出國報告（出國類別：國際研討會議）

「APEC 優質基礎設施指南」修訂研討會
(APEC Seminar for Upgrading “APEC Guidebook on Quality of Infrastructure”)

服務機關：經濟部水利署
姓名職稱：鍾朝恭副署長
葉俊明科長
陳明城正工程司

派赴國家：日本
出國期間：107 年 2 月 27 日至 3 月 2 日
報告日期：107 年 3 月

摘要

依據 2017 年 11 月 8 日亞太經濟合作組織（Asia-Pacific Economic Cooperation, APEC）部長級會議（AMM）聯合聲明，為提升亞太經濟合作組織各經濟體負責基礎建設投資之官員的能力及分享最佳範例，針對 2014 年所訂「APEC 優質基礎建設發展與投資指南」(APEC Guidebook on Quality Infrastructure Development and Investment, 2014)進行修正，將內容範圍擴大到適用於不同基礎建設部門的實際方法和工具，從而得以被基礎建設發展的所有利益相關者使用，並且針對供水及污水部分新訂「APEC 優質水資源基礎建設指南」(APEC Guideline for Quality Water Infrastructure)草案。

本會議由日本經濟產業省(Ministry of Economy, Trade and Industry, METI)主辦，邀請 APEC 各經濟體之高階政府官員參加，實際出席共 10 個經濟體 31 人。

會議安排共 2 日，2 月 28 日第 1 天研討會議地點為日本東京三田共用會議所(Mita Kaigisho)，上午針對 2014 年所訂「APEC 優質基礎建設發展與投資指南」修正草案進行討論，下午針對新訂「APEC 優質水基礎建設指南」進行討論，其中包括由經濟部水利署鍾朝恭副署長進行主題為「永續水庫-以石門水庫為例」20 分鐘演講，分享我國水庫更新改善成功經驗，我方針對二份指南提出具體意見，並與 APEC 各出席經濟體就基礎建設進行交流分享與學習，主辦單位後續會將各出席單位意見納入修訂參考。

為加深 APEC 各經濟體對優質水利公共基礎建設採用 PPP 或 PFI 模式推動之信心，本次主辦方(日本經濟產業省)安排以一天時間參訪 3 處採用 PPP/PFI 模式之成功案例。都是利用私人資金，管理技能和技術能力，來建設，維護和運營公共設施之新方法。在政府有限之人力與財力下，引導民間資金參與公共建設與公共設施之營運管理維護，可減輕政府財政負擔，提昇公共建設品質，提高公共資源使用效率，促進國家經濟及產業發展；對廠商而言，可進行多角化經營，提升企業形象，降低營運成本；對民眾而言，可提早享受公共建設服務，提升生活品質，創造就業機會，因此採

用 PPP/PFI 具有創造政府、廠商、民眾三贏局面之潛力。

出國行程概要如下：

日期	行程
2/27(二)	啟程 (台灣 → 日本東京)
2/28(三)	研討會議 上午：討論修正「APEC 優質基礎建設發展與投資指南」草案 下午：討論新訂「APEC 優質水資源基礎建設指南」(含水利署鍾朝恭副署長專題演講 20 分鐘)
3/1(四)	參訪：橫濱北部污泥處理中心、橫濱川井淨水場、東京芝浦水再生中心等三處民間參與公共建設成功案例
3/2(五)	返程 (日本東京 → 台灣)

目次

附件資料：

一、 背景及目的

(一)背景

2014 年 11 月 10 日至 11 日在北京舉行的亞太經合組織經濟領袖會議（APEC Economic Leaders’ Meeting, AELM）上，各經濟體領袖根據 2013 年在印尼峇里島 AELM 會議的承諾，批准「2015-2025 年 APEC 連結性藍圖」(APEC ConnectivityBlueprintfor 2015-2025)，致力於採取明確具體之行動，以達成實體、制度性和人與人連結，強化服務業發展及增進區域連結性，俾實現 APEC 追求貿易暨投資自由化之核心宗旨。該「藍圖」規定，在考量跨部門問題的實體連通性情況下，各經濟體領袖除了改善投資環境和透過公私伙伴關係（public private partnership）加強基礎建設融資外，同時將關注：（1）採取綜合評估方法來評估基礎建設提案時之關鍵品質要素（2）強化良好的應用作法及以人為本的投資來規劃及進行基礎建設計畫。

接續前述 APEC 連結性藍圖的後續行動，亞太經合組織於 2014 年制定「亞太經合組織優質基礎建設發展和投資指南」（APEC Guidebook on Quality Infrastructure Development and Investment, 2014 ），網址：https://www.apec.org/Publications/2014/11/APEC-Guidebook-on-Quality-of-Infrastructure-Development-and-Investment，為確保優質基礎建設提供基本的概念和方法。在本指南中，定義了生命週期成本、環境和其他影響、及安全保證，為優質基礎建設的三個關鍵要素。

後來，2017 年 11 月 8 日在越南峴港舉行的 2017 年亞太經合組織部長級年會（APEC Ministerial Meeting, AMM），部長們所發表 2017 年 AMM 聯合部長級聲明，贊成針對 APEC 優質基礎建設發展與投資指南進行修正。

(二)目的

修正 APEC 優質基礎建設發展與投資指南工作由貿易暨投資委員會(Committee on Trade and Investment, CTI)主導，相關工作由日本經濟產業省(Ministry of Economy, Trade and Industry, METI)辦理，將透過下列行動達成預

定目標：

- 針對確保優質基礎建設投資及發展進行研究。
- 修正本指南，包括基本概念，將其範圍擴大到適用於不同基礎建設部門的實際方法和工具，使得本指南適用於所有基礎建設發展相關者來使用，另外針對供水及污水部分新訂(本指南中提到的重點領域之一)發展指南。
- 舉辦研討會分享研究成果，並與利益相關者討論如何制定指南，包括修正「APEC 優質基礎建設發展及投資指南」草案及新訂「APEC 優質水基礎建設指南」(APEC Guideline for Quality Water Infrastructure)草案。

二、 過程及工作紀要

(一)研討會

1、會議地點：

日本東京三田共用會議所(Mita Kaigisho)，如照片 1。

照片 1、研討會舉辦地點外觀

2、參與者

所有 21 個亞太經合組織均受邀參加，邀請對象為負責基礎建設政策制定及執行的部會級高層官員，會議預定出席共 12 個經濟體 36 人(我方及澳大利亞、中國大陸、印尼、日本、馬來西亞、巴布亞紐幾內亞、秘魯、菲律賓、泰國、美國及越南)，但巴布亞紐幾內亞及秘魯二經濟體代表會議當天未出席，故實際出席共 10 個經濟體 31 人(我方及澳大利亞、中國大陸、印尼、日本、馬來西亞、菲律賓、泰國、美國及越南，如照片 2)，我方由經濟部水利署鍾朝恭副署長、葉俊明科長、陳明城正工程司共三人參加。

照片 2、各經濟體出席人員大合照

3、主辦機構

研討會由日本經濟產業省（Ministry of Economy, Trade and Industry, METI）舉辦，相關事務執行單位為新日本有限責任監查法人（Ernst & Young ShinNihon LLC）。

4、使用語言

會議以英文進行。

5、研討會議程

時間	議程
09:30-10:00	報到
10:00-10:10	歡迎致辭：日本經濟產業省貿易經濟合作局局長石川正樹(Masaki Ishikawa)
10:10-10:15	合照
第一場次：「APEC 優質基礎建設發展及投資指南」介紹及討論	
10:15-10:45	演講 1：介紹「APEC 優質基礎建設發展指南」修正草案綱要內容 主講人：日本經濟產業省通商政策局通商戰略室主任豐田康平(Kohei Toyoda)
10:45-11:00	演講 2：適當的風險分配及價值評估方法

	主講人：美國法律顧問公司 Milbank Tweed，Hadley & McCloy LLP 公司東京辦事處特別顧問 Justen Fleming
11:00-11:15	休息
11:15-12:15	開放提問及討論 主持人：日本經濟產業省通商政策局通商戰略室主任豐田康平(Kohei Toyoda)、新日本有限責任監查法人基礎建設顧問小組執行董事佐佐本仁(Jin Sasaki)博士
12:15-14:00	午餐
第二場次：「APEC 優質水資源基礎建設指南」介紹及討論	
14:00-14:20	演講 1：永續水庫-以石門水庫為例 主講人：經濟部水利署副署長鍾朝恭博士
14:20-14:40	演講 2：Maynilad 採購程序 主講人：菲律賓 Maynilad Water Service Inc.計畫管理工程主管 Yolanda C. LUCAS 女士
14:40-14:55	休息
14:55-15:25	演講 3：介紹「APEC 優質水資源基礎建設指南」綱要 主講人：日本經濟產業省製造產業局國際計畫、基礎建設及水產業促進辦公室副主任梅津亞耶(Aya Umetsu)女士
15:25-16:25	開放提問及討論 主持人：新日本有限責任監查法人基礎建設顧問小組執行董事佐佐本仁(Jin Sasaki)博士
16:25-16:50	總結

6、研討會紀要

6.1 開場致詞

由日本經濟產業省貿易經濟合作局局長石川正樹(Masaki Ishikawa)進行致詞(如照片 3)，主要談到「改善區域連結性、深化區域經濟一體化」是今年於巴布亞新幾內亞主辦 2018 年亞太經合組織會議的優先項目，其中修正「APEC 優質基礎設施發展與投資指南」為優先重要措施之一，為了促進本計畫的順利進行，日本經濟產業省將全力支持，並提供瞭解基礎設施建設發展的相關人員來提供必要協助。

照片 3、日本經產省貿易經濟合作局石川正樹局長開場致詞

6.2 第 1 場次「APEC 優質基礎建設發展及投資指南」介紹及討論

本場次一開始，安排由日方主辦機關經濟產業省通商政策局通商戰略室主任豐田康平(Kohei Toyoda)主講(如照片 4)，介紹「APEC 優質基礎建設發展及投資指南」修正草案的概要內容，本次修正與 2014 年版本主要包括以下五點：

(1)定義基礎建設的主要特性。

(2)確保優質基礎建設的關鍵要素。

(3)明確承認私人企業為基礎建設發展的重要夥伴之一，並適當地提及促

進民間參與機制(Public-Private Partnerships)的有效利用。

(4)規範政府部門為確保優質基礎建設的必要關鍵作為。

(5)期望政府部門應達到的舉措。

照片 4、日方經產省通商政策局通商戰略室主任豊田康平主講

草案針對基礎建設提出包括公共財、外部效應、對社會和環境產生廣泛影響、計畫週期長及透明度和問責制等五項特性。

原本 2014 年版本中定義基礎建設的三項要素，分別為生命周期成本、環境與其他衝擊、及安全，經本次重新檢討修正為下列五項(詳圖 1)：

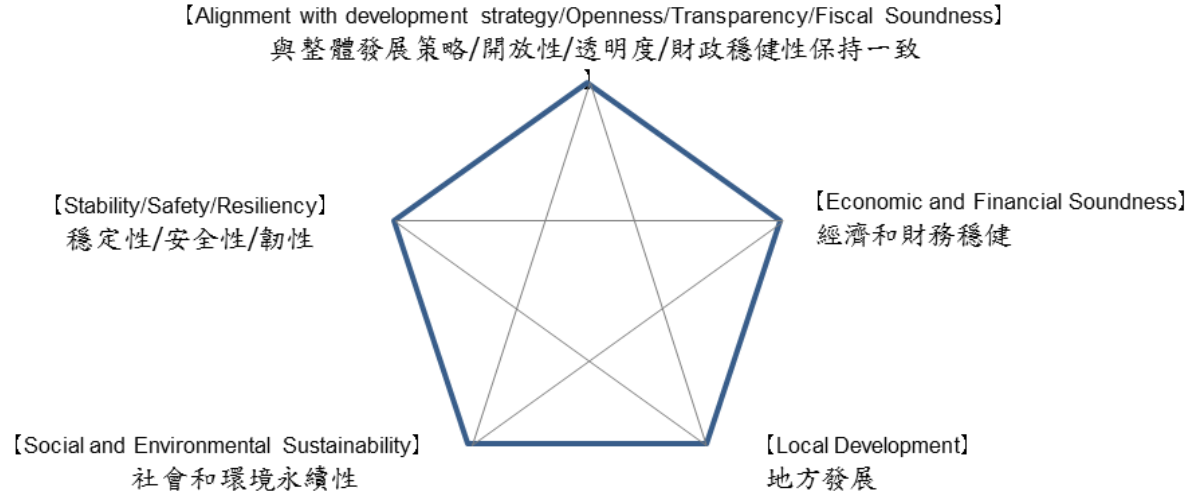


圖 1、確保優質基礎建設的五大要素

針對促進民間參與機制(Public-Private Partnerships, PPP)的有效利用部

分，鑑於近年促進民間參與公共建設機制的使用愈來愈多，本指南將提供促進民間參與機制的基本原則及國際上有效使用 PPP 的作法，包括傳統採購與 PPP 的差異比較、PPP 的特點、PPP 契約型式分類、及 PPP 計畫各階段需考量的事項，表 1 總結傳統採購與 PPP 間的主要差異。

表 1、傳統採購和 PPP 採購間的典型差異

特徵	傳統採購	PPP 採購
風險分擔	風險分擔有限（公共部門承擔風險）	公私部門之間適當的風險分擔
採購組合	分別採購	集合採購
契約期限	單年契約	多年契約
規格	輸入規格	輸出規格
獎勵機制	非基於績效	基於績效

針對政府部門為確保優質基礎建設的必要關鍵作為部分，則提出基礎建設計畫的生命週期以及其中每個階段需要考慮的事項，以確保基礎建設的品質。圖 2 描繪了由執行機構在基礎建設計畫生命週期各階段應採取的關鍵作為。

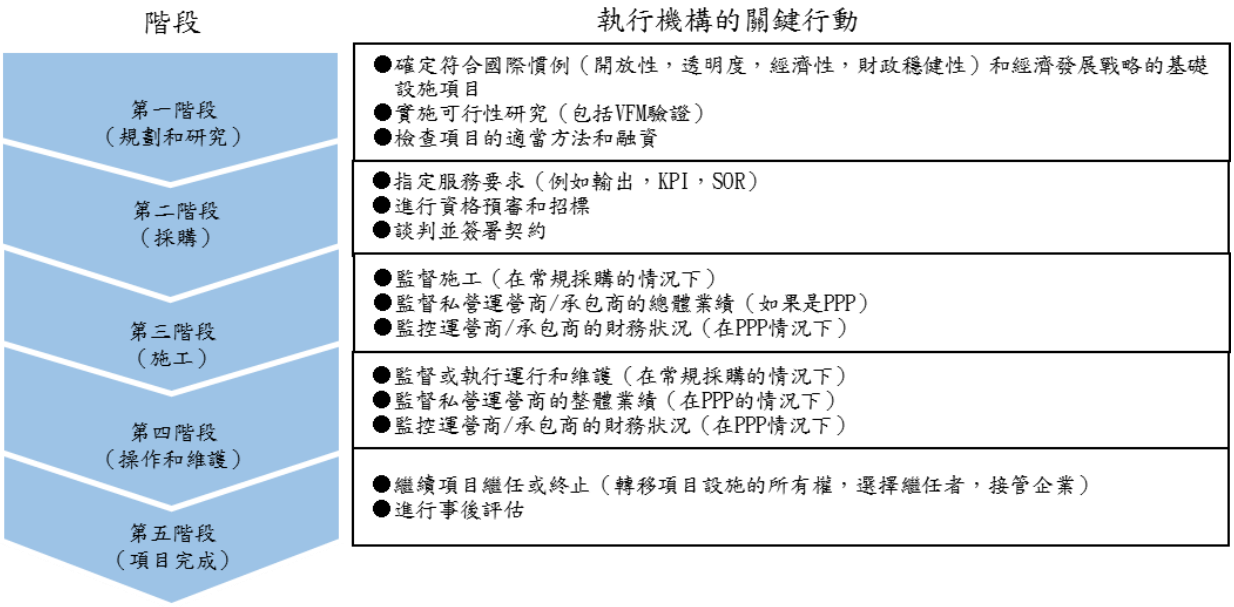


圖 2、執行機構在基礎建設計畫生命週期各階段應採取的關鍵作為

為了確保優質基礎建設仍有賴於政府部門的執行能力，因此，本指南特別新增對於政府部門應持續辦理事項的說明，分為強化管控和計畫管理執行機構能力、動員私人資金的準備、及人力資源開發三方面。

接下來，則由美國法律顧問公司 Milbank Tweed, Hadley ＆McCloy 公司東京辦事處特別顧問 Justen Fleming(如照片 5)簡報促進民間參與機制(PPP)適當的風險分配及價值評估方法(Value for Money)，從基本的 PPP 計畫架構來說明各項風險分配概念，列舉包括信用風險、匯率風險、政府重大政策變動、土地取得風險等，對於各項風險之發生、分擔及補償，均需要在契約議訂階段明確納入契約架構內容中，最後提出因政策變動或財務收入變化等不恰當的風險轉移樣態，因而導致促參計畫失敗的案例。

照片 5、美國法律顧問公司 Fleming 主講促參風險

最後，針對本指南開放各出席單位代表提問及進行討論，由日本經濟產業省通商政策局通商戰略室主任豐田康平主持。各出席經濟體代表發言重點摘錄如下：

- 美國代表首先表達對於本指南修正草案內容中，有關優質基礎建設的定義並不夠明確，希望能夠在內文中針對各項優質基礎建設的特性加以補充說明(如照片 6)。
- 中國代表指出引進最新的技術是必要的，但是開發適當的技術也是

至關重要的，另外，可參考其他多邊開發銀行（Multilateral Development Banks，MDBs）如世界銀行、亞洲開發銀行等相關指南或手冊來明確解釋「物有所值評估(Value for money)」的定義或評估方法。

- 我方則提出正面建議，表達本次指南修正相較於 2014 年版本有大幅度之補充或強化，相信對於 APEC 各經濟體將更具參考作用，並具體建議於第 3 章 3.1 治理和計畫管理機構第 3 段文字部分，加入預知維護及可靠度分析的概念。
- 印尼代表則提出除著重於「技術開發」外，也應注重「人力資源開發」，同時可考慮在指南中納入「社會包容性」和「性別社會」。
- 接下來馬來西亞代表則詢問在確保發展策略時如何將政府政策的變動納入考量，並指出於指南應明確說明發展策略中「財務穩健」與計畫過程中「財務穩健」二者間的區別。
- 泰國代表則提出公私部門對於計畫的效益計算方法及結果可能有認知上的差異，另建議可增加提到意外風險、不可抗力因素及網路攻擊等風險。
- 越南方面則呼應美國代表的意見，表示指南中應增加定義優質基礎建設的指標或方法。

照片 6、美方代表發言情形

對於各單位意見，日方表達感謝，並表示均將納入後續修正參考，預估至 4 月份將提再次提出修正後草案。

上午場次結束後，由主辦方提供午餐，我方代表亦於此時與各方代表加強社交聯誼、交好與國，分享我國成功經驗或案例，深化我國參與公共建設議題及尋求合作機會(如照片 7 及 8)。

照片 7 及 8、我方利用會議休息及午餐時間加強與各方代表交流

6.3 第 2 場次「APEC 優質水基礎建設指南」介紹及討論

下午第 2 場次，先由我方經濟部水利署鍾朝恭副署長簡報「永續水庫-以石門水庫為例」(詳照片 9)，以我國水庫更新改善經驗，向大家分享我方在面對水資源環境的嚴峻挑戰下，已有十分成功及有效的基礎建設成果，簡報內容摘要如下：

- 背景：石門水庫是台灣第一座多目標水庫，功能包括提供生活用水，農業用水和工業用水。水庫位於台灣人口最密集的地區，人口 400 萬。
- 挑戰：2004 年艾利颱風侵襲台灣，石門水庫集水區降雨量達 973 毫米，上游發生嚴重土石坍塌，石門水庫庫區淤積 2,800 萬立方公尺，不但大大降低水庫容量，而且造成台灣北部原水高濁度導致停水 18 天，嚴重影響了人民的生活和經濟產出。
- 進展：創新的石門水庫「分層取水工」和「水力排砂隧道」突破了

傳統工程，2009 年完成的「分層取水工」是一個 40 公尺深的取水井，可以有效地分層取得清潔的水源， 2012 年完成「水力排砂隧道」，將現有電廠水輪發電機組改造成具有發電和排砂功能的裝置，世界上任何其他國家都沒有嘗試過這種創新。

- 實際執行情形：2013 年蘇力颱風侵襲台灣，為台灣北部山區帶來 900 毫米的累積降雨， 這些創新建設首次受到自然災害的考驗，原水高濁度在 15 小時內得到有效降低，台灣北部地區維持供水穩定。
- 效益：排砂隧道的成功，減緩了水庫淤積並延長了水庫的使用壽命，而且有利於下游沉積物和水的平衡、減少河道沖刷及穩定海床。儘管該項工程耗資 2,200 萬美元，但 2013 年藉由排砂隧道清除 100 萬立方公尺泥砂，若用傳統疏浚方法清除需耗資 2,000 萬美元。在一年半的時間裡，排砂隧道產生的效益已達到付出成本相當的程度。截至 2017 年 6 月，通過排砂隧道排出的泥砂總量，以疏浚成本來計算節省了 9,500 萬美元，說明水力排砂具有相當高的經濟效益。

照片 9、我方水利署鍾朝恭副署長分享永續水庫作法

第二場演講由菲律賓 Maynilad Water Service 公司計畫管理工程主管 Yolanda C. LUCAS 女士分享該公司辦理採購程序(如照片 10)，該公司為菲律賓馬尼拉西部地區城市和鄉鎮的供水和廢水處理服務供應商，供水服務人

口約 900 萬人，年營業額約 250 萬美元，LUCAS 女士說明該公司辦理大型採購案如淨水場設計施工計畫，除均遵循世界銀行的國際標採購規定外，針對營運維護階段支出成本占經費比例較大的計畫，則採取全生命週期(Life Cycle Cost)評估方式，此方法可以有效的降低計畫成本及激勵承包商提出最佳化的營運維護方案，故於議價階段納入全生命週期(Life Cycle Cost)的資本支出(Capital Expenditure, CAPEX)及 15-20 年營運支出(Operating Expenditure, OPEX)來計算，並分享主要的困難點在於資格審查階段如何選擇出優良承包商、承包商能否持續符合及發展出營運維運需要的最佳技術及管理能力、招標過程通常更為複雜及耗時、及業主如何準確預測營運維護成本等。

照片 10、菲律賓 Maynilad 公司 LUCAS 女士分享採購程序

前二場演講結束後，接著由日本經濟產業省國際計畫、基礎建設及水產業促進辦公室副主任梅津亞耶(Aya Umetsu)女士介紹新訂「APEC 優質水資源基礎建設指南」草案綱要（如照片 11，註:會中僅提供簡報資料，尚未完成文字稿），摘要如下：

