

Zoos, Aquariums & Wildlife Conservation Facilities Qualifications



Biohabitats

conservation planning + ecological restoration + regenerative design

SECTION 1

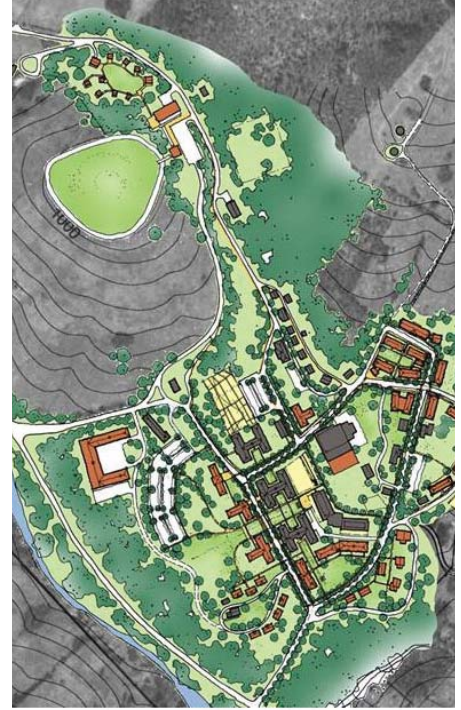
Zoos

Firm Profile

Biohabitats is a Baltimore-based environmental design and consulting firm specializing in ecological restoration, conservation planning and regenerative design. Our focus for over 30 years has been on restoring ecological processes and regenerating the human spirit. We do this with an interdisciplinary team of ecologists, biologists, soil scientists, natural resource planners, geomorphologists, landscape architects and engineers. Our work portfolio includes many successful planning and design projects at several zoos and animal research institutions, including: the Smithsonian National Zoological Park at both, the Rock Creek and Front Royal Campuses, the Bronx Zoo, Werribee Zoo (Australia), San Diego Animal Park, Woodland Park Zoo, and the National Aquarium in Baltimore. Biohabitats recognizes the institutional, economic and social challenges that zoos and animal reserves face in incorporating sustainable design measures into their campus/park planning, design and day-to-day operations – aiming to find ways to weave sustainability into the infrastructure, operations and community fabric of a campus, ensuring full integration with its overall mission and vision.

We help institutions such as zoos revitalize landscape ecology to protect and restore biodiversity, incorporate site-wide habitat enhancement measures, integrate green infrastructure initiatives (stormwater, wastewater, potable water and energy), and develop institutional frameworks to make sustainability a way of life while maintaining the unique sense of place for the zoo community. We are familiar and actively involved in helping institutions develop strategies to meet various permitting requirements in ways that enhance public spaces through delivery of ecosystem services. By providing natural resource inventories, analyses, recommendations, concept plans and designs, Biohabitats is able to minimize current and future stormwater management and landscape maintenance costs while enhancing campus aesthetics, developing functional landscapes for animal holdings, and strengthening ties with visitors and guests.

Biohabitats operates out of eight Bioregional offices and three satellite offices throughout North America and works frequently around the globe, including: Canada, Mexico, Costa Rica, Panama, Bahamas, Fiji, Columbia, India, China, Cambodia, Afghanistan, Saudi Arabia, Abu Dhabi, and Australia.



