

RESTORING NATURAL INFRASTRUCTURE:

Strategies for Thriving Communities, Businesses and Ecosystems



A Report on Participant
Observations and
Recommendations from the
Restoring Natural
Infrastructure Summit

New York, New York
November 4, 2015

Hosted by

CATERPILLAR®



Photo Details and Credits

Cover: Louisiana Coastal Area Ecosystem Restoration by Diane Huhn, Blue Dog Nights
Full page: Tenaya Lake Restoration, Yosemite by Yosemite Conservancy
Page 3: Salt Marsh Restoration by NOAA

All other images were captured at the November 4, 2015 Restoring Natural Infrastructure Summit.

Disclaimer

This report reflects observations and recommendations expressed by various participants at the Restoring Natural Infrastructure Summit held in New York on November 4, 2015. Statements contained in this report do not necessarily reflect the views of Caterpillar or those of all other participants who attended this event. The contents of this report have not been approved or endorsed by the participants who attended the conference. All quotations used throughout this report reflect statements made by presenters at this event.

Table of Contents

EXECUTIVE SUMMARY	4
BACKGROUND	7
A CALL TO ACTION	8
STATUS AND RECOMMENDATIONS	9
POLICY	9
Current State	9
Pathways for Progress	10
Immediate Opportunities	13
ADVOCACY AND AWARENESS	14
Current State	14
Pathways for Progress	15
Immediate Opportunities	16
THE BUSINESS CASE	17
Current State	17
Pathways for Progress	18
Immediate Opportunities	21
COLLABORATION	22
Current State	22
Pathways for progress	23
Immediate Opportunities	24
ACKNOWLEDGMENTS	25
SUMMIT ATTENDEES	a



*We believe we have an opportunity to
do things differently going forward. And,
to do it better as we work to meet the
needs of the next two billion additional
people on this earth.*

Karl Weiss, Vice President, Earthmoving
Caterpillar Inc.


RESTORING NATURAL INFRASTRUCTURE:

Strategies for Thriving Communities, Businesses and Ecosystems

EXECUTIVE SUMMARY

Natural infrastructure such as forests, prairies, agricultural lands, estuaries, coastal landscapes and wetlands provide resilience, materials and services needed by communities and businesses. These natural systems purify our water and air and sequester billions of tons of carbon into plants and soils. They produce food, fiber, and lumber which provide our nourishment and much of the raw materials for clothing and housing. They are essential for the health of our economy, our communities, and our planet.

A significant proportion of the earth's natural infrastructure has been lost or degraded. Depletion of natural infrastructure has led to declines in land productivity, water quality and storm resilience. Reductions in economic vitality and quality of life have occurred in many parts of the world as a result of degraded natural infrastructure. Restoring these resources is critical.



Caterpillar is focused on restoring natural infrastructure because we understand that we must balance the need to maximize productivity of our land today and sustain that productivity for the future, for our long-term sustainable future.

Karl Weiss,
Vice President, Earthmoving
Caterpillar Inc.

To help address this critical need, Caterpillar Inc. convened the **Restoring Natural Infrastructure Summit** in New York on November 4, 2015. Attended by 140 experts and leaders representing engineering, construction, financial, non-governmental organizations (NGOs), academia and government sectors, the Summit focused on the current state of the natural infrastructure restoration industry and measures that could catalyze its development and expansion. This white paper is a **summary of notable observations and recommendations** that were made by various individuals during the Summit. The observations and recommendations address: policy, advocacy and awareness, solidifying the business case and collaboration.

POLICY

Restoration projects are being undertaken around the world, however there is **limited coordinated policy on national or global levels** to promote, support, and guide the prioritization, funding and best practice implementation of these activities. Immediate opportunities for action include:

- Leveraging recent policy initiatives and developing trends in natural infrastructure restoration to capitalize on the interest, momentum and frameworks that they have created.
- Leveraging existing standards and metrics to develop best practice standards for designing, constructing, and rating natural infrastructure.

ADVOCACY AND AWARENESS

Lack of understanding of the importance of natural infrastructure and the social, economic and environmental benefits that can be achieved through restoration of degraded landscapes **hinders the development of effective public policy as well as the funding and execution of restoration projects**. Community and stakeholder support for natural infrastructure restoration could be promoted through advocacy and raising public awareness of the important issues at stake. Immediate opportunities for action include:

- Promoting and building on success stories of restoration projects that produce maximum return on investment.
- Targeting innovators to try new ideas and methods, and promote the business case for restoration.
- Reaching out to policy makers for leadership and recruiting champions (leaders who understand and support natural infrastructure restoration and promote it within their sphere of influence).
- Establishing public/private partnerships to support dialogue and drive change.
- Developing initiatives with communities, schools and students.

THE BUSINESS CASE

Solidifying the business case for natural infrastructure restoration could provide incentives and mechanisms for expanded private sector investment in the industry. Private sector involvement is also likely to foster innovation within the industry. Immediate opportunities for action include:

We don't want to do 'sustainable development' on something that is already badly damaged.

Instead, we want to do 'restorative development', meaning that we can meet our needs while restoring the land. In doing this, we would behave just like every other organism on Earth does, making a contribution to the ecosystem.

Dr. William Moomaw
Tufts University

We are in the process of learning what we should be doing – how do we make this work? How do we finance this? How do we make policy progress? We are very excited about the opportunities.

Kathryn Karol, Vice President,
Global Government and Corporate
Affairs
Caterpillar Inc.

