Eco-Intelligence
Restoring the Industrial Landscape
After 85 years, Ford's Rouge Center undergoes a transformation into a model of 21st-century sustainable manufacturing.

By William McDonough and Michael Braungart

What does it take to support and celebrate life on an industrial site? In 1999, that's the question Ford Motor Co., William McDonough + Partners, and McDonough Braungart Design Chemistry asked as we began working together on the $2 billion restoration of Ford's 600-acre Ford Rouge Center manufacturing complex in Dearborn, MI.

It was not an unprecedented question in the history of Ford. Founder Henry Ford thought using agricultural products to build cars could support farming and preserve the rural landscape. He pursued his vision vigorously, developing natural textiles and other soy-based materials for use on the assembly line. Over the years, however, the industrial might of his own factories overwhelmed even that remote connection to the landscape.

But what if an industrial site itself could be a fecund place? What if a 600,000-square-foot automotive assembly plant could create habitat, filter stormwater with a living roof and natural swales, and restore life to its surroundings-all cost-effectively?

Company history aside, that was a challenging question for Ford Motor Co. Ford's engineers were skeptical, its executives quizzical. There were raised eyebrows all around.

Tim O'Brien, vice president of real estate at Ford, recalls sitting through long meetings in the Rouge Room, our design think-tank near the site, wondering, "Oh my God, what have we gotten ourselves into?" His colleagues would corner him in his office after a particularly challenging design exercise. "Tim!" they'd say, "Do you know what they want us to do now?"

The engineers were vexed, too. "The traditional engineering approach," said the Rouge project manager Jay Richardson, "is to build a box, put the tools in, and worry about how the factory functions." For most engineers, sustainability just isn't a big item on the agenda.

"I was skeptical," Richardson said, recalling the early days of the project, "as to whether or not we could find sustainable solutions that added value. At that point, a green roof just didn't make good business sense."

The Design Process

Ford persevered. Chairman and CEO Bill Ford had declared that the restoration would "transform a 20th-century industrial icon into a model of 21st-century sustainable manufacturing." He was committed and optimistic. Ford's Rouge team was committed too, though perhaps not as flushed with optimism. But with wild ideas ricocheting off the walls of the Rouge Room, they rolled up their sleeves and brought their can-do spirit and "healthy skepticism" to the table.

"We made sure we didn't dismiss ideas simply because they were unconventional," O'Brien said. "On the other hand, we had to evaluate them against recognized business criteria and principles. That was an interesting challenge."

Indeed it was. As the Rouge project team-representatives from a number of Ford divisions, along with WM+P, MBDC and local architects and engineers-worked through the design process, every element of the factory and landscape plans had to survive rigorous questioning. Cost effectiveness and shareholder value mixed it up with worker safety and ecological health.

Each issue inspired debate and revision, and asked that every member of the team approach the process with imagination and flexibility. Rather than trying to balance concerns to reduce the negative impacts of the site, the project team aimed to maximize economic, social and environmental value with every design decision. The team's inquiries extended to the manufacturing processes used to make new cars, exploring everything from the chemistry of automotive materials to the disassembly and recovery of auto parts. Ultimately, the intention was to make the Rouge a place that celebrates human activity and creates a wide variety of delightful, positive effects. More habitat, more clean water, more natural light on the factory floor, more productivity. In short, we were all coming together to create a new way of understanding and generating value. That was not always a comforting proposition.

"Just the fundamental premise that we should determine the soil conditions on the site was untraditional," said O'Brien. "There is no legal requirement to assess soil conditions or remediate them. For an environmental administrator trained to do what is minimally required by law to deal with a problem, that's a very unconventional thing to do." Nevertheless, O'Brien, Richardson and the rest of Ford's Rouge team eventually did a lot of unconventional things.

The Site

The Rouge site was begging for new ideas. Built between 1917 and 1925, the Rouge is one of the largest manufacturing facilities in the world. In its heyday, it was an enormously productive complex of blast furnaces, stamping mills, warehouses and assembly plants capable of chewing up raw materials and spitting out automobiles. The Rouge River and the 90 miles of railroad tracks crisscrossing the grounds were the plant's supply lines. Deliveries of ore, sand

and every other material that went into a car or truck arrived every day via barge, while finished components were ferried from factory to factory on the rails. During the 1930s, more than 100,000 Rouge employees worked in 15 million square feet of factory space. They produced airplanes, cars, tractors and trucks by the millions. There was nothing quite like it in the world.

