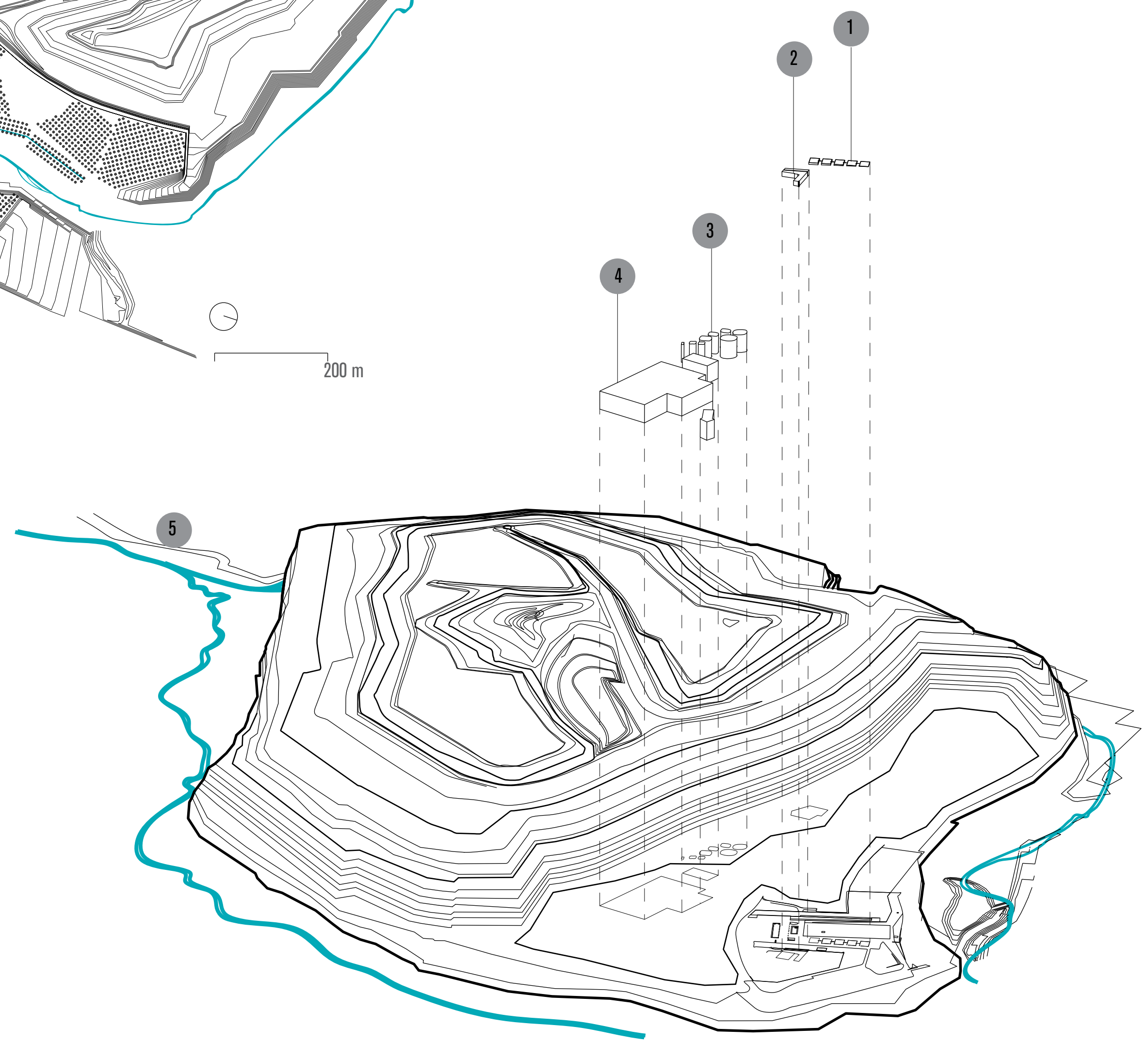
HIRIYA LANDFILL RECYCLING PARK

Latz+Partners, Weinstein Vaadia Architects
Ayala Water & Ecology

Site: Tel Aviv, Israel
Longitude & Latitude: 32°01'N 34°49' E
Water Volume/Day: 40m³

