

# Chemicals

natural waste water treatment

# ARM Group Ltd

## natural wastewater treatment



Whether you're thinking about a new reed bed system, or you just want some timely expert advice about effective operation, we can help.



### Harnessing natural technology

**E**ver since natural waste water treatment systems came of age in the 1980s, ARM Ltd has led the way in reed bed and constructed wetland technology.

Working with the UK water companies, councils, contractors, industrial clients and research institutes, we have designed, built and maintained many hundreds of reed bed systems. These range in size from 10m<sup>2</sup> up to 20,000m<sup>2</sup>, and we have consulted on reed beds of many hundreds of hectares.

Harnessing natural processes, we engineer them to deliver all the advantages of cost-effective, versatile and sustainable wastewater treatment – and we guarantee the performance of every system we design and install.

As the largest dedicated UK company by far in this specialised field, with a reputation dating back to 1947, ARM brings you unique expertise and experience. We can support you at every stage of the process – from initial planning and design through construction and commissioning to ongoing maintenance – ensuring the optimum performance of your reed bed system.

We continue to pioneer new and innovative ideas. Recent developments include an aggregate recycling system to reduce landfill costs and material usage, and a plough to retrofit FBA™ airlines into existing reed beds.

### Why use reed beds?

**T**he Chinese used wetlands more than two thousand years ago for their impressive effluent and water treatment capabilities.

Reed beds provide an ideal environment for a wide range of treatment processes. The combination of micro-organisms, plant roots, rhizomes and substrate matrix remove contaminants in a variety of natural ways.

They treat waste water as it flows through the system just like the process in conventional sewage treatment, but without using energy-intensive machinery.

With low maintenance requirements,

low or zero power consumption and a long, productive lifespan, reed bed systems are both proven and sustainable, enhancing any landscape. Their removal mechanisms include settlement, filtration, biological and chemical action, containment and plant uptake. They can reduce levels of soluble organic matter, suspended solids, ammonia, pathogens, hydrocarbons, and metals.

The various types of reed bed can be used in different configurations to treat a variety of pollutants from industrial or municipal sources.

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## Performance guaranteed

**O**ur reed beds are used at all stages of the sewage treatment process providing primary, secondary and tertiary treatment as well as sludge dewatering.

They can also extend the life of older treatment works by providing a tertiary polish to effluent, bringing it within regulator consent, and saving capital expenditure.

They are increasingly used for tackling industrial effluent. Uses range from treating fire-fighting foam and metal removal from minewater drainage, to reducing ammonia levels in leachate and removing hydrocarbons from groundwater.

Other applications include treatments connected with:

- agriculture
- pharmaceutical
- food processing
- chemicals
- refinery waste
- distillery wastewater
- airport run off
- Sustainable Urban Drainage Systems (SUDS)

They can also be used to create wetland habitats – enhancing bio-diversity.

*Whatever the application, we provide contractual guarantees of effectiveness, performance and quality – so you can be sure you're going to get the results you're looking for.*



## Our comprehensive range of services includes:

**Consultancy:** feasibility studies, process design, site surveys, landscape design, and advice on managing future changes

**Project management:** our experienced managers will look after your entire project from conception through to completion.

**Design and build:** our turnkey service delivers systems on time and within budget, including liaising with regulators and enforcement authorities on your behalf.

**Design and supply of materials and equipment:** a service we provide on request, for example to framework contractors.

**Construction service:** using our design or your own, we make it easy for contractors and save our clients significant amounts of money through design reviews based on experience – without compromising quality or performance.

**Field services for system maintenance:** we extend the life of your system, bring you peace of mind and help you get the best possible results.

**Asset assessment:** we evaluate process efficiency, check your system is operating at top performance, and make recommendations.

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# ARM Group Ltd

## About Us



ARM Group Ltd, a Staffordshire based privately owned company, is the leading designer and constructor of natural waste water treatment systems and associated technologies for the industrial and municipal waste water treatment market in the UK. The Company is noted for its invention and subsequent commercial development of equipment and processes within its chosen markets.

ARM Group Ltd has been trading since 1947 and was originally involved in development, design, manufacture, and construction within Agricultural Engineering. However, in the late 1980s ARM Group Ltd redefined its objectives and moved its customer and product bases into the global market of wastewater treatment specialising in the use of reed bed/wetland systems.

Today the Company operates out of offices in Rugeley, Staffordshire employing 21 people and using Associates and sub-contractors as required.



