Transformation from River Channelisation to River Revitalisation

Richard LEUNG Wah-ming[a], Ivan NG Yu-ting[b], Stanley CHAN Chi-wai[c], Alex WU Yat-fei[d]

[a] *Drainage Services Department, Government of the HKSAR, Hong Kong SAR, rwmleung@dsd.gov.hk*
[b] *Drainage Services Department, Government of the HKSAR, Hong Kong SAR, ytng02@dsd.gov.hk*
[c] *AECOM Asia Company Ltd., Hong Kong SAR, stanley.chan@aecom.com*
[d] *AECOM Asia Company Ltd., Hong Kong SAR, alex.yf.wu@aecom.com*

ABSTRACT

River channelisation is a conventional approach of resolving flooding problem in view of its outstanding hydraulic performance. Such design, however, has a negative impact on the city landscape and also leads to degradation in the ecology and subsequent decline in ecological habitats and overall biodiversity. With a vision of providing sustainable drainage services and pursuing a higher standard in environmental and ecological preservation, the Drainage Services Department (DSD) of the Government of the Hong Kong Special Administrative Region has incorporated environmentally friendly design in its drainage improvement projects in Ho Chung River, Upper Lam Tsuen River and Kai Tak River. Indeed, incorporation of environmentally friendly drainage design in a densely developed area like Hong Kong is a great challenge. In this paper, the improvement of ecology, enhancement of biodiversity and the characterised features of the abovementioned rivers achieved in the drainage improvement projects will be discussed. Looking ahead, by adopting the concept of manifesting and revitalising water bodies into drainage improvement works and development of new development areas, the community will be further benefited from the improved environment. In the revitalisation of Tsui Ping River at Kwun Tong as well as the drainage planning of new development areas, DSD will adopt new standards in the planning and construction of drainage facilities with a view to providing a better environment for the public.

Keywords: *channelization, blue infrastructure, community empowerment, ecological enhancement, flood protection, green infrastructure, revitalisation, water friendliness*

1. INTRODUCTION

From 1970s to 1980s, there was a need for new towns development through urbanisation of rural areas to cope with the increase in population and to improve the living environment by decentralising the population from the over-crowded urban districts. Once served the purpose for natural land drainage, natural rivers and waterways flowing through these development areas have to be modified in a form of new man-made (engineered) channels.

As a result of modification of land use, change of drainage characteristics and pattern, and increase in impervious areas, the quantity and peak stormwater runoff within these urbanised areas would be increased. As the surface runoff was no longer able to infiltrate into the ground, substantial rapid surface flows would occur which would not only cause imminent inundation to local areas, but also create secondary flooding due to overflow from those under-capacity rivers and waterways.

To improve the situation, the Hong Kong Government decided to develop flood control strategy to increase the drainage capacity of the concerned waterways. Channelising natural rivers and waterways such as concretising, straightening, deepening and widening were typical solutions to enhance the drainage capacity.

Although the flooding situations were improved through extensive drainage improvement works, this type of channelisation works has led to degradation in the existing ecology and subsequent decline in ecological habitats and overall biodiversity. In addition, the robust and flood-proofing-tight engineering facilities also discouraged the public from accessing and enjoying these valuable natural resources.

In late 1990s, the Hong Kong Government took a first step forward to restore the ecology within the channels by applying green elements into the drainage improvement works. This was a significant step shifting from sole flood control focus onto two-dimensional consideration of flood management and riparian ecology.

Since then, the Hong Kong Government has been continuing to improve the drainage networks by adopting the concept of river revitalisation with holistic consideration on functional, environmental, ecological and aesthetic

aspects, with an aim to creating the world's built, natural and social environments. This is also a "transformation" from two- to multi-dimensional management strategy to achieve the goal of sustainable drainage services provision.

2. RIVER CHANNELISATION

Hong Kong was experiencing continuously flooding in various areas from 1970s to 1980s, the Government understood that the early constructed drainage systems were insufficient to drain the substantial surge of runoff due to rapid urbanisation. Therefore, the government conducted the Territorial Land Drainage and Flood Control Strategy Study – Phase 1 (TEL I) in 1988. The study identified the levels of protection against flood on drainage requirements. This study also developed a drainage masterplan for New Territories to cater for the future new town developments.

In 1991, Territorial Land Drainage and Flood Control Strategy Study – Phase 2 (TEL II) was conducted to identify and manage flooding black spots. It also developed a strategy to manage drainage system along private areas to improve the overall drainage operation and management to enhance the drainage functionality and reduce the consequents of flooding. In 1995, Territorial Land Drainage and Flood Control Strategy Study was moved into Phase 3. In this phase, the cost effectiveness and impacts on environment for drainage projects were reviewed. These studies were not just forming the backbone for the stormwater design standards, but also leading the way on identification of flood protection levels and determination on the extent and degree of associated drainage improvement works.

