Introduction to LEED®
and
Application to Dairy/Livestock Facilities

Presentation By:

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DPR Construction

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Introduction to Sustainability

“Meeting the needs of the present without compromising the ability of future generations to meet their own needs.”

– Brundtland Commission (1987)

Sustainable Built Environment
- Green Buildings: Offices, Schools, Homes, Livestock Facilities
- Green Infrastructure: Roads, Bridges, Factories, Treatment Plants, etc.
- Sustainable Communities and Cities
- Green Machines: Smart Appliances, Electric Cars, etc.
- Renewable Energy: Macro & On-site scales
- Smart Grid: Transmission and Distribution

Green Building Movement
- After OPEC embargo, there was a push towards energy efficient buildings
- It went on and off till 1990’s when the green movement started to take hold
- By early to mid 2000, it was widely believed that green buildings have entered the mainstream of society
- Now, when most people think of Green Buildings, they think of LEED Buildings - just like Xerox for photocopying
- Many corporate and government owners have already adopted LEED and are now looking for consultants, designers, contractors and operators as “value-added” partners who understand LEED requirements

LEED® (Leadership in Energy and Environmental Design)

Background on LEED
- U.S. Green Building Council (USGBC), a non-profit organization, was established in 1993 to support and promote sustainable building design and construction practices.
- LEED v 1.0 - launched in 1998
- LEED v 2.0 - released in 2000 with extensive modification
- LEED v2.1 - an administrative update in 2002 to LEED v2.0
- LEED v2.2 - launched in 2005
- LEED v.3.0/2009 – released as fully updated version
- LEED v.4.0 – currently undergoing public comments

Current Status and Projections
- As of December 2011, around 125,000 buildings are LEED registered or certified
- USGBC has committed that by 2020, there will be one million LEED certified commercial buildings and ten million LEED certified homes
LEED Rating Systems

Credits Distribution

<table>
<thead>
<tr>
<th>LEED Category</th>
<th>Available Credits</th>
<th>Credits' Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>SS</td>
<td>14</td>
<td>21.9%</td>
</tr>
<tr>
<td>WE</td>
<td>5</td>
<td>7.8%</td>
</tr>
<tr>
<td>EA</td>
<td>17</td>
<td>26.5%</td>
</tr>
<tr>
<td>MR</td>
<td>13</td>
<td>20.3%</td>
</tr>
<tr>
<td>IEQ</td>
<td>15</td>
<td>23.5%</td>
</tr>
<tr>
<td>ID</td>
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<tr>
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<tr>
<td><strong>Total:</strong></td>
<td><strong>64+5</strong></td>
<td></td>
</tr>
</tbody>
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<table>
<thead>
<tr>
<th>LEED Category</th>
<th>Available Credits</th>
<th>Credits' Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>SS</td>
<td>26</td>
<td>26.0%</td>
</tr>
<tr>
<td>WE</td>
<td>10</td>
<td>10.0%</td>
</tr>
<tr>
<td>EA</td>
<td>35</td>
<td>35.0%</td>
</tr>
<tr>
<td>MR</td>
<td>14</td>
<td>14.0%</td>
</tr>
<tr>
<td>IEQ</td>
<td>15</td>
<td>15.0%</td>
</tr>
<tr>
<td>ID</td>
<td>6</td>
<td>-</td>
</tr>
<tr>
<td>RP</td>
<td>4</td>
<td>-</td>
</tr>
<tr>
<td><strong>Total:</strong></td>
<td><strong>100+10</strong></td>
<td></td>
</tr>
</tbody>
</table>

Certification Levels:
- Certified: 26+ Points
- Silver: 33+ Points
- Gold: 39+ Points
- Platinum: 52+ Points

* These rating systems are under development or in pilot. Once they are available, supplements will be sold for the new LEED 2009 Reference Guides.
Case Study Overview
• W.K. Kellogg Biological Station – Pasture Dairy Research and Education Center
• 1,688 sq. ft. Support Area and 19,232 sq. ft. free-stall area
• $2.8 million
• Constructed Fall 2008 – Spring 2009
• Received LEED® Silver Certification under v2.2
## Sustainable Sites (SS)

<table>
<thead>
<tr>
<th>Credit</th>
<th>Description</th>
<th>v 2009</th>
<th>v 2.2</th>
<th>EP*</th>
<th>Applicability</th>
</tr>
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<tbody>
<tr>
<td>Prerequisite 1</td>
<td>Construction Activity Pollution Prevention</td>
<td>Req.</td>
<td>Req.</td>
<td></td>
<td>High (CS)</td>
</tr>
<tr>
<td>Credit 1</td>
<td>Site Selection</td>
<td>1</td>
<td>1</td>
<td></td>
<td>Low</td>
</tr>
<tr>
<td>Credit 2</td>
<td>Development Density and Community Connectivity</td>
<td>5</td>
<td>1</td>
<td>✔</td>
<td>Low</td>
</tr>
<tr>
<td>Credit 3</td>
<td>Brownfield Redevelopment</td>
<td>1</td>
<td>1</td>
<td></td>
<td>Medium</td>
</tr>
<tr>
<td>Credit 4.1</td>
<td>Alternative Transportation - Public Transportation Access</td>
<td>6</td>
<td>1</td>
<td></td>
<td>Low</td>
</tr>
<tr>
<td>Credit 4.2</td>
<td>Alternative Transportation - Bicycle Storage and Changing Rooms</td>
<td>1</td>
<td>1</td>
<td>✔</td>
<td>High (CS)</td>
</tr>
<tr>
<td>Credit 4.3</td>
<td>Alternative Transportation - Low-Emitting and Fuel-Efficient Vehicles</td>
<td>3</td>
<td>1</td>
<td></td>
<td>High (CS)</td>
</tr>
<tr>
<td>Credit 4.4</td>
<td>Alternative Transportation - Parking Capacity</td>
<td>2</td>
<td>1</td>
<td></td>
<td>Medium (CS)</td>
</tr>
<tr>
<td>Credit 5.1</td>
<td>Site Development - Protect or Restore Habitat</td>
<td>1</td>
<td>1</td>
<td>✔</td>
<td>High (CS)</td>
</tr>
<tr>
<td>Credit 5.2</td>
<td>Site Development - Maximize Open Space</td>
<td>1</td>
<td>1</td>
<td>✔</td>
<td>High (CS)</td>
</tr>
<tr>
<td>Credit 6.1</td>
<td>Stormwater Design - Quantity Control</td>
<td>1</td>
<td>1</td>
<td></td>
<td>Medium</td>
</tr>
<tr>
<td>Credit 6.2</td>
<td>Stormwater Design - Quality Control</td>
<td>1</td>
<td>1</td>
<td>✔</td>
<td>High (CS)</td>
</tr>
<tr>
<td>Credit 7.1</td>
<td>Heat Island Effect - Nonroof</td>
<td>1</td>
<td>1</td>
<td>✔</td>
<td>High</td>
</tr>
<tr>
<td>Credit 7.2</td>
<td>Heat Island Effect - Roof</td>
<td>1</td>
<td>1</td>
<td>✔</td>
<td>High (CS)</td>
</tr>
<tr>
<td>Credit 8</td>
<td>Light Pollution Reduction</td>
<td>1</td>
<td>1</td>
<td></td>
<td>High (CS)</td>
</tr>
</tbody>
</table>

**Total Points:** 26 **14**

*Exemplary Performance*
Format and Information Reference

For each credit, the intent is copied from *LEED 2009 for New Construction and Major Renovations Rating System* (referred to as LEED Rating Document).

To see the “Requirements” after intent, please refer to the LEED Rating Document. The page number of each credit is provided in the handout.

Example Slide with Various Information:
SS Prerequisite 1 (HIGH) – Construction Activity Pollution Prevention
Refer to page 1 of LEED Rating Document

**Intent**
Reduce pollution from construction activities by controlling soil erosion, waterway sedimentation and airborne dust generation.

**Justification for Applicability to Livestock Facilities**
- Must satisfy LEED prerequisite
- Local ordinance requirements for erosion and sedimentation control plan

**Case Study Documentation**

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**Soil Erosion and Sedimentation Control Program**

201 W. Michigan Avenue, Room 202 - Kalamazoo, Michigan 49007
Phone: (269) 384-0117 / Fax: (269) 383-0662

**Earth Change Permit**
Issued under Authority of Part 91 of Michigan's Natural Resources and Environmental Protection Act, Public Act 451 of 1994

<table>
<thead>
<tr>
<th>Name:</th>
<th>Kellogg Biological Center</th>
</tr>
</thead>
<tbody>
<tr>
<td>Address:</td>
<td>10861 S. 40th Street</td>
</tr>
<tr>
<td></td>
<td>Michigan County, MI</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PERMIT NO.</th>
<th>C08-131</th>
</tr>
</thead>
<tbody>
<tr>
<td>DATE ISSUED</td>
<td>9/30/08</td>
</tr>
<tr>
<td>DATE EXPIRES</td>
<td>9/30/09</td>
</tr>
</tbody>
</table>

Under provision of Part 91, Soil Erosion and Sedimentation Control (PA 451, 1994) authority is hereby granted to:

New dairy facility.

As shown on plans dated held on file at the Soil Erosion (SESC) Office
Section Township of Road Kalamazoo County, MI
Subdivision: __________ Lot Number: __________
Project Address: same as above

Work completed under authority of this permit is subject to the following special restriction, limitations and instructions: (Note: Council requirements of Ordinance passed July 10, 2002 by Kalamazoo County Board of Commissioners.)

**ON SITE AUTHORITY**

<table>
<thead>
<tr>
<th>Name:</th>
<th>Hoffman Bros.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phone:</td>
<td>509-045-1207</td>
</tr>
<tr>
<td>Address:</td>
<td>8874 Verona Rd.</td>
</tr>
<tr>
<td></td>
<td>Battle Creek, MI 49010</td>
</tr>
</tbody>
</table>

Approved: [Signature]

Self Erosion & Sedimentation Control Agent

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Indicators:
- Pre-Inspection
- Final Inspection
- Other Inspection
- Variation

[Formal approval and inspection details]
SS Credit 4.2 (HIGH) – Alternative Transportation: Bicycle Storage & Changing Rooms
Refer to page 7 of LEED Rating Document

Intent
Reduce pollution and land development impacts from automobile use.