ARM Group Ltd is broadly divided into seven operating functions these can provide client support either individually, as a team, incorporating the requisite elements, or as a whole providing continuity of support for turnkey solutions from project conception through design construction, commissioning and maintenance, depending on the specific needs of the client. The functions are:

- Sales
- Design
- Project management
- Construction
- Research and Development
- Refurbishment and Maintenance
- Administration





## Experience

For the past 30 years ARM Group Ltd have specialised in reed bed and wetland systems having designed and installed over 700 beds during this period. This provides us with unique and extensive experience of their application, design and construction across the wastewater treatment spectrum. Our experience and knowledge has been accumulated through:

- Design and construction of reed bed systems
- Value engineering optimisation
- Application experience
- Working with academic institutions.
- The international constructed wetlands conference circuit
- Presenting papers
- Personal contact with leading researchers
- Working relationships with leading specialist in specific reed bed applications
- Founder member of the Constructed Wetland Association (CWA)
- Founder member of Global Wetland Technology (GWT)
- Over 1000 reed bed surveys

We have designed and constructed reed beds that provide treatment for:

- Mine water
- BOD and COD reduction
- Methanol removal
- Copper removal
- Pathogens
- Landfill leachate
- Hydrocarbons
- Septic tank waste
- Ammonia
- Surface water run off
- Solids
- Sludge dewatering
- Storm water
- Metals
- Glycol



# British Petroleum, Casper

## Aerated horizontal subsurface flow: Contaminated groundwater



### Project

British Petroleum, Casper

### Location

Casper, Wyoming

### Project type

Groundwater remediation

### Wastewater type

Hydrocarbon contaminated  
groundwater

### Completion date

2003

### Treatment

Subsurface flow wetland with  
forced bed aeration

### Need

The former Casper, Wyoming refinery was one of the oldest refineries in the Western United States. It operated from 1908 until 1991. As a result of common management practices during the 80 years of operation, much of the site is underlain with residual hydrocarbons. It has been estimated that 114,000 m<sup>3</sup> of hydrocarbons (oil) had leaked into the shallow alluvial aquifer adjacent to the North Platte River.

### Solution

BP and the City of Casper agreed to convert the former refinery site into a golf course and office park, with a trail system along the North Platte River. The presence of a large amount of contaminants below the water table created a major challenge. The remediation treatment system needed to handle up to 11,350 m<sup>3</sup> per day of gasoline-contaminated groundwater, blend it into the middle of a premier golf course and operate for more than 100 years. Knowing that petroleum hydrocarbons are biodegradable and keeping in mind the cost of pumping groundwater for decades, BP chose a wetland treatment technology as the most appropriate solution. The full-scale wetland had to be capable of operating at 6,000 m<sup>3</sup> per day and deal with potential fouling of the wetland media. A cascade aeration system for iron oxidation and a surface flow wetland for iron precipitation were added to the system. To address flow distribution, an innovative radial-flow wetland configuration was adopted. This innovative system is the largest remediation wetland in North America.

### Benefits

By using new “green” technology, the old refinery site has been transformed from what once seemed destined to remain an unused brownfield, to a community landmark. There is now a beautiful green space adjacent to the City, with amenities including walking trails, a river park, a whitewater kayak course, and an 18 hole golf course. The wetlands are integrated into the golf course water features. When compared to a conventional mechanical plant, construction of an engineered wetland system saved BP \$12.5 million. Over the first 50 years of the site remediation, the lower operating costs associated with constructed wetlands is anticipated to save an additional \$15.7 million.





# Forced Bed Aeration (FBA)

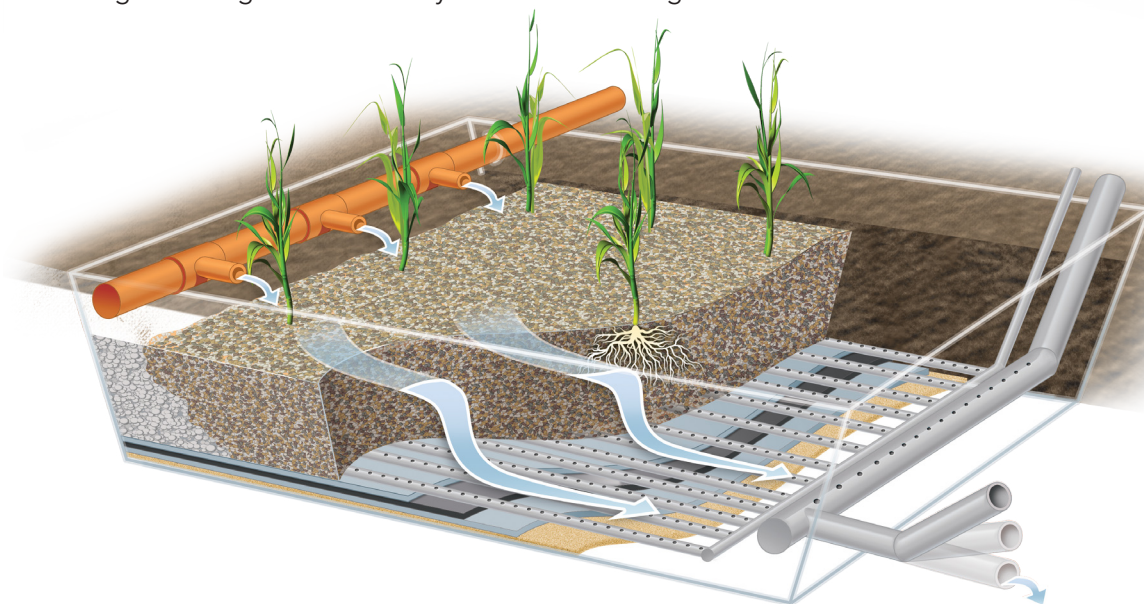
Forced Bed Aeration™ compliments and enhances existing reed bed technology, increasing treatment capacity by up to 15 times.