To alleviate the potential flood risk, one of the solutions was to straighten, widen and deepen the existing natural meandering rivers, and channelised to rectangular or trapezoidal concrete-lined canals in order to increase the hydraulic conveyance. However, these treatments would degrade the riparian ecology and waterway's health without environmental benefits being taken into consideration.

In addition, some of the long-existing rock channels or open nullahs in urban areas were decked to create additional lands for development as well as to mitigate odour issue due to cross connection to sewer. These additional lands were generally for constructing open spaces, such as parks and roads. While the properties of these drainage facilities were changed entirely as they were transformed to underground culverts, the entire ecosystem was destroyed.

2.1 Case Study: Sheung Yue River

Sheung Yue River is also known as River Beas which is located in northern side of New Territories. In the 1990s, the areas alongside Sheung Yue River were frequently experiencing severe flooding during wet season. In late 1990s, DSD decided to conduct improvement works to enlarge its hydraulic capacity and hence reducing the flooding risk.

The original alignment of the river was being straightened to improve the flow path along the river as well as to increase the width of the river to enlarge the cross section. Additional to these works, it also concretised the banks to increase the conveyancy of the channel to provide additional capacity of the river.

As the river was trained and straightened to improve the hydraulic capacity, these works destroyed some of the habitats and increase the flow velocity within the river which some of the fauna and flora were disappeared from the river.

3. ECOLOGICAL IMPROVEMENT FOR CHANNELS

In late 1990s, flooding situations alongside the rivers have been greatly improved after completion of a series of drainage improvement works. With a vision of providing sustainable stormwater drainage services and pursuing a higher standard in environmental and ecological preservation, the Hong Kong Government adopted the sustainable development approach and started to implement greening elements into drainage improvement works to enhance the ecology in the channelised waterways. Most of these works were mainly adopted for ecology enhancement which provided some environmentally friendly elements to allow aquatic fauna to breed and live healthy within the channel. During this stage, some early revitalisation initiatives were taken on board including:

- Using gabion and geo-fabric reinforced grass lining to stabilise river banks;
- Leaving channel beds unlined to provide natural substrate that supports aquatic flora and fauna;
- Leaving embankment unlined to promote vegetation growth;
- Retaining meanders as wetland habitats, and creating by-pass channels to preserve natural river and stream channels;
- Creating shallow ponds for aquatic planting along drainage channels to provide habitat for wetland fauna;
- Creating wetland habitats and reed beds adjacent to drainage channels; and
- Providing habitat enhancement measures to enhance the habitat complexity.

In 2005, DSD published the Practice Note No. 1/2005 – Guidelines on Environmental Considerations for River Channel Design. This Practice Note recommended a design framework, with an objective to produce a river channel design as environmentally friendly as possible, for use in the project planning and design stages. It covered the essential environmental aspects to be considered in conjunction with requirements/standards with respect to other design aspects.

3.1 Case Study: Ho Chung River

In order to provide a better balance between the needs of reducing flood risks and conserving the river ecology, a number of ecological features has been adopting in the drainage improvement works at Ho Chung River. For example, the flow deflectors formed with big boulders not only provide potential refuges for fish during spates, they also enhance the habitat complexity to create more diverse micro-habitats. In the sections where concrete retaining walls have to be adopted due to land constraints, the fish shelters can provide hiding spaces so that aquatic animals may protect themselves by moving inside.

To address the needs for re-provisioning of an original Fung Shui Weir while reducing the potential effects of obstructing the upstream movement of fish and other aquatic animals, the construction of fish ladder not just provides easier pathways for upstream migration, its appearance also follows the general pool and riffle pattern at the immediate upstream natural section. Such integration of ecological enhancement features and engineering techniques has demonstrated that engineers and conservation groups can work together to find out more sustainable solutions to address our social needs on flood control, where drainage improvement works in natural streams are inevitable.

3.2 Subtitle Case Study: Upper Lam Tsuen Rive

Lam Tsuen River valleys area, including upper Lam Tsuen River had suffered from flooding threat and these valleys had been listed as flooding black spots. Therefore, drainage improvement works was conducted in Upper Lam Tsuen River with primary aim to reduce the flood risk of the river course. During construction, various measures have been adopted in order to minimise the negative impacts brought out by the works done to the surroundings, including translocation of Paramesotriton hongkongensis (Hong Kong Newts) and conducting ecological monitoring.

