



# cascadia

Green Wall Systems



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# MSE GREEN WALL SYSTEM

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# Cascadia MSE Green Wall System Manual

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# Cascadia Green Wall Systems, building on 30 years of industry experience

## **OFFERING INNOVATIVE, ENGINEERED LANDSCAPE AND ENVIRONMENTAL SOLUTIONS**

Based in the heart of British Columbia's Fraser Valley, Cascadia Green Wall Systems' objective is to provide environmentally sound and sustainable products with high-level performance characteristics.

Cascadia was born out of the more than 30 years of experience and success of its partners and suppliers, Denbow and Filtrexx, in offering innovative, engineered landscape and environmental solutions. This experience has enabled us to participate in both large and technically challenging projects with a very high degree of competency, capability and success.

## **SPECIALISTS WITH PROVEN PERFORMANCE**

As specialists in erosion and sediment control, Cascadia adheres to rigid environmental, engineering and construction Best Practices. We understand the factors that contribute to the long-term success of an engineered retaining wall, and the potential pitfalls and hazards associated as well. All of this knowledge and experience has been designed into the Cascadia Green Wall System.

- **Engineers** will find that the structural integrity, longevity and proven performance of the Cascadia GWS offer them the confidence to specify it in many challenging applications.
- **Landscape Designers** are able to use the Cascadia GWS as a new 'vertical canvas' to create eye-catching, aesthetically-pleasing planted areas.
- **Environmental Consultants** will note how Cascadia GWS provides a natural barrier against erosion, and promotes native vegetation growth.

## **SUSTAINABLE ENGINEERING**

With the Cascadia GWS, engineers, landscape architects and construction management professionals can trust that a highly engineered and proven design has been successfully merged with a sustainable, and aesthetically beautiful end result.

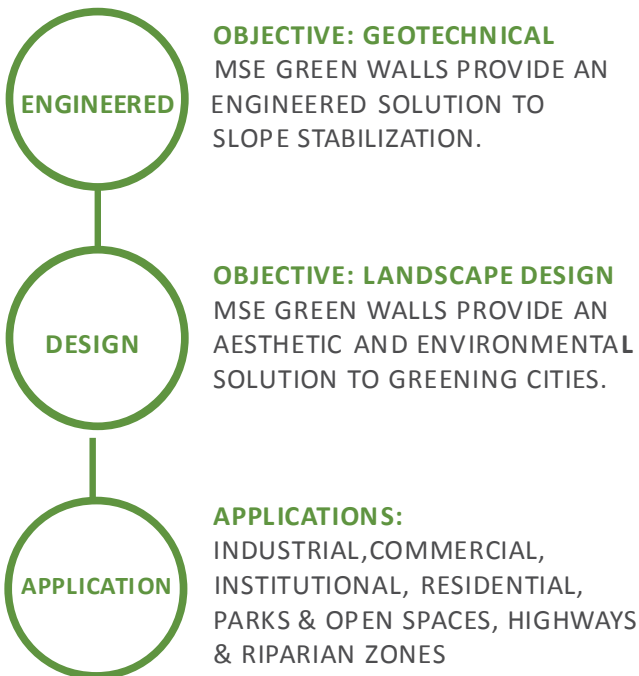


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# PROVEN TECHNOLOGY, MSE GREEN WALL SYSTEMS



## BUILDING ON PROVEN MECHANICALLY STABILIZED EARTH (MSE) PRINCIPLES



## BENEFITS OF ENGINEERED SYSTEM THAT IS TRULY GREEN:

The main advantages of MSE walls compared to conventional reinforced concrete walls is their ease of installation, cost effectiveness and relatively quick construction. They do not require form work or curing and each layer is structurally sound as it is laid, reducing the need for support, scaffolding or cranes. They also do not require additional work on the facing, reducing transportation costs and carbon emissions.

### PROVEN TECHNOLOGY:

MSE technology has been utilized for centuries in walls, dykes and embankments. Since the 1960s architects have applied this technology to modern building practices.

The Cascadia Green Wall System is comprised of Cascadia wall fascia units, growing media and a robust geotextile sock. A variety of grades of heavy-duty geotextile grid are incorporated into the system giving it structural integrity to meet specific environmental and engineering requirements. Non-engineered structures below 1.2M (4'), will fall under basic design and construction guidelines. Engineered structures will require a full engineer's geotechnical report.

### FLEXIBILITY & ACCESSIBILITY :

Due to the flexibility of the MSE green wall system components both challenging and inaccessible project sites can be facilitated with ease.

