



**Ingenieurbüro Blumberg**

Germany

# 生态工程建设成功案例和方案介绍 生态工程建设成功案例和方案介绍 Introduction To Ecological Engineering Case Studies And Solutions

人工湿地水处理  
Constructed Wetlands For Wastewater Treatment



# Contents / 目录



<b>1-2</b>	Natural wetlands / 天然湿地
<b>3</b>	Delta of Yangtze river / 长江三角洲
<b>4</b>	River Bank Wetlands at Yangtze / 长江岸边的天然湿地
<b>5</b>	Definition “Ecological engineering” (ecotechnologies) / 生态工程的定义
<b>6-7</b>	Reed bed treatment system / 人工湿地处理系统
<b>8</b>	Network of roots and rhizomes of reed / 芦苇发达的根系
<b>9</b>	Reed bed treatment system with network of roots and rhizomes flushed out / 芦苇床人工湿地系统
<b>10-11</b>	Advantages of constructed wetlands / 人工湿地的优势
<b>12-38</b>	Case Studies And Solutions / 案例及方案介绍
13-17	1. Domestic wastewater treatment / 生活污水处理
18	2. Industrial Wastewater Treatment / 工业污水处理
19-20	3. Stormwater Treatment and Retention / 生态湿地蓄雨洪处理
21-22	4. Sludge Drying Beds / 生态型污泥处理
23-24	5. Tertiary Treatment of effluents of conventional wastewater treatment plants / 深度水处理中水回用
25-26	6. Natural Swimming Pools / 天然生态游泳池
27-32	7. Wetland Roofs / 湿地花园屋顶
33-38	8. Natural Treatment of Polluted Rivers and Lakes / 景观水处理及生态修复

# Natural wetlands / 天然湿地

Kidneys of big streams before entering the ocean /  
大江大河入海前天然的肾



Delta of Ganges

恒河三角洲



# Natural wetlands / 天然湿地

Kidneys of big streams before entering the ocean /  
大江大河入海前天然的肾



Delta of Nile

尼罗河三角洲



# Delta of Yangtze river / 长江三角洲



Most of formerly  
existing wetlands  
destroyed

绝大多数原始湿地已不  
复存在



# River Bank Wetlands at Yangtze 长江岸边的天然湿地



River Bank Wetlands at  
Yangtze, still existing at  
one side of the river

长江岸边残存的天然湿地



# Definition “Ecological engineering” (ecotechnologies) 生态工程的定义



Systematic arrangement and use of naturally existing ecosystems for continuous purposes of production and / or disposal