- Taking advantage of current low interest rates to incentivize and mobilize access to funding for projects.
- Promoting proven quantifiable benefits of restored (or constructed) natural infrastructure which in some instances offer financial advantages over conventional infrastructure.
- Partnering with organizations that design natural infrastructure to develop the business practices necessary for the development and expansion of the market.
- Engaging with investor audiences.
- Matching investors with projects.
- Engaging with the insurance industry to leverage their experience and expertise in assessing and pricing risks (such as coastal storm surges and floods) that could be mitigated with restored natural infrastructure.
- Establish public-private partnerships to address market failures.

COLLABORATION

Collaboration between governments, communities, businesses and NGOs on policy development and improvement would promote, support, and guide the prioritization, funding and best practice implementation of natural infrastructure restoration. Immediate opportunities for action include:

- Building on existing collaborations and partnerships.
- Fostering regional collaboration.

The way we'll make the fastest progress is on this collaborative basis. That's where the big breakthroughs happen.

Mark Tercek, CEO
The Nature Conservancy



BACKGROUND

Historically, infrastructure has been viewed as the basic physical and organizational structures and facilities (e.g., buildings, roads, sanitation, water management, energy, etc.) needed for the operation of a society and the communities and businesses that support it. Economic growth is widely associated with regions that have established effective infrastructure that has been well planned, constructed, operated and maintained. Infrastructure frequently provides the primary interface between the economic, environmental and social dimensions of civilization. It is critical that our growing world population has access to adequate infrastructure. Consequently, the materials and methods used to build and operate infrastructure are key components of sustainable development.

Infrastructure is usually perceived by the public to be comprised exclusively of structures and facilities built by people (henceforth referred to as “conventional infrastructure”). However, as our understanding has grown with respect to the relationships between the human-made and the natural world, so has our understanding of all of the services and benefits provided by natural systems (henceforth referred to as “natural infrastructure”). Natural infrastructure includes resources such as forests, prairies, agricultural lands, estuaries, coastal landscapes and wetlands. These resources purify our water and air and productively sequester billions of tons of carbon into plants and soils. The food, fiber, and lumber produced from natural infrastructure provide our nourishment and much of the raw materials for clothing and housing. Wetlands provide necessary resilience to storm impacts and effectively manage storm waters while removing and storing excess nutrients and improving water quality.



An increasing global population and the resulting demand for land for urban development and agriculture as well as resources such as timber and minerals have resulted in impacts

The ‘unintended consequences’ of restoring natural ecosystems are going to be mostly beneficial: clean water, health ecosystems, things that we want anyway.

Dr. Phil Duffy
Woods Hole Research Center

The planet actually works as a linked biological and physical system. So it makes sense to respect that and try to manage this as the living planet that it is – and restoration can play a key role.

Dr. Thomas Lovejoy
UN Foundation

These are opportunities – not some burden that has been placed on us. These are opportunities to make things better – and oh by the way, one of the fringe benefits is that it helps to address climate change.

Dr. William Moomaw

to much of the world's natural infrastructure. In some instances, depletion of natural infrastructure has led to declines in land productivity, water quality and storm resilience. Reductions in economic vitality and quality of life have occurred in many parts of the world as a result of degraded natural infrastructure. Restoring these resources to a state that functions ecologically and provides the resilience, materials and services needed by communities and businesses would make a significant contribution to the continued health of our economy, our communities and our planet.

A CALL TO ACTION

As the earth's population grows from 7 billion to over 9 billion in the next few decades, restoring the health and productivity of our natural infrastructure will become paramount for addressing the growing need for food, clean air and clean water. Many countries have developed initiatives to conserve remaining natural infrastructure assets but initiatives to restore degraded assets have lagged.

It's so much more than carbon. There are so many other benefits that you get back. You restore a grassland, you get better grazing. You restore carbon into the agricultural soils, you get greater soil fertility. When you begin to add all of these things together, it becomes a really compelling agenda.

Dr. Thomas Lovejoy

The global need for natural infrastructure restoration is staggering. The United Nations estimates that over 25 percent of the earth's lands (an area approximately the size of the North American continent) are now considered to be "highly degraded" due to poor management practices that have resulted in deforestation, desertification, wetland destruction, severe erosion and contamination. Over half of the globe's wetlands have been lost since 1900. The loss of vegetation from degraded lands has a twofold contribution to atmospheric greenhouse gas increases through carbon dioxide release from the decomposition of biomass and oxidation of soils and the lack of vegetation to absorb carbon dioxide through photosynthesis.

Successful restoration projects are now occurring all over the world. However, given the scale of the degraded natural infrastructure, restoration projects usually take place on a small scale and often in isolation from each other. There is also limited coordination in developing and applying mechanisms such as policy, financing and standards of practice. A more systematic approach to addressing this issue is therefore warranted.


STATUS AND RECOMMENDATIONS

POLICY

Current State

No coherent strategy currently exists to deal with natural infrastructure restoration at either national or global levels. Although successful restoration projects are now occurring all over the world, they are often undertaken on a small scale and often in isolation from each other. Even specific issues such as coastal resilience have not been addressed to any degree of consistency. Governments have a role in supporting stakeholders and encouraging them to come together to address natural infrastructure needs. Establishing national and global priorities along with procedures for selecting and addressing the most urgent projects would create efficiencies and potentially expand the benefits that can be achieved from a local to a regional scale. A window of opportunity currently exists for governments, communities, businesses and NGOs to collaborate on policy development strategies that are both flexible and effective. Doing so will require both government action and attractive incentives for the private sector.

