渠務署
Drainage Services Department

靜洪邃屏

SILENT SHIELDS

PUBLISHED BY
Drainage Services Department
The Government of The Hong Kong Special Administrative Region

PRINTED BY
Government Logistics Department
The Government of The Hong Kong Special Administrative Region

DESIGNED BY
Toppan Vite Limited

游洪遂屏

SILENT SHIELDS

隱藏於地底深處的雨水排放隧道，只有少部分組件外露，大眾對它們的認識或限於偶爾一瞥，然而這些含蓄但浩大的建設，正是渠務署市區防洪基建的骨幹。在香港持續發展、市民生活和商貿活動如常進行的同時，雨水排放隧道正致力疏導洪水，保護這個城市免受水患威脅。

渠務署希望透過本書，帶領讀者窺探這些地下守衛秘道，並分享隧道施工期間所面對的種種挑戰，與及以多番努力才取得的成功故事。

01 引

ABOUT THIS BOOK

Seen only in glimpses, the drainage tunnels of the Drainage Services Department constitute the backbone of the city's urban flood protection infrastructure. These inconspicuous feats of engineering lie deep underground with only a few components visible on the surface. As the tunnels calm raging torrents and surging waters, the city of Hong Kong goes about its daily life—growing, evolving and prospering.

This book hopes to shed light on these hidden labyrinths that are keeping Hong Kong safe. In relating their story, DSD wishes to share with readers both the challenges and hard-won successes that shaped these notable projects.

02 序

DEVELOPMENT BUREAU'S MESSAGE

The idea of using a shield for protection is hardly new. Shields have been unearthed dating to the Bronze Age. Indeed, many ancient military formations comprise shield walls—fortifications made up of lines of shields.

The linkage between shields and our three drainage tunnels is more direct than it may appear. The tunnels were constructed with tunnelling shields—a protective structure first developed for the Thames Tunnel in London in 1825 that temporarily supported the tunnel during its excavation. Equally prominently, Hong Kong's drainage tunnels stand guard silently as shields allowing the dynamic business of Hong Kong to continue without disruptions from the threat of heavy rainstorms. As torrents are controlled to bypass urban areas for direct discharge into the harbour, the 'Silent Shields' that Drainage Services Department (DSD) has built for the public smoothly function and prove their life-saving worth.

One of DSD's endeavours is to provide a robust drainage infrastructure to keep Hong Kong safe. It takes thoughtful planning and a resourceful team to tackle the wide-ranging flood risks Hong Kong faces. DSD's extraordinary efforts find parallels in the biblical account of Noah, who built a great ark and confronted the awesome threat of a deluge. With meticulous planning and toil, Noah and his animals survived the greatest of all storms—DSD personnel exemplify this steadfast and enterprising spirit.

With Hong Kong's continuing development, there is more to do to keep the city safe and sound. I firmly believe that our vision and commitment will enable us to deliver on our promises. With greater confidence than ever, we assure the people of Hong Kong a safer and better living environment for years to come.

Permanent Secretary for Development (Works)
IR **WAI CHI-SING**

以盾作防衛之用由來已久，盾的出現可追溯至青銅時代。事實上，很多古代的軍隊陣形都以盾牌組成防禦盾牆。

盾與雨水排放隧道之間有著直接的關係。始於1825年的倫敦泰晤士河隧道工程、很多隧道的建造，包括我們的雨水排放隧道，均應用一個名為隧道盾的結構物，為挖掘工序提供臨時支撐。不單如此，渠務署建造的雨水排放隧道在暴雨時就如一道護盾屏障，靜悄地引導洪水繞過市區排出海港。這個「靖洪邃屏」沉默地守護著大眾，保障市民的生命安全，讓香港蓬勃的活動如常運作，免受暴雨水浸威脅。

渠務署其中一個重任，是為香港提供一套穩健妥善的防洪基建。這項任務需要慎密的規劃，以及一支高效能和善於應變的團隊。渠務署肩負使命，就如聖經記載的挪亞，要為抵抗洪水而建造龐大的方舟。挪亞及一眾動物終可脫離險境，藉着的是周詳策劃和努力不懈，渠務署的團隊亦正是展現出這種堅毅和積極進取的精神。

在防洪保障上，配合香港的持續發展，前面仍有很多工作。我深信憑着抱負和信念，我們將可實現承諾，以無比的信心，繼續致力為香港市民帶來一個更安全、更美好的居住環境。

發展局常任秘書長（工務）

韋志成 工程師

03 概

A WORD FROM THE DIRECTOR

香港位處沿海地區，經常受風暴吹襲，因此過往不時出現水浸，導致經濟損失，嚴重時甚至造成人命傷亡。

香港政府於1989年成立渠務署，負起防洪及提供污水處理服務兩方面的責任，以保障公眾安全及衛生。

渠務署自成立以來，已投放逾240億港元發展香港的防洪基建。我們的抱負淺易而進取：提供世界級的污水和雨水處理排放服務，以促進香港的可持續發展。

要達至這個重大目標，我們需要在這個人口極其稠密的城市中進行防洪改善工程，並要將施工帶來的滋擾及對環境的影響減至最低，對我們是極具意義的任務，同時亦是一項挑戰。

本書將會介紹三條分別位於香港島西部、荔枝角和荃灣的雨水排放隧道，它們為廣泛市區提供防洪保障，無論是個別或是整體上，這三條隧道不僅是整個防洪基建的關鍵部分，更是渠務署在實踐抱負上重要的一步。

本書特別獻給香港市民，三條雨水排放隧道的工程得以順利完成，實有賴大眾的體諒和支持。我們衷心希望您會享受閱讀這本特刊。

渠務署署長
陳志超 工程師

A coastal city frequently lashed by severe storms, Hong Kong has from time to time been affected by flooding, causing financial loss and, in extreme cases, casualties. In 1989, the Hong Kong Government established the Drainage Services Department (DSD), charged with the dual roles of protecting the city from the ravages of rainstorms and providing sewerage services to safeguard public health. In these pages we focus on DSD's flood prevention efforts.

Since its establishment, DSD has invested over HK$24 billion to develop Hong Kong's drainage infrastructure. Our vision is straightforward yet ambitious—to provide world-class wastewater and stormwater drainage services, enabling the sustainable development of Hong Kong.

Achieving this vital goal is not without its challenges, not least working in one of the most densely populated cities on earth. In taking on this meaningful task, DSD ensures that disruptions to the community and impact on the environment are minimised and mitigated.

In this book, we look at the three drainage tunnels in western Hong Kong Island, Lai Chi Kok and Tsuen Wan that protect a major portion of Hong Kong's urban areas. The tunnels, both individually and collectively, constitute a major component of our drainage infrastructure, as well as an essential part of DSD's endeavour towards fulfilling our vision.

This book is dedicated to the general public of Hong Kong, whose understanding and support of the three drainage tunnel projects have been indispensable to their completion. We sincerely hope you enjoy reading this special publication.

Director of Drainage Services
IR **CHAN CHI-CHIU**

04 程

MOMENTOUS MOMENTS

YEAR

07 08 09

04

Ground investigation begun for tunnels

為興建雨水排放隧道展開地質勘探

05 / 06

Detailed design and physical model hydraulics tests

詳細設計及水力模型測試

JAN

MAR

HKWDT launching of tunnel boring machine

港島西雨水排放隧道鑽挖機啓動

LCKDT alignment finalised

荔枝角雨水排放隧道路綫定案

MAY

JUL

SEP

HKWDT and TWDT alignments finalised

港島西及荃灣雨水排放隧道路綫定案

NOV

LCKDT contract signed and works commenced

荔枝角雨水排放隧道簽署合約及動工

HKWDT and TWDT contracts signed and works commenced

港島西及荃灣雨水排放隧道簽署合約及動工

10

LCKDT launching of tunnel boring machine

荔枝角雨水排放隧道鑽挖機啓動

TWDT launching of tunnel boring machine

荃灣雨水排放隧道鑽挖機啓動

11

Breakthrough in HKWDT tunnel

港島西雨水排放隧道貫通

+

Breakthrough in LCKDT branch tunnel

荔枝角雨水排放隧道分支隧道貫通

Breakthrough in LCKDT main tunnel

荔枝角雨水排放隧道主隧道貫通

12

Breakthrough in TWDT tunnel

荃灣雨水排放隧道貫通

Commissioning of HKWDT

港島西雨水排放隧道啟用

Commissioning of LCKDT

荔枝角雨水排放隧道啟用

13

Commissioning of TWDT

荃灣雨水排放隧道啟用

One of the wettest cities in the Pacific Rim, Hong Kong experiences an average annual rainfall of 2,400 millimetres, often as squally downpours. This, coupled with frequent tropical cyclones and tidal surge effects, makes flooding a major concern to address.

Apart from geographical factors, Hong Kong's rapid urbanisation in the past few decades has resulted in significant expansion of the coastal urban strips as well as substantial development in the urban hinterland. Large areas of natural ground surface turned into paved areas. Rainwater that formerly percolated became surface flow.

The increasing rainwater runoff led to increasing flooding threats in urban areas. The aging underground stormwater drainage system was gradually overwhelmed and could no longer meet present-day flood protection standards.

In the early 2000s, DSD conducted a number of drainage master plan studies to comprehensively review the city's urban drainage infrastructure, and subsequently embarked on a series of major drainage improvement schemes to bring about long-term efficacious flood protection.

05 洪

AN IMMERSING CHALLENGE

香港每年平均降雨量達2,400毫米，是太平洋周邊地區最高的城市之一，且時有暴雨、加上經常受熱帶氣旋及其間可能發生的風暴潮影響，防禦水浸因而構成一項考驗。

除了地理因素外，香港過去數十年的急速城市化，不僅從大幅擴闊了沿海的市區帶可以看到，更展現在市區腹地的廣泛發展，大範圍的天然土地轉化為鋪築的地面，過往滲入泥土疏導的雨水，變成為地面徑流。

日益增加的雨水徑流，令市區的水浸威脅不斷增加。日漸老化的地下雨水排放系統開始不勝負荷，不能滿足現今的防洪標準。

自2000年代初，渠務署進行了多項雨水排放整體計劃研究，以全面檢討本港市區的排水基建，並隨之展開一系列大型雨水排放系統改善計劃，以達至長遠有效的防洪保障。

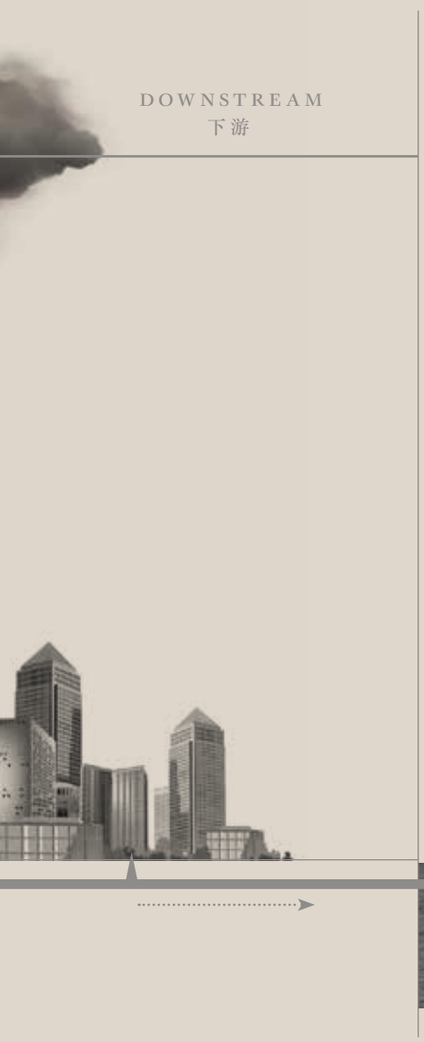
06 創

INNOVATION IN ACTION

The challenge of substantially upgrading the drainage infrastructure in a metropolitan urban area like Hong Kong cannot be overstated. In the traditional approach, whereby additional drainage conduits are laid underground or existing ones enlarged, works require extensive opening of busy roads in densely-populated and commercial districts. Trenchless techniques will reduce the extent of open excavation, but their application can be greatly hindered by the lack of underground space owing to congested utilities. Such a traditional approach to drainage improvement typically requires long construction periods and causes traffic disruptions as well as inconvenience to the public and commercial activities.