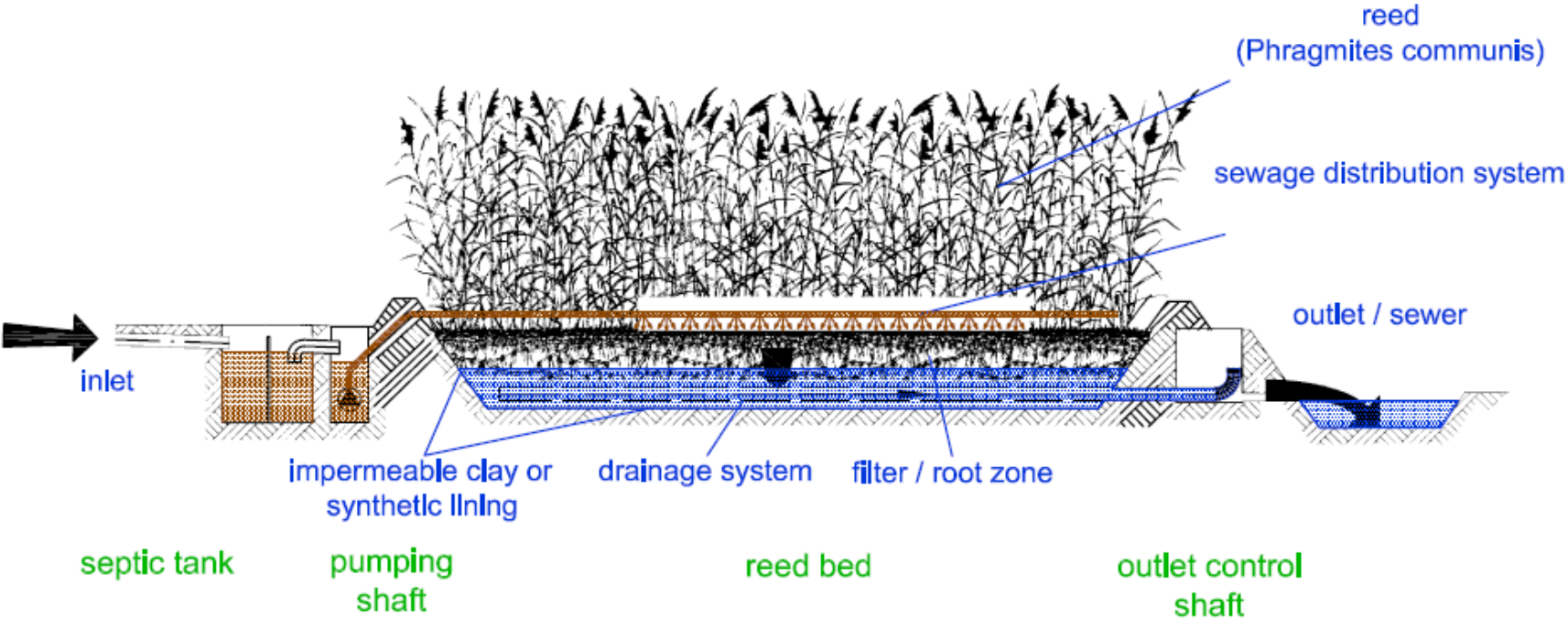
经过系统性设计，利用自然生态系统元素，进行可持续性的生产或处理。



人工湿地处理系统  
Constructed wetland

# Reed bed treatment system / 人工湿地处理系统

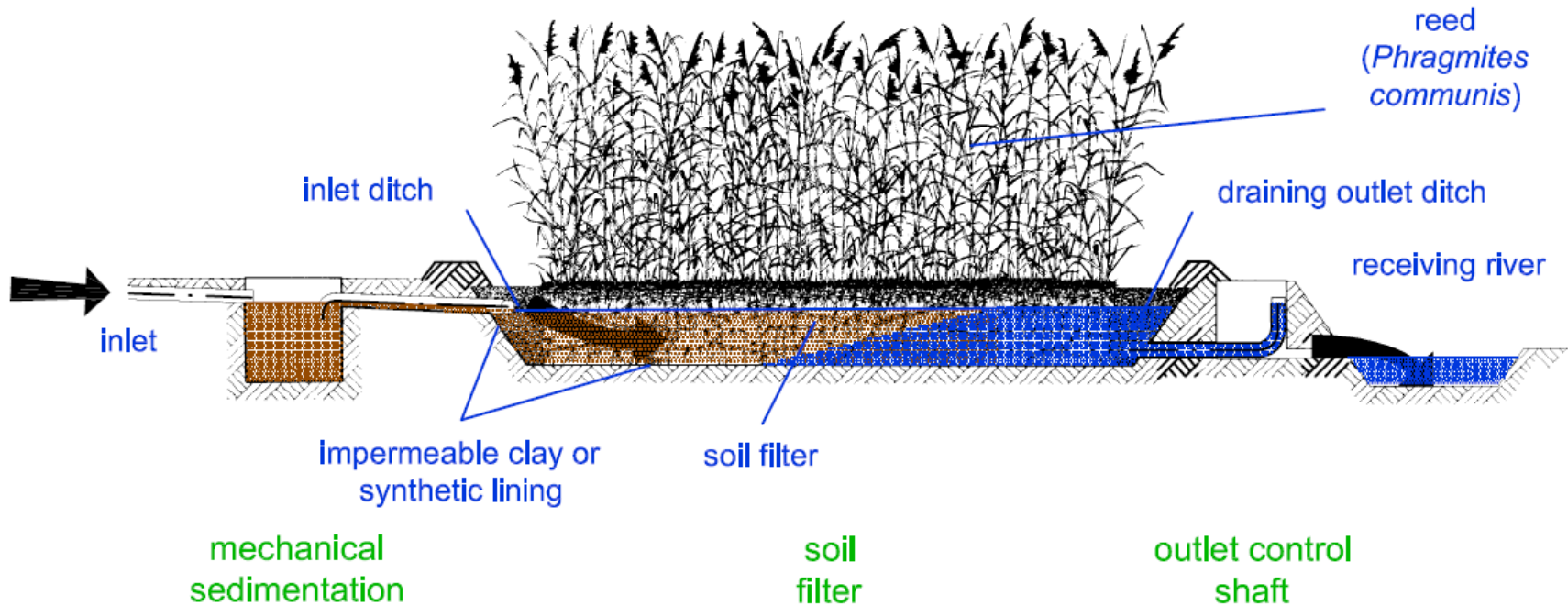
Vertical subsurface flow / 垂直流





# Reed bed treatment system / 人工湿地处理系统

Horizontal subsurface flow / 水平流



# Network of roots and rhizomes of reed / 芦苇发达的根系



拉丁名：  
*Phragmites communis*

# Reed bed treatment system with network of roots and rhizomes flushed out / 芦苇床人工湿地系统



# Advantages of constructed wetlands / 人工湿地的优势



1. Being self-regulating ecosystems ,with nearly no electrical or mechanical parts, no chemical additives.  
自我调节的生态系统，几乎没有电子或机械部件，操作简单，无化学添加剂。
2. Decentralized wastewater treatment ,saving a large quantity of investment into the sewerage system.  
分散式污水处理，节省了对污水收集系统的大量投资。
3. Low energy and maintenance costs.  
低能耗，低维护费。
4. No noise ,no smell, much less sewage sludge production.  
无噪音，无气味，很少的污泥产生。

## Advantages of constructed wetlands / 人工湿地的优势



5. Naturally regenerative, long lifetime.  
自然再生，使用寿命长。
6. Treatment capability for a wide variety of effluents, domestic and industrial.  
具备各类水处理能力，包括家庭和工业污水。
7. Fitting in the local landscape and offering a great wildlife conservation potential.  
与当地景观相协调，并提供一个大型的野生动物栖息地。
8. Reed harvesting as a regenerative energy source may contribute to generate electricity (biogas).  
收割的芦苇作为一个可再生能源的来源产生沼气，用于发电。



1. Domestic Wastewater Treatment  
生活污水处理

2. Industrial Wastewater Treatment  
工业污水处理

3. Stormwater Treatment and Retention  
生态湿地蓄雨洪处理

4. Sludge Drying Reed Beds  
生态型污泥处理

5. Tertiary Treatment of Effluents or Conventional  
Wastewater Treatment Plants  
深度水处理中水回用

6. Natural Swimming Pools  
天然生态游泳池

7. Wetland Roofs  
湿地花园屋顶

8. Natural Treatment of Polluted Rivers and Lakes  
景观水处理及生态修复

# 1. Domestic wastewater treatment / 生活污水处理

## 1.1 Wastewater treatment plant Gadenstedt (Germany)

Gadenstedt 污水处理厂 (德国)



