Stormwater Management in Tama, Japan

5 Typologies and their relative benefits

Kristal Peters

Goal: To harvest, treat and use stormwater for on-site household, industrial, commercial, agricultural and energy production purposes in order to reduce the overall water load entering the municipal water system.

Guiding principles behind Stormwater Management:

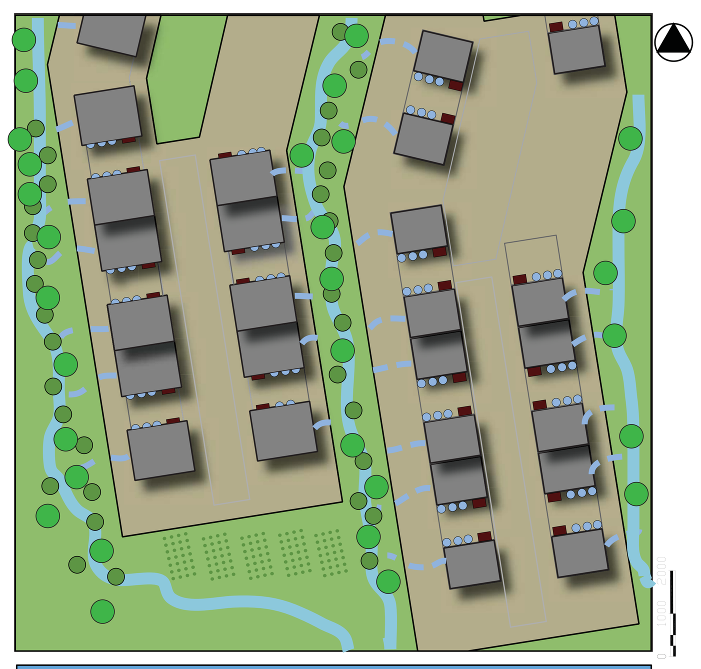
1. Maximize on-site stormwater management.
2. Integrate stormwater management components for capture, conveyance, filtration, storage, distribution and purification into building typology and site design.
3. Integrate stormwater management components with those used for gray water and waste-water management, agricultural systems, energy production and information technology.
4. Use more natural elements to manage stormwater to encourage biodiversity/ the creation of micro-habitats for plants and animals.

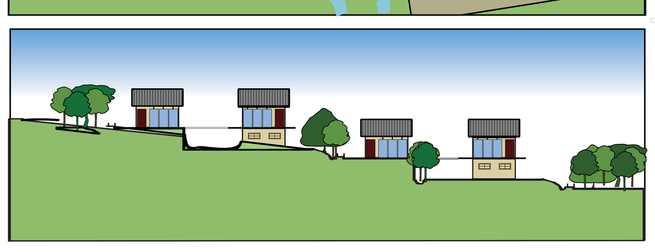
Overall Challenges

1. Retrofitting and redesign of existing buildings and infrastructure to allow for on-site stormwater management.
2. Requires a social and cultural paradigm shift in approach to stormwater use and treatment.
3. Micro-habitats require monitoring to ensure balance of symbiotic relationships between species.

Opportunities

1. With new construction, there is the opportunity for new building and site design typologies.
2. New topics for research and development related to stormwater management.
3. Community members become active participants in their water management systems.
4. Reintroduction of nature can enhance the environment and improve sense of wellbeing.
5. Innovative use of stormwater improves local economy. New systems can be less expensive to build and maintain. More localized water management reduces costs of conveyance of water to and from central water treatment plants which themselves are expensive to oper ate. Localized water treatment can also create new job opportunities for the local commu nity.





