



• *working with nature to protect the environment*

z naravo do čistega okolja



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Limnos je specializirano podjetje za ekologijo, varstvo okolja in ohranjanje narave. Poseben poudarek dajemo raziskovanju, razvijanju, uporabi in trženju inovativnih, sonaravnih in trajnostnih rešitev v prid vodnim ekosistemom. Naše dejavnosti segajo od ocen stanj in presoje vplivov na okolje, prek sanacij odpadnih voda, deponij in degradiranih ekosistemov do izvajanja študij upravljanja z okoljem.

Z razumevanjem naravnih zakonov, s poudarjeno skrbjo za okolje, s strokovnimi izkušnjami in s širokim pregledom znanja ustvarjamo inovativne, predvsem pa življenjske rešitve pri ohranjanju in vzpostavljanju sonaravnega okolja.

Limnos is a private company specializing in applied ecology, environmental protection and nature conservation. Our work focuses primarily on the research, development, marketing and use of innovative and sustainable solutions for the protection of water ecosystems. Our activities range from waste water treatment and co-natural reclamation of landfills to environmental impact assessment and environmental management studies.

With a deep understanding of ecosystems, a concern for the well-being of the environment and a wealth of professional knowledge and experience we create innovative and meaningful solutions to conserve and restore the natural environment.



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Čiščenje odpadnih vod *Waste Water Treatment*
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Environmental Impact Reports and Studies

Ekoremediacije v celostnem upravljanju z vodami

Ekoremediacije (ERM)

vkjučujejo sisteme in procese, ki potekajo v naravnih in umetnih ekosistemih ter ščitijo okolje ali ga obnavljajo. Z razmeroma nizkimi stroški lahko dosežemo visoke učinke pri zaščiti vodnih virov, potokov, rek, jezer, podtalnice in morja. Osnovne funkcije ERM, ki jih uporabljamo oziroma lahko izboljšujemo, so velike puferske in samočistilne lastnosti ter ohranjanje naravnih habitatov in biološke raznovrstnosti.

Ekosistemi

Narava oziroma ekosistemi so v milijonih let razvili izjemne obrambne in samočistilne sposobnosti, s katerimi se ščitijo pred nenadnimi ali premočnimi vplivi in odpravljajo njihove škodljive posledice. Zato je narava v svoji zgodovini doživela in preživela marsikatero katastrofo. Vodni in obvodni ekosistemi ter druga

mokrišča imajo veliko sposobnost kompenziranja vodnih udarov, pa tudi močnih in specifičnih fizikalno-kemičnih ter toksičnih onesnaževanj. V njih se nevtralizirajo strupi in uspešno zmanjšujejo količine različnih patogenih organizmov. Poleg tega zagotavljajo tudi veliko biotsko raznovrstnost in prispevajo k mnogim, danes še malo znanim procesom ravnovesja na planetu.

Osnovni namen uporabe ERM

je večnamensko gospodarjenje z vodotoki, jezeri in mokrišči, kar bo omogočilo celostni razvoj posameznih območij in prispevalo k sožitju človeka in narave. Zato so ERM ekonomsko in ekološko, predvsem pa dolgoročno, med najuspešnejšimi načini varovanja okolja.