*Smithsonian National Zoological
Park Front Royal Campus Plan*

ZOO EXPERIENCE

ZOO/PARK LOCATION	EXHIBITS	LLS BACKWASH RECOVERY	ECOLOGICAL WATER PLANNING	STORMWATER PLANNING/ DESIGN	WATER TREATMENT DESIGN	HABITAT DESIGN	MASTER PLAN TEAM MEMBER	EXHIBIT DESIGN TEAM MEMBER
Woodland Park Zoo–Seattle, Washington	Humboldt Penguins	■						■
Woodland Park Zoo–Seattle, Washington	Asia Forest Otters	■	■			■		■
Edmonton Valley Zoo –Edmonton, Alberta, Canada	Arctic Shores Pinnipeds	■					■	■
Edmonton Valley Zoo –Edmonton, Alberta, Canada	The Wander & Trout Ponds	■	■	■			■	■
Edmonton Valley Zoo –Edmonton, Alberta, Canada	Stormwater Plan			■			■	
Calgary Zoo–Calgary, Alberta, Canada	Water Master Plan		■	■				
Fresno Chaffee Zoo–Fresno, California	Sea Lion Cove Pinnipeds	■						■
Werribee Open Range Zoo–Werribee, Australia	Kubu River Hippos Experience		■		■	■		■
San Diego Wild Animal Park–San Diego Zoo, California	Water Master Plan		■				■	
Parque Municipal Summit–Panama City, Panama	Jaguar Exhibit Washdown Treatment	■	■		■			
National Aquarium–Baltimore, Maryland	Center for Aquatic Life & Conservation		■			■		
Bronx Zoo–Bronx, New York	Woodland & Stormwater Management Plans		■	■			■	
Bronx Zoo–Bronx, New York	Master Plan		■	■			■	
Smithsonian National Zoological Park–Front Royal, Virginia	Conservation & Research Center		■	■			■	
Smithsonian National Zoological Park–Washington D.C.	Rock Creek Campus		■	■		■	■	■
Smithsonian National Zoological Park–Washington D.C. *	Birdhouse Renewal Marvelous Migrations	■	■	■		■		■
Detroit Zoo–Detroit, Michigan *	Beaver Exhibit	■						
Riverbanks Zoo–Columbia, South Carolina*	Seal and Sea Lion Exhibit	■						■
San Diego Zoo–San Diego, California*	Africa Rocks Penguins							■
Sequoia Park Zoo–Eureka, California*	Watershed Heroes River Otter & Salmon		■			■		■

* under construction or in design

WILDLIFE CONSERVATION SOCIETY

Bronx Zoo Master Plan

Bronx, New York



Initial conditions

The largest metropolitan zoo in the nation, the Bronx Zoo is a world-renowned center for science and education. It is also the headquarters for wildlife and wildlands conservation projects around the world.

In 2002 the Wildlife Conservation Society (WCS) engaged the team of Ayers/Saint/Gross Architect and Planners, Michael Vergason Landscape Architects and Biohabitats to prepare a master plan for the campus that reflects and facilitates the

Inherent throughout the Bronx Zoo's master plan is the recognition that the landscape surrounding the animal exhibits should be restored, protected and celebrated.

Zoo's mission and institutional values. "We spend a lot of money overseas working toward wildlife conservation, and if we're going to do that, we had better be living our mission at home," said Sue Chin, Director of Planning and Design for WCS.

Biohabitats' responsibilities focused on assessing the natural systems of the site including hydrology, soils, vegetation, landscape ecology, invasive plant threats and overall environmental sustainability. Concept development included preparing diagrams that explored and tested the spatial implications of the site's natural systems and their relationships with built systems, operations, and cultural features. The final master plan

evolved from the concept diagrams through a series of two-day workshops with WCS staff and various stakeholders.

A unique aspect of the final master plan was its recognition that the landscape fabric that weaves around and throughout the Zoo's exhibits is, in itself, an exhibit of the local ecology of the Bronx River Watershed that has been displaced by urban development. Inherent throughout the master plan is the recognition that this ecology should be protected, restored and celebrated.

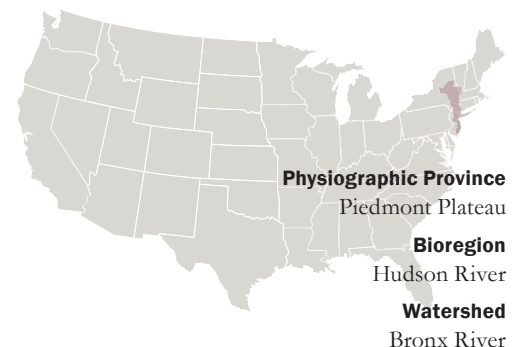
SERVICES

Inventory & Assessments
Planning
Public Outreach
Program Management

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WILDLIFE CONSERVATION SOCIETY

Bronx Zoo Woodland & Stormwater Management Plans

Bronx, New York



After assessing the ecological conditions of the Bronx Zoo and contributing recommendations for the Zoo's Master Plan, Biohabitats was called upon by the Wildlife Conservation Society (WCS) to prepare a Woodland Management and Stormwater Management Plan for the Bronx Upland Riparian Restoration Project.