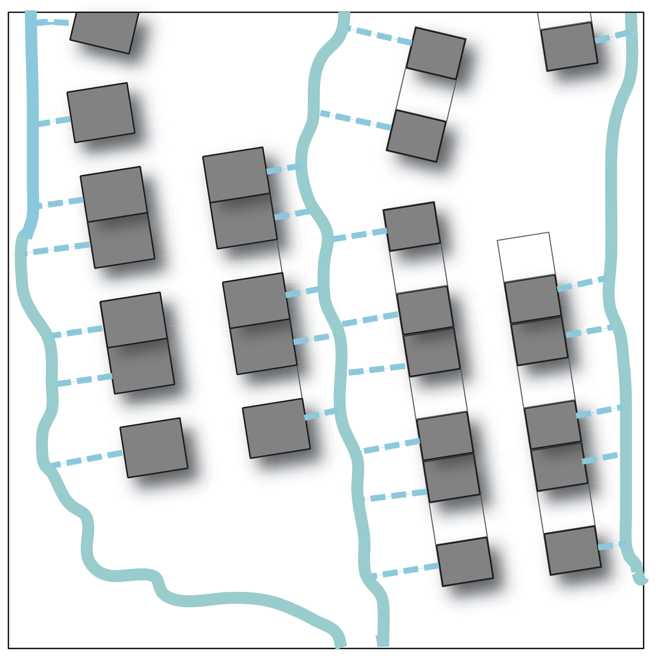
Multi-Family Building 1

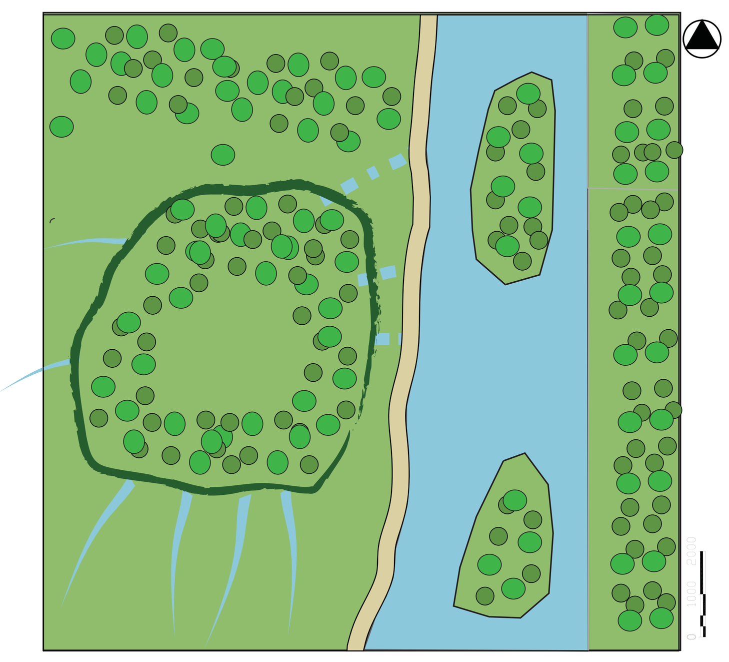
Description: These units hug the contours of the slopes to form a series of terraces that descend into the lowlands. Two units share a common deck area where harvested rainwater is stored along with other building systems control panels. These decks create openings in the facade to allow for cross-ventilation between the units and the central corridor. Runoff and greywater from the upper slope is treated in lower swales immediately adjacent to the site.

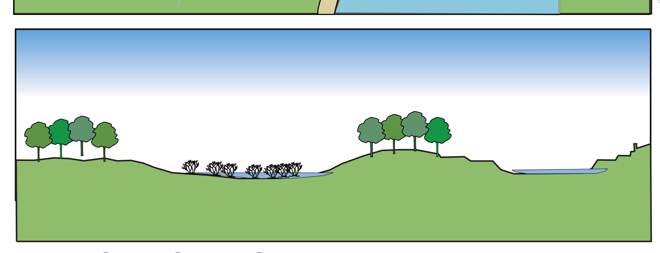
Pros: Each unit harvests its own rainwater on the immediate site for household use. Water receptacles are integrated into the form of the unit and complex.

Cons: • Tenants are responsible for the maintenance of their own water collection and treatment system.

Best Usage: Parallel to the contours of the slope.