Natural infrastructure has unique features, needs and advantages that are not adequately addressed in current policies and regulations. Most existing policies used to regulate natural infrastructure were developed in the 1970s when governments focused on controlling environmental pollution or regulating practices associated with the design and construction of conventional infrastructure. The mindset used to establish existing policies was focused on stopping negative actions to the environment. Thus existing policies often lack flexibility and are not appropriate for restoring natural infrastructure, causing delays in approvals and project execution. Policies need to be modified to incorporate positive action by encouraging the innovation and experimentation needed to develop more creative solutions that allow flexibility and promote entrepreneurial opportunities. To be effective policies should be tied to national, state and local priorities and include perspectives from the scientific, financial and insurance communities. A dedicated fund or other source of public revenue may be appropriate. It should be noted however that just like conventional infrastructure, natural infrastructure provides resilience, materials and services needed by communities and businesses. Funding for natural infrastructure restoration could therefore also be considered within existing conventional infrastructure funding mechanisms.



We have an outdated system of environmental regulations which are based on a series of prohibitions and 'thou shalt not's'. But what we're talking about with natural infrastructure is how to incentivize and stimulate positive action to expand the range of environmental benefits and services. That's a very different regulatory frame.

Dr. Todd Bridges
U.S. Army Corps of Engineers

There is no shortage of tools in the toolbox, rather a shortage of opportunities to apply them. We need to focus on incentivizing these creative approaches.

Dr. Mike Donahue
AECOM

Restoring infrastructure of all types is a relatively new concept in the US and policy changes and updates are needed that consider strategies and tactics deployed in other countries that have successfully restored their natural infrastructure. Proposed outcomes need to be realistic and focus on achieving goals that emphasize functioning ecosystems that function together with human development vs. restoring to pre-settlement conditions. Natural infrastructure is an emerging market that can be integrated with conventional infrastructure components depending on the various needs and applications available. Natural and conventional infrastructure can and should be developed in concert with each other. To help promote development of an industry focused on restoration activities, agencies should facilitate dialog among stakeholders who depend on natural infrastructure resources and develop a systems-based approach to policy development and implementation.

Pathways for Progress

Some initiatives have been launched recently that could be used to leverage action to promote natural infrastructure restoration. For instance on October 7, 2015, the White House issued a memorandum titled “Incorporating Natural Infrastructure and Ecosystem Services in Federal Decision Making”. The memorandum formally recognizes that

The natural world provides critical contributions that support and protect our community and the economy. Nature creates benefits that contribute to our economic prosperity, protect the health and safety of vulnerable populations, and help build more resilient communities but these ecosystem services are often overlooked. Integrating ecosystem services into planning and decision-making can lead to better outcomes, fewer unintended consequences, and more efficient use of taxpayer dollars and other resources.

The memorandum directs agencies to develop and institutionalize policies that promote consideration of the ecosystem services provided by natural infrastructure, where appropriate and practicable in planning, investment and regulatory contexts. It also establishes a process for the Federal government to develop a more detailed guidance on integrating ecosystem service assessments into relevant programs and projects to help maintain ecosystem and community resilience, sustainable use of natural resources and the recreational value of the nation’s unique landscapes.

Additionally, in December 2015 the U.S. Department of Interior announced plans to establish a Natural Resource Investment Center to spur partnerships with the private sector. The Center is intended to develop creative financing opportunities that support economic development goals while advancing the Department's resource stewardship mission. The Center could serve as another important catalyst for natural infrastructure restoration.

Similar to the President's Centers on Advanced Manufacturing, a federal initiative to establish a national center of excellence focused on advancing restoration of natural infrastructure could jump start short term projects. This type of center of excellence could provide science-based authority in achieving some goals such as addressing monetization of benefits, validating best practices, and developing guidelines for certifying the benefits of restoration projects. Ideally this would be a public-private applied research and validation center and could be located at a national lab or university but it would require strong governance from industry and NGOs to provide broad-based credibility for the needed actions. The center could work in cooperation with initiatives focused on standards and systems to rate, rank and report the status of natural infrastructure, similar to the method used by the American Society of Civil Engineers (ASCE) to evaluate conventional infrastructure.

Public-private partnerships will be critical for expediting the natural infrastructure restoration industry in the near term. Some communities have demonstrated excellent partnership capabilities that have led to successful projects and programs. However, communities do not always possess the resources needed to successfully implement large, complicated projects.

While corporations benefit from conventional infrastructure, they also benefit greatly from the economic, social and environmental services associated with healthy natural infrastructure. They therefore have a stake in the development of an effective and efficient restoration industry. Corporations could help to stimulate the sector by advocating for more appropriate policies and investing in worthwhile projects that demonstrate the importance

Terms like restoration, resiliency, and sustainability are absolutely meaningless unless you put an end point or metric to them. When evaluating a restoration project, the first thing I ask when I look at a restoration project potential is 'what are we restoring to?' There are a lot of approaches to take. Defining the terms very clearly is a real challenge. You need that metric or end point so you know when you've achieved success and you can monitor progress as you move forward.

Dr. Mike Donahue

We need to have more investment in demonstration and pilot-scale studies. We have to find a way to grant ourselves license or permission to engage in such demonstrations, in essence, free ourselves from up from existing policy constraints as a trial and allow ourselves to learn from that.

Dr. Todd Bridges

and effectiveness of natural infrastructure restoration. They also have the opportunity to leverage their resources and influence to raise awareness regarding the issues and opportunities of restoration.

