



**Long-term Strategy for
Cavern Development**
岩洞發展長遠策略

Geotechnical Engineering Office,
Civil Engineering & Development Department

Agreement No. CE 12/2012 (GE)

Long-term Strategy for Cavern Development - Feasibility Study Executive Summary



土木工程拓展署
Civil Engineering and
Development Department

ARUP

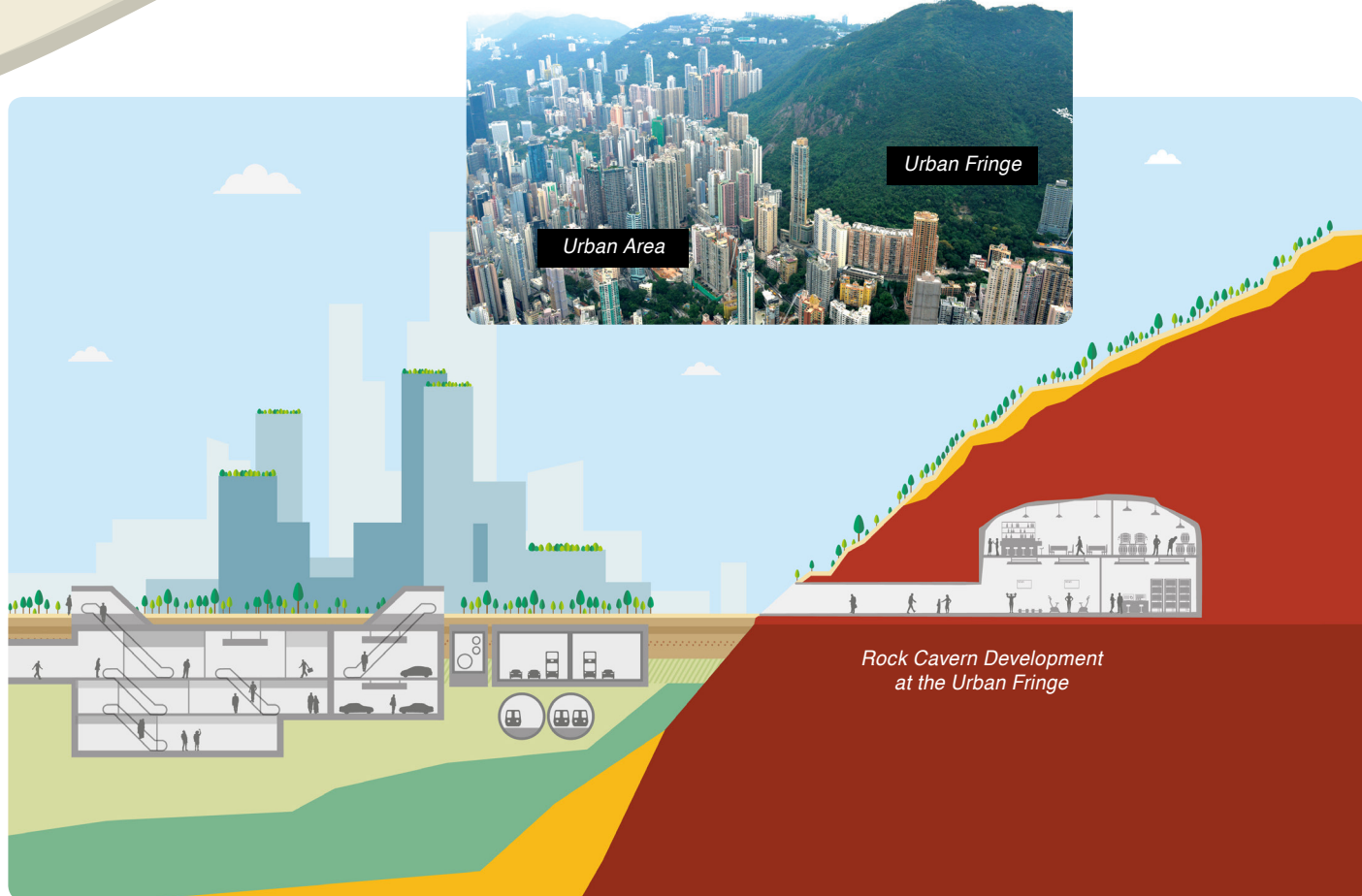


Figure 1 - Rock cavern development at the urban fringe

1 Introduction

Land is a scarce resource in Hong Kong and there is a pressing need to increase land supply in sustaining our social and economic development. Cavern development is a viable source of long-term land supply, which can provide solution space for a broad variety of land uses and help address problems encountered in the congested urban environment. The hilly terrain with strong rocks in Hong Kong is highly suitable for developing rock caverns, particularly on the urban fringe (**Figure 1**).