**F**orced Bed Aeration™ (FBA™) is a new wastewater treatment technology which enhances constructed wetland treatment performance. Significantly higher contaminant removal rates are attained along with an increased consistency of performance. Developed in the USA, by our partners Naturally Wallace, FBA™ can be used in both horizontal and vertical flow constructed wetland systems. Blowing air through the wetland system

makes the system oxygen unlimited increasing the treatment capacity by up to 15 times. This new technology can treat wastewaters high in BOD, SS, NH<sub>4</sub>-N and other organic contaminants.

Forced Bed Aeration™ reed beds can reach performance levels which have been unobtainable in standard reed bed systems with less performance variability. Aeration of horizontal and vertical flow reed beds has multiple advantages.



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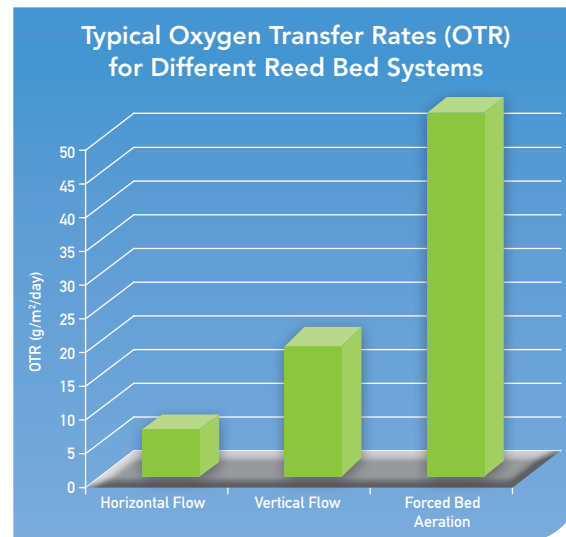


- FBA™ can completely nitrify wastewater
- FBA™ systems can be deeper than conventional reed beds therefore taking up 50% less space than passive systems.
- Plants thrive in FBA™ systems because the introduced oxygen prevents the formation of toxic products that can stunt plant growth in strongly anaerobic, passive system
- FBA™ reed beds can be divided into aerobic and anoxic zones to both nitrify and denitrify.
- FBA™ reed beds are ideal for treating fluctuating loads such as CSO's and locations with variable occupancy.
- Initial studies indicate FBA™ systems have reduced clogging rates extending the operational life of a treatment system.

technology prevents root rhizomes penetrating the emission points.

### Adapting FBA™

FBA™ can be retrofitted to existing reed bed systems, especially those which are overloaded. This prolongs the life of the reed bed and enhance effluent treatment.

