Zurich Airport
De-Icing Wastewater

Zurich Airport

DE-ICING WASTEWATER

In the winter half-year from mid-October to mid-April, a very special type of wastewater is produced at Zurich Airport as a result of aircraft and surface de-icing: The de-icing waste water. This contains a large amount of carbon and must therefore never be discharged directly into water bodies. Over the past few years, special facilities worth around CHF 100 million have been set up to collect and treat the de-icing wastewater. This means that around 95 % of the carbon contained in wastewater can now be collected and treated. The use of de-icing agents is necessary to ensure safe flight operations even at temperatures below freezing. Aircraft and operating areas must be cleared of snow and ice. Snow clearance and de-icing of the apron, runways, taxiways and other areas, is carried out by Flughafen Zürich AG. De-icing of aircraft before take-off is the responsibility of the handling companies.

SURFACE DE-ICING

In the event of snowfall, the aircraft operating areas are first cleared mechanically. For this purpose, special sweepers are used, which remove snow and ice by means of a rotating steel brush and compressed air. Surface de-icing agents are then applied. These can also be used preventively, for example when there is a risk of icing after precipitation. Formate (liquid potassium formate or solid sodium formate) has been used for surface de-icing since winter 2005/2006. Formate has also proven itself at many other airports. Due to its corrosive properties, conventional road salt is only used in public areas (e.g. driveways) and on surfaces without aircraft taxiing traffic.

The specialised clearing vehicles also serve to suck up highly concentrated de-icing waste water.


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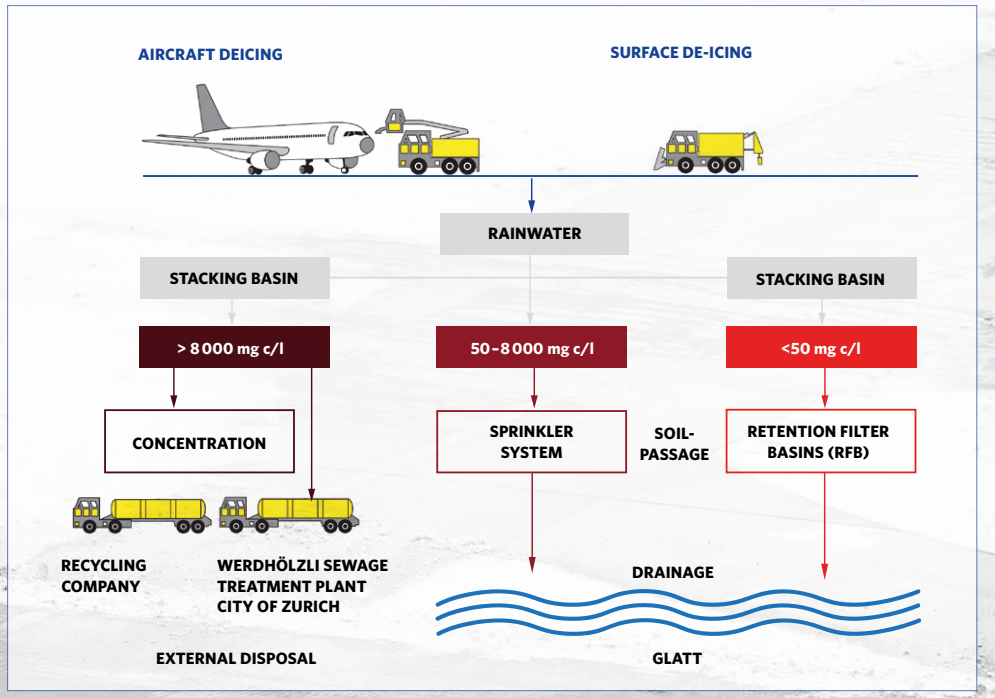

AIRCRAFT DEICING
SURFACE DE-ICING
RAINWATER
STACKING BASIN
STACKING BASIN
> 8000 mg c/l
50–8000 mg c/l
<50 mg c/l
CONCENTRATION
SPRINKLER SYSTEM
SOIL-PASSAGE
RETENTION FILTER BASINS (RFB)
RECYCLING COMPANY
WERDHÖLZLI SEWAGE TREATMENT PLANT CITY OF ZURICH
DRAINAGE
EXTERNAL DISPOSAL
GLATT

Aircraft de-icing on the de-icing pad.

