Appendix E

Urban-Wildland Interface Design Guidelines

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Background

The purpose of the HCP/NCCP is to protect and enhance ecological diversity within the rapidly urbanizing region of eastern Contra Costa County. Development of a comprehensive Preserve System, designed and managed to protect and contribute to the recovery of covered species, is central to the Plan's Conservation Strategy.

Because the Plan is necessitated by the increasing development and urbanization of eastern Contra Costa County, some of the preserves will be bordered by land use types that are unsuitable for covered species; these include single-family homes with back or side yards, residential streets, and parking lots. The adjacency of such areas to planned future preserves poses potential hazards to the protection and recovery of covered species. These urban land uses could result in damaging effects on covered species and habitats, including trampling, mountain bicycle use, and off-road vehicle use; runoff from adjacent streets and landscaped areas containing lawn fertilizer, pesticides, and vehicle waste (petroleum byproducts); introduction of invasive species (e.g., pampas grass, French broom, Argentine ants, giant reed); light and noise from nearby development; unregulated movement of domestic animals; and movement of covered species into developed areas.

The Conservation Strategy includes measures to create buffer zones between incompatible land uses and the Preserve System. However, creation of such buffer zones may not always be possible if habitats with high biological value occur adjacent to or existing development. Furthermore, the width of the buffer zone can be reduced (saving the Plan money) if the indirect effects of adjacent development are reduced through good design practices.

The urban-wildland interface is defined as the narrow zone (<100 feet) between urban development and natural land cover in which structures can be built to minimize the damaging indirect effects on covered species or habitats of activities within urban areas. To minimize the damaging indirect effects of urban development, the urban-wildland interface should be carefully designed and managed. While it is not practicable to retrofit existing urban and developed areas that border planned preserves, it is possible to incorporate features into the design of proposed projects to mitigate the potential risks mentioned above.

Conceptual Approach

The final location and configuration of the Preserve System is unknown; it is, therefore, not possible to prescribe site-specific design features for interface areas. Rather, a set of guidelines should inform the design process as individual preserves are established and individual development projects implemented.

Covered wildlife species of particular interest in developing the guidelines for urban-wildland interface design are San Joaquin kit fox, western burrowing owl, Alameda whipsnake, California red-legged frog, and California tiger salamander. Amphibians and reptiles can disperse from preserve areas into surrounding developed areas, where they can fall prey to domestic animals; human-habituated wildlife species (e.g., raccoons, opossums) that thrive in urban and residential areas; and motor vehicles. Additionally, domestic and wild predators can forage into adjacent preserves, where they can inflict severe damage on populations of covered species. Domestic dogs and cats can cause physical harm and behavioral stress to native birds, amphibians, and mammals including California red-legged frog, California tiger salamander, and San Joaquin kit fox; moreover, lighting and noise from adjacent development can adversely affect many native species.

Beyond minimizing such direct and immediate impacts, the design of the urban-wildland interface should consider indirect and long-term effects, such as runoff from developed areas[1] that can transport harmful substances (e.g., pesticides, automotive fluids, sediment) into preserves; establishment of invasive nonnative species that can disperse from nearby landscaped areas; and structural and biological damage (e.g., soil compaction, creation of unauthorized trails, disturbance of sensitive species) that can result from unmanaged human access and use.

The interface design should address the following key questions, which are based on those proposed by Kelly and Rotenberry (1993) for urban reserves in California.

1. What external forces or processes may have a negative impact on covered species and habitats at or near the preserve boundary? (What vectors are present?)
2. To what extent are those external forces likely to penetrate the boundary and result in negative impacts on covered species and habitats? (How permeable is the boundary?)
3. Which covered species are likely to exit the preserve and expose themselves to increased risk of injury or death?
4. What structures can be built or programs implemented to prevent or mitigate these impacts? For example, how can boundary permeability be altered?

[1] In general, development in the inventory area will occur downslope from HCP/NCCP preserves, so runoff should flow away from preserves. However, because construction grading often alters local drainage patterns, some runoff could flow into preserves if precautions are not taken.

With these questions in mind, site-specific interface design elements should serve the functions listed below; it should be noted that not all the listed objectives will be appropriate for all interface areas. The wildland-urban interface should be designed to accomplish the following functions.

- Control or restrict pet and human access (e.g., fencing, signage).
- Reduce the chance of covered amphibians, reptiles, and mammals entering urban/residential areas.
- Reduce attractions for pets and attractions for urban-tolerant wildlife species within the preserve (e.g., cat feeding stations, open trash containers that attract opossums or racoons).
- Divert urban runoff from preserve boundaries.
- Allow limited and controlled recreational use in appropriate locations and restrict existing uncontrolled recreational uses (e.g., hiking, mountain biking, off-highway vehicle use, dog walking) that currently take place in sensitive habitats.
- Serve as a firebreak.
- Act as a buffer zone to reduce risk of incursion by nonnative species used in urban landscaping.
- Minimize disturbance (e.g., noise, glare) from adjacent land to covered wildlife species.
- Provide areas for public education and interpretation of the preserves' natural resources in order to generate local support for the HCP/NCCP and the Preserve System.
- Provide an aesthetically appealing visual transition between development and the preserves.

Specific Design Elements

Fencing

A fundamental objective of the urban-wildlife interface design should be reduction of the unwarranted exchange of biota between the preserve and adjacent developed areas. The creation of a physical barrier between these two habitats is the most basic element of achieving this objective.

Fencing should be designed to exclude undesired species from entering the preserve and covered species from leaving the preserve. The design and installation of the optimum fencing are intimately connected with the design of proposed developments. For example, in theory, it might appear that *front-loading* residential lots—that is, positioning dwelling units and infrastructure nearest the street, while leaving the rear portion of the lots undeveloped with a

sound, approved fence separating the development from the preserve—might be the most desirable design solution. While this approach reduces some of the risks of roadways immediately adjacent to the preserve and can reduce development-related disturbances (e.g., lighting, noise), it is dependent on long-term owner compliance with and maintenance of prescribed design features (e.g., drainage patterns, species selected for landscaping, upkeep of appropriate fencing design and materials). Such individual landowner decisions may be difficult or impossible to monitor and enforce.

On the other hand, placement of minor roads (e.g., internal subdivision roads) immediately outside preserve boundaries allows the Implementing Entity to retain management authority of perimeter areas. Fences can be properly monitored and maintained; landscaping can be monitored to ensure that appropriate species are used; drainage infrastructure can be monitored and maintained to ensure that it is performing according to desired specifications. Such placement of minor roads also simplifies communication in the event of problems. Fencing, landscaping, and other structures along public roads are more clearly the responsibility of a homeowner association or public agency than of individuals (as in the case of backyard fences). Therefore, if remedial measures are needed to repair damaged or ineffective structures, the Implementing Entity has a single point of contact rather than multiple homeowners. If perimeter fencing is properly designed and installed, and if the roadways placed along these perimeters are designed such that they are not likely to convey heavy traffic, vehicle-related mortality should be minimized. Moreover, any wildlife species (e.g., amphibians, reptiles) moving from preserve areas into development areas are at high risk, whether the area entered is a roadway or a residential yard.

Fences should accomplish all the goals described above. Designs elements that should be considered and combined in a single fence are listed below.

- A solid or fine-mesh fence several feet high to exclude amphibians (not all individuals will be excluded, but 100% success is likely not feasible[2]).
- A low, solid masonry fence buried in the ground (e.g., 1 foot deep) to discourage burrowing rodents (e.g., California ground squirrels) from digging tunnels beneath it and allowing amphibians to circumvent the barrier.
- Use of a slick surface on the preserve-side of the fence to discourage amphibians from climbing the wall.
- A fence that is tall enough (e.g., > 5 feet tall) to discourage pets from entering the preserve and San Joaquin kit fox from exiting the preserve.
- A fence that allows people to see into the preserve, encouraging a sense of ownership and stewardship.

[2] It should be noted that regulatory agencies generally discourage the use of amphibian exclusion fencing for temporary construction sites because they may create more hazards than they prevent. However, for permanent hazards in dense urban development, amphibian exclusion fencing may be effective at reducing injury or mortality.

Lighting

Lighting is an important urban "pollutant" into adjacent open space. Longcore and Rich (2004) define "ecological light pollution" to include chronic or periodically increased illumination, unexpected changes in illumination, and direct glare, all from artificial sources. Species react differently to ecological light pollution depending on the distance from the source and the type of lighting; many of these ecological effects are well documented (Longcore and Rich 2004). Effects range from disorientation, attraction to artificial lighting, entrapment in or near lighting, repulsion from artificial lighting, altered reproduction, altered communication, and altered interactions with competitors or predators.

The amount of light pollution must be minimized adjacent to preserves. Lighting requirements should be incorporated into the Homeowner Association regulations using the following guidelines.

- Outdoor lighting should be low-intensity, focused, and directional to reduce night illumination of the adjacent preserve.
- Outdoor lighting should be placed as far from the preserve boundary as possible given safety constraints.
- Housings of outdoor lights should be sealed to prevent insects from becoming trapped inside.
- Public facilities such as ballparks and fields that require high-intensity night lighting (i.e., flood lights) should be sited as far from the preserve boundary as possible. High-intensity lighting facing the preserve should be as low to the ground as possible to minimize long-distance glare.

Trails

Recreational trails can be a useful feature incorporated into the urban-wildland interface. A recreational trail along an urban boundary provides public access to open space while minimizing the adverse effects of this access on sensitive biological resources that might occur nearby. Recreational trails can easily be combined with other interface elements such as wildlife-exclusion fencing, drainage controls, and firebreaks. Interpretive signs placed along recreational trails can inform the public about the adjacent preserve and create a sense of ownership and stewardship among local residents. These residents can then serve as informal patrols for the Implementing Entity to help ensure that resources within the preserves are protected.

Paved trails may be preferable to gravel or dirt trails because paved trails require less long-term maintenance than unsurfaced trails. Paved trails also reduce the amount of runoff or erosion that occurs as a result of the trail itself. However, paved trails attract basking reptiles, increasing their risk of injury or death from bicycles or pedestrians. Trails through particularly sensitive areas can be

designed to minimize impacts through the use of boardwalks, bridges, or raised platforms.

Buffering vegetation can be effectively used adjacent to trails to serve as a physical and visual barrier between the trail and the preserve. For example, native drought-tolerant and fire-resistant shrubs could be planted between a trail and a low barrier fence to discourage entry into sensitive areas of the preserve. Noninvasive ornamental shrubs could also be used if necessary (Jones & Stokes 2001).

Development Guidelines

While the physical boundaries of individual preserves can be designed, monitored, and maintained by the Implementing Entity, some features of the wildland-urban interface are necessarily dependent upon the design specifications of development projects. The design approach described above would allow roadways and adjacent rights-of-way (or other public spaces that may be incorporated into project designs) to be utilized as buffer zones to help reduce incursion of nonnative plant species into preserve areas, to serve as firebreaks, and to manage runoff from urban areas that might adversely affect sensitive habitats within the preserves.

Accordingly, it is recommended that the HCP/NCCP include terms requiring that project proponents incorporate design specifications to ensure that the portions of developed areas adjoining preserves contribute to Plan objectives. Such requirements could include those listed below.

- Landscaping with native species or with nonnative species that are unlikely to colonize preserve areas. Lists of approved landscaping species to plant, and invasive species not to plant, could be developed through consultation with the California Exotic Pest Plant Council, the California Department of Agriculture, the County Agricultural Commission, and the California Native Plant Society. In addition, a list could be developed for pest control methods that are recommended and not recommended for use.
- Design of areas adjoining preserve boundaries to meet fuel modification requirements. Such an approach would obviate the necessity to implement fuel modification activities, which can have adverse effects on covered species and habitats, within the preserve.
- Specifications prescribing that grading plans, drainage infrastructure, and roadway construction ensure that urban runoff be directed away from preserve boundaries or, in the event that topography renders such an approach infeasible, that appropriate filtration provisions are incorporated into project designs.