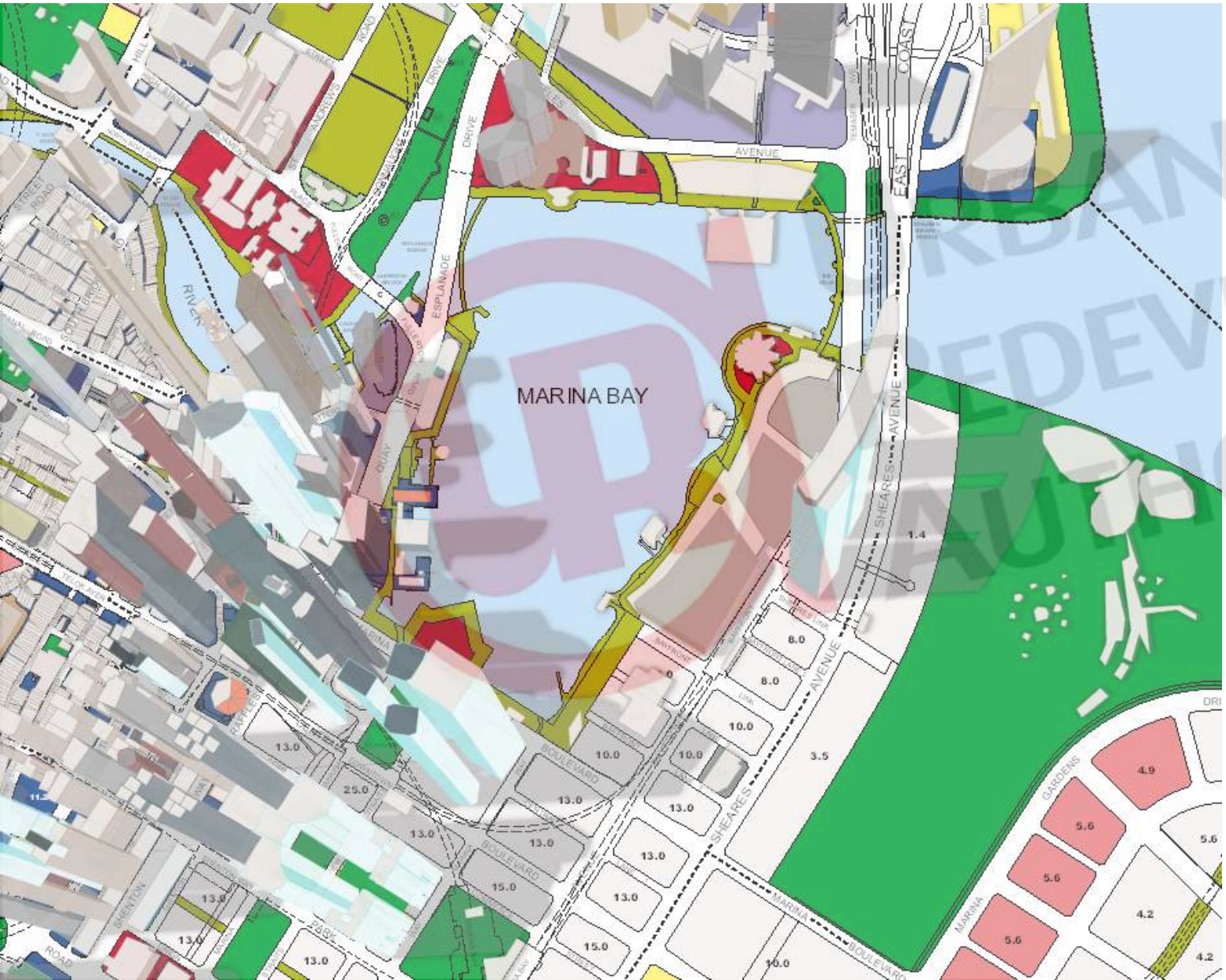
# Marina Bay, An Attractive & Sustainable Precinct

*- Development of the Common Services Tunnel*

# Planning for Marina Bay

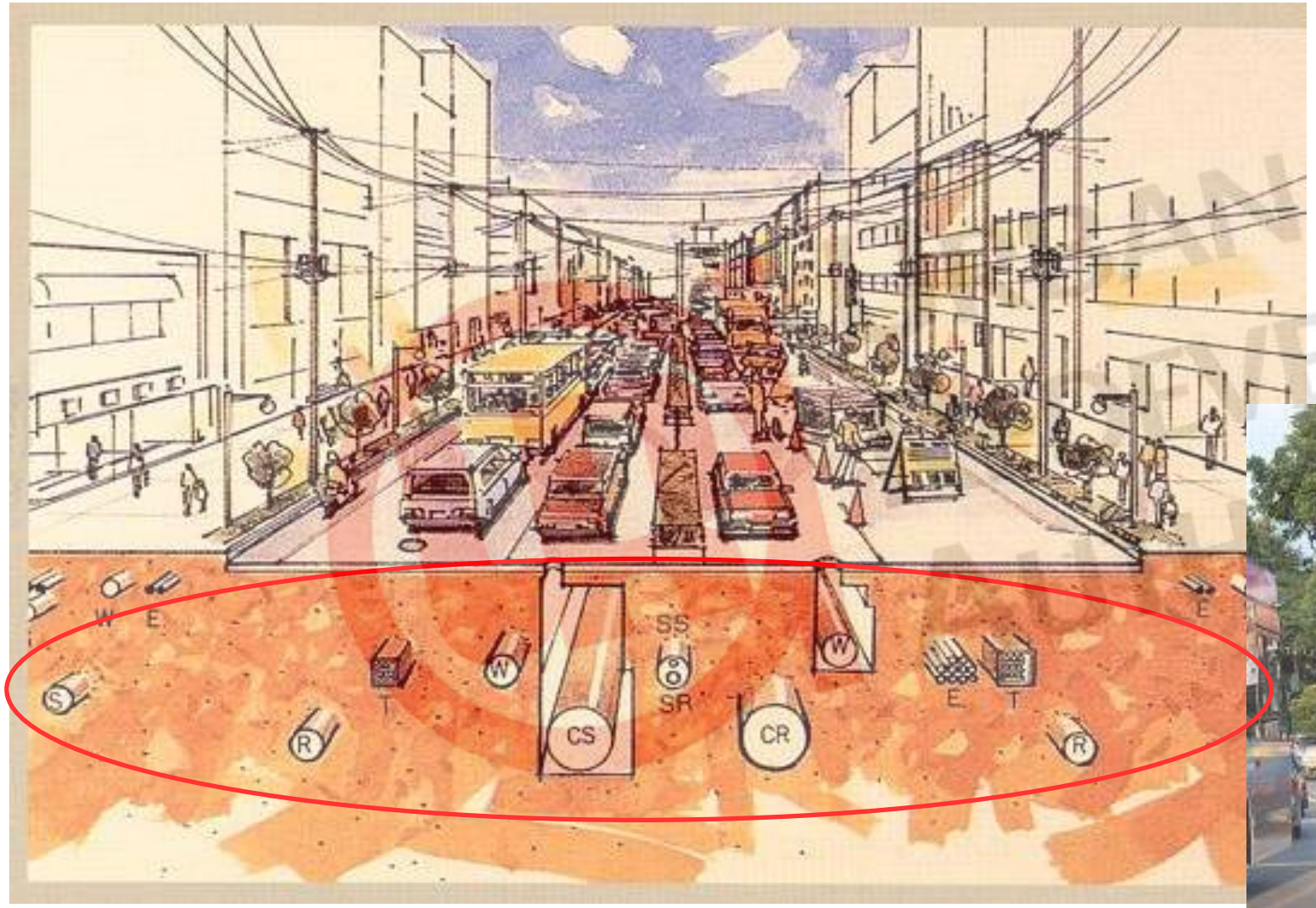
*- A pro-active and holistic approach*




- **URA - the Development Agency for Marina Bay:**
  - Prepares master plan for land & water activities
  - Co-ordinates planning & infrastructure implementation
  - Acts as land sales agent
  - Programmes events & activities
  - Markets & place manages the district
- **Developed through public & private partnership**
- **Govt. provides infrastructure & release land for private development**

# Common Services Tunnels

# Traditional Design of Infrastructure Services




Services laid under the roadside verges or road carriageways


Road digging not just causes traffic delays, but also affects the image of the area

# Benefits of the CST

- Minimal traffic disruption
- A better urban environment
- More reliable services
- Shorter services laying time
- Optimisation of land
  - Reduction of road reserve width (more land for development)
  - Integration of ancillary structures with developments

# Utilities in the Common Services Tunnel


**Services in CST:**

- Power cables
- Telecom cables
- Potable Water pipes
- Newater pipes
- District Cooling Pipes
- Pneumatic refuse collection pipes (future)

