

## **Saving biodiversity: Be the Change**

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### **Abstract**

Traditional efforts to preserve biodiversity and address climate change won't succeed until we change the way people interact with the world. Public gardens can play a major role in creating that change. To do this, and be seen with credibility, we must first ensure that our actions reflect our message. When Phipps opened in 1893 people believed there was no limit to the natural resources we used or pollution we produced. 110 years later, by questioning and challenging conventional design and operations, Phipps transformed itself from a relic of the last industrial revolution to one of the world's greenest gardens. In 2005, Phipps opened the first LEED certified visitor center in a public garden: in 2006 the most energy efficient conservatory in the world: and in 2009 completed designs for a zero net energy and water building to meet the Living Building Challenge and exceed LEED Platinum. Simultaneously, Phipps "greened" its operations and developed extensive new educational programs and collaborations. By demonstrating environmental stewardship and leading by example, Phipps garnered numerous awards, public recognition and funding, and was selected by President Obama to be the G20 Summit host site for the opening reception and leader's dinner in September 2009.

### **Key Words**

Biodiversity, conservatory, environment, green buildings, LEED, Phipps, SITES, sustainability

### **Introduction**

The mitigation of biodiversity loss is a critically important service that public gardens can render to society today. As we look at the strategies public gardens employ to address the loss of biodiversity it is imperative that we emphasize long term solutions over short term solutions. That is not to say that short term solutions are not important and indeed many species have been saved by them. Nevertheless, the most important long term solution to stop the loss of biodiversity is changing the way people interact with the world. Fundamental, pioneering, visible and inspirational changes in the way public gardens operate can lead to long term solutions to the problems leading to the loss of biodiversity.

What are the problems that require long terms solutions? They are the very same man-made problems that are manifest in global climate change. Our relentless pursuit of natural resources and reliance on fossil fuels, our exponential population growth and the vast disparity in social and economic equity that exists throughout most of the world are placing unprecedented pressure on species and the habitats that support them. Our children are growing up in societies that often do not support the development of meaningful connections with the natural world. Another factor that we need to recognize is that this planet cannot support the world's population living the same lifestyle we enjoy

in the US. It has been estimated that if everyone in the world were to live the lifestyle we do in the US, we would need seven planets' worth of natural resources to sustain us. We must change the way we live and it is imperative that those of us in the developed world lead that change. We need better solutions for living in harmony with the natural world at a level of shared equitable resource consumption that can be sustained around the world.

Mohandas Gandhi famously said "You must be the change you wish to see in the world". What is so powerful about this statement and the man who made it is that he truly exemplified the change he wanted to see. Are we doing that?

### **The Phipps Conservatory**

It is interesting to look at the history of Phipps Conservatory as a model of how peoples, wants, desires and attitudes have changed, and how we have transformed Phipps to lead by example. Phipps Conservatory was given to the city of Pittsburgh in 1893 by Henry Phipps, a partner of Andrew Carnegie in the steel business. The gift was made at a time when people had a completely different view of the world. At that time, people believed there was no limit to the amount of natural resources we used or the amount of pollution we produced. In fact people believed that we were going to conquer nature. This view was symbolized by the original purpose of the Conservatory, which was to grow and display exotic plants from warm climates in glass houses located in Pittsburgh, where the climate is anything but tropical. In the first 100 years of its history, Phipps gained quite a regional reputation for staging elaborate seasonal flower shows. In 1993, the city of Pittsburgh relinquished operation and control of the conservatory to a non-profit organization. After privatization, we expanded the tradition of spectacular flower shows, and embarked on a three phase master plan to address visitor amenities, add additional exhibit space and replace dilapidated facilities.

Our first project was to replace the main entrance. In the process we learned about Leadership in Energy and Environmental Design (LEED). LEED buildings are energy efficient, water efficient, use local resources and have high indoor environmental quality. We didn't start out to build a green building, but after learning about the program we decided our buildings should reflect our values. When we finished in 2005, we had built the first LEED certified visitor centre in a public garden.

It was during construction of this building that I experienced a revelation. One day, I noticed the contractors were installing floor tiles from a distant country. I was surprised, because I thought LEED buildings were supposed to use local materials. When I questioned the reason for using imported tiles, I was told that "we already got the point for local materials" so it didn't matter anymore. I suddenly realized that we needed to look beyond LEED. That one tile changed the way we looked at our entire operation. We decided not to stop with the building; we decided to look at everything we do to make it as green as possible.

When we looked at operators for our café, we sought out an operator who agreed to focus on local and organic foods. In our gift shop we featured fair trade items and made sure that we were not selling products illegally harvested from tropical forests. It makes no sense to tell people to care about the rainforest and then sell trinkets in your gift shop from people cutting them down. We began to question our use of pesticides and cleaning products, rejecting chemical approaches and adopting innovative and earth-friendly practices in every aspect of our operation. We started to compost all of our pre-

and post-consumer café waste and food waste from events at Phipps. We banned plastic disposables and bottled water and got our café green-restaurant certified. LEED required us to use 10% renewable energy for our welcome centre; we decided to use 100% renewable energy for all of our buildings.