Protection, restoration and management strategies will be implemented in a predictable, economical, yet flexible manner to protect and enhance natural resources at the Bronx Zoo.

These two management plans are a significant step in WCS's efforts to employ environmentally sustainable design initiatives throughout the Zoo's ongoing development and operations.

For the Woodland Management Plan, Biohabitats developed a woodland restoration action plan based on an adaptive management framework. The plan addressed issues such as invasive plant species management, aged tree replacement, native woodland planting, and soil regeneration strategies. It also included a framework for directing the allocation of funds, materials and labor to implement recommended actions. Finally, the plan provided a detailed

schedule (including timing and frequency) for implementing specific woodland restoration action items.

The Stormwater Management Plan focused on the integration of water quality best management practices to treat stormwater from impervious surfaces. Biohabitats identified many opportunities and a wide variety of BMP treatment methods for the site. Based on a prioritization schedule, Biohabitats will develop detailed design and construction drawings for a bioretention facility to treat stormwater.

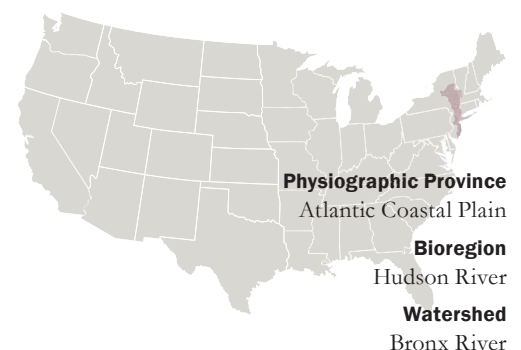
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THE SMITHSONIAN INSTITUTION, OFFICE OF PLANNING AND PROJECT MANAGEMENT

Slate Hill Conservation Area Precinct Study, Smithsonian National Zoological Park

Front Royal, Virginia



Biohabitats participated in an interdisciplinary planning study for the 240-acre Slate Hill precinct of the Smithsonian National Zoological Park and Conservation Biology Institute in Front Royal, VA. Nestled

The Smithsonian Institution's state-of-the-art field research facility will be an international hub for the conservation of rare wildlife species and a national model for environmental stewardship.

in the hills of the Blue Ridge Mountains, the site includes sensitive ecosystems such as woodlands, streams that serve as some of the headwaters for the Potomac River, and meadow areas that provide important habitat for regionally significant birds.

After contributing to the development of a sustainable Comprehensive Facilities Master Plan for the Front Royal property, which includes the Smithsonian Mason School of Conservation, Biohabitats supported this more detailed study of the landscape's capacity for reproductive research of rare or threatened wildlife from around the world. Biohabitats provided guidance related to preserving and restoring existing ecological resources, enhancing ecosystem function, promoting natural resource

stewardship, and minimizing disturbance and fragmentation of existing habitat.

The challenge was to balance the habitat needs of animals, including birds, canids, ungulates, and carnivores, with research requirements, and the sensitive and unique native ecology and hydrologic systems that occur on the site. Accommodating flexibility in form and use of the research facilities was a key goal along with promoting sustainability through wise energy and water use, and management of waste.