**Exclusion:**

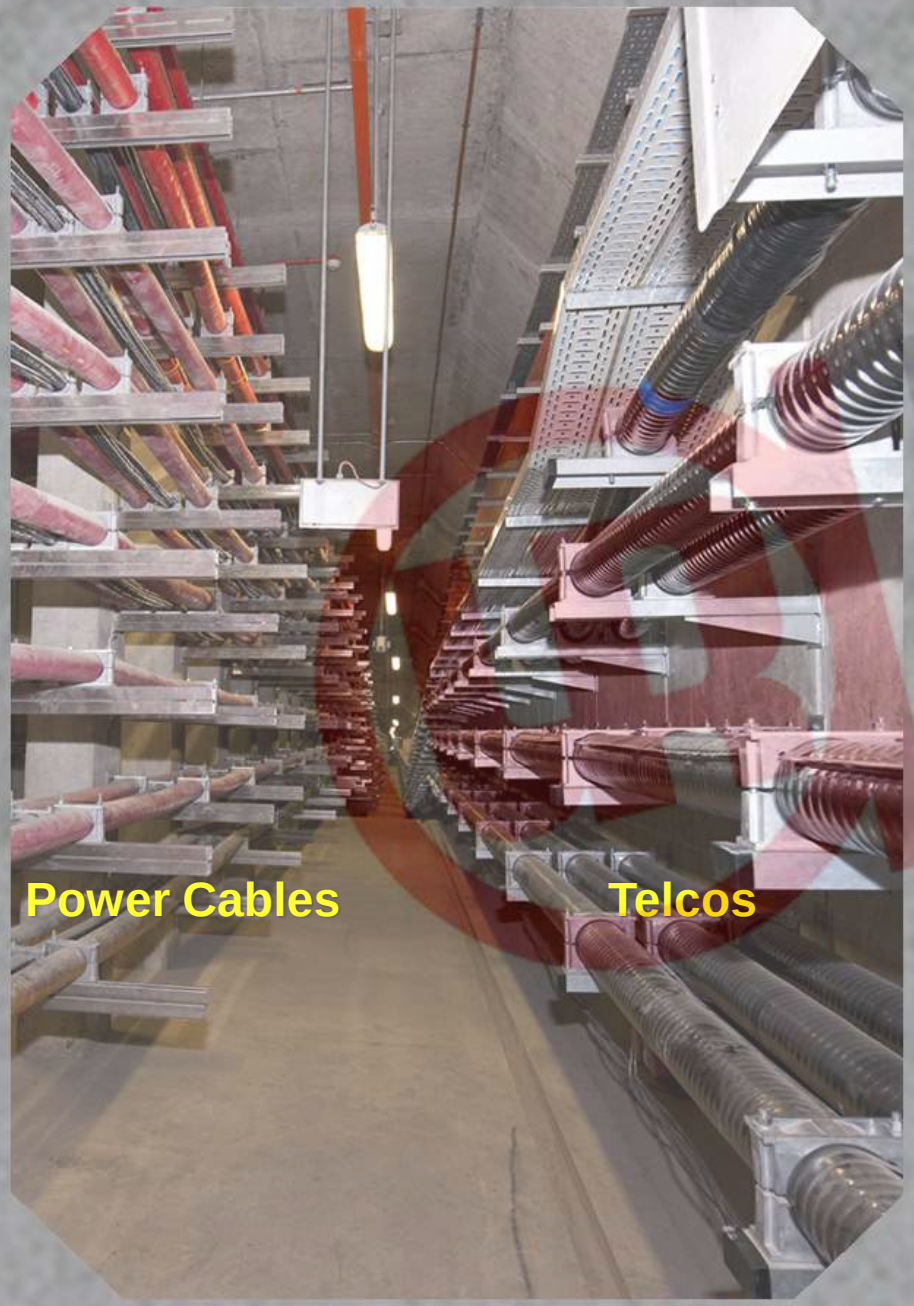
- Gas pipes
- Sewer pipes

# Common Services Tunnel

## View of pipe tunnel


View of Pipe Tunnel

# Common Services Tunnel




# Implementation of the CST at Marina Bay
## - Key Considerations

### (1) Land Use Considerations

- Marina Bay is a **Greenfield** development
- Planning up to **detailed Master Planning** (individual land parcellation)
- **Firm plans of underground developments** which will impact CST design & planning
- Area with **high GPR/density for** commercial developments

### (2) Other Key Requirements

- A **Development Agent**
- A **Owner**
- A CST O&M **Operator**

# Design of the Tunnels

# CST Design Considerations

## Flexibility

- Design for ultimate capacity & 120 years life span
- Easy to lay and maintain services

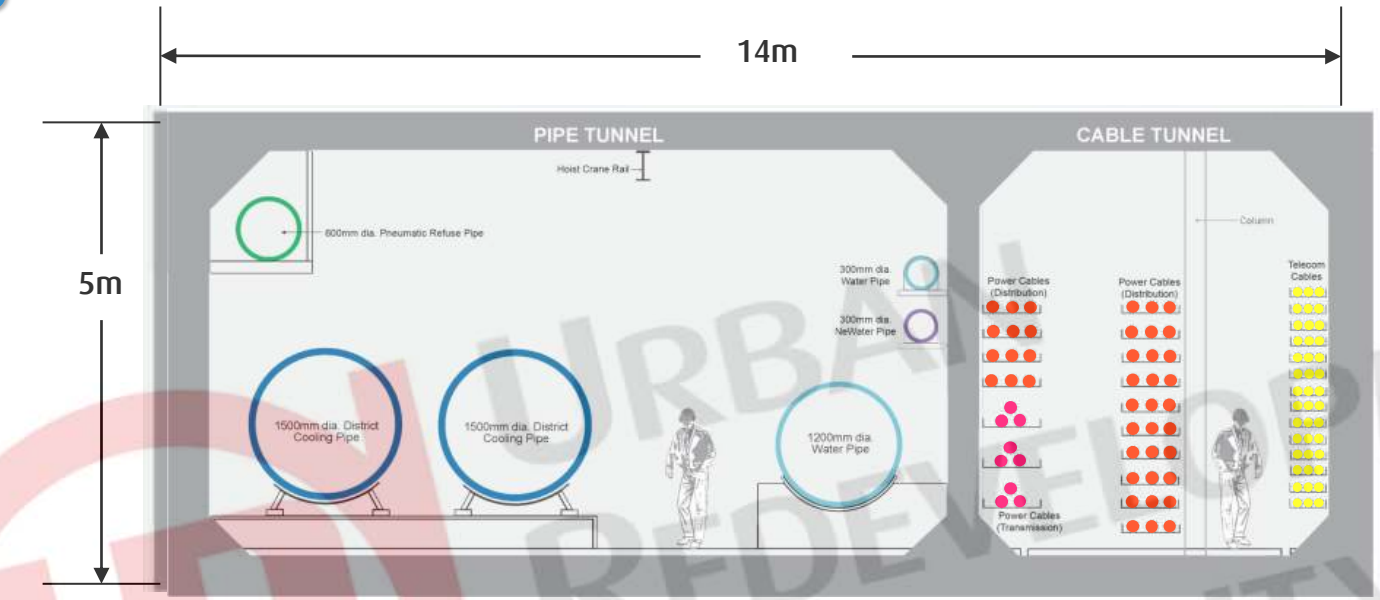
## Safety

- Use of only non-combustible materials
- Separation of cables and pipes tunnel
- Tunnel is always safe for work

## Security

- 24/7 Centralized control/monitoring system
- Restricted access points

# CST Design Dimensions




CST

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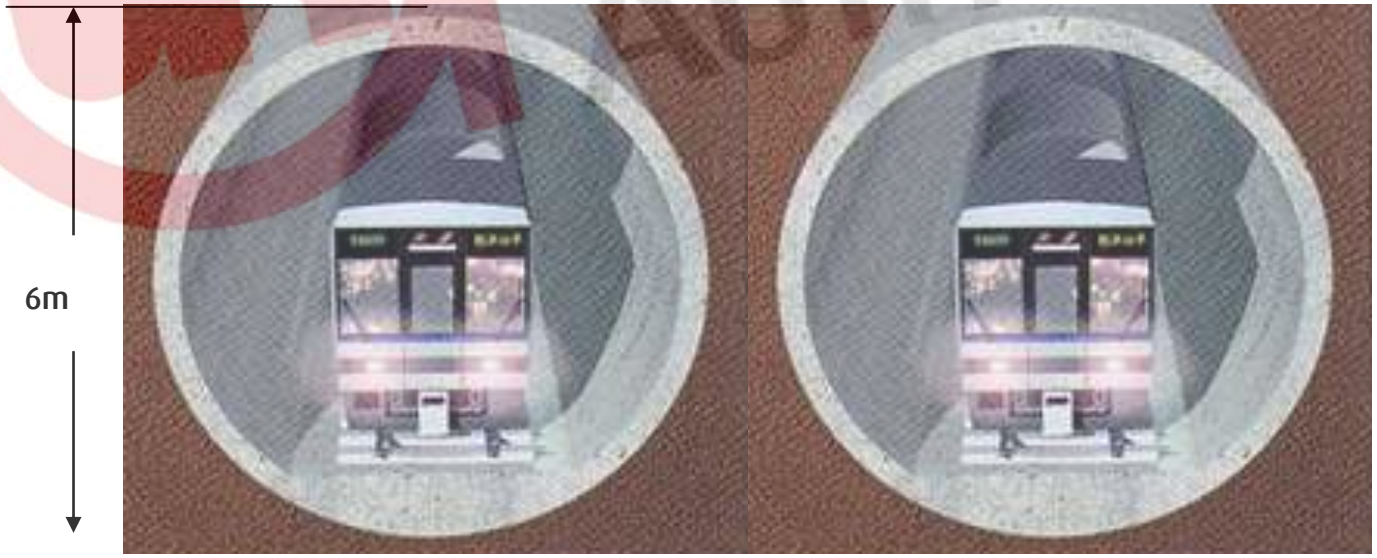
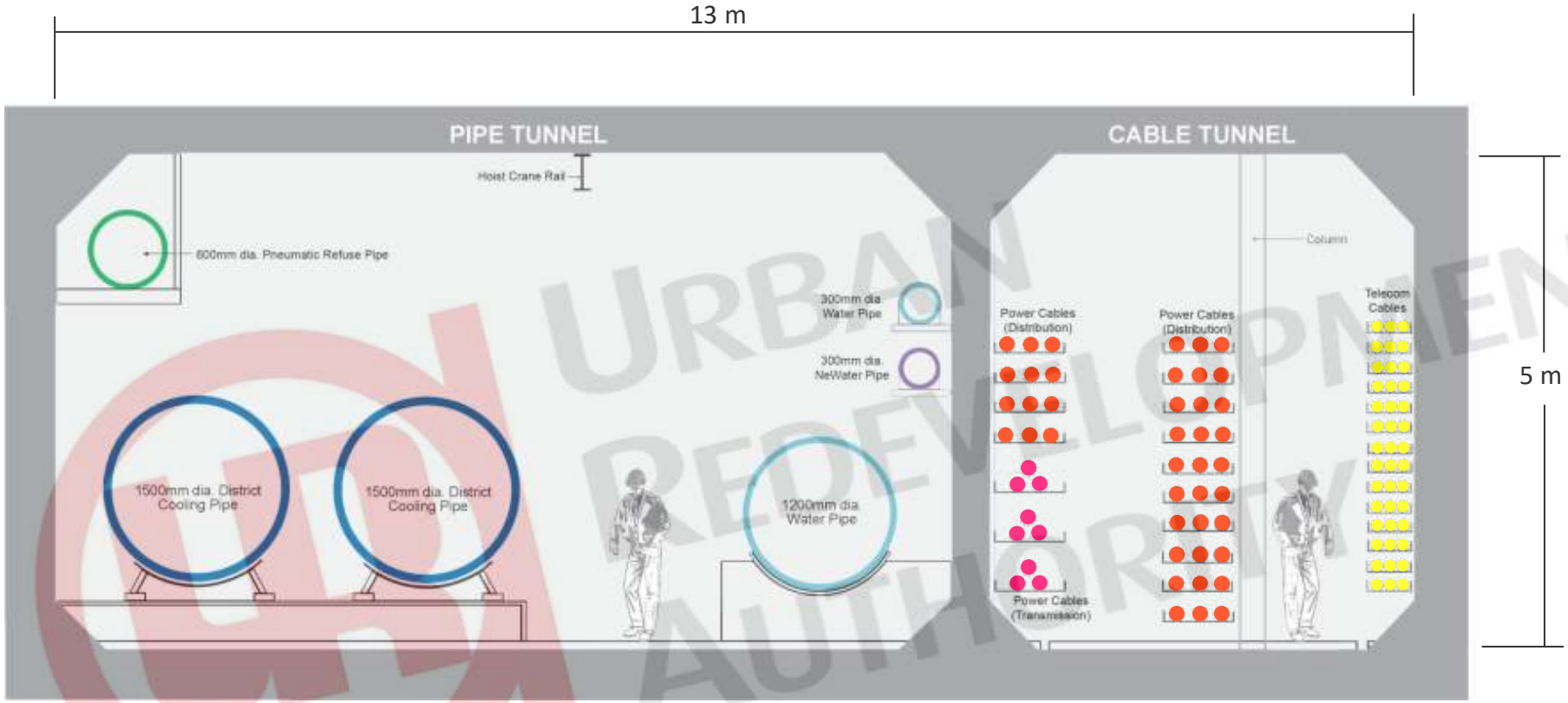