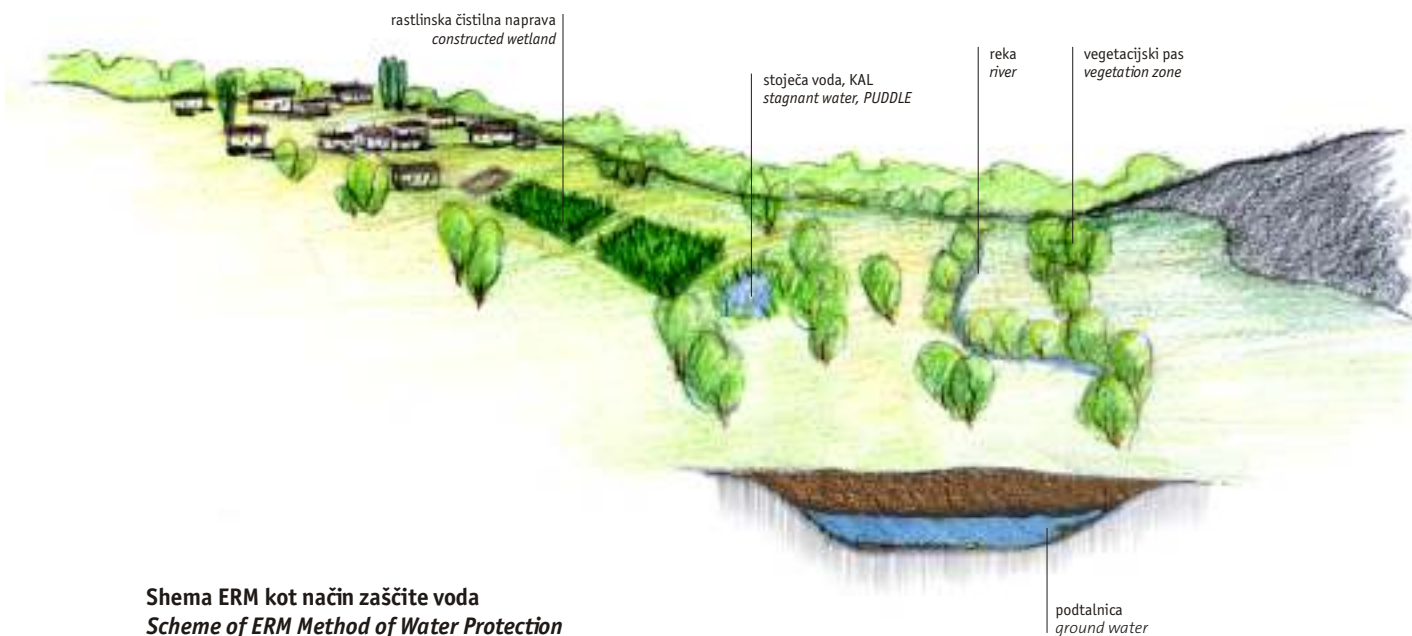
Možnosti uporabe

- odpravljanje dolgotrajnih posledic škodljivih vplivov človekovih aktivnosti v okolju
- povečanje razbremenilnih, samočistilnih in habitatnih sposobnosti vodotokov
- čiščenje netočkovnih virov odpadnih voda
- odpravljanje posledic po sezonskem

- onesnaževanju, npr. zaradi turizma terciarno oz. dopolnilno čiščenje komunalnih, živinorejskih in industrijskih in drugih problematičnih odpadnih vodah
- kondicioniranje vode za večnamensko uporabo (zalivanje, namakanje, pitno vodo, za zadrževalnike, itd.)
- zaščita naravovarstvenih področij
- zaščita podtalnice, vodnih zajetij, zaščitnih okolij
- zaščita pred vtokom onesnaženih voda v jezera in morje
- sonaravno vzdrževanje melioracijskih jarkov
- blažilne cone (»vegetacijski pasovi«)
- revitalizacija (biološka obnova) degradiranih vodotokov, jezer, gramoznic, glinokopov, kalov itd.
- izgradnja oz. obnova ekosistemov za redke in ogrožene vrste rastlin in živali

Perspektive

Čeprav so prisotni nekateri pomisleki o tem, da sistemi ERM še niso »tehnično« dorečeni, da potekajo počasi in se jih ne da uravnovati, se njihova uporaba neazdržno širi, vse bolj pa se utrjuje tudi v zavesti naravovarstveno osveščenih ljudi.



Shema ERM kot način zaščite voda
Scheme of ERM Method of Water Protection

Ecoremediation in Integrated Water Management



Ecoremediation (ERM)

Ecoremediation comprises systems and processes which function in natural and artificial ecosystems; it protects and restores the environment.

It is comparatively inexpensive and highly efficient in protection of water resources, streams, rivers, lakes, groundwater and the sea. The basic characteristics of ERM, which can be utilized and improved, are its high buffer and self-protective capacities, and preservation of natural habitats and biological diversity.

Ecosystems

In millions of years, the nature and ecosystems evolved exceptional defensive and self-protective capacity to safeguard themselves against sudden and powerful impacts and to remove their harmful consequences. Through its history, the nature has experienced many a catastrophe and survived them for this reason. Aquatic and waterside ecosystems and other wetlands have a high retention capacity and could prevent flooding as well as severe and specific physical, chemical and toxic pollution. These ecosystems neutralise toxins and efficiently reduce various pathogenic organisms. Moreover, they increase biodiversity and contribute to many so far unknown or hardly known processes maintaining the equilibrium on our planet.

