Leidsche Rijn sustainable urban development, Netherlands

Year of issue

2025

Summary

Leidsche Rijn is no longer only “under development”: the VINEX new town has largely been delivered (c. 1997–2025; ~30,000 homes). The original ambition was to retain stormwater on site, minimise imports of poor-quality water, and use extensive SuDS. It has been realised as a near-closed urban water system. Rainwater is stored and infiltrated via wadis/bioswales, canals and ponds; the Haarrijnseplas functions as the seasonal buffer and as a public bathing lake. The system is actively managed by water authority HDSR through circulation and level control with large pumping stations (e.g., Vleuterweide and Terwijde; Vleuterweide’s two pumps move ~107 m³/min). Utrecht has tightened rainwater policy, prioritising reuse → retention/infiltration → discharge and incentivising disconnection from sewers. Routine monitoring now covers wadi performance (annual coring for 10–15 pollutants and renewal of the top layer when saturated); vertical sand/reed filters are used to polish water before inflow to Haarrijnseplas. Recreation and ecology remain integral, with recent seasons reporting good bathing-water status.

Photo Gallery



Location

52.0964879, 5.0522518

Project

NWRM

National ID

Netherlands_03

Sector

Hydromorphology

Installation Date

1997–2017

Implementation status

Completed

Contact

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Overview

Location of the project

The site, Leidsche Rijn, is located on the outskirts of Utrecht, in the Netherlands.

Country

Netherlands

NUTS2 Code

Utrecht

Sponge measures implemented in the case study

Basins

Ponds and scrapes

Swales

Permeable surfaces

Filter Strips

Soakaways

Objectives

The project aimed to create a climate-resilient urban water system by capturing and purifying rainwater locally, reducing runoff, enhancing biodiversity, improving water quality (Less than 0,15 mg/L P (phosphate) in watersystem), and providing recreational and ecological value. It integrates water into urban life as a visible and functional element.

Involved partners

Authority type	Authority name	Authority role	Comments	Authority responsibility
Local water authority	HDSR	Monitoring	Water authority Hoogheemraadschap De Stichtse Rijnlanden	Responsible
Other	Gemeente Utrecht	Implementation	Communal authority responsible for collection of storm water and other urban water in Vleuten-De Meern district	Responsible
Other	Gemeente Vleuten-De Meern	Implementation	Communal authority responsible for collection of storm water and other urban water in Vleuten-De Meern district	Supporting
Regional / sub-national water authority	Provincie Utrecht	Monitoring	Regional authority (Province) responsible for natura 2000 and spatial planning	Supporting

Site Information

Climate Zone

Cool temperate moist

Precipitation

850.00 mm

Temperature (°C)

10.00 °C

Runoff

765.00 mm

Runoff coefficient

0.90

Elevation range

1 m

Slope range

1-2%

Groundwater level

-1,75

Vegetation class

Urban green matrix with grassed bioswales (wadi’s), nature-friendly banks and emergent macrophytes (notably reeds in the helophyte filter), plus parkland trees/meadows in Máximapark and edible landscape plantings in Rijnvliet.

WFD Ecological status

Moderate

WFD Chemical status

Failing to achieve good

Water quality status

Historic signals: specific pollutants (ammonium, copper) in the Leidsche Rijn water body; summer risks of cyanobacteria/botulism in regional open waters; active provincial bathing-water monitoring at Haarrijnse Plas.

Design and Implementation

Project scale

Meso

Project scale specifications

Leidsche Rijn is one of the Netherlands’ largest urban expansions.

Project area

2400

Size

146.00

Size unit

ha

Basis of design

2-year storm

Principles

Closed/near-closed urban water cycle to minimize imports/exports; widespread SuDS (roofs→streets→wadi infiltration), nature-friendly banks, and a vertical-flow reedbed (helophyte) filter for polishing; operational recirculation via major pump stations; dynamic water-level management for buffering. Indicative capacities: water-level fluctuation designed at ~0.30 m; pump station Vleuterweide 2 pumps, total 107 m³/min; design documentation refers to handling “extreme rainfall” and phased control of stuwen (weirs).