Government agencies such as the U.S. Army Corps of Engineers (USACE) possess unique capabilities for engagement on natural infrastructure issues. These agencies can leverage funds and serve as stewards for pilot projects. However, they lack key programs and policies that are needed to take comprehensive actions. Collaboration and communication through effective partnerships among all stakeholders will be paramount to drive needed actions.

At a state level, resources from economic development agencies are being invested in natural infrastructure restoration projects. For instance, Louisiana Economic Development identified water management as one of the state's top high growth, new market opportunities. A study by McKinsey & Co. estimates that by 2029 \$3 to \$4 billion per year will be spent in Louisiana on water management, including coastal restoration, generating as many as 45,000 jobs. This policy focus on the benefits of natural infrastructure restoration has the potential to drive investment.

Considerable interest and support has emerged recently from broad constituents to facilitate the development of natural infrastructure policies that are flexible, effective and attract investment. Federal agencies such as the U.S. Forest Service, the U.S. Environmental Protection Agency, U.S. Department of Agriculture and USACE have been working with organizations such as the newly formed (by Executive Order) Gulf Coast Ecosystem Restoration Council to embed natural infrastructure considerations into local, regional and specific project plans. Additionally, the October 7, 2015 White House memorandum titled "Incorporating Natural Infrastructure and Ecosystem Services in Federal Decision Making" could be leveraged to expedite action at the federal level.

Globally, bold restoration goals and pilot projects are being initiated. Specifically, World Resources Institute has worked with partners in Latin America and Africa to establish goals to restore 100 million hectares of natural infrastructure. To date 28 million hectares have been restored in Latin America and 31 million hectares in Africa. Currently \$750 million

USD in private finance, backed by more than \$1 billion USD in development bank guarantees is available for restoration projects in Latin America. A further \$1 billion USD is available for restoration in Africa. Unfortunately, maintaining momentum in the funding and implementation of restoration projects presents challenges. Restoration initiatives frequently lack the resources needed to efficiently get the projects off the ground and drive them to completion. For example there is no systematic way to find project developers, companies, communities or others that are interested in using private capital to restore degraded lands. These issues result in huge transaction costs (the cost of being able to do the project). Further transaction costs are incurred due to policing and regulatory requirements such as the need for certifications, social assessments, infrastructure assessments, environmental impact assessments and permitting. Projects also require ongoing monitoring upon completion. Ongoing maintenance of completed projects is also problematic, particularly in developing countries. These transaction costs increase overall costs which reduce the return on investment and hinders future investment. They also slow down the entire project development and implementation process. Developing mechanisms which standardize and/or simplify planning, implementation and monitoring processes would reduce transaction costs thereby making projects more cost effective and speeding up project delivery.

Immediate Opportunities

Leverage recent initiatives and developing trends

Given the high interest and significant momentum in expanding natural infrastructure restoration, a unique opportunity exists for businesses to work with communities, regions, agencies, foundations and NGOs to develop projects and funding mechanisms that can grow this sector and produce benefits for the economy, communities and the environment.

Leverage existing standards and metrics

Development and utilization of accepted standards for designing, constructing and rating natural infrastructure will be necessary for strengthening the business case and expanding the market. Currently, very few standards and metrics exist specifically for natural infrastructure restoration projects. However, it may be possible to address this deficit through existing programs for rating conventional infrastructure combined with systems for rating ecosystem health. The American Society of Civil Engineers (ASCE) has developed a

We have to identify the obstacles and then quickly get them out of the way so that natural infrastructure is not at a disadvantage.

Mark Tercek

rating system for 17 components of conventional infrastructure ranging from roads and bridges to ports and waterways. Given that ASCE already has systems in place to rank and report conventional infrastructure condition, adding natural infrastructure solutions to their system could be an efficient approach to developing and deploying standards as well as driving integrated thinking about the interconnection between conventional infrastructure and natural infrastructure. Similarly, America's Watershed Initiative produces a report card that measures six broad goals for America's Watersheds: ecosystems: flood control and risk reduction, transportation, water supply, economy and recreation. Features of this model could be integrated with the ASCE approach to make it applicable to other forms of natural infrastructure. The Institute for Sustainable Infrastructure has developed planning tools specifically for the purpose of designing solutions for restoring natural infrastructure. Use of these types of tools could help ensure that the restored systems will be sustained by nature itself, and limit lifecycle restoration costs.

ADVOCACY AND AWARENESS

Current State

*There is a sense of the things
that the individual can do to
make a difference, and then
there are the things that industry
can do at scale.*

Dr. Thomas Lovejoy

The general public is often unaware of the issues and opportunities associated with natural infrastructure restoration. This lack of awareness creates challenges with respect to making natural infrastructure restoration a priority for decision makers. Natural infrastructure projects frequently compete for funding against initiatives that may be perceived to be more urgent because they stimulate the economy or address safety and security issues in more traditional ways. In the specific case of coastal hazards, lack of understanding of the benefits natural infrastructure within coastal communities can contribute to the common misguided belief that conventional infrastructure is always superior to natural infrastructure and that if built to the right standard will reduce all risk and fully protect them from all hazards in all circumstances. However, natural infrastructure restoration opportunities are gaining interest as our understanding of the vast suite of social and economic benefits provided by natural infrastructure has grown. If the public understood these dynamics more widely, support for natural infrastructure initiatives would be easier to garner.

