

廁所背後的故事——污水處理 WHERE HAS ALL THE SEWAGE GONE?

沖水馬桶替我們解決許多煩惱，但你有沒有統計過自己每天沖廁多少次？香港這小小的城市住了七百多萬人口，我們每日從廁所、廚房等排出的污水，每天便超過二百七十萬立方米。在二零一零至一一年，渠務署便處理了約九億七千九百萬立方米污水。

Are you mindful of how many times you flush a toilet within one day? The 7 million people living on this modest island of Hong Kong produce over 2.7 million m³ sewage from toilets and kitchens per day, and about 979 million m³ of sewage was treated by the Drainage Services Department in 2010-11.

假如我們的排泄物和污水像數十年前一樣，未經處理便流入大海河川，久而久之，必會釀成生態大災難。幸而香港緊倚著浩瀚的大海，海洋因每日潮汐而有一定的自我潔淨能力，我們可將處理過的污水排出大海，污水處理相對較內陸地區容易。全港有九成三人口使用公共污水收集系統，污水由總長約一千六百四十公里的污水渠網絡分送至六十七家污水處理廠，經處理後排放至大海；至於從污水中篩隔出來的固體廢物，則送往堆填區填埋。至於沒有接駁公共污水渠的偏遠地區，則會使用化糞池或小型地下污水處理系統。

It would be disastrous if such a huge amount of untreated sewage is discharged into the sea and river, just like decades ago. However, we are fortunate to be surrounded by the vast sea, the tides and wave of which may dilute or wash away certain amount of pollutants. Sewage discharge in a seaside city is thus slightly easier than inland areas. 93% of the Hong Kong population is covered by public drainage system - a sewer network of 1,640 km is connected to 67 sewage treatment plants. Treated effluent is let out to the sea, and filtered solid wastes are sent to landfill. For remote areas they mainly rely on septic tanks or small-scale sewage treatment works.

渠務署每日處理的污水量 Sewage treated by DSD per day: **2,700,000m³**
渠務署每年處理的污水量 Sewage treated by DSD per year: **979,000,000m³** (2010-2011)
香港目前的污水處理廠數目 No. of sewage treatment plants in HK: **67**
公共污水收集系統覆蓋率（人口） Coverage of public drainage system (in terms of population): **93%**
污水管總長度 Length of sewage pipe network: **1,640 km**
(約香港至北京的距離 approx. the distance between Hong Kong and Beijing)

在香港，污水處理大致分為五級：基本處理表示只會進行隔篩及沉砂程序，去除較大的固體廢物和砂礫；一級處理會再加上沉澱程序；化學強化一級處理是在沉澱程序中加入化學品，加強懸浮物的沉澱能力；二級處理亦即生物處理，表示在污水處理過程中加入了微生物，分解水中的有機污染物；三級處理是最高級的處理程序，在生物處理後再以過濾方式濾走大部分污物，只有經過三級處理的污水能成為再造水。

Sewage treatment in Hong Kong is of five levels. Preliminary treatment involves only screening and degritting to remove larger solids and grits. Primary treatment is enhanced with sedimentation, and CEPT adds chemicals to the sewage to conglomerate particles for easier removal. Secondary treatment involves biological treatments of having microorganisms to decompose organic matters in the sewage. Tertiary treatment, the highest level of all, further filters the treated effluent from the secondary process for water that is clean enough to become reclaimed water.

香港的污水處理級別 Types of sewage treatment in Hong Kong	可去除的水中污染物 Pollutants to be cleared	
	懸浮固體 Suspended solids	生化需氧量 Biochemical oxygen demand (BOD)
基本處理 Preliminary Treatment	直徑超過六毫米的固體廢物及砂礫 Solids and grits larger than 6mm in diameter	
一級處理 Primary Treatment	80%	60%
化學強化一級處理 Chemically Enhanced Primary Treatment (CEPT)	80%	70%
二級處理 Secondary Treatment	90%	80%
三級處理 Tertiary Treatment	減低至 Reduced to ≤ 30 毫克/升 (mg/L)	減低至 Reduced to ≤ 20 毫克/升 (mg/L)

註：生化需氧量 (BOD) 指水中微生物分解有機物所耗用的氧氣量，BOD越高，代表水中有機污染物越多，可作為水污染的指標。

N.B.: Biochemical oxygen demand is the amount of oxygen needed by microorganisms to decompose organic pollutants in the water. A higher BOD means that there are more pollutants in water, thus an indication of pollution level.