Justification for Applicability to Livestock Facilities
- Low FTE at livestock facilities, requires only 1 rack

Exemplary Performance
- Institute comprehensive transportation plan to reduce personal automobile use.
- Only 1 EP credit available for 4.1-4.4

Case Study Content

Project: Kellogg Biological Farm & Dairy Research Facility

Full Time Equivalent
FTE Occupants = Occupant Work Hours
8 (hours)

Full Time
Diary Staff
3 Full Time x 8 = 3
8

Part-Time
Researchers
4 Conference Center x 2 Hours = 1
8

Visitors
School Class 24 x 1 Hour = 3
8

Total Full Time Equivalent Occupancy = 7
5% of the FTE = .35 or one space.

Figure X – Bicycle Rack Calculation
SS Credit 4.3 (HIGH) – Alternative Transportation: Low-Emitting & Fuel-Efficient Vehicles
Refer to pages 8-9 of LEED Rating Document

Intent
Reduce pollution and land development impacts from automobile use.

Justification for Applicability to Livestock Facilities
- Low FTE at livestock facility, requires only 1 space

Exemplary Performance
- Institute comprehensive transportation plan to reduce personal automobile use.
- Only 1 EP credit available for 4.1-4.4

Case Study Content

Plan View with Fuel Efficient Vehicle Space

Fuel Efficient Vehicle Sign
SS Credit 5.1 (HIGH) – Protect or Restore Habitat
Refer to pages 12-13 of LEED Rating Document

**Intent**
Reduce pollution and land development impacts from automobile use.

**Justification for Applicability to Livestock Facilities**
- Easy to accomplish
- Protects farmland from development and construction traffic

**Exemplary Performance**
- Restore or protect at least 75% of site (excluding building footprint) or 30% of site (including building footprint) with native or adapted vegetation.

**Case Study Content**

![Site Plan with Construction Limits](image)

**Narrative**
The project's approach to this credit was to limit the disturbance caused by the construction activities. For this previously developed and graded site, we protected a minimum of 50% of the site area (excluding the building footprint) with native or adapted vegetation.

- We establish clearly marked construction boundaries to minimize disturbance of the existing site by running a temporary fence line
- Where we needed to disturb the area for septic and running utility lines we restored areas to their natural state.
SS Credit 5.2 (HIGH) – Maximize Open Space
Refer to page 14 of LEED Rating Document

**Intent**
Promote biodiversity by providing a high ratio of open space to development footprint.

**Justification for Applicability to Livestock Facilities**
- Availability of open farmland space surrounding agriculture buildings

**Exemplary Performance**
Double the amount of open space within LEED project boundary required for credit achievement.

**Case Study Content**

![Site Plan with Open Space Calculation](image-url)
SS Credit 6.2 (HIGH) – Stormwater Management: Quality Control
Refer to page 16 of LEED Rating Document

**Intent**
- Limit disruption of natural water flows by managing stormwater runoff

**Justification for Applicability to Livestock Facilities**
- Implementation of Stormwater Management Plan benefits site

**Exemplary Performance**
- No standard exists. Document a comprehensive approach to capture and treat stormwater runoff beyond credit requirements.
- Only one credit available for SSc6.1 and SSc6.2

**Case Study Content**

![Site Plan with Stormwater Management Techniques](image)

**Figure X – Site Plan with Stormwater Management Techniques**

**W.K. Kellogg Biological Station Stormwater Best Management Plan**

**Definition**
Best Management Practices (BMPs) are techniques used to control stormwater runoff, sediment control, and soil stabilization, as well as management decisions to prevent or reduce nonpoint source pollution. The EPA defines a BMP as a “technique, measure or structural control that is used for a given set of conditions to manage the quantity and improve the quality of stormwater runoff in the most cost-effective manner.”
Practices Employed

Infiltration Strip
An infiltration basin is a shallow impoundment which is designed to infiltrate storm water into the ground water. This practice is believed to have a high pollutant removal efficiency and can also help recharge the ground water, thus restoring low flows to stream systems.

Porous Surfaces
Porous pavement is a permeable pavement surface with an underlying stone reservoir to temporarily store surface runoff before it infiltrates into the subsoil. This porous surface replaces traditional pavement, allowing parking lot storm water to infiltrate directly and receive water quality treatment.

Bioretention
Bioretention areas are landscaping features adapted to provide on-site treatment of storm water runoff. They are commonly located in parking lot islands or within small pockets of residential land uses. Surface runoff is directed into shallow, landscaped depressions. These depressions are designed to incorporate many of the pollutant removal mechanisms that operate in forested ecosystems.

Monitoring
The BMPs described here are intended to assist in controlling social and environmental impacts related to stormwater collection on-site. Monitoring the success of BMPs, whether they are structural like a check for debris in the swale or gutter or procedures like limiting drop height, will help assure compliance with requirements. BMP monitoring also involves scheduling of inspections to ensure that the outcomes of BMPs meet expectations. At the heart of BMP effectiveness monitoring is a listing of each BMP, its expected performance and an assessment of whether the controlled value (noise, dust, water quality, etc.) is within targeted limits.
### Infiltration Areas

<table>
<thead>
<tr>
<th>Activity</th>
<th>Schedule</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inspect facility for signs of wetness or damage to areas</td>
<td>Semi-Annually</td>
</tr>
<tr>
<td>Note eroded areas</td>
<td></td>
</tr>
<tr>
<td>If dead or dying grass is observed, check to ensure that water is percolating 2-3 days following a storm</td>
<td></td>
</tr>
<tr>
<td>Note signs of percolum or hydrocarbon contamination and handle properly</td>
<td></td>
</tr>
<tr>
<td>Mow &amp; remove litter &amp; debris</td>
<td>As needed</td>
</tr>
<tr>
<td>Stabilize any eroded banks</td>
<td></td>
</tr>
<tr>
<td>Repair undercut or eroded areas at the intact</td>
<td></td>
</tr>
<tr>
<td>Disturb or otherwise aerate bottom</td>
<td>Annually</td>
</tr>
<tr>
<td>Delhath or Basin Bottom</td>
<td></td>
</tr>
<tr>
<td>Shape bottom to remove sediment, Restore original cross-section and infiltration rate</td>
<td>3-year</td>
</tr>
<tr>
<td>Seed or sod to restore ground cover</td>
<td></td>
</tr>
</tbody>
</table>

### Porous Surfaces

<table>
<thead>
<tr>
<th>Activity</th>
<th>Schedule</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avoid sealing or paving with non-porous materials</td>
<td>N/A</td>
</tr>
<tr>
<td>Ensure that porous area is clear of debris</td>
<td>Monthly</td>
</tr>
<tr>
<td>Ensure that porous areas drain between storms</td>
<td></td>
</tr>
<tr>
<td>Ensure area is clean of sediments</td>
<td></td>
</tr>
<tr>
<td>Mow, upland and adjacent areas, and seed bare areas</td>
<td>As needed</td>
</tr>
<tr>
<td>Inspect surface for deterioration or pooling</td>
<td>Annually</td>
</tr>
</tbody>
</table>

### Pasture / Pasture

<table>
<thead>
<tr>
<th>Activity</th>
<th>Schedule</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mow turf areas</td>
<td></td>
</tr>
<tr>
<td>Inspect soil and repair eroded areas</td>
<td>Monthly</td>
</tr>
<tr>
<td>Remove litter and debris</td>
<td></td>
</tr>
<tr>
<td>Remove and replace dead or diseased vegetation</td>
<td>3-Annually</td>
</tr>
</tbody>
</table>
SS Credit 7.1 (HIGH) – Heat Island Effect: Nonroof: (Not in Case Study)
Refer to pages 17-18 of LEED Rating Document

**Intent**
- Reduce heat island to minimize impacts on microclimates and human and wildlife habitats.

**Justification for Applicability to Livestock Facilities**
- Limited amount of hardscapes in agricultural buildings

**Exemplary Performance**
Demonstrate that either (1) 100% of nonroof impervious surfaces were constructed with high albedo or open-grid paving, or will be shaded within 5 years; or (2) 100% of the on-site parking spaces have been located under cover.

**Example**

<table>
<thead>
<tr>
<th>SS Credit 7.1</th>
<th>Heat Island Effect: Nonroof</th>
</tr>
</thead>
<tbody>
<tr>
<td>Example</td>
<td></td>
</tr>
</tbody>
</table>

A building is located on a 25,000-square-foot site, of which 15,000 square feet is occupied by the building footprint and vegetated areas. The project team employs strategies to reduce heat island effect for nonroof surfaces, installing deciduous trees to shade parking and driveway areas and using light-colored concrete with an SR of 35 for driving aisles and walkways (Figure 1). Areas that contain both light-colored hardscapes and are shaded by trees are counted only once. Table 2 lists the areas of qualifying surfaces.

**Table 2. Sample Qualifying Surface Areas**

<table>
<thead>
<tr>
<th>Description</th>
<th>Area (sf)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total nonroof hardscapes</td>
<td>10,000</td>
</tr>
<tr>
<td>Shaded areas</td>
<td>3,090</td>
</tr>
<tr>
<td>Areas of hardscapes with minimum SR of 35</td>
<td>4,080</td>
</tr>
<tr>
<td>Total qualifying surfaces</td>
<td>7,000</td>
</tr>
</tbody>
</table>
SS Credit 7.2 (HIGH) – Heat Island Effect: Roof
Refer to pages 19-20 of LEED Rating Document

Justification for Applicability to Livestock Facilities
• Ability to utilize highly reflective roofing materials

Exemplary Performance
• Demonstrate 100% of roof area consists of vegetated roof system.