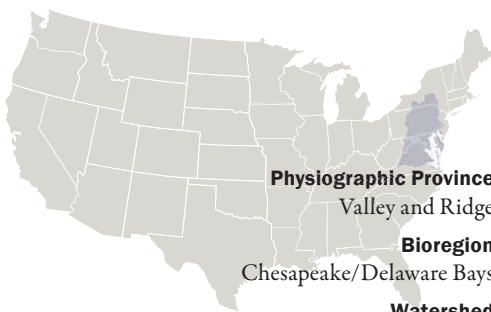
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Headwaters of the Potomac River, South Fork of the Shenandoah River

NATIONAL AQUARIUM IN BALTIMORE

Center for Aquatic Life & Conservation

Baltimore, Maryland



Image Courtesy of Michael Vergason Landscape Architects



To complement its world-renown Inner Harbor facility, the National Aquarium in Baltimore proposed developing a new aquatic animal care and conservation education center on a site along the Middle Branch of the Patapsco River. As part of a master planning team led by Ayers Saint Gross and Michael Vergason Landscape Architects, Biohabitats

Regenerative design strategies including water quality BMPs, energy conservation, and adaptive reuse are being seamlessly combined with ecological restoration initiatives including coastal wetland restoration, riparian buffer enhancement and greenway corridor conservation.

integrated an adaptive management approach into the design of the multiple-phase campus development plan that includes the renovation of a public works garage, a public park, water access piers, and ecological demonstration gardens.

Among the strategies proposed were tidal wetland and woodland restoration, phytoremediation, and upland water treatment wetlands, all of which are aimed at regenerating ecological processes in a portion of the Middle Branch riparian corridor and shoreline. These efforts related directly to the Aquarium's mission by supporting Chesapeake Bay ecosystem recovery and

inspiring stewardship of aquatic environments.

Biohabitats' main objective was to demonstrate how the ecological interests of the project could be best served by using an adaptive management strategy that establishes a series of natural processes, monitors them over time, and adjusts elements according to the continual evolution of the elements and their processes. This strategy also supported program development and enhancement of the visitor experience.

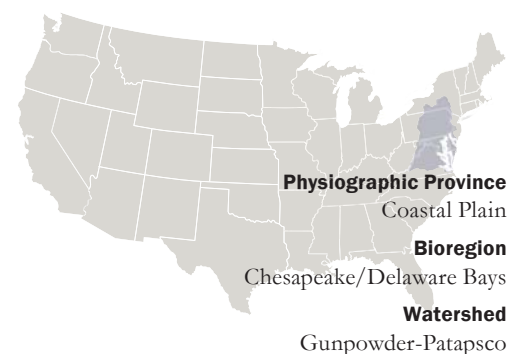
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SAN DIEGO ZOO

San Diego Wild Animal Park Water Master Plan

San Diego, California



The San Diego Wild Animal Park is a zoo in the San Pasqual Valley area of San Diego, California. It is one of the largest tourist attractions in the city and

Southern California. The Park houses a fabulous array of wild and endangered animals including species from the continents of Africa, Asia, Europe, North and South America, and Australia. The animals are housed in free-range enclosures similar to their natural environments. The park, visited by 2 million people annually, has an area of 1,800 acres (7 km²) and, in 2005, housed 3000 animals of more than 400 species plus 3,500 species of unique plants.

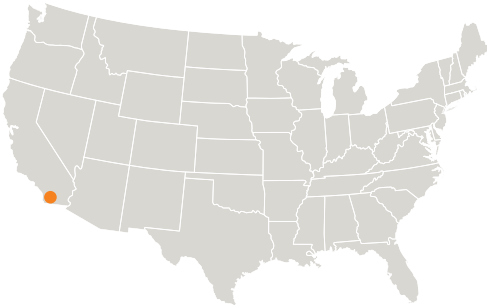
Biohabitats participated in a master planning exercise for storm water management and restoration of ponds and

water sheds. Overgrazing of the enclosures and concentrations of large animals led to accumulations of animal manure and sediment in habitat/stormwater ponds. Biohabitats identified opportunities to implement a series of techniques including stormwater wetlands for sediment control, edge details for bank protection and animal access control, and reed beds for treatment of pond sediment and organic matter. These techniques were included in the master plan not only for water management (reuse for irrigation) but also to control nutrients and sediment in off-site discharges of storm water.

