the biological elements	ECOLOGICAL
Quality Element	**River Continuity**	
Name of indicator:	**Continuity of river for river sediments**	NO **EL 21**

Operationalisation	**Measured parameter:** Number of sediment traps (bariers) Amount of sediment trapped Balance of transported sediments	**Unit:** - m3 -
	Benchmarks: **Tendency:** as little as possible variation from undisturbed conditions	**Potential classification:** individual
	Temporal scope: individual **Spatial scope:** individual	
Rational	**Rational:** rational to come **References:** -	
Data enquiry	**Enquiry method:** Counting / mapping Estimation Calculation **Potential sources of data:** Individual	

<table>
<tr><td colspan="2">Category
Subcategory</td><td colspan="2">Hydromorphology and continuity
Hydromorphological quality elements supporting the biological elements</td><td rowspan="2">ECOLOGICAL</td></tr>
<tr><td colspan="2">Quality Element</td><td colspan="2">Flood plain connectivity (additional to WFD)</td></tr>
<tr><td colspan="2">Name of indicator:</td><td colspan="2">Flooded floodplain ratio</td><td>NO
EL 22</td></tr>
<tr><td rowspan="3">Operationalisation</td><td colspan="2">Measured parameter:
Flooded floodplain area
Total floodplain area</td><td colspan="2">Unit:
-</td></tr>
<tr><td colspan="2">Benchmarks:
type specific
Tendency:
as little as possible variation from undisturbed conditions</td><td colspan="2" rowspan="2">Potential classification:
see WFD Annex V</td></tr>
<tr><td colspan="2">Temporal scope:
individual
Spatial scope:
individual</td></tr>
<tr><td>Rational</td><td colspan="4">Rational:
rational to come
References:
Lorenz C M (1999), p. 101</td></tr>
<tr><td>Data enquiry</td><td colspan="4">Enquiry method:
Flooded floodplain area / total floodplain area
Potential sources of data:
Monitoring programs, inquiery</td></tr>
</table>

Category Subcategory	Hydromorphology and continuity Hydromorphological quality elements supporting the biological elements	ECOLOGICAL
Quality Element	**Flood plain connectivity (additional to WFD)**	
Name of indicator:	**Natural floodplain ratio**	NO **EL 23**

Operationalisation	**Measured parameter:** Area of natural floodplain Total floodplain area	**Unit:** -
	Benchmarks: type specific **Tendency:** as little as possible variation from undisturbed conditions	**Potential classification:** see WFD Annex V
	Temporal scope: individual **Spatial scope:** individual	
Rational	**Rational:** rational to come **References:** Lorenz C M (1999), p. 102	
Data enquiry	**Enquiry method:** Area of natural floodplain / total floodplain area **Potential sources of data:** Monitoring programs, inquiery	

Category Subcategory	Hydromorphology and continuity Hydromorphological quality elements supporting the biological elements	ECOLOGICAL
Quality Element	**Morphological conditions**	
Name of indicator:	**Channel patterns**	NO **EL 24**

Operationalisation	**Measured parameter:** Channel patterns	**Unit:** -
	Benchmarks: type specific **Tendency:** as little as possible variation from undisturbed conditions	**Potential classification:** see WFD Annex V
	Temporal scope: individual **Spatial scope:** individual	
Rational	**Rational:** rational to come **References:** CIS Working Group '2.7' (2003), p. 43f	
Data enquiry	**Enquiry method:** Expert judgement, Rossgen classification But, no common methodology **Potential sources of data:** Monitoring programs, inquiery	

Category Subcategory	Hydromorphology and continuity Hydromorphological quality elements supporting the biological elements	ECOLOGICAL
Quality Element	**Morphological conditions**	
Name of indicator:	**Width variation**	NO **EL 25**

Operationalisation	**Measured parameter:** Width variation	**Unit:** -
	Benchmarks: type specific **Tendency:** as little as possible variation from undisturbed conditions	**Potential classification:** see WFD Annex V
	Temporal scope: individual **Spatial scope:** individual	
Rational	**Rational:** rational to come **References:** CIS Working Group '2.7' (2003), p. 43f	
Data enquiry	**Enquiry method:** No common methodology **Potential sources of data:** Monitoring programs, inquiery	

Category Subcategory	Hydromorphology and continuity Hydromorphological quality elements supporting the biological elements	ECOLOGICAL
Quality Element	**Morphological conditions**	
Name of indicator:	**Depth variation**	NO **EL 26**

Operationalisation	**Measured parameter:** Bed topography	**Unit:** -
	Benchmarks: type specific **Tendency:** as little as possible variation from undisturbed conditions	**Potential classification:** see WFD Annex V
	Temporal scope: individual **Spatial scope:** individual	
Rational	**Rational:** rational to come **References:** CIS Working Group '2.7' (2003), p. 43f, p. 52	
Data enquiry	**Enquiry method:** Sonar device (echosounder), phathometer, Transect methodology with metered sounding poles But, no common methodology **Potential sources of data:** Monitoring programs, inquiery	

<table>
<tr><td>Category
Subcategory</td><td colspan="2">Hydromorphology and continuity
Hydromorphological quality elements supporting the biological elements</td><td rowspan="2">ECOLOGICAL</td></tr>
<tr><td>Quality Element</td><td colspan="2">Morphological conditions</td></tr>
<tr><td>Name of indicator:</td><td colspan="2">Flow velocities</td><td>NO
EL 27</td></tr>
<tr><td rowspan="3">Operationalisation</td><td>Measured parameter:
Flow velocity</td><td colspan="2">Unit:
m/s</td></tr>
<tr><td>Benchmarks:
type specific
Tendency:
as little as possible variation from undisturbed conditions</td><td colspan="2" rowspan="2">Potential classification:
see WFD Annex V</td></tr>
<tr><td>Temporal scope:
individual
Spatial scope:
individual</td></tr>
<tr><td>Rational</td><td colspan="3">Rational:
rational to come
References:
CIS Working Group '2.7' (2003), p. 43f, p. 52</td></tr>
<tr><td>Data enquiry</td><td colspan="3">Enquiry method:
ISO/TC 113 for current velocity, current meter
Potential sources of data:
Monitoring programs, inquiery</td></tr>
</table>

<table>
<tr><td>Category
Subcategory</td><td>Hydromorphology and continuity
Hydromorphological quality elements supporting the biological elements</td><td rowspan="2">ECOLOGICAL</td></tr>
<tr><td>Quality Element</td><td>Morphological conditions</td></tr>
<tr><td>Name of indicator:</td><td>Substrate conditions</td><td>NO
EL 28</td></tr>
</table>

<table>
<tr><td rowspan="3">Operationalisation</td><td>Measured parameter:
Substrate conditions of the river bed, tidal area</td><td>Unit:
to come</td></tr>
<tr><td>Benchmarks:
type specific
Tendency:
as little as possible variation from undisturbed conditions</td><td rowspan="2">Potential classification:
see WFD Annex V</td></tr>
<tr><td>Temporal scope:
individual
Spatial scope:
individual</td></tr>
<tr><td>Rational</td><td colspan="2">Rational:
rational to come
References:
CIS Working Group '2.7' (2003), p. 43f, p. 52</td></tr>
<tr><td>Data enquiry</td><td colspan="2">Enquiry method:
Core and grab samplers
But, no common methodology
Potential sources of data:
Monitoring programs, inquiery</td></tr>
</table>

Category Subcategory	Hydromorphology and continuity Hydromorphological quality elements supporting the biological elements		ECOLOGICAL
Quality Element	**Morphological conditions**		
Name of indicator:	**Degradation / aggradation of river or coastal bed (additional)**		NO **EL 29**
Operationalisation	**Measured parameter:** Average absolute altitude of river bed	**Unit:** m/cm absolute altitude	
	Benchmarks: type specific **Tendency:** as little as possible variation from undisturbed conditions	**Potential classification:** see WFD Annex V	
	Temporal scope: individual **Spatial scope:** individual		
Rational	**Rational:** rational to come **References:** -		
Data enquiry	**Enquiry method:** Survey and mapping **Potential sources of data:** Monitoring programs, inquiery		

<table>
<tr><td>Category
Subcategory</td><td colspan="2">Hydromorphology and continuity
Hydromorphological quality elements supporting the biological elements</td><td rowspan="2">ECOLOGICAL</td></tr>
<tr><td>Quality Element</td><td colspan="2">Morphological conditions</td></tr>
<tr><td>Name of indicator:</td><td colspan="2">Structure and condition of the riparian zone</td><td>NO
EL 30</td></tr>
<tr><td rowspan="3">Operationalisation</td><td>Measured parameter:
Length
Width
Species present, Continuity, Gound cover</td><td colspan="2">Unit:
m
m
-</td></tr>
<tr><td>Benchmarks:
type specific
Tendency:
as little as possible variation from undisturbed conditions</td><td colspan="2" rowspan="2">Potential classification:
see WFD Annex V</td></tr>
<tr><td>Temporal scope:
individual
Spatial scope:
individual</td></tr>
<tr><td>Rational</td><td colspan="3">Rational:
rational to come
References:
CIS Working Group '2.7' (2003), p. 43f, p. 52</td></tr>
<tr><td>Data enquiry</td><td colspan="3">Enquiry method:
Transects, aerial photography, planimetry
But, no common methodology
Potential sources of data:
Monitoring programs, inquiery</td></tr>
</table>

<table>
<tr><td>Category
Subcategory</td><td>Water quality
Chemical and physico-chemical elements supporting the biological elements</td><td rowspan="2">ECOLOGICAL</td></tr>
<tr><td>Quality Element</td><td>General conditions</td></tr>
<tr><td>Name of indicator:</td><td>Nutrient conditions</td><td>NO
EL 31</td></tr>
</table>

<table>
<tr><td rowspan="3">Operationalisation</td><td>Measured parameter:
Total Phosphorus (TP), Total Nitrogene (TN), Soluble Reactive Phosphorus (SRP), NO3 + NO2, NH4</td><td>Unit:
to come</td></tr>
<tr><td>Benchmarks:
type specific
Tendency:
as little as possible variation from undisturbed conditions</td><td rowspan="2">Potential classification:
see WFD Annex V, Trophic states (lakes)</td></tr>
<tr><td>Temporal scope:
individual
Spatial scope:
individual</td></tr>
<tr><td>Rational</td><td colspan="2">Rational:
rational to come
References:
CIS Working Group '2.7' (2003), p. 45f</td></tr>
<tr><td>Data enquiry</td><td colspan="2">Enquiry method:
Sample collection in field followed by laboratory analysis
Potential sources of data:
Monitoring programs, inquiery</td></tr>
</table>

