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Peninsula Corridor Joint Powers Board (Caltrain)
Attention: Stacy Cocke, Senior Planner
1250 San Carlos Avenue
San Carlos, CA 94070-1306

RE: Peninsula Corridor Electrification Project Draft EIR

Dear Peninsula Corridor Joint Powers Board (Caltrain):

The California Environmental Quality Act (CEQA) requires every public agency proposing to take an action that might have a significant negative impact on the environment to prepare an Environmental Impact Report (EIR) on the proposed project. CEQA specifies both the procedures to be followed and outlines exactly what subjects an EIR must address. This letter is to submit comments on the Draft Environmental Impact Report (DEIR) prepared by Caltrain for its proposed Peninsula Corridor Electrification Project (PCEP).

The following comments are being submitted on behalf of the Community Coalition on High-Speed Rail (CC-HSR):

1. The DEIR is flawed and fatally deficient, in that it fails to describe and analyze the environmental impacts of the "whole project." Caltrain has done exactly what CC-HSR urged it not to do in a letter submitted to the Caltrain Joint Powers Board (JPB) on March 14, 2013, when CC-HSR commented on the Notice of Preparation (NOP) circulated prior to the preparation of the current DEIR. A copy of our March 2013 letter is attached. In that letter we stated:

    - The environmental review undertaken at this time must analyze the "whole project" that is ultimately being considered. This project includes electrification not only for the purpose of a modernization of current Caltrain service, but for the eventual use of the Caltrain right of way by the state's proposed high-speed train system. From our review of the NOP, it does not appear to CC-HSR that Caltrain is, in fact, planning to analyze the whole project. It would be hard to overstate the importance of this point. In order to comply with CEQA, the EIR must fully analyze the high-speed train impacts of the proposed electrification project.

- Caltrain cannot fund this project as a high-speed train project and then claim that the project relates only to an electrification of the Peninsula corridor for local passenger service operated by Caltrain. Again, we cannot emphasize enough the importance of doing a full and fair analysis, as required by CEQA, that considers the "whole project," and that therefore examines the impacts of the whole project. In this case, that means the EIR must consider all of the impacts that will ultimately be associated with any high-speed train use of the project that is proposed to be constructed.

- We urge Caltrain not to proceed on the premise that an analysis of the high-speed train impacts associated with the proposed project can be deferred to some later time. We urge you not to think that an analysis of these impacts can be dealt with summarily, as some kind of "cumulative impact," or that some claimed "independent utility" of the proposed facilities for local service will excuse Caltrain from the obligation to do a full analysis of the entire project, including an analysis of the impacts of the high-speed train service that would use the project. Again, this is particularly true since it is high-speed train funding that is largely going to be paying for the project.

- Caltrain cannot have it both ways. If Caltrain is going to use high-speed train bond funds to build the proposed electrification project (which is what the NOP indicates is the plan), then the environmental review carried out on the project must analyze the impacts that might result from using the Caltrain corridor, and the proposed electrification facilities, for high-speed train operation.

2. A seminal California Supreme Court case, *Laurel Heights Improvement Association of San Francisco, Inc. v. The Regents of the University of California* (1988) 47 Cal.3d 376 emphasizes how important it is that an EIR review the "whole project":

    - We find the EIR was inadequate because: (1) it fails to discuss the anticipated future uses of the new facility and the environmental effects of those uses, and (2) the discussion of alternatives is inadequate under CEQA.

3. It is worth remembering what the CEQA Guidelines says in providing a list of "General Concepts" [Guidelines §15002(d)]:

    - The term "project" has been interpreted to mean far more than the ordinary dictionary definition of the term. See Section 15378.

4. Guidelines Section 15378 says "Project" means the whole of an action, which has a potential for resulting in either a direct physical change in the environment, or a reasonably foreseeable indirect physical change in the environment, and that is … an activity … which is supported in whole or in part through public agency contracts, grants, subsidies, loans, or other forms of assistance from one or more public agencies." That statement perfectly describes the "blended" Caltrain/high-speed rail use of the Caltrain facilities, which is clearly the ultimate use proposed in connection with the current electrification project. That "whole project" is the project that the DEIR must analyze, and because it fails to do so, the current DEIR is inadequate and fatally flawed.

5. The DEIR claims, at Page ES-3, "Electrification can be analyzed as a separate project under the California Environmental Quality Act (CEQA) because it has independent utility (providing Caltrain electrified service) and logical termini (station end points)." This claim is conjured out of some sort of wishful thinking. Caltrain obviously wants to avoid the hard questions. Many projects that CEQA requires be considered as "whole projects," and in their entirety, are composed of smaller, subsidiary parts that have independent utility. That was exactly the situation in the *Laurel Heights* case, for instance, where the building that the University purchased and proposed to convert to University uses had independent utility in the short term, for certain kinds of educational activities, while the University knew at the time of the EIR that the building would later be used for a set of expanded activities. The Court said the EIR had to describe and analyze the expanded uses, not the initial use (which of course did have independent utility):

   > We hold that an EIR must include an analysis of the environmental effects of future expansion or other action if: (1) it is a reasonably foreseeable consequence of the initial project; and (2) the future expansion or action will be significant in that it will likely change the scope or nature of the initial project or its environmental effects.

   That is exactly the case here. It is clear that Caltrain can provide train service (even improved train service) without electrification. However, it is also clear that once electrification is provided, future high-speed train service is a "foreseeable consequence." In fact, if such high-speed rail service weren't "foreseeable," why would the state contribute $620 million to the current electrification project? Answer, the state wouldn't do that, and in fact couldn't legally do that, since the source of the funding being used is strictly limited to expenditures to support the construction of a high-speed rail project in California. In accepting and spending high-speed rail money, Caltrain is making a commitment

on behalf of itself and the state to a "blended" high-speed rail service. Because that commitment is being made now, the environmental analysis needs to be done now. That is what CEQA requires. Caltrain knows that the PCEP electrification project will have impacts beyond what they cover in the current DEIR. Caltrain knows that there will be further impacts when high-speed service commences. Therefore, Caltrain needs to be frank, forthright, and honest, and analyze the environmental impacts of the "whole project," and that analysis needs to happen "now," not at some future time.

6. As in the *Laurel Heights* case, the failure of Caltrain to consider the "whole project" has led to its failure to provide an adequate discussion and review of reasonable alternatives, as both CEQA and the CEQA Guidelines require. The inadequate alternatives analysis in the DEIR is another reason that the DEIR is fatally flawed. Let us not forget that there is a fundamental "good government" reason that the State Legislature has required all public agencies to do EIRs, and has required that these EIRs cover the "whole project." An EIR is an "informational document" that is supposed to help governmental agency decision makers, like the members of the Caltrain Joint Powers Board, make better decisions. Unless there is a full and adequate analysis of alternatives, it will be impossible for the Caltrain Joint Powers Board to carry out the following direction, found in §21002 of CEQA:

   > The Legislature finds and declares that it is the policy of the state that public agencies should not approve projects as proposed if there are feasible alternatives … which would substantially lessen the significant environmental effects of such projects …

7. While the current DEIR doesn't really contain a "stable" project description (also a CEQA requirement, incidentally), it does provide a pretty clear list of the objectives of the PCEP. On Page ES-6, the DEIR says that the primary purposes of the Proposed Project are to: (1) improve train performance; (2) reduce costs; (3) reduce long-term environmental impact by reducing noise and vibration; (4) improve regional air quality; (5) reduce greenhouse gas emissions, and (6) provide electrical infrastructure that would be compatible with separate later use for Blended Service. In order to achieve the state policy just quoted in comment #6, CEQA requires that the EIRs produced by agencies consider a "range of reasonable alternatives of the project … which would feasibly attain most of the basic objectives of the project but would avoid or substantially lessen any of the significant effects of the project, and evaluate the comparative merits of the alternatives." [CEQA Guidelines §15126.6]. This is where the DEIR goes off track, with respect to the alternatives analysis required

by CEQA. There are a number of alternatives that might achieve every one of the objectives just quoted, except the objective to provide "electrical infrastructure … compatible with separate later use for Blended Service" (for high-speed rail). The rejection of any genuine effort to see if non-electrification options might achieve objectives (1) through (5), which would certainly be "most" of the basic objectives listed, demonstrates that this project is actually a high-speed rail project. Again, because that is really what the project is, a high-speed rail project, and because the DEIR doesn't analyze the impacts from high-speed rail, the current DEIR totally inadequate under CEQA.

8. On Page ES-1, the DEIR discusses a "Final" EIR on the proposed project that the Caltrain JPB did not certify "because of the need for resolution of issues regarding joint planning for shared use of the Caltrain corridor for Caltrain service and for future high-speed rail (HSR) service." In fact, CC-HSR objected to the certification of that "Final" EIR for pretty much the same reasons we now state that the current DEIR is inadequate: the EIR was for a project that really was a high-speed rail project, but it didn't analyze the impacts from HSR. A copy of our March 31, 2010 letter is attached.

9. On Page ES-2, we note that the DEIR frankly admits, "The JPB and CHSRA are committed to advancing a blended system concept." As stated earlier, this is the actual project that the DEIR must address.

10. The DEIR does not make it clear exactly how many trains will be using the Caltrain tracks. This can be seen, first, on Page ES-3. The DEIR is supposed to help members of the public understand exactly what impacts to expect. The EIR should have a table or other easy to understand presentation that will tell the reader: (1) how many trains use the Caltrain right of way now; (2) how many trains are proposed if the PCEP is implemented as is proposed in the DEIR; (3) how many trains are proposed when the Caltrain right or way is being used for HSR. All the various impacts discussed in the EIR should clearly relate to these numbers. As currently written, it is unclear what impacts the project will have either prior to or after HSR is implemented, and thus it is extremely difficult to evaluate the impacts.

11. It also appears on Page ES-3 that the number of trains that are likely to use the Caltrain right of way is not based on the latest HSR Business Plan, released in February 2014. This means that the current document inadequately describes project impacts.

12. As with the description of the number of trains that will be using the Caltrain right of way, it is difficult to understand how many miles of catenary wires will be installed. On Page ES-7, it is said both that the project will encompass 51 miles, from 4th and King Street in San

Francisco to two miles south of the Tamien Station in San Jose, but there will be 130-140 single-track miles or overhead contact system wires. How do these numbers relate?

13. The explanations of the electrical system on Page ES-8 and throughout the document are extremely difficult to understand. The EIR should explain the difference between "traction power substations" and the "auto-transformer power feed system." In addition, how does the "auto-transformer" feed system reduce EMF/EMI effects? What is the difference between a TPF and a TPS?

14. Attached to this letter is a blog entry with a diagram copied from a "Caltrain HSR Compatibility Blog," published by a blogger who uses the name Clem, and who provides reliable and often expert information on high-speed rail related issues. Among other things, this document discusses the vegetation clearance issues mentioned on Page ES-8. Are there any inaccurate statements contained in Clem's blog document with respect to state and federal regulatory standards applicable to the PCEP as currently proposed? If the statements in Clem's blog are correct, don't they demonstrate that it would be possible to design the power distribution system in a way that would better protect existing trees? CC-HSR believes that the DEIR must be rewritten clearly to show all available alternative design options so that the option that will best protect existing trees can be considered.

15. On Page ES-7, the DEIR describes the proposal to power the overhead contact system with 25-kilovolt alternating current. Is this power configuration used anywhere else in the United States, or elsewhere, and if so, what issues, if any, have arisen? What alternative power configurations would be possible, and why is the 25-kv system considered to be preferable?

16. On Page ES-8, the use of "two parallel aerial feeders, one on each side of the alignment," is mentioned. It appears that this design is intended to reduce EMF and EMI. Is that correct? Is there a trade off between the reduction of EMF and EMI and the use of center pole feeders, which would reduce impacts on trees? If so, CC-HSR believes that there needs to be a much more extensive analysis of the benefits versus the detriments, in view of the huge impact that the proposed project would have on trees in or along the Caltrain right of way.

17. In view of the fact, reported on Page ES-9, that there "is currently no United States-based prototype for the EMU proposed," why doesn't the DEIR consider what design features of an entirely new vehicle could provide passenger loading benefits that could help improve travel times without the need to use electrified vehicles? Wouldn't it be possible to

explore alternatives that might provide the same travel times as the project currently proposed, but without the need for electrification?

18. On Page ES-10, it is said that there would be a total of 114 trains per day between San Joe and San Francisco. As per our earlier comment, this figure is different from other figures used in the DEIR. The DEIR should include an easy to understand table or other presentation that will make clear what is actually being proposed, under the various scenarios that are possible, including when a "blended" service is instituted.

19. On Page ES-10, the DEIR mentions the wear that will occur on the carbon-copper collector strips that are proposed to be used on the electric vehicles. What noise is produced in connection with the friction that produces the wear indicated)? The DEIR must analyze possible noise impacts, which seem to have been overlooked.

20. The DEIR also does not analyze the possible toxicity of the dust that will be generated as the carbon and copper collector strips wear away. It is clearly expected that these materials will be released into the ambient environment in connection with such wear, so it is important that the DEIR investigate and document any potential health problems. Fine dust particles generated along the right of way, where significant air turbulence can be expected, and where dust-removing vegetation has been taken out, could pose a health problem for residents and business patrons along the right of way. Attached is a document indicating that copper can have adverse health impacts. The DEIR needs to be revised to discuss this potential health issue.

21. On Page ES-12, in discussing high-speed rail, the DEIR says that the project proposed will not support speeds greater than 79-mph for Caltrain vehicles, and 110-mph for HSR vehicles. If a main purpose of the project is to provide an electrification of the Caltrain right of way that will ultimately support high-speed trains (and that will be paid for with high-speed rail bond act monies), is there any evidence that the ultimate "blended" project can meet the design requirements of Proposition 1A, the high-speed rail bond act, which requires that the *maximum* time allowed for a trip between San Francisco and San Jose is no more than30 minutes? [See Streets and Highways Code §2704.09(b)(3)]

22. Since horn noise is a major impact, and an increased number of trains, as contemplated by the project, will mean more horn noise, what could be done by way of mitigations to eliminate the need for horns to be sounded at every street intersection? The DEIR says that grade separations at every crossing would be prohibitively expensive, but what about so-called "quad gates" or other automatic mechanisms

to provide intersection safety to the degree that the need to use horns as a warning can be eliminated? CEQA requires that mitigations of significant impacts be accomplished *to the greatest degree feasible*. The DEIR does not adequately explore possible mitigation measures that could reduce horn noise.

23. Another impact along the Caltrain right of way is a significant number of deaths caused by accident, or by suicide. The DEIR must examine this reality, and document increased hazards that might occur because the proposed project will increase the number (and perhaps speed) of trains using the right of way. In this case, too, the DEIR must explore any feasible mitigation measures that could reduce such train related deaths.

24. In *Save Tara v. City of West Hollywood* (2008) 45 Cal. 4th 116, the California Supreme Court held that an agency has made a "decision" that it will undertake a project, and thus has taken an action requiring CEQA review, when the agency makes a substantial monetary commitment to the project. To reiterate a point made earlier, Caltrain and the State High-Speed Rail Authority have collectively decided to carry out what is essentially a high-speed rail project, and the current DEIR fails to describe and analyze the impacts of the actual project being advanced.