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ZOOS VICTORIA

Hippo Habitat at Werribee Open Range Zoo

Victoria, Australia



Zoos Victoria is committed to reducing water consumption while maintaining diverse environments for the animals at its three zoos and providing visitors with immersive experiences. Spanning over three hectares, the Kubu River Hippos Experience in the Werribee Open Range Zoo features eight adult hippos in three separate pools that are connected hydraulically.

Biohabitats designed a system to treat the exhibit's 2,000-cubic-meter pools and the organic waste from the hippos. Recognizing that hippos play a major role in the East African river ecology by providing nutrients for algae eating fish, we considered a design which incorporated an Australian Ecosystem. Working with a local Australian design team and U.S. partners Studio

Hanson Roberts, we developed a marsh concept using a 6,000-square-meter wetland which provides treatment and habitat while enhancing the zoo exhibit. Because the treatment is passive, significant capital and energy savings were immediately realized, resulting in more money for animal care and the exhibit.

Using low head, high flow pumps water is circulated one time a day through the 6000 m² wetlands where suspended solids and nutrients are removed. The nutrients and suspended solids provide food for native micro and macro invertebrates and fish that feed on these organisms. The fish, in turn, become food for birds. A portion of the treated effluent water is used for irrigation. Make up water is provided from the Werribee River.

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WOODLAND PARK ZOO

On-Site Water Treatment and Reuse System

Seattle, Washington



from top: Constructed Wetlands Backwash Recovery System at the exhibit entrance; exhibit with blue heron; penguins in the exhibit.

Woodland Park Zoo has been a cherished community asset for more than a century. A unique urban oasis, it has inspired generations of families from the Puget Sound region and all over the country to observe the animals and experience the surroundings.

The site encompasses 92 acres and features more than 1,000 individual animals representing nearly 300 species. The grounds are divided into climate zones that represent habitats from around the world. Climate zones include everything from tropical rain forests to the arctic habitat of the North.

Biohabitats partnered with longtime collaborator Studio Hanson Roberts on the design of the zoo's new Humboldt Penguin Exhibit. To minimize the use of potable water in the exhibit, Biohabitats designed an innovative backwash recovery system to harvest, treat and reuse the filtration system's backwash. The heart of the system is a constructed wetland that is integrated into the exhibit for educational and interpretive purposes.

The system is projected to save over 150,000 gallons of potable water per year by diverting backwash water from the sanitary sewer.

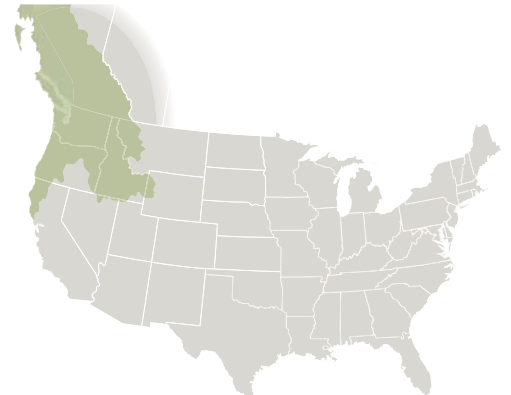
The application of natural systems to zoo projects is in its infancy, and the backwash recovery system installed at Woodland Park Zoo is one of the first of its kind. Using passive settling in a primary treatment tank followed by filtration of nutrients and solids within the wetlands, recovered water is able to be disinfected and returned to the exhibit pools.

The Humboldt Penguin Exhibit has been awarded the 2010 Exhibit Achievement Award from the AZA and the 2009 Design Excellence Award from the Seattle Design Commission.

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Additional Zoo Projects

SEQUOIA PARK ZOO WATERSHED HEROES EXHIBIT, EUREKA, CA

Biohabitats is designing a low-energy Life Support System (LSS) for the Otter and Salmon Exhibits that incorporates a hybrid approach of utilizing both mechanical and ecological systems for filtration. The filtration systems which include skimming and pre-filtration, incorporate energy efficient pumps, bead filters and disinfection, while also utilizing innovative pool bottom biofilters and active edge wetlands to increase circulation and filtration in an energy-efficient manner.