Mindful of these constraints and potential impact, DSD explored novel ideas to formulate alternative approaches that would allow adequate flood protection with much-reduced impact. The quest yielded two innovative schemes: stormwater interception and flood storage.

The stormwater interception scheme is devised to protect coastal urban areas juxtaposed by a hilly hinterland, by way of a drainage tunnel routed midhill. Stormwater runoff from upland areas is intercepted via intakes located on the main drainage paths and funnelled into the tunnel for direct discharge. This alternative drainage path significantly reduces the amount of stormwater runoff flowing to urban areas downstream, effectively alleviating flood risks. Drainage tunnels are designed to cope with extreme rainfalls of a 1-in-200-years return period.



Innovative Flood Control Strategy

創新防洪策略

The flood storage scheme applies to urban areas with a flat or low-lying terrain. It entails the installation of an underground tank to temporarily store excessive flows to avoid overloading the existing drainage system. The stored flow is subsequently discharged in a controlled manner after the peak flows have subsided.

The two innovative schemes directly confront torrential flows upstream and midstream. The downstream urban areas, without any major works, can thereby withstand heavy rainstorms of up to 1-in-50-years severity. Notably, in raising the general flood protection standard of an extensive urban region, construction works are concentrated in the urban fringe or localised areas, greatly reducing disturbance to the public, traffic and commercial activities.

Straightforward as their working principles may seem, drainage tunnels demand conscientious planning in order to be optimised. The tunnel route needs to be carefully chosen, not only based on geological and engineering considerations, but also to avoid encroachment into private lots and minimise sterilising future land use. The latter is favoured by a more uphill rural tunnel alignment. On the other hand, intakes have to be positioned for effective interception, implying preference for more downhill locations. The various considerations should be suitably balanced and, at the same time, retain overall compactness and cost-effectiveness as the tunnel and intakes are components of the same system.

The three drainage tunnels constructed in western Hong Kong Island, Lai Chi Kok, and Tsuen Wan embody an important step in protecting the city from flooding. Works began in November 2007, and all three projects were completed within a one-year time span between August 2012 and March 2013. Since their commissioning, no flooding has recurred in these urban areas.

要大規模提升香港這個繁華都會的市區排洪設施，面對的挑戰實在不少。傳統的方案，一般是透過加設或擴建現有的地下排水管道，需要在人口稠密和商貿繁忙的鬧市廣泛開挖街道；採用無坑挖掘技術雖可減少開挖範圍，然而密集的公共設施很多時候佔用了大量地下空間，有礙無坑技術的應用。這類以傳統方案為本的雨水排放系統改善工程，施工期普遍較長，會引起交通擠塞之餘，更會為市民帶來不便，並對商業活動造成影響。

考慮到傳統方案的各項限制和潛在影響，渠務署致力構思其他既可達到防洪目標同時能顯著減少影響的工程模式，最終得出兩項嶄新方案：雨水截流及蓄洪。

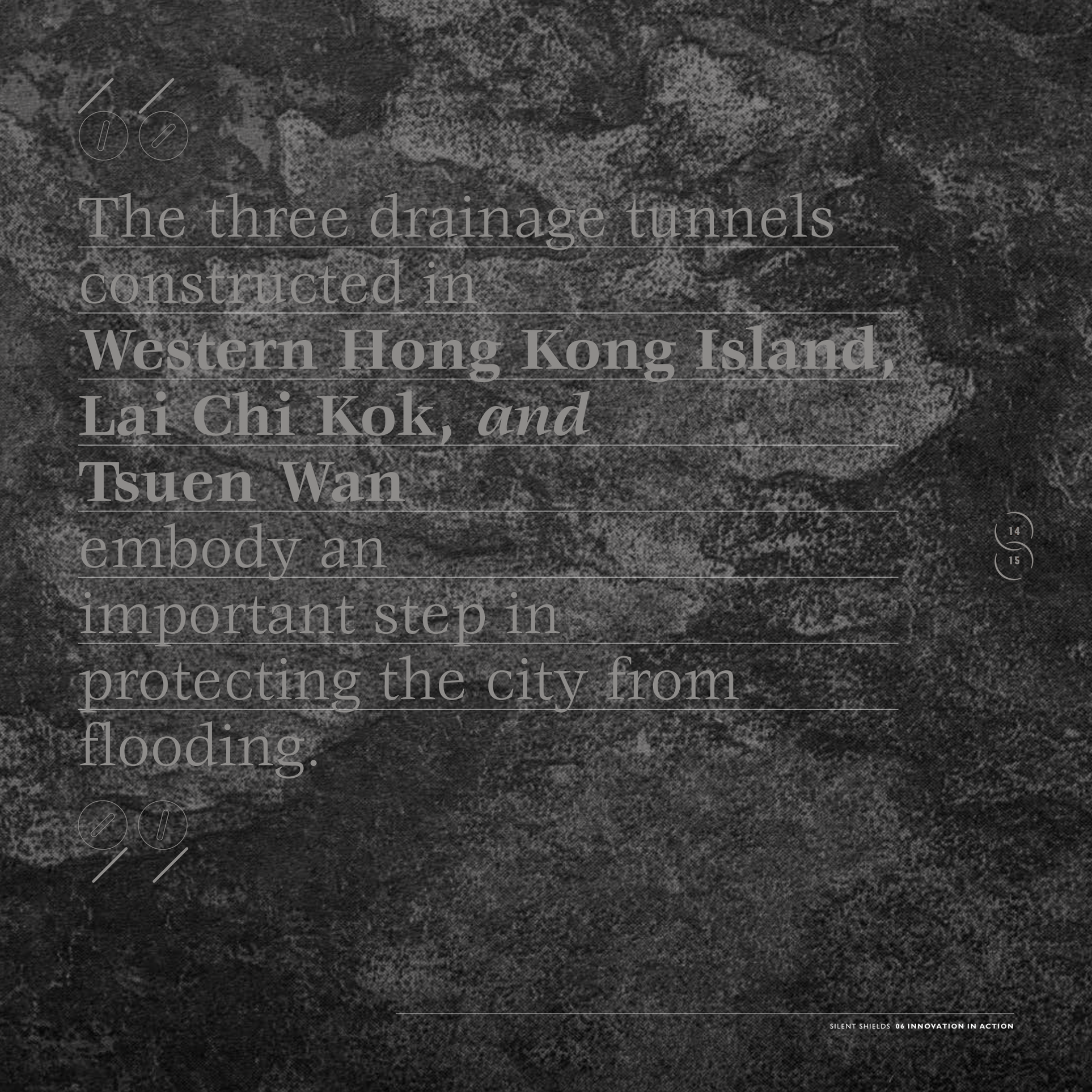
雨水截流是專為保障連接山嶺腹地的沿海市區而設，透過建於半山位置的進水口，將源自上游高地的徑流截進雨水排放隧道，然後直接排放出海，從而大幅減少流向下游市區的雨水，有效降低水浸風險。雨水排放隧道的設計排洪量，足以應付二百年一遇的大暴雨。

蓄洪方案適用於平坦或低窪的市區。工程主要是於地底建設蓄洪池，作暫時貯存過量雨水之用，以免現有的排水系統不勝負荷；貯存的雨水則在洪峰過後再作排放。

這兩個嶄新方案分別於上游及中游源頭治理洪流，下游的市區無需廣泛施工，亦可有效抵禦五十年一遇的暴雨。由於施工地點集中在市區周邊或局部地區，工程對市民、交通和商業活動帶來的影響亦大幅減少。

雨水截流的原理看似簡單直接，但要達到最周全的效果，必須謹慎籌劃。隧道的路綫在設計上除了要考慮地質及工程因素外，還要避免涉及私人土地，及減少對未來土地用途的影響。就土地的考慮，隧道宜建在較上游的郊野位置；另一方面，要有效地截取雨水，進水口應設在較下游位置。隧道設計須在各方面取得平衡，並要充份顧及整體系統的規模和成本效益。

於香港島西部、荔枝角及荃灣興建的三條雨水排放隧道，為保護香港免受洪水威脅跨出重要一步。於 2007 年 11 月開始動工後，三項工程均在 2012 年 8 月至 2013 年 3 月期間順利完成。自各條隧道啟用以來，市區在暴雨期間已再沒發生水浸情況。



> The three drainage tunnels constructed in **Western Hong Kong Island, Lai Chi Kok, *and* Tsuen Wan** embody an important step in protecting the city from flooding.

07 銳

SPEARHEADING THE EFFORT

All the drainage tunnels detailed in this book were constructed using tunnel boring machines (TBMs). These sophisticated machines are incredibly well-equipped to perform multiple tasks in tunnel construction. Apart from drilling through ground, they also remove excavated materials and construct tunnel walls using precast concrete segments. These activities are conducted in cycles as the machinery advances intermittently, steadily completing the entire tunnel.

Owing to its length, Hong Kong West Drainage Tunnel concurrently enlisted two TBMs, affectionately named *Oshin* and *Nuwa*. With an 8.3-metre diameter cutterhead, *Oshin* was then the largest hard-rock TBM ever employed in Hong Kong. It completed 6.5km of tunnel starting from the downstream portal at Cyberport in 22 months, crossing the major Sandy Bay fault in its course, while *Nuwa* covered the other 4km in a period of 20 months from the upstream portal at Tai Hang.

It has been a long-standing practice for a TBM to be named after a famous woman. *Dae Jang Geum* and *Oshin* are historical figures from Korea and Japan respectively, both well-known for their perseverance and intelligence. *Nuwa* is a fabled goddess from China who saved the world from inundation. These remarkable females all possess the qualities called for in the mission to deliver a drainage tunnel.

Tunnel Boring Machine	Drainage Tunnel	Length *(m)*	Diameter *(m)*	Type	Geology
Nuwa	HKWDT Eastern section	170	7.2	Shielded	Hard rock
Oshin	HKWDT Western section	180	8.3	Shielded	Hard rock
Dae Jang Geum	LCKDT	125	5.7	Slurry Shielded	Hard rock, soil rock mixed, soft ground
Running Free Dragon	TWDT	140	7.3	Shielded	Hard rock

A TBM is typically equipped with a refuge chamber able to withstand fire in the tunnel for some 12 hours. The chamber supplies breathable air, water and food for the crew as they wait for rescue.

隧道鑽挖機一般配備能承受隧道內火警達 12 小時的避難室，提供空氣、水和食物，讓工作人員等待救援。

Lai Chi Kok Drainage Tunnel developed a sophisticated hybrid TBM, *Dae Jang Geum*, able to cope with wide-ranging geological conditions from hard rock to mixed ground and soil. Its design utilised a pressurised slurry to stabilise the excavation face. *Dae Jang Geum* alone completed both the branch tunnel in 11 months and the main tunnel in another seven months.

Tsuen Wan Drainage Tunnel's TBM, *Running Free Dragon*, is also a hard-rock TBM. After 23 months of boring through numerous geological faults underneath Tai Mo Shan, it successfully completed its tunnelling works.