25. As a good example of how the current DEIR is deficient in failing to examine the impacts of the project that is actually being pursued, the DEIR reports on Page ES-17 that "Blended service with more than two high-speed trains would require a set of passing tracks. Depending on location, this may result in a significant change in local visual character in combination with the Proposed Project's impacts related to tree removal and OCS installation." This statement significantly underestimates the impacts that the construction of passing tracks would have. Those impacts would be more than "visual." However, although admitting that impacts are possible, related to passing tracks (and CC-HSR would say that such impacts are "virtually certain"), the current DEIR doesn't analyze these visual impacts it admits are possible, much less explore other, and arguably more significant impacts.

26. On Page ES-19, the DEIR mentions that Blended Service operations could have adverse impacts on freight service. CC-HSR has two comments:

    - First, the Union Pacific Railroad (UPRR) has informed the High-Speed Rail Authority, in a letter dated April 3, 2014, and a copy of which was sent to the Executive Director of the Caltrain JPB, that the Authority and Caltrain are proceeding with the current

electrification project without recognizing Union Pacific's exclusive rights to operate intercity passenger service on the San Francisco Peninsula, and without taking into account requirements that none of the proposed facilities can be built in such a way that the facilities do not limit UPRR's use of its property for freight and railroad purposes. It seems clear that the current DEIR is deficient in that it does not address issues that must be part of any project ultimately pursued. In fact, until an agreement is reached between Caltrain/CHSRA and UPRR, there really isn't a "project" to analyze. The current DEIR is premature from this perspective, because the actual shape of the project cannot be known until some arrangement is reached with UPRR. A copy of the UPRR letter will be submitted by CC-HSR separately for consideration as Caltrain prepares responses to comments submitted on the DEIR.

- Second, the DEIR fails adequately to analyze the impacts that would occur if, in fact, UPRR operations were disrupted by the project as currently proposed by Caltrain. The diversion of freight transport from rail to trucks could be significant, and must be analyzed.

27. On Pages ES-20 and ES-21, a "DMU" alternative is outlined. The DEIR acknowledges that this alternative would meet many of the purposes of the project, but not what the DEIR calls a "fundamental" purpose, which is "to provide electrical infrastructure compatible with high-speed rail." To reiterate, if a "fundamental" purpose of the current project is to provide the infrastructure for high-speed rail, then the impacts of high-speed rail need to be analyzed.

28. On Page ES-21, the DEIR says that only a "single-level" DMU car is analyzed because a "double-deck would not fit in the Caltrain system tunnels." Current Caltrain vehicles appear to include "double-deck" models; what would be different about a DMU double-deck? Further, since Caltrain has not yet designed the vehicle that it would use for the service it is proposing, why couldn't an appropriate DMU be designed? If a DMU, properly designed, could provide a reasonable alternative that would eliminate one or more significant environmental impacts then CEQA demands that this alternative be analyzed.

29. On Page ES-21, the DEIR disqualifies the Dual-Mode MU alternative because of its failure to provide what the DEIR says is the "fundamental" requirement that the system must provide an electrical infrastructure compatible with high-speed rail. The same comment applies here as applied to DEIR's treatment of a DMU option.

30. On Page 1-1, the DEIR says that the proposed project "consists" of converting Caltrain trains from diesel-hauled to electric-powered vehicles. The cost, earlier outlined, is $1.2 billion dollars. Presuming that $620 million dollars were *not* available, what improvements could be accomplished to the Caltrain system with the other $605 million that is indicated as part of the proposed funding? Again pointing to the "good government" purpose of CEQA, the Caltrain JPB should be given alternatives that include the "Cadillac" plan at $1.2 billion, and a more "Chevrolet" plan at $605 million. If Caltrain wanted to spend $605 to improve Caltrain (but not electrify it) what could Caltrain accomplish? The JPB must be given real alternatives and real options. CEQA requires this. So does a commitment to good government in general. The fact that this kind of cost/benefit comparison has apparently not been done indicates that the "real" project is, in fact, building the electrical infrastructure for high-speed rail. That may well be a worthy project, but if the "real" project being pursued is all about high-speed rail, then CEQA requires that the EIR consider all of the impacts associated with high-speed rail. The current DEIR doesn't do that, and so is fatally flawed.

31. The "Need" for the proposed project, as outlined on Page 1-3, should be the focus of the discussion in the DEIR, and a reasonable range of alternatives should be considered, with different costs and different benefits (and with different environmental impacts), so that the JPB can truly carry out the state policy encompassed in CEQA, and see if there is an alternative that best eliminates or mitigates the environmental impacts. However, because Caltrain is "committed" to HSR, as the DEIR candidly admits, the alternatives analysis that CEQA demands has not been done. And an analysis of the full impacts of high-speed rail hasn't been done either.

32. The proposed project is artfully described in the DEIR, to try to distract the reader, so that he or she doesn't notice that the project can be seen as two different things (if not exactly simultaneously, then with just the slightest shift in vision). Consider the "Rubin Vase," below. This figure was developed by the Danish psychologist Edgar Rubin. Looked at one way, the figure appears to be a "vase." Looked at another way, the picture is of two persons facing each other. Those two visions keep switching back and forth, no matter how much one tries to keep one's focus on either the "vase" or on the "facing persons."

Caltrain would like the reader to understand the proposed project as being aimed at improving Caltrain commuter service, with the high-speed rail part of the program just "incidental." That's something for the future, to be thought about then. As the DEIR puts it on Page 1-9, the PCEP is just going to "accommodate" future high-speed rail. That idea of just "accommodating" high-speed rail might make the electrification aspect of the project seem to be just a minor feature. Looked at another way, however, as CC-HSR has been pointing out in this comment letter, the proposed project is all about constructing the infrastructure of electrification and putting that in place for high-speed rail. That is not any thing that is "incidental" to the proposed project. It is in fact, as the DEIR says, "fundamental" to the project. Like the Rubin Vase, the project is "both" things – depending on one's perspective.

33. The fact that the proposed project is "both" things doesn't mean that Caltrain can pick one way of looking at it, and ignore the other way. Just like the Rubin Vase, the "other" way of looking at the project keeps popping into focus. The PCEP is "both" a proposed improvement for Caltrain commuters AND the basic infrastructure for high-speed rail. Even if one accepted the idea that the "main" purpose of the project was to benefit Caltrain, and that high-speed rail is just an incidental, CEQA would *still* mandate a full analysis of the impacts of the high-speed rail features. Again, think about that "Rubin Vase." What CEQA essentially says is that if you can "see" something, and what you see "might" be either a vase or two facing persons, <u>you have to analyze both alternatives</u>, because CEQA requires the analysis of anything that "might" have an adverse environmental impact.

34. The correctness of the analysis just presented is particularly visible on Page 2-2 of the DEIR. At the top of the page, the DEIR says "the proposed project is part of a program to modernize operation of the Caltrain rail corridor between San Jose and San Francisco." In the middle of the page, the DEIR says, "the JPB and CHSRA are committed to advancing a blended system concept." Since the proposed project is "both" of these things, CEQA requires a full environmental analysis of

"both" of the sets of future impacts. And that is not what the DEIR has delivered. Therefore, it needs to be reworked, and recirculated.

35. On Page 2-5 of the DEIR, it appears that no other United States transportation agency is using the 25-kv system that Caltrain is proposing. Why has this power supply system been selected? What are the pros and cons of the other systems mentioned by not really described on Page 2-5?

36. On Page 2-10, it is stated that the proposed project would require a change in the warning devices for at-grade crossings. Why couldn't the project include significant new protection at such at-grade crossings, since there will have to be some replacements anyway? What would need to be done to make at-grade crossings so safe that horn noise could be eliminated?

37. Figure 3.1-4 seems to indicate a particularly unsightly installation, and also one that seems potentially dangerous, since children from nearby residences might be tempted to explore this "unattractive nuisance." Can this site be changed, better protected, and/or the visual qualities of the proposed project at this site improved? What dangers are there to someone getting onto the property where the installation is located?

38. Figure 3.1-5 provides a "simulated view" of the proposed project at Oak Grove Avenue in Burlingame. Is there a commitment by Caltrain that if the project is approved that this picture will be a "condition" of the project, and what is shown here as a "simulated" view will be the "actual" view? Isn't it true, in fact, that the project, if approved as presented, would allow Caltrain to cut down or trim more extensively with no real limit except their own best judgment? What conditions would need to be imposed on the project to guarantee that no trimming or tree removal could be undertaken that would result in a view less appealing than the "simulated" view in Figure 3.1-5?

39. The same question posed in Comment #38 is posed with respect to Figure 3.1-7, showing the Atherton Caltrain Station.

40. The same question posed in Comment #38 is posed with respect to Figure 3.1-9, showing Churchill Avenue in Palo Alto.

41. Figure 3.1-12 seems to indicate a particularly unsightly installation, and also one that seems potentially dangerous, since children from nearby residences might be tempted to explore this "unattractive nuisance." Can this site be changed, better protected, and the visual qualities of the proposed project at this site improved? What dangers

are there to someone getting onto the property where the installation is located?

42. With respect to Figure 3.1-16, what conditions would need to be imposed to make sure that the aesthetic qualities of that site would never be worse than the simulated view shown?

43. With respect to Figure 3.1-17 the following questions are pertinent: Can this site be changed, better protected, and/or the visual qualities of the proposed project at this site improved? What dangers are there to someone getting onto the property where the installation is located?

44. With respect to the DEIR's analysis of Air Quality, the EIR must do a more thorough analysis of what new dangers from PM_{10} or $PM_{2.5}$ may be experienced by persons residing on properties in areas where significant vegetation is removed, as proposed, since existing trees and other vegetation has a significant effect in filtering and stopping dust.

45. The DEIR does an inadequate job of evaluating what impacts to birds and bats will occur from the proposed tree removal and pruning. CEQA does not say that the only significant issues are biological impacts affecting endangered or threatened species. The DEIR is supposed to evaluate all negative environmental impacts. What effects would the proposed tree cutting have on raptors that utilize existing tree cover along the Caltrain right of way?

46. The DEIR does not provide an adequate analysis of possible impacts to El Palo Alto, the heritage tree located twenty-six feet from the Caltrain right of way. The tree is 1,000 years old and is 110 feet tall. The DEIR's conclusion that the project would have "no impact" on the tree is unsubstantiated.

47. The DEIR's analysis of Greenhouse Gas Emissions is deficient. While the DEIR discusses the reduction in emissions caused by the replacement of diesel-powered vehicles with electric vehicles which don't themselves generate toxic exhaust, there is no significant analysis of the environmental impacts associated with the electricity generation that will be needed to power the Caltrain and high-speed rail trains.

48. Furthermore, Appendix F of the CEQA Guidelines requires that "potentially significant energy implications of a project shall be considered…." The DEIR is not in compliance with the requirements of Appendix F.

49. The DEIR discusses noise, but in an "abstract" way. The DEIR should have begun with an investigation of current noise complaints, then evaluating what impact the project would have, either positive or negative, on the noise complaints already being expressed.

50. The noise charts in Tables 3.11-6 and 3.11-15 are totally unhelpful. It is impossible to use these charts to understand what various noise impacts might be, since the sites are not identified.

51. The DEIR "lists" various public facilities within one-quarter mile of the Caltrain corridor, but does not analyze the impacts that the proposed project might have on schools, libraries, and city facilities. The DEIR should do that.

52. On Page 3.14-6, the EIR says that weekday service would be provided to the Atherton and Broadway stations if the proposed project goes ahead. What commitment would guarantee that? On what basis is that assertion made?

53. On Page 3.14-7, the DEIR shows travel times from San Francisco to San Jose. As noted earlier, the bond act that is providing the funding that Caltrain proposes to use for the PCEP requires that the time from San Jose to San Francisco must be 30 minutes *maximum*. On what basis can the blended system achieve that, since the fastest time shown for current operations is 60 minutes, or twice that?

54. The DEIR indicates, on Page 3.14-27, that there are a number of parking lots that are at capacity at the present time. Since the proposed project will expand capacity, the project should include measures to meet new parking demand, where no excess capacity currently exists. The success of the proposed project depend on riders being able to access the trains, and that means that adequate parking is a necessity. Furthermore, the lack of parking will exacerbate the traffic problems already identified in the DEIR.

55. The "trackage rights" of the Union Pacific Railroad Company are mentioned on Page 3.14-28. By a separate letter, I am submitting a copy of a letter dated April 3, 2014, outlining the many problems that the lack of a viable agreement with UPRR poses for the proposed project. Caltrain should enter into an agreement with UPRR so that it will actually know what sort of project will be possible, and then rework the Draft EIR and recirculate it, once the DEIR can reflect the realities of what Caltrain can actually do on the Caltrain right of way, taking UPRR's rights into account.

56. CC-HSR believes that the potential for the proposed project to interfere with existing freight operations is a significant factor in what sort of

project should actually be pursued. The current DEIR does not adequately evaluate the impacts that the proposed project would have on freight operations, and then the environmental impacts that would occur should existing freight operations be limited. Nor does the DEIR permit the JPB to see what operational problems the proposed project would actually encounter, in view of UPRR's trackage rights.

57. The comment about the traffic problems caused by "gate down" occurrences, found on Page 3.14-41 is not an analysis. The DEIR must actually analyze the likely VMT and air quality impacts of the "gate down" problems that the proposed project will cause.

58. The DEIR indicates at Page 3.14-62 that Caltrain "emphasizes station access by walking, transit, and bicycling…" The DEIR must do more than state Caltrain's policy preferences (laudable as they may be). To be adequate, the DEIR must actually review buildout in areas near to the Caltrain corridor, to see if there is any future potential for new populations that can, in fact, access Caltrain without using a car. This is particularly important where parking capacity is constrained.

59. Referring to Page 3.14-63, the DEIR needs to identify those stations at which Caltrain believes that "providing automobile access is not a priority." In this case, as in others, the DEIR reads like a bunch of statistics which, even if accurate, are not presented in a way that can help members of the public understand exactly what is being proposed, and whether or not they think that the impacts of the project are properly described or characterized.

60. On Page 4-1 (and elsewhere in the DEIR), Caltrain asserts that the high-speed rail project (the project that will be "accommodated" by the proposed PCEP project) is not part of the "project" that the DEIR is evaluating. Instead, Caltrain says that the high-speed rail project should be considered under the rubric of those "cumulative impacts" that CEQA requires agencies to consider. This is not a correct analysis, and the current DEIR violates CEQA because this is how Caltrain is trying to insulate itself from the full review that CEQA demands.

61. Saying that the high-speed rail part of the project isn't part of the current "project," but just a "cumulative impact," is exactly the point at which Caltrain wants to get the reader to transform the "Rubin Vase" of this project from one thing to another. Clever though this is, any vision of the project that sees it as "just" an improvement of Caltrain service misstates the project. Our understanding quickly slips back to the real vision of a "project" that includes the entirety of high-speed rail as an impact.