- 背景：由於人口增長和經濟快速發展，造成 APEC 地區城市用水需求增加，造成水環境污染負荷增加，同時，充足穩定的供水和適當的廢水處理對生活水準和經濟活動有重要影響，保證充足和穩定的供水，並確保適當的廢水處理是每個 APEC 經濟體最緊迫和最重要

的挑戰。

- 目的：讓各經濟體對水資源基礎建設的規劃、研究和營運有更深入地了解，並分享相關案例研究，以提供有用的建議，確保水資源基礎建設的品質。
- 範圍及目標：本指南主要針對都市區域的淨水處理場及污水處理場，提供基本方法、績效指標、評估方法。其中，基本方法應適用於各種的水資源基礎建設(如現地處理系統、管網或工業設施等)。
- 指南架構：分為 4 章(如圖 3)，分別為第 1 章「確保優質水資源基礎建設的要素」；第 2 章及第 3 章分別提出在可行性研究/設計/採購/施工階段、營運維護階段確保水資源基礎建設的具體措施；第 4 章指出計畫及持續發展能力的考慮因素。

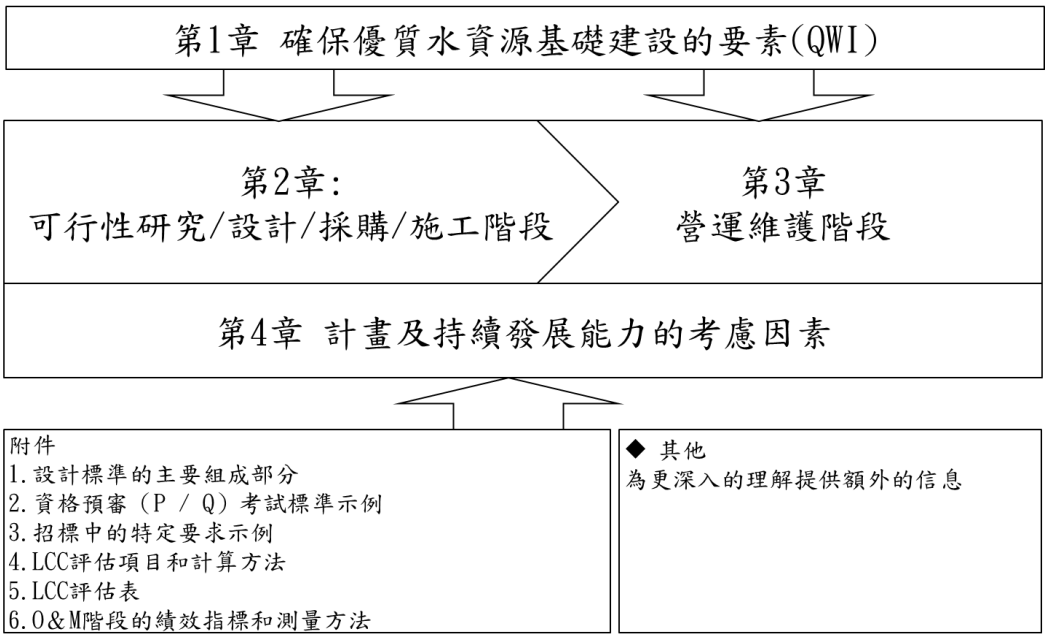


圖 3、APEC 優質水資源基礎建設指南草案架構

- 確保優質水資源基礎建設的要素：與「APEC 優質基礎建設發展及投資指南」所指五大要素相同，分別為與整體發展策略/開放性/透明度/財政穩健性保持一致、穩定性/安全性/韌性、社會和環境永續性、經濟和財務穩健、地方發展等五項(與圖 1 相同）。

照片 11、日本經產省梅津亞耶女士介紹水資源基礎建設指南綱要

完成綱要內容說明後，接著由新日本有限責任監查法人基礎建設顧問小組執行董事佐佐本仁(Jin Sasaki)博士主持，針對本指南開放各出席單位代表提問及進行討論，各出席經濟體代表發言重點摘錄如下：

- 澳洲出席代表表示，會將指南內容轉知該國水資源基礎建設相關機關後再提供意見。
- 中國代表則就本指南名稱使用「guideline」與「guidebook」二者間差異及建議是否均改為「guidebook」，另提出建議將第 2 章的採購程序及施工程序再區分為二個更詳細的獨立章節，於社會及環境永續內容中另加入依當地社會及經濟情形適當考量環境永續問題、在全生命周期的成本計算中加入拆除及後續重新提出使用的成本。
- 我方代表(如照片 12)則表示本次所訂指南對於 APEC 各經濟體將具參考作用，針對草案內容，我方具體建議如下:

(1) 在氣候變遷下近年降雨極端事件頻率增加，可能影響供水穩定性，建議在第 2 章可行性評估及設計階段加入氣候變遷相關考量。

(2) 智慧水資源管理是未來營運管理趨勢，建議於第 2 章 2.1 可行性分析及 2.2 設計中，考量納入如智慧防洪網絡、節水灌溉管理、動

態地下水和智慧水庫管理等概念。

(3) 建議在第 3 章維護營運階段加入預知維護及可靠度分析，以減少設施故障造成損害及降低維護成本。

(4) 另外，針對第 3 章水資源建設維護營運階段的永續性中，應再增加對於跨區域供水調度的項目。

照片 12、我方代表發言情形

- 印尼代表則指出針對優質水資源基礎建設要素中，地方區域發展因子並未清楚的定義或說明，並詢問在資格審查階段如果廠商採聯合承攬模式應否僅針對其主要或需要對個別分包商之財務穩建性進行認定，以及資格審查階段是否即要求廠商就環境永續性進行評估。
- 馬來西亞代表 (如照片 13) 則指出，優質水資源基礎建設要素中的地方區域發展因子，應加入當地經濟體的資源如材料使用及專業技術顧問提升。

照片 13、馬來西亞代表發言情形

- 泰國代表則針對採購階段的資格審查中，特別加註在某些案例中會採用資格後審(post-qualification)的方式感到好奇，希望增加適用時機的相關說明，另外建議於全生命周期的資本支出計算中納入備用材料及監造費用等項目，並要求在指南提出的二種承包商評選方法中(即最低價及最有利標)能夠研提適用計畫型式的建議，最後，希望指南中五大優質水資源基礎建設要素，有關水資源建設的可能經濟收益如供水收入等應否或如何納入加以考量。
- 菲律賓出席代表因為實際上屬於私部門代表，因此針對本指南中對於政府機關即業主的必要責任及應負擔風險應加強說明，尤其是在議約階段，亦是計畫是否能成功的關鍵因素之一，另外，應參考納入現有如世界銀行及亞洲開發銀行出版的採購相關指導手冊。
- 美國代表則對本指南全面性的內容及其功能表示肯定，美方歡迎並期待本指南草案能夠提升公共基礎建設不管是在採購方式、財務穩建或環境社會永續上的正面成果，未來全文草案提出後，美方會再就內容部分提出回應意見。
- 最後是越南代表針對本指南既然是針對水資源基礎建設，應該與通案性或其他類型的建設指南有更詳盡且有差別的內容，其次，建議

對於公、私部門等利害關係人於確保優質基礎建設的角色及關聯加強說明。

6.4：會議總結及未來計劃

會議最後，由日本經濟產業省貿易經濟合作局綜合課課長藤本武士（Takeshi Fujimoto）先生總結研討會(如照片 14)如下：

- 與會各經濟體針對「APEC 優質基礎建設發展及投資指南」的重要性及修正的必要性已有共識。
- 針對各與會各經濟體提供的意見將納入修本版本參考。
- 「APEC 優質水資源基礎建設指南」草案全文將於 2018 年四月份提出。

照片 14、日本經產省貿易經濟合作局藤本武士進行會議總結

(二)現地參訪

1、參訪行程

日期	時間	行程
3 月 1 日	09:00-09:30	路程
	09:30-11:00	參訪橫濱北部污泥處理中心（污泥處理廠）
	11:00-13:00	路程及午餐
	13:00-14:30	參訪橫濱川井淨水場、東京芝浦水生再中心
	14:30-15:30	路程
	15:30-17:00	參訪東京芝浦水再生中心（複式污水處理廠）
註：所有路程交通由日本經濟產業省負責		

2、PPP 及 PFI 介紹

PPP(Public-private partnership)與 PFI（Private Finance Initiative）都是利用私人資金，管理技能和技術能力，來建設，維護和運營公共設施之新方法。在政府有限之人力與財力下，引導民間資金參與公共建設與公共設施之營運管理維護，可減輕政府財政負擔，提昇公共建設品質，提高公共資源使用效率，促進國家經濟及產業發展；對廠商而言，可進行多角化經營，提升企業形象，降低營運成本；對民眾而言，可提早享受公共建設服務，提升生活品質，創造就業機會。因此 PPP 與 PFI 可以創造政府、廠商、民眾三贏局面。

日本在 1999 年 7 月頒布了「民間資金等の活用による公共施設等の整備等の促進に関する法律（PFI 法）」，2000 年 3 月則頒布了 PFI 理念及其實施的“基本方針”，由總理在 PFI 促進委員會審議後製定，並建立了 PFI 的項目框架。

其中在活用民間資金來促進公共建設之改造部分，以「污泥處理」、「淨水場」等設施為日本水利事業施行 PFI 模式之大宗。主要原因係昭和 40 年代（1965 年），日本為應付快速經濟成長衍生之用水需求而大量興

建水利設施，然隨著使用年份增加，多數設施都已屆維修汰換之年限。依日本經濟產業省於 2010 考量設施之性能以及使用年限，推估 2011～2061 年 50 年間，必要之水利設施更新費用約達 36,404 億日圓～44,087 億日圓； 此外，日本因人口減少，工程師除呈現高齡化外，人數亦有不足，造成淨水場運作堪慮，為維持穩定且高水準之服務品質，勢必須提升管理面的技術水平。基於上述兩因素，日本期望藉由活用民間資金及管理技術，減緩政府之財政壓力及相關水利業務之運行。

為加深 APEC 各經濟體對優質水利公共基礎建設採用 PPP 或 PFI 模式推動之信心，本次主辦方(日本經濟產業省)安排以一天時間參訪 3 處採用 PPP 或 PFI 模式之成功案例，包括橫濱北部污泥處理中心、川井淨水場及芝浦水再生中心。

3、參訪橫濱北部污泥處理中心

橫濱市於 1861 年起在外國人居住的區域，開始有下水道進行現代化的污水收集工作。不過，應對 1965 年開始的迅速人口增長，污水處理系統的擴建速度也很快。在 1980 年開始的 15 年期間，每年約投資 100 億日圓及 15 年總額 1,900 億日圓的巨額支出，使納入污水下水道集污區的人口急劇增加，在 2010 年時，下水道普及率就已達到 99.8%。現在橫濱市正在努力維持從水源頭到海洋的完整水循環。

本次參訪之橫濱市北部污泥處理中心的位置如圖 4，其任務係將各污水處理廠最後產物之含水污泥，予以進行濃縮、消化(分解)及脫水等處理程序，分階段去除水分，最終進行燒卻(焚燒)處理。並收集處理過程中所產生的溫室氣體(如二氧化碳（CO_2）、甲烷（CH4）、和氧化亞氮（N_2O）等)，及將焚燒後的飛灰資源予以有效利用，為形成循環型社會做有效貢獻。

圖 4、橫濱市污水處理廠、污泥輸送管及污泥處理中心位置示意圖

考慮到橫濱市七條河流和地形狀況，為利於污水處理和雨水管理，將橫濱市分為九個區，目前橫濱市的污水處理系統包括長度約為 11,600 公里的污水管道，以及 11 個水再生中心和 26 個泵站。2008 年，一共處理了大約 6.4 億噸的廢水。處理過程中產生的含水污泥通過管道輸送到市內的兩個污泥資源中心進行焚燒。有效利用來自污泥焚燒的全部飛灰，每年約達 17,000 噸(換算後，北部污泥處理中心平均一天產生約 20 噸飛灰)。對橫濱市來說，廢水深度處理產生的廢水是一種珍貴的城市水資源，並供應到城市的不同地點。且為了防止因東京灣等封閉水域的富營養化而造成的水質惡化(如圖 5)，排放的廢水也會被處理去除氮和磷等物質。

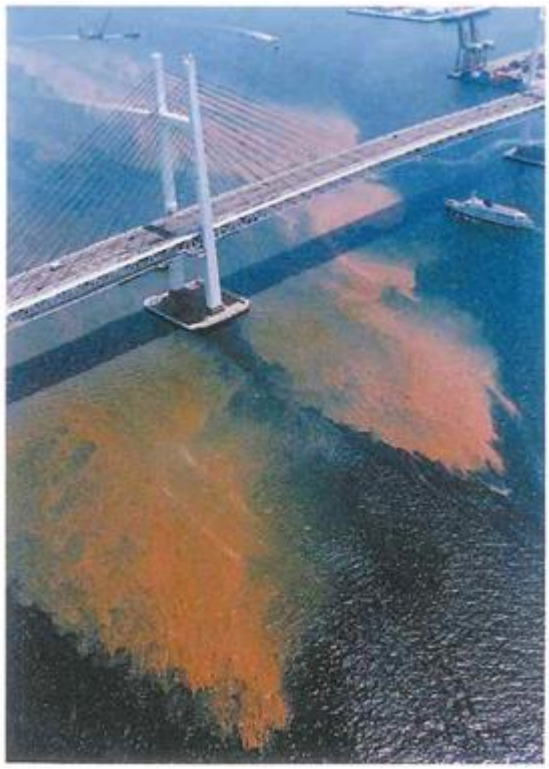


圖 5、2010 年 5 月 21 日於橫濱灣所發生的紅潮現象

註：紅潮係因浮游性的藻類在水中含較高濃度之氮、磷物質等適合的環境條件下(通常是水體優氧化的結果)會大量繁殖，因藻體光合色素的存在，加以細胞密度高而造成有色水的現象均稱之。

本參訪團參訪橫濱市北部污泥處理中心(如照片 15 至 24)，先到簡報室聽取簡報，簡報人員說明北部污泥處理中心之處理流程為：「受泥」→「濃縮」→「消化(分解)」→「脫水」→「燒卻(焚燒)」(如圖 6)，說明如下：

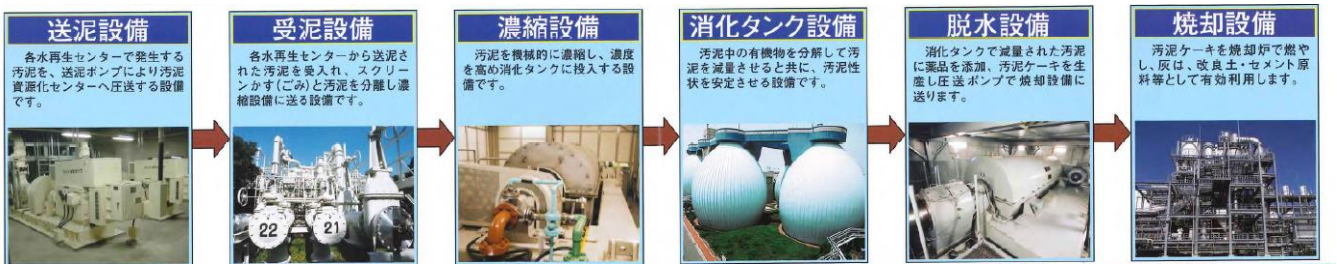


圖 6、橫濱市北部污泥處理中心之處理流程示意圖

1.受泥：收集由各水再生中心處理後之含水污泥(約每日 8,000 噸)至本中心的濃縮設施內。

2.濃縮：以離心濃縮機或其他機械設備去除含水污泥中約 70%的水分，剩餘 30%較高濃度泥水。

3.消化(分解)：於消化槽內將污泥內的有機物進行分解消化，可以使污

泥固化物減量及達成污泥安定化。

4.脫水：於完成消化(分解)污泥加藥沉澱後，進行脫水，可再去除約85%水分，製成泥餅。

5.燒卻(焚燒)：將泥餅置入焚化爐焚燒(燒却)製成爐灰(飛灰)，每日約可產製 20 噸，可以作為土壤改良及混凝土的原料，以進一步有效利用。

照片 15 及 16、本參訪團至橫濱市北部污泥處理中心參訪並聽取簡報

照片 2.3、橫濱市北部污泥處理中心每日約接受含水污泥約 8,000 噸，經濃縮、消化、脫水、燒卻等程序後，最後產出約 20 噸飛灰


照片 17 及 18、參訪團聽取接待人員對污泥處理流程之說明


照片 19 及 20、參訪團至蛋形消化槽頂參觀運作情形並合影


照片 21 及 22、接待人員帶領參訪團參觀北部污泥處理中心之監控室

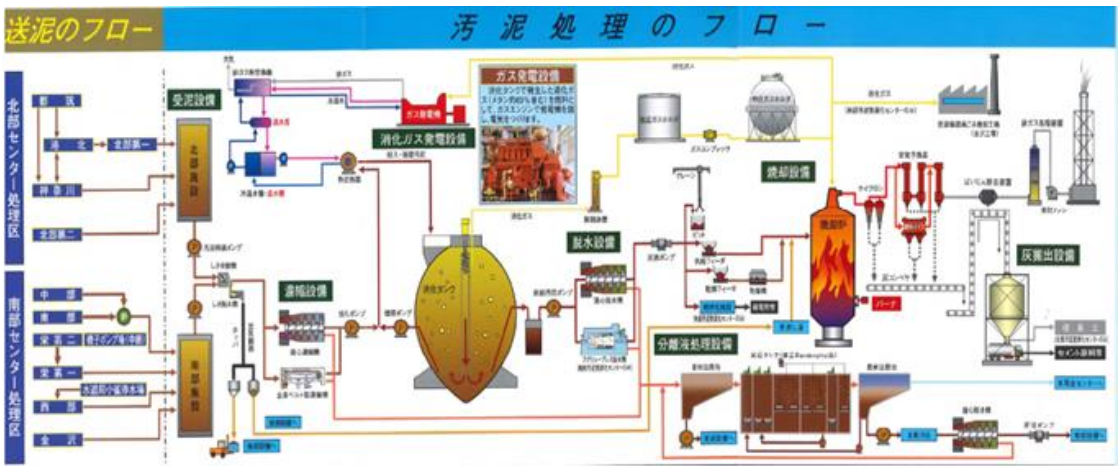


圖 7、橫濱市北部及南部污泥處理中心之污泥處理流程圖

本次參訪了解下水道污泥資源化概分為三大類(如圖 8)，包括消化(分解)後產生的甲烷（CH4）等可燃氣體，可供作電力及燃料用途，飛灰可做為改良土及水泥材料，及將污泥燃料化，也就是作為化石燃料的代替品等用途。故俟我國開始收取污水費，有較充裕之財源後，為環境改善及資源有效利用，應可進一步對我國之下水道建設增加相關後續污泥處理作為。

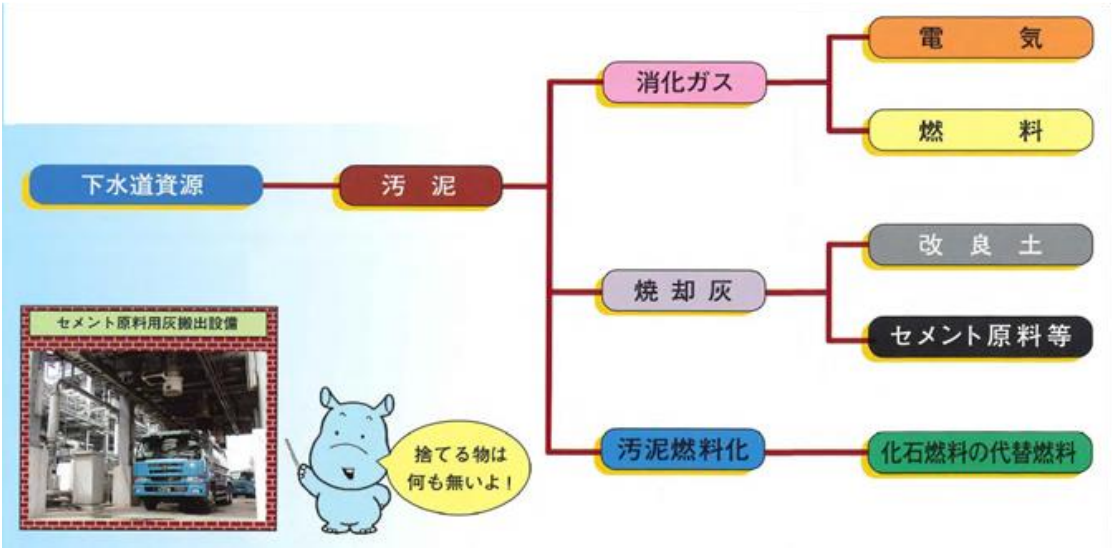
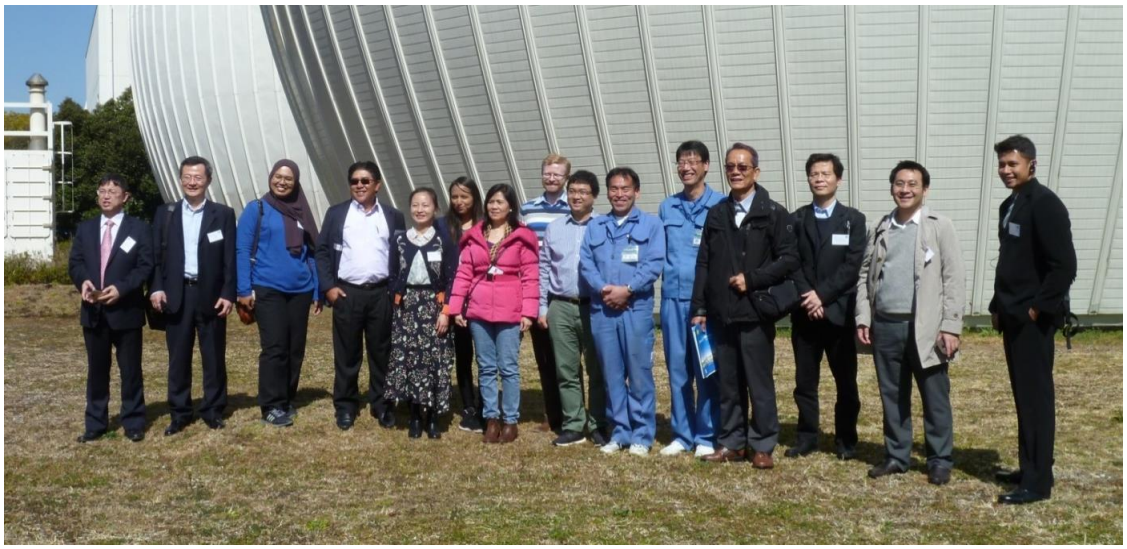