By the 1980s, however, the plant had fallen into disrepair. The aging facilities were rusting and out of date and decades of manufacturing had taken a heavy toll on the soil, the landscape and the waters of the Rouge River. That's usually the point where a manufacturer closes up shop and moves its flagship factory off shore. But Ford Motor decided to re-invest in the Rouge. From our perspective, the company was declaring itself native to Dearborn, taking responsibility for making the Rouge a healthy, productive, life-supporting place. With the project well underway, it might be hard to appreciate the importance of that decision. But it was the bold first step that preceded all others. No investment in industrial restoration happens without it.

Water, Water Everywhere

After a year of rigorous design meetings, a strategy for restoring the site began to emerge. Right from the start, storm water run-off was one of the key areas of concern at the Rouge complex.

Henry Ford, like other Detroit industrialists, built his factory along the Rouge River. Early in the 20th century, rivers were the industrial corridors, and the Rouge River, up to Ford's plant, was more of a dredged canal than a living stream. The plant's proximity to its namesake, along with the site's shallow water table and the high clay-content of its soil, made the natural drainage system more of a wide-open sluice than a slow, percolating flow of water. When heavy rains fell, storm water washed toxins and cinders off all the impervious surfaces-vast parking lots, buildings, chimneys, gas towers-and carried them swiftly away. There was little between the rooftops and the river to slow the water down. A green roof was the most compelling solution to the storm water problem at the Rouge. At first, the idea fell into the "unconventional" category and turned the Rouge Room into a tableau of wrinkled brows. But not for long. The idea made intuitive sense: The soils and grasses that comprise functional living roofs absorb water just like the soil and plants in a healthy landscape. Why not a living roof on a factory?

The 10-acre roof on the Rouge assembly plant could be blanketed with a thin layer of soil and growing plants. On the grounds, new green spaces could naturally absorb storm water and impervious paved surfaces could be replaced by porous paving, which allows water to seep into underground retention beds and percolate slowly into the soil or into swales. Swales are channels cultivated with wetland plants that absorb and filter water. In many places on the site, particularly along roadways, the project team believed the swales could be lined with hedgerows to create green breaks in the landscape and even greater

capacity for storm water retention. The natural storm water system would also create new and revived habitats on the site for native birds, butterflies, insects and microorganisms, generating a larger biological order.

After lots of discussion and several visits to buildings with green roofs, Richardson's skepticism began to give way. The U.S. Environmental Protection Agency was developing new storm water regulations and Ford had estimated that the conventional technical controls required to comply with the new rules could cost almost $50 million. The natural storm water management system was estimated to cost only $15 million. The math was simple and compelling: The living roof offered millions of dollars in savings, with the landscape thrown in for free. Kind of gets your attention.

It certainly got Richardson's. "Managing storm water with a green roof and swales made sense on an intellectual level," he said. "This is something you can do to save money while responding to regulatory issues on the horizon. But I had to prove to myself that we could figure out how to offset costs such as the structural steel needed to handle the extra load on the roof."

The Rouge design team did indeed figure that out, discovering a host of cost-effective benefits. In addition to absorbing storm water, soil and vegetation on the roof would also:
* provide extra insulation
* protect the roof membrane from wear and thermal shock
* create habitat for native birds
* contribute to mediating the urban heat island effect
* capture harmful particulates

"At the end of the day," said Richardson, "we engineered some solutions and now we have facts that say if we're as successful as we think we're going to be, these systems can be replicated at other Ford facilities."

An array of storm water management elements are now nearly in place. The porous paving system, which was designed for the site in collaboration with the water resource planning firm, Cahill Associates, has already gone from a wild idea to a standard practice-one that Ford may replicate at other sites. The living roof will be completed this autumn and the installation itself will be a wonder. Near the Rouge site, 15 acres of thin, soil mats have been planted with sedum, a drought-resistant flowering succulent. The sedum, which absorbs water like a sponge, has been taking root and growing for about six months. In late September, the mats will be rolled up, trucked to the Rouge factory and unrolled on the roof. When it's completed, the 10-acre living roof will be the largest in the world. Next summer, the roof will bloom with scarlet and yellow flowers.