WOODLAND PARK ZOO ASIAN FOREST OTTER POND WETLANDS, SEATTLE, WA

The new Otters & Play exhibit at the Woodland Park Zoo utilizes an innovative energy-efficient natural system to provide filtration and recirculation for the river otter stream and pond system. Instead of employing a purely mechanical solution, Biohabitats worked with T.A. Maranda and Associates to develop a system of undergravel biofiltration cells and fringe/edge wetlands that complement more conventional filtration and disinfection systems. The wetlands also become part of the exhibit itself.

EDMONTON VALLEY ZOO TROUT POND WETLANDS AND BACKWASH RECOVERY AT THE WANDER, EDMONTON, CANADA

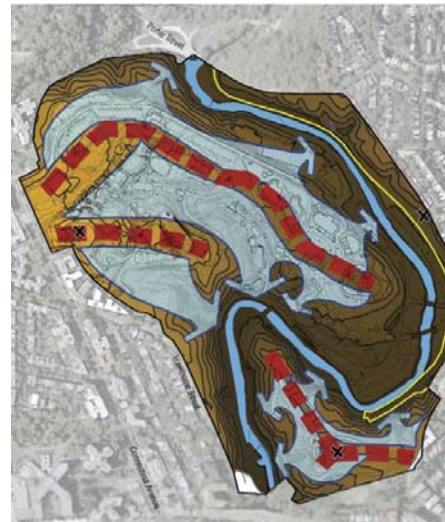
Proper water filtration is key to keeping trout in a contained exhibit/water feature environment. Biohabitats worked with T.A. Maranda and Associates, exhibit designer and local trout farmer to design a filtration system that used both the inherent filtration capacity of fringe/edge wetlands coupled with mechanical filtration and disinfection to provide clean, clear water in this recirculating water feature. The resulting system provides habitat for benthic organisms, birds, and fish, is low-energy and simple to maintain, and informs and educates visitors. A separate backwash recovery constructed wetlands treats and recycles water discharged from the LSS system that would otherwise be wasted to the sewer.

EDMONTON VALLEY ZOO – ARCTIC SHORES PINNIPEDS, EDMONTON, CANADA

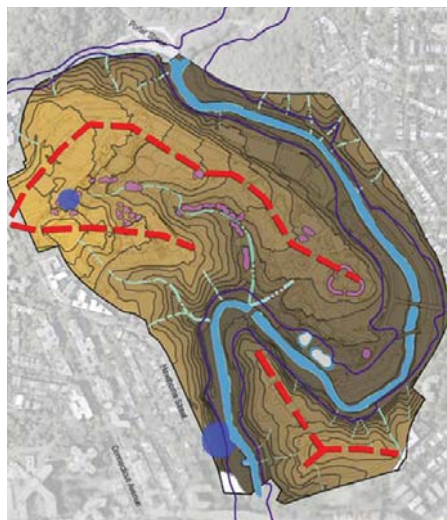
Biohabitats, along with T.A. Maranda and Associates, provided design of innovative biological systems to treat and re-circulate water discharged from some of its new exhibits using an ecological approach. At the pinniped exhibit, home to sea lions, seals and other fin-footed friends, a settling and equalization tank and constructed wetlands captures, treats, and recycles saltwater backwash that would otherwise be wasted to the sewer. Beyond treating 615 gallons water per day, other challenges presented by this saltwater system were the selection of non-corrosive equipment and appropriate non-coastal, arctic plant species.