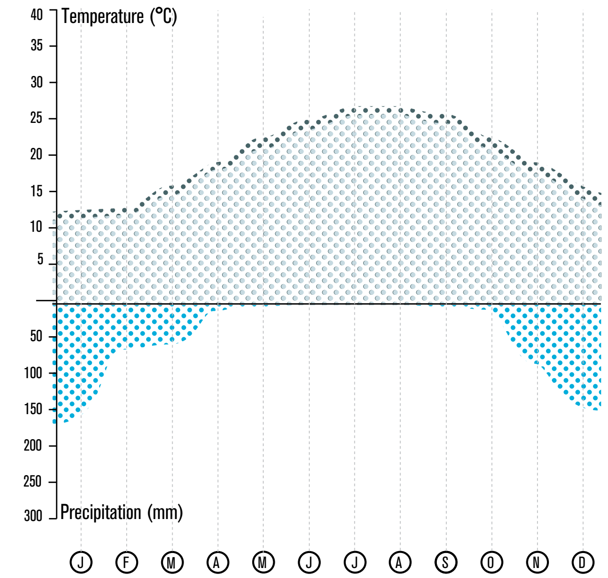
Year: 2007
Status: Completed
Annual Precipitation: 530mm
Dimensions: 570 m²

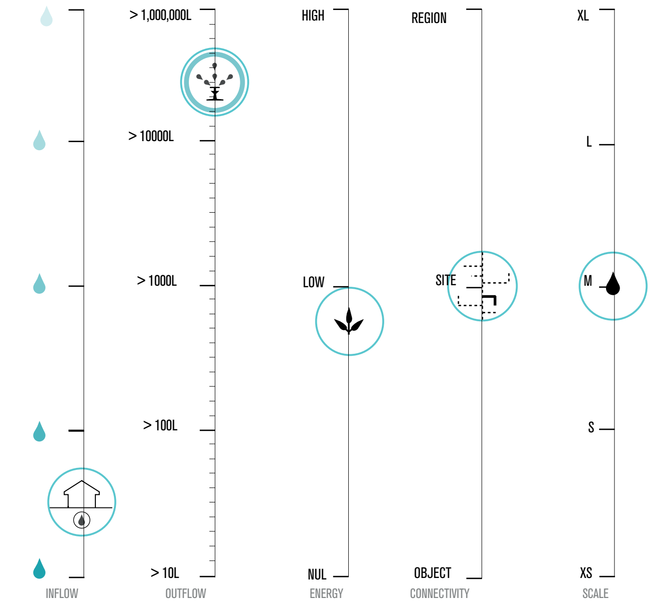
SITE PLAN



LEGEND
1 subsurface wetland cells
2 visitor center
3 effluent storage
4 solid waste processing
5 Ayalon stream

AXONOMETRIC





The Hiriya landfill served as the Tel Aviv Metropolitan Area's main disposal facility for municipal solid waste from 1954 to 1988. Its ongoing restoration consists of an 800-hectare public park, which includes a recycling facility and constructed wetlands for treating contaminated effluent on-site. The recycling facility processes municipal, construction, and yard waste and produces biogas. There are several sources of contaminated effluent at Hiriya, including landfill leachate, runoff from daily washing of garbage trucks, and effluent from the waste transfer's ArrowBio trash separation process, which accounts for 70,000 tons per year of separated organic and inorganic waste (Finstein, 2003). The 2004 winning masterplan for the Hiriya Park by Latz + Partners (with Weinstein Vadia and Ayala Water & Ecology) includes the design of 570 m² of constructed wetland gardens with horizontal subsurface flow (SFW), designed to treat 40 m³ of effluent daily. Extending out from the visitors' center, the wetland garden serves as an emblem for Hiriya's Environmental Education Center.

Constructed wetlands (CW) are engineered systems that have been designed to utilize natural processes involving wetland vegetation, soil, and associated microbial assemblages to treat wastewater. These systems have been used for municipal or domestic wastewater treatment for more than 30 years. Today, municipal SFW systems also treat effluent from pharmaceuticals, oil refining, chemical production, pulp and paper production, tannery, textile manufacturing, abattoirs, food processing, and runoff from agriculture, airports, highways, and greenhouses, as well as landfill leachate (Vymazal, 2009).