<table>
<tr><td colspan="2">Category
Subcategory</td><td colspan="2">Water quality
Chemical and physico-chemical elements supporting the biological elements</td><td rowspan="2">ECOLOGICAL</td></tr>
<tr><td colspan="2">Quality Element</td><td colspan="2">General conditions</td></tr>
<tr><td colspan="2">Name of indicator:</td><td colspan="2">Level of salinity</td><td>NO
EL 32</td></tr>
<tr><td rowspan="3">Operationalisation</td><td colspan="3">Measured parameter:
Electrical conductivity</td><td>Unit:
µS/cm</td></tr>
<tr><td colspan="2">Benchmarks:
type specific
Tendency:
as little as possible variation from undisturbed conditions</td><td colspan="2" rowspan="2">Potential classification:
see WFD Annex V</td></tr>
<tr><td colspan="2">Temporal scope:
individual
Spatial scope:
individual</td></tr>
<tr><td>Rational</td><td colspan="4">Rational:
rational to come
References:
CIS Working Group '2.7' (2003), p. 45f</td></tr>
<tr><td>Data enquiry</td><td colspan="4">Enquiry method:
In-situ using submersible probe, e.g. Theoprax-Method (http://www.theoprax-research.com/theoprax.pdf, 05/08/17)
Potential sources of data:
Monitoring programs, inquiery</td></tr>
</table>

<table>
<tr><td>Category
Subcategory</td><td>Water quality
Chemical and physico-chemical elements supporting the biological elements</td><td rowspan="2">ECOLOGICAL</td></tr>
<tr><td>Quality Element</td><td>General conditions</td></tr>
<tr><td>Name of indicator:</td><td>Acidification status (Alkalinity)</td><td>NO
EL 33</td></tr>
</table>

<table>
<tr><td rowspan="3">Operationalisation</td><td>Measured parameter:
Alkalinity</td><td>Unit:
pH</td></tr>
<tr><td>Benchmarks:
type specific
Tendency:
as little as possible variation from undisturbed conditions</td><td rowspan="2">Potential classification:
see WFD Annex V</td></tr>
<tr><td>Temporal scope:
individual
Spatial scope:
individual</td></tr>
<tr><td>Rational</td><td colspan="2">Rational:
rational to come
References:
CIS Working Group '2.7' (2003), p. 45f</td></tr>
<tr><td>Data enquiry</td><td colspan="2">Enquiry method:
In-situ using submersible probe
Potential sources of data:
Monitoring programs, inquiery</td></tr>
</table>

<table>
<tr><td colspan="2">Category
Subcategory</td><td colspan="2">Water quality
Chemical and physico-chemical elements supporting the biological elements</td><td rowspan="2">ECOLOGICAL</td></tr>
<tr><td colspan="2">Quality Element</td><td colspan="2">General conditions</td></tr>
<tr><td colspan="2">Name of indicator:</td><td colspan="2">Oxygenation conditions</td><td>NO
EL 34</td></tr>
<tr><td rowspan="3">Operationalisation</td><td colspan="2">Measured parameter:
Concentration of dissolved O2</td><td colspan="2">Unit:
mg/L, %sat</td></tr>
<tr><td colspan="2">Benchmarks:
type specific
Tendency:
as little as possible variation from undisturbed conditions</td><td colspan="2" rowspan="2">Potential classification:
see WFD Annex V</td></tr>
<tr><td colspan="2">Temporal scope:
individual
Spatial scope:
individual</td></tr>
<tr><td>Rational</td><td colspan="4">Rational:
rational to come
References:
CIS Working Group '2.7' (2003), p. 45f</td></tr>
<tr><td>Data enquiry</td><td colspan="4">Enquiry method:
In-situ using submersible probe, or sample collection and Winklers titration
Potential sources of data:
Monitoring programs, inquiery</td></tr>
</table>

<table>
<tr><td>Category
Subcategory</td><td>Water quality
Chemical and physico-chemical elements supporting the biological elements</td><td rowspan="2">ECOLOGICAL</td></tr>
<tr><td>Quality Element</td><td>General conditions</td></tr>
<tr><td>Name of indicator:</td><td>Acid neutralising capacity (ANC)</td><td>NO
EL 35</td></tr>
</table>

<table>
<tr><td rowspan="3">Operationalisation</td><td>Measured parameter:
Acid neutralising capacity (ANC)</td><td>Unit:
DH</td></tr>
<tr><td>Benchmarks:
type specific
Tendency:
as little as possible variation from undisturbed conditions</td><td rowspan="2">Potential classification:
see WFD Annex V</td></tr>
<tr><td>Temporal scope:
individual
Spatial scope:
individual</td></tr>
<tr><td>Rational</td><td colspan="2">Rational:
rational to come
References:
CIS Working Group '2.7' (2003), p. 45f</td></tr>
<tr><td>Data enquiry</td><td colspan="2">Enquiry method:
In-situ using submersible probe
Potential sources of data:
Monitoring programs, inquiery</td></tr>
</table>

<table>
<tr><td colspan="2">Category
Subcategory</td><td>Water quality
Chemical and physico-chemical elements supporting the biological elements</td><td rowspan="2">ECOLOGICAL</td></tr>
<tr><td colspan="2">Quality Element</td><td>General conditions</td></tr>
<tr><td colspan="2">Name of indicator:</td><td>Transparency</td><td>NO
EL 36</td></tr>
<tr><td rowspan="3">Operationalisation</td><td colspan="2">Measured parameter:
Secchi depth
Turbidity
Colour</td><td>Unit:
m/cm</td></tr>
<tr><td colspan="2">Benchmarks:
type specific
Tendency:
as little as possible variation from undisturbed conditions</td><td rowspan="2">Potential classification:
see WFD Annex V
for rivers also see BWD</td></tr>
<tr><td colspan="2">Temporal scope:
individual
Spatial scope:
individual</td></tr>
<tr><td>Rational</td><td colspan="3">Rational:
rational to come
References:
CIS Working Group '2.7' (2003), p. 55f</td></tr>
<tr><td>Data enquiry</td><td colspan="3">Enquiry method:
In situ using Secchi disc
TSS: field sample collection followed by laboratory analysis
Turbidity: in situ turbidimeters, nephelometers
Colour: in situ comparison to Forel-Ule scale or in lab.
Potential sources of data:
Monitoring programs, inquiery</td></tr>
</table>

<table>
<tr><td>Category
Subcategory</td><td>Water quality
Chemical and physico-chemical elements supporting the biological elements</td><td rowspan="2">ECOLOGICAL</td></tr>
<tr><td>Quality Element</td><td>General conditions</td></tr>
<tr><td>Name of indicator:</td><td>Thermal condition</td><td>NO
EL 37</td></tr>
<tr><td rowspan="3">Operationalisation</td><td>Measured parameter:
Water temperature</td><td>Unit:
C</td></tr>
<tr><td>Benchmarks:
type specific
Tendency:
as little as possible variation from undisturbed conditions</td><td rowspan="2">Potential classification:
see WFD Annex V</td></tr>
<tr><td>Temporal scope:
individual
Spatial scope:
individual</td></tr>
<tr><td>Rational</td><td colspan="2">Rational:
rational to come
References:
CIS Working Group '2.7' (2003), p. 45f; p. 55</td></tr>
<tr><td>Data enquiry</td><td colspan="2">Enquiry method:
In-situ using submersible probe; In situ using thermistor probes or reversing type Hg thermometer
Potential sources of data:
Monitoring programs, inquiery</td></tr>
</table>

Category Subcategory	Water quality Chemical and physico-chemical elements supporting the biological elements	ECOLOGICAL
Quality Element	**Specific synthetic pollutants**	
Name of indicator:	**Concentrations of hazardous synthetic substances**	NO **EL 38**

Operationalisation	**Measured parameter:** Concentrations of WFD priority list substances Other synthetic substance depending on catchment pressures	**Unit:** µg/L, mg/L
	Benchmarks: type specific **Tendency:** as little as possible variation from undisturbed conditions	**Potential classification:** see WFD Annex V
	Temporal scope: individual **Spatial scope:** individual	
Rational	**Rational:** rational to come **References:** -	
Data enquiry	**Enquiry method:** Sample collection in field followed by laboratory analysis using e.g. AAS (Atom-Absorbing Spectrometer) **Potential sources of data:** Monitoring programs, inquiery	

Category Subcategory	Water quality Chemical and physico-chemical elements supporting the biological elements	ECOLOGICAL
Quality Element	**Specific non-synthetic pollutants**	
Name of indicator:	**Concentrations of hazardous non-synthetic pollutants**	NO **EL 39**

Operationalisation

Measured parameter:

Concentrations of selected non-synthetic substances

Other synthetic substance depending on catchment pressures

Unit:

µg/L, mg/L

Benchmarks:

type specific

Tendency:

as little as possible variation from undisturbed conditions

Potential classification:

see WFD Annex V

Temporal scope:

individual

Spatial scope:

individual

Rational

Rational:

rational to come

References:

-

Data enquiry

Enquiry method:

Sample collection in field followed by laboratory analysis using e.g. AAS (Atom-Absorbing Spectrometer)

Potential sources of data:

Monitoring programs, inquiery

<table>
<tr><td>Category
Subcategory</td><td>Water quality
Additional water related</td><td rowspan="2">ECOLOGICAL</td></tr>
<tr><td>Quality Element</td><td>Ecological functioning</td></tr>
<tr><td>Name of indicator:</td><td>Self-cleanign capacity</td><td>NO
EL 40</td></tr>
</table>

<table>
<tr><td rowspan="3">Operationalisation</td><td>Measured parameter:
Concentrations of selected nutrients (assimilation of nutrients/change in nutrient load)</td><td>Unit:
mg/L</td></tr>
<tr><td>Benchmarks:
type specific
Tendency:
as little as possible variation from undisturbed conditions</td><td rowspan="2">Potential classification:
see WFD Annex V</td></tr>
<tr><td>Temporal scope:
individual
Spatial scope:
individual</td></tr>
<tr><td>Rational</td><td colspan="2">Rational:
rational to come
References:
cf. Lorenz C M (1999), p. 99</td></tr>
<tr><td>Data enquiry</td><td colspan="2">Enquiry method:
Nutrient input in river section / nutrient output from river section
Potential sources of data:
Monitoring programs, inquiery</td></tr>
</table>

<table>
<tr><td colspan="2">Category
Subcategory</td><td colspan="2">Nature conservation
Nature conservation</td><td rowspan="2">ECOLOGICAL</td></tr>
<tr><td colspan="2">Quality Element</td><td colspan="2">Nature conservation value</td></tr>
<tr><td colspan="2">Name of indicator:</td><td colspan="2">Nature conservation value</td><td>NO
EL 41</td></tr>
<tr><td rowspan="3">Operationalisation</td><td colspan="2">Measured parameter:
Value for the affected area for nature conservation</td><td colspan="2">Unit:
-</td></tr>
<tr><td colspan="2">Benchmarks:
case specific
Tendency:
stabile / increasing</td><td colspan="2" rowspan="2">Potential classification:
Individual</td></tr>
<tr><td colspan="2">Temporal scope:
individual
Spatial scope:
individual</td></tr>
<tr><td>Rational</td><td colspan="4">Rational:
rational to come
References:
?</td></tr>
<tr><td>Data enquiry</td><td colspan="4">Enquiry method:
to come
Potential sources of data:
measuring</td></tr>
</table>

Category Settings	Existing Conditions and Quality of River and River Site	SOCIAL
Subcategory	Public Accessibility to River and River Site	
Quality Element	**Access from City to River Site**	
Name of indicator:	**Soft Mode Access Barriers**	NO: **S 1**

Operationalisation

Measured parameter:

1) Length of barriers cutting of access from residential areas to river site or river/ length of river section

2) Number of people in the catchment area having to barriers to reach the river site/Number of inhabitants in river corridor

Unit:

%

Benchmarks:

individual

Tendency:

stable or decreasing

Temporal scope:

with implementation

Spatial scope:

River site and adjacent neighbourhood

Potential classification:

individual

Rational

Rational:

The more access barriers exist, the less people are able and willing to access the site. Potential barriers to be considered include major roads, industrial or non-residential areas, gates or styles which are difficult to traverse, pathways hardly to cross in bad weather.