本書所載的三條雨水排放隧道，建造過程均利用了隧道鑽挖機。這些精密的機械設計非常精良，可於興建工程中發揮多種功能。除了鑽挖外、還可移除挖掘產生的泥土碎石，及以預製混凝土組件砌建隧道壁。隨着隧道鑽挖機循環地向前推進並進行這些工序，整個隧道便逐步建成。

鑑於它的長度，港島西雨水排放隧道的興建同時採用了兩部分別以阿信和女媧命名的隧道鑽挖機。阿信配備一個直徑 8.3 米的鑽頭，於當時是香港歷來最大型的硬石隧道鑽挖機，它從數碼港即隧道的最下游開始，在 22 個月內完成了 6.5 公里長的隧道，其間穿越一條位於大口環的主要斷層；女媧則於 20 個月內，自隧道於大坑的上游端建成其餘 4 公里長的隧道。

至於荔枝角雨水排放隧道所採用的，是一部特別研製的混合型隧道鑽挖機，名為大長今。它可應付堅硬岩石、泥石夾雜層及軟土不同類型的地質，它的設計是以高壓的泥漿鞏固鑽挖機前面的泥土。大長今獨力在 11 個月及 7 個月內分別完成了分支隧道和主隧道的建造工程。

順風龍是荃灣雨水排放隧道採用的鑽挖機，它同樣是一部堅石鑽挖機。它成功越過大帽山地下的多個斷層，於 23 個月內完成隧道鑽挖工程。

RUNNING FREE DRAGON, TUNNEL BORING MACHINE OF TWDT 荃灣雨水排放隧道的鑽挖機順風龍

傳統上隧道鑽挖機會以一位為人熟識的女性命名。如大長今與阿信這兩位分別屬韓國及日本的歷史人物，皆是代表著聰慧機智和堅毅不屈；而女媧則是在中國傳說中，從洪水中拯救世界的女神。這幾位表現卓越的女性，均擁有構建一條雨水排放隧道須具備的特質。

隧道鑽挖機	雨水排放隧道	長度 (米)	直徑 (米)	類別	地質
女媧	港島西，東段	170	7.2	護盾	岩石
阿信	港島西，西段	180	8.3	護盾	岩石
大長今	荔枝角	125	5.7	護盾泥漿式	岩石，泥石夾雜，軟土
順風龍	荃灣	140	7.3	護盾	岩石

A TBM complete with back-up units is 170m long, approximately the length of an eight-carriage Tsuen Wan Line train.

一部隧道鑽挖機連同配備卡組的長度達 170 米，與一列八節車廂的荃灣綫列車相約。

NUWA AND *OSHIN*, TUNNEL BORING MACHINES OF HKWDT 港島西雨水排放隧道的鑽挖機女媧及阿信

DAE JANG GEUM, TUNNEL BORING MACHINE OF LCKDT 荔枝角雨水排放隧道的鑽挖機大長今

08 鉅

MIGHTY ENDEAVOUR

港島西

08 AUG 2012
Commissioning Date

10.5 KM
Tunnel Length

6.25 / 7.25 M
Tunnel Diameter

34
Intakes

135 M^3/S
Design Flow

The *Hong Kong West* Drainage Tunnel

港島西雨水排放隧道

At a cost of $3.4 billion, Hong Kong West Drainage Tunnel is DSD's largest urban flood prevention project. It is the longest drainage tunnel in Hong Kong, as well as the largest in diameter, measuring 10.5km in length and 6.25m to 7.25m in diameter.

The tunnel extends from Tai Hang in the east to Cyberport in the west. It intercepts about 30 per cent of the stormwater runoff in northern Hong Kong Island for direct discharge into the sea off Cyberport, bypassing Causeway Bay, Wanchai, Central and Sheung Wan, thereby raising the flood protection level of these urban areas.

The 34 stormwater intakes for flow interception are positioned throughout the midhill region of Hong Kong Island, which is dotted with residential developments. In many instances, intake shafts are located in the immediate vicinity of buildings.

The significant scale of the works implies heavy machinery is required. To control and mitigate environmental impact, the project team called in technological advancements to reduce work-related nuisance to the greatest extent possible.

The project employed four Raise Boring Machines (RBM) to excavate 23 dropshafts of 32m to 172m depth, marking the first extensive use of such technology in Hong Kong. A small bore was first sunk at ground level to connect to the adit below. The shaft was then drilled by an RBM machine from the bottom up. In the process, excavated soil collected under gravity in the adit below for disposal via the tunnel. This construction method minimised the handling of soil and rock spoil on the surface, thus greatly reducing noise and dust nuisance, as well as traffic and other impact on the surrounding areas.

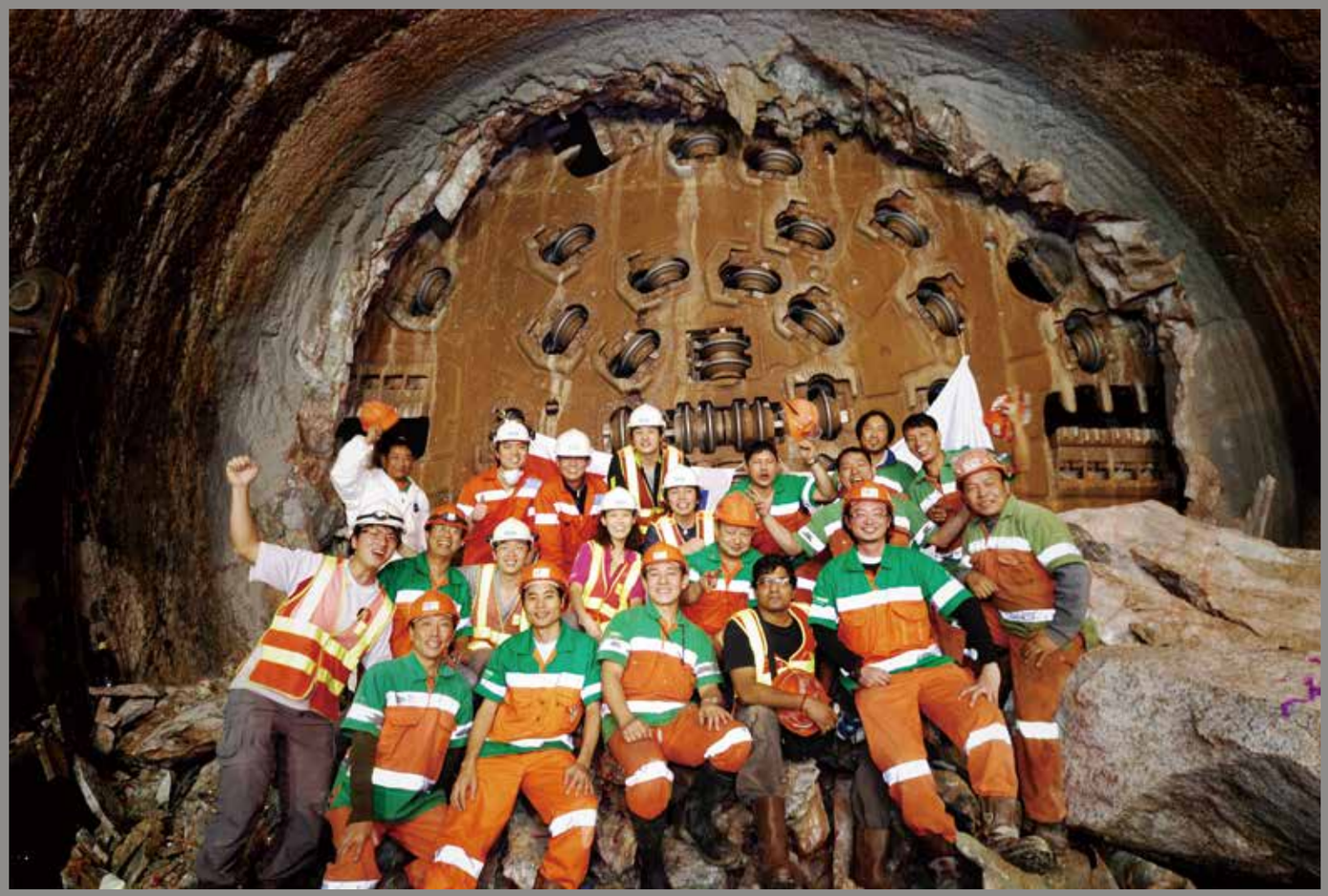
Just as importantly, extra sensitivity was shown to historical structures located nearby. A good example was the Haw Par Mansion, a historically unique Grade 1 building situated in Tai Hang right next to the eastern tunnel portal. Thanks to extensive control and monitoring work, this 80-year-old, four-storey structure stayed well protected from any possible impact.

Each stormwater intake is connected to the tunnel via an adit. The whole works site resembled a complicated underground network with numerous work fronts. Using the raise boring method for intake shaft construction also meant that any such shaft could only commence after the relevant tunnel segment and adit were completed. Moving material and personnel efficiently proved a great challenge.

While the tunnel was excavated by tunnel boring machines (TBMs), the adit was constructed by blasting. Conventionally, safety considerations would mean that blasting cannot commence until the TBM has advanced a considerable distance away from the adit. Such a safety requirement posed great constraints on work sequencing and logistics.

To overcome these issues, the project team devised, for the first time in Hong Kong, a methodology that would allow blasting to start with the TBM still in relatively close proximity. It further permitted the concurrent blasting of multiple adits. This new technique dramatically shortened the construction time to achieve timely commissioning of the project.

DRILLING AND BLASTING WORKS FOR ADIT EXCAVATION 以鑽爆方法挖掘連接隧道



DRILL AND BLAST FOR ADITS 連接隧道的鑽爆工程

22
23

HKWDT's adits add up to a length of 8km.
Together with the 10.5km main tunnel, the total length exceeds that of the entire 13.3km-long Hong Kong Island Line railway.

港島西雨水排放隧道的連接隧道共長 8 公里，連同 10.5 公里長的主隧道，總長度超越 13.3 公里長的港島綫鐵路。


MBD2

THE 10.5KM LONG HONG KONG WEST DRAINAGE TUNNEL 全長 10.5 公里的港島西雨水排放隧道

The total length of rail tracks used in constructing HKWDT is 42,165m, approximately the distance from Hung Hom to Lo Wu along the East Rail Line.

興建港島西雨水排放隧道所用的路軌共長 42,165 米，約等於東鐵綫紅磡至羅湖間的距離。

造價達 34 億港元的港島西雨水排放隧道，是渠務署最大型的市區防洪項目。隧道長達 11 公里，直徑闊 6.25 至 7.25 米，是香港最長及最大的雨水排放隧道。

此隧道由大坑延伸至港島西面的數碼港，截取流向香港島北部約百分之三十的徑流，並引導雨水繞過銅鑼灣、灣仔、中環、及上環，至數碼港旁的海域直接排放，從而提升這一帶市區的防洪水平。

34 個截流進水口均位處香港島滿佈住宅的半山區域，許多進水口的豎井均與建築物相鄰。

進行如此大規模的工程，無可避免需要採用重型機械。為降低及紓緩對環境的影響，工程團隊採用了嶄新技術，將施工帶來的滋擾減至最低。

工程採納了在香港首次廣泛應用的反井鑽挖技術，以四台反井鑽機挖掘 23 個深度為 32 至 172 米的豎井。這項技術首先從地面向下鑽挖一個小孔至連接隧道，繼而利用反井鑽挖機由下至上挖掘豎井，過程中鑽出的沙石會掉下至連接隧道內，再經由隧道移走。這種建造方式省卻在地面處理大量泥土碎石的工序，令噪音和塵埃，與及對交通和周邊環境的影響減至最低。

工程團隊亦非常關注施工對鄰近歷史建築物的影響。以位於大坑的虎豹別墅為例，這座一級歷史建築與隧道的入口非常接近。有賴全面的控制和監察工作，這座擁有八十年歷史、樓高四層的大宅未有因為工程的進行而造成任何破損。

隧道系統的進水口與隧道之間是以連接隧道連繫，整個工地就像是一個複雜的地底網絡；利用反井鑽挖技術建造進水口豎井，更意味著挖掘豎井的工序須在有關的隧道段及連接隧道建成後方可展開，因此在隧道內要有效運送物料和工作人員，是一項巨大挑戰。

隧道是利用隧道鑽挖機挖掘，而連接隧道則採用爆破方式，基於安全考慮，連接隧道的爆破工程只可在鑽挖機與連接隧道之間有一段相當大的距離後方可進行，然而這個安全措施，會對施工程序及物流構成很大限制。

面對這些掣肘，工程團隊構思了一個在香港首次採用的方案，讓爆破工程可在鄰近隧道鑽挖機的位置進行，此方法更容許多條連接隧道同時進行爆破，藉此顯著縮減整體施工時間，讓雨水排放隧道可早日啟用。●

OPPOSITE PAGE:
LEFT 左
INTAKE CONSTRUCTION IN CLOSE PROXIMITY TO RESIDENTIAL PREMISES 在民居旁建造進水口
TOP RIGHT, BOTTOM RIGHT 右上，右下
RAISE BORING MACHINE AND CUTTERHEAD 反井鑽挖機及其鑽頭

With a diameter measuring 7.25m, HKWDT can accommodate a seven-seater car on top of a double-decker bus with room to spare.