Case Study Content
Roof Specification
1. Ribbed Metal Roofing: Tapered-Rib-Profile, Exposed Fastener Metal Roof Panels: formed with raised ribs; designed to be field assembled by lapping side edges of adjacent panels and mechanically attaching panels to supports using exposed fasteners in side laps.
   a. Profile similar to Classic Rib or Pro Panel II from Metal Sales Mfg.
   b. Material: Zinc-coated (galvanized) steel sheet, 26 gage thick.
      1) Exterior Finish: Fluoropolymer
      2) Color: White.
   c. Panel Coverage: 36 inches
   d. Single sheet from ridge to eave. Where single sheet is not practical, allow for minimum of full purlin-to-purlin end lap.
   e. Minimum 82,000 psi, grade E steel.
LEED 2.2 NC PROGRAM

The LEED Green Building Rating System is a system developed to certify “green” buildings under a system created and promulgated by the U.S. Green Building Council. LEED stands for “Leadership in Energy and Environmental Design”. The current version of this program is LEED 2.2 NC, for New Construction. Architects attempt to certify their buildings for a variety of reasons, including state and local government incentives in some areas, Federal government requirements on some projects, professional recognition and because they want to be environmentally responsible.

The rating system gives points for a project in the following categories: SS sustainable sites (14 possible points), WE water efficiency (5 possible points), EA energy and atmosphere (17 possible points), MR materials & resources (13 possible points), EQ indoor environmental quality (15 possible points), and ID innovation & design process (5 possible points). The total possible points are 69. To become certified takes 26 to 32 points. 33 to 38 points gets the building Silver Certification. 39 to 51 points achieves Gold Certification and 52 to 69 points obtains Platinum Certification. There are also several items that are minimum requirements for any certification level and do not earn any points. These items are erosion and sediment control, fundamental building systems commissioning, minimum energy performance, CFC reduction in HVAC&R equipment, storage & collection of recyclables, minimum indoor air quality performance, and environmental tobacco smoking control. The LEED program certifies buildings only; not individual construction products so Fabral cannot seek LEED certification of any of our products.

Let’s get to specifics of how an Architect can gain LEED points by using Fabral’s products! The first possible point is under sustainable sites. One point can be earned under credit SS 7.2 by using a roof system that is highly reflective AND has a high emissivity as rated by a new method called the Solar Reflectance Index (SRI). This requirement is intended to reduce the heat island effect. LEED no longer uses the Energy Star program requirements. One nice change is that the SRI is calculated from the initial reflectivity and the initial emissivity. This means that, unlike Energy Star approval, we no longer have to wait 3 years for aged reflectivity values for the LEED program. For a low slope roof of 2:12 or less, the SRI must be at least 78. For a steep slope roof of over 2:12 pitch the SRI must be at least 29. We have many colors that meet the steep slope requirements and a few that meet the stiffer low slope requirements. The SRI values for our standard colors and some special colors are listed on the tables at the end of this technical bulletin. A reflective metal roof can also help toward the energy efficiency prerequisite and the optimized energy performance requirements in credit EA 1 which is up to 10 credits under energy & atmosphere section. This section compares the reduced design energy cost for the project compared to the energy cost budget according to ASHRAE Standard 90.1. The greater the energy savings, the more the points. up to 10 points for a 42% reduction in energy requirements over the ASHRAE energy budget. ASHRAE is the American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. Highly reflective metal roofing helps reduce the air-conditioning costs and helps to meet this requirement, but it’s only a small part of the equation. Under credit EA 2, between 1 and 3 points are available for developing on-site renewable energy. This can be accomplished using Fabral’s Solar SSR system. EA 2.1 allows 1 point for generating 2.5% of the building’s energy requirements on-site with solar panels. EA 2.2 allows 2 point for generating 7.5% of the building’s energy requirements on-site with solar panels and EA 2.3 allows 3 points for...
SS Credit 8 (HIGH) – Light Pollution Reduction
Refer to pages 21-24 of LEED Rating Document

**Intent**
- Minimize light trespass from the building and site, reduce sky-glow to increase night sky access, improve nighttime visibility through glare reduction, and reduce development impact from lighting on nocturnal environments.

**Justification for Applicability to Livestock Facilities**
- Fixtures are available to limit light pollution

**Case Study Content**

*Exterior Lighting in Plan Figure*  
*Exterior Lighting Simulation*  
*Exterior Light Fixture*
SS Credit 3 (MEDIUM) – Brownfield Redevelopment
Refer to page 5 of LEED Rating Document

Intent
Rehabilitate damaged sites where development is complicated by environmental contamination, reducing pressure on undeveloped land.

Justification for Applicability to Livestock Facilities
Not all farmland will contain brownfield for redevelopment.

Possible brownfield qualification on farmland:
- Oil Spills
- Toxic Crop
- Fertilizer Spill/Storage
- Other Livestock
- Asbestos Abatement (within an existing structure)

SS Credit 4.4 (MEDIUM) – Alternative Transportation: Parking Capacity
Refer to pages 10-11 of LEED Rating Document

Intent
Reduce pollution and land development impacts from automobile use.

Justification for Applicability to Livestock Facilities
Not all farms will require carpool parking or have enough parking to justify a dedicated space.

Case Study Content

W.K. Kellogg Biological Station

Carpool Program

Located between Kalamazoo and Battle Creek, Michigan (about 65 miles southwest of the main campus), the 4,065-acre (1,636 hectares) station includes Kellogg Bird Sanctuary, Kellogg Farm, the Kellogg Biological Laboratories, the KBS Conference Center, Extension and Outreach offices and the Lux Arbor Reserve. The biological station also includes dormitories and housing amenities and the students are encouraged to use alternative means of transportation. Facilities are provided for bicycle storage, preferential parking is provided for car or van pool vehicles. Ridesharing is encouraged whenever possible, requests regarding rides should be posted to the KBS email list [NEWS-L-owner@lists.msu.edu] to help facilitate the coordination of ridesharing where ever possible.

The Kellogg Biological Station (KBS) encourages its staff to carpool whenever possible.

- Individuals traveling from KBS to campus or other locations off site should check the “Vehicle Sign-Out Sheet” in the Academic Building mail room to arrange carpool rides.
- When traveling between sites within KBS employees should carpool whenever possible.
- If employees would like help to arrange a carpool to and from work please speak with your supervisor.
SS Credit 6.1 (MEDIUM) – Stormwater Management: Quantity Control
Refer to page 15 of LEED Rating Document

*Intent*
Limit disruption of natural hydrology by reducing impervious cover, increasing on-site infiltration, reducing or eliminating pollution from stormwater runoff and eliminating contaminants.

*Justification for Applicability to Livestock Facilities*
- Requires measurement of stormwater infiltration before development and after
- Measured stormwater infiltration rate must improve
- Difficult to demonstrate when land is natural pasture or farmland
- KBS unable to prove redistributed runoff potential on project

SS Credit 1 (LOW) – Site Selection
Refer to pages 2-3 of LEED Rating Document

*Intent*
To avoid the development of inappropriate sites and reduce the environmental impact from the location of a building on a site.

*Justification for Applicability to Livestock Facilities*
- Need to construct facilities on farmland for agricultural projects
- Only Possible if site:
  - Was previously developed
  - Is above the 100yr flood plain
  - Is 50+ ft. from nearest water body
  - Is adjacent to farmland in location that could not be farmed

SS Credit 2 (LOW) – Development Density & Community Connectivity
Refer to page 4 of LEED Rating Document

*Intent*
Channel development to urban areas with existing infrastructure, protect greenfields and preserve habitat and natural resources.

*Justification for Applicability to Livestock Facilities*
Difficult to fulfill requirements in rural areas.

SS Credit 4.1 (LOW) – Alternative Transportation: Public Transportation Access
Refer to page 6 of LEED Rating Document

*Intent*
Reduce pollution and land development impacts from automobile use.

*Justification for Applicability to Livestock Facilities*
Requires ½ mile walking distance to rail station or ¼ mile walking distance to bus stop (minimum 2 bus lines), therefore, only possible if near rural rail station or bus stop
## Water Efficiency (WE)

<table>
<thead>
<tr>
<th>Credit</th>
<th>Description</th>
<th>v 2009</th>
<th>v 2.2</th>
<th>EP*</th>
<th>Applicability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prerequisite 1</td>
<td>Water Use Reduction</td>
<td>Req.</td>
<td>Req.</td>
<td>High (CS)</td>
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</tr>
<tr>
<td>Credit 1</td>
<td>Water Efficient Landscaping</td>
<td>2-4</td>
<td>2</td>
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<tr>
<td>Credit 2</td>
<td>Innovative Wastewater technologies</td>
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<td>Credit 3</td>
<td>Water Use Reduction</td>
<td>2-4</td>
<td>2</td>
<td>✓ High (CS)</td>
<td></td>
</tr>
</tbody>
</table>

Total Points: 10

*Exemplary Performance

## WE Prerequisite 1 (HIGH) – Water Use Reduction

Refer to pages 25-26 of LEED Rating Document

**Intent**

Increase water efficiency within buildings to reduce the burden on municipal water supply and wastewater systems

**Justification for Applicability to Livestock Facilities**

- Must satisfy LEED Prerequisite
- Utilize low flow fixtures

**Case Study Content**
WE Credit 1 (HIGH) – Water Efficient Landscaping  
Refer to pages 27-28 of LEED Rating Document

*Intent*
Limit or eliminate the use of potable water, or other natural surface or subsurface water resources available on or near the project site, for landscape irrigation

*Justification for Applicability to Livestock Facilities*
- Limited landscaping requirements for livestock facilities

*Case Study Content*
- No landscape irrigation on site

WE Credit 3 (HIGH) – Water Use Reduction  
Refer to pages 30-31 of LEED Rating Document

*Intent*
Further increase water efficiency within buildings to reduce the burden on municipal water supply and wastewater systems.