After the completion of the project, some beautification works were conducted to preserve the natural environment. As a result, the concept of sustainable development can be implemented.

4. RIVER REVITALISATION

The 2015 Policy Address stated "We will adopt the concept of revitalising water bodies in large-scale drainage improvement works and planning drainage networks for new development areas so as to build a better environment for the public." and "… this is aimed at promoting greening, biodiversity, beautification and water friendliness in addition to achieving efficient drainage, with a view to building sustainable drainage facilities and providing a better living environment.". From this onward, the concept of river revitalisation has further been formally materialised with an aim to changing the culture of the community with water friendliness.

In the same year, DSD promulgated the Practice Note No. 1/2015 – Guidelines on Environmental and Ecological Considerations for River Channel Design. This version is an update based on DSD's Practice Note No. 1/2005 and all items summarised in previous section are relevant. In addition, blue-green infrastructure concept is particularly introduced. This concept aims at improving the sustainability and resilience of Hong Kong's drainage systems to meet the contemporary public aspirations for natural environment, to protect local culture and rural lifestyle.

With the prime objective of flood protection in mind, to revitalise a river, it will not only restore ecological value or enhance the environment, but also provide additional social and economic benefits to the surrounding community. The potential benefits arising from river revitalisation are summarised in above figure.

Looking ahead, by adopting the concept of manifesting and revitalising water bodies into drainage improvement works and development of new development areas, the community will be further benefited from the improved environment. In the end of 2015, DSD commissioned a consultancy study on revitalisation of water bodies to assess the feasibilities and benefits could be provided by revitalisation of water bodies. All these works were aimed to moving Hong Kong from a flood resistance city to a flood resilience city and enhancing the sustainability of the overall development in Hong Kong.

In the revitalisation of Tsui Ping River at Kwun Tong as well as the drainage planning of new development areas, DSD will adopt new standards in the planning and construction of drainage facilities with a view to providing a better environment for the public.

4.1 Case Study: Tsui Ping River

King Yip Street nullah was constructed more than 50 years ago. Riding on the opportunity of the transformation of Kowloon East into an attractive alternative Core Business District (CBD2) to sustain the economic growth of Hong Kong, DSD will adopt an integrated approach to transform King Yip Street nullah into a blue-green infrastructure "Tsui Ping River" with environmental, ecological and landscape upgrading, including enhancement of drainage capacity, provision of riverside walkways and landscaped decks, and improvement of pedestrian facilities in the adjacent area. The scope of the revitalisation of Tsui Ping River comprises but not limited to the following main items:

- Beautification of existing nullah by provision of attractive waterscape design, water retention features to retain water during low tide;
- Provision of landscaped walkways along Tsui Ping River to enhance walkability;
- Provision of landscaped decks over Tsui Ping River;
- Modification and face-lifting of Kwun Tong Road Footbridge; and
- Pedestrian path enhancement in the vicinity of Tsui Ping River.

4.2 Case Study: Kai Tak River

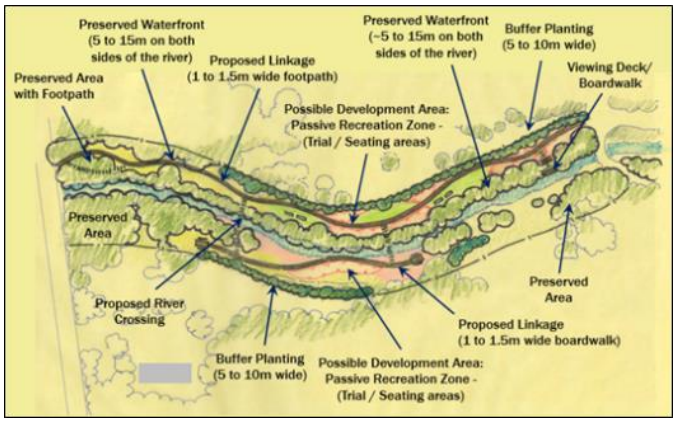
Kai Tak River has been continually modified since 1920s to suit the development needs in the vicinity. Experiencing about a century of transition, it is geographically and historically bonded with the surrounding districts, witnessed the development of Hong Kong. In order to improve the drainage capacity of Kai Tak River and to mitigate the flooding risk to surrounding areas, DSD is carrying out improvement works since 2011 at upstream and midstream sections of the river. With this opportunity, landscaping measures and ecological features have been incorporated into the river channel design to revitalise it as a "green channel corridor" via the following solutions:

- Placing boulders at the river bed to slow down the river flow at local spots for fish gathering and enhance the appearance to be more natural;
- Inclusion of fish shelters alongside river bank for providing a refuge to prevent fish and other aquatic organisms from being swept away during periods of high water flow, in order to enable a sustainable ecological environment;
- Beautification works at river wall; and
- Planting shrubs and plant alongside the river banks.