62. CEQA defines a "project" as:

- An activity
- Which *may*
- Cause … a direct physical change … or
- A reasonably foreseeable indirect physical change
- In the environment [Public Resources Code §21065]

Besides the fact that the PCEP would be paid for by $600 million dollars of state bond act money that can *only* be used for high-speed rail, and besides the fact that the "whole of an action" must be evaluated under CEQA, it is indubitably true that the electrification work that can help improve Caltrain service (if the project is looked at that way) will "cause … a reasonably foreseeable … physical change" by way of high-speed rail blended service on the Caltrain right of way. This is how we see the "Rubin's Vase" of this project from the other perspective. The development of blended high-speed rail service, from San Jose to San Francisco, is definitely one part of the proposed project, and the impacts of that part of the project will happen, if the project goes forward. Therefore, these impacts MUST be fully evaluated. As Caltrain admits, the current DEIR doesn't provide that full evaluation, which makes it deficient.

63. The concept that the future implementation of a "blended" high-speed rail service isn't part of the current project, but a future "cumulative impact," founders on the definition of "cumulative impact" outlined in the Guidelines, when that definition is tested against the specifics of this project.

64. Guidelines §15065 (a)(3) says that "cumulatively considerable" means that the incremental effects of an individual project are significant when viewed:

- In connection with the effects of *past* projects,
- The effects of *other current projects* and
- The effects of probable *future* projects

Is the blended high-speed rail service on the Caltrain corridor, to which Caltrain and the High-Speed Rail Authority are mutually "committed," and which will be "accommodated" by the electrification system that is going to be paid for with money that can be used only for high-speed rail really a "future" project? The DEIR wants you to see the project as if that were true, but it is just an "illusion," like the shifting back and forth of the "Rubin's Vase." The high-speed part of the "project" isn't in the future, it's NOW, and the "fundamental" nature of the project, as the DEIR admits, is to build the electrification system that can make high-speed rail a reality. OTHER objectives

of the project, as the DEIR seeks to define it, can be accomplished without electrification, but not high-speed rail. The "fundamental" element is the electrification for high-speed rail, so this is one "whole project." To confine the analysis of this single project to the least fundamental part, while authorizing something much greater, is to fly directly in the face of what CEQA demands.

65. On Page 4-15, the DEIR talks about the statewide HSR "program-level" analysis. The text should reflect the fact that the adequacy of the program level analysis for the connection between the Bay Area and the Central Valley is still being litigated, with oral argument on a lawsuit brought by the cities of Atherton, Menlo Park, PCL, and CC-HSR, among others, set for oral argument on May 20th of this year.

66. On Page 4-16, the DEIR says that Caltrain has "simulated" the blended system at speeds of up to 100 mph, and that this simulation "shows a blended system to be viable." What does this mean – to be "viable?" Doe this mean that at speeds of 110 mph the blended system can meet the 30 minute requirement contained in Proposition 1A?

67. On Page 4-19, the DEIR says, in Note a, that the "Blended Service would have up to four trains per peak hour and up to four trains per off-peak hour." Here is another example of the DEIR not being very understandable. If both "peak" and "off-peak" are the same, what is the difference? And what is the real figure that the DEIR advances for high-speed trains in the blended system? 19 hours times 4 trains per hour equals 76 trains, but Note b says that the DEIR presumes 40 daily high-speed trains, a considerably smaller number.

68. Figure 4-2 illustrates proposed passing track locations. The DEIR analyze and evaluate these, since they are a required part of the high-speed train service that is, in fact, part of the proposed project.

69. The "rule of reason" mentioned by the DEIR on Page 5-1 does, indeed, properly state the kind of alternatives analysis that CEQA requires. Unfortunately, the present DEIR does not analyze a reasonable range of alternatives. To provide an informational document that carries out CEQA's public involvement and "good government" objectives, Caltrain will have to evaluate non-electrified options that can include things like changes in boarding levels, to reduce loading times and make trip times shorter. These kinds of alternatives should then be evaluated against the proposed electrification project. Because Caltrain takes the position that the "fundamental" essence of the project is a system of electrification that will permit high-speed rail service to go forward in a "blended system," the DEIR provides only minimal consideration of other kinds of approaches that might achieve "most" of the objectives of the project in a non-electrified fashion, and by doing that, eliminate

many and probably "most" of the impacts that are identified as significant and unavoidable. Until Caltrain does this kind of alternatives analysis, the project EIR will be deficient under CEQA.

70. To demonstrate the minimal analysis provided to non-electrified alternatives, one only needs to see that the DEIR claims on Page 5-9 that a double-deck DMU would not fit in the Caltrain system tunnels, without making clear why that is, since it appears that both electrified and existing vehicles do fit in those tunnels. And, another example, on Page 5-11, the DEIR says that "no ridership evaluation" was conducted for the DMU alternative.

71. As far as I can tell, the only reference to the impacts that the proposed project might have on nesting birds and bats is on Page 5-14, where the DEIR admits that a non-electrified alternative would have fewer impacts that the proposed project. As noted earlier, the DEIR actually has to evaluate this issue, not just gloss over it in passing.

Thank you for taking our comments seriously.

Very truly yours,

Gary A. Patton, Attorney

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March 14, 2013

Comments sent by U.S. Postal Mail (below) and by Email to: electrification@caltrain.com

Peninsula Corridor Joint Powers Board (Caltrain)
Attention: Stacy Cocke, Senior Planner
1250 San Carlos Avenue / P.O. Box 3006
San Carlos, CA 94070-1306

RE: **Peninsula Corridor Electrification Project**
Comments On Notice of Preparation of an Environmental Impact Report (EIR)
For The Proposed Peninsula Corridor Electrification Project

Dear Peninsula Corridor Joint Powers Board:

I am submitting this comment letter on behalf of the Community Coalition on High Speed Rail (CC-HSR). This letter addresses the proposed Caltrain Peninsula Corridor Electrification Project, as that project has been described in a Notice of Preparation (NOP) dated January 31, 2013. I have previously written to you about this proposed project, with specific reference to the scope of the environmental review that you are required to carry out under the California Environmental Quality Act (CEQA). Most recently, I submitted a letter dated January 23, 2013, and that letter attached a copy of an earlier letter, which was dated March 31, 2010. Both of these letters have now been independently submitted for consideration in connection with your review of the NOP. This letter supplements the comments made in that earlier correspondence. We hope you will take seriously the following points:

1. The environmental review undertaken by Caltrain should be a "new" environmental review, not an environmental review that attempts simply to "update" earlier environmental review documents. The last EIR prepared on the proposed Caltrain electrification project was prepared in 2004, almost ten years ago. Conditions have substantially changed. We are pleased that Caltrain seems to be proceeding with a completely new EIR.

2. The environmental review undertaken at this time must analyze the "whole project" that is ultimately being considered. This project includes electrification not only for the purpose of a modernization of current Caltrain service, but for the eventual use of the Caltrain right of way by the state's proposed high-speed train system. From our review of the NOP, it does *not* appear to CC-HSR that Caltrain is, in fact, planning to analyze the whole project. It would be hard to overstate the importance of this point. <u>In order to comply with CEQA, the EIR must fully analyze the high-speed train impacts of the proposed electrification project</u>.

3. Anticipated funding for the proposed project, as noted in the NOP, includes $620 million dollars coming from Proposition 1A, the "Safe, Reliable High-Speed

Passenger Train Bond Act for the 21st Century." While Proposition 1A has a limited amount of funding that can be used for "connectivity" projects, an extremely significant portion of the funding for this currently proposed project would come from funds identified in the Bond Act for expenditures directly related to the construction of a high-speed train system. Caltrain cannot fund this project as a high-speed train project and then claim that the project relates only to an electrification of the Peninsula corridor for local passenger service operated by Caltrain. Again, we cannot emphasize enough the importance of doing a full and fair analysis, as required by CEQA, that considers the "whole project," and that therefore examines the impacts of the whole project. In this case, that means the EIR must consider all of the impacts that will ultimately be associated with any high-speed train use of the project that is proposed to be constructed.

4. We urge Caltrain not to proceed on the premise that an analysis of the high-speed train impacts associated with the proposed project can be deferred to some later time. We urge you not to think that an analysis of these impacts can be dealt with summarily, as some kind of "cumulative impact," or that some claimed "independent utility" of the proposed facilities for local service will excuse Caltrain from the obligation to do a full analysis of the entire project, including an analysis of the impacts of the high-speed train service that would use the project. Again, this is particularly true since it is high-speed train funding that is largely going to be paying for the project.

5. Our conclusion could well be different if Caltrain reconfigures the project to eliminate any use of high-speed train funding for the proposed project, limiting the project to an electrification aimed only at improving local service. However, Caltrain cannot have it both ways. If Caltrain is going to use high-speed train bond funds to build the proposed electrification project (which is what the NOP indicates is the plan), then the environmental review carried out on the project must analyze the impacts that might result from using the Caltrain corridor, and the proposed electrification facilities, for high-speed train operation.

6. In addition to the fact that a large part of the proposed funding is going to come from the high-speed train bond act, Caltrain is planning to enter into a Memorandum of Understanding (MOU) with the California High-Speed Rail Authority, and with agencies of the Metropolitan Transportation Commission, which makes clear that Caltrain is planning to permit high-speed train use of the Peninsula Corridor, and that the electrification of the Peninsula Corridor, as proposed in this project, is a *sine qua non* of that high-speed train service. This is another reason that Caltrain is obligated to do an EIR that fully explores all the possible impacts of the high-speed train service that would be facilitated by the proposed Peninsula Corridor Electrification Project.

7. The NOP does not provide a clear definition of the "project" that the EIR will analyze. The NOP indicates that the EIR will be focused on a project to support a "blended system." This phrase, as the NOP notes, has been used by the California High-Speed Rail Authority in the Authority's Business Plan. However, the specifics of such a "blended system" have never been defined by the Authority or anyone else.

The description of the project as implementing a "blended system" is an effort to use a nice-sounding phrase as a project description, in place of providing a specific definition of what that the proposed project would actually entail. Since this EIR will be on the "blended system," the EIR must necessarily provide a specific definition. The project description in the NOP is not adequate.

8. The Authority clearly intends that a "blended system" will serve both local Caltrain service and high-speed train service, and it seems clear that the purpose of the Peninsula Corridor Electrification Project is to permit that kind of dual use of the facilities. However, there are various ways that there could be a "shared use" of the Peninsula Corridor and the proposed electrification of the Corridor. We believe that Caltrain must define the proposed project clearly, and we urge the Joint Powers Board to make specific in the EIR that the "blended system" to be constructed will be fully consistent with what have been called the "Simitian/Eshoo/Gordon" or "SEG" principles. In other words, the project that the Joint Powers Board should be seeking to fund and implement (and the project that should be analyzed in the EIR) is a project with the following characteristics: (1) the project will be, essentially, a two-track system, designed to stay within the existing Caltrain right of way, with no significant expansion of current facilities, or the current right of way, and (2) the project will not allow for aerial track structures on the Peninsula, except when such structures are specifically requested by a local government agency with jurisdiction over the area in which such an aerial structure would be built. In addition (3), the project described above, meeting the above criteria, should be "the project" upon which environmental review is undertaken, and if approved, that project should not be subject to modification in the future unless the Joint Powers Board goes through a completely new project approval and environmental review process. These three points are the "SEG" principles, and CC-HSR strongly believes that these three principles must be "minimum standards" for the modernization of the Caltrain right of way. By adhering to these three principles, the Joint Powers Board will make certain that any future use of the right of way by high-speed trains is more acceptable to local communities.

9. The CC-HSR is particularly concerned about any proposal to add "passing tracks," or otherwise expanding the currently existing facilities located either outside or within the current right of way. Any proposal to do this must be clearly specified, and analyzed in the EIR for the current project, since the impacts on adjacent residential areas of any expansion of the current facilities could be devastating. An analysis at this time is required, even if any such proposal will also be examined later, in connection with a specific implementation action. The EIR must explicitly examine those possible impacts in a detailed and fully analyzed manner for each passing track option Caltrain is currently reviewing.

10. The EIR should consider and analyze all possible alternatives to the project, including electrification alternatives that would not need the construction of overhead catenary facilities at this time.

11. The EIR must provide a detailed examination of the noise impacts of the proposed project, including an examination of the installation of "quad gates," and the

expanded use of "quiet zones," to achieve both noise and safety benefits. The EIR, in general, should consider every possible and feasible way to reduce train and train horn noise. Quality of life impacts for the communities through which the train travels should be considered to be of equal importance to the proposed improvement of service for those who ride the train.

12. The EIR must provide a detailed examination of the impact of the proposed project on trees, and examine every possible and feasible way to eliminate or reduce the removal or trimming of trees located along the Peninsula Corridor.

13. The Caltrain Joint Powers Board must be the "Lead Agency," and take responsibility for the project – and again, that means the "whole" project, including the potential use of the proposed facilities to provide high-speed train service on the Peninsula Corridor.

14. In the environmental review process, the Joint Powers Board must disclose if shoofly tracks will be necessary to continue both Caltrain and freight rail service during any construction of the electrification project. Full disclosure concerning possible business and residential takings necessary for this accommodation must be documented and analyzed. Union Pacific has specified the need for uninterrupted service in the UP/HSR MOU, a copy of which is attached. The impacts associated with this commitment to uninterrupted freight traffic service must be fully examined in the electrification EIR.

15. Finally, as the Joint Powers Board concludes the project review and environmental review process, we believe that any ultimate project approval should be structured and conditioned so as to require a vote of the people, in each of the three affected counties, should any future modification of the project be proposed, either by the Joint Powers Board or by the California High Speed Rail Authority.

Thank you for taking these concerns and suggestions into account, along with the concerns outlined in our earlier letters.

Very truly yours,

Gary A. Patton, Of Counsel
WITTWER & PARKIN, LLP

cc: Congress Member Anna Eshoo
State Senators Jerry Hill and Leland Yee
Assembly Members Richard Gordon and Kevin Mullin
Former State Senator (now County Supervisor) Joe Simitian
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March 31, 2010

Board of Directors
Peninsula Corridor Joint Powers Board
1250 San Carlos Avenue
San Carlos, CA 94070

RE: Proposal To Certify An EA/EIR For The Caltrain Electrification Program
Agenda, Item #11, April 1, 2010 Board Meeting Agenda

Dear Members of the Board:

This letter is written on behalf of the Planning and Conservation League (PCL), the Planning and Conservation League Foundation (PCLF), and the Community Coalition on High Speed Rail (CC-HSR). These organizations object to the proposed adoption, at your April 1, 2010 meeting, of a resolution that would certify a Final Environmental Impact Report for the proposed Caltrain Electrification Program, as is recommended in Agenda Item #11. Taking the action recommended to you by staff would violate the California Quality Act (CEQA). We urge the Board to comply with CEQA, and to revise and recirculate the EA/EIR for additional agency and public comment, before making a project decision.

CEQA requires public agencies to analyze and consider the possible environmental impacts of their proposed actions before they make a decision that might have adverse environmental impacts. The current, not past, environmental setting needs to be analyzed. CEQA does not permit governmental agencies to study the impacts of a project as those impacts might have been felt many years ago, and then to take action on the project today. The impacts need to be analyzed as of the time the agency proposes to undertake the project.

