

## **1.1 SECTION INCLUDES**

- .1 Root Protection Layer.
- .2 Water Retention Materials.
- .3 Vegetation.
- .4 Vegetated roofing accessories.

## **1.2 REFERENCES**

- .1 ASTM International (ASTM).
  - .1 ASTM D4632/D4632M – 2013, Standard Test Method for Grab Breaking Load and Elongation of Geotextiles.
  - .2 ASTM E2399 - 2011 Standard Test Method for Maximum Media Density for Dead Load Analysis of Green Roof Systems.
  - .3 ASTM E2400-2006, Standard Guide for Selection, Installation, and Maintenance of Plants for Green Roof Systems.
- .2 Canada Green Building Council (CaGBC).
  - .1 LEED v4-2009, LEED (Leadership in Energy and Environmental Design): Green Building Rating System.
- .3 City of Toronto.
  - .1 Toronto Municipal Green Roof Code-[2013].
- .4 Forschungsgesellschaft Landschaftsentwicklung Landschaftsbau's (Landscape Research, Development and Construction Society) (FLL).
  - .1 FLL-[2008], Green Roofing Guideline.
- .5 International Organization for Standardization (ISO).
  - .1 EN ISO 10319-[2008], Geosynthetics - Wide-Width Tensile Test.

## **1.3 ADMINISTRATIVE REQUIREMENTS**

- .1 Pre-installation Meeting: Conduct pre-installation meeting after Award of Contract and one week prior to commencing work of this Section in accordance with Section [01 31 19 - Project Meetings] to verify project requirements, substrate conditions and co-ordination with other building sub-trades, and to review vegetated roofing system supplier's installation recommendations and warranty requirements.
  - .1 Notify attendees two weeks prior to meeting and ensure meeting attendees include as minimum:
    - .1 Owner;
    - .2 Consultant;
    - .3 Vegetated Roof System Provider;
    - .4 Vegetated Roof System Installer;

- .5 Roofing Membrane Manufacturer's Representative;
- .6 Roofing Membrane Installer.
- .2 Ensure meeting agenda includes review of methods and procedures related to installation of work of this Section including co-ordination with related work.
- .3 Record meeting proceedings including corrective measures and other actions required to ensure successful completion of work and distribute to each attendee within 1 week of meeting
- .4 Copy of FLL - Green Roofing Guideline will be available for viewing at pre-installation meeting.
- .2 Sequencing: Schedule delivery of vegetated mats and plants to ensure installation within 24 hours of arrival at site.
  - .1 Sequence work of this section in accordance with vegetated roof supplier's written recommendations for sequencing construction operations and planting.
- .3 Scheduling: Recommended Schedule for planting of vegetation:
  - .1 Spring planting between April 15<sup>th</sup> and June 15<sup>th</sup>.
  - .2 Fall planting between September 1<sup>st</sup> and October 15<sup>th</sup>.

#### **1.4 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Make submittals in accordance with Section [01 33 00: Submission Procedures].
- .2 Product Data: Product data for components of vegetated roof covering indicating compliance with specified requirements.
  - .1 Submit plant list identifying species and vegetation.
    - .1 Indicate planting method, and conditions for care during establishment period.
    - .2 Include preparation instructions and recommendations, and storage and handling requirements.
    - .3 Include contact information for manufacturer and their representative for this Project.
- .3 Submit Cradle to Cradle Silver certification from McDonough Braungart Design Chemistry LLC (MBDC).
- .4 Letters of Reference: Submit references clearly indicating that vegetated roof technology has been successfully installed on projects on annual basis of similar scope and nature for [15] years minimum.
- .5 Letters of Assurance and Certification:
  - .1 Submit certification for root barrier tested in accordance with FLL.
  - .2 Submit letter from structural engineer registered in Province of [Ontario] verifying that roofing system can support weight of vegetated roof system when saturated.
  - .3 Submit certification for fire resistance .
  - .4 Submit certification for wind uplift resistance.

