



HOPE IN A CHANGING CLIMATE

Discussion Guide on Ecosystem Restoration



The Open University



THE WORLD BANK

It is with gratitude and great pleasure that I welcome you to join with the Environmental Education Media Project (EEMP) to launch a new film, *“Hope in a Changing Climate,”* to help educate people worldwide about the potential of integrated poverty eradication and large-scale ecosystem rehabilitation.

It has been more than fifteen years since I was first exposed to China’s Loess Plateau. In this time I have learned that the old saying is very literally true, *“if we do not learn from history we are destined to relive it.”* The unsustainable agricultural practices that destroyed the ecological viability of the cradle of Chinese Civilization are still being used in many parts of the world today, with predictable results. Many other parts of the world remain degraded following millennia of exploitation. In most of these places, there has never been an attempt made to restore these systems because for generations, people have believed they were irrevocably ruined.

The realization that human impact is negatively affecting climate change is not something that should frighten us into inactivity; exactly the opposite is true, it is a wake-up call to action. This crisis is showing us what our purpose must be in order to ensure future generations will be able to survive and thrive. It is showing us the limits and the potential of human consciousness.

On the Loess Plateau, and working with many others, I have been studying what was done to transform a place that was literally known as *“the most eroded place on Earth”* into a place that can teach the principles needed for humanity to create a sustainable future. We have learned that it is possible to rehabilitate large-scale damaged ecosystems and we have seen that in doing so millions of the desperately poor are lifted out of poverty.

We have seen the importance of biodiversity, biomass, accumulated organic matter, photosynthesis, nutrient cycling and the infiltration and retention of rainfall and I suggest that you learn everything you can about these processes. This knowledge is of profound importance to the world today and in the future. There are many essays, films, scholarly papers and other research that will help you gain a good understanding of these issues. Personally I’ve found that there is nothing more satisfying and useful that I could be doing. This is indeed *“The Great Work,”* and it is extremely exciting to welcome you to participate.

John D. Liu
Founder
Environmental Education Media Project

A whirling cosmic boulder surrounded by toxic gas has evolved over geologic and evolutionary time into the blue planet we now know as Earth. The trajectory that marks this remarkable transformation continues today, hard as it is to see over the course of a single human lifespan.

If we can look out beyond our individual lives, across generations; if we can look beyond the limits of one or another area of expertise and develop an integrated view; if we can mimic the stunning complexity, flexibility, and profound simplicity of the natural world, then this generation has the potential to truly repair our Earth.

Despoiled ecosystems sit on the crust of the earth like rust on metal, scars that will expand, wounds that need to be addressed before they spread. In these scarred regions, natural cycles have been disrupted, people live in deep poverty, and economies are paralyzed. But as we have seen across the globe, people have the potential to arrest this rusting — to restore damaged areas.

In each of these degraded and denuded areas, the finely calibrated and integrated natural cycles that make the Earth a livable planet have gone badly awry. Photosynthesis, the amazing bio-chemical photo-reactive process that removes carbon from the atmosphere and releases oxygen, has been disrupted as plant cover has vanished. In a catastrophic cascade, nutrient cycling, hydrological regulation and the carbon cycle are also profoundly disrupted.

Wherever we live, whether urban dwellers in Europe or farmers in Africa, we are all dependent on these fundamental cycles of nature to live. If you think, perhaps, that decaying leaf matter in the forest is of no importance to you, think again.

Whether from plant matter in the form of decaying leaves or biological remains in the form of fecal matter and deceased animals, this layer of dead matter atop the soil is the source of new life. Before one dismisses these natural rhythms, something of interest to tree-huggers and soft environmentalist types, consider the following: nutrient cycling is the source of all carbon-based energy in the world. As plants decayed, eventually became submerged in water, and then were cooked in volcanic heat, coal was created.

This process took a long time — about 350,000,000 years. Fossil fuels such as oil, gas, and coal are aptly named. They contain the fossilized energy from the sun that was first absorbed into plant matter and then naturally sequestered underground. That human release of sequestered carbon has disrupted critical planetary life cycles should not really come as any surprise if we consider our historic and ongoing actions in the context of geologic and evolutionary time.