圖 8、下水道污泥資源化的可能方式

照片 23、飛灰可作為園藝改良土或工程建設之原料



照片 24、參訪團於結束參訪前在蛋形消化槽前合影

最後回到本次參訪之主題 PPP 辦理情形，橫濱市北部污泥處理中心於 2008 年 4 月 1 日起，通過委外代操作進行管理(由民間企業辦理經營管理、維護等工作，但例行檢查、清潔、物品採購及小修等管理工作則由公部門另行辦理)。 不過該契約於 2017 年到期，為提高維護管理效率， 因此橫濱市政府(環境創造局)決定更新委外代操作契約，於 2017 年起進行全面的委託管理和營運，以利用民間企業運營管理的專有技術來提高運營效率，降低成本，減少公共支出等，並一次發包 6 年的委託代操作契約，此案於 2016 年 12 月 5 日已簽訂契約(如表 2)。

表 2、橫濱市北部污泥處理中心委外代操作之發包過程

平成 28 年 4 月 20 日	第 5 回包括的管理委託検討部会（事業概要、落札者決定基準の検討）
平成 28 年 6 月 7 日	調達公告
平成 28 年 8 月 19 日	入札書類受付
平成 28 年 9 月 21 日	第 6 回包括的管理委託検討部会（提案書評価作業）
平成 28 年 11 月 14 日	第 7 回包括的管理委託検討部会（落札候補者の決定）
平成 28 年 11 月 21 日	落札者の決定（環境創造局第一委託業者選定委員会）
平成 28 年 12 月 5 日	契約締結

而在挑選民間企業時，除秉持公平透明原則外，不能僅考慮委託費高低，還須考慮到民間企業之技術建議，橫濱市政府為了挑選優質廠商，成立“橫濱市下水道事業管理研究小組綜合管理委託審查小組委員會”，評估各投標企業之優先順序，最後通過橫濱環境創造局之局內程序決定由哪一個企業得標。其中的評選委員成員由以下學術專家組成(如表 3)：

表 3、横濱市北部污泥處理中心委外代操作之評選委員會成員

部　会　長	長岡　裕	東京都市大学工学部　都市工学科教授
委　　員	池田　陽子	明大昭平・法律事務所　弁護士
委　　員	稲員　とよの	首都大学東京　大学院　都市環境科学研究科教授
委　　員	高橋　賢	横浜国立大学経営学部・大学院国際社会科学研究院教授
委　　員	尾﨑　正明	一般社団法人全国上下水道コンサルタント協会　専務理事

招標結果只有 1 家企業投標，得標者是 JFE 環境サービス・JFE エンジニアリング共同企業體，投標價格為 60 億 4,800 日圓(不含稅)。這家公司是由ＪＦＥ環境サービス株式會社出資 70%，ＪＦＥエンジニアリング株式會社出資 30%所成立。

4、參訪川井淨水場

橫濱水道局是日本第二大水務公司，在 438 平方公里的土地上為 370 萬人提供服務（如圖 10），且是 1887 年全國首個高壓配水系統的發源地。

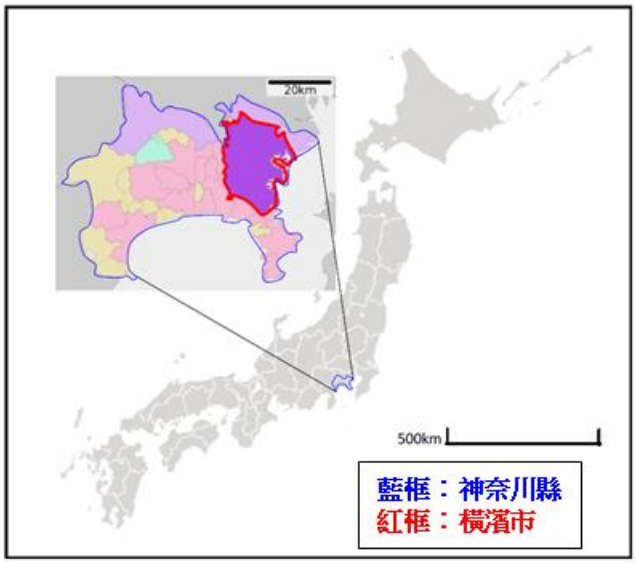


圖 10、橫濱水道局供水範圍

橫濱市有三個主要淨水場，分別是西谷淨水場、小雀淨水場以及川井淨水場，處理來自道志川等 5 個水源，水源及水道設施如圖 11：

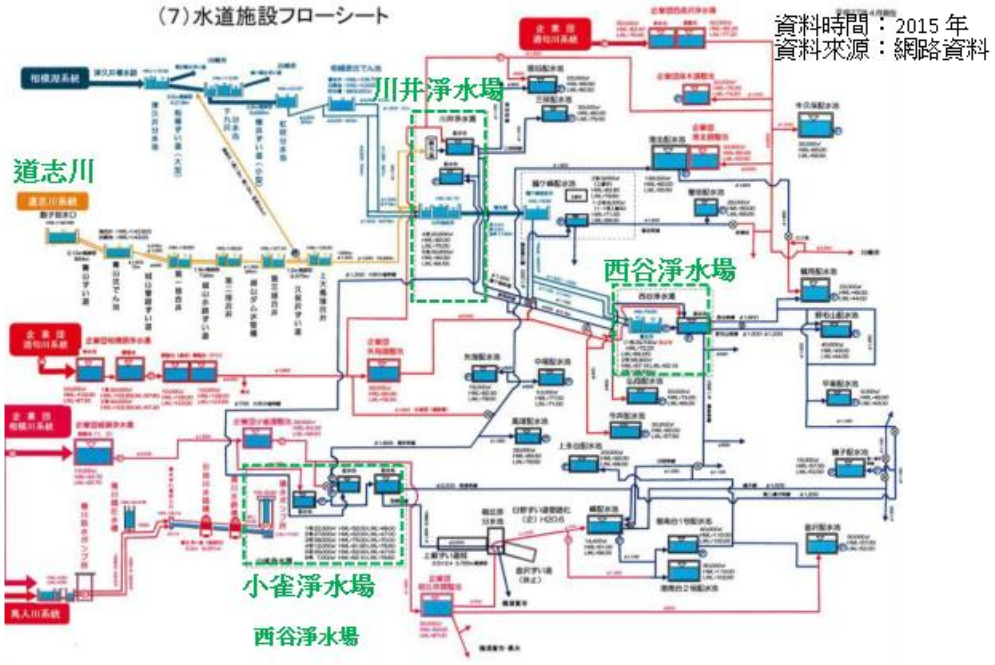


圖 11、橫濱市水源及水道設施圖

川井淨水場設立於 1901 年（明治 34 年），是橫濱市最古老的淨水場(註：西谷淨水場及小雀淨水場分別於 1915 年及 1965 年設立)，其於道志川之鮑子取水堰取用潔淨的原水(約每秒 2 立方公尺=每日 17.28 萬噸)，先加

藥混凝後輸送至青山沉砂池進行沉砂，再輸送經城山水庫，利用天然地形高程差，全程以重力方式輸送原水長達 29 公里至川井淨水場(如圖 12)，經淨水處理後提供安全、優質、穩定的自來水給橫濱市用水戶。

圖 12、川井淨水場水源輸送路線圖

川井淨水場曾在 1963 年更新主要設施。自那以後，負責供給橫濱地區自來水亦已接近 50 年，相關設備達汰換年限，因此橫濱市水道局從 2009 年（平成 21 年）啟動淨水場改造工作，並一併加強淨水場主要組成部分的抗震能力，包括沉澱池，過濾池和配水池等。

為了減輕公共財政負擔，維持穩定且高水準之服務品質，提高效能，橫濱水道局認為利用私營部門的活力和專業技術非常重要。在考慮各種形式的公私合作關係後，決定使用 BTO（建設-移轉-運營）類型的 PFI 計劃(如表 4)。

表 4、川井淨水場辦理 BTO 之過程

平成19年12月14日	実施方針の公表
平成20年３月３日	特定事業の選定・業務要求水準書（案）の公表
平成20年６月３日	入札説明書等の公表
平成20年９月24日	入札・提案書の受付
平成20年12月４日	落札者の決定
平成20年12月26日	基本協定の締結
平成21年２月27日	事業契約の締結
平成21年４月１日	事業開始

經招標後川井淨水場改造案由ウォーターネクスト横浜株式会社得標， 整體改造計畫說明如下：

(1)計畫名稱：川井淨水場再整備事業

(2)契約金額：276 億 7,917 萬 3,328 日圓（含稅）

(3)契約範圍：川井浄水場改造之資金調度、設計施工、運轉維護管理及產生污泥的有效利用等

(4)契約期間

設施維修期（第一階段/新設施的建設）：2009/04/01 至 2014/03/31

設施維修期（第二階段/舊設施搬遷）：2014/04/01 至 2015/03/31

運轉維護管理期間：2014/04/01～2034/03/31 (20 年期間）

(5)促參類型：BTO（Build Transfer Operate）方法

募集資金，進行設施建設後，設施所有權轉移給橫濱市水道局，至於公司運營和維護設施仍由得標廠商負責。

(6)設施所在地：神奈川縣橫濱市旭区上川井町 2555 番地

(7)設施概覽：如下表所示，除規模擴大外，整體結構更新讓抗震性符合規定。

表 5、新設及原有淨水場設施比較

	新設淨水場	原有淨水場
生產水量	171,070m^3／日	106,400m^3／日
淨水處理方式	陶瓷膜過濾系統	快速砂濾法
配水池	1 池 有効容量：30,000m^3	3 池（1 号～3 号） 有効容量（合計）：10,100m^3
排水處理設施	排水・脱水処理施設	排水池 3 池、排泥池 1 池

(8)特點

- 採用不易損傷的陶瓷膜
- 最大限度地利用水源地和淨水場之間的能量差異
- 通過太陽能發電來節能和減少二氧化碳的排放
- 產生的污泥 100%有效使用

至於得標之ウォーターネクスト横浜株式会社，是由メタウォーター株式会社、メタウォーターサービス株式会社、三菱 UFJ リース株式会社、月島機械株式会社、東電工業株式会社、東電環境エンジニアリング株式

会社及東京電力株式会社等 7 家不同專長的企業於 2009 年(平成 21 年)1 月 22 日所合資組成，資本額為 1 億日圓，針對這 7 家企業所負責項目分工如表 6：

表 6、得標企業所負責項目分工表

參與合資企業	負責之專長工作
メタウォーター株式会社	過濾膜裝置製造、機械・電氣工事、維持管理
メタウォーターサービス株式会社	第三者委託受託、維持管理
三菱 UFJ リース株式会社	財務顧問、財務管理
月島機械株式会社	污泥有効利用管理
東電工業株式会社	機械・電氣工事、維持管理
東電環境エンジニアリング株式会社	維持管理
東京電力株式会社	能源供應(電力）

註：改造案有關土木建築之設計監造與施工，係分別委由株式会社東京設計事務所及鹿島建設株式会社負責。

這個淨水場改造案與眾不同之處在於它是 “日本第一個使用 PFI 進行整座淨水場之改造”及“有日本最大的膜過濾設備”(如圖 13)，其中為在有限的現場空間建造一個新的水淨化設施，因此採用了能處理提供每日 17.28 萬噸水量的重力式陶瓷膜過濾系統，取代了原有淨水場的快速過濾方法（每日 10.64 萬噸）。採用膜過濾這個決定是基於膜過濾法所需要的空間較小，以便在原有淨水場設施仍在運作時可以同步設置新設施。此外，川井淨水場得天獨厚擁有 35 公尺高差之重力流的自然能源，因此水可以用重力流形式通過膜過濾淨化，毋須額外消耗能源，而且從道志川取得之原水經混凝初沉後非常乾淨(據現場接待人員說明濁度僅約為 2NTU)，可以有效減少膜的消耗。當然，陶瓷膜過濾系統可以確保處理後的水質等於或高於傳統的快速過濾系統，亦方便設施管理，實現高效運行和維護。另外，通過與橫濱市水道局進行適當的風險分擔和管理，以公私合作有效確保營運之穩定。

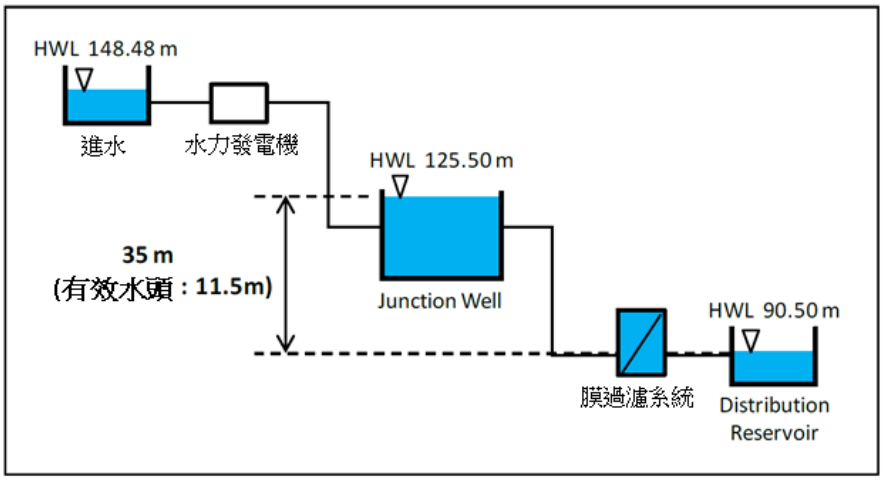


圖 13、川井淨水場使用天然能量進行膜過濾示意圖

註：一般膜過濾通常需要大量的能量用泵將壓差施加到膜上。在川井淨水場則利用進水點和淨水場間的海拔差異，如圖所示，小型水力發電機位於沿途，但當水達到淨水場時，相當於 11.5 米水頭的剩餘壓力仍然存在。該剩餘壓力用於進行陶瓷膜過濾並將處理後的水輸送到分配儲存器中。這樣，川井淨水場實現了需要零電量的膜過濾工藝。

照片 25 及 26、左為川井淨水場新設施建設後舊設施搬遷前之全景 (約 2014 年)，右邊為舊設施搬遷後全景

當我們抵達川井淨水場，廠方接待人員請我們先到屋頂參觀該淨水場屋頂所設置之太陽能發電設備(如圖 14 及照片 25 至 29)，太陽能發電系統安裝在配水池和其他設施的屋頂上。通過安裝 1,400 塊太陽能電池板，合併發電能力為 336 千瓦，巨大的屋頂空間得到有效利用。在天氣晴朗的白天，這種能源可以讓整個淨水場在沒有額外的電網供電的情況下運行，甚至可以出售剩餘電力。透過充分利用太陽能及水源取自道志川的重力能等自然能源，也彰顯出本件 PFI 案所揭示的環保、減汙的主張。

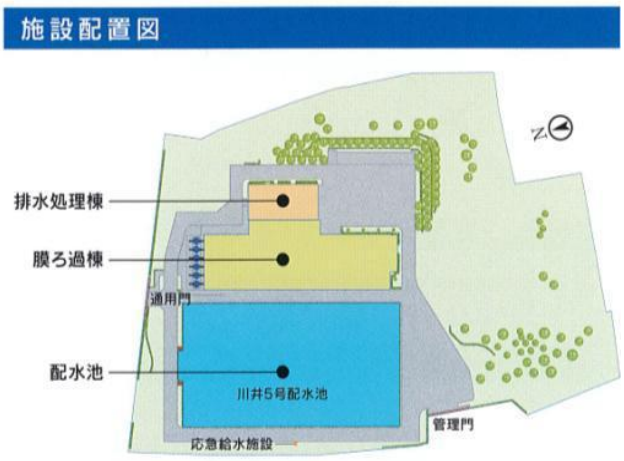


圖 14 及照片 27、1,400 塊太陽能板設置於配水池及其他設施之屋頂上

照片 28 及 29、參訪團於膜過濾建築屋頂參觀設置太陽能板情形

照片 30 及 31、接待人員說明川井淨水場之條件、優勢以及 PFI 案操作的過程

之後廠方接待人員帶領我們至膜過濾建築棟，說明川井淨水場的條件、優勢、淨水處理流程以及 PFI 案操作的過程等(如照片 30 及 31)，並輔以影片說明及現場進行小型試驗，讓與會人員對川井淨水場所採用之膜過濾系統，僅需要低壓力、可逆洗、可快速獲得潔淨水源及淨水場四大特色

等有進一步之體認(如圖 15)。

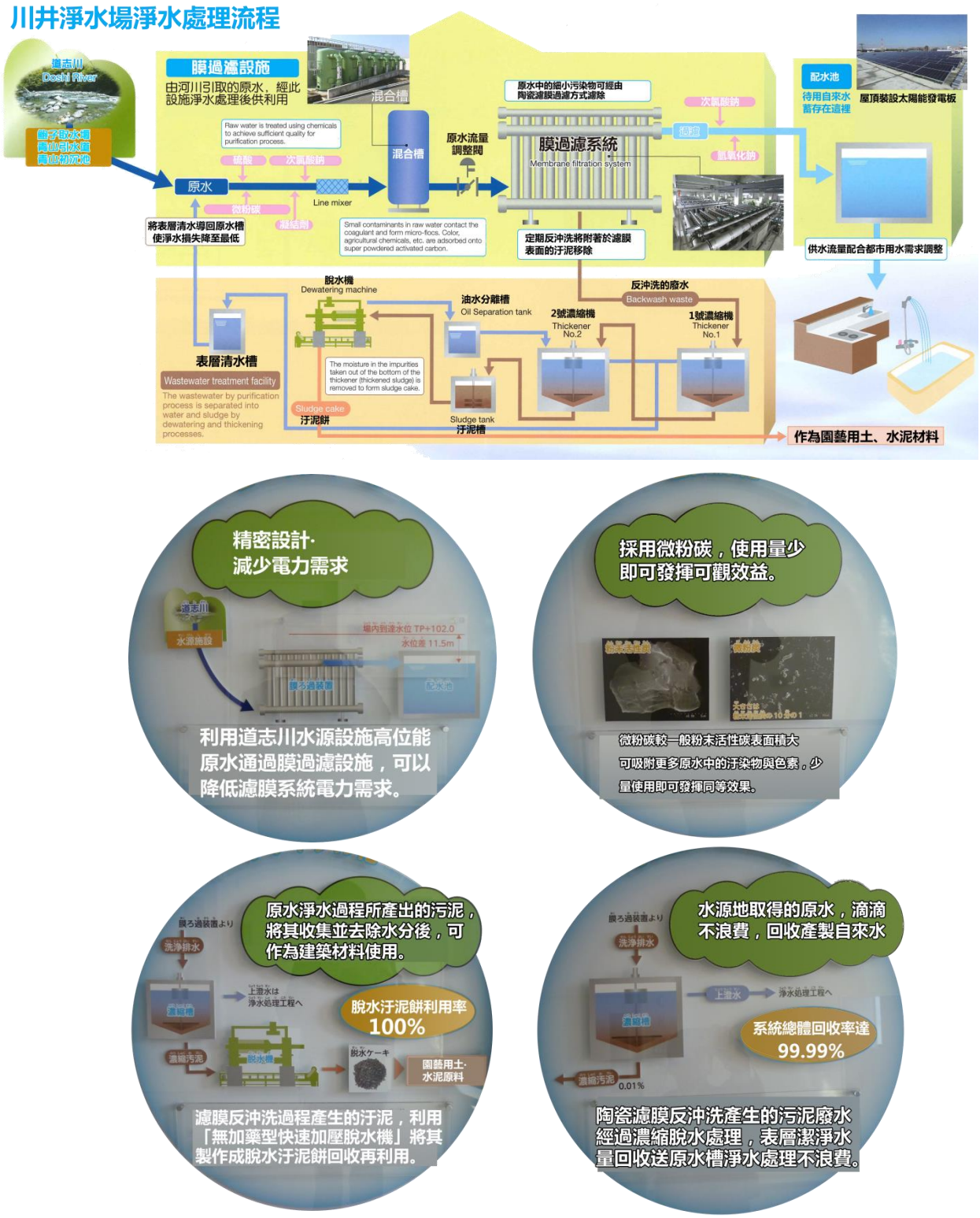


圖 15、川井淨水場四大特色

其中膜過濾後，其洗滌水被送入污泥處理，上清液回到處理過程的開始。因此，該淨水場的總體回收率達到了 99.99%，這意味著超過 99%的原水被轉化為飲用水，只有不到 1%的水及泥被排出系統。這使得整個淨

水過程非常環保。至於淨水過程中所產生的污泥，也可以透過園藝用土或水泥原料而被百分之百回收利用，因此讓環保落實於每一細節中。

另因川井淨水場位於橫濱所有淨水場的最高處，這允許重力供水分配到廣闊的區域。而隨著川井淨水場之改造，提高了處理能力，因此將該場的服務戶數從 19 萬增加到 31 萬戶，從而減少其他淨水場使用泵加壓供水服務的戶數。在 2011 年至 2015 年的五年期間，根據其五年的管理計劃，橫濱市成功地將通過重力流動分配的飲用水比例提高至 36%，並計劃在未來五年內進一步擴大這一比例(如圖 16)。

圖 16、川井淨水場改造後供水區域擴大範圍示意圖

照片 32 及 33、現場以手動方式進行小型試驗以深入認識膜的運作

於了解陶瓷膜之運作原理後，接著接待人員帶領參訪團了解水質檢查儀器及以養魚作為水質快速反應指標，後者與我國自來水公司之作法雷同，隨後並帶領參訪團試飲該淨水場引以為傲一世紀之安全優質自來水。


照片 34 及 35、場方帶領參訪團參觀水質檢查室對於水質管控方式


照片 36 及 37、參訪團現場試飲川井淨水場所生產之自來水

緊接著參觀川井淨水場之過濾膜實際運作現場，於挑高空間中，多部機組正在運作，不過因川井淨水場因本身擁有重力位能，毋須再以泵浦加壓，故而並沒有明顯的機器運作聲響。且接待人員表示，由於原水水質優良，因此川井淨水場之膜過濾相關設備，預計可使用長達 20 年(亦即在 BTO 契約存續期間，除個別情況損壞外，設備毋須依年限汰換)。


照片 38 及 39、參訪團於膜過濾現場參觀並提出問題

另經詢問，川井淨水場所採用的陶瓷膜係 METAWATER 公司所生產的 MF 等級陶瓷膜(如圖 17)，該陶瓷膜過濾系統是一種水處理系統，通過清除河流系統和井水中的雜質（細菌和隱孢子蟲等原生動物）以及原水中的濁度，產出乾淨清澈的自來水。主要特點包括孔隙夠小（0.1 μm），能夠去除寄生蟲和細菌的小孔，對濁度快速變化具有相對穩定的處理能力及高耐化學腐蝕和高抗壓力，節省空間等。在水處理領域，迄目前為止，METAWATER 的陶瓷膜過濾系統已引入日本超過 140 家淨水場。而 2014 年 4 月，川井淨水場改造工作順利供水，成功的案例亦有助於在日本國內推廣公私合作夥伴關係。

為了使膜污染最小化，營運方通過硫酸噴射來控制 pH，並且通過根據原水水質調整的適當的凝結劑注入比來提高凝結的有效性。出於節能的目的，運營商試圖減少反洗，盡可能每六小時進行一次。該膜每年還要進行兩次化學清洗。