References:

Silva et. al. (2003) URBEM - Classification of the aesthetic value of the selected urban rivers – Methodology – Deliverable 4.2., CESUR-IST/UTL, Portugal

PAGE C (1997) Predicting the Social Impacts of Restoration in an Urban Park. In: Yale F&ES Bulletin, p. 100 et seqq. Found at: www.yale.edu/environment/publications/ bulletin/100pdfs/100page.pdf

IOER (2003) Urban Green Environment (URGE). A framework for assessing the quality of urban green environments. Institute of Ecological and Regional Planning Dresden, 2003, unpublished (?)

Data enquiry

Enquiry method:

On site visit

Desk study

Potential sources of data:

Aerial pictures, topographical maps

Application

Application and Applicability:

The indicator will easy to be assessed, if GIS data of the site exists, but it is also easily to be assessed through an on site visit. It should be assessed if recreational use of the site is of importance.

Relation to other Indicators:

Reverse to Access Points for Soft Modes (S 4)

Example

Category Settings Subcategory	Existing Conditions and Quality of River and River Site Public Accessibility to River and River Site	SOCIAL
Quality Element	**Access from City to River Site**	
Name of indicator:	**Parking Lots**	NO: **S 2**

Operationalisation

Measured parameter:

1) Available parking lots per river length

2) Number of parking lots related to number of visitors coming by car

Unit:

1) number/ km

2) n/ visitor

Benchmarks:

1) best achievable minimum

2) 0,5 - 0,25 (URGE)

Tendency:

individual

Potential classification:

individual

Temporal scope:

with implementation

Spatial scope:

River site and adjacent neighbourhood

Rational

Rational:

Reduction of parking lots may forces people to use public transportation and may decreases quantity of private traffic. In turn this may reduces noise and air pollution close at the site.

References:

Silva et. al. (2003) URBEM - Classification of the aesthetic value of the selected urban rivers – Methodology – Deliverable 4.2., CESUR-IST/UTL, Portugal

IOER (2003) Urban Green Environment (URGE). A framework for assessing the quality of urban green environments. Institute of Ecological and Regional Planning Dresden, 2003, unpublished (?)

Data enquiry

Enquiry method:

On site visit, desk study

Potential sources of data:

Aerial pictures, tourist service, city planning department

Application

Application and Applicability:

Only relevant if river site has a city wide importance and a big percentage of visitors are likely to access the site by car. The need for parking lots will be influenced by the availability of public transportation. In general number of parking lots may be kept as small as possible.

Relation to other Indicators:

influenced by Indicator Public Transportation Stops (S3)

Example

<table>
<tr><td colspan="2">Category Settings</td><td colspan="2">Existing Conditions and Quality of River and River Site</td><td rowspan="3">SOCIAL</td></tr>
<tr><td colspan="2">Subcategory</td><td colspan="2">Public Accessibility to River and River Site</td></tr>
<tr><td colspan="2">Quality Element</td><td colspan="2">Access from City to River Site</td></tr>
<tr><td colspan="2">Name of indicator:</td><td colspan="2">Public Transportation Stops (PTS)</td><td>NO: S 3</td></tr>
<tr><td rowspan="3">Operationalisation</td><td colspan="2">Measured parameter:
1) Number of Public Transportation Stops/river length
2) Average frequency of stops per hour (at weekends)/river length</td><td colspan="2">Unit:
1) number/km
2) average number/hour /km</td></tr>
<tr><td colspan="2">Benchmarks:
individual
Tendency:
stable or increasing</td><td colspan="2" rowspan="2">Potential classification:
individual</td></tr>
<tr><td colspan="2">Temporal scope:
with implementation
Spatial scope:
River site and adjacent neighbourhood</td></tr>
<tr><td>Rational</td><td colspan="4">Rational:
A high density of public transportation and a high frequency of stops increases attractiveness to use public transportation, instead of a car to reach the site. Public transportation is especially important for user groups with limited mobility abilities (elderly, children and others).
References:
Silva et. al. (2003) URBEM - Classification of the aesthetic value of the selected urban rivers – Methodology – Deliverable 4.2., CESUR-IST/UTL, Portugal
IOER (2003) Urban Green Environment (URGE). A framework for assessing the quality of urban green environments. Institute of Ecological and Regional Planning Dresden, 2003, unpublished (?)</td></tr>
<tr><td>Data enquiry</td><td colspan="4">Enquiry method:
1) On site visit, desk study
2) Calculation: number of public transportation stops times average frequency of stops
Potential sources of data:
Public transportation companies, schedules of public transportation</td></tr>
<tr><td>Application</td><td colspan="4">Application and Applicability:
The indicator may only be relevant, where river and river site have a high importance for recreational use. In addition to the quantitative assessment of public transportation, a qualitative appraisal of accessibility by public transportation may be conducted, considering the connection to other city centres, dense settlement areas etc.
Relation to other Indicators:</td></tr>
<tr><td>Example</td><td colspan="4"></td></tr>
</table>

Category Settings	Existing Conditions and Quality of River and River Site	SOCIAL
Subcategory	Accessibility	
Quality Element	**Access from City to River Site**	
Name of indicator:	**Access Points for Soft Modes**	NO: **S 4**

Operationalisation

Measured parameter:

Access points to river site / river length

Unit:

n/km

Benchmarks:

Minimum: 2 - 4/km

URGE: one entrance per 100 m edge length of river corridor

Tendency:

stable or increasing

Temporal scope:

with implementation

Spatial scope:

River site and adjacent neighbourhood

Potential classification:

< 6/km very good

5-6/km good

2-4/km acceptable

> 2/km unacceptable

Rational

Rational:

The more access points to the river site exist, the easier it is accessible. A low number of access points may control accessibility and function as a indirect measure to control the number of visitors. This may be relevant for ecological sensitive areas.

References:

IOER (2003) Urban Green Environment (URGE). A framework for assessing the quality of urban green environments. Institute of Ecological and Regional Planning Dresden, 2003, unpublished (?)

Data enquiry

Enquiry method:

On site visit, desk study

Potential sources of data:

Arial pictures, topographical maps

Application

Application and Applicability:

Access points determined based on topographical maps should be verified on site. Quality of access points may be taken into account and evaluated.

Relation to other Indicators:

Reverse to Soft Mode Access Barriers (S 1)

Example

<table>
<tr><td>Category
Settings
Subcategory</td><td>Existing Conditions and Quality of River and River Site

Public Accessibility to River and River Site</td><td rowspan="2">SOCIAL</td></tr>
<tr><td>Quality Element</td><td>Physical Access to the Water</td></tr>
<tr><td>Name of indicator:</td><td>Water Contact Zones</td><td>NO: S 5</td></tr>
</table>

<table>
<tr><td rowspan="3">Operationalisation</td><td>Measured parameter:
a) Access points to water / river length
b) Direct (touchable) accessible reach of river / river length</td><td>Unit:
1) number (per type) / km
2) km/km, %</td></tr>
<tr><td>Benchmarks:
1) individual
2) 100 or achievable maximum %
Tendency:
stable or increasing</td><td rowspan="2">Potential classification:
individual</td></tr>
<tr><td>Temporal scope:
with implementation
Spatial scope:
River</td></tr>
<tr><td>Rational</td><td colspan="2">Rational:
Water Contact Zones enable sensorial interaction with the water. This may include visual, physical and acoustic contact. Contact points may include soft access over graded banks or hard access over steps, bridges, ladders ramps, stairs, and piers and others. Continuous pathways along the water may be included in the assessment. For a typology of contact zones with water, see Silva et. al. (2003), p. 49.
References:
Silva et. al. (2003) URBEM - Classification of the aesthetic value of the selected urban rivers – Methodology – Deliverable 4.2., CESUR-IST/UTL, Portugal</td></tr>
<tr><td>Data enquiry</td><td colspan="2">Enquiry method:
On site visit, desk study
Potential sources of data:
Arial pictures, topographical maps</td></tr>
<tr><td>Application</td><td colspan="2">Application and Applicability:
Depending on the physical layout of the site either parameter 1) or 2) may be more relevant. It is an easily accessible indicator through on site visits or even interpretation of aerial pictures. Assessment may be done by volunteers.
Relation to other Indicators:
Anchorage points (S 6), River Crossings (S 8) may be a part of the indicator
Indicator may also be part of subcategory Sensorial Conditions</td></tr>
<tr><td>Example</td><td colspan="2"></td></tr>
</table>

Category Settings Subcategory	Existing Conditions and Quality of River and River Site Public Accessibility to River and River Site	SOCIAL
Quality Element	**Access from River to Site**	
Name of indicator:	**Anchorage Points**	NO: **S 6**

Operationalisation	**Measured parameter:** Number of anchorage points (for water transport purposes) / length (in Km) of	**Unit:** n/km
	Benchmarks: individual **Tendency:** increase or stable	**Potential classification:** individual
	Temporal scope: with implementation - long term **Spatial scope:** River	
Rational	**Rational:** The number of exiting anchorage points reflects the degree of accessibility from the river to the site. Depending on the type of anchorage points, the number of people accessing or leaving the site will vary. Anchorage points to consider include anchorage places, docks, floating piers and others. **References:** Silva et. al. (2003) URBEM - Classification of the aesthetic value of the selected urban rivers – Methodology – Deliverable 4.2., CESUR-IST/UTL, Portugal	
Data enquiry	**Enquiry method:** On site visit, desk study **Potential sources of data:** Arial pictures, topographical maps	
Application	**Application and Applicability:** It is an easily to enquire indicator for navigable rivers. It may be used as a proxy indicator, if passenger boat capacity (S 7) is not readily available and cannot be feasibly enquired. **Relation to other Indicators:** Passenger Boat Capacity (S 7) may be a part of the indicator Water Contact Zones (S 5)	
Example		

Category Settings	Existing Conditions and Quality of River and River Site	SOCIAL
Subcategory	Public Accessibility to River and River Site	
Quality Element	**Access from River to Site**	
Name of indicator:	**Passenger Boat Capacity**	NO: **S 7**

Operationalisation	**Measured parameter:** Average passenger capacity of boats docking at the site per season / river length	**Unit:** people/season/km
	Benchmarks: individual **Tendency:** individual	**Potential classification:** number of passengers per day or season
	Temporal scope: with implementation **Spatial scope:** River	
Rational	**Rational:** Passenger boat capacity reflects potential accessibility of the site for people. The higher the passenger boat capacity per season the more people will be able to access the site from the river. **References:**	
Data enquiry	**Enquiry method:** frequency of boats docking at the site times passenger capacity **Potential sources of data:** boat companies, boat owners	
Application	**Application and Applicability:** The indicator will only be applicable at river sites, where boat traffic or ferries play a major role for transport of people. **Relation to other Indicators:** Anchorage points (S 6)	
Example		

Category Settings	Existing Conditions and Quality of River and River Site	SOCIAL
Subcategory	Public Accessibility to River and River Site	
Quality Element	**River Crossings**	
Name of indicator:	**River Crossings**	NO: **S 8**

Operationalisation

Measured parameter:

1) Number of crossings / river length

2) Number of soft mode crossings / river length

Unit:

number/km

Benchmarks:

individual

Tendency:

stable or increase

Potential classification:

individual

Temporal scope:

with implementation

Spatial scope:

River site

Rational

Rational:

Accessibility of both river sites will increases with the number of possible crossings and the river will become more of a connecting than a dividing element in the city structure. A high number of pedestrian bridges increases accessibility of surrounding facilities through decreasing walking distances.

