TOTAL RESILIENT APPROACH - GENERAL STRATEGY

The Total Resilient Approach aims at an inclusive sustainable development based on a multilevel protection at the urban and the harbor scale.

Generating a mosaic of coastal bio-structuring habitats, prone to sea level rise, a stream of ecological services will be made accessible to developmental citizens:

- flood protections, connecting and supportive living structures;
- regulation of fresh and marine waters and best use of solar, tide, wind and wave energy;
- photosynthetic algae production, fisheries, horticulture and recreational networks for carbon sequestration, bio-fuel and compassionate local food production;
- bio-regulation of post–panama harbor channels integrated to tidal network;
- public rail and bike routes;
- space for wind turbine, solar panels, algae fuel production, biodiversity, community fisheries;
- creative opportunities for man and endangered species.

Boston, similarly to Venice, will be totally resilient because outer green dikes, mobile barriers, and a mosaic of interweaved water interfaces will protect the city from sea level rise, with minimum damages in case of a storm exceeding design criteria.

The developmental transformation strategy of working at different scales within the same framework will result in a progressive harmonic implementation of the project for a sustainable and persistent co-evolution of the natural and socio-economical system.

This comprehensive open approach calls for the creation of a living toolbox.

BOSTON HARBOR STRATEGY

Vision

Coastal landscape of Boston Harbor is going to withstand sudden changes due to global warming and sea-level rise and population encroachment. This kind of landscape is suitable for strong dynamics with only a residual degree resiliency. What is not actually suitable for transformations is a frozen man-built environment. The capacity of artifacts to change along their lives strictly relates to the capacity of renovation actions undertaken by men and based on living toolbox.

The threat of short time water level rise gives way to possible economies capable of driving strategic choices that makes it possible to design ecosystem based infrastructures and implement the ecosystem based approach .

The options of defense represent a melting pot of opportunities for accelerating the transformations toward a new landscape in harmony with compassionate citizens.

The interaction of different technical expertise and needs is hence the perfect landscape architecture toolkit to interact between man and nature, resulting in a progressive transformation of the bay into a safer and friendlier place to live with nature.

Method

Urban development and territorial transformations undergone during 19th and 20th centuries resulted in the drastic reduction of littoral, tidal flat and salt marsh habitats with the loss of their bio-structuring capacities in time of increased urbanization and global change pressure.

The mosaic of interweaved natural works at the bay scale will restore ecosystem protecting functions, improving biodiversity and enhance accretion of self-adaptive habitats (microbial mats, eel grass, tidal flats, salt marshes, oyster reef, dunes).

Imported sand and re-use of harbor dredged sediments will be extensively applied to regenerate the ecosystem.

Because of its relatively large tidal range, Boston Harbor is reasonably well flushed. Shea and Kelly (1992) estimated the harbor residence time to be about 3.4 days. Hence the presence of the storm gates represents an opportunity to control carbon cycle and water quality by judicious phasing of their opening and closing, as has been proposed in Venice with the Mose gates. The gates will be operated also to preferentially transport spilled contaminants offshore where it would have less impact or easy contaminant removal.

The reactivation of estuarine hydro-morphological and biological processes will create new opportunities for coastal regeneration, including community fisheries.

The gates will complemented with super levee connecting the southern and northern part of the harbor by rail and bike.

URBAN SITE LEVEL STRATEGY

Vision

The focus on Columbia Point gives the opportunity to organize a set of actions, an intervention toolkit, capable of showing the possible results on short-term interventions. The long term operation on Boston Bay will add benefits to these first term interventions.

Today water is mostly regarded as a threat, as it is clearly visible by hard elements at the shores. What we are looking for, is a new relationship with nature through connecting salty and fresh waters.

The marine wetted perimeter will be extended by new channels. A network of acquatic habitat will be installed in and around the urban area. The habitat will be equipped to be part of the human settlement being used for any kind of easy available recreation.

The new landscape expressed by the project is equipped with the toolbox necessary for conducting a compassionate and economically sustainable regeneration of the Boston Harbor communities.