直徑達 7.25 米的港島西雨水排放隧道，可容下一輛七人私家車和一架雙層巴士重疊在一起，仍剩餘少量空間。

09 鋒

荔枝角

18 OCT 2013
Commisioning Date

3.7 KM
Tunnel Length

4.9 M
Tunnel Diameter

6
Intakes

102 M^3/S
Design Flow

The *Lai Chi Kok* Drainage Tunnel

荔枝角雨水排放隧道

Delivery of the $1.7 billion Lai Chi Kok Drainage Tunnel is the culmination of technological advancements and a pioneering spirit.

The 3.7km tunnel project comprises a 2.5km midhill branch tunnel that runs from Tai Wo Ping to Butterfly Valley, and a 1.2km main tunnel extending underneath Lai Chi Kok's urban strip to the coast. Connecting the two tunnels is a stilling basin.

BAFFLE RING AT THE BOTTOM OF AN INTAKE SHAFT FOR TURBULENCE SUPPRESSION
進水豎井底用以減低湍流的幾環結構

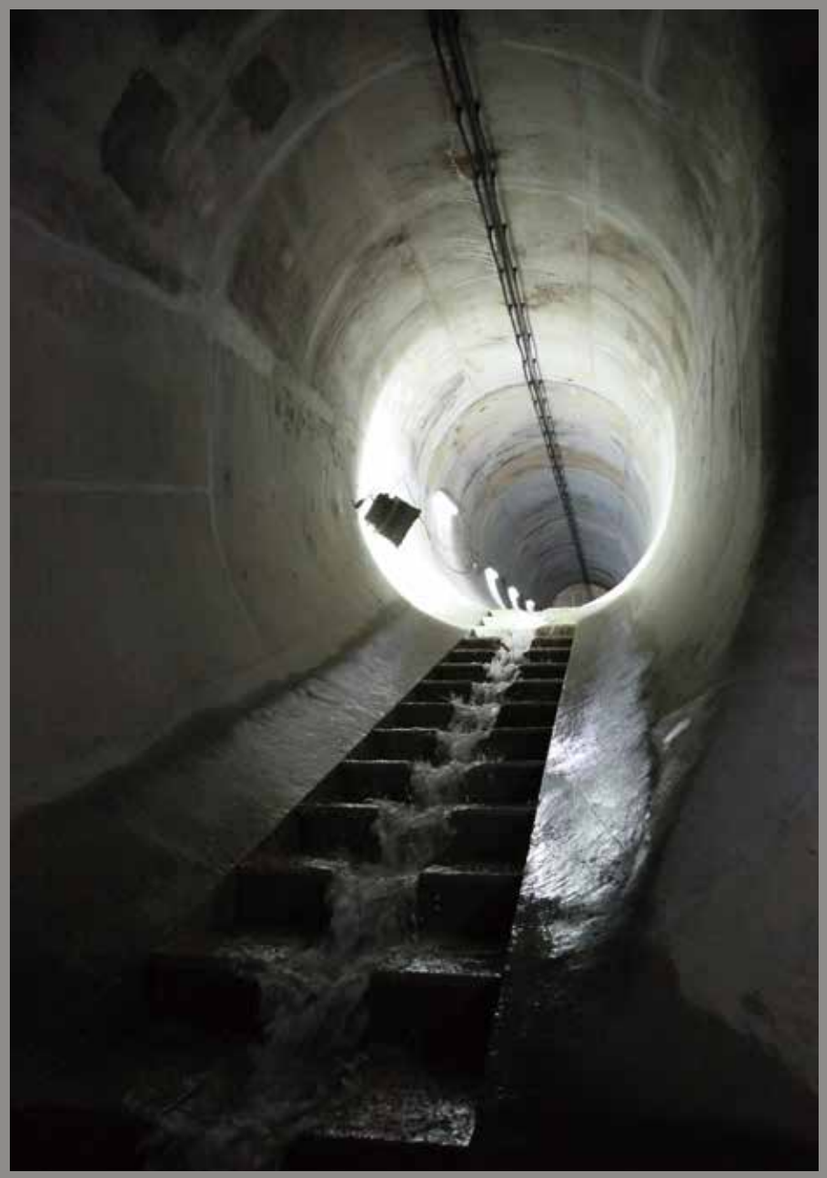
Stormwater runoff from a 290-hectare uphill area, north of Ching Cheung Road, is intercepted into the branch tunnel through six intakes installed along its length. Runoff from Butterfly Valley also discharges directly into the stilling basin. From this point, the main tunnel then conveys the combined flows to a coastal outfall near Stonecutters Island.

As stormwater flowing downhill is significantly reduced, flooding risks in Lai Chi Kok, Cheung Sha Wan and Sham Shui Po are largely mitigated.

The need for two tunnel segments and a stilling basin stems from the project's unique complexity. To reach the harbour, the main tunnel is aligned along Tsing Sha Highway, which is the only viable corridor without encroachment into private lots. This brings about a direct encounter with five railways, including two subterranean ones—the Tsuen Wan Line at a depth of 25m below ground and the Guangzhou-Shenzhen-Hong Kong Express Rail Link situated at 37m depth. The resulting design is a deep tunnel just below the Express Rail Link with vertical inlet and outlet shafts at each end.

Stormwater torrents carry a considerable amount of silt and debris. The stilling basin serves the primary function of calming the flow for debris settlement to protect the main tunnel from siltation. As will be clear in the subsequent sections, the basin offers exciting added-value opportunities well beyond the project's engineering objectives.

Throughout the tunnel's planning, design and construction, the project team overcame various challenges and achieved a number of breakthroughs in engineering technology.



The two tunnels are distinct not only for their elevations but also the geology. The midhill branch tunnel runs entirely through rock, while the main tunnel winds through diverse conditions dominated by soft or mixed soil and rocky ground.

Different geology normally translates into tunnel boring machines (TBM) of entirely different design and working mechanisms. Regardless of its design, a TBM is a mammoth machine requiring substantial material and resources input. The project team conceived a specially-designed hybrid TBM to cope with the varying geology, thus eliminating the need for a second TBM. The ensuing smooth and timely completion of the two tunnels is a testament to the success of the design, celebrating the team's commitment toward sustainable project design and construction.

NORTHWEST KOWLOON—THE AREA PROTECTED BY THE LAI CHI KOK DRAINAGE TUNNEL 西北九龍—荔枝角雨水排放隧道的保障範圍

The soft and mixed geology of the main tunnel, coupled with its proximity to the sea, posed immense risks of ground collapse and groundwater ingress. Such occurrences could be catastrophic given the tunnel's very close proximity to major railways, viaducts, buildings and their piled foundations. The clearance between the Guangzhou-Shenzhen-Hong Kong railway tunnel and the main tunnel is actually as slim as 1.8 metres!

To manage the risks, the project team took on the task of applying compressed air construction techniques at an unprecedentedly high pressure in Hong Kong of 4.2 times the atmospheric pressure. A series of activities swung into action, from the engagement of a world-renowned physician who specialises in compressed air tunnelling to the painstaking formulation of safety and work protocols, and from the acquisition of special statutory approvals for high pressure works to the training, medical examination and support of personnel throughout the process.

Meanwhile the project team implemented an all-round risk monitoring and control programme covering all potentially affected facilities, complete with contingency traffic management plans in case of any road subsidence or emergencies.

The meticulous work paid off well. No impact was caused to any of the railway lines, highway foundations, roads or facilities. The tunnelling works achieved zero complaints throughout the 18 months of boring despite the very short distance to sensitive receivers like the Caritas Medical Centre and some residential developments. Most notably, the project recorded no decompression sickness among all personnel despite the high air pressure applied—an impressive achievement by any standard.

OUTFALL UNDER CONSTRUCTION, THE COMPLETED WORKS IS THE COASTAL OCTAGONAL STRUCTURE VISIBLE IN THE LOWER MIDDLE OF THE LEFT PHOTOGRAPH
建造中的出水口，建成後為左圖中下位置海旁的八角形結構

The main tunnel of LCKDT is located 45m below ground, approximately the depth of a 15-storey underground building.

荔枝角雨水排放隧道的主隧道位於地面以下 45 米深處，深度約相等於一棟 15 層的地庫。

This drainage project also extends beyond engineering to achieve broader objectives. The deck of the stilling basin and its surroundings, originally designated as a maintenance area, were developed into a sizable pet garden to align with the public's aspirations, adding yet one more use to the land already being shared between the basin and the Tsing Sha Highway above.

OCTAGONAL CASCADES AROUND THE OUTFALL FOR CALMING THE DISCHARGE. THE VANTAGE POINT IS NOW BELOW SEA LEVEL 出水口周邊以減慢流速的八角形階梯結構，取景位置現處於海面下

耗資17億港元興建的荔枝角雨水排放隧道，是結合先進科技與創新精神的成果。

隧道全長3.7公里，包括一段長2.5公里、由大窩坪至蝴蝶谷沿半山興建的分支隧道，與及一段1.2公里長由蝴蝶谷延伸至海旁、貫穿荔枝角市區地底的主隧道，兩條隧道由一個靜水池連繫。

沿分支隧道共有六個進水口，截取呈祥道以北、面積達290公頃高地的雨水至隧道內。靜水池亦直接收集經蝴蝶谷的徑流，主隧道則將匯聚的洪水排放到昂船洲附近海岸的排水口。

截流系統大幅減少湧向下游的雨水，令荔枝角、長沙灣及深水埗一帶的水浸風險亦得以全面紓緩。

兩段隧道配以靜水池的設計，源於這項工程獨具的複雜性。主隧道要伸延至海港，沿青沙公路的路綫是唯一可行而不會影響私人土地的方案。然而這條路綫會與五條鐵路相遇，當中兩條位於地下—在25米深處的荃灣港鐵綫、及深入地底37米的廣深港高速鐵路。主隧道的最終設計，是一條兩端配備進水及出水豎井、建於高速鐵路之下的深層隧道。

湍急的山洪會夾雜大量沙石，靜水池的基本作用，是將沙石沉澱，以防主隧道淤塞。這個靜水池亦帶來多個在防洪目標以外的機遇，為這項工程增值，下文將進一步闡述。

兩段隧道的不同之處，除了是一條位於半山，而另一條則在地底深處，還有它們截然不同的地質。在半山的分支隧道穿越的是堅石，主隧道則是在泥土層或泥石夾雜的地質蜿蜒而建。

不同的地質一般需要使用不同設計和運作模式的隧道鑽挖機，然而不論是何種模式，隧道鑽挖機都是一部需要投入大量物料及資源製造的龐大機器。工程團隊特意構建一部多功能、適用於不同地質的隧道鑽挖機，以省回多製造一部鑽挖機的需要。分支隧道和主隧道其後順利依期完成，足證團隊致力令工程更配合可持續發展理念的努力，取得圓滿成功。