A paradigm shift is needed to ensure the public gains a better understanding of the benefits of natural infrastructure. It will be important to shift the understanding from narrow

perspectives that view environmental protection as mandates that require tax dollars to a broader understanding that investing in natural infrastructure can generate economic and community benefits, just as investing in conventional infrastructure. This transformation will not be easy and teaching the concepts early to upcoming generations will reduce the need for changing mindsets in the future. In the meantime, strong leadership and advocacy from businesses, governments, communities, agencies, NGOs and other stakeholders could drive productive change. The current strong interest in the topic among diverse stakeholders could be aligned with respect to directional approaches and the need for action.

Challenges exist with respect to quantifying all the benefits of natural infrastructure restoration in terms that are understood and accurately valued by markets. No “cookie cutter” approach exists to fund the restoration of natural infrastructure. Consequently, developing models for financing projects and initiatives can also be challenging and many worthwhile projects are not funded for this reason. Collecting and sharing accurate data that fully characterizes and communicates the costs and benefits of natural infrastructure will be critical for achieving stakeholder support and facilitating the growth of this sector. Tools such as *Envision*, the product of a joint collaboration between the Zofnass Program for Sustainable Infrastructure at the Harvard University Graduate School of Design and the Institute for Sustainable Infrastructure, could be more effectively used to provide a holistic framework for evaluating and rating the community, environmental, and economic benefits of restored natural infrastructure to support the value proposition and business case.

Pathways for Progress

Most people do not think holistically about natural infrastructure issues and do not have a good understanding of the options available for addressing these issues. Education about the issues and opportunities is paramount and mechanisms are needed to gather and organize information and spread awareness. Some of the issues are complicated and a sustained effort will be required (e.g., the campaign against smoking) to educate the public, including mainstream citizens, business decision makers, policy makers and educators. Development of Master's level university programs in building and restoring natural infrastructure could be practical and impactful.

There are some great innovators and risk takers out there, who – if they were encouraged rather than constrained – we would see a lot more good going on.

Dr, Mike Donahue

Awareness campaigns that publicize successful projects may increase knowledge and contribute to changing public perceptions. Highlighting projects where natural infrastructure has been shown to be as effective as conventional infrastructure from a cost and engineering perspective may increase community and business support. Presenting examples using story-telling techniques reach people at an emotional level and therefore are more likely to motivate them to take action and support worthwhile projects. A searchable inventory of successful projects with emphasis on the business models used could be a useful tool. Focus groups could also help concentrate attention on key issues.

Immediate Opportunities

Promote and build on success stories

Identify and execute local projects that can produce maximum benefits with minimal investment and carefully document the project parameters. Ensure that these success stories and all their benefits (environmental, economic and social) are well publicized and shared with the public. These projects could provide needed data and design parameters for larger scale projects and could also facilitate more significant investment.

When we think about nature as a thing to invest in, so many great things can happen.

Mark Tercek

Target innovators

In the long-term, governments are key for widespread adoption of natural infrastructure restoration strategies. They possess massive land holdings and administer agencies that manage these resources. However, governments also bring challenges associated with navigating bureaucracy, policies and regulations. While this industry is still developing, quicker progress may be possible with organizations that tend to be more agile, such as businesses, foundations, local governments and NGOs that also possess considerable land holdings. These organizations tend to be more flexible and can be more innovative with respect to trying new ideas and methods. They can also be more effective at analyzing and communicating the business case.

Reach out to policy makers for leadership and recruit champions

For US advocacy efforts, it may prove beneficial to encourage a set of hearings on Capitol Hill in order to highlight the need for restoration and the urgency of the discussion. Additionally, partnerships with governors' associations could aid in gaining traction at state and federal levels. Such partnerships should focus on both educating government officials

and encouraging them to advocate for restoration initiatives, policies and programs at all levels of government. By highlighting state successes and initiatives, government leaders will be able to communicate restoration benefits to their constituents.

Develop initiatives with communities, schools, students

Natural infrastructure projects tend to be very visual, especially if they can be viewed in a before-during-after sequence that tells a compelling story. Video segments that tell the story would be very effective tools in schools that could capture student's imaginations at an early age. The National Education Association and other groups that represent educators could be engaged to incorporate issues relating to natural infrastructure into education planning in science programs in primary schools. Additionally, special projects could be organized in cooperation with NGOs and corporations where students could work alongside other citizens to engage in small-scale restoration projects in their communities.

THE BUSINESS CASE

Current State

Government agencies such as USACE and the U.S. Department of the Interior possess unique capabilities for engagement but government alone has not been able to effectively address the vast array of natural infrastructure needs that continue to emerge.

Governments can leverage funds and serve as pilot project stewards but their capacity for fully managing and executing large scale projects is limited. For instance, USACE regularly receives authorization to proceed with projects but rarely receives the needed funding allocation to take action.

Harnessing market forces and providing incentives may encourage corporations to develop and implement innovative solutions. Even though considerable uncertainty still exists with respect to preparing a detailed business case, a general understanding of the opportunities and benefits exists. Leaders possess good technical understanding of practices that can be effective and there is often reasonable consensus with respect to priorities, especially when it comes to where to start. Given the magnitude of the issues and the consequences of inaction, waiting for universal expectations and standards to be developed is not a reasonable option.

Sometimes the natural infrastructure is just a better deal - great. Sometimes the natural ties with the grey, or at first glance it may look a little more expensive. But remember, we have these co-benefits that are important - but we're not as good at quantifying them. Biodiversity, carbon sequestration, community benefits. They aren't just nice to have, they can make the decision more compelling.

Mark Tercek

What's difficult is to create economic incentives that allow or promote or incentivize restoration of the biosphere.

