



CHAPTER

4

Designing Green Connections



Every Green Connection should strive to accomplish one or more project goals:

- » **PUBLIC HEALTH: Increase active transportation to parks.** This is achieved by prioritizing non-motorized transportation, such as walking and biking.
- » **SUSTAINABILITY: Enhance Urban Ecology.** This may include reducing stormwater runoff and creating and improving wildlife habitat.
- » **LIVABILITY: Support neighborhood stewardship and placemaking.** This may include programming elements, wayfinding and signage.

4.1 DESIGN OVERVIEW

This Chapter will discuss principles for designing Green Connection routes that meet multiple project goals while building on existing streetscape design elements. Improvements and enhancements to the Green Connections network should result in a complete network, that balances the multiple project goals and builds on basic principles for streetscape design.

Create a distinct, identifiable and consistent network.

Streets along the Green Connections network should be distinguishable and recognizable. Distinguishing Green Connections streets can facilitate users' ability to navigate the network with ease. Wayfinding and signage, generous landscaping, robust traffic calming, public artwork and programming elements can all contribute to a route's legibility.

Balance multiple goals. Green Connections should be designed as multi-functional streetscapes that achieve numerous project goals. For example, in addition to calming vehicular traffic and improving pedestrian crossings, a bulb-out could provide an opportunity for artwork or habitat. Streetscapes should support active transportation, enhance urban ecology and encourage stewardship and placemaking.



Use a Context-based approach. Every street in San Francisco is a unique place. The scale and architecture of buildings, as well as land use patterns, climatic zones, the existence of local animal and plant life and neighborhood demographics contribute to the local context. Green Connections should build on a street's context and amplify the street's unique character and urban ecology.

Maintain essential streetscape functions.

Streets along the Green Connections network should accommodate various users and functions. In addition to addressing the project's goals, streets along the network need to accommodate traditional streetscape functions, including: providing access for local residents and emergency vehicles; accommodating the unique mobility needs of people with disabilities; and providing space for essential public utilities. In limited cases, such as where the Green Connections network



overlaps with the Muni network, public transit should be accommodated.

Design to the appropriate scale. The level and type of intervention across the Green Connections network may vary, reflecting differing context, street functions, and opportunities. Full implementation of the network will see roughly three levels of improvements within the network: *Light Interventions*, *Moderate Interventions*, and *Showcase Projects*. Most of the network will have light or moderate enhancements that will signify the Green Connections Network and showcase projects will punctuate the network and celebrate unique locations.

In many instances, meeting the various Green Connections project goals can have complimentary design solutions. For example, traffic-calming measures like curb extensions, or traffic circles may also provide opportunities for habitat creation, rain



gardens and/or public art. Some portions of the network may not be able to respond to all three project goals. Characteristics of a street will inform the articulation of the Green Connections network; for instance, streets along the bike network should account for bicyclists' needs in the design whereas segments on steep slopes, such as portions of the Ridge Trail near Mt. Sutro should focus on pedestrian comfort.

The principles detailed in this chapter, along with the traffic calming and placemaking elements described in the subsequent Design Toolkit, describe the vision and design considerations for creating Green Connections. An integrated approach to placemaking will result in a network of streets that both improves San Franciscans' health, safety and mobility, while enhancing and restoring the ecology of the City for generations to come.

Green Connections Levels of Intervention



Light Intervention

Every Green Connection should include signage and wayfinding, and low cost improvements like bicycle stencils and street murals. Portions of the network that achieve light level may feature basic greening like sidewalk landscaping gardens and filling in gaps in street trees. Some basic traffic calming, such as recommended by the Better Streets Plan may also be included in portions of the network that warrant light intervention.

Moderate Intervention

These portions of the network typically offer a greater emphasis on the goals of the Green Connections network, and may require a more holistic streetscape re-design. In addition to the amenities included in light level segments, moderate interventions may also include minor sidewalk enhancements, curb extensions and stormwater infrastructure as well as intersection treatments that calm traffic. Moderate level segments will more clearly embody the goals of Green Connections and will involve a greater level of community engagement.



Showcase Intervention

Showcase segments are those portions of the network that most successfully achieve the project goals, by providing ample walking and bicycling space, habitat, stormwater management, and community meeting spaces. These portions of the network may feature considerable reductions in traffic volumes and dedication of considerable space to habitat and/or other community gathering spaces.

Showcase segments are nodal points distributed regularly along the network, offering destinations and pause points for users. Showcase segments could be a small grouping of blocks or a few blocks placed periodically along a route. Special segments can also

mark important locations along the Network such as the intersection of two Green Connection routes, or adjacent to important community facilities such as libraries, community centers or schools.

The Design Toolkit (Chapter 5) contains several examples of interventions that could be incorporated into showcase projects such as: Super Bulbs, Intersection Islands, Diverters, Street Parks and Play Streets.

4.2 DESIGN PRINCIPLES FOR PUBLIC HEALTH

Green Connections routes should be designed to provide legible, continuous paths from important neighborhood-serving destinations (e.g. commercial districts, schools etc.) to open spaces. One of the goals of the Green Connections network is to improve public health by encouraging people to choose active transportation modes to access parks.

