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Mono County
Community Development Department

P.O. Box 347
Mammoth Lakes, CA 93546
(760) 924-1800, fax 924-1801
commdev@mono.ca.gov

Planning Division

P.O. Box 8
Bridgeport, CA 93517
(760) 932-5420, fax 932-5431
www.monocounty.ca.gov

APPEAL
APPLICATION

In order to be valid, appeal must be filed within 10 days of action date for Parcel Maps or Tract Maps, or 15 days for all other appeals.

APPLICATION # _____ FEE $ 495—
DATE RECEIVED 10.19.12 RECEIVED BY CD
RECEIPT # 16323 CHECK # 2308 (NO CASH)

APPELLANT Laborers Int'l Union of North America, Local 783 (c/o Richard Drury,C. Caro

ADDRESS 410 12th Street, Suite 250 CITY/STATE/ZIP Oakland, CA 94607

TELEPHONE (510) 836-4200 E-MAIL richard@lozeaudrury.com

APPLICATION # BEING APPEALED CUP12-004;V12-002;R12-001

DATE OF ACTION October 11, 2012 **DATE OF APPEAL** October 19, 2012

NATURE OF APPEAL: Describe what is being appealed. If it is a condition of approval, attach a copy of the project conditions and indicate which conditions are being appealed.

Appellants appeal the Notice of Decision and 10/11/2012 approvals by the Planning Comm'n of Mammoth Pacific I Replacement Project,including inter alia,Use Permit 12-004, Var.12-002, Reclamation Plan 12-001, CEQA approvals (FEIR, CEQA findings), Gen. Plan Amendment.

REASON FOR APPEAL: Describe why the decision is being appealed.

Appellants appeal the 10/11/2012 Planning Commission approvals and Notice of Decision for all of the reasons identified in their comment letter of October 11, 2012, attached hereto, and for reasons raised by commenters on the Project CEQA documents, incorporated by reference.

APPLICATION SHALL INCLUDE:

A. Completed application form.
B. Deposit for project processing: See Development Fee Schedule.

I CERTIFY UNDER PENALTY OF PERJURY THAT I am: ☐ legal owner(s) of the subject property, ☐ corporate officer(s) empowered to sign for the corporation or authorized legal agent, or ☒ other interested party.

Christina M. Caro
Signature

Signature

10/19/2012
Date

LOZEAU DRURY LLP
T 510.836.4200
F 510.836.4205
410 12th Street, Suite 250
Oakland, Ca 94607
www.lozeaudrury.com
richard@lozeaudrury.com

BY ELECTRONIC MAIL AND US MAIL

October 19, 2012

ATTN: Scott, Burns
Community Development Director
County of Mono
437 Old Mammoth Road, Suite P
Mammoth Lakes CA 93546

Cc Via Email only: Dan Lyster, dlyster@mono.ca.gov

RE: Appeal of Planning Commission Notice of Decision and Approvals Related to Mammoth Pacific I Replacement Project (State Clearinghouse No: 2011022020), Final Environmental Impact Report for the Mammoth Pacific I ("MP-I") Replacement Project (State Clearinghouse No: 2011022020); Clarifying General Plan Amendment 12-003(b); Condition Use Permit 12-004; Variance 12-002 & Reclamation Plan 12-001; Special Meeting Agenda Items 5 and 6

Dear Community Development Director Mr. Burns:

Pursuant to Mono County local procedures and the Mono County General Plan Land Use Element, CHAPTER 47 – APPEALS, Section 47.020 Procedures & fees, Appellants Laborers International Union of North America, Local 783, and its members living in Mono County ("Appellants") hereby appeal the October 11, 2012 Planning Commission approvals and Notice of Decision of Mammoth Pacific I Replacement Project, including inter alia, Use Permit 12-004, Variance 12-002, Reclamation Plan 12-001, and related CEQA approvals, including certification of the Final Environmental Impact Report ("FEIR"), related CEQA findings, and General Plan Amendment / Clarification 12-003(b) ("Project").

Enclosed herewith are the following:

- Mono County Appeal Application
- Appeal fee of $495.00

- Appellants' October 11, 2012 comment letter to the County regarding the Project.

Please send notices of any appeal hearing and documentation by electronic mail and U.S. Mail to:

Richard Drury
Christina Caro
Lozeau Drury LLP
410 12th Street, Suite 250
Oakland, CA 94607
richard@lozeaudrury.com; christina@lozeaudrury.com

Please call should you have any questions. Thank you for your attention to this matter.

Sincerely,

Richard T. Drury
Christina M. Caro
Counsel for LIUNA Local 783 and Mono County members

EXHIBIT 1

LOZEAU DRURY LLP
T 510.836.4200
F 510.836.4205
410 12th Street, Suite 250
Oakland, Ca 94607
www.lozeaudrury.com
richard@lozeaudrury.com

October 11, 2012

Via Electronic Mail and Hand Delivery

Mr. Steve Shipley, Chair
and Honorable Members of the
Mono County Planning Commission
C.D. Ritter, Commission Secretary
County of Mono
Mono County Planning Commission
P.O. Box 347
Mammoth Lakes, CA 93546
Email: cdritter@mono.ca.gov (Planning Commission Secretary)

Mono County Economic
Development Dept.
ATTN: Dan Lyster, Planner
Courtney Weiche, Associate
Planner
PO Box 2415
Mammoth Lakes, CA 93546
Email: dlyster@mono.ca.gov;
cweiche@monocounty.ca.gov

With Hand Delivery to Planning Commission Meeting:
Town/County Conference Room
Minaret Village Mall
437 Old Mammoth Road
Mammoth Lakes, CA 93546

Re: Comment re: Final Environmental Impact Report for the Mammoth Pacific I ("MP-I") Replacement Project (State Clearinghouse No: 2011022020); Clarifying General Plan Amendment 12-003(b); Condition Use Permit 12-004; Variance 12-002 & Reclamation Plan 12-001; Special Meeting Agenda Items 5 and 6.

Honorable Chair Shipley and Members of the Planning Commission, Mr. Villa:

This letter is submitted on behalf of Laborers International Union of North America, Local Union 783, and its members living in Mono County (collectively "LIUNA" or "Commenters") regarding the Final Environmental Impact for the Mammoth Pacific I (MP-1) Replacement Project (State Clearinghouse No: 2011022020), Clarifying General Plan Amendment 12-003(b), Conditional Use Permit ("CUP") 12-004, Variance 12-002 & Reclamation Plan 12-001, Special Meeting Agenda Items 5 and 6 (collectively "Project" or "Mammoth Project").

As discussed herein, after reviewing the Final Environmental Impact Report ("FEIR") for the Project together with our expert consultants, it is evident that the document fails to resolve significant deficiencies raised in prior comment letters on the Draft Environmental Impact Report ("DEIR"), Revised DEIR ("RDEIR") and Second Revised DEIR ("RDEIR2"), that lead agency Mono County ("County") failed to comply

with the California Environmental Quality Act, Public Resources Code § 21000 et seq. ("CEQA"), and with State Land Use and Planning laws, in all aspects of the Project, and the FEIR contains errors and omissions that continue to preclude accurate analysis of the Project.

As a result of these inadequacies, the FEIR fails as an informational document, fails to analyze all significant impacts of the Project, fails to identify and impose feasible mitigation measures to reduce the Project's impacts, and fails to properly analyze Project alternatives and cumulative impacts.[1] The Project and its proposed General Plan amendments also render it fatally inconsistent with the County's General Plan. As a result, the Project will result in significant environmental impacts on the Mammoth Lakes area, including its animal and plant populations, air quality, water quality, and aesthetic impacts, among other impacts. LIUNA Local 783 therefore requests that the County prepare and circulate a Supplemental Draft Environmental Impact Report ("SEIR") to address the issues raised in this and other comments, and to require implementation of feasible mitigations and alternatives required by law.

In particular, the Project will have the following adverse impacts that remain inadequately mitigated:

General Plan Inconsistency:

- The Project is inconsistent with the Mono County General Plan ("General Plan") in that it requires the County to amend the Mono County General Plan to authorize the Applicant to develop geothermal facilities within 500 feet of a watercourse within the Hot Creek Buffer Area. To remedy this inconsistency, the RDEIR2 proposed a General Plan amendment to allow geothermal development in areas that were previously prohibited in the County. The amendment is both facially inconsistent with the Plan's Conservation and Open Space Element, which requires the County to minimize impacts of geothermal energy production on water resources in the Casa Diablo area, and opens the door for new geothermal projects to develop facilities within this previously protected, sensitive habitat.

Inaccurate Project Description:

- The Project description in the FEIR is inaccurate and legally insufficient in that it:
    - Fails to describe the Project in light of the newly proposed General Plan Amendments identified for the first time in the RDEIR2.
    - The Project, as described, would violate its own proposed mitigation measures for impacts to biological resources, rendering either the Project description, or its mitigation measures, inaccurate and facially inconsistent with each other.

[1] We reserve the right to supplement these comments at any later hearings and proceedings related to this Project. *See Galante Vineyards v. Monterey Water Dist.* (1997) 60 Cal. App. 4th 1109.

Inadequate Cumulative Impacts Analysis:

- The FEIR fails to adequately analyze cumulative impacts resulting from planned construction of the Casa Diablo IV geothermal power plant and facilities, wells, and pipelines, currently undergoing joint NEPA and CEQA review by the U.S Bureau of Land Management ("BLM") and the Great Basin Air Pollution and Control District ("GBAPCD"), including but not limited to:
    - **Hydrology**: The FEIR fails to adequately analyze cumulative impacts on the geothermal aquifer and nearby surface waterways.
    - **Seismic Activity**: Enhanced geothermal systems can trigger earthquakes as part of hydraulic fracturing. The FEIR fails entirely to analyze the cumulative impacts of Project-generated seismic activity, combined with that of the proposed Casa Grande IV facility on nearby communities and existing structures.
    - **Biological Resources**: The FEIR fails to adequately analyze cumulative impacts on fisheries dependent on Hot Creek.

Impacts on Biological Resources:

- The FEIR fails to adequately assess impacts to biological resources, including mule deer and other mammals, native plants, and fish species, including some special status species.

- The FEIR fails to disclose potentially significant impacts on species from loss of foraging from the Project's conversion of forest acreage, including in particular mule deer.

- The FEIR fails to provide a complete and valid assessment of impacts to wildlife movement corridors and habitat fragmentation.

- The FEIR fails to provide adequate information on sensitive wildlife species likely to be impacted by the Project, and fails to establish regional and ecological context for sensitive species that will be affected by the Project including, but not limited to, possible impacts on the nearby Owens tui chub.

- The FEIR fails to analyze or provide any mitigations for cumulative impacts to biological and natural resources.

- The FEIR improperly defers mitigation, and provides insufficient mitigation monitoring, of various impacts to species, including mule deer.

- The FEIR provides inadequate baseline data on migration of mule deer.

Air Quality:

- Project construction will have significant air quality impacts from excess emissions of nitrogen oxides produced during combustion (NOx) that the County has failed to properly analyze and mitigate due to reliance on inappropriately high significant thresholds borrowed from Imperial County.

- The FEIR fails to analyze diesel particulate matter ("DPM") emissions from Project construction.

- The FEIR relies on a legally improper baseline for operational emissions, given the new location of the proposed M-1 plant and the simultaneous operations of both the MP-1 and M-1 plants for up to 2 years during the M-I startup period.

Expert Comments

These comments are supported by the expert comments of expert Wildlife Ecologist Luke Macauley, M.S.

Mr. Macauley is an expert wildlife biologist and ecologist who has expertise in the areas of rare and special status plants, animal density and distribution, habitat selection, habitat restoration, interactions between wildlife and human infrastructure and activities, conservation of rare and endangered species, and on the ecology of invading species, and other species impacts relevant to this Project. His comments and curriculum vitae are attached hereto as Exhibit A and are incorporated by reference in their entirety. These expert comments are incorporated herein in full.

LIUNA Local 783 recognizes that the development of reliable renewable energy sources is critical for California's future. LIUNA supports the development of clean, renewable energy technology, including the use of geothermal power generation where feasible. All geothermal and related mineral extraction extraction projects must be properly analyzed and carefully planned to minimize impacts on the environment. Geothermal and mineral extraction projects should avoid impacts to sensitive species and habitats, and should take all feasible steps to ensure that the production of renewable energy is not done at the expense of the State's natural resources, and dependent species. Only by maintaining the highest standards in these and other ways can energy supply development be truly sustainable. Unfortunately, the Project falls short in these and other ways. As a consequence, a Subsequent or Supplemental Draft Environmental Impact Report ("SEIR") is required to analyze the Project impacts discussed above, including impacts raised by other commenters and not adequately addressed by the County, and to propose feasible mitigation measures to bring the Project in compliance with applicable laws.

Citation to FEIR Documents

The Final EIR consists of the DEIR, RDEIR, and RDEIR2, as well as all comments received on the DEIR, RDEIR, and RDEIR2, the County's Responses to

Comments, and all Appendices Exhibits thereto. These documents and their content constitute the FEIR on the proposed Project. Citations herein may refer to "DEIR" pages, "RDEIR pages", "RDEIR2" pages, or "FEIR" pages. All references are intended as citations to the Final EIR.

I. BACKGROUND

a. Mammoth Pacific I Geothermal Facility.

The existing Mammoth Pacific Unit I ("MP–I") project is a commercial geothermal development project operated by Mammoth Pacific L.P. ("MPLP") and located near Casa Diablo Hot Springs in Mono County, California. (FEIR at p. 1) The MP-I plant was the first geothermal power plant to be built at the Mammoth Pacific Complex, commencing operation in 1984 under a Condition Use Permit ("CUP") issued by Mono County. The MP-2 geothermal plant was established in 1990 under a separate Mono County CUP. (RDEIR App. L (Reclamation Plan), p. 1) The existing MP–I project consists of a binary power plant with a design capacity of about 14 megawatts ("MW"), a geothermal wellfield, production and injection fluid pipelines, and ancillary facilities that have been operating since 1984. The existing MP–I power plant site is located approximately 1,200 feet northeast of the intersection of U.S. Highway 395 and California State Route 203 on 90 acres of private (fee) land owned by Ormat Nevada, Inc. ("Ormat"), the parent company of MPLP. (FEIR at p. 1)

b. The M-I Replacement Project.

The Project proposes to replace the existing MP-I plant with a more modern M-I generation plant. The M-I replacement plant site would be located entirely on private land about 500 feet northeast of the existing MP-I power generation facilities and immediately adjacent to the existing MP-II power plant. The Project would replace the existing MP-I power generation facilities. (FEIR at p. 1) The Project was proposed by Project applicant Mammoth Pacific L.P., under the ownership of Ormat Nevada Inc., a wholly owned subsidiary of Ormat Technologies, Inc. ("MPLP"). According to the FEIR, the purpose of the Project is to replace the aging MP–I power plant with a new, more modern and efficient binary power plant while maintaining the existing geothermal wellfield, pipeline system and ancillary facilities. The proposed M–1 replacement power plant would be capable of generating, on average, approximately 18.8 MW (net) of electricity. The FEIR states that the Project would result in no net change in the rate of geothermal fluid produced and supplying the existing Casa Diablo geothermal development complex, and no substantive change to the geothermal reservoir is anticipated. (FEIR at p. 4) A pipeline will connect the replacement plant with the existing wells, and a new 12.47 KV substation / switching station will be constructed to connect the new power plant to the existing transmission line.

The Project is located approximately 2 miles west of the town of Mammoth Lakes, approximately 4 miles from the Mammoth Mountain ski resort area, and approximately 1.25 miles to the east of Mono County's office buildings. (RDEIR at p. 4-40) The project footprint will result in the grading of 5.7 acres of land, which contains 3.5

acres that is dominated by Antelope bitterbrush, an important browse species for mule deer. (RDEIR at pp. 2-1, 4-66)

During M–1 plant startup operations, the existing MP–I plant would continue to operate until the new M–1 plant becomes commercial, after which time MPLP would close and dismantle the old MP-I plant. The old MP-I plant site would be converted to an equipment storage area as part of the decommissioning process. The transition period during which both the MP–I and M–1 operations would overlap would be a period of up to two years from the date the M–1 plant begins startup operations. (FEIR at p. 4)

The M-1 plant is anticipated to operate until 2045, at which time it will be decommissioned, and both the M-I and MP-I sites, as well as the MP-2 site, will be reclaimed. Included in the reclamation will be the geothermal well sites which support the M-I, MP-I and MP-2 plants. These wells will also remain in operation until approximately 2045. (RDEIR App. L at p. 1) If the geothermal resource remains available beyond 2045, the Project's Reclamation Plan will need to be revised. (*Id.*)

The following approvals are required from Mono County for the Project:

- A Conditional Use Permit for the M-1 replacement plant (including the granting of a height exception for mechanical appurtenances) and decommissioning/reuse of the existing MP-I plant site as a storage area;
- A Variance for setback reductions from property line(s); setback reductions from streams designated by a blue line on USGS topographic maps for structures within the 5.7-acre proposed M-1 plant site; and for grading of the existing MP-I plant site for use as an equipment storage area;
- A Variance to construct an aboveground electrical transmission line;
- Clarifying General Plan Amendments;
- Grading Permit;
- Building Permits; and
- A Reclamation Plan. (RDEIR2 at p. 29)

II. STANDING

Members of LIUNA Local 783 live, work, and recreate in the immediate vicinity of the proposed Project site. These members will suffer the impacts of a poorly executed or inadequately mitigated Project, just as would the members of any nearby homeowners association, community group, or environmental group. Members of LIUNA Local 783 live and work in areas that will be affected by geothermal and mineral exploration and water source reduction, air pollution, and impacts on plant and wildlife species generated by the Project. In addition, construction workers in particular will suffer many of the most significant impacts from the Project as currently proposed, such as close proximity exposure to construction-related air pollution. Therefore, LIUNA Local 783 and its members have a direct interest in ensuring that the Project is adequately analyzed and that its environmental and public health impacts are mitigated to the fullest extent feasible.

III. LEGAL STANDARD

A. CEQA.

CEQA requires that an agency analyze the potential environmental impacts of its proposed actions in an environmental impact report ("EIR") (except in certain limited circumstances). (*See, e.g.*, Pub. Res. Code § 21100.) The EIR is the very heart of CEQA. (*Dunn-Edwards v. BAAQMD* (1992) 9 Cal.App.4th 644, 652.) "The 'foremost principle' in interpreting CEQA is that the Legislature intended the act to be read so as to afford the fullest possible protection to the environment within the reasonable scope of the statutory language." (*Communities for a Better Environment v. Calif. Resources Agency* (2002) 103 Cal. App. 4th 98, 109.)

CEQA has two primary purposes. First, CEQA is designed to inform decision makers and the public about the potential, significant environmental effects of a project. (14 Cal. Code Regs. ("CEQA Guidelines") § 15002(a)(1).) "Its purpose is to inform the public and its responsible officials of the environmental consequences of their decisions before they are made. Thus, the EIR 'protects not only the environment but also informed self-government.'" (*Citizens of Goleta Valley v. Board of Supervisors* (1990) 52 Cal. 3d 553, 564) The EIR has been described as "an environmental 'alarm bell' whose purpose it is to alert the public and its responsible officials to environmental changes before they have reached ecological points of no return." (*Berkeley Keep Jets Over the Bay v. Bd. of Port Comm'rs.* (2001) 91 Cal. App. 4th 1344, 1354 ("Berkeley Jets"); *County of Inyo v. Yorty* (1973) 32 Cal.App.3d 795, 810)

Second, CEQA requires public agencies to avoid or reduce environmental damage when "feasible" by requiring "environmentally superior" alternatives and all feasible mitigation measures. (CEQA Guidelines § 15002(a)(2) and (3); See also, *Berkeley Jets*, 91 Cal. App. 4th 1344, 1354; *Citizens of Goleta Valley v. Board of Supervisors* (1990) 52 Cal.3d 553, 564) The EIR serves to provide agencies and the public with information about the environmental impacts of a proposed project and to "identify ways that environmental damage can be avoided or significantly reduced." (Guidelines §15002(a)(2)) If the project will have a significant effect on the environment, the agency may approve the project only if it finds that it has "eliminated or substantially lessened all significant effects on the environment where feasible" and that any unavoidable significant effects on the environment are "acceptable due to overriding concerns." (Pub.Res.Code § 21081; 14 Cal.Code Regs. § 15092(b)(2)(A) & (B))

While the courts review an EIR using an "abuse of discretion" standard, "the reviewing court is not to 'uncritically rely on every study or analysis presented by a project proponent in support of its position. A 'clearly inadequate or unsupported study is entitled to no judicial deference.'" (*Berkeley Jets*, 91 Cal. App. 4th 1344, 1355 (emphasis added), quoting, *Laurel Heights Improvement Assn. v. Regents of University of California*, 47 Cal. 3d 376, 391 409, fn. 12 (1988)) As the court stated in *Berkeley Jets*, 91 Cal. App. 4th at 1355:

> A prejudicial abuse of discretion occurs "if the failure to include relevant information precludes informed decisionmaking and informed public participation,

thereby thwarting the statutory goals of the EIR process." (*San Joaquin Raptor/Wildlife Rescue Center v. County of Stanislaus* (1994) 27 Cal. App. 4th 713, 722]; *Galante Vineyards v. Monterey Peninsula Water Management Dist.* (1997) 60 Cal. App. 4th 1109, 1117; *County of Amador v. El Dorado County Water Agency* (1999) 76 Cal. App. 4th 931, 946)

B. General Plan Consistency.

State law requires each county to adopt a long-term general plan governing development in all unincorporated areas. (Gov. Code §65300; *Napa Citizens for Honest Gov't*, 91 Cal. App. 4th at 352) The general plan sits at the top of the land use planning hierarchy (*DeVita v. County of Napa* (1995) 9 Cal.4th 763, 773), and serves as a "constitution" or "charter" for all future development. (*Lesher Commc'ns v. Walnut Creek* (1990) 52 Cal.3d 531, 540) General plan consistency is "the linchpin of California's land use and development laws; it is the principle which infused the concept of planned growth with the force of law." (*deBottari v. Norco City Council* (1985) 171 Cal. App. 3d 1204, 1213)

State law mandates two levels of consistency. First, a general plan must be internally or "horizontally" consistent: its elements must "comprise an integrated, internally consistent and compatible statement of policies for the adopting agency." (Gov. Code § 65300.5; *Sierra Club v. Bd. of Supervisors* (1981) 126 Cal. App. 3d 698, 704) A general plan amendment thus may not be internally inconsistent, nor may it cause the general plan as a whole to become internally inconsistent. (*DeVita*, 9 Cal. 4th at 796, n. 12) Second, state law requires "vertical" consistency, meaning that zoning ordinances must be consistent with the general plan. (See § 65860(a)(2); *Neighborhood Action Group v. Calaveras* (1984) 156 Cal. App. 3d 1176, 1184) Consistency is found when "[t]he various land uses authorized by the ordinance are compatible with the objectives, policies, general land uses, and programs specified in the [general] plan." (*Id.* at (a)(2))

A project cannot be found consistent with a general plan if it conflicts with a general plan policy that is "fundamental, mandatory, and clear," regardless of whether it is consistent with other general plan policies. (*Endangered Habitats League v. County of Orange* (2005) 131 Cal. App. 4th 777, 782-83; *Families Unafraid to Uphold Rural El Dorado County v. Bd. of Supervisors* (1998) 62 Cal. App. 4th 1332, 1341-42) Any subordinate land use action that is not consistent with a city's current general plan is "invalid at the time it is passed." (*Lesher*, 52 Cal. 3d at 544) Findings that a zoning ordinance is consistent with its general plan must be reversed if they are based on evidence from which no reasonable person could have reached the same conclusion. (*A Local & Reg'l Monitor v. Los Angeles* (1993) 16 Cal. App. 4th 630, 648)

IV. DISCUSSION

A. THE PROJECT IS INCONSISTENT WITH THE COUNTY'S GENERAL PLAN, CREATING PER SE SIGNIFICANT IMPACTS UNDER CEQA, AND THE NEWLY PROPOSED CLARIFYING GENERAL PLAN AMENDMENT WOULD RENDER THE GENERAL PLAN INTERNALLY INCONSISTENT.

The Project is inconsistent with the Mono County General Plan ("General Plan") in that it requires the County to amend the Mono County General Plan to authorize the Applicant to develop geothermal facilities within 500 feet of a watercourse within the Hot Creek Buffer Area. To remedy this inconsistency, the RDEIR2 proposed a General Plan amendment to allow geothermal development in areas that were previously prohibited in the County. The amendment is both facially inconsistent with the Plan's Conservation and Open Space Element, which requires the County to minimize impacts of geothermal energy production on water resources in the Casa Diablo area, and opens the door for new geothermal projects to develop facilities within this previously protected, sensitive habitat.

It is well-established that the elements, data, assumptions and projections used in various parts of a general plan must be consistent with one another. (Gov. Code §65300.5; *see Concerned Citizens of Calaveras County*, 166 Cal. App. 3d at 96-97; *Sierra Club*, 126 Cal. App. 3d at 704) Additionally, general plan inconsistencies are, themselves, also potentially significant impacts under CEQA. (*See Pocket Protectors v. City of Sacramento* (2004) 124 Cal. App. 4th 903, 930, 934 (requiring project's conflicts with land use policies adopted to avoid environmental effects to be discussed in an EIR))

Here, General Plan Land Use Element, Development Standards section 15.070(B)(1)(d) expressly prohibits geothermal development within 500 feet of surface waters. It provides in relevant part:

> No geothermal development located within the Hot Creek Buffer Zone shall occur within 500 feet on either side of a surface watercourse (as indicated by a solid or broken blue line on U.S. Geological Survey 7.5- or 15-minute series topographic maps). (General Plan at LU- II-263)

Additionally, Conservation / Open Space Element, Goal 7 provides, in relevant part:

> **GOAL 7:** Minimize the visual and environmental impacts of electrical transmission lines and fluid conveyance pipelines....
> **Objective B**
> Transmission and distribution lines shall not adversely impact wildlife or fisheries.
> Policy 1: New transmission or distribution lines shall avoid open expanses of water and wetland, particularly those heavily used by birds. They shall also avoid nesting and rearing areas.
> Policy 2: Avoid the placement of transmission or distribution lines through crucial wildlife habitats, such as deer fawning and migration areas. (See Conservation/Open Space Element at V-47 to V-49)

Nevertheless, the Project proposes two variances to exempt it from critical elements of the General Plan's Land Use Element and Conservation/Open Space Element:

> □ A Variance for setback reductions from property line(s); setback reductions from streams designated by a blue line on USGS topographic maps for structures within the 5.7-acre proposed M-1 plant site; and for grading of the existing MP-I plant site for use as an equipment storage area;
> □ A Variance to construct an aboveground electrical transmission line. (RDEIR2 at p. 29)

The FEIR incorrectly concludes that the Project is consistent with the General Plan under its proposed Clarifying General Plan Amendment. The RDEIR2 proposed a General Plan Amendment to relieve the Project from the General Plan 500-foot setback requirement contained in Land Use Element Section 15.070(B)(1)(d) that will amend the Conservation/Open Space Element to authorize development of geothermal facilities within 500 feet of a watercourse within the Hot Creek Buffer Zone, as follows:

> **Conservation and Open Space Element**
> **Energy Resources, Objective D, Policy 1**
> Action 1.13: ~~No geothermal development located within the Hot Creek Buffer Zone shall occur~~ Adoption of land development regulations for geothermal development within 500 feet on either side of a surface watercourse (as indicated by a solid or broken blue line on U.S. Geological Survey 7.5- or 15-minute series topographic maps) within the Hot Creek Buffer Zone (See Mono County Land Development Regulations, Chapter 15, section 15.070(B)(1)(d).)
>
> (RDEIR2 at p. 34)

The amendment was included for the first time in the RDEIR2, in subsection 4.10 of the document, and was not included in the Project description in either the RDEIR2 or the FEIR's updated Project Location or Project Summary. (RDEIR2 at pp. 33-34; FEIR at pp. 1-4) On its face, the proposed amendment would render Section 15.070(B)(1)(d) of the General Plan facially inconsistent with Objective D, Policy 1 of the Conservation / Open Space Element, which provides in relevant pat:

> Policy 1: Geothermal exploration and development projects shall be sited, carried out and maintained by the permit holder in a manner that best protects hydrologic resources and water quality and quantity.
>
> (See Conservation/Open Space Element at V-41)

If approved, the Clarifying General Plan Amendment will render these General Plan provisions internally inconsistent with one another. The County would be exceeding its authority if it were to issue permits or variances related to the Project as described in the FEIR, based on the proposed amendment or otherwise, because the Project is inconsistent with the County's General Plan, particularly its Land Use and Conservation/ Open Space Elements. (*See Neighborhood Action Group v. County of*

Calaveras (1984) 156 Cal.App.3d 1176, 1184) In *Neighborhood Action Group*, the Court of Appeal held that "a use permit is struck from the mold of the zoning law....the zoning law must comply with the adopted general plan...[and] the adopted general plan must comply with state law." (*Id.* at 1184) The general plan delimits the authority of the permit-issuing agency; thus, where an agency issues a permit that is inconsistent with the general plan, it exceeds its legal authority and the permit is invalid. (*Id.*)

B. THE PROJECT DESCRIPTION IN THE FEIR IS INACCURATE AND IMCOMPLETE.

"An accurate, stable and finite project description is the sine qua non of an informative and legally adequate EIR." (*County of Inyo v. City of Los Angeles* (1977) 71 Cal.App.3d 185, 192; *Berkeley Jets*, 91 Cal. App. 4th 1344, 1354; *Sacramento Old City Assn. v. City Council* (1991) 229 Cal. App. 3d 1011, 1023; *Stanislaus Natural Heritage Project v. County of Stanislaus* (1996) 48 Cal. App. 4th 182, 201) "[A] curtailed or distorted project description," on the other hand, "may stultify the objectives of the reporting process. Only through an accurate view of the project may affected outsiders and public decision-makers balance the proposal's benefit against its environmental costs, consider mitigation measures, assess the advantage of terminating the proposal (i.e., the "no project" alternative) and weigh other alternatives in the balance." (*Id.;* see also, 14 CCR § 15124) As one analyst has noted:

> The adequacy of an EIR's project description is closely linked to the adequacy of the EIR's analysis of the project's environmental effects. If the description is inadequate because it fails to discuss the complete project, the environmental analysis will probably reflect the same mistake. (Kostka and Zischke, "Practice Under the California Environmental Quality Act," p. 474 (8/99 update); *see also Santiago County Water Dist. v. County of Orange* (1981) 188 Cal. App. 3d 818, 829)

A "rigorous analysis" is required to dispose of an impact as insignificant. (*Kings County Farm Bureau v. City of Hanford* (1990) 221 Cal.App.3d 692) Such a rigorous analysis is not possible is not possible if the project description is inaccurate, inconsistent, or misleading.

The Project description in the FEIR fails to comply with CEQA' s requirements because (1) the FEIR fails to describe the Project and its impacts in light of the newly proposed General Plan Amendments identified for the first time in the RDEIR2; and (2) the Project, as described, would violate its own proposed mitigation measures for impacts to biological resources, rendering either the Project description, or its mitigation measures, inaccurate and facially inconsistent with each other.