Project of world exhibition Expo 2000  
Hanover, Germany

2000年汉诺威世博会项目，德国



# 1. Domestic wastewater treatment

1.2 Wastewater treatment plant ahshahr (Iran) 4.000 people /  
Mahshahr 污水处理厂(伊朗) 4000人



After construction,  
before planting

施工后，种植前





# 1. Domestic wastewater treatment

1.3 Wastewater treatment plant Mahshahr (Iran) 4.000 people /  
Mahshahr 污水处理厂(伊朗) 4000人



After planting

种植后



# 1. Domestic wastewater treatment

1.4 Wastewater treatment plant Shenyang (China) 6.000 people /  
沈阳污水处理厂(中国) 6000人



After construction,  
before planting

施工后，种植前



# 1. Domestic wastewater treatment

1.5 Wastewater treatment plant Shenyang (China) 6.000 people /  
沈阳污水处理厂(中国) 6000人



After planting

种植后



## 2. Industrial wastewater treatment / 工业污水处理

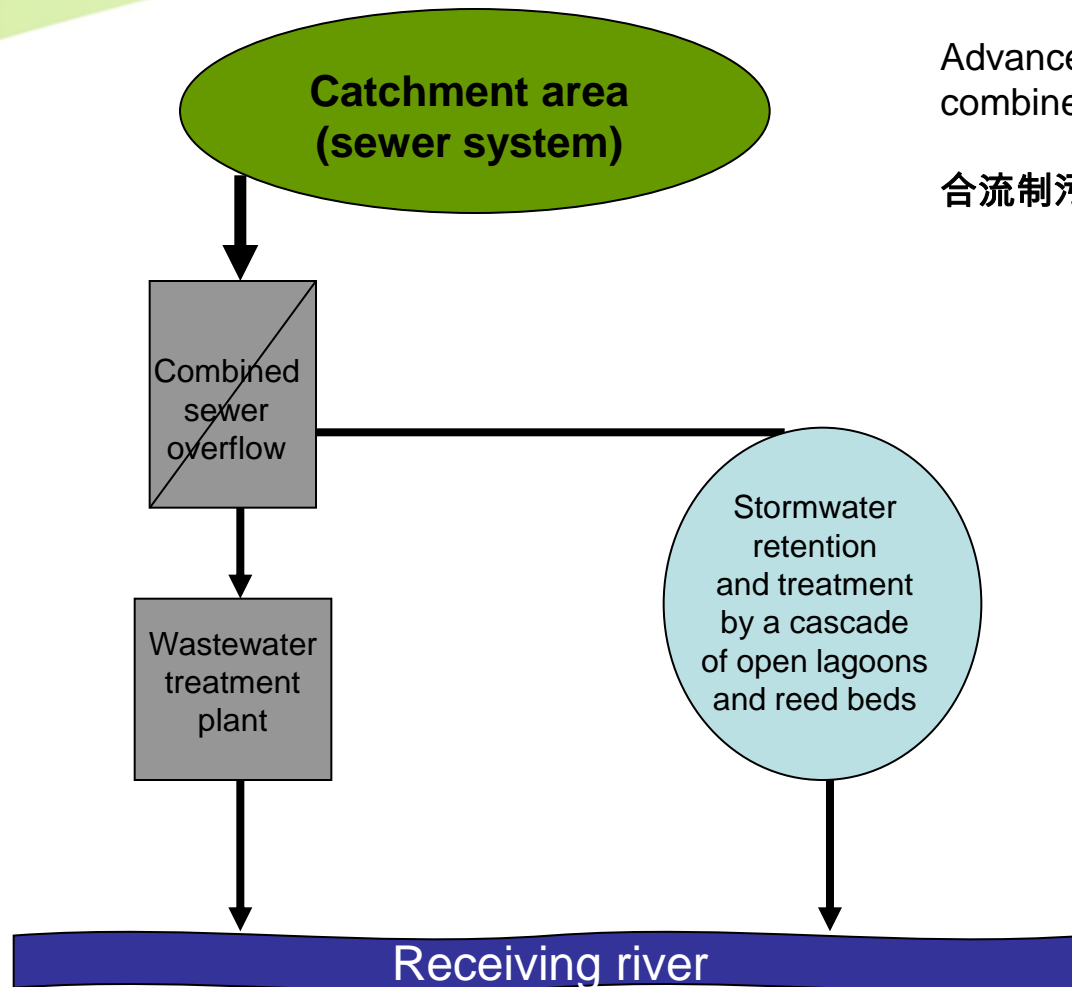
(ICI Zeneca / England) / 70,000 m<sup>2</sup>  
化工工业污水处理 ( ICI Zeneca / 英国 )