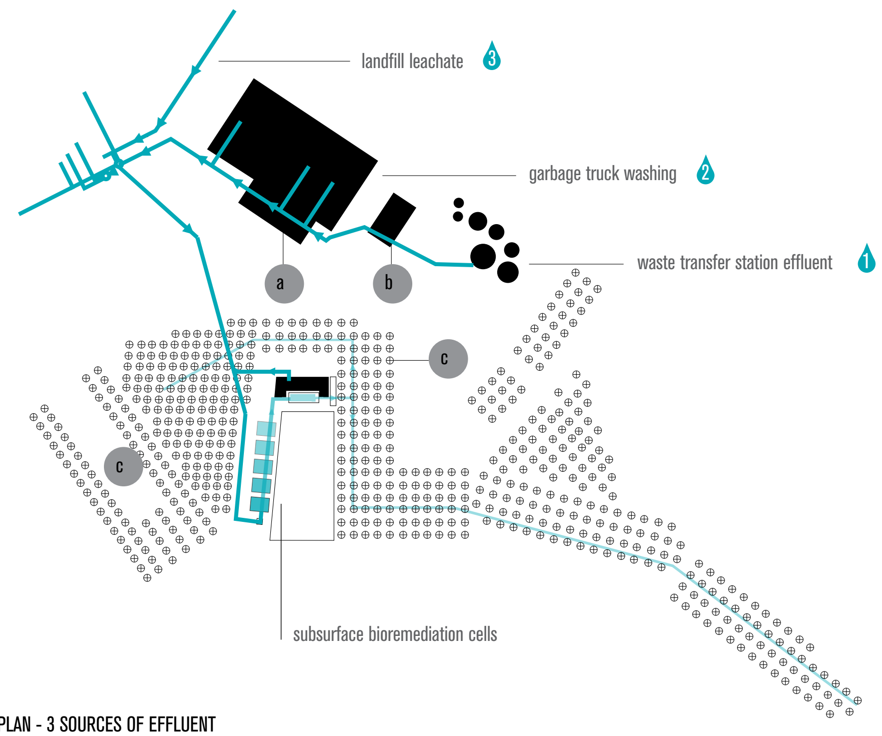
SFW systems are particularly well suited for small to moderately-sized installations (Bulc, 2006). For example, in a domestic pilot project in central Mexico, treated water was suitable for irrigation purposes, alleviating local water scarcity (Belmont, et al., 2004). SFW systems can accommodate the diurnal flow pattern of domestic, municipal, and industrial wastewater. They are not suited for treatment of stormwater discharges, where peak flow may be much higher than the average, or agricultural runoff, with its intermittent peak events and high inorganic sediment loads (U.S. Environmental Protection Agency [EPA], 1993).

At Hiriya, the wetland garden consists of five rectangular SFW cells, arranged in a linear sequence along a 5% slope. Each is made of concrete, lined with a polymeric (ethylene propylene diene monomer) liner, and filled with aggregate and macrophytes that enable the removal of contaminants. These include Cyperus papyrus, Haspen, Cyperus alopecuroides, Thalia dealbata, Iris pseudacorus, Scirpus lacustris, Eleocharis geniculata, Cyperus gymnocaulos, and Canna generalis.

Aggregate size decreases incrementally from 50 mm in the first cell to 5 mm in the last. The effluent flows through settling chambers, and is then pumped into a mixing tank which regulates outflow in different seasons. From there it passively flows downward via gravitation through the SFW cells. Each cell includes a level spreader or weir to ensure uniform distribution of wastewater. The overall retention time is 3.5 days, and the treated water is used for on-site irrigation. The water surface remains unexposed below the media surface, eliminating odors and insect vectors, while keeping evaporation to a maximum of 3%.