1. **The Proposed General Plan Amendment to Relieve the Project from the General Plan's 500-Foot Surface Water Setback Requirement Was Not Included in the Project Description, and Its Impacts Have Not Been Analyzed.**

The RDEIR2 proposed a General Plan Amendment to relieve the Project from the General Plan 500-foot setback requirement contained in Land Use Element Section 15.070(B)(1)(d), discussed in Section IV.A above, by amending the Conservation/Open Space Element to authorize development of geothermal facilities within 500 feet of a watercourse within the Hot Creek Buffer Zone, as follows:

> **Conservation and Open Space Element**
> **Energy Resources, Objective D, Policy 1**
> Action 1.13: ~~No geothermal development located within the Hot Creek Buffer Zone shall occur~~ Adoption of land development regulations for geothermal development within 500 feet on either side of a surface watercourse (as indicated by a solid or broken blue line on U.S. Geological Survey 7.5- or 15-minute series topographic maps) within the Hot Creek Buffer Zone (See Mono County Land Development Regulations, Chapter 15, section 15.070(B)(1)(d).)

(RDEIR2 at p. 34)

The amendment was included for the first time in the RDEIR2, in subsection 4.10 of the document, and was not included in the Project description in either the RDEIR2 or the FEIR's updated Project Location or Project Summary. (RDEIR2 at pp. 33-34; FEIR at pp. 1-4) The FEIR fails to adequately respond to this issue, raised in prior Comment Letter 12. Including a significant land use change in a subsection of the RDEIR2, and not amending the overall Project Description to both describe the Project revision and evaluate its environmental impacts, fails to satisfy CEQA's requirement to describe all aspects of the Project which may result in potentially significant environmental impacts. (14 CCR § 15124) As a result of the surface water setback reduction, the Project may result in significant surface water impacts within the Hot Creek Buffer Zone that have not been properly disclosed or analyzed in the EIR. (*See County of Inyo v. City of Los Angeles* (1981) 124 Cal. App. 3d 1, 7 (revised EIR that fails to describe or analyze surface water impacts is legally insufficient as a CEQA document))

2. **The Project Description Is Inaccurate Because It is Facially Inconsistent With Bio Protection Measure 7.**

The Project, as described in the FEIR, will install approximately 2000 feet of linear barriers in the area between the existing MP-I plant site and the replacement M-1 plant site. Specifically, the project will construct 500 feet of interconnection injection fluid pipeline and about 1,500 feet of interconnection transmission line. (FEIR, p. 4-65)

This component of the Project is directly inconsistent with Bio Protection Measure 7, which calls for no additional linear barriers to be constructed:

> "The Project shall not erect any linear barriers to movement of deer or other wildlife in the area between the existing MP-I plant site and the replacement M-1 plant site. During M-1 plant site construction, no temporary fencing or pipeline racks shall be erected in this same area during the normal periods of mule deer migration, from April 1st to May 30th or from September 15th through November 15th." (FEIR, p.4-73)

As discussed by expert Macauley, "the pipelines that would be constructed appear to be permanent, and would violate this mitigation measure. While the Applicant notes that wildlife could move both over and beneath the interconnection pipeline and transmission line conduit, it is nonetheless an additional linear barrier that clearly violates the Applicant's own proposed mitigation measures." (Exh. A at p. 8)

CEQA requires that an EIR's project description must provide "enough information to ascertain the project's environmentally significant effects, assess ways of mitigating them, and consider project alternatives." (Sierra Club v. County of Orange (2008) 163 Cal. App. 4th 523) The Mammoth Project description does exactly the opposite here. The inconsistency between the Project's described transmission lines and its required Bio Measure 7 create a presumption of a per se significant impact that was not properly disclosed or analyzed in the EIR.

The Project description must be amended, and the FEIR revised and recirculated, to correct these deficiencies.

C. THE FEIR'S CUMULATIVE IMPACTS ANALYSIS IS INADEQUATE.

The Mammoth Project is one of several existing and planned geothermal projects within the Casa Grande geothermal complex and the Great Basin Valleys Air Basin, which air basin encompasses Mono, Inyo and Alpine counties. (RDEIR at p. 4-37, 4-378) The RDEIR fails to include an adequate analysis of the Project's cumulative impacts on hydrology, seismicity, and biological resources, among other issues, as together with the existing MP-I, MP-II, PLES-I, and Basalt Canyon Pipeline facilities, and, in particular, the proposed 33 MW Casa Diablo IV Project, including its proposed wellfield expansion of up to 14 additional wells. (See Exhibit B, Casa Grande IC BLM Project webpage)

An EIR must discuss significant cumulative impacts. (CEQA Guidelines § 15130(a)) This requirement flows from CEQA section 21083, which requires a finding that a project may have a significant effect on the environment if "the possible effects of a project are individually limited but cumulatively considerable. . . . 'Cumulatively considerable' means that the incremental effects of an individual project are considerable when viewed in connection with the effects of past projects, the effects of other current projects, and the effects of probable future projects." (*See also* 14 Cal. Code Regs. § 15130(a))"Cumulative impacts" are defined as "two or more individual effects which, when considered together, are considerable or which compound or increase other environmental impacts." (*Id.* § 15355(a)) "[I]ndividual effects may be changes resulting from a single project or a number of separate projects." (*Id.*) Incremental contributions must be assessed "when viewed in connection with the effects of past projects, the

effects of other current projects, and the effects of probably foreseeable projects." (14 Cal. Code Regs. § 15065(a)(3))

"The cumulative impact from several projects is the change in the environment which results from the incremental impact of the project when added to other closely related past, present, and reasonably foreseeable probable future projects. Cumulative impacts can result from individually minor but collectively significant projects taking place over a period of time." (*Communities for a Better Environment v. Cal. Resources Agency ("CBE v. CRA")*, (2002) 103 Cal.App.4th 98, 117) A legally adequate cumulative impacts analysis views a particular project over time and in conjunction with other related past, present, and reasonably foreseeable probable future projects whose impacts might compound or interrelate with those of the project at hand. "Cumulative impacts can result from individually minor but collectively significant projects taking place over a period of time." (CEQA Guidelines § 15355(b))

As the court recently stated in *CBE v. CRA*, 103 Cal. App. 4th at 114:

> Cumulative impact analysis is necessary because the full environmental impact of a proposed project cannot be gauged in a vacuum. One of the most important environmental lessons that has been learned is that environmental damage often occurs incrementally from a variety of small sources. **These sources appear insignificant when considered individually, but assume threatening dimensions when considered collectively with other sources with which they interact.**

(Citations omitted)

In particular, the FEIR fails to adequately analyze cumulative impacts resulting from planned construction of the Casa Diablo IV geothermal power plant and facilities, wells, and pipelines, currently undergoing joint NEPA and CEQA review by the U.S Bureau of Land Management ("BLM") and the Great Basin Air Pollution and Control District ("GBAPCD"). The Casa Diablo IV Project, proposed by Mammoth Project Applicant MPLP, is to be located in the immediate vicinity of the existing MPLP geothermal projects, near the intersection of California State Route 203 and U.S. Highway 395, approximately 3 miles east of Mammoth Lakes, California, and may construct up to 14 additional geothermal wells. (Exhibit B; RDEIR p. S-17)

1. Hydrology.

The FEIR fails to adequately analyze cumulative impacts on the geothermal aquifer and nearby surface waterways, and the FEIR failed to adequately respond to comments on this issue.

Commenter 9C on the RDEIR stated:

> The RDEIR fails to adequately evaluate cumulative impacts that could result from the operation of the plant in conjunction with other future projects. Because cumulative impacts were not properly evaluated, they are unmitigated.

> The proposed CD-4 facility includes the drilling of up to 14 new production wells over the life of the plant (RDEIR, p. S-17). The RDEIR includes a map (Fig. 40) that shows a total of three existing production wells. Therefore, addition of CD-4 to the Casa Diablo geothermal complex will increase, by more than four times, the number of production wells in the wellfield. With the addition of the 33 MW CD-4 facility, the expansion of the well field is matched by an equally substantial increase in power generation at the Casa Diablo geothermal complex. Section S, Cumulative Effects, provides no analysis of the combined effects of MP-I, MP-II, and PLES-1 and CD-4 on the geothermal aquifer and the discharge to Hot Creek Headsprings. No analysis is provided to determine if the operation of the wells for M-1 along with the operation of the 16 proposed CD-4 wells will potentially deplete the thermal qualities of the geothermal aquifer and alter the discharge from the Hot Creek Headsprings.

(Comment Letter 9C at pp. 1-2) The FEIR fails to properly respond to these comments, and fail to provide for recirculation of the FEIR to analyze all significant impacts and to identify and impose feasible mitigation measures to reduce the Project's impacts.

2. Seismic Activity.

Enhanced geothermal systems can trigger earthquakes as part of hydraulic fracturing, as demonstrated by recent analysis of similar geothermal projects in Imperial County. (See Exhibit C, 9/11/2012 Hudson Geothermal Imperial County comments of SWAPE at pp. 5-6)

As described in the Hudson comment:

> Induced seismicity has been documented in association with number of operating geothermal fields in the United States and globally. The Geysers and the Coso geothermal fields in California have a well-known association of geothermal production and induced seismicity, producing thousands of earthquakes annually. Most are small and are not perceived by humans, but some earthquakes of up to magnitude 4 have been documented. (http://esd.lbl.gov/research/projects/induced_seismicity/egs/history.html). Communities near geothermal fields have expressed concerned about damage from single seismic events and cumulative effects. Concerns include the potential for structural damage and that small events may trigger larger events. (http://esd.lbl.gov/research/projects/induced_seismicity/egs/local_outreach.html) (Id. at p. 5)

The FEIR fails entirely to analyze the cumulative impacts of current Project-generated seismic activity, combined with that of the proposed Casa Grande IV facility on nearby communities and existing structures. This inadequacy must be addressed in a revised and recirculated EIR.

3. Biological Resources.

As discussed in Comment Letter 9C at pp. 1-2, and by wildlife expert Mr. Macauley, the FEIR fails to adequately analyze cumulative impacts on fisheries dependent on Hot Creek, as well as cumulative impacts on mule deer.

Mr. Macauley states:

> The Applicant characterizes the 5.7 acres of habitat destruction as insignificant due to the relatively small area of development in comparison to expansive public lands in the area which can meet the needs of deer in the area. However, this type of small incremental development that the Applicant describes as "a tiny fraction...of available mule deer habitat in the area," is exactly the kind of development that CEQA seeks to regulate in sections addressing cumulative impacts. The Applicant fails to meet the standard to declare insignificant cumulative impacts, especially given the conservation status of the deer in this area.
>
> The Round Valley deer population has seen "dramatic declines over the last 10 – 20 years"[2] and it is likely that any additional habitat loss, no matter how small, will contribute to cumulative impacts. The Casa Diablo herd is likely to be sensitive to any habitat loss on winter range "because deer are frequently in poor condition at the end of summer before moving onto winter range in the fall; this means that quality winter forage is critical for sustaining population numbers."[3]
>
> Additionally, the CDFG biologist on the project noted that:
>
> "The loss of *deer holding area* and migration corridor acreage is a concern not only for the G-1 Plant replacement site but for the cumulative impacts to deer from the proposed CD-4 Plant and other existing and proposed projects on Round Valley deer herd range."(emphasis added)[4]
>
> Habitat loss is widely considered the primary threat to wildlife across the country.[5] Studies on the Round Valley and Casa Diablo deer populations have also found development to be a primary threat, with recommendations of previous studies explicitly calling for keeping road and building infrastructure to a bare minimum

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[2] Ferranto SP. 2006. Conservation of mule deer in the eastern Sierra Nevada. M.S. Thesis, University of Nevada, Reno, p. 50.

[3] Ferranto SP. 2006. Conservation of mule deer in the eastern Sierra Nevada. M.S. Thesis, University of Nevada, Reno, p. 46.

[4] RDEIR Appendix C, G-1 Plant Replacement Site Visit – Summary, Mammoth Lakes, CA, March 22, 2011.

[5] Wilcove, David S., David Rothstein, Jason Dubow, Ali Phillips and Elizabeth Losos. 1998. Quantifying Threats to Imperiled species in the United States. *BioScience*. 48(8), pp. 607-615.

and avoiding locations with healthy stands of Antelope Bitterbrush as building sites.[6]

Given that development is considered a contributor to the declines in the Round Valley deer population, and given the sensitivity of the Casa Diablo herd to loss of winter habitat, any additional loss of habitat likely would result in further negative incremental impacts to deer herds.

A review of CEQA regulations clarifies that this type of negative impact is exactly what would qualify as cumulatively significant impacts.

"Cumulative impacts" refers to two or more individual effects which, when considered together, are considerable or which *compound or increase other environmental impacts*.... The cumulative impact from several projects is the change in the environment which results from the *incremental impact* of the project when added to other closely related past, present, and reasonably foreseeable probable future projects. Cumulative impacts can result from *individually minor but collectively significant* projects taking place over a period of time. (emphasis added)[7]

CEQA requires discussion of cumulative impacts in either of the following ways, which the Applicant has not performed sufficiently:

(A) A list of past, present, and probable future projects producing related or cumulative impacts, including, if necessary, those projects outside the control of the agency, or

(B) A summary of projections contained in an adopted general plan or related planning document, or in a prior environmental document which has been adopted or certified, which described or evaluated regional or areawide conditions contributing to the cumulative impact. Any such planning document shall be referenced and made available to the public at a location specified by the lead agency.[8]

While the Applicant has provided a brief assessment of current and probable future projects in relation to the current project in their response to comment, they have not discussed how past impacts may have resulted in declines of the Casa Diablo and Round Valley deer herds. While the Applicant correctly notes that CEQA directs that an EIR should not discuss impacts which do not result in part from the project evaluated in the EIR, this is not the case here. This project

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[6] Ferranto SP. 2006. Conservation of mule deer in the eastern Sierra Nevada. M.S. Thesis, University of Nevada, Reno, p 61.

[7] CEQA Section 15355.

[8] CEQA Section 15130.

will cause additional loss of deer habitat, which will contribute to the larger cumulative impacts on these deer herds.

While Cumulative Bio Measure 1 is designed to address cumulative impacts to biological resources, it is lacking in any mitigation for habitat loss due to the construction of the M-1 power plant, and as a result does not reduce the impacts to less than significant.

Mitigation can consist of avoidance or replacement of lost habitat. In this case, appropriate mitigation such as the restoration of 3.7 acres of habitat would qualify as mitigation. As the Applicant has noted the infeasibility of locating the new plant on the old plant site, an ideal site for such restoration would be on the site of the decommissioned power plant after demolition. Under the current plan, the old plant site will be converted to a *fenced* storage yard and as occasional overflow parking.[9] It is unclear whether additional fenced storage yards and overflow parking are essential for the goals of the project, and as such, restoring this area to usable habitat for deer, would do much to mitigate the impacts of habitat removal to less than significant.

While the Applicant determined that "the main use of the existing MP-I Project area by deer is as a movement corridor," this does not negate the fact that important browse, cover, and habitat for deer will be significantly impacted by the construction of the M-1 power plant.

(See Exhibit A at pp. 3-5)

4. Air Quality.

The RDEIR failed to address cumulative air quality impacts of the Project, and the FEIR failed to adequately respond to comments on this issue, or to prepare an update analysis.

In particular, the FEIR fails to consider the Project's air quality impacts in combination with the MP-I, MP-II, PLES-I, Casa Diablo geothermal complex production pipeline networks and geothermal and reinjection well fields, the Basalt Canyon Pipeline, the proposed Casa Diablo IV facility, and the Casa Diablo IV well field expansion project. The RDEIR fails to consider the combined air quality impacts of these existing facilities and projects. In particular, the cumulative impact analysis fails to consider ROG emissions from the MP-I facility, the Casa Diablo geothermal complex production pipeline networks and geothermal and reinjection well fields, and the Basalt Canyon Pipeline. This analytical deficiency renders the analysis invalid for the purpose of CEQA. The County must prepare a revised DEIR which considers the Project's air quality impacts together with past, present, and reasonably foreseeable projects.

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[9] FEIR, p. 1-1.

(see Comment Letter 9D, RDEIR at pp. 5-10) This inadequacy must be addressed in a revised and recirculated EIR.

D. THE FEIR FAILS TO ANALYZE AND MITIGATED ALL POTENTIALLY SIGNIFICANT IMPACTS OF THE PROJECT.

CEQA requires that an agency analyze the potential environmental impacts of its proposed actions in an environmental impact report ("EIR") (except in certain limited circumstances). (*See, e.g.*, Pub. Res. Code § 21100.) The EIR is the very heart of CEQA. (*Dunn-Edwards v. BAAQMD* (1992) 9 Cal.App.4th 644, 652.) "The 'foremost principle' in interpreting CEQA is that the Legislature intended the act to be read so as to afford the fullest possible protection to the environment within the reasonable scope of the statutory language." (*Communities for a Better Environment v. Calif. Resources Agency* (2002) 103 Cal. App. 4th 98, 109.)

CEQA requires public agencies to avoid or reduce environmental damage when "feasible" by requiring "environmentally superior" alternatives and all feasible mitigation measures. (CEQA Guidelines § 15002(a)(2) and (3); See also, *Berkeley Jets*, 91 Cal. App. 4th 1344, 1354; *Citizens of Goleta Valley v. Board of Supervisors* (1990) 52 Cal.3d 553, 564) The EIR serves to provide agencies and the public with information about the environmental impacts of a proposed project and to "identify ways that environmental damage can be avoided or significantly reduced." (Guidelines §15002(a)(2)) If the project will have a significant effect on the environment, the agency may approve the project only if it finds that it has "eliminated or substantially lessened all significant effects on the environment where feasible" and that any unavoidable significant effects on the environment are "acceptable due to overriding concerns." (Pub.Res.Code § 21081; 14 Cal.Code Regs. § 15092(b)(2)(A) & (B))

A prejudicial abuse of discretion occurs "if the failure to include relevant information precludes informed decisionmaking and informed public participation, thereby thwarting the statutory goals of the EIR process." (*San Joaquin Raptor/Wildlife Rescue Center v. County of Stanislaus* (1994) 27 Cal. App. 4th 713, 722]; *Galante Vineyards v. Monterey Peninsula Water Management Dist.* (1997) 60 Cal. App. 4th 1109, 1117; *County of Amador v. El Dorado County Water Agency* (1999) 76 Cal. App. 4th 931, 946)

The comments provided below are supplemental to and in accord with those provided by Mr. Macauley, LIUNA's expert consultant, which comments are attached hereto as Exhibit A.

1. The FEIR Fails to Adequately Analyze Impacts to Biological Resources.

It is the policy of the State of California to

Prevent the elimination of fish or wildlife species due to man's activities, insure that fish and wildlife populations do not drop below self-perpetuating levels, and preserve for future generations representations of all plant and animal communities.

(Pub. Res. Code § 21001(c).) An EIR may not avoid studying impacts to biological resources by proposing future study or mitigation based on future studies unless the mitigation measures and performance standards are explicit in the DEIR. (*San Joaquin Raptor Rescue Center v. County of Merced* (2007) 149 Cal.App.4th 645, 671)

As discussed below, the FEIR fails to assess impacts to wildlife, especially sensitive species and plants. Where impacts are identified, the FEIR impermissibly relies on vague, unenforceable and deferred mitigation measures, most of which lack a foundation in science and performance standards. Consequently, the FEIR must be revised to reassess impacts to biological resources and, where appropriate, propose adequate mitigation measures with definite terms and verifiable performance standards.

Deferral of mitigation measures is prohibited under CEQA:

> By adopting the condition that applicant would comply with environmental standards for sludge disposal, the County effectively removed this aspect of the project from environmental review, trusting that the Regional Water Quality Control Board and the applicant would work out some solution in the future..... Having no "relevant data" pointing to a solution of the sludge disposal problem, the County evaded its duty to engage in a comprehensive environmental review by approving the use permit subject to a condition requiring future regulatory compliance. *Sundstrom*, 202 Cal.App.3d at 309.
> [R]eliance on tentative plans for future mitigation after completion of the CEQA process significantly undermines CEQA's goals of full disclosure and informed decisionmaking; and[,] consequently, these mitigation plans have been overturned on judicial review as constituting improper deferral of environmental assessment. *Communities for a Better Environment v. City of Richmond* (2010) 184 Cal.App.4th at 92.

Similarly, an agency cannot fail to analyze potentially significant impacts, then rely on that failure to conclude that a Project has no significant impacts. An agency may not assert that there is no evidence of a significant environment impact because the agency failed to undertake an adequate environmental analysis. *(Sundstrom v. County of Mendocino* (1988) 202 Cal.App.3d 296, 311 ("The agency should not be allowed to hide behind its own failure to gather relevant data.").

a. The Project Will Result In Significant Impacts to Deer Habitat That the FEIR Fails to Properly Analyze or Mitigate.

Mr. Macauley has reviewed the FEIR and all proposed biological resources mitigations, and concludes that the FEIR's proposed mitigations are insufficient to protect sensitive Round Valley and Casa Diablo deer herds.

Mr. Macauley states:

> The location of the proposed M-1 plant site is within the general spring and fall migration path identified for members of the Round Valley and Casa Diablo deer

herds. It is also within the expansive area that may be used by winter residents of these herds. The project footprint will result in the grading of 5.7 acres of land, which contains 3.5 acres that is dominated by Antelope bitterbrush, an important browse species for mule deer.[10] Furthermore, the site is described as consisting of 1.6 acres of Jeffery Pine, 1.9 acres of Big Sagebrush Scrub, and .2 acres of Wright Buckwheat Dwarf Scrub communities on the 5.7 acre site.[11] These plant communities provide important cover and forage resources for deer.

In response to comments, the Applicant describes the habitat on the building site as degraded or absent. While *Bromus tectorum* is present on the site and is even a dominant herbaceous species in certain places, this does not make the site unsuitable for deer, especially since deer in this area feed largely on browse and not grass.[12] On the contrary, the Applicant has already described quality habitat and forage that exists on the majority of the project site:

> "Characteristics of the vegetation at and nearby the M-1 Project *meet known habitat requirements for deer* that enter the area to hold or forage as residents, or who pass through the area during normal migration. *About 3.5 acres of vegetation where bitterbrush, an important browse species, is a canopy dominant would be affected by construction of the M-1 power plant.*" (emphasis added).[13]

Indeed, this is in agreement with other research on the diet of these deer herds in the winter months, which is characterized by "> 93% shrubs, with antelope bitterbrush, sagebrush, blackbrush (*Coleogyne ramosissima*), and Gregg's ceanothus (*Ceanothus Gregii*) as the dominant shrub species. Bitterbrush is most frequent in the diet during the first few months and again in April (coinciding with spring growth). Sagebrush is most common [forage species] during mid-winter months."[14]

The Applicant has failed to recognize the significance of the habitat loss that will result from building the M-1 power plant, and mitigation should be required for this loss, especially for the habitat communities that are not mechanically or thermally disturbed. According to the Applicant's estimation, this would equal 3.7 acres.[15]

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[10] FEIR, p. 4-66.

[11] FEIR, Table 21. p. 4-64.

[12] Ferranto SP. 2006. Conservation of mule deer in the eastern Sierra Nevada. M.S. Thesis, University of Nevada, Reno, p. 50.

[13] FEIR, p. 4-66.

[14] Ferranto SP. 2006. Conservation of mule deer in the eastern Sierra Nevada. M.S. Thesis, University of Nevada, Reno, p. 50.

[15] FEIR, Table 21, p. 4-64.

(See Exhibit A at pp. 2-3)

b. The Project's Construction Schedule Will Interfere with Spring and Fall Migration of Mule Deer.

Mr. Macailey concludes that the Project's proposed Bio Mitigation measures fail to adequately address potentially significant impacts to deer migration during spring and fall. He states:

> The construction schedule overlaps with spring migration of deer, and will likely have an impact on deer during this time where deer are recovering from condition lost from winter conditions. Summary notes from a site visit with Department of Fish & Game biologist Tim Taylor note that deer migrate through the proposed project site from late April through the third week of May, depending on weather conditions.[16] Additional research on the deer in this area also found that migration began in late April and continued into May, while the fall migration occurs from September through November. [17]
>
> The spring and fall migration period overlaps with the peak periods of construction, which shows that 60 workers will be on site in May as well as September and October.[18] The peak levels of construction activity will involve on average three (3), 40–foot delivery trucks to transport material to or from the site during the construction period. In addition, four (4), 60–foot trucks per day would deliver materials to the site over an approximate 10–day period early in the construction period, which will likely have an even greater impact on pregnant does in spring migration.[19] Peak levels of construction early in this period will mean more than 7 large trucks a day may be moving to and from the site during the spring migration period. This can result in an average of 14 trips (to and from) a day in the area.

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[16] RDEIR Appendix C, G-1 Plant Replacement Site Visit – Summary, Mammoth Lakes, CA, March 22, 2011.

[17] Kucera, Thomas E. 1987. Casa Diablo Geothermal Development Project: Deer Migration Study, spring 1987.

[18] FEIR, Figure 12, p. 2-13.

[19] FEIR, Figure 12, p. 2-12.

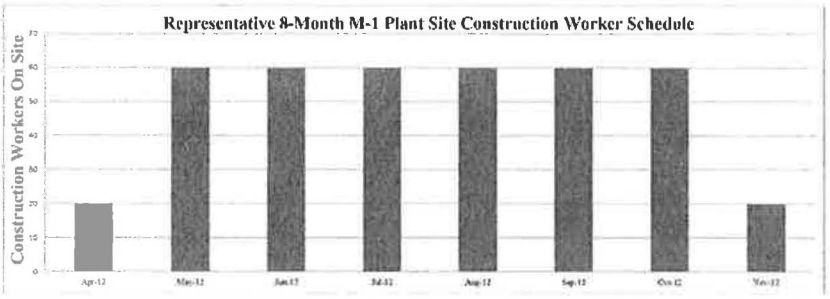

Figure 12: Representative 8-Month M-1 Plant Site Construction Worker Schedule

It is likely that construction would have significant impacts on migrating deer in the spring. While the Applicant has described the noise produced by trucks, they have not evaluated or mitigated its effect on migrating deer, particularly during the heaviest period of construction that will coincide with spring migration.

(Exhibit A at p. 7)

c. The Project as Built Violates Proposed Mitigation Measures, and Several Mitigation Measures are Insufficient to Mitigate Identified Species Impacts.

As observed by Mr. Macauley:

Bio Protection Measure 7 calls for no additional linear barriers to be constructed:

> "The Project shall not erect any linear barriers to movement of deer or other wildlife in the area between the existing MP-I plant site and the replacement M-1 plant site. During M-1 plant site construction, no temporary fencing or pipeline racks shall be erected in this same area during the normal periods of mule deer migration, from April 1st to May 30th or from September 15th through November 15th."[20]

However, the new plant construction will result in approximately 2000 feet of additional linear barriers in the area. The project will construct 500 feet of interconnection injection fluid pipeline and about 1,500 feet of interconnection transmission line.[21] While the mitigation measure calls for no construction of pipeline racks during migratory periods, the pipelines that would be constructed appear to be permanent, and would violate this mitigation measure. While the Applicant notes that wildlife could move both over and beneath the interconnection pipeline and transmission line conduit, it is nonetheless an additional linear barrier that clearly violates the Applicant's own proposed mitigation measures.

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[20] FEIR, p.4-73.

[21] FEIR, p. 4-65.

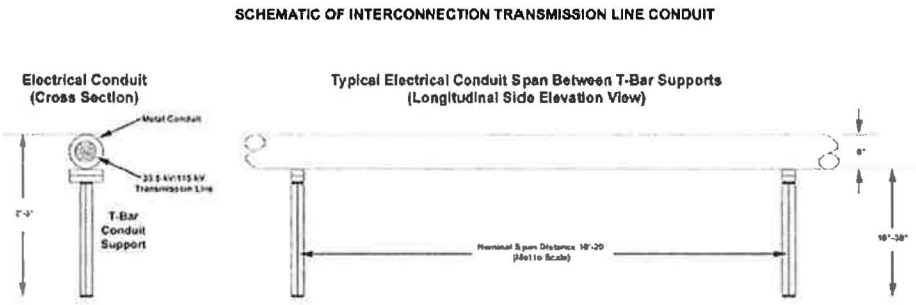

Figure 11: Schematic of Interconnection Transmission Line Conduit

Furthermore, the Applicant's conclusion that these linear facilities would not be a substantive obstacle to wildlife movement in the area is not clear. The Applicant has acknowledged that resident deer are more likely to adapt to changes in the surroundings than migratory deer.[22] As such, the assertion that an additional pipeline would not be viewed as substantive obstacles become less clear when it comes to migratory deer, which will not have opportunities to adapt to these changes.

While it is likely that deer can cross this pipeline, it adds further disturbance to migratory paths that are unlikely to be mitigated by the single crossing that has been proposed to mitigate for these impacts (additional problems with this mitigation measure will be addressed more fully below). With the addition of transmission lines, the remaining corridor passageway that is uninhibited by a pipeline will be reduced to approximately 100 feet if the proposed project is constructed.[23]

[22] Applicant's Response to Comment 9A-12.

[23] FEIR, Figure 10, p. 2-11.

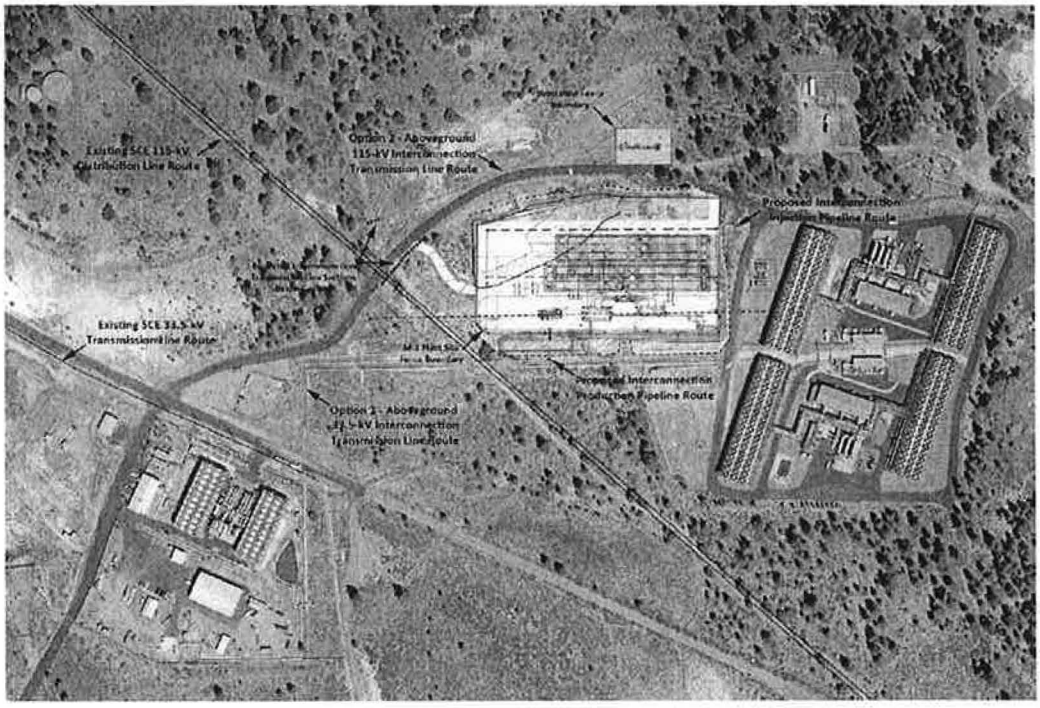

Figure 10: Interconnection Transmission Line Options, Interconnection Pipelines and New Fence Boundaries

In order to properly mitigate for the reduction of the migratory corridor, the Applicant should bury all lines to reduce potentially significant impacts to deer movement. This seems especially warranted given that general Mono County regulations require that all new utilities shall be installed underground,[24] and that the project is seeking a variance from this regulation.

The Applicant says that these transmission lines would "necessarily be located aboveground",[25] but do not provide any justification for why this is the case, when CD-4 project lines would be placed underground.