AIRCRAFT DE-ICING

The aim of aircraft de-icing is to remove adhering snow and ice from the aircraft (de-icing) and to prevent ice from forming on the wings and engines (anti-icing). This is achieved by the application of propylene glycol by special vehicles. Depending on the application, the agent is diluted with hot water. On average, 350 litres of de-icing agent and 450 litres of hot water are used to de-ice an Airbus A330 long-haul aircraft. The quantity actually used can vary greatly depending on precipitation conditions.

Around 70 % of the de-icing takes place at the central de-icing pads. These are drained in such a way that dripping aircraft de-icing agents can be collected in concentrated form in stacking tanks immediately after application. In the case of the other de-icing operations at the apron stands, the drip losses are now collected with suction vehicles and fed for further treatment.

Approximately 35 % of the applied agents already drip off during application, a further 10–15 % on the way to the start (apron, taxiways and runways). During and after the take-off, the remaining 50–55 % of the agent is finally blown away, with most of it reaching the adjacent green areas.

ENVIRONMENTAL IMPACT OF DE-ICING AGENTS

Waste water contaminated with de-icing agents causes water pollution with organically bound carbon (DOC) without appropriate treatment. An increased concentration of DOC in the water can lead to high bacterial growth and consequently to oxygen deficiency, silting up and fungal growth. Due to the very strong variation in use over time, the Glatt and Himmelbach streams were previously subjected to pronounced peak loads (e.g. during a snowfall event). Today, the effects described are largely eliminated by the operation of the treatment plant.

De-Icing
Clearing the aircraft from snow and ice. Use of a mixture of hot water and de-icing fluid to remove ice or snow.

Anti-Icing
Preventive protection against icing. This can occur in different weather conditions, e.g. fog in autumn. For anti-icing, good adhesion of the agents to the aircraft for the take-off and climb phase is required, which is achieved with additives.

TREATMENT CONCEPT

There are three different ways of treating de-icing waste water:
- Recycling (high DOC concentration)
- Sprinkling and soil passage (medium concentration DOC)
- Infiltration into retention filter basins (low concentration DOC)

The catchment area of the de-icing equipment covers all the sites regularly used for de-icing, the apron areas and various taxiways. In addition to the piping system, the plant consists of various underground pumping stations, inspection shafts and eleven underground stacking basins for intermediate storage of the de-icing waste water to be treated. The rain areas are arranged along the slopes. 7 retention filter basins (RFB) are used for the fraction with low contamination. The disposal route is controlled by online measurements of the carbon content via the control system.

Collection basins for heavily contaminated de-icing runoff.

RECYCLING

De-icing waste water, which accumulates directly at the central de-icing sites, has a high carbon content (DOC > 8 000 mg/l). It is therefore suitable for recycling. The highly concentrated waste water is collected directly at the de-icing stations and stacked separately. It is then concentrated in the airport's own distillation plant (from 10 % to 60 % glycol content) and delivered to industry as a raw material, closing the material cycle. This fraction accounts for 75 % of the carbon produced, but only 1 % of the water volume.

Control room.

KEY FIGURES OF THE TREATMENT PLANT

147 ha	catchment area
46 ha	Sprinkler area
1486	Sprinkler heads
6 ha	retention filter basin
10 000 m^3	Stacking basin
280 km	pipeline system

SPRINKLER SYSTEM

The medium-polluted fraction of the de-icing waste water (around 40 % of the water produced) is rained by a system of sprinklers onto suitable green areas on the airport site. During the subsequent infiltration into the ground, the waste water is purified. The idea for this process is based on the observation that a considerable proportion of the de-icing agents used have always been blown onto the green areas and seeped away there without any increased contamination being detected in the groundwater. The degradation of the de-icing agents takes place naturally through microbiological activity in the uppermost 60 – 90 cm of the soil. The degradation process is aerobic, i.e. it consumes oxygen. The treated deicer waste water reaches the Glatt via a drainage system.