# 3. Stormwater Treatment and Retention (Germany) / 生态湿地蓄雨洪处理



## 3.1 Basic design / 基础设计



Advanced treatment of combined sewage

合流制污水处理

# 3. Stormwater Treatment and Retention (Germany)



## 3.2 Cascade of ponds and reed bed treatment systems / 多级生态湿地蓄雨洪处理 (德国实例)



Oberg



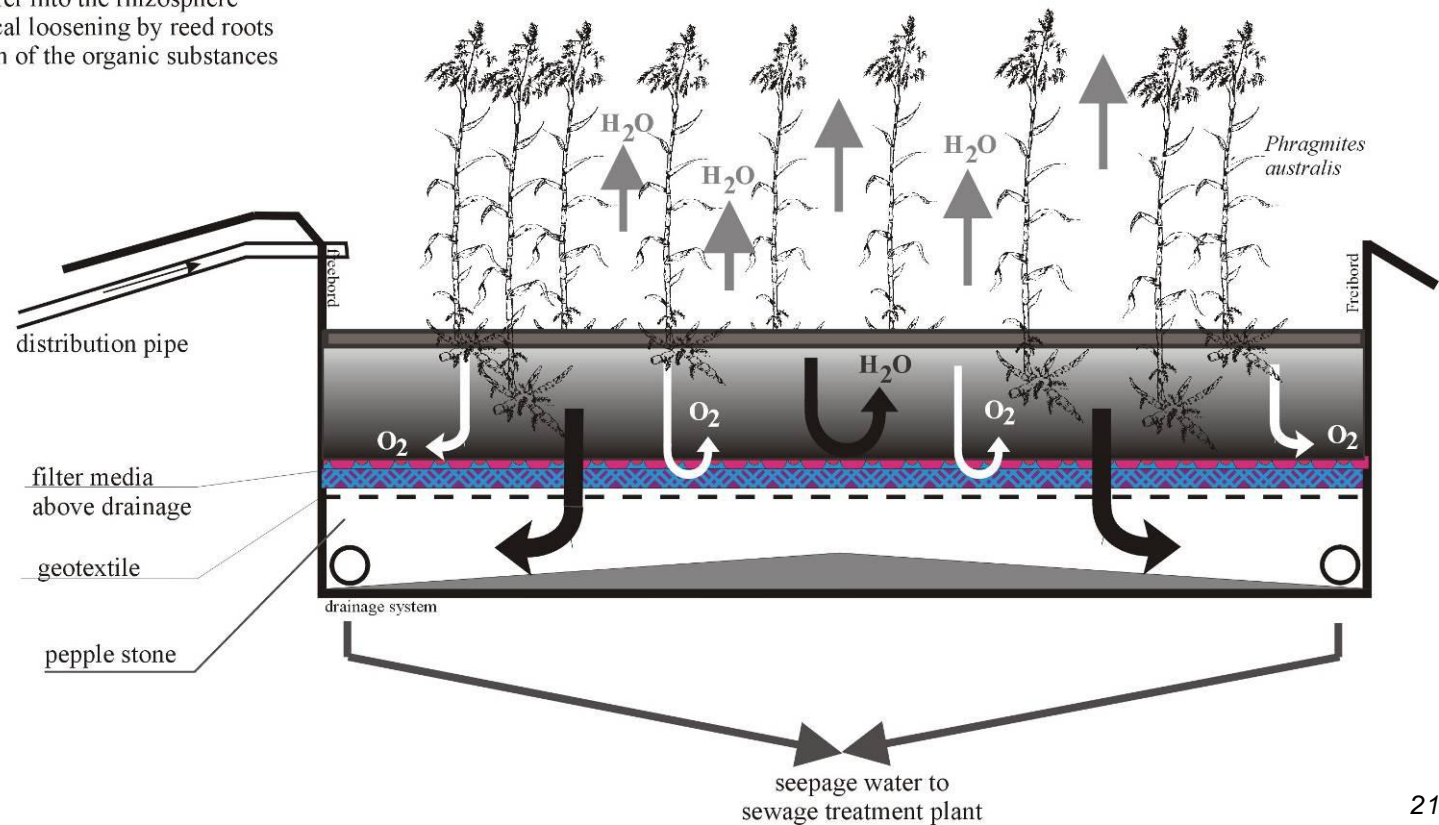
Gadenstedt

# 4. Sludge Drying Beds / 生态型污泥处理

## 4.1 Basic design / 生态型污泥处理原理图



- Infiltration
- Percolation
- Evapotranspiration
- Oxygen transfer into the rhizosphere and mechanical loosening by reed roots
- Mineralization of the organic substances
- Dewatering



