Next Level™
STORMWATER MANAGEMENT

Flora Garden

Intensive Maintenance Guideline

Maintenance needs are project specific and based on the client's expectation, e.g. visible or publicly accessible green roofs often have higher aesthetic expectation and thus require more maintenance. The schedule in Table 1 is intended for general recommendation only. It should be tailored according to project needs and climatic conditions.

Table 1: Maintenance schedule for Flora Garden intensive green roof systems

After Installation	Frequency	Approximate timeline
Year 1: Installation month and following month	Weekly to bi-weekly	
Year 1: Spring (after last frost)	2x per season	Mid May – Early June
Year 1: Summer	5x per season	Mid June, Early July, Mid Aug, Early Sept, Early Oct
Year 1: Fall (before first frost)	1x per season	Early Nov
Total visits Year 1:	**Approx. 12**	
Year 2: Spring (after last frost)	1x per season	Mid May
Year 2: Summer	5x per season	Mid June, Mid July, Mid Aug, Mid Sept.
Year 2: Fall (before first frost)	1x per season	Mid Oct.
Total visits Year 2:	**7**	
Year 3: Spring (after last frost)	1x per season	Mid May
Year 3: Summer	4x per season	Mid June, Mid July, Mid Aug
Tear 3: Fall (before first frost)	1x per season	Mid Sept
Total visits Year 3:	**6**	

** Green roofs planted with traditional landscape perennials & ornamental grasses may have different maintenance and irrigation needs requirements depending on the plant material and exposure.*

1. Rooftop Safety

Rooftops present fall hazards. Maintenance crew must be trained in fall arrest protection and their work must comply with local labour code. All crew personnel shall be equipped with safety gear and tied off when working on rooftops. The crew must be properly trained in Flora Garden green roof systems and how to maintain them. Contact a Next Level Stormwater Management™ representative for details.

2. Dormancy

In Autumn, as winter approaches, green roofs enter the dormancy cycle. As rooftop conditions are harsher than at the ground level, the exposed vegetation on rooftops enter into the dormancy cycle earlier than at ground level. Dormancy is a natural reaction to adverse environmental conditions. It can happen in the summer during periods of intense heat and drought, or in the fall in preparation for the coming cold winter months. During dormancy, plants simply stop further growth and development to conserve energy. Dormancy is a plant's defense mechanism to keep itself alive. The retreating plants are not dead. Dormancy synchronizes with the environment and can be triggered by a temperature drop or sudden changes in climactic conditions, such as reduction in rainfall and water shortages.

3. Plant Performance

Check coverage, health and diversity of vegetation. Note problematic areas and identify causes if possible. Some common problems and solutions are as follow:

- *Ponding:* For small ponding area, remove green roof layers and install additional drainage layer(s) as needed to raise the vegetation above ponded water.
- *Rotting:* Plants may rot and die in standing water. Check for ponding, roof drainage and reduce irrigation frequency as needed.
- *Wilting:* Irrigate until saturation. Repeat in a few days as necessary until conditions improve.
- *Dryness:* Check for causes such as fan exhaust and reflected surfaces (e.g. glass and metal sidings) on the roofs. Correct these conditions if possible and provide irrigation. If conditions do not improve, replace affected area with hard landscape such as pebbles and concrete pavers.
- *Disease:* Fungus growth is rare and usually an indication of excessive dampness. Check for ponding, reduce irrigation frequency and if necessary, apply an organic fungicide to control.
- *Pest:* Pest such as caterpillars and garden snails eat vegetation. If their population becomes too high and cause excessive damage to the green roof, apply an organic pesticide to control.

Act at first sight of problem to minimize potential damage to the green roof. When in doubt, please consult a Next Level Stormwater Management™ representative.

4. General Maintenance

Remove unwanted vegetation (e.g. weeds and grasses) before they flower, form seeds and multiply on the green roof. Remove any woody plants and tree seedlings as soon as possible. Remove overgrown vegetation in non-vegetated borders. Remove vegetation by hand; use of herbicide is not recommended.

Fertilization rates can vary widely for intensive green roofs. Depth of growing medium, moisture levels and temperature/climate should all be considered before fertilizing the green roof. To minimize leaching of fertilizer into stormwater runoff, fertilize only when soil tests or plant health indicates lack of nutrients. Fertilizing only when fertilizing is needed also lessens weed growth and maintenance needs. If fertilizing a green roof, use slow release, organic fertilizer in the spring. A second application may be needed to compensate for excessive nutrients runoff on slope roofs or following long periods of heavy rainfall.

5. Roof Servicing

Wind-blown garbage and dead plant biomass can accumulate on the green roof. Accumulation of debris in and around the drainage channels and roof outlets can hinder drainage, which can lead to ponding and excessive loading on the roof. Clear the roof drains of debris regularly, especially after major storm or rain events. Remove debris from vegetated areas, non-vegetated borders and access paths. Visually inspect exposed roof membrane and flashing for any sign of damage and leak.

6. Irrigation System

The green roof must be kept moist but not soggy during the first 4 weeks. An irrigation system is highly recommended for hot and dry climates.

Irrigation can be done manually with a garden hose or using automated systems such as drip lines or overhead spray. Drip system loses less water through evaporation and it is not affected by high wind compared to spray. If installing a spray irrigation system, it is important to take plant height into consideration. Tall plants can block the spray and reduce the system's effectiveness across the green roof.

Check to ensure that the irrigation coverage is uniform. Adjust the irrigation system/regime as necessary, e.g. amount, time and frequency of irrigation zones. Avoid over- or under-watering. Routinely clean out dirt traps in the system to avoid blockage. Check often to ensure that the automated system is in working order. When lengthy repair is expected, make arrangement for a temporary sprinkler system or water manually with a garden hose until repair is completed.