The Main Purpose of ERM

ERM is used for multipurpose management of watercourses, lakes and wetlands, which enables integrated develop-

ment of particular areas and contributes to the coexistence of man and nature. Therefore, the ERM is among the most successful and sustainable methods of environmental protection, from the economic and ecological point of view.

Possible Utilization

- remedy of long-term consequences of harmful human activities in the environment
- enhancement of disburdening and self-protective capabilities of habitats and running waters from non-point pollution sources
- remedy of seasonal pollution impacts, e.g. tourism
- tertiary or supplementary treatment of communal, stockfarming, industrial and other harmful wastewaters
- conditioning of water for various uses (watering, irrigation, drinking water, retention basins, etc.)
- protection of nature reserves
- protection of ground water, water-points and other sensitive areas
- protection against polluted water discharges in lakes and the sea
- sustainable maintenance of amelioration ditches
- buffer zones ("vegetation zones")
- revitalisation (biological restoration) of degraded watercourses, lakes, gravel pits, claypits, puddles, etc.
- construction and restoration of ecosystems for rare and endangered plant and animal species.

Prospects

Although there is still some consideration present as regards "technical indeterminateness", slow functioning and difficult regulation of ERM systems, their utilization is spreading steadily and gaining ground among environmentally aware people.



Čiščenje odpadnih vod Waste Water Treatment

Z rastlinskimi čistilnimi napravami (RČN) posnemamo samočistilno sposobnost narave. Njihove značilnosti so:

- zmanjšujejo dušikove in fosforjeve spojine, težke kovine ter druge strupene snovi in bakterije,
- učinkovitost zmanjševanja obremenitve voda dosega 90 %,
- nizki stroški izgradnje, obratovanja in vzdrževanja,
- za delovanje nista potrebni niti energija niti strojna oprema,
- enostavna postavitev in vzdrževanje,
- krajinska privlačnost.

Rastlinske čistilne naprave čistijo:

- komunalne odpadne vode (naselja, turistični centri, naravni parki),
 - tehnološke vode (industrijski obrati, farme),
 - izcedne vode (komunalne deponije),
 - netočkovno onesnaženje (padavinske vode s cestnišč, kmetijskih zemljišč),
 - terciarne odpadne vode z možnostjo ponovne uporabe vode (zalivanje, gašenje požarov).



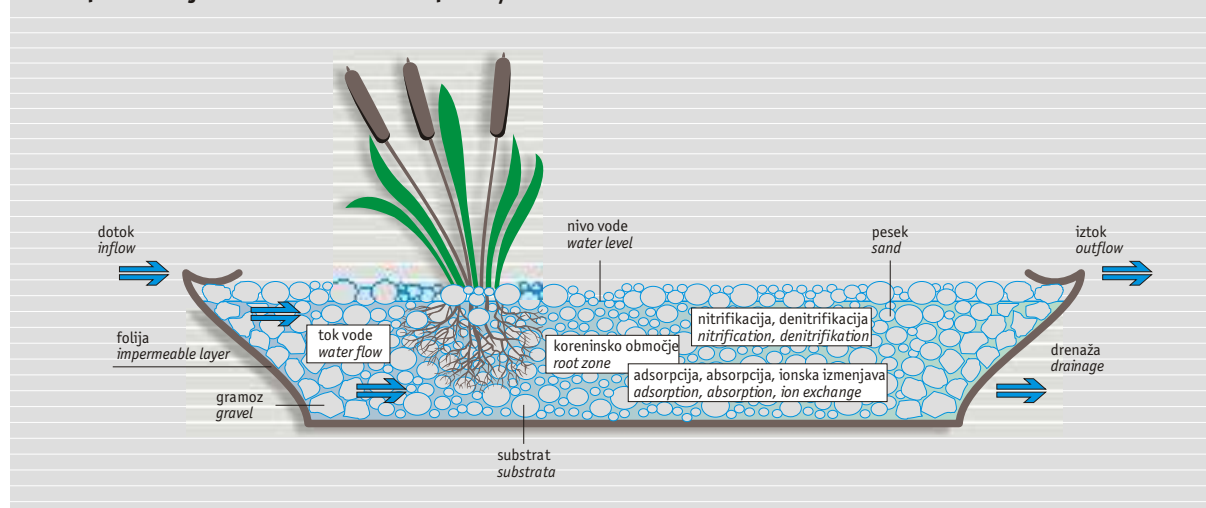
Constructed wetlands (CW) imitate the self-cleaning ability of nature. Their characteristics are:

- reduction of nitrogen, phosphorus substances, heavy metals and other toxic compounds, and bacteria,
- removal efficiency up to 90 %,
- cost-effective construction, performance and maintenance,
- no need for energy or mechanical equipment,
- easy to set-up and maintain,
- nice fit into the local environment.

Constructed wetlands treat:

- sewage (settlements, tourist centers, natural parks),
- technological waste water (industries, farms),
- landfill leachate (municipal landfill sites),
- non-point sources of pollution (highway run-off, agricultural run-off),
- tertiary waters with the potential for reuse (irrigation, fire fighting).

Princip delovanja rastlinske čistilne naprave / How Constructed Wetlands work



Sanacija odlagališč odpadkov Co-natural Reclamation of Landfills

Sanacija odlagališč odpadkov je v praksi preizkušena, inovativna in v skladu z zakonodajo dovoljena sonaravna sanirna metoda.

Tehnologija vključuje:

- gosto zasadnjo dreves,
- rastlinsko čistilno napravo in
- namakalni sistem.

Kombinacija vseh treh sistemov pospeši razgradne procese in omogoči hitrejšo spremembo namembnosti odlagališča. Metoda je stroškovno ugodna ter krajinsko in ekosistemsko okolju dolgoročno prijaznejša.

This is an improved and innovative reclamation method.

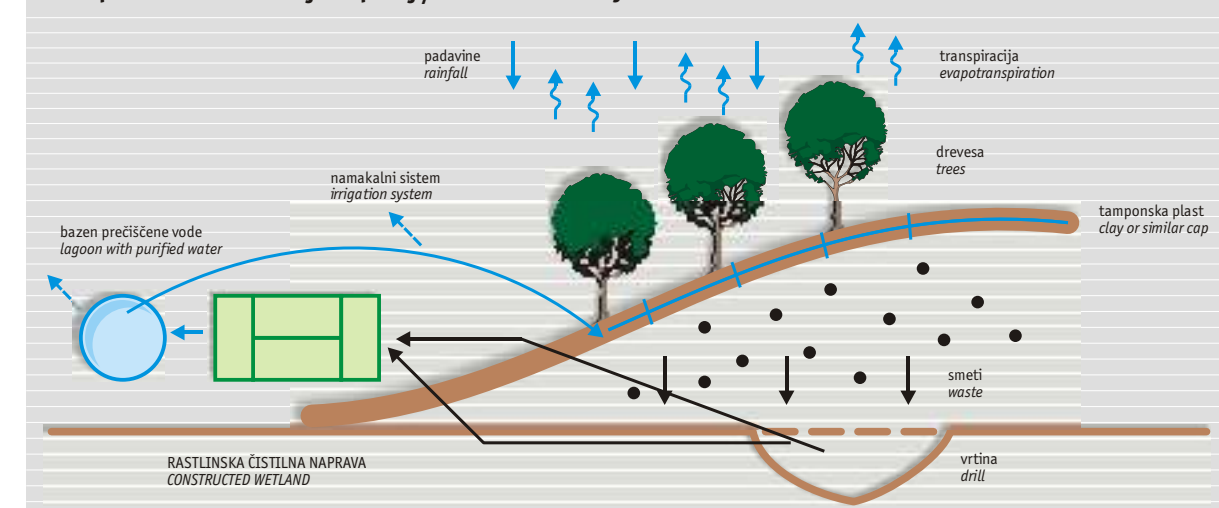
Its technology includes:

- a dense woodland establishment,
- a constructed wetland,
- an irrigation system.

Such a combination speeds up mineralization processes and allows for a quicker transition in the land use. The method is cost-effective and environmentally friendly.