Dr. Phil Duffy

If you think about investing in nature, as opposed to protecting nature philanthropically, it sharpens the mind. When we borrow the money, it's a very different dialogue, i.e. 'Here is what we expect you will obtain, year-by-year.' In this model, you quickly improve your investing acumen.

Mark Tercek

Most financial markets and models are not structured in a manner that supports natural infrastructure restoration projects. Financial institutions are accountable for demonstrating acceptable returns from their investments. To make viable deals, benefits need to be linked to expenses in ways that meet investor expectations. Liquidity, credit quality and size all matter a great deal to investors. Measuring and accounting for these aspects to justify natural infrastructure projects is often more challenging than most conventional investments.

Many benefits from natural infrastructure investments are not realized within a time frame that justifies investment through traditional financial channels (e.g., forests do not sequester much carbon until the trees achieve some size). Additionally, some benefits such as risk mitigation and carbon capture and sequestration are not accurately valued in existing markets and the benefits often accrue to parties that do not invest, and will not do so without some sort of authority-based intervention such as taxes or fees. Mechanisms that effectively address these types of market failure and incentivize investment are paramount to growing this sector. Industries skilled in assessing and monetizing risk such as the insurance industry need to be engaged in valuing natural infrastructure improvements.

Pathways for Progress

Many efforts have been undertaken in recent years to estimate the monetary value of the services provided by natural infrastructure. For instance, investing in restoration to improve storm resilience and reduce community vulnerability can make good economic sense if the business case can be standardized. For example, the Gulf Coast suffers annual losses of about \$14 billion because of storm damage. Healthy marshes, wetlands, reefs and other coastal habitats can help reduce vulnerability and risk by protecting against storm surges, erosion and coastal flooding. Over the next 20 years, the Gulf is vulnerable to almost \$300 billion in economic damages from hurricanes. A recent Federal Emergency Management Agency (FEMA)-funded study found that every dollar invested in hazard mitigation results in four dollars of costs savings.

Considerable progress has been made monetizing natural infrastructure's services. The Natural Capital Project has developed tools and approaches that estimate nature's

contributions to society. However, these outcomes have not yet been widely adopted and the restoration industry remains without recognized standards and methods. Mechanisms for accounting, allocating and charging for the services are not well accepted or institutionalized. Further, willingness of beneficiaries to pay for the services is lagging. Addressing these issues will be complicated and may take many years to develop and institutionalize into our markets and culture. However, waiting for a fully developed system is not an option and methods for managing gaps need to be developed and implemented in the interim. Small scale pilot projects and case studies focused in particular regions will be key to growing this sector. They will generate information and establish best practices that can be used to reduce the risk associated with future larger projects. The need for natural infrastructure restoration is staggering and developing techniques that can be scaled up will be crucial.

As an example, the Great Rivers Partnership (GRP) worked with diverse partners to secure the health of the world's Great Rivers. These large, iconic rivers sustain entire nations with food, water, energy and more, ultimately building stable and equitable economies, and improving the health and well-being of people, especially the poor. The GRP addressed key areas such as flood risk management, sustainable hydropower, agriculture and water. These efforts were implemented across four continents, focusing on eight GRP basins:

- North America - Mississippi and Colorado river basins
- South America - Magdalena and Tapajós river basins
- Asia - Yangtze and Mekong river basins
- Africa - Niger and Ogooué river basins

Building on the success of the GRP, the America's Watershed Initiative (AWI) also provides a model for how stakeholders in North America and elsewhere can work together to assess and improve infrastructure at scale. AWI is a cross-sector collaboration working to improve the infrastructure and governance of the Mississippi River watershed. The project has developed a report card tool to measure the status of six broad multipurpose infrastructure-based goals for the watershed, to include ecosystems. AWI leadership aims to realize \$1 billion annually in new public and private investment to ensure that the natural and conventional infrastructure in America's Watershed continues.

This isn't an attempt to 'put a price on nature.' It's recognizing some of the value of the services that nature provides for us. Because otherwise you value it at zero.

Dr. Thomas Lovejoy

Creative models for financing natural infrastructure projects are becoming increasingly common. In instances where projects are being constructed near developed areas, tax increment financing (TIF) is a public financing method that is used as a subsidy for redevelopment, infrastructure and other community improvement projects. TIF models can be implemented that are based on the increase in property values that occurs when the restoration is completed. Green bonds are another funding mechanism that has emerged in recent years that can help address failure of existing markets to measure and allocate costs and benefits. They enable borrowers to access lower interest rates and access incentives such as tax deferrals to help offset some of the uncertainty associated with quantifying and allocating monetary benefits. Green bonds are designated as such by their use of proceeds, which need to have some quantifiable environmental benefit which may include: renewable energy, energy efficiency, clean transportation, waste management, land use, biodiversity, conservation and clean water infrastructure. Third-party verification firms are beginning to certify that debt securities meet specific green bond guidelines.

We can bring banking and investment perspective to this very important environmental challenge in order to find instances where ecosystems are recovering and generating cash flows at the same time. While many of these projects are not wildly commercial, they are non-zero, they are at least partially replenishing economics.

Matt Arnold
JP Morgan Chase

The green bond market is small but growing rapidly. Much of the recent volume and momentum of green bonds has been driven by international development banks but domestic municipal bonds and project bonds are also emerging. In January this year Forbes reported that \$36.6 billion in new green bonds were issued in 2014 – almost equaling the combined \$37.8 billion in green bond issues that Bloomberg tracked from 1995 to 2013. Continued growth in green bond demand and availability can help make the business case, particularly if vested interests collaborate to provide funding.