Civil Engineering and Development Department (CEDD) had carried out studies to explore the opportunities of enhancing rock cavern development in Hong Kong in recent years. Subsequent to those studies, a few pilot projects on relocation of existing Government facilities to caverns have been initiated and now being pursued by respective departments (**Figure 2**). To follow up the findings of the previous studies, CEDD commenced the "Long-term Strategy for Cavern Development – Feasibility

Study" (the Study) in September 2012 to formulate a long-term strategy for cavern development. In brief, the Study has prepared a Cavern Master Plan to delineate Strategic Cavern Areas for cavern development, drawn up a list of suitable Government facilities for relocation to caverns, proposed measures to facilitate cavern development for both public and private sectors, and investigated a number of technical matters relating to rock cavern development.

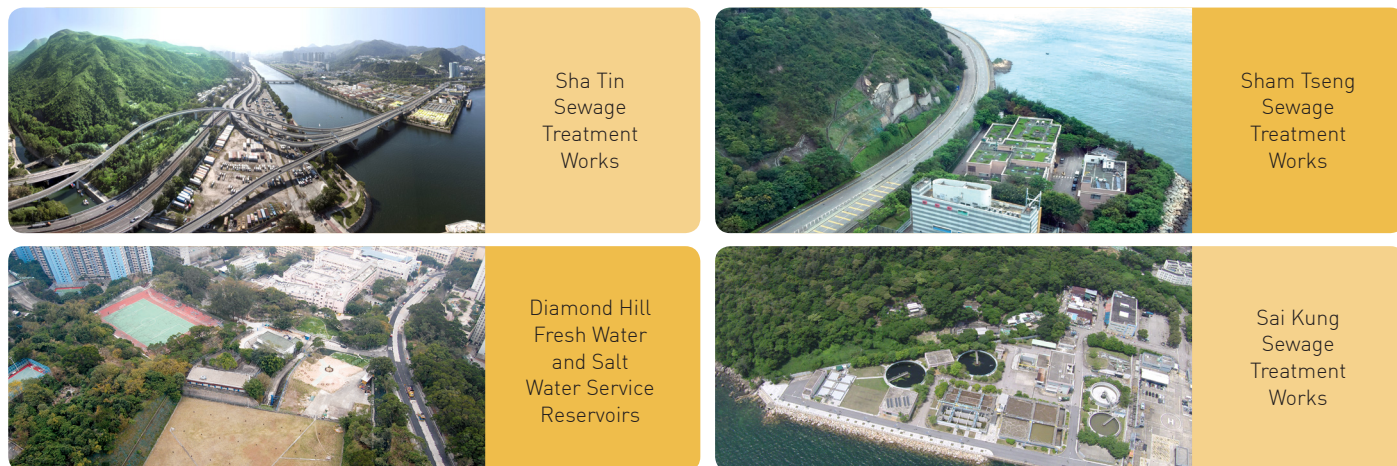


Figure 2 - Pilot projects on relocation of existing Government facilities to caverns

2 Benefits and Limitations of Cavern Development

The benefits of cavern development are manifold. Developing rock caverns strategically can bring about planning and development gains, including but not limited to the following:

- (i) Release surface sites for other beneficial uses by relocating existing government facilities to rock caverns;
- (ii) Remove incompatible land uses by housing unpopular facilities in caverns for minimizing their nuisance to the community whilst increasing the development potential of the released land and its surrounding areas;
- (iii) Reduce surface land take by placing

new facilities (including suitable new public and private sector facilities) in caverns;

- (iv) Reserve developable land for other priority uses (such as open spaces, community/residential uses) by accommodating suitable new facilities in caverns; and
- (v) Recycle excavated rocks arising from cavern construction, to be used as aggregates to support the local construction industry.

Some notable overseas examples on various uses of caverns are shown in Figure 3.

Cavern development would however have its limitations. Given that the development of rock caverns usually involves considerable capital investment and relatively long implementation time-frame, the pace and scale of land creation would not be comparable to other land development approaches such as rezoning, reclamation and site formation. The technical issues encountered could be more complicated. Cost-effectiveness may also vary significantly among cases. As such, the use of cavern development alone could not resolve the imminent problem of shortage of developable land.