MRT

# Typical CST Cross Section and Interior Layout

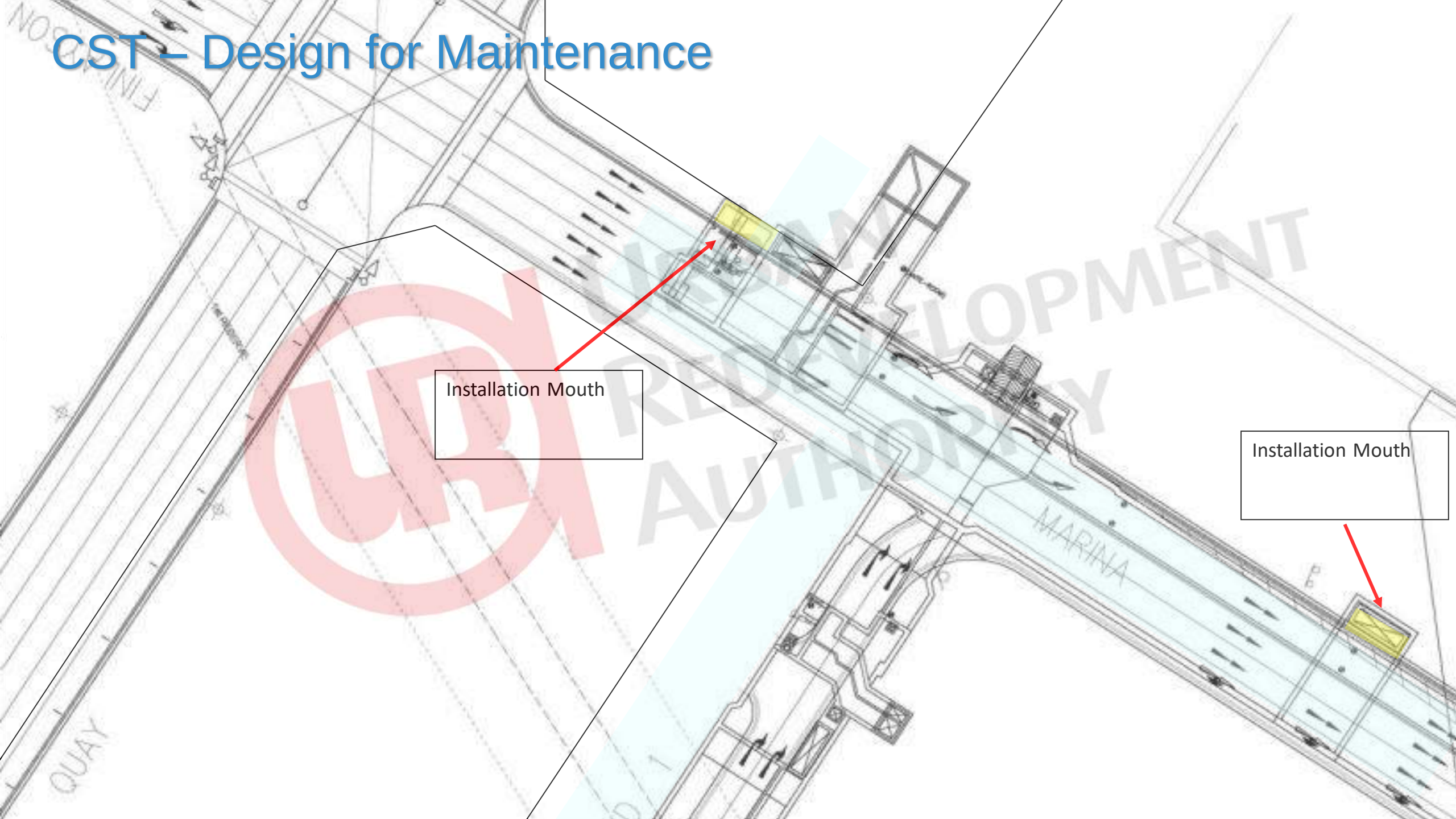



**TYPICAL CROSS SECTION OF COMMON SERVICES TUNNEL**

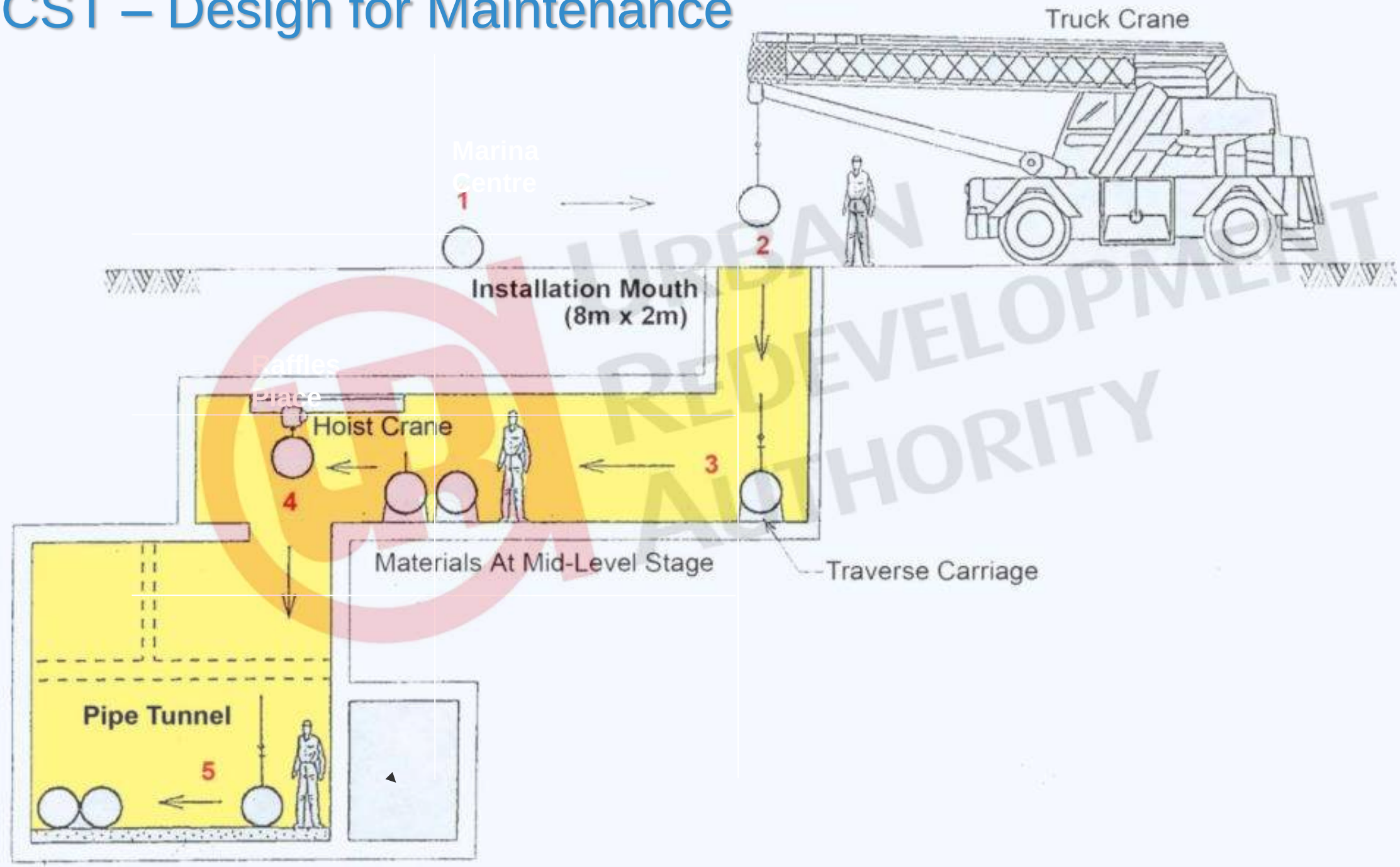
Pipes


Cables

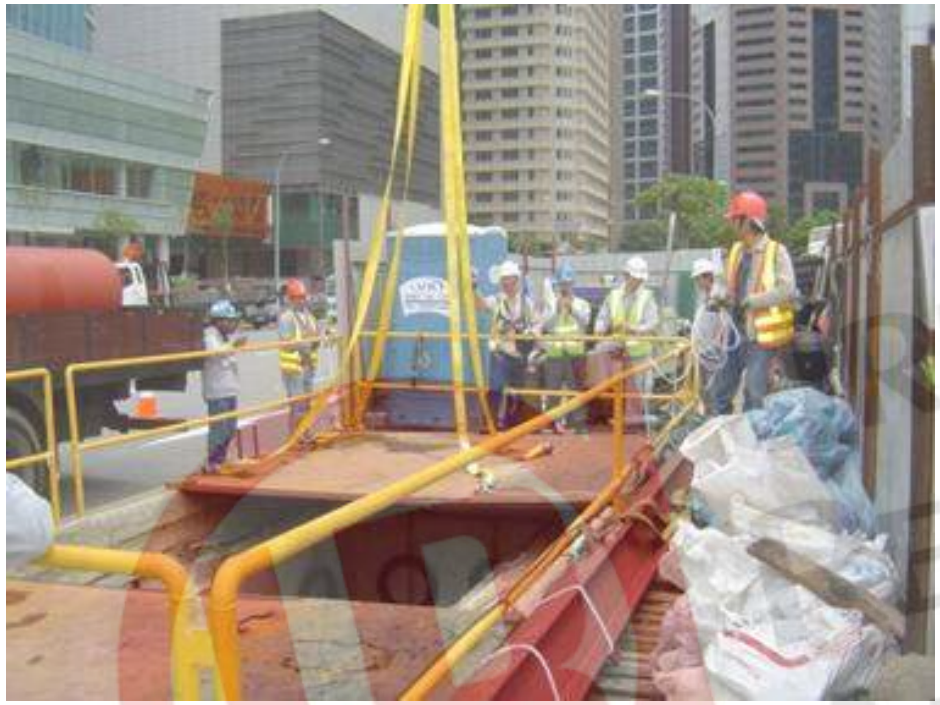
# CST – Design for Maintenance



# CST – Design for Maintenance



# CST – Design for Maintenance

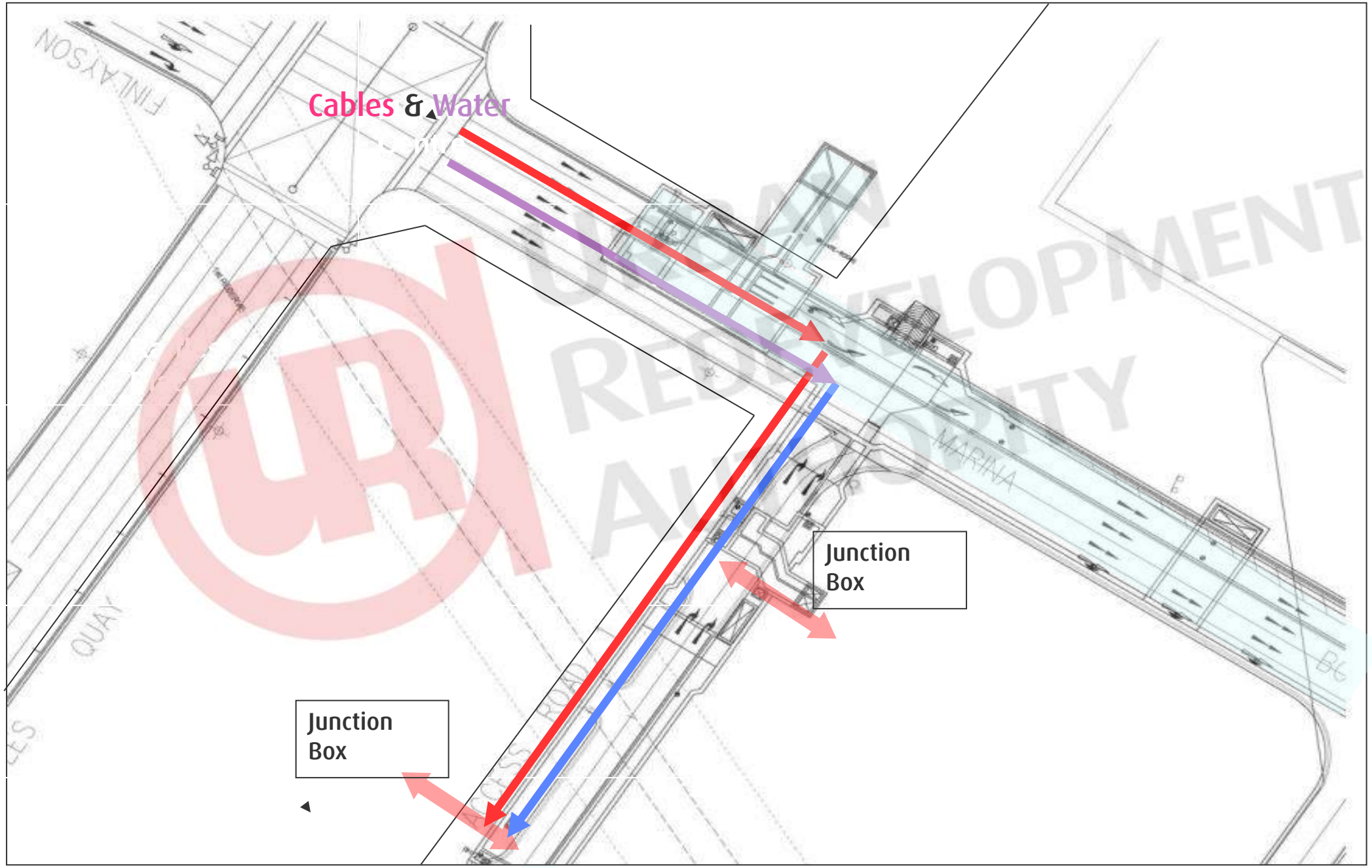


# Depth considerations for the CST

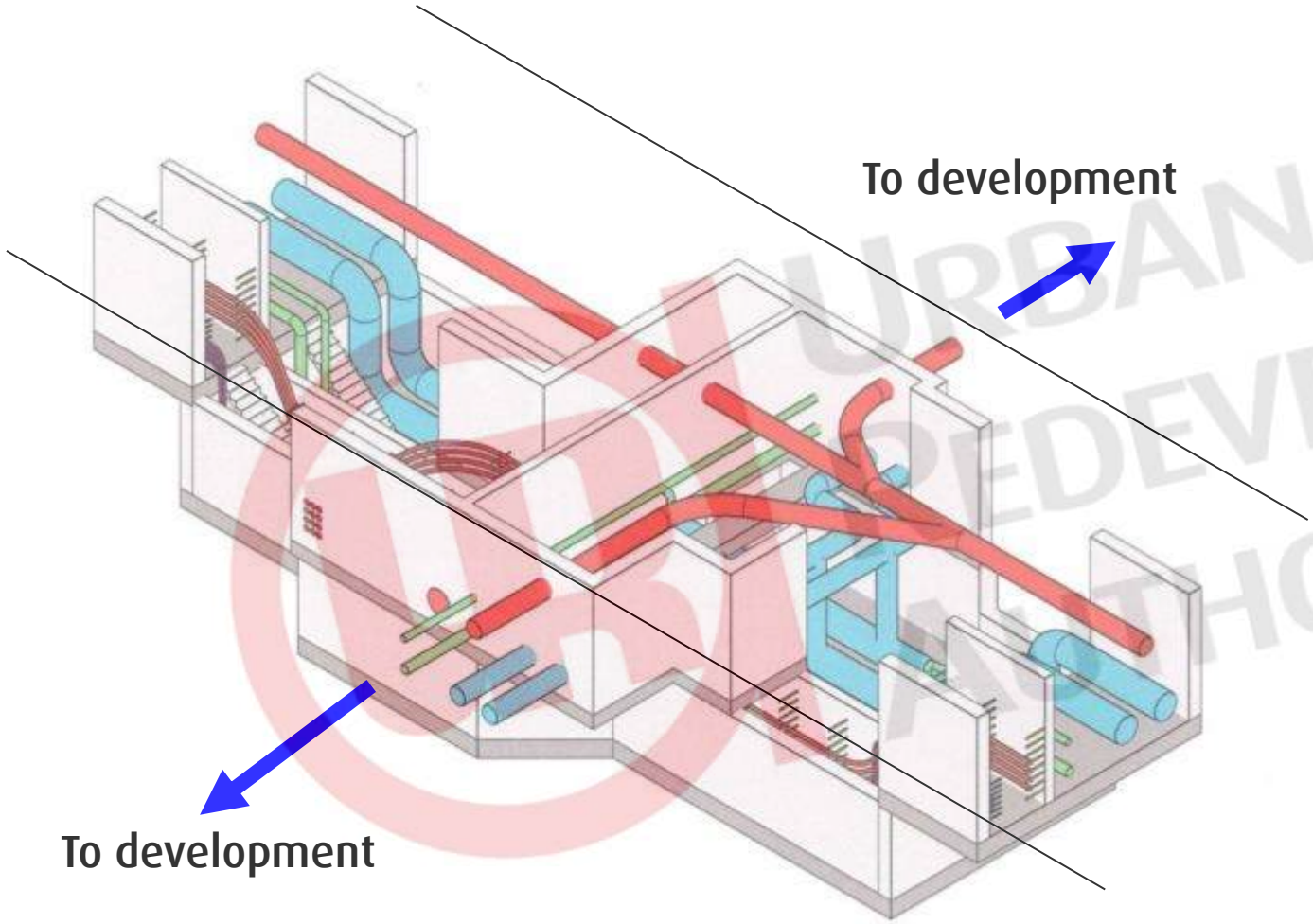

**Longitudinal/ cross section of CST**

– bottom depth ranges from 7.5m to 30m

# Design to Connect Directly to Building

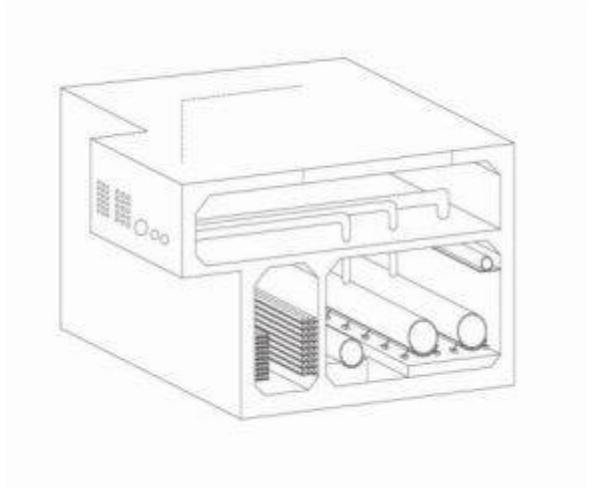


# Connection of CST to developments




## Junction Box

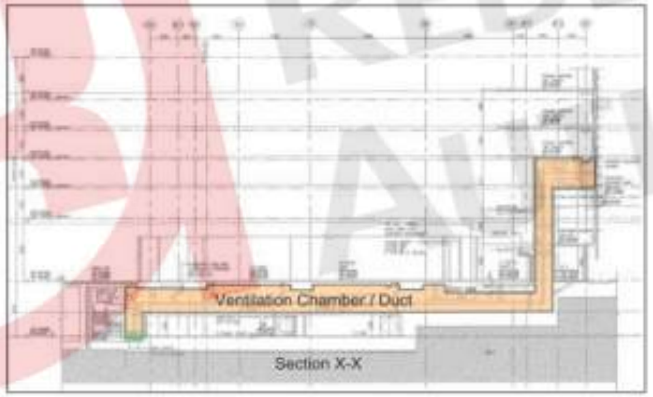