照片 40、現場陶瓷膜原型及原水、膜過濾水及逆洗排水供了解水質差異

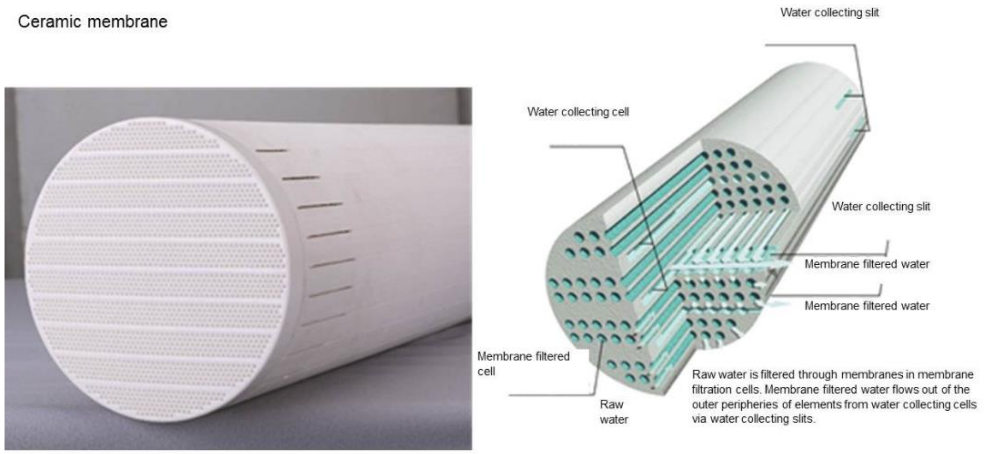


圖 17、橫濱川井淨水場採用 METAWATER 公司所生產的 MF 等級陶瓷膜

METAWATER 成立於 2008 年 4 月，是日本第一家從事水和環境業務的綜合性工程公司，也是少數幾家擁有整合機器和電氣工程技術的水利和環境基礎設施公司之一。該公司的優勢在有豐富的經驗和先進的信息和通信技術（ICT ），能夠從設計、施工到維護階段，結合機械和電氣工程技術，維護技術和 ICT 來提出解決問題之方案，此外透過 ICT，可以簡化日常檢查並同時分析和使用累計數據，幫助實現更高效和更高質量的水和環境基礎設施。

於結束參訪行程時，川井淨水場還致贈參訪人員每人一隻代表該淨水場吉祥物(圖騰)相同之小玩偶(如照片 41)，讓人印象深刻，亦顯示出日方對經營該淨水場之用心。

照片 41 及 42、川井淨水場吉祥物及 APEC 參訪團合影留念

5、參訪芝浦水再生中心及「品川シーズンテラス」大樓

5.1 參訪芝浦水再生中心

“芝浦水再生中心”於 1931 年開始營運，是東京第三古老的水回收中心。早期該區原本是碼頭倉庫的環境，但現在早已被許多辦公大樓所取代。芝浦水回收中心的集水區包含千代田，中央區，港區，新宿區和澀谷區的大部分區域，還有文京區，目黑區，世田谷區和豐島區的一部分等面積約 6,440 公頃的地區。這相當於 JR 山手線繞行範圍內的土地面積。經過該中心處理後的水多數排入東京灣（運河）。

一般都市下水道系統主要由 3 個設施組成，這些設施每天進行檢查、清潔和維修，以確保每個設施都能正常運作(如圖 18 及表 7)。說明如下：

1.下水道：負責收集和運送廢污水。

2.泵站：污水被抽上來，使下水道不會太深。

3.水再生中心：在這裏廢水經過處理成為清潔水。

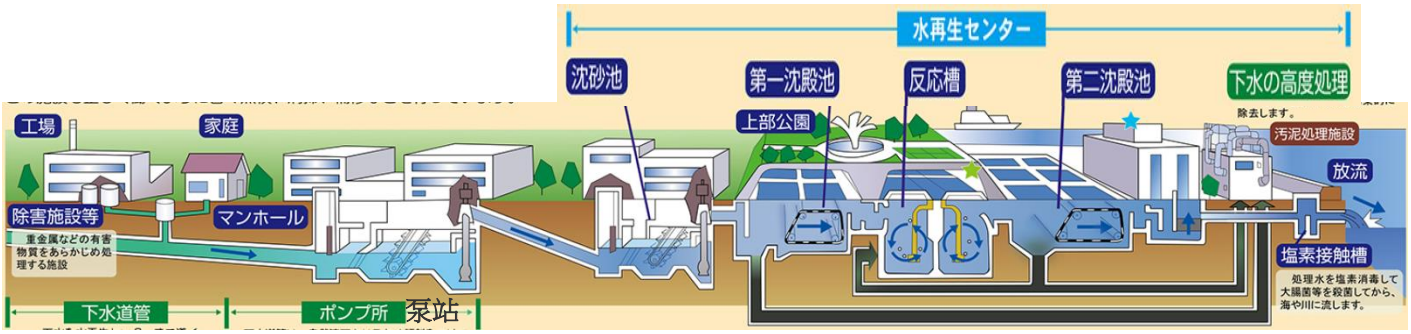


圖 18、都市污水下水道系統的運作方式

表 7、芝浦水再生中心 2017 年設施諸元

運轉開始	1931 年(昭和 6 年 3 月)	
基地面積	199,127 平方公尺	
處理能力	830,000 立方公尺／日	
水處理設施	沈砂池	14 池
	第一沈殿池	10 池
	反應槽	17 槽
	第二沈殿池	24 池
	高速過濾池	2 系列
雨天時貯留池	94,600 立方公尺(含 2015 年竣工 76,000 立方公尺)	

其中“芝浦水再生中心”即具備包括沉砂池、第一沉澱池、反應槽、第二沉澱池及高速過濾池等污水處理設施(如圖 19)。

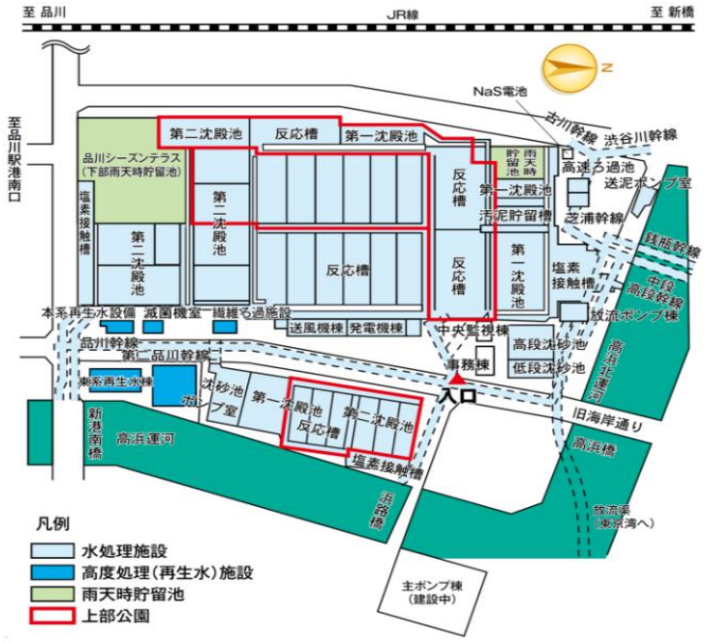


圖 19、芝浦水再生中心之設施平面布置圖

從“芝浦水再生中心”排出的水均符合該國“環境保護公民健康和安全條例”的水質標準(如表 8 中數據為平成 27 年，24 小時試驗平均值)。

表 8、芝浦水再生中心水質標準

項目	流入水		放流水		規定之放流水水質標準
	本系	東系	本系	東系	
BOD	220	180	10	9	—
COD	110	99	11	10	35 以下
總氮	44.6	46.2	17.2	15.8	30 以下
總磷	4.3	4.2	0.5	0.4	3 以下

“芝浦水再生中心”之特色在於污水處理量很大，放流水質穩定，可以作為再生水有效利用。芝浦水再生中心利用沙過濾設施處理水中的細小污泥，並註入次氯酸鈉，並將其用於洗滌和冷卻中心內之相關機械設備，以及用於廁所的清潔用水。此外，一部分的水再進一步通過臭氧殺菌淨化的水則提供給鄰近的建築物作為沖廁用水。至於產生的污泥則透過壓力管道輸送至南部污泥處理中心進行處理。

另外，從 2010 年 4 月起，首次在日本的再生水處理程序中使用 MF 等級且耐久性高的陶瓷作為滲透過濾產水設施(註：膜的種類有 MF、UF、NF 及 RO 膜等，膜之孔隙大小分別為 MF>UF>NF>RO，MF 膜用於過濾大腸桿菌、乳化油脂，UF 膜用於過濾二氧化矽、病毒，NF 及 RO 膜用於過濾更小的蛋白質等分子物質。)

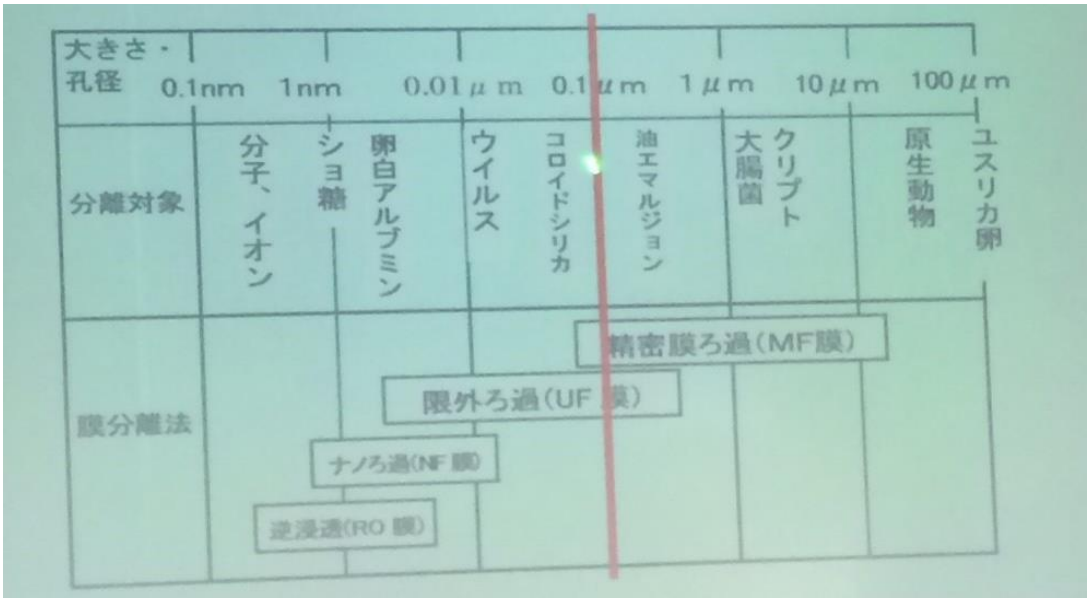


圖 20、膜的種類及其處理範圍

至於其再生水處理流程為污水經反應槽生物處理、臭氧處理等程序，匯集後再經陶瓷濾膜過濾處理，之後進入貯存槽待用。芝浦水再生中心有能力長期穩定且廉價地製造再生水，足供沖廁、道路沖洗及公園噴水池、打水仗等活動之再生水用途。

表 9、芝浦水再生中心產製再生水之運轉管理值

工程	管理項目	原設計值	實際設定值
臭氧處理	溶存臭氧濃度	0.5 mgO_3/L	**0.3 mgO_3/L**
混凝	凝集劑注入率	68 mgPAC/L	**50 mgPAC/L**
	pH控制值	6.3	**6.8**
MF膜過濾	過濾流束	28 m/日	**4.2 m/日**
	水逆洗週期	1.5 小時	**2 小時**
	酸逆洗週期	3日(72小時)	**2次/週**
	次亞逆洗週期	7日(168小時)	**1次/週**
	藥品逆洗週期	3個月	**1年**

其中，芝浦水再生中心採用之 MF 陶瓷過濾膜的特性有：

1.機械強度大：內壓破壞強度達 2Mpa 以上。

2.高化學安定性：耐藥性及耐臭氧性高。

3.膜的更換周期長：膜的壽命高達 10 年以上。

4.高透水能力：過濾壓力低。

5.重複使用性：製膜材料具重複使用性

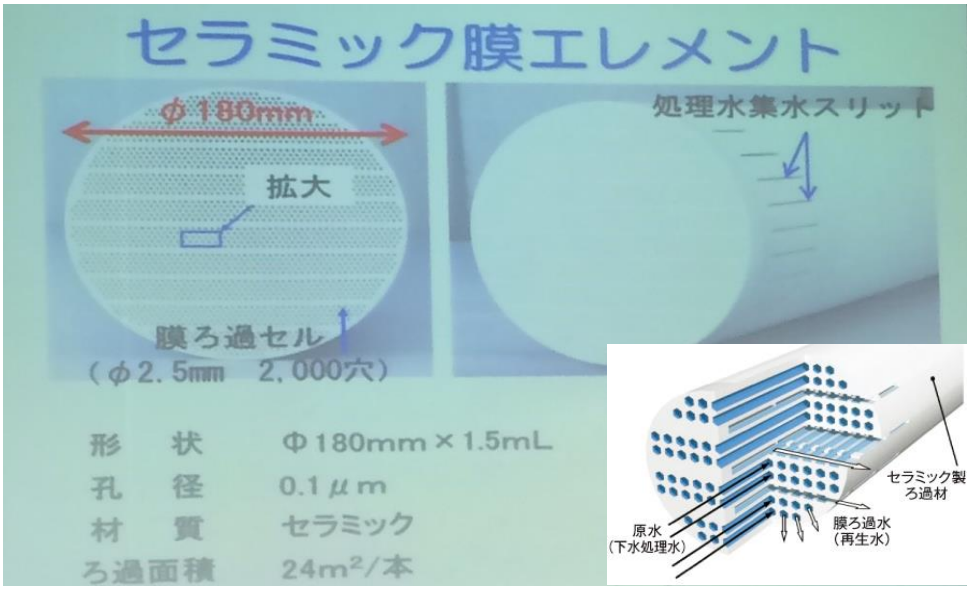


圖 21、芝浦水再生中心使用之 MF 陶瓷精密膜簡介

芝浦水再生中心之再生水處理過程，耗能比例分別為原水輸送 16%、生物反應 20%、臭氧處理 34%、MF 陶瓷精密膜過濾 25%、再生水輸送 5%。

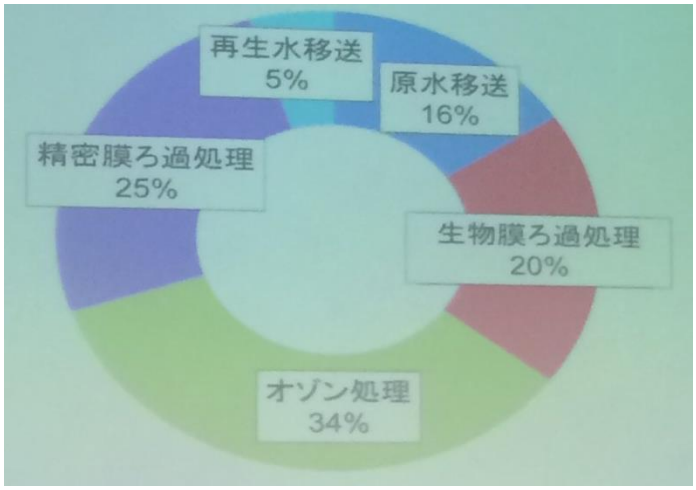


圖 22、再生水主要設備之耗能比率

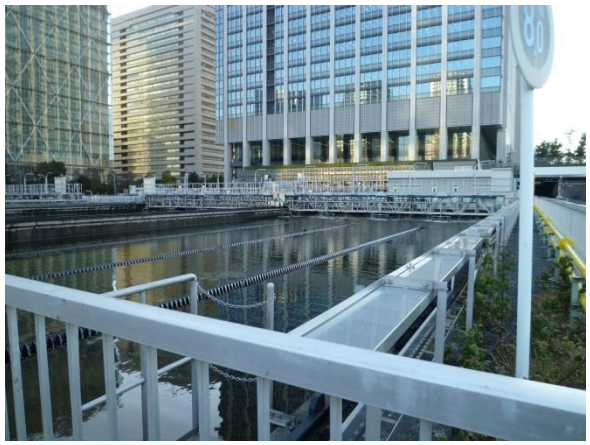
目前在東京都內之 3 處水再生處理中心，將污水通過高度處理後成為再生水，並使用於沖廁用水、街道灑水，及使河川清流復活等。就沖廁用圖之再生水供水範圍分為七大區及 189 個設施，供水量大約每日 1 萬噸左右。東京都下水道局藉由管理這 3 處再生水設施相關業務，對循環型社會作出貢獻。

表 10、東京都再生水利用情況

開始供水時間	再生水產水點	供水範圍	再生水日供水量
1984 年(昭和 59 年)	落合水再生中心	供應西新宿・中野坂上地区的高層建築物沖廁用水	3,600 m^3（2016 年實績）
1996 年(平成 8 年)	有明水再生中心	作為由台場地區，有明地區和青海地區等臨海副都心地區的廁所用水	2,300 m^3（2016 年實績）
1997 年(平成 9 年)	芝浦水再生中心	品川車站東邊地區	5,800 m^3（2016 年實績）
1998 年(平成 10 年)	芝浦水再生中心	大崎地區	
2002 年(平成 14 年)	芝浦水再生中心	汐留地區	
2007 年(平成 19 年)	芝浦水再生中心	永田町及霞ヶ関地區	
2008 年(平成 20 年)	芝浦水再生中心	八潮及東品川地區	

註：依芝浦水再生中心簡報及東京都下水道局網站資料增修

另外，雖然芝浦水再生中心須回收集污區之污水再進行處理，然參訪過程中，均未聞到特殊異味，甚至於水池中，亦多可見到悠遊的水鳥，顯示日本對於這方面之處理，亦十分注重。

照片 43 及 44、未封蓋之第二沉澱池中可見水鳥棲息

5.2 參訪「品川シーズンテラス」大樓

本參訪團於聽完接待單位之簡報後，緊接著被引領步行前往參觀建築於“芝浦水再生中心”內之「品川シーズンテラス」大樓。

圖 23、芝浦水再生中心與品川車站位置關係示意圖(摘自 Google Earth)

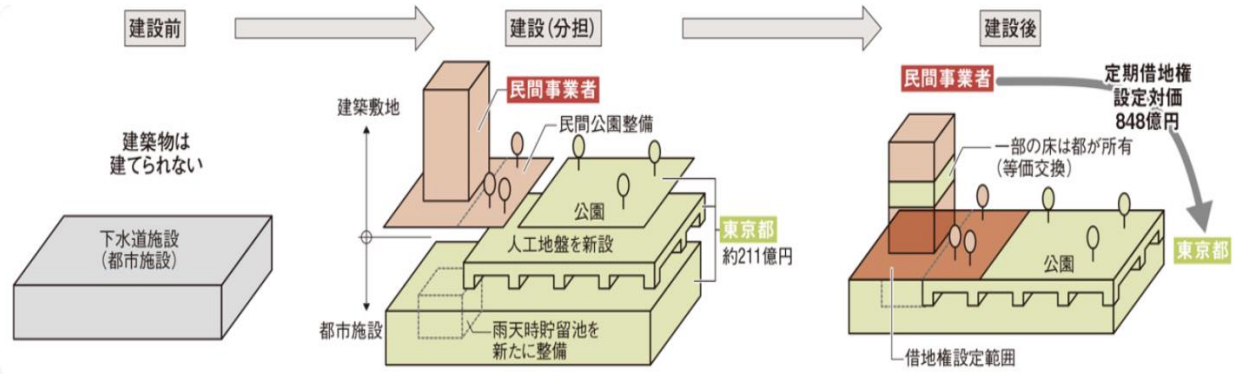
圖 24、芝浦水再生中心及「品川シーズンテラス」大樓鳥瞰(摘自 Google Earth)

“芝浦水再生中心”為 1931 年完工之污水處理設施，因為相關污水處理設施已經老化，必須加以改善以持續發揮其功能。同時，“芝浦水再生中心” 因位於品川車站旁，且為東京都稀有之大面積土地，該位置所在的港區，為配合羽田機場之國際化及新幹線車站之規劃而有其大量用地需求。因此，東京都政府決定採用 PPP 的方式，透過競標，與選定的民營企業合作，共同改造污水設施，並充分利用其地上空間，也就是以其優勢位置，提高土地之利用價值。

圖 25「品川シーズンテラス」大樓係委託株式会社 NTT ファシリティーズ(建築設計事務所)、NTT 都市開發、大成建設、日本水工設計等單位共同設計，建築施工部份則由大成建設負責，全案於 2012 年(平成 24 年)2 月開工，並於 2015 年（平成 27 年）2 月竣工(圖像摘自 http://shinagawa-st.jp/access/)。

本案於 2009 年（平成 21 年）決標，期限為 30 年，由 NTT 都市開発、大成建設、ヒューリック、東京都市開発及東京都下水道局等單位共同參與出資建設。

其中東京都下水道局所負擔的建設費用，包括在基地南側新設雨水貯留池費用 133 億日圓，及在既有下水道設施之上，新設人工地盤及公園設施費用 78 億日圓，合計投資 211 億日圓。



至於廠商設定地上權之得標金額為 848 億日圓(不含大樓建設成本)。惟依照契約這筆錢並非以現金支付，而是部份以等價交換(大約佔金額的一半)，由東京都政府擁有該棟建築物的部分比例，其餘的則在後續年度支付土地租金。東京都政府並將所獲配之辦公室出租，因此在第一個財政年度即賺取辦公室租金約 26 億日圓，並轉作為污水處理場營運費用的一部分。

這個計畫在基地的南側地面下新設一個可蓄存約 7.6 萬立方公尺之雨水貯留池，貯留池寬約 110 公尺，長約 84 公尺，高約 17 公尺至約 22 公尺，在其上方則建造了一個地上 32 層和地下 1 層之超高層建築，作為辦公室及商業等複合用途。其中大樓一樓至三樓以商業為主，目前共有 21 家商店，主要是餐廳。 5 樓以上的樓層為辦公室。辦公室標準樓層的面積約為 1,500 坪。大樓採用了隔震結構，亦配備儲水箱、緊急發電機等設施，其目標是即使在水電等生命線受到破壞的情況下也能保持 72 小時的部分建築功能。

為了承受上部荷載，雨水貯留池與高樓共構之基礎工程係使用高強度混凝土

材料資料來源：

http://www.nikkeibp.co.j

圖 27、大樓雨水貯留池資料照片(資料來源：東京都下水道局)