Constraints

Life-threatening incident: cross-connection contamination in 2002 led to gastroenteritis and abandonment of the dual-pipe potable/non-potable water system

Favourable preconditions

VINEX designation (planned large-scale housing development) allowed coordinated infrastructural integration.
Relatively flat terrain with shallow groundwater (~–1.75 m) and gentle slope helped infiltration design.
Existing canal and Lek water source supported testing of dual/third-pipe and reed-bed systems .Support from EU (LIFE+ funds) and locality helped financing and knowledge transfer.

Financing

Total cost

4000000.00 €

Total cost information

Costs of the water management aspects of the project not quantified (incorporated with overall development)

Costs investment information

Costs of the water management aspects of the project not quantified (incorporated with overall development)

Costs operation maintenance information

Costs of the water management aspects of the project not quantified (incorporated with overall development)

Financing authorities

Authority name	Type of funding	Comments
European Union	EU-funds: LIFE+	pilot study in 2009 through LIFE
—	Local funds	budget of local authorities

Policy and Governance

Policy description

By keeping storm water in the Lijdsche Rijn area (through storage and infiltration), the communal waste water sytem and treatmentplant will be relieved. Emissions to surface water will be reduced.

Land ownership

Municipality of Utrecht held/assembled most development land (esp. Leidsche Rijn Centrum) and leased/sold plots; water assets are operated by water authority HDSR.

Policy targets

Groundwater Recharge

Runoff control

Peak-flow reduction

Pollutants Removal

Part of a wider plan

Yes

Wider plan

Wider plan type	Wider plan focus	Name	Comments
Local	Urban	Masterplan Leidsche Rijn	Complete urban development project of the site.

Public consultation

No

Has contractual arrangements

No

Impacts and Monitoring

Monitoring System

Monitoring parameters

Annual performance sampling under the NetworkNature plan :
Wide Infiltration Trenches (Wadi) soils are tested yearly (10–15 pollutants, including heavy metals)
Wadis are topped up or partly replaced based on results

Vertical reed-bed (LIFE VERBAL) monitoring:
Includes continuous pH, oxygen, and transparency measurements.
Regular sampling of nitrates, phosphates.
Two-year pilot simulated an accelerated 30-year lifespan and consistently reduced effluent phosphate to below 0.05 mg/l

Maintenance

Maintenance requirements

General maintenance is overseen by HDSR (region), the municipality, and coordinated via multi-annual plans

Impact Assessment Methodology

Performance impact assessment method

Unknown

Socio-economic Impacts

Direct benefits information

Reduced requirements for sewer system and waste water treatment capacity.
Public health : clean drinking water sourced (~5 M m^3/year) via deep groundwater wells.
Social engagement: community rules reinforce stewardship and prevent pollution; pump stations maintain aesthetics and prevent mosquitoes.

Ancillary benefits information

Potential for recreational activities in the water courses that will be created (e.g. canoeing, plazas, ice-skating)

Information on ecosystem impact, reduced energy use

Reduced reliance on pumped drainage lowers energy consumption.

Biophysical impacts: Hydrology

Hydrological effects

The system retains 2.2 million m³ rainwater yearly, reduces peak runoff, increases infiltration and groundwater recharge, and minimizes external inputs. Dynamic water levels and swales prevent flooding and stagnation.

Retained water

2200000.00

Retained water unit

m3/year

Information on retained water

Shift from sewer-conveyance to on-site retention/infiltration; reduced dependency on Amsterdam-Rhine Canal inputs; dual recirculating loops with managed ~0.30 m level variation for storage; major pumps (e.g., 107 m³/min Vleuterweide) move water between sub-catchments; creation of buffer lake (Haarrijnse Plas).