4.3 Case Study: Tung Chung River Park

Tung Chung River is identified as an ecologically important stream with important ecological functions. With the extension of Tung Chung New Town, the Government is planning to restore the existing man-made river channel at the downstream, and develop a 3.3-hectare of land adjacent to the river as Hong Kong's first river park where the public can get close to the river for enjoyment.

In order to balance the impact to the habitat and enjoyment of the public, passive designs, such as boardwalks, viewing decks and footpaths are envisaged. Native vegetation will be preserved as far as possible to maintain the existing habitat. The river park will set as an example for the public to treasure rivers as a crucial social and ecological resource to nurture water friendly culture.



5. CONCLUSION

For Hong Kong, it comes a long way from river channelisation to river revitalisation, from flood protection to ecological enhancement, from isolation to water friendliness and public enjoyment. The ultimate goal is to create, enhance and sustain the world's built, natural and social environments. The transformation of channelisation to revitalisation demonstrated the agility to embrace change and adaptation of the Government and the society in response to the request of building a sustainable environment.

Looking forward, river revitalisation is an overwhelming and irresistible trend, not just in the Hong Kong context, but worldwide, and as one of the core subjects in water management for sustainable development. The below table shows the concept for developing a strategy for revitalisation from different aspects.

	Urban Waterfront	Ecosys Restoration	River Restoration
Strategy	- Analysis of the Overall Economic Benefits - Analysis of Direction for Waterfront Development - Investment and Financing Strategy - Mechanisms of Implementation and Operation Mode - Sustainable Development Strategy	- Feasibility Study/ Benefit Analysis - Mechanisms of Implementation and Operation Mode - Policy Assessment	- Feasibility Study/ Benefit Analysis - Integrated Water Resources Management Program - Policy Assessment
Planning	- Urban Spatial Structure/ Development Strategy - Waterfront City Planning - Waterfront Landscape Planning - Ecotourism Planning	- Ecological Environment System Planning/ Design - Development of Water Ecology Strategy - Operation and Maintenance Program	- Overall Design of River - Watershed Pollution Survey/ EIA - Drainage Planning - Flood control and Drainage Scheme - Water Recycling Scheme
Design	- Architecture and Urban Design Strategy - Green Space and Waterfront Open Space Design - Waterfront Landscape Design - Waterfront Transportation Design	- Environmental Remediation Technology Program - Design of Natural River - Water Sensitive Urban Design	- Physical Design Parameters - Water Purification Process Design - Hydraulic Structures/ Slope Revetment Design
Engineering	- Cost and Contract Management - Construction Management/ Value Engineering - Later Stage Management/ Optimization	- Project Feasibility Analysis - Cost and Contract Management - Construction Management/ Value Engineering - Later Stage Management/ Optimization	- Project Feasibility Analysis - Cost and Contract Management - Construction Management/ Value Engineering - Later Stage Management/ Optimization

By adopting the concept of manifesting and revitalising water bodies into drainage improvement works and development of New Development Areas, the community will be further benefited from the improved environment. In revitalisation of river as well as the drainage planning of new development areas in the future, the Government could consider adopting new standards in the planning and construction of drainage facilities with a view to providing a better environment for the public.

REFERENCES

[1] Binnie Manusell Consultants (1993), Territorial Land Drainage and Flood Control Strategy Study – Phase 2, Report to Drainage Services Department, Hong Kong Government.

[2] Drainage Services Department (2015), DSD Practice Note No. 1/2015 – Guidelines on Environmental and Ecological Considerations for River Channel Design, Drainage Services Department, The Government of HKSAR, http://www.dsd.gov.hk/EN/Files/Technical_Manual/dsd_TechCirculars_n_PracticeNotes/DSDPN_201501.pdf (Accessed 27 September 2016).

[3] Mott-MacDonald (1990), Territorial Land Drainage and Flood Control Strategy Study – Phase 1, Report to Drainage Services Department, Hong Kong Government.

[4] Scott J. L. (ed.) (2015), Going the Extra Miles, Drainage Services Department, The Government of HKSAR, pp 109-157, http://www.dsd.gov.hk/EN/Files/publications_publicity/Publications/2014book.pdf (Accessed 27 September 2016)

[5] The Government of HKSAR (2015), 2015 Policy Address, The Government of HKSAR, Paragraph 181.