References:

Silva et. al. (2003) URBEM - Classification of the aesthetic value of the selected urban rivers – Methodology – Deliverable 4.2., CESUR-IST/UTL, Portugal

Data enquiry

Enquiry method:

On site visit, desk study

Potential sources of data:

Arial pictures, topographical maps

Application

Application and Applicability:

Indicator is easily to enquire. An increase of river width and a lower density of inhabitant in the river corridor correlates to a lower number of river crossings.

Relation to other Indicators:

may be a part of the indicator Water Contact Zones (S 5)

Example

Category Settings	Existing Conditions and Quality of River and River Site	SOCIAL
Subcategory	Open Space Extend and Quality	
Quality Element	**Extend of Open Space**	
Name of indicator:	**Public Utility of River Site**	NO: **S 9**

Operationalisation

Measured parameter:

area of public open areas/overall area of intervention site

Unit:

km2/km2, %

Benchmarks:

individual

Tendency:

stable or increase

Temporal scope:

with implementation, long term

Spatial scope:

Intervention area/ river corridor

Potential classification:

> 80 % very good

60 - 80 % good

40 - 60 % acceptable

< 40 % unacceptable

Rational

Rational:

A high ratio means that there is a non-restricted access to the watercourse in benefit of people.

References:

Silva et. al. (2003) URBEM - Classification of the aesthetic value of the selected urban rivers – Methodology – Deliverable 4.2., CESUR-IST/UTL, Portugal

Data enquiry

Enquiry method:

Desk study

Potential sources of data:

Topographical maps, land registry offices

Application

Application and Applicability:

The indicator is easy accessible if a GIS System exists. It may be used as a proxy indicator for the Subcategory Accessibility. In addition to the quantitative assessment a qualitative assessment of the public open areas may be done. This will be assessed by the quality element Quality of Open Space.

Relation to other Indicators:

as proxy indicator for sub-category Accessibility, integral part of Carrying capacity

Example

Category Settings Subcategory	Existing Conditions and Quality of River and River Site Open Space Extend and Quality	SOCIAL
Quality Element	**Extend of Open Space**	
Name of indicator:	**Carrying Capacity of Public Open Space**	NO: **S 10**

Operationalisation

Measured parameter:

size of green public assessable area related to inhabitants of catchment area

Unit:

in Germany the suggested value equals 6 m2 of green public open space /inhabitant

Benchmarks:

6m2/inhabitant (Germany)

Tendency:

individual

Potential classification:

individual

Temporal scope:

with implementation, long term

Spatial scope:

Intervention area/ river corridor

Rational

Rational:

To avoid unpleasant experience and an ecological degradation of the river and river site it will be important to access the carrying capacity, the amount of people or the intensity of use, a place can carry to renew itself or maintain its state.

References:

LYNCH K, HACK G (1998) Site Planning. Third edition. MIT Press, Cambridge, Massachusetts and London, England

Data enquiry

Enquiry method:

Desk study:

area of public open space in the river corridor / inhabitant of the river corridor = target value of available public open space per inhabitant

Potential sources of data:

City Planning Department

Application

Application and Applicability:

Only relevant if an over use of the site is anticipated.

Relation to other Indicators:

Public Utility of River site (S 9)

Example

<table>
<tr><td>Category
Settings
Subcategory</td><td>Existing Conditions and Quality of River and River Site

Open Space Extend and Quality</td><td rowspan="2">SOCIAL</td></tr>
<tr><td>Quality Element</td><td>Visual and spatial quality</td></tr>
<tr><td>Name of indicator:</td><td>Landmarks</td><td>NO: S 11</td></tr>
</table>

<table>
<tr><td rowspan="3">Operationalisation</td><td>Measured parameter:
1) Number of landmarks visible from intervention area
2) Number of landmarks visible from intervention area/river length</td><td>Unit:
1) n
2) n/km</td></tr>
<tr><td>Benchmarks:
individual
Tendency:
stable or increase number</td><td rowspan="2">Potential classification:
individual</td></tr>
<tr><td>Temporal scope:
with implementation, long term
Spatial scope:
Landmarks visible from river site or intervention area</td></tr>
<tr><td>Rational</td><td colspan="2">Rational:
Landmarks are remarkable points in the landscape of the river corridor, which provide for orientation and identification with the site. Landmarks may include architectural points such as prominent landforms, structures, monuments or architecture.
References:
Silva et. al. (2003) URBEM - Classification of the aesthetic value of the selected urban rivers – Methodology – Deliverable 4.2., CESUR-IST/UTL, Portugal
LYNCH K, HACK G (1998) Site Planning. Third edition. MIT Press, Cambridge, Massachusetts and London, England</td></tr>
<tr><td>Data enquiry</td><td colspan="2">Enquiry method:
On site visit, desk study
Potential sources of data:</td></tr>
<tr><td>Application</td><td colspan="2">Application and Applicability:
The assessment may require some mapping experience. An onsite visit has to be combined with analysis of maps, to determine landmarks potentially visible from the site after implementation of the project.
Relation to other Indicators:
influences Quality Element Perception of Place Identity</td></tr>
<tr><td>Example</td><td colspan="2"></td></tr>
</table>

Category Settings	Existing Conditions and Quality of River and River Site	SOCIAL
Subcategory	Cultural components	
Quality Element	**Spatial Qualities of Open Space**	
Name of indicator:	**Viewpoints**	NO: **S 12**

Operationalisation

Measured parameter:

Number of viewpoints with views to or crossing the river/ river length

Unit:

n/km

Benchmarks:

individual

Tendency:

stable or increase

Potential classification:

individual

Temporal scope:

with implementation, long term

Spatial scope:

Intervention area

Rational

Rational:

Viewpoints with view to and across the river increase interest for the river corridor, raise connectivity with the city fabric and therefore increase integration of the site. Views stimulate curiosity and a sense of exploration. It stimulates emotional experience of the site. Assessment may include viewing points with vistas, panoramas and with overviews.

References:

Silva et. al. (2003) URBEM - Classification of the aesthetic value of the selected urban rivers – Methodology – Deliverable 4.2., CESUR-IST/UTL, Portugal

Data enquiry

Enquiry method:

On site visit, desk study

Potential sources of data:

Arial pictures, topographical maps, existing 3D-models

Application

Application and Applicability:

View points should be considered in the intervention area (where they are likely to change in number). A consideration of viewpoints in the river corridor may be done. Those may be impacted through spatial changes in the intervention area.

Relation to other Indicators:

will influence Subcategory Perception of Site

Example

Category Settings	Existing Conditions and Quality of River and River Site	SOCIAL
Subcategory	Open Space Extend and Quality	
Quality Element	**Sensorial Qualities of Open Space**	
Name of indicator:	**Noise Pollution**	NO: **S 13**

Operationalisation

Measured parameter:

1) noise level

2) amount of cars passing by per time unit

Unit:

1) decibel

2) cars/time

Benchmarks:

1) In residential areas at day 55-45 dB, at night 40-35 dB (Germany)

2) individual

Tendency:

1) decrease

2) individual

Potential classification:

1) For recreational purposes at day

< 45 very good

45 - 50 good

50 - 60 acceptable

> 60 - 65 unacceptable

2) cars related to dB?

Temporal scope:

during implementation/short

Spatial scope:

Intervention area

Rational

Rational:

It is assumed that riverfronts in the past have often been used as "natural" traffic corridors. Bank stabilisation and realignment measures are often combined with the re-alignment of roads and other communication infrastructure. A decrease in traffic noise emmission will have positive effects on the liveability of the surrounding neighbourhood and the sensorial experience at the site. Reduced noise emission will reduce the stress level. Other sources of noise such as industry etc. may be considered.

References:

Data enquiry

Enquiry method:

1) Measurement of the noise level in intervention area, especially where recreational functions are proposed and a interference with noise emission can be expected

2) Estimation of noise level based on count of cars (number of cars - db?)

Potential sources of data:

Street planning department, Environmental Agencies

Application

Application and Applicability:

1) Requires technical equipment and experience with the measurement.

2) Easy to enquire in an onsite survey, but only Proxy measure for above mentioned measurement

Relation to other Indicators:

influences Quality element Restorative capacity

Example

<table>
<tr><td colspan="2">Quality Element Sensorial Qualities of Open Space</td><td></td></tr>
<tr><td colspan="2">Name of indicator: Width of River Site</td><td>NO: S 14</td></tr>
<tr><td rowspan="3">Operationalisation</td><td>Measured parameter:
average width of river site in the intervention area</td><td>Unit:
meter</td></tr>
<tr><td>Benchmarks:
as wide as possible
Tendency:
increase</td><td rowspan="2">Potential classification:
individual</td></tr>
<tr><td>Temporal scope:
with project
Spatial scope:
River site</td></tr>
<tr><td>Rational</td><td colspan="2">Rational:
The wider the (green) river site the less important are edge effects from urban pressures (traffic noise etc.). Aversion experience will decrease and potential restorative capacity of site will be increased.
References:
IOER (2003) Urban Green Environment (URGE). A framework for assessing the quality of urban green environments. Institute of Ecological and Regional Planning Dresden, 2003, unpublished (?)</td></tr>
<tr><td>Data enquiry</td><td colspan="2">Enquiry method:
On site visit, desk study
Potential sources of data:
Arial pictures, topographical maps</td></tr>
<tr><td>Application</td><td colspan="2">Application and Applicability:
It is an easily to enquire indicator. It may be used as a proxy measure for the whole quality element Sensorial Qaulities of Open Space.
Relation to other Indicators:
influences Quality element Restorative capacity</td></tr>
<tr><td>Example</td><td colspan="2"></td></tr>
</table>

Category Settings Subcategory	Existing Conditions and Quality of River and River Site Quality and Extend of Recreational and Cultural Facilities	SOCIAL
Quality Element	**Quality and Amount of Recreational Facilities**	
Name of indicator:	**Recreational Facilities**	NO: **S 15**

Operationalisation	**Measured parameter:** number of recreational facilities / river length or river side area	**Unit:** number/ km or km2
	Benchmarks: individual **Tendency:** stable or increasing, for ecological sensitive areas eventually decreasing	**Potential classification:** individual
	Temporal scope: with project **Spatial scope:** River site	
Rational	**Rational:** A diversity of recreational facilities will provide for different user groups. This indicator will consider punctual elements and may include playgrounds, sitting areas, bars, restaurants, museum, sport centre etc. **References:**	
Data enquiry	**Enquiry method:** On site visit, desk study **Potential sources of data:** aerial pictures	
Application	**Application and Applicability:** The indicator does not say anything about the use of the provided facilities, therefore it may be accessed in combination with Recreational Activities. **Relation to other Indicators:** influences Visitor Frequency (S 36), Recreational Activities (S 37)	
Example		

Category Settings	Existing Conditions and Quality of River and River Site	SOCIAL
Subcategory	Quality and Extend of Recreational and Cultural Facilities	
Quality Element	**Quality and Amount of Recreational Facilities**	
Name of indicator:	**Recreational Paths**	NO: **S 16**

Operationalisation

Measured parameter:

length of paths/ river length

Unit:

km/km, %

Benchmarks:

approximately 1 or 100% (continuous pathway)

Tendency:

stable or increase

Potential classification:

individual

Temporal scope:

with implementation

Spatial scope:

River site

Rational

Rational:

This indicator will considers linear elements used for recreational purposes and may include biking, walking, riding trails etc. Continuous pathways along the river increase the recreational usability of the site.