主隧道穿越的泥土及泥石夾雜地質，加上位處沿岸，意味建造過程面對極大的地面塌陷及地下水灌入風險。由於隧道緊貼主要的鐵路、高架橋、建築物及它們的地基，一旦發生上述情況，將會導致災難性後果。事實上，主隧道與廣深港鐵路隧道之間僅相隔1.8米！

要適當管理風險，工程團隊引進高壓施工技術，首次在香港應用高達4.2倍大氣壓力的壓縮空氣工序。為此一連串籌備工作迅速展開，包括特聘一位世界知名、具備豐富高壓隧道工程經驗的海外專科醫生、仔細制定相關安全指引和工作守則、按法例申領進行此等高壓工序所需的特殊核准、並在工程期間為人員提供培訓、健康檢查及支援。

與此同時，工程團隊對一切有可能受工程影響的設施，建立一套全面監控系統，更就各種如路陷等的緊急情況，訂定周詳應變計劃。

嚴謹的施工取得良好效果，工程完全沒有對鐵路、高速公路、道路、地基或其他設施構成任何影響。隧道鑽挖工程非常接近明愛醫院及住宅等多個易受影響的建築物，共歷時18個月的挖掘過程成功達到零投訴。在安全方面，縱然高壓工序的氣壓十分高，工程更錄得零減壓症個案的驕人成績。

這個防洪項目亦超越工程領域邁向更廣闊的目標：工程團隊將原本闢作維修用地的靜水池上蓋和周邊範圍，因應市民大眾的期望，發展成一個大型寵物公園，讓這幅原已由靜水池和青沙高架橋共用的土地再增添另一用途，更能地盡其用。

TRANSPORTATION-LEISURE-DRAINAGE THREE-FOLD LAND USE: THE STILLING BASIN BENEATH TSING SHA HIGHWAY WITH THE BASIN DECK BEING DEVELOPED INTO A PET GARDEN
防洪、康樂、運輸一地三用：位於青沙高架橋下的靜水池，上蓋建為寵物公園

Delivery of the *$1.7 billion* Lai Chi Kok Drainage Tunnel is **the culmination of technological advancements *and* a pioneering spirit**.

Decompression sickness, also known as divers' disease or the bends, is a potentially serious condition caused by the formation of inert gas bubbles in the bloodstream and body tissues resulting from reduced ambient pressure. Working in compressed air requires meticulously-controlled compression of the personnel beforehand and decompression afterwards. Proper decompression timing and procedures serve to prevent decompression sickness.

減壓症，又稱潛水夫病，起因是身體周邊的氣壓下降令體內的惰性氣體形成氣泡，可引致嚴重後果。工程人員進出壓縮空氣環境，必須進行嚴謹的加壓及減壓程序。適當的減壓時間和程序可防止減壓症發生。

CONFLUENCE OF AN ADIT AND THE BRANCH TUNNEL 連接隧道與分支隧道交匯點

10 諧

A HARMONIZING FEAT

荃灣

28 MAR 2013
Commisioning Date

5.1 KM
Tunnel Length

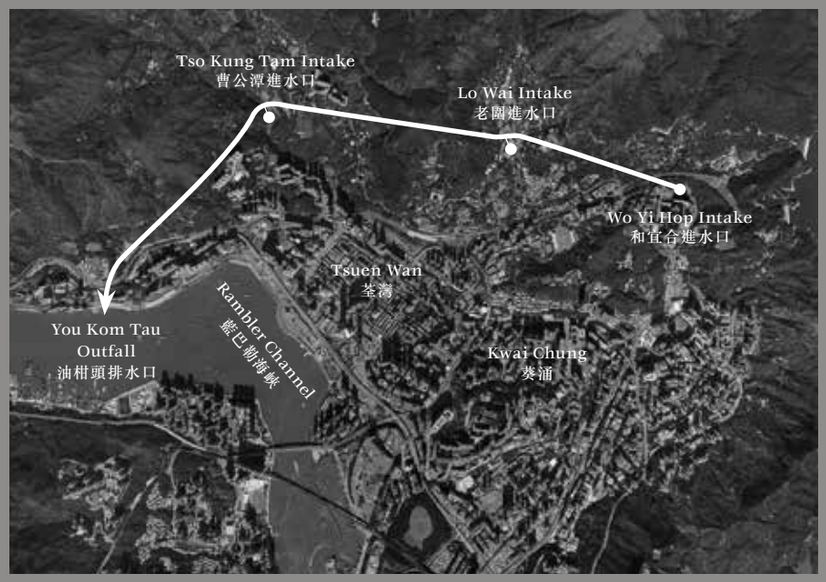
6.5 M
Tunnel Diameter

3
Intakes

226 M^3/S
Design Flow

The *Tsuen Wan* Drainage Tunnel

荃灣雨水排放隧道



Tsuen Wan Drainage Tunnel runs along the southern periphery of Tai Mo Shan towards the coast west of Tsuen Wan, significantly raising the flood protection level of the Tsuen Wan and Kwai Chung areas through flood interception. The tunnel is 5.1km long and 6.5m in diameter with three stormwater intakes. The outfall is located at Yau Kom Tau.

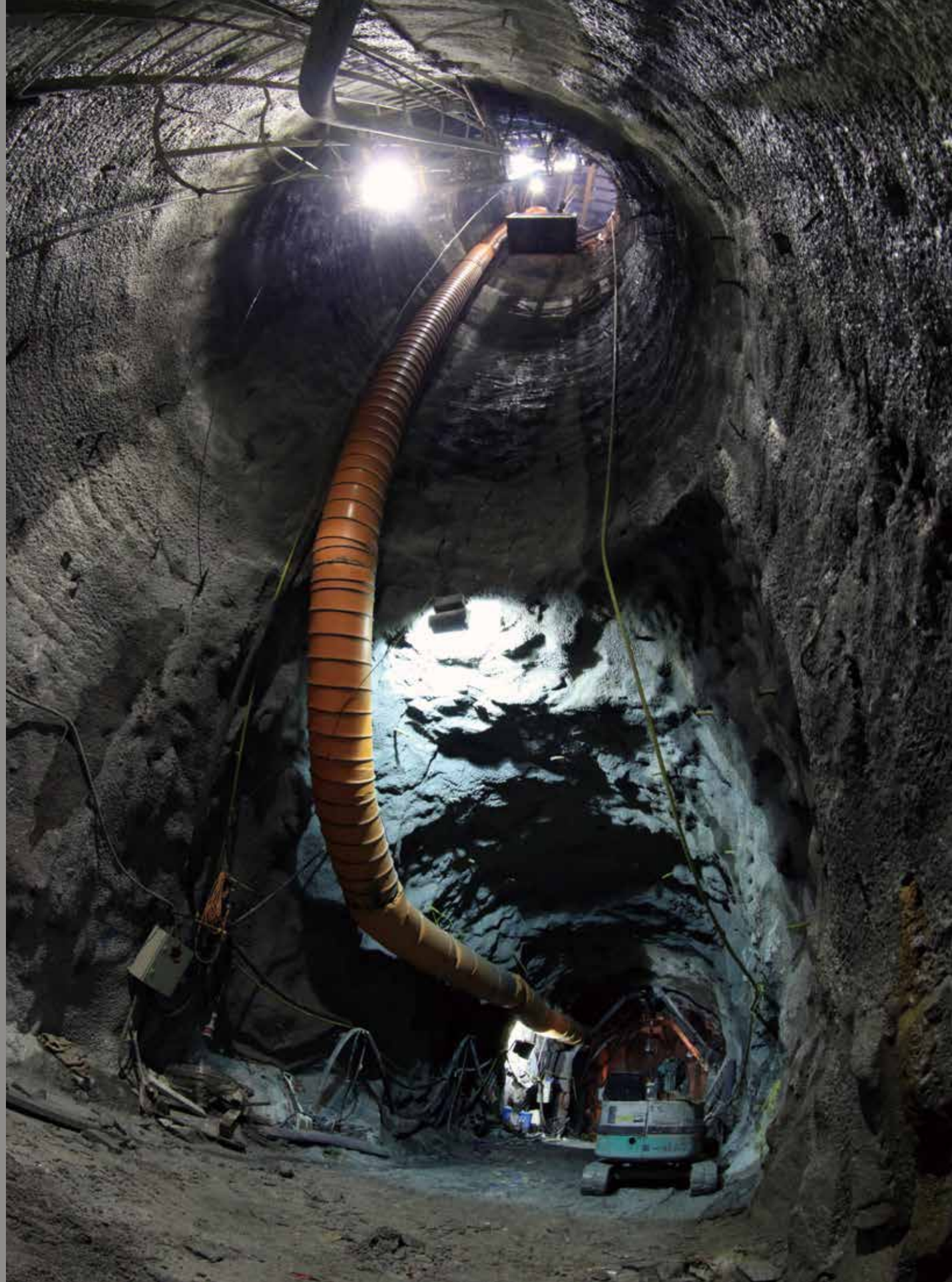
With only 12 metres to spare, the tunnel passes in close proximity to the Tai Lam Water Tunnel, an unlined aqueduct of the Water Supplies Department built in 1957 and a key freshwater supply line. Another critical aspect is the crossing of a major geological fault underneath Cheung Pei Shan Road. Through careful planning and precise control, these challenges were efficiently overcome without adverse impact.

As the chapter title suggests, harmonising with the environment is one of the most notable features of this project. The outlet portal of the tunnel at Yau Kom Tau is located adjacent to residential developments. It is also an area with extensive rock formation, out of which the portal and access facilities need to be carved. The project team implemented one of the most elaborate noise control facilities DSD has undertaken to minimise and control any nuisances.

The three stormwater intakes are all located on natural streams. In terms of sheer number, this tunnel has the fewest intakes. Despite this, it has the largest flow, with a catchment covering 1,370 hectares—larger than those of Hong Kong West and Lai Chi Kok combined. The Tso Kung Tam intake, located close to Tai Mo Shan Country Park, conveys the highest amount of stormwater among the three drainage tunnels.

Conscious of the project's rural settings, the project team strove to blend the works well with their surroundings. Apart from generous greening, a good example is the nailing of natural boulders themselves, in lieu of other artefacts like concrete blocks, in front of the inlet screens of intakes to protect them from boulder impact.

While the primary objective of the tunnel is to effectively intercept flow, the design also takes due account of the ecological needs of the streams. To ensure the ecology would not be adversely affected, the intakes were specially designed to start flow interception only when the river flow exceeds a pre-set amount corresponding to the amber rainstorm warning. This way the habitat downstream continues to receive a sufficient flow to ensure various species will not be affected, achieving a fine balance between flood prevention and ecological conservation.



Over 50,000 shrubs and trees were planted around TWDT's intakes and outfall. The total greening areas amount to 12,000m².