The insurance industry has considerable experience with measuring and monitoring risk. Recent reports from multinational insurance companies Munich Re and Swiss Re document the magnitude of growing risks from natural disasters resulting from natural infrastructure depletion and are calling for action to mitigate the risks. Engaging the insurance industry to help assign value to the monetary benefits of natural infrastructure and the reduction in risks that it provides would be very helpful in establishing the business case for projects.

Immediate Opportunities

Take advantage of low interest rates

Current market conditions present very favorable opportunities for growing the natural infrastructure restoration industry. Interest rates remain low and innovative financing models such as green bonds can provide access to cheap financing. Interest is also high amongst diverse stakeholders in moving projects forward. Mobilizing private wealth and institutional investors interested in markets that reflect their personal values represents a huge opportunity to grow access to funding.

Promote proven practices and benefits

Some natural infrastructure projects do offer specific benefits that can be readily quantified using conventional evaluation methods. For instance, construction of wetlands as a means to treat certain industrial and municipal wastewater streams is now a proven option in some applications that offers financial advantages over conventional wastewater treatment systems. Identifying and spreading awareness regarding such proven technologies will be an important step from improving acceptance of natural infrastructure approaches to addressing the needs of society. Coastal restoration and protection projects that utilize natural infrastructure are major concerns right now, and could be a special category for emphasis in the near term.

Partner with organizations that design natural infrastructure

Effectively developing and expanding the natural infrastructure restoration market will require partnership with and support from organizations like the American Council of Engineering Companies (ACEC). ACEC, in particular, can be an important partner in defining the natural infrastructure market and associated business practices needed to accelerate the market growth in the US.

Engage with investor audiences

Engaging with investor audiences through proactive participation in presentations, panels and discussions and working with financing institutions to add natural infrastructure restoration opportunities and issues to the agendas of various investor summits will be critical steps in gaining the financial community's support for restoration.

When we use the word natural 'infrastructure', I'm thinking something that's more systematic - as opposed to random acts of kindness in the name of the environment. How do we knit these random acts into something that performs and provides benefits at a systems scale?

Dr. Todd Bridges

Investing in nature is an approach that can let us get a lot more done. The way to do that is to bring different groups together to collaborate: businesses, governments, scientists, engineers, NGOs. That's when the big breakthroughs really happen.

Mark Tercek

If you can't communicate the value of a product, it's difficult to attract investment for that product.

Dr. Todd Bridges

Match investors with projects

A very diverse mix of investors is interested in investing in natural infrastructure restoration projects, including: governments (from the local to national levels, including governmental agencies), corporations, financial institutions, NGOs, and foundations. Adding diversity to the funding mix will help to mitigate the uncertainty and risk often associated with natural infrastructure projects. Developing mechanisms that match potential investors with potential deals would facilitate more project funding options. They can work together to finance green bonds and tie benefits to expenses in creative ways that facilitate deal making.

Engage the insurance industry

Risk mitigation is one of the major benefits of natural infrastructure restoration but it is often not accurately accounted for in project development. The insurance industry holds the most experience and expertise associated with assessing and pricing the value of risk. Their input, in combination with the financial, engineering and scientific communities, will be extremely valuable in growing the restoration industry.

Establish public-private partnerships to address market failures

Making the business case to broad markets will be challenging until systems are in place to fully account for benefits in market-based terms. To fill this gap in the near term, public-private partnerships could be established with businesses, policy makers, government agencies, communities, foundations, NGOs and economic development agencies to address the market failure. Projects that restore natural infrastructure fit well within the mission of many of these organizations. They can (and have) invested in restoration projects that can be used to quantify and demonstrate the benefits. These projects can help establish best practices and provide case studies needed for spreading awareness

COLLABORATION

Current State

In response to the issues and needs identified above, a number of collaborations have been formed. In the United States these include, the Collaborative Forest Landscape Restoration Program which encourages collaborative, science-based ecosystem restoration of priority forest landscapes, and the Restore the Earth Foundation whose

mission is to restore one million acres of degraded forest and wetland ecosystems in the Mississippi River Basin to its natural state. Both organizations were formed in 2010. The Bonn Challenge aims for the global aspiration to restore 150 million hectares of the world's degraded and deforested lands by 2020. It is overseen by the Global Partnership on Forest Landscape Restoration, with the International Union for Conservation of Nature as its Secretariat.

Additionally, the TNC and WRI recently formed a partnership around the “New Restoration Economy”. The intention of this partnership is to focus on the business models that work, seeking to understand their corresponding value chains, incentives, economic opportunities and financing mechanisms. The partnership will also work to promote these projects around the world through existing networks. Initial funding has been provided by the Doris Duke Charitable Foundation.

Pathways for progress

Increased collaboration between governments, communities, businesses and NGOs would contribute to the development of policy, promoting advocacy and awareness and making the business case for natural infrastructure restoration. Ideally, any collaborative efforts should be guided by leaders from NGOs, governments, academia and the private sector. They should develop strategy, set goals, establish priorities, recruit participants, host meetings and events, and secure the resources needed to ensure the long term success of the emerging natural infrastructure industry. Sub-group and/or initiatives could also be established as necessary to address specific topics such as policy, advocacy, awareness, standards, business models, financing, international, domestic, science and engineering, etc.