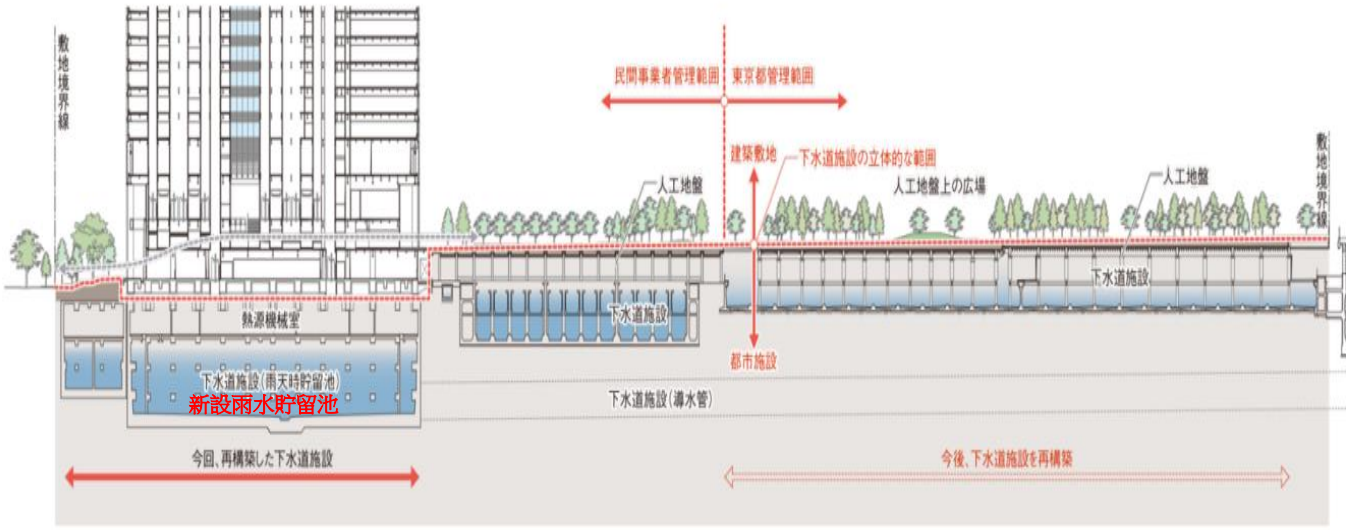


圖 28、基地布置之縱斷面示意圖

至於基地北側下水道設施之上則設置人工地盤，透過造景形成港區芝浦中央公園。其為連接到建築物的開放式綠地，除提供在都市內休閒遊憩與放鬆之空間，有助於抑制城市溫度上升，相關布置亦有考慮風從東京灣到武藏野台地的流動。

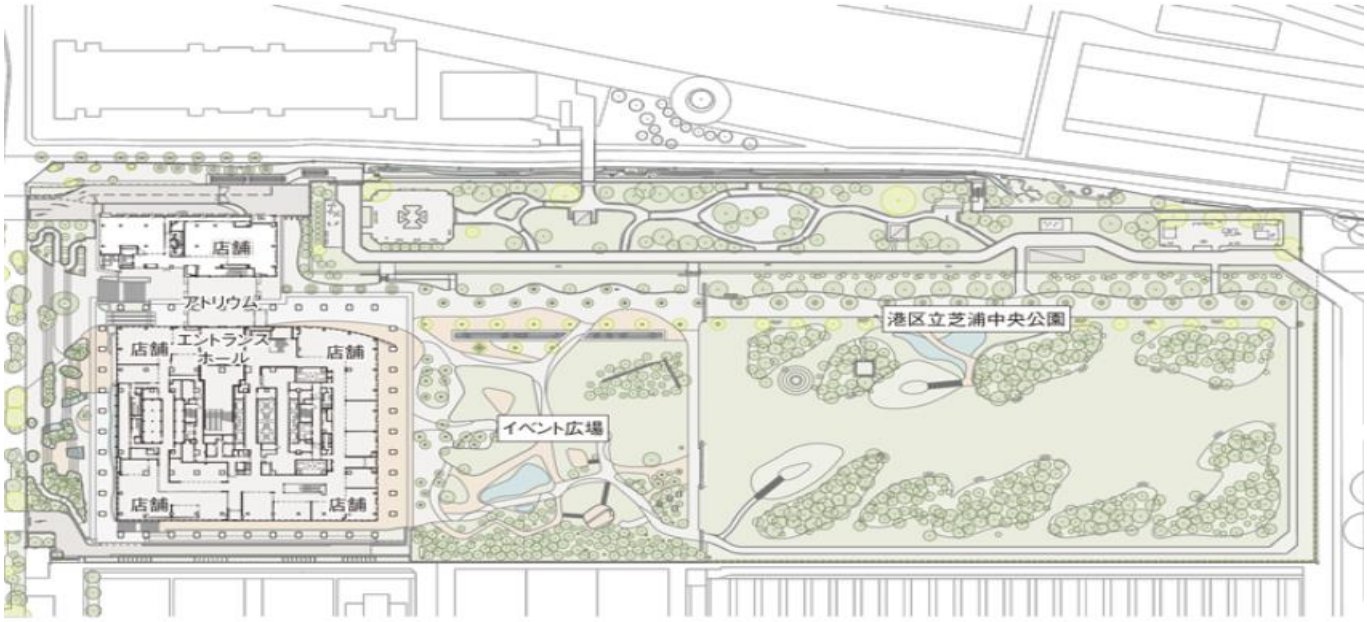
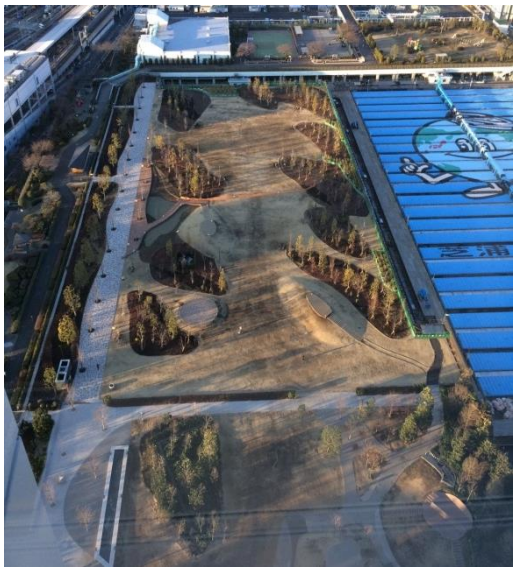


圖 29、從 2 樓高度鳥瞰大樓所在基地示意圖


照片 45 及 46、接待人員帶領參訪團從 1 樓看港區芝浦中央公園

照片 47 及 48、接待人員帶領參訪團從 25 樓鳥瞰港區芝浦中央公園

而這座高約 144 公尺的大樓也非常注重節能表現。每天在高樓的地下室收集污水並將其淨化後再生利用。高樓的最大特點是與下水道設施的更新一體化並加強開發上部空間。因此，本大樓也利用與污水處理場共構的優勢，充分利用污水溫度與外部空氣相比較為穩定之特點，將污水與大樓空調冷卻機組進行熱交換，進而免除一般須在屋頂興建冷卻水塔之經費，亦可減少將水加壓輸送至屋頂之能源消耗，發揮節能功效。

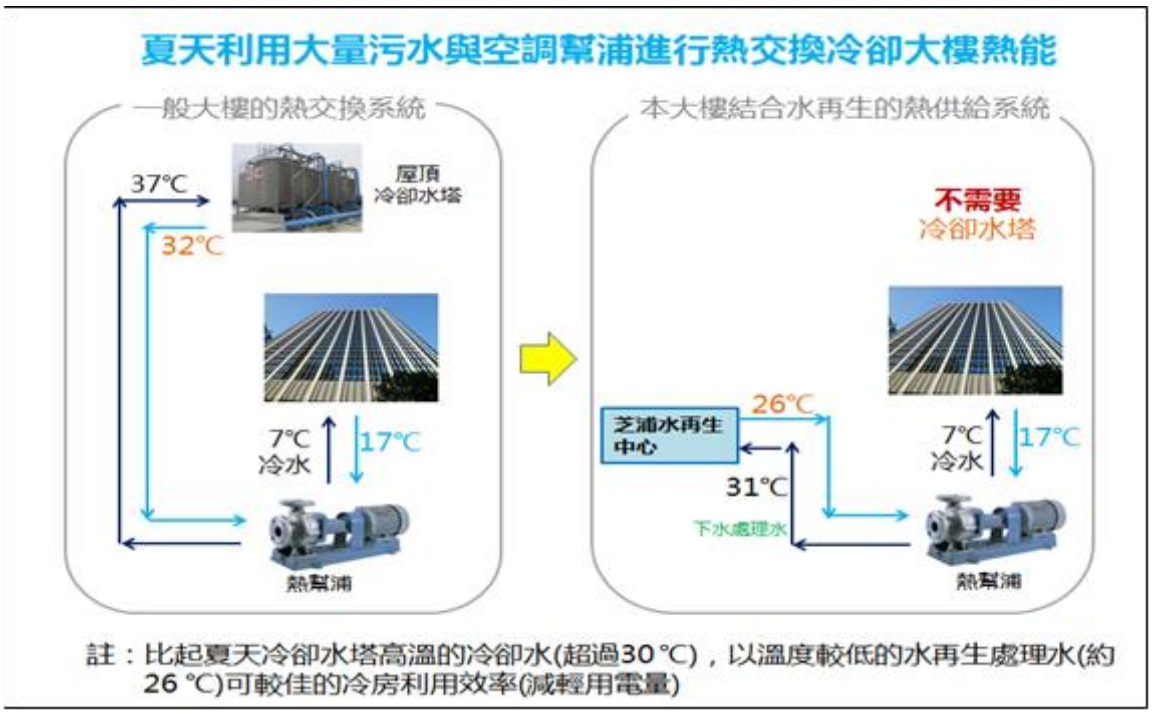


圖 30、大樓利用芝浦水再生中心之污水降溫而免設冷卻水塔原理示意圖

照片 2.35 及 2.36、接待人員於地下一樓說明大樓利用污水降溫節能方法

另本大樓透過安裝於屋頂之不同角度鏡子，將自然光線透過天井引至每個樓層來抑制照明燈具之使用。

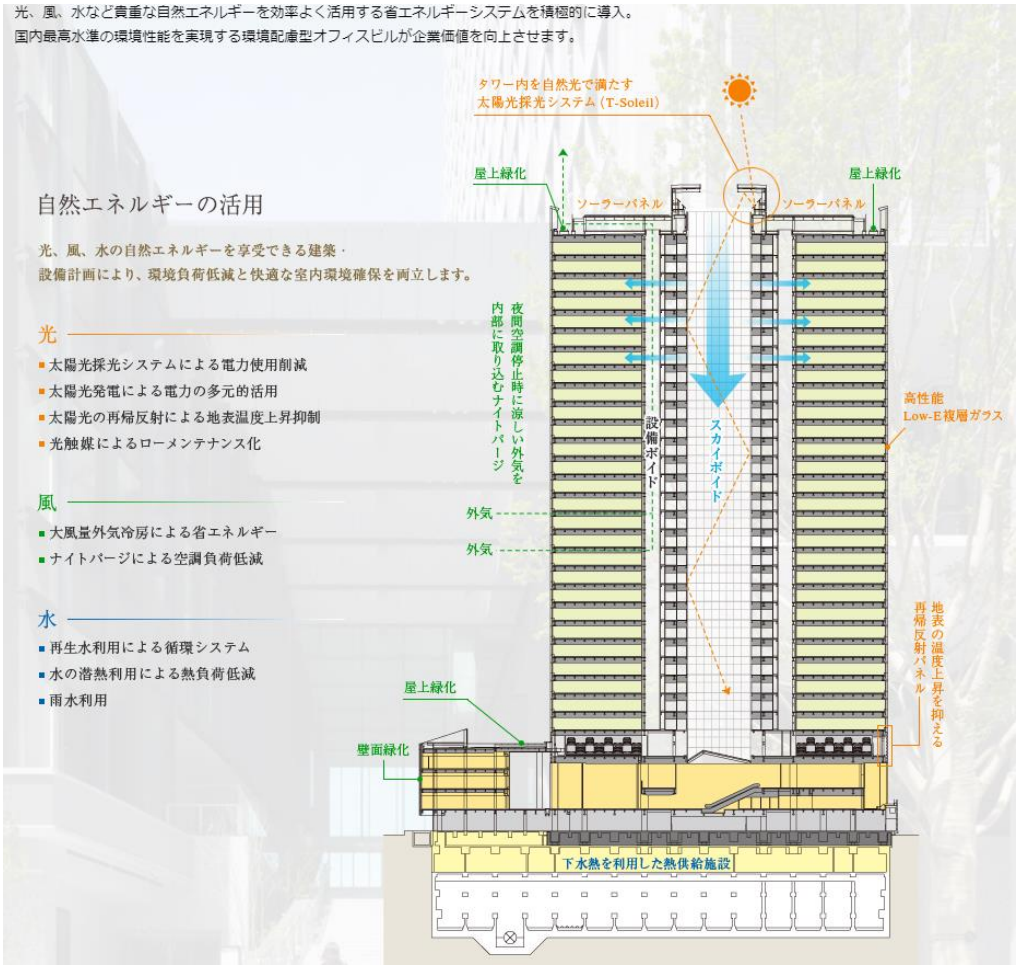


圖 31、大樓充分利用自然資源，節能省碳之相關說明(資料來源：http://shinagawa-st.jp/concept/)

照片 49 及 50、接待人員說明本大樓利用天井採光情形

綜合言之，「品川シーズンテラス」大樓係透過下水道設施更新之時機，進行公私合作，讓超高層建築和一個廣闊的公園出現在東京品川車站旁，使既有污水處理設施的地上空間獲得充分利用的機會，也增加政府收入，挹注於下水道設施之營運維護。為一成功之 PPP 案例。

三、 心得及建議

(一)心得：

1、主辦單位具研擬 APEC 手冊實力並利用主辦會議提升能見度

日本已累積多年品質良好之公共基礎建設實際經驗及案例，同時在國際間亦持續參與各國基礎建設，因此，由日本方面延續 APEC 於 2014 年提出之優質公共基礎建設指南版本加以修正及新訂針對水資源基礎建設指南，以全生命周期概念納入維護營運階段之重要元素，並分析比較傳統採購方法及民間參與公共建設機制之異同優劣，作為 APEC 各經濟體之參考，應能有效提升各經濟體之公共基礎建設品質，並達到 APEC 領袖會議共識中有關促進各經濟體間實體連結性之目的。

2、日本民間參與公共建設(PPP)發展日趨成熟

就本次研討會文件中，多次提到以民間參與公共建設方式(PPP)作為提升公共基礎建設品質及減輕政府財政負擔之途徑，會後日方安排參訪相關案例包括橫濱北部污泥處理中心、橫濱川井淨水場、東京芝浦水再生中心等三處民間參與公共建設成功案例，顯示日本陸續採用 PPP 作為相關公共基礎建設及營運管理方式，降低政府投入之成本，卓有成效，故能於一日可達之範圍內安排多個成功案例，亦顯示日本有足夠之經驗與案例，可供 APEC 各經濟體深入瞭解及順帶達到日方宣傳效果。

3、有助瞭解各經濟體公共基礎建設發展情形

各出席會議經濟體均以其自身公共基礎建設發展經驗提出分享，在深入瞭解後，也能提升我方視野及高度，例如現地參訪日本 PPP/PFI 模式成功案例，都是利用私人資金，管理技能和技術能力，來建設，維護和運營公共設施，可減輕政府財政負擔，提昇公共建設品質，提高公共資源使用效率，促進國家經濟及產業發展；對廠商而言，可進行多角化經營，提升企業形象，降低營運成本；對民眾而言，可提早享受公共建設服務，提升生活品質，創造就業機會，創造政府、廠商、民眾三贏局面。

(二)建議

1、持續參與 APEC 會議分享臺灣建設經驗及提升對我技術認同

APEC 會議或活動為我國與各經濟體官方交流互動的重要場合，我國透過技術專業積極參與 APEC 會議，應有助建立我方積極的正面國際形象，並促使 APEC 各經濟體進一步瞭解我國推動公共建設之臺灣經驗，增進與各方合作契機，也有助我國對國際社會作出貢獻之機會，以贏得相關各方尊重及認同，建議未來仍視相關主題爭取積極參與機會。

2、針對 APEC 研討會主題，建議組成跨領域代表參與

本次 APEC 研討會主題包括一般性基礎建設及水資源基礎建設，內容為建設計畫之政策形成、可行性研究、設計、施工、營運及維護等全生命周期，討論重點包括傳統採購及民間參與公共建設方式之比較，而本次我方出席代表為水利主管機關人員，針對水資源議題較為熟悉，若能邀請工程會或財政部促參司派員共同參與，將可大幅提升我方參與程度及分享我方採購或民間參與公共建設成功經驗。

附件資料

附件1、 APEC 優質基礎建設發展與投資指南修正草案 (APEC Guidebook on Quality Infrastructure Development and Investment (Revision))

Draft

APEC Guidebook on Quality Infrastructure Development and Investment (Revision)

Committee on Trade and Investment

As of February 20, 2018

APEC Project: CTI 06 2017S

Issued 2018

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APEC# CTI 06 2017S

Table of Contents

Glossary of Terms

Government:	Central government of the economy
Implementing Agency:	Government agency in charge of individual infrastructure projects such as ministries and local governments
LCC:	Life cycle cost or total cost of a project over its life which may include costs for design, construction, operation and maintenance
Local Government:	Governments of the sub-sovereign levels of the economy, including state, prefecture, city, and municipality
PPP:	Public-Private Partnerships or a modality of infrastructure project which utilizes various capacities of the private sector
PPP Project Company:	A private entity who carries out a PPP project based on a contract with an implanting agency
Public Agency:	Public organization of the economy, including ministries, agencies, regional governments, state-owned enterprises and other forms of public organizations
VFM:	Value of public expenditure for infrastructure project both in terms of quantity and quality

About This Guidebook

APEC economies expect rapid infrastructure development and investment growth in conjunction with their economic growth and urbanization. It is observed that some economies, facing budgetary constraints for infrastructure investment, fix their attention to minimizing initial capital investment cost in their project and service procurement. However, such practices have brought some unfavorable consequences such as (a) lack of long-term durability due to insufficient maintenance and operation, (b) unstable and intermittent delivery of service, (c) insufficient attention to prevention of and recovery from natural disasters, and (d) insufficient attention to protection of environmental and social safety.

In light of these circumstances, APEC Leaders' Declaration 2013 recognized the importance of ensuring "Quality of Infrastructure", that encourages APEC economies to pay more attention to quality aspects of infrastructure services such as (a) achievement of optimal LCC with considerations for service performance and durability, (b) mitigation of social and environmental impacts, (c) ensuring safety and maintenance. It was also recognized that APEC economies are encouraged to continuously carry out (d) capacity development for government officials to plan infrastructure projects in consideration of the above-mentioned factors.

Importance of ensuring quality of infrastructure has been recognized not only in the APEC regions but also in the world. The G7 Ise-Shima Summit 2016, to take an example, adopted G7 Ise-Shima Principles for Promoting Quality Infrastructure Investment which reaffirmed crucial importance for stakeholders to work coherently to bridge the existing global demand-supply gap of infrastructure investment by promoting quality infrastructure investment so as to promote strong, sustainable and balanced growth and to enhance resilience in our society. In fact, development of quality infrastructure is identified as one of the goals set in the 2030 Agenda for Sustainable Development Goals (SDGs 9.1) of the United Nations.

Against this background and recognition, this Guidebook articulates concrete approaches and procedures for implementing infrastructure projects based on common understanding and principles of quality infrastructure development and investment for government officials and stakeholders of APEC economies.

It is understood that each APEC economy has different policies, capabilities and experiences, and therefore, the Guidebook is also assumed to be used as a practical reference by the economies at different stage of economic and institutional maturity. Then, it will contribute to improving the capacity of government officials and quality of infrastructure projects.

Chapter 1: Quality of Infrastructure

1.1 Characteristics of Infrastructure Projects

Infrastructures are indispensable social basis for supporting business activities and people's daily lives in fields such as transportation (roads, railways, airports, and seaports), electricity, water supply and waste water treatment, and solid waste management. Infrastructure development is essential to promote sustainable social and economic development to meet basic needs of people, while achieving inclusive growth though job creation and poverty reduction. The general characteristics of infrastructure projects are summarized as follows:

a) Public Goods

Infrastructures are provided as public goods for the purpose of holistic development of the society. Public goods entails non-competitiveness and non-exclusiveness and "openness" (natures and universal access to services). Traditionally, infrastructure development is regarded as the role of governments where public fund is used as a primary funding source. In cases where private enterprises are responsible for a part or the whole of construction and operation of infrastructure projects, they are selected through fair and transparent public procurement process.

b) Externalities

Infrastructures not only provides benefits to its users but also influences the broader social economy. The latter effect is called external effect or "externality". Infrastructure development generates various ripple effects such as revitalizing regional economies through large public investment as well as improving regional productivity and creating new industries and employment in the medium and long term.

c) Extensive Impacts on Society and Environment

Given that infrastructure development entails large scale investment, it has far reaching influences over society. Its impacts may include both positive and negative effects: The former contributes to socioeconomic development, while the latter impedes the sustainability of local communities and environment. In order to prevent such negative impacts, it is helpful that international standards and practices are properly taken into account, especially with respects to social and environmental safeguards.

d) Long Project Life

Infrastructures provide services over long periods of time. The expected lifetime of infrastructure could be over 30 years in case of power generation plants and transportation facilities such as roads and airports. Therefore, "economy" and "fiscal soundness" as well as

physical durability need to be secured. At the same time, infrastructure needs to be resilient to disasters and flexible to climate changes from a long-term perspective.

e) Transparency and Accountability

In development of infrastructure projects, public funds and resources are often utilized. Thus it is imperative that planning and implementation (construction and operation) of projects by public agencies need to be "transparent" and accountable. In addition, infrastructure facilities are immovable and cannot be traded easily in the market. Therefore, once implemented, an infrastructure project cannot be canceled or postponed in principle.

1.2 Elements to Ensure the Quality of Infrastructure

In consideration of the characteristics of infrastructure projects which are addressed in the previous section, this guidebook defines the following five elements as the principle elements to ensure quality of infrastructure.