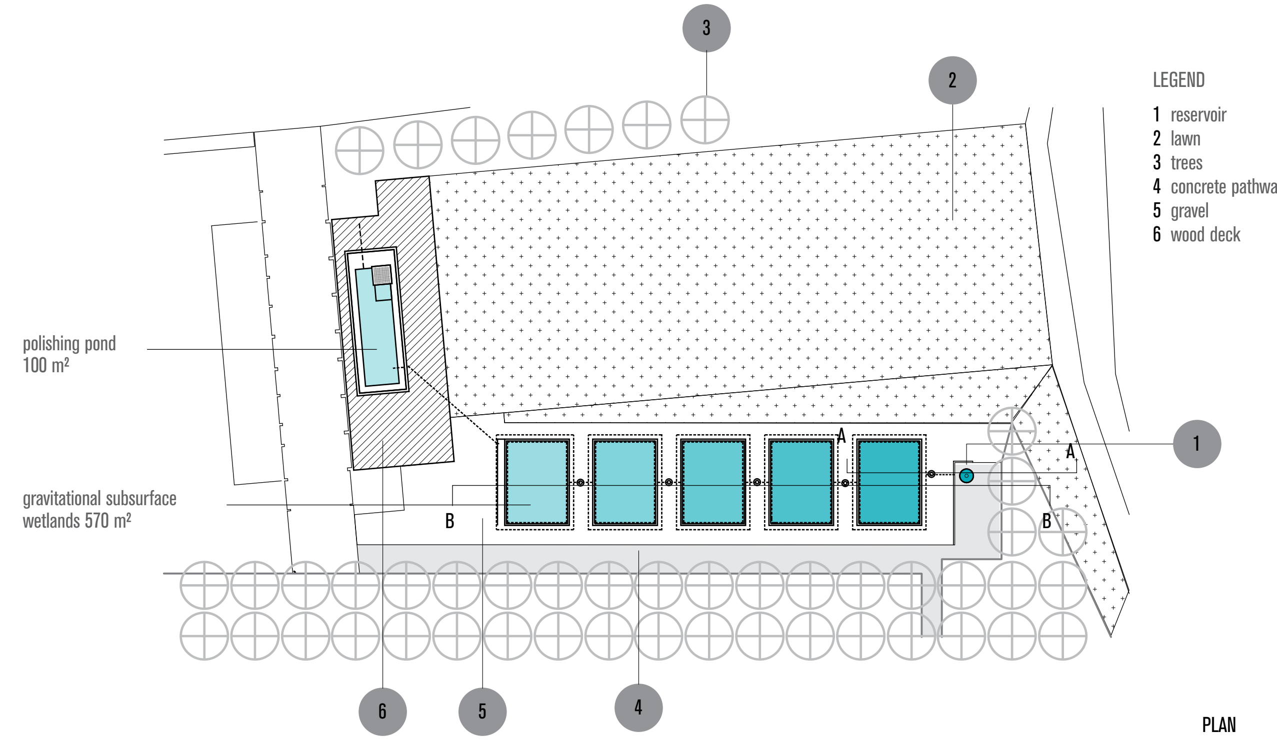
The removal of organic and suspended solids and biochemical oxygen demand (BOD) through the long-term performance of SFW systems has been found to be effective. However, nitrogen and phosphorous are removed at lower rates (Vymazal, 2007, 2011; Verhoeven and Meuleman, 1999). The SFW systems are capable of achieving a reduction in fecal coliform, yet not enough to routinely satisfy discharge requirements (EPA, 1993). The removal of BOD is believed to occur through entrapment of particulate matter in the void spaces in the gravel media. BOD is removed by microbial growth on the media surfaces and attached to the plant roots and rhizomes penetrating the bed. Smaller rock sizes provide more surface area for treatment. This method's primary deficiency is the clogging of the void spaces either by the vegetation roots or by accumulation of suspended solids (EPA, 1993). A case study in Tanzania has demonstrated the capacity of Phragmites and Typha macrophyte species to remove 54% and 42.2% of nitrogen respectively (Senzia, Mashauri, and Mayo, 2003).