The City has issued several design guidelines and policy documents that address the goals of supporting active transportation and traffic calming. Three documents particularly relevant to Green Connections include: The Better Streets Plan, <http://www.sfbetterstreets.org>; The Bicycle Master Plan, <http://www.sfmta.com/projects-planning/projects/bike-plan/documents>; and the SFMTA's Innovative Bicycle Treatment Toolbox, (Contact SFMTA Livable Streets Division).

This section provides design principles for Green Connections that relate this goal.



Principle: Prioritize walking and bicycling. Green Connections' designs should consider the mobility needs of both bicyclists and pedestrians, where conditions allow. With the exception

of the pedestrian-only segments (such as the hilly routes that have staircases) and the northeast quadrant of the City where higher traffic volumes may preclude doing so, Green Connections should be designed as mixed-traffic areas, or Neighborhood Greenways, where bicyclists and cars share the road-space. (See page 2, Off the Beaten Path: New Concepts in Street Design).

Where Green Connections routes are on streets with high traffic volumes or fast moving vehicles, generous sidewalk areas and separated bicycle facilities should be favored.

In most instances routes along the Green Connections network are intended for both walking and biking. However due to constraints created by staircases and steep topography, parts of the Network are best oriented toward people walking. Designs on these sections of the network should be oriented towards pedestrian mobility and comfort.



Principle: Calm traffic to support active transportation for all users. Slowing vehicular speeds and reducing pedestrian crossing

distances improve the safety and comfort of pedestrians routes were selected because they are non-arterial, residential streets that are typically characterized by slower-moving traffic and lower vehicle volumes than arterials.

Many routes will likely benefit from further modifications to bring them up to Green Connections standards. Interventions may include strategies that slow cars and in some cases, reduce traffic volumes on Green Connection streets. The Design Toolkit in the following chapter contains numerous examples of traffic calming devices.





Principle: Focus on conflict points. Whenever possible, the Green Connections network avoids arterial streets; however where a Green Connections route intersects with heavily trafficked streets may require special focus on safety for Green Connections users. Ensuring that all street users, regardless of ability, can comfortably cross arterials will make the network's accessible to children, seniors, and individuals with mobility disabilities.

Arterial crossings should prioritize vulnerable users and be considered a high priority for early implementation projects along the network.

When a Green Connection route crosses an arterial, consider traffic-calming elements that shorten the crossing distance, provide high visibility of pedestrians, and provide ample time for pedestrians and bicyclists to safely cross. The Green Connections Design Toolkit includes special signal crossings appropriate at these intersections (see Pages 68 and 69).



Principle: Celebrate park edges to facilitate access to parks and open spaces. Park edges and entrances present design opportunities for connecting to and marking the Green Connections network. Green Connection routes start and end at parks, creating opportunities for design features that create a defined "gateway," celebrating the park space and welcoming users.

Where Green Connection routes run parallel to parks, they are an opportunity to extend parks into the neighborhood. In these cases, the sidewalk and park should read as an integrated cohesive space, potentially extending landscaping into the right of way.



4.3 DESIGN PRINCIPLES FOR SUSTAINABILITY

Green Connections will enhance San Francisco's urban ecology by planting areas that create wildlife habitat and reducing stormwater runoff; the introduction of route-specific target species; and encouragement of programming elements like artwork, wayfinding and signage into the design of Green Connections.

Green Connections utilizes the street system to further environmental stewardship, celebrating the City's wildlife, unique setting and natural environment. Green Connections should promote ecological stewardship in our public rights-of-ways, increase the ecoliteracy of the City's residents and, where appropriate, enhance the habitat function of the City's street system and manage stormwater. Green Connections should include programming elements like public artwork and signage that reveal the City's natural systems, educate the public about San Francisco's ecological heritage and foster a culture of stewardship. This section provides design principles supporting enhanced habitat and managing stormwater with green infrastructure.



Principle: Emphasize greening and street trees.

Green Connections should be verdant places with generous landscaping and, where appropriate encouraging contiguous tree canopies. Green Connections should have a greater level of landscaping in their design than a typical San Francisco street, giving users the experience of moving through a linear garden.



Principle: Cultivate ecoliteracy among San Franciscans.

San Francisco's character is related to the City's unique setting and strong relationship with the natural environment. The dynamic light and fog, views toward prominent natural features like grassy hilltops and mountain ranges to the north and south, and water bodies like the Bay and Pacific Ocean all contribute to San Francisco's sense of place. While San Francisco is highly urbanized, it is also home to a wide array of ecosystems, inhabited by plants, birds, insects, mammals, reptiles and amphibians. Many San Franciscans are unaware of the tremendous biological diversity around them amidst the people,

buildings and infrastructure that make up the City. The lives and rhythms of the City's wildlife offer a rich opportunity for placemaking, community engagement, ecological restoration and cultural enrichment.

Green Connections should integrate educational elements that inform the public about the City's ecological heritage and the importance of stormwater management and green infrastructure.