*Justification for Applicability to Livestock Facilities*
- Utilize water efficient fixtures

*Case Study Content*
Research papers on the efficiency of robotic milking machines:
- Power and Water Consumption with AMS, FarmTest #61, December 2009
- Rasmussen and Pedersen, Electricity and Water Consumption at Milking, Danish Agricultural Advisory Service, 2004

![Robotic Milking Machine](image)
WE Credit 2 (MEDIUM) – Innovative Wastewater Technologies
Refer to page 29 of LEED Rating Document

*Intent*
- Reduce wastewater generation and potable water demand while increasing the local aquifer recharge

*Justification for Applicability to Livestock Facilities*
- Additional expense to treat wastewater
- Water-conserving fixtures available

*Exemplary Performance*
- Reduce projected potable water use by 45%
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<th>v 2.2</th>
<th>EP*</th>
<th>Applicability</th>
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<td>Prerequisite 1</td>
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<td>Req.</td>
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<td>Fundamental Refrigerant Management</td>
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<td>Req.</td>
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<td>On-Site Renewable Energy</td>
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<td>Credit 3</td>
<td>Enhanced Commissioning</td>
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<td>1</td>
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<tr>
<td>Credit 4</td>
<td>Enhanced Refrigerant Management</td>
<td>2</td>
<td>1</td>
<td></td>
<td>Medium</td>
</tr>
<tr>
<td>Credit 5</td>
<td>Measurement and Verification</td>
<td>3</td>
<td>1</td>
<td></td>
<td>High (CS)</td>
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<td>Credit 6</td>
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<td>2</td>
<td>1</td>
<td>✔</td>
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</tr>
</tbody>
</table>

**Total Points:** 35 17

*Exemplary Performance
EA Prerequisite 1 (HIGH) – Fundamental Commissioning of the Building Energy Systems

Refer to pages 33-34 of LEED Rating Document

**Intent**
Verify that the building’s energy related systems are installed, calibrated, and perform according to the owner’s project requirements, basis of design, and construction documents.

**Justification for Applicability to Livestock Facilities**
- LEED Requirement
- Commissioning ensures building performance to specifications

**Case Study Content**

1. HVAC
   a. Air Conditioning System consisting of warm air furnace and split system air conditioner, controlled by programmable thermostat. A building automation system is not utilized in this building.
   b. Electric Unit Heater in Room 102
   c. Electric Unit Heaters in Robotic Milking Room (Deferred to July 16)
   d. Energy Recovery Ventilator
   e. Ventilation Fans for Robotic Milking Room

2. DHW
   a. Electric water heater and mixing valves.

3. Lighting and Daylighting Controls
   a. Occupancy sensors (Deferred to July 16)
   b. Daylighting controls installed in the Viewing area (Deferred to July 16)

4. Renewable Energy - None installed
EA Prerequisite 2 (HIGH) – Minimum Energy Performance
Refer to pages 35-37 of LEED Rating Document

Intent
- Establish the minimum level of energy efficiency for the proposed building and systems

Justification for Applicability to Livestock Facilities
- LEED Prerequisite Requirement

EA Credit 1 (HIGH) – Optimize Energy Performance
Refer to pages 39-42 of LEED Rating Document

Intent
Achieve increasing levels of energy performance beyond the prerequisite standard to reduce environmental and economic impacts associated with excessive energy use.

Justification for Applicability to Livestock Facilities
- Saves energy, money and has potential to earn up to 19 LEED points

Exemplary Performance
Only available for Option 1: Improve performance of ASHRAE 90.1-2007 by 50% for new building, 46% for existing building.
Clarification Requested by LEED:

The LEED Submittal Template and supporting documentation have been provided stating that the project has achieved an energy cost savings of 41.6% using the ASHRAE 90.1-2004 Appendix G methodology. Energy efficiency measures include an improved thermal envelope, high efficiency glazing, reduced lighting power density, and high efficiency split system air conditioner. However, several issues should be addressed for the final review.

TECHNICAL ADVICE:
1. Windows for the Proposed Case were modeled with a U-value of 0.24, which does not appear to account for the impact of the window frames on the whole assembly as required by ASHRAE modeling protocol. Please provide additional information to confirm that the framed assembly U-value was used, or revise the model to reflect framed assembly U-values as shown in ASHRAE 90.1-2004 Table A-8.2.

2. The energy savings reported for exterior lighting does not appear to be substantiated based on the energy inputs reported in Table 1.4. Please review the Baseline and Proposed inputs for the model to confirm that they conform with Appendix G modeling protocol, and provide sufficient information regarding the energy inputs in Table 1.4 to justify the reported energy savings [Note: You may also submit an accompanying narrative if this would more easily facilitate the confirmation of energy savings].

3. An Economizer is being used in the Baseline design. However, this does not comply with G3.1.2.6 of ASHRAE 90.1-2004. Please review the Baseline input for the economizer to comply with Table G3.1.2.6A of ASHRAE 90.1-2004.

Response Provided:
1. Window properties were originally taken from specifications. The simulation has been modified and re-run with the corrected properties. See the attached photo of installed window sticker.

2. Exterior Lighting:
   a. Base Case: Exterior lighting power for the base case has been recalculated according to ASHRAE 90.1-2004 – Table 9.4.5, and corrected in Table 1.4 for Uncovered Parking areas and Building Entrances, other. As the drawings indicate, the parking and drive allowance is 32,820 sf X 0.15W/sf = 4.92 KW, and the door allowance for 7-3-foot doors and one 6-foot door X 20W/ft = 0.54KW, for a total of 5.46 KW. See the attached drawings for boundaries and areas.
   
   b. Proposed Case: The proposed case power is entered as the actual fixture power installed of 0.75 KW.

3. The economizer was removed prior to recalculating the model. An economizer is not required according to Table G3.1.2.6A
EA Prerequisite 3 (HIGH) – Fundamental Refrigerant Management
Refer to page 38 of LEED Rating Document

Intent
• Reduce stratospheric ozone depletion

Justification for Applicability to Livestock Facilities
• LEED Prerequisite Requirement

EA Credit 2 (HIGH) – On-Site Renewable Energy (Not in case study)
Refer to page 43 of LEED Rating Document

Intent
Encourage and recognize increasing levels of on-site renewable energy self-supply to reduce environmental and economic impacts associated with fossil fuel energy use.

Justification for Applicability to Livestock Facilities
• Receive up to 7 LEED points under v2009
• Tax incentives
• Public visibility
• Farm provides several options:
  o Space for wind and photovoltaic (solar)
  o Methane from livestock manure
  o Biomass (plant material that can be converted to heat energy to produce electricity)

Exemplary Performance
Document that on-site renewable energy accounts for 15% or more of annual energy cost.

EA Credit 5 (HIGH) – Measurement & Verification
Refer to pages 48-49 of LEED Rating Document

Intent
• Provide for the ongoing accountability of building energy consumption over time

Justification for Applicability to Livestock Facilities
• Actual energy use data is beneficial to owner
EA Credit 6 (HIGH) – Green Power (not in case study)
Refer to page 50 of LEED Rating Document

**Intent**
Encourage the development and use of grid-source, renewable energy technologies on a net zero pollution basis.

**Justification for Applicability to Livestock Facilities**
- Easy to accomplish – purchase green energy from utility
- Two LEED points available – could increase LEED rating if at threshold

**Exemplary Performance**
- Purchase 100% of electricity from renewable sources.

EA Credit 3 (MEDIUM) – Enhanced Commissioning
Refer to pages 44-45 of LEED Rating Document

**Intent**
Begin the commissioning process early during the design process and execute additional activities after systems performance verification is completed.

**Justification for Applicability to Livestock Facilities**
- Extra cost may not be justified for agricultural building
- Could interfere with operation of facility

EA Credit 4 (MEDIUM) – Enhanced Refrigerant Management
Refer to pages 46-47 of LEED Rating Document

**Intent**
Reduce ozone depletion and support early compliance with the Montreal Protocol while minimizing direct contributions to climate change.

**Justification for Applicability to Livestock Facilities**
- May affect dairy production (milk bulk tank cooling and storage)
## Materials and Resources (MR)

<table>
<thead>
<tr>
<th>Credit</th>
<th>Description</th>
<th>v 2009</th>
<th>v 2.2</th>
<th>EP*</th>
<th>Applicability</th>
</tr>
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<tbody>
<tr>
<td>Prerequisite 1</td>
<td>Storage and Collection of Recyclables</td>
<td>Req.</td>
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<td></td>
<td>High (CS)</td>
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<tr>
<td>Credit 1.1</td>
<td>Building Reuse - Maintain Existing Walls, Floors and Roof</td>
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<td>2</td>
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<td>1</td>
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<td>Low</td>
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<tr>
<td>Credit 2</td>
<td>Construction Waste Management</td>
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<td>2</td>
<td>✓</td>
<td>High (CS)</td>
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<tr>
<td>Credit 3</td>
<td>Materials Reuse</td>
<td>1-2</td>
<td>2</td>
<td>✓</td>
<td>Medium</td>
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<tr>
<td>Credit 4</td>
<td>Recycled Content</td>
<td>1-2</td>
<td>2</td>
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<td>High (CS)</td>
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<tr>
<td>Credit 5</td>
<td>Regional Materials</td>
<td>1-2</td>
<td>2</td>
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<td>High (CS)</td>
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<tr>
<td>Credit 6</td>
<td>Rapidly Renewable Materials</td>
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<td>1</td>
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<td>Credit 7</td>
<td>Certified Wood</td>
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</tbody>
</table>

**Total Points:** 14

*Exemplary Performance*
MR Prerequisite 1 (HiGH) – Storage & Collection of Recyclables

Refer to page 51 of LEED Rating Document

Intent

- Facilitate the reduction of waste generated by building occupants that is hauled to and disposed of in landfills.

Justification for Applicability to Livestock Facilities

- LEED Requirement
- Ease to implement

Case Study Content

W.K. Kellogg Biological Station

Recycling Policy

Here at the Kellogg Biological Station (KBS) Dairy Facility we are committed to our community and our environment as a result we are implementing the following policy:

The KBS Dairy will be recycling our paper, metal, glass and plastic waste. In office and copy areas we are providing receptacles for paper and trash, these will be picked up daily (or every other day). Receptacles for trash and recyclables (metal, glass, and plastic) are located in the Break Room and Robotic Milking Viewing Area; recyclables will be emptied as needed and taken to the recyclables pick-up area at the McCrary Dining Hall.