Water deeply and infrequently to encourage deep root growth and robust plants. Ensure that the sub-layers are saturated with each watering. Runoff at roof drains does not necessarily mean that the sub-layers are saturated, such as on sloped green roofs where surface runoff is high compared to absorption. Check by examining the depth of saturation of the growing medium. Allow the green roof to dry somewhat between watering to conserve water and promote hardy plants.

Avoid irrigating in mid-day during intense sunlight because of high evaporation loss. Irrigation is most effective during early mornings and evenings when the temperature is cool and the sun is less intense. Water has time soak into the green roof for the plants to take up. Irrigation regime (amount and frequency) depends on many factors such as the weather conditions, the water retention capacity of the green roof system and the slope of the roof.

7. Water Quality

Irrigation water can come from sustainable sources such as rain water capture and grey water reuse on site, or natural streams and ponds nearby. However, it is important that the irrigation water is free from chemicals and pollutants that might be harmful to the plants on the green roof. When in doubt, the irrigation water should be tested to confirm its quality.

8. Extreme Weather Events

Prolonged heat/drought: A rule of thumb is to compensate the evapotranspiration with irrigation. For example, if the daily evapotranspiration is 5 mm in the summer, irrigating the green roof with 25-30mm every 5-6 days will be sufficient.

Wind Storm: Hurricanes may displace green roof, especially on newly installed roof where the plants have not had a chance to root in. Check for missing growing medium and plants from wind erosion and replace as needed (see "*General Maintenance"*). Clear wind-blown debris from the roof, especially in and around the drainage channels and roof outlets. Check for displacement of pebbles in the non-vegetated borders, redistribute pebbles as needed. Ensure irrigation system remains in working order.

Heavy Rain: Heavy rain can wash off debris and dislodge growing medium green roof. Check and clear dirt and debris from drainage channels, roof outlets and non-vegetated borders. Replenish growing medium and plantings as needed.

Hail: Hail stones can damage plants on green roof through crushing and freezing. Fortunately, the damage is usually temporary. Do not walk on frozen plants as this can cause further damage. The green roof should recover in a few months.

9. Foot Traffic

Avoid unnecessary foot traffic on vegetation at all times. Use designated access path or walk on stones in the non-vegetated borders whenever possible. Install designated access path to rooftop units that require frequent access.

Avoid putting heavy load on green roof as this will crush the plants. Any damage to the plants must be repaired immediately (see "*General Maintenance*").

10. Membrane Repair

The components in a Flora Garden green roof system can be removed to allow access to the roof membrane for repair.

For small area, remove plantings with root balls intact, growing medium, filter fabric, drainage layer and root barrier, layer by layer to expose the roof membrane. Take care not to damage the roof membrane when cutting. After membrane repair is completed, cut a new piece of root barrier, with at least 30 cm larger on all sides than the original cutout for overlap, place over the opening left by the existing root barrier. Replace all layers one by one into their original spots, followed by the plantings. Keep the area moist until the plants have rooted in again, about 2-4 weeks. Replace permanently damaged plantings, if needed.

For larger area remove plantings with root balls intact, growing medium, filter fabric, drainage layer and root barrier, layer by layer to expose the roof membrane. Plantings should be salvageable depending on length of time of removal, maturity and root development. Roll back and remove sub-layers, one layer after another, to expose the membrane. Do not cut but roll the

root barrier to one side. After membrane repair is completed, roll root barrier back into position, taking care to maintain the 30 cm overlap between sheets. Replace all other layers and plant material as needed.

11. Routine Inspection

The owner or his/her representative is encouraged to conduct routine visual checks to help decide what maintenance measures and schedule to follow, e.g. irrigation regime and weeding frequency. Report any sign of problem (e.g. wilting or pest damage) immediately to a Next Level Stormwater Management™ representative for remedial actions to minimize potential damage to the green roof.

12. Third Party Materials

All our components have been tested for quality and compatibility according to the German FLL Green Roof Guidelines. To maintain the high performance of the Flora Garden green roof system, only approved components may be used for maintenance. This includes but not limited to growing media, water retention layers, drainage/filter layer, root barrier, fertilizer, and metal edging. Please contact a Next Level Stormwater Management™ representative for details.

13. Disclaimer

This guideline serves as general recommendation only and does not preclude owner responsibility for routine green roof care and oversight. Specific projects may require special maintenance actions and schedule. Should there be any queries, please contact a Next Level Stormwater Management™ representative.

Next Level Stormwater Management™
Intensive Green Roof System – Maintenance Check List

Project Name:		**Last Inspection Date:**	
System Buildup:		**Inspection Date:**	
Completion Date:		**Inspected by:**	

		Observations	Actions
1.	Plant Performance		
	a. Coverage		
	b. Health – disease and pest damage		
	c. Diversity		
2.	General Maintenance		
	a. Remove foreign and overgrown vegetation		
	b. Remove vegetation in non-vegetated borders		
	c. Replenish missing growing medium		
	d. Replace plantings if needed		
	e. Fertilize		
	f. Irrigate		
3.	Roof Servicing		
	a. Clear debris from drainage channels, outlets and borders		
	b. Ensure working order of drainage channels and outlets		
	c. Inspect exposed roof membrane		
4.	For Sloped Roof Only		
	a. Check anti-sliding/anti-shearing elements		
	b. Replace missing soil and plants from erosion		
	c. Check for uniform irrigation coverage		
5.	For Irrigation System Only		
	a. Uniform irrigation coverage		
	b. Over or under watering		
	c. Clean out dirt traps		
	d. Functioning of automated system		
6.	Comments and Recommendations		

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