### A DESIGNED SUSTAINABLE LIVING SYSTEM:

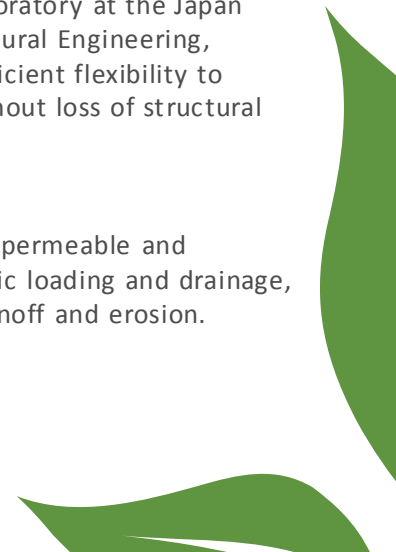
MSE walls provide attractive, and dynamic vegetated landscapes, that promote biodiversity and enhance people's living environments. Both LEED & LID recognise the 'green' value of MSE walls.

### SEISMIC STABILITY

In addition to the flexibility of MSE walls in design and construction, seismic testing, conducted on a large scale shaking table laboratory at the Japan National Institute of Agricultural Engineering, showed that they retain sufficient flexibility to withstand deformations without loss of structural integrity.

### DRAINAGE & PERMEABILITY

MSE wall systems are highly permeable and therefore mitigate hydrostatic loading and drainage, significantly reducing site runoff and erosion.



# SYSTEM COMPONENTS



## 1. CASCADIA FASCIA UNITS

The standard Cascadia Green Wall System fascia units are available at 12" (300mm) diameter. Other sizes are available, as special order, including: 8" (200mm) to 24" (600mm) in diameter and are reconstructed of a variety of materials with the following characteristics:

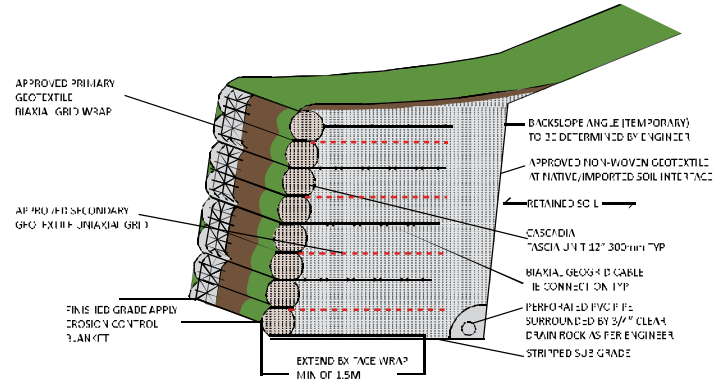
<b>Geotextile grid:</b>	<b>Polypropylene Multi-Filament</b>
<b>Raw Material</b>	<b>Polypropylene</b>
<b>Tensile Strength</b>	<b>982 lbs (8 in) 1669 (12 in) 2487 (18 in)</b>
<b>Opening size</b>	<b>1/8 Opening – T-stitch pattern</b>
<b>Construction</b>	<b>Multi-Filament</b>
<b>Ultraviolet Stability % Original Strength (ASTM G-155)</b>	<b>100% at 1000 hr</b>

\* Cascadia Green Wall Systems can be manufactured to meet site specific needs.

## 2. CASCADIA REINFORCEMENT GRID

Cascadia reinforcement Grid, (primary & secondary) is a commonly used component for engineered retaining structures. It may be installed using approved brands of geotextile grid to meet the requirements of the project engineer.

In light load-bearing and stress situations, Geosynthetic woven netting is recommended to increase the integrity of Cascadia Green Wall Systems.



## 3. GEOTEXTILE LOCKDOWN NETTING

Lockdown netting consists of HDPE material 5 mil plastic with a hexagon 1" mesh opening. A UV inhibitor is added to extend the life of the product in direct exposure to sunlight. The UV inhibitor provides a 3-5 year life. Cotton alternatives are available.

## 4. ECO-COMPOST BLANKET

The compost blanket sandwiches the lockdown netting between the ground and the compost. As vegetation roots begin to penetrate the compost and netting layer and sink into the substrate, they stabilize the entire system.