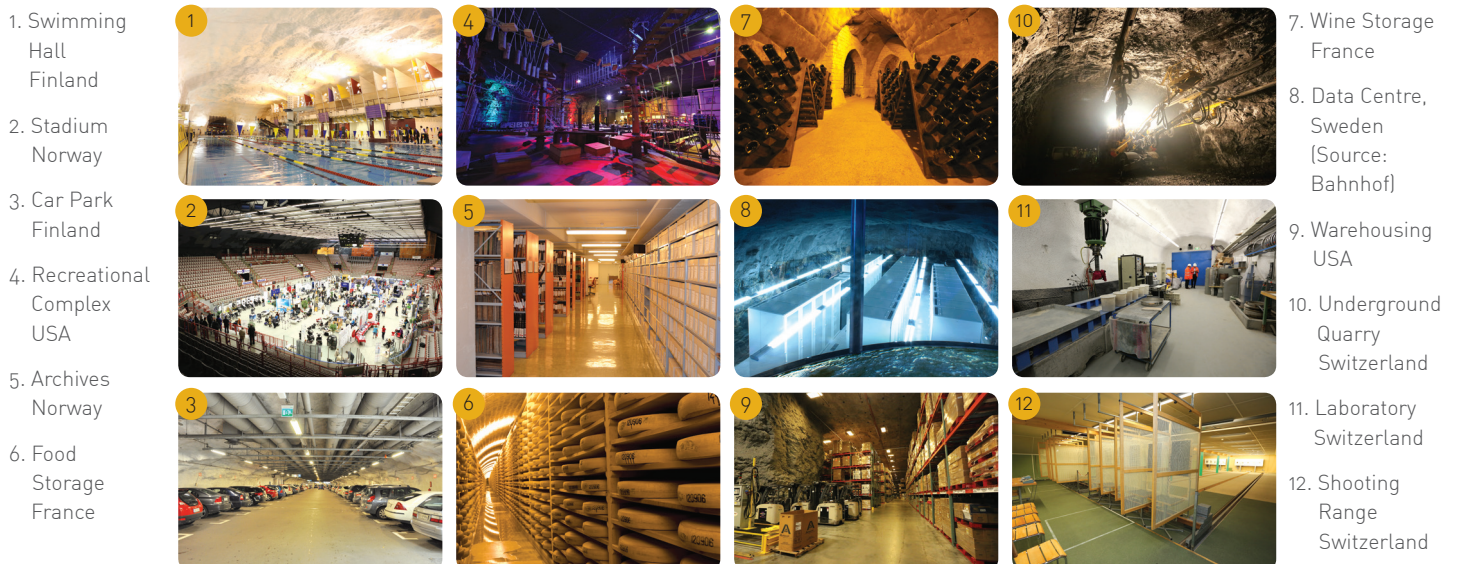


Figure 3 - Notable overseas examples on various uses of caverns

3 Cavern Master Plan

The Cavern Master Plan (CMP) (Figure 4) has been prepared under the Study with the aim of providing a broad strategic planning framework to guide and facilitate territory-wide cavern development, and to promulgate essential information for project proponents to identify suitable cavern sites for their development projects.

The CMP delineates forty-eight (48) Strategic Cavern Areas (SCVAs) in the territory that are well placed for developing rock caverns to meet the existing or future needs of the adjoining districts. An SCVA is defined as an area that is easy to access and can accommodate multiple facilities in rock caverns to meet the

need of development. The area should be sufficiently large and located at the urban fringe with supporting infrastructure network. The sizes of individual SCVAs range from approximately 30 to 200 hectares. The area of an SCVA does not represent the actual developable cavern space because provisions have to be made for features like buffer zones between individual facilities, intervening rock pillars for support and adits for portal access and inter-connection.

The CMP is accompanied by an Explanatory Statement and a set of Information Notes. The Explanatory Statement is intended to provide the key information on the CMP.

The Information Note is to describe the characteristics, development potential, constraints, potential land uses and the extent of potential portal locations of the SCVA. A reference drawing is appended to each Information Note to illustrate the spatial context of the information provided. The complete set of CMP is available in the websites of the CEDD (<http://www.cedd.gov.hk/eng/cavern/index.html>) and Planning Department (http://www.pland.gov.hk/pland_en/info_serv/cmp/index.html).

Figure 5 illustrates the possibilities within an SCVA.