細看香港污水處理廠的分佈，會發現二級污水廠大多設在新界和離島，維港兩岸則多是基本或一級污水處理廠，這原來和排放水域的環境大有關連。

Most secondary sewage treatment plants are located in the New Territories and the outlying islands, while most of the treatment plants on both sides of the Victoria Harbour are preliminary or primary. Such distribution is closely related to the environment.

基本或一級污水廠

Preliminary / Primary treatment plants:

經處理的污水排往維港或外海，海洋的強大水流能夠將污染物帶走

Treated effluent is discharged into Victoria Harbour or the outer seas, where strong currents carry away pollutants.

二級污水廠

Secondary treatments plants:

排放水排往較為平靜的內陸、內海、受保護水域或鄰近眾多泳灘的水域，因此對排放水質的要求較嚴格。

Treated effluent is discharged into calm inner seas or rivers, protected waters or near public beaches, thus higher level of treatment is required.

另外，有些處理後的污水還會輸送到另一家較高級別的污水廠處理，例如在第一期「淨化海港計劃」下，在九龍及港島東北部基本處理廠隔篩後的污水會經海底管道送到昂船洲的化學強化一級污水處理廠，所以該些污水實際上是會經過化學處理而非直接排放。總括而言，要設置哪個級別的污水廠，是需要考慮排放水的地點以及成本效益。

Some treated effluent will enter a higher level treatment plant for further treatment. In Stage 1 of the Harbour Area Treatment Scheme, screened sewage from preliminary plants in Kowloon and northeast Hong Kong Island are actually conveyed to the CEPT treatment works on Stonecutters Island via deep tunnels instead of immediate discharge. In general, it is the site of discharge and operational costs that determines the level of treatment plants to be built.



在天壇大佛腳下一角有個幽靜的魚塘，數十條錦鯉正在一池清澈的水中暢泳，你相信這些池水曾經是來自廁所、廚房的污水嗎？經過全港唯一一家三級污水處理廠的淨化後，污水從此有了「再造水」這新生命，除了潔淨得可以種花養魚，還供給昂坪旅遊區作沖廁用途。這次《野外動向》便親身來到昂坪污水處理廠，一探他們如何「化腐水為神奇」……

There are dozens of kois in a limpid pool under the feet of the Big Buddha. Would you believe that the clear water that the carps swim in is originally sewage from toilets and kitchens? Under the scrupulousness of Hong Kong's only tertiary sewage treatment plant, sewage becomes reclaimed water that is clean enough to water plants and keep fishes, and is also used to flush toilets in Hong Kong's eco-tourism landmark. We are excited to investigate how this is possible.



昂坪：人、污水與自然 Ngong Ping: people, sewage and nature

在約十多年前，昂坪還是大嶼山鳳凰山腰一處幽靜的高原地帶，雖然有一座寶蓮禪寺和聞名世界的天壇大佛，但由於交通不便，還能夠保持一片寧謐。自從連接東涌和昂坪的纜車和周邊新旅遊景點在二零零六年落成，這裡搖身變成香港最熱門的旅遊點之一，中外遊客人聲鼎沸。為了減少對自然環境的影響，昂坪開始整體規劃之先，已有一籃子的環境保護措施預備實行。

A decade ago Ngong Ping was still a sleepy village on the plateau below Lantau Peak. The village was famous for the century-old Po Lin Monastery and the enormous bronze statue of a Buddha, but visitors were few due to its remoteness. The completion of the cable car system between Ngong Ping and Tung Chung turned the village overnight into a major tourist attraction. To minimize environmental impact to the area, there was a comprehensive plan on protecting the natural environment of the whole region.

昂坪360纜車在建造時已採取不少措施，例如僱用六頭驢子來運送纜車的建築物料，以及用升高的木板建造救援徑（昂坪棧道），以免割斷山坡的自然植被。可是，隨纜車開放而至的人流以及所帶來的污染，依然令昂坪地區的生態受到巨大壓力。對此，昂坪360商業及市務總管關敏怡博士及安全及環境保護助理經理周永聰先生說，早於昂坪旅遊區落成前的二零零三年，纜車公司已與政府合作進行環境評估，計劃在此設置全港第一家三級污水處理廠。



A number of measures were adopted during the construction of Ngong Ping 360 Skyrail to minimize any environmental impact that it might incur, such as using a team of 6 mules to transport cable car construction materials, and building an elevated wooden path as the rescue way to avoid cutting apart the vegetation on the hill slope. But promising number of visitors means higher environmental pressure. Dr Stella Kwan, Head of Commerce & Marketing, and Mr Anderson Chow, Assistant Manager in Safety & Environment, explained, "Well before the tourist project in Ngong Ping was completed in 2003, Ngong Ping 360 had worked closely with the authorities to carry out environmental impact assessment, and a tertiary sewage treatment plant was pinned down here."