Today, we are knitted together into the proverbial global village, forced to confront climate change as a species-level problem. Though industrialized nations used the Earth's atmosphere as a free carbon dump for many decades, carbon and other greenhouse gases know no borders. We will either learn to address global challenges together, learn to restore our planet to a stable climate, for example, or we will surely face the same end as has befallen other magnificent and sophisticated civilizations of the now ancient past.

It is a fateful choice. It is ours to make.

PEOPLE

‘We are part of the earth and it is part of us ...What befalls the earth befalls all the sons [and daughters] of the earth’

—Chief Seattle

It is an age-old debate; Are humans part of the natural environment or are we unique, apart, yet empowered to be stewards of that environment? As a practical matter, regardless of how one answers the question, it is clear that how we act as a species has a profound impact on the environment — and that impact often echoes across the generations.

In the past, civilizations on the edge of ecological survival sometimes opted to migrate. On a global scale this is not an option: We cannot just abandon an overgrazed or denuded planet.

And whether the products grown are coffee, palm oil, or timber, we now know that the appetites of the globally well-off drive behavior and create incentives for farmers and nations around the globe. So it is not about us or them. We all have only one backyard now. In the race to the bottom, we are all losers. But, we can all become winners as well.

Joining forces, sharing knowledge, and empowering people to lift themselves out of poverty is fundamental to ecosystem restoration. A new model for development and participatory assessment is thus at the center of successful ecosystem restoration. We now

know with great certainty that local people, with international support and investment, are the key to solving problems that need to be addressed in very physical ways in precise locations. The methodology of participatory assessment turns on its head the traditional development model.

As seen in Rwanda, China, and Ethiopia, a new model has evolved that draws on local cultural traditions, honors sound practices from the community, and builds a learning and education process into development — creating a truly a two-way street. The people of the Loess Plateau have the most to lose and the most to gain from what happens in their communities. Their ancestors have been living on the same land for thousands of years. But this does not mean that past destructive practices can be maintained; quite the contrary, it means they have to be banned or stopped. Rather than create resistance from the community, this change must be rooted in its support. Participatory assessment calls for the joint understanding of what needs to change and why — and for the local population to experience the full range of benefits from a successful restoration project.

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Whether in temperate zones with average rainfall of 45 inches per year, or in rainforests averaging near 100 inches per year, the fundamentals of our planet's water cycle is the same — ocean evaporation, atmospheric condensation, precipitation, infiltration into soils and groundwater discharge.

Vast swaths of the planet are in trouble — from the Sahel that stretches over 2,000 miles from the Atlantic Ocean to the Red Sea — to the more than 4 million hectares of degraded agricultural land in Turkey; once fertile lands sit exposed and denuded. And the more we learn about global ecosystems, the more clear it becomes that degradation someplace is degradation everywhere. Contrary to what one might think from televised reports or snippets of information in the media, lack of rain is rarely the real cause of the problem. Rain does not so much fail people, as people fail the rain.

Destructive agricultural practices carried out over thousands of years have profoundly disrupted the water cycle. Soil stripped of its cover — be it moss, lichen, grasses, or trees — has no defense against the rain. Water cannot infiltrate hard, crusted soil, and cannot percolate down into the vast underground streams and ponds that are the planet's reservoirs. As unprotected soil is pulled away, the top layer of nutrient rich soil where decayed biomass has created fertile ground

for new growth is ripped away and washed into gulleys. The eroded soil clogs rivers downstream, wreaking havoc on navigation, driving up costs of clean water for industrial processes, and often leaving people destitute.

But planned interventions can reverse this, even in areas lacking significant rainfall. Small dams, little more than berms, and effective terracing enable water to be held locally, so it can seep into despoiled lands. Planting can then begin near these catchments, and as the green carpet spreads, more water is captured without additional physical intervention. With a little boost, natural cycles spring back to life, demonstrating nature's inspiring resiliency.

While rainfall varies from season to season, and may become more unpredictable as a result of an increasingly unstable climate, the key to effective management of rainfall is to harvest it — trapping and preserving this precious elixir, ensuring its infiltration into the soil.