茎灣雨水排放隧道的進水口和出水口周邊地帶，共種植了超過 50,000 棵灌木和喬木，綠化面積達 12,000 平方米。

TSO KUNG TAM INTAKE 曹公潭進水口

荃灣雨水排放隧道沿大帽山南面一直延伸至荃灣西面，顯著提升了荃灣及葵涌區的防洪水平。隧道全長 5.1 公里，直徑闊 6.5 米，途中設有三個進水口 ，排水口則位於油柑頭。

此隧道與水務署的大欖輸水隧道僅 12 米之隔；後者建於 1957 年，屬主幹食水供應管道。而此雨水排放隧道亦要穿越位於象鼻山路下的大型斷層。工程團隊透過仔細的規劃和精密監控，成功克服這些挑戰，令大欖輸水隧道沒有受到絲毫影響。

如標題所述，和諧共融是此項隧道工程的重點。位於油柑頭的隧道出口毗鄰住宅物業，而且這一帶的地質為堅石，要在此處建造規模龐大的排水口及隧道進出設施，便需要大量挖掘石層。為了將施工所產生滋擾減至最少，工程團隊設置了一套渠務署歷來其中一個最全面的噪音控制措施，盡量減少對環境造成的影響。

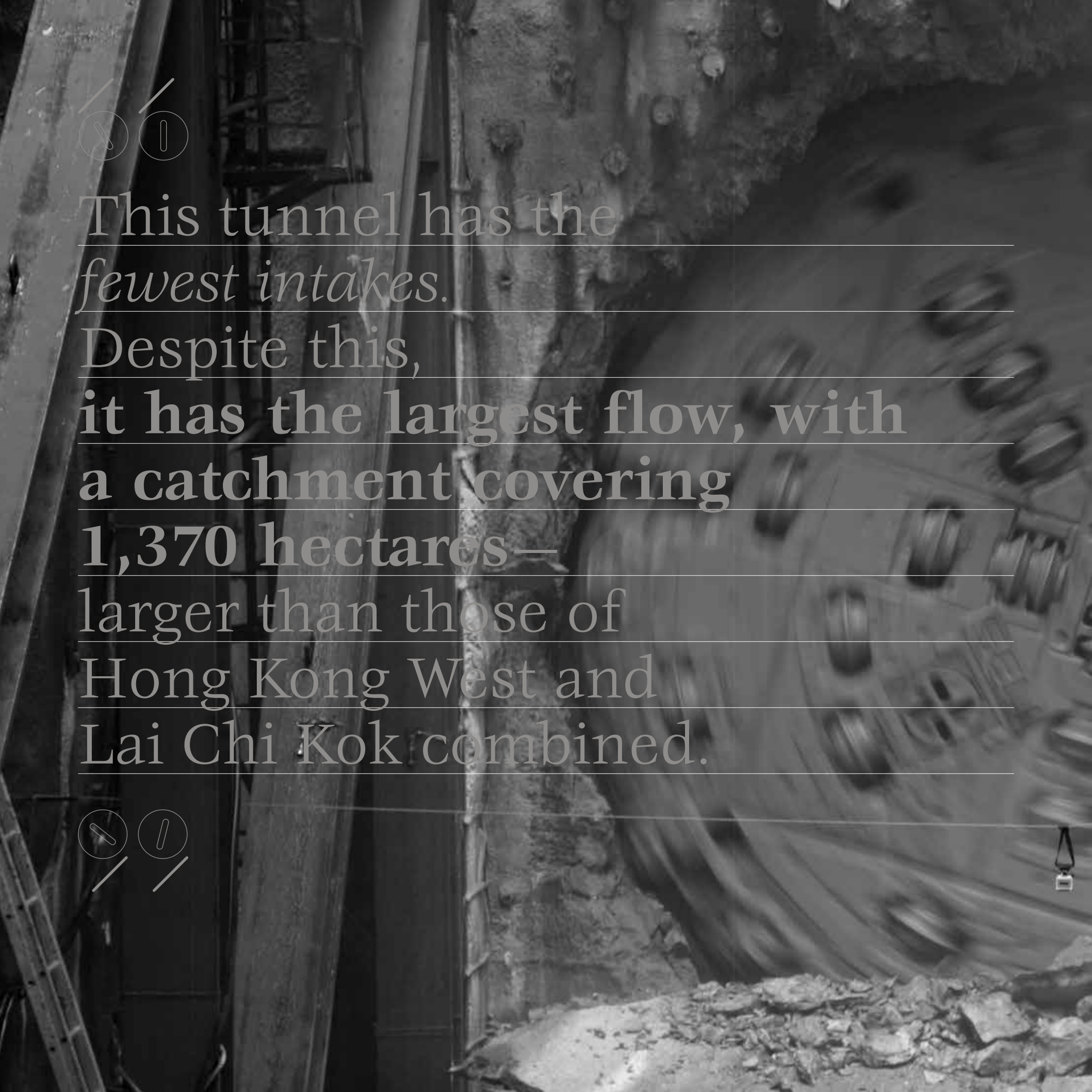
三個截流進水口均是設於天然河道上，單看數字，荃灣雨水排放隧道設有最少的進水口，然而其收集雨水範圍達 1,370 公頃，比港島西及荔枝角兩條隧道合併起來的範圍還要大，而設計排水量亦相應是三條雨水排放隧道中最大的。位於曹公潭鄰接大帽山郊野公園的進水口，截取的雨水量也是眾隧道之冠。

顧及隧道周邊的郊野環境，團隊致力將工程與大自然相融合。除廣泛綠化外，更有一些別具心思的設計，例如以天然的巨型石塊而非較易處理的混凝土建設，作為進水口前擋隔大石衝擊的屏障。

隧道在設計上要達到有效截流，同時工程團隊亦要對各進水口所處的河流生態作出周詳考慮。因此每個進水口均經過特別設計，當水流超過一個與黃色暴雨警告雨量相應的預設水平，截流機制才會啟動。這樣的設計可讓下游的河流維持一定流水量，確保生態免受影響，平衡防洪和生態保育兩方面所需。

SPIRAL MAINTENANCE RAMP AT WO YIP HOP INTAKE 和宜合進水口的螺旋形維修通道

OUTFALL AT YAU KOM TAU 位於油柑頭的出水口



This tunnel has the
fewest intakes.
Despite this,
it has the largest flow, with
a catchment covering
1,370 hectares—
larger than those of
Hong Kong West and
Lai Chi Kok combined.

TWDT's design water flow is 226m³ per second, a rate sufficient to fill an Olympic-size swimming pool in 10 seconds.

荃灣雨水排放隧道的設計排水量為每秒 226 立方米，足以在十秒內注滿一個奧林匹克標準游泳池。


MAEDA
中国中铁
SELI
渠務署
Drainage Services Department
Mott MacDonald
荃灣雨水排放隧道啟用典禮

11 眾

REACHING THE COMMUNITY

Throughout the planning and delivery of the drainage tunnels, the project teams never lost sight of the great importance of connecting with the community. A multitude of communications initiatives was launched to explain the projects and their objectives, maintain close liaison with stakeholders, and effectively address any concerns.

Stakeholder engagement plans were drawn up in the early stages of the projects. Briefing sessions and discussion forums were scheduled in tandem with the works programme for advance consultation with stakeholders. These communications were reinforced by the publication of project newsletters and a 24-hour telephone hotline service. DSD also attended District Council meetings from time to time to keep the Councils abreast of the latest project developments.

The scale of the drainage projects entailed operations which, if not carefully controlled, could have caused potentially serious impact. Examples include tunnel boring and blasting. The project teams realised that, in addition to conducting impact assessment and control as well as briefings about the measures undertaken, the single most effective way to engage concerned stakeholders was through first-hand experience. Accordingly, site visits were arranged when appropriate for stakeholders to witness prominent construction operations such as the first blast for the excavation of an intake shaft.

Effective communication is founded on understanding, and education holds the key to building lasting understanding. DSD placed strong emphasis on outreach activities to schools, introducing to students both project specifics as well as general flood protection and sewerage services in Hong Kong. These activities were sometimes enriched by special events like design competitions for site hoardings to further heighten the participants' interest. All the outreach programmes were enthusiastically received by students and teachers alike as a valuable chapter of their civic education.


Dragon Boat Association
寶嘉


真 忠 理


ASCE ISG

OPPOSITE PAGE:

TOP RIGHT 右上
WITNESSING THE FIRST BLAST WITH THE PUBLIC 公眾見證隧道的首次爆破工程

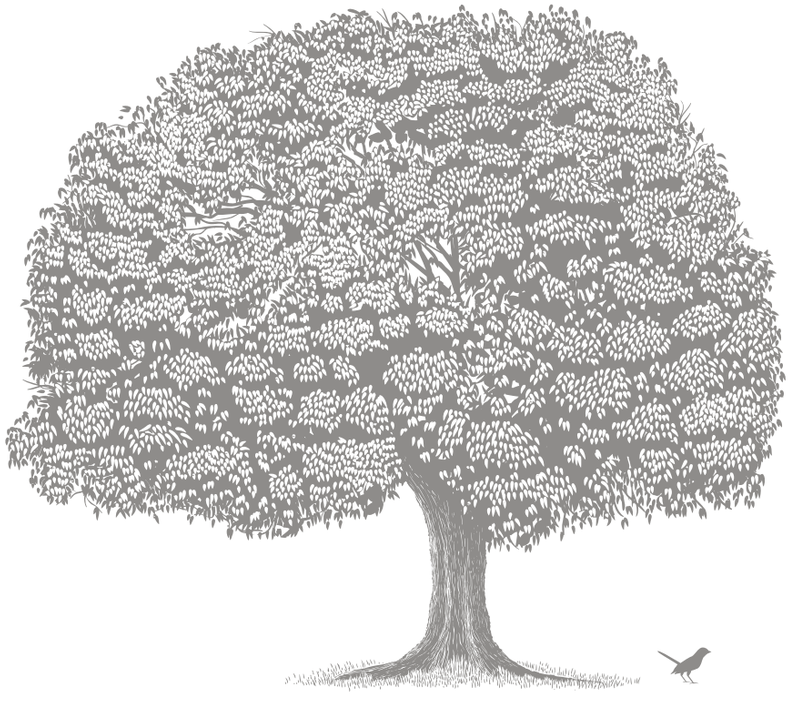
整個雨水排放隧道工程由規劃至完成，工程團隊均一直與社區保持緊密連繫，透過不同形式闡述工程資訊，及回應大眾的關注。

持份者參與活動自項目開展初期已啟動，簡報及討論會的安排與工程時間表相互配合，再輔以通訊刊物和24小時電話服務熱線，確保與各持份者適時溝通。渠務署亦會不時出席區議會會議，講解工程的最新進度。

工程的規模龐大，涉及多項具潛在影響的大型工序，如鑽挖隧道、豎井爆破等。工程團隊理解到在技術評估、緊密監控、仔細解釋之餘，第一身體驗乃是最有效的資訊，因而在合適情況下，邀請多方面的持份者親臨工地，視察大眾關注的工序，如進水豎井的鑽爆工程。

有效的溝通建基於理解，而教育是促進理解的關鍵。渠務署十分重視對學校的宣傳教育，除了向他們講解雨水截流概念和雨水排放隧道的具體細節，更會介紹香港的整體防洪和污水處理服務；有時候工程團隊亦會加插一些特別活動，如工地圍板設計比賽，以增加參與者的興趣。學生與老師們對這些資訊交流都反應熱烈，並視之為公民教育的重要一課。

DSD planted a total of **1,670 trees, 50,070 shrubs *and* 1,120 climbers** across the sites of the three drainage tunnels.



Sustainability has been a key guiding principle throughout the delivery of the three drainage tunnel schemes.

Minimising and mitigating environmental impact formed the basis for design and construction decisions. The use of raised-boring techniques in Hong Kong West Drainage Tunnel and the ecologically-conscious intake design of Tsuen Wan Drainage Tunnel are good illustrations. And in the case of Lai Chi Kok Drainage Tunnel, the special hybrid tunnel boring machine eliminated the need for a second machine, saving substantially on materials and resources that otherwise would have been consumed.

In continuation of its enthusiastic dedication to building a greener city, DSD planted a total of 1,670 trees, 50,070 shrubs and 1,120 climbers across the sites of the three drainage tunnels.

The drainage tunnels fulfil their flood protection functions without consuming power. This is especially significant for Lai Chi Kok Drainage Tunnel considering its spatial constraints amid existing railways and foundations, thanks to the special design of the main tunnel with a purposely-introduced stilling basin.

DSD seized the opportunity to maximise utilisation of the stilling basin. As its roof provides precious space for a pet garden, the rainwater collecting into it is harvested for non-potable uses after simple treatment. Apart from tapping the water for irrigation of the pet garden, flushing and general cleansing, DSD took initiatives to supply it to other government parties for off-site uses like street washing as an ideal alternative to freshwater.

It is hoped that, taken together, these small but constructive steps will contribute to a greener society and deepen everyone's dedication to sustainable development.