If the Peninsula Corridor Joint Powers Board were to take action today on an Environmental Impact Report prepared six years ago, it would be basing its decision on information that is demonstrably no longer current. In six years, things change! This is particularly true as to the possible impacts that the public and other governmental agencies might identify, and to which CEQA requires a response.

If the Board today certifies the out of date, 2004 EIR, the right of the public and other agencies to comment has been shortchanged, and this violates CEQA. CEQA simply does not permit the Board to avoid a contemporary examination of the possible environmental impacts of the proposed project, by saying that the agency looked into possible impacts six years ago. You can't, legally, feed people with dairy and other products when the product "shelf life" has expired. Similarly, you cannot meet the legal requirements of CEQA by relying on an analysis (and agency and public comments) made six years ago.

The proposed electrification project could have many positive environmental impacts, but it could have negative impacts, too. Current impacts need to be examined, and CEQA provides both members of the public and other governmental agencies with the right to comment on those impacts in the context of the current situation, and to have you respond to those comments, before you act.

The need to revise and recirculate the EIR is specifically compelled by the fact that that the project has changed in significant ways since the 2004 analysis, and that there is thus "new information" that requires recirculation, Pub. Resources Code Section 21092.1; CEQA Guidelines Section 15088.5, *Laurel Heights Improvement Association v. Regents of the University of California* (1993) 6 Cal. 4th 1112 [26 Cal. Rptr. 2d 231]. The "Caltrain electrification" brochure, for instance, included in the Board's agenda packet, notes at page three that the project weekday ridership in the 2004 Draft EA/EIR was anticipated to be 57,918 by the year 2020, but that the Final EA/EIR now concludes that weekday ridership will be 72,029 by the year 2035. These are quite different figures. The Final EA/EIR now projects an increase in weekday ridership that is about 25% more than the previous estimate (albeit this increase is now measured over a different time period). Increased weekday ridership will translate into increased automobile-related and other impacts within local communities, and will also probably be associated with an increase in the frequency of trains, and the associated noise and community impacts related to frequent train trips. What are those differences, precisely? What will the impacts actually be? The public and the various local government agencies that might be impacted by the different project have a right, under CEQA, to have this analysis fully spelled out, and then to comment on it.

Even more fundamentally, the Caltrain electrification project, in 2004, was not directly tied to the establishment of a High Speed Rail system, using the Caltrain right of way, in the same way it is today. The "Final" EA/EIR mentions major new plans that are in the works that will impact the proposed Caltrain electrification project. Discussion in Sections 1.25, 1.3, 1.3.1, and 1.34 of the "Final" EA/EIR tries to say that these new developments, all related to the proposed High Speed Rail system, are somehow "Other" projects, albeit the Final EA/EIR does admit that they are "related" projects. The public and other governmental agencies need to be able to comment on just how these various projects are *now* related, and to have the Final EA/EIR respond to those comments.

CEQA requires that the analysis undertaken on a proposed project consider the "whole" of the project. A so-called "piecemeal" analysis is strictly forbidden, *Laurel Heights Improvement Association v. Regents of the University of California* (1988) 47 Cal. 3d 376 [253 Cal. Rptr. 426]. Yet, such a "piecemeal" consideration of possible impacts is exactly what the Peninsula Corridor Joint Powers Board would be attempting to do, unless it revises and recirculates the EIR to take account of and to allow comment on the proposed High Speed Rail project as it is *currently* planned. The proposed High Speed Rail system now ties directly into the electrification project, in a way that it didn't in 2004. In fact, a 2009 agreement between the California High Speed Rail Authority and the Peninsula Corridor Joint Powers Board (attached), which was adopted in 2009, significantly after the 2004 EIR, makes clear that the Caltrain project is now clearly considered by both agencies to be essentially the "same" project. That 2009 Agreement states, for example, that the electrification project "creates an immediate

opportunity for phased implementation of the high speed rail system….” In addition, as is made clear by Agenda Item #12 on the April 1, 2010 Agenda, the funding for the proposed Caltrain electrification project is now directly linked to High Speed Rail funding. Again, this demonstrates that the state’s High Speed Rail project and the Caltrain electrification project is essentially the “same” project, and CEQA requires the environmental analysis to cover the actual impacts of the whole project that the government agency proposes to approve. Certainly, members of the public and other governmental agencies have the right to comment, and to have their comments responded to, prior to the Board’s decision on the electrification project.

To comply with CEQA, the Board must revise and recirculate the EA/EIR on the proposed electrification project, and in doing so give members of the public and other governmental agencies the right to comment on the proposed Caltrain electrification project, which is now so clearly linked to High Speed Rail. Failure to follow the requirements of CEQA that the EA/EIR must be recirculated, and the public and other governmental agencies given a renewed opportunity to comment, will not lead to a quicker and more certain decision to move ahead with electrification. Instead, it will likely lead to litigation that will adversely impact both electrification, and the proposed High Speed Rail project.

PCL, PCLF, and the Community Coalition on High Speed Rail also believe that many of the CEQA findings in Exhibit A are inadequate or improper under CEQA, and register our objection without extensive argument, since it is clear that the Board must revise and recirculate the EA/EIR to allow contemporary comment on the contemporary and current impacts, with the result that specific objections to the Exhibit A findings can thus be made during the recirculation and comment period.

On behalf of PCL, PCLF, and the Community Coalition on High Speed Rail, I strongly urge the Board to follow the requirements of CEQA, and to revise and recirculate the EA/EIR on the proposed Caltrain electrification project, prior to taking action on the proposed project.

Very truly yours,

Gary A. Patton, Of Counsel
WITTWER & PARKIN, LLP

cc: PCL
PCLF
CC-HSR
Peninsula Cities

Caltrain HSR Compatibility Blog

The passage of California Proposition 1A (2008) set in motion a complete reconstruction of the railroad between San Jose and San Francisco. This blog exists to discuss compatibility between HSR and Caltrain, integration issues, and the impact on adjoining communities.

http://caltrain-hsr.blogspot.com/

08 April 2014

HSR Peer Review Group on Blending

The California High-Speed Rail Peer Review Group was established by AB 3034 (the Proposition 1A bond law) to independently review the HSR Authority's plans, assumptions, analyses and estimates. The Peer Review Group recently sent the legislature its comments on the Draft 2014 Business Plan, including a number of recommendations concerning the plan to "blend" HSR and Caltrain on the peninsula corridor. The Peer Review Group comments on blending follow:

Blended System issues*. Access to San Francisco's Transbay Terminal has posed a challenge to the program from the beginning. The ideal engineering outcome – a new, four track system separating HSR from Caltrain and freight service – was problematic because of its high cost and environmental impact. An alternative approach was adopted that blends the services of Caltrain and HSR on the same two track system, mostly within the existing right-of-way but with specific additions of passing tracks where needed and with the possibility of incremental increases in capacity when justified by demand. When combined with electrification of the Caltrain lines, paid half-and-half by Caltrain and HSRA, this approach should work to serve the needs of both systems at least through the first decades of the Phase I Blended system. In a number of our previous letters, the Group has supported the blended system approach; our comments below are aimed at improving its implementation.*

The blended approach will require a true joint effort by Caltrain and HSRA with full participation of other parties including the Transbay Joint Powers Authority (that has the responsibility for the connection from the current Caltrain terminus at 4th and King Streets to the Transbay Terminal) and the Union Pacific Railroad (that has freight operating rights on the same lines). There are a number of issues on which the interests of the parties must be explicitly balanced if the blending is to work:

- *Currently, Caltrain uses a platform height of 8" above rail. This means that boarding/de-boarding requires stepping up/down from the floor of the train (25" above rail), which can impose delays and risks of tripping and falling, especially when the needs of disabled passengers must be accommodated. The result is longer and less reliable schedules. The low platform height is dictated by the regulations of the California Public Utilities Commission (PUC) that require platforms to be no higher than 8" on tracks that may also carry freight trains. Unless a waiver from this regulation is granted, or expensive track work is installed, Caltrain will be limited to low platforms. At its current frequency of services, the lack of level boarding is manageable (if undesirable), but it will become much less tenable when Caltrain frequencies are increased and HSR trains are added.*

- *Under current plans, the floor of HSR trains will be about 50" above the rails, which is typical practice for most of the world's HSR systems and consistent with Amtrak's plans in the Northeast*

Corridor. Caltrain is experiencing rapid demand growth, a process that will accelerate when service to the Transbay Terminal is inaugurated. Caltrain's plans call for acquiring new bi-level, electric multiple-unit rolling stock. Since the existing Caltrain coaches have a 25" floor level, consistency would suggest a 25" floor level for the new equipment. This would mean that platforms for the two systems would be at different levels, making transfers within station more difficult to arrange. This might be manageable at many common stations where Caltrain and HSR could have separate platforms, but the platform disparity would be more serious at the Transbay Terminal because the number of platforms is limited. As a result, routing of traffic into and out of the station will be more complex, and dispatchers will not have the flexibility to send either system to all platforms when delays or operating problems would otherwise dictate. One approach, turning a number of Caltrain services at 4th and King and limiting the number of Caltrain services to the Transbay Terminal, has been suggested, but would pose restrictions for Caltrain's access to the Transbay Terminal.

- *The basic standards of the PUC for electric catenary wire call for a clearance of 22 feet 6 inches above the rail. One the one hand, both Caltrain and HSR may want a lower catenary height in order to reduce construction cost for which the PUC will have to grant permission: on the other hand, the Union Pacific and port interests may want to protect the hypothetical possibility of future freight cars requiring even more clearance. HSR's current electrification designs are appropriate for HSR-only operations and may not be acceptable for use in the Caltrain area. There are a number of specific locations where Caltrain's clearance is already below 22 feet 6 inches, but there is no generally agreed height limitation.*

- *Positive Train Control (PTC) is a requirement of Federal law. Facing this mandate, Caltrain developed its own system – CBOSS – that is now being implemented. CBOSS may not be appropriate for use by HSR trains. If so, HSR trains may have to deal with two signal systems. In addition, the Union Pacific Railroad will have to operate in the same territory so will have to have conforming signal systems in its locomotives.*

None of these problems is impossible to resolve, albeit at added investment and operating cost by one or more of the parties. There is nothing unique about having multiple freight and passenger operators on a single line and there is experience in the U.S. and Europe with resolving the normal issues. All parties in the blended area are aware of the issues and there has been full cooperation among them.

We are concerned, however, that near-term decisions could be made by the parties acting separately that would ultimately compromise the performance of the system. For example, a decision by Caltrain not to plan for at least 25" platforms, which would provide an essential approach to level boarding, would lead to increased delays and uncertainty that could become unmanageable when Caltrain frequencies increase to meet the rapidly growing demand, especially that caused by the opening of the Transbay Terminal. This problem would get worse when four HSR trains per hour are added to the blended system in 2026. Caltrain will definitely need an expanded fleet, and bi-level cars are an efficient way to meet the need. That said, a decision to buy 25" floor level, bi-level coaches would mean that Caltrain and HSR would be committed to operating on incompatible platforms, which would add rigidity to a system that will be challenged for

capacity. This problem could be alleviated if Caltrain ordered coaches that can serve both platform levels or if it adopted a uniform 50" platform, but either solution would clearly add investment costs above those planned. In all cases, the design of the electrification for Caltrain will need PUC approval and will need to consider the interests of all of the operators on the line.

This is a complex issue involving technology, investment, system performance and sequencing including the interests of a number of parties. Clearly there is no perfect answer and it is actually a problem resulting from success in attracting more passengers. ***We recommend that the Legislature request periodic joint reports from Caltrain, HSR and the Union Pacific Railroad that will use the tools available, including line capacity simulators, to assess the impact of alternative approaches to coach floor and platform height on capital and operating cost, capacity and reliability of both systems. This would include the impact on Caltrain if it has to construct 25" or 50" platforms. This study should also include the investment and operating cost impact of the alternative approaches to catenary height and platform clearance and should outline the decisions that the PUC will be asked to make****.*

Blended operations also pose the issue of accidents at grade crossings. Even at its existing speeds and frequencies, Caltrain experiences about 20 grade crossing and intruder deaths per year and generates delays on the local streets as autos and trucks wait for passing trains. This will get worse as train frequency and road traffic both increase over time. It would be difficult to overstate the risks of more frequent, faster and quieter Caltrain service combined with 110 mph HSR trains interacting with growing road traffic in the middle of California's increasingly busy cities. ***We recommend that the Legislature ask Caltrain, HSR and the communities involved to develop a joint report assessing the likely future risks of increasing train traffic and speeds on the grade crossings in the areas impacted and identifying possible approaches to resolving the issue over time.***

The Peer Review Group's comments are a wake-up call to start breaking out of the silo mentality that is prevalent in our transportation agencies, where "staying the course" is too often the overriding consideration. The blend can only succeed if all stakeholders adjust their plans and projects to achieve better coordination and system-level integration. The Peer Review Group understands that we are at a juncture where this opportunity must not be squandered.

Posted by Clem at 9:22 PM 21 comments:

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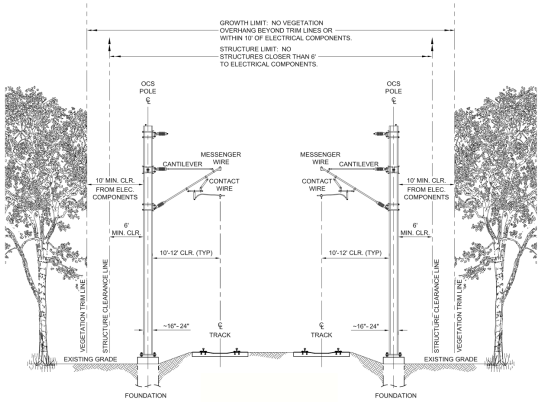
05 April 2014

Saving Some Trees

One of the most controversial elements of the Caltrain electrification DEIR is the need for tree pruning or removal to establish adequate clearance between vegetation and the live parts of the overhead contact system, energized at 25,000 volts or more. While the exact regulatory details governing 25 kV electrification are still being hammered out at the CPUC, vegetation clearances are likely to be governed by General Order 95, Rule 35, Appendix E, which states:

The radial clearances shown below are recommended minimum clearances that should be established, at time of trimming, between the vegetation and the energized conductors and associated live parts where practicable. Reasonable vegetation management practices may make it advantageous for the purposes of public safety or service reliability to obtain greater clearances than those listed below to ensure compliance until the next scheduled maintenance. Each utility may determine and apply additional appropriate clearances beyond clearances listed below, which take into consideration various factors, including: line operating voltage, length of span, line sag, planned maintenance cycles, location of vegetation within the span, species type, experience with particular species, vegetation growth rate and characteristics, vegetation management standards and best practices, local climate, elevation, fire risk, and vegetation trimming requirements that are applicable to State Responsibility Area lands pursuant to Public Resource Code Sections 4102 and 4293.