Princip sonaravne sanacije deponij / Co-natural Landfill Site Rehabilitation



Jezerca, zadrževalniki in močvirja

Lakes, Reservoirs and Wetlands

V Sloveniji imamo nad 1270 stoječih voda, približno 210 jih ima značaj jezera. Jezera in zadrževalniki imajo velik ekološki in gospodarski pomen, zato moramo z njimi ravnati razumno. Upravljanje je potrebno prilagoditi mejam naravnega ravnovesja voda. Uporaba je tesno povezana s kvaliteto vode. Večnamensko uporabo lahko zagotovimo le z upočasnitvijo evtrofikacije (s kontrolo bilance hranilnih snovi), s preprečevanjem zasipanja in kontaminacije jezer s strupenimi snovmi ter z ohranjanjem naravnega ravnovesja jezerskih in objezerskih ekosistemov.

Izvajamo projekte gospodarjenja z jezeri, zadrževalniki, močvirji ipd.:

- določitev izhodišnega stanja,
- določitev ciljnega stanja (večnamenske uporabe),
- izdelava strokovnih podlog za preventivne in sanacijske ukrepe,
- predlogi za gospodarjenje,
- programi monitoringa.

There are over 1270 standing freshwaters in Slovenia, of which about 210 have lake characteristics. Lakes and reservoirs are of great ecological and economic importance and therefore require careful and rational management. Lake management needs to consider the natural balance of waters. The use of lakes is strongly dependent on the quality of water. Multipurpose use can only be assured by slowing down eutrophication (control nutrient balance), by preventing large sediment accumulation and pollution from toxic substances, and by preserving the natural balance of lake and lakeshore ecosystems.

Lake, reservoir and wetland management projects include:

- assessment of the actual state (trophic status),
- identification of the desired state (multipurpose use),
- preparation of expert recommendations for protection measures and restoration methods,
- development of management proposals,
- design of monitoring programmes.



Vplivi na prehranjevalno verigo v jezeru /
Bottom-up and top-down forces in a lake foodweb



Taksonomija alg

Taxonomy of Algae

Alge so najbolj raznolika in za vse ekosisteme zelo pomembna skupina rastlinskih organizmov. Pestrost sladkovodnih alg v Sloveniji pogojuje veliko število različnih biotopov (potoki, reke, naravna in umetna jezera, močvirja, mrtvice, slapovi, ...) Alge so pomembni primarni producenti v stoječih in tekočih vodah. Raziskave alg obsegajo razširjenost in ogroženost posameznih skupin ali vrst, ekologijo alg, pojavljanje alg v povezavi s procesom evtrofikacije v jezerih. Zaradi onesnaženja okolja lahko preživijo le najodpornije vrste, zato se splošno upo-rablja kot indikatorji kakovosti vode.

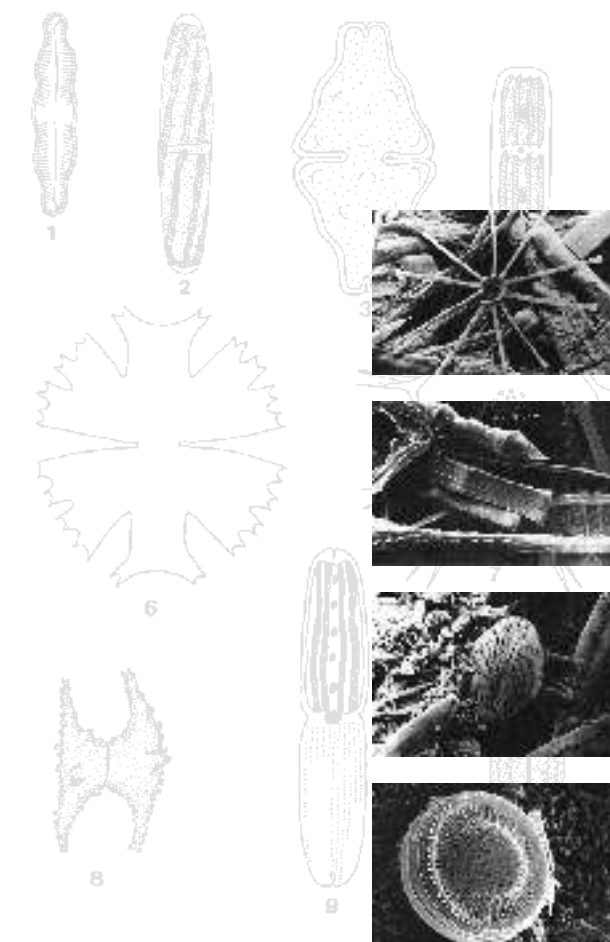
V podjetju Limnos izvajamo:

- vzorčevanje in določevanje alg z oceno bioindikatorske vrednosti,
- monitoring fitoplanktona v jezerih in akumulacijah,
- monitoring perifitona v tekočih vodah,
- saprobiološke analize,
- bazične in aplikativne ekološke in taksonomske raziskave.