References:

Data enquiry

Enquiry method:

On site visit, desk study

Potential sources of data:

Arial pictures, topographical maps

Application

Application and Applicability:

The indicator is easily to enquire. The indicator does not say anything about the use of the provided facilities, therefore it may be accessed in combination with Recreational Activities.

Relation to other Indicators:

influences Visitor Frequency (S 36), Recreational Activities (S 37)

may be part of Water Contact Zones (S 5)

Example

Category Settings Subcategory	Existing Conditions and Quality of River and River Site Quality and Extend of Recreational and Cultural Facilities	SOCIAL
Quality Element	**Sites of Cultural Events**	
Name of indicator:	**Cultural Events**	NO: **S 17**

Operationalisation

Measured parameter:

1) number of continuous events related to the river/year

2) number of single events related to the river/year

Unit:

n/year

Benchmarks:

individual

Tendency:

stable or increase

Potential classification:

individual

Temporal scope:

short - long term

Spatial scope:

River site

Rational

Rational:

Local events in connection to the river or river site create temporary contact zones for people, may promote place identity, awareness and stewardship. The number of events may depend on size of river, importance of site and resident density. Events to be considered include boat races, paddling tours, fishing competitions, markets any festivals related to the river etc.

References:

Data enquiry

Enquiry method:

Potential sources of data:

local calendars, neighbourhood councils, interest groups, city administration

Application

Application and Applicability:

The indicator is easily to enquire. It may only be applicable for rivers of bigger size.

Relation to other Indicators:

influences Visitor Frequency (S 36), Recreational Activities (S 37)

Example

Category Settings	Existing Conditions and Quality of River and River Site	SOCIAL
Subcategory	Quality and Extend of Recreational and Cultural Facilities	
Quality Element	**Heritage Sites**	
Name of indicator: **Integration of Cultural Heritage and Cultural Assets**		NO: **S 18**

Operationalisation	**Measured parameter:** 1) proportion of relevant historical and cultural assets onsite integrated into urban life 2) Amount and attractiveness of Heritage sites/river length	**Unit:** %
	Benchmarks: 80 - 100% **Tendency:** stable or increase	**Potential classification:** individual
	Temporal scope: short - long term, later integration may be a result of a rehabilitation project **Spatial scope:** River site or River Corridor	
Rational	**Rational:** Integrated cultural and heritage increase the attractiveness of the site, provides for a better understanding of local history and increases the local identity. They provide an economic resource through attracting visitors and residents to the river site. Historical sites may include water mills, industrial buildings, gardens, castles and so on. **References:**	
Data enquiry	**Enquiry method:** **Potential sources of data:** conservation departments, local administration	
Application	**Application and Applicability:** If information is not readily available local historians may be a helpful source of information. **Relation to other Indicators:** influences Distinctiveness (S 26), Continuity (S 27), Fascination (S 30)	
Example		

Category Settings	Existing Conditions and Quality of River and River Site	SOCIAL
Subcategory	Incidents and Provisions for Public Health and Safety	
Quality Element	**Accidents and Health related Incidents**	
Name of indicator:	**Accidents**	NO: **S 19**

Operationalisation	**Measured parameter:** 1) average number of people injured through floods/year 3) number of accidents caused trough recreational use/year	**Unit:** 1) n/year 2) n 3) n/year
	Benchmarks: 1) and 3) city or adjacent neighbourhood average **Tendency:** as low as possible	**Potential classification:** individual
	Temporal scope: short-middle term **Spatial scope:** River site	
Rational	**Rational:** A decreasing number of accidents with causalities or injuries reflects an increased provision for safety and/or a higher risk awareness of people. **References:**	
Data enquiry	**Enquiry method:** Desk study **Potential sources of data:** accident statistics, nearby hospitals, city administration	
Application	**Application and Applicability:** Indicator will only be relevant for bigger rivers with recreational use or for rivers with a high flooding risk. Information may not be easily accessible, because data is seldom assessed on a local scale. **Relation to other Indicators:** Flood Risk, Fear of hazardous floods	
Example		

Category Settings Subcategory	Existing Conditions and Quality of River and River Site Incidents and Provisions for Public Health and Safety	SOCIAL
Quality Element	**Provisions for Public Health and Safety**	
Name of indicator:	**Flood Risk**	NO: **S 20**

Operationalisation	**Measured parameter:** 1) statistic (mean) return period, where no damage occurs 2) potentially affected persons during a certain flood event	**Unit:** 1) 1/x year 2) n
	Benchmarks: depending on national and local regulations and the need protection requirement of adjacent land uses flood control targets may vary from 30 year to 300 year return period. **Tendency:** increase, where property and life has to be protected	**Potential classification:** individual
	Temporal scope: short - long term **Spatial scope:** River site and eventually downstream of the intervention site	
Rational	**Rational:** The lower the risk for flooding, the higher the safety for the settlement areas and the better the protection of public health and safety. **References:** IKSR, Internationale Kommission zum Schutz des Rheins (2001): Rhein Atlas. http://www.iksr.org/rheinatlas/Start.pdf	
Data enquiry	**Enquiry method:** Hydrological Modelling **Potential sources of data:** Planning authorities, city administration, expert consultation	
Application	**Application and Applicability:** Requires expert assessment with hydrological Modelling. **Relation to other Indicators:** influences Fear of Hazardous Floods (S 24)	
Example		

Category Settings	Existing Conditions and Quality of River and River Site	SOCIAL
Subcategory	Incidents and Provisions for Public Health and Safety	
Quality Element	**Type and Quantity of Crime at River Site**	
Name of indicator:	**Crime Rate**	NO: **S 21**

Operationalisation

Measured parameter:

1) Aggression against people

2) Property related crime (theft etc.)

Unit:

n/1000 inhabitants/year

Benchmarks:

comparison to baseline values or city average

Tendency:

decreasing, as low as possible

Potential classification:

individual

Temporal scope:

middle

Spatial scope:

River site or River Corridor

Rational

Rational:

Abandoned or derelict river sites and sites in neighbourhoods with economic and social problems tend to attract crime. Crime rates, and even the fear of crime contribute to dissatisfaction of residents and site users, reducing quality of life. Crime rates have been found to decrease through enhancement projects of river sites.

References:

WALKER P, LEWIS J, LINGAYAH S, SOMMER F (2000) Prove It. Measuring the effect of neighbourhood renewal on local people. Groundwork, The New Economics Foundation and Barclays PLC, June 2000

Data enquiry

Enquiry method:

Desk study

Potential sources of data:

crime statistics, police department

Application

Application and Applicability:

Relation to other Indicators:

influences Fear of Crime (S 23)

Example

Category Settings Subcategory	Existing Conditions and Quality of River and River Site Incidents and Provisions for Public Health and Safety	SOCIAL
Quality Element	**Type and Quantity of Crime at River Site**	
Name of indicator:	**Vandalism**	NO: **S 22**

Operationalisation

Measured parameter:
Number of incidents/1000 inhabitants/year

Unit:
n/1000 inhabitants/year

Benchmarks:
comparison to baseline values or city average

Tendency:
as low as possible

Potential classification:
individual

Temporal scope:
short - long-term

Spatial scope:
River site or River Corridor

Rational

Rational:
A low number of vandalism reflects a well maintained and secure site.

References:

Data enquiry

Enquiry method:
Desk study

Potential sources of data:
crime statistics, police department, city administration

Application

Application and Applicability:

Relation to other Indicators:
Replacement cost related to Vandalism

Example

Category Subcategory	Appreciation and Use Public Appreciation of River and River Site	SOCIAL
Quality Element	**Perception of Public Health and Safety**	
Name of indicator:	**Fear of Crime**	NO: **S 23**

Operationalisation

Measured parameter:

1) People who fear crime related to themselves

2) People who fear crime related to property

Unit:

% of respondents

Benchmarks:

individual

Tendency:

decreasing, as low as possible

Potential classification:

individual

Temporal scope:

middle term

Spatial scope:

River site

Rational

Rational:

People need to feel safe, to enjoy and appreciate their environment. A feeling of dangerousness causes stress to owners, residents and users. Actual Crime statistics may not correlate with the Fear of Crime. A change in perfection may be delayed compared to actual decrease in crime incidents.

References:

PAGE C (1997) Predicting the Social Impacts of Restoration in an Urban Park. In: Yale F&ES Bulletin, p. 100 et seqq. Found at: www.yale.edu/environment/publications/ bulletin/100pdfs/100page.pdf

WALKER P, LEWIS J, LINGAYAH S, SOMMER F (2000) Prove It. Measuring the effect of neighbourhood renewal on local people. Groundwork, The New Economics Foundation and Barclays PLC, June 2000

Data enquiry

Enquiry method:

Resident survey in River corridor

Example question:

1) "Do you feel safe walking along the river/in this neighbourhood?"

2) "Are you afraid of burglary?"

3) "Do you fear any type of crime in the neighboorhood / rivercorridor?"

Potential sources of data:

Application

Application and Applicability:

The spatial relation of the questions has to be determined for the specific project.

Relation to other Indicators:

Crime, Property values

Example

Category Subcategory	Appreciation and Use Public Appreciation of River and River Site	SOCIAL
Quality Element	**Perception of Public Health and Safety**	
Name of indicator:	**Fear of hazardous Floods**	NO: **S 24**

Operationalisation

Measured parameter:

1) People, who fear flooding harming themselves

2) People, who fear flooding harming their property

Unit:

% of respondents

Benchmarks:

individual

Tendency:

decreasing, as low as possible

Potential classification:

individual

Temporal scope:

middle term

Spatial scope:

River corridor

Rational

Rational:

People need to feel safe, to enjoy and appreciate their environment. A fear of floods harming people and property causes stress to owners and residents. It will limit attachment to and appreciation of the site. It may cause people to move away from the site or to invest elsewhere.

References:

PAGE C (1997) Predicting the Social Impacts of Restoration in an Urban Park. In: Yale F&ES Bulletin, p. 100 et seqq. Found at: www.yale.edu/environment/publications/ bulletin/100pdfs/100page.pdf

Walker P, Lewis J, Lingayah S, Sommer F (2000) Prove It. Measuring the effect of neighbourhood renewal on local people, Groundwork, The New Economics Foundation and Barclays PLC, London

Data enquiry

Enquiry method:

Resident survey in River corridor

Example question:

1) "Are you afraid of floods harming you ?"