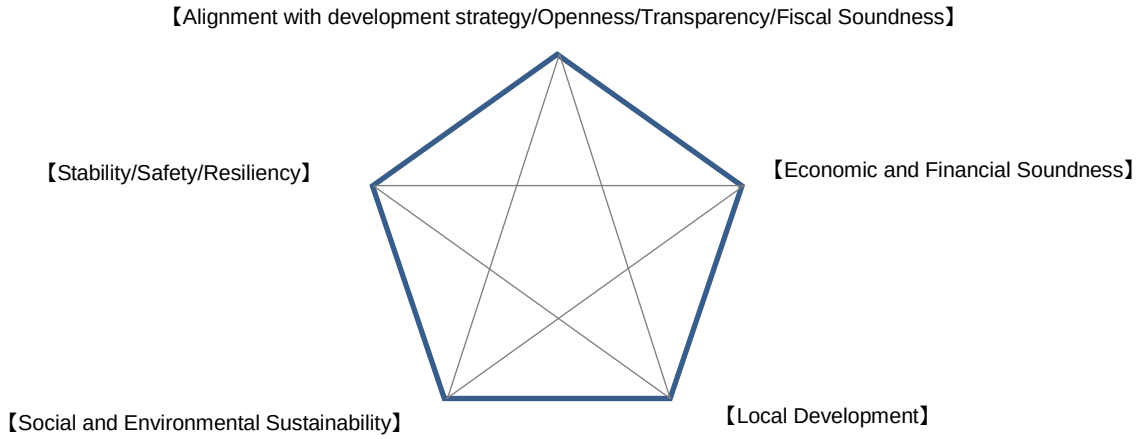


Figure 1 Five Elements that Ensure Quality of Infrastructure

● Alignment with Development Strategy/Openness/Transparency/Fiscal Soundness

Infrastructure projects shall be implemented in consideration of openness, transparency, economic efficiency in view of LCC and fiscal soundness as referred in the previous section. They shall be in line with medium- and long-term development strategies at national and regional levels, while holding dialogues with stakeholders from the early stages of projects such as project preparation and prioritization. In particular, careful attention should be paid to the following elements:

(a) Expansion of global supply chain through strengthening connectivity

(b) Use of state-of-art technology such as information and communication technology

(c) Attraction of private investment and development of new industries

(d) Development of mid-term development plan based on a long-term multi-sector demand forecast

(e) Assessment of debt sustainability and fiscal outlook

(f) Adoption of public procurement procedures based on international norms

(g) Openness in operation

(h) Transparency in infrastructure development

(i) Consideration of ecosystem and further promotion of green infrastructure

(j) Resilience to climate change

(k) Energy security and sustainability

(l) Conservation of biodiversity

(m) Disaster prevention

● Stability / Safety / Resiliency

In order to ensure stable, and continuous access to infrastructure for all people, appropriate measures should be taken in each process of project, i.e. planning, design, construction, and operation. For that purpose, reliable organization and human resources should be secured by the governments and/or private enterprises, together with sufficient project funds. It is also important to ensure safety by carefully assessing the risks of unforeseen events including natural disasters, terrorism, cyber-attacks and preparing measures to avoid or transfer those risks. Also, appropriate counter-mechanisms shall be designed and put in place to minimize negative impacts over the society, and ensure prompt resumption of infrastructure service provision when the above-mentioned risks are materialized. Deliberate preparation of such measures significantly improves overall resiliency of the society and economy.

● Economic and Financial Soundness: Cost-effectiveness including LCC and utilization of markets

In the project planning stage, it is important to verify cost-effectiveness of project to achieve Value for Money (VFM) of the infrastructure investment. With respect to the cost, it is indispensable to estimate not merely the initial investment but whole LCC of the project. With regard to the effectiveness, both quantitative and qualitative effects shall be examined taking account of external effects, which were mentioned in the previous section of this

guidebook. In order to "leverage" VFM of public investment, cooperation with MDB and other development partners, and mobilization of private funds through PPP are important and worth considering. To mobilize private funds, it is necessary to secure sound investable climate for private enterprises, while ensuring transparency and prevent corruptions. In the meanwhile, governments are required to verify their financial sustainability of the project, by checking and controlling fiscal status of the implementing agencies in charge.

● Social and Environmental Sustainability

Social and environmental standards applied to infrastructure projects shall be determined at appropriate levels with objective and numerical indicators. These targets should be reviewed continuously throughout the project life to ensure sustainability for future generations. It is expected that negative social and environmental impacts shall be avoided or mitigated through application of reliable safeguards procedures and standards which comply with international practices including those of MDBs. It is also important to promote green infrastructure to realize low-carbon society which can flexibly correspond to the progress of global warming and climate change. In terms of existing facilities, proactive rehabilitation and reinforcement are effective to prevent negative impacts of climate change.

● Local Development: Job creation / capacity building and transfer of technologies

Infrastructure projects, in general, are large in scale and bring significant impact on the development of surrounding regions and economies. In view of achieving inclusive and sustainable growth through infrastructure projects, it is desirable that projects are ultimately owned and operated by local resources. Bearing this in mind, infrastructure projects need to be the ones which are welcomed and/or accepted by the local community. It is also crucial to promote the local employment and establish conditions and schemes for job creation .In case the capability and the skill of local community are insufficient in the early stage of the project, it is worthwhile for the government to establish mechanism for capacity building and transfer of technology and know-how from medium- and long-term perspectives.

Chapter 2: How to Proceed Infrastructure Development

2.1 Methods of Infrastructure Project Procurement and Delivery

(1) Conventional Procurement and PPP

Public sector has traditionally assumed the primary role of developing infrastructure and provided public services to the people in many economies. However, in the last few decades, private sectors have been taking over the government's role by assuming a part or all of infrastructure development and service provision. Accordingly, methods of infrastructure project procurement have been diversified. It is expected that agency in charge of infrastructure project shall select the most appropriate method among them.

In traditional procurement, design, construction, operation and maintenance of a project are separately procured by implementing agencies. The project is financed by using public funding sources. On the other hand, in PPP procurement, some or all of the above works are lumped and entrusted to a single private entity, i.e. PPP Project Company. Also, various risks associated with project are transferred to the PPP Project Company based on a PPP agreement which is concluded between an implementing agency and a PPP Project Company. The primary purpose of adopting PPP procurement is to improve VFM of the public spending by taking advantage of capacities and innovation of private enterprises. This consequently causes provision of infrastructure with well-balanced between quality and quantity.

Now a days, PPP has been widely adopted across APEC economies and its effective use is expected for future projects in the region. However, PPP cannot be adopted by hands-free, and governments are responsible for creating and sustaining "PPP-enabling environment" through various efforts such as improvement of general investment environment, development of relevant regulatory and institutional frameworks, implantation of capacity development of public officials with regard to new procurement methods and contract management.

(2) Characteristics of PPP

There is no single clear-cut definition of PPP and the modalities in fact are various. Typical features of PPP include appropriate risk-sharing between public and private sectors, collective procurement, long-term contract, output specification, as well as performance-based incentives. The essence of these features are summarized below.

- Appropriate risk-sharing between public and private

  Risks which private sector can manage better than public sector are transferred to private sector based on a general understanding that "A risk should be borne by those who can best manage it". Specific risk-sharing is determined and stipulated in PPP agreement which is concluded between a government implementing agency and PPP Project Company.

● Collective procurement

Some or all of project-related works such as design, construction, operation, maintenance, and financing are entrusted collectively to a single private entity namely, PPP Project Company. In particular, by combining of design, construction and operation works, it is expected that various innovations by private sector are forged and they contribute to improve VFM; optimal project design is made, efficiency of construction is improved, and flexible and appropriate operation and maintenance are carried out, and high-quality services are provided in a seamless manner.

● Long-term contract

PPP projects, not like conventional projects, usually adopt multi-year contract. This mitigates government's annual fiscal constraints and helps ensure stable provision of public services both in terms of quantity and quality. Private sector is expected to prepare and implement medium- and long-term maintenance and rehabilitation plan irrespective of government's fiscal status of every year, which also leads to stable service provision as well as optimization of LCC.

● Output specification

PPP agreements specify services (outputs) required by implementing agencies and quantitative Key Performance Indicators (KPI) are stipulated, while minimizing input specifications related to facilities and equipment. This ensures governments to appropriately procure services that are truly required by people or enterprises. This also avoids "gold-plating" of projects and helps to achieve optimal LCC.

● Performance-based Incentives

Revenues of PPP project companies are properly linked to their performance, i.e. quality and quantity of services as well as its availability. It enables to avoid moral hazards of private enterprises and gives incentives to continuously deliver required services. It can even has a function to encourage private enterprises to proactively make effort to improve quality of services. Incentive mechanisms, including performance evaluation criteria and procedures are stipulated in PPP agreement.

The table below summarizes the key differences between conventional procurement and PPP.

Table 1 Typical difference between conventional procurement and PPP

Feature	Conventional Procurement	PPP projects
Risk Sharing	Limited risk sharing (public sector bears risks)	Appropriate risk sharing between public and private
Procurement Package	Separate procurement	Collective procurement
Contract Period	Single-year contract	Multi-year contract
Specification	Input specification	Output specification
Incentive	Non performance-based	Performance-based

The basic idea of the PPP is to provide incentives to private sector to create innovation and to enhance VFM by adopting some or all of the features above.

It is widely recognized that these features of PPP, in fact, can also be adopted in conventional procurement. There are also hybrid models of conventional procurement and PPP, like DBO (Design-Build-Operate), where public sector procure financing while entrusting all other works to a private entity. It is advised, therefore, all these features should be appropriately considered regardless of project modality and procurement type. It is expected that public agencies also make efforts to create innovation in its infrastructure procurement through trial and errors.

(3) Classification of PPP

PPP can be simply categorized based on contract type which stipulates revenue sources of PPP Project Company; these are concession, off-take, and availability payment. It is important to correctly understand differences and features of these modalities and proper select the best option which incorporates uniqueness and characteristics of independent projects.

● Concession

A concession is given to a PPP project company based on a PPP agreement. PPP Project Company constructs project facilities and provides services to end-users. PPP Project Company receives fee/tariff directly from end-users as its own revenue. This modality is typically seen in toll roads and airports. PPP Project Company bears demand risk in principle. There are cases that government's fiscal support is provided to a project to secure its financial viability; this kind of mechanism is widely recognized as Viability Gap Funding (VGF).

● Off-take

PPP Project Company constructs project facilities and produces and delivers products or services to implementing agencies in accordance with PPP agreement. The revenue of PPP

Project Company is purchase payment by implementing agencies, not fees\tariffs from end-users. This modality is commonly adopted in power generation and water supply projects. Implementing agencies are responsible for delivering the products and services to end-users and therefore, implementing agencies bear primary demand risks.

● Availability Payment

PPP Project Company construct the project facilities and provides services defined in a PPP agreement directly to end-users however, it does not collect fees\tariffs as its own revenue. Implementing agency pays service fee called "Availability Payment", depending on availability of the services. This modality is typically adopted in social sectors such as schools and hospitals. Implementing agencies bear demand risk in principle. Performance of PPP Project Company is carefully monitored and evaluated by implementing agencies in charge. Amount of Availability Payment can be adjusted based of the performance of PPP Project Company.

2.2 Considerations to Ensure the Quality of Infrastructure in Each Stage

(1) Overview of life cycle of infrastructure project

This section explains life cycle of infrastructure projects and items to be considered at each stage of the cycle to ensure the quality of infrastructure. Figure 2 depicts a typical life cycles of infrastructure project with actions to be taken by implementing agencies.

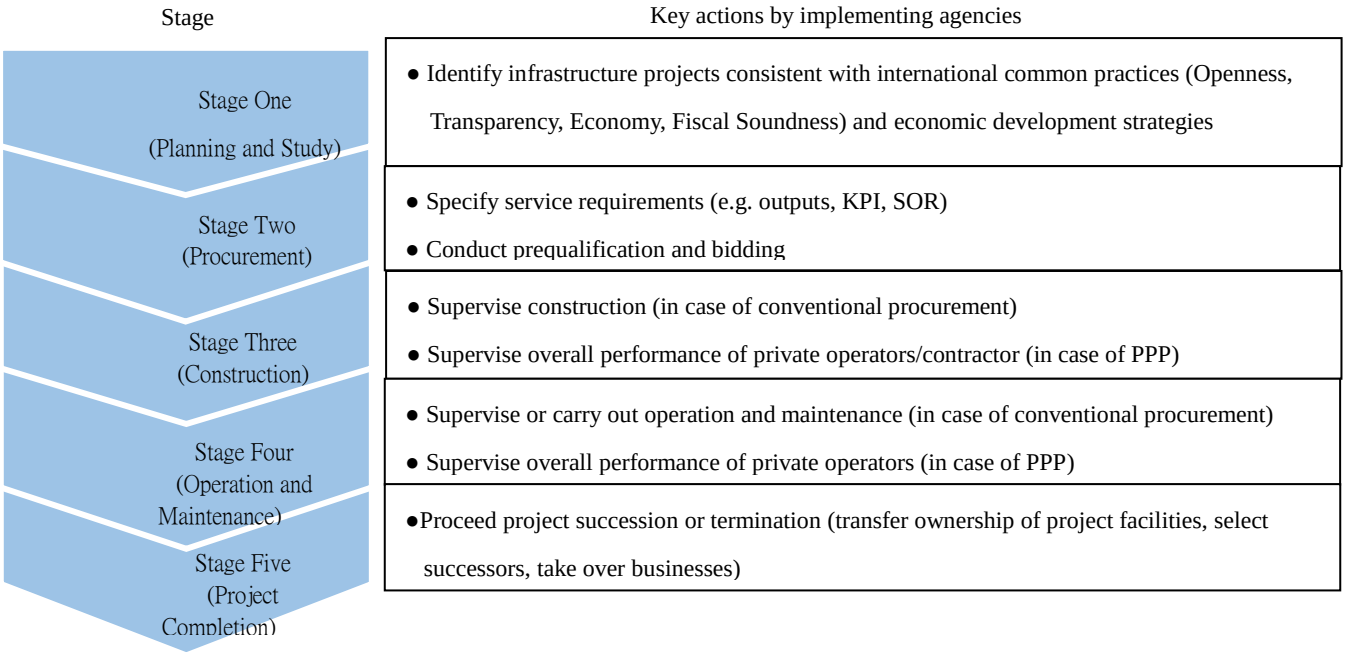


Figure 2: Infrastructure Project Stages and Key Actions by Implementing Agencies

In Stage One, project planning and feasibility study are the key actions to be taken by implementing agencies. Necessity and effects of the project should be verified. Then scope of

work, technical requirements, project modality, schedule, funding sources should also be studied. It is particularly important to (a) identify specific infrastructure projects which meet international common practices (Openness, Transparency, Economy, Fiscal Soundness) in line with its own development strategy, (b) implement feasibility studies, including VFM verification and (c) examine funding sources.

In Stage Two, private entities that implement some or all parts of the project are selected. Generally, prequalification (P/Q) and bid, including evaluation of proposals, will be conducted to select the best proponent as the preferred bidder to negotiate and conclude a contract. Although the process may vary depending on types of projects, the entire procedure must ensure fairness and transparency.

In Stage Three and Stage Four, design, construction, operation, maintenance of the project are carried out. Design and construction of project facilities are commonly entrusted to private sector. As for operation and maintenance, implementing agencies either conduct by themselves or entrust to private sector. In the latter case, implementing agencies should manage contracts and supervise overall performance of the private operator.

In Stage Five, where the project reaches its closure, project asset transfer of project asset, selection of successive operator, and operation taking-over of operation procedure should be carried out. It is necessary to properly implement these procedures so that it does not affect stable supply of the infrastructure service. Also, it is desirable to conduct ex-post evaluation of the project to draw lessons learned.

(2) Practical Considerations in Each Stage

[Stage One: Planning and Study]

- Identify infrastructure projects consistent with international common practices (Openness, Transparency, Economy, Fiscal Soundness) and economic development strategy

It is a prerequisite for formulating individual infrastructure projects that the projects are consistent with international common practices with particular attentions to Openness, Transparency, Economy, and Fiscal Soundness. It is also necessary for governments and public agencies to develop a medium- and long-term cross-sectorial economic development strategies. Master Plans that defines medium- and long-term strategy in each sector and sub-sector can enhance effectiveness of the infrastructure. Each infrastructure project should be contextualized within these strategies and master plans. Among the projects identified in those plan, project preparation and related studies are carried out in consideration of the priority.

- Implement Feasibility Studies (FS) including VFM verification

FS examines feasibility from technical, economic, financial and legal perspectives. Typical items to be considered in FS are shown in the following table.

Table 2 Typical Items to be Considered in FS

Item to be considered	Contents
1. Alignment with policies and regulations	Confirm alignment with government policy, development strategy, related laws and regulations
2. Location and natural environment	Identify project locations and surrounding natural conditions
3. Demand forecast	Conduct demand forecast with regard to the infrastructure services
4. Basic technical requirements	Examine required functions, scale and specification of the project assets
5. Cost Estimation	Estimate life cycle project costs including land acquisition, construction, operation and maintenance etc.
6. Economic efficiency from LCC perspective	Examine social and economic benefit to be generated by the project from LCC perspective
7. Profitability	Examine profitability of the project based on cost estimation and demand forecast
8. Project method and funding	Examine project method and funding sources including VFM verification
9. Environmental and Social Impacts	Assess environmental and social impacts of the project and consider its countermeasures
10. Schedule	Develop detailed implementation schedule and action plan

In the first step information collections and its analysis should be conducted with regard to items such as project location, natural environment, existing facilities, and future demand for the service as basic data. Then, basic technical requirements of the project asses are considered. FS also explores project modalities such as conventional procurement or PPP and funding sources at this stage (see the next section for details). When implementing agencies face difficulty in securing sufficient human resources to implement FS by their own, use of external resources such as private consultants should be considered.

● Examination of project modality and funding sources

It is essential to study project modality and funding sources in FS. They should be selected

based on VFM consideration from the viewpoint of government and taxpayers. Typical modalities are conventional procurement and PPP which has further variations. The scope of work of private sector and funding sources should be carefully examined. For example, funding sources can be government budget (tax revenue, bonds), ODA (multilateral, bilateral), private finance and combination of these. It is also necessary to examine fiscal sustainability of government in relation with project budget preparation.

【 Stage Two : Procurement 】

● Specification and Incentive Mechanism

Implementing agencies should define specifications such as required services (outputs) and standards both in quantity and quality. It is also important to properly stipulate them in the contracts to be closed between public and private. Clear definition of the standards as part of contracts will ensure smooth implementation of quality project as well as quality of service. In case performance-based payments mechanism is adopted, appropriate evaluation procedures and incentives, including penalties, such as revenue reduction due to under-performance and contract termination due to extreme defection should be incorporated in order to maintain performance of private operators.

● Pre-qualification and Bidding

This process consists of two stages: pre-qualification stage and bidding stage (evaluation an award of proposals). Criteria of review and evaluation may differ by project, however, fairness and transparency should be always secured in the whole transactions. Reference to international procurement rules and guidelines (e.g. WTO Government Procurement Agreement, World Bank Procurement Guidelines) should be made as necessary.

In those stages, appropriate review and evaluation criteria should be determined by taking account of the purpose and nature of the project. The review and evaluation should be conducted on objective grounds; it is important to carefully review track-records of applicants including its performance and evaluation by the clients. Testimony or certification by a third party or public authority can also be good evidence to evaluate the real track-records of the applicants. It should be noted that too strict requirements can be obstacles for new comers in the market and it may eventually undermine sound competition. It is critically important to strike a balance between required qualification and competition.

[Examples of pre-qualification criteria]

- Number of experience of undertaking the similar projects in terms of scale and technology
- Track records and third-party certification which proves performance of those
- Good track-records and/or representation letter in terms of environmental protection

and safety

After pre-qualification, proposals from pre-qualified bidders are submitted and evaluated. Comprehensive evaluation should be made which examines both quantitative and qualitative aspects. The technical evaluation should include appropriate criteria that ensure the quality of infrastructure described in Chapter 1. It should also ensure objectivity and transparency to avoid arbitral and subjective judgment. As the results, a preferred bidder, which has obtained the highest score in the evaluation is determined and publicly announced.

【 Example of Evaluation Items: Water Processing Facilities】

Quality Evaluation (50 points)

1. Durability of facilities
2. Schedule
3. Capacity for flexible responses to seasonal changes in quality and quantity
4. Flexibility in problem management
5. Feasibility of future extension
6. Stable plant capacities in accordance with guidelines defined by the local government
7. Principles to avoid financial risks
8. Operator's financial security for the period of construction and operation (financial sources, scope and period of guarantee)
9. Security against environmental risks (financial sources, assurance, warranty, etc.)
10. Financial planning
11. Contribution to the local community and the national economy through local procurement, employment and technology transfer
12. Independence against bribery of public servants

LCC Evaluation (current value after risk adjustment) (50 points)

- LCC (including design, construction, operation, renewal fee)
- Adjustment according to risks of the employer

● Contract Closure

The procedure for contract closure should commence swiftly after the selection and award of the preferred bidder. In the contract negotiation, it is not allowed to change substantial parts of bidding conditions and specifications presented by the implementing agency in the bidding stage, in consideration of fairness and equality among bidders. Given that precondition, it is important to (a) verify the details of proposal with the preferred bidder, (b) listen to their questions, clarifications, requests and suggestions, and (c) appropriately reflect the results of the discussion in the contract. It is not easy to amend the contract once closed and therefore,

details of the contract and its provisions should be thoroughly examined at this stage. The contract should be signed after each party fully understood and agreed with the contents. Particularly in case of PPP projects, coordination with financial institutions is required and sufficient time allowance should be secured to complete necessary procedures satisfactorily.

【 Stage Three and Four : Construction, Operation and Maintenance】

● Project Supervision

Selecting private entity and entering into contract with it is not end of the story. Both in conventional procurement and PPP, the implementing agencies are responsible for supervising implementation of the project in construction and operation stages to assure the quality of infrastructure and its services. Regular performance reports should be submitted from the private entity to the implementing agencies in charge and the project status should be property grasped. In case any problem is found, implementing agencies should provide instruction and guidance to the private entity to remedy it as appropriate.

● Role of Implementing agencies in PPP

In PPP projects, roles and risks are allocated between implementing agency and PPP Project Company. Implementing agencies are typically responsible for acquisition of land, coordination between government officials, issuing licenses, financial support to the projects, and other roles which private cannot fulfill. It is essential for the implementing agencies to take responsibility in these roles while monitoring the performance of private operators.

【 Stage Five: Project Completion 】

● Project succession

In case operation of the project is entrusted to private operators, ownership of the project asset is transferred from the operator to the implementing agency with appropriate inspection on the condition of the asset. If the implementing agency determines to entrust the operation to a private entity, a successor to the existing operator should be selected with sufficient time allowance. The selection process ensure transparency and efforts should be made to realize competition among several candidates.

● Ex-post evaluation

In the end of the project life, it is important to conduct an ex-post evaluation. It should cover quantitative achievements such as actual LCC and other environmental effects as well as qualitative achievements such as compliance with and deviation from the original plan and requirements. The implementing agencies in charge are responsible for conducting the evaluation to draw lessons learned for future projects.

Chapter 3: Expected Initiatives by Governments

3.1 Governance and Project Management Body

Effectiveness of infrastructure projects can be assured only when the government and project implementing agencies demonstrate effective governance. Governance by public agencies affects various aspects of a project such as scope of work, schedule, service standards, funding, and financial sustainability. Public agencies are required to demonstrate effective governance in procurement and management of infrastructure projects in line with economic development strategy and properly stipulated legal framework.