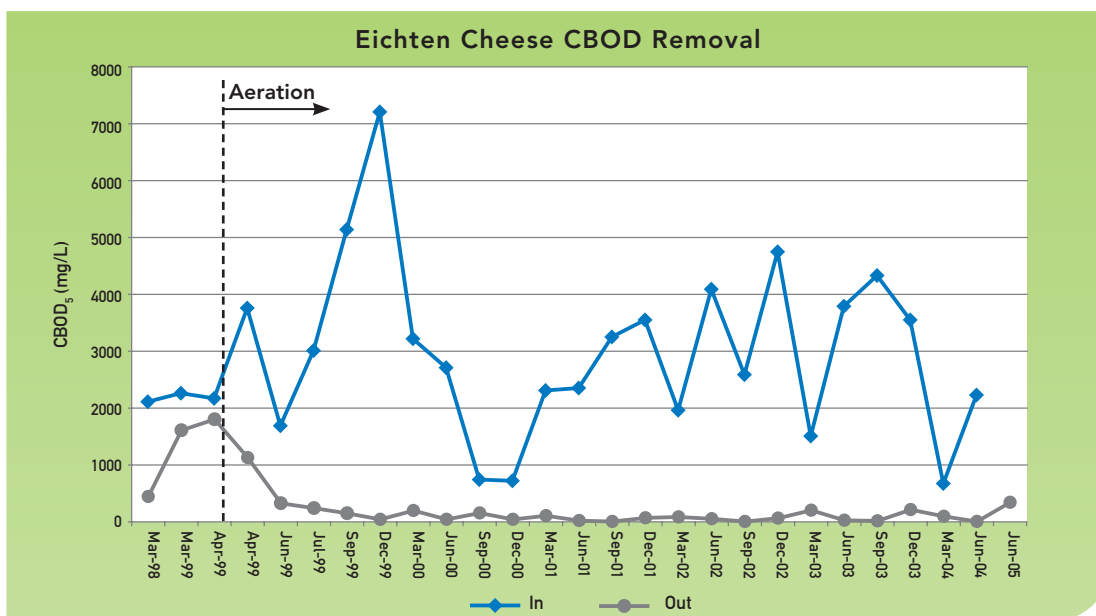


### Pipelines

FBA™ has a unique network of pipelines which provides a constant flow of oxygen into the reed bed. Patented rootguard

### FBA™:

- Improves treatment capability.
- Reduces clogging rates.
- Requires minimum power input.



Graph indicating the treatment performance of an FBA™ wetland system treating cheese production effluent

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# Phragmifiltre: Full sewage treatment by reed beds

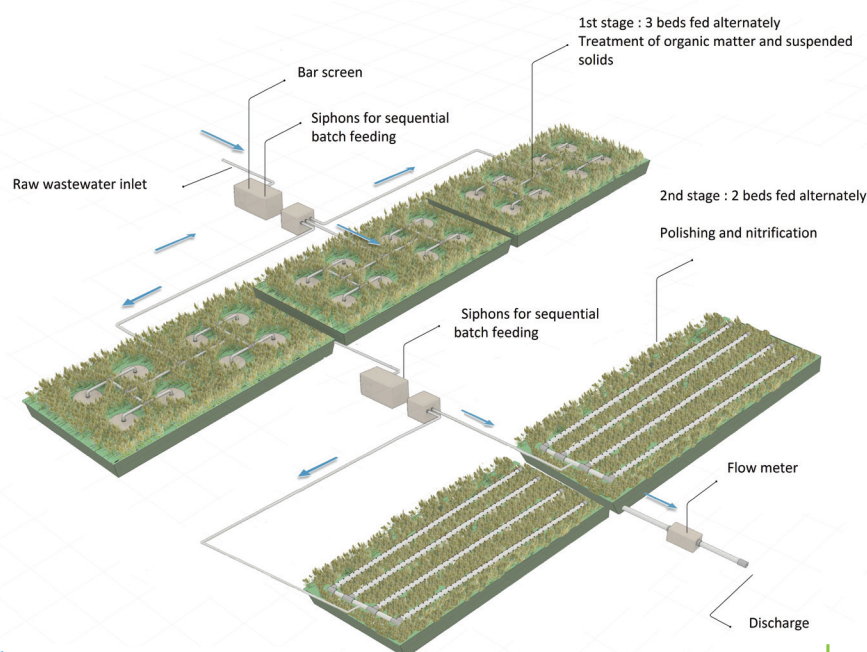
Phragmifiltre exemplifies the rapid evolution of reed bed technology over the past 20 years, from the initial tertiary treatment application to the full treatment of sewage wastewater.



From their first application as a tertiary treatment, 'final polish', solution through secondary treatment, including nitrification, reed bed wastewater treatment systems are now widely being used for the full treatment of sewage all over the globe through the application of the **Phragmifiltre** system.