2) "Are you afraid of floods harming your property?"

answers: 5 value-scale: I disagree completely to I agree completely

Potential sources of data:

Application

Application and Applicability:

Answers will be influenced by awareness of existing risk and existing flood control measures. Recent flood events may increase fear of floods.

Relation to other Indicators:

Example

Category Subcategory	Appreciation and Use Public Appreciation of River and River Site	SOCIAL
Quality Element	**Perception of Place Identity**	
Name of indicator:	**Self Efficacy**	NO: **S 25**

Operationalisation

Measured parameter:

average level of self-efficacy (related to site and project)

Unit:

% of respondents

Benchmarks:

baseline assessment as reference value

Tendency:

stable or increase

Temporal scope:

middle-long-term

Spatial scope:

Intervention area

Potential classification:

individual

Rational

Rational:

Self-efficacy is defined as an individual's belief in their capabilities to meet with the environmental demands. Self-efficacy beliefs provide the foundation for human motivation, well-being, and personal accomplishment.

References:

Silva et. al. (2003) URBEM - Classification of the aesthetic value of the selected urban rivers – Methodology – Deliverable 4.2., CESUR-IST/UTL, Portugal
Pajares (2002). Overview of social cognitive theory and of self-efficacy. Retrieved 11. 07.2004, from http://www.emory.edu/EDUCATION/mfp/eff.html.
WALKER P, LEWIS J, LINGAYAH S, SOMMER F (2000) Prove It. Measuring the effect of neighbourhood renewal on local people. Groundwork, The New Economics Foundation and Barclays PLC, June 2000

Data enquiry

Enquiry method:

Resident Survey, Example statements:

Self efficacy related to site:
1) I have advantages living close to the river. (WP 4)
2) Living next to the river provides me with a feeling of tranquillity/relaxation. (WP 4)

Self efficacy related to project:
3) I feel, that I could contribute to the project through my knowledge/capabilities/skills.
4) I believe, I could influence the site design through my participation.
5) I feel I could change attitudes and improve things around here. (Barclay site Savers Indicators)

answers: 5 value-scale: I disagree completely to I agree completely

Potential sources of data:

residents

Application

Application and Applicability:

Relation to other Indicators:

Example

Category Subcategory	Appreciation and Use Public Appreciation of River and River Site	SOCIAL
Quality Element	**Perception of Place Identity**	
Name of indicator:	**Distinctiveness**	NO: **S 26**

Operationalisation

Measured parameter:

average level of distictiveness (related to site)

Unit:

% of respondents

Benchmarks:

baseline assessment as reference value

Tendency:

stable or increase

Temporal scope:

middle-long-term

Spatial scope:

Intervention area

Potential classification:

individual

Rational

Rational:

Distinctiveness is the attribution of positive features to a place in comparison to other places. A perception of greater distinctiveness will increase appreciation and attachment to the site and the river.

References:

Silva et. al. (2003) URBEM - Classification of the aesthetic value of the selected urban rivers – Methodology – Deliverable 4.2., CESUR-IST/UTL, Portugal

Data enquiry

Enquiry method:

Resident Survey

Example statements:

1) This river is more beautiful than others.

2) This river site is unique to me.

3) For me, this city/neighbourhood is more beautiful than other cities/neighbourhoods.

answers: 5 value-scale: I disagree completely to I agree completely

Potential sources of data:

residents

Application

Application and Applicability:

Relation to other Indicators:

Example

Category Subcategory	Appreciation and Use Public Appreciation of River and River Site	SOCIAL
Quality Element	**Perception of Place Identity**	
Name of indicator:	**Continuity**	NO: **S 27**

Operationalisation

Measured parameter:

average level of continuity (related to site)

Unit:

% of respondents

Benchmarks:

baseline assessment as reference value

Tendency:

stable or increase

Temporal scope:

middle-long-term

Spatial scope:

Intervention area

Potential classification:

5 value-scale:

I disagree completely to

I agree completely

Rational

Rational:

Continuity relates to the human desire to preserve cultural continuity over time giving reference to past actions and occurrences related to personal values. Continuity will increase appreciation and attachment to the site and the river.

References:

Silva et. al. (2003) URBEM - Classification of the aesthetic value of the selected urban rivers – Methodology – Deliverable 4.2., CESUR-IST/UTL, Portugal

Data enquiry

Enquiry method:

Resident Survey

Example statements:

1) I feel like a citizen of (name of city or neighbourhood)

2) Many of my memories are connected with the river.

3) Contemplating/Recreating at the river is part of my life.

answers: 5 value-scale: I disagree completely to I agree completely

Potential sources of data:

residents

Application

Application and Applicability:

Relation to other Indicators:

Example

Category Subcategory	Appreciation and Use Public Appreciation of River and River Site	SOCIAL
Quality Element	**Perception of Place Identity**	
Name of indicator:	**Self- esteem**	NO: **S 28**

Operationalisation	**Measured parameter:** average level of self-esteem (related to site)	**Unit:** % of respondents
	Benchmarks: baseline assessment as reference value **Tendency:** stable or increase	**Potential classification:** individual
	Temporal scope: middle-long-term **Spatial scope:** Intervention area	
Rational	**Rational:** Self-esteem refers to a sense of confidence and positive relations to a place. **References:** Silva et. al. (2003) URBEM - Classification of the aesthetic value of the selected urban rivers – Methodology – Deliverable 4.2., CESUR-IST/UTL, Portugal	
Data enquiry	**Enquiry method:** Resident Survey Example statements: I am proud living near the river site. answers: 5 value-scale: I disagree completely to I agree completely **Potential sources of data:** residents	
Application	**Application and Applicability:** **Relation to other Indicators:**	
Example		

Category Subcategory	Appreciation and Use Public Appreciation of River and River Site	SOCIAL
Quality Element	**Perception of Restorative Capacity**	
Name of indicator:	**Being Away**	NO: **S 29**

Operationalisation

Measured parameter:

average level of being away (related to site)

Unit:

% of respondents

Benchmarks:

individual

Tendency:

increase

Temporal scope:

with project- short term

Spatial scope:

Intervention area

Potential classification:

individual

Rational

Rational:

Being away - the first condition for restoration involves getting distance from further demands on directed attention and the ordinary present or routine aspects of

one's life. There are three ways in which a sense of being away can come about: escaping from unwanted distractions in the surroundings, distancing oneself from

one's usual work and reminders of it, and suspending the pursuit of particular purposes (Kaplan and Kaplan, 1989).

References:

Silva et. al. (2003) URBEM - Classification of the aesthetic value of the selected urban rivers – Methodology – Deliverable 4.2., CESUR-IST/UTL, Portugal

Data enquiry

Enquiry method:

User or resident survey

Example statement:

1) Being here helps me to relax.

2) This place helps me to rest.

3) Coming here helps me to forget my duties.

answers: 5 value-scale: I disagree completely to I agree completely

Potential sources of data:

residents

Application

Application and Applicability:

Relation to other Indicators:

Example

Category Subcategory	Appreciation and Use Public Appreciation of River and River Site	SOCIAL
Quality Element	**Perception of Restorative Capacity**	
Name of indicator:	**Fascination**	NO: **S 30**

Operationalisation

Measured parameter:

average level of fascination (related to site)

Unit:

% of respondents

Benchmarks:

individual

Tendency:

increase

Temporal scope:

with project- long term

Spatial scope:

Intervention area

Potential classification:

individual

Rational

Rational:

Fascination - the natural environments are important sources of fascinating elements. These are restorative because they demand effortless attention and use the involuntary attention.

References:

Silva et. al. (2003) URBEM - Classification of the aesthetic value of the selected urban rivers – Methodology – Deliverable 4.2., CESUR-IST/UTL, Portugal

Data enquiry

Enquiry method:

User or resident survey

Example statements:

1) This place is charming.

2) This place is boring.

3) I would like to come here more often.

answers: 5 value-scale: I disagree completely to I agree completely

Potential sources of data:

residents

Application

Application and Applicability:

Relation to other Indicators:

Example

Category Subcategory	Appreciation and Use Public Appreciation of River and River Site	SOCIAL
Quality Element	**Perception of Restorative Capacity**	
Name of indicator:	**Extent**	NO: **S 31**

Operationalisation

Measured parameter:

average level of extent (related to site)

Unit:

% of respondents

Benchmarks:

individual

Tendency:

increase

Temporal scope:

with project- long term

Spatial scope:

Intervention area

Potential classification:

individual

Rational

Rational:

Extent - the natural environment has also the function of extent that is treated by the Kaplans (1989) as a function of connectedness and scope. People in contact with

the natural environment feel beyond there own limits, almost as being part of nature.

References:

Silva et. al. (2003) URBEM - Classification of the aesthetic value of the selected urban rivers – Methodology – Deliverable 4.2., CESUR-IST/UTL, Portugal

Data enquiry

Enquiry method:

User or resident survey

Example statements:

1) This is a confusing place.

2) Everything here is coherent.

3) Everything here is in harmony.

answers: 5 value-scale: I disagree completely to I agree completely

Potential sources of data:

residents

Application

Application and Applicability:

Relation to other Indicators:

Example

Category Subcategory	Appreciation and Use Public Appreciation of River and River Site	SOCIAL
Quality Element	**Perception of Restorative Capacity**	
Name of indicator:	**Compatibility**	NO: **S 32**

Operationalisation

Measured parameter:

average level of comatibility (related to site)

Unit:

% of respondents

Benchmarks:

individual

Tendency:

increase

Temporal scope:

with project- short term

Spatial scope:

Intervention area

Potential classification:

individual

Rational

Rational:

Compatibility - the match between the person's goals and inclinations, environmental demands, and the information available in the environment for the support of intended and required activities (Kaplan, 1983). In short, compatibility exists in situations in which what the person wants to do matches what the environment demands and supports.

References:

Silva et. al. (2003) URBEM - Classification of the aesthetic value of the selected urban rivers – Methodology – Deliverable 4.2., CESUR-IST/UTL, Portugal

Data enquiry

Enquiry method:

User or resident survey

Example statements:

1) I identify myself with this place.

2) I feel well here.

answers: 5 value-scale: I disagree completely to I agree completely

Potential sources of data:

residents

Application

Application and Applicability:

Relation to other Indicators:

Example

Category Subcategory	Appreciation and Use Recreational use	SOCIAL
Quality Element	**Recreational User groups**	
Name of indicator:	**User Catchment Area**	NO: **S 33**

Operationalisation

Measured parameter:

size of user catchment area

Unit:

m2, km2

Benchmarks:

individual

Tendency:

Stable or increase

Temporal scope:

short - middle

Spatial scope:

River site or River Corridor

Potential classification:

individual

Rational

Rational:

It is anticipated, that the bigger the user catchment area, the higher is the attraction of the site and the related appreciation by the visitors.

The population living in walking distance, approximately 500 m (or about 5 min walking distance) to both sides of the river or river corridor edge, provides a target value for the site.

References:

IOER (2003) Urban Green Environment (URGE). A framework for assessing the quality of urban green environments. Institute of Ecological and Regional Planning Dresden, 2003, unpublished (?)