可持續發展理念是渠務署在推展三個雨水排放隧道計劃上的重要方針。

工程的設計和施工均以盡量減少和緩解對環境造成的影響為基本原則，當中的例子包括在港島西雨水排放隧道使用的反井鑽挖技術，以及在荃灣雨水排放隧道中合乎生態所需的進水口截流設計。而在荔枝角雨水排放隧道方面，特別設計的單一混合式隧道鑽挖機，成功節省多建一台鑽挖機所需不少的材料和資源。

渠務署在三條雨水排放隧道的範圍廣泛種植，共栽種了 1,670 棵樹木、50,070 棵灌木和 1,120 棵攀緣植物，致力綠化香港。

雨水排放隧道的防洪功能無需耗用電力，當中的荔枝角雨水排放隧道，儘管面對鐵路和密集地基構成的複雜空間限制，但憑著主隧道的特別設計，和特意加入的靜水池，仍可做到雨水自流防洪的目標。

渠務署致力讓靜水池發揮最大效用，除了地盡其用將池面開放改建為寵物公園，亦將池內匯集的雨水，淨化後作寵物公園的園林灌溉、沖廁和清洗用途；更首次將雨水供應給其他政府部門，替代食水作清洗街道。

渠務署希望結合這些細小但具意義的措施，促進可持續發展的實踐，並加強各人對這個重要理念的承擔。


Design and Construction of
Lai Chi Kok Transfer Scheme
荔枝角雨水轉運計劃
AECOM

LAI CHI KOK DRAINAGE TUNNEL ADOPTED A SPECIALLY-DESIGNED HYBRID TBM TO COMPLETE TWO SECTIONS OF TUNNELS OF MARKEDLY DISTINCT GEOLOGY. ELIMINATING THE NEED FOR A SECOND MACHINE AND SAVING SUBSTANTIALLY ON MATERIALS AND RESOURCES

荔枝角雨水排放隧道以特別設計的混合式隧道鑽挖機建造兩段地質截然不同的隧道，節省多建一台鑽挖機所需的大量材料和資源

The use of a single hybrid TBM in constructing LCKDT saved 650 tonnes of metal and other materials, heavier than the weight of a fully-loaded A380 aircraft.

荔枝角雨水排放隧道的建造利用單一部混合型隧道鑽挖機，成功節省 650 噸金屬及其他材料，重於一架滿載的 A380 客機。

13 嘉

RECOGNITION

The determined efforts to offer better services in the three drainage tunnel projects can be measured through the recognition gained in international and local awards that extol innovation and excellence.

三項雨水排放隧道工程中眾人付出的努力，呈現於多項表揚創新求精和傑出表現的國際及本地獎項。

"Engineering Wonder of the 21st century", organised by the Hong Kong Institution of Engineers. Selection resulted from voting by the general public.

「21 世紀香港十大傑出工程項目」，香港工程師學會主辦，由公眾投票選出

Winner of Project of the Year, "International Tunnelling Awards 2011", organised by New Civil Engineer and Ground Engineering, U.K.

「2011 年度國際隧道工程獎」年度工程冠軍，《*New Civil Engineer*》及《*Ground Engineering*》合辦

Finalist for Project of the Year, "International Tunnelling Awards 2012", organised by New Civil Engineer and Ground Engineering, U.K.

「2012 年度國際隧道工程獎」年度工程最終入圍項目，《*New Civil Engineer*》及《*Ground Engineering*》合辦

Finalist for International Project of the Year, "Ground Engineering Awards 2012", organised by Ground Engineering, U.K.

「2012 年度國際工程獎」年度工程最終入圍項目，《*Ground Engineering*》主辦

Silver Prize in General Public Service Award, "Civil Service Outstanding Service Award" for 2011 and 2013, organised by the Civil Service Bureau, HKSAR

2011 年及 2013 年分別奪得「公務員優質服務獎」一般公共服務銀獎，香港特別行政區政府公務員事務局主辦

Innovation and Creativity Award of the "Hong Kong Awards for Industries" for 2012 and 2013, organised by the Hong Kong General Chamber of Commerce and the Trade and Industry Department, HKSAR

2012 年及 2013 年分別奪得「香港工商業獎」創意獎，香港特別行政區政府工業貿易署及香港總商會合辦

Merit Award of "2012—2013 in the Innovation Award for the Engineering Industry", organised by the Hong Kong Institution of Engineers

「2012—2013 年度工程創意大獎」，香港工程師學會主辦


Hong Kong West Drainage Tunnel
INTERNATIONAL
TUNNELLING
AWARDS 2011


INTERNATIONAL
TUNNELLING
AWARDS 2011


International Project of the Year
Finalist
Drainage Services Department, AECOM
and Leighton-John Holland
Lai Chi Kok Drainage Tunnel, Hong Kong

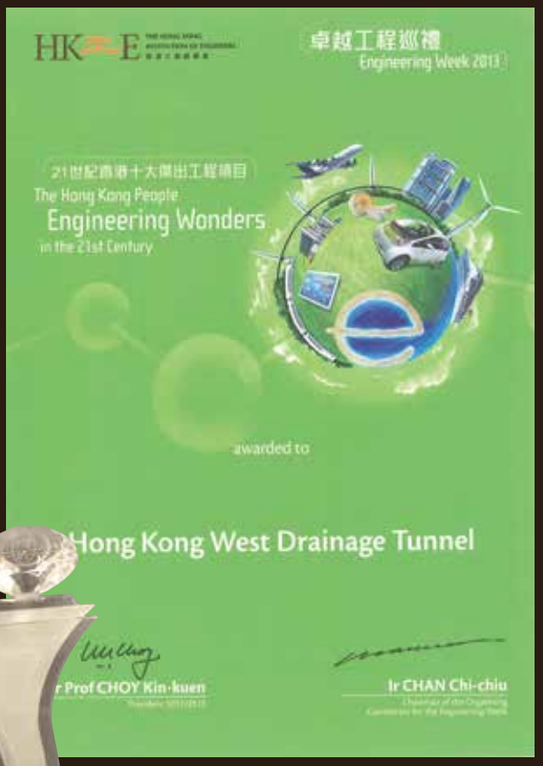

卓越工程巡禮
Engineering Week 2013


ITA
AITES
INTERNATIONAL
TUNNELLING
AWARDS 2012
FINALIST


INTERNATIONAL TUNNELLING AWARDS 2011
Conrad Hilton Hotel
1 December 2011
Hong Kong
WINNER
TUNNELLING PROJECT OF THE YEAR (BETWEEN $100M AND $1BN)
Arup / DSD / DNJV
Hong Kong West Drainage Tunnel
ROUGHT TO YOU BY
nce
FOUNDING PARTNER
ITA
AITES
www.tunnellingawards.com


公務員優質服務獎勵計劃
2013


AECOM Asia Company Limited


HKIE
卓越工程巡禮
Engineering Week 2013
21世紀香港十大傑出工程項目
The Hong Kong People
Engineering Wonders
in the 21st Century
awarded to
Hong Kong West Drainage Tunnel
Prof CHOY Kin-kuen
Ir CHAN Chi-chiu


Merit
HKIE

14 啟

TORRENTS THIS WAY

COMMISSIONING OF HKWDT ON 22 AUGUST 2012 2012年8月22日港島西雨水排隧道啟用

22 AUG 12

港島西雨水排放隧道

Hong Kong West Stormwater Drainage Tunnel

THE MOMENT OF COMMISSIONING MARKED BY THE RAINWATER SPATE DOWN THE 45M DEEP MAIN TUNNEL FROM THE STILLING BASIN 啟用一刻雨水從靜水池湧進 45米深的主隧道

18
OCT
12

荔枝角 雨水排放隧道

Lai Chi Kok Drainage Tunnel

62
63

COMMISSIONING OF LCKDT ON 18 OCTOBER 2012 2012年10月18日荔枝角雨水排隧道啟用

28 MAR 13

荃灣 雨水排放隧道

Tsuen Wan Drainage Tunnel

COMMISSIONING OF TWDT ON 28 MARCH 2013 2013年3月28日荃灣雨水排隧道啟用

15 感

IN
THEIR
OWN
WORDS

合作無間，

DSD, HKWDT

FRANKY PONG

Senior Engineer

The Hong Kong West Drainage Tunnel was a very challenging project, that won the International Tunnelling Awards 2011. It was an excellent experience to work with such a dedicated team.

DSD, LCKDT

HS KAN

Senior Engineer

The Lai Chi Kok Drainage Tunnel helped me realise that when you aspire to greatness, something wonderful can happen.

ARUP, HKWDT

DAMAN LEE

Project Director

The project realises the dream of engineers, with a fine team working and creating sustained value for society.

SEAMLESS COOPERATION

DRAGAGES-NISHIMATSU, HKWDT

DANIEL ALTIER

Project Director

We are proud to take part in making Hong Kong more sustainable through the construction of this world-class stormwater drainage system. This one-of-a-kind technically demanding project is being realised through the adoption of a number of technical firsts.

LEIGHTON LCKDT

PIERS VERMAN

Project Manager

Construction of the bored tunnels with innovative tunnelling solutions presented huge challenges for the tunnel team. Pushing the technical boundaries enabled big outcomes to the benefit of the client, engineer, contractor and all the individuals involved.

ARUP, HKWDT

BOB EVANS

Chief Resident Engineer

It has been a great privilege to help alleviate the risk of flooding and improve the living environment of Hong Kong citizens for generations to come.

LEIGHTON, LCKDT

MALCOLM PLUMMER

Project Director

When we started the Lai Chi Kok Drainage Tunnel, there were many challenges not previously encountered in Hong Kong. Cooperation between the client, engineer and contractor enabled practical solutions in a timely fashion, which made this contract a noteworthy success.

ARUP, HKWDT

JACKSON WONG

Chief Resident Engineer

I enjoyed every moment working on this challenging project. Upon its completion, the Hong Kong West Drainage Tunnel supports the continuous economic growth of Hong Kong.

AECOM, LCKDT

EDWIN CHING

Chief Resident Engineer

Partnership between DSD, AECOM and Leighton to address conflict as it arose was a key ingredient in the successful completion of the Lai Chi Kok Drainage Tunnel.

MOTT MACDONALD, TWDT

THOMAS KANE

Chief Resident Engineer

The Tsuen Wan Drainage Tunnel posed many challenges; however, with the close cooperation of all involved, the project was successfully completed for the betterment of the communities in Tsuen Wan and Kwai Chung.

MOTT MACDONALD, TWDT

CHRIS HOWLEY

Project Manager

We are proud to have contributed to Hong Kong's innovative drainage improvement scheme through our involvement in the Tsuen Wan Drainage Tunnel, working closely with DSD, the contractor and community stakeholders for the successful delivery of this challenging project

AECOM, LCKDT

KEITH TSANG

Project Director

It is an unforgettable experience to participate in such a world-class tunnelling project.

MOTT MACDONALD, TWDT

KM YEUNG

Project Director

We are deeply proud of being the lead consultant on the Tsuen Wan Drainage Tunnel, from scheme inception to design and construction. Its successful completion has demonstrated the great partnership and proactive working attitude of the whole project team.

DRAGAGES-NISHIMATSU, HKWDT

HIROSHI UETAKE

Deputy Project Director

The successful delivery of this project is a fitting testament to the seamless cooperation of all parties involved. Even with the best tunnel experts on board, we could not achieve this ambitious project without the support of our client and the community.

DSD

RAYMOND TAI

Chief Engineer

能夠參與三條雨水排放隧道的建設，是一項不可多得的經驗，在我的專業生涯裏留下了一個美好及難忘的回憶。

CARITAS MEDICAL CENTRE

JOHANNES LEUNG

Senior Hospital Administrator

It is hard to put into practice what is already well-known in theory but the excellent team work witnessed the hands-on success of this project. Seamless and efficient coordination mitigated concerns regarding construction in the vicinity of our hospital.