The process achieves a cleaning performance of 99.7 %. It was the winner of a competition in 1997 for the treatment of de-icing waste water. In 2002 a pilot plant was put into operation and in 2007 the final permit for further operation was granted. Since then, the plant has been expanded in stages and is the first of its kind in the world.

The stacking volume of around 10 000 m^3 each in stacking basins and in the piping system ensures controlled application of the de-icing runoff on the spray irrigation areas. In order to avoid leakages, the impact reference values – in relation to the total discharge per hour, day and in total per m^2 – may not be exceeded. The relevant operating parameters of the sprinkler system are the hydraulic load – i.e. the amount of water – and the carbon load on the sprinkling surfaces. The sprinklers are heated to prevent the systems from freezing even during periods of prolonged frost.

During the pilot phase 2000 to 2006, the environmental compliance of the site could be confirmed through an intensive monitoring program of the aspects water, soil, biosphere and air. The pilot phase was accompanied by an expert group with representatives from authorities and universities. During this time, Flughafen Zürich AG set up its own laboratory to monitor water quality in detail. For the operating phase starting in 2007, comprehensive monitoring was reduced and adapted to continuous operation. The focus here is on the early detection of any long-term effects. The most important objectives of the monitoring are the monitoring of discharge limits, the monitoring of soil degradation performance and the documentation of material flows.

Overflow gutter of a retention filter basin.

Spray irrigation area directly adjacent to the runway.

CRITERION	RESULT
Degradation rates for carbon	In normal operation > 99.7 % (without load tests, incorrect measurements and damage events)
Groundwater quality	No influence discernible
Conditions of discharge	Compliance (exceeded at certain points due to load tests, incorrect measurements and damage events)
Air emissions	No correlation established
Soil: Nutrient balance	Sprinkling does not constitute fertilisation
Soil: Water balance	No waterlogging, no sealing of the soil pores
Soil: Microbiology	No detectable changes
Soil: Pollutants	No accumulation measurable
Vegetation, cuttings	No influence on species composition, no residues detectable in cuttings

Monitored parameters during the pilot phase.

Retention filter basin north of runway 10/28 under construction.