Data enquiry

Enquiry method:

Onsite User Survey

Example question)

"Where are you living/working"

Potential sources of data:

local representatives, tourist offices

Application

Application and Applicability:

easy to enquire in an onsite survey

catchment area should cover at least a corridor of approx. 500 meter of each side from river or edge of river corridor (walking distance), the size of the corridor can change depending on physical and social barriers, the size of the river and the importance of the site in a nationwide context

Relation to other Indicators:

Example

Category Subcategory	Appreciation and Use Recreational use	SOCIAL
Quality Element	**Recreational User groups**	
Name of indicator:	**Access by Users**	NO: **S 34**

Operationalisation

Measured parameter:

proportion of people accessing site by:

1) soft modes (foot, bicycle etc.)

2) public transportation

3) private car

Unit:

%

Benchmarks:

URGE: reduce dependence on private car traffic (less than 25 to 10%), increase access by foot (more than 70%)

Tendency:

URGE: reduce dependence on private car traffic, increase access by foot

Temporal scope:

short-long-term depending on project

Spatial scope:

River site

Potential classification:

matrix for all 4 groups:

> 50%, 50%-25%, <25%

Rational

Rational:

An increase of users accessing river corridor by foot or bicycle reflects better accessibility and increases attractiveness for regular use.

References:

SCHANZE J, TOURBIER J T, OLFERT A and GERSDORF I (i.p.) Urban River Rehabilitation in Europe: A Case Study Analysis, EcoMed, Dresden.

IOER (2003) Urban Green Environment (URGE). A framework for assessing the quality of urban green environments. Institute of Ecological and Regional Planning Dresden, 2003, unpublished (?)

Data enquiry

Enquiry method:

Onsite user survey:

Q) How have you accessed this site?

Answer) Matrix: <50%, 50%<x<25%, <25% and by soft mode (bicycle or foot), private car, public transportation

Potential sources of data:

Application

Application and Applicability:

survey during week and divers day times, comparison

Relation to other Indicators:

influenced by quality element accessibility

Example

Category Subcategory	Appreciation and Use Recreational use	SOCIAL
Quality Element	**Recreational User groups**	
Name of indicator:	**Social Structure of Recreational User Groups**	NO: **S 35**

Operationalisation

Measured parameter:

presence of social groups at site e.g.

1) age groups

2) ethnicity

3) special need groups (elderly, handicapped, mother and children etc.)

Unit:

%

Benchmarks:

comparison with social structure of river corridor

Tendency:

diversity of users

Temporal scope:

short - middle term

Spatial scope:

River site

Potential classification:

individual

Rational

Rational:

A successful project provides for and attracts all social groups of the neighbourhood community. Age groups < 16 (age of drivers licence) and > 65 bound to the site are in special need of open space qualities. So are groups with special needs (mother/child, handicapped, homeless etc)

References:

IOER (2003) Urban Green Environment (URGE). A framework for assessing the quality of urban green environments. Institute of Ecological and Regional Planning Dresden, 2003, unpublished (?)

Data enquiry

Enquiry method:

Onsite observation

Onsite user survey

Potential sources of data:

local residents, neighbourhood representatives, local services with view to river/river corridor

Application

Application and Applicability:

Indicator should be assessed in connection with activities. Assessment should be done over a period of time to account for temporal differences in use (during day, during week, during seasons). Indicator only needs to be considered, if special need groups have been identified during problem definition baseline assessment.

Relation to other Indicators:

Example

Category Subcategory	Appreciation and Use Recreational use	SOCIAL
Quality Element	**Amount and Diversity of Recreational Activities**	
Name of indicator:	**Visitor Frequency**	NO: **S 36**

Operationalisation	**Measured parameter:** 1) number of users attending the rehabilitated area or a defined part of it (e.g.. River banks) in a certain time 2) average time spend at the site	**Unit:** 1) number/time unit (day, hour, week, seasonal, point of time) 2) average time
	Benchmarks: average baseline value, baseline distribution **Tendency:** Stable or increase, in case of overuse in ecological sensitive areas decreasing	**Potential classification:** Stable or increase, in case of overuse in ecological sensitive areas decreasing
	Temporal scope: short - middle term **Spatial scope:** River site	
Rational	**Rational:** An increase in visitor frequencies can be correlated with an increased appreciation of the site, which in turn has also economic implications. **References:** SCHANZE J, TOURBIER J T, OLFERT A and GERSDORF I (i.p.) Urban River Rehabilitation in Europe: A Case Study Analysis, EcoMed, Dresden. DEPARTMENT OF ENVIRONMENTAL PROGAMS METROPOLITAN WASHINGTON COUNCIL OF GOVERNMENTS (2001) Anacostia Watershed Restoration Indicators and Targets for Period 2001 – 2010	
Data enquiry	**Enquiry method:** Onsite Survey 1) Ex.-Question: "How often do you come here during x-time in summer/fall/spring/winter?", Onsite Observation, count of people per time unit , Sequence photography (e.g. via web-cameras that supply a defined sequence of photographs over the day time: 9 AM; 12 AM, 3 PM, 6 PM, 9 PM) Average and time specific densities can be established 2) Ex.-Question: "Approximately how many hours do you spend per visit?" **Potential sources of data:** Tourist offices for sites of grater importance, residents	
Application	**Application and Applicability:** It is an important indicator to assess, if recreation use has been a target of the project. It reflects the actual acceptance and appreciation of the site for recreation. The indicator can be used to measure all users or specific user groups, for example: Number of Anglers **Relation to other Indicators:** Recreational activities (S 37)	
Example		

Category Subcategory	Appreciation and Use Recreational use	SOCIAL
Quality Element	**Amount and Diversity of Recreational Activities**	
Name of indicator:	**Recreational Activities**	NO: **S 37**

Operationalisation

Measured parameter:

1) List of activities and their frequency

2) named or perceived activities

- water related activities (swimming, fishing, canoeing etc.)

- city related (shopping, restaurants, museum, disco etc.)

- river site related (nature watching, relaxing, walking, biking, picnicking etc.)

classification of answers: never, rarely, sometimes, often, very often

Unit:

1) % for naming of activities

2) % for frequency of uses percentage of distribution (Verteilung der Aktivitäten)

Benchmarks:

individual,

target may be based on a preference inquiry during baseline sampling (EX. Question: "What would you like to do along the river/in the river corridor")

in general site should support as many different activities as possible to satisfy needs of different user groups

Tendency:

Increase and increased diversity of recreational activities

Potential classification:

individual

Temporal scope:

short - middle term

Spatial scope:

River site

Rational

Rational:

If people are engaged in diverse activities at the site, it is providing for different needs and therefore satisfies different social groups. It also reflects, how much a site is appreciated for recreation.

References:

PAGE C (1997) Predicting the Social Impacts of Restoration in an Urban Park. In: Yale F&ES Bulletin, p. 100 et seqq. Found at: www.yale.edu/environment/publications/ bulletin/100pdfs/100page.pdf

Data enquiry

Enquiry method:

Onsite User Survey

Question) " What activities are you engaged in along the river ?"

Onsite Observation

Potential sources of data:

local residents, neighbourhood representatives

Application

Application and Applicability:

Indicator should be assessed in connection with presence of social groups. Therefore age, gender, ethnicity and eventually income and occupation should be recorded. Assessment should be done over a period of time to account for temporal differences in use (during day, during week, during seasons).

Relation to other Indicators:

Visitor Frequency (S 36)

Example	Visitors to the West River Memorial Park were observed and recorded on four separate dates in September and October 1996. Sampling was conducted in late morning, early afternoon, and late afternoon on two Saturdays and two weekdays to account for differences in temporal use patterns. The sampling process attempted to simulate a “snapshot” of park use at a certain time. Sampling consisted of moving through the entire park, recording each individual’s observed activity as well as his or her estimated age, ethnicity, and gender (PAGE C, 1997).

Category Subcategory	Appreciation and Use Recreational use	SOCIAL
Quality Element	**Amount and Diversity of Recreational Activities**	
Name of indicator:	**Educational Use trough Schools**	NO: **S 38**

Operationalisation

Measured parameter:

number of schools using intervention site / schools in user catchment area

Unit:

%

Benchmarks:

75-100%???

Tendency:

Potential classification:

individual

Temporal scope:

short - middle term

Spatial scope:

River site and River corridor

Rational

Rational:

Rehabilitation of River sites may provide increased ecological diversity and therefore provide for a "Green Classroom". Early environmental education will increase awareness and appreciation for the river and the river site and nature in common.

References:

Data enquiry

Enquiry method:

Asking school representative questions as e.g..

Are you using the river for green classrooms?

Potential sources of data:

local schools, school boards, NGO's

Application

Application and Applicability:

It is an easy to enquire indicator.

Relation to other Indicators:

Quality element: Provision for awareness and environmental education

Example

Category Subcategory	Appreciation and Use Residential Use and Social Structure of Residents	SOCIAL
Quality Element	**Quality of Residential Use**	
Name of indicator:	**Dwelling Satisfaction**	NO: **S 39**

Operationalisation	**Measured parameter:** moving wish of dwellers	**Unit:** number of naming of certain reason
	Benchmarks: other city districts; city average **Tendency:** decreasing, stabilizing	**Potential classification:** individual
	Temporal scope: short - long term **Spatial scope:** River corridor	
Rational	**Rational:** It is assumed that the hypothetic wish of dwellers to leave or to stay in an area indicates the image and the quality the area has in relation to other areas in town **References:** dissatisfaction in Newton 1998, Table 3.3	
Data enquiry	**Enquiry method:** resident enquiry **Potential sources of data:** statistical office	
Application	**Application and Applicability:** The assessment of the indicator requires elaborate enquiries. Therefore it may only be used, if data is already available and a second enquiry can be expected after the implementation of the project. Due to that dwelling satisfaction may depend on several factors, results of the enquiry will be influenced by external factors. **Relation to other Indicators:** Migration balance (S 40) Vacancies (nyd)	
Example		

Category Subcategory	Appreciation and Use Image	SOCIAL
Quality Element	**Quality of Residential Use**	
Name of indicator:	**Migration Balance**	NO: **S 40**

Operationalisation	**Measured parameter:** Moving in / moving out ratio	**Unit:** %
	Benchmarks: other city districts; city average/ = 0 **Tendency:** stable or positive	**Potential classification:** individual
	Temporal scope: short - long term **Spatial scope:** River corridor	
Rational	**Rational:** A positive migration balance can be an indicator of improved image and living conditions in an area with vacancies. **References:**	
Data enquiry	**Enquiry method:** **Potential sources of data:** local census	
Application	**Application and Applicability:** Results of assessment may be distorted, through population loss due to moving in of rich people utilising more square meter per person **Relation to other Indicators:** Vacancies (nyd)	
Example		

Category Subcategory Stakeholders	Social Relations and Social Organisation Relations between Institutions/Organisations and	SOCIAL
Quality Element	**Stakeholder Participation**	
Name of indicator:	**Advocacy and Stewardship Groups**	NO: **S 41**

Operationalisation

Measured parameter:

1) number of groups actively involved in the project, in monitoring or other activities

2) number of active members

Unit:

n

Benchmarks:

none, related to participating culture of each country (relative to number of catchments inhabitants?)