## DESIGN APPLICATIONS



## Features

The Cascadia Green Wall System can be used for a wide variety of structural and non-structural applications including:

### DESIGN FEATURES

- Commercial, residential, industrial and institutional applications
- Green design options - LEED sustainable sites
- Aesthetic value - greening cities

### ENGINEERED FEATURES

- Steep Slope Stabilization
- Slip-Slope Repairs
- Culvert Headwalls
- Streambanks
- Retaining Walls
- Roadway Walls
- Bridge Abutments
- Dikes, Berms
- Sound Barriers
- Flood Protection

### ENVIRONMENTAL FEATURES

- Habitat restoration-enhancement
- Supports biodiversity & native flora & fauna
- Bio-mimicry, mirroring existing terrain
- Bioswales & rain gardens
- Green roof rain gardens



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## CASCADIA GROWING MEDIA & VEGETATION OPTIONS



### CASCADIA GREEN WALL SYSTEM FASCIA

A tubular geotextile containment unit forms the fascia of the Cascadia Green Wall. These units are designed to retain growing medium, while encouraging healthy root and vegetation growth. Moisture permeates through the wall, reducing hydrostatic pressure and increasing drainage.

### CASCADIA GROWING MEDIA

Specifically formulated Cascadia growing media establishes and supports vegetation and resists washout. When housed in Cascadia Green Wall System, the growing media is the ultimate wall fascia material. The reinforcement provided by Cascadia GWS promotes successful establishment of both native and naturalized vegetation.

Biomimicry can be applied to Cascadia walls to mirror local habitats and increase biodiversity.

### VEGETATION CHOICES

- Turf/Reclamation grasses
- Native/ Riparian species
- Seed Mixes e.g. meadow
- Native species
- Vines, etc.
- Shrubs & perennials

### METHODS FOR ESTABLISHING VEGETATION

- Terraseeding
- Hydroseeding
- Live staking
- Broadcast seeding
- Plug planting

### VEGETATION SELECTION

When selecting vegetation for Cascadia Green Wall Systems the following should be considered:

- Maintenance requirements
- Local ecology/habitats
- Drought resistance
- Freeze tolerance

Note: Cascadia provides consultation on seed mixes.

### RETROFITTING USING CASCADIA GWS

Cascadia can conveniently be applied as a method of :

- Facing/greening existing concrete walls
- Screening visual eyesores
- Repairing sections of banks
- Creating terraces





# CONSTRUCTION ADVANTAGES & MAINTENANCE OPTIONS



## FROM STRENGTH TO STRENGTH

When constructing a Cascadia Green Wall System, a Geotextile wrap is recommended for every course. Geotextile-grid spacing varies from application to application (See elevations as shown on the construction drawings).

Prescribed vertical Geotextile grid, spacing as per Engineer		Geotextile wall fascia unit diameter	
Inches	mm	Inches	mm
<b>10</b>	<b>250</b>	<b>12</b>	<b>150</b>
16	400	(standard size)	450
20	500	18	600
		24	
		(special order)	

## ADVANTAGES

The Cascadia Green Wall System offers many advantages including:

- Flexibility
- Varied applications
- Accessibility to hard-to-reach areas
- Lightweight components
- Highly efficient installation by certified technicians
- No footing or leveling pad required
- Seed injection into geotextite sock
- Compost growing medium
- Gravity or reinforced
- Cost effective compared to alternatives

## MAINTENANCE OPTIONS

The Cascadia Green Wall System requires limited maintenance. Appropriate vegetation types are selected and drainage is addressed during the design and build stages. In dryer climates, drip irrigation systems may be installed as part of the Cascadia Green Wall System to ensure hydration to vegetation.

For specific maintenance requirements please contact Cascadia Green Wall Systems and see specification. Maintenance contracts can be arranged for 1-2 years, if required, or longer. See appendix (1) for maintenance program.



## THE NATURAL DESIGN SOLUTION, MSE WALLS



### SUSTAINABLE VEGETATED LANDSCAPES

The Cascadia Green Wall System allows for the creation of sustainable and appealing vegetated landscapes, in the most challenging of situations. They are designed to :

- 1) Stabilize and retain earth
- 2) Reduce erosion and run-off
- 3) Provide a comprehensive environmental solution for vegetated walls-terrain.
- 4) Provide a green alternative to traditional methods
- 5) Provide a natural solution for designers

### GREEN PRODUCT SOLUTIONS FOR DESIGNERS

The Cascadia Green Wall System provides robust soil retention and erosion protection while providing a very productive environment for vegetation establishment. When combined with geotextile grid, Cascadia Green Wall Systems provides structural support to hillslopes and streambanks in situations where concrete, block walls, gabions and rip rap are traditionally used. In each situation, Cascadia Green Wall Systems offers sustainable, green solutions for designers wishing to keep their projects looking and functioning like natural areas.