## 4. Sludge Drying Beds

### 4.2 Practical applications (Germany) / 生态型污泥处理 (德国实例)



Groß Lafferde



Naumburg



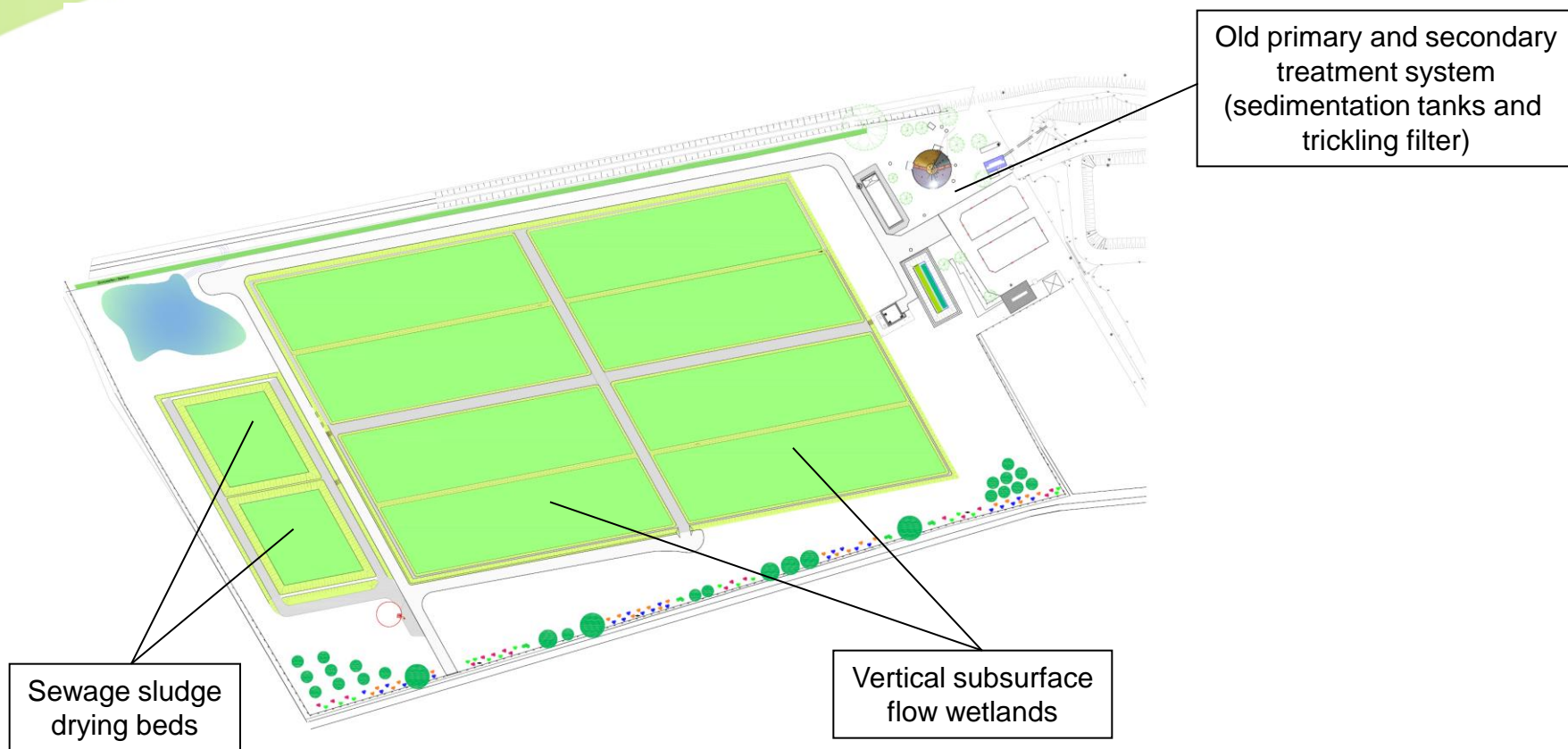
Bad Emstal



## 5. Tertiary Treatment of effluents of conventional wastewater treatment plants / 深度水处理中水回用



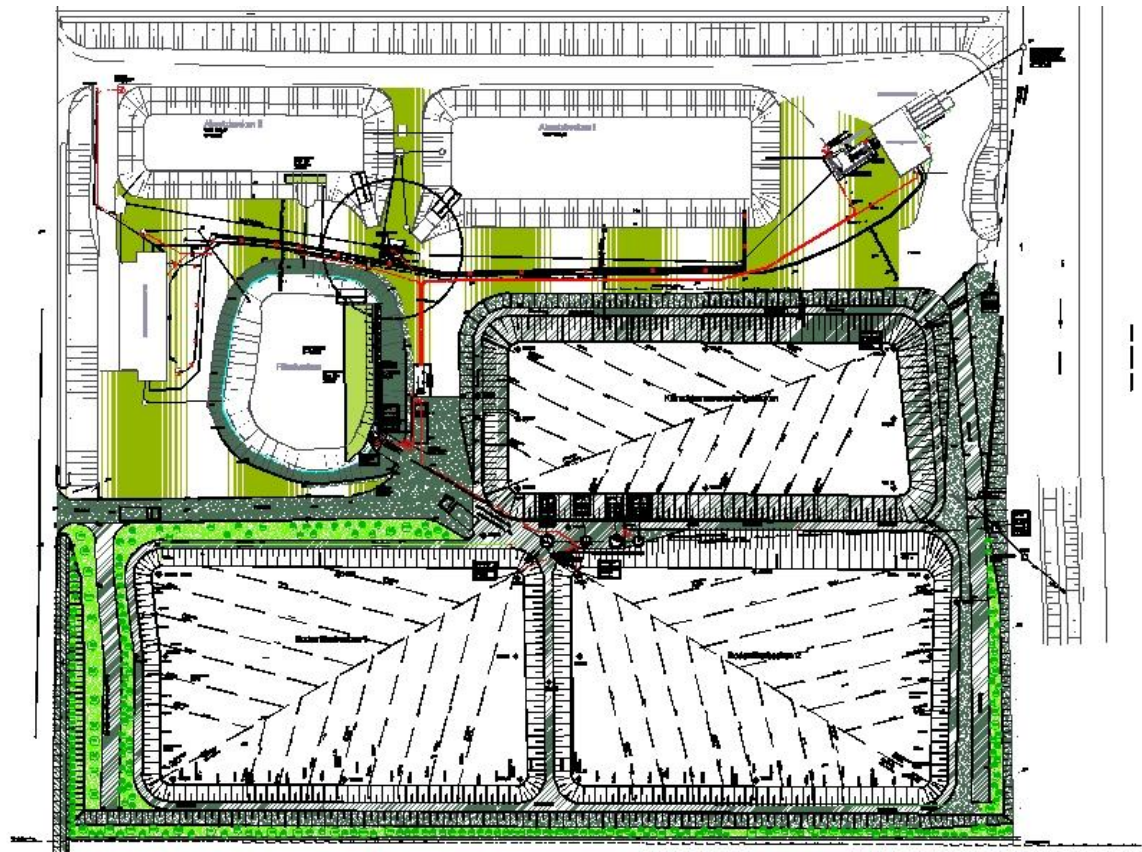
### 5.1 Münstedt (Germany) 4,000 people / 深度处理中水回用 (德国实例)



# 5. Tertiary Treatment of effluents of conventional wastewater treatment plants



## 5.2 Fronhausen (Germany) 5,000 people / 深度处理中水回用 (德国实例)



# 6. Natural Swimming Pools / 天然生态游泳池

## 6.1 Swimming Pool Göttingen (Germany) for public use / 天然游泳池生态水处理 Goettingen (德国实例)



-Water treatment without any chlorine / chlorine dioxide by treatment in a constructed wetland and recirculation