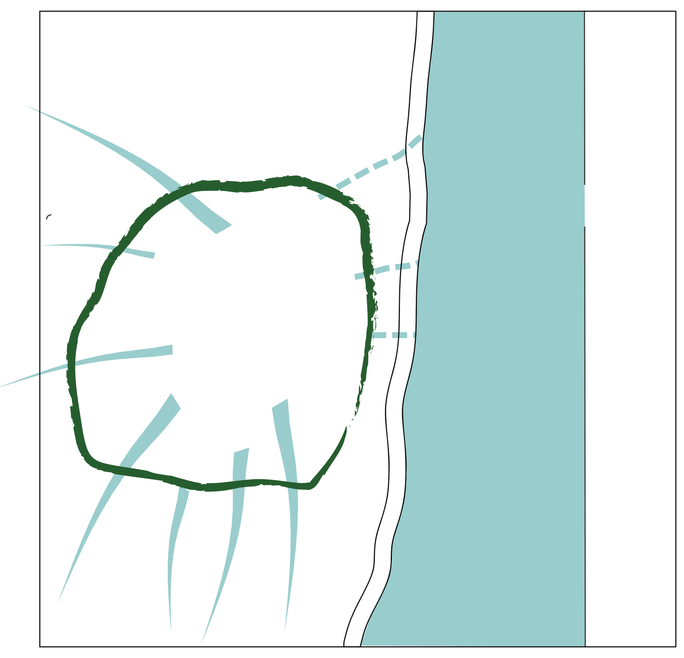
Wetland and Green Stream

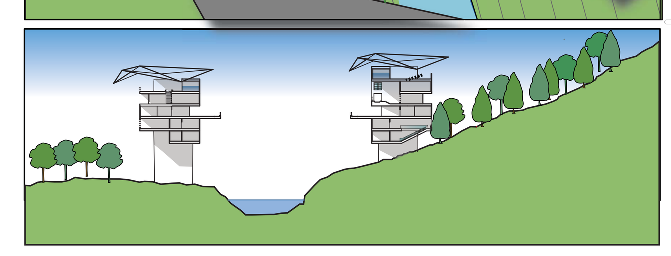
Description: The wetland is located to the immediate west of the stream, and serves to treat runoff and greywater coming down the slopes. Flow is controlled through inlet and outlet valves and feeds into the stream. The size of the actual wetland will vary according to the size of the area served by it. Small earth mounds are located along the stream bed to slow the rate of water flow and also to create other habitable spaces for plants and animals.

Pros: • Wetland retains, treats, and then slowly releases runoff and greywater. It can also serve as a habitat for wildlife, and so too can the vegetated earth mounds.

Cons: • Wetlands may require delicate maintenance to ensure that it continues to work as a natural water treatment system. Because of this recreational activity may be restricted around the site.

Best Usage: • At the base of a slope where the gradient is very gentle of almost flat.