Beyond soil infiltration, as critical as that is, there is an even more essential relationship between water, land, plants, and the atmosphere. Plants themselves are 80-90% water, so beyond water the eye can see, a vegetated landscape has its water, stored inside plant life, while a barren landscape has lost its water.

SOIL

“We know more about the movement of celestial bodies than about the soil underfoot.”

—Leonardo da Vinci

Soil is not dirt, but rather the living, permeable ‘skin’ that connects and anchors our world. It is made up of geologic material — rock dust that has been weathered by wind and rain over eons of time. The mineral particles are then combined with decaying organic materials, and as each generation of life succumbs, together these materials become a habitat for vast microbiological communities. These “living soils” then perform many functions necessary to life. They recycle nutrients, they regulate the water cycle, and they provide the habitat for plants, which bridge the underground and above ground worlds.

While the soils of the Loess plateau in China differ tremendously from soils in the tropical rainforests of South America, they are in both cases essential stabilizing forces for their respective ecosystems. And soils and plants enjoy one of nature’s most profoundly successful symbiotic relationships.

Of all the nutrient cycles, nitrogen is perhaps the most important — and multi-faceted. Although the atmosphere of the earth is nearly 80% nitrogen, it cannot be taken up by living systems until it is first ‘fixed’ and transformed when it attaches to hydrogen or oxygen — work done mostly by bacteria. Nitrogen fixing plants absorb the nitrogen through respiration during photosynthesis. Balancing this transformation of nitro-

gen into ammonia and ammonium, nitrogen-rich plant and animal wastes are then kept in balance through de-nitrification that returns nitrogen as gas to the atmosphere. And nitrous oxide, the least understood and least well-measured of the greenhouse gases (such as carbon and methane), persists in the atmosphere for more than 100 years.

While understanding the complexity of living soil is critical to effective ecosystem restoration, there is a readily visible and even a spiritual dimension to soil. Soil uncovered is in an unnatural state, like a tree lacking bark or a mollusk without its shell. The life-giving quality of soil demands nutrient cycling through the roots of the plants. Without plants, soil eventually dies — just as without healthy soil — plants shrivel and die.

While it is easy to miss the broader cycle of life that is actively underway in and on the soil — be it in grasslands or a climax forest — that cycle is quite literally the death of past life to ensure life in the future. The accumulated biomass of recently-deceased biological matter, might well be called *necromass* — for whether it is leaves, branches, roots, an animal carcass, or a fallen butterfly, the dead matter on the forest floor forms a natural carpet of nutrients that seep back into the soil so that new life can spring forth.

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LAND



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Long-term ecosystem restoration requires a clear definition of the relationship between people and the land. While conservation and preservation have a critical role to play in global environmental stewardship, they are not synonymous with the restoration of a vibrant landscape that supports people living and farming in a balanced and sustainable manner.

Pivotal to defining this sustainable relationship between people and the land is the recognition that not all land is created equal. There is land that makes sense to farm, and land that is best left in its natural state. And it is critical to understand that this approach does not imply that some land is in ‘use’ and some not. On the contrary, both types of land are in-use, as dual investments over time. When ecologic land is allowed to return to a more natural state, then economic can be improved to support high-yield agriculture. In severely degraded lands it is thus possible to increase productivity by reducing the area in cultivation.

Land not farmed provides tremendous value to exactly the people who are not using it. Be it water retention at the ‘hats’ of the hills, or terraced ‘belts’ on the slopes, land left in its natural state provides a host

of ecosystem services to people. It is thus essential that lands be designated into economic and ecologic zones. Both provide immense value, through different means, and thus need to be managed to maximize their respective contributions.

While the designation criteria may differ significantly from region to region, the slope of the land is a critical factor. And work on many continents has shown that political leadership is essential to limit the temptation of subsistence farmers to attempt agricultural production on ever-steeper slopes, once formerly suitable lands become degraded. In a cruel imitation of Sisyphus’ doomed efforts to push the rock up the hill, the key to success is rarely reaching farther up into the hills. Rather, farming and grazing techniques need to shift to enable water infiltration on covered hillsides so that less steep and more accessible lands can then be brought back into productivity. Once this is accomplished, the incentive to use (and degrade) ecologic lands for near-term economic purposes is eliminated. A virtuous cycle of appropriate land-use thus replaces the vicious cycle of degrading ever-larger areas.