Bio Protection Measure 8 Will Not Mitigate the Reduction in Movement Corridor for Migratory Deer

The Applicant has proposed mitigation to reduce significant impacts to connectivity for wildlife and mule deer in Bio Protection Measure 8. However, this mitigation measure, which calls for an earthen ramp to be constructed over a pipeline, is unproven and, without further empirical support, the Applicant cannot

[24] FEIR, p. 4-5.

[25] FEIR, p. 5-8.

support the claim that it will reduce significant impacts to migratory deer to less than significant.

The Applicant acknowledges that resident deer are more likely to adapt to changes due to Project construction than migratory deer.[26] However, the Applicant's proposed mitigation for impacts to movement by deer – including movements by migratory deer – involves building a new earthen ramp over the pipeline. While this ramp is intended to serve as connectivity at least in part for migrating deer, the Applicant fails to recognize the inherent difficulty that migrating deer may have in encountering this new feature on the landscape. It is questionable that deer in the midst of migration, having never encountered this feature, will use this crossing. As such, without further empirical evidence, this mitigation measure cannot be expected to alleviate the significant impacts that will result in reduced movement connectivity for migratory mule deer.

While the Applicant has attempted to provide empirical support, the data is not provided or cited. The Applicant refers to 2011 deer studies which found that constructed crossings of this type in the Basalt Canyon area are regularly used by deer during both the residency and migratory periods. But because the data for these studies is not cited, the results are not verifiable.[27] Furthermore, close reading of the statement also suggests that while deer may be using this ramp *during both residency and migratory periods*, the vagueness of wording could mean that *only resident deer* are using the ramps *during migratory periods*. It is not clear that *any* migratory deer are using these ramps during migratory periods. If only resident deer are using these ramps, then the proposed mitigation of creating this ramp serves only to help connectivity of resident deer, and does not address significant impacts to migratory deer.

Recent and available peer-reviewed research on overpasses for connectivity has focused on road mortalities and use of overpasses, and meta-analyses have found a lack of before and after data as making "the efficacy of these techniques nearly impossible to evaluate."[28] Given the questionable efficacy of connectivity overpasses in peer-reviewed meta-analyses, the Applicant needs to provide empirical data to support the finding that an earthen ramp will mitigate for significant movement corridor impacts that the project will cause.

Description of Bio Protection Measure 8 Is Unclear

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[26] Applicant's Response to Comment 9A-12

[27] Applicant's Response to Comment 9A-13

[28] Glista, David J., Travis L. DeVault, J. Andrew DeWoody. 2009. A review of mitigation measures for reducing wildlife mortality on roadways. *Landscape and urban planning.* 91(1) p. 1-7.

While the efficacy of Bio Protection Measure 8 is doubtful, the description of the mitigation measure is vague, inaccurate, and internally inconsistent. First, the characteristics of the earthen ramp that is proposed for mitigation are not sufficiently described. While the Applicant describes the ramp it to be 30 feet wide, they do not provide any information on the slope of the ramp. Second, the Applicant describes the earthen ramp to be "tree-screened", however, there are only trees on the northern end of the proposed area for the ramp construction, and the lack of tree cover on the southern portion of the ramp will likely diminish its use. Third, the existing road on the northern portion of the proposed ramp would likely be blocked by such a ramp, and the Applicant does not address how vehicles will pass this area with a 30 foot ramp crossing the road.

The description of this proposed ramp is internally inconsistent. The Applicant notes that the "The finished crossing shall resemble the existing crossing at the SCE easement located approximately 320 feet east of the 90 degree turn."[29] However, the Applicant has described the SCE crossing as an area where the pipeline racks are *buried underground* for 50 feet.[30] In terms of mitigation for deer connectivity, burying the pipeline for a distance of 50 feet—as the pipeline is buried at the SCE easement—would certainly be superior to the creation of an earthen ramp. In fact, as suggested earlier, appropriate mitigation that would reduce connectivity impacts to less than significant would require burying all the transmission lines so as to compensate for the area that will be blocked by the construction of the M-1 power plant.

Part of Cumulative Bio Mitigation Measure 1 does not constitute mitigation for this project's impacts

Cumulative Bio Mitigation Measure 1 calls for three main actions to mitigate for cumulative impacts. The first of these calls for new projects to conduct baseline deer studies of proposed projects and monitoring deer use within and near new proposed projects.[31]

Calling for baseline deer studies without any clear and concrete performance actions does not constitute mitigation. CEQA describes five types of mitigation:

> (a) Avoiding the impact altogether by not taking a certain action or parts of an action.
> (b) Minimizing impacts by limiting the degree or magnitude of the action and its implementation.
> (c) Rectifying the impact by repairing, rehabilitating, or restoring the impacted environment.

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[29] FEIR, p. 4-73.

[30] RDEIR Appendix D, p. 25.

[31] FEIR, p. 5-12.

(d) Reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action.
(e) Compensating for the impact by replacing or providing substitute resources or environments.[32]

Conducting surveys do not qualify as any of these types.

Surveys are a critically important tool for evaluating and determining mitigation measures to be taken, and this use of surveys is clearly useful. However, action items surrounding the findings of this survey data that is consistent with the definition of mitigation under CEQA is necessary. While these action items would certainly need to be site specific, and some flexibility is necessary in designing them, basic requirements or standards and resulting action items need to be described for this measure to constitute mitigation and reduce significant cumulative impacts. Some standards for action could involve standards in percentage reduction in deer use. For example, if surveys reveal that deer use of the area has ceased in connection with construction, mitigation should call for the reduction of construction activity until surveys show improvement in deer use.

Mitigation requires that some action be taken to minimize or compensate. Simply calling for studies without remedial actions does not constitute mitigation.

Bio Protection Measure 9 is Vague

Bio Protection Measure 9 calls for the designation of a movement corridor on the northeastern side of the existing Casa Diablo geothermal complex shall be maintained free from further development and mechanical disturbance.[33] The area would be designated for long-term preservation in the Reclamation Plan prepared for the County for the Casa Diablo geothermal development.

While the preservation of habitat is crucial for biological resource protection, maintaining already existing habitat and already existing corridor does qualify as mitigation in terms of preservation, however, it does not fully compensate for the loss that is occurring. This corridor to the north of the complex is currently preserved, and any development on it would have to undergo its own mitigation. It is unclear whether preserving this area alone would sufficiently mitigate for impacts caused.

Furthermore, the Applicant does not define "long-term" and does not make it clear that the land will be preserved from other development besides geothermal development.

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[32] CEQA Section 15370.

[33] FEIR, p. 4-74.

> One example of replacement and compensation that would serve to make the impacts of construction less than significant could include the restoration of degraded habitat in the area. An ideal place for such replacement of habitat and improve connectivity would be to restore the decommissioned plant site to habitat that would be usable by deer and wildlife. The use of the old site as a fenced storage yard and overflow parking lot – unusable and inaccessible to wildlife and deer – appears to be a relatively unnecessary use of this area when significant impacts are caused due to additional construction.
>
> (See Exhibit A at pp. 7-13)

The County has repeatedly failed to address these significant impacts to biological resources, despite multiple opportunities to do so, and despite substantial evidence in the form of expert comments throughout the EIR stages that have identified these impacts. The County must not be permitted to rely upon inadequate mitigation measures in light of substantial evidence that the Project will have significant, unmitigated impacts on species. The FEIR must be revised and recirculated to address these impacts.

2. The FEIR Fails to Properly Analyze the Project's Air Quality Impacts from Project Construction and Operations.

Project construction will have significant air quality impacts from excess emissions of nitrogen oxides produced during combustion ("NOx") that the County has failed to properly analyze and mitigate due to reliance on inappropriately high significant thresholds borrowed from Imperial County. (See RDEIR Comment Letter 9D). The FEIR fails to provide any analysis of toxic diesel particulate matter emissions ("DPM").

The FEIR must be revised and recirculated to fully and adequately disclose the potentially significant impacts to regional air quality and health impacts on local residents and construction workers from the Project's NOx and DPM emissions. (*See Communities for a Better Environment v. South Coast Air Quality Management Dist.* (2010) 48 Cal. 4th 310, 317 (refinery CEQA document inadequate for failure to analyze nitrogen oxide emissions, known to have significant effects on human health); *Berkeley Keep Jets Over the Bay Com. v. Bd. of Port Comrs.* (2001) 91 Cal.App.4th 1344, 1369 (EIR must include a "human health risk assessment" to address impacts from exposure to toxic air contaminants); *see also Bakersfield Citizens for Local Control v. City of Bakersfield* (2004) 124 Cal.App.4th 1184, at 1219-20 ("the health consequences that necessarily result from the identified adverse air quality impacts.... On remand, the health impacts resulting from the adverse air quality impacts must be identified and analyzed in the new EIR's.")) In particular, because construction NOX emissions estimates are so close to thresholds the FEIR should not be certified until these measures are incorporated for application to the entire project construction period.

Diesel exhaust contains nearly 40 toxic substances and may pose a serious public health risk for residents in the vicinity of the facility. Diesel exhaust has been linked to a range of serious health problems including an increase in respiratory disease, lung damage, cancer, and premature death. Fine diesel particles

are deposited deep in the lungs in the smallest airways and can result in increased respiratory symptoms and disease; decreased lung function, particularly in children and individuals with asthma; alterations in lung tissue and respiratory tract defense mechanisms; and premature death. Exposure to diesel exhaust increases the risk of lung cancer. It also causes non-cancer effects including chronic bronchitis, inflammation of lung tissue, thickening of the alveolar walls, immunological allergic reactions, and airway constriction. As early as 1988, the National Institute for Occupational Safety and Health identified diesel exhaust as a potential occupational carcinogen. In 1998, the California Air Resources Board ("CARB") formally identified the particulate fraction of diesel exhaust as a toxic air contaminant and concluded that exposure to diesel exhaust particulate matter causes cancer and acute respiratory effects. The U.S. EPA followed suit in 2002 and concluded that "long-term (i.e., chronic) inhalation exposure is likely to pose lung cancer hazard to humans, as well as damage the lung in other ways depending on exposure. Short term (i.e., acute) exposures can cause irritation and inflammatory symptoms of a transient nature... The assessment also indicates that evidence for exacerbation of existing allergies and asthma symptoms is emerging."Diesel exhaust is estimated to contribute to more than 75% of the added cancer risk from air toxics in the United States.

The FEIR must be revised and recirculated to address these significant impacts, and to prepare a legally adequate Health Risk Assessment for exposure to sensitive receptors in close proximity to Project construction.

3. The FEIR Relies on a Legally Improper Baseline for Operational Emissions.

Every CEQA document must start from a "baseline" assumption. The CEQA "baseline" is the set of environmental conditions against which to compare a project's anticipated impacts. *Communities for a Better Environment v. So Coast Air Qual. Mgmnt. Dist.* (2010) 48 Cal. 4th 310, 321. Section 15125(a) of the CEQA Guidelines (14 C.C.R., § 15125(a)) states in pertinent part that a lead agency's environmental review under CEQA:

> "...must include a description of the physical environmental conditions in the vicinity of the project, as they exist at the time [environmental analysis] is commenced, from both a local and regional perspective. This environmental setting will normally constitute the baseline physical conditions by which a Lead Agency determines whether an impact is significant."

(See, *Save Our Peninsula Committee v. County of Monterey* (2001) 87 Cal.App.4th 99, 124-125 ("*Save Our Peninsula*.") As the court of appeal has explained, "the impacts of the project must be measured against the 'real conditions on the ground,'" and not against hypothetical permitted levels. (*Save Our Peninsula*,87 Cal.App.4th 99, 121-123.) As the court has explained, using such a skewed baseline "mislead(s) the public" and "draws a red herring across the path of public input." (*San Joaquin Raptor Rescue Center v. County of Merced* (2007) 149 Cal.App.4th 645, 656; *Woodward Park Homeowners v. City of Fresno* (2007) 150 Cal.App.4th 683, 708-711.)

By relying on the existing MP-I emissions as a baseline, the FEIR fails to utilize the proper baseline for its operation air emissions, given the new location of the proposed M-1 plant, and the planned simultaneous operations of both the MP-1 and M-1 plants for up to 2 years during the M-I startup period. (See RDEIR at pp. 4-36 to 4-48; Comment Letter 9-D.

This inaccurate baseline renders the FEIR legally deficient as a matter of law.

E. THE COUNTY SHOULD PREPARE AND RECIRCULATE A SUPPLEMENTAL FEIR.

Recirculation of an EIR prior to certification, as here, is addressed in CEQA § 21092.1, and CEQA Guidelines §15088.5. "When significant new information is added to an environmental impact report after notice has been given pursuant to Section 21092 ... ***but prior to certification***, the public agency shall give notice again pursuant to Section 21092, and consult again pursuant to Sections 21104 and 21153 before certifying the environmental impact report." PRC § 21092.1.

"Significant new information" includes:

> (1) A new significant environmental impact would result from the project or from a new mitigation measure proposed to be implemented.
>
> (2) A substantial increase in the severity of an environmental impact would result...
>
> (3) A feasible project alternative or mitigation measure considerably different from others previously analyzed would clearly lessen the significant environmental impacts of the project...
>
> (4) The draft EIR was so fundamentally and basically inadequate and conclusory in nature that meaningful public review and comment were precluded.
>
> 14 CCR §15088.5; *Mountain Lion Coal. v. Fish and Game Comm'n* (1989) 214 Cal.App.3d 1043.

In *Mountain Lion,* the court held that when a detailed project analysis is not prepared until the FEIR, then the document must be recirculated for public comment.

> If we were to allow the deficient analysis in the draft EID[34] to be bolstered by a document that was never circulated for public comment ... we would be subverting the important public purposes of CEQA. Only at the stage when the draft EID is circulated can the public and outside agencies have the opportunity to analyze a proposal and submit comment. No such right exists upon issuance of a final EID unless the project is substantially modified or new information becomes available. (See Cal. Code Regs., tit. 14, § 15162.) To evaluate the draft EID in conjunction with the final EID in this case would only countenance the practice of releasing a report for public consumption that hedges on important

[34] EID is essentially the same as an EIR since the Dept. of Fish and Game had a certified environmental program.

> environmental issues while deferring a more detailed analysis to the final EID that is insulated from public review.

Mountain Lion, 214 Cal.App.3d at 1052.

In *Laurel Heights Impr. Assn. v. Reg. of Univ. of Cal.* (1993) 6 Cal. 4th 1112 ("*Laurel Heights II*, the Supreme Court explained that Section 21092 favors EIR recirculation prior to certification. The Court stated:

> ***Section 21092.1 was intended to encourage meaningful public comment.*** (See State Bar Rep., supra, at p. 28.) Therefore, new information that demonstrates that an EIR commented upon by the public was so fundamentally and basically inadequate or conclusory in nature that public comment was in effect meaningless triggers recirculation under section 21092.1. (See, *Mountain Lion Coalition v. Fish & Game Com., supra*, 214 Cal.App.3d 1043.)

Laurel Heights II, 6 Cal.4th at 1130 (emph. added).

Here, the FEIR has failed to properly analyze cumulative impacts of the Project in conjunction with both existing and reasonably forseeable future projects in the Casa Grande geothermal basin, has failed entirely to analyze cumulative seismic impacts the Projects, and fails to adequately analyze or mitigate impacts to biological resources.

The FEIR must be revised to address these many impacts. Unless the FEIR is revised to address these deficiencies and unless that FEIR is recirculated for further public review, the public and decision makers will be deprived of an opportunity for full input and informed decision making.

V. CONCLUSION

LIUNA Local Union No. 783 believes the Project FEIR is wholly inadequate and requires significant revision, recirculation and review. Moreover, LIUNA believes that the Project as proposed would result in too many unmitigated adverse impacts on the environment to be justified. California is in need of renewable energy. However, that energy cannot be obtained at the expense of other resources of the State. The Mammoth Project will result in significant that have not been adequately considered, creating the potential for great harm to humans and the natural environment. All of these considerations weigh against approval of the project as proposed.

Thank you for your attention to these comments. Please include this letter and all attachments hereto in the record of proceedings for this project.

Sincerely,

Richard T. Drury
Christina M. Caro
Lozeau Drury LLP
Attorneys for Laborers' International Union of North America (LIUNA), Local Union No. 783

EXHIBIT A

October 10, 2012

Ms. Christina Caro
Lozeau | Drury LLP
410 12th Street, Suite 250
Oakland, CA 94607

Subject: Comments on the Final Environmental Impact Report for the Mammoth Pacific I Replacement Project

Dear Ms. Caro:

This letter contains my comments on the Final Environmental Impact Report ("FEIR") prepared for Mammoth Pacific Limited Partnership's ("Applicant") proposed Mammoth Pacific I Replacement Project. The project involves replacing the aging Mammoth Pacific Unit I (MP–I) power plant with a new, more modern and efficient binary power plant (M–1), while maintaining the existing geothermal wellfield, pipeline system and ancillary facilities. The proposed location is on private land approximately 500 feet northeast of the existing MP I facility. Hereafter, I refer to the project at the proposed location as the "Project."

I am an environmental scientist with five years of academic and professional experience in wildlife ecology, rangeland management, and natural resource management. To date, I have served as a biological resources expert for six renewable energy projects, including a geothermal project. My experience in this regard includes preparing testimony for the California Energy Commission and assisting clients with evaluations of biological resource issues. I have five years of experience with the U.S. Department of Justice, where I worked in the Antitrust Division, the Office of Public Affairs, and the U.S. Attorney's Office, from which I have gained experience with regulatory compliance and legal proceedings. My educational background includes a B.A. in Liberal Arts from the University of Notre Dame, and an M.S. in Range Management from the University of California, Berkeley. I am currently a Ph.D. candidate in Environmental Science, Policy, and Management at the University of California, Berkeley.

The comments contained herein are based on a review of the environmental documents prepared for the Projects, a review of scientific literature pertaining to biological resources known to occur in Mono County, consultations with additional biological resource experts, and the knowledge and experience I have acquired during more than ten years of working in the field of law and natural resources management.

Citation to FEIR Documents

The Final EIR consists of the DEIR, RDEIR, and RDEIR2, as well as all comments received on the DEIR, RDEIR, and RDEIR2, the County's Responses to Comments, and all Appendices Exhibits thereto. These documents and their content constitute the FEIR on the proposed Project. Citations herein may refer to "DEIR" pages, "RDEIR pages", "RDEIR2" pages, or "FEIR" pages. All references are intended as citations to the Final EIR.

Significant Impacts to Deer Habitat

The location of the proposed M-1 plant site is within the general spring and fall migration path identified for members of the Round Valley and Casa Diablo deer herds. It is also within the expansive area that may be used by winter residents of these herds. The project footprint will result in the grading of 5.7 acres of land, which contains 3.5 acres that is dominated by Antelope bitterbrush, an important browse species for mule deer.[1] Furthermore, the site is described as consisting of 1.6 acres of Jeffery Pine, 1.9 acres of Big Sagebrush Scrub, and .2 acres of Wright Buckwheat Dwarf Scrub communities on the 5.7 acre site.[2] These plant communities provide important cover and forage resources for deer.

In response to comments, the Applicant describes the habitat on the building site as degraded or absent. While *Bromus tectorum* is present on the site and is even a dominant herbaceous species in certain places, this does not make the site unsuitable for deer, especially since deer in this area feed largely on browse and not grass.[3] On the contrary, the Applicant has already described quality habitat and forage that exists on the majority of the project site:

> "Characteristics of the vegetation at and nearby the M-1 Project *meet known habitat requirements for deer* that enter the area to hold or forage as residents, or who pass through the area during normal migration. *About 3.5 acres of vegetation where bitterbrush, an important browse species, is a canopy dominant would be affected by construction of the M-1 power plant.*" (emphasis added).[4]

Indeed, this is in agreement with other research on the diet of these deer herds in the winter months, which is characterized by "> 93% shrubs, with antelope bitterbrush, sagebrush, blackbrush (*Coleogyne ramosissima*), and Gregg's ceanothus (*Ceanothus Gregii*) as the dominant shrub species. Bitterbrush is most frequent in

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[1] FEIR, p. 4-66.
[2] FEIR, Table 21. p. 4-64.
[3] Ferranto SP. 2006. Conservation of mule deer in the eastern Sierra Nevada. M.S. Thesis, University of Nevada, Reno, p. 50.
[4] FEIR, p. 4-66.

the diet during the first few months and again in April (coinciding with spring growth). Sagebrush is most common [forage species] during mid-winter months."[5]

The Applicant has failed to recognize the significance of the habitat loss that will result from building the M-1 power plant, and mitigation should be required for this loss, especially for the habitat communities that are not mechanically or thermally disturbed. According to the Applicant's estimation, this would equal 3.7 acres.[6]

Significant Cumulative Impacts to Deer Habitat

The Applicant characterizes the 5.7 acres of habitat destruction as insignificant due to the relatively small area of development in comparison to expansive public lands in the area which can meet the needs of deer in the area. However, this type of small incremental development that the Applicant describes as "a tiny fraction...of available mule deer habitat in the area," is exactly the kind of development that CEQA seeks to regulate in sections addressing cumulative impacts. The Applicant fails to meet the standard to declare insignificant cumulative impacts, especially given the conservation status of the deer in this area.

The Round Valley deer population has seen "dramatic declines over the last 10 – 20 years"[7] and it is likely that any additional habitat loss, no matter how small, will contribute to cumulative impacts. The Casa Diablo herd is likely to be sensitive to any habitat loss on winter range "because deer are frequently in poor condition at the end of summer before moving onto winter range in the fall; this means that quality winter forage is critical for sustaining population numbers."[8]

Additionally, the CDFG biologist on the project noted that:

> "The loss of *deer holding area* and migration corridor acreage is a concern not only for the G-1 Plant replacement site but for the cumulative impacts to deer from the proposed CD-4 Plant and other existing and proposed projects on Round Valley deer herd range."(emphasis added)[9]

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[5] Ferranto SP. 2006. Conservation of mule deer in the eastern Sierra Nevada. M.S. Thesis, University of Nevada, Reno, p. 50.
[6] FEIR, Table 21, p. 4-64.
[7] Ferranto SP. 2006. Conservation of mule deer in the eastern Sierra Nevada. M.S. Thesis, University of Nevada, Reno, p. 50.
[8] Ferranto SP. 2006. Conservation of mule deer in the eastern Sierra Nevada. M.S. Thesis, University of Nevada, Reno, p. 46.
[9] RDEIR Appendix C, G-1 Plant Replacement Site Visit – Summary, Mammoth Lakes, CA, March 22, 2011.

Habitat loss is widely considered the primary threat to wildlife across the country.[10] Studies on the Round Valley and Casa Diablo deer populations have also found development to be a primary threat, with recommendations of previous studies explicitly calling for keeping road and building infrastructure to a bare minimum and avoiding locations with healthy stands of Antelope Bitterbrush as building sites.[11]

Given that development is considered a contributor to the declines in the Round Valley deer population, and given the sensitivity of the Casa Diablo herd to loss of winter habitat, any additional loss of habitat likely would result in further negative incremental impacts to deer herds.

A review of CEQA regulations clarifies that this type of negative impact is exactly what would qualify as cumulatively significant impacts.

> "Cumulative impacts" refers to two or more individual effects which, when considered together, are considerable or which *compound or increase other environmental impacts*.... The cumulative impact from several projects is the change in the environment which results from the *incremental impact* of the project when added to other closely related past, present, and reasonably foreseeable probable future projects. Cumulative impacts can result from *individually minor but collectively significant* projects taking place over a period of time. (emphasis added)[12]

CEQA requires discussion of cumulative impacts in either of the following ways, which the Applicant has not performed sufficiently:

> (A) A list of past, present, and probable future projects producing related or cumulative impacts, including, if necessary, those projects outside the control of the agency, or
>
> (B) A summary of projections contained in an adopted general plan or related planning document, or in a prior environmental document which has been adopted or certified, which described or evaluated regional or areawide conditions contributing to the cumulative impact. Any such planning document shall be referenced and made available to the public at a location specified by the lead agency.[13]

While the Applicant has provided a brief assessment of current and probable future projects in relation to the current project in their response to comment, they have not discussed how past impacts may have resulted in declines of the Casa Diablo and Round Valley deer herds. While the Applicant correctly notes that CEQA directs that an EIR should not discuss impacts which do not result in part from the project evaluated in the EIR, this is not the case here. This project will cause

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[10] Wilcove, David S., David Rothstein, Jason Dubow, Ali Phillips and Elizabeth Losos. 1998. Quantifying Threats to Imperiled species in the United States. *BioScience.* 48(8), pp. 607-615.
[11] Ferranto SP. 2006. Conservation of mule deer in the eastern Sierra Nevada. M.S. Thesis, University of Nevada, Reno, p 61.
[12] CEQA Section 15355.
[13] CEQA Section 15130.

additional loss of deer habitat, which will contribute to the larger cumulative impacts on these deer herds.

While Cumulative Bio Measure 1 is designed to address cumulative impacts to biological resources, it is lacking in any mitigation for habitat loss due to the construction of the M-1 power plant, and as a result does not reduce the impacts to less than significant.

Mitigation can consist of avoidance or replacement of lost habitat. In this case, appropriate mitigation such as the restoration of 3.7 acres of habitat would qualify as mitigation. As the Applicant has noted the infeasibility of locating the new plant on the old plant site, an ideal site for such restoration would be on the site of the decommissioned power plant after demolition. Under the current plan, the old plant site will be converted to a *fenced* storage yard and as occasional overflow parking.[14] It is unclear whether additional fenced storage yards and overflow parking are essential for the goals of the project, and as such, restoring this area to usable habitat for deer, would do much to mitigate the impacts of habitat removal to less than significant.

While the Applicant determined that "the main use of the existing MP-I Project area by deer is as a movement corridor," this does not negate the fact that important browse, cover, and habitat for deer will be significantly impacted by the construction of the M-1 power plant.

The Applicant Fails to Recognize Significant Differences Between Spring and Fall Migration Resulting in Inadequate Baseline Data To Evaluate Impacts to Migrating Deer

The Applicant has not conducted deer surveys in the spring. In response to comments raised about incomplete understanding of deer due to a lack of spring surveys, the respondent replies that there is "only one movement corridor, and therefore no possibility of seasonal variation in migratory routes."[15] They add that there is "no basis for suspecting spring migrants would respond differently than fall migrants to environmental constants." The Applicant notes that "it is reasonable to conclude that neither the location nor the magnitude of seasonal movements vary significantly within the 5.7 acre project area and adjacent movement corridor."

The Applicant is misinformed. It is unclear what is meant by "only one movement corridor," as there are 2-3 gaps between the current buildings at the site and additional movement paths around the outside of these buildings. There is clearly the possibility of deer to prefer certain routes over others, and given the limited survey data, the Applicant is unable to determine what those may be.

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[14] FEIR, p. 1-1.

[15] Applicant's Response to Comment 9A-03.

Furthermore, while the Applicant may describe spring and fall seasons as "environmental constants," the different stages of vegetative growth between seasons and the different life cycle stage of deer are two notable differences that the Applicant fails to realize. In the fall, female deer are often with young fawns, while in spring they are often pregnant.

Kucera (1987) describes this pattern in further detail:

> *"The spring migration begins in April, when deer leave their winter ranges and move to intermediate altitudes. They congregate in "staging areas" for as long as six weeks, feeding on spring vegetation and regaining condition lost over the winter, until they move to summer ranges. Here, mainly west of the Sierra Crest, fawns are produced and reared. The fall migration back to the winter range typically is more rapid than that of the spring, and usually is patterned by fall storms. Deer arrive on the winter range during September, October and November, breed in December and January, and begin the annual cycle again.*[16]

Furthermore, summary notes from a site visit with Department of Fish & Game biologist Tim Taylor notes that the proposed plant site is part of the Round Valley Deer Herd holding area prior to migration, where deer regain condition that is lost over the winter. Spring holding areas are of particular importance because does -- heavy with unborn fawns - need to be well fed along the way to their summer ranges in order to have successful reproduction.[17]

It is clear that significant seasonal differences exist between spring and fall migration patterns. While fall migration tends to be more rapid and brought on by fall storms, it is highly likely that there will be different movement patterns associated with spring migration, which will result in a more prolonged period in which the deer are moving through and using the area for much needed nutrition, especially for does to support pregnancy. The impacts to deer by the project, and the amount of use in the area are likely to be far greater in the spring than what can be estimated from fall survey counts.

It is critical to have this knowledge to properly evaluate the impacts that the project will have on migratory corridors and habitat for deer. Without this data, the Applicant cannot conclude that mitigation will be adequate to reduce impacts to less than significant levels.

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[16] Kucera, Thomas E. 1987. Casa Diablo Geothermal Development Project: Deer Migration Study, spring 1987.

[17] Rogers, RD. Protecting and Managing Deer Winter Range at Antelope Valley Wildlife Area. Outdoor California magazine, September – October 1999.

Construction Schedule Will Interfere with Spring and Fall Migration

The construction schedule overlaps with spring migration of deer, and will likely have an impact on deer during this time where deer are recovering from condition lost from winter conditions. Summary notes from a site visit with Department of Fish & Game biologist Tim Taylor note that deer migrate through the proposed project site from late April through the third week of May, depending on weather conditions.[18] Additional research on the deer in this area also found that migration began in late April and continued into May, while the fall migration occurs from September through November. [19]

The spring and fall migration period overlaps with the peak periods of construction, which shows that 60 workers will be on site in May as well as September and October.[20] The peak levels of construction activity will involve on average three (3), 40–foot delivery trucks to transport material to or from the site during the construction period. In addition, four (4), 60–foot trucks per day would deliver materials to the site over an approximate 10–day period early in the construction period, which will likely have an even greater impact on pregnant does in spring migration.[21] Peak levels of construction early in this period will mean more than 7 large trucks a day may be moving to and from the site during the spring migration period. This can result in an average of 14 trips (to and from) a day in the area.

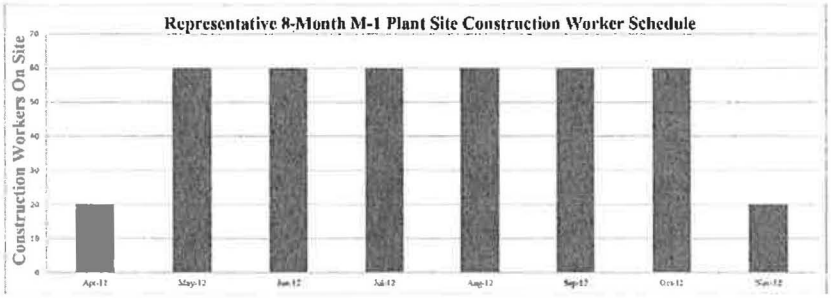

Figure 12: Representative 8-Month M-1 Plant Site Construction Worker Schedule

It is likely that construction would have significant impacts on migrating deer in the spring. While the Applicant has described the noise produced by trucks, they have not evaluated or mitigated its effect on migrating deer, particularly during the heaviest period of construction that will coincide with spring migration.

Project Violates Proposed Mitigation Measure

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[18] RDEIR Appendix C, G-1 Plant Replacement Site Visit – Summary, Mammoth Lakes, CA, March 22, 2011.

[19] Kucera, Thomas E. 1987. Casa Diablo Geothermal Development Project: Deer Migration Study, spring 1987.

[20] FEIR, Figure 12, p. 2-13.

[21] FEIR, Figure 12, p. 2-12.

Bio Protection Measure 7 calls for no additional linear barriers to be constructed:

> "The Project shall not erect any linear barriers to movement of deer or other wildlife in the area between the existing MP-I plant site and the replacement M-1 plant site. During M-1 plant site construction, no temporary fencing or pipeline racks shall be erected in this same area during the normal periods of mule deer migration, from April 1st to May 30th or from September 15th through November 15th."[22]

However, the new plant construction will result in approximately 2000 feet of additional linear barriers in the area. The project will construct 500 feet of interconnection injection fluid pipeline and about 1,500 feet of interconnection transmission line.[23] While the mitigation measure calls for no construction of pipeline racks during migratory periods, the pipelines that would be constructed appear to be permanent, and would violate this mitigation measure. While the Applicant notes that wildlife could move both over and beneath the interconnection pipeline and transmission line conduit, it is nonetheless an additional linear barrier that clearly violates the Applicant's own proposed mitigation measures.