- Connection Point to development

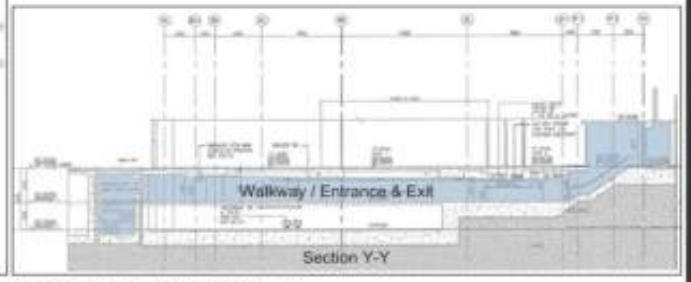


# Design to Integrate Ancillary Structures with Development – CST Vent Shaft

## Common Services Tunnel - Ventilation Shaft




Details of Ventilation Shaft / Entrance & Exit integrated With MBFC T2

## Before


One of existing standalone
Ventilation Shaft / Entrance & Exit

## After


Ventilation Shaft integrated
With MBFC T2


Ventilation Shaft integrated
With Marina Bay Residences


Entrance & Exit integrated
With MBFC T2


Ventilation Shaft integrated
With The Sails

# Key Challenges

**Planning Stage**

- Need to plan ahead of time
- Need for close coordination with other infra agencies

**Construction Stage**

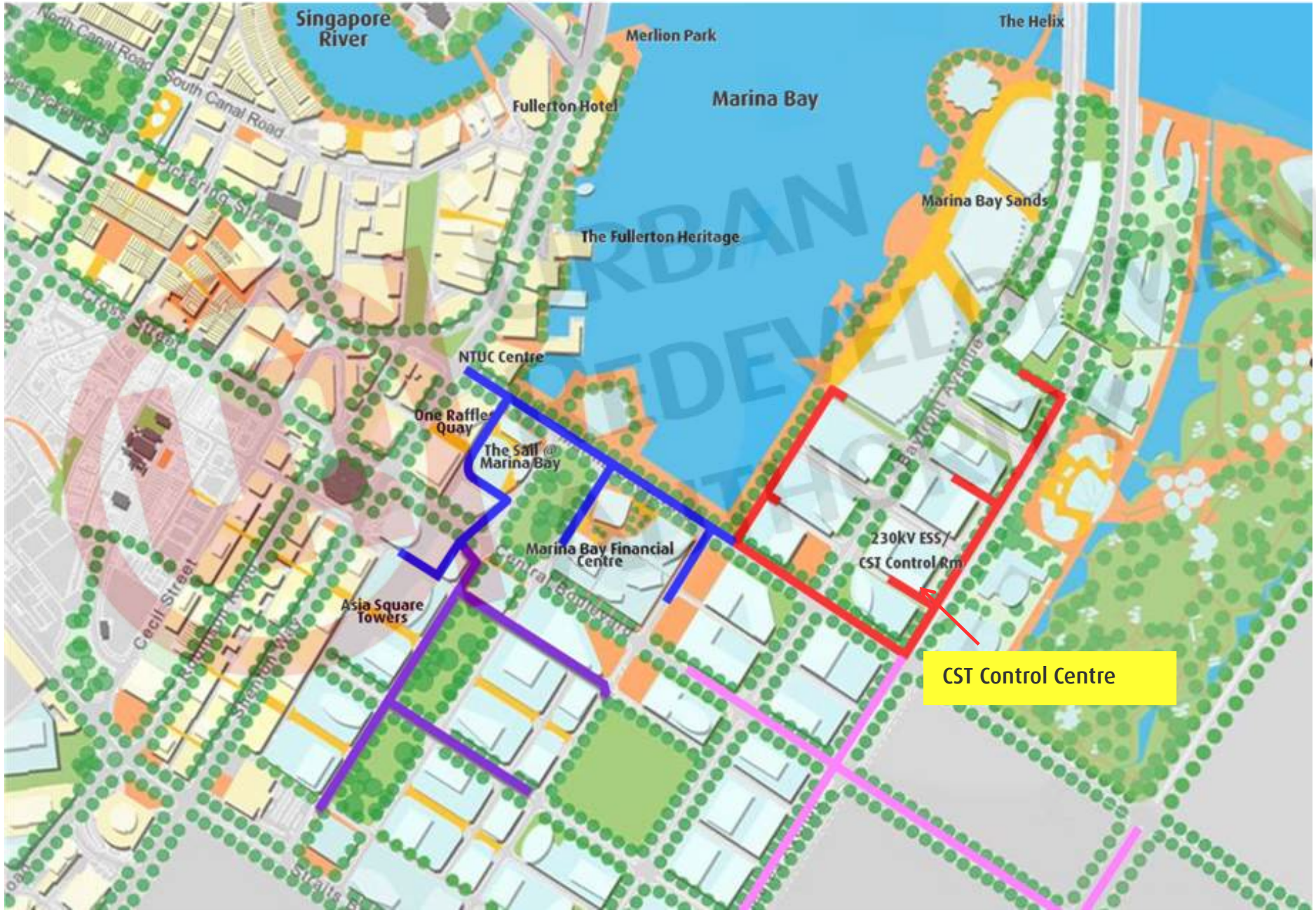
- Reclaimed Land

**O&M Stage**

- Security of CST
- Protection of CST structure

# Operation & Maintenance (O&M) of the tunnels

# CST Control Centre



# Systems in the CST Control Centre

Operation & Maintenance

- 24/7 Manned

- Operation & Management of the CST
  - Monitoring & control of all systems
  - Security checks
  - Recording of  utility usage by the users
  - Auto-paging when system malfunctions
  - Routine maintenance

# M&E systems in the CST


Safety systems

- Fire Detection System – ensure fire safety
- Ventilation system – ensure good air quality
- Environment Monitoring system – ensure the environment is fitted for work.
- Comm. System – establish comm during emergency
- Lighting System – ensure work is done safely.