Please be diligent in your sorting practices, the success of this endeavor relies on your participation. Thank you for your assistance.
**MR Credit 2 (HIGH) – Construction Waste Management**  
*Refer to page 54 of LEED Rating Document*

**Intent**
Divert construction and demolition debris from disposal in landfills and incinerators. Redirect recyclable recovered resources back to the manufacturing process and reusable materials to appropriate sites.

**Justification for Applicability to Livestock Facilities**
- Contractor responsibility - can be incorporated in the contract

**Exemplary Performance**
- Divert 95% of construction waste

**Case Study Content**

<table>
<thead>
<tr>
<th>Date</th>
<th>Recycled (tons)</th>
<th>Landfilled (tons)</th>
</tr>
</thead>
<tbody>
<tr>
<td>KBS</td>
<td></td>
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</tr>
<tr>
<td>8/21/08 Crushed Concrete</td>
<td>1855 5</td>
<td>4.6375</td>
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<tr>
<td>Wash Out</td>
<td>1855 3</td>
<td>2.7825</td>
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</tbody>
</table>

**Waste Management**
- Cardboard/Glass/Cans: 1.39 tons
- Wood: 9 tons
- Metal: 0.89 tons
- Trash: 7.3 tons

**Totaled Recycled**: 18.7 tons  
**Totaled Landfilled**: 7.3 tons

**Total**: 26 tons  
**Percentage of Recycled**: 71.92%
MR Credit 4 (HIGH) – Recycled Content
Refer to page 56 of LEED Rating Document

Intent
Increase demand for building products that incorporate recycled content materials, thereby reducing impacts resulting from extraction and processing of virgin materials.

Justification for Applicability to Livestock Facilities
- Easy to implement - suppliers and contractors can provide most needed information

Exemplary Performance
- Achieve a total recycled-content value of 30% or more.

Case Study Content

MSU - KBS Pasture Based Dairy Facility
MR4 Credit Recycled Content

<table>
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<tr>
<th></th>
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<tr>
<td>1</td>
<td>Hoffman Bros. Excavating</td>
<td>Consumers Concrete</td>
<td>2&quot; x 6&quot; Crushed Concrete</td>
<td>$30,000.00</td>
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<td>0%</td>
</tr>
<tr>
<td>2</td>
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<td>Crane Composites</td>
<td>Kerply</td>
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<td>Roof &amp; Sidewall Steel</td>
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<td>Ceco Door</td>
<td>HM Doors &amp; Frames</td>
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<td>6</td>
<td>Specialty Concrete Con</td>
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<td>Lever Locks</td>
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<td>Quality Drywall</td>
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<td>Fiberglass Building Insulation</td>
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<td>Yale</td>
<td>Door Closers</td>
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<td>Raytar Seamless Eaves</td>
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<td>Acoustic Grid Ceiling w. Tile</td>
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<td>Epoxy Primer &amp; Paint</td>
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<td>Primer &amp; Finish Paint</td>
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<td>ChemProof Rheimers</td>
<td>PermaTec 500</td>
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<td>0%</td>
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<td>Contractor's Services</td>
<td>Overhead Door Co.</td>
<td>Rolled Steel Doors</td>
<td>$14,010.94</td>
<td>0%</td>
<td>0%</td>
</tr>
</tbody>
</table>

Total Material Costs $369,395.94
Total % of Recycled Content 22.09%
Intent

Increase demand for building materials and products that are extracted and manufactured within the region, thereby supporting the use of indigenous resources and reducing the environmental impacts resulting from transportation.

Justification for Applicability to Livestock Facilities

- Livestock facility able to comply with requirements easily.

Calculation

\[
\% \text{ Local Materials} = \left( \frac{\text{Total Cost of Local Materials}}{\text{Total Materials Cost}} \right) \times 100
\]

Exemplary Performance

- Achieve a total value of regional materials of 30% or more.

Case Study Content
**MR Credit 3 (Medium) – Materials Reuse**  
*Refer to page 55 of LEED Rating Document*

**Intent**  
Reuse building materials, and products to reduce demand for virgin materials and reduce waste, thereby lessening impacts associated with the extraction and processing of virgin resources.

**Justification for Applicability to Livestock Facilities**  
Requires contractor to:
- Provide cost of all materials (sensitive information), or
- Fit within default materials cost (45% of total construction cost)

**Calculation**  
% Reused Materials = \( \frac{\text{Cost of Reused Materials}(\$)}{\text{Total Materials Cost}(\$)} \) * 100

**Related Credits**  
- MRc1: Building Reuse
- MRc2: Construction Waste Management

---

**MR Credit 6 (Medium) – Rapidly Renewable Materials**  
*Refer to page 59 of LEED Rating Document*

**Intent**  
Reduce the use and depletion of finite raw materials and long-cycle renewable materials by replacing them with rapidly renewable materials.

**Justification for Applicability to Livestock Facilities**  
- Multiple products available for consideration, including woods, composites, plant based resins or dyes.

**Calculation**  
% of Rapidly Renewable Materials =  
\[ \frac{\text{Total Cost of Rapidly Renewable Materials}(\$)}{\text{Total Materials Cost}(\$)} \] * 100
MR Credit 7 (MEDIUM) – Certified Wood
*Refer to page 60 of LEED Rating Document*

**Intent**
- Encourage environmentally responsible forest management

**Justification for Applicability to Livestock Facilities**
- Requires lumber supplier to be FSC certified

**Calculations**
Certified Wood Material Percentage =
\[
\frac{\text{Certified Wood Material Value($)}}{\text{Total New Wood Material Value($)}} \times 100
\]

MR Credit 1 (LOW) – Building Reuse
*Refer to pages 52-53 of LEED Rating Document*

**Intent**
To extend the lifecycle of existing building stock, conserve resources, retain cultural resources, reduce waste and reduce environmental impacts of new buildings as they relate to materials manufacturing and transport.

**Justification for Applicability to Livestock Facilities**
Possible if:
- Existing building is on site
- Able to incorporate or salvage existing structure
# Indoor Environmental Quality (IEQ)

<table>
<thead>
<tr>
<th>Credit</th>
<th>Description</th>
<th>v 2009</th>
<th>v 2.2</th>
<th>EP*</th>
<th>Applicability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prerequisite 1</td>
<td>Minimum Indoor Air Quality Performance</td>
<td>Req.</td>
<td>Req.</td>
<td></td>
<td>High (CS)</td>
</tr>
<tr>
<td>Prerequisite 2</td>
<td>Environmental Tobacco Smoke (ETS) Control</td>
<td>Req.</td>
<td>Req.</td>
<td></td>
<td>High (CS)</td>
</tr>
<tr>
<td>Credit 1</td>
<td>Outdoor Air Delivery Monitoring</td>
<td>1</td>
<td>1</td>
<td></td>
<td>Medium/Low</td>
</tr>
<tr>
<td>Credit 2</td>
<td>Increased Ventilation</td>
<td>1</td>
<td>1</td>
<td></td>
<td>High (CS)</td>
</tr>
<tr>
<td>Credit 3.1</td>
<td>Construction Indoor Air Quality Management Plan</td>
<td>1</td>
<td>1</td>
<td></td>
<td>High (CS)</td>
</tr>
<tr>
<td>Credit 3.2</td>
<td>Construction Indoor Air Quality Management Plan</td>
<td>1</td>
<td>1</td>
<td></td>
<td>High</td>
</tr>
<tr>
<td>Credit 4.1</td>
<td>Low-Emitting Materials - Adhesives and Sealants</td>
<td>1</td>
<td>1</td>
<td></td>
<td>High (CS)</td>
</tr>
<tr>
<td>Credit 4.2</td>
<td>Low-Emitting Materials - Paints and Coatings</td>
<td>1</td>
<td>1</td>
<td></td>
<td>High (CS)</td>
</tr>
<tr>
<td>Credit 4.3</td>
<td>Low-Emitting Materials - Flooring Systems</td>
<td>1</td>
<td>1</td>
<td></td>
<td>High</td>
</tr>
<tr>
<td>Credit 4.4</td>
<td>Low-Emitting Materials - Composite Wood and Agrifiber Products</td>
<td>1</td>
<td>1</td>
<td></td>
<td>High (CS)</td>
</tr>
<tr>
<td>Credit 5</td>
<td>Indoor Chemical and Pollutant Source Control</td>
<td>1</td>
<td>1</td>
<td></td>
<td>Medium</td>
</tr>
<tr>
<td>Credit 6.1</td>
<td>Controllability of Systems - Lighting</td>
<td>1</td>
<td>1</td>
<td></td>
<td>High</td>
</tr>
<tr>
<td>Credit 6.2</td>
<td>Controllability of Systems - Thermal Comfort</td>
<td>1</td>
<td>1</td>
<td></td>
<td>High (CS)</td>
</tr>
<tr>
<td>Credit 7.1</td>
<td>Thermal Comfort - Design</td>
<td>1</td>
<td>1</td>
<td></td>
<td>Medium</td>
</tr>
<tr>
<td>Credit 7.2</td>
<td>Thermal Comfort - Verification</td>
<td>1</td>
<td>1</td>
<td></td>
<td>Medium</td>
</tr>
<tr>
<td>Credit 8.1</td>
<td>Daylight and Views - Daylight</td>
<td>1</td>
<td>1</td>
<td>✔</td>
<td>High (CS)</td>
</tr>
<tr>
<td>Credit 8.2</td>
<td>Daylight and Views - Views</td>
<td>1</td>
<td>1</td>
<td>✔</td>
<td>High (CS)</td>
</tr>
</tbody>
</table>

**Total Points:** 15

*Exemplary Performance*
IEQ Prerequisite 1 (HIGH) – Minimum Indoor Air Quality Performance

Refer to pages 61-62 of LEED Rating Document

**Intent**

To establish minimum indoor air quality (IAQ) performance to enhance indoor air quality in buildings, thus contributing to the comfort and well-being of the occupants.