-游泳水生态循环处理无需加氯粉消毒



FREIBADSANIERUNG GÖTTINGEN-GRÖNE  
UMBAU ZU EINEM NATURERLEBNISBAD

**Sport und Freizeit**  
GmbH & Co. KG

# 6. Natural Swimming Pools

6.2 Outdoor Natural Swimming Pool Göttingen (Germany)  
天然游泳池生态水处理 Goettingen (德国)

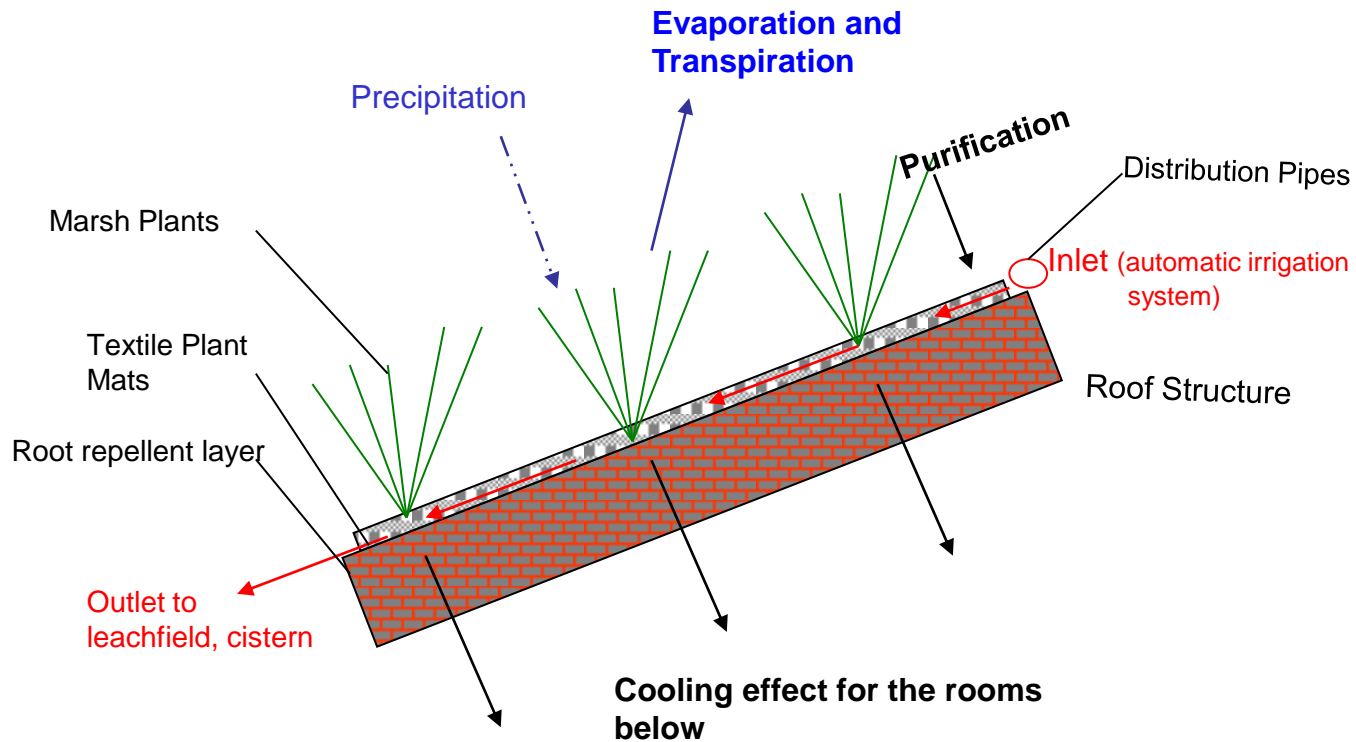


# 7. Wetland Roofs / 湿地花园屋顶



## 7.1 Structure and principle of a wetland roof / 湿地花园屋顶原理图

### *Ecoroof with irrigation of rainwater*



# 7. Wetland Roofs

## 7.2 Functions and advantages of a wetland roof / 湿地屋顶功能与优势



1. Compensation of temperature amplitudes (of the roof skin, of the building, of the ambient microclimate) and cooling
  - due to the irradiation shielding
  - due to the evapotranspiration of the artificially irrigated roof caused by the lush roof vegetation even during the summer months.

温差补偿 ( 屋面 , 建筑 , 周围小气候 ) 和降温

- 由于辐射屏蔽
- 由于湿地屋顶灌溉所造成的蒸腾作用。

2. Stormwater discharge reduction (retaining 60 % of runoff and thus reducing stormwater fees)

减少雨水排放 ( 截留60 % 的径流 , 从而降低雨水收费 )

3. Increase of durability of the roof by a temperature reduction and protection against a direct impact of UV-radiation leading to a reduced surface ageing (reduced membrane replacement costs).

增强屋顶的耐久性 , 避免因紫外线辐射导致表面老化。

## 7. Wetland Roofs

### 7.3 Functions and advantages of a wetland roof / 湿地屋顶功能与优势



4. Compensation of the surface impermeability (factor  $\geq 50\%$ ).

增强表面抗渗性 (  $\geq 50\%$  )

5. Considerable reduction of the need for technical air-conditioning (supplied by fossil sources of energy) because of a passive cooling of the building (energy savings).

被动式节能建筑减少空调的需求。

6. Improvement of the microclimate and contribution to the prevention of an overheating of urban conglomerates during the summer months (hot spots).