# M&E systems in the CST

Security systems

- Access control & CCTV system - to ensure all entrances are secured
- Magnetic contacts & Infra Red detectors – to ensure all access points are secured

CCTV Camera and Monitor

# District Cooling System

# Conventional Aircon System

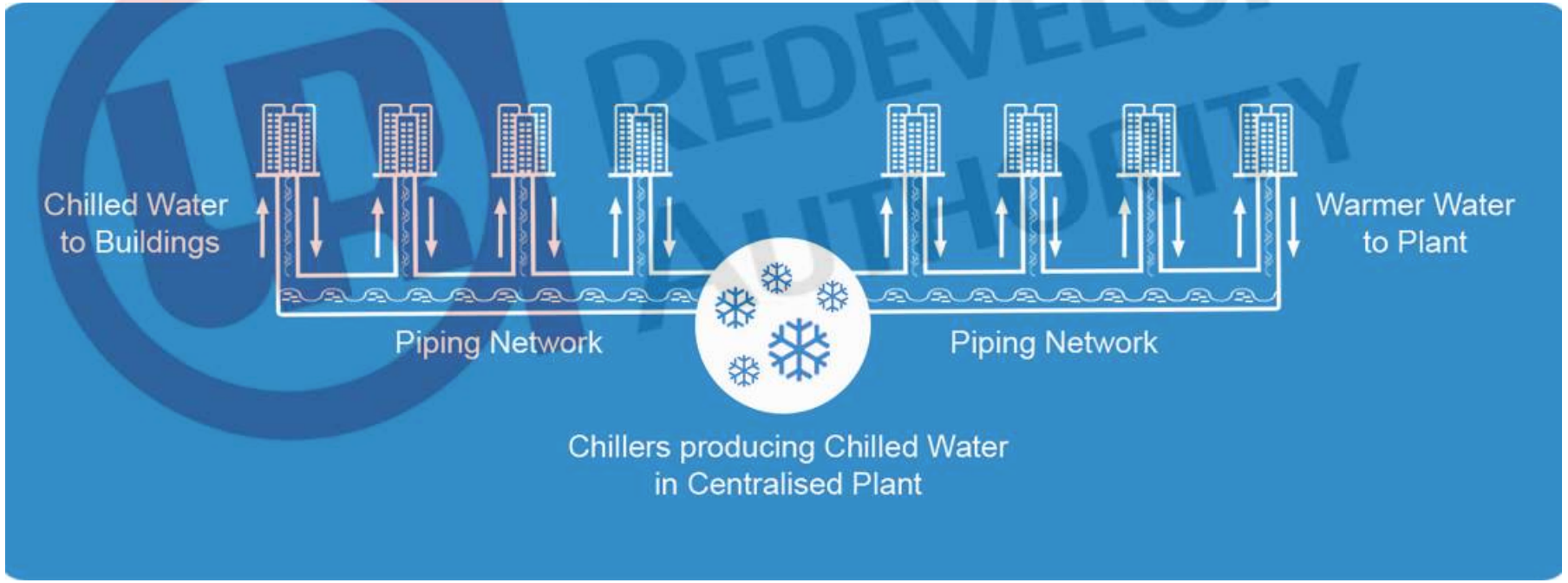
- In-Building Chiller Plant (IBCP) System
- One building, one chiller plant

Rooftop cooling towers

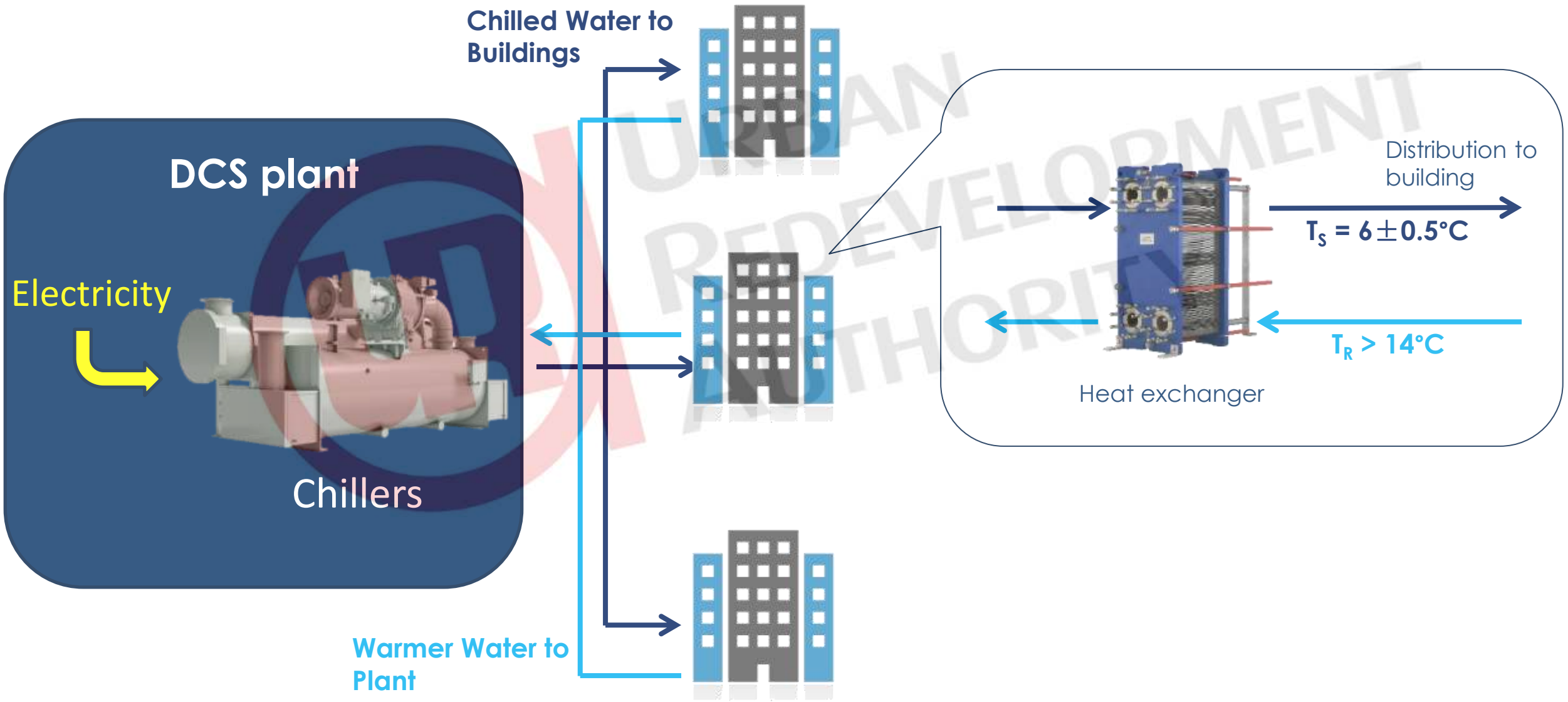
Chiller plant room

# What is District Cooling?

The general idea of DC is the production and distribution of chilled water from a central source to facilitate air-conditioning.



# Supply connection and interface

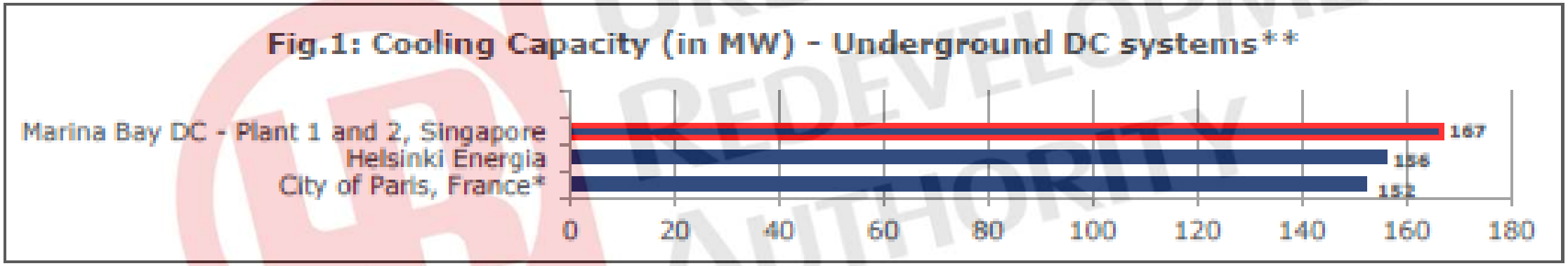


# District Cooling System (DCS)

- Single operator
- Operates as a business
- Operates as a utility
- 24/7 Professional O&M
- May have thermal storage system

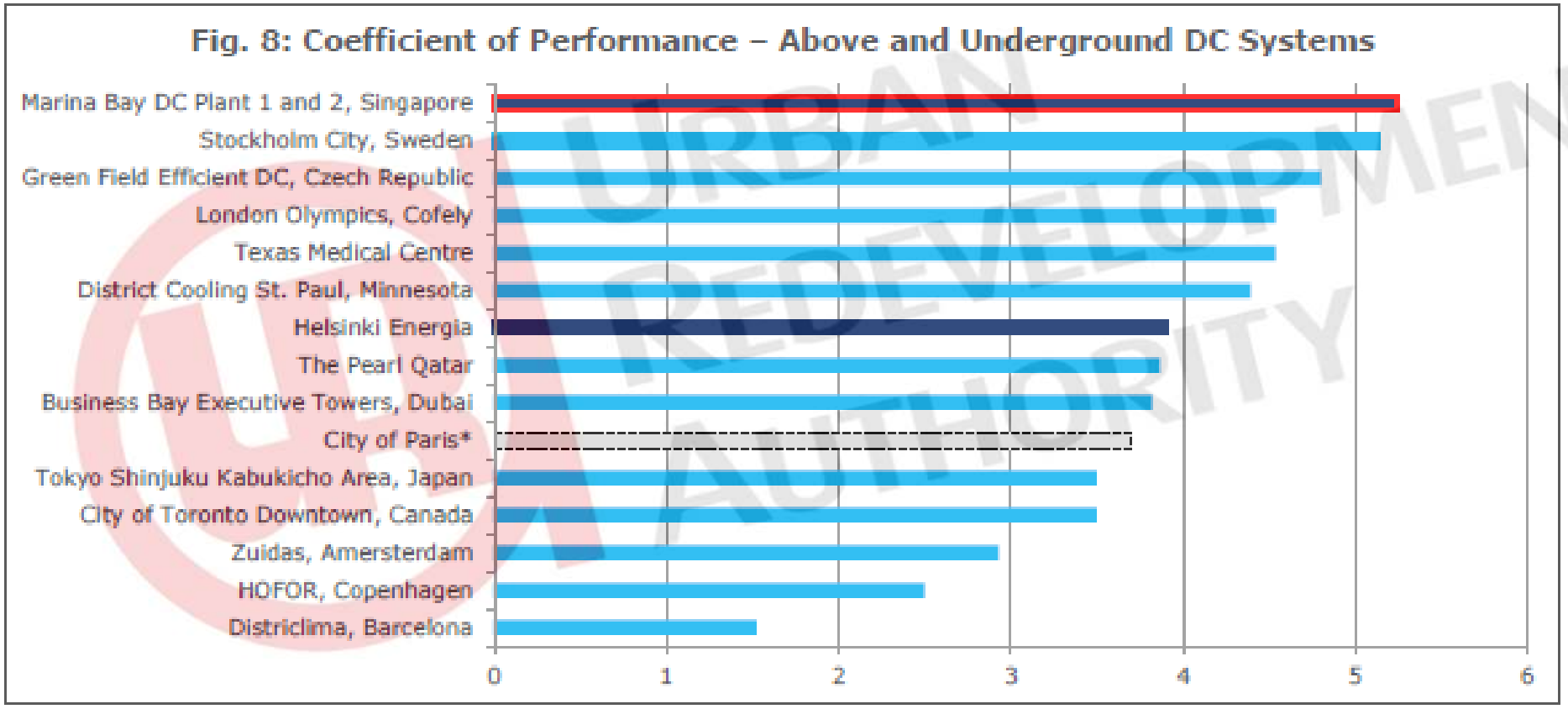
# Largest Underground District Cooling Network In the World

# Largest Underground District Cooling Network In the World




* According to DNV.GL Benchmarking Report 2014

# One of the Most Energy Efficient DC System in the World




* The City of Paris DC system in France is a partial underground system, with only 5 out of its 7 production plants being underground.