昂坪是香港其中一個擁有獨特生態環境的地區，它被南大嶼和北大嶼郊野公園緊緊包圍，又位處石壁水塘的集水區，附近還是珍貴的盧氏小樹蛙的繁殖地。周永聰說，在污水廠落成前，這裡的居民用山水來沖廁，污水直接排落河川，如再加上纜車帶來每年一百八十萬人次旅客產生的污水，將是昂坪地區無法承受的。為了保護附近水體的水質，決定讓這裡的污水在排放前經過最高級的三級處理。

Ngong Ping's natural setting is unique yet fragile. Enclosed by Lantau North and Lantau South Country Parks, Ngong Ping is the catchment area of Shek Pik Reservoir as well as the habitat of Hong Kong's threatened endemic Romer's Tree Frog. Mr Chow said, "Before the treatment plant was installed in Ngong Ping, villagers flushed toilets with water from the mountain streams and the waste water was discharged into the rivers untreated. To protect the water quality of the whole area, a tertiary treatment plant was set up here."

昂坪污水處理廠距離昂坪市集約一百米，但放眼並不見有突兀廠房的痕跡，原來遠處一堆白牆灰瓦的小平房，就是污水處理設施的所在，和昂坪市集的設計一致。事實上，整個昂坪地區公共設施的設計也以融入周圍自然環境為主，比如在巴士站旁邊的這個廁所，就在素淨的牆身刻上「淨」「靜」的大字。

Ngong Ping Sewage Treatment Works is subtly located about a hundred metres away from Ngong Ping Village. Concealed in white-walled houses with grey-tiled roofs, its outlook is in harmony with the Village and the natural setting. So are other public facilities here. The toilets beside the bus terminus, for instance, have white-washed walls engraved with the Chinese characters of "purity" and "serenity".



昂坪污水處理流程

Sewage Treatment Process at Ngong Ping

昂坪污水處理廠與纜車同年啟用，污水從昂坪市集、纜車總站、寶蓮禪寺及昂坪的十多間村屋收集，每年處理約四百五十萬立方米污水。經過多重處理後，其中三分一會成為再造水，供給市集、纜車站及附近公廁作沖廁水，以及灌溉污水廠內的植物和飼養魚塘內的錦鯉。

Ngong Ping Sewage Treatment Works was inaugurated in the same year of Ngong Ping 360. It receives 4.5 million m³ sewage per year from Ngong Ping Village, cable car terminus, Po Lin Monastery and a dozen of village households in Ngong Ping. After the sophisticated treatment process, about one third of the total sewage received becomes reclaimed water for flushing, watering plants and keeping fishes.

以下是污水在昂坪污水處理廠的處理程序：

This is how sewage is treated in Ngong Ping Sewage Treatment Works:

一級 Preliminary	① 粗隔篩 Coarse Screen	配合機械刮耙，篩走較大的固體廢物。 Mechanical scraper screens out the larger solid wastes in the raw sewage.
	② 幼隔篩 Fine Screen	用密度較高的隔篩篩走較小的垃圾。 Sieve finer pollutants with a denser screen.
	③ 沉砂池 Grit Chamber	靠攪拌污水產生離心力，使砂粒沉澱。 Sewage is whipped by giant paddles in a cylindrical tank, generating centrifugal force for sands to deposit at the bottom.
	④ 氣浮式除油池 Grease Separator	全港污水處理廠獨有的設施，油脂在污水面層凝結並被撇走。 A unique installation among all sewage treatment works in Hong Kong. Grease that coagulate on the water surface are being removed.
二級 Secondary	⑤ 生物處理 Biological Treatment	以空氣擴散器將氧氣注入污水池，促進水中微生物分解污水裡的有機污染物。該些微生物和細菌由污水廠自行培植，不同污水廠會調配不同的細菌，以消化不同程度和特性的污水。 Oxygen is supplied to the sewage tank through air diffusers to encourage breaking down of organic pollutants by microorganisms. The microorganisms and bacteria are grown by the water treatment works itself, but the formula varies among treatment works to treat sewage contaminated to different degrees and of different characteristics.
三級 Tertiary	⑥ 雙層過濾 Dual Media Filter	這程序就好比家中水龍頭的濾水器，用上層為活性碳粒子、下層為矽石粒的雙層濾池過濾水中懸浮粒子。 resembles the water filter attached to our kitchen faucets. The dual media filter consists of an upper layer of carbon grinds and a lower later of silicon sands to filter out suspended particles.
	⑦ 紫外光消毒 UV Disinfection	經三級處理的污水最後由紫外光照射消毒，主要消滅水中的大腸桿菌，消毒後的排放水水質達到極高標準。 Effluent is finally disinfected by ultraviolet rays that kill mainly the Escherichia coli. The treated effluent is up to a very high cleanliness standard.