LIVESTOCK



Free-range grazing of sheep, goats, cows and other farm animals has profound implications for the overall health and sustainability of ecosystems. Nomadic or semi-nomadic herding traditions, such as have been practiced historically in Mongolia, Tanzania, and Kenya, are well adapted to local rainfall and landscape. But when pushed to cultivation, especially in the face of competition over the same land for urban or industrial uses, the equilibrium of people, land, and animals can be lost. And what begins as a local problem can quickly expand into a dramatic downward spiral.

The root dilemma was well characterized in 1968, in a famous essay by Garrett Hardin, *The Tragedy of The Commons*.

The tragedy of the commons develops in this way. Picture a pasture open to all. It is to be expected that each herdsman will try to keep as many cattle as possible on the commons. Such an arrangement may work reasonably satisfactorily for centuries... Finally, however, ... the inherent logic of the commons remorselessly generates tragedy.

As a rational being, each herdsman seeks to maximize his gain...[and] concludes that the only sensible course for him to pursue is to add another animal to his herd. And another; and another.... But this is the conclusion reached by each and every rational herdsman sharing a commons. Therein is the tragedy. Each man is

locked into a system that compels him to increase his herd without limit — in a world that is limited. Ruin is the destination toward which all men rush, each pursuing his own best interest in a society that believes in the freedom of the commons. Freedom in a commons brings ruin to all.

To avoid common ruin, and to preserve social freedom for all, it is thus necessary to manage grazing to enable the natural regeneration of groundcovers and soils. Whether through penning of animals, or rotational grazing or other communally imposed guidelines, it is essential to curtail grazing practices that allow animals to rip a hole in the fabric of the plants and land. A single sliver of land grazed until root structures are stripped bare — until the soil is exposed and vulnerable — becomes a target for wind and rain. Over time the sliver expands. The gnawed rip becomes a denuded gully. The gully drains a hillside of topsoil. Groundcover is lost and the vicious cycle drives one herder after another to more and more destructive practices.

But the commons *can* be preserved for all, across generations. It requires responsible exercise of social freedoms, political leadership and social incentives. It is essential for community and tribal elders to demonstrate leadership by embracing new practices and modeling positive examples.

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“Planting a tree is for me a sign of hope.”

—Wangari Maathai,
Nobel Laureate and founder
of the Green Belt Movement

VEGETATION

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On the Loess Plateau in China, and in many other areas of the world that have been farmed for thousands of years, it is very apparent that originally the plateau had been completely vegetated and that over human history the vegetation cover was completely lost. And this reflects a common, if very short-sighted, approach that places high value on agriculture but struggles to understand the importance of natural vegetation left alone, neither cut nor burnt.

In a world where billions go to sleep hungry, and famine threatens vast regions over and over again, one might ask how can anything be more important than growing crops to feed hungry people? The simple answer is that *just* growing crops won't feed the hungry people of the world over time — nor will it enable people to escape the cycle of grinding poverty, ecological ruin, and famine. We must repair the land — restore the ecosystems — upon which both hi-protein and hi-yield food crops and natural vegetation depend.

Natural vegetation has evolved over hundreds of millions of years. We literally owe our lives to the oxygen that photosynthetic plants and microbes have released into the atmosphere over hundreds of millions of years. When the plants breathe they absorb carbon, exhale oxygen and help cycle water. Their shade alters the

temperature of the soil and the humidity below the leafy foliage.

Plants are much more than just food. They are intimately engaged in initially producing and then continuously renewing the atmosphere. They help to regulate the temperature and the moisture in the soil and in the air. And they regulate water in many ways, including storing it in their bodies.

We need to rethink the purpose and value of natural vegetation and we need to realize that our own local systems are connected to global systems — meaning that even if our land is vegetated, if there is land anywhere that is de-vegetated, it is affecting global systems like the climate.

We need to feed billions of people and we need natural vegetation, rich soils, appropriate technology, and a host of other inputs — at a scale that marries short-term objectives with long-term sustainability. We need to think very carefully about how we can make our agricultural systems emulate as closely as possible those of natural vegetation so that we don't disrupt nutrient cycling, the water cycle and perhaps most importantly biodiversity.