- .5 Roofing membrane: Submit verification that roofing membrane meets minimum requirements for installation of roofing system by roofing system manufacturer
- .6 Submit letter from vegetated roof system supplier verifying age of vegetated mats. Submit letter from vegetated roofing system supplier that vegetated system is suitable for use with project's roofing system.
- .7 Submit letter from vegetated roof system sub-contractor verifying:
  - .1 Each vegetated roofing system product, vegetation material, and component are appropriate for use with FLL and to ASTM E2400.
  - .2 Installer has reviewed and approved details of membrane roof system roof deck, flashings, penetrations and copings.
  - .3 Installer has been approved by vegetated roof system Consultant.
  - .4 Vegetated roofing system meets warranty requirements.
  - .5 Successful water leakage test has been conducted over the roofing membrane about to be covered by the vegetated roof system.
- .6 Shop Drawings: Include on shop drawings:
  - .1 Details of installation showing conditions at terminations, transitions, and penetrations.
  - .2 Details of root protection layer and drainage layer at parapets and other roof appurtenances.
  - .3 Schematic profile detailing thickness of vegetated roofing system materials.
- .7 Installer's Qualifications: Submit verification of experience.
- .8 Test and Evaluation Reports: Submit evaluation service reports or other independent testing agency reports showing compliance with specified performance characteristics and physical properties as follows:
  - .1 Submit test report for Maximum Water Capacity Test to ASTM E2399.
  - .2 Submit maintenance evaluation report after each maintenance visit.
  - .3 Submit verification of compliance with Toronto Municipal Green Roof Code.
- .9 Vegetated Roofing System Installer's Qualifications: Submit verification of experience.
- .10 Irrigation System Installer's Qualifications: Submit verification of experience
- .11 Sustainable Design Submittals: In accordance with Section 01 81 13: Sustainable Design Requirements. Retain the following paragraph for LEED -C1 Credit MR 5.
  - .1 Product Certificates for LEED Credit MR 5: For products and materials required to comply with requirements for regional materials.
    - .1 Include statement indicating location of manufacturer and distance to Project for each regionally manufactured material.

## **1.5 CLOSEOUT SUBMITTALS**

- .1 Supply 24-month maintenance agreement with vegetated roofing system installer for care of vegetation included in Work of this Section.

- .2 Sustainable Design Closeout Documentation (LEED).
  - .1 Provide calculations on end-of-project recycling rates, salvage rates, and landfill rates for work of this Section demonstrating percentage of construction wastes which were recycled.
  - .2 Submit verification from recycling facility showing receipt of materials.
- .3 Record Documentation:
  - .1 List materials used in vegetated roofing system including plants.
  - .2 Show on roof plan locations of drains and extent of vegetated coverage with identification.
  - .3 Warranty: Submit warranty documents specified.

## **1.6 QUALITY ASSURANCE**

- .1 Vegetated Roofing System Installer's Qualifications: Company or individual specializing in work similar to work of this section with three years minimum documented experience.
- .2 Irrigation System Installer's Qualifications: Company or individual specializing in work similar to work of this section with two years minimum documented experience.
- .3 Maintenance Qualifications: Submit documentation showing qualifications of maintenance contractor's horticulturalist.
- .4 Mock-up: Construct mock-up where directed by Consultant.
  - .1 Construct 3 x 3 m mock-up of vegetated roofing system using proposed procedures, materials, vegetation and quality of work.
    - .1 Ensure mock-up includes roof drain.
  - .2 Purpose: To judge quality of work, vegetated roof system preparation, operation of equipment and material application.
  - .3 Do not proceed with work prior to receipt of written acceptance of mock-up by Consultant.
  - .4 When accepted, mock-up will demonstrate minimum standard of quality required for Work of this Section.
  - .5 Approved mock-up will remain part of finished Work.
- .5 Test roofing system in accordance with Toronto Municipal Green Roof Code and as directed by Consultant.
- .6 Water Leakage Test: Carry out water leakage testing of roofing system at request of and as directed by Consultant.
  - .1 Owner will pay for initial costs of water leakage testing.
  - .2 Do not conceal roofing membrane with vegetated roofing system until receipt of instruction to proceed has been received from Consultant.