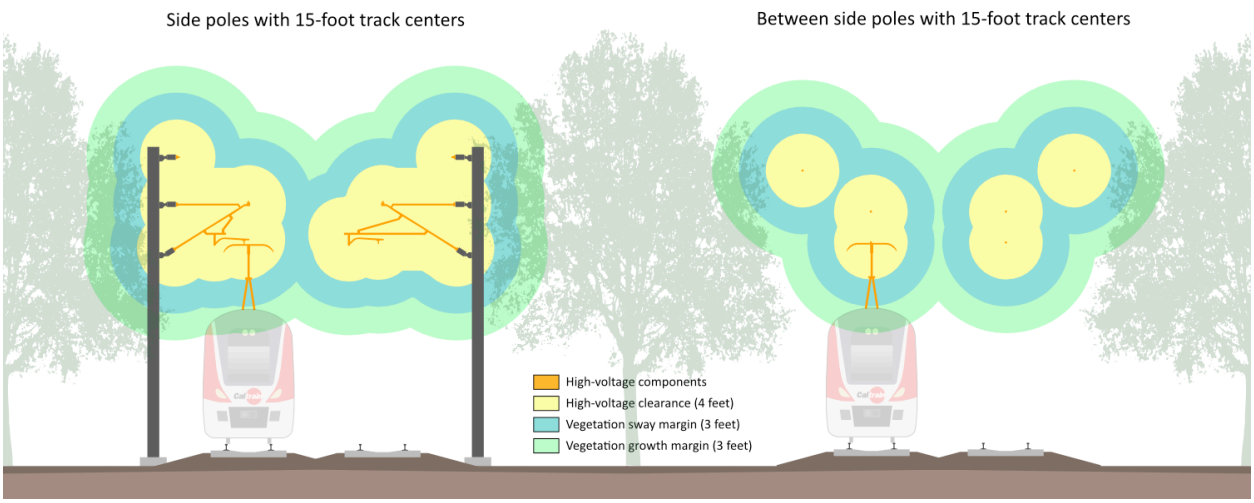
10-foot tree clearances, from DEIR

The CPUC rule establishes minimum clearance of 4 feet *at the time of trimming*, and gives Caltrain discretion to increase the clearance as needed. Caltrain has added another 3 feet of allowance for wind sway, and another 3 feet on top of that for vegetation growth between trimmings. This brings the overall clearance carried in Caltrain's DEIR to 10 feet, as shown in the diagram at right.

This 10-foot clearance drives the number of trees impacted by the project: 2,200 are due for removal and another 3,600 for pruning according to http://www.caltrain.com/projectsplans/CaltrainModernization/Modernization/PeninsulaCorridorElectrificationProject/DEIR_Release.html the DEIR.

Outside Poles

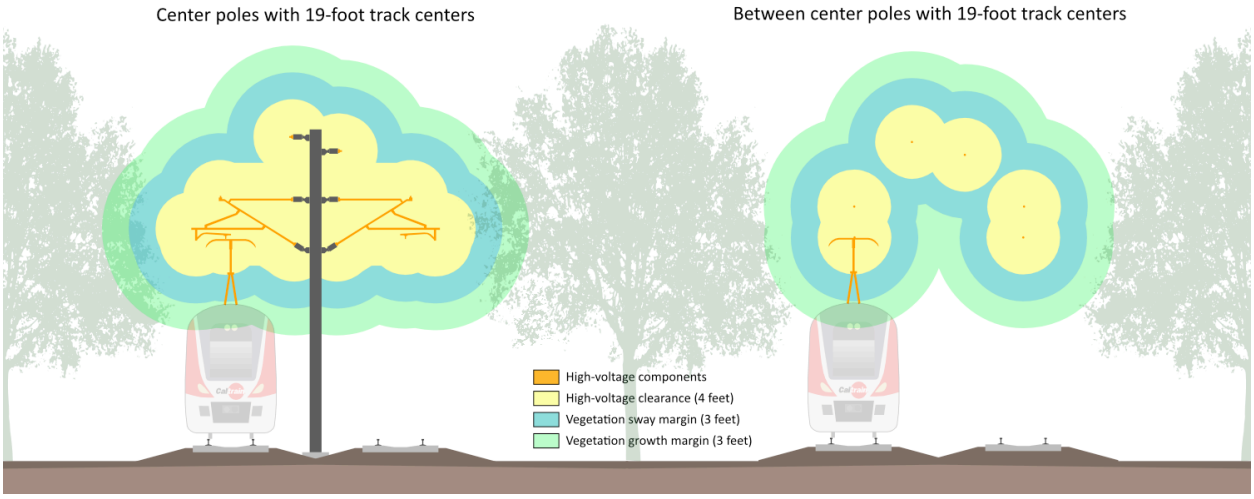
The standard configuration of the overhead contact system places poles on the outside of the tracks, near vegetation. The clearances look like this:



This configuration tends to have the worst impact on vegetation, mostly because the 50 kV feeder wires attached to the tops of the poles are near vegetation all along the right-of-way, even in the long open spaces between poles (right-hand diagram). This is the main reason why 2,200 trees face the chain saw.

Inside Poles

To keep high-voltage components away from vegetation, it is possible to locate the poles between the tracks in the middle of the right-of-way. This requires slightly more space between the tracks; the regulatory minimum is approximately 18 feet (2x 8'3" minimum from track center line to pole face, plus the width of the pole itself, plus some error margin). The diagram below shows 19-foot spacing, with taller poles to carry both feeders with adequate clearance from each other:

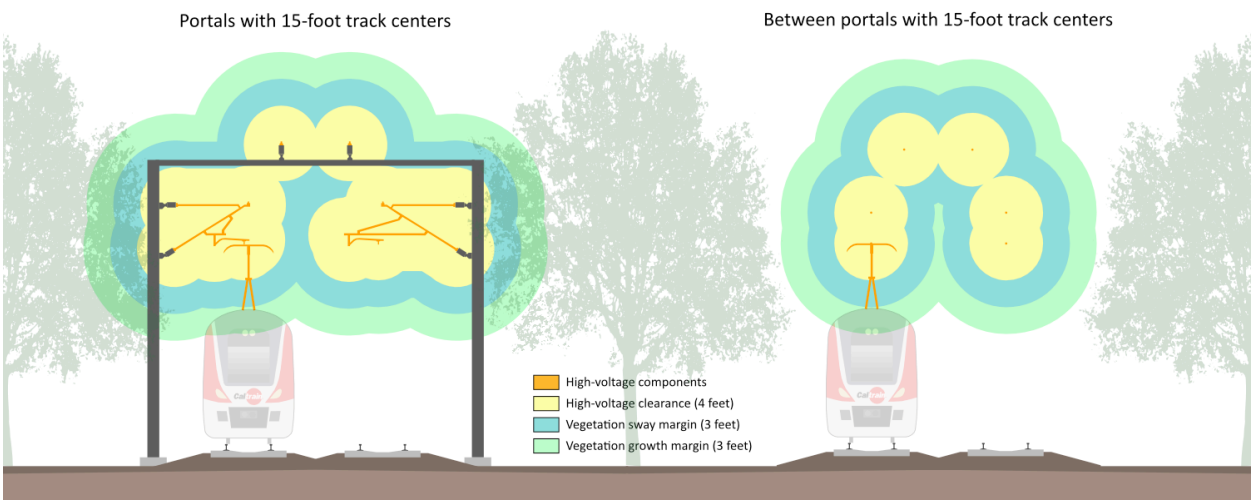


While this configuration spreads the tracks apart by four feet, the resulting impact to vegetation is less, especially between pole locations, because the feeders are kept away from vegetation. The down side is

that tracks need to be moved apart; this is not very difficult except where cross-overs are located.

Portals

Portal gantries are basically the same as side poles, with a cross-bar across the top. Like center poles, the portal arrangement allows the 50 kV feeders to be located in the middle away from vegetation. Unlike center poles, portals do not require the tracks to be further apart than 15 feet:



The portal configuration has the least impact on vegetation between poles (right-hand diagram) but isn't particularly beautiful (left-hand diagram)…

TOXICOLOGICAL PROFILE FOR COPPER

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES Public Health Service Agency for Toxic Substances and Disease Registry

September 2004

DISCLAIMER

The use of company or product name(s) is for identification only and does not imply endorsement by the Agency for Toxic Substances and Disease Registry.

UPDATE STATEMENT

A Toxicological Profile for Copper, Draft for Public Comment was released in September 2002. This edition supersedes any previously released draft or final profile.

Toxicological profiles are revised and republished as necessary. For information regarding the update status of previously released profiles, contact ATSDR at:

Agency for Toxic Substances and Disease Registry Division of Toxicology/Toxicology Information Branch 1600 Clifton Road NE, Mailstop F-32 Atlanta, Georgia 30333

QUICK REFERENCE FOR HEALTH CARE PROVIDERS

Toxicological Profiles are a unique compilation of toxicological information on a given hazardous substance. Each profile reflects a comprehensive and extensive evaluation, summary, and interpretation of available toxicologic and epidemiologic information on a substance. Health care providers treating patients potentially exposed to hazardous substances will find the following information helpful for fast answers to often-asked questions.

Primary Chapters/Sections of Interest

Chapter 1: Public Health Statement: The Public Health Statement can be a useful tool for educating patients about possible exposure to a hazardous substance. It explains a substance's relevant toxicologic properties in a nontechnical, question-and-answer format, and it includes a review of the general health effects observed following exposure.

Chapter 2: Relevance to Public Health: The Relevance to Public Health Section evaluates, interprets, and assesses the significance of toxicity data to human health.

Chapter 3: Health Effects: Specific health effects of a given hazardous compound are reported by type of health effect (death, systemic, immunologic, reproductive), by route of exposure, and by length of exposure (acute, intermediate, and chronic). In addition, both human and animal studies are reported in this section.

> ***NOTE***: Not all health effects reported in this section are necessarily observed in the clinical setting. Please refer to the Public Health Statement to identify general health effects observed following exposure.

Pediatrics: Four new sections have been added to each Toxicological Profile to address child health issues: Section 1.6 How Can (Chemical X) Affect Children? Section 1.7 How Can Families Reduce the Risk of Exposure to (Chemical X)? Section 3.7 Children's Susceptibility Section 6.6 Exposures of Children

Other Sections of Interest: Section 3.8 Biomarkers of Exposure and Effect Section 3.11 Methods for Reducing Toxic Effects

ATSDR Information Center ***Phone:*** 1-888-42-ATSDR or (404) 498-0110 ***Fax:*** (770) 488-4178 ***E-mail:*** atsdric@cdc.gov ***Internet***: http://www.atsdr.cdc.gov

The following additional material can be ordered through the ATSDR Information Center:

Case Studies in Environmental Medicine: Taking an Exposure History—The importance of taking an exposure history and how to conduct one are described, and an example of a thorough exposure history is provided. Other case studies of interest include *Reproductive and Developmental Hazards; Skin Lesions and Environmental Exposures; Cholinesterase-Inhibiting Pesticide Toxicity*; and numerous chemical-specific case studies.

Managing Hazardous Materials Incidents is a three-volume set of recommendations for on-scene (prehospital) and hospital medical management of patients exposed during a hazardous materials incident. Volumes I and II are planning guides to assist first responders and hospital emergency department personnel in planning for incidents that involve hazardous materials. Volume III—*Medical Management Guidelines for Acute Chemical Exposure*s—is a guide for health care professionals treating patients exposed to hazardous materials.

Fact Sheets (ToxFAQs) provide answers to frequently asked questions about toxic substances.

Other Agencies and Organizations

The National Center for Environmental Health (NCEH) focuses on preventing or controlling disease, injury, and disability related to the interactions between people and their environment outside the workplace. Contact: NCEH, Mailstop F-29, 4770 Buford Highway, NE, Atlanta, GA 30341-3724 • Phone: 770-488-7000 • FAX: 770-488-7015.

The National Institute for Occupational Safety and Health (NIOSH) conducts research on occupational diseases and injuries, responds to requests for assistance by investigating problems of health and safety in the workplace, recommends standards to the Occupational Safety and Health Administration (OSHA) and the Mine Safety and Health Administration (MSHA), and trains professionals in occupational safety and health. Contact: NIOSH, 200 Independence Avenue, SW, Washington, DC 20201 • Phone: 800-356-4674 or NIOSH Technical Information Branch, Robert A. Taft Laboratory, Mailstop C-19, 4676 Columbia Parkway, Cincinnati, OH 45226-1998 • Phone: 800-35-NIOSH.

The National Institute of Environmental Health Sciences (NIEHS) is the principal federal agency for biomedical research on the effects of chemical, physical, and biologic environmental agents on human health and well-being. Contact: NIEHS, PO Box 12233, 104 T.W. Alexander Drive, Research Triangle Park, NC 27709 • Phone: 919-541-3212.

Referrals

The Association of Occupational and Environmental Clinics (AOEC) has developed a network of clinics in the United States to provide expertise in occupational and environmental issues. Contact: AOEC, 1010 Vermont Avenue, NW, #513, Washington, DC 20005 • Phone: 202-347-4976 • FAX: 202-347-4950 • e-mail: AOEC@AOEC.ORG • Web Page: http://www.aoec.org/.

The American College of Occupational and Environmental Medicine (ACOEM) is an association of physicians and other health care providers specializing in the field of occupational and environmental medicine. Contact: ACOEM, 55 West Seegers Road, Arlington Heights, IL 60005 • Phone: 847-818-1800 • FAX: 847-818-9266.

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THE PROFILE HAS UNDERGONE THE FOLLOWING ATSDR INTERNAL REVIEWS:

1. Health Effects Review. The Health Effects Review Committee examines the health effects chapter of each profile for consistency and accuracy in interpreting health effects and classifying end points.
2. Minimal Risk Level Review. The Minimal Risk Level Workgroup considers issues relevant to substance-specific Minimal Risk Levels (MRLs), reviews the health effects database of each profile, and makes recommendations for derivation of MRLs.
3. Data Needs Review. The Research Implementation Branch reviews data needs sections to assure consistency across profiles and adherence to instructions in the Guidance.

PEER REVIEW

A peer review panel was assembled for copper (September 2002 profile). The panel consisted of the following members:

1. Dr. Jonathan H. Freedman, Center for Environmental Genomes, Duke University, Durham, North Carolina;
2. Dr. Paul Mushak, PB Associates, Durham, North Carolina; and
3. Dr. Robert B. Ruckner, School of Medicine, Department of Nutrition, University of California at Davis, Davis, California.
4. Dr. Edward Massaro, U.S. Environmental Protection Agency, Reproductive Toxicology Facility, Durham, North Carolina

These experts collectively have knowledge of copper's physical and chemical properties, toxicokinetics, key health end points, mechanisms of action, human and animal exposure, and quantification of risk to humans. All reviewers were selected in conformity with the conditions for peer review specified in Section 104(I)(13) of the Comprehensive Environmental Response, Compensation, and Liability Act, as amended.

Scientists from the Agency for Toxic Substances and Disease Registry (ATSDR) have reviewed the peer reviewers' comments and determined which comments will be included in the profile. A listing of the peer reviewers' comments not incorporated in the profile, with a brief explanation of the rationale for their exclusion, exists as part of the administrative record for this compound. A list of databases reviewed and a list of unpublished documents cited are also included in the administrative record.

The citation of the peer review panel should not be understood to imply its approval of the profile's final content. The responsibility for the content of this profile lies with the ATSDR.

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1. PUBLIC HEALTH STATEMENT

This public health statement tells you about copper and the effects of exposure to it.