*** According to DNV.GL Benchmarking Report 2014**

# Benefits of District Cooling

# Asset Efficiency

- Minimal upfront capital cost

Conventional In-Building Chiller Plant

District Cooling

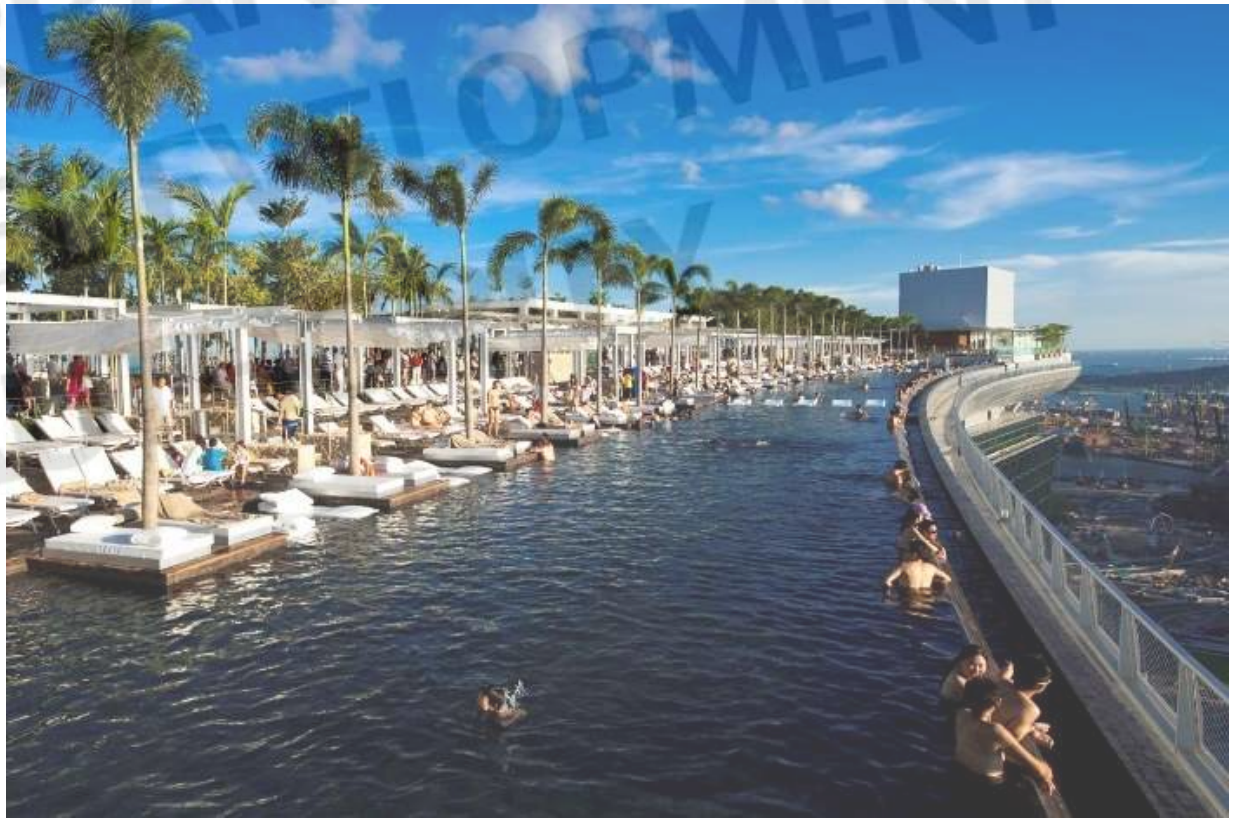
# Asset Efficiency

Thermal Storage Tank

- Stored cooling energy in the form of ice or chilled water stored at night
- Used during peak in cooling demand to help reduce peak demand ("Peak Shaving")
- Reduce chilled capacity of DCS

# Better Roofscape

- Full exploitation of roof-top spaces



MBS Hotel Infinity Pool

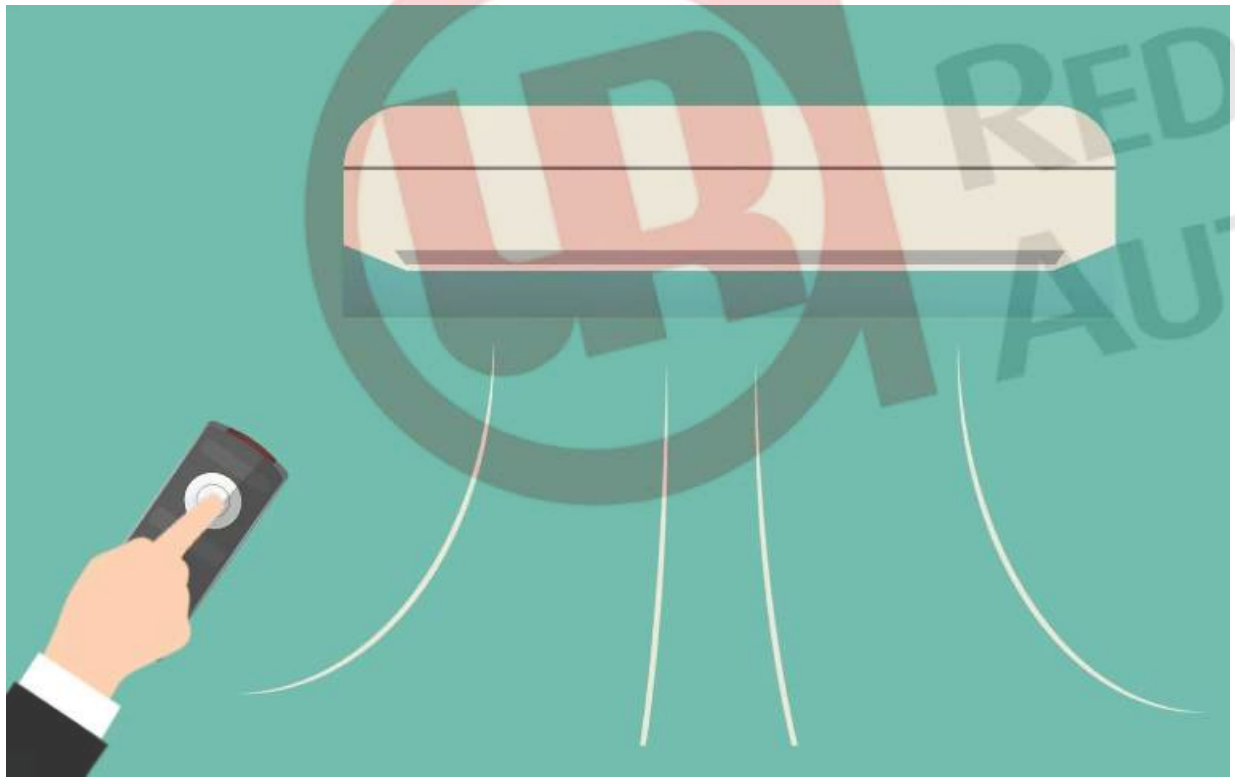
# Better O&M Reliability

## Dedicated O&M Team

- Attention to details by the professionals
- 24/7 stand-by and monitoring
- Fast response to any equipment failure

# Other Benefits

- Greater awareness of consumption
- Manpower savings



# Savings in Electricity Consumption

Marina Bay DCS electricity savings

**80,000 MWh***

Sufficient to power up 23,718 number of Singapore public housing 3-room flat, annually