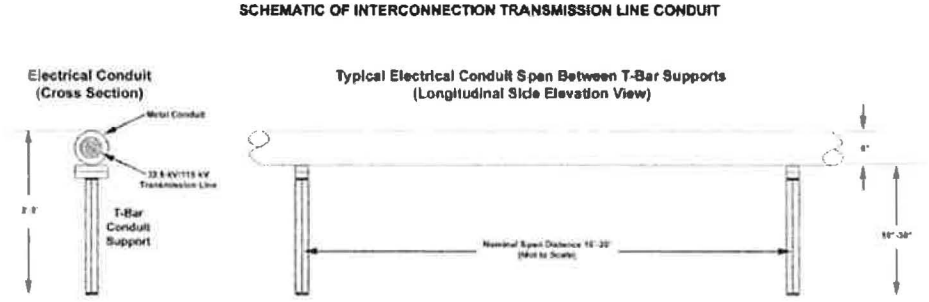

Figure 11: Schematic of Interconnection Transmission Line Conduit

Furthermore, the Applicant's conclusion that these linear facilities would not be a substantive obstacle to wildlife movement in the area is not clear. The Applicant has acknowledged that resident deer are more likely to adapt to changes in the surroundings than migratory deer.[24] As such, the assertion that an additional pipeline would not be viewed as substantive obstacles become less clear when it comes to migratory deer, which will not have opportunities to adapt to these changes.

While it is likely that deer can cross this pipeline, it adds further disturbance to migratory paths that are unlikely to be mitigated by the single crossing that has been proposed to mitigate for these impacts (additional problems with this mitigation measure will be addressed more fully below). With the addition of

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[22] FEIR, p.4-73.
[23] FEIR, p. 4-65.
[24] Applicant's Response to Comment 9A-12.

transmission lines, the remaining corridor passageway that is uninhibited by a pipeline will be reduced to approximately 100 feet if the proposed project is constructed.[25]

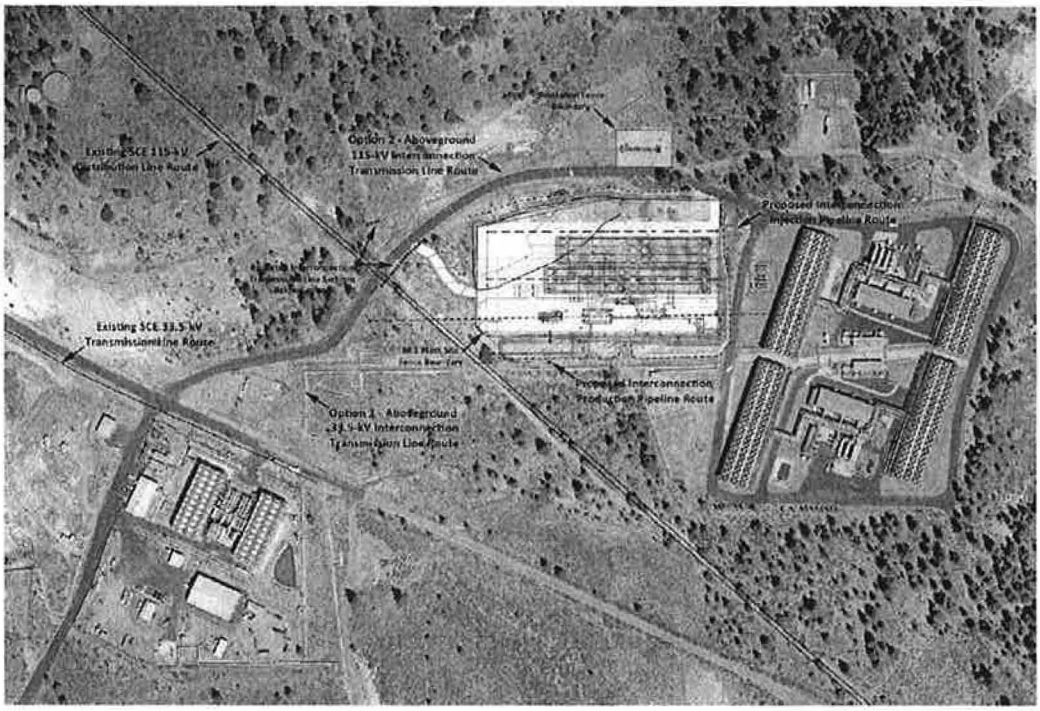

Figure 10: Interconnection Transmission Line Options, Interconnection Pipelines and New Fence Boundaries

In order to properly mitigate for the reduction of the migratory corridor, the Applicant should bury all lines to reduce potentially significant impacts to deer movement. This seems especially warranted given that general Mono County regulations require that all new utilities shall be installed underground,[26] and that the project is seeking a variance from this regulation.

The Applicant says that these transmission lines would "necessarily be located aboveground",[27] but do not provide any justification for why this is the case, when CD-4 project lines would be placed underground.

Bio Protection Measure 8 Will Not Mitigate the Reduction in Movement Corridor for Migratory Deer

The Applicant has proposed mitigation to reduce significant impacts to connectivity for wildlife and mule deer in Bio Protection Measure 8. However, this mitigation measure, which calls for an earthen ramp to be constructed over a pipeline, is

[25] FEIR, Figure 10, p. 2-11.
[26] FEIR, p. 4-5.
[27] FEIR, p. 5-8.

unproven and, without further empirical support, the Applicant cannot support the claim that it will reduce significant impacts to migratory deer to less than significant.

The Applicant acknowledges that resident deer are more likely to adapt to changes due to Project construction than migratory deer.[28] However, the Applicant's proposed mitigation for impacts to movement by deer – including movements by migratory deer – involves building a new earthen ramp over the pipeline. While this ramp is intended to serve as connectivity at least in part for migrating deer, the Applicant fails to recognize the inherent difficulty that migrating deer may have in encountering this new feature on the landscape. It is questionable that deer in the midst of migration, having never encountered this feature, will use this crossing. As such, without further empirical evidence, this mitigation measure cannot be expected to alleviate the significant impacts that will result in reduced movement connectivity for migratory mule deer.

While the Applicant has attempted to provide empirical support, the data is not provided or cited. The Applicant refers to 2011 deer studies which found that constructed crossings of this type in the Basalt Canyon area are regularly used by deer during both the residency and migratory periods. But because the data for these studies is not cited, the results are not verifiable.[29] Furthermore, close reading of the statement also suggests that while deer may be using this ramp *during both residency and migratory periods*, the vagueness of wording could mean that *only resident deer* are using the ramps *during migratory periods*. It is not clear that *any* migratory deer are using these ramps during migratory periods. If only resident deer are using these ramps, then the proposed mitigation of creating this ramp serves only to help connectivity of resident deer, and does not address significant impacts to migratory deer.

Recent and available peer-reviewed research on overpasses for connectivity has focused on road mortalities and use of overpasses, and meta-analyses have found a lack of before and after data as making "the efficacy of these techniques nearly impossible to evaluate."[30] Given the questionable efficacy of connectivity overpasses in peer-reviewed meta-analyses, the Applicant needs to provide empirical data to support the finding that an earthen ramp will mitigate for significant movement corridor impacts that the project will cause.

Description of Bio Protection Measure 8 Is Unclear

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[28] Applicant's Response to Comment 9A-12
[29] Applicant's Response to Comment 9A-13
[30] Glista, David J., Travis L. DeVault, J. Andrew DeWoody. 2009. A review of mitigation measures for reducing wildlife mortality on roadways. *Landscape and urban planning.* 91(1) p. 1-7.

While the efficacy of Bio Protection Measure 8 is doubtful, the description of the mitigation measure is vague, inaccurate, and internally inconsistent. First, the characteristics of the earthen ramp that is proposed for mitigation are not sufficiently described. While the Applicant describes the ramp it to be 30 feet wide, they do not provide any information on the slope of the ramp. Second, the Applicant describes the earthen ramp to be "tree-screened", however, there are only trees on the northern end of the proposed area for the ramp construction, and the lack of tree cover on the southern portion of the ramp will likely diminish its use. Third, the existing road on the northern portion of the proposed ramp would likely be blocked by such a ramp, and the Applicant does not address how vehicles will pass this area with a 30 foot ramp crossing the road.

The description of this proposed ramp is internally inconsistent. The Applicant notes that the "The finished crossing shall resemble the existing crossing at the SCE easement located approximately 320 feet east of the 90 degree turn."[31] However, the Applicant has described the SCE crossing as an area where the pipeline racks are *buried underground* for 50 feet.[32] In terms of mitigation for deer connectivity, burying the pipeline for a distance of 50 feet—as the pipeline is buried at the SCE easement—would certainly be superior to the creation of an earthen ramp. In fact, as suggested earlier, appropriate mitigation that would reduce connectivity impacts to less than significant would require burying all the transmission lines so as to compensate for the area that will be blocked by the construction of the M-1 power plant.

Part of Cumulative Bio Mitigation Measure 1 does not constitute mitigation for this project's impacts

Cumulative Bio Mitigation Measure 1 calls for three main actions to mitigate for cumulative impacts. The first of these calls for new projects to conduct baseline deer studies of proposed projects and monitoring deer use within and near new proposed projects.[33]

Calling for baseline deer studies without any clear and concrete performance actions does not constitute mitigation. CEQA describes five types of mitigation:

> (a) Avoiding the impact altogether by not taking a certain action or parts of an action.
> (b) Minimizing impacts by limiting the degree or magnitude of the action and its implementation.
> (c) Rectifying the impact by repairing, rehabilitating, or restoring the impacted environment.

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[31] FEIR, p. 4-73.
[32] RDEIR Appendix D, p. 25.
[33] FEIR, p. 5-12.

(d) Reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action.
(e) Compensating for the impact by replacing or providing substitute resources or environments.[34]

Conducting surveys do not qualify as any of these types.

Surveys are a critically important tool for evaluating and determining mitigation measures to be taken, and this use of surveys is clearly useful. However, action items surrounding the findings of this survey data that is consistent with the definition of mitigation under CEQA is necessary. While these action items would certainly need to be site specific, and some flexibility is necessary in designing them, basic requirements or standards and resulting action items need to be described for this measure to constitute mitigation and reduce significant cumulative impacts. Some standards for action could involve standards in percentage reduction in deer use. For example, if surveys reveal that deer use of the area has ceased in connection with construction, mitigation should call for the reduction of construction activity until surveys show improvement in deer use.

Mitigation requires that some action be taken to minimize or compensate. Simply calling for studies without remedial actions does not constitute mitigation.

Bio Protection Measure 9 is Vague

Bio Protection Measure 9 calls for the designation of a movement corridor on the northeastern side of the existing Casa Diablo geothermal complex shall be maintained free from further development and mechanical disturbance.[35] The area would be designated for long-term preservation in the Reclamation Plan prepared for the County for the Casa Diablo geothermal development.

While the preservation of habitat is crucial for biological resource protection, maintaining already existing habitat and already existing corridor does qualify as mitigation in terms of preservation, however, it does not fully compensate for the loss that is occurring. This corridor to the north of the complex is currently preserved, and any development on it would have to undergo its own mitigation. It is unclear whether preserving this area alone would sufficiently mitigate for impacts caused.

Furthermore, the Applicant does not define "long-term" and does not make it clear that the land will be preserved from other development besides geothermal development.

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[34] CEQA Section 15370.
[35] FEIR, p. 4-74.

One example of replacement and compensation that would serve to make the impacts of construction less than significant could include the restoration of degraded habitat in the area. An ideal place for such replacement of habitat and improve connectivity would be to restore the decommissioned plant site to habitat that would be usable by deer and wildlife. The use of the old site as a fenced storage yard and overflow parking lot – unusable and inaccessible to wildlife and deer – appears to be a relatively unnecessary use of this area when significant impacts are caused due to additional construction.

Sincerely,

Luke Macaulay, M.S.

LUKE T. MACAULAY

3027 Fulton St. ● Berkeley, CA 94705 ● (703) 798-8459 ● luke.macaulay@gmail.com

EDUCATION

UNIVERSITY OF CALIFORNIA, BERKELEY — **Berkeley, California**
Environmental Science, Policy, and Management — **2008-Present**

Ph.D. Student – Fall 2010 - Present: Dr. Reginald Barrett.
Topic: ***Wildlife Management Intensity for Hunting: Economic and Environmental Effects in Oak Woodlands***

- Interview landowners, wildlife management consultants, Cooperative Extension staff, and state fish & game officials to gather economic and environmental data about ranch operations with hunting in Texas and California
- Present research to landowner groups and academic seminars
- Utilize GIS mapping software to assess environmental impacts of management activities

Masters of Science: Range Management - Spring 2010

- GPA: 4.0
- Environmental Economics
- Graduate Wildlife Biology Seminar
- Management of Rangeland Ecosystems
- Grazing Management Plans for Cowell and Macedo Ranches (CA State Parks)
- Ecological Data Analysis – Statistics

UNIVERSITY OF NOTRE DAME — **South Bend, Indiana**
College of Arts and Letters — **1998-2002**

Bachelor of Arts: Program of Liberal Studies, a Great Books Program
Second Major: Spanish; *Study Abroad in Toledo, Spain*

- GPA: 3.6; Cum Laude; Recipient of Father Wilson Scholarship
- Summer Service Fellowship in El Salvador

EXPERIENCE

UNIVERSITY OF CALIFORNIA, BERKELEY — **Berkeley, California**
Environmental Science, Policy, and Management — **April 2008 – Present**

Researcher – East Bay Regional Parks – Spring 2008- Present

- Perform bird surveys, vegetation transects and invertebrate sampling in grasslands of East Bay Regional Parks
- Analyze data to determine how factors (particularly grazing) are affecting native species presence and diversity
- Draft portions of annual report to inform park management on composition of grassland and effects of grazing

UC Berkeley Center for Forestry – Fall 2010:

- Evaluated and provided future recommendations of Cooperative Extension Integrated Hardwood Management Program in California

Visiting Scholar – Spain: *Consejo Superior de Investigaciones Cientificas* – Fall 2009

- Conducted field work on research projects in Spanish oak savannas involving tree growth and productivity
- Interviewed Spanish researchers and visited research sites in Andalucia region of Spain

Graduate Student Instructor – American Wildlife: Conservation and Identification – Fall 2008

- Prepared and revised lectures and exams, teaching ~50 students about 180 wildlife species and their conservation
- Due to unexpected absence of professor, doubled anticipated GSI responsibilities to keep course on schedule

INDEPENDENT ENVIRONMENTAL CONSULTING — **May 2009 – Present**

Renewable Energy Environmental Impact Review

- Evaluate environmental impacts for solar mega-projects in Mojave Desert on BLM land and geothermal power plant at "The Geysers" of Sonoma County; research and evaluate claims of impacts to special status plant and wildlife species; evaluate survey techniques; assess wildlife corridor needs
- Attend hearings and submit data requests and testimony to California Energy Commission to ensure thorough consideration of environmental impacts

POINT REYES NATIONAL SEASHORE — **Point Reyes National Seashore, California**
University of California, Berkeley, and National Park Service — **December 2007 – March 2008**

Graduate Research Fieldwork

- Investigated the mechanisms driving the population dynamics of wild free-ranging tule elk

- Utilized radio telemetry to conduct relocations of radio-collared tule elk; conduct field necropsies of tule elk; collect elk fecal samples to examine diet, stress levels, and disease prevalence

HILL & KNOWLTON — **San Francisco, California**
Global Public Relations and Public Affairs Consultancy — **May 2007 – December 2007**

Senior Account Executive

- Consulted for diverse group of clients including Hewlett-Packard, Qualcomm, University of California (UC) Medical Centers, Natural Selection Foods, and the Kauffman Foundation
- Developed crisis communications strategy and proactive messaging for food safety emergencies
- Managed news announcements from conception to execution including: identified target audience and publication; performed competitive and industry research; conducted outreach; and developed written materials
- Wrote and posted updates and fliers online about union negotiations for 19,500 employees in UC Medical Centers
- Developed, promoted, and managed www.ucnurses.com and www.ucpatientcaretechs.com
- Managed $300,000 public relations budget for one client

UNITED STATES DEPARTMENT OF JUSTICE — **San Francisco, California**
U.S. Attorney's Office – Northern District of California — **September 2004 – April 2007**

Spokesman -- Public Affairs Officer

- Drafted public statements, op-eds, letters to editors, award nominations and press releases (over three per week)
- Advised and strategized with top management in creating and disseminating message to the media
- Issues included: Steroids and perjury investigations into athletes (Balco), California leopard shark poaching and a $1.5 million partnership for rehabilitation, stock options backdating, Enron and Reliant energy market fraud
- Prepared management for interviews with reporters: created briefing memos, talking points, Q&As, and fact sheets
- Organized and moderated press conferences: determined message, briefed speakers, and led preparatory meetings
- Fielded approximately 15-25 media inquiries daily; explained office work & initiatives in on-the-record interviews
- Conducted on-camera media interviews; attended Justice Department training for on-camera interviews
- Crisis response team: responsible for coordinating media response across multiple government agencies
- Initiated and implemented student intern program: interviewed, trained, and managed interns
- Involved in front page coverage in the *Wall Street Journal*, *New York Times*, *San Francisco Chronicle* and others
- Featured in San Francisco Examiner profile

UNITED STATES DEPARTMENT OF JUSTICE — **Washington, DC**
Office of Public Affairs and Antitrust Division — **August 2002 – September 2004**

Press Assistant – Antitrust Division, 2003-2004: Created media briefs; provided public affairs support for *U.S. v. Oracle* antitrust trial; assisted with organization of press conferences for Attorney General John Ashcroft

Paralegal Specialist, 2002-2003: Drafted detailed investigative reports for antitrust investigations; appointed lead paralegal for three multi-billion dollar transactions in the defense, turbine, and waste industries

PHILMONT BACKPACKING RANCH — **Cimarron, New Mexico**
Boy Scouts of America — **Summers of 1999 and 2001**

Program Counselor: Taught Boy Scouts about Native American and pioneering traditions of the Southwest
2001 – Pioneering: Certified muzzleloader rifle instructor; taught blacksmithing; lived in primitive cabin conditions;
1999 – Native American Tradition: Arrowhead-making, teepees, sweat lodges, Native American cultural traditions

PUBLICATIONS, ACHIEVEMENTS, ORGANIZATIONS, INTERESTS

- National Science Foundation Graduate Research Fellowship Program – Honorable Mention 2010
- Invertebrate Analysis in *East Bay Regional Parks Annual Monitoring Report*. UC Berkeley. 2009.
- Outstanding Graduate Student Instructor Award - Fall 2008
- 2008 Range Management Scholarship Award
- Wildlife Society: Webmaster of San Francisco Bay Area Chapter 2009-2011
- Eagle Scout
- Biking, hunting, archery, surfing, hiking, fishing, backpacking, skiing, archaeology
- Fluent in Spanish: comprehension, speaking, reading, and writing

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Review

A review of mitigation measures for reducing wildlife mortality on roadways

David J. Glista [a], Travis L. DeVault [b,*], J. Andrew DeWoody [c]

[a] Indiana Department of Transportation, Office of Environmental Services, Ecology Unit, 100 North Senate Avenue, IGCN, Room N642, Indianapolis, IN 46204, USA
[b] United States Department of Agriculture, Wildlife Services, National Wildlife Research Center, 5757 Sneller Road, Brewerton, NY 13029, USA
[c] Department of Forestry and Natural Resources, Purdue University, 195 Marsteller Street, West Lafayette, IN 47907, USA

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ABSTRACT

A growing literature in the field of road ecology suggests that vehicle/wildlife collisions are important to biologists and transportation officials alike. Roads can affect the quality and quantity of available wildlife habitat, most notably through fragmentation. Likewise, vehicular traffic on roads can be direct sources of wildlife mortality and in some instances, can be catastrophic to populations. Thus, connectivity of habitat and permeability of road systems are important factors to consider when developing road mortality mitigation systems. There are a variety of approaches that can be used to reduce the effects of roads and road mortality on wildlife populations. Here, we briefly review wildlife-crossing structures, summarize previous wildlife road mortality mitigation studies, describe common mitigation measures, and discuss factors that influence the overall effectiveness of mitigation strategies. Because there are very few road mortality studies "before" and "after" the installation of wildlife-crossing structures, their efficiency is nearly impossible to evaluate. However, simple and relatively inexpensive measures reviewed herein can almost certainly reduce the number of collisions between wildlife and automobiles.

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Contents

1. Introduction

Although roads provide some ecological benefits, such as maintenance of grassland plants in intense agricultural areas (Forman, 2000), they also can act as both physical and biological barriers to many wildlife species (Forman and Alexander, 1998; Jackson, 2000). Roads can affect the quality and quantity of available wildlife habitat, most notably through fragmentation. Likewise, vehicular traffic on roads can be direct sources of wildlife mortality, and in some instances, can be catastrophic to animal populations (Langton, 1989a). Many other ecological effects of roads on species, soils, and water have been identified, with effects varying in distance outward from meters to kilometers (Ellenberg et al., 1991; Forman, 1995). "Road-effect zones" impact an estimated 15–20% of the land mass in the United States (Forman and Alexander, 1998).

Collisions with automobiles are a major source of direct mortality in some animal populations (Romin and Bissonette, 1996; Trombulak and Frissell, 2000; Gibbs and Shriver, 2002; Glista et al., 2008). Lalo (1987) estimated vertebrate mortality on roads in the United States at 1 million individuals per day. A variety of mitigation approaches are used to reduce the effects of roads and road mortality on wildlife populations. In general, these approaches fall into one of two categories: the modification of motorist behavior and/or the modification of animal behavior. Modification of motorist behavior often involves speed limits, lights, and signs, whereas modification of animal

* Corresponding author. Tel.: +1 315 698 0940; fax: +1 315 698 0943.
E-mail address: Travis.L.DeVault@aphis.usda.gov (T.L. DeVault).

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behavior often involves habitat alterations and/or installation of wildlife-crossing structures (Romin and Bissonette, 1996; Forman et al., 2003). Wildlife-crossing structures range from exclusion fences and culverts to overpass/underpass systems (Romin and Bissonette, 1996). Many structures are designed to reduce large animal–vehicle collisions (Forman et al., 2003). Such structures should be designed to allow safe passage for animals, promote habitat connectivity, be accessible, and encourage natural movements.

Unfortunately, the frequency at which road mortality mitigation measures are implemented does not correlate with their perceived effectiveness; the most promising measures often are the least used. For example, Romin and Bissonette (1996) reported that many U.S. states used wildlife-crossing signs and public awareness programs to reduce automobile collisions with large animals, although most state natural resource agencies admitted that the effectiveness of such measures was largely unknown to them. Conversely, relatively few U.S. states used fences, overpasses, and underpasses to reduce collisions, even though most agencies that used them reported that these structures were effective. Undoubtedly, economic factors often dictate the choice of road mortality mitigation measures that are implemented. Moreover, evaluations of mitigation success often are based on opinion rather than research (Forman et al., 2003). Poor road mortality mitigation designs do little to minimize road effects on wildlife and are generally a waste of time and money. Furthermore, poorly designed structures can interrupt natural processes that can lead to various ecological problems such as overgrazing, increased erosion, or population declines (Forman et al., 2003).

A growing literature in the field of road ecology suggests that vehicle/wildlife collisions can be major sources of vertebrate mortality and thus potentially limit wildlife populations (Aresco, 2005). For example, one recent study documented nearly 10,000 mortality events over 17 months at a single site (Glista et al., 2008). Mitigation measures that potentially reduce such collisions have been developed, and transportation officials should be aware of methods to reduce wildlife mortality on roadways. In this review, we summarize previous wildlife road mortality mitigation monitoring studies, describe some of the most common mitigation measures employed, and discuss factors that lead to the overall effectiveness of road mortality mitigation measures (Table 1).

2. Types of crossing structures

Pipe culverts are relatively small structures (0.3–2 m diameter) made of concrete, smooth steel, or corrugated metal designed to carry water under roads. Europe has led the way in implementing smaller pipe-style culverts, also referred to as "amphibian tunnels" (Forman et al., 2003; Fig. 1). Box culverts, generally larger than pipe culverts, also are used to allow water to pass under roads. Unlike pipe culverts, they usually remain dry except in periods of heavy runoff. Culverts may be used by a variety of wildlife species to cross roads (Yanes et al., 1995; Rodriguez et al., 1996; Clevenger and Waltho, 2000). Kaye et al. (2005) reported that spotted turtles (*Clemmys guttata*, a state threatened species) used a box culvert under a highway improvement project to move between two habitats in MA, United States. The use of a system consisting of a retaining well, box culverts, and pipe culverts reduced wildlife road mortality by 93.5% in the Paynes Prairie State Preserve, FL, United States (Dodd et al., 2004). Clevenger et al. (2001) monitored 36 culverts along the Trans-Canada highway and found a total of 618 crossings by a minimum of 9 species, with an average of 2.8 species at each culvert. In Australia, Taylor and Goldingay (2004) recorded 17 different vertebrate species

Fig. 1. Amphibian tunnel for mitigating road mortality (Federal Highway Administration, 2002).

using purpose-built fauna culverts in combination with exclusion fencing under the Pacific Highway. Of all wildlife-crossing structures, culverts may be one of the most economical. Furthermore, with some modification (e.g., the addition of drift fences, habitat modification at entrances, incorporation of dry ledges in culverts frequently inundated with water), preexisting culverts often may be used as crossings. A drawback to some culverts is that their size may not promote use by larger animals. Also, care must be taken to ensure that culverts remain open for animals to use.

Wildlife underpasses, also known as wildlife bridges, are large underpasses that provide a relatively unconfined passage for wildlife (Jackson and Griffin, 2000). Where roads cross over water or other roads, underpasses can provide a passageway for many wildlife species, especially those that use riparian corridors. In situations where underpasses hold excessive amounts of water, ledges can be incorporated into their designs to allow animal passage. Veenbaas and Brandjes (1999) reported that mammals used all (100%) existing highway underpasses along waterways, and 75% of underpasses were used by amphibians. Underpasses with the largest diameters were used most frequently by mammals; this relationship did not hold for amphibians. Passages with extended banks were used by more species overall. Some advantages to underpasses are that they can utilize natural terrain features to promote animal crossings and can accommodate a greater variety of species. Unfortunately, underpasses can be expensive due to construction costs, such as in instances where they must span large riparian areas.

Overpasses for wildlife are primarily designed for larger animals such as large carnivores and ungulates. They can range in width from 30 to 50 m to over 200 m on each end (Jackson and Griffin, 2000; Forman et al., 2003). Overpasses are sometimes referred to as "green bridges", a term used to describe wildlife overpasses with relatively large strips of natural vegetation crossing over roads (Bekker et al., 1995). "Landscape connectors" are especially wide overpasses that maintain the connectivity of horizontal ecological flows across the landscape (Forman et al., 1997). Wildlife overpasses accommodate a larger variety of species than do underpasses (Jackson and Griffin, 2000).

Van Wieren and Worm (2001) reported that a wildlife overpass in the central Netherlands was used frequently by large mammals, specifically red deer (*Cervus elaphus*) and wild boar (*Sus scrofa*). They also noted that animal crossings had increased almost threefold since previous monitoring in 1989 and suggested that the increase was due to habituation of red deer to the structure. Keller (1999) also noted that ungulates, most notably roe deer

Table 1
Wildlife passage monitoring studies (modified from Forman et al., 2003).

Study	Mitigation measure(s)	Location	Target species (or group)	Monitoring duration	Species encountered
AMBS Consulting (1997)[a]	Underpasses	New South Wales, Australia	Unspecified	9 months in 1997	Unspecified
Aresco (2005)	Drift fence and culverts	FL, USA	Reptiles and amphibians	April 2000–November 2003	Reptiles and amphibians
Ballon (1985)[a]	Unspecified	Upper Rhine, France	Unspecified	9 months in 1985	Ungulates
Cain et al. (2003)	Bridges and culverts	TX, USA	Bobcats	August 1997–May 1999	Bobcats
Clevenger (1998)[a]	Underpasses and overpasses	Alberta, Canada	Unspecified	January 1998–December 1998	Large mammals
Clevenger and Waltho (1999)	Dry drainage culverts	Alberta, Canada	Small- and medium-sized mammals	74 days in late winter/early spring	Weasels
Clevenger and Waltho (2000)[a]	Underpasses and culverts	Alberta, Canada	Large mammals	January 1995–March 1996, November 1996–June 1998	Elk
Clevenger and Waltho (2005)	Underpasses and overpasses	Alberta, Canada	Large mammals	November 1997–August 2000	Deer
Dodd et al. (2004)	Culverts	FL, USA	Unspecified	March 2001–March 2002	Southern leopard frogs
Donaldson (2005)	Underpasses	VA, USA	Large mammals	June 2004–May 2005	White-tailed deer
Fitzgibbon (2001)	Culverts	Vancouver, Canada	Amphibians and small mammals	2000	Weasels
Foresman (2001)	Culverts	MT, USA	Small mammals	January 2001–August 2001	Unspecified
Foster and Humphrey (1995)[a]	Underpasses	FL, USA	Florida panthers	2 months, 16 days in 1995	Medium- to large-sized mammals
Hunt et al. (1987)[a]	Tunnels	New South Wales, Australia	Unspecified	2 months in 1987	Small- to medium-sized mammals
Jackson (1996)	Amphibian tunnels	MA, USA	Spotted salamanders	Spring 1998	Spotted salamanders
Jackson and Tyning (1989)[a]	Drift fences and tunnels	MA, USA	Spotted salamanders	1988	Spotted salamanders
Jones (2000)	Reflectors, ramps, and pipes	Tasmania	Eastern quolls, Tasmanian devils	October 1990–April 1993	Unspecified
Kaye et al. (2005)	Culverts	MA, USA	Spotted turtles	April 2004–July 2004	Unspecified
Keller (1999)	Overpasses	Switzerland, Germany, France, and Netherlands	Unspecified	Unspecified	Roe deer
Land and Lotz (1996)[a]	Underpasses	FL, USA	Florida panthers	Unspecified	Raccoons, white-tailed deer
Langton (2002)	Amphibian tunnels	England	Amphibians	Unspecified	Common toad
LaPoint et al. (2003)	Various under-road passages	NY, USA	Unspecified	March 2002–April 2002	Raccoons
Lesbarreres et al. (2004)	Amphibian tunnels	France	Common toad, water frogs, agile frogs	February 2001–May 2001	Water frogs, common toads
Pfister et al. (1997)[a]	Overpasses	Switzerland, Germany, France, Netherlands	Unspecified	2 years	Mammals
Puky and Vogel (2003)	Various types of passages	Hungary	Amphibians	Unspecified	Unspecified
Reed et al. (1975)[a]	Underpasses	WY, USA	Deer	2 years	Ungulates
Rodriguez et al. (1996)[a]	Culverts, underpasses, and overpasses	Montes de Toledo, Spain	None	September 1991–July 1992	Small mammals
Roof and Wooding (1996)[a]	Underpasses	FL, USA	Black bears	December 1994–December 1995	Rabbits
Rosell et al. (1997)[a]	Underpasses	Catalonia, Spain	Unspecified	11 months in 1997	Unspecified
Taylor and Goldingay (2004)	Culverts	New South Wales, Australia	Unspecified	Spring/summer 2000	Bandicoots
Van Wieren and Worm (2001)	Overpasses	Netherlands	Mammals	1989, 1994, 1995	Red deer
Veenbaas and Brandjes (1999)[a]	Various types of passages	Netherlands	Unspecified	Unspecified	Mice, voles
Woods (1990)[a]	Underpasses	Alberta, Canada	Unspecified	3 years	Ungulates
Yanes et al. (1995)[a]	Culverts	Central Spain	None	Four seasonal periods over 1 year	Small mammals

[a] Cited in Forman et al. (2003).