FRESNO ZOO SEA LION COVE, FRESNO, CA

Fresno Zoo's Sea Lion Cove exhibit, which opened in August 2012, is modeled on the ecology of California's Central coast and features sea lions, seals and pelicans in a 200,000 gallon pool. Visitors are afforded an up close and personal view 35 ft underwater through a massive glass window into the depths of the exhibit. Underwater viewing requires pristine water quality, however, and that's where Biohabitats' expertise comes in. Working with lead designer The Portico Group, and T.A. Maranda & Associates who designed the primary water filtration and life support systems, Biohabitats created a constructed wetlands system to recycle the backwash water



*Smithsonian National Zoological Park
Comprehensive Facilities Master Plan Rock
Creek Campus, Washington, D.C. Drainage*



*Smithsonian National Zoological Park
Comprehensive Facilities Master Plan Rock
Creek Campus, Washington, D.C. Hydrology*

generated by the filtration system, saving the Zoo up to 200,000 gallons of fresh, potable water per year. Instead of dumping the backwashed water to the sewer, the natural treatment system first settles the water to reduce solids, then provides biofiltration of organic matter and nutrients in the subsurface flow constructed wetlands. Water recovered from the wetlands is then returned to the filtration system for polishing and disinfection before being returned to the exhibit's pools.

THE SMITHSONIAN NATIONAL ZOOLOGICAL PARK'S FRONT ROYAL CAMPUS, FRONT ROYAL, VA

The Smithsonian National Zoological Park's Front Royal Campus, known as the Conservation and Research Center (CRC), is one of the world's most extensive conservation biology research programs. The CRC's mission is to: conserve endangered species through captive management and research; train professionals and students; and conduct research relevant to conservation biology.

In an effort to plan for future upgrades and expansions which would provide new partnership opportunities, public visitor experiences, special events, research and education opportunities and administrative and operational space, the CRC initiated the creation of a 20-25 year master plan.

As a member of a multi-disciplinary planning team lead by Ayers/Saint/Gross Architects and Planners, Biohabitats was asked to develop and illustrate an understanding of the ecological conditions of the site and the region.

SMITHSONIAN NATIONAL ZOOLOGICAL PARK COMPREHENSIVE FACILITIES MASTER PLAN ROCK CREEK CAMPUS, WASHINGTON, D.C.