The **Phragmifiltre** system comprises vertical flow constructed wetlands (reed beds) for the full treatment of sewage and has been successfully operating in

France through Epur Nature and SINT since the 1990's. To date there are over 800 **Phragmifiltre** systems treating raw sewage for loads from 20 to 5,000 PE (population Equivalents). The systems are typically designed to have two stages, the first with three beds, the second with two beds. The first stage filters out and dewateres the solids in the raw waste water on the surface of the bed. The filtrate passes down through the reed bed which acts as a typical batch flow vertical flow



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reed bed reducing BOD primarily but also undertaking nitrification of ammonia. The second stage vertical flow beds provide additional BOD reduction and completes

	INLET CONCENTRATION (MG/L)		OUTLET CONCENTRATION (MG/L)		REMOVAL EFFICIENCIES (%)	
	Mean	SD	Mean	SD	Mean	SD
COD	651	282	50	29	92	7
BOD5	291	140	8	9	97	3
SS	242	133	8	6	97	3
TKN	56	34	7	12	90	12
TP	7	4	6	3	32	25

nitrification of ammonia prior to discharge. Wastewater, preferably flowing by gravity, is fed to each bed in rotation thereby allowing all the beds to have a rest period. The use, where possible, of siphon technology for dosing both stages minimises, or eliminates, power requirements.

In the past the UK sewage treatment industry has tended to use constructed wetlands as a back stop, a means to cover for upstream process deterioration. The recent adoption of **Phragmifiltre** by a major UK Water Company signifies a major step change in thinking and indicates recognition of the TOTEX benefits.

Conventional sewage treatment works (STW) generate sludges which have to be taken from small rural works to larger STW for treatment. **Phragmifiltre** stores and composts sludge on site and therefore no tanker costs (opex) and no roadways (capex) are required. **Phragmifiltre** also provides wildlife habitats that conventional STW do not. Conventional STW are hazardous areas and can be



vulnerable to vandalism, they need security fencing around the whole site (capex).

**Phragmifiltre** only requires security fencing around a few chambers. Conventional STW require weekly operator visits,

**Phragmifiltre** require monthly visits (opex).

**Phragmifiltre** constructed wetlands are an ideal replacement for aging STW and an environmentally attractive, low totex option for new developments. Typical treatment performance data from 70 plants is given in the table above.

There is potential for this technology to be aligned with other intensive reed bed treatment technologies such as Forced Bed Aeration™ to enhance treatment capabilities further if required.

- Full primary, secondary and tertiary sewage treatment by reed beds.
- Proven robustness with high tolerance of temporary hydraulic overloading.
- Low to zero energy consumption
- Integrated sludge treatment, therefore no tankering and associated access features required.
- Simple operation
- Low cost operation
- Excellent integration into the landscape and no nuisance such as odours or noise.

**ARM Ltd** in association with **Epur Nature** and **SINT** in France are proud to be bringing this technology to the UK and happy to supply further information on request.

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## Asset Assessment & Support Package

Knowledge and proactive management of assets is a key area where water companies can cut operational and capital expenditure. The optimisation and enhancement of remote reed bed treatment systems can secure performance for many years without the need for full site refurbishment and the associated costs.



In the September 2012 issue of *Water & Wastewater Treatment* it was reported by the editor that knowledge by the majority of water companies of the condition of their assets is poor. According to the report from the consultancy company E C Harris, some 90% of maintenance in the UK water industry is reactive. Yet it is well known that proactive maintenance will cut costs by upwards of 50%.

Although this is not the case with all water companies we thought it would be an ideal opportunity to offer a simple solution. ARM Ltd have been designing, constructing, refurbishing and retrofitting reed beds for many of the UK's water companies

for decades. It is for this reason we feel best placed to offer you our new Asset Assessment and Support Package (**AASP**).

Reed beds are generally tucked away in Sewage Treatment Works and because they provide treatment with minimal maintenance requirements often get overlooked until the works are close to breaching consent. Our Asset Assessment and Support Package will highlight the condition of the system and give an indication of when refurbishment may be required. This allows expenditure to be planned and therefore controlled and ensures the works performs to its full capability.



Our Asset Assessment and Support Package works in two ways:

## 1. Asset Assessment

### Visual Appraisal

- Condition of the reeds
- Extent of sludge build up on and in the gravel matrix
- Condition of the flow path
- Site layout and accessibility
- Photographic evidence

### Fitness for Purpose

- Review design basis, 'as built' drawings and O & M Manual
- Review current and future loads and recent performance data

### Monitoring program

- Sampling and monitoring program to include influent flows/loads and discharge levels to characterise performance

### Reporting

- Verbal and written report of the assessment complete with conclusions, recommendations and indicative prices of any required remedial work

## 2. Support Service

- Asset longevity prediction
- Sampling and monitoring to establish performance
- Refurbish to 'as built'
- Re-engineering to improve performance
- Maintenance
- System operation
- Retrofit with latest technologies to enhance capability

We would be happy discuss any aspects of this service with you and can be contacted at [info@armgrouppltd.co.uk](mailto:info@armgrouppltd.co.uk) or telephone on 01889 583811.

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