When it was time to build our new conservatory we wanted to make it as efficient as possible. The two major energy demands in conservatories are summer cooling and winter heating. In order to investigate the relationship between energy demands and glasshouse design, we went all the way back to the 1840's when the first conservatories were built in Europe to study their design. We found big glass buildings with small vents at the top to allow the hot air to escape. We looked at many other conservatories all the way up to the present and found that in 160 years very little has changed in conservatory design. Actually, we did find one major change. Starting around the 1980's people began to install giant fans in the glasshouses to introduce outside air and accelerate the escape of hot air through the vents. The fans keep the conservatories cooler in summer, but they use a considerable amount of electricity.

We began to question conservatory design. We asked our engineers to show us how air moves through a conservatory. We modeled air movement through various implementations of the traditional two-vent system. We saw very little change in temperature. We asked our engineers to show us what would happen if instead of a small roof vent, half the roof opened. They objected and stated that we would ruin the chimney effect; we persisted. The result was astonishing. On a 32°C day in a traditionally-designed conservatory, the temperature would be high as 37°C. Using our open-roof design, the temperature was in the low 30's all throughout the conservatory. We immediately had them change the design so that every other row of glass on the roof of our 1,100 m<sup>2</sup> conservatory would open. We then designed our own two-stage shading system to close the shades under the stationary panels of the roof and leave them wide open under the vents to achieve maximum air flow. We learned about earth tubes and installed six concrete pipes a half metre in diameter and 100 metres long, 5 metres underground beneath the new production greenhouses. The ground stays at 13°C year-round at this depth, and by using the draft created by air exiting the roof vents of the conservatory, we could use the ground to passively cool the air. We added a fogging system for evaporative cooling. By the time we finished, we had a conservatory that has no greenhouse effect. It cannot get hotter inside than outside, and it uses virtually no energy to stay cool.

We then looked at heating. Originally our building was designed with single pane glass to allow for the maximum amount of daylight penetration during the winter months when the days are short and the sun is low in the horizon. The building was designed to be wedge shaped with a high south-facing wall so that the new addition would not be visible from the front lawn of the original 1893 conservatory. We requested a sun tracking study and found that all the direct winter sunlight entered through the south-facing wall and none through the roof. This allowed us to make the roof double pane insulated glass, because that is where most heat is lost, and keep the south wall single pane glass to maximize direct winter sunlight penetration. We modified our shading system to function as an energy blanket to conserve heat. We insulated the outside of the northwest and northeast concrete walls for thermal massing. We added a root zone heating system in all of the planting beds so that we could turn the air temperature down on cold winter nights. Our engineers estimated that these changes reduced the heating requirements to 1/7 of a typical conservatory of similar size. We installed an energy-efficient prototype

solid oxide fuel cell to make electricity and tempered water for the new conservatory. By the time we finished, we had built the most energy efficient conservatory in a public garden in the world.

Around the same time we heard of the Living Building Challenge to build a building to exceed LEED Platinum (the current highest level of green building) to be net-zero energy and water. We designed our new education, research and administrative building, the Centre for Sustainable Landscapes (CSL), to meet the challenge. The building will rely on a number of strategies to meet the net-zero energy requirements including a robust building envelope, photovoltaics, wind power, daylight, and natural ventilation. Net-zero water strategies include rain gardens, lagoons, cisterns, green roofs, permeable paving, and constructed wetlands to treat and recycle sanitary water. The CSL was also accepted as a pilot project for the new Sustainable Sites Initiative, which is like LEED for landscapes.

The transformation of Phipps has been an extraordinary experience, but it is not just about building green buildings. We see these efforts as a way to inspire the public to explore ways to live a more sustainable lifestyle and we see the CSL in particular as a venue to help us change the way people interact with the world. The CSL provides us with an opportunity to develop pace-setting collaborative research with local universities and institutions. We have great talent in our region focused on green buildings, but research is lacking in how to sensitively incorporate buildings into the landscape. We see our research programmes influencing our education programmes, making the connection between people and plants, making connections between the human and natural worlds where the natural and the built environment intersect.

All of this has resulted in extraordinary publicity and awards for Phipps. In September 2009, after President Barack Obama selected Pittsburgh as the host site for the G20 summit we had an opportunity to put Phipps forward for consideration as one of the host sites. In our presentation on Phipps we highlighted the contrast between the Phipps of 1893, a product of man's quest to conquer nature, and the Phipps of 2009, a model of green buildings and operations. The pitch worked and Phipps was selected as the host site for the official welcome and opening reception for all the delegates and the working dinner for the world leaders.

Have we gone far enough? We don't think so. It is important that all of us continue to look for opportunities to make our institutions more sustainable and influence the public. We need to ensure that our actions support our values. All of us have an incredible opportunity to connect people to nature and an opportunity to change the way people interact with the world. A redefinition of the relationship between people and world resources is necessary to preserve the loss of biodiversity in the long-term. Our actions speak louder than our words; we need to be the change we wish to see in the world.