## **1.7 DELIVERY, STORAGE AND HANDLING**

- .1 Delivery and Acceptance Requirements:

- .1 Deliver materials and accessories in vegetated roofing supplier's original packaging with identification labels intact and in sizes to suit project.
- .2 Deliver plant materials in manner which preserves quality of plants.
- .3 Protect vegetation mats from damage due to temperature and wind during transportation.
- .4 Use closed or open trailers for transportation times of 24 hours maximum.
- .5 Use climate controlled trailer for transport durations greater than 24 hours.
- .2 Storage and Handling Requirements: Upon arrival at site off-load vegetated mats and remove non-breathable wrappings if used.
  - .1 Ensure plants and vegetated mats are installed within 24 hours of arrival at site.
  - .2 Establish holding area to unroll and store vegetated mats until installation if timely installation is not achievable.
    - .1 Store vegetated mats until installation only after receipt of permission from Consultant.
    - .2 Consultant has right to have mats removed and replaced with new mats if vegetated mats are damaged or degraded.
- .3 Packaging Waste Management:
  - .1 Remove waste packaging materials from site and dispose of packaging materials at appropriate recycling facilities.

## **1.8 FIELD CONDITIONS**

- .1 Do not install vegetated roofing mats or plants if growing media or ambient conditions are less than 10 °C.

## **1.9 VEGETATION COVERAGE GUARANTEE**

- .1 Deliver mats with 80 % minimum vegetation coverage at time of installation and achieve 90 % minimum vegetation coverage 12 months after installation.
- .2 Guarantee is in effect only if maintenance recommendations are followed.

## **1.10 WARRANTY**

- .1 Issue Certificate of Warranty for 2 years from date of Substantial Performance.

## **Part 2 Products**

### **2.1 VEGETATED ROOFING SYSTEM SUPPLIER**

- .1 Xeroflor Canada Inc., One Yonge Street., Suite 1801, Toronto, Ontario;  
Phone: (416) 637-5772; e-mail: [info@xeroflorcanda.ca](mailto:info@xeroflorcanda.ca); URL: [www.xeroflorcanada.ca](http://www.xeroflorcanada.ca).

- .1 Ensure project superintendent has 3 years minimum experience in work similar to work of this Section and oversees critical aspects of installation and testing of Work.

## **2.2 VEGETATED ROOFING SYSTEM**

- .1 XF301 Sedum Secured over a Protected Membrane Roof Assembly

## **2.3 SINGLE SOURCE RESPONSIBILITY**

- .1 Co-ordinate installation of vegetated roof system components and vegetation.
- .2 Components include but are not limited to:
  - .1 Root protection layer;
  - .2 Water retention materials;
  - .3 Vegetation.
  - .4 Vegetated roofing accessories.

## **2.4 PROTECTION MATERIALS**

- .1 Root Barrier: Flexible 0.508 mm water-impermeable low-density polyethylene (LDPE) sheet that has been tested for root resistance in accordance to FLL.
  - .1 Basis of Design: Xeroflor, XF112 Root barrier.

## **2.5 WATER RETENTION MATERIALS/FILTER FABRICS**

- .1 Retention Fleece: Constructed from recycled polymeric fibre fabric [and located as indicated]:
  - .1 Water-saturated weight: 10.30 kg/m<sup>2</sup> maximum.
  - .2 Water retention capacity: 9.10 L/m<sup>2</sup> minimum.
  - .3 Basis of Design: Xeroflor, XF159 Retention fleece.

## **2.6 VEGETATION**

- .1 Sedum Mat: Light, flexible and durable textile-based vegetation carrier composed of three-dimensional matting of looped polymeric filaments covered on one side with non-woven geotextile polyethylene terephthalate (PET) fibre core with sheath of polyamide (PA) fabric. The geotextile fabric is sewn together by polymeric filaments to a lightweight recycled polymeric fibre fabric.
  - .1 Vegetation coverage: 80% minimum.
  - .2 Non-woven geotextile fabric tensile strength: to EN ISO 10319.
  - .3 Mat thickness: 30 mm.
  - .4 Mat size: 1 x 2 m roll with 100 mm vegetation free fabric edge on one adjoining side.
  - .5 Field weight: 19.7 kg/m<sup>2</sup>.
  - .6 Saturated weight: 37 kg/m<sup>2</sup>.