Method

<u>The system of transportation infrastructures</u>

Transportation infrastructures represent the core elements of the design proposal:

Raised multipurpose Boulevards: Morrissey is elevated at 18ftto maintain its functionality in the worst case scenarios and to convert it into a physical protection for lower areas. The levee includes the adjacent buildings creating a multifunctional platform: underneath the street a system of water cisterns is set to increase the area's resilience to storm events and at the same time to reuse processed water. Other

facilities includes: parking spaces underneath new buildings and utilities (dual aqueduct network, water condensed waterloop).

Amtrak station and neighborhood connections: JFK/UMass Station represents the main site connection to the city. Its renovation will be realized in stages, conforming it to the new altimetry planned for the site. This new multilevel building will include a service platform at lower level, allowing a direct pedestrian connection with the Dorchester neighborhood and the train station. The higher parts of the building will host neighborhood facilities and a mixed use spaces to maximize the building hours of operation.

Slow mobility: the proposed Columbia Point bicycle and pedestrian network spans from the peripheral cycle paths along the peninsula borders to the internal connections which provide slow mobility routes alternative to Mt Vernon St.

The water management system

Two connected ecosystems are proposed: the seawater system connected to the bay and the freshwater system which processes rainwater and wastewater.

Seawater: three new waterways provide a direct connection between the bay and the peninsula's internal neighborhoods: two run along Morrissey from Savin Hill Cove to the site's center, the third runs along the Harbor Blvd and ends aside Harbor walk. The combination of the three allows a natural tidal flushing of the water parks.

Water circulation is also used to feed a water condensed water loop through a central heat-exchange station. The water loop – serving the near redevelopment – is then connected with heat pumps serving each building.

The first two canals are urban extension of Savin Hill Cove salt marshes within the area, they improve the landscape's biodiversity offering new opportunities of leisure and allowing a direct contact between the residents and the re-naturalized environment.

The new Harbor Blvd canal has an urban character, hence the banks have been modeled to host various facilities according to their different levels above water: boat pier, dock, waterfront terrace, bike paths.

Fresh water: A system of freshwater streams hosting floating gardens is proposed in the northern part of the site. Its purposes are phytoremediation wastewater treatment - in the two ponds serving the new settlements- and water collection in the wetland along the eastern side of Morrissey.

This wetland feeds the water reservoirs placed under the boulevard and it increases the area resilience against storms. Any excess of water is discharged in the adjacent canal during low tide or with pumps in case of emergency.

The tide protection system

To protect existing and redevelopment areas two possible approaches have been devised:

Urban seawalls: Harbor Point will maintain its actual configuration and altimetry (10 ft). The site is subdivided into two areas and their perimeters elevated at safe level (15 ft) through the creation of multipurpose urban seawalls which take various shapes: that of a dune park along the eastern shore, that of a bank and bicycle path along the Harbor blvd Canal; the rest of them is integrated in the near park design. Within each enclosed areas a pond is created to store rainwater. Such basins are then emptied into the sea during low tides or discharged with pumps in case of emergency.

Levee: where major urban renovations are planned a comprehensive approach is adopted: ground level is reset at 18-15 ft. Ground reshaping is obtained by reusing excavated ground for canals creation and through the installation of urban facilities underneath these levels (parking, water cisterns, utilities, etc.). Both Morrissey and the Columbia Point Master plan redevelopment areas are proposed to be rebuilt on levees.

To protect the peninsula from erosion a system of oyster reefs and eelgrass meadows is proposed along the eastern shore while a salt marsh reconstruction is proposed at Savin hill Cove.

Such spaces offer further uses to trigger local participation: an urban park along the bay where seasonal activities and community initiatives take place (e.g. Summer festivals, horticultural societies, etc.) and a one to one scale eco-lab in Savin Hill Cove serving U-Mass research projects (e.g. bio mimicking, water treatment, renewable energies, etc.).

<u>The system of morphological elements and park.</u>

Infrastructures.
The site of Columbia Point presents a heavy infrastructural backbone that shapes the landscape. The whole area is actually a reclamation on the coast, and freeways, tracks and roads act as morphological elements defining inner and outer sides. On the proposal, these linear elements become part of the design integrating the new safety levels required. Morrissey clearly becomes the new safety line on the coast, generating a development platform along its inner side. The coastal line, redesigned as a dynamic system of sand dunes, designs both a natural landscape and a first defense against sea level rise. Water streams in the northern part of the site are designed within a park connected through a linear system of walkways.