**Case Study Content**

<table>
<thead>
<tr>
<th>Building</th>
<th>System Tag Name</th>
<th>Key Daily Research Support</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>- Water Heating</td>
</tr>
</tbody>
</table>

### Inputs for System

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Unit</th>
<th>System</th>
</tr>
</thead>
<tbody>
<tr>
<td>Airflow</td>
<td>cfm</td>
<td>-</td>
</tr>
<tr>
<td>System population including diversity</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Primary supply for air change rate</td>
<td>cfm</td>
<td>-</td>
</tr>
<tr>
<td>Average outdoor airflow rate per unit area for the system</td>
<td>cfm/h</td>
<td>1.39</td>
</tr>
<tr>
<td>Average outdoor airflow rate per person for the system</td>
<td>cfm/h</td>
<td>0.30</td>
</tr>
</tbody>
</table>

### Inputs for Potentially Critical Areas

<table>
<thead>
<tr>
<th>Zone Name</th>
<th>Zone Tag</th>
<th>Potential Critical Areas</th>
</tr>
</thead>
<tbody>
<tr>
<td>Office</td>
<td></td>
<td>100%</td>
</tr>
<tr>
<td>Lab</td>
<td></td>
<td>100%</td>
</tr>
<tr>
<td>Storage</td>
<td></td>
<td>100%</td>
</tr>
<tr>
<td>Computer</td>
<td></td>
<td>100%</td>
</tr>
</tbody>
</table>

### Outputs

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Unit</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ventilation Efficiency</td>
<td>-</td>
<td>0.06</td>
</tr>
<tr>
<td>Outdoor air make up airflow rate required for conditioned area</td>
<td>cfm</td>
<td>128</td>
</tr>
<tr>
<td>Outdoor air make up airflow rate per zone</td>
<td>cfm/h</td>
<td>0.14</td>
</tr>
<tr>
<td>Outdoor air make up airflow rate per person served by system including diversity</td>
<td>cfm/h</td>
<td>14.3</td>
</tr>
<tr>
<td>Uncorrected outdoor air make up airflow rate</td>
<td>cfm</td>
<td>116</td>
</tr>
</tbody>
</table>

### C. Occupancy:

- Calculation of FTE occupants is attached, however, that calculation is averaged over eight hours and does not consider short term occupancy. The calculation below follows ASHRAE 62.1-2004, section 6.2.6.2

- Maximum instantaneous occupancy for Vbz calculation is:
  - 24 students (classroom visits) — typical one hour total visiting time
  - 3 Full time staff — typical 8 hours
  - 4 part-time researchers, assumed to not be present during student visits

- Design maximum for Vbz calculation will be 27 occupants

### D. Ventilation Air Required:

- For the areas served, Rp=5, Ra=0.06, therefore:
  - Vbz=5*27+0.06*911=190 cfm
  - T, averaging time, =3*10932/190 = 2.9 hours
  - Time averaged equivalent occupancy is calculated on attached spreadsheet.
  - Total time averaged occupancy is 10 occupants

### E. Required Outside Air:

- As calculated by the ventilation rate procedure, 128 cfm outside is required
- Credit EQ2 requires 130% of minimum outside air, or 1.3*128=167 cfm
- Total outside air provided as shown on the TAB report is 172 cfm, therefore the credit requirement is met.
IEQ Prerequisite 2 (HIGH) – Environmental Tobacco Smoke (ETS) Control

Refer to pages 63-65 of LEED Rating Document

Intent
To prevent or minimize exposure of building occupants, indoor surfaces and ventilation air distribution systems to environmental tobacco smoke (ETS).

Case Study Content
Organization’s policy:

W.K. Kellogg Biological Station

Smoke-Free Policy (MSU University Policy)
(http://www.hr.msu.edu/HRSite/Documents/Uwide/Policies/default.htm)

This policy was approved by the Board of Trustees on July 16, 1993.

The compelling scientific findings, as summarized by the United States Surgeon General (1986) and the Environmental Protection Agency (1989, 1992), indicate that the simple separation of buildings into "smoking" and "non-smoking" sections does not eliminate the unequivocal health risks that result from Environmental Tobacco Smoke (ETS). In light of these findings, Michigan State University is committed to eliminating harmful exposures to environmental tobacco smoke unwanted by students, faculty, staff and visitors, and adopts the following SMOKE-FREE policy.

1. Smoking will not be permitted in any closed space, regardless of location, except specifically designated private residential space and hotel rooms. Smoking will not be permitted near exits and entrances of buildings, except at a reasonable distance or unless otherwise designated.*

   * Reasonable Distance Guideline: Smoking is permitted outside of buildings and should be 25 feet away from exits and entrances, unless otherwise designated.

2. Cigarettes and other tobacco products will not be sold on university grounds.

3. This smoke-free policy applies to all Michigan State University facilities and vehicles, owned or leased.

Smoking cessation programs provided by Healthy U and Olin Health Center are available to assist persons who wish to quit smoking. Questions, problems and complaints regarding this policy should be handled through existing departmental administrative channels and administrative procedures, including the Housing Options Committee. Persons found to have violated this policy will be subject to disciplinary action in the same manner and magnitude as violations of other University policies.

The success of this policy will depend on the thoughtfulness, consideration, and cooperation of smokers and non-smokers. All employees share in the responsibility for adhering to and enforcing this policy.
IEQ Credit 2 (HIGH) – Increased Ventilation
Refer to pages 69-73 of LEED Rating Document

Intent
To provide additional outdoor air ventilation to improve indoor air quality (IAQ) and promote occupant comfort, well-being and productivity.

Justification for Applicability to Livestock Facilities
- Increased ventilation beneficial to occupants
- Small occupied space improves ability to comply with requirements

Case Study Content
See documents from IEQp1 and response to LEED clarification

Design Application
9/29/2009
The LEED Submittal Template has been provided stating that the project has increased breathing zone outdoor air ventilation rates to all occupied spaces by at least 30% above the minimum rates required by ASHRAE Standards 62.1-2004 as determined by EQp1. A narrative has been provided describing the project’s ventilation system design. However, the Submittal Template for EQp1 states that natural ventilation is also being used.

TECHNICAL ADVICE: Please clarify how the mixed mode system is designed and provide a detailed narrative describing the calculation methodology and model results used to demonstrate that the natural ventilation design for the project complies with the standards set by the CIBSE Method or Analytic Model.

Construction Application
1/6/2010
The project changed strategies. The former proposal was in conflict with information found in EQp1 stating that natural ventilation was used. The project has been coordinated and the ventilation design using mechanical ventilation only. The project team has provided a LEED Submittal Template stating that the project has increased breathing zone outdoor air ventilation rates to all occupied spaces by at least 30% above the minimum rates required by ASHRAE Standards 62.1-2004 as determined by EQp1. A supplemental narrative has been provided to describe the project’s ventilation design. The documentation demonstrates credit compliance.
IEQ Credit 3.1 (HIGH) – Construction Indoor Air Quality Management Plan—During Construction
Refer to pages 74-75 of LEED Rating Document

Intent
To reduce indoor air quality (IAQ) problems resulting from construction or renovation and promote the comfort and well-being of construction workers and building occupants.

Justification for Applicability to Livestock Facilities
- Livestock building will have fewer ventilation ducts and equipment
- Ensures building materials remain clean and dry

Case Study Content

Construction IAQ Management Plan

| Project: | MSU Kellogg Biological Station Dairy Barn |
| Location: | Gull Lake Michigan 49060 |

BY: Debra Sypien, LEED Administrator Rockford Construction
TO: All subcontractors

Objective: To meet or exceed all requirements related to LEED credit EQ3c and to prevent indoor air quality problems resulting from the construction / renovation process in order to help sustain the comfort and well-being of construction workers and building occupants.

Specific Goals and Associated Tasks:

Goal: To keep moisture levels as low as possible to minimize the possibility of mold growth.

Actions:
- Create a construction schedule that will get the building in the dry as early as possible. Including roofing, glass and curtain wall systems, damp proofing and caulking.
- Erect temporary enclosures as needed to keep rain from entering the building.
- Assign clean-up personnel to remove standing water if necessary.
- Store absorptive materials in such a way that they stay dry at all times.

Goal: To keep construction dirt and dust from getting into finished areas.

Actions:
- Assign clean-up personnel to keep dirt and debris cleaned up daily.
- All subcontractors shall be responsible for daily clean-up.
- Finished areas will be sealed off while other areas of the building are still under construction.

Goal: To keep dirt and dust from getting into return air plenum and supply ductwork.

Actions:
- HVAC contractor shall seal all ductwork during construction.
- All ductwork shall be sealed at the end of the work day.
- All ductwork shall be inspected as a part of the commissioning to insure that it is free of dirt, debris or other contaminates.

Goal: To ensure that HVAC units and coils stay clean and free from construction dust.

Actions:
- Do not run the units until the commissioning and blowout phase.
- To the extent it is necessary to run the units during construction, the HVAC contractor shall be responsible for installing filter media in all return air filter frames and maintain clean filters on an as needed basis.
Source Control - To keep moisture levels as low as possible to minimize the possibility of mold growth, and to keep construction dirt and dust from getting into finished areas.

- We create a construction schedule that will get the building in the dry as early as possible including roofing, glass and curtain wall systems, damp proofing and calking. (see the MSU-KBS revised schedule.pdf)
- We erected temporary enclosures as needed to keep rain from entering the building.
- We assigned clean-up personnel to remove standing water when necessary.
- We stored absorptive materials in such a way that they stayed dry at all times.
- We assigned clean-up personnel to keep dirt and debris cleaned up daily.
- All subcontractors were be responsible for daily clean-up.
- All finished areas were sealed off while other areas of the building are still under construction.