“When one tugs at a single thing in nature,
he [or she] finds it attached to the rest of
the world.”

—John Muir

ECOSYSTEMS

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If ever one needed an example where the whole adds up to dramatically more than the sum of its parts, our planet’s ecosystems would be that example. Cognizant of the immensity of geologic time, and aware that a lauded scientist can spend a lifetime developing an illustrious career from the study of one micro-organism in the soil, how are we to come to grips with ecosystem restoration on a global scale?

In the middle of the 20th century the development of natural resource and environmental economics vastly expanded human understanding of the relationship of people (and our economic activities) and the environment. And these tools, as well as others, can help us grasp the challenge and the opportunity before us.

That unspoiled natural environments have immense economic value is now enshrined in public thinking; the value of a forest cannot be measured simply in board feet. A hotel room facing the ocean does indeed cost more than one overlooking the parking lot.

It is also, for example, now accepted that prices set by markets often don’t fully or effectively incorporate social costs – such as the cost of carbon pumped into the global atmosphere from human activities. National governments and multilateral institutions have a critical role in shaping agreements, creating level-playing fields and ensuring that incentives (regulatory or market-based) meet the needs of our global community.

Communities that today can invest in the maintenance, restoration, and creation of resilient ecosystems to support life are setting the stage for a global transformation. In time, ecologic and economic valuation seemed destined to merge. Financing for unsustainable investments is subject to greater scrutiny, and sustainable investment initiatives often enjoy favorable or lower hurdle rates. What is good for the environment is clearly good for the economy, even if human knowledge is at this point still not fully able to explain this profound truth.



Knowledge brings with it both opportunity and responsibility. And surely we can appreciate the humbling distinctions between geologic time (measured in billions of years), the millions of years of evolutionary time, and the very recent activities of the human species that we measure in thousands of years.

To accept this is not in any way to diminish our power and stature as humans. Rather, to acknowledge how much we have done — for good and ill — over such a short time-span is to savor the triumph of human knowledge. To devise new ways to integrate into tomorrow's activity what the span of geologic time means for our species is to celebrate human ingenuity in its greatest glory.

Two concrete recent advances further bolster our capacity to understand our natural environment — and this also increases the burden on us for responsible action. First, the widespread availability of satellite images of our planet gives us the ability to concretely see what is happening in precise geographic locations.

Combined with the power of geographic information systems, we can also now layer characteristics and descriptions to the images of those locations. We can 'see' and assess deforested areas of the world — and restored ecosystems, rainfall, and ground cover.

It takes time for it to sink in, but the logical conclusion of these advances in understanding is the realization that 'poor people,' who call the forests of the world home, are in fact the billionaires of the next age. When we finally work out the mechanics of how to value ecosystems — be it for water retention and filtering, carbon sequestration, naturally produced medicines, or a host of other critically important human products and services — the changes will be profound.

Though there is much we don't know, and though there is of course great uncertainty, we can no longer hide behind the veil of ignorance. The question is not whether we know everything about the challenges we face; of course we do not. But do we know enough to act, to act now, and to act responsibly?

Indeed, we do. We must. Today.

The value of talk is often diminished, with priority given to tangible action. And while action, of course, is essential, talk also matters. When talk leads us to understand, that is important. When talk leads to changes in how we think, that matters. When talk leads to new ways of thinking and the invention of new ways to solve persistent challenges, then the value of talk becomes clear.

So talk we must: one-to-one, in groups, as a community, nationally, regionally and globally. We talk to share and learn. And listen we must, too — for it is *in* conversation that we find connection, community and the possibility of working together to repair the world.

Large-scale ecosystem restoration is not a do-it-yourself project — something to start and finish over a weekend. But start we must, and as important as it is, talk is surely not enough.

We each have a unique mix of skills, inclinations, professional and personal obligations, opportunities and dreams for our families and ourselves. We do not all need to act similarly; indeed we should not and could not do so. But each of us can contribute. Once we understand how much can be accomplished, and how important it is that this restoration work must be done, we have a responsibility to act.