Baker (1998) notes that in arid regions where high-quality water is limited, wetlands that can treat nitrate could play an important role in the development of water resources. Similarly, Greenway (2005) discusses the potential of SFW for effluent polishing in subtropical and arid climates in Queensland, Australia, and adds that enhancing macrophyte diversity will maximize the removal of nutrients and pathogens. Kivaisi (2001) notes that wastewater reuse is an important strategy in countries that suffer from water shortage (e.g., Morocco, Tunisia, Egypt, Sudan, Namibia, India, and China). While nutrient content in wastewater is economically beneficial for its function as a fertilizer, there is a high risk of water-borne disease when raw, untreated sewage is used. While there is potential for the incorporation of low-cost constructed wetlands in small rural communities in developing countries due to ease of operation and maintenance, these systems have not found widespread use, due to lack of awareness of the technology and lack of local expertise in developing it (Kivaisi, 2001).



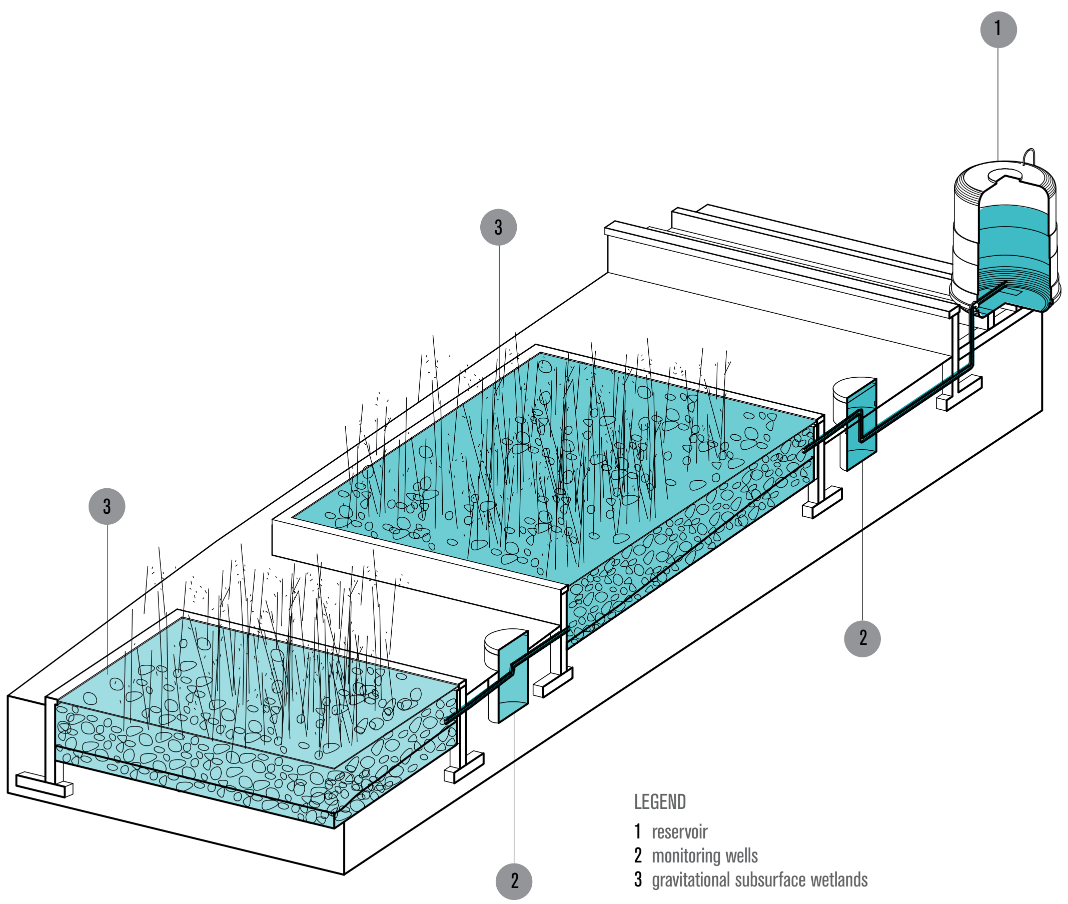
LEGEND
a solid waste processing center
b visitor Center
c vegetated area
d trees