The Environmental Protection Agency (EPA) identifies the most serious hazardous waste sites in the nation. These sites are then placed on the National Priorities List (NPL) and are targeted for long-term federal clean-up activities. Copper has been found in at least 906 of the 1,647 current or former NPL sites. Although the total number of NPL sites evaluated for this substance is not known, the possibility exists that the number of sites at which copper is found may increase in the future as more sites are evaluated. This information is important because these sites may be sources of exposure and exposure to this substance may harm you.

When a substance is released either from a large area, such as an industrial plant, or from a container, such as a drum or bottle, it enters the environment. Such a release does not always lead to exposure. You can be exposed to a substance only when you come in contact with it and your body is able to absorb it. You may be exposed by breathing, eating, or drinking the substance, or by skin contact.

If you are exposed to copper, many factors will determine whether you will be harmed. These factors include the dose (how much), the duration (how long), and how you come in contact with it. You must also consider any other chemicals you are exposed to and your age, sex and other genetic traits, diet, family traits, lifestyle, and state of health, including pregnancy and developmental stage of embryo/fetus.

1.1 WHAT IS COPPER?

Copper is a reddish metal that occurs naturally in rock, soil, water, sediment, and, at low levels, air. Its average concentration in the earth's crust is about 50 parts copper per million parts soil (ppm) or, stated another way, 50 grams of copper per 1,000,000 grams of soil (1.8 ounces or 0.11 pounds of copper per 2,200 pounds of soil). Copper also occurs naturally in all plants and animals. It is an essential element for all known living organisms including humans and other

animals at low levels of intake. At much higher levels, toxic effects can occur. The term copper in this profile not only refers to copper metal, but also to compounds of copper that may be in the environment.

Metallic copper can be easily molded or shaped. The reddish color of this element is most commonly seen in the U.S. penny, electrical wiring, and some water pipes. It is also found in many mixtures of metals, called alloys, such as brass and bronze. Many compounds (substances formed by joining two or more chemicals) of copper exist. These include naturally occurring minerals as well as manufactured chemicals. The most commonly used compound of copper is copper sulfate. Many copper compounds can be recognized by their blue-green color.

Copper is extensively mined and processed in the United States and is primarily used as the metal or alloy in the manufacture of wire, sheet metal, pipe, and other metal products. Copper compounds are most commonly used in agriculture to treat plant diseases, like mildew, or for water treatment and as preservatives for wood, leather, and fabrics. For more information on the properties and uses of copper, please see Chapters 4 and 5.

1.2 WHAT HAPPENS TO COPPER WHEN IT ENTERS THE ENVIRONMENT?

Copper can enter the environment through releases from the mining of copper and other metals, and from factories that make or use copper metal or copper compounds. Copper can also enter the environment through waste dumps, domestic waste water, combustion of fossil fuels and wastes, wood production, phosphate fertilizer production, and natural sources (for example, windblown dust, from native soils, volcanoes, decaying vegetation, forest fires, and sea spray). Therefore, copper is widespread in the environment. About 1,400,000,000 pounds (640,000,000,000 grams) of copper were released into the environment by industries in 2000. Copper is often found near mines, smelters, industrial settings, landfills, and waste disposal sites.

When copper is released into soil, it can become strongly attached to the organic material and other components (e.g., clay, sand, etc.) in the top layers of soil and may not move very far when it is released. When copper and copper compounds are released into water, the copper that

dissolves can be carried in surface waters either in the form of copper compounds or as free copper or, more likely, copper bound to particles suspended in the water. Even though copper binds strongly to suspended particles and sediments, there is evidence to suggest that some water-soluble copper compounds do enter groundwater. Copper that enters water eventually collects in the sediments of rivers, lakes, and estuaries. Copper is carried on particles emitted from smelters and ore processing plants, and is then carried back to earth through gravity or in rain or snow. Copper is also carried into the air on windblown metallurgical dust. Indoor release of copper comes mainly from combustion processes (for example, kerosene heaters).

Elemental copper does not break down in the environment. Copper can be found in plants and animals, and at high concentrations in filter feeders such as mussels and oysters. Copper is also found in a range of concentrations in many foods and beverages that we eat and drink, including drinking water. You will find additional information on the fate of copper in the environment in Chapters 5 and 6.

1.3 HOW MIGHT I BE EXPOSED TO COPPER?

Copper is common in the environment. You may be exposed to copper by breathing air, drinking water, eating food, and by skin contact with soil, water and other copper-containing substances. Most copper compounds found in air, water, sediment, soil and rock are strongly attached to dust and dirt or imbedded in minerals. You can take copper into your body upon ingestion of water or soil that contains copper or by inhalation of copper-containing dust. Some copper in the environment is less tightly bound to soil or particles in water and may be soluble enough in water to be taken up by plants and animals. In the general population, soluble copper compounds (those that dissolve in water), which are most commonly used in agriculture, are more likely to threaten your health. When soluble copper compounds are released into lakes and rivers, they generally become attached to particles in the water within approximately 1 day. This could lessen your exposure to copper in water, depending on how strongly the copper is bound to the particles and how much of the particles settle into lake and river sediments. However, fine particles have an enormous surface area and can remain suspended for prolonged periods of

time. Therefore, at high fine particle concentrations, both exposure and uptake can be considerable even under conditions of tight copper binding to the suspended particulates.

The concentration of copper in air ranges from a few nanograms (1 nanogram equals 1/1,000,000,000 of a gram or 4/100,000,000,000 of an ounce) in a cubic meter of air (ng/m^3) to about 200 ng/m^3. A cubic meter (m^3) is approximately 25% larger than a cubic yard. Near smelters, which process copper ore into metal, concentrations may reach 5,000 ng/m^3. You may breathe high levels of copper-containing dust if you live or work near copper mines or processing facilities.

You may be exposed to levels of soluble copper in your drinking water that are above the acceptable drinking water standard of 1,300 parts copper per billion parts of water (ppb), especially if your water is corrosive and you have copper plumbing and brass water fixtures. The average concentration of copper in tap water ranges from 20 to 75 ppb. However, many households have copper concentrations of over 1,000 ppb. That is more than 1 milligram per liter of water. This is because copper is dissolved from copper pipes and brass faucets when the water sits in the pipes overnight. After the water is allowed to run for 15–30 seconds, the concentration of copper in the water decreases below the acceptable drinking water standard.

The concentration of copper in lakes and rivers ranges from 0.5 to 1,000 ppb with an average concentration of 10 ppb. The average copper concentration in groundwater (5 ppb) is similar to that in lakes and rivers; however, monitoring data indicate that some groundwater contains levels of copper (up to 2,783 ppb) that are well above the standard of 1,300 ppb for drinking water. This copper is generally bound to particles in the water. Lakes and reservoirs recently treated with copper compounds to control algae or receive cooling water from a power plant can have high concentrations of dissolved copper. Once in natural water, much of this copper soon attaches to particles or convert to other forms that can settle into sediments. This can limit exposure to copper unless the sediments are stirred; for example, by the resuspension and swallowing of sediments by swimmers in recreational waters.

Garden products containing copper that are used to control certain plant diseases are also a potential source of exposure through contact with skin or if they are accidentally swallowed. For example, you can find copper compounds in some fungicides.

Soil generally contains between 2 and 250 ppm copper, although concentrations close to 17,000 ppm have been found near copper and brass production facilities. High concentrations of copper may be found in soil because dust from these industries settles out of the air, or wastes from mining and other copper industries are disposed of on the soil. Another common source of copper in soil results from spreading sludge from sewage treatment plants. This copper generally stays strongly attached to the surface layer of soil. You may be exposed to this copper by skin contact. Children may also be exposed to this copper by hand to mouth contact and eating the contaminated dirt and dust.

Food naturally contains copper. You eat and drink about 1 milligram (1/1,000 of a gram or 4/100,000 ounces) of copper every day.

While some hazardous waste sites on the NPL contain high levels of copper, we do not always know how high it is above natural levels. We also do not know what form it is in at most of these sites. However, evidence suggests that most copper at these sites is strongly attached to soil.

You may be exposed to copper in the workplace. If you work in the industry of mining copper or processing the ore, you are exposed to copper by breathing copper-containing dust or by skin contact. If you grind or weld copper metal, you may breathe high levels of copper dust and fumes. Occupational exposure to forms of copper that are soluble or not strongly attached to dust or dirt would most commonly occur in agriculture, water treatment, and industries such as electroplating, where soluble copper compounds are used. Exposure to copper in air in the workplace is regulated and is set to be below concentrations that can be harmful to you.

For more information on the potential for exposure to copper, please refer to Chapter 6.

1.4 HOW CAN COPPER ENTER AND LEAVE MY BODY?

Copper can enter your body when you drink water or eat food, soil, or other substances that contain copper. Copper can also enter your body if you breathe air or dust containing copper. Copper may enter the lungs of workers exposed to copper dust or fumes.

Copper rapidly enters the bloodstream and is distributed throughout the body after you eat or drink it. Certain substances in foods eaten with copper can affect the amount of copper that enters the bloodstream from the gastrointestinal tract. Your body is very good at blocking high levels of copper from entering the bloodstream. We do not know how much copper enters the body through the lungs or skin. Copper then leaves your body in feces and urine, mostly in feces. It takes several days for copper to leave your body. Generally, the amount of copper in your body remains constant (the amount that enters your body equals the amount that leaves). More information on how copper enters and leaves the body is presented in Chapter 3.

1.5 HOW CAN COPPER AFFECT MY HEALTH?

Scientists use many tests to protect the public from harmful effects of toxic chemicals and to find ways for treating persons who have been harmed.

One way to learn whether a chemical will harm people is to determine how the body absorbs, uses, and releases the chemical. For some chemicals, animal testing may be necessary. Animal testing may also help identify health effects such as cancer or birth defects. Without laboratory animals, scientists would lose a basic method for getting information needed to make wise decisions that protect public health. Scientists have the responsibility to treat research animals with care and compassion. Scientists must comply with strict animal care guidelines because laws today protect the welfare of research animals.

Copper is essential for good health. However, exposure to higher doses can be harmful. Long-term exposure to copper dust can irritate your nose, mouth, and eyes, and cause headaches, dizziness, nausea, and diarrhea. If you drink water that contains higher than normal levels of

copper, you may experience nausea, vomiting, stomach cramps, or diarrhea. Intentionally high intakes of copper can cause liver and kidney damage and even death. We do not know if copper can cause cancer in humans. EPA does not classify copper as a human carcinogen because there are no adequate human or animal cancer studies.

More detailed information on the health effects of copper in animals and humans can be found in Chapter 3.

1.6 HOW CAN COPPER AFFECT CHILDREN?

This section discusses potential health effects in humans from exposures during the period from conception to maturity at 18 years of age.

Exposure to high levels of copper will result in the same types of effects in children and adults. We do not know if these effects would occur at the same dose level in children and adults. Studies in animals suggest that children may have more severe effects than adults; we do not know if this would also be true in humans. There is a very small percentage of infants and children who are unusually sensitive to copper. We do not know if copper can cause birth defects or other developmental effects in humans. Studies in animals suggest that ingestion of high levels of copper may cause a decrease in fetal growth.

1.7 HOW CAN FAMILIES REDUCE THE RISK OF EXPOSURE TO COPPER?

The greatest potential source of copper exposure is through drinking water, especially in water that is first drawn in the morning after sitting in copper piping and brass faucets overnight. To reduce copper in drinking water, run the water for at least 15–30 seconds before using it. Additionally, if there is concern about the concentration of copper in drinking water exceeding the minimum value of 1,300 ppb, families should have their water tested.

If your doctor finds that you have been exposed to substantial amounts of copper, ask whether your children might also have been exposed. Your doctor might need to ask your state health department to investigate.

1.8 IS THERE A MEDICAL TEST TO DETERMINE WHETHER I HAVE BEEN EXPOSED TO COPPER?

Copper is normally found in all tissues of the body, blood, urine, feces, hair, and nails. High levels of copper in the blood, urine, hair, and nails can show that you have been exposed to higher than normal levels of copper. Tests to measure copper levels in the body are not usually available at a doctor's office because they require special equipment, but the doctor can send samples to a specialty laboratory. Although these tests can show that you have been exposed to higher than normal copper levels, they can not be used to predict the extent of exposure or potential health effects. More detailed information on the measurement of copper is provided in Chapters 3 and 7.

1.9 WHAT RECOMMENDATIONS HAS THE FEDERAL GOVERNMENT MADE TO PROTECT HUMAN HEALTH?

The federal government develops regulations and recommendations to protect public health. Regulations *can* be enforced by law. The EPA, the Occupational Safety and Health Administration (OSHA), and the Food and Drug Administration (FDA) are some federal agencies that develop regulations for toxic substances. Recommendations provide valuable guidelines to protect public health, but *cannot* be enforced by law. The Agency for Toxic Substances and Disease Registry (ATSDR) and the National Institute for Occupational Safety and Health (NIOSH) are two federal organizations that develop recommendations for toxic substances.

Regulations and recommendations can be expressed as "not-to-exceed" levels, that is, levels of a toxic substance in air, water, soil, or food that do not exceed a critical value that is usually based on levels that affect animals; they are then adjusted to levels that will help protect humans.

Sometimes these not-to-exceed levels differ among federal organizations because they used different exposure times (an 8-hour workday or a 24-hour day), different animal studies, or other factors. Recommendations and regulations are also updated periodically as more information becomes available. For the most current information, check with the federal agency or organization that provides it. Some regulations and recommendations for copper include the following:

The EPA has determined that drinking water should not contain more than 1.3 mg copper per liter of water (1.3 mg/L). The EPA has also developed regulations on the amount of copper that industry is allowed to release.

The OSHA has set a limit of 0.1 milligrams/cubic meter (mg/m^3) for copper fumes (vapor generated from heating copper) and 1.0 mg/m^3 for copper dusts (fine metallic copper particles) and mists (aerosols of soluble copper) in workroom air to protect workers during an 8-hour work shift (40-hour workweek).

The Food and Nutrition Board of the Institute of Medicine has developed recommended dietary allowances (RDAs) of 340 micrograms (μg) of copper per day for children aged 1–3 years, 440 μg/day for children aged 4–8 years, 700 μg/day for children aged 9–13 years, 890 μg/day for children aged 14–18 years, and 900 μg/day for adults. This provides enough copper to maintain health.

Further information on regulations and guidelines pertaining to copper is provided in Chapter 8.

1.10 WHERE CAN I GET MORE INFORMATION?

If you have any more questions or concerns, please contact your community or state health or environmental quality department, or contact ATSDR at the address and phone number below.

ATSDR can also tell you the location of occupational and environmental health clinics. These clinics specialize in recognizing, evaluating, and treating illnesses that result from exposure to hazardous substances.