HVAC Protection - To keep dirt and dust from getting into return air plenum and supply ductwork, and to keep dirt and dust from getting into return air plenum and supply ductwork.
- The HVAC contractor sealed all ductwork during construction.
- All ductwork was sealed at the end of the work day.
- All ductwork was inspected as a part of the commissioning to insure that is free of dirt, debris or other contaminates.
- We did not run the units until the commissioning and blowout phase.

Pathway Interruption - To interrupt the contamination pathways
- We put down walk off mats in finished areas and entry ways.
- We isolated areas as we completed them to keep containments out of finished areas.

Scheduling - Coordinate and schedule activities that will affect the indoor air quality.
- We coordinated activities so that contaminated were kept to a minimum.
- We coordinated activities so like activities were done at the same time.
- We coordinated activities so that contaminates would not affect finished areas.

Housekeeping - During final clean-up the following areas shall be thoroughly cleaned.
- All under floor spaces were inspected and cleaned as needed.
- All decking on ceiling decks were checked and cleaned as needed cleaned.
- All floors were cleaned.
- All cabinets and drawers were washed down.
- All furniture systems were cleaned.
- All sills and finishes surfaces were cleaned.
- All finished walls wiped down.
- All ceiling systems were inspected and cleaned as needed.
IEQ Credit 3.2 (HIgh) – Construction Indoor Air Quality Management Plan—Before Occupancy
Refer to pages 76-77 of LEED Rating Document

Intent
To reduce indoor air quality (IAQ) problems resulting from construction or renovation to promote the comfort and well-being of construction workers and building occupants.

Justification for Applicability to Livestock Facilities
- Ease and benefit of flush-out or air test

IEQ Credit 4.1 (HIgh) – Low-Emitting Materials—Adhesives and Sealants
Refer to pages 78-79 of LEED Rating Document

Intent
Reduce the quantity of indoor air contaminants that are odorous, irritating and/or harmful to the comfort and well-being of installers and occupants.

Justification for Applicability to Livestock Facilities
- Availability of low VOC materials
- VOC data provided by manufacturer

Case Study Content

MSU - KBS Pasture Based Dairy Facility

Adhesives and Sealants

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Product Number</th>
<th>Product Type</th>
<th>VOC (actual)</th>
<th>VOC (allowed)</th>
<th>Quantity (gallons)</th>
<th>Quantity Allowed</th>
<th>Total VOC</th>
<th>Allowed VOC</th>
</tr>
</thead>
<tbody>
<tr>
<td>P-6000</td>
<td>700</td>
<td>PVC Plastic Pipe Cement</td>
<td>600</td>
<td>510</td>
<td>0.625</td>
<td>650</td>
<td>1350</td>
<td>1350</td>
</tr>
<tr>
<td>B-6000</td>
<td>704</td>
<td>PVC Primer</td>
<td>550</td>
<td>550</td>
<td>0.57</td>
<td>600</td>
<td>1200</td>
<td>1200</td>
</tr>
</tbody>
</table>

Case Study Content

MSU - KBS Pasture Based Dairy Facility

Adhesives and Sealants
FLEX-GRIP® 650

Indoor/Outdoor Water Based Duct Sealant

TECHNICAL DATA

<table>
<thead>
<tr>
<th>Color</th>
<th>Gray</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contaminants</td>
<td>Aqueous-based Duct Sealer</td>
</tr>
<tr>
<td>Solvent</td>
<td>Water</td>
</tr>
<tr>
<td>Unified Systems</td>
<td>Yes</td>
</tr>
<tr>
<td>Mixed Systems</td>
<td>No</td>
</tr>
<tr>
<td>Coverage</td>
<td>250 sq ft per gallon</td>
</tr>
<tr>
<td>Base</td>
<td>Gray</td>
</tr>
<tr>
<td>Auger</td>
<td>No</td>
</tr>
<tr>
<td>Shoe</td>
<td>No</td>
</tr>
<tr>
<td>Temperature</td>
<td>40°F to 90°F</td>
</tr>
<tr>
<td>Interior Temperature</td>
<td>50°F to 90°F</td>
</tr>
<tr>
<td>Exterior Temperature</td>
<td>40°F to 100°F</td>
</tr>
<tr>
<td>Color Stability</td>
<td>Standard</td>
</tr>
<tr>
<td>Acid Resistance</td>
<td>Standard</td>
</tr>
<tr>
<td>UV Resistance</td>
<td>Standard</td>
</tr>
<tr>
<td>pH</td>
<td>4.5 to 6.0</td>
</tr>
<tr>
<td>Resin</td>
<td>Cationic Polyacrylate</td>
</tr>
<tr>
<td>Water</td>
<td>80%</td>
</tr>
</tbody>
</table>

APPLICATION

Temperature: 50°F to 90°F (10°C to 32°C)

Mixing: Stir thoroughly before use. No mixing is necessary.

Preparation: Surfaces must be clean, dry, and free of dirt, oil, and primer.

Clean Up: Water is used to clean up.

For additional information contact:

HARDCAST

For more information, visit our website:
www.flexgrip.com

INGREDIENTS (CAS Number)

Antioxidant (115-84-4)

Aromatic Resin (111-89-8) (11249-52-9)

Cylohexylamine (108-86-7)

NIP Easton (39636-86-7)

NIP Easton (39636-96-7)

APPROVALS AND LISTINGS

NSF Standard 61

AQL, ODM, AEC

Meets ASTM D-2594

PHYSICAL/Chemical Properties

Appearance: Clear liquid

Viscosity: 500 cP (3°F to 2°F)

Low Shear Strength (Minimum per ASTM Standards):

2 hours: 350 psi

16 hours: 550 psi

72 hours: 900 psi

Set-Up Time:

30°F to 50°F: 4 - 5 minutes

50°F to 70°F: 3 - 4 minutes

70°F to 80°F: 1 - 2 minutes

Use Life:

3 years from manufacture date

Environmental VOC per SOLVEND: 1.6g/L or AVOID

Method 401: 117 g/L

PRODUCT NUMBER SIZE PACK CARTON WEIGHT

3007S 4 oz. 12 36 oz.

3007 32 oz. 12 24 lb.
IEQ Credit 4.2 (HIGH) – Low-Emitting Materials—Paints and Coatings
Refer to pages 80 of LEED Rating Document

Intent
To reduce the quantity of indoor air contaminants that are odorous, irritating and/or harmful to the comfort and well-being of installers and occupants.

Justification for Applicability to Livestock Facilities
- Most paint is low VOC suppliers provide all needed documentation

Case Study Content

MSU Kellogg Biological Station's Dairy & Research Facility

IEQ Credit 4.2
Paints and Coatings

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Product Number</th>
<th>Product Type</th>
<th>VOC Installed</th>
<th>VOC Allowed</th>
<th>Quantity (gallons)</th>
<th>Quantity (liters)</th>
<th>Total VOC</th>
<th>Allowed VOC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sherwin-Williams</td>
<td>B51W501</td>
<td>ProGreen 202 Interior Latex Semi-G</td>
<td>46</td>
<td>150</td>
<td>1</td>
<td>1.74129</td>
<td>567.811</td>
<td>567.811</td>
</tr>
<tr>
<td>Sherwin-Williams</td>
<td>B28W650</td>
<td>ProGreen 202 Interior Latex Primer</td>
<td>43</td>
<td>150</td>
<td>1</td>
<td>1.786413</td>
<td>567.811</td>
<td>567.811</td>
</tr>
<tr>
<td>Sherwin-Williams</td>
<td>B70E213</td>
<td>Water Based Epoxy</td>
<td>128</td>
<td>150</td>
<td>1</td>
<td>3.786413</td>
<td>567.811</td>
<td>567.811</td>
</tr>
<tr>
<td>Sherwin-Williams</td>
<td>B66W310</td>
<td>ProCry Acrylic Primer</td>
<td>89</td>
<td>150</td>
<td>1</td>
<td>3.786413</td>
<td>567.811</td>
<td>567.811</td>
</tr>
</tbody>
</table>

Total Installed VOC: 1158.338
Total Baseline VOC: 2271.248
Compliance: YES

IEQ Credit 4.3 (HIGH) – Low-Emitting Materials—Flooring Systems
Refer to pages 81-83 of LEED Rating Document

Intent
Reduce the quantity of indoor air contaminants that are odorous, irritating and/or harmful to the comfort and well-being of installers and occupants.

Justification for Applicability to Livestock Facilities
- Less flooring material in livestock facilities than commercial buildings
- Manufacturers and suppliers can provide most of the data

IEQ Credit 4.4 (HIGH) – Low-Emitting Materials—Composite wood and Agrifiber Products
Refer to page 84 of LEED Rating Document

Intent
Reduce the quantity of indoor air contaminants that are odorous, irritating and/or harmful to the comfort and well-being of installers and occupants.

Justification for Applicability to Livestock Facilities
- Availability of low VOC materials
- VOC data provided by manufacturers and suppliers

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IEQ Credit 6.1 (HIGH) – Controllability of Systems—Lighting
Refer to page 87 of LEED Rating Document

Intent
Provide a high level of lighting system control by individual occupants or groups in multi-occupant spaces (e.g., classrooms and conference areas) and promote their productivity, comfort and well-being.

Justification for Applicability to Livestock Facilities
• Low FTE at livestock facilities requires fewer lighting controls

IEQ Credit 6.2 (HIGH) – Controllability of Systems—Thermal Comfort
Refer to page 88-89 of LEED Rating Document

Intent
Provide a high level of thermal comfort system control by individual occupants or groups in multi-occupant spaces (e.g., classrooms or conference areas) and promote their productivity, comfort and well-being.

Justification for Applicability to Livestock Facilities
• Operable windows meet requirement for small facility

Case Study Content
NARRATIVE (Required)

Please provide a narrative describing the project’s comfort control strategy. Include data regarding the type and location of individual and shared group-occupancy controls.

Operable windows are provided for each regularly occupied space, consistent with ASHRAE 62.1-2004, section 5.1. Both window size and space size meet the requirements of 62.1 and the credit requirement. Note that the Viewing/Reception room is 25’ in its longest dimension, from window to wall, meeting the 62.1 requirement of 25 feet. Since the viewing windows (where viewers using the room as a multi-occupied space) are within 20’ of the operable window, the requirement of this credit for windows to be within 20 feet is also met. Therefore, the space meets the requirement of 62.1-2004 and the requirements of credit EQ6.2.