In the stage of planning and study, presence and role of a focal unit is essential for planning appropriate infrastructure development, clear mapping of individual projects in the development plan, and coordination among stakeholders including determination of funding sources. In case of PPP, it is desirable to establish an inter-ministerial project steering platform with sufficient expertise and capacity on selecting project methods, funding and legal issues including contract management.

In the stage of implementing infrastructure projects (construction, operation and maintenance), it is important for the implementing agency to secure sufficient personnel resources, skills, and budget. The management team needs to have technical capability, expertise and skills in procurement, financing, evaluation, legal affairs, and contract management. Especially in case of implementing PPP projects, high expertise and experience is essential with respect to operational methods, financing, and contract management.

3.2 Preparation for Mobilizing Private Funds

In PPP projects, investors and financiers are assumed to manage various risks such as credit risks of the implementing agency, political risks and demand risks. Also, foreign exchange risks, together with inflation risks, cannot be ignored by foreign entities. It is important to comprehensively understand these risks at the early stage of the project. Then, these risks should be appropriately allocated among the stakeholders to avoid or mitigate the risks to secure bankability of projects, which will result in achieving VFM. Although the risk allocation depends on political and economic situations of each economy, it is meaningful to learn the risk mitigation measures and risk allocations of PPP projects in the other economies.

3.3 Human Resource Development

Regardless of project methods, human resource development of government, implementing agencies and local communities, is an essential to ensure the quality of infrastructure. It is expected that each economy should plan and implement capacity building of its human

resources continuously. In case the economy does not have sufficient capacities, cooperation with other economies including capacity development and technology transfers is worth considering.

附件2、 APEC 優質水基礎建設指南草案綱要簡報 (Overview of the draft APEC Guideline for Quality Water Infrastructure)

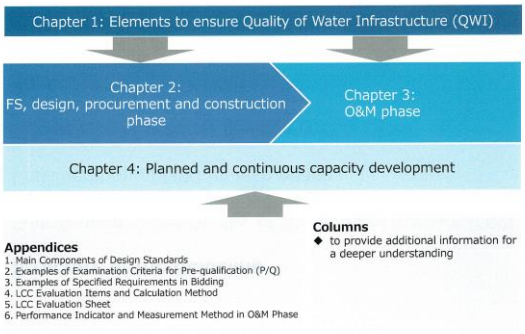
Overview of the draft APEC Guideline for Quality of Water Infrastructure

February 28, 2018

Proposed by Ministry of Economy, Trade and Industry, The Government of Japan

Contents

Structure of the Guideline



Background and Objectives

Background

- ◆ Urban water demand is increasing in the APEC region due to rapid population growth and economic growth, along with the resulting wastewater quantity and pollution load on the water environment.
- ◆ An adequate and stable water supply and appropriate wastewater treatment have important effects on living standards and economic activities.
- ◆ Securing an adequate and stable water supply and ensuring appropriate wastewater treatment are among the most urgent and important challenges for every APEC economy.
- ◆ In a joint statement in November 2017, the APEC ministers expressed that they welcome advances in ensuring the quality of infrastructure and agreed with upgrading of existing APEC Guidebook on Quality Infrastructure Development and Investment.

Objectives

- ■ To give readers a deeper understanding of how water infrastructure is planned, built, and operated
- ■ To share case studies related to water infrastructure among readers
- ■ To provide readers with useful suggestions on methods for securing the quality of water infrastructure

Scope/Target and Intended Readers

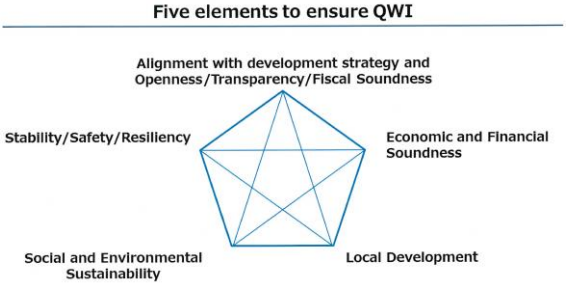
Scope and Target

- ◆ This guideline focuses mainly on water treatment plants and wastewater treatment plants in urban areas.
- ◆ This guideline provides the basic approach, performance indicators, and evaluation methods and metrics.
- ◆ The basic approach is applicable to all kinds of water infrastructure facilities (e.g. on site treatment systems, pipeline networks, industrial facilities) as well.

The primary intended readers of this guideline

- ◆ Regional government organizations and private enterprises that handle water and sewerage projects in each economy
- ◆ Policymakers at central governments related to water infrastructure investment
- ◆ Private sectors that supply goods, services, and financing for water and sewerage projects, and other stakeholders

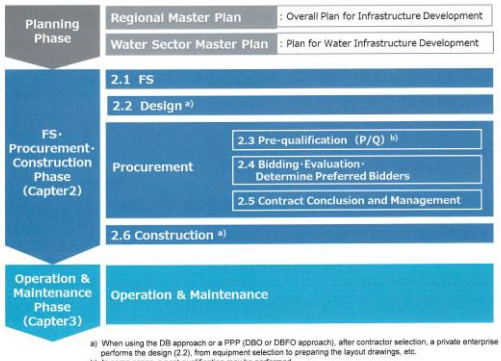
Five elements to ensure QWI



Five elements to ensure QWI

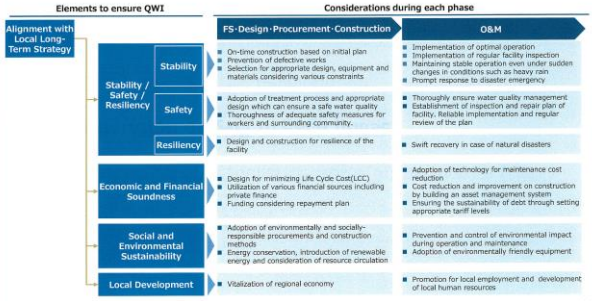
Five elements to ensure QWI	Details
1.Alignment with Development Strategy and Openness, Transparency, Fiscal Soundness	• Alignment with economic and development strategies and environmental strategies • Making effective use of the capital, technology, and expertise of private company • Communication with local residents • Coordination with administrative entities
2.Stability/ Safety/ Resiliency	• Ensuring stability in each process • Providing safe water infrastructure services • Ensuring resiliency in order to minimize the negative effects caused by various risks
3.Economic and Financial Soundness	• Cost effectiveness including life-cycle cost (LCC) • Use of diverse financing including private sector funds • Debt sustainability
4.Social and Environmental Sustainability	• Preventing environmental damage • Coexistence with the local community
5.Local Development	• Job creation • Capacity building • Transfer of technology and expertise

Phases of water infrastructure development

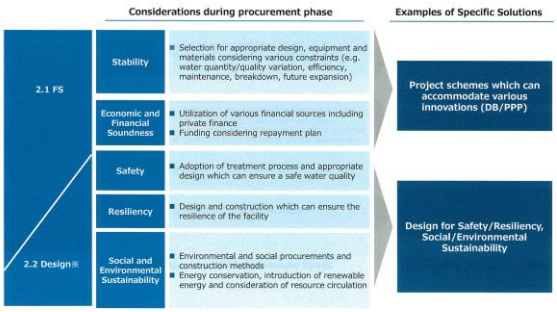


a) When using the DB approach or a PPP (DBO or DBFO approach), after contractor selection, a private enterprise performs the design (2.2), from equipment selection to preparing the layout drawings, etc.
b) In some cases, a post-qualification may be performed.

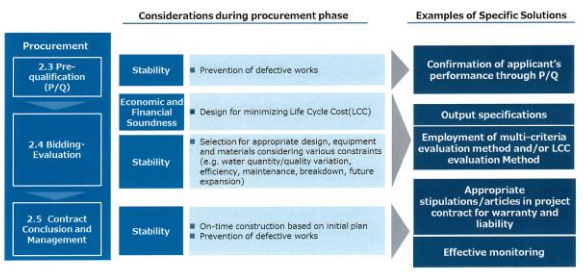
Considerations of QWI during each phase (Summary)



(Chapter2) Considerations during FS/Design phase and examples of specific solutions



(Chapter2) Considerations during procurement phase and examples of specific solutions

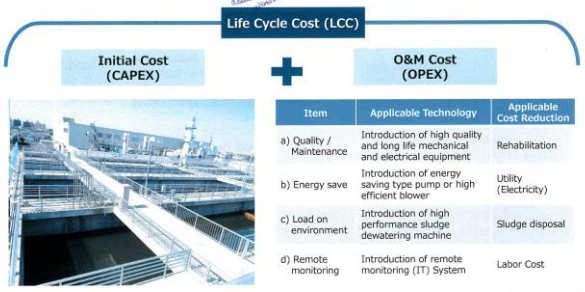


Prequalification (P/Q)

Items	Examples of P/Q requirements	Examples of certification
(a)Experiences & Credentials	Credentials which include construction (and operation) with similar scale and performance	Copies of contracts, Certification from clients and/or official letters from clients which prove their performance
(b)Capabilities for product and construction	Evidence of capabilities which includes factories to produce the products and construction facilities with similar scale and performance	Certification issued by governments of official agencies, ISO certification
(c)Financial robustness	Financial statements with positive earnings in past 3 years	Audited financial statements
(d) Performance credentials	Evidence of the performance of the products (e.g. actual credentials of durability after the earthquake (Magnitude XX))	Certification and/or official certified letters from clients

LCC Evaluation:
A methodology to secure the quality of the service

◆ Life Cycle Cost (LCC) evaluation, which take account of not only initial cost but also operation and maintenance cost, is one of the effective mean to maximize the Value for Money.



Item	Applicable Technology	Applicable Cost Reduction
a) Quality / Maintenance	Introduction of high quality and long life mechanical and electrical equipment	Rehabilitation
b) Energy save	Introduction of energy saving type pump or high efficient blower	Utility (Electricity)
c) Load on environment	Introduction of high performance sludge dewatering machine	Sludge disposal
d) Remote monitoring	Introduction of remote monitoring (IT) System	Labor Cost

Basic Components for LCC Evaluation

Items for LCC Evaluation

Cost Items		Costs Included
CAPEX	Design cost	—
	Procurement and construction costs	Preparation costs (Survey, ground leveling, fund procurement, insurance, offices and storage costs, safety and hygiene)
		Construction (Civil engineering and construction, machinery, electrical)
		Trial runs
OPEX	Fixed costs	Power costs
		Renewal costs
		Maintenance and repair costs
		Labor costs
	Variable costs	Power costs
		Chemical costs
		Waste disposal costs
	Inspection requirements	—
	Others	—

16

Evaluation Methods

	Cost-oriented evaluation	Comprehensive evaluation
Subject	Cost Only (Bidder who propose the least cost wins)	Financial and Technical (Bidder whose score of the sum of financial and technical aspects is the highest wins)
Project Cost	Unusually low project cost, which is lower than the client assumption, may be proposed under the highly competitive environment	Project cost is based on the bidder's proposal. Creativity and ingenuity of private sector may reduce the project cost
Quality	Significantly lower bid may lead to difficulty in securing quality	The project cost is based on the proposed technology by the bidder. Thus, quality of the works shall be secured
Difficulty in Evaluation	Easy since evaluation focuses on cost only	Expertise in evaluation of proposed technology required
Transparency	High due to quantitate evaluation only	Transparency may not be secured since arbitrariness may work in evaluation of technical proposal

17

Appropriate differentiation of input and output specifications

◆ In "Input Specification" method, since clients sorely check whether the bidders' offer match to the specifications or not, securement of performance cannot be guaranteed.
◆ "Output Specification" method allows the details of operation, design and construction methods to private sector. The maximization of Value for Money can be expected through bidders' creativity and ingenuity.

	Input Specification	Output Specification
Scope of Works	Limited scope (e.g. fuel or chemicals may be supplied by public sector)	Comprehensive scope (collective order including operation and maintenance etc.)
Creativity and ingenuity of private sector	Limited (e.g. the number of staffs is fixed in the specification and reduction of man power may not allowed.)	Flexible (e.g. number of staff for operation is based on the proposal by the private sector, thus Enhancement of efficiency can be expected.)
Risk Share	Responsibility for satisfying the specification, not for performance	Responsible for performance

18

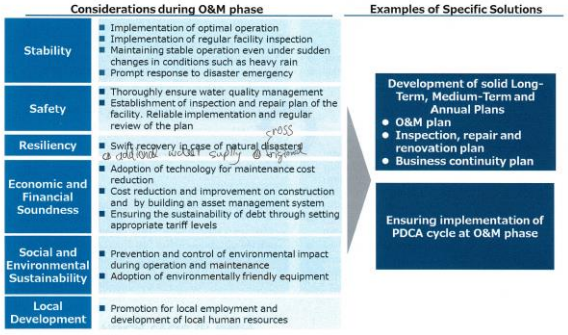
(Chapter2) Considerations during procurement phase and examples of specific solutions

Examples of construction management with QWI consideration

- safety of the neighboring residents
- occupational safety measures for worker's safety
- construction schedule which is fully taken into account local conditions such as meteorology
- various anti-pollution measures including air pollution, noise, vibration, water pollution (turbid water) etc.

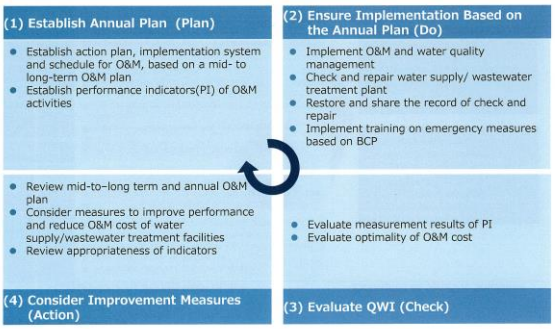
19

(Chapter3) Considerations for O&M and examples of specific solutions



20

(Chapter3) PDCA cycle in O&M



21

22

(Chapter4) Planned and continuous capacity development

Items	Content of Capacity Development
Financial	• Finance/accounting knowledge • Knowledge about funds procurement • Knowledge about tariff estimation and cost calculation
Technical	• Basic technical knowledge about water treatment • Design capacity, process management • Mastery of operating methods and knowledge of maintenance • Knowledge about disaster and accident response
Management	• Securing compliance and knowledge about preventing corruption • Securing transparency in implementing project • Communication and coordination with stakeholders • Knowledge about performance indicators and management reform
Legal	• Knowledge about water supply and sewage works and related laws concerning PPP • Risk analysis of water supply and sewage works

23

1. Structure of the Guideline
2. Specification of the Quality of Water Infrastructure (QWI)
3. Consideration of QWI in each phase
4. Importance of capacity development
5. **Appendices of the Guideline**

Appendices

◆ Information and formats useful to implement the guideline are provided in Appendices

1. Main Components of Design Standards
2. Examples of Examination Criteria for Pre-qualification (P/Q)
3. Examples of Specified Requirements in Bidding
4. LCC Evaluation Items and Calculation Method
5. LCC Evaluation Sheet
6. Performance Indicator and Measurement Method in O&M Phase (Water quality standards non-conforming rate, Target water quality achievement rate, Total cost per 1m^3 (Water supply cost, sewage treatment cost) etc.)

Thank you

附件3、 「APEC 優質基礎建設發展指南」修正草案綱要簡報

Overview of Draft APEC Guidebook on Quality Infrastructure Development and Investment (Revision)

February 28, 2018

Proposed by Ministry of Economy, Trade and Industry, The Government of Japan

Background of revision

1. Original guidebook was developed in 2014 in consideration of:

(a) achievement of **optimal life cycle costs (LCC)** with considerations for service performance and durability,
(b) **mitigation of social and environmental impacts**,
(c) ensuring **safety, maintainability**.
※APEC Guideline for Quality Electric Power Infrastructure was developed in 2016

2. There have been new consensus and initiatives regarding importance of ensuring quality of infrastructure as illustrated by:

(a) G7 Ise-Shima: Ise-Shima Principles for Promoting Quality Infrastructure Investment adopted in 2017
(b) G20 Hangzhou: MDBS Joint Declaration of Aspirations on Actions to Support Infrastructure Investment
(c) The 2030 Agenda for Sustainable Development Goals (SDGs 9.1) of the United Nations.

3. In light of rapid evolution of global economy and rising importance of infrastructure to sustain it, APEC Ministers welcomed upgrading APEC Guidebook on Quality Infrastructure Development and Investment and developing new guideline for water infrastructure

Main revision points (MRPs)

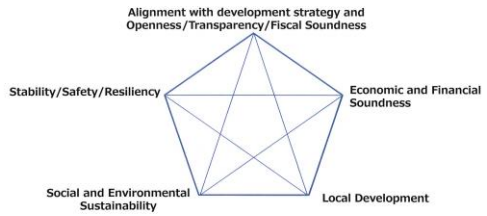
1. Characteristics of infrastructure are defined.
2. Key elements to ensure quality of infrastructure are reviewed.
   - Importance of alignment with development strategy is explicitly emphasized.
   - Key concepts are newly addressed such as VFM (Value for Money), fiscal soundness, resiliency and local development.
3. Private entities are explicitly recognized as development partners and effective use of Public-Private Partnerships are properly addressed.
4. Key actions by government agencies to ensure quality of infrastructure are stipulated
5. Expected initiatives by governments area added.

MRP1. Characteristics of infrastructure

1. **Public Goods**
2. **Externalities**
3. **Extensive Impacts on Society and Environment**
4. **Long Project Life**
5. **Transparency and Accountability Requirements**

MRP2. Five elements to ensure quality of infrastructure

The original guidebook (2014) identified three elements (i.e., Life-cycle cost, environmental and other impact, and safety) which is deliberately reviewed and augmented and now become five.



MRP2-1. Alignment with development strategy

Infrastructure project should be planned and implemented in line with the economy's development strategy:

MRP2-2. Concepts newly addressed in the revision

(a) Value for money and Cost effectiveness,
(b) Fiscal soundness
(c) Resiliency
(d) Stability
(e) Transparency
(f) Local development, including Job creation, capacity building and transfer of technologies
(g) Openness/Universal access
(h) Sustainable development goals

MRP3. Effective use of PPP

Governments are quite active in using PPP in recent years. The Guideline provides basics of PPP, and some insights for effective use of PPP based on the global best practices

(a) Difference between conventional procurement and PPP
(b) Characteristics of PPP, such as
   - Appropriate risk-sharing between public and private
   - Collective procurement
   - Long-term contract
   - Output specification
   - Performance-based incentives
(c) Classification of contract type i.e, Concession, Off-take, and Availability Payment
(d) Considerations to be taken in each stage of Project

MRP4. Key actions by government agencies

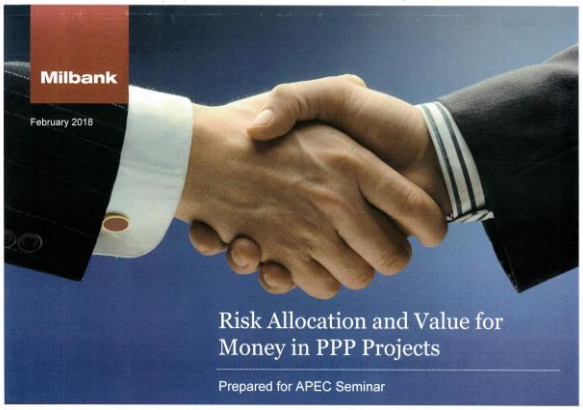
Stage	Key actions by implementing agencies
Stage One (Planning and Study)	● Identify infrastructure projects consistent with international common practices (Openness, Transparency, Economy, Fiscal Soundness) and economic development strategies ● Implement feasibility study (including VFM verification) ● Examine appropriate methods and financing of project
Stage Two (Procurement)	● Specify service requirements (e.g. outputs, KPI, SOR) ● Conduct prequalification and bidding ● Negotiate and sign contracts
Stage Three (Construction)	● Supervise construction (in case of conventional procurement) ● Supervise overall performance of private operators/contractor (in case of PPP) ● Monitor financial status of operators/contractor (in case of PPP)
Stage Four (Operation and Maintenance)	● Supervise or carry out operation and maintenance (in case of conventional procurement) ● Supervise overall performance of private operators (in case of PPP) ● Monitor financial status of operators/contractor (in case of PPP)
Stage Five (Project Completion)	●Proceed project succession or termination (transfer ownership of project facilities, select successors, take over businesses) ●Conduct Ex-post evaluation

MRP5. Expected initiatives by governments

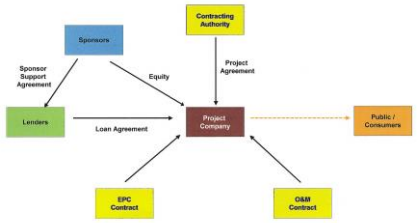
1. Governance and Project Management Body
2. Preparation for Mobilizing Private Funds
3. Human Resource Development

Appendix: Table of Contents of the Guidebook

附件4、 適當的風險分配及價值評估方法簡報



Basic PPP Project Structure and Risk Allocation



Contracting Authority perspective:

- Fundamental drivers:
  - Belief services can be more efficiently procured and delivered by private sector
  - Best **value for money** solution
    - Innovation - ask private sector to define functionality of project
    - Time and budget control – risk management
  - **Off balance sheet** financing of public asset:
    - Reconcile capital investment needs v budgetary constraints
    - Public accounting requirement of sufficient risk transfer
    - private sector bears construction and availability (performance) or demand risk (*Eurostat*)
- Risk transfer is not always value for money:
  - Who is best placed to manage a given risk – private or public sector?
- Unrealistic risk transfer can easily make a project unbankable

Credit Risk

- Solid credit fundamental to underpin a bankable PPP Project Agreement
- PPP project can involve:
  - direct service to public (User Pay) or
  - contracted payments from contracting authority (Government Pay)
- Central government body guarantee to underpin the Project?
- Contracting Authority - multi-year commitment needs assurance that budgetary approval will be forthcoming

Currency Risk

- Local bank market may not have sufficient long term liquidity to fund the Project
- Investor capital and long term debt (to cover cost of construction/equipment) may be hard currency
- Payment sources may be local currency
- Three classic currency risks:
  - Convertibility
  - Transferability
  - Depreciation
- Important that host governments:
  - Provide suitable undertaking within PPP Framework
  - Implement reforms to promote development of domestic financial market and long term liquidity

Material Adverse Government Action

- Acts or omissions of host government and agencies can adversely affect Project implementation
- Allocate risk to Contracting Authority
  - Project Company granted relief from being in breach of its obligations if non-performance due to MAGA
  - Contracting Authority typically required to continue payments on basis of "deemed availability":
    - for inability to provide service during operating period
    - for delay in start-up during construction phase
  - Cost compensation/tariff adjustment for increased costs in Project Company performing its obligations under Project Agreement
  - Long term MAGA can lead to termination of Project Agreement and payment of compensation by Contracting Authority

Project Land

- Acquiring suitable land for project site is critical
- Government may have powers or necessary means of procuring land
- Putting risk on private sector leads to actual cost increase and delay and may not lead to best value for money in PPP bid
- Risks associated with land availability typically allocated to Contracting Authority as Material Adverse Government Action

Compensation on termination

- **Termination Events covered by compensation**
  - Project Company Default
  - Contracting Authority Default
  - External Force Majeure making it impossible to continue with the Project
- **Philosophical and commercial debate**
  - Compensation payment on termination for "**Project Company Default**"
    - Why should Contracting Authority pay when counterparty Project Company is in default
    - In traditional contracting, defaulting Contractor would be liable in damages to Contracting Authority
    - The idea of paying compensation by the Contracting Authority would run contrary to the intent of a PPP project in transferring risk to the private sector
    - Project Company investing capital asset and practical reality may be that Government better placed to take over asset on a termination

Compensation on termination (Cont'd)

- General accepted practice in Asian infrastructure/power is that compensation payable on **Project Company Default**:
  - if Contracting Authority exercises option to purchase
  - equal to sum of outstanding loans, accrued interest and break costs minus cash held in Project Company bank accounts and any unfunded equity committed by shareholders
- Practical reality needed to entice banks to lend
- Compensation payable on "**Contracting Authority Defaults**" as stipulated in Project Agreement seeks to achieve ***Full Pay Out***
  - Compensation is equal to debt and hedging costs plus equity contributions plus termination costs (i.e., under EPC Contract) plus equity return (and sometimes subject to a deduction for cash in Project Company bank accounts)
  - NPV of future Service Charges (so effectively covers the same subject to termination costs) but subject to a floor equal to the debt and hedging costs outstanding

Compensation on termination (Cont'd)

- Should compensation be payable on termination for prolonged FM event making it impossible to continue the Project
- Practice varies depending on nature of FM event

Type of Force Majeure	
Political Force Majeure	Full Pay Out*
Natural Force Majeure affecting Project	• Sometimes no termination right – rely on insurance • If termination right exists and exercised by Contracting Authority and project transferred, pays debt and hedging costs plus termination costs (and in some (rare and historical) cases % of equity)
Natural Force Majeure affecting Contracting Authority	Full Pay Out*

* Contracting Authority may elect to continue to make payments based on deemed availability.