Constructing a Cascadia Green Wall System involves stacking Cascadia fascia units on top of one another in a recessed fashion on steep slopes to near vertical situations. When required, a variety of grades of geotextile grid are seamlessly incorporated into the system giving it structural integrity to meet specific environmental and load-bearing requirements.



## BEST PRACTICES FOR INSTALLATION



### Embedment for engineered walls

At least one-tenth of total wall height should be buried below the final grade in front of the wall when grade is level. Embedment depth increases for special conditions.

### Maximum Height without Geogrid

A maximum height of 4' (1.2m) is recommended for a non-structural wall in a cut-slope situation. For fill slopes, a maximum of 3' (1m) is recommended. Whenever possible, it is recommended that a thorough site investigation be conducted prior to construction of Cascadia Green Wall System.

### Geotextile Grid Length

In general, geogrid length is 0.6 to 0.7 times wall height. Lengths will increase with slope and wall load.

### Maximum Geotextile Grid Spacing

Each course of Cascadia Green Wall System should be wrapped with geotextile grid or geotextile netting. Therefore, the site specific design for vertical spacing will determine Cascadia fascia unit size.



## BEST PRACTICES CONTINUED



### BACKFILL

Foremost, the backfill needs to be approved by the Geotechnical consultant. From a compaction standpoint the ideal backfill materials are rock and sand. In addition to compacting well, these materials drain well. While drainage must always be a consideration, it is important to remember that a Cascadia Green Wall System fascia unit is permeable and the vegetation growing in it requires water. The most successful installations will balance the requirements of drainage, compaction and moisture availability for healthy vegetation. High clay soils that shrink and swell rapidly as well as soils high in organics should be avoided.



### BACKFILL COMPACTION

It is recommended that backfill be placed and compacted in 6" (150mm) to 10" (250mm) lifts in order to ensure consistent compaction and to reduce undue pressure on wall before the geotextile grid is wrapped around the fascia and secured. For site specific information on compaction consult your site engineer.



### FINISHING THE GREEN WALL

To avoid exposing the geotextile grid, the 12" Cascadia fascia unit is to be either backfilled with growing media or wrapped with a geotextile lockdown netting. If pedestrian guard rails or fencing is to be added to the top of the wall, details should be obtained from the engineer or landscape architect.

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## **SUSTAINABILITY STANDARDS: LEED - LEADERSHIP IN ENERGY AND ENVIRONMENTAL DESIGN LID - LOW IMPACT DEVELOPMENT**

### **LID**

Low Impact Development is a comprehensive land planning and engineering design approach with a goal of maintaining and enhancing the pre-development hydrologic regime of urban and developing watersheds. Low-impact development technology employs microscale and distributed management techniques, called integrated management practices (IMPs), to achieve desired post-development hydrologic conditions. The LID site planning process has identified how fundamental design techniques can be used to minimize the hydrologic effects of development. The hydrologic analysis demonstrates how to quantify the predevelopment and post development conditions under various design scenarios. National Manuals are available from [www.lowimpactdevelopment.org](http://www.lowimpactdevelopment.org). Cascadia's products and practices may be used to achieve LID.

### **LEED**

The Leadership in Energy and Environmental Design (LEED) is a program rating system that promotes and certifies environmentally sustainable building. To be LEED Certified, a project must attain at least 26 credits out of a possible 69. Levels of LEED Certification include: Certified = 26-32, Silver = 33-38, Gold = 39-51, Platinum = 52-69.

### **LEED NEW CONSTRUCTION**

LEED-New Construction C is the most widely used program in which Cascadiaproducts and practices can be readily adopted and used to help a project teamaccrue credits toward LEED Certification.