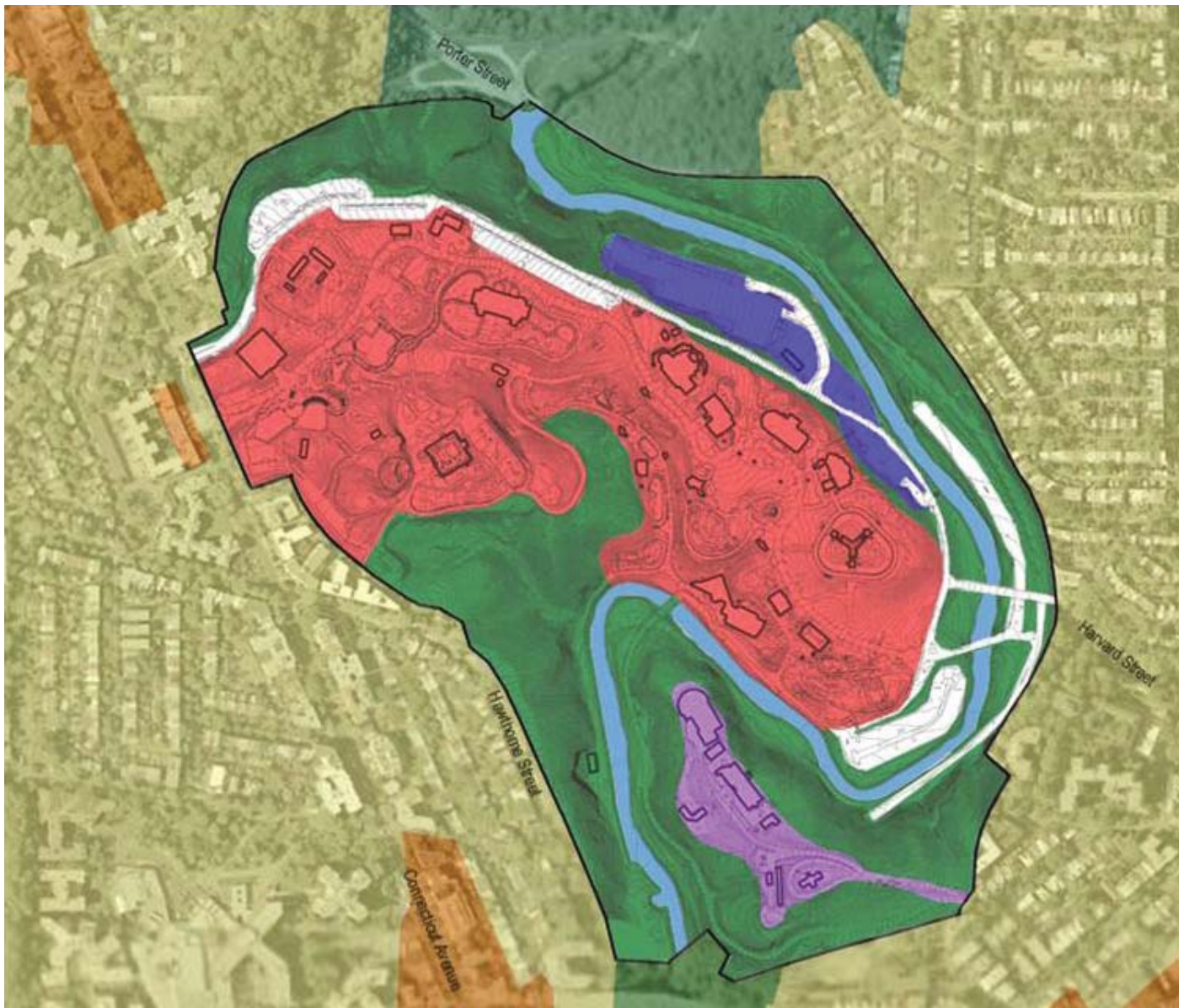
Biohabitats' analysis focused on identifying important ecological corridors and connections, as well as existing constraints such as roads and fence lines that prevent unencumbered migration of plants and animals. The information was used to inform circulation and development plans associated with the campus expansion. Biohabitats' findings were also used to create site planning solutions that maintained or enhanced the ecological integrity of the forests, fields, and waterways on and adjacent to the site.

Biohabitats has participated in two components of the National Zoological Park's (NPZ) Comprehensive Facilities Master Plan process. Our first role was to provide environmental sustainable design ideas and wetlands expertise for the schematic design of a new migratory bird exhibit.

Biohabitats' primary role for the migratory bird exhibit involved providing guidance and direction with sustainable site design issues pertaining to landscape ecology, energy conservation, stormwater, resource allocation and operations. We also provided expertise in wetland design and construction. Biohabitats' primary responsibilities included participation in a two-day design charrette along with performing research, site reconnaissance and a report.

As part of the Comprehensive Facilities Master Plan, Biohabitats co-facilitated a two-day "green charrette" to learn more about sustainable design and set goals for the future development and operation of the National Zoo. Leaders from within NZZ, OFEO, FONZ, and SI attended the work sessions. Early in the master planning process, green building practices and sustainability were identified as important to the future of the zoo. As a leader in conservation science, the National Zoo has elevated sustainability to one of its top four strategic planning goals, along with excellence in animal care, science and education. The green charrette was the first step to institutionalize goals and a process for sustainable practices throughout the National Zoo.

Biohabitats' primary role for the green charrette involved providing guidance and direction on environmental sustainable design goals and initiatives for energy, water, habitat and material resources for both the NZP and the Front Royal Campus. Biohabitats' primary responsibilities included co-facilitating the workshops, providing pre-workshop research and support, and the preparation of a follow-up report on specific sustainability goals and initiatives.



Smithsonian National Zoological Park Comprehensive Facilities Master Plan Rock Creek Campus, Washington, D.C. Land Use

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