(*Capreolus capreolus*), were the most frequent users of wildlife overpasses in Switzerland, Germany, France, and the Netherlands. At two overpass structures in Banff National Park, Canada, along the Trans-Canada Highway, Clevenger and Waltho (2005) reported that elk (*Cervus elaphus*) and deer (*Odocoileus* spp.) were large mammals that most frequently used the structures. Some advantages of overpasses are that they are less confining, quieter, maintain ambient conditions of rainfall, temperature, and light, and can serve as both passageways for wildlife and intermediate habitats for smaller animals (e.g., small mammals, reptiles, and amphibians) (Jackson and Griffin, 2000). One of the drawbacks of overpasses is that they often are the most expensive option due to their large size and construction costs.

3. Factors influencing the effectiveness of crossing structures

Several factors affect the ability of a crossing structure to facilitate wildlife movements. Location of crossing structures is very important and may be the most important factor predicting effectiveness (Podloucky, 1989; Foster and Humphrey, 1995; Yanes et al., 1995; Land and Lotz, 1996; Rodriguez et al., 1996; Clevenger and Waltho, 2000). Location is especially vital for smaller, less mobile species such as reptiles and amphibians (Jackson and Griffin, 2000). Rodriguez et al. (1996) suggested that crossing structures should be placed in areas of suitable habitat and that passages implemented near continual disturbance (e.g., excessive human presence) were less frequently used by several wildlife species (e.g., carnivores and ungulates).

The dimensions of structures are also important in designing passageways for vertebrates (Ulbrich, 1984; Ballon, 1985 [as cited in Yanes et al., 1995]). The size and shape of a particular structure may be the determining factor for crossing success (Reed et al., 1975; Ballon, 1985; Cain et al., 2003; Clevenger and Waltho, 2005). In Europe, hourglass-shaped overpasses are used regularly by wild boar, but not by red deer that become unnerved or frightened by the constriction at the center (Vassant et al., 1993 [as cited in Forman et al., 2003]). For some species, the relative openness in a passage may be more important than overall size (Foster and Humphrey, 1995; Clevenger and Waltho, 2005). Structures along the Trans-Canada Highway with high openness ratios (short in length, high and wide) were used most often by grizzly bears (*Ursus arctos horribilis*), wolves (*Canis lupus*), elk, and deer, whereas more constrictive structures were used more often by black bears (*Ursus americanus*) and cougars (*Felis concolor*) (Clevenger and Waltho, 2005). Tunnels that allow animals to see the other end were positively correlated with use by some species (Rosell et al., 1997 [as cited in Jackson and Griffin, 2000]). Conversely, some studies (Rodriguez et al., 1996; Clevenger and Waltho, 1999) have suggested that smaller passages may be better for some small mammals. There is some evidence that predators use crossing structures to increase prey capture (Hunt et al., 1987; Foster and Humphrey, 1995), which can limit the use of crossing structures by prey species. Culverts and underpasses that are exposed, restricted, or narrow may reduce the effectiveness of escape mechanisms of prey species (Reed et al., 1975; Yanes et al., 1995; Clevenger et al., 2001).

Approaches to structures also can affect their use by animals (Veenbaas and Brandjes, 1999; Clevenger and Waltho, 2000). The availability of cover (or lack thereof) at the approach to a crossing structure can determine whether a particular species will use it. Natural vegetation can enhance the "attractiveness" of crossing structures to animals and allow a continuity of habitat. Cover may influence the use of crossings by small to mid-sized mammals (Hunt et al., 1987; Rodriguez et al., 1996; Clevenger and Waltho, 1999), but deter other species like deer and other ungulates if it restricts their vision (Pedevillano and Wright, 1987; Clevenger and Waltho, 2000).

The use of fencing and/or barrier walls in conjunction with passages can help prevent animal access to roads and facilitate movement of animals towards crossing structures (Ratcliffe, 1983; Feldhamer et al., 1986; Jackson and Tyning, 1989; Jackson, 1996; AMBS Consulting, 1997; Bissonette and Hammer, 2000; Jackson and Griffin, 2000; Dodd et al., 2004). A barrier wall in conjunction with a culvert system was effective in reducing wildlife road mortality 93.5% in the Paynes Prairie State Preserve, Florida (Dodd et al., 2004). For many larger species, fencing is necessary because of their inherent avoidance of passages. Many ungulates avoid underpasses unless there is no other way to cross a road (Ward, 1982) and mountain lions traveling along streams are known to leave the stream and cross over highways rather than use under-road culverts (Beier, 1995). Fencing in the absence of crossing structures, however, can be detrimental, because it can act as a barrier to natural movements and contribute to habitat fragmentation (Jaeger and Fahrig, 2004). Fencing should extend far enough to either side of a crossing structure to promote guidance to the structure. The length of fencing often is dictated by the target species and the surrounding terrain. Because there is no universal design that works well for all roads, we recommend that transportation officials work with wildlife biologists to customize fencing regimes.

Moisture, temperature, light, substrate, and noise (disturbance) all can influence whether animals will use wildlife passages (Langton, 1989b; Mansergh and Scotts, 1989; Beier, 1995; Yanes et al., 1995; Jackson, 1996). Amphibians generally require moist conditions during migration, thus designing passages to allow rain to moisten the passage may be important (Jackson, 1996). Langton (1989b) reported that temperature differences between the interior and exterior of culverts may dissuade use by some amphibian species. The ability of air to flow freely through a passage (e.g., by using grate tops rather than solid tops) may help negate temperature differences and allow freer use by a wider range of species. Moreover, open tops will allow more ambient light to enter crossing structures. Jackson and Tyning (1989) noted that increased natural light in tunnels accelerated the rate at which spotted salamanders (*Ambystoma maculatum*) would cross. Conversely, artificial light often may deter animals from using a crossing structure (Reed, 1981; Jackson, 2000).

The inclusion of a natural substrate within a crossing structure can provide continuity of habitat and may encourage animals to pass (Yanes et al., 1995; Jackson, 2000). In controlled experiments between bare concrete tunnels, soil-lined tunnels, and open grass, Lesbarreres et al. (2004) found that water frogs (*Rana esculenta*) and common toads (*Bufo bufo*) preferred the tunnels to the grass, whereas agile frogs (*Rana dalmatina*) preferred grass. Use and crossing success were both higher in the soil-lined tunnel. Mougey (1996) suggested that frogs are deterred from bare concrete due to its alkalinity. Juvenile western toads (*Bufo boreas*) and red-legged frogs (*Rana aurora*) showed greater movement in culverts with substrate as opposed to culverts without (Bernard, 2000 [as cited in Fitzgibbon, 2001]).

Noise levels (e.g., traffic) can influence animal use of crossing structures (Clevenger and Waltho, 2000, 2005; Jackson, 2000). In Banff National Park, Canada, carnivore and ungulate movements through passages near the town of Banff were significantly affected by human activity and noise (Clevenger and Waltho, 2000). As such, planners should consider the use of noise-reducing materials during construction of crossing structures.

4. Nonstructural methods

Financial considerations are often a major concern when considering the implementation of wildlife road mortality mitigation measures. Cost can be extremely variable depending on the method chosen, availability of materials, and scale of the project. Usually, however, nonstructural methods are less expensive than structural methods. Bank et al. (2002) reported on a variety of nonstructural methods of road mortality mitigation currently being researched in Europe. These include: (1) olfactory repellents whereby scented foam is sprayed on vegetation and structures along the road, (2) ultrasound, (3) road lighting (which may have negative consequences for nesting birds), (4) population control (e.g., hunting), and (5) habitat modification, used primarily to keep animals away from roads or increase driver and animal visibility. Development of less expensive alternatives to expensive structures (e.g., overpasses) would allow wider use and promote permeability of road corridors (Forman et al., 2003). Biological consequences of nonstructural methods are not well understood, and more research is needed to ascertain their effectiveness.

Although it is impossible to predict exactly where and when animals will appear on roads, motorists who are aware of the potential for animal crossings can sometimes help mitigate wildlife road mortality. The use of signs and/or speed bumps to reduce speed and enhancing speed limit enforcement may help reduce road mortality of wildlife in areas of known animal crossings. High-speed traffic is often considered one of the main causes of wildlife–vehicle collisions (Pojar et al., 1975; Case, 1978). Wildlife-crossing signs also can be installed in areas of intense animal activity to help make drivers more aware of wildlife presence, although their effectiveness is questionable (Pojar et al., 1975; Aberg, 1981 [as cited in Groot Briunderink and Hazebroek, 1996]). Even stuffed mule deer (*Odocoileus hemionus*) placed in road rights-of-way failed to evoke a reaction from many drivers (D.F. Reed, personal communication [as cited in Groot Briunderink and Hazebroek, 1996]), suggesting that traffic control is one of the most difficult options in wildlife road mortality mitigation.

5. Mitigation for birds

Although most wildlife road mortality mitigation measures focus on mammals, reptiles, and amphibians, roads also can affect birds through fragmentation, isolation, and direct mortality. Although most birds possess the ability to fly over roads rather than walk or run across them, they also have some unique problems. Birds often define territories by the use of songs, and if those songs cannot be heard over (or are distorted by) vehicular traffic noise, males may find it difficult to attract and keep mates (Ferris, 1979; Reijnen et al., 1995). Traffic noise could potentially force males to conduct wider searches for females and bring them closer to roads. Many migrating species rely on starlight navigation (Emlen, 1975), thus light pollution from a variety of sources, including highway lighting, may cause birds to become disoriented, resulting in collisions with automobiles (Ogden and Evans, 1996). Non- or low-flying birds (e.g., quail, turkeys, owls), birds that forage at ground level, and scavengers are even more susceptible to road mortality because of their habits (Stoner, 1925). Therefore, birds present several road mortality mitigation challenges compared to other vertebrates. Jacobson (2005) addressed several of these problems and suggested possible solutions, including the reduction of noise and light pollution.

6. Conclusions

Everyone (transportation officials, wildlife biologists, the general populace) can agree that collisions between vehicles and wildlife are undesirable. Unfortunately, the reduction of such collisions is difficult and nuanced because of many factors, including economics, human attitudes, and wildlife biology. The inherent problem when designing effective wildlife-crossing structures concerns the need to accommodate high priority species while maintaining an economic and structurally sound building plan. When possible, target sites for road mortality mitigation should be identified *a priori* in consultation with transportation planners and wildlife biologists, but more often are identified *a posteriori*. Either way, mitigation approaches usually are targeted for a particular species or group of organisms. Although many studies have reported on the use of various structures for reducing road mortality, relatively few have measured the success of such structures. As such, more research is needed concerning the effectiveness of various road mortality mitigation programs. Although specific recommendations are best made in consultations among planners, engineers, and local biologists, we provide below some general recommendations regarding wildlife collision reduction:

(1) Preconstruction planning is generally more economical than retrofitting existing roads and potentially could be considered during environmental impact assessments.
(2) Connectivity of habitat and permeability of road systems are important factors.
(3) Financial considerations may dictate nonstructural approaches to collision reduction, but structural methods are probably more effective (and more expensive).
(4) Finally, the efficiency of road mortality mitigation approaches should be determined via a post-implementation monitoring program.

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CASA DIABLO GEOTHERMAL DEVELOPMENT PROJECT:

DEER MIGRATION STUDY, SPRING 1987

Thomas E. Kucera

INTRODUCTION

A proposal has been made to develop a geothermal electric generating plant in the southwest portion of Long Valley in Mono County, California. The development, known as the Casa Diablo Geothermal Project, has raised concerns with respect to potential deleterious impacts on migratory mule deer (Odocoileus hemionus) which use the project area and vicinity. The Biotic Assessment of the project prepared in January 1987 was considered by the management agencies involved to be deficient in data on migratory mule deer in the area. The present investigator was subsequently contracted to gather data to allow an assessment of the importance of the area to migratory deer through an annual cycle, i.e., spring, summer and fall. No wintering activity is to be expected. This report concerns only the period of spring migration.

This part of the Eastern Sierra Nevada is known for its visual and biological resources, and the quality of the natural environment. Among the most important components of this natural environment, symbolically, esthetically and economically, are the impressive numbers of mule deer. Only in the last three years has intensive ecological research on these animals been conducted. It is now known that more than half of the 6000 deer which winter near Bishop migrate to the north and pass near the town of Mammoth Lakes to get to their summer ranges (Kucera, unpubl.). The annual life cycle of deer in the Eastern Sierra Nevada may be divided into four periods: winter, spring migration and staging, summer, and fall migration. These seasonal movements are a response to the seasonal availability of habitat, and as parts of

a component system, all are important in maintaining deer populations.

Most deer in this part of the Eastern Sierra winter at lower elevations some 20 airline miles to the southeast and east of the proposed geothermal area (Figure 1). Several "herds" as defined by the California Department of Fish and Game (DFG) are of concern in the present situation. These are the Buttermilk and Sherwin Grade herds, which winter in Round Valley, at the base of the eastern escarpment of the Sierra Nevada just west of Bishop, and the Casa Diablo herd, which winters between the Benton Range and the White Mountains, from the Casa Diablo Peak area north past the town of Benton (DFG 1984, 1985a, 1985b).

The spring migration begins in April, when deer leave their winter ranges and move to intermediate altitudes. They congregate in "staging areas" for as long as six weeks, feeding on spring vegetation and regaining condition lost over the winter, until they move to summer ranges. Here, mainly west of the Sierra Crest, fawns are produced and reared. The fall migration back to the winter range typically is more rapid than that of the spring, and usually is patterned by fall storms. Deer arrive on the winter range during September, October and November, breed in December and January, and begin the annual cycle again.

The objective of the present work is to describe and quantify the amount, timing and specific locations of mule deer use of the Casa Diablo Geothermal Project Area ("Study Area") during the Spring 1987 deer migration. This information is designed to meet the information needs of public resource management and planning agencies with respect to baseline

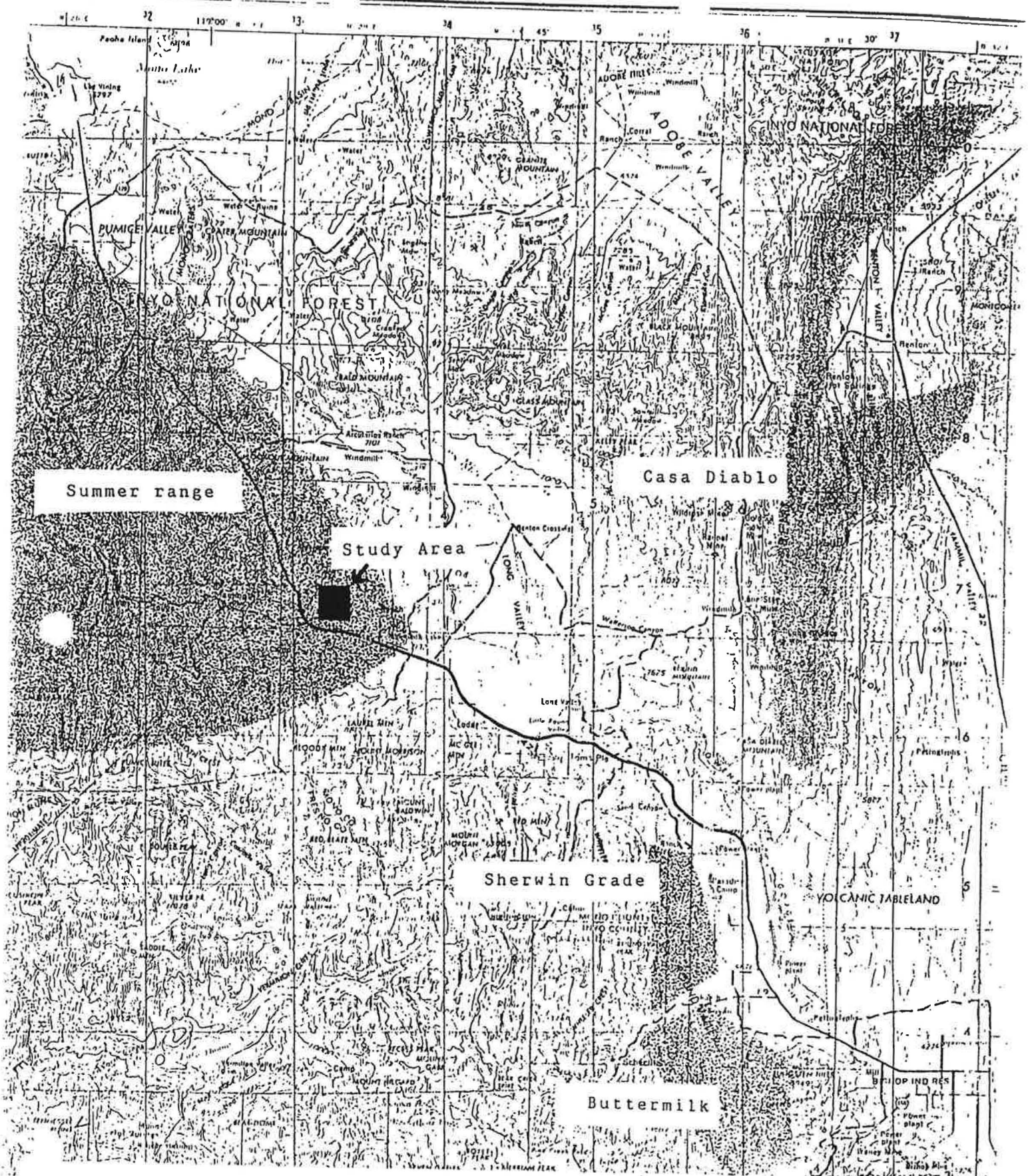


Figure 1. Regional map indicating locations of Buttermilk, Sherwin Grade and Casa Diablo Winter ranges, and approximate summer ranges of deer using the Long Valley area on migration.

conditions in the Study Area, and to assist in assessing impacts to deer of a geothermal development and designing measures to reduce those impacts.

ACKNOWLEDGMENTS

This investigation was conducted under a contract from Environmental Management Associates, Brea CA. Some of the data presented here are from a larger investigation of Eastern Sierra deer supported by the Bishop Resource Area of the Bureau of Land Management, the California Department of Fish and Game, Inyo and Mono Counties, the University of California, Berkeley, and several private funding organizations. Most of the fieldwork was conducted by Timothy Taylor.

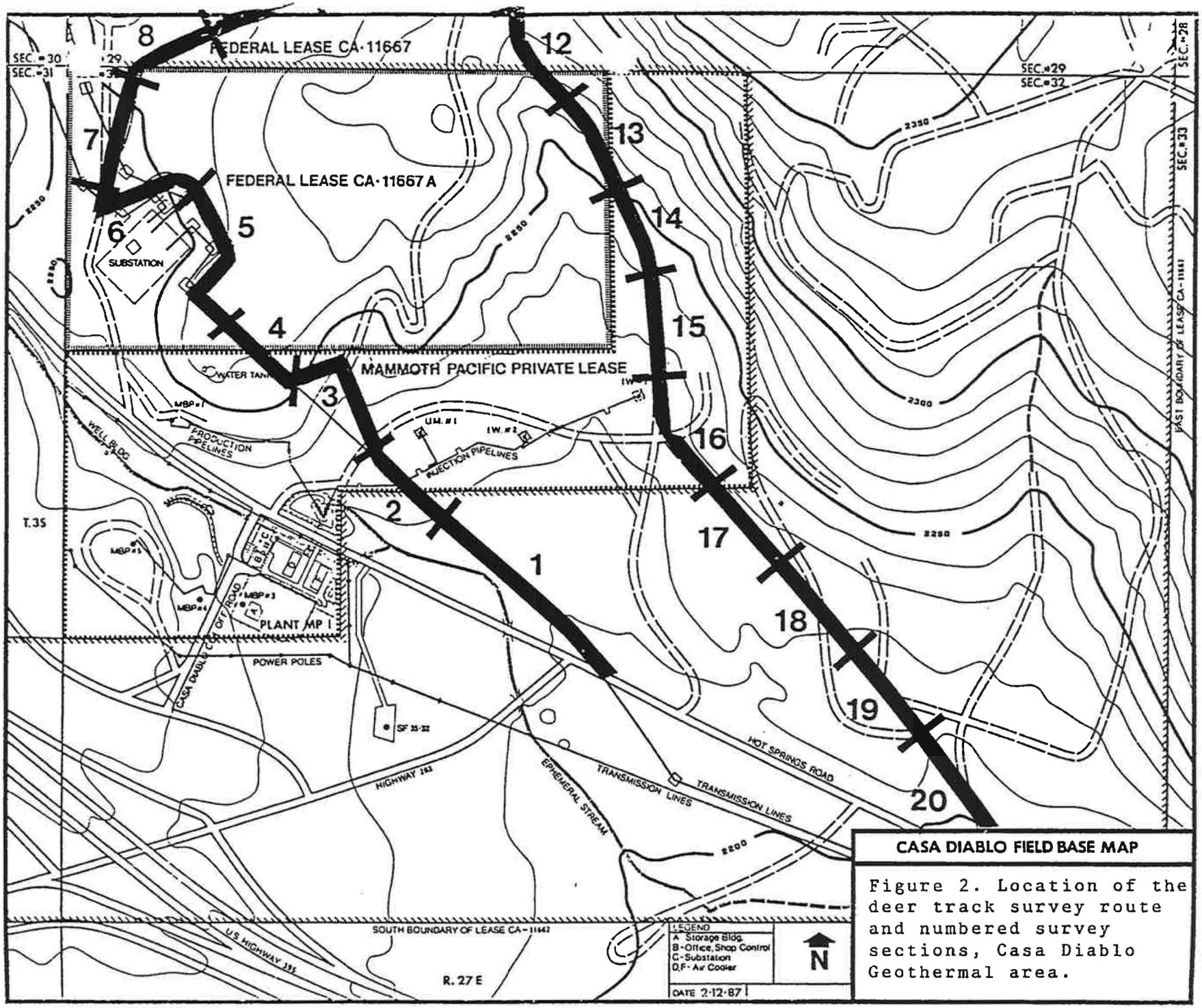
The data in this report are to be used solely for the purposes of planning and analyzing potential environmental impacts of the proposed Casa Diablo Geothermal Project, and are not for publication, citation, or other use without the permission of the author.

STUDY AREA

The Casa Diablo Geothermal Study Area is located in portions of Sections 29 and 32 of T. 3 S, R. 28 E, Mono County, CA (Figure 2). It is immediately north of Highway 395, approximately 3 miles east of the town of Mammoth Lakes. The land is a mixture of both public and private ownership.

METHODS

A track survey route was laid out on the dirt roads which pass through the Study Area (Figure 2). This route was divided and marked into 20 sections each 0.1 miles long except Section 1, which was 0.2 miles long. In adition, the dirt road leading from



CASA DIABLO FIELD BASE MAP

Figure 2. Location of the deer track survey route and numbered survey sections, Casa Diablo Geothermal area.

Hot Springs Road to well SF 35-32 was included in the surveys.

Beginning on 21 April 1987, the entire route was cleared of tracks and a tracking substrate prepared by dragging it with a "sled" of automobile tires pulled by a vehicle. This was done in late afternoon, and the following morning, the route was walked or driven and all deer tracks observed on the road were counted, both by survey section and by direction of travel. Data recorded were the number of individual deer making the observed tracks and their direction of travel. Because the route was dragged each evening before a survey to obliterate all tracks, the tracks counted on the surveys were made by animals within approximately the previous 12-18 hours. Recording tracks by survey section was designed to give a quantitative picture of the local pattern of deer movement in the Study Area. Recording tracks by direction of movement was designed to allow separation of back-and-forth or very localized movements from migrational movements.

RESULTS

1. Timing of deer activity

Figure 3 shows the total number of tracks made by individual deer throughout the period of study, presented without regard to direction of movement. A pattern of a gradual increase in the number of tracks throughout the period is apparent, with the greatest number of tracks counted, 20, on 13 June.

Figure 4 shows the breakdown of tracks counted on the surveys by direction of movement. Movements to the north and west are generally in the direction of the spring migration; those to the south and east west are opposite. Thus, subtracting the south and east-moving tracks from the north and west-moving ones,

Figure 3. Total deer tracks counted on surveys in the PLES geothermal site, Spring 1987.

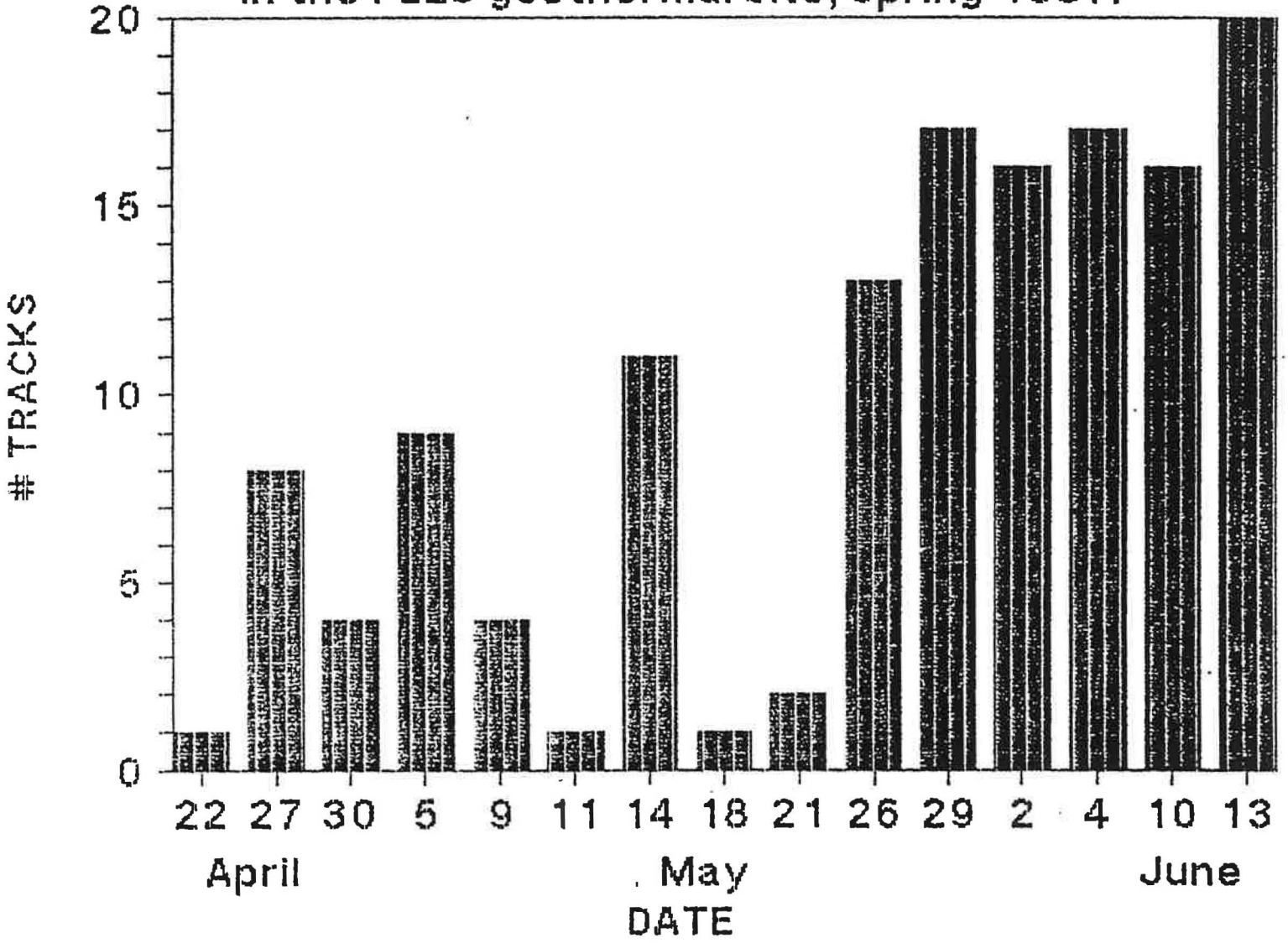
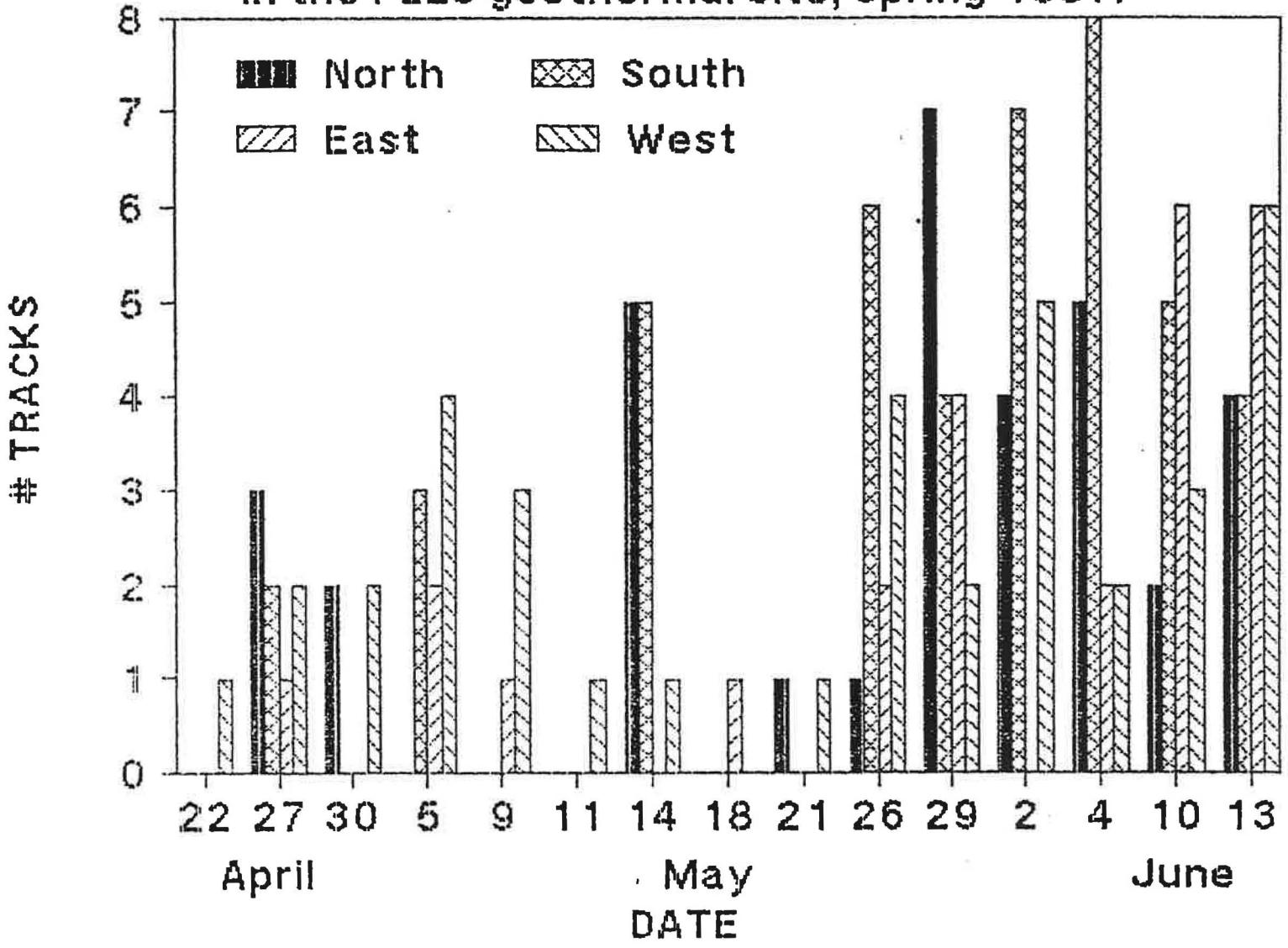


Figure 4. Deer tracks by direction of movement in the PLES geothermal site, Spring 1987.



respectively, yields a crude estimate of the net number of deer moving through between the the dragging of the route and the survey. This is shown in Figure 5, in which the number of tracks heading south was subtracted from those heading north, and the number of tracks heading east was subtracted from those heading west, on each survey. Negative numbers may be interpreted as indicating predominantly localized, nondirectional movements. As indicated in Figure 5, most migrational movements in the Study Area occurred throughout late April and May. Beginning in late May, the negative net track numbers indicate fewer directional or migrational movements and more local movements, likely from deer on what will be their summer range.