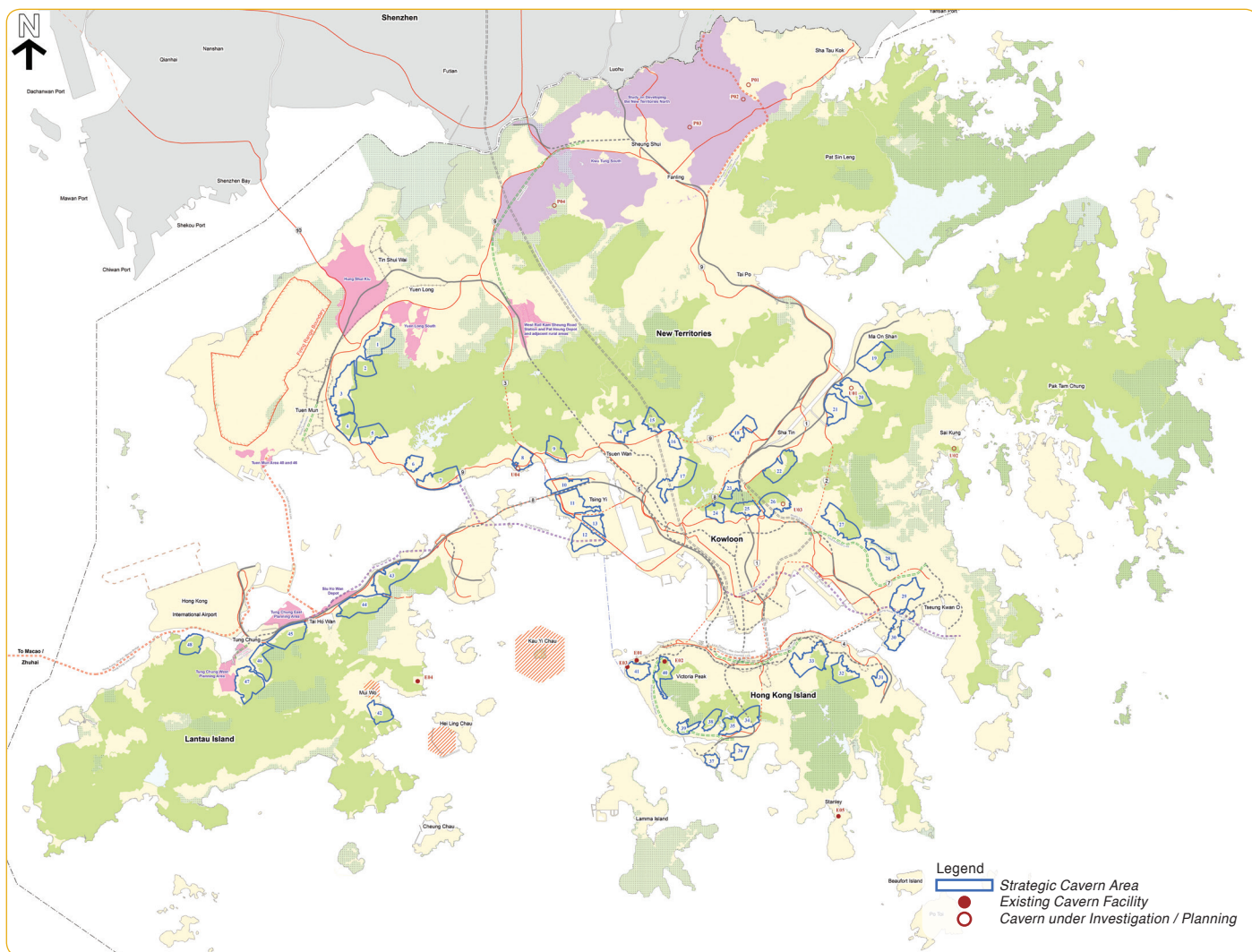


Figure 4 - Cavern Master Plan



Figure 5 - Possibilities within an SCVA

4 Identification of Government Facilities for Relocation

The identification of Government facilities for relocation in the Study adopted a systematic approach of stocktaking, rationalisation, screening, ranking and appraisal. Thirty (30) facilities with higher relocation potential were selected from over 500 facilities located throughout the territory based on their respective merits and limitations under the selection criteria of site conditions, potential land uses, development constraints, relocation time frame and client department's consent. These 30 facilities, some in

clusters, covered a variety of facility types, such as sewage treatment works, refuse transfer stations, service reservoirs, and other pioneers in terms of cavern use in Hong Kong including vehicle depots, archives, warehouse and material testing laboratory.

Broad planning and technical assessments were conducted on the 30 facilities to further review various needs and requirements of Government to achieve this, as well as the overall benefits to the public and communities

arising from relocation of the facilities. The assessment findings will facilitate the Government in prioritising suitable facilities for launching detailed feasibility studies on relocation to caverns so as to make way for housing or other beneficial uses. This can serve as a means to increase long-term land supply and meet specific needs.