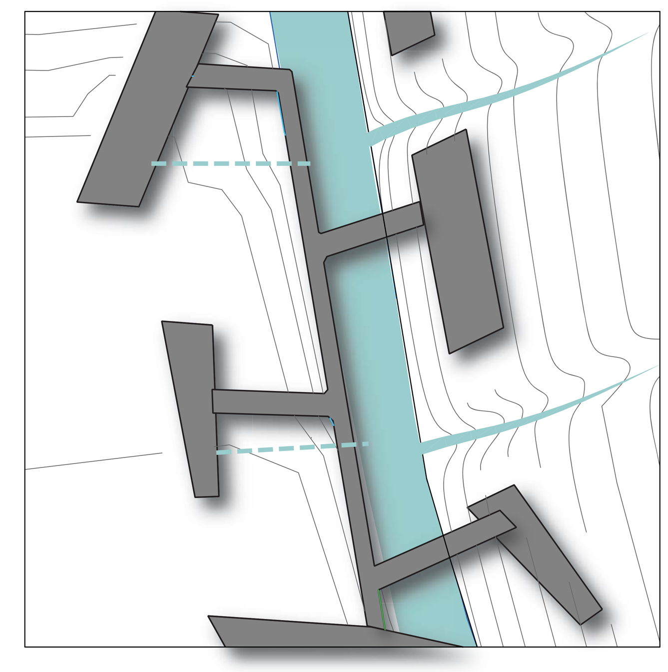
Mixed-Use Building Straddling Stream

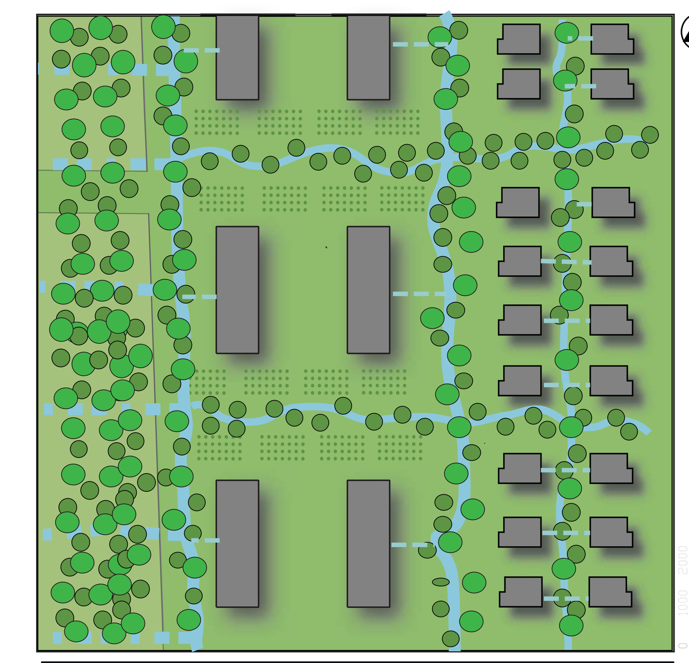
Description: The multi-use complex straddles the stream/rivers that goes through the town. Various activity spaces are suspended from an enormous structural system. The roof is comprised of a series of undulating panels with funnel openings to channel captured rainfall. Water cisters are located under the floors of the lowest deck to be used by tenants on site.

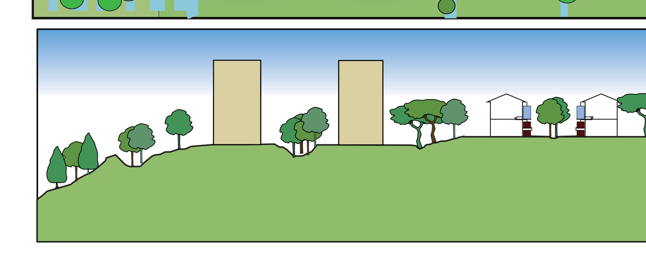
Pros: Tenants are in close proximity to water (harvested rainfall and stream), and this fosters an intimate relationship between man and the natural elements. Water collection, conveyance, storage, treatment and disposal components are integrated seamlessly into form of building.

Cons: Positioning the building so close to the stream may make it vulnerable to flooding. Care must be taken to ensure that tenants do not pollute water in stream.

Best Usage: • Sites with potential for new water-front developments.