### **CASCADIA PRODUCTS FOR LEED**

Categories under the LEED-NC rating program include the following; categories in bold are areas where Cascadia's products and practices may be used for a total accrual of 12 credits\*:

1. **Sustainable Sites** (potential credits = 14)
2. **Water Efficiency** (potential credits = 5)
3. **Energy and Atmosphere** (potential credits = 17)
4. **Materials and Resources** (potential credits = 13)
5. **Indoor Environmental Quality** (potential credits = 15)
6. **Innovation and Design Process** (potential credits = 5)

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# APPENDIX 1

## MAINTENANCE OPTIONS

### 1.0 MAINTENANCE

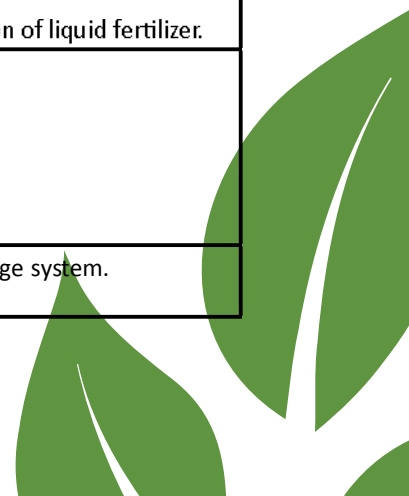
#### 1.1 MAINTENANCE UNDER WARRANTY

A basic maintenance package is included by Cascadia throughout the warranty period.

#### 1.2 OPTIONAL EXTENDED MAINTENANCE CONTRACT

Cascadia can also provide 1-2 year maintenance program. An example is provided:

TIMEFRAME	STRUCTURAL	PLANT CARE	IRRIGATION
Early Spring	Check structural integrity. Ensure no tears/holes in sock. Note any slippage that has occurred. Inspect area around wall for erosion concerns.	Visual inspection. Plant replacement when necessary. Removal of invasive species/weeds. Removal of dead material.	Visual Inspection of driplines, filter, moisture sensors and control assembly. Recharge system and ensure performance of all driplines and fittings. Replace as necessary.
Late Spring	N/A	Visual inspection. Plant replacement when necessary. Removal of invasive species and weeds.	Injection of liquid fertilizer.
Early Summer	N/A	Visual inspection. Plant replacement when necessary. Removal of invasive species and weeds.	Increase irrigation frequency at Control Assembly. Inspect wall for even water usage. Adjust as necessary.
Late Summer	N/A	Visual inspection. Plant replacement when necessary. Removal of invasive species and weeds.	Injection of liquid fertilizer.
Early Fall	Check structural integrity. Ensure no tears/holes in sock. Note any slippage that has occurred. Inspect area around wall for erosion concerns.	Inspect plant health and reduce irrigation frequency as required.	N/A
Late Fall Early Winter	N/A N/A	N/A N/A	Discharge system. N/A



## APPENDIX 2

# MSE WALL PLANTINGS

### LIST OF SUGGESTED MSE WALL PLANT SPECIES:

Argostis pallens	Dune Bentgrass (partial green winter appearance)
Allium cernuum	Nodding onion (plant as a bulb - pink flowers on tall stems)
Arctostaphylos uva-ursi	Kinnikinnick, evergreen groundcover with red berries
Camassia quamash	Common Camas (plant as a bulb-star-shaped purple flowers)
Carex densa	Dense Sedge (wetter areas near drainage strips)
Carex pansa	Sand Dune Sedge (wetter areas near drainage strips)
Cotoneaster dammeri	Bearberry, evergreen groundcover with red berries
Eschscholzia californica	California Poppy (orange flower)
Euonymus japonicus	Japanese Spindle (orange fruit in fall)
Festuca idahoense	Idaho Blue Fescue (tan winter appearance)
Festuca ovina 'Glauca'	Blue Fescue (tan bluish winter appearance)
Festuca ovina vulgaris	Sheep's Fescue (tan winter appearance)
Festuca rubra	Red Fescue (tan winter appearance)
Fragaria chioensis	Coastal Strawberry (fast coverage, green winter appearance)
Gaultheria procumbens	Eastern teaberry, American wintergreen (low ground cover, with red berries)
Heuchera micrantha	Alumroot (small white flowers on red stems)
Juniperus communis	Common juniper, with bluish-black berries
Polypodium glycyrrhiza	Licorice fern, many footed fern
Sedum acre	Goldmoss Stonecrop (green winter appearance)
Sedum album	White Stonecrop (fast coverage, yellow green winter appearance)
Sedum divergens	Spreading Stonecrop (reddish winter appearance)
Sedum oreganum	Oregon Stonecrop (green winter appearance)
Sedum floriferum 'W.Gold'	Weihenstephaner Gold Stonecrop (yellowish winter appearance)
Sedum rupestre	Blue Stonecrop (blue-green foliage in winter)
Sisyrinchium douglasii	Blue-eyed-grass (plant as a bulb - purple flowers)



## REFERENCES

### REFERENCES

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