While the “Get Involved” section of our web site www.eemp.org continues to evolve, and will never be static, there are immediate steps we can all consider:

- Does anyone know another organization, with a different constituency, that could host another discussion to further spread the messages of the film?
- Does anyone have access to public policy leaders and advisors who can and should be briefed on the key themes in the film?
- Who can begin to develop an inventory of locations that should be considered for regional ecosystem restoration projects?
- Does someone know people in the media who can help spread the knowledge and messages discussed?
- Who knows educators who can be brought into the discussion to develop curriculum materials?

With a little brainstorming, more ideas can be readily identified, spanning the spectrum from an initial discussion, to building berms and planting native grasses. Share those ideas with us. Send us your thoughts and suggestions.

As it is with the restoration of natural ecosystems, so too, it is with human effort to improve and change the world; there is no one right thing to do, but rather a set of linked efforts that together change the conversation and change the world. Ideas, actions, financial resources, leadership, public attitudes, business practices, academic scholarship and a host of other pieces of our social fabric need to be rewoven to create a sustainable and secure future for our species and for the Earth.

Please join us.

In addition to materials available via www.eemp.org as well as the websites of our sponsors that are listed below, the selected bibliographic citations in this section provide interested people with stepping stones to greater knowledge and understanding. The range of materials available on the myriad topics that together comprise the body of knowledge around ecosystem restoration, climate stability, poverty eradication and sustainable agriculture is immense. Articles and books cited below are but truly the tip of this academic, technical, spiritual and global iceberg. And the synthesis of this knowledge is a journey we will all travel in our unique ways.

Note please that although we have only listed materials published in English, this in no way implies that materials in other languages may not be as or more useful. As you identify additional publications about which you think we should become aware, please do send them to us.

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The following organizations provided generous financial support for this project and the information and ideas on their websites may be useful in the pursuit of deeper understanding of the issues.

IUCN — NATIONAL COMMITTEE OF THE NETHERLANDS

www.iucn.nl

OPEN UNIVERSITY

www.open.ac.uk

THE ROCKEFELLER FOUNDATION

www.rockfound.org

SYNGENTA FOUNDATION FOR SUSTAINABLE AGRICULTURE

www.syngentafoundation.org

THE WORLD BANK

www.worldbank.org

Numerous people provided invaluable support in the development and preparation of this Discussion Guide on Ecosystem Restoration. As noted elsewhere, it is not a guide to the film but rather to the central themes of ecosystem restoration as presented in “Hope in a Changing Climate.” Principal among the contributors have been John D. Liu, whose grasp of facts and relationships across disciplines and geography have made this entire effort possible. Over many years this effort has entailed collaborations with numerous people in China, chief among them Kosima Weber Liu, Patrick Augenstein, Clement Duhamel, Joachim Siegert, Gabrielle Harris, Eva Sternfeld, and Sagnik Roy.

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A Rocha South Africa • Addis Ababa University • Africa 2000 Network-Burundi
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NatureKenya • REMA • Rwanda TV • South African National Biodiversity Institute
Swaziland National Trust Commission • Tanzania Association for Environmental Engineers
Tanzania Natural Resource Forum • Tsingua University • Uganda Environmental Education Foundation

As the global discussion unfolds and expands, we welcome comments on this guide as well as our work more broadly. Complex enough when addressed singularly, the issues we face our stunningly complex when viewed in

the integrated manner we think is necessary for deeper understanding. With every new effort, every new film, every discussion we realize how much there is we still do not know. Please share your suggestions so we can continue to improve what we know, what we share, how we talk about the challenges and opportunities of our world.

To propel ideas out into the world, whether in text or video, takes financial resources. Though indicated on the cover, we want to draw everyone's attention to the commitment and support of the organizations that provided the funds to launch and deliver this project. Our deep thanks are thus extended to Juergen Voegele at The World Bank, Gary Toenniessen at The Rockefeller Foundation, Marco Ferroni at the Syngenta Foundation for Sustainable Agriculture; to Willem Ferwerda at the International Union for Conservation of Nature — National Committee of the Netherlands and to Janet Sumner at Open University; and all their professional colleagues and associates who have done their utmost to support our efforts. Any errors, of course, remain the sole responsibility of EEMP.

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