Algae are the most diverse group of plant organisms playing an important role in all types of ecosystems. The diversity of freshwater algae in Slovenia results from the presence of numerous biotopes (creeks, rivers, lakes and reservoirs, wetlands, falls etc.). Algae are important primary producers both in standing and running waters. Algae research looks at the distribution and conversation status of individual groups or species, their ecology, as well as the dynamics of algae growth with respect to lake eutrophication. As only the most resistant algae species can survive effects of environmental pollution, algae generally serve as bioindicators for the quality of water.

Limnos activities in this area are:

- sampling and species determination with the use of bioindicator value,
- monitoring of phytoplankton in lakes and reservoirs,
- monitoring of periphyton in running waters,
- saprobiological analyses,
- basic and applied research in ecology and taxonomy.



Ekološko sprejemljiv pretok

Ecologically Acceptable Flow

Ekološko sprejemljiv pretok (Qes) je tista količina in kvaliteta vode, ki zagotavlja ohranitev ekološkega ravnotežja v in ob vodnem prostoru.

Qes določamo:

- pri odjemih vode iz vodotokov, izvirov, jezer in podtalnice,
- za uporabnike kot so hidroelektrarne, ribogojnice, pri namakanju, za vodoskrbo, za potrebe industrije,
- z namenom, da je kljub odjemu vode zagotovljena normalna struktura in funkcija vodotoka kot ekosistema.

V primeru, da je naravni pretok nižji od Qes, se vode iz vodotoka ne sme odvzemati.

The ecologically acceptable flow (EAF) is defined as the quantity and the quality of water, which preserves the ecological balance in streams and riparian zones.

EAF should be determined:

- for water abstractions from running waters, springs, lakes and underground water,
- for users such as hydroelectric power stations, fish farms, industry, water supply and irrigation projects,
- with the purpose to preserve the structure and the function of water ecosystems.

If the natural flow is lower than the EAF value, no abstractions should be made from the running water.



Revitalizacije vodotokov

River Restoration

Z enonamenskimi posegi v vodotoke (meloracije, kanaliziranje) so bili številni vodotoki v Sloveniji uničeni, z njimi pa tudi nekateri izjemni ekosistemi z redkimi rastlinami in živalmi.

Revitalizacija pomeni obnovitev ekološkega ravnotežja v degradiranem vodotoku v sonaravno stanje z ustreznimi vodnogospodarskimi posegi. Na takšen način ciljano obnovimo zgradbo in funkcijo vodnega in obvodnega biotopa ter opredelimo ekosistemsko, krajinsko in večnamensko izrabo prostora.

Single-purpose interventions, such as the reclamation of land by drainage or the building of sewage systems, have destroyed numerous running waters in Slovenia, as well as some extraordinary ecosystems with rare plant and animal species. River restoration means that the ecological balance in a degraded water ecosystem is reestablished through the application of appropriate water management steps. This means that the structure and the function of water biotope is restored and the ecosystem, landscape and multipurpose use of land is defined.