Plants With an Appetite

As we've seen, 85 years of 20th-century manufacturing has a heavy impact on the land. Nowhere is that more evident than in the soils of the Rouge, which are contaminated with hazardous chemicals. Typically, industrial sites with toxic earth are "cleaned-up" by excavating the topsoil and hauling it away. The project team had a different idea-it decided to do on-site remediation instead. Along with landscape architect Julie Bargmann, the team has been working with Dr. Clayton Rugh, a professor in the Department of Crop and Soil Sciences at Michigan State University, who is doing pioneering research in phytoremediation.

Phytoremediation is a process that uses plants to neutralize toxins in the soil. Dr. Rugh has been testing phytoremediation at the Rouge for the past year. He has cultivated 20 native plants in contaminated soil and is monitoring them to test how well each breaks down and purifies polycyclic aromatic hydrocarbons (PAH), a prevalent on-site toxin. So far, big bluestem and green ash seem to have the biggest appetites for PAHs. With other native plants, which will be monitored by Rugh and a group of scientists, big bluestem and green ash are being planted in phytoremediation gardens along the Rouge's main thoroughfare. The researchers will continue to systematically test which plants are the best long-term toxic avengers. These industrial strength plants, adding luster to the landscape as they purify the soil, may be the most productive living things at the Rouge.

On the Factory Floor

And indoors? We've tried to bring as much of the outdoors into the Rouge factory as possible. Our work with other manufacturing companies has shown that job satisfaction increases measurably when workers are able to experience a relationship to nature from the factory floor. At Herman Miller, in Zeeland, MI, where the company's furniture assembly plant provides fresh air, sunlight and ample opportunities to observe the outdoors, researchers have credited our building design with elevating both worker productivity and employee retention.

The design team aimed for the same sensitivity to worker satisfaction at the Rouge. Our first goal was to bring sunlight deep into the building so workers could sense the changing light and weather and have visual contact with the outdoors. To achieve this, the factory design includes 10 25- by 100-foot rooftop monitors-essentially, pop-up roofs-each glazed on all four sides. Skylights of this scale are unprecedented in an automotive assembly plant, which as Richardson pointed out, are typically boxes filled with tools. In addition, the roof is sloped to the north to allow more northern light to enter the building and to block some of the strong, direct sunlight from the south. The glass is frosted to cut glare and thermally insulated to mediate heat fluctuations. Thirty-five smaller skylights establish an even, well-tempered level of light.

Worker safety was an important consideration, too. How would people safely and conveniently traverse the building in the midst of heavy forklift traffic? The design includes a mezzanine to get people up and away from the busy factory floor. The mezzanine level also houses services for workers, office space and employee team rooms, all open to the skylights and bathed in natural light.

The factory's state-of-the-art manufacturing processes are designed for flexibility. The assembly lines will be capable of handling three different vehicle platforms and nine different models. That's impressive, but we're especially interested in manufacturing flexibility for the opportunities it provides for disassembling cars and trucks.

Building a truly sustainable automobile industry means developing closed-loop systems for the manufacturing and re-utilization of auto parts. In Europe, the End-of-Life Vehicle Directive, which makes manufacturers responsible for automotive materials, is pushing companies to consider design for disassembly and effective resource recovery more seriously. Cradle-to-cradle systems, in which materials either go back to industry or safely back to the soil, are built for effective resource recovery. American automakers, with a glance over the pond, have an opportunity to see the future and prepare.

It is our hope that Ford will lead the way to effective cradle-to-cradle manufacturing by developing profitable closed-loop systems in which cars are assembled from safe, healthy materials and disassembled at the end of their useful lives. In such a system, each part of every car is either returned to the soil or recovered and reused in the assembly of new cars, generating extraordinary productivity and consistent employment in the transportation industry. In other words, just as Henry Ford was the father of the assembly line, we hope Bill Ford will become the father of the re-assembly line.

As Ford nears its centennial celebration, that sounds like a very apt way to honor the heritage of the Rouge River complex and close a century-long historical loop. Why not encourage and celebrate both restorative facilities and restorative manufacturing? Though the engineers in the Rouge Room might be little skeptical, we think they might come around. After all, they're putting a flowering living roof on a vehicle assembly plant. Could cradle-to-cradle manufacturing be far behind?

William A. McDonough, FAIA, and Michael Braungart are founders of McDonough Braungart Design Chemistry, a consultancy that works with a wide variety of companies to implement eco-effective design and commerce strategies. For more information, visit www.mbdc.com <http://www.mbdc.com>.