Collaborative efforts should drive progress in natural infrastructure restoration through a balance of: 1) executing short-term tactics that capitalize on the immediate opportunities identified and 2) developing long-term strategies that ensure sustainable outcomes. There should be a focus on a combination of both strategic activates for developing an effective community of practice (collective knowledge and learning) and functional activities which drive successful project delivery. Collaborative efforts should engage key stakeholders including:

Large scale ecosystem restoration efforts are a marathon, not a 100-yard dash. And that's why one of the challenges we have in dealing with the way these projects are funded. That's why there is so much promise in public-private partnerships and other alternative delivery mechanisms.

Dr. Mike Donahue

- Policy – political leaders, government agencies, intergovernmental organizations, NGOs, and communities
- Methods – academia, consultants, trade associations, and industry
- Financial and business models – financial institutions, foundations, philanthropists, governments
- Delivery mechanisms – planners, designers and construction enterprises

Geography should be an additional consideration for this global-scale collaboration. As an example, World Resources Institute have found through their experiences in Latin American and Africa that the most traction on restoration comes regionally (e.g. continent). Regional groups want to learn from other continental efforts, but the governments and others feel more affinity with those from the same continent.

Immediate Opportunities

Leverage existing collaborations and partnerships

There is the opportunity to build on existing and recently formed collaborations and partnerships. Collaborative actions could focus on strategies that would contribute to meeting the United Nation's Sustainable Development Goals (SDGs): 9 - resilient infrastructure, 13 - climate change and 15 - reverse land degradation. Investment in projects as well as the collection and publication of examples of both needs and successful projects and their associated costs and benefits could also be considered. Resources of members could be leveraged to raise awareness regarding issues and opportunities with restoration in order to amplify the message in a consistent manner using a common language.

Foster regional collaboration

On a global scale, there are significant differences in restoration needs and practices, government and policy frameworks, mechanisms for advocacy and awareness, and project funding mechanisms. There are often greater synergies on regional and continental levels than globally. Therefore a suite of continental coalitions may be most effective.

ACKNOWLEDGMENTS

Initial drafts of this report were prepared by Dr. Tim Lindsey, in his role as Global Director of Sustainability (now retired) for Caterpillar Inc., and were based on observations and opinions expressed by various participants who attended the conference. Comments and suggested edits were provided by Bob Sinkler of The Nature Conservancy, Jane Ingram of Ernst and Young, and Sean DeWitt and Craig Hanson of The World Resources Institute. Caterpillar's corporate sustainability team created the final version of the report.

The speakers at the Summit - Dr. Tom Lovejoy, Dr. Bill Moomaw, Dr. Philip Duffy, Mark Tercek, Dr. Todd Bridges, Dr. Mike Donahue, shared their extensive knowledge and provided a solid foundation for discussions during the participatory sessions. Caterpillar's External Advisory Board Members - Aidan Davy, Stuart L. Hart, Thomas Lovejoy, Kevin McKnight, William R. Moomaw, Steve Skerlos, Leena Srivastava also contributed their considerable knowledge to the discussions and provided input throughout the development of this paper.

Summit emcee Rusty Dunn, Caterpillar and moderators Dr. Heather Goldstone, WRAI Radio and Matt Arnold, Managing Director and Head of Environmental Affairs, JP Morgan Chase kept the Summit presentations and participatory sessions on track and provided thoughtful insight on the topics raised.

Caterpillar Vice Presidents, Kathryn Karol, Gwenne Henricks and Karl Weiss lent their support to the initiative from its inception and provided leadership and guidance throughout.

All participants in the Summit are acknowledged for their contributions to the participatory sessions. These contributions are gratefully acknowledged however contributors have not endorsed the content of this report.



SUMMIT ATTENDEES



The Summit was attended by representatives from the following organizations.

AC Business Media	Forum for the Future	Ray C. Anderson Foundation
AECOM	Georgia Conservancy	Red Cross
Alcoa Inc.	Goldman Sachs	SIMCO Engineering, P.C
American Council of Engineering Companies'	Great Ecology	Stantec
American Shore Beach Preservation Association	Great Lakes Dredge & Dock Co. LLC	Taylor Engineering, Inc
Baird	Greenvest	Teri University
Blanchard	Hanson	TerraCarbon
Carolina Cat	HDR Inc.	The Nature Conservancy
Carpenters District Council	Hewitt Equipment Limited	The Rockefeller Foundation
Catalynics	HO Penn	Tufts University
Cashman Equipment Co.	Holt CAT	UN Foundation
Caterpillar	Impax Asset Management	University of Michigan, ESAB
CH2MHill	Institute of Sustainable Infrastructure	U.S. Army Corps of Engineers
Citi Foundation	JP Morgan Chase	Waste Management
Consorzio Venezia Nuova	Keep America Beautiful	Water Asset Management
CookFox Architects	Kelly Tractor	Waterways Council
Cuba Strategies	KPMG	WCAI
Dewberry	Kuerig Green Mountain	Wildlife Habitat Council
Ducks Unlimited	McKinsey	Winston Eco-strategies
Ecology & Environment, Inc	Motionry	Woods Hole Research Center
Encourage Capital	Native Energy	World Resources Institute
Engineering News Record	Pantropic Power, Inc.	World Wildlife Fund
Environmental Defense Fund	Perficient	Yancy Brothers
EY	Phillips & Jordan	ZF North America, Inc
Ferreycorp	PwC	



MAKING SUSTAINABLE PROGRESS POSSIBLE
Caterpillar.com/Sustainability

© 2016 Caterpillar. All Rights Reserved.

CAT, CATERPILLAR, their respective logos, "Caterpillar Yellow," the "Power Edge" trade dress as well as corporate and product identity used herein, are trademarks of Caterpillar and may not be used without permission.