Increased water storage

1000.00

Increased water storage unit

m3/ha

Information on increased water storage

Reduced extreme water levels by ≈35 cm; during high flows ~⅓ of discharge is routed via the Spiegelwaal; overtopping threshold provides controlled activation; creation of a new island and low-flow habitats altered local hydromorphology.

Ecosystem water supply

1

Information on ecosystem water supply

Increased infiltration to groundwater

Biophysical impacts: Biodiversity

Improved biodiversity

Yes

Information on improved biodiversity

In the scheme as a whole, many new water features, including channels and lakes, are created to provide maximum biodiversity opportinites, taking account of the requirements of target species.

Numerous new water bodies with nature-friendly banks and fish passages support aquatic and riparian habitat diversity. Water transparency (~1 m+) enhances ecological conditions.

Biophysical impacts: Water & Soil Quality

Water quality overall improvements

Positive impact-WQ improvement

Information on water quality overall

A test vertical infiltration reedbed was installed at the site, with larger reedbeds now being installed as part of the main development. Improvements to water quality were seen from the test reedbed.

Water quality improvements - Phosphorus (P)

80.00

Water quality improvements - Phosphorus (P) - Unit

% reduction pf pollutant

Information on water quality improvements (P)

80% reduction in P seen from the test reedbed.

Water quality improvements - Total Suspended Solid (TSS)

50.00

Water quality improvements - Total Suspended Solid (TSS) - Unit

% reduction pf pollutant

Information on water quality improvements (TSS)

50% reduction in TSS seen from the test reedbed.

Soil quality overall improvements

N/A info

Information on soil quality overall improvements

N/A info

Biophysical impacts: Others

Ecosystem impact climate regulation

Reduced energy use (farm operations)

Information on ecosystem impact climate regulation

In overall scheme, there will be a probable reduction in pumping requirements compared to the existing agricultural water management system. Green corridors and water bodies provide microclimate cooling and urban heat mitigation.

Lessons Learned

Key lessons

Integration of water retention measure in a developing area is only possible in coordination with many parties, in particular to achieve the ambitious goal of an independently operating (self-sustaining) water system. The water system was designed as an integral part of the overall masterplan, and was considered from a very early stage in development.
Although original implementation aimed for completion by 2017, delays extended development into the 2020s. Ongoing monitoring confirms that sponge measures remain functional and effective.

Barriers

Barrier type	Barrier role	Comments
Lacking coordination between authorities	Secondary barrier	A lot of authorities are involved, over a long time period
Lacking financing sources	Secondary barrier	Delays to implementation of the entire residential development have occurred as a result of the economic climate

Drivers

Driver type	Driver role	Comments
Balancing different objectives	Main driver	Development of a sustainable water system with recreation and ecological goals

Success factors

Success factor type	Success factor role	Comments

Attitude of relevant stakeholders	Main factor	There should be a shared desire to create a sustainable water system in an area to be developed

Cost effectiveness

Reed-bed systems are likely cost-effective where land prices are high. Figures on entire SuDS cost vs. traditional drainage aren’t published.

Transferability

A general design model emerged from LIFE VERBAL, enabling dimensions, equipment needs, maintenance schedules, and cost estimates applicable elsewhere. Comparable initiatives (e.g., Milan sponge cities, Tilburg Wetlands4Cities) show uptake potential across EU contexts. However, the transferability depends on suitable hydrogeological conditions (flat terrain, shallow groundwater), so site-specific analysis is critical .

Sources

Sources

Nieuwe stad, schoon water

Voorbereiding praktijkonderzoek verticaal doorstroomd hylofytenfilter

Utrecht - NbS for for urban resilience and citizens’ wellbeing

Leidsche Rijn Centrum, het nieuwe stadshart van Utrecht

Gebiedsbeleid wijk Leidsche Rijn

Schoon water in Leidsche Rijn