RETENTION FILTER BASINS

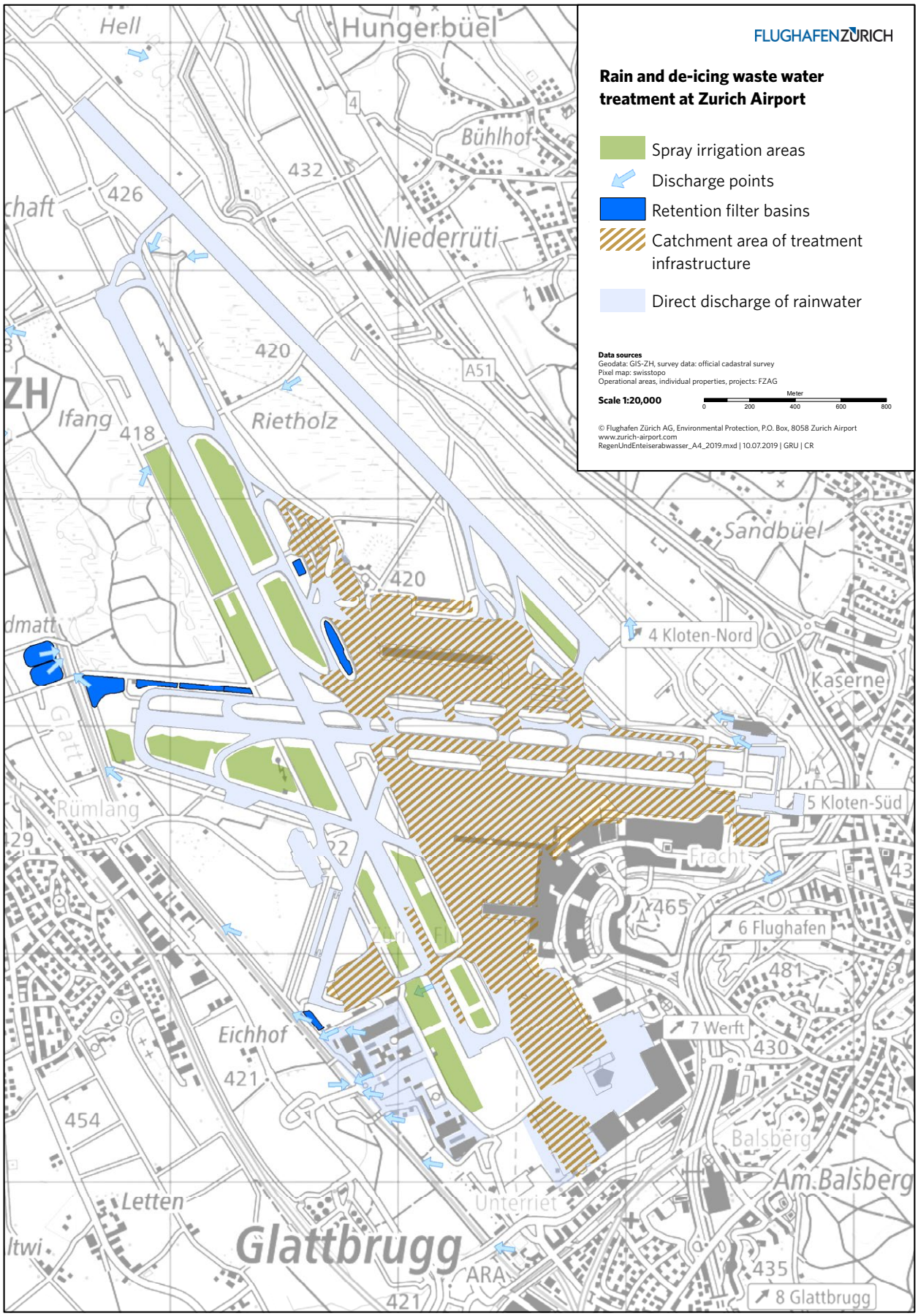
Low-pollution de-icing waste water (DOC < 50 mg/l, 55 % of the water produced) is passed through retention filter basins (RFB). These consist of artificially constructed, shallow and overgrown basins into which introduced water slowly seeps away. As the main function, large quantities of water can be retained and throttled to the drain (water retention). The RFBs are state-of-the-art technology for the treatment of rainwater from high-performance roads.

Dirt particles washed away by the air traffic areas are permanently deposited on the humus during percolation through the overgrown soil layer. Tests and measuring programmes have shown that the discharge of slightly contaminated de-icing waste water in winter is also sensible and expedient. Carbon is degraded during soil passage. The purified water is collected in seepage pipes and fed to the Glatt.

RAIN WATER

Unlike rainwater in winter, rainwater in summer does not contain any de-icing residues. This wastewater is treated via retention filter basins before it is cleaned and discharged into the Glatt.

Roads and taxiways that are not connected to the treatment plant are drained via the shoulder. This means that the lightly polluted wastewater flows from the paved area directly to the adjacent green areas where it seeps away.


FLUGHAFENZÜRICH
Rain and de-icing waste water treatment at Zurich Airport
Spray irrigation areas
Discharge points
Retention filter basins
Catchment area of treatment infrastructure
Direct discharge of rainwater
Data sources
Geodata: GIS-ZH, survey data: official cadastral survey
Pixel map: swisstopo
Operational areas, individual properties, projects: FZAG
Scale 1:20,000
Meter
0 200 400 600 800
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Ifang
Sandbüel
4 Kloten-Nord
Kaserne
5 Kloten-Süd
Fracht
6 Flughafen
7 Werft
8 Glattbrugg
Rümlang
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PUBLICATION DETAILS

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As at: October 2019

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