Tendency:

stable/increasing

Potential classification:

individual

Temporal scope:

during project

Spatial scope:

River corridor

Rational

Rational:

An increasing number of people involved in stewardship or advocacy groups directly or partly concerned with the river reflects an increased importance and appreciation for the site. "Adopt a brook groups" provide valuable human resources for maintaining the site, monitoring and other tasks in environmental management.

References:

SCHANZE J, TOURBIER J T, OLFERT A and GERSDORF I (i.p.) Urban River Rehabilitation in Europe: A Case Study Analysis, EcoMed, Dresden.

Data enquiry

Enquiry method:

Count

Potential sources of data:

advocacy/stewardship groups, local authorities

Application

Application and Applicability:

Relation to other Indicators:

Volunteers (S 42)

Example

Category Subcategory Stakeholders	Social Relations and Social Organisation Relations between Institutions/Organisations and	SOCIAL
Quality Element	**Stakeholder Participation**	
Name of indicator:	**Volunteers**	NO: **S 42**

Operationalisation

Measured parameter:

1) average hours of voluntary work/year

2) number of people signed in volunteer groups/residents in river corridor

3) number of people participating in clean up events/residents in river corridor

Unit:

1) hr/year

2) %

3) %

Benchmarks:

individual

Tendency:

stable/increasing

Potential classification:

individual

Temporal scope:

during project

Spatial scope:

River corridor

Rational

Rational:

Ideally adjacent neighbourhoods will play an active role during the project. It is anticipated that the more user groups have been participating during the design and implementation process the more potential stress factors have been considered and mitigated. Also, people's trust and their sense of ownership may increase.

References:

SCHANZE J, TOURBIER J T, OLFERT A and GERSDORF I (i.p.) Urban River Rehabilitation in Europe: A Case Study Analysis, EcoMed, Dresden.

Data enquiry

Enquiry method:

1) Volunteer - enquiry: average volunteering time/month /person

Example-Question: "Approximately how many hours during a month are you spending for volunteering for river related activities?"

2) Count

3) Count

Potential sources of data:

Planning authorities, NGO's neighbourhood associations

Application

Application and Applicability:

May only be applicable for long term projects.

Relation to other Indicators:

Example

Category	Social Relations and Social Organisation	SOCIAL
Subcategory Stakeholders	Relations between Institutions/Organisations and	
Quality Element	**Stakeholder Participation**	
Name of indicator:	**Business Coalitions**	NO: **S 43**

Operationalisation

Measured parameter:

number of businesses supporting the river rehabilitation project or management actions

Unit:

n

Benchmarks:

existing

Tendency:

Planning authority

Temporal scope:

during project

Spatial scope:

River corridor

Potential classification:

individual

Rational

Rational:

Business coalitions (commerce, industry, trade) facilitate a better support of the project, which may also provide for additional founding and allow for extra investment.

References:

SCHANZE J, TOURBIER J T, OLFERT A and GERSDORF I (i.p.) Urban River Rehabilitation in Europe: A Case Study Analysis, EcoMed, Dresden.

Data enquiry

Enquiry method:

Potential sources of data:

Planning authorities

Application

Application and Applicability:

Relation to other Indicators:

Example

Category Subcategory	Utility Values Direct Use Values		ECONOMY
Quality Element	**Property values and taxes**		
Name of indicator:	**Median Property value**		NO: **EN 1**
Operationalisation	**Measured parameter:** median property value	**Unit:** €	
	Benchmarks: other city districts; city average **Tendency:** increase	**Potential classification:** individual	
	Temporal scope: short - long term **Spatial scope:**		
Rational	**Rational:** River rehabilitation may contribute to a raise in median property values. The increase in value will also increase the tax base for local community. **References:** PAGE C (1997) Predicting the Social Impacts of Restoration in an Urban Park. In: Yale F&ES Bulletin, p. 100 et seqq. Found at: www.yale.edu/environment/publications/ bulletin/100pdfs/100page.pdf		
Data enquiry	**Enquiry method:** Hedonic Pricing method, expert interview **Potential sources of data:** real state agents		
Application	**Application and Applicability:** The assessment requires an elaborate method. See annex 1. **Relation to other Indicators:**		
Example			

Category Subcategory	Utility Values Direct Use Values	ECONOMY
Quality Element	**Economic Activities and Employment**	
Name of indicator:	**Unemployment**	NO: **EN 2**

Operationalisation

Measured parameter:

share of unemployed people among the employable population

Unit:

%

Benchmarks:

other city districts; city average

Tendency:

decreasing

Temporal scope:

short - middle term

Spatial scope:

river corridor/effect area

Potential classification:

individual

Rational

Rational:

Unemployment rate indicates the overall prosperity of the area which may change as effect of population shift after image of the effect area has been improved by the rehabilitation project

References:

DIAZ REDONDO M (2003) Social Impact Assessment for River Restoration – a more sustainable perspective. University of East Anglia. School of Environmental Sciences. Norwich. United Kingdom.

Data enquiry

Enquiry method:

document analysis

household based enquiry

Potential sources of data:

local census

Application

Application and Applicability:

The shift of population can also indicate segregation and is thus not an indicator for social stability which might in any case be a city wide issue. Nevertheless, taken alone, it can prove the image rising potential of a project. Possible contradiction

Relation to other Indicators:

Example

Category Subcategory	Utility Values Direct Use Values	ECONOMY
Quality Element	**Economic Activities and Employment**	
Name of indicator:	**Activities to create income**	NO: **EN 3**

Operationalisation

Measured parameter:

public income from public activities at river corridor/maintenance costs river and river corridor

Unit:

%

Benchmarks:

-

Tendency:

100%

Potential classification:

individual

Temporal scope:

short - long term

Spatial scope:

Rational

Rational:

A sustainable integration of activities in the river corridor may support economic self sufficiency of the site, e.g.: concerts, boating tours, swimming days, rental for bikes, boats, celebrations, cafés etc.

References:

IOER (2003) Urban Green Environment (URGE). A framework for assessing the quality of urban green environments. Institute of Ecological and Regional Planning Dresden, 2003, unpublished (?)

Data enquiry

Enquiry method:

local enquiry

Potential sources of data:

city administration

Application

Application and Applicability:

Relation to other Indicators:

Example

Category Subcategory	Project Costs and Maintenance Costs Maintenance costs	ECONOMY
Quality Element	**Annual Maintenance**	
Name of indicator:	**Maintenance costs**	NO: **EN 4**

Operationalisation	**Measured parameter:** Cost per area unit (m, ha) needed for site maintenance (state before rehabilitation divided by state after rehabilitation)	**Unit:** €/m2
	Benchmarks: other sites with comparable uses **Tendency:** decrease	**Potential classification:** individual
	Temporal scope: short - long term **Spatial scope:**	
Rational	**Rational:** It is assumed that with a restoration a state of ecological equibrillium and social equilibrium is targeted. Therefore maintenance effort and therefore costs should decrease with the establishment of the measures implemented. **References:**	
Data enquiry	**Enquiry method:** annual financial account **Potential sources of data:** management plans, maintenance companies	
Application	**Application and Applicability:** If a previous 'zero maintenance area' (cf. Schanze et al. i.p.) is rehabilitated, maintenance cost may increase. **Relation to other Indicators:**	
Example		

Category Subcategory	Project Costs and Maintenance Costs Maintenance costs	ECONOMY
Quality Element	**Annual Maintenance**	
Name of indicator:	**Replacement cost related to Vandalism**	NO: **EN 5**

Operationalisation	**Measured parameter:** Cost of damage replacement caused by vandalism year/area of intervention area	**Unit:** €/year/m2 or km2
	Benchmarks: at least city average **Tendency:** stable or decreasing	**Potential classification:** individual
	Temporal scope: short - long term **Spatial scope:** intervention area	
Rational	**Rational:** (Graffiti, benches, Signs, Bus stops)/lower number of vandalism reflects a well maintained and secure site **References:**	
Data enquiry	**Enquiry method:** **Potential sources of data:** city administration, garden and park department	
Application	**Application and Applicability:** **Relation to other Indicators:**	
Example		

Category Subcategory	Project Costs and Maintenance Costs Maintenance costs	ECONOMY
Quality Element	**Event related Maintenance**	
Name of indicator:	**(Potential) Flood Damage Cost**	NO: **EN 6**

Operationalisation	**Measured parameter:** Potential flood damage cost during design flood events	**Unit:** €/ design flood event
	Benchmarks: 0€/ design flood event **Tendency:** as low as possible	**Potential classification:** individual
	Temporal scope: with implementation - long term **Spatial scope:** intervention area	
Rational	**Rational:** as higher the potential flood damage as lower the value of the site and as lower the willingness to invest onsite, a lower damage potential increases safety perception of site and therefore appreciation **References:** Rodriguez, R., Zeisler et at. (2001): Übersichtskarten der Überschwemmungsgefährdung und der möglichen Schäden bei Extremhochwasser am Rhein - Vorgehensweise zur Ermittlung der überschwemmungsgefährdeten Flächen sowie Vorgehensweise zur Ermittlung der Vermögenswerte. Abschlußbericht für die IKSR. derived Nov. 2004 at http://www2.ms-visucom.de/r30/vc_content/bilder/firma20/pdf/bericht_nr_131.pdfc) LFI RWTH Aachen, ProAqua, Pflügner, W. (2001): Potentielle Hochwasserschäden am Rhein in NRW. derived Nov. 2004 at: http://www.proaqua-gmbh.de/hws/hwsnrw/hws/index.htm Sönnichsen (2003): Hochwasser-Aktionsplan Werre. Erläuterungsbericht. derived Nov. 2004 at: http://www.stua-mi.nrw.de/hwap/Erl%E4uterungsbericht-HWAP-Werre.pdf	
Data enquiry	**Enquiry method:** Hydraulic / hydrologic modelling and consequence estimation **Potential sources of data:** Terrain models, land use information	
Application	**Application and Applicability:** **Relation to other Indicators:** (Real) Replacement costs for flood damage (EN 2)	
Example		

Category Subcategory	Project Costs and Maintenance Costs Maintenance costs	ECONOMY
Quality Element	**Event related Maintenance**	
Name of indicator:	**(Real) Replacement costs for flood damage**	NO: **EN 7**

Operationalisation	**Measured parameter:** 1) Replacement cost after certain occurred flood events 2) Annual Replacement Costs	**Unit:** 1) € 2) €/year
	Benchmarks: comparison with former flood events of the same size **Tendency:** decrease	**Potential classification:** individual
	Temporal scope: long term **Spatial scope:** intervention area/ downstream	
Rational	**Rational:** An improved flood control, will decrease replacement costs for the same flood event. **References:**	
Data enquiry	**Enquiry method:** **Potential sources of data:** documented events, statistical data of economical flood damage, Insurance companies,	
Application	**Application and Applicability:** The assessment of this indicator rely on the comparison of flood events with the same discharge. Therefore a before and after comparison will need to be conducted, whenever a defined flood event has occurred. Potential flood damage costs based on hydraulic modelling may be used as a proxy indicator. **Relation to other Indicators:** (Potential) Flood Damage Cost (EN 1)	
Example		