DSD, LCKDT

PAKIN CHEUNG

Engineer

Commissioning the LCKDT is just like working out M.C. Escher's masterpiece "Waterfall"—making the impossible possible.

MCSJV, TWDT

MATSUKI DOITSU

Deputy to Project Manager

We are indebted to DSD for helping us in our pursuit of the relevant parties to proceed with blasting to expedite the intake construction, which was critical to the timely completion of the project.

蕭志新

可風中學校長

感謝渠務署多年來對社區的貢獻，使區內的排洪系統得以改善，造福市民。

黃遠平

隧道工人

在隧道工作雖然辛苦，但能成為大型基建的一份子及解決市區水浸問題，令我覺得有入錯行

DRAGAGES-NISHIMATSU, HKWDT

ALAN KAM

Deputy General Construction Manager

Excavation of drop shafts within an area as small as half of a basketball field presented great challenges. Through active engagement of stakeholders and adoption of eco-friendly raise boring construction methods, we managed the successful completion of all 34 intakes.

A WIN-WIN SITUATION

MCSJV, TWDT

SIMON LI

Chief Section Engineer

We were never short of constructive advice and full support from both the Supervising Officer's Representative and the Client in dealing with the most prickly problems involving opinions of the public that might hinder the progress of our Works.

AECOM, LGKDT

STEPHEN LAI

Project Manager

We made it! What an achievement to realise this innovative and cost-saving tunnel scheme!

DSD, TWDT

HARRY LOUIE

Senior Engineer

What a relief to see the commissioning of the Tsuen Wan Drainage Tunnel. A difficult job well done. Thanks to you all.

DSD, TWDT

AGNES SO

Engineer

作為工程師，有機會參與建設香港三條雨水排放隧道之其一，實感榮幸。當隧道啟用後，再沒有收到荃灣葵涌一帶的水浸報告，深深感受到何謂「利民工程」。

RAI DEB BAHADUR

Tunnel Foreman

We are working within clusters of buildings. While sorting out various technical challenges, we also need to have good relations with our neighbours. Good coordination between production team members and the community is key to the smooth progress of the work.

黃偉傑

荃灣區議會議員

官民協商合作，建成利民工程！

切實利民。

LEIGHTON LGKDT

PATRICK KWONG

Senior Site Agent

The Lai Chi Kok Drainage Tunnel was a very challenging job. This really was a job to remember.

葉永成

中西區區議會主席

感謝渠務署規劃及建造「港島西雨水排放隧道」，改善了中西區的排水系統，有效減輕區內水浸問題。

DSD, HKWDT

ALEX MAN

Engineer

The Hong Kong West Drainage Tunnel proved to be a model tunnelling project delivered under difficult circumstances. I'm proud to be part of this history-making team.

葉彬棠

隧道工人

在這地盤工作了近四年了，完工典禮上渠務署和公司邀請我與特首同台主禮，真是令我意想不到，原來政府和業界是非常重視我哋建築工人的貢獻

DSD

WC IP

Chief Engineer

As an engineer, I am proud to be able to participate in these important infrastructural projects to serve the people of Hong Kong.

許觀順

老圍村村代表

渠務署治水疏洪基建為民，專業精英造福村民。

黃家華

荃灣區議會議員

欣賞及感謝渠務署與其工程團隊多年來為雨水排放隧道付出的努力，刻服了工程上的各種困難，使荃灣及葵涌區水浸的風險大大降低。

吳偉文博士

瑪利諾神父教會學校 (小學部) 校長

首先恭賀荔枝角雨水排放隧道圓滿成功。還記得2009年初，本校遷進新校舍，正值工程的開展，轉瞬四載，工程順利完成，解決了西九龍地區的水浸問題。在此特別感謝渠務署及承建商，在施工期間落實連串環境保護措施，大大減低了工程對學校的影響。

DSD

GABRIEL WOO

Chief Engineer

我很高興見證荃灣雨水排放隧道的啟用。這工程既能在暴雨期間截取半山徑流以減少下游水浸風險，同時可在晴天或微雨時維持河道流水，保護生態環境。

團結的力量。

THE POWER OF COLLABORATION

黎大勝

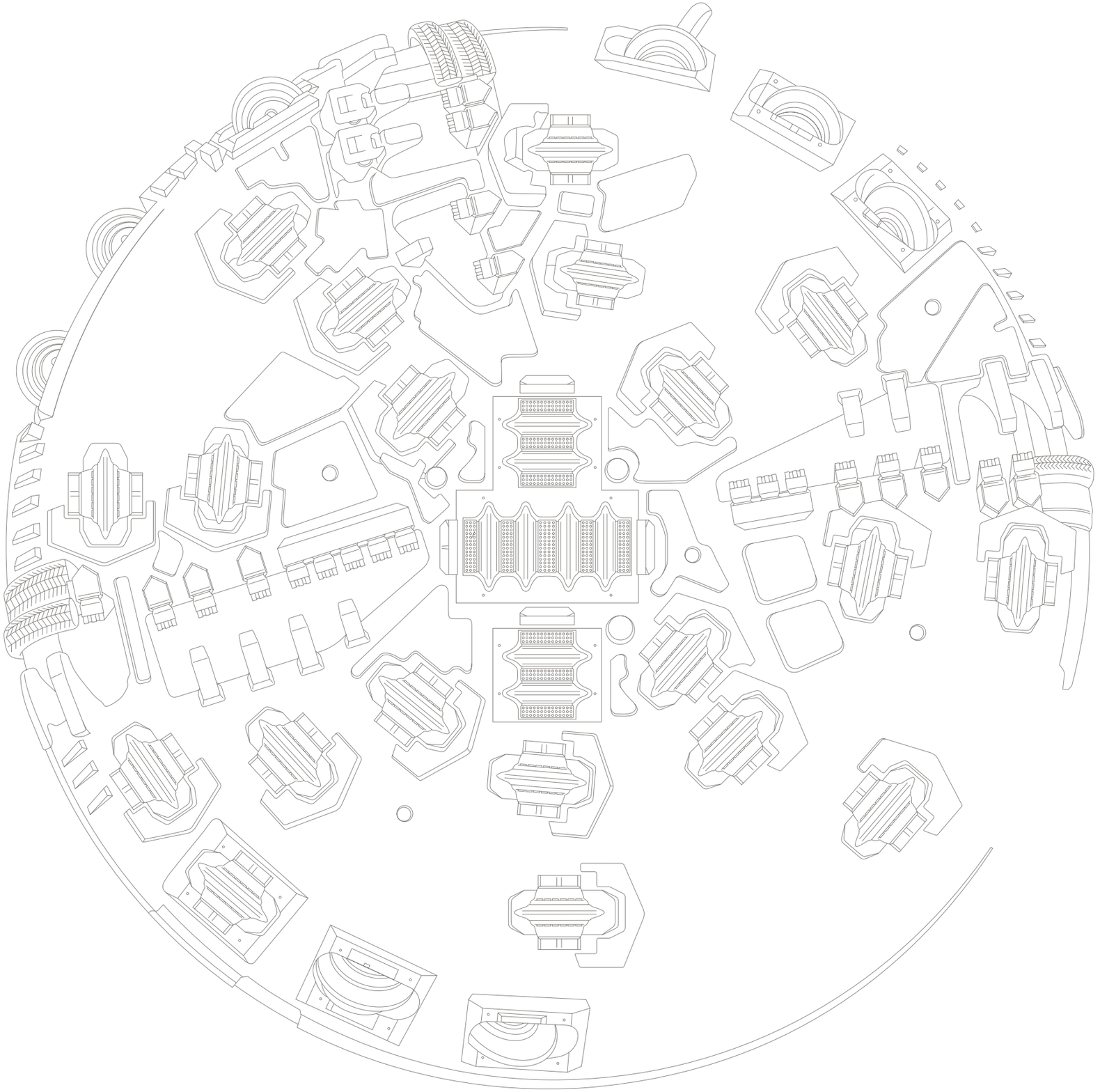
助理管工

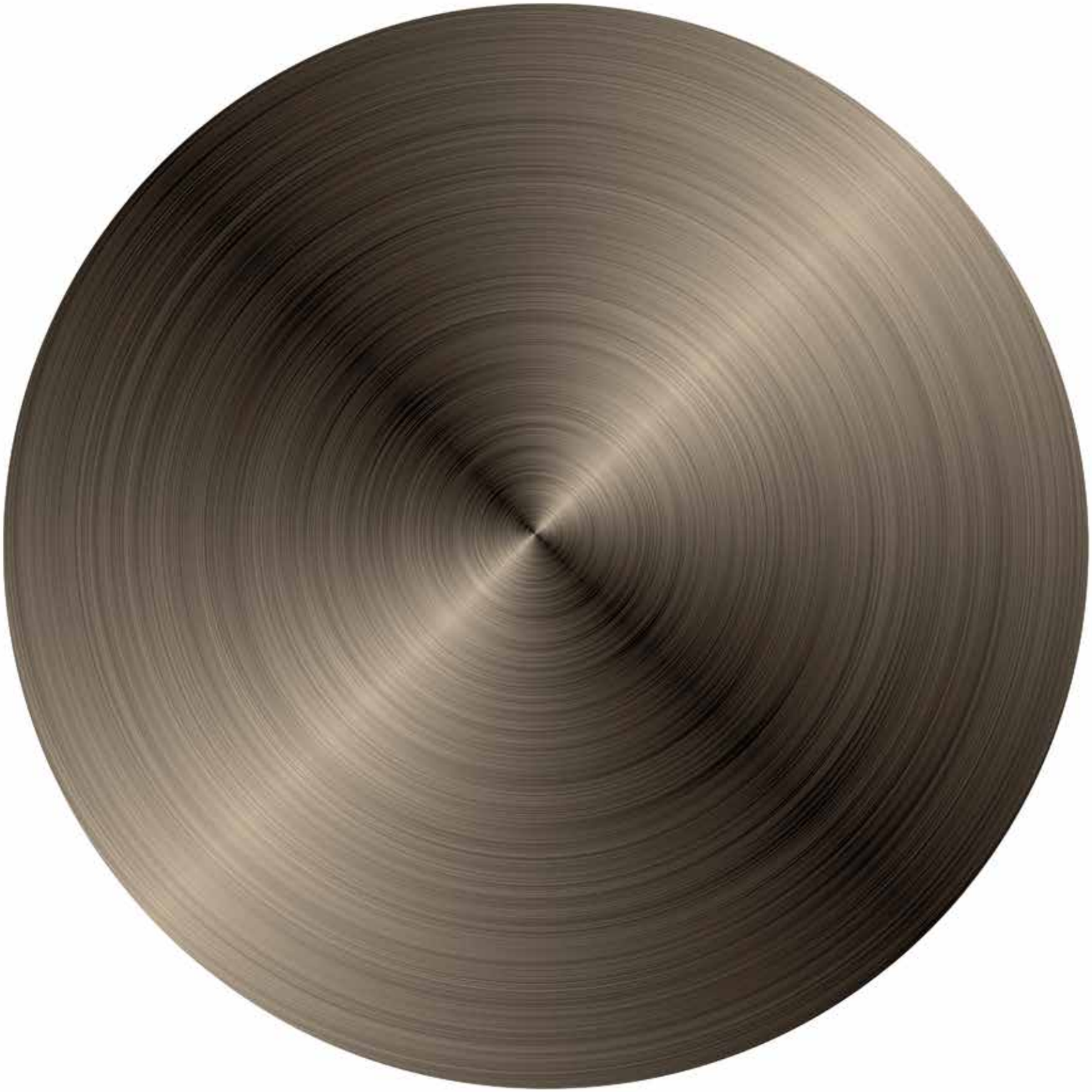
最高興者莫如一次雨後聞得當地村民互道云：「老圍不再水浸了！」

鄧德全

隧道工人

有幸參與是項建設，方信座落在大玄、大曹二澗間之入水口不單截洪，更且增添附近怡人景緻的效果。





渠務署
Drainage Services Department