2. Locations of deer movements

Figure 6 presents the total number of deer tracks by survey section counted during the spring of 1987. The large number of tracks indicated for Section 1 is somewhat misleading because that section is twice as long as the others. With this in mind, the distribution of tracks in the survey sections appears rather uniform. The net tracks by survey section are presented in Figure 7. No consistent pattern of movements is indicated. It is apparent that directional movements occurred in Sections 8, 10-12 and 18-20, which correspond to the most northerly and northwesterly, and southwesterly portions, respectively, of the Study Area.

Additionally, on the road to well SF 35-32, single sets of west-moving tracks were observed on 10, 18, 21 and 26 May. Throughout the survey period, only two deer were observed; on 4 June, 2 adult females were seen near Sections 10 and 11. No

Figure 5. Net numbers of tracks by direction of movement in the PLES geothermal site, Spring 1987.

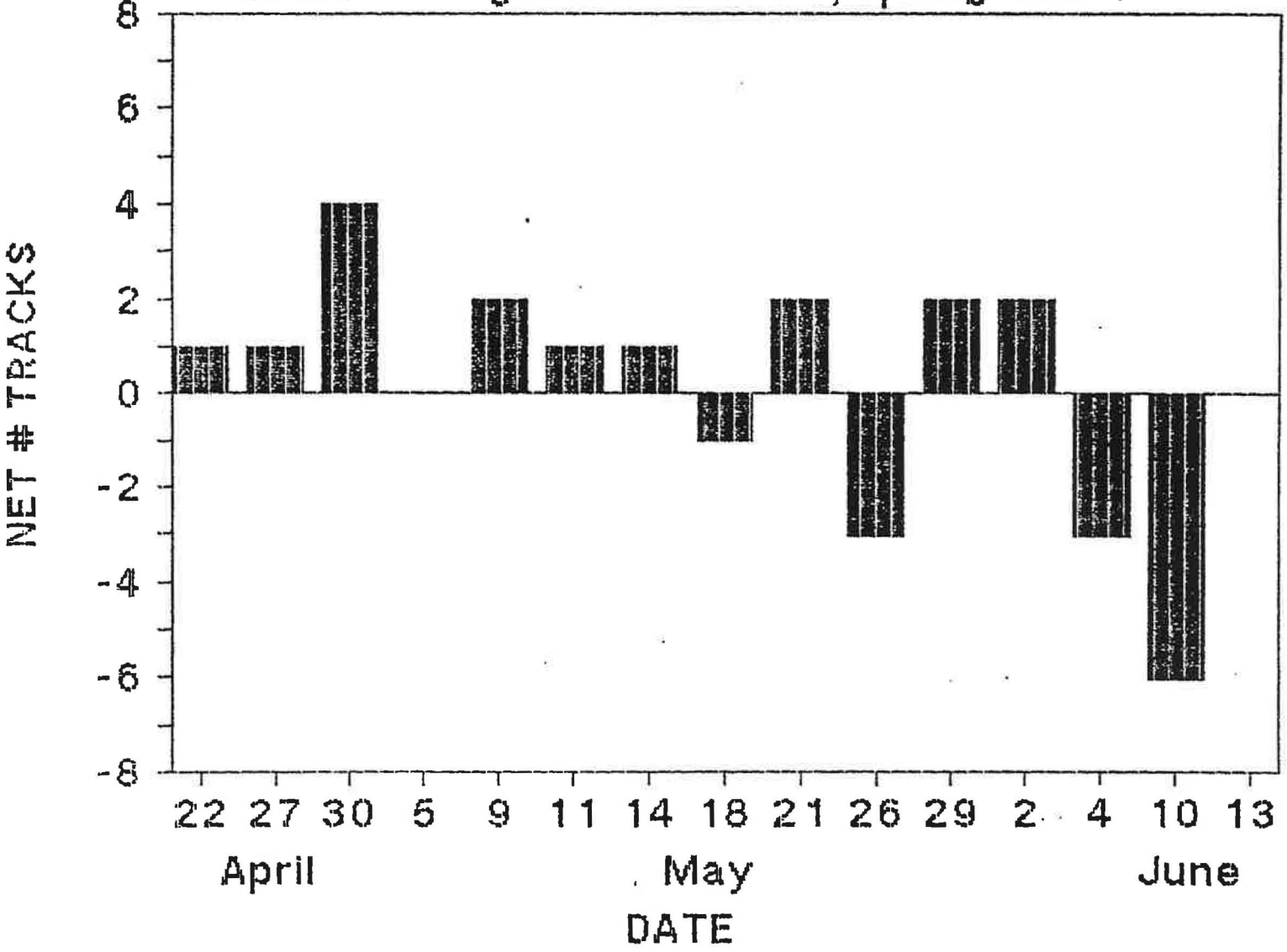


Figure 6. Total numbers of tracks counted by survey section in the PLES geothermal site, Spring 1987.

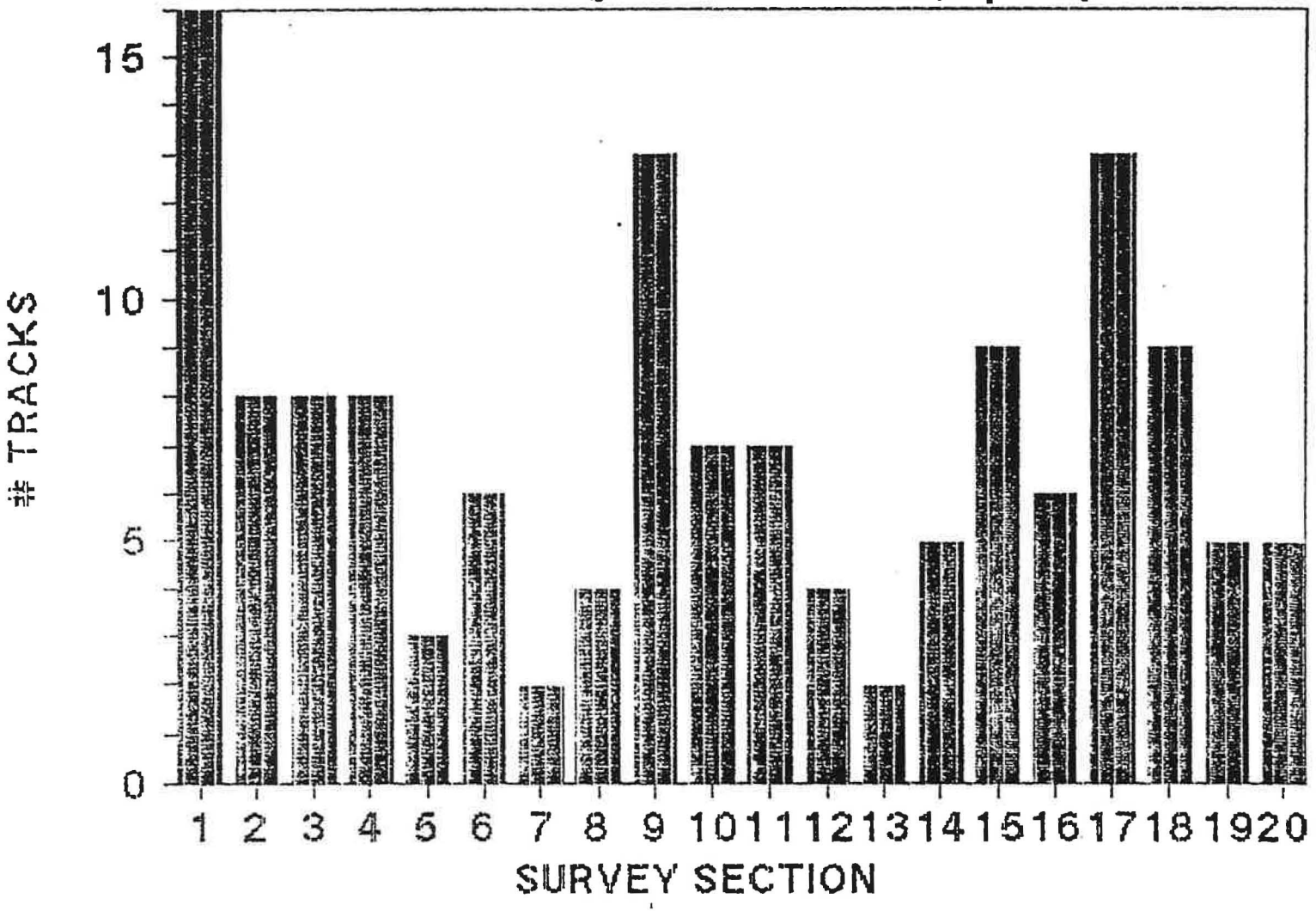
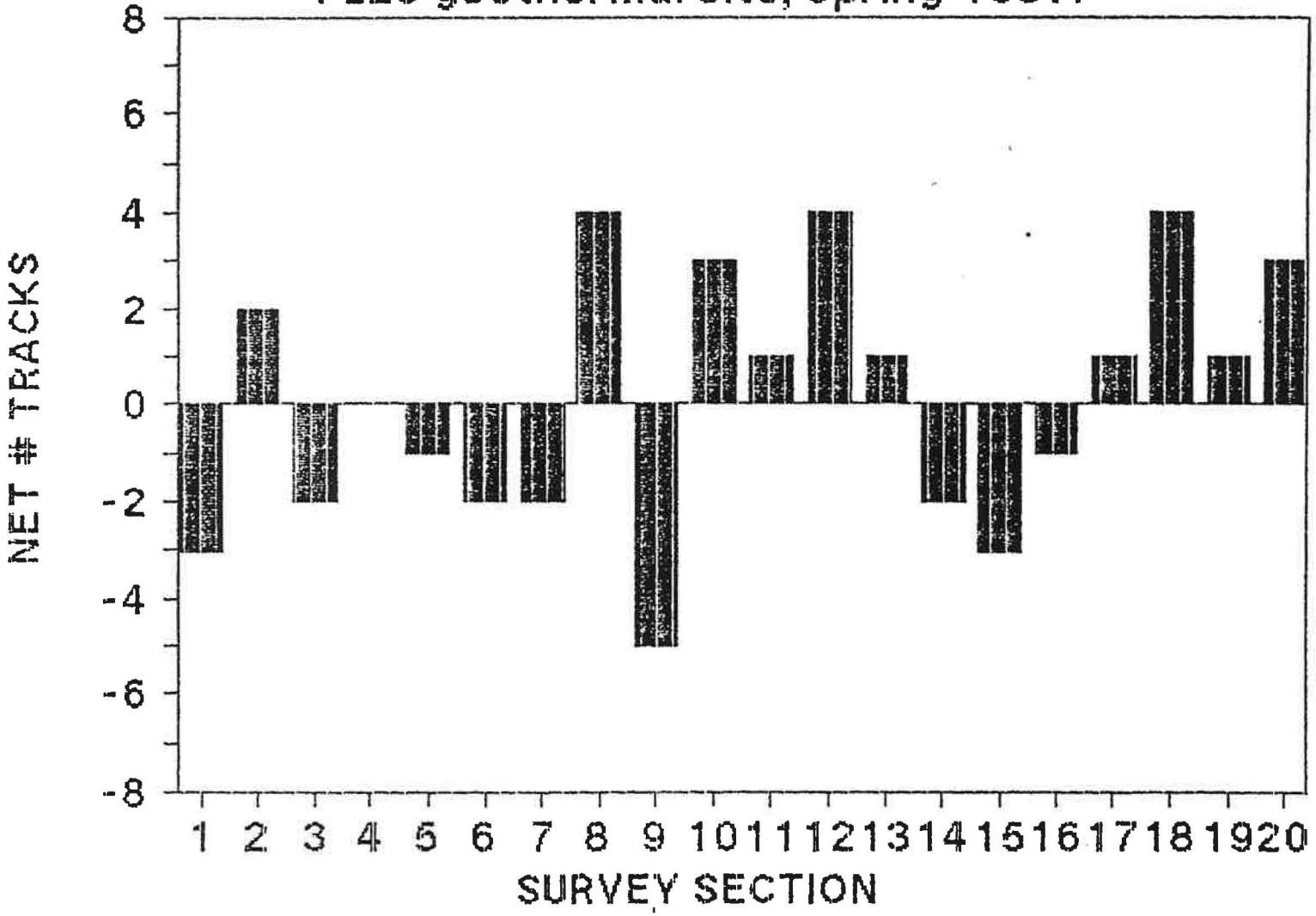


Figure 7. Net numbers of tracks by survey section, PLES geothermal site, Spring 1987.



specific areas of deer movement or well-defined concentration areas were apparent from covering the area on foot.

DISCUSSION

Results of the spring 1987 track surveys indicate a generally somewhat dispersed pattern of deer activity in and movement through the Study Area. No well-defined migration trails were observed, and the track counts indicate deer activity in all sections. One could make the rather weak case that Figure 7 shows a preference for the less developed portions of the area, i.e., Sections 8, 10-13, and 17-20, but the data are hardly compelling.

Nevertheless, deer movement through the area was apparent, and the number of animals involved can be at least roughly estimated. On the assumption that the period of spring migration was 15 April to 2 June, the 12 surveys covered approximately 25% of the 48 days in this period. The net number of tracks during this period was 13 (Figure 5). Assuming this to be a reasonable approximation of the number of deer actually moving through between the time the road was dragged and when tracks were counted the next morning, a total of 52 (13/0.25) deer moved through the Study Area during the survey period. This does not take into account those deer that may have moved through during the day. Making the assumption that 75% of deer would migrate at night (between dragging and counting) and 25% would migrate during the day, a grand total of 69 (45/0.75) deer moving through during the spring period can be estimated, given the stated assumptions.

This estimate of 69 deer is meant only as an approximation of the number of deer using the Study Area on spring migration.

Potential sources of error, e.g., multiple counts of the same animal, or tracks missed because of poor tracking medium, are impossible to quantify. However, the precise number is not important; what matters is the estimate of magnitude. There certainly are not hundreds or thousands of animals using the area, as is the case in other local areas, but likely there are dozens. This movement does not appear to be concentrated in any localized portion of the Study Area, but is dispersed throughout it, which may not be surprising given its relatively small area and lack of extreme topography. It is likely that deer from three designated "herds" are involved: the Buttermilk, Sherwin Grade, and the Casa Diablo herds. Radioed or otherwise marked deer from all three herds have been observed in the vicinity of the Study Area.

Recent radio-telemetry information indicates that, in general, most of the Buttermilk and Sherwin Grade deer which migrate north do so along the base of the mountains west of Highway 395. Likewise, most Casa Diablo deer move along the base of the Glass Mountains northwest of the Study Area. A portion of each herd, however, does move near or right through the Study Area. The specific areas used as migration corridors are probably dictated as such by both local topography and tradition.

Impacts of geothermal development on these migrating deer are difficult to predict precisely, but in a general sense are a function both of the location, amount and kinds of changes associated with the development, and of the availability of potential alternate travel routes. It seems to be the case that deer activity is rather dispersed throughout the area. The

locations of the proposed project facilities (Fig. 8), including a number of proposed wells, pipelines, and a transmission line and access road, as well as the power plant site, in general are adjacent to the existing geothermal plant and facilities. Assuming a "worst case" scenario, one in which deer completely avoid the proposed facilities and associated human disturbance, it is difficult to see how making several dozen deer move several hundred yards around the facilities would constitute a great hardship. Given the existing terrain, such an avoidance would likely have a trivial impact on migrating deer. Of course, certain facilities, e.g., fences, pipelines, etc., could be designed to minimize any impacts to deer and to facilitate their passage.

From the standpoint of deer migration, the locations of the proposed facilities (Figure 8) are preferable to those of the alternate site (Figure 9). This latter alternative would move the power plant to the northeast, across Hot Springs Road, and effectively increase the area impacted by the project. In general, the more concentrated an area of disturbance, the less will be its deleterious impacts.

Thus, at present, alternate routes for spring migration exist, giving deer an opportunity to avoid the project area if developed. However, there are proposals for additional developments in the region. Although it is impossible to discuss thoroughly the impacts of a project without reference to the context in which the project occurs, a regional summary and analysis taking such additional projects into account are not within the scope of the present work. No doubt the consequences

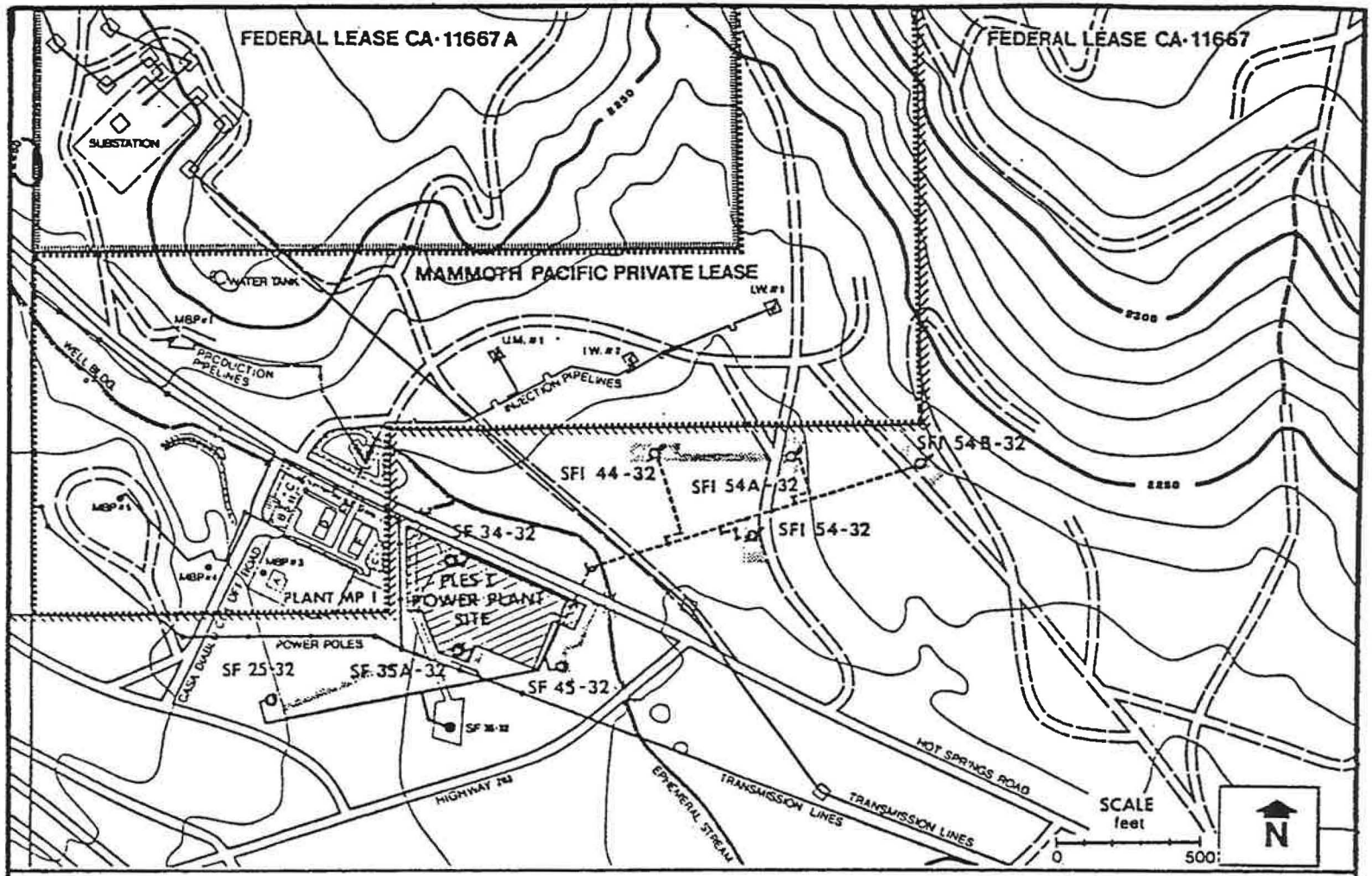


Figure 8. Proposed facilities locations, Casa Diablo Geothermal area.

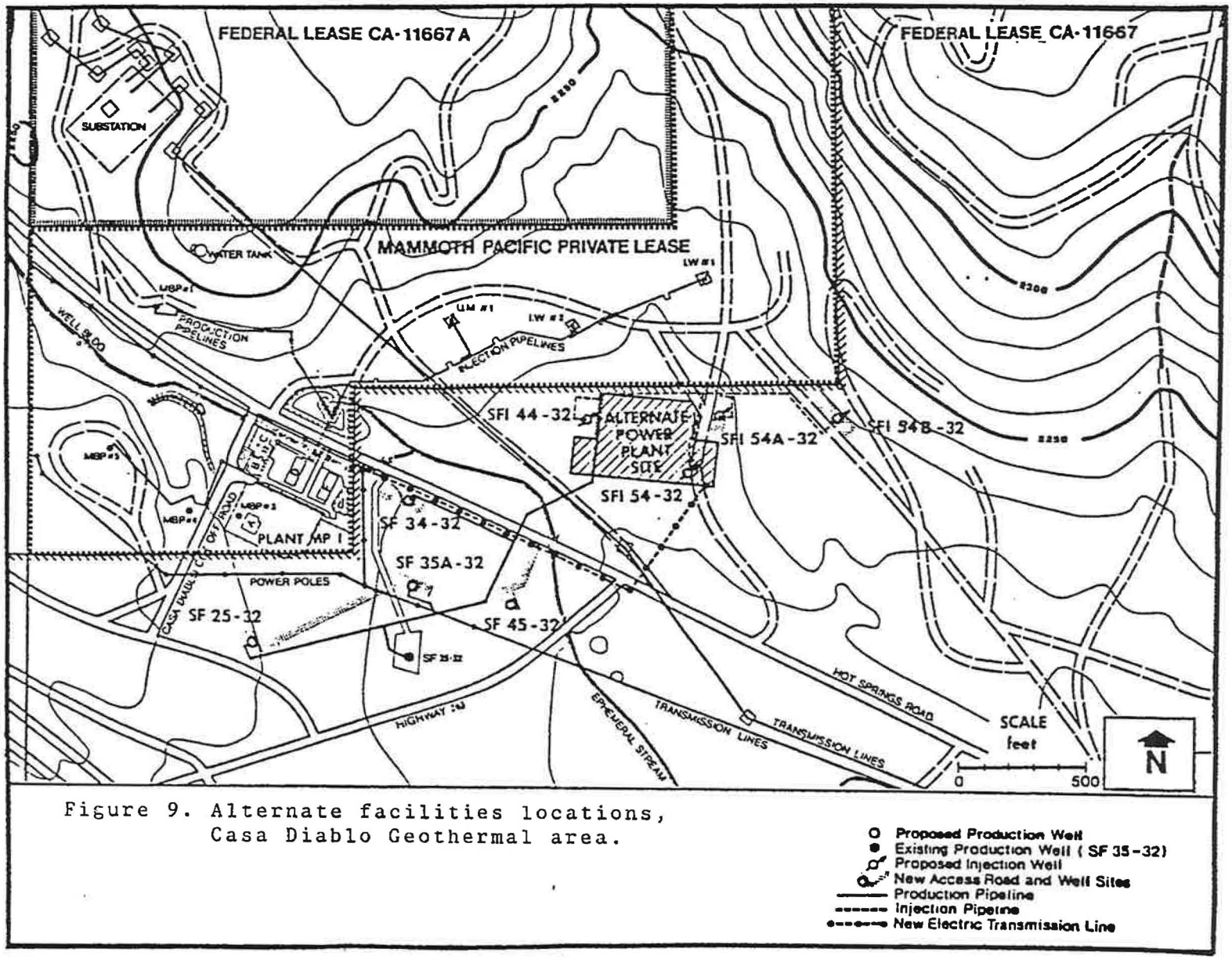


Figure 9. Alternate facilities locations, Casa Diablo Geothermal area.

of some of these proposed projects, because of their nature, size, and/or geographic location, are potentially much greater than those to be anticipated from Casa Diablo. Others may be more benign. A comprehensive study of the cumulative impact of potential development, however desirable from a resource management perspective, is not possible within the time constraints of this project.

The present investigation and discussion indicate that the Casa Diablo Geothermal Project, considered by itself, will likely not have a significant impact upon the spring migration. In the worst and unlikely case that deer avoid the project entirely, there are at present alternate routes available to allow migrating deer to reach their summer ranges. Thus, the Casa Diablo Geothermal Project by itself will likely have minimal negative impact.

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Quantifying Threats to Imperiled Species in the United States

Assessing the relative importance of habitat destruction, alien species, pollution, overexploitation, and disease

David S. Wilcove, David Rothstein, Jason Dubow, Ali Phillips, and Elizabeth Losos

Biologists are nearly unanimous in their belief that humanity is in the process of extirpating a significant portion of the earth's species. The ways in which we are doing so reflect the magnitude and scale of human enterprise. Everything from highway construction to cattle ranching to leaky bait buckets has been implicated in the demise or endangerment of particular species. According to Wilson (1992), most of these activities fall into four major categories, which he terms "the mindless horsemen of the environmental apocalypse": overexploitation, habitat destruction, the introduction of non-native (alien) species, and the spread of diseases carried by alien species. To these categories may be added a fifth, pollution, although it can also be considered a form of habitat destruction.

Surprisingly, there have been relatively few analyses of the extent to which each of these factors—much less the more specific deeds encompassed by them—is responsible for endangering species. In general, scientists agree that habitat destruction is currently the primary lethal agent (Ehrlich 1988, Wilson 1992), followed by the spread of alien species (Wilson 1992). However, apart from several notable exceptions—including studies of North American fishes by Williams et al. (1989), endangered plants and animals in the United States by Flather et al. (1994, 1998), aquatic organisms by Richter et al. (1997), and imperiled birds by Collar et al. (1994)—few quantitative studies of threats to species have been conducted. More such studies are needed to provide conservationists, land stewards, and decision makers with a better understanding of the relationships between specific human activities and the loss of biodiversity.

Habitat loss is the single greatest threat to biodiversity, followed by the spread of alien species

In this article, we quantify the extent to which various human activities are imperiling plant and animal species in the United States. Our analysis has two parts: a coarse-scale examination of the numbers and types of US species imperiled by the major categories of threats, and a fine-scale analysis of the types of habitat destruction affecting US plants and animals protected under the federal Endangered Species Act (ESA). We also speculate on how these threats have changed over time and are likely to change in the future. We conclude with a brief discussion of the implications of our findings for the long-term protection of imperiled species in the United States.

David S. Wilcove is a senior ecologist at the Environmental Defense Fund, Washington, DC 20009. David Rothstein received his J.D. in 1997 from Northeastern University Law School, Boston, MA 02115 and now works for the federal government. Jason Dubow is an environmental analyst at the Eastern Research Group, Arlington, VA 22201; he formerly worked for The Nature Conservancy. Ali Phillips is a natural resources specialist at The Wilderness Society, Denver, CO 80221. Elizabeth Losos is director of the Center for Tropical Forest Sciences at the Smithsonian Tropical Research Institute, Washington, DC 20560.

An overview of the threats

To obtain an overview of the threats to biodiversity in the United States, we tabulated the number of species threatened by five categories of threats: habitat destruction, the spread of alien species, overharvest, pollution (including siltation), and disease (caused by either alien or native pathogens). We restricted this coarse-scale analysis to imperiled plants and animals occurring within the 50 states and falling into any of four categories: all full species of mammals, birds, reptiles, amphibians, and fish with status ranks of "possibly extinct," "critically imperiled," or "imperiled," as determined by The Nature Conservancy (TNC) in association with the Network of Natural Heritage Programs and Conservation Data Centers (Master 1991); all full species of freshwater mussels, butterflies and skippers, tiger beetles, and dragonflies and damselflies with status ranks of possibly extinct, critically imperiled, or imperiled, as determined by TNC; all full species of vascular plants with status ranks of possibly extinct or

Table 1. Taxonomic breakdown of species used in the coarse-scale analysis. Included are species classified as imperiled by The Nature Conservancy and all species, subspecies, and populations that, as of January 1996, are listed as endangered or threatened under the Endangered Species Act or have been formally proposed for listing.

	Number of imperiled species	Number of imperiled species with threats data	Percentage of imperiled species with threats data
Vertebrates	541	494	91
Mammals	88	85	97
Birds	101	98	97
Reptiles	40	38	95
Amphibians	69	60	87
Fishes	243	213	88
Invertebrates	471	331	70
Dragonflies and damselflies	33	18	54
Freshwater mussels	150	102	68
Crayfish	110	67	61
Tiger beetles	8	6	75
Butterflies and skippers	46	33	72
Other invertebrates	124	104	84
Plants	1478	1055	71
Total	2490	1880	75

critically imperiled, as determined by TNC; and all species, subspecies, or vertebrate populations listed by the US Fish and Wildlife Service (USFWS) or the National Marine Fisheries Service as threatened or endangered or officially proposed for listing under the ESA as of 1 January 1996. (The ESA permits the listing of species and subspecies of plants and animals as well as "distinct population segments" of vertebrates.) A total of 2490 imperiled species, subspecies, and populations fit these criteria.

Information on the threats to each of these species, subspecies, and populations was obtained from a number of sources, including the *Federal Register* (i.e., the listing notices published for all species designated as threatened or endangered under the ESA), a survey of biologists conducted by Richter et al. (1997) for aquatic species, the Natural Heritage Central Databases managed by TNC, and interviews with specialists in particular species groups and geographical regions. We included only known threats and excluded potential or hypothetical ones. We did not attempt to distinguish between ongoing and historical threats, partly because such information is usually lacking and partly because the distinction itself is problematic in the case of habitat destruction. Nor did we try to distinguish between major and minor threats to each species because such information was not consistently available. In a few cases, it was impossible to assign a particular human activity to one of the major threat categories; we excluded these activities from our coarse-scale analysis.

We were able to obtain information on threats for 1880 (75%) of the 2490 imperiled species, subspecies, and populations that met our criteria for inclusion in this study (Table 1). (For 52 of the species, we could not identify any anthropogenic threats.) We used the resulting database to determine the relative significance of the major threats categories and to investigate differences between species groups in their vulnerability to particular threats. We compared the distribution of threats among plants and animals, among vertebrate and invertebrate animals, and within vertebrate classes. We also compared the distribution of threats among terrestrial and aquatic species, Hawaiian and mainland vascular plants, and Hawaiian and mainland birds. For all comparisons, statistical significance was assessed using the chi-squared contingency test (two-tailed).

We emphasize at the outset that there are some important limitations to the data we used. The attribution of a specific threat to a species is usually based on the judgment of an expert source, such as a USFWS employee who prepares a listing notice or a state Fish and Game employee who monitors endangered species in a given region. Their evaluation of the threats facing that species may not be based on experimental evidence or even on quantitative data. Indeed, such data often do not exist. With respect to species listed under the ESA, Easter-Pilcher (1996) has shown that many listing notices lack important biological information,

Table 2. Percentages of species in different groups that are imperiled by habitat degradation and loss, alien species, pollution, overexploitation, and disease. Categories are nonexclusive and therefore do not sum to 100.