Open spaces. The collection of vast and different open spaces of Columbia point is put into contrast with the articulated waterfront on the bay. By letting water enter and circulate the site through different ecosystems, the proposal seeks for a more articulate interface between land and water, with transactions through dikes, terraces, sand dunes, marshes and wetlands. The augmentation of water interface area is generally thought as an invitation to use the open spaces as connecting surfaces for pedestrian and bicycle mobility. Similar to existing linear parks like the Emerald Necklace, this collection of various open spaces combines leisure with mobility. Green areas integrate the existing developments looking for a sense of integration between older blocks and new developments.

Buildings. Urban settlements along Morrissey are developed in close connection with infrastructure acting as water protection device and with open spaces. The new landscape generated by the raise of the road lines and the presence of water in the mainland is counterbalanced by the development of urban blocks of residential and mixed use buildings. New settlements culminate with the redesign of the new JFK-UMASS train station that develops as a central point for activities and connections through the rail line and South-East Expressway, the building itself becoming the bridge on east-west connection.

Landscape Ecology. Columbia Point, despite its conspicuous human presence, is of ecological interest for its condition of borderline between ecological systems. The proposal tries to enhance the presence of ecological clusters, researching the ecological complexity typical of borderline conditions. Most of the coastal line is hence turned from a rock waterfront into a sand dune habitat capable of nesting a multiplicity of animals and plants. The whole system of saltwater canals entering the site touches various gradients of land and sea conditions, from beach to marshland to earth slopes. On the northern part, freshwater basins and canals develop a different ecology and habitat. We believe that the combination of

significantly sized natural habitats, each with specific character, would generate a particularly rich landscape ecology paradigm.

Greenways. Confirming the existing road network and consolidating the presence of the JFK train station, raise the question of connection between public transport and conspicuous points like UMASS and JFK library. As the proposal developed, it became clear that the opportunity of using the collection of open spaces as a network of paths was structuring a backbone of greenways, of different nature, allowing for pleasure and safe movements through the whole of Columba Point.

ECONOMIC SUSTAINABILITY

The proposed Living with nature adaptive measures fully comply, at the local scale, with the worst case scenario of sea level rise presented in the call.

The overall costs for the specific urban site is estimated in the order of 80 mln USD:

- Canals' excavation 20
- Fills and shore restoration 15
- Urban facilities 5
- Civil works 40

Housing construction costs (1 Billion USD as estimated by the Columbia Point Master Plan) are not included and will be sustained by third party developers.

The long lasting adaptive transformation and co-evolution of nature and bay will be obtained by the system of mobile gates and related infrastructures, enabling the whole Boston harbor territory to face extreme sea level rise scenarios and storms.

The budgetary cost of the system of works to control the water level in the bay area, to face any sea level rise scenarios is in the order of 5 Billion USD. Such investments include the construction of the mobile barriers and the associated infrastructures for the re-activation of the ecological services of the bay.

This cost could be partially covered by the investment for using the barriers as transport infrastructures.

In terms of benefits, this system has higher resilience and operational flexibility and allows:

- protection against flooding of the territory from extreme events, through the management of river flows and open-sea storm tides through an optimized combined use of Charles and Mystic rivers barriers and storm barriers at sea;
- better control of the emergencies and worst case scenarios in a more flexible way, adapting to different combinations of storm factors;
- management of water quality through a better control of inflow and outflow through the rivers and the bay inlets;
- protection from extreme events and tides of the self-adaptive capacity of the bay environment (e.g. salt marshes and oyster barriers);
- better and safer management of the harbor activities and Massachusetts bay economic activities.

With reference to the Italian experience, the benefit vs cost analysis carried out in the design phase of the Venice Mose system (1997) demonstrated the positive economic balance of protecting Venice from flooding just for the cost saving connected with the physical damages induced to the city by the flooding,

and a more recent independent economical study by the University of Padova (2010) demonstrated a positive balance reached in just 50 years only considering the cost of the maintenance of the buildings damaged by flooding.

To conclude, a benefit vs. cost analysis has to be used to evaluate the integration of the “living with water” approach with a system of mobile storm surge barriers enabling the whole bay territory to face future sea level rise scenarios. A positive result is expected from the analysis.