1/3 成為再造水，供附近地區沖廁、灌溉和養魚之用。
Become reclaimed water for toilet flushing, irrigation and fish rearing in nearby areas.



2/3 經管道在大嶼山南面的東灣水域排放
Discharged to Tung Wan south of Lantau Island via export pipe.



糊狀的淤泥經濃縮及脫水程序，成為固體的污泥餅，送往堆填區。
Pasty sludge is thickened and dehydrated to become sludge cakes, finally transported to the landfill.

我們在昂坪市集光顧的公廁，馬桶上都貼上了「再造水」的標誌，顯示了昂坪污水循環再用的成果。「昂坪污水處理廠每年產生八千萬公升的再造水用於沖廁，約相等於節省了一個足球場一米深的用水量！」周永聰說。那麼清澈的再造水除了用來沖廁外，還可以用來洗手或飲用嗎？「用來洗手的水是另一套淡水系統，如要將再造水加入淡水系統，除了要接駁新的管道，還需要通過另一些淡水水質的標準，同樣道理也適用於食水。相反，沖廁水和污水處理廠則構成一個完整的污水循環系統。」另外，要市民用再造水洗手甚至飲用，亦需跨過公眾的心理關口，因此再造水仍未有計劃用於其他用途。

We saw signage of reclaimed water in toilets of Ngong Ping Village. "Ngong Ping Sewage Treatment Works produces 80 million litres of reclaimed water for flushing. The volume is enough to submerge a standard soccer field in 1m-deep water!" said Mr Chow. Can reclaimed water be used for washing and drinking? "Flushing water and sewage treatment belong to the one system. We use another water supply system for washing and drinking. Adding reclaimed water into this system requires extra network and approval." Nonetheless, the general public is still reluctant to drink reclaimed water or to wash hands with it.





若要更深入了解香港的污水處理和昂坪污水的再造過程，可參觀設在昂坪污水處理廠內的昂坪污水處理資訊中心：
For more on sewage treatment and reclaimed water, why not visit Ngong Ping Sewage Treatment Works yourself?

開放時間 Opening hours:

逢星期二至日 Tue to Sun 10:00-12:30; 13:30-16:30

逢星期一及公眾假期休館 Closed on Mondays & public holidays



再造水使用至今超過五年，周永聰認為成效主要有四方面：「第一，如果沒有這家污水廠，污水便會排放到河川，現在我們把污水淨化及循環再用，保護及優化了附近環境；第二，一般處理過的污水會排出公海，但現在我們把它循環再造為沖廁水，把我們排出的廢水轉化為有用資源，十分環保；第三，把再造水設施設在昂坪旅遊點是一個地利，除了香港居民使用外，也能『推己及人』，乘機將再造水的應用推廣給不同國家的遊客；第四，我們的例子可以作為模範，說明商業機構也能夠藉利用再造水，保護地球的水資源。」

It has been over 5 years since reclaimed water is in use. Mr Chow reckoned that it is encouraging in four main aspects. "First, without this Works sewage will be discharged directly into rivers. Treated and reclaimed water enhance the natural environment here. Second, reclaiming water means saving water. It is a waste to discharge treated clean water into the sea. Third, it is good publicity to let the general public and overseas tourist understand the merits of reclaimed water. Lastly, we have set a good example for other corporations to reclaim and save water."

關博士還補充，再造水為這裡的生態旅遊增添了新的亮點。「在我們自行舉辦的導賞團中，我們也會告訴遊客這裡不只有大佛、大澳等優美的風景可看，還可以看看我們怎樣利用再造水。香港缺少關於水資源的生態教育，經常只限於觀賞花草樹木或海豚。我們便正好開拓了這個範疇，透過昂坪的特殊例子，教導人們熱愛大自然和珍惜水資源。」

Dr Kwan was proud of the significance of reclaim water in good eco-tourism practice. "In our tours we promote wise use of water resources other than seeing the Buddha and the fishing village of Tai O. This is one of the very few eco-education locations in the city where people learn about the importance of conserving water resources and natural environment at the same time."