Cause	All species (n = 1880)	Vertebrates (n = 494)	Invertebrates (n = 331)	Plants (n = 1055)	Mammals (n = 85)	Birds (n = 98)	Reptiles (n = 38)	Amphibians (n = 60)	Fishes (n = 213)	Freshwater mussels (n = 102)	Crayfish (n = 67)	Tiger beetles (n = 6)	Butterflies and skippers (n = 33)	Other invertebrates (n = 104)
Habitat degradation/loss	85	92	87	81	89	90	97	87	94	97	52	100	97	94
Alien species	49	47	27	57	27	69	37	27	53	17	4	0	36	52
Pollution	24	46	45	7	19	22	53	45	66	90	28	0	24	19
Overexploitation	17	27	23	10	45	33	66	17	13	15	0	33	30	46
Disease	3	11	0	1	8	37	8	5	1	0	0	0	0	0

including data on past and possible future impacts of habitat destruction, pesticides, and alien species. Depending on the species in question, the absence of information may reflect a lack of data, an oversight, or a determination by USFWS that a particular threat is not harming the species. The extent to which such limitations on the data influence our results is unknown.

Ranking the threats

Table 2 presents a summary of the percentages of species that are imperiled by habitat loss, alien species, pollution, overexploitation, and disease. Not surprisingly, habitat destruction and degradation emerged as the most pervasive threat to biodiversity, contributing to the endangerment of 85% of the species we analyzed (Figure 1). Indeed, habitat loss is the top-ranked threat (in terms of the number of species it affects) for all species groups. Competition with or predation by alien species is the second-ranked threat in the overall analysis, affecting 49% of imperiled species.

Alien species affect a higher proportion of imperiled plants (57%) than animals (39%); this difference is statistically significant (chi square = 60.23, d.f. = 1, $P<<0.001$). However, certain groups of animals (most notably birds and fish) appear to be as broadly affected as plants by alien species. There is also an unsurprising biogeographic component to the alien species problem: Higher proportions of Hawaiian birds and plants than continental birds and plants are threatened by alien species (Table 3, Figure 2). Similarly, a much higher proportion of Hawaiian birds is threatened by disease than is the case for continental birds. By contrast, nearly the same proportion of Hawaiian plants and continental plants are affected by disease (Table 3, Figure 3).

For all aquatic animal groups (amphibians, fish, dragonflies and damselflies, freshwater mussels, and crayfish), pollution is second only to habitat loss as a cause of endangerment. Our finding that a large number of aquatic species are threatened by pollution may reflect the fact that our definition of pollution includes siltation, which is one of the leading threats to aquatic biodiversity in North America (Richter et al. 1997).

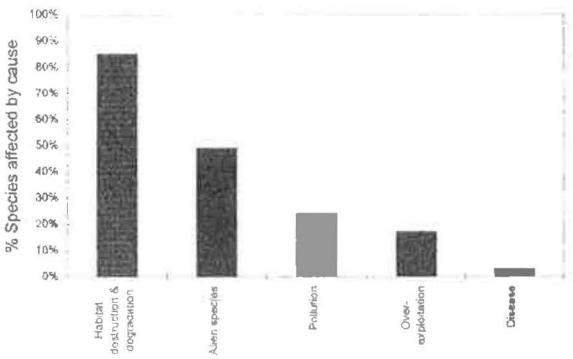

Figure 1. The major threats to biodiversity. Data refer to species classified as imperiled by The Nature Conservancy and to all endangered, threatened, and proposed species, subspecies, and populations protected under the Endangered Species Act. See also Table 2.

A closer look at habitat destruction

Given the primacy of habitat destruction as a threat to biodiversity, we examined its causes in greater detail. For this fine-scale analysis, we focused exclusively on US species, subspecies, and populations that have been added to the federal endangered species list or have been formally proposed for such listing by USFWS as of 1 January 1996. We focused on listed species because more information is usually available for them than for imperiled but unlisted species. We also included species that are federally listed or proposed for listing from Puerto Rico, the US Virgin Islands, and the Pacific Trust Territories. A total of 1207 species, subspecies, and populations was included in this phase of the analysis (Figure 4). (USFWS has listed as endangered all Hawaiian snails of the genus *Achatinella*. Approximately 41 species in that genus have been described to date, of which at least 18 are thought still to survive. However, USFWS did not treat these species individually in its formal listing notice in the *Federal Register*. For the purposes of this part of our analysis, we have therefore counted the entire genus as one "species.")

Categorizing habitat destruction. For the fine-scale analysis, we divided habitat destruction and degradation into 11 major categories (see box page 611). As in the coarse-scale analysis, we did not distinguish between current and historical threats or between major and minor threats. In many instances, the apparent threat to a species was actually spawned by another threat. Wherever possible, we attributed threats to their ultimate cause, based on the information in the *Federal Register*. For example, logging operations near a stream can lead to siltation, which is harmful to certain rare fishes and mussels. Thus, logging rather than siltation would have been scored as the threat to those fishes and mussels. For all comparisons of the prevalence of specific threats in different species groups, statistical significance was assessed using the chi-squared contingency test (two-tailed).

Again, we note some caveats with

Table 3. Percentages of imperiled birds and plants in Hawaii and in the continental United States that are threatened by habitat degradation and loss, alien species, pollution, overexploitation, and disease. Categories are nonexclusive and therefore do not sum to 100.

Cause	Continental US birds (n = 56)	Hawaiian birds (n = 42)	Continental US plants (n = 641)	Hawaiian plants (n = 414)
Habitat degradation/loss	88	93	90	66
Alien species	48	98	30	99
Pollution	38	2	12	0
Overexploitation	39	24	13	6
Disease	4	81	1	0

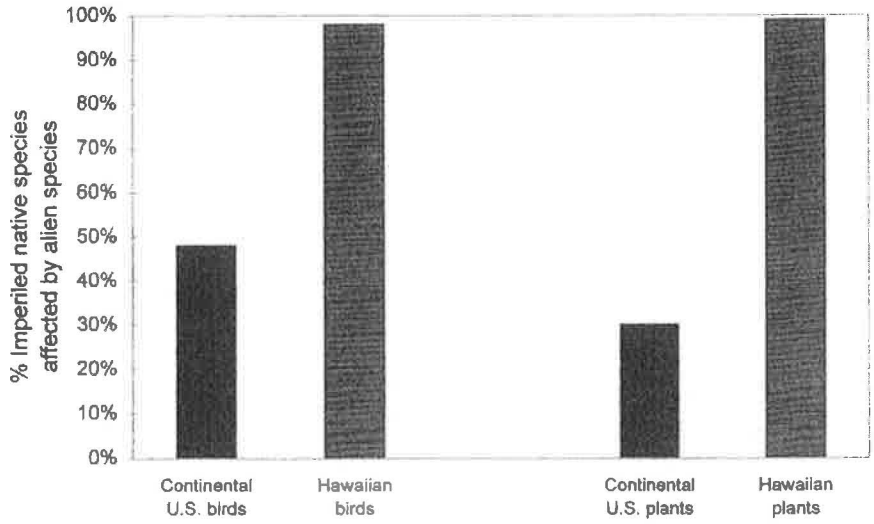

Figure 2. A comparison of the impacts of alien species on imperiled birds and plants in Hawaii and in the continental United States. A much higher proportion of Hawaiian birds and plants than continental birds and plants is threatened by alien species (chi-square = 27.60, d.f. = 1, P <<0.001 for birds; chi-square = 484.28, d.f. = 1, P<<0.001 for plants). Data are taken from Table 3.

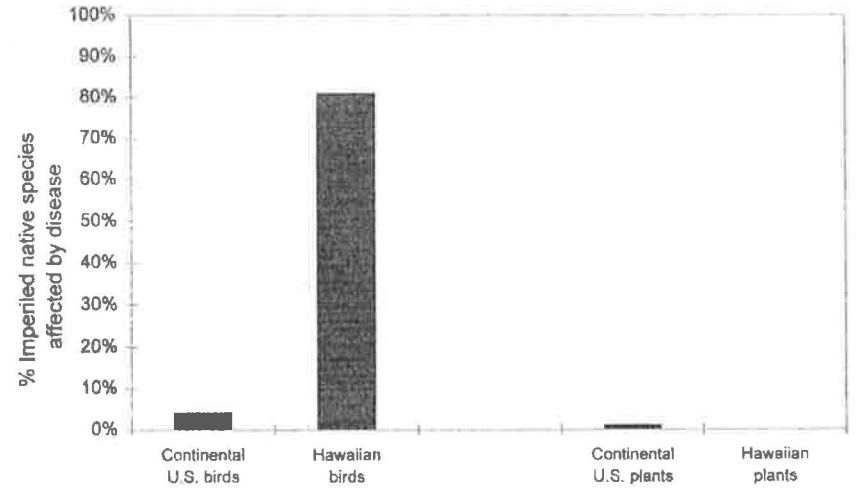

Figure 3. A comparison of the impacts of disease on imperiled birds and plants in Hawaii and in the continental United States. A much higher proportion of Hawaiian birds than continental birds is threatened by disease (chi-square = 62.03, d.f. = 1, P<<0.001). By contrast, similar proportions of Hawaiian and continental plants are affected by disease (although the difference is statistically significant: chi-square = 4.02, d.f. = 1, P = .045).

respect to the data in this phase of the analysis. Species added to the endangered list prior to 1980 (238 species) tended to have fewer threats delineated in the listing notices than species listed in later years. Although there may be a biological basis for this difference, we strongly suspect that it reflects the less controversial nature of endangered species protection at that time. Before 1980, USFWS probably was under less pressure to produce detailed justifications for its listing decisions. We do not know how this pattern may have influenced our results. Also, as noted in our coarse-scale analysis, assessments of the threats to individual species are often based on the subjective opinions of knowledgeable individuals, rather than experimental evidence or quantitative data.

Ranking the causes of habitat destruction. The most overt and widespread forms of habitat alteration were, as might be expected, the leading threats to species that are either listed or proposed for listing (hereafter referred to collectively as "endangered" species), as measured by the number of species they affect (Table 4). These forms include agriculture (affecting 38% of endangered species), commercial development (35%), water development (30% when agricultural diversion is included; 17% for just dams, impoundments, and other barriers), and infrastructure development (17%). Not surprisingly, the impacts of water development are felt most acutely by aquatic species. Ninety-one percent of endangered fish and 99% of endangered mussels are affected by water development, in contrast to 10% of mammals and 22% of birds. Within the category of infrastructure development, roads affect a wide array of species (15% of all endangered species), confirming their reputation as "a leading threat to biodiversity" (Noss and Cooperrider 1994).

Outdoor recreation also harms a large number of endangered species (27%). It affects a significantly higher proportion of plants than animals (33% vs. 17%; chi square = 39.03, d.f. = 1, P<<0.001). Within the category of outdoor recreation, the use of off-road vehicles is implicated in the demise of approximately 13% of endangered species.

Among extractive land uses, logging, mining, and grazing have contributed to the demise of 12%, 11%, and 22%, respectively, of the endangered species we analyzed. Both logging and mining are especially serious threats to freshwater mussels, probably because they result in increased amounts of silt, in the cases of both logging and mining, and of toxic pollutants, in the case of mining. Livestock grazing, on the other hand, is particularly harmful to plants, affecting 33% of endangered plant species compared to 14% of endangered animals; the difference is highly significant (chi square = 51.95, d.f. = 1, P<<0.001).

Finally, 168 species (14%) are threatened by disruption of fire regimes in the ecosystems in which they live. Of these, 85 (7%) are

threatened by fire suppression and 83 (7%) are threatened by controlled or uncontrolled fires.

Comparisons with other studies

Flather et al. (1994, 1998) catalogued the threats to US endangered species based on information from the *Federal Register*, the USFWS *Endangered Species Technical Bulletin*, recovery plans for individual species, federal agency reports, and consultations with USFWS biologists and state Natural Heritage Program scientists. Their analysis covered 667 species, subspecies, and populations protected by the ESA as of August 1992; it did not include species proposed for listing.

Although the way in which Flather et al. categorized threats was not identical to our approach, the major findings from the two studies can still be compared. These authors also identified habitat loss and alien species as the two most widespread threats to endangered species, affecting more than 95% and 35% of listed species, respectively. (Comparable figures from our study are 85% for habitat destruction and 49% for alien species.) The smaller percentage of species affected by exotics in Flather et al.'s study probably reflects the large number of Hawaiian species that were included in our study but were not on the endangered species list at the time Flather et al. conducted theirs. Flather et al. (1998) also point out that the relative frequency of particular threats to species varies geographically.

Two previous studies have focused on threats to aquatic species. Williams et al. (1989) catalogued threats to 364 species and subspecies of imperiled fish from Canada, the United States, and Mexico; Richter et al. (1997) surveyed aquatic biologists to identify the threats to 135 imperiled freshwater fishes, crayfishes, dragonflies and damselflies, mussels, and amphibians in the United States. Narrowing the scope of Williams et al. to imperiled US and Canadian fishes (254 species), we can compare their results with ours. The findings of the two studies are similar: Williams et al. identified habitat destruction and degradation as the most widespread threat to imperiled fishes, affecting 96% of the species (versus 94% in our study; Table 2). Next in significance was an amalgamated category of hybridization, alien species, predation, and competition, which affected 39% of the fish species (versus our tally of 53% for alien species, which probably covers most of the same threats). Finally, Williams et al. found that overharvest and disease affected 4% and 2%, respectively, of the fishes (versus 13% and 1% in our study).

Richter et al. (1997) concluded that the three leading threats to aquatic species nationwide were agricultural nonpoint pollution (e.g., siltation and nutrient inputs), alien species, and altered hydrologic regimes due to dams and impoundments. This conclusion is consistent with our findings from the fine-scale analysis, which identified pollution and impoundments (including dams) as significant threats to fish and mus-

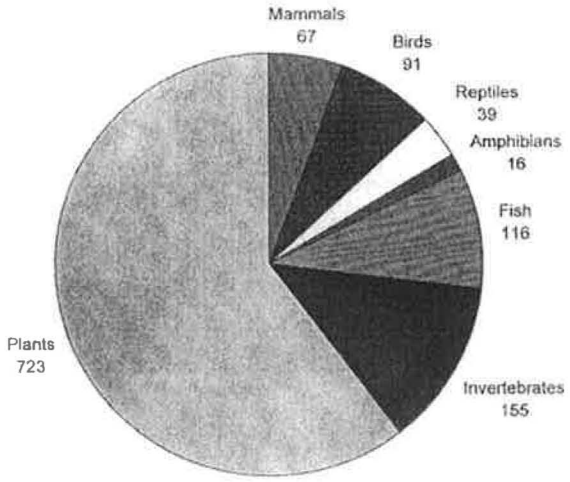

Figure 4. Taxonomic breakdown of the species, subspecies, and populations used in the fine-scale analysis. The 1207 species, subspecies, and populations include those that are listed as endangered or threatened under the Endangered Species Act or are proposed for listing.

The major categories of habitat destruction used in this analysis

- Agriculture (including agricultural practices, land conversion and water diversion for agriculture, pesticides and fertilizers; excluding livestock grazing)
- Livestock grazing (including range management activities)
- Mining, oil and gas, and geothermal exploration and development (including roads constructed for and pollutants generated by these activities)
- Logging (including impacts of logging roads and forest management practices)
- Infrastructure development (including bridges, dredging for navigation, and road construction and maintenance)
- Road construction and maintenance specifically (including logging and mining roads)
- Military activities
- Outdoor recreation (including swimming, hiking, skiing, camping, and off-road vehicles)
- Off-road vehicles specifically
- Water development (including diversion for agriculture, livestock, residential use, industry, and irrigation; dams, reservoirs, impoundments, and other barriers to water flow; flood control; drainage projects; aquaculture; navigational access and maintenance)
- Dams, impoundments, and other barriers to water flow specifically
- Pollutants (including siltation and mining pollutants)
- Land conversion for urban and commercial development
- Disruption of fire ecology (including fire suppression)

sels (Table 4). Our coarse-scale analysis, which included a larger pool of imperiled species than the fine-scale analysis, also highlighted the importance of alien species as a threat to US fish.

Richter et al. (1997) point out that there are important geographic differences in the nature of the threats facing aquatic species. Aquatic species in the eastern United States are experiencing particular harm from agricultural nonpoint pollution; in the West, the dominant threat is alien species, followed by habitat degradation and altered hydrologic regimes. Richter et al. attribute these differences to differences in both land use patterns in the East versus the West and in the ecological sensitivities of eastern versus western species.

Using information from USFWS recovery plans, Schemske et al. (1994) identified the primary cause of endangerment for each of 98 US plant species protected under the ESA. These authors did not distinguish between historical and contemporary threats, and they listed only one (i.e., the primary) threat per species, although they acknowledged that most species experience more than one threat. The top six threats in their study (in terms of frequency of appearance) were development (affecting 20.4% of the species); grazing (10.2%); collecting (10.2%); water control (8.2%); oil, gas, and mining (8.2%); and trampling (8.2%). By contrast, our coarse-scale analysis identified habitat destruction and alien species as the two most widespread threats to imperiled plants, affecting 81% and 57% of species, respectively. Moreover, in our fine-scale analysis of habitat destruction, the top five threats to imperiled plants protected under the ESA were land conversion (i.e., development; 36%), agriculture (33%), grazing (33%), outdoor recreation (33%), and disruption of fire ecology (20%).

The consistently higher percentages for all threats in our study compared to that of Schemske et al. (1994) undoubtedly stem from our practice of tallying multiple threats per species. Perhaps the most noticeable difference between the two studies lies in their assessments of the importance of alien species as a threat to rare plants. Schemske et al. (1994) considered alien species the primary threat to only 6.1% of the plants they studied, whereas we found that 57% of endangered plants were affected by alien species. Their lower percentage stems in part from the small number of Hawaiian plants that had been listed as endangered or threatened at the time of their study. Our results do indicate that alien species are a frequent threat to continental plants as well (Table 3), but they are not necessarily the primary threat, which may account for the remainder of the difference.

Collar et al. (1994) identified the primary threat to each of 1111 bird species they regarded as imperiled. Because they evaluated endangered birds worldwide, focused on primary threats only, and categorized the

Table 4. Percentages of federal endangered, threatened, or proposed species, subspecies, or populations that are harmed by various types of habitat destruction and degradation. Categories are nonexclusive and therefore do not sum to 100.

Cause	Overall (n = 1207)	Vertebrates (n = 329)	Invertebrates (n = 155)	Plants (n = 723)	Mammals (n = 67)	Birds (n = 91)	Reptiles (n = 39)	Amphibians (n = 16)	Fish (n = 116)	Insects (n = 39)	Arachnids (n = 4)	Crustaceans (n = 20)	Mollusks (n = 23)	Mussels (n = 69)
Agriculture	38	40	57	33	25	42	33	63	45	56	75	55	35	64
Livestock grazing	22	17	10	33	19	20	8	19	16	15	0	30	9	1
Mining, oil and gas, geothermal	11	12	31	11	2	3	13	13	23	10	0	0	17	58
Logging	12	16	25	7	12	18	13	19	19	5	25	5	13	46
Infrastructure development (including roads)	17	16	12	20	9	8	28	38	17	23	25	10	9	6
Road construction and maintenance	15	15	10	17	8	8	23	38	16	18	25	5	9	6
Military activities	4	2	1	5	2	3	5	0	0	0	0	5	4	0
Outdoor recreation (including ORVs)	27	16	19	33	18	15	31	25	9	41	0	30	26	4
Off-road vehicles	13	6	12	16	6	7	13	13	1	31	0	25	4	0
Water development (including dams, etc.)	30	47	66	15	10	22	28	63	91	21	0	70	48	99
Dams, impoundments, and other barriers	17	28	54	5	3	9	15	13	64	15	0	15	35	96
Pollutants	20	27	66	7	5	10	21	25	55	26	75	55	48	97
Land conversion for commercial development	35	30	42	36	31	33	56	44	16	67	75	65	13	29
Disruption of fire ecology	14	5	6	20	7	8	5	6	0	18	25	0	4	0

threats differently than we did, their results are not directly comparable to ours. Nonetheless, it is worth noting that both studies identified habitat loss as the most widespread threat. In Collar et al.'s study, the next most important threats, in order of decreasing frequency, were small range or population, overhunting, and alien species. In our study, the next most important threats, also in order of decreasing frequency, were alien species, disease, overhunting, and pollution. The higher rankings accorded alien species and diseases in our analysis are probably due to the Hawaiian avifauna, which constitutes a large fraction of endangered birds in the United States and is profoundly affected by these threats. In our study, we did not classify small range per se as a threat.

Changes in threats over time

As human activities and customs change over time, one would expect to see corresponding changes in the threats to biodiversity. Because our study does not distinguish between historical and contemporary threats, it is not well suited to test this hypothesis. For example, the relatively large percentage of species affected by overexploitation (17%) includes a variety of animals that were once hunted but are now reasonably well protected from this threat (e.g., the whooping crane [*Grus americana*] and the California condor [*Gymnogyps californianus*]). Similarly, pesticide pollution is listed as the primary threat to the bald eagle (*Haliaeetus leucocephalus*) and to North American populations of the peregrine falcon (*Falco peregrinus*), but the primary pollutant harming both species—DDT—has been banned in the United States since 1972 (although it continues to be used in other countries where peregrines spend the winter). Thus, our study may overestimate the number of animals that are currently harmed by overexploitation and pollutants.

There are no accurate figures on the total number of alien species now established in the United States, although the Office of Technology Assessment [OTA] (1993) has estimated that there are at least 4500 (a number that OTA acknowledges is probably an underestimate). What is indisputably clear, however, is that the cumulative number of alien species in the United States has skyrocketed since the late 18th century (Sailer 1978, OTA 1993); this pattern holds for all types of species, from plants, to insects, to vertebrates. Given that the cumulative number of alien species is increasing over time, one may confidently predict that alien species will pose an ever-increasing threat to native flora and fauna.

A somewhat more complicated question is whether the *rate* of alien introductions has increased over time, which would indicate a rapidly worsening situation for imperiled species. The data from published studies are ambiguous on this point. Reviewing the numbers of alien terrestrial vertebrates, fishes, mollusks, and plant pathogens added to the United States per decade over the past 50 years, OTA (1993) found no consistent increase for any of the groups. The greatest numbers of terrestrial vertebrates and fishes were added during the 1950s and 1960s, whereas the 1970s saw the greatest increase in the numbers of mollusks and plant pathogens. On the other hand, a detailed study of alien species in the San Francisco Estuary shows that there have been more introductions in recent years than in earlier years (Cohen and Carlton 1995).

Many factors influence the rate at which alien species are introduced into the United States, so the lack of a consistent increase in that rate over time should not be surprising. Species can be brought into the country and released intentionally, or their release can occur as an unintentional byproduct of cultivation, commerce, tourism, or travel. Each new development in the field of transportation creates new opportunities for the transport of alien species, from the first sailing ships to reach US shores, to the building of the nation's road and highway system, to the advent of jet airplanes. As transporation technology changes, so do the opportunities for alien stowaways. Empty cargo ships arriving in the United States, for example, used to carry dry ballast in the form of rocks and soil, which was then off-loaded around wharves to provide cargo space. Numerous insects and plants were accidentally introduced into the United States in this dry ballast, including fire ants (*Solenopsis invicta* and *Solenopsis richteri*) and purple loosestrife (*Lythrum salicaria*). Today, ships use water for ballast instead of dry material, thus ending the spread of alien species via dry ballast. However, the release of ballast water into US waterways has been implicated in the introduction of at least eight alien species since 1980, including the zebra mussel, *Dreissena polymorpha* (OTA 1993). Finally, the public's growing infatuation with ornamental plants, tropical fish, and tropical birds has led to numerous unintentional releases of alien species, including over 300 plants in California alone (McClintock 1985).

Looking ahead, as the human population of the United States continues to grow, one might predict an increase in the frequency of biodiversity threats associated with urbanization, such as infrastructure development, water development, and land conversion. Comparable increases in the proportion of species affected by agriculture are also a possibility. There is, in fact, good reason to suspect that a growing human population in the United States will disproportionately affect this nation's imperiled species. Dobson et al. (1997) have shown that most endangered species in the United States are clustered in a relatively small number of areas, particularly in Hawaii, Southern California, and Florida. The human populations in all three states are projected to increase at rates well beyond the national average. Thus, whereas the population of the United States as a whole is expected to grow by 14% between 1995 and 2010, the populations of Hawaii, California, and Florida are projected to increase by 27%, 27%, and 22%, respectively (US Bureau of the Census 1995).

Although climate change was not listed as a current threat to any species in our databases, it is almost certain to become one in the foreseeable future due to increasing concentrations of greenhouse gases from fossil-fuel use, land-use changes, and agriculture. Climate models developed by the Intergovernmental Panel on Climate Change predict a 0.9–

3.5 °C increase in global mean temperature over the course of the next century (Houghton et al. 1995). That increase will cause a rise in sea levels of 15–95 cm and significant changes in the frequencies of severe floods and droughts.

These changes are likely to affect a broad array of imperiled species. For example, Morse et al. (1993) estimate that 7–11% of North America's vascular plant species would no longer encounter a suitable climatic regime ("climate envelope") within their present ranges in the event of a 3 °C increase in temperature. Due to their small ranges and weak dispersal abilities, imperiled plants would be disproportionately affected. Morse et al. (1993) also estimate that 10–18% of North America's rare plants could be excluded from their climate envelope due to climate change.

In another well-publicized study, Britten et al. (1994) noted that relictual populations of the critically endangered Uncompahgre fritillary butterfly (*Boloria acrocnema*) living atop a few peaks in the San Juan Mountains of southwestern Colorado were extremely vulnerable to unusual weather events. They further hypothesized that a regional warming trend (as might occur due to global climate change) could eliminate all of the butterfly's habitat, essentially pushing it off of the mountains and into extinction. Indirect support for this hypothesis comes from a recent study of another butterfly. Parmesan (1996) censused populations of the Edith's checkerspot (*Euphydryas editha*) throughout its known range (Baja California, the western United States, and western Canada) and found significant latitudinal and altitudinal differences in the proportion of populations (in suitable habitat) that had become extinct. Populations in Mexico were four times more likely to have vanished than those in Canada, a North–South gradient in survival that is consistent with the predicted impacts of global warming on species' ranges.

Conservation implications

The major findings of this study confirm what most conservation biologists have long suspected: Habitat loss is the single greatest threat to biodiversity, followed by the spread of alien species. However, the discovery that nearly half of the imperiled species in the United States are threatened by alien species—combined with the growing numbers of alien species—suggests that this particular threat may be far more serious than many people have heretofore believed. The impact of alien species is most acute in the Hawaiian Islands, as demonstrated by the fact that nearly 100% of the archipelago's imperiled plants and birds are threatened by alien species, compared with 30% and 48%, respectively, for mainland plants and birds (Table 3). This finding is also consistent with numerous other studies that have highlighted the unique vulnerability of island communities to alien species (Culliney 1988, Simberloff 1995).

Pollution (including siltation) ranks well below alien species as a threat to imperiled species in general, but it exceeds alien species as a threat to aquatic taxa. As Richter et al. (1997) point out, the pollutants affecting the largest number of aquatic species are agricultural pollutants, such as silt and nutrients, that enter lakes and rivers as runoff from farming operations. These nonpoint source pollutants have proved to be exceedingly difficult to regulate and control (Young and Congdon 1994).

Finally, this study and one by Wilcove and Chen (in press) raise troubling questions about the future of imperiled species in the United States. Both studies found that a high proportion of imperiled species is threatened by either fire suppression within their fire-maintained habitats or alien species. Both types of threats must be addressed through active, "hands-on" management of the habitat, such as pulling up alien plants and trapping alien animals or using prescribed fire to regenerate early successional habitats. Although the ESA prohibits actions that directly harm listed animals and, to a lesser extent, listed plants, it does not require landowners to take affirmative actions to maintain or restore habitats for listed species. Thus, a landowner is under no obligation to control exotic weeds, undertake a program of prescribed burning, or do any of the other things that may be absolutely necessary for the long-term survival of many imperiled species. In fact, it may be possible for a landowner to rid himself of an endangered species "problem" by literally doing nothing and waiting until the habitat is no longer suitable for the species in question. Even those landowners who care deeply about endangered species and wish to protect them face a daunting burden: The costs of undertaking these management actions can be considerable and, at present, are usually not tax deductible.

With a growing list of species in need of attention and less money to spend per species (Wilcove et al. 1996), the USFWS cannot hope to cover the necessary management costs for most of the plants and animals it aspires to protect. Nor can it count on the goodwill of landowners to contribute their own money or labor for actions they are not obligated to perform and that ultimately may result in restrictions on the use of their property. As a nation, therefore, we are incurring a growing "management debt" associated with efforts to protect imperiled species. To address this problem, it will be necessary to supplement the regulatory controls of the ESA and other wildlife protection laws with a wide array of incentives to reward landowners who wish to manage their property to benefit endangered species (Wilcove et al. 1996). Without such incentives, the United States stands to lose a large proportion of its imperiled plants and animals.

Acknowledgments

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EXHIBIT B

Casa Diablo IV Geothermal Development Project (CACA 11667)

Toward a safe, clean energy future: The proposed Casa Diablo Geothermal Energy Project has recently started the environmental review and public participation process required by Federal law. The project would be built on Inyo National Forest lands and private lands.

Vitals

Proposed Location: Mammoth Pacific, L.P. (MPLP) has submitted an application to the BLM to build and operate the Casa Diablo IV Geothermal Development Project in the immediate vicinity of the existing MPLP geothermal projects near the intersection of California State Route 203 and U.S. Highway 395 approximately 3 miles east of Mammoth Lakes, California. The proposed project would be located on Inyo National Forest lands and adjacent private lands within portions of Federal geothermal leases CACA-11667, CACA-11672 and CACA-14408.

Electricity Production Capacity: 33 net megawatts

Company: Mammoth Pacific, L.P. (MPLP)

Acreage: 100 acres

Status: Notice of Intent published in the Federal Register 3/25/11

Public Comment: Scoping period ended 5/9/11

Public Scoping Meetings:

- Scoping meeting presentation

Electrictrical Transmission Connection: A 500-foot transmission line is proposed to interconnect the new power plant to the existing Southern California Edison (SCE) substation at Substation Road.

Casa Diablo (CACA 11667)
Fact Sheet
Federal Process & Documents

Photo of existing Geothermal well pad.

Last updated: 04-11-2012

EXHIBIT C

SWAPE Technical Consultation, Data Analysis and Litigation Support for the Environment

2503 Eastbluff Dr., Suite 206
Newport Beach, California 92660
Fax: (949) 717-0069

Matt Hagemann
Tel: (949) 887-9013
Email: mhagemann@swape.com

September 11, 2012

Christina Caro
Lozeau | Drury LLP
410 12th Street, Suite 250
Oakland, CA 94607

Subject: **Comments on the Hudson Ranch Power II and Simbol Calipatria II Projects, Imperial County**

Dear Ms. Caro:

We have reviewed August 2012 Final Environmental Impact Report (FEIR) for the Hudson Ranch Power II and Simbol Calipatria II projects which would involve: (1) construction of the Hudson Ranch Power II Geothermal Project, a 49.9 MW geothermal power plant and well field; and (2) construction of the Simbol Calipatria Plant II, a commercial lithium carbonate production plant ("Projects").