5 Measures to Facilitate Cavern Development

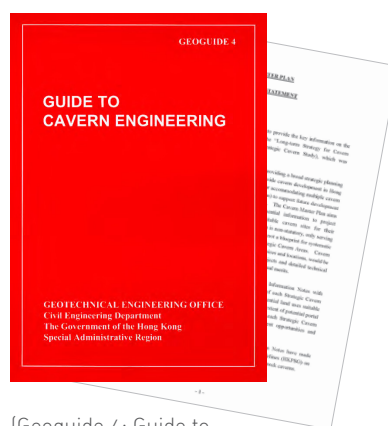
The proposed measures to facilitate cavern development are summarised as follows:

- (i) Promulgating cavern development information through the promulgation of the CMP and other relevant Government guidelines and circulars;
- (ii) Proactively considering cavern option when proposing new refuse transfer station, sewage treatment works and service reservoir, and carrying out cavern option assessment;
- (iii) Rezoning land for cavern development by launching planning and engineering (P&E) studies of suitable cavern areas to rezone land for land uses with identified needs or strong private sector interest, to reduce project lead-time;
- (iv) Integrating cavern development in area-based P&E studies to capitalise strategic benefits and synergy effect of integrating cavern development with surface development where there are suitable SCVAs nearby; and
- (v) Developing cavern by means of underground quarrying to bring about benefit in enhancing the long-term land supply by creating a cavern land bank.

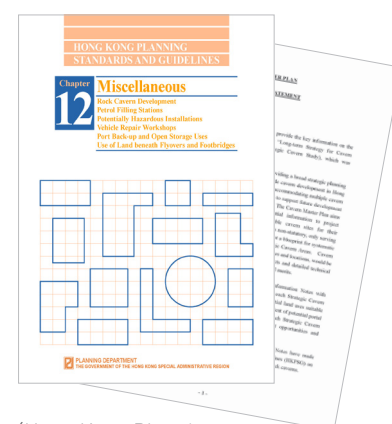
6 Technical Matters

Various technical matters for cavern development have been investigated under the Study. The following are the major tasks that have been carried out:

- (i) Updating Geoguide 4: Guide to Cavern Engineering;
- (ii) Revising the list of land uses with the potential for development in rock caverns in the Hong Kong Planning Standards & Guidelines;
- (iii) Conducting Strategic Environmental Assessment on cavern development; and
- (iv) Developing conceptual fire safety schemes for cavern developments.



[Geoguide 4: Guide to Cavern Engineering, Second Edition]



[Hong Kong Planning Standards and Guidelines]

7 Recommendation and Way Forward

The Study has prepared the CMP to provide a strategic planning framework to guide and facilitate territory-wide cavern development in Hong Kong. The CMP should be referenced to alongside the Hong Kong Planning Standards & Guidelines in the course of planning and engineering studies, preparation/revision of town plans and development control for surface, subsurface and cavern developments in the territory.

The Study has broadly reviewed a list of suitable Government facilities with potential for relocation to caverns. The Government

should further formulate a priority list for launching feasibility studies on relocation of suitable facilities, taking into account various factors including resource implications, relocation programme and any earmarked schedule for releasing the land.

Various measures have been proposed under the Study to facilitate cavern development for both public and private sectors. The Government should follow up and develop guidelines to implement the measures and promulgate the requirements through relevant technical

circulars. The Government is also recommended to launch further studies to rezone suitable areas for cavern development and explore the technical feasibility and financial viability of underground quarrying-cum-cavern development in Hong Kong.

The Government should continue the current effort and seek further opportunities to enhance the promulgation of the use of cavern development as an innovative option to increase the long-term land supply of Hong Kong.

8 Epilogue

The CMP has gained international recognition and was awarded by the International Tunnelling and Underground Space Association (ITA) as the winner of the Innovative Underground Space Concept of the Year in the ITA Tunnelling Awards 2017 on 15 November 2017. The details of this award are available in <https://awards.ita-aites.org/>.



The CMP was also awarded a Certificate of Merit by the Hong Kong Institute of Planners in 2016 given its merit in unlocking the hidden land resources in Hong Kong. The details of this award are available in <http://www.hkip.org.hk/Editorfile/files/ipipawards.pdf>.



9 Enquiry

For enquiry, please contact the Geotechnical Engineering Office of the Civil Engineering and Development Department:

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10 Related Information

1. Long-term Strategy for Cavern Development Website
www.cavern.gov.hk/home.htm
2. Cavern Master Plan
www.cedd.gov.hk/eng/cavern/index.html