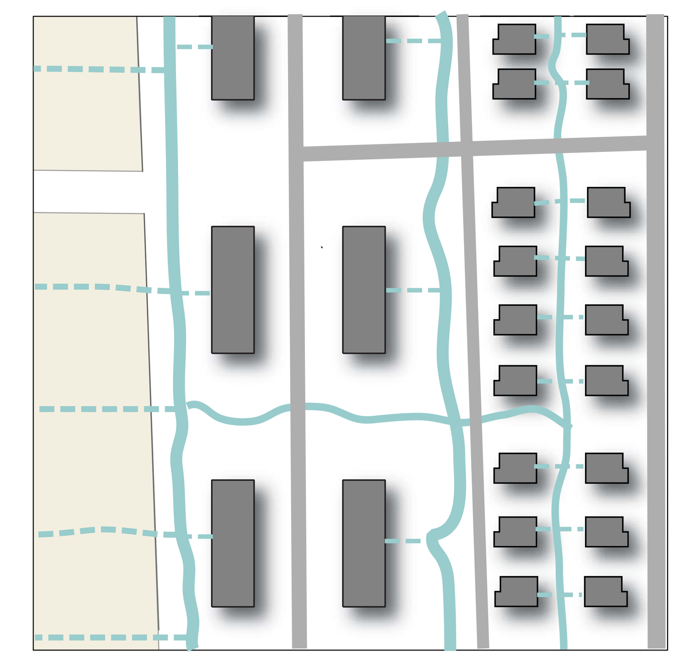
Multi-Family Building 2

Description: Rainfall is harvested from the detached house units, stored in cisterns, and then the greywater produced in collected and treated. Treated water is then channeled to a vegetated swale . On-site runoff also goes to this swale for treatment and dispersion. Greywater from larger buildings is first directed to large vegetated swales.

Pros: On-site water collection, treatment, and disposal reduces the need for massive community scale infrastructure to handle the water load. Swales create a more natural environment in which runoff and greywater can be treated and dispersed. They may also function as a micro-habitat for plants and animals. T Water receptacles are integrated into the form of the unit and complex.

Cons: Intensive construction and dredging necessary for placement of underground pipes.

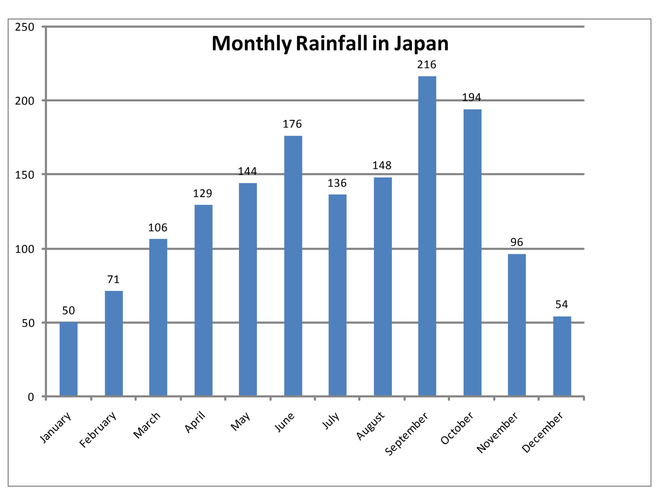
Best Usage: Suitable for steep slopes on which run-off may be very difficult to control.



Metrics in Stormwater calculations

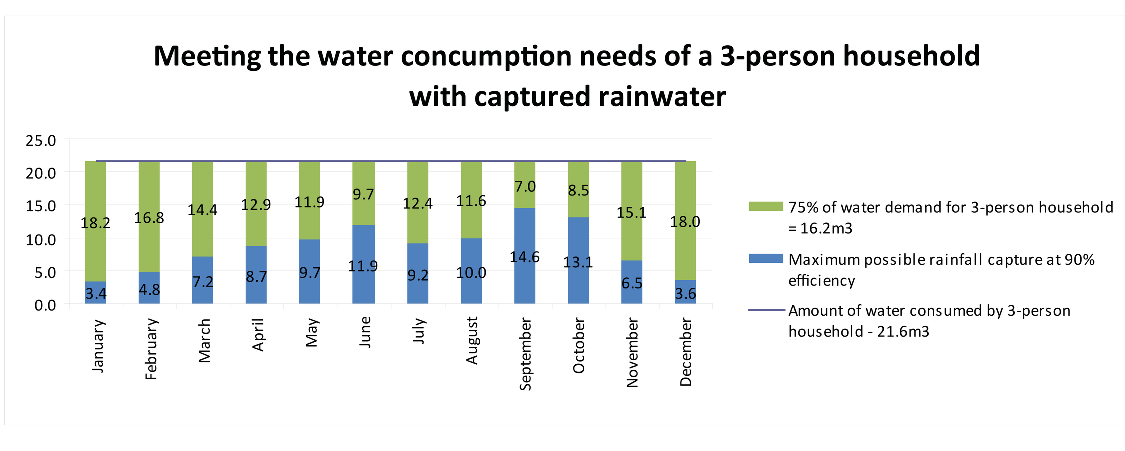
In order to design a rain water harvesting system it is necessary to estimate the number of users as well and know the pattern of rainfall throughout the year. Chart1 shows the average amount of rainfall per month in Japan. Another important metric used to calculate rainwater harvesting potential is the runoff coefficient which is a measure of the ratio of stormwater that will not percolate into a surface. Table2 lists a number of surface types and their re- spective runoff coefficients. For this project, rainfall harvest potential was calculated using the average monthly rainfall, the average roof surface area for each residential unit (75m3) and a runoff coefficient of 90%. The formula is as follows:

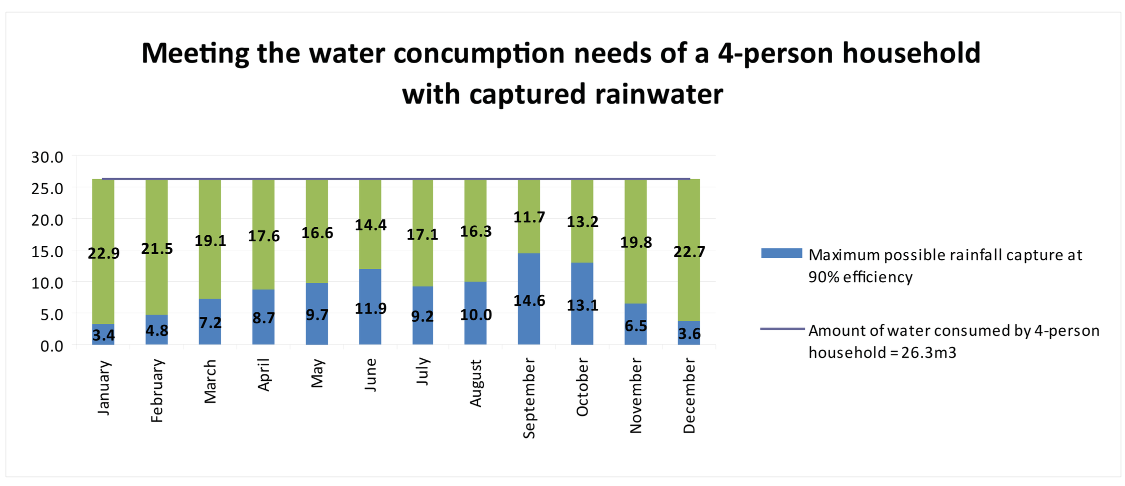
monthly rainfall (in meters) x roof surface area (=75m3) x runoff coefficient (0.9)



Surface	Runoff Coefficient
Forested Area	0.059 – 0.2
Asphalt	0.7 – 0.95
Brick	0.7 – 0.85
Concrete	0.8 – 0.95
Shingle Roof	0.75 – 0.95

Materials and runoff coefficients





Based on the results of these calculations (see Chart2 and Chart3) it can be seen that rain water harvesting alone will not yield enough water to meet the consump- tion demands of either a 3-person or a 4-person house- hold.

For the 4-person household annual total deficit is 213m3 (67%) with a maximum deficit of 22.9m3 (87%) in January and a minimum deficit of 11.7m3 (44%) in September.

For the 3-person household the total annual deficit is 156.6m3 (60%) with a maximum deficit of 18.3m3 (84%) in January and a minimum deficit of 7m3 (32%) in Sep- tember.

Therefore, given the current water consumption levels for 3- and 4-person households in Japan, the residents of Tama cannot entirely depend on rainfall to meet their demands. One possible solution to increase the amount of rainfall captured is to increase the rainfall capture area. Another option is to curb water consumption. If implemented together these two strategies can help reduce the reliance of residents on piped water.