.7 Basis of Design: Xeroflor, XF301 Sedum Mat

**2.7 IRRIGATION METHODS**

- .1 Ensure irrigation method for vegetated roofing system is appropriate for extensive vegetated systems.

**2.8 ACCESSORIES**

- .1 Stone Ballast for vegetation mats: Smooth rounded and washed river stone 25-38 mm in size.

**Part 3 Execution**

**3.1 INSTALLERS**

- .1 Use only supplier certified installers with three years minimum experience with work similar to work of this section and approved by vegetated roofing system provider.

**3.2 EXAMINATION**

- .1 Verification of Conditions: Verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for vegetated roofing installation in accordance with vegetated roofing supplier's written recommendations.
  - .1 Visually inspect substrate in presence of Consultant.
  - .2 Ensure roofing structure has positive slope and no ponding water.
  - .3 Verify with project structural engineer that roofing structure has been designed to incorporate additional structural loading of vegetated roofing system.
  - .4 Verify water source for installation, irrigation and maintenance of vegetated roofing system.
  - .5 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Consultant.

- .2 Start of vegetated roofing installation indicates installer's acceptance of substrate conditions.

**3.3 PREPARATION**

- .1 Clean surface of roof to receive vegetated roof system.
  - .1 Remove screws, splinters and other excess materials from surface of roofing.
- .2 Protect roofing membrane traffic areas including corridors for transporting vegetated roofing system materials using 25 mm extruded polystyrene horizontal protection board covered with 13 mm plywood.
- .3 Ensure underlying roof components are installed and tested in accordance with manufacturer's written recommendations.
- .4 Ensure roof leakage test has been performed as directed by Consultant.

- .1 Consultant will advise if roof leakage test is not required.

### **3.4 INSTALLATION - GENERAL**

- .1 Install vegetative roofing in accordance with supplier's written recommendations.
- .2 Ensure vegetative free zone around roof drains and other penetrations.

### **3.5 INSTALLATION OVER PROTECTED MEMBRANE ROOFING SYSTEM**

- .1 Install root barrier over roofing surface.
  - .1 Overlap edges 300 mm minimum.
  - .2 Stagger root barrier roll ends to avoid creating continuous perpendicular seam for adjacent rolls.
  - .3 Ensure root barrier continues under non-vegetated areas of roof and up sides of walls and parapet walls.
  - .4 Cut to fit tightly around roof penetrations.
  - .5 Cut root barrier to prevent blocking at [overflow scuppers and] vegetated roof termination.
- .2 Install roofing components including insulation and stone ballast before installation of water retention materials.
- .3 Water Retention Materials:
  - .1 Install two layers of water retention fleece on top of stone ballast.
    - .1 Overlap first layer of fleece 50 mm minimum between adjacent rows.
      - .1 Stagger ends of adjacent rolls 1.8 m minimum during installation to avoid continuous perpendicular seams.
      - .2 Cut to fit tightly along roof penetrations.
    - .2 Install second layer of fleece using butt joints with no overlap.
      - .1 Stagger ends of adjacent rolls 1.8 m minimum during installation to avoid continuous perpendicular seams.
      - .2 Cut to fit tightly along roof penetrations.

### **3.6 VEGETATION**

- .1 Vegetated Mat Installation: Install vegetated mat for extensive vegetated roofing system.
  - .1 Saturate base layers immediately before installation of vegetated mats.
  - .2 Overlap mats on fabric edge of preceding mat and butt vegetation layers of mats together.
  - .3 Stagger mats by approximately half lengths to avoid alignment of end seams across rows.
  - .4 Apply top dressing of growing media along vegetation mat seams, and anywhere growing media was lost during transport and handling and where directed by Consultant.
- .2 After completion thoroughly water newly installed vegetation.

### **3.7 STONE BALLAST**

- .1 Evenly distribute stone ballast over vegetation mats at rate of 24 kg/m<sup>2</sup>.

### **3.8 ROOF EDGES, DRAINS, AND OTHER PENETRATIONS**

- .1 Maintain 300mm minimum between vegetation mats or growing substrates and parapet, roof edge, drains, vents and other roof penetrations.
- .2 Ensure vegetation mats and growing substrates have fixed boundary such as edging strip, concrete curb, stones or concrete pavers.
- .3 Distribute stone ballast or concrete paver blocks in non-vegetated border areas as indicated. Stone ballast or concrete paver blocks must exceed vegetated roof system by 6 mm minimum.