Strategies for telling habitat stories may include informational signage as well as programming elements such as works of art that provide both aesthetic beauty and habitat function. Strategies for telling stories about urban watersheds and stormwater management may include informational signage, or design cues in the built environment that showcase stormwater movement through the site. These may include incorporating weirs, notched curbs, works of art or similar features that reveal and explain stormwater flow patterns. (See Placemaking Elements, page 62).

Green Connections Ecology Guides: Connecting with nature in your neighborhood

Even in San Francisco's more densely urbanized neighborhoods, there are reminders of nature all around us: modest front yard gardens provide refuge for bees and butterflies, street trees host flocks of birds that chirp noisily throughout the day, and many streets offer scenic vistas of the bay, ocean and nearby hills and green spaces.

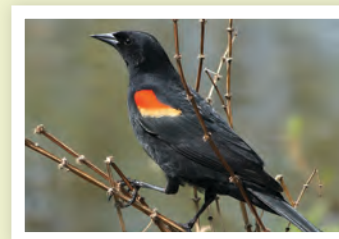
Green Connections seeks to connect people with nature – not only by making it easier for people to visit parks and open spaces, but also by encouraging streets that enhance urban ecology with native landscaping, stormwater plantings and street trees. In addition to providing ecological benefits, these features can cultivate ecoliteracy by providing visitors an opportunity to interact with local habitat and species, which can be supported through educational signage, artwork, and programming. In support of this goal, a key product of the Green Connections project includes Ecology Guides, which provide information on local flora, fauna and habitat that could be enhanced as part of the network.

Each of the 24 routes is named after a target species or target habitat that is particularly suited to that area. Routes can create a wildlife corridor, and in some cases correspond with flight, mobility, and nesting patterns. The Coastal Prairie Route (#7), for instance, suggests native plants that designers and residents could use to support this endemic habitat type. These species and habitats were selected in consultation with project partners (Nature in the City, San Francisco Parks Alliance, and Walk San Francisco), and with input from community members and experts in local ecology.

The Ecology Guides are a tool for visitors who want to learn about nature along the routes and surrounding neighborhoods, as well as for neighbors, designers and gardeners who want to help support a vibrant urban ecosystem. (See Appendix A1).

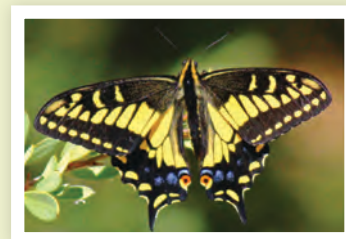
EACH ECOLOGY GUIDE INCLUDES:

A description of the route's Key Species or Key Habitat, and the important role it plays as part of the larger urban ecosystem.



Credit: Wikimedia Commons

YOSEMITE CREEK SPECIES: RED-WINGED BLACKBIRD



Credit: Vivian Reed

MISSION TO PEAKS SPECIES: ANISE SWALLOWTAIL

6

MISSION TO PEAKS
SPECIES: ANISE SWALLOWTAIL

ROUTE HIGHLIGHTS

- The Castro, The Mission, Potrero Hill, Mission Bay, Jackson Playground, Franklin Square, Mount Sutro Open Space Preserve, The Blue Greenway

ANISE SWALLOWTAIL – *Papilio zelicaon*

Flying giant!
The Anise Swallowtail is one of the three biggest San Francisco butterflies! The others, the Western Tiger Swallowtail and the Pipevine Swallowtail, can be identified with a simple trick: Anise Swallowtails have black "shoulders." Western Tiger Swallowtails have black tiger stripes, and Pipevine Swallowtails can vary in color from slate grey brown to rich shiny blue black. Anise Swallowtail females lay eggs on plants in the carrot family (Apiaceae) which include Anise, Parsley, Fennel, and Dill. When the egg hatches, the 1st instar (first larval stage) turns around and eats its own eggshell! During later instars, caterpillars feeling threatened may react by deploying a bright red, antler-like scent gland (osmeterium) that emanates a strong anise-flavored odor intended to scare off predators. In San Francisco, the Anise Swallowtail is plentiful! During San Francisco's 17th Annual Butterfly Count on July 2, 2011, observers counted a record number of Anise Swallowtails at 110 individuals counted. In his field notes, lepidopterist Liam O'Brien notes: "New high (for the) count. With 44 hills and fennel in every vacant lot in this city, this record number makes perfect sense."

RESIDENT OR MIGRATORY
Resident

KEY HABITAT FEATURES
Fairly open country, and most likely to be seen on bare hills or mountains, in fields or at the roadside. It is often seen in towns, in gardens or vacant lots.

DIET
Nectar Plants: Zinnia, Aster, Butterfly Bush, Host Plants: Dill, Fennel, Parsley, Queen Anne's Lace.

ASSOCIATED PLANTS & ANIMALS
Wild Aster – *Symphoricarpos chilense*, Holly leaf (blais) Cherry – *Prunus illicifolia*, Yarrow – *Achillea millefolium*, Cow Parsnip – *Heracleum maximum*.

NESTING INFORMATION
Eggs are laid singly, on the undersides of leaves.

ADDITIONAL HABITAT PLANTS
Anise, Caraway, Carrot, Cilantro, Dill, Fennel family including Common, Sweet, Comarostaphylis, Yampah, Lovage, Parsley, Parsnip, Queen Anne's Lace, Rue.

A description of places along the route, including parks, schools, and neighborhood commercial districts.

Descriptions of:

- Associated Plants & Animals
- Design and habitat considerations
- Resident or Migratory
- Diet
- Nesting information, where applicable
- Additional Habitat Plants

PRINCIPLES FOR ENHANCING HABITAT



Principle: Incorporate target species and target habitat in Green Connections. Each route along the network is matched with a "target species" or "target habitat" – a local plant, animal, or ecosystem type tied to the historic and current ecology of the City. These species and habitats can be supported along an urban corridor through planting, programming and other interventions.

Highlighting and encouraging target species and target habitat can educate the public about the City's diverse biological heritage while potentially increasing the footprint of habitat for wildlife. Where site conditions allow, target species and habitats should inform the selection of plants, interpretive signage, and other artistic interventions on Green Connections. Communities may also support target species and habitat in nearby open spaces, like community gardens, park edges or private yards. More information about the target species and target habitat is in the Ecology Guides, Appendix A1.

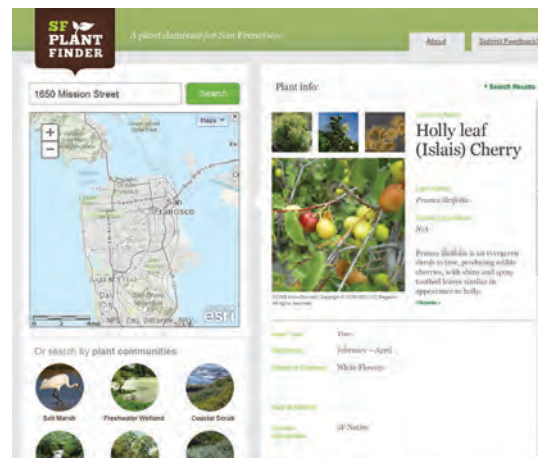
Although Green Connections should create habitat that supports target species and habitat where possible, this may not be feasible or desirable on every segment of the network.



Principle: Understand the target species' life cycle. To design quality habitat, every phase of a target species' life cycle should be considered, including how a target species hunts or forages for food, the types of spaces it requires to hide from predators and its mating habits. Many animals require unique habitat features. For example, butterfly species will typically lay their eggs on a specific plant where the caterpillars hatch and feeds; and bats need roosting sites where they can sleep undisturbed during the day. Insectivores, like songbirds, need ample food sources, so supportive habitat will need to incorporate insect habitat as well.



Principle: Create habitat structure. San Francisco has wetlands, oak woodlands, dunes, coastal scrub hilltops, grasslands, shoreline beaches, riparian areas and urban street tree canopies. Within each, habitat structure is created by spatial patterns and forms of plantings, stones, woody debris, leaf litter, and other materials that create spaces for animals to live. Different species may have divergent structural needs though many animals can coexist in the same habitat. As a general principle, complex and diverse forms provide superior habitats that can sustain a greater mix of wildlife.



Plant Database

The planning process for Green Connections included compiling a list of recommended street trees and plants. This information will be incorporated into an online database.

The plant database will be a resource for gardeners, designers, ecologists and community members that will provide planting recommendations for the public right-of-way and backyards. The database will also provide route-specific information for the Green Connections Network.



Green Hairstreak Corridor

In early spring, female Green Hairstreaks (*Callophrys viridis* – a locally endangered butterfly) mate and disperse, looking for host plants to expand their population. This iridescent green, nickel-sized butterfly can only fly a few hundred feet from her original habitat. Only two distinct hilltop populations remain in San Francisco, at the Hawk Hill and Rocky Outcrop open spaces in the Inner Sunset District, managed by the San Francisco Recreation & Parks Department's (SFRPD) Natural Areas Program. These open spaces are surrounded by neighborhoods devoid of the butterfly's habitat, and because the populations are small and isolated, the butterflies would vanish without intervention.

In 2006, the Green Hairstreak Corridor project was initiated by lepidopterist Liam O'Brien and continues to be managed by Nature in the City, a local nonprofit organization. The project has utilized the City's Street Parks Program, a partnership between the Department of Public Works (DPW), the San Francisco Parks Alliance and the residents of San Francisco. The Street Parks Program enables residents to transform underutilized public rights-of-way owned by DPW into vibrant parks and habitat areas.

Since the Green Hairstreak Corridor's inception, neighborhood residents have converted nine public parcels over ten blocks into Street Parks planted with upland dune habitat, the natural ecosystem of the butterfly. The corridor is a habitat bridge linking the two formerly isolated butterfly populations with strategically placed street parks planted with the Hairstreak's habitat and cared for by neighborhood residents and schoolchildren.

Since the corridor's inception, the population of butterflies, and other associated insects and birds, has doubled each year.

For more information:

Nature in the City:
www.natureinthecity.org/

DPW Street Park Program:
www.sfdpw.org/index.aspx?page=1237

SFRPD Natural Areas Program:
<http://sfrecpark.org/parks-open-spaces/natural-areas-program/>
ecpark.org/parks-open-spaces/natural-areas-program/



Community members planting a habitat garden for the Green Hairstreak, an endangered butterfly that lives in San Francisco.

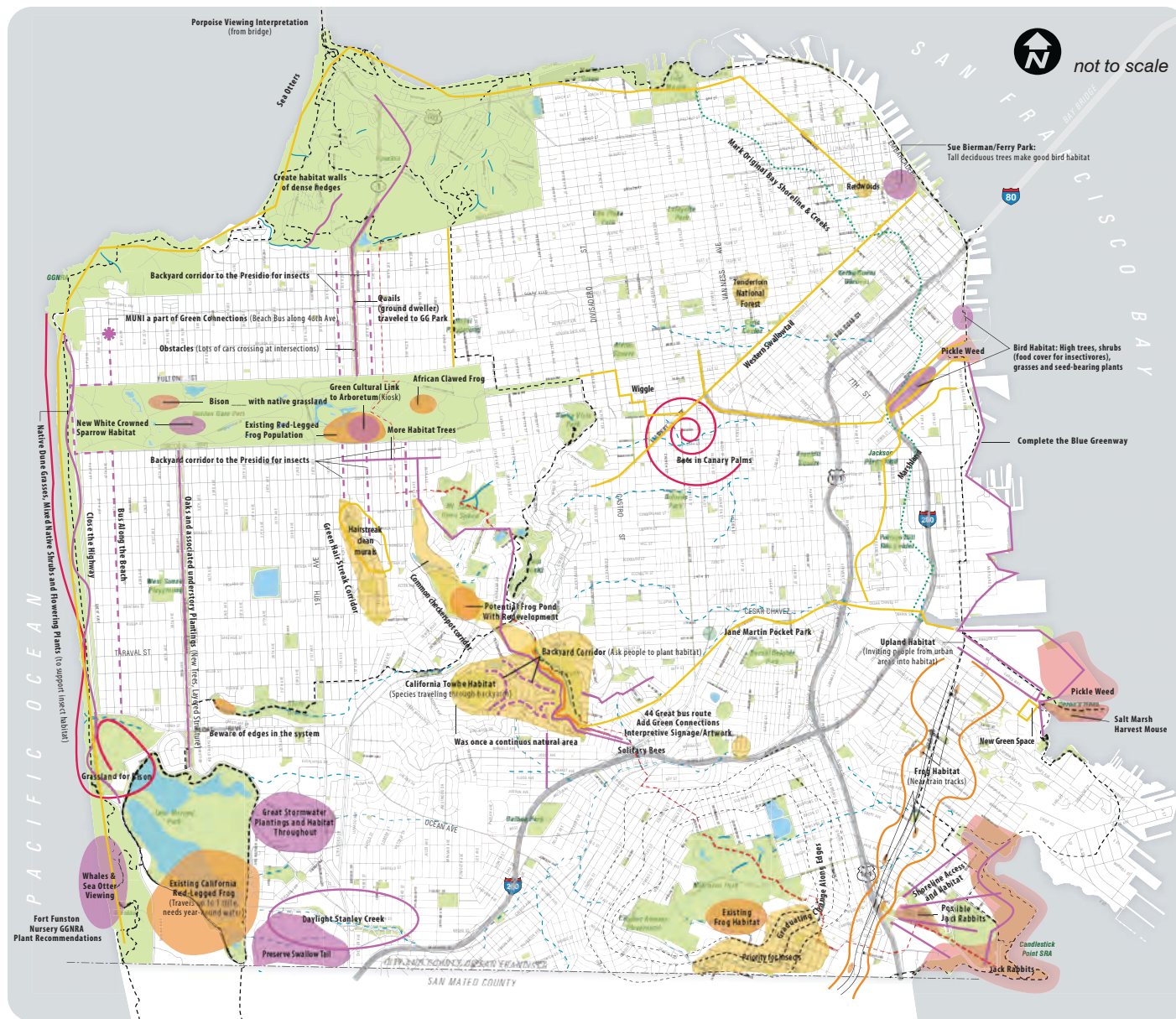
Photo: Nature in the City

Ecology Think Tanks

In Spring of 2012, Green Connections partnered with Nature in the City (a local nonprofit organization) to facilitate three Ecology Think Tanks – a series of brainstorming sessions focused on reimagining how the City’s public right-of-ways could be functional wildlife habitat. The meetings focused on bird species, insect species, reptiles, amphibians and mammals. Attendees included local naturalists, ecology experts, environmental artists and city officials. These conversations resulted in two documents: a map showing opportunities for improving wildlife habitat in the City, and a document outlining goals, principles, and strategies for achieving the project’s habitat goals. Many of the guidelines and principles articulated in this chapter were developed through this collaborative process.

Ecology Thinktank Summary

-
- | | | | |
|--|--------------------|--|---|
| | Bird Path | | Cultural/Other Path |
| | Backyard Bird Path | | Cultural/Other Patch |
| | Bird Patch | | Current Creeks |
| | Herptile Path | | Historic Creeks |
| | Herptile Patch | | Existing and Planned Trails |
| | Insect Path | | Conceptual Cross-town Trail Connections |
| | Insect Patch | | Water |
| | Mammal Path | | Parks and Open Space |
| | Mammal Patch | | |



Green Connections should layer different species and scales of plants, such as trees, shrubs, perennials and ground covers. Stones, fallen leaves and sticks are also important habitat components. For example, fallen logs and branches are home to many native insect species (decomposers) which in turn act as food sources for larger animals like birds, lizards and frogs.

Generally, good design for habitat includes appropriate planting for food, breeding, habitation and protection of target species. Well-designed habitat patches within the public right-of-way, like curb extensions and sidewalk gardens, can provide quality habitat for smaller animals like birds and insects. For larger animals, creating habitats along Green Connections that meet all of these functions may not be feasible due to spatial constraints.



Principle: Consider habitat patch scale and density. Habitat patches are discrete areas that are home to wildlife. The scale and spacing of

habitat patches can vary considerably depending on the species. Patches are found through the city ranging from very small like a landscaped curb extension, to very large, like the Twin Peaks Natural Area and Golden Gate Park. Large habitat patches house San Francisco's most species-rich and healthy ecosystems. Green Connections segments

adjacent to these sites present promising opportunities for habitat expansion, if equipped with functional, well-designed habitat.

Larger species like coyotes and hawks require big patches like urban parks that provide enough habitat function for them to survive. Smaller species like butterflies thrive in smaller patches. Well-designed sidewalk gardens can provide adequate space for them to feed, breed and hide from predators. The Green Connections target species were selected based on compatibility with the size patch that could be achieved on a streetscape.

Patch density is another important consideration when designing habitats along Green Connections corridors. Where possible, habitat patches should be placed sequentially to create habitat corridors along Green Connections. While small patches may provide limited habitat function for some animals, they can act as stepping-stones, providing refuge spaces for animals traveling between larger patches like Golden Gate Park and the Presidio. Larger animals and birds can generally traverse larger patches spaced further apart, whereas smaller animals like insects require smaller habitat patches, spaced closer together. Understanding a target species' lifecycle will inform patch scale and spacing.



Principle: Avoid habitat sinks.

Habitat sinks are places where degraded habitat causes species loss, gradually reducing an estab-

lished wildlife population. Fast-moving traffic on a city street can be a habitat sink for raccoons, and exposure to pesticides in people's gardens is a sink for local insects. Similarly, some places in the public right-of-way make for poor habitat locations. For example, insect habitats designed for native butterflies and bees are better along the outer edges of a street away from vehicular traffic. Though well intended, butterfly gardens and bee hotels placed on a center-median on a street with fast-moving traffic may expose the target species to high mortality rates.

Local constraints such as microclimate, spatial limitations and vehicular movements can all contribute to species loss, so habitat may not be appropriate for all segments of the network.

PRINCIPLES FOR MANAGING STORMWATER



Principle: Where feasible include green infrastructure to manage stormwater. In addition to managing stormwater and reducing

strain on the city's aging sewer system, green infrastructure (ecological features that retain and treat stormwater) can provide traffic calming, increase wildlife habitat, and beautify the streetscape. Common types of green infrastructure used in streetscape design include rain gardens (also known as *bioretention planters*), permeable pavement and bioswales.



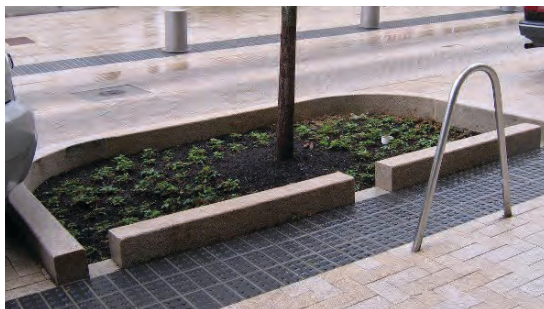
Principle: Increase planted areas in the right-of-way. Many green infrastructure tools such as rain gardens and swales include landscaped areas that can add significant amounts of greenery to the right-of-way. Other tools like permeable pavement are effective at managing stormwater runoff, but don't result in increased planted areas. Where possible, Green Connections should prioritize green infrastructure tools that add greenery to the street over hardscape strategies like permeable pavement.

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Principle: Design for site hydrology. Stormwater facilities should be sited to maximize the volume of water diverted from the

City's sewer system. On typical San Francisco streets, landscaped medians and islands may provide aesthetic and habitat value, but are ineffective tools for capturing stormwater. Most streets in San Francisco drain to the curbs, with water flowing from the center of the street to the outside edges along the gutter line. Bioretention facilities should be sited along the gutter line downslope from the high point in the center of the street.



Rain Gardens



Rain Gardens

Bioretention facilities sited on the downslope corner of a block will capture more stormwater than those sited on uphill corners, because the catchment area is larger and spans the entire block length. Thoughtful placement of raised crosswalks running parallel to Green Connections features, in conjunction with downslope bioretention facilities can potentially increase a bioretention facility's catchment area by extending it uphill to an adjacent block. Under this scenario, the raised crosswalk could also improve pedestrian safety and calm traffic.



Biophilic Cities

Biophilia – a love of life and the natural world – is an evolutionary biology concept gaining prominence within urban planning and design professions. The term, credited to Edward O. Wilson, refers to an idea that human brains are hardwired to need daily contact with nature for individual health and productivity, and by extension, the public health of the larger community as a whole. An expanding body of academic research supports the restorative power of contact with nature. The biophilic city movement encourages urbanism that integrates nature into the design of the built environment.

At its heart, a biophilic city is a biodiverse city. It is a city full of nature, where in the normal course of work, play and daily life residents feel, see, and experience plants, animals and trees. The intent of biophilic design is to integrate ecosystem functions into the urban environment by restoring existing natural areas, parks and open spaces, and by extending them into built spaces like streets and buildings.

San Francisco is a member city of the Biophilic Cities Peer Network. Green Connections is one of many projects currently underway in cities around the world that seeks to advance biophilic city planning and design.

To learn more about biophilic cities visit
<http://biophiliccities.org/>

Reducing Stormwater Runoff in San Francisco

In San Francisco, paved surfaces such as buildings, streets, and parking lots cover most of the city, preventing rainwater from infiltrating into the ground. Instead of slowly filtering into soil, stormwater runoff now travels quickly over these paved areas, picking up pollutants like oil, bacteria, and debris before it flows to the city's combined or separate sewer systems. Streets make up approximately 25% of the city's land area, contributing significantly to these stormwater flows.

Most of San Francisco is served by a *combined sewer system* that moves wastewater and stormwater in the same set of sewer pipes. Typically, this combined effluent is sent to a treatment plant before being discharged into the Bay or Ocean. However, during heavy rain storms, the large influx of water can exceed the capacity of the city's treatment plants. During these storms, our sewer system treats the combined effluent to the equivalent of primary treatment standards before discharging it to the bay or ocean. This is called a *combined sewer discharge*. Reducing these discharge events is one of San Francisco's goals.

During heavy rainfall, the sudden influx of stormwater can also cause flooding in low lying areas of the city like historic creek beds. In *combined sewer* areas, one of the city's stormwater management goals is to decrease the **quantity** of runoff traveling to our combined sewer system.

Some areas of San Francisco have *separate storm sewer systems*. In these areas, stormwater and sewage travel in separate sets of pipes. In areas served by separate storm sewer systems, street runoff generally flows untreated directly to the Bay or Ocean. In these areas, one of the city's stormwater management goals is to improve the **quality** of stormwater runoff before it reaches the bay or ocean.

Green infrastructure requires a greater level of technical engineering and design expertise than simple greening strategies like sidewalk landscaping. Different soil conditions, slope, distance to groundwater, and other factors are all critical design considerations when determining the feasibility of green infrastructure on a given site. The City is creating programs, policies, and design specifications to improve stormwater

management practices and encourage green infrastructure, such as:

San Francisco's Green Infrastructure Program: The San Francisco Public Utilities Commission (SFPUC) is the agency charged with managing the City's sewer system. The SFPUC has undertaken several recent initiatives to encourage and facilitate the use of green infrastructure in San Francisco.

The San Francisco Stormwater Management Ordinance: Stormwater Design Guidelines were enacted in 2010 and require new and redevelopment projects that disturb 5,000 square feet or more to manage a percentage of their stormwater on site. Green infrastructure is one of the recommended strategies to achieve the requirements of the Stormwater Management Ordinance.

www.sfwater.org/sdg/

The Sewer System Improvement Program (SSIP): The SSIP is a 20-year, multi-billion dollar capital program to upgrade the City's aging sewer infrastructure and ensure a reliable and seismically safe system. SSIP projects

will include both green infrastructure (rain gardens, permeable pavement, etc.) and grey infrastructure (pipes, pump stations, and treatment plant upgrades). Where Green Connections routes overlap with high priority areas for stormwater management, they may be eligible for green infrastructure funding through SSIP's program.

www.sfwater.org/ssip/

The San Francisco Green Infrastructure Typical Plans, Details and Specifications Project. The SFPUC is developing typical details and specifications for green stormwater infrastructure installed within the City, which are for use by public and private sector design teams to support the development of approved construction-level designs. These typical details and design specifications will be available for use in Green Connections projects.

To learn more about green infrastructure and stormwater management tools, see:

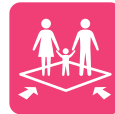
www.sfbetterstreets.org/find-project-types/greening-and-stormwater-management/stormwater-overview

<http://www.sfwater.org/index.aspx?page=433>

4.4 DESIGN PRINCIPLES FOR LIVABILITY



Principle: Engage communities in design and stewardship. Local stakeholders including residents, merchants, neighborhood associations and similar organizations, can bring unique perspectives on needs and opportunities in their neighborhood, and should be included early on in the design and programming process. These stakeholders can also play a critical role in supporting implementation, maintenance and stewardship of Green Connections routes.



Principle: Design for community gathering spaces. Community gathering spaces are intended to facilitate interaction among neighbors.

Gathering spaces can be as small as a seating nook, or larger and more complex, such as a block that can be temporary closed to accommodate farmers markets or street parties. Other examples of design elements that encourage people to gather and play include:

- » Public gardens
- » Event spaces (e.g. street designed to accommodate block parties or farmers markets)
- » Seating nooks
- » Children's play elements, such as slides and skate dots

The Design Toolkit includes several traffic calming elements that can also function as community gathering spaces, such as Partial Diverters, Play Streets and Block-end Plazas.





Principle: Program spaces to encourage stewardship and placemaking.

Placemaking elements such as art, gathering spaces and signage along a Green Connection route can create unique, special and memorable places

and can help foster neighborhood pride and stewardship. Placemaking elements should also support the project goals of connecting to parks, enhancing ecological function and making streets comfortable for people of all abilities to walk and bike.

Elements can take many forms and should reflect the aspirations, diversity and creativity of communities. See *Placemaking Elements* below for creative design features that could be implemented on Green Connections.



Principle: Create wayfinding and signage. Signage along Green Connections routes will improve the network's legibility for users and facilitate mobility throughout the City. See the following page for more information on what a comprehensive signage program should include.

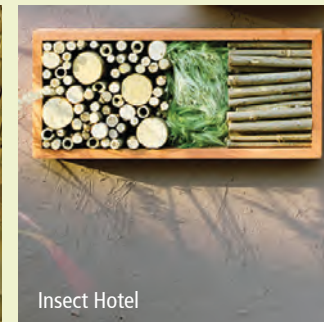
Signage and wayfinding can also tell a story about the history or culture of a place; or it can enhance ecoliteracy, educating the public about urban ecology, stormwater management, target species, and natural history. Important points of the City's natural history and geography can be good locations for informational signs, like ridgelines, watershed boundaries, historic shorelines, buried creeks, former Ohlone settlements, or other community-identified places. In addition to signage, the Green Connections network should integrate "wayfinding markers" that provide physical cues in the landscape.

Placemaking Elements

Design elements are encouraged that explore or reveal the City's rich ecological heritage; provide support for a route's target species; engage users in play or recreation; and encourage neighborhood interaction and community building. For example, ecologically-themed artwork like bird and insect hotels also function as wildlife habitat; custom street furniture like benches and bike racks can make a street more inviting for pedestrians and bicyclists; informational signage and murals can depict the history of an important local open space.

Potential works of art may include:

- » Bird and bat boxes, bee hotels, nesting and perching sculptures, Insect hotel
- » Clean up murals
- » Community chalk board
- » Custom design details (e.g. custom tile work, paving treatments or similar features)
- » Street murals



Considerations in developing a wayfinding and signage program



The Better Streets Plan (www.sfbetterstreets.org) contains comprehensive guidelines for designing neighborhood-oriented and interpretive signage in the City. In addition to the design principles articulated in this chapter, Green Connections

wayfinding and signage elements should comply with the guidelines in the Better Streets Plan. For more information, visit: <http://www.sfbetterstreets.org/find-project-types/streetscape-elements/street-furniture-overview/signage/>

A Green Connections signage program should consider the following:

Strive for simplicity. Signage along the Green Connections network should be simple and legible. The Green Connections wayfinding system should be iconic and contain information relevant to system users. Signage should be sited to integrate with the streetscape design without cluttering the street. Signage information could include:

- » Green Connections icon
- » Route name and target species/habitat icon

- » Walking and biking travel times, and/or distances to parks
- » Walking and biking travel times and/or distances to local neighborhood-serving destinations

Integrate with other wayfinding systems.

Many Green Connections routes overlap with the city's cycling and trail networks, which have their own branded wayfinding systems. As much as possible, Green Connections should complement and integrate signage for overlapping active transportation systems.

Scale signage for active transportation users.

Signage should be targeted to people walking, bicycling, and using other active modes, and should consider rate of travel, location and legibility.

Develop a multi-tiered approach. Several levels of informational hierarchy should be addressed within the Green Connections wayfinding system. Some elements of the wayfinding system should be universal throughout the network, whereas others may be customized to take advantage of site-specific opportunities or important cultural, historic or ecological landmarks.

System-wide information: Green Connections signage should use consistent typography, color

pallets, iconography and materiality throughout the system.

Route-based information: Signs should include the route name, route icon, target species/habitat and endpoints along the route.

Local context: Local contextual information may include directional signage pointing to landmarks of civic importance (such as schools, libraries, and commercial districts). It may also include educational signage that teaches the public about natural history and culture. Educational signage may also include information about ecological design interventions along the route such as information about a habitat garden and the species it serves, or stormwater management strategies.

Express wayfinding through materiality.

Wayfinding along the Green Connections network should also include physical cues in the landscape, or *wayfinding markers*. Some examples of potential wayfinding markers include:

- » Street paint stencils with icons of target species
- » Stone markers at watershed boundaries
- » Special paving to denote historic creeks
- » Sculptural elements at the intersections of two Green Connections routes