Toxicological profiles are also available on-line at www.atsdr.cdc.gov and on CD-ROM. You may request a copy of the ATSDR ToxProfiles™ CD-ROM by calling the toll-free information and technical assistance number at 1-888-42ATSDR (1-888-422-8737), by e-mail at atsdric@cdc.gov, or by writing to:

Agency for Toxic Substances and Disease Registry Division of Toxicology 1600 Clifton Road NE Mailstop F-32 Atlanta, GA 30333 Fax: 1-770-488-4178

Organizations for-profit may request copies of final Toxicological Profiles from the following:

National Technical Information Service (NTIS) 5285 Port Royal Road Springfield, VA 22161 Phone: 1-800-553-6847 or 1-703-605-6000 Web site: http://www.ntis.gov/

2. RELEVANCE TO PUBLIC HEALTH

2.1 BACKGROUND AND ENVIRONMENTAL EXPOSURES TO COPPER IN THE UNITED STATES

Copper is a metallic element that occurs naturally as the free metal, or associated with other elements in compounds that comprise various minerals. Most copper compounds occur in +1 Cu(I) and +2 Cu(II) valence states. Copper is primarily used as a metal or an alloy (e.g., brass, bronze, gun metal). Copper sulfate is used as a fungicide, algicide, and nutritional supplement. Copper particulates are released into the atmosphere by windblown dust; volcanic eruptions; and anthropogenic sources, primarily copper smelters and ore processing facilities. Copper particles in the atmosphere will settle out or be removed by precipitation, but can be resuspended into the atmosphere in the form of dust. The mean concentration of copper in ambient air in the United States ranges from 5 to 200 ng/m^3. Copper is released into waterways by natural weathering of soil and rocks, disturbances of soil, or anthropogenic sources (e.g., effluent from sewage treatment plants). Copper concentrations in drinking water vary widely as a result of variations in pH and hardness of the water supply; the levels range from a few ppbs to 10 ppm. The mean concentration of copper in soil in the United States ranges from 5 to 70 mg/kg. The estimated daily intake of copper from food is 1.0–1.3 mg/day for adults (0.014–0.019 mg/kg/day).

The general population is exposed to copper through inhalation, consumption of food and water, and dermal contact with air, water, and soil that contains copper. The primary source of copper intake is the diet; however, the amount of copper in the diet usually does not exceed the average dietary requirements (RDAs) for copper. Drinking water is the primary source of excess copper. Populations living near sources of copper emissions, such as copper smelters and refineries and workers in these and other industries may also be exposed to high levels of copper in dust by inhalation. Copper concentrations in soils near copper emission sources could be sufficiently high to result in significantly high intakes of copper in young children who ingest soil. For example, copper concentrations of 2,480–6,912 ppm have been measured near copper smelters. These levels of copper in soils would result in the intake of 0.74–2.1 mg copper per day in a child ingesting 300 mg of soil. Copper has been identified in at least 906 of the 1,647 hazardous waste sites that have been proposed for inclusion on the EPA NPL.

2.2 SUMMARY OF HEALTH EFFECTS

Copper is an essential nutrient that is incorporated into a number of metalloenzymes involved in hemoglobin formation, drug/xenobiotic metabolism, carbohydrate metabolism, catecholamine biosynthesis, the cross-linking of collagen, elastin, and hair keratin, and the antioxidant defense mechanism. Copper-dependent enzymes, such as cytochrome c oxidase, superoxide dismutase, ferroxidases, monoamine oxidase, and dopamine β-monooxygenase, function to reduce activated oxygen species or molecular oxygen. Symptoms associated with copper deficiency in humans include normocytic, hypochromic anemia, leukopenia, and osteoporosis; copper deficiency is rarely observed in the U.S. general population. In the United States, the median intake of copper from food is 0.93–1.3 mg/day for adults (0.013–0.019 mg Cu/kg body weight/day using a 70-kg reference body weight). A recommended dietary allowance (RDA) of 0.9 mg/day (0.013 mg/kg/day) has recently been established. Copper is readily absorbed from the stomach and small intestine. After nutritional requirements are met, there are several mechanisms that prevent copper overload. Excess copper absorbed into gastrointestinal mucosal cells induces the synthesis of and binds to the metal binding protein metallothionein. This bound copper is excreted when the cell is sloughed off. Copper that eludes binding to intestinal metallothionen is transported to the liver. It is stored in the liver bound to liver metallothionen, from which it is ultimately released into bile and excreted in the feces. Although copper homeostasis plays an important role in the prevention of copper toxicity, exposure to excessive levels of copper can result in a number of adverse health effects including liver and kidney damage, anemia, immunotoxicity, and developmental toxicity. Many of these effects are consistent with oxidative damage to membranes or macromolecules. Copper can bind to the sulfhydryl groups of several enzymes, such as glucose-6-phosphatase and glutathione reductase, thus interfering with their protection of cells from free radical damage.

One of the most commonly reported adverse health effect of copper is gastrointestinal distress. Nausea, vomiting, and/or abdominal pain have been reported, usually occurring shortly after drinking a copper sulfate solution, beverages that were stored in a copper or untinned brass container, or first draw water (water that sat in the pipe overnight). The observed effects are not usually persistent and gastrointestinal effects have not been linked with other health effects. Animal studies have also reported gastrointestinal effects (hyperplasia of forestomach mucosa) following ingestion of copper sulfate in the diet. Copper is also irritating to the respiratory tract. Coughing, sneezing, runny nose, pulmonary fibrosis, and increased vascularity of the nasal mucosa have been reported in workers exposed to copper dust.

The liver is also a sensitive target of toxicity. Liver damage (necrosis, fibrosis, abnormal biomarkers of liver damage) have been reported in individuals ingesting lethal doses of copper sulfate. Liver effects have also been observed in individuals diagnosed with Wilson's disease, Indian childhood cirrhosis, or idiopathic copper toxicosis (which includes Tyrollean infantile cirrhosis). These syndromes are genetic disorders that result in an accumulation of copper in the liver; the latter two syndromes are associated with excessive copper exposure. Inflammation, necrosis, and altered serum markers of liver damage have been observed in rats fed diets with copper sulfate levels that are at least 100 times higher than the nutritional requirement. Damage to the proximal convoluted tubules of the kidney has also been observed in rats. The liver and kidney effects usually occur at similar dose levels; however, the latency period for the kidney effects is longer than for the liver effects.

There is some evidence from animal studies to suggest that exposure to airborne copper or high levels of copper in drinking water can damage the immune system. Impaired cell-mediated and humoral-mediated immune function have been observed in mice. Studies in rats, mice, and mink suggest that exposure to high levels of copper in the diet can result in decreased embryo and fetal growth.

The carcinogenicity of copper has not been adequately studied. An increase in cancer risk has been found among copper smelters; however, the increased risk has been attributed to concomitant exposure to arsenic. Increased lung and stomach cancer risks have also been found in copper miners. However, a high occurrence of smoking and exposure to radioactivity, silica, iron, and arsenic obscure the association of copper exposure with carcinogenesis. Animal studies have not found increased cancer risks in orally exposed rats or mice. The IARC has classified the pesticide, copper 8-hydroxyquinoline, in Group 3, unclassifiable as to carcinogenicity in humans and EPA has classified copper in Group D, not classifiable as to human carcinogenicity

A more detailed discussion of the critical targets of copper toxicity, the gastrointestinal tract and the liver, follows.

Gastrointestinal Effects. The available human and animal data suggest that the gastrointestinal tract is a sensitive target of toxicity. There are numerous reports of nausea, vomiting, and/or abdominal pain in humans ingesting beverages contaminated with copper or water containing copper sulfate. These symptoms typically occur shortly after ingestion and are not persistent. The results of three single exposure studies suggest that the threshold for gastrointestinal symptoms is between 4 and 6 ppm, which is equivalent to doses of 0.11 mg/kg and 0.017–0.018 mg Cu/kg. Nausea, vomiting, and/or abdominal

pain also appear to be the most sensitive end point following repeated exposure to copper in drinking water. These symptoms were reported by adults drinking water containing ≥3 ppm copper as copper sulfate (0.0731 mg Cu/kg/day) for 1–2 weeks or 4 ppm copper as copper sulfate (0.091 mg Cu/kg/day) for 2 months. Similar gastrointestinal effects were observed in adults ingesting copper oxide in drinking water. Although gastrointestinal irritation may play a role in the observed gastrointestinal effects, data from ferrets and monkeys suggest that vagal afferent fibers and 5-HT_3 and 5-HT_4 receptors are involved in copper-induced emesis.

Hepatic Effects. In humans, copper-induced hepatic damage is dependent on several factors including genetics, age, and copper intake. Liver damage is rarely reported in adults; the few reported cases of liver damage (centrilobular necrosis, jaundice, and increased aspartate aminotransferase activity) have been associated with intentional ingestion of a lethal dose of copper sulfate. In infants and children, reported liver effects are usually manifested in one of three syndromes: Wilson's disease, Indian childhood cirrhosis, and idiopathic copper toxicosis. Wilson's disease is an autosomal recessive genetic disorder associated with impaired copper metabolism. Dietary exposure to higher than normal levels of copper does not appear to be necessary for the manifestation of liver damage. Some heterozygous carriers of Wilson's disease also have elevated hepatic levels of copper and increased urinary excretion, although adverse health effects have not been reported in these individuals. There is evidence that Indian childhood cirrhosis and idiopathic copper toxicosis are also caused by a genetic defect that is transmitted in an autosomal recessive mode. However, unlike Wilson's disease, manifestation of the disease is associated with exposure to unusually high levels of dietary copper from milk stored in copper or brass containers or from drinking water. The clinical age of onset is usually between 6 months and 5 years, and the observed liver effects include pericellular fibrosis, abnormal biochemical markers of liver damage (e.g., increased serum aspartate aminotransferase and alkaline phosphatase activities and serum bilirubin levels), and very high levels of copper in the liver. In general, the potential hepatotoxicity of copper has not been extensively investigated in healthy humans. No effect levels of 0.14–0.17 and 0.315 mg Cu/kg/day for liver effects in adults and infants (3–12 months of age), respectively, had been reported in intermediate-duration studies (2–9 months); these studies used serum chemistry biomarkers (e.g., alanine aminotransferase, aspartate aminotransferase) to assess liver damage. Two community survey studies also found no evidence of liver damage in infants living in households with 0.8 ppm copper in drinking water. The results of the three studies involving infants should be interpreted cautiously due to the high drop out rate, small number of subjects examined for possible liver damage, and the dismissal of anomalous findings as secondary to infection rather than possibly indicative of copper toxicity.

Adverse liver effects have been observed in rats exposed to dietary copper levels that were more than 100 times higher than the nutritional requirement. The liver effects included inflammation, necrosis, and abnormal serum chemistry markers of liver damage. Rats appear to develop a tolerance to copper doses of 180–<550 mg Cu/kg/day. Tolerance is defined as "the ability to endure the continued or increasing administration of a toxicant and the capacity to exhibit less response to a test dose than previous." As the levels of hepatic copper increase, so does the severity of the damage until peak copper levels are reached. After about 3–5 weeks of exposure, the copper levels begin to decline and are maintained at a steady level for the remainder of the exposure period. When the hepatic levels decline, regeneration of hepatic tissue is observed, and continued exposure or exposure to higher doses does not result in more tissue damage. The decline in hepatic copper levels and regeneration of damaged tissue occurs early at higher doses. At doses >550 mg Cu/kg/day, the liver becomes permanently overloaded and chronic hepatitis develops.

2.3 MINIMAL RISK LEVELS (MRLs)

Estimates of exposure levels posing minimal risk to humans (Minimal Risk Levels or MRLs) have been made for copper. An MRL is defined as an estimate of daily human exposure to a substance that is likely to be without an appreciable risk of adverse effects (noncarcinogenic) over a specified duration of exposure. MRLs are derived when reliable and sufficient data exist to identify the target organ(s) of effect or the most sensitive health effect(s) for a specific duration within a given route of exposure. MRLs are based on noncancerous health effects only and do not consider carcinogenic effects. MRLs can be derived for acute, intermediate, and chronic duration exposures for inhalation and oral routes. Appropriate methodology does not exist to develop MRLs for dermal exposure.

Although methods have been established to derive these levels (Barnes and Dourson 1988; EPA 1990), uncertainties are associated with these techniques. Furthermore, ATSDR acknowledges additional uncertainties inherent in the application of the procedures to derive less than lifetime MRLs. As an example, acute inhalation MRLs may not be protective for health effects that are delayed in development or are acquired following repeated acute insults, such as hypersensitivity reactions, asthma, or chronic bronchitis. As these kinds of health effects data become available and methods to assess levels of significant human exposure improve, these MRLs will be revised.

A User's Guide has been provided at the end of this profile (see Appendix B). This guide should aid in the interpretation of the tables and figures for Levels of Significant Exposure and the MRLs.

Inhalation MRLs

The available data on the toxicity of inhaled copper were considered inadequate for derivation of acute-, intermediate-, or chronic-duration inhalation MRLs. Data on the inhaled toxicity of copper in humans following acute-duration exposure are limited to a report of workers developing metal fume fever while cutting brass pipe with an electric cutting tool in a poorly ventilated area (Armstrong et al. 1983); exposure levels were not reported. Respiratory effects and impaired immune function have been observed in mice following a single 3-hour exposure to 3.3 mg Cu/m^3 as copper sulfate or repeated exposure (3 hours/day, 5 days/week for 1–2 weeks) to 0.12–0.13 mg Cu/m^3 as copper sulfate (Drummond et al. 1986). The Drummond et al. (1986) study was not selected as the basis of an acute-duration inhalation MRL because a small number of animals was tested (four per group) and a limited number of end points (respiratory tract and immune function) were examined. Intermediate-duration data are limited to studies by Johansson et al. (1983, 1984), which did not find any histological alterations in the lungs or functional or morphological alterations in alveolar macrophages of rabbits exposed to copper chloride. As with the acute-duration data, the limited number of end points examined precludes deriving an intermediate-duration inhalation MRL. The chronic-duration database for copper consists of two occupational exposure studies reporting respiratory (Askergren and Mellgren 1975; Suciu et al. 1981) and gastrointestinal (Suciu et al. 1981) irritation, hepatic effects (Suciu et al. 1981), and possible neurological and reproductive effects (Suciu et al. 1981). Chronic-duration inhalation MRLs cannot be derived from these studies due to poor exposure characterization and/or lack of controls.

Oral MRLs

- _An MRL of 0.01 mg/kg/day has been derived for acute-duration oral exposure (1–14 days) to copper.