The 52-acre Geothermal Project (HR-2 Plant) would involve:

- Drilling and development of up to eight geothermal wells and up to four injection wells;
- Construction of a stormwater retention basin, wastewater treatment plant, and potable water treatment plant;
- Construction of a geothermal flash power plant consisting of a brine production facility, a turbine generator facility, control room, office, maintenance shop, supporting geothermal production and injection wells, and associated pipelines; and
- Well abandonment if a well does not have commercial potential.

The 48-acre Lithium Carbonate Project (SmCP–2 Plant) would include:

- Construction of facilities to extract lithium, manganese, zinc from geothermal brine to produce commercial quantities of lithium, hydrochloric acid, manganese, and zinc products;
- Construction and operation of brine pipelines connected to the HR-2 plant; and

- Construction of a power distribution line. (FEIR. pp. 1-2, 1-3.)

The FEIR fails to: (1) identify current baseline soil conditions at the Project sites which may pose hazards to construction workers; (2) adequately describe waste handling from brine production; (3) potential impacts to the Salton Sea from conversion of agricultural lands; (4) consider the potential for induced seismic activity; and (5) adequately evaluate air impacts during construction. The FEIR needs to be supplemented to adequately disclose and mitigate these impacts, if significant, prior to certification of the FEIR.

Hazards and Hazardous Materials

Current baseline soil and groundwater conditions at the Project sites are unknown. Land use, which has included agriculture, may have resulted in soil contamination from pesticide use which may pose risks to workers involved in construction activity.

1. A Phase I Environmental Site Assessment (ESA) was prepared for the Geothermal Project in August 2009 (Appendix H-1). The Phase I is unreliable because it was prepared more than three years ago. Standard industry practices dictate that a Phase I ESA is invalid after a year.[1] Prior to certification of the FEIR, a new Phase I ESA should be completed to ensure hazardous conditions do not exist on the Geothermal Project site.

2. A Phase I ESA has not been prepared for the 48-acre Lithium Carbonate Project. The August 2009 Phase I Environmental Site Assessment was prepared only for 52-acre Geothermal Project. The FEIR mistakenly states:

> Simbol, Inc. has conducted a Phase 1 environmental site assessment (Appendix H-2) and no recognized environmental conditions were identified within 1 mile of the proposed Project site

Instead, Appendix H-2 is only an Agency Database Record Search (completed in March 2012). A records search is only one component of a Phase I ESA which includes a review of historical site activities, an inspection, and interviews with landowners. Prior to FEIR certification, a new Phase I ESA should be prepared for the Geothermal Project site and a Phase I should be prepared for the Lithium Carbonate Project site to ensure that conditions, which may include pesticide contamination, do not pose hazards to construction workers.

Brine Handling

Spent fluid or brine produced following heat extraction from the geothermal wells will be sent to the Lithium Carbonate Plant by a brine delivery pipeline. Once the brine has been processed, it will be sent for disposal to the injection wells. Solids produced from evaporation at the brine pond will be classified as hazardous waste (p. 3-31). Chemical compounds in the brine include high concentration of sulfate, sodium, and chloride (Table 3-7). Handing of the brine will likely require a Report of Waste Discharge

[1] http://blog.augustmack.com/blog/environmental-considerations-for-real-estate/phase-i-esa-update

(ROWD) from the Colorado River Regional Water Quality Control Board (RWQCB), a report not included in the FEIR.

The Hudson Ranch I Geothermal Exploration Project, which broke ground in May 2010[2], required a Report of Waste Discharge and issuance of Waste Discharge Requirements from the RWQCB to address well drilling and brine handling practices.[3] The Waste Discharge Requirements govern the handling of drilling wastes and brine handling and include information regarding:

- the chemical characteristics of the brine and the drilling mud and rock cuttings drilling waste containment units;
- drilling waste disposal;
- surface water in the area of exploration;
- regional and local groundwater;
- the RWQCB Basin Plan, including information on beneficial uses of groundwater and surface water; and
- stormwater management during construction.

Waste Discharge Requirements specify:

- waste containment at all times;
- capacity of sumps and containment basins;
- analytical testing requirements for contaminants in brine which may include sodium, chloride calcium and potassium; and
- a prohibition on the release of pollutants, or waste constituents in a manner that could cause or contribute to a condition of contamination, nuisance, or pollution.

Poor waste management practices for other geothermal projects in the area have led to enforcement actions by the RWQCB at other geothermal facilities. In 2006, the RWQCB filed an administrative action against a group of geothermal operators in the area of the Hudson II project for failure to improve brine filter cake storage areas and to take measures to including to prevent filter cake from being released or disposed during transport.[4]

The FEIR includes measures for the Geothermal Plant to "minimize or avoid hydrology and/or water quality impacts" but does not include a ROWD and, in fact makes no specific reference for the need of a

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[2] http://latimesblogs.latimes.com/money_co/2010/05/hudson-ranch-geothermal-power-facility-underway-in-imperial-valley.html

[3] http://www.swrcb.ca.gov/rwqcb7/board_decisions/adopted_orders/orders/2007/42_hudson_wdr.pdf

[4] http://www.dtsc.ca.gov/HazardousWaste/Projects/upload/CAL_ENERGY_ENF_FinalJudgmnt.pdf

ROWD, stating only that the Projects could violate water quality standards or waste discharge requirements (p. 4.8-20) and identifying measures to address these impacts. Without the preparation of a ROWD and RWQCB review, the effectiveness of these measures is unknown. The FEIR should not be certified until it includes a draft ROWD and documentation that the RWQCB will review and issue a Waste Discharge Requirement permit.

Hydrology

Agricultural runoff from Imperial County accounts for 75% of inflows to the Salton Sea.[5] Construction of the Projects will convert agricultural lands which will lead to a reduction in inflows and, consequently, lake levels, leading to potential water quality degradation. Additionally, the FEIR does not address the potential that dust emissions might result from reductions in water inflows to the Salton Sea from the Project construction.

The HR-2 Plant will convert 52 acres of farmland for 30 years over the Project life span while the SmCP-2 Plant will convert 48 acres of farmland for the 30 year life span (FEIR, p. 5-18). Agricultural water use in Imperial County is 5.6 acre-feet per acre per year.[6] The Project's conversion of 100 acres, therefore, will reduce inflows to the Salton Sea by 16,800 acre-feet over their lifespan.

The FEIR identifies 26 other projects in Imperial County that will also convert agricultural land. These 26 projects, together with the HR-2 Plant and SmCP-2 Plant, will convert 17,047 acres of farmland (FEIR, p. 5-20). Conversion of this farmland will result in a decrease of approximately 95,500 acre-feet of water per year to the Salton Sea.[7] The Salton Sea Restoration Program estimates median inflows to the Salton Sea to be 717,000 acre-feet per year for 2018-2078.[8] Conversion of 17,047 acres of farmland will result in a 13% reduction[9] of inflows to the Salton Sea per year – an undisclosed cumulative impact.

The level of the Salton Sea will be further lowered from reductions of inflows under the Quantification Settlement Agreement (QSA). The QSA was approved in 2003 and requires the Imperial Irrigation District to conserve 303,000 acre-feet per year of water by 2026 for transfer to San Diego and 103,000 acre-feet per year of water to the Coachella Valley Water District.[10]

As agricultural inflows to the Salton Sea decrease, salts and nutrients become more concentrated and threaten ecologic habitat which has been designated a National Wildlife Refuge and is a critical stop on the Pacific Flyway for migrating birds, including several state and federal listed endangered and threatened species.[11] The Regional Water Quality Control Board has characterized the Salton Sea to be in "serious trouble" and that it "may be unable to support ... beneficial uses in the future".[12]

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[5] http://www.waterboards.ca.gov/coloradoriver/water_issues/programs/salton_sea/index.shtml
[6] Imperial County Farm Bureau. Imperial County Agriculture. http://www.icfb.net/countyag.html
[7] 17,047 acres * 5.6 acre-feet/year = 95,463. 2 acre-feet per year
[8] http://www.water.ca.gov/saltonsea/historicalcalendar/wg/01.18.2006/Hydrology_Report_Draft.pdf, p. 52
[9] (95,463.2 acre-feet/year)/(717,000 acre-feet/year)* 100 = 13.3%
[10] http://www.iid.com/Modules/ShowDocument.aspx?documentid=3445, p. 2
[11] http://www.waterboards.ca.gov/coloradoriver/water_issues/programs/salton_sea/index.shtml
[12] http://www.waterboards.ca.gov/coloradoriver/water_issues/programs/salton_sea/index.shtml

Reductions of inflows from lowered Salton Sea lake levels will result in the exposure of formerly submerged shoreline areas, increasing dust generation potential. A commission formed to evaluate the effects of the lowering of the Salton Sea concluded:

> The overall consensus of the workshop panel is that episodes of windblown dust should be expected if there is a significant reduction in Salton Sea water levels.[13]

Generation of dust from lowered levels in other arid lake basins, like Owens Lake, have led to significant PM emissions and have required extensive mitigation. Water diversions by the Los Angeles Department of Water and Power since early in the 20th century cut Owens Lake from its natural sources of water, causing lake level declines. Frequent winds in the Owens Valley generate dust from former wetted lake bed soils and cause the PM10 violations. Emissions from Owens Lake contributed to reclassification of the southern Owens Valley as a "serious nonattainment" area for PM10. Extensive mitigation has resulted in attempt to improve air quality for residents over 50 miles away.[14]

The FEIR should not be certified until the potential for Project-related reductions of inflows to the Salton Sea, along with cumulative reductions, to include all projects that propose conversion of agricultural land, can be evaluated for impacts on water quality and PM generation.

Injection Induced Seismicity

The FEIR describes a high potential for a magnitude 7.4 to 7.9 earthquake along the San Andreas Fault, located 14 miles northwest of the Project sites. Since 1987, 70 earthquakes with a magnitude greater than 5.0 have been reported within 100 miles of the Project sites. A maximum earthquake of magnitude 6.4 is also possible along the Brawley seismic zone approximately 2.6 miles southwest of the Project sites. (p. 4.6-2). Although the FEIR adequately describes the seismic setting of the Projects, the FEIR does not consider the potential for seismicity to be induced by injection of geothermal fluids.

Induced seismicity has been documented in association with number of operating geothermal fields in the United States and globally. The Geysers and the Coso geothermal fields in California have a well-known association of geothermal production and induced seismicity, producing thousands of earthquakes annually. Most are small and are not perceived by humans, but some earthquakes of up to magnitude 4 have been documented.[15]

Communities near geothermal fields have expressed concerned about damage from single seismic events and cumulative effects. Concerns include the potential for structural damage and that small events may trigger larger events.[16]

These well-known concerns are not identified in the FEIR. Potential structural damage impacts in communities, including Niland which is located 2.3 miles northeast, are not considered in the FEIR. The

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[13] http://www.usbr.gov/lc/region/saltnsea/pdf_files/Final_Air_Quality_Paper.pdf
[14] http://www.gbuapcd.org/airqualityplans.htm
[15] http://esd.lbl.gov/research/projects/induced_seismicity/egs/history.html

[16] http://esd.lbl.gov/research/projects/induced_seismicity/egs/local_outreach.html

FEIR should be revised to include a thorough discussion about the potential for induced seismicity from development of the Geothermal Project. Mitigation should also be considered in the FEIR, including establishment of a monitoring network to determine any increases in seismic activity resulting from Project operation. Mitigation should also include a program for outreach to inform nearby communities of the potential relationship between geothermal development and seismic activity.

Air Impacts

Emissions of NOx during construction are estimated to be significant only for approximately two months during overlap of construction of the Lithium Carbonate Plant and the Geothermal Project in 2015 (p. 4.3-33). Our review has shown that construction emissions of NOx would potentially exceed the Imperial County Air Pollution Control District threshold during other construction in 2013 and 2014, at a minimum.

NOx emissions from the FEIR for the Geothermal Project are estimated to be just below thresholds for 2013 and 2014 (below).

These estimates are after mitigation – Attachment P to Appendix C, p. 2 includes the following table which shows the basis for the estimates above.

August - October 2013

Grading						
August through October 2013 - Unmitigated Winter						
Winter Unmitigated	Emission Rate (lbs/day)					
	ROG	NOx	CO	SO2	PM10	PM2.5
Total	18.77	157.13	73.85	0.17	37.30	12.32
ICAPCD Significance	75.00	100.00	550.00	150.00	150.00	
CEQA Significant?	No	Yes	No	No	No	
September through October 2013 - Unmitigated Summer						
Summer Unmitigated	Emission Rate (lbs/day)					
	ROG	NOx	CO	SO2	PM10	PM2.5
Total	18.86	157.14	74.66	0.17	37.30	12.32
ICAPCD Significance	75.00	100.00	550.00	150.00	150.00	
CEQA Significant?	No	Yes	No	No	No	
September through October 2013 - Mitigated Winter						
Winter Mitigated	Emission Rate (lbs/day)					
	ROG	NOx	CO	SO2	PM10	PM2.5
Total	5.57	96.57	93.29	0.17	19.79	8.62
ICAPCD Significance	75.00	100.00	550.00	150.00	150.00	
CEQA Significant?	No	No	No	No	No	
September through October 2013 - Mitigated Summer						
Summer Mitigated	Emission Rate (lbs/day)					
	ROG	NOx	CO	SO2	PM10	PM2.5
Total	5.66	96.58	94.10	0.17	19.79	8.62
ICAPCD Significance	75.00	100.00	550.00	150.00	150.00	
CEQA Significant?	No	No	No	No	No	

The table above shows unmitigated emissions for grading from August through October 2013 to be 157 lbs/day, in excess of the Imperial County threshold of 100 lbs/day. The mitigated emissions are reduced to an estimate of 97 lbs/day (the figure cited in Table 4.3-7 in the FEIR for 2013), just below the Imperial County threshold of 100 lbs/day.

No substantiation of the effectiveness of the mitigation is provided in the FEIR. Even if mitigation effectiveness can be demonstrated, the estimate of emissions of NOx at 97 pounds per day in 2013 (Table 4.3-7 in the FEIR – just three pounds less than the Imperial County threshold -- is not defensible. Modeling estimates are just that: estimates. They may be higher or lower based on the values used for input parameters. In the case of the geothermal plant construction, Appendix C acknowledges that geothermal projects are not a project that is contemplated by the model used in the analysis, CalEEMod. Therefore, estimates of project construction emissions of NOx should be considered even more imprecise and an estimate of 97 pounds per day should be considered a significant impact.

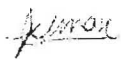
Additional mitigation for construction NOx emissions during the entire construction period should be incorporated into the FEIR prior to certification. The FEIR identifies Mitigation Measure AQ-2.1 to address what was identified as a NOx threshold exceedence only during concurrent construction of the Geothermal Plant and the Lithium Carbonate Plant (p. 4.3-35).

- Utilize all Tier 3 or Tier 4 construction equipment.
- Prohibit idling of equipment not in use; for equipment in use reduce idling time to a maximum of 5 minutes.
- Where feasible replace fossil fuel burning equipment with electrically driven equivalents provided they are not powered via a portable generator.
- Register all portable engines 50 horse power or greater with the ICAPCD.
- Submit to the Air District prior to any earthmoving activity a complete list of all construction equipment to be utilized during the construction phase identifying Make, Model, Year, and estimated hours of usage.
- In the event NOx emissions are calculated to exceed ICAPCD thresholds for construction, the Permittee shall provide for "off-site" mitigation or comply with Policy Number 5. Policy Number 5 allows a project to pay in-lieu impact fees utilizing the most current

Because construction NOX emissions estimates are so close to thresholds the FEIR should not be certified until these measures are incorporated for application to the entire project construction period.

Sincerely,

Matt Hagemann, P.G., C.Hg.



Uma Bhandaram

SWAPE Technical Consultation, Data Analysis and Litigation Support for the Environment

2503 Eastbluff Dr., Suite 206
Newport Beach, California 92660
Tel: (949) 887-9013
Fax: (949) 717-0069
Email: mhagemann@swape.com

Matthew F. Hagemann, P.G., C.Hg., QSD, QSP

Geologic and Hydrogeologic Characterization
Industrial Stormwater Compliance
CEQA Review
Investigation and Remediation Strategies
Litigation Support and Testifying Expert

Education:

M.S. Degree, Geology, California State University Los Angeles, Los Angeles, CA, 1984.
B.A. Degree, Geology, Humboldt State University, Arcata, CA, 1982.

Professional Certification:

California Professional Geologist
California Certified Hydrogeologist
Qualified SWPPP Developer and Practitioner

Professional Experience:

Matt has 25 years of experience in environmental policy, assessment and remediation. He spent nine years with the U.S. EPA in the RCRA and Superfund programs and served as EPA's Senior Science Policy Advisor in the Western Regional Office where he identified emerging threats to groundwater from perchlorate and MTBE. While with EPA, Matt also served as a Senior Hydrogeologist in the oversight of the assessment of seven major military facilities undergoing base closure. He led numerous enforcement actions under provisions of the Resource Conservation and Recovery Act (RCRA) while also working with permit holders to improve hydrogeologic characterization and water quality monitoring.

Matt has worked closely with U.S. EPA legal counsel and the technical staff of several states in the application and enforcement of RCRA, Safe Drinking Water Act and Clean Water Act regulations. Matt has trained the technical staff in the States of California, Hawaii, Nevada, Arizona and the Territory of Guam in the conduct of investigations, groundwater fundamentals, and sampling techniques.

Positions Matt has held include:

- Founding Partner, Soil/Water/Air Protection Enterprise (SWAPE) (2003 – present);
- Geology Instructor, Golden West College, 2010 – present;
- Senior Environmental Analyst, Komex H2O Science, Inc (2000 -- 2003);

- Executive Director, Orange Coast Watch (2001 – 2004);
- Senior Science Policy Advisor and Hydrogeologist, U.S. Environmental Protection Agency (1989–1998);
- Hydrogeologist, National Park Service, Water Resources Division (1998 – 2000);
- Adjunct Faculty Member, San Francisco State University, Department of Geosciences (1993 – 1998);
- Instructor, College of Marin, Department of Science (1990 – 1995);
- Geologist, U.S. Forest Service (1986 – 1998); and
- Geologist, Dames & Moore (1984 – 1986).

Partner, SWAPE:

With SWAPE, Matt's responsibilities have included:

- Lead analyst and testifying expert in the review of numerous environmental impact reports under CEQA that identify significant issues with regard to hazardous waste, water resources, water quality, air quality, greenhouse gas emissions and geologic hazards.
- Stormwater analysis, sampling and best management practice evaluation at industrial facilities.
- Lead analyst and testifying expert in the review of environmental issues in license applications for large solar power plants before the California Energy Commission.
- Technical assistance and litigation support for vapor intrusion concerns.
- Manager of a project to evaluate numerous formerly used military sites in the western U.S.
- Manager of a comprehensive evaluation of potential sources of perchlorate contamination in Southern California drinking water wells.
- Manager and designated expert for litigation support under provisions of Proposition 65 in the review of releases of gasoline to sources drinking water at major refineries and hundreds of gas stations throughout California.
- Expert witness on two cases involving MTBE litigation.
- Expert witness and litigation support on the impact of air toxins and hazards at a school.
- Expert witness in litigation at a former plywood plant.

With Komex H2O Science Inc., Matt's duties included the following:

- Senior author of a report on the extent of perchlorate contamination that was used in testimony by the former U.S. EPA Administrator and General Counsel.
- Senior researcher in the development of a comprehensive, electronically interactive chronology of MTBE use, research, and regulation.
- Senior researcher in the development of a comprehensive, electronically interactive chronology of perchlorate use, research, and regulation.
- Senior researcher in a study that estimates nationwide costs for MTBE remediation and drinking water treatment, results of which were published in newspapers nationwide and in testimony against provisions of an energy bill that would limit liability for oil companies.
- Research to support litigation to restore drinking water supplies that have been contaminated by MTBE in California and New York.
- Expert witness testimony in a case of oil production-related contamination in Mississippi.
- Lead author for a multi-volume remedial investigation report for an operating school in Los Angeles that met strict regulatory requirements and rigorous deadlines.
- Development of strategic approaches for cleanup of contaminated sites in consultation with clients and regulators.

Executive Director:

As Executive Director with Orange Coast Watch, Matt led efforts to restore water quality at Orange County beaches from multiple sources of contamination including urban runoff and the discharge of wastewater. In reporting to a Board of Directors that included representatives from leading Orange County universities and businesses, Matt prepared issue papers in the areas of treatment and disinfection of wastewater and control of the dischrge of grease to sewer systems. Matt actively participated in the development of countywide water quality permits for the control of urban runoff and permits for the discharge of wastewater. Matt worked with other nonprofits to protect and restore water quality, including Surfrider, Natural Resources Defense Council and Orange County CoastKeeper as well as with business institutions including the Orange County Business Council.

Hydrogeology:

As a Senior Hydrogeologist with the U.S. Environmental Protection Agency, Matt led investigations to characterize and cleanup closing military bases, including Mare Island Naval Shipyard, Hunters Point Naval Shipyard, Treasure Island Naval Station, Alameda Naval Station, Moffett Field, Mather Army Airfield, and Sacramento Army Depot. Specific activities were as follows:

- Led efforts to model groundwater flow and contaminant transport, ensured adequacy of monitoring networks, and assessed cleanup alternatives for contaminated sediment, soil, and groundwater.
- Initiated a regional program for evaluation of groundwater sampling practices and laboratory analysis at military bases.
- Identified emerging issues, wrote technical guidance, and assisted in policy and regulation development through work on four national U.S. EPA workgroups, including the Superfund Groundwater Technical Forum and the Federal Facilities Forum.

At the request of the State of Hawaii, Matt developed a methodology to determine the vulnerability of groundwater to contamination on the islands of Maui and Oahu. He used analytical models and a GIS to show zones of vulnerability, and the results were adopted and published by the State of Hawaii and County of Maui.

As a hydrogeologist with the EPA Groundwater Protection Section, Matt worked with provisions of the Safe Drinking Water Act and NEPA to prevent drinking water contamination. Specific activities included the following:

- Received an EPA Bronze Medal for his contribution to the development of national guidance for the protection of drinking water.
- Managed the Sole Source Aquifer Program and protected the drinking water of two communities through designation under the Safe Drinking Water Act. He prepared geologic reports, conducted public hearings, and responded to public comments from residents who were very concerned about the impact of designation.

- Reviewed a number of Environmental Impact Statements for planned major developments, including large hazardous and solid waste disposal facilities, mine reclamation, and water transfer.

Matt served as a hydrogeologist with the RCRA Hazardous Waste program. Duties were as follows:

- Supervised the hydrogeologic investigation of hazardous waste sites to determine compliance with Subtitle C requirements.
- Reviewed and wrote "part B" permits for the disposal of hazardous waste.
- Conducted RCRA Corrective Action investigations of waste sites and led inspections that formed the basis for significant enforcement actions that were developed in close coordination with U.S. EPA legal counsel.
- Wrote contract specifications and supervised contractor's investigations of waste sites.

With the National Park Service, Matt directed service-wide investigations of contaminant sources to prevent degradation of water quality, including the following tasks:

- Applied pertinent laws and regulations including CERCLA, RCRA, NEPA, NRDA, and the Clean Water Act to control military, mining, and landfill contaminants.
- Conducted watershed-scale investigations of contaminants at parks, including Yellowstone and Olympic National Park.
- Identified high-levels of perchlorate in soil adjacent to a national park in New Mexico and advised park superintendent on appropriate response actions under CERCLA.
- Served as a Park Service representative on the Interagency Perchlorate Steering Committee, a national workgroup.
- Developed a program to conduct environmental compliance audits of all National Parks while serving on a national workgroup.
- Co-authored two papers on the potential for water contamination from the operation of personal watercraft and snowmobiles, these papers serving as the basis for the development of nation-wide policy on the use of these vehicles in National Parks.
- Contributed to the Federal Multi-Agency Source Water Agreement under the Clean Water Action Plan.

Policy:

Served senior management as the Senior Science Policy Advisor with the U.S. Environmental Protection Agency, Region 9. Activities included the following:

- Advised the Regional Administrator and senior management on emerging issues such as the potential for the gasoline additive MTBE and ammonium perchlorate to contaminate drinking water supplies.
- Shaped EPA's national response to these threats by serving on workgroups and by contributing to guidance, including the Office of Research and Development publication, Oxygenates in Water: Critical Information and Research Needs.
- Improved the technical training of EPA's scientific and engineering staff.
- Earned an EPA Bronze Medal for representing the region's 300 scientists and engineers in negotiations with the Administrator and senior management to better integrate scientific principles into the policy-making process.
- Established national protocol for the peer review of scientific documents.

Geology:

With the U.S. Forest Service, Matt led investigations to determine hillslope stability of areas proposed for timber harvest in the central Oregon Coast Range. Specific activities were as follows:

- Mapped geology in the field, and used aerial photographic interpretation and mathematical models to determine slope stability.
- Coordinated his research with community members who were concerned with natural resource protection.
- Characterized the geology of an aquifer that serves as the sole source of drinking water for the city of Medford, Oregon.

As a consultant with Dames and Moore, Matt led geologic investigations of two contaminated sites (later listed on the Superfund NPL) in the Portland, Oregon, area and a large hazardous waste site in eastern Oregon. Duties included the following:

- Supervised year-long effort for soil and groundwater sampling.
- Conducted aquifer tests.
- Investigated active faults beneath sites proposed for hazardous waste disposal.

Teaching:

From 1990 to 1998, Matt taught at least one course per semester at the community college and university levels:

- At San Francisco State University, held an adjunct faculty position and taught courses in environmental geology, oceanography (lab and lecture), hydrogeology, and groundwater contamination.
- Served as a committee member for graduate and undergraduate students.
- Taught courses in environmental geology and oceanography at the College of Marin.

Matt currently teaches Physical Geology (lecture and lab) to students at Golden West College in Huntington Beach, California.

Invited Testimony, Reports, Papers and Presentations:

Hagemann, M.F., 2008. Disclosure of Hazardous Waste Issues under CEQA. Presentation to the Public Environmental Law Conference, Eugene, Oregon.

Hagemann, M.F., 2008. Disclosure of Hazardous Waste Issues under CEQA. Invited presentation to U.S. EPA Region 9, San Francisco, California.

Hagemann, M.F., 2005. Use of Electronic Databases in Environmental Regulation, Policy Making and Public Participation. Brownfields 2005, Denver, Coloradao.

Hagemann, M.F., 2004. Perchlorate Contamination of the Colorado River and Impacts to Drinking Water in Nevada and the Southwestern U.S. Presentation to a meeting of the American Groundwater Trust, Las Vegas, NV (served on conference organizing committee).

Hagemann, M.F., 2004. Invited testimony to a California Senate committee hearing on air toxins at schools in Southern California, Los Angeles.

Brown, A., Farrow, J., Gray, A. and **Hagemann, M.**, 2004. An Estimate of Costs to Address MTBE Releases from Underground Storage Tanks and the Resulting Impact to Drinking Water Wells. Presentation to the Ground Water and Environmental Law Conference, National Groundwater Association.

Hagemann, M.F., 2004. Perchlorate Contamination of the Colorado River and Impacts to Drinking Water in Arizona and the Southwestern U.S. Presentation to a meeting of the American Groundwater Trust, Phoenix, AZ (served on conference organizing committee).

Hagemann, M.F., 2003. Perchlorate Contamination of the Colorado River and Impacts to Drinking Water in the Southwestern U.S. Invited presentation to a special committee meeting of the National Academy of Sciences, Irvine, CA.

Hagemann, M.F., 2003. Perchlorate Contamination of the Colorado River. Invited presentation to a tribal EPA meeting, Pechanga, CA.

Hagemann, M.F., 2003. Perchlorate Contamination of the Colorado River. Invited presentation to a meeting of tribal repesentatives, Parker, AZ.

Hagemann, M.F., 2003. Impact of Perchlorate on the Colorado River and Associated Drinking Water Supplies. Invited presentation to the Inter-Tribal Meeting, Torres Martinez Tribe.

Hagemann, M.F., 2003. The Emergence of Perchlorate as a Widespread Drinking Water Contaminant. Invited presentation to the U.S. EPA Region 9.

Hagemann, M.F., 2003. A Deductive Approach to the Assessment of Perchlorate Contamination. Invited presentation to the California Assembly Natural Resources Committee.

Hagemann, M.F., 2003. Perchlorate: A Cold War Legacy in Drinking Water. Presentation to a meeting of the National Groundwater Association.

Hagemann, M.F., 2002. From Tank to Tap: A Chronology of MTBE in Groundwater. Presentation to a meeting of the National Groundwater Association.

Hagemann, M.F., 2002. A Chronology of MTBE in Groundwater and an Estimate of Costs to Address Impacts to Groundwater. Presentation to the annual meeting of the Society of Environmental Journalists.

Hagemann, M.F., 2002. An Estimate of the Cost to Address MTBE Contamination in Groundwater (and Who Will Pay). Presentation to a meeting of the National Groundwater Association.

Hagemann, M.F., 2002. An Estimate of Costs to Address MTBE Releases from Underground Storage Tanks and the Resulting Impact to Drinking Water Wells. Presentation to a meeting of the U.S. EPA and State Underground Storage Tank Program managers.

Hagemann, M.F., 2001. From Tank to Tap: A Chronology of MTBE in Groundwater. Unpublished report.

Hagemann, M.F., 2001. Estimated Cleanup Cost for MTBE in Groundwater Used as Drinking Water. Unpublished report.

Hagemann, M.F., 2001. Estimated Costs to Address MTBE Releases from Leaking Underground Storage Tanks. Unpublished report.

Hagemann, M.F., and VanMouwerik, M., 1999. Potential Water Quality Concerns Related to Snowmobile Usage. Water Resources Division, National Park Service, Technical Report.

VanMouwerik, M. and **Hagemann, M.F.** 1999, Water Quality Concerns Related to Personal Watercraft Usage. Water Resources Division, National Park Service, Technical Report.

Hagemann, M.F., 1999, Is Dilution the Solution to Pollution in National Parks? The George Wright Society Biannual Meeting, Asheville, North Carolina.

Hagemann, M.F., 1997, The Potential for MTBE to Contaminate Groundwater. U.S. EPA Superfund Groundwater Technical Forum Annual Meeting, Las Vegas, Nevada.

Hagemann, M.F., and Gill, M., 1996, Impediments to Intrinsic Remediation, Moffett Field Naval Air Station, Conference on Intrinsic Remediation of Chlorinated Hydrocarbons, Salt Lake City.

Hagemann, M.F., Fukunaga, G.L., 1996, The Vulnerability of Groundwater to Anthropogenic Contaminants on the Island of Maui, Hawaii. Hawaii Water Works Association Annual Meeting, Maui, October 1996.

Hagemann, M. F., Fukanaga, G. L., 1996, Ranking Groundwater Vulnerability in Central Oahu, Hawaii. Proceedings, Geographic Information Systems in Environmental Resources Management, Air and Waste Management Association Publication VIP-61.

Hagemann, M.F., 1994. Groundwater Characterization and Cleanup at Closing Military Bases in California. Proceedings, California Groundwater Resources Association Meeting.

Hagemann, M.F. and Sabol, M.A., 1993. Role of the U.S. EPA in the High Plains States Groundwater Recharge Demonstration Program. Proceedings, Sixth Biennial Symposium on the Artificial Recharge of Groundwater.

Hagemann, M.F., 1993. U.S. EPA Policy on the Technical Impracticability of the Cleanup of DNAPL-contaminated Groundwater. California Groundwater Resources Association Meeting.

Hagemann, M.F., 1992. Dense Nonaqueous Phase Liquid Contamination of Groundwater: An Ounce of Prevention... Proceedings, Association of Engineering Geologists Annual Meeting, v. 35.

Other Experience:

Selected as subject matter expert for the California Professional Geologist licensing examination, 2009-2011.