改善小气候，夏季减少城市热岛效应。

7. Filtration of dust emissions and of other air polluting matters.

过滤空气中粉尘及其他污染物。

## 7. Wetland Roofs



### 7.4 Functions and advantages of a wetland roof / 湿地屋顶功能与优势

**8.** Higher short-wave radiative reflexion compared to a dark bitumen roof.  
与深色沥青屋顶有较高的短波辐射反射性。

**9.** Reduced roof loads due to a substrate-free planting procedure with only one textile water accumulating mat on which the selected types of wetland plants have been pre-cultivated. This procedure ensures that the roof surface is fully covered by plants after one period of egeation.  
无机质的土工布垫层种植湿地植物减少屋顶负荷，预先栽培的湿地植物确保施工后一段时间内屋面被植物完全覆盖。

**10.** Possible design as a roof garden (flat roof) with a highly aesthetic component due to the variety of usually untypical types of roof plants like wetland or marsh plants (aquatic acrophytes) and by the animals belonging to such a kind of ecosystem (e.g. butterflies and birds) instead of succulent or grass roofs with their poor vegetation during the summer months. Employees use the roof space for recreation during breaks.

屋顶花园的设计是高度审美的组合，生态系统中有各种湿地植物和动物（如蝴蝶和鸟类）的栖息  
员工可以利用屋顶空间，休息娱乐。



## 7. Wetland Roofs

### 7.5 Functions and advantages of a wetland roof / 湿地屋顶功能与优势



**11.** Possible use as a roof sewage treatment plant both for municipal and for industrial waste water (constructed wetlands) or for greywater recycling or stormwater treatment (benefits of natural water purification).

屋顶污水处理厂不但处理市政和工业废水，而且可以对灰水和雨水的回收利用。

**12.** Irrigation system that is activated by means of an irrigation computer automatically when water in the drainage layer gets low.

灌溉系统通过电脑根据排水层水位高低自动运行。

## 7. Wetland Roofs

### 7.6 Wetland Roof Brunswick (Germany) / 湿地花园屋顶 Brunswick (德国实例)



## 8. Natural Treatment of Polluted Rivers and Lakes / 景观水处理及生态修复



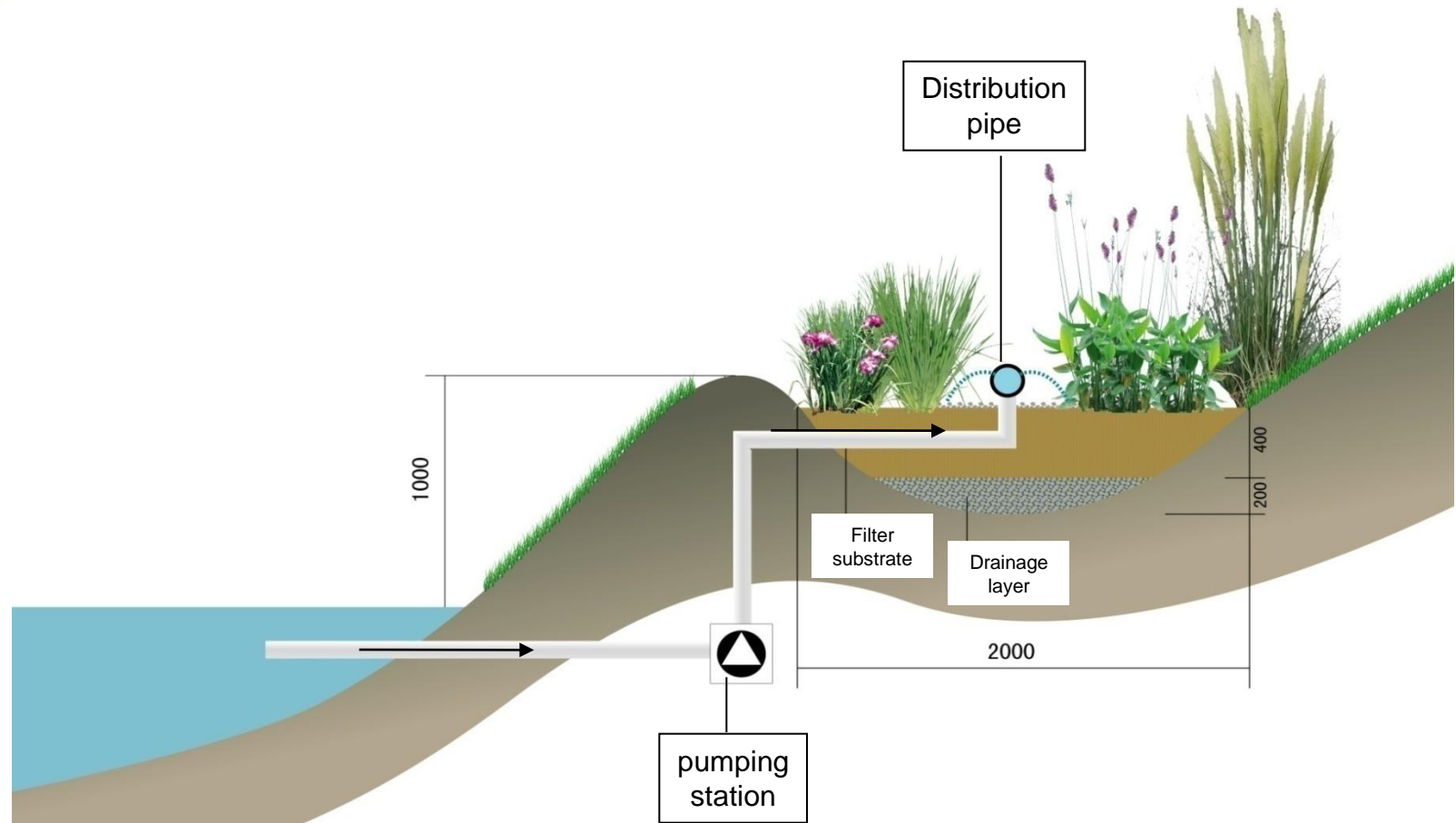
### 8.1 Useful areas for river bank wetland gardens / 可作为滨河景观人工湿地的现有用地