*** Study done in accordance with the World Resources Institute's Greenhouse Gas Protocol Corporate Standard, 2015**

Source: SP Group

# Reduction of Carbon Footprint

Elimination of over 34,000,000 Kg of $CO_2$

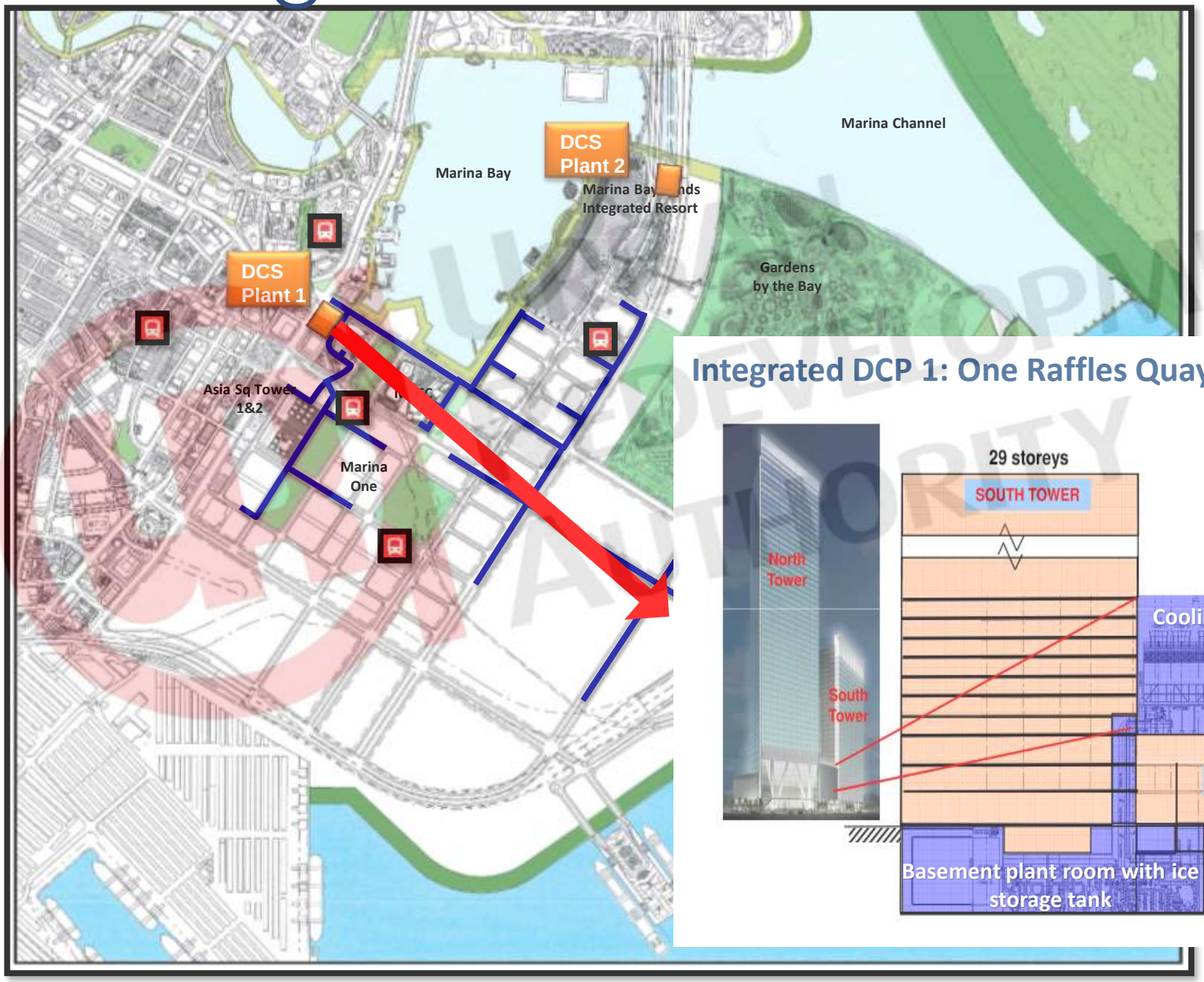
Removing 10,381 cars from the roads every year

*** Study done in accordance with the World Resources Institute's Greenhouse Gas Protocol Corporate Standard, 2015**

Source: SP Group

# Marina Bay District Cooling

# District Cooling Plants




## Integrated DCP 1: One Raffles Quay

# District Cooling Plants

## Integrated DCP 2: Marina Bay Sands IR

# Developer's Feedback

"We can say that [DCS] has been extremely helpful in a number of ways:

- It gives our tenants **"24/7" service demand and increased flexibility and more reliable services** than traditional chiller plants
- It has **simplified the architectural design process** by not having to disguise large cooling towers and chiller plant rooms."

Mark Rada
Project Director
Asia Square Towers 1 & 2

"It has been our pleasure to work with Singapore District Cooling to ensure optimal operating conditions are maintained at Marina Bay Sands.

We have had regular discussions to reviews operations and explore options, with the aim of providing best practices and setting new standards for the industry. We look forward to working closely and collaboratively with Singapore District Cooling to achieve greater energy savings."

Raymond Koh
Vice-President, Facilities
Marina Bay Sands

# Facilitating DCS

# Why facilitate?

- High capital costs
  - Requires enough customers within short period of time
- Stable policy framework required
  - E.g. provisions for pipe laying in public/private land
- **Government needs to facilitate for DCS to succeed**

"DC is a capital intensive business… and thus the barrier of financing is ever present….The capital intensive issue makes DC not the preferred business for many investors.

The lack of a stable policy framework [e.g. rules for pipe laying in private/public ground]…furthermore increases insecurity and makes a sound financing difficult."

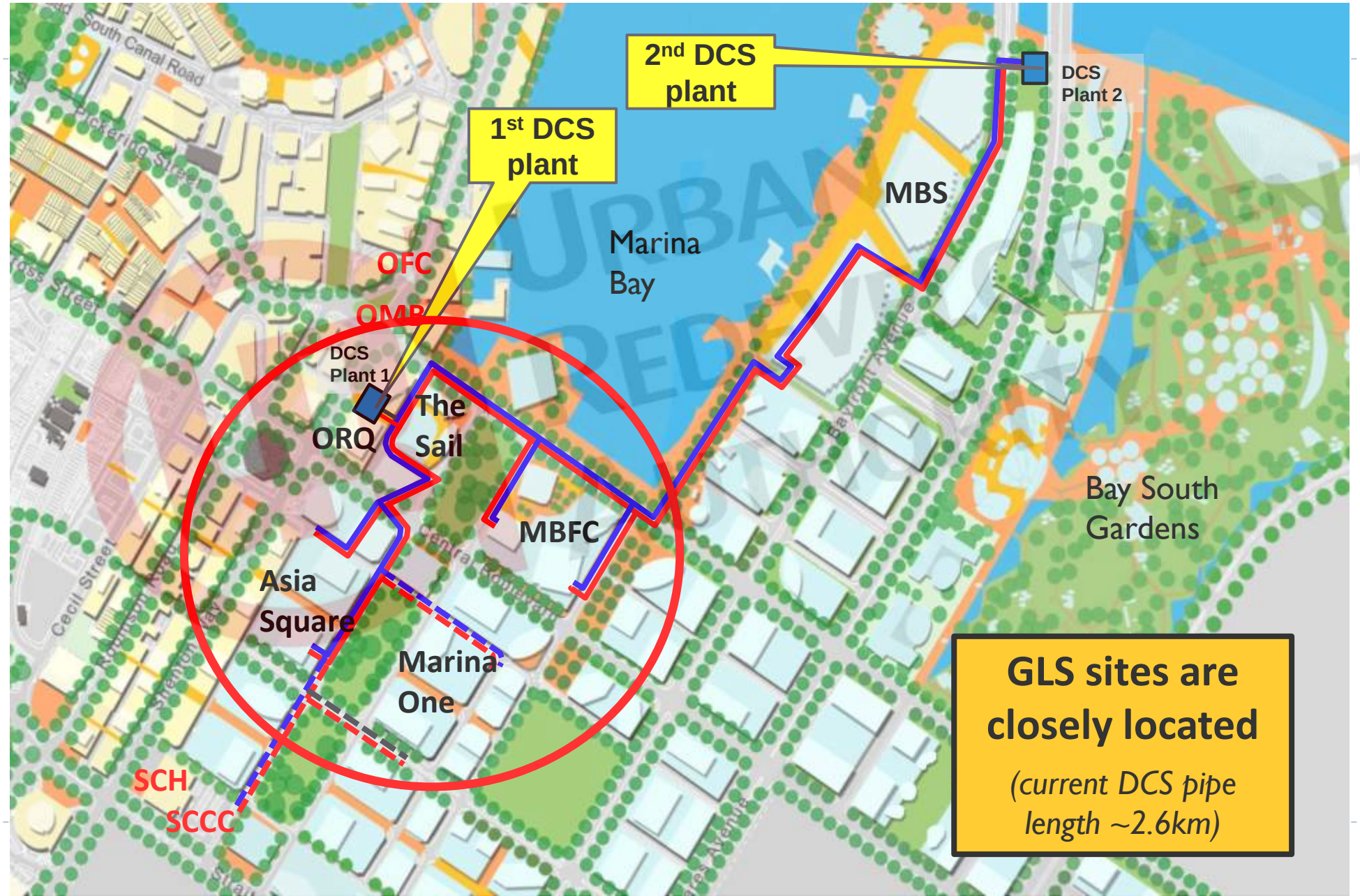
*Ramboll, Hot|Cool 1/2013 (international magazine on district heating and cooling)*

# DCS Pilot Zone Facilitation

- Mandated use
  - Ensures build up of critical mass
  - EMA as regulator to safeguard users' interest
- Staging GLS programme to facilitate DCS
  - To build up critical mass quickly
  - Sites relatively closely located
- DCS space provision
  - Network in CST
  - Integrated plant



# Facilitating DCS through GLS



# Facilitating DCS through GLS

| Facilitation strategy | | Pilot zone |
|---|---|---|
| **Mandatory use** | | ✓ |
| **Staging GLS programme to facilitate DCS** | *Quick build up of sites* | ✓ |
| | *Closely located sites* | ✓ |
| **Infrastructure provision** | *CST network* | ✓ |
| | *Integrated plant* | ✓ |



# JURONG LAKE DISTRICT


*Singapore's West Region is home to Jurong Lake District, Singapore's top two universities, Tuas Port, Jurong Innovation District and one-north.*

Urban Redevelopment Authority

# JURONG LAKE DISTRICT

# COMMITING TO SUSTAINABLE GROWTH


## City in Nature

- Double annual tree planting between 2020 and 2030
- Increase nature parks' land area by over 50%
- Every household within 10-min walk from a park

## Green Buildings

- Green 80% of Singapore's buildings
- 80% of new buildings to be SLE buildings
- 80% improvement in energy efficiency

## Green Commutes

- 75% mass public transport peak-period modal share
- Expand rail network from by 120km by early 2030s
- Triple cycling paths by 860km by early 2030s

## Green Energy

- Increase solar energy deployment by five-fold
- Best-in-class generation technology that reduces carbon emissions
- Diversified electricity supply

# Thank You


Image taken by Goh Hak Liang
1st Prize Winner of MBSC 2015 Photo Competition