See the uploaded floor plan for details.
**IEQ Credit 8.1 (HI GH) – Daylight and Views—Daylight**  
*Refer to pages 92-94 of LEED Rating Document*

**Intent**  
Provide building occupants with a connection between indoor spaces and the outdoors through the introduction of daylight and views into the regularly occupied areas of the building.

**Justification for Applicability to Livestock Facilities**  
- Easy to incorporate in design especially for small facilities in open areas  
- Productivity of people and animals benefit from daylight  
- Designers and Glazing companies can provide standard calculations

**Exemplary Performance**  
- Achieve 95% daylighting based on credit requirements and guidelines.

**Case Study Content**

- Clarification Requested – Excluded Milking and Viewing Room  
  - Milking Room: Robotic milking machine, not regularly occupied  
  - Viewing Room: Borrow daylight from office, extra light would compromise visitors visibility of electronic displays

- Credit Denied: Animal occupancy spaces are not excluded from credit calculations
IEQ Credit 8.2 (HiGH) – Daylight and Views-Views
Refer to page 95 of LEED Rating Document

**Intent**
Provide building occupants a connection to the outdoors through the introduction of daylight and views into the regularly occupied areas of the building.

**Justification for Applicability to Livestock Facilities**
- Same as 8.1

**Exemplary Performance**
Meet 2 of the following 4 measures
1. 90% or more of regularly occupied spaces have multiple lines of sight to vision glazing in different directions at least 90 degrees apart.
2. 90% or more of regularly occupied spaces have views that include views of at least 2 of the following 3 options:
   1. Vegetation
   2. Human activity
   3. Objects at least 70 feet from the exterior of the glazing
3. 90% or more of regularly occupied spaces have access to unobstructed views located within the distance of 3 times the head height of the vision glazing.
4. 90% or more of regularly occupied spaces have access to views with a view factor of 3 or greater.

**Case Study Content**
- Similar to credit 8.1, credit 8.2 also denied since animal occupancy spaces should not be excluded from calculations
IEQ Credit 1 (MEDIUM) – Outdoor Air Delivery Monitoring  
*Refer to pages 66-68 of LEED Rating Document*

**Intent**
- Provide capacity for ventilation system monitoring to help promote occupant comfort and well-being.

**Justification for Applicability to Livestock Facilities**
- Rating Justification Varies Based on Complexity of Facility
  - Medium for most low complexity facilities without existing central building management capability
  - Highly applicable for complex buildings where a central building management system is already in place
  - Most agricultural buildings will not have these capabilities

IEQ Credit 5 (MEDIUM) – Indoor Chemical and Pollutant Source Control  
*Refer to pages 85-86 of LEED Rating Document*

**Intent**
- Minimize building occupant exposure to potentially hazardous particulates and chemical pollutants.

**Justification for Applicability to Livestock Facilities**
- The rural air does not require as much filtration as air in an urban setting

**Case Study Content**
- IEQc5 was not attempted as the residential furnace did not allow MERV 13 filters
IEQ Credit 7.1 (MEDIUM) – Thermal Comfort—Design
Refer to page 90 of LEED Rating Document

*Intent*
Provide a comfortable thermal environment that promotes occupant productivity and well-being.

*Justification for Applicability to Livestock Facilities*
- Varies based on building size
- Larger buildings have opportunities for synergy with IEQ Credit 6.2

IEQ Credit 7.2 (MEDIUM) – Thermal Comfort—Verification
Refer to page 91 of LEED Rating Document

*Intent*
Provide for the assessment of building occupant thermal comfort over time.

*Justification for Applicability to Livestock Facilities*
- Requires project achieve IEQ Credit 7.1
- Varies based on building size
- Larger buildings have opportunities for synergy with IEQ Credit 6.2
**Innovation in Design (ID)**

<table>
<thead>
<tr>
<th>Credit</th>
<th>Description</th>
<th>v 2009</th>
<th>v 2.2</th>
<th>EP*</th>
<th>Applicability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Credit 1</td>
<td>Innovation in Design</td>
<td>1-5</td>
<td>4</td>
<td></td>
<td>High (CS)</td>
</tr>
<tr>
<td>Credit 2</td>
<td>LEED Accredited Professional</td>
<td>1</td>
<td>1</td>
<td></td>
<td>High (CS)</td>
</tr>
</tbody>
</table>

**Total Points:** 6 5
ID Credit 1 (HIGH) – Innovation in Design
Refer to page 97 of LEED Rating Document

Intent
Provide design teams and projects the opportunity to achieve exceptional performance above the requirements set by the LEED Green Building Rating System and/or innovative performance in Green Building categories not specifically addressed by the LEED Green Building Rating System.

Exemplary Performance
- 1-3 Points Possible
- An exemplary performance point may be earned for achieving double the credit requirements and/or achieving the next incremental percentage threshold of an existing credit in LEED.

<table>
<thead>
<tr>
<th>Credit</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>SSc4.2</td>
<td>Create a comprehensive transportation plan to reduce personal automobile use.</td>
</tr>
<tr>
<td>SSc4.3</td>
<td>Restore or protect at least 75% of site (excluding building footprint) or 30% of site (including building footprint) with native or adapted vegetation.</td>
</tr>
<tr>
<td>SSc5.1</td>
<td>Double the amount of open space within LEED project boundary required for credit achievement.</td>
</tr>
<tr>
<td>SSc5.2</td>
<td>No standard exists. Document a comprehensive approach to capture and treat stormwater runoff beyond credit requirements.</td>
</tr>
<tr>
<td>SSc7.1</td>
<td>Demonstrate that either (1) 100% of nonroof impervious surfaces were constructed with high albedo or open-grid paving, or will be shaded within 5 years; or (2) 100% of the on-site parking spaces have been located under cover.</td>
</tr>
<tr>
<td>SSc7.2</td>
<td>Demonstrate 100% of roof area consists of vegetated roof system.</td>
</tr>
<tr>
<td>WEc3</td>
<td>Reduce projected potable water use by 45%.</td>
</tr>
<tr>
<td>EAc1</td>
<td>Only available for Option 1: Improve performance of ASHRAE 90.1-2007 by 50% for new building, 46% for existing building.</td>
</tr>
<tr>
<td>EAc2</td>
<td>Document that on-site renewable energy accounts for 15% or more of annual energy cost.</td>
</tr>
<tr>
<td>EAc6</td>
<td>Purchase 100% of electricity from renewable sources.</td>
</tr>
<tr>
<td>MRc2</td>
<td>Divert 95% or more of total construction waste.</td>
</tr>
<tr>
<td>MRc4</td>
<td>Achieve a total recycled-content value of 30% or more.</td>
</tr>
<tr>
<td>MRc5</td>
<td>Achieve a total value of regional materials of 30% or more.</td>
</tr>
<tr>
<td>IEQc8.1</td>
<td>Achieve 95% daylighting based on credit requirements and guidelines.</td>
</tr>
<tr>
<td>IEQc8.2</td>
<td>Meet 2 of 4 strategies for 90% or more of regularly occupied spaces.</td>
</tr>
</tbody>
</table>
Case Study Content

- Educational outreach: Strategies for improving, expanding and promoting pasture dairy farming.
  - [http://www.kbs.msu.edu/research/pasture-dairy](http://www.kbs.msu.edu/research/pasture-dairy)
• Educational program: Published case study describing the project’s design features and the LEED program, and public tours.

KBS

IDc1.2
Educational Program

Intent

To provide public education focusing on green building strategies and solutions

Requirements

1. The development of a brochure, guideline to inform the public and other design professionals and is based on the successes of this project. This brochure will be made available to the USGBC for sharing with other projects.

2. The development of a guided tour used by the sales people and NuCraft associates in highlighting the sustainable features of the building and product.

3. The development of a case study to inform the design of other buildings based on the successes of this project. This manual will be made available to the USGBC for sharing with other projects.

Michigan State University
W. K. Kellogg Biological Station
Pasture Dairy Research and Education Center
Free-Stall Dairy Barn

Case Study presented to:
The United States Green Building Council
Seeking LEED® NC Version 2.1 Silver Certification
for the newly constructed dairy free-stall barn
Development and implementation of a green housekeeping program

ID Credit 2 (HIGH) – LEED Accredited Professional

Refer to page 98 of LEED Rating Document

Intent
Support and encourage the design integration required by LEED to streamline the application and certification process.
RP Credits (VARIES) – Regional Priority
Refer to page 99 of LEED Rating Document

*Intent*
Provide an incentive for the achievement of credits that address geographically-specific environmental priorities.

Search tool available through USGBC website:
https://www.usgbc.org/RPC/RegionalPriorityCredits.aspx?CMSPageID=2435

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**Case Study Comparison**
LEED® v2.2 vs. 2009

- What would the KBS Dairy Livestock Facility have earned in LEED-NC 2009?

<table>
<thead>
<tr>
<th>LEED® v2.2</th>
<th>LEED® 2009</th>
</tr>
</thead>
<tbody>
<tr>
<td>Certification Levels:</td>
<td>Certification Levels:</td>
</tr>
<tr>
<td>Certified</td>
<td>40+ Points</td>
</tr>
<tr>
<td>Silver</td>
<td>50+ Points</td>
</tr>
<tr>
<td>Gold</td>
<td>60+ Points</td>
</tr>
<tr>
<td>Platinum</td>
<td>80+ Points</td>
</tr>
</tbody>
</table>

- Total credits received:
  - v2.2: 37 (Silver Certification)
  - 2009: 55 (Silver Certification)

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**The Future of LEED**

- LEED NC v4 launch in June 2013 (2009 to remain open for at least six months following launch)
- LEED v4 likely to include:
  - Increased emphasis on location and transportation
  - Clarification of existing credits
  - Integration of new green technologies and innovation
- Follow the progress!