PLAN - 3 SOURCES OF EFFLUENT



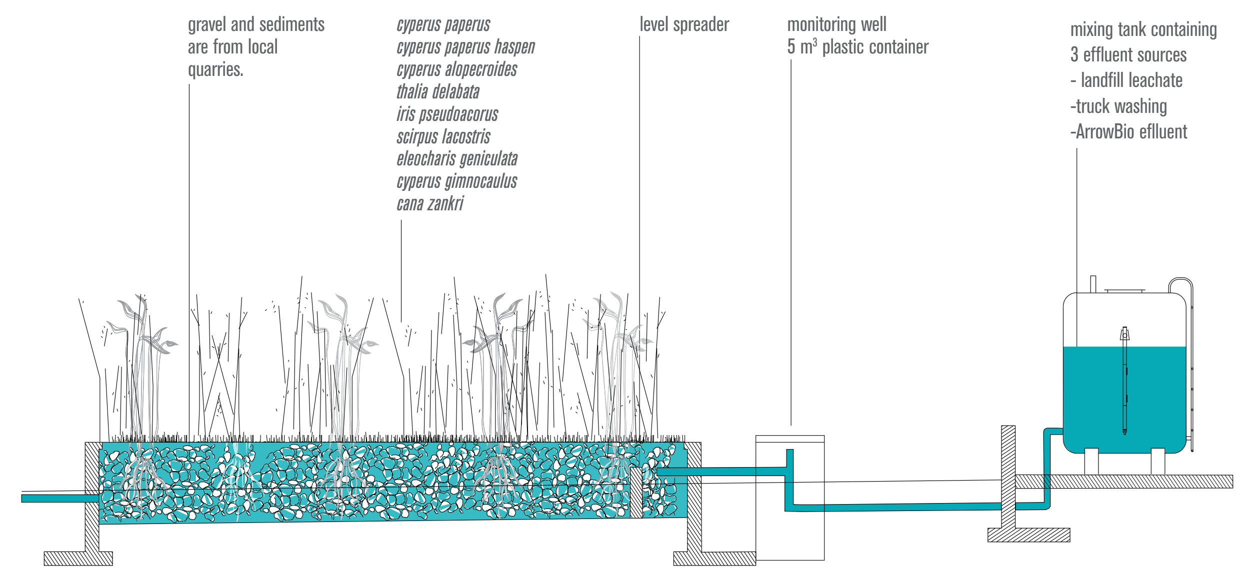
LEGEND
1 reservoir
2 lawn
3 trees
4 concrete pathway
5 gravel
6 wood deck

PLAN

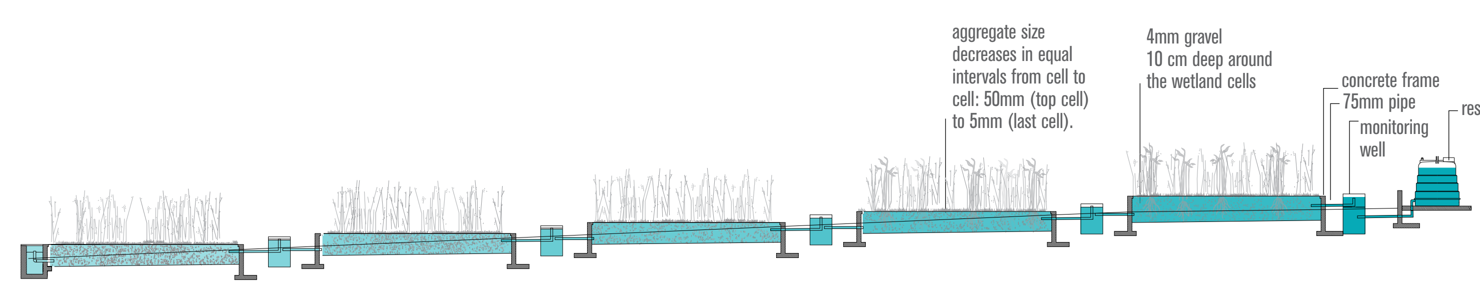


LEGEND
1 reservoir
2 monitoring wells
3 gravitational subsurface wetlands

GRAVITATIONAL SUB-SURFACE TREATMENT WETLAND AXONOMETRIC



DETAIL SECTION A-A



SECTION B-B