Stable Legal Framework

- Perceived (or actual) risk of **change in law?**
  - Lack of investment history in emerging economy?
  - Cost implication in Bid – is this value for money?
  - So cost implications usually passed through to Contracting Authority
- Change in tax law sometimes passed through if discriminatory against project or type of business
- Project Agreement is critical in setting out clear and objective obligations on parties – importance of clarity of documentation
- International arbitration
- May be underlying legislation that supports the basis of the PPP project

Lender Security

- Lenders to projects financed on non-recourse basis require **security over all assets** of (and shares in) the Project Company
  - Legal system in emerging markets may:
    - limit scope of security that can be provided to international lenders or
    - limit nature of remedies that can be exercised
  - Enforcement of security may be subject to court interference or not be practicable – no established precedent
- Government may need **specific legislation** to allow security to be granted or enforced
- Step in **contractual arrangements** for lender to cure breaches and avoid termination (a key tool to get to negotiating table) may be practical solution for lenders when tied to compensation regime

Standardisation of Contract Terms

- PPP Implementing Authorities seek to produce model contracts that are "standard"
- Established and accepted allocation of risk will facilitate the process of implementing PPP across government agencies/Contracting Authorities
- Positions advocated for developed and well established PPP models may not be appropriate for emerging markets:
  - Change in law risks
  - MAGA
- Important for PPP Implementing Authorities to be realistic in understanding risk allocation and requirements of investors and lenders
- Once a track record of successful PPP projects is proven, opportunities then for Contracting Authority to push risk back on to private sector

Unrealistic risk transfer examples

- Failed PPP projects in the USA where the political risks sank the deals despite initial private sector interest:
  - *Chicago Midway Airport ; Pennsylvania Turnpike and Harrisburg Parking.*
- Projects that were financed but where commercial risks pushed on to the private sector (mainly traffic risk in toll roads) led to financial default:
  - *Indiana Toll Road; South Bay Expressway, Greenville Southern Connector and Pocahontas Parkway.*
- First category of projects were never ultimately built / Second category the projects operate just fine, and the public sector did not bail out the lenders or investors, despite the financial losses borne by the original equity and debt holders.

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附件5、 永續水庫-以石門水庫為例簡報

經濟部

APEC Seminar for Upgrading " APEC Guidebook on Quality Infrastructure "

Sustainable Reservoirs
Shihmen Reservoir as an example

Presented by Dr. Jong, Chaur-Kong , Deputy Director of
Water Resources Agency , Ministry of Economic Affairs
CHINESE TAIPEI

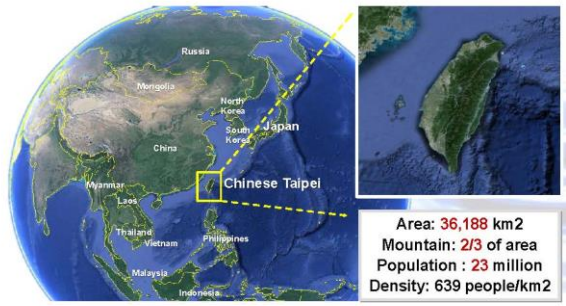
經濟部水利署 WATER RESOURCES AGENCY

2018/2/28

Outline

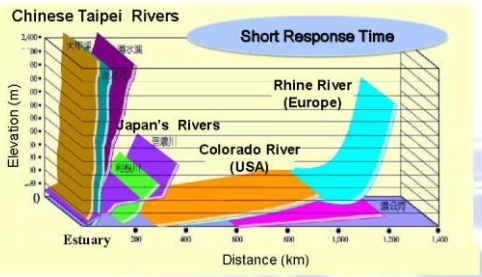
I The Water Environment in Chinese Taipei

1. Geographic Location of Chinese Taipei



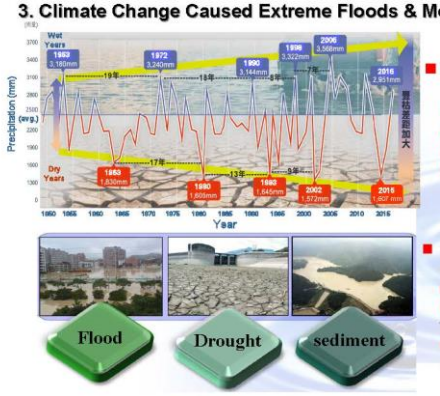
Area: 36,188 km2
Mountain: 2/3 of area
Population : 23 million
Density: 639 people/km2

2. Comparison of River Slope



- Comparing to the other economies , our rivers are **steeper** .
- The rainfall from the upstream rush to the cities in hours, i.e. we have only **a few hours responding to flood control** .

3. Climate Change Caused Extreme Floods & More Droughts



- We observed a tendency of **decreasing rain duration** and **increasing intensity** .
- It means we have more **frequent** and **extreme flood** and **drought** , which trigger more **sedimentation** in the reservoirs .

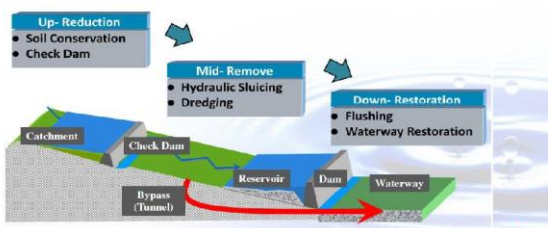
II Strategies Against Reservoir Sedimentation

1. Main Causes of Sedimentation in Reservoirs

Steep Slope	Heavy Rainfall	Insufficient Sediment
Fragile geologic conditions	& Flood Erosion	Releasing Facilities
1999 Ji-ji Earthquake		
Landslides at watersheds		

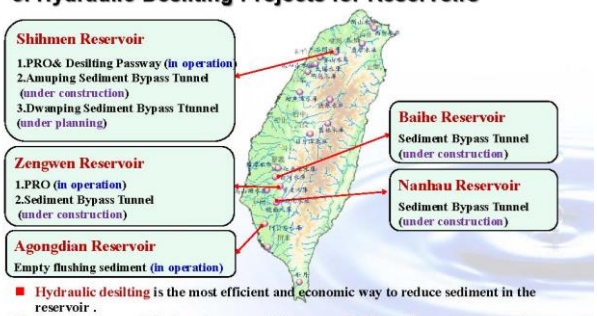
- Two major natural hazards are **earthquake** and **typhoon** .
- The heavy rainfall carries a great amount of water blended with **muds** and **rocks** and flood carrying large amount of sediment to the watershed and reservoir .

2. Strategies to Maintain Reservoir Capacity



- From up-stream to down-stream, it's to strengthen the **watershed conservation** 、 **reservoir dredging** and **add hydraulic desilting passways** to reducing reservoir sedimentation .

3. Hydraulic Desilting Projects for Reservoirs



- Hydraulic desilting is the most efficient and economic way to reduce sediment in the reservoir .
- Agondian reservoir is the only one applied "empty flushing sediment" to empty the reservoir to flush bottom sediment .
- For the rest reservoirs, we take advantage of high density turbid currents to flush away the silts through the bottom outlets .

P.8

Hydraulic Desilting of Shihmen Reservoir

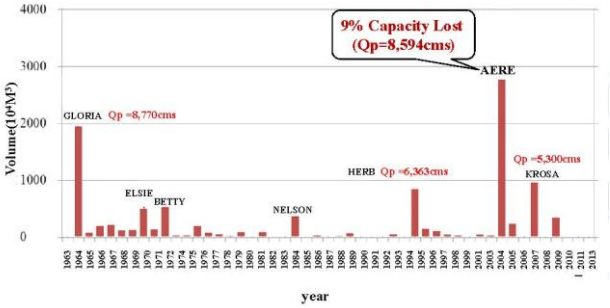
1. Basic Data

- ✓ Completed in 1964
- ✓ Designed effective capacity: 309 million M^3
- ✓ Multipurpose: water supply , hydro-power , flood control , irrigation, and tourism.
- ✓ With the largest watershed area 763km^2 in Chinese Taipei .
- ✓ Capacity lost 32% due to sedimentation .

P.9

2. Sediment Caused by 7 Major typhoons Events

Seven major typhoons accumulated sediment 77 million m^3, about 76% of the total sediment in the reservoir .



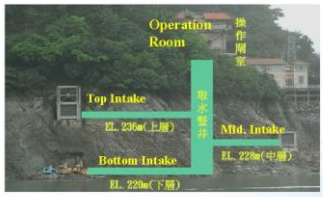
P.10

Typhoon Aere 2004 Aug. 29. 2004

- Typhoon Aere caused high turbidity, more than 200,000 NTU (Nephelometric Turbidity Unit) was measured and caused muddy reservoir 28 million M^3 of sedimentation , and water supply suspended for 18 days .
- The major cause is insufficient bottom outlets for venting turbidity currents .

P.11

To obtain low-turbidity water the "Stratified Water Intake Well" was completed in 2009



- The "Stratified Water Intake Well" is a 40-meter-deep water intake facility that effectively obtains low-turbidity water at the upper layer of the reservoir once the water is muddy .
- By this way the water supply remained function well during typhoon or heavy rainfall since the completion until now.

P.12

3. Desilting Projects Conducted for Shihmen Reservoir

Shihmen Reservoir :

In use	PRO 2008-2011	On going	Amuping Bypass Tunnel -2020
	Penstock 2009-2012		Dwanping Bypass Tunnel

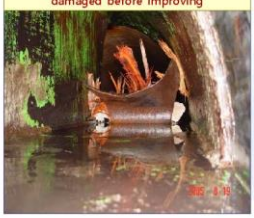
- In the case of Shihmen Reservoir , one permanent river outlet (PRO) and one penstock were remolded into desilting passways . They have been in used since 2012 .
- 2 more on going projects Ampuping and Dwanping sediment bypass tunnel will be constructed .

P.13

3-1 Improving the Permanent River Outlet (PRO)

- A "Howell-Bunger valve" has been replaced by a "Jet Flow Gate" with a larger discharge capacity of 34 cms .
- The improvement increases hydraulic desilting by 0.15 million M^3 per year .

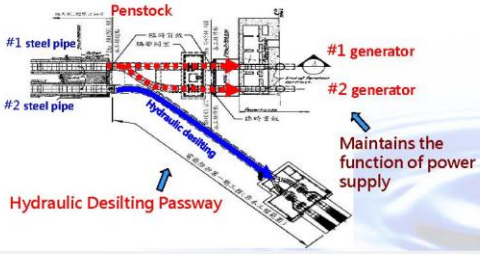
Driftwood caused PRO choked and damaged before improving



Sediment releasing after improving of the PRO

P.14

3-2 Remold an Existing Penstock into Hydraulic Desilting Passway



- ✓ In 2012, an existing penstock was remolded into a hydraulic desilting passway with a discharge capacity increased from 65 cms to 300 cms .
- ✓ During 2013~2016 3.1 million M^3 of sediment had been desilted during typhoon seasons, saving US$ 50 million in dredging costs .

P.15

Video of Hydraulic Desilting in 2015 Typhoon Dujuan

Sediment desilted over 0.3 million m^3, saving US$ 5 million .

P.16

3-3 Comparison the Ratio of Desilting

With Desilting Passway

Year	2013	2013	2015	2015	2016
Typhoon	Soulik	Trami	Soudelor	Dujuan	Megi
Ratio of desilting	34.3%	37.2%	36.7%	37.4%	21.1%

Without Desilting Passway

Year	2008	2008	2008	2009	2010	2011
Typhoon	Fung-Wong	Sinlaku	Jangmei	Morakot	Fanapi	Saola
Ratio of desilting	12.9%	26.5%	17.9%	14.3%	3.0%	15.0%

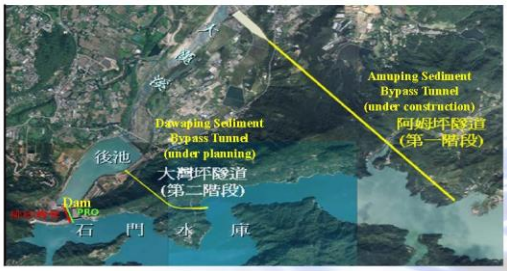
P.17

4. Sediments Transport Monitoring System

The system was setup to gather data on **turbidity、sand amount** and **to track sediment transport behavior** for understanding the migration state and **optimizing desilting operations**.

P.18

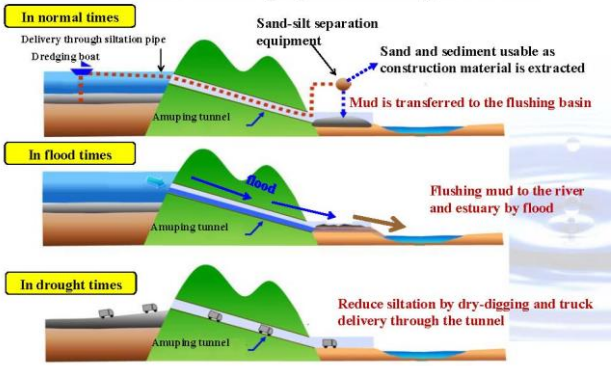
5. Two More Sediment Bypass Tunnels will be Constructed



- ✓Fine sediment can be released from the existing PRO and desilting passway .
- ✓ To remove coarse sediment , **Amuping and Dawaping sediment bypass tunnels** will be constructed .
- ✓As a goal, reservoir storage capacity in the **long-term will be maintained** .

P.19

■ Function of the Amuping Sediment Bypass Tunnel



P.20

Ⅳ Conclusions

Necessity	• 0.96% of storage lost annually in Chinese Taipei . • Sediment removal is necessary .
Efficiency	• Soil conservation, sediment digging, dredging and sluicing are all adopted in Chinese Taipei . • Hydraulic desilting is the most efficient and economical way .
Optimization	• It' s necessary to monitor the location of density current so the high density silt can be flushed out with an optimum operation .
Localization	• Sediment removal approaches vary place to place . • Depend on conditions of sedimentation, topography and hydrological characteristics .

P.21

Thank you for listening

Welcome to
The 3rd International Workshop on Sediment Bypass Tunnels
on Apr. 9~12 2019 in Chinese Taipei

附件6、 Maynilad 公司採購程序簡報

Outline of Presentation

- What we procure
- Project Classification
- Modes of Procurement
- Life Cycle Cost
- Challenges
- Learning process & benefits

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What we procure?

GOODS
- Pipes
- Fittings
- Office Supplies

SERVICES
- Janitorial
- Security
- Consultancy

INFRASTRUCTURE
- Pipe Laying
- Plants, Reservoirs, PS
- Buildings

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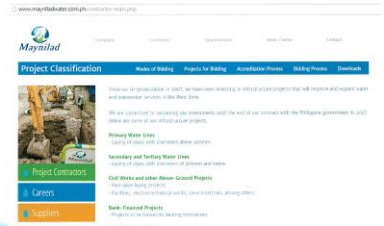
How do we classify projects?



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How do we procure?

Competitive Bidding

- Open Invitation — Open: Where all interested contractors may participate in the bidding
- Direct Invitation — Direct: Where only accredited contractors may participate in the bidding

Alternative Bidding

- Raffle — Raffle: For typical secondary / tertiary pipe laying projects
- Negotiation — Nego: Under exceptional circumstances like threat to life, property, and after 2 failed biddings

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Thru open invitation

For **bank-funded projects**, the procurement procedures of the bank is used.

For large and complex projects such as treatment plants, Maynilad uses the **international competitive bidding** process, patterned with World Bank procedures

Advertise → Shortlist → Invite → Pre-bid conference → Submit & Open bids → Evaluate → Award

Advertise → Pre-qualify → Invite → Pre-bid conference → Submit & Open bids → Evaluate → Award

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Advertise → Pre-qualify → Invite → Pre-bid conference → Submit & Open bids → Evaluate → Award

Projects will have their own set of pre-qualification requirements, which is usually based on the scope and magnitude of the proposed works.

Only prequalified applicants will be allowed to submit their technical and financial proposals

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Advertise → Pre-qualify → Invite → Pre-bid conference → Submit & Open bids → Evaluate → Award

Technical evaluation is performed to check compliance to the technical requirements.

Life Cycle Cost evaluation is used for design-build projects wherein operation and maintenance is a huge part of the cost.

The bidder that submitted the technically complying proposal and lowest life cycle cost wins the award

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Why use LCC approach?

Advertise → Pre-qualify → Invite → Pre-bid conference → Submit & Open bids → Evaluate → Award

- Recommended for major capital projects which involves high operational expenses
- Understand tradeoffs between the purchase price and operating costs.
- Minimize total cost of ownership
- Motivate contractors to optimize the design considering balance of purchase price and operating costs in the entire life of plant.
- Ensure sustainability of plant

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Advertise → Pre-qualify → Invite → Pre-bid conference → Submit & Open bids → Evaluate → Award

Life Cycle Cost evaluation is done in consideration of the following:

- Capex Cost
- Opex for 15-20 years

*Opex includes labor, chemical, power, maintenance, spare parts, even sludge disposal)

Life Cycle Cost (LCC) is computed using the formula below:

$$\text{Discounted OPEX for Year}_n = \frac{\text{Total OPEX for Year}_n}{(1+\text{discount rate})^{\text{year number}}}$$

$$\text{Life Cycle Cost} = \text{CAPEX} + \sum_{n=1}^{n} \frac{\text{Total OPEX for Year}_n}{(1+\text{discount rate})^{\text{year number}}}$$

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Advertise → Pre-qualify → Invite → Pre-bid conference → Submit & Open bids → Evaluate → Award

The bidder that submitted the technically complying proposal and lowest life cycle cost wins the award

YEAR	Description	Contract Amount
2012	Pasay Sewage Treatment Plant	Php1.03 B (approx USD20.6M)
2013	Valenzuela Sewage Treatment Plant	Php1.22 B (approx USD 24.4M)
2013	Cupang Sewage Treatment Plant	Php1.04 B (approx USD20.8M)
2013	Tunasan Sewage Treatment Plant	Php0.69 B (approx USD13.8M)
2014	Paranaque Water Reclamation Facility	Php1.40 B (approx USD28M)
2015	Cavite Water Reclamation Facility	Php0.64 B (approx USD12.8M)
2016	Putatan Water Treatment Plan	Php4.67 B (appox USD 93.4M)
2016	La Mesa Treatment Plant 1 Improvement	Php4.71 B (approx USD94.2M)

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Challenges of using LCC approach

Advertise → Pre-qualify → Invite → Pre-bid conference → Submit & Open bids → Evaluate → Award

- Pre-qualifications or selection of contractors capable of delivering high quality infrastructures
- Capacity building in terms of technical understanding on best available technology, managing implementation of high quality infrastructures and its effective operation and maintenance.
- More complex evaluation – more time required
- Verifying the forecasted operational and maintenance cost of bidders
- Process Proving is limited to one year and newly installed equipment are expected to perform well. How to guarantee the succeeding years?

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How to overcome?

Advertise → Pre-qualify → Invite → Pre-bid conference → Submit & Open bids → Evaluate → Award

- Pre-qualifications or selection of contractors capable of delivering high quality infrastructures
  - hiring of capable consultant
- Capacity building in terms of technical understanding on best available technology, managing implementation of high quality infrastructures and its effective operation and maintenance.
  - continuous trainings of in-house engineers

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How to overcome?

Advertise → Pre-qualify → Invite → Pre-bid conference → Submit & Open bids → Evaluate → Award

- More complex evaluation – more time
  - *Must have available actual data of performance of similar plants*
  - *Exert more effort in detailing major components of cost*
  - *Ensure competency of technical working group*
- Verifying the forecasted operational and maintenance cost
  - *Must have experience and expert people to evaluate reasonableness of forecasted O&M cost*
  - *Actual data from previous similar projects*
  - *Post Contract Monitoring*

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How to overcome?

Advertise → Pre-qualify → Invite → Pre-bid conference → Submit & Open bids → Evaluate → Award

- Process Proving is limited to one year and newly installed equipment are expected to perform well. How to guarantee the succeeding years?
  - *Thru Functional Guarantees*

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Learning Process (Functional Guarantees)

Advertise → Pre-qualify → Invite → Pre-bid conference → Submit & Open bids → Evaluate → Award → Construction

Before 2011
Guarantees were set only for the design flow.
Total amount OPEX is paid regardless of actual flow during process proving

2011-2013
Guarantees were set for ranges of flow @ 25%, 50%, 75%, and 100%.

2014 onwards
Guarantees were set on:
- unit costs of OPEX
- life cycle cost.

Contractor will be paid based on the guaranteed unit costs and actual flows.

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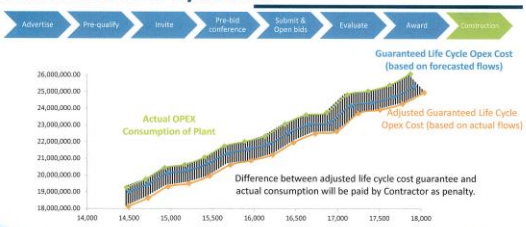
Guarantee of Life Cycle Cost



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Benefits of Life Cycle Cost

- Contractors are expected to submit more realistic values for the OPEX cost
- Contractors will be more careful in their design and project implementation

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Thank You

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