### **3.9 IRRIGATION**

- .1 Ensure appropriate extensive irrigation method is provided to meet Project requirements.
- .2 Use only irrigation system installers with minimum two years documented experience with work similar to work of this section.

### **3.10 FIELD QUALITY CONTROL**

- .1 Field Inspection: Co-ordinate field inspection with Consultant.
- .2 Supplier's Services:
  - .1 Have supplier review work involved in handling, installation, protection, and cleaning of vegetated roofing and accessories, and submit written reports in acceptable format to verify compliance of Work with Contract conditions.
  - .2 Supplier's Field Services: Provide supplier's field services consisting of product use recommendations and periodic site visits for vegetated roofing installation review in accordance with manufacturer's instructions.
    - .1 Report any inconsistencies from supplier's recommendations immediately to Consultant.
  - .3 Schedule site visits to review work at stages listed:
    - .1 Upon completion of Work, after cleaning is carried out.
- .3 Obtain reports within three days of review and submit immediately to Consultant.

### **3.11 CLEANING**

- .1 Progress Cleaning: Perform cleanup as work progresses.
  - .1 Leave work area clean at end of each day.
- .2 Final Cleaning:
  - .1 Remove surplus materials, rubbish, tools, and equipment.
- .3 Waste Management:

- .1 Co-ordinate recycling of waste materials.
- .2 Collect recyclable waste and dispose of or recycle field generated construction waste created during construction or final cleaning related to work of this Section.
- .3 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

### **3.12 PROTECTION**

- .1 Protect vegetated roofing from damage during construction period.
  - .1 Prevent deterioration of installed vegetated roof system by limiting use of vegetation surfaces for material and equipment storage, and walking surface.
- .2 Repair damage to adjacent materials caused by vegetated roofing installation.

### **3.13 MAINTENANCE**

- .1 Conduct maintenance annually for 2 years to match length of warranty period.
- .2 Maintain vegetated roofing system in accordance with vegetated roofing system supplier's written recommendations.
- .3 Extensive Roofing System Maintenance:
  - .1 Initial maintenance: Conduct inspection of entire vegetated roof two times each month for first two months.
    - .1 Perform weeding, irrigation, debris removal, addition of growing media and clippings as required to ensure survival of vegetated roofing system and growing of newly transplanted vegetation.
    - .2 Irrigation: Ensure irrigation method and schedule are suitable for extensive vegetated roofing system.
      - .1 Irrigate vegetated roofing system every two to three days during prolonged dry weather spells or when natural irrigation is inadequate.
      - .2 If an irrigation system is used winterize irrigation system in late fall each year.
  - .2 Regular maintenance: Conduct inspection of entire vegetated roof once each month.
    - .1 In summer months conduct extra inspections during dry spells when irrigation requirements are greater.
    - .2 Perform weeding, irrigation, debris removal, addition of growing media and clippings as required to ensure survival of vegetated roofing system.
    - .3 Add growing media and clippings to any bare areas, as required.
  - .3 Ongoing Maintenance for Consecutive Years:
    - .1 Fertilize in late spring with a controlled release fertilizer (NPK 17-7-10 or similar), supplying nitrogen (N) at a rate of 20g/m<sup>2</sup>.

- .2 Conduct inspection of entire vegetated roof once every two months starting in spring until first frost.
    - .3 Perform weeding, irrigation, debris removal from roof surface and from drains, addition of growing media and clippings as required to areas experiencing dieback.
  - .4 Reports: Keep maintenance log and submit quarterly maintenance reports to Owner and Vegetated Roof System Manufacturer to maintain warranty.
    - .1 Reports should summarize dates, personnel at each visit, growing conditions and work done, in accordance with specification requirements and be signed by approved maintenance contractor's representative.
  - .5 Responsibility: Maintenance contractor is responsible for replacing vegetation if maintenance is not carried out in accordance with vegetation roofing supplier's written recommendations.

**END OF SECTION**