# 8. Natural Treatment of Polluted Rivers and Lakes



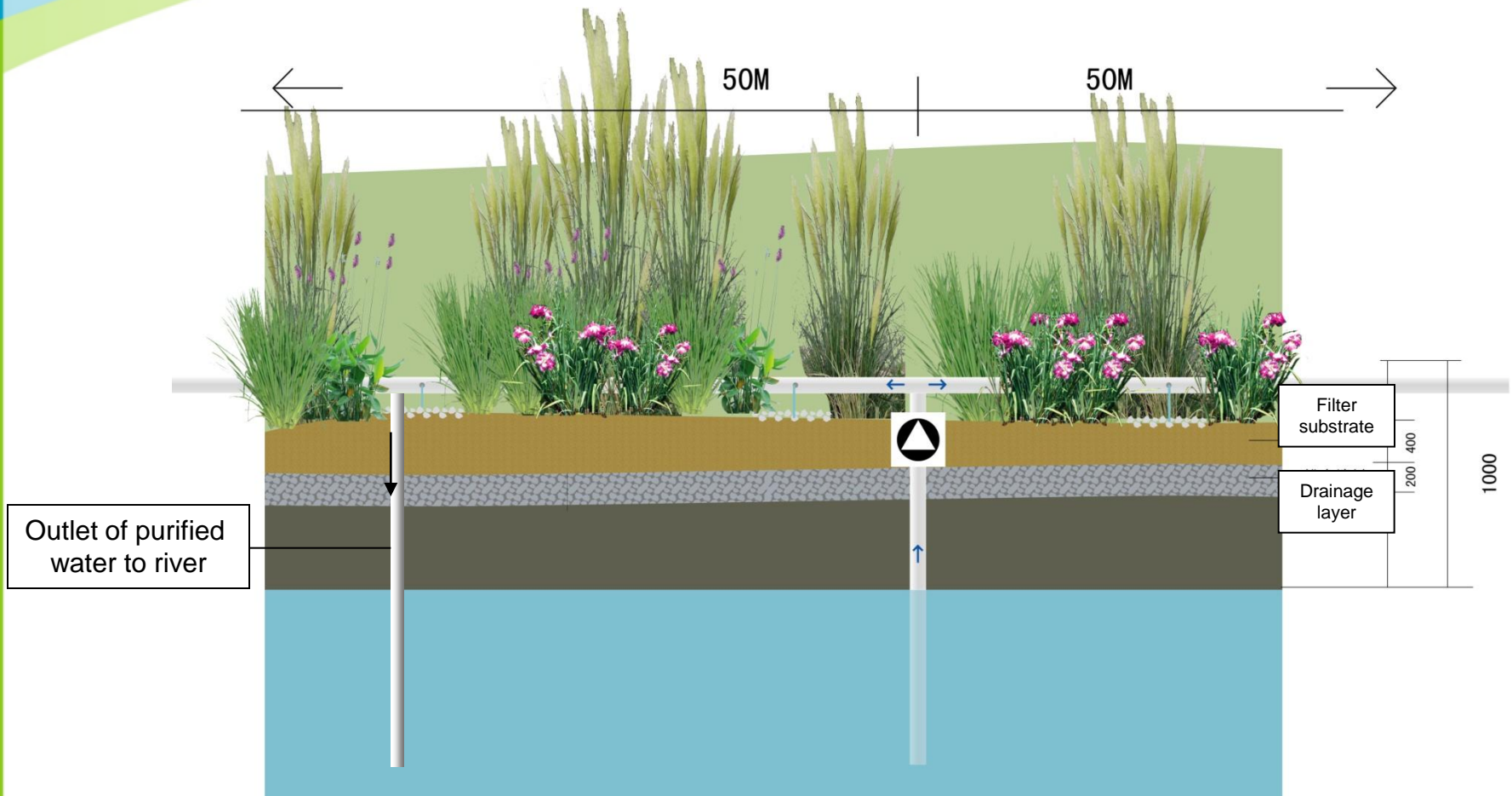
## 8.2 Riverbank wetland garden (cross section) / 滨河景观人工湿地(横剖面)



# 8. Natural Treatment of Polluted Rivers and Lakes



## 8.3 Riverbank wetland garden (longitudinal section) / 滨河景观人工湿地 (纵剖面)



# 8. Natural Treatment of Polluted Rivers and Lakes

## 8.4 Riverbank wetland garden / 滨河景观人工湿地



Outlet of purified water to river

## 8. Natural Treatment of Polluted Rivers and Lakes



8.5 Water circulation system for polluted river water Rosebush park, Changzhou (China) / 常州蔷薇园水循环处理系统



Distribution pipe

## 8. Natural Treatment of Polluted Rivers and Lakes



8.6 Using open grasslands on the border of lakes for river water rehabilitation / 利用现有湖边大规模开放式草地营造人工湿地





Copyright holder  
版权所有



**Ingenieurbüro Blumberg**  
**Gänsemarkt 10**

D-37120 Bovenden-Germany  
e-mail: [contact@blumberg-engineers.de](mailto:contact@blumberg-engineers.de)  
[www.blumberg-engineers.de](http://www.blumberg-engineers.de)



Arundo donax/植物名