The available human and animal acute-duration studies strongly suggest that the gastrointestinal tract is the most sensitive target of copper toxicity. Numerous studies and case reports have reported nausea, vomiting, and/or abdominal pain in humans immediately following ingestion of copper-contaminated water or other beverages (Araya et al. 2001, 2003a, 2003b, 2003c; Chuttani et al. 1965; Gotteland et al. 2001; Knobeloch et al. 1994; Nicholas and Brist 1968; Olivares et al. 2001; Pizarro et al. 1999, 2001; Spitalny et al. 1984). In human studies involving a single exposure to copper following an overnight fast, adverse gastrointestinal effects (nausea, vomiting, abdominal pain, and/or diarrhea) have been observed at doses of 0.011–0.03 mg Cu/kg (Araya et al. 2001, 2003a, 2003c; Gotteland et al. 2001; Olivares et al. 2001). Under these experimental conditions, the apparent threshold appears to fall between 0.011 and

0.017 mg Cu/kg (Araya et al. 2001, 2003a; Olivares et al. 2001). Slightly higher thresholds for gastrointestinal symptoms were observed in two acute-duration repeated exposure studies in which subjects used a copper-containing water as their primary source of drinking water for 1 or 2 weeks (Pizarro et al. 1999, 2001). In the 2-week study, 60 women were given copper sulfate containing water to be used for drinking and cooking purposes. No significant alterations in serum biomarkers of liver damage (alanine aminotransferase, aspartate aminotransferase, γ-glutamyl transferase) were observed in the subjects at the end of the study. An increased occurrence of nausea, vomiting, and/or abdominal pain was observed when the women were exposed to 3 ppm copper as copper sulfate (0.0731 mg Cu/kg/day) (Pizarro et al. 1999); no significant increases in the incidence of gastrointestinal symptoms were noted at 1 ppm (0.0272 mg Cu/kg/day). Nausea, vomiting, and/or abdominal pain were also reported by women ingesting water containing 5 ppm (0.096 mg Cu/kg/day) as copper sulfate or copper oxide for 1 week (Pizarro et al. 2001). Animal studies support the identification of the gastrointestinal tract as a sensitive target of toxicity. Hyperplasia of the forestomach mucosa was observed in rats exposed to 44 mg Cu/kg/day as copper sulfate in the diet (NTP 1993) and in mice exposed to 197 mg Cu/kg/day as copper sulfate in the diet (NTP 1993). At higher doses, liver and kidney damage have been observed (Haywood 1980; Haywood and Comerford 1980; Haywood et al. 1985b; NTP 1993).

The Pizarro et al. (1999) 2-week study was selected as the basis of the acute-duration oral MRL for copper. This study identified no-observed-adverse-effect level (NOAEL) and lowest-observed-adverse-effect level (LOAEL) values of 0.0272 and 0.0731 mg Cu/kg/day for increases in the incidence of nausea, vomiting, and/or abdominal pain. Although the LOAEL values identified in the single exposure studies (Araya et al. 2001, 2003; Olivares et al. 2001) are slightly lower than the than the NOAEL identified in the Pizarro et al. (1999) study, the Pizarro et al. (1999) study was selected as the critical study because it is a longer-duration study and it more closely mimics an exposure scenario of a population drinking copper-contaminated drinking water. The NOAEL was divided by an uncertainty factor of 3 (to account for human variability) to yield an acute-duration oral MRL of 0.01 mg Cu/kg/day. The observed gastrointestinal effects were probably due to direct contact; thus, only a partial uncertainty factor of 3 was used to account for human variability because toxicokinetic differences among individuals should not affect sensitivity. The acute-duration MRL is intended to protect against the health effects associated with exposure to copper-contaminated drinking water; it assumes that the affected population will have a normal intake of copper from the diet.

- _An MRL of 0.01 mg/kg/day has been derived for intermediate-duration oral exposure (15– 365 days) to copper.

There are limited data on the intermediate-duration toxicity of copper in humans. Araya et al. (2003b) exposed groups of 327–355 adults to <0.01 (control group), 2, 4, or 6 ppm copper sulfate in water for 2 months. The subjects prepared the copper sulfate solution to be used at home by mixing a stock copper sulfate solution with tap water; this solution was used for drinking water and preparing beverages and soups. Exposure to copper sulfate resulted in increases in the occurrence of gastrointestinal symptoms; the incidence was significantly higher than controls at 6 ppm when the data were analyzed using the chi-square test with Bonferroni correction and at 4 ppm when the Bonferroni correction was not used. Only one test was used to assess whether exposure to copper results in adverse gastrointestinal effects (reported symptoms); thus, the Bonferroni correction is not needed for this end point. Therefore, the 4 ppm concentration is identified as the LOAEL and the 2 ppm concentration as the NOAEL. The study authors reported copper intakes for 48–49 subjects per group who provided blood samples; no information on selection criteria were provided. The copper intakes were 0, 0.042, 0.091, and 0.17 mg Cu/kg/day for the control, 2, 4, and 6 ppm groups, respectively. The dietary intake of copper was not measured in this study; however, Araya et al. (2003b) noted that copper intake found in a survey of other community residents was 0.9 mg Cu/day. No significant alterations in copper status or liver function (as assessed by serum alanine aminotransferase, asparatate aminotransferase, and γ-glutamyl transferase activities) were observed in a subset of subjects from each group. In a study by Pratt et al. (1985), a group of seven adults were administered 10 mg Cu/day (0.14 mg Cu/kg/day) as copper gluconate in a capsule for 12 weeks. No significant alterations in serum markers of liver damage (cholesterol and triglyceride levels and serum aspartate aminotransferase, alkaline phosphatase, γ-glutamyl transferase, and lactate dehydrogenase activities) were found. Similarly, no alterations in total bilirubin or serum alanine aminotransferase, aspartate aminotransferase, or γ-glutamyl transferase activities were observed in infants exposed to 0.315 mg Cu/kg/day for 9 months (Olivares et al. 1998). Zietz et al. (2003a, 2003b) also did not find evidence of liver damage in infants living in households with water concentrations of 0.8 ppm and higher. The Pratt et al. (1985), Olivares et al. (1998), and Zietz et al. (2003a, 2003b) studies did not report significant alterations in the occurrence of gastrointestinal disturbances and the study design did not include symptoms questionnaires, although the high dropout rate observed in the Olivares et al. (1998) study may have been related to gastrointestinal effects. Severe liver damage (pericellular fibrosis and increased serum aminotransferase and alkaline phosphatase activities) has been observed in children with a genetic susceptibility to high levels of copper in the liver. The liver was a critical target of toxicity in rats exposed to very high levels of copper in diet (greater than 100 times the nutritional requirement),

Inflammation, necrosis, and increased alanine and aspartate aminotransferases activities have been

reported in rats at exposure levels of 16 mg Cu/kg/day as copper sulfate in the diet (Haywood 1980, 1985; Haywood and Comerford 1980; Haywood and Loughran 1985; Haywood et al. 1985a; NTP 1993). No liver effects where observed at 8 mg Cu/kg/day (NTP 1993). Histological alterations in stomach, indicative of irritation (hyperplasia of the squamous mucosa on the limiting ridge separating the forestomach from the glandular stomach), have also been observed in rats and mice exposed to 33 or 267 mg Cu/kg/day, respectively, as copper sulfate in the diet for 13 weeks (NTP 1993).

An intermediate-duration oral MRL of 0.01 mg Cu/kg/day was derived for copper based on gastrointestinal effects using the data from the Araya et al. (2003b) study. This study identified NOAEL and LOAEL values of 0.042 and 0.091 mg Cu/kg/day, respectively; these copper doses were in excess of normal dietary intake. The NOAEL was divided by an uncertainty factor of 3 (to account for human variability) to yield an intermediate-duration oral MRL of 0.01 mg Cu/kg/day. As with the acute-duration MRL, the intermediate-duration MRL is intended to protect against exposure to excess copper in drinking water and assumes a normal copper dietary intake.

The database on the chronic oral toxicity of copper is inadequate for derivation of a MRL. Massie and Aiello (1984) reported a 15% decrease in the lifespan in mice exposed to 4.2 mg Cu/kg/day as copper gluconate in drinking water.

3. HEALTH EFFECTS

3.1 INTRODUCTION

The primary purpose of this chapter is to provide public health officials, physicians, toxicologists, and other interested individuals and groups with an overall perspective on the toxicology of copper. It contains descriptions and evaluations of toxicological studies and epidemiological investigations and provides conclusions, where possible, on the relevance of toxicity and toxicokinetic data to public health. A glossary and list of acronyms, abbreviations, and symbols can be found at the end of this profile.

3.2 DISCUSSION OF HEALTH EFFECTS BY ROUTE OF EXPOSURE

To help public health professionals and others address the needs of persons living or working near hazardous waste sites, the information in this section is organized first by route of exposure (inhalation, oral, and dermal) and then by health effect (death, systemic, immunological, neurological, reproductive, developmental, genotoxic, and carcinogenic effects). These data are discussed in terms of three exposure periods: acute (14 days or less), intermediate (15–364 days), and chronic (365 days or more).

Levels of significant exposure for each route and duration are presented in tables and illustrated in figures. The points in the figures showing no-observed-adverse-effect levels (NOAELs) or lowest-observed-adverse-effect levels (LOAELs) reflect the actual doses (levels of exposure) used in the studies. LOAELs have been classified into "less serious" or "serious" effects. "Serious" effects are those that evoke failure in a biological system and can lead to morbidity or mortality (e.g., acute respiratory distress or death). "Less serious" effects are those that are not expected to cause significant dysfunction or death, or those whose significance to the organism is not entirely clear. ATSDR acknowledges that a considerable amount of judgment may be required in establishing whether an end point should be classified as a NOAEL, "less serious" LOAEL, or "serious" LOAEL, and that in some cases, there will be insufficient data to decide whether the effect is indicative of significant dysfunction. However, the Agency has established guidelines and policies that are used to classify these end points. ATSDR believes that there is sufficient merit in this approach to warrant an attempt at distinguishing between "less serious" and "serious" effects. The distinction between "less serious" effects and "serious" effects is considered to be important because it helps the users of the profiles to identify levels of exposure at which

major health effects start to appear. LOAELs or NOAELs should also help in determining whether or not the effects vary with dose and/or duration, and place into perspective the possible significance of these effects to human health.

The significance of the exposure levels shown in the Levels of Significant Exposure (LSE) tables and figures may differ depending on the user's perspective. Public health officials and others concerned with appropriate actions to take at hazardous waste sites may want information on levels of exposure associated with more subtle effects in humans or animals (LOAELs) or exposure levels below which no adverse effects (NOAELs) have been observed. Estimates of levels posing minimal risk to humans (Minimal Risk Levels or MRLs) may be of interest to health professionals and citizens alike.

A User's Guide has been provided at the end of this profile (see Appendix B). This guide should aid in the interpretation of the tables and figures for Levels of Significant Exposure and the MRLs.

3.2.1 Inhalation Exposure

3.2.1.1 Death

No studies were located regarding death of humans or animals following inhalation exposure to copper.

3.2.1.2 Systemic Effects

No studies were located regarding cardiovascular, musculoskeletal, renal, dermal, or body weight effects in humans or animals following inhalation exposure to copper.

Respiratory, gastrointestinal, hematological, hepatic, endocrine, and ocular effects were observed in humans. Respiratory effects have also been observed in animals exposed to copper sulfate aerosols.

Respiratory Effects. In humans, copper is a respiratory irritant. Workers exposed to copper dust report a number of symptoms that are suggestive of respiratory irritation, including coughing, sneezing, thoracic pain, and runny nose (Askergren and Mellgren 1975; Suciu et al. 1981). In the Suciu et al. (1981) study of 75–100 workers involved in sieving copper, lung radiographs revealed linear pulmonary fibrosis, and in some cases, nodulation. During the first year of operation, the workers were exposed to 434 mg Cu/m^3; the exposure levels declined each year, and by year 3, the levels were 111 mg Cu/m^3. In

sheet metal workers exposed to patina dust (copper-hydroxide-nitrate, copper-hydroxide-sulfate, copper silicate, copper oxide), 6 of the 11 examined workers had increased vascularity and superficial epistatic vessels in the nasal mucosa (Askergren and Mellgren 1975); no exposure levels were reported.

Copper is considered the etiologic agent in the occupational disease referred to as "vineyard sprayer's lung". This disease, which is observed in vineyard workers spraying an antimildew agent containing 1–2.5% copper sulfate neutralized with hydrated lime, was first described in humans by Cortez Pimentel and Marques (1969). In most cases, published information on this disease comes from case reports (Cortez Pimentel and Marques 1969; Cortez Pimentel and Menezes 1975; Stark 1981; Villar 1974; Villar and Nogueira 1980) with no concentration-response information. Common findings (obtained by alveolar lavage and biopsy) include intraalveolar desquamation of macrophages, formation of histiocytic and noncaseating granulomas containing inclusions of copper, and healing of lesions in the form of fibrohyaline nodules, very similar to those found in silicosis (Cortez Pimentel and Marques 1969; Plamenac et al. 1985). Higher incidences of abnormal columnar cells, squamous metaplasia without atypia, copper containing macrophages, eosinophilia, and respiratory spirals were found in the sputa of smoking and nonsmoking vineyard sprayers, as compared to rural workers from the same geographic region who did not work in the vineyards (Plamenac et al. 1985).

The potential of copper to induce respiratory effects has been tested in mice, hamsters, and rabbits. Decreased cilia beating was observed in Syrian-Golden hamsters exposed to 3.3 mg Cu/m^3 as copper sulfate for 3 hours (Drummond et al. 1986); this effect was not observed in similarly exposed CD-1 mice. Repeated exposure resulted in alveolar thickening in CD-1 mice exposed to 0.12 mg Cu/m^3 as copper sulfate for 3 hours/day, 5 days/week for 1–2 weeks (Drummond et al. 1986); the severity of the effect increased with the duration of exposure. In rabbits (strain not reported) exposed to 0.6 mg Cu/m^3 as copper chloride for 6 hours/day, 5 days/week for 4–6 weeks, the only histological alteration in the lungs was a slight increase in alveolar type II cell volume density (Johansson et al. 1984); this effect was not considered adverse. No functional or morphological alterations were observed in the alveolar macrophages of similarly exposed rabbits (Johansson et al. 1983).

Gastrointestinal Effects. In workers involved in grinding and sieving copper dust, anorexia, nausea, and occasional diarrhea were reported (Suciu et al. 1981); exposure levels ranged from 111 to 434 mg Cu/m^3 over a 3-year period. It is likely that the observed gastrointestinal effects were due to oral exposure to copper. Ingestion probably resulted from mucocilliary clearance of copper particles deposited in the nasopharyngeal and tracheobronchial regions of the respiratory tract.

No studies were located regarding gastrointestinal effects in animals following inhalation exposure to copper.

Hematological Effects. Decreased hemoglobin and erythrocyte levels have been observed in workers exposed to airborne copper levels of 0.64–1.05 mg/m^3. Results of hair analysis reveal that the workers were also exposed to iron, lead, and cadmium (Finelli et al. 1981).

No studies were located regarding hematological effects in animals following inhalation exposure to copper.

Hepatic Effects. Hepatomegaly was observed in workers involved in grinding and sieving copper dust (Suciu et al. 1981); the exposure levels ranged from 111 to 434 mg Cu/m^3.

No studies were located regarding hepatic effects in animals following inhalation exposure to copper.

Endocrine Effects. Seven cases of enlargement of the sella turcica, nonsecretive hypophyseal adenoma, accompanied by obesity, arterial hypertension, and "red facies" were observed in a group of 100 workers exposed to 111–434 mg Cu/m^3 as copper dust (Suciu et al. 1981). The study authors noted that there was a possibility that the clinical manifestations of hypophyseal adenoma or of Cushing's syndrome may have been the result of a disturbance of copper metabolism. The significance of this effect and its relationship to copper exposure cannot be determined.

Ocular Effects. Eye irritation has been reported by workers exposed to copper dust (Askergren and Mellgren 1975). The irritation is likely due to direct contact with the copper rather than a systemic effect resulting from inhalation exposure.

Other Systemic Effects. A few studies have reported metal fume fever