Poročila o vplivih na okolje in okoljske študije

Environmental Impact Reports and Studies

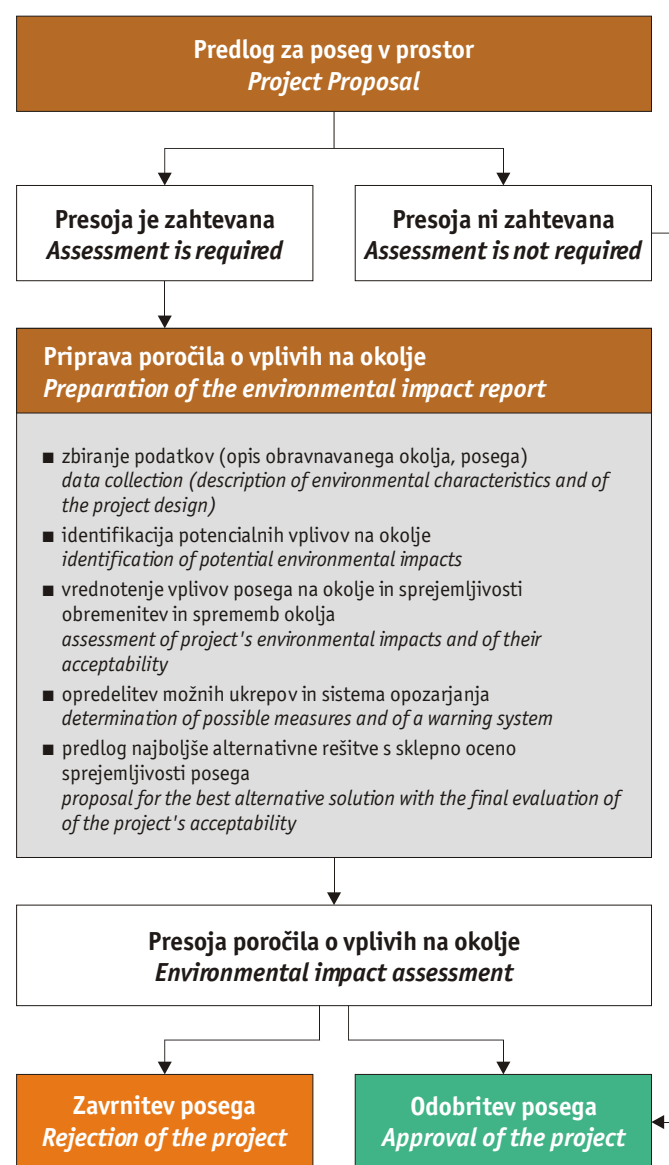
Poročila o vplivih na okolje

Izdelava poročila o vplivih na okolje je potrebna ob posegih v prostor, kjer postopek izdaje dovoljenja za poseg v prostor zahteva presojo o vplivih na okolje. Podjetje Limnos ima splošno pooblastilo Ministrstva za okolje, prostor in energetika za izdelovanje celovitih poročil o vplivih na okolje.

Poročilo, ki je podlaga za presojo o vplivih na okolje, zajema opise, ugotovitve in ocene neposrednih in posrednih vplivov posega na sledeče dejavnike:

- človeka, fauno in floro,
- tla, vodo, zrak, klimo in krajino,
- materialne dobrine, naravno in kulturno dediščino,
- interakcijo med biotskimi in abiotskimi dejavniki.

Cilj priprave poročila je zagotoviti naročnikom ustrezne in točne ocene ter napovedi potencialnih vplivov posega na okolje, izdelati alternative za načrtovane posege in podati potrebne dodatne ukrepe pri izvedbi projekta.



Environmental Impact Reports

The official procedure for issuing an operation licence defines which projects require environmental impact assessment. Limnos Ltd. received the general certificate for the preparation of complete environmental impact reports issued by the Ministry of the Environment, Spatial and Energy Planning. Environmental impact reports represent the basis on which the Ministry completes environmental impact assessments.

An environmental impact report identifies, describes, and assesses a project's direct and indirect effects on the following factors:

- humans, fauna, and flora,
- soil, water, air, climate, and landscape,
- material assets, natural and cultural heritage,
- the interaction between biotic and abiotic factors.

The report's aim is to prepare relevant and accurate evaluations and predictions of potential impacts on the environment, to suggest alternatives to the planned project, and to determine additional measures necessary for the project implementation.

Študije okolja: monitoring in vrednotenje

Namen okoljskih študij je ohranjanje in izboljšanje kakovosti okolja, zagotavljanje razumne rabe naravnih virov in s tem ohranjanja naravnega ravnovesja. Cilji našega dela so uvajanje metod, ki upoštevajo celostno upravljanje z okoljskimi viri, pospeševanje trajnostnega razvoja ter uporaba sonaravnih rešitev.

Študije zajemajo naslednja področja:

- vzorčevanje in terenske meritve parametrov,
- ocene stanj vodnih in obvodnih ekosistemov,
- načrti upravljanja z vodami na zavarovanih površinah,
- strategije upravljanja z odpadnimi vodami v naseljih,
- ocene ekološke škode.

Environmental Studies: Monitoring and Evaluation

The purpose of environmental studies is to preserve and improve the quality of the environment, to assure reasonable use of natural sources and thereby to preserve the natural balance. Our work aims to introduce methods, which incorporate principles of integrated natural resource management, as well as to promote sustainable development and the use of co-natural environmental solutions.

Studies cover the following areas:

- sampling and field parameter measurements,
- assessment of the state of water and riparian zone ecosystems,
- sustainable water management plans for protected areas,
- wastewater management strategies for settlements,
- environmental damage evaluation.



Ilustracija / Cartoon by: Miroslav Bartak (Green Cartoons for CARE)

Ekoremediacija Ecoremediation

Neživo *Abiotic*

- Mehansko *Mechanical***
- hidromorfologija • *hydromorphology*
 - erozija • *erosion*
 - tok • *current*
 - usedanje • *sedimentation*
 - podloga za organizme • *substrate for organisms*
 - evapotranspiracija • *evapotranspiration*
 - itd. • *etc.*
- Fizikalno-kemijsko *Physico-chemical***
- svetloba • *light*
 - temperatura • *temperature*
 - pH – CO₂ • *pH – CO₂*
 - prevodnost • *conductivity*
 - redoks • *redox*
 - itd. • *etc.*
- Kemijsko *Chemical***
- CO₂, O₂ • *CO₂, O₂*
 - hranila • *nutrients*
 - elementi • *elements*
- Onesnaževalci *Pollutants***
- težke kovine • *heavy metals*
 - pesticidi • *pesticides*
 - patogeni organizmi • *pathogenic organisms*

STRUKTURA
STRUCTURE

Živo *Biotic*

- Primarni proizvajalci *Primary producers***
- alge (fitoplankton) • *algae (phytoplankton)*
 - perifiton • *periphyton*
 - mahovi • *musci*
 - makrofiti • *macrophytes*
- Sekundarni proizvajalci *Secondary producers***
- zooplankton • *zooplankton*
 - zoobentos • *zoobentos*
- Terciarni proizvajalci *Tertiary producers***
- ribe • *pisces*
 - sesalci • *mammals*
- Razgrajevalci *Decomposers***
- bakterije • *bacteria*
 - glive • *fungi*
- Patogeni organizmi *Pathogenic organisms***
- bakterije • *bacteria*
 - virusi • *viruses*
 - glive • *fungi*

FUNKCIJA
FUNCTION

Stabilen ekosistem Ecosystem Stability

Čas *Time*

- čiščenje • *purification*
- zadrževanje vode • *water retention*
- pokrajina • *landscape*
- biološka raznolikost • *biodiversity*
- ustvarjanje habitatov • *habitat creation*

Dejavnosti Limnosa

- projektiranje, izvedba in upravljanje rastlinskih čistilnih naprav (RČN),
- sanacija odlagališč odpadkov,
- določanje ekološko sprejemljivega pretoka vode,
- izdelava strokovnih podlag za večnamensko izrabo jezer, zadrževalnikov in močvirij s predlogi za gospodarnjenje,
- presoja vplivov na okolje,
- ocena stanj in monitoring vodnih ter obvodnih ekosistemov,
- sonaravno urejanje vodnih in obvodnih ekosistemov (revitalizacije),
- ocena ekološke škode,
- načrti upravljanja z vodami,
- okoljsko svetovanje,
- taksonomija alg.

Limnos Activities

- *planning, construction and operation of constructed wetlands,*
- *co-natural reclamation of landfills,*
- *determination of the ecologically acceptable flow,*
- *preparation of expert recommendations for the multipurpose use of lakes, reservoirs and wetlands including management proposals,*
- *environmental impact assessment,*
- *assessment and monitoring of water and riparian zone ecosystems,*
- *co-natural management of water and riparian zone ecosystems (river restoration),*
- *environmental damage evaluation,*
- *water management proposals,*
- *eco-counselling,*
- *algae taxonomy.*



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Spremeni en dejavnik (npr. svetlobo) in glej, kako se spreminjajo drugi dejavniki.
Change one parameter (e.g. light) and watch which parameters are changing.