

preserves' western boundaries have been permitted by the City of Santa Rosa and are now partially constructed. This new road and construction has partially blocked the western migration route between breeding pools at the Air Center and the pools at the FEMA and Broadmore North preserves. Planned future phases of this project, also permitted by the City of Santa Rosa, will totally block migration between the FEMA/Broadmore North Preserves and the Air Center.

(3) *Engel Preserve*: This is a 16-ha (40-ac) privately owned preserve that contains approximately 7 ha (18 ac) of wetlands. Three pools appear to have ponding levels adequate for salamander breeding in normal to dry rainfall years. Sonoma County California tiger salamanders were not documented at this site prior to the 2001/2002 rainy season. Based on the small number of larvae found at this site, however, it is likely that there are low numbers of salamanders inhabiting this site. Todd Road runs along the southern boundary of this site and automobile traffic poses a threat to salamanders migrating between the Engel Preserve and estivation sites to the south.

(4) *Northwest Air Center*: This breeding site contains one breeding pond and is located on private land. Much of the associated upland has recently been developed. This site is bordered on the west and north by roads subject to heavy traffic from housing developments that have been constructed under the City of Santa Rosa's Southwest Area Development Plan. Housing has eliminated migration routes to the east and south, thus leaving this site as an isolated breeding site with less than 22 ha (55 ac) of remaining undeveloped upland area and pool with private lands surrounding it to the south and east (M. Enright, pers. comm., 2001).

(5) *Southwest Air Center*: This breeding site is located on private land and contains one breeding pool. The City of Santa Rosa has issued permits for a residential development that likely will result in the elimination of salamanders at this location. Preparation of this site for construction was initiated, but further development has been delayed as a result of the emergency listing of this species. The salamanders at this location also may utilize the breeding ponds at the FEMA/Broadmore North preserves by an existing migration corridor to the east. The destruction of this breeding site likely will further isolate the animals inhabiting this location. Loss of this breeding site will contribute to the

overall isolation of the remaining breeding sites.

(6) *North Air Center*: There is one breeding pool on this privately owned site. Recent residential and commercial developments that border the breeding site on three sides severely restrict the potential for migration. The City of Santa Rosa has approved residential and road projects for this location that will adversely affect the salamanders. This site is bordered by houses to the west, a road with high levels of automobile traffic to the north, and a corporate park to the east. There is a small tract of undeveloped private land to the south. No protection exists for the uplands or breeding pool which is located directly south of Sebastopol Road. The upland area is about 15 ha (37 ac). Portions of Sebastopol Road have been widened to four traffic lanes, including the construction of storm drains and curbs. The curbs likely funnel migrating salamanders into storm drains where they perish after being washed into the sewer system. Residential and commercial projects currently are under construction in this area. The City of Santa Rosa has issued permits for the development of this site, and the Corps has requested formal consultation from us for the fill of this breeding site. Development plans will also result in the loss of estivation habitat. Preparation of this site for construction was initiated, but further development has been delayed as a result of the emergency listing of this species.

(7) *Wright Avenue*: This breeding site is located on private land. Approved development described in the City of Santa Rosa's Southwest Area Development Plan will isolate this breeding site through increased automobile traffic and residential development along Wright and Ludwig Avenues. No construction is specifically proposed for this property, but no protection exists to prevent the breeding site and associated uplands from being developed. This site is on agricultural lands, and access has not been allowed for several years. Thus, the condition, or even the continued existence of this pool, cannot be confirmed.

(8) *South Ludwig Avenue*: This breeding site is located on private land, and current threats to the salamanders include increased traffic along Ludwig Avenue due to increasing residential development. The breeding site and associated uplands are currently not protected from potential development. This site is on agricultural lands, and access has not been allowed for several years. Thus, the condition, or even the continued existence of this pool cannot be confirmed.

#### Conclusion for Factor A

Except for the Hall Road Preserve, all of the known breeding sites of the Sonoma County California tiger salamander are found on small locations in areas being rapidly converted from low-intensity farming, cattle grazing, and low-density housing, to high-density housing and office buildings. Only three breeding sites (the Hall Road Preserve, FEMA/Broadmore North Preserve, and Engel Preserve) have hydrologic regimes adequate to provide recruitment for Sonoma County California tiger salamanders in normal to dry years. Five of the breeding sites are on private property. Two of the breeding sites on private lands are on agricultural lands where access for salamander surveys has not been allowed in recent years. Thus, it is unknown if these two breeding sites still have Sonoma County California tiger salamanders, or if they retain hydrological features required for successful salamander breeding. Four of the breeding locations associated with the old airfield in southwest Santa Rosa are slated for development, which will disrupt the hydrology of the surrounding uplands by altering natural runoff. If plans for the development of the area in the vicinity of these four breeding sites are completed, there will be no migratory corridors remaining between any of the currently extant breeding locales.

Maintenance of tracts of habitat between breeding sites will likely play a pivotal role in maintenance of the Sonoma County California tiger salamander metapopulation dynamics. If breeding sites are eliminated and the metapopulation becomes so fragmented that individuals are unable to disperse between suitable patches of habitat, the probability of natural recolonization will not offset the probability of extinction. Some of the salamander breeding sites, such as the FEMA Preserve/ Broadmore North Preserve and the pools associated with the Air Center, are linked to each other by suitable habitat. If movements through these linkages are disrupted or precluded (e.g., by urban development), then the stability of the metapopulation (i.e., the exchange of individuals between breeding sites) will be affected. Isolation, whether by geographic distance or ecological factors, will prevent the influx of new genetic material, and likely to result in inbreeding and eventual extinction (Levin 2002). We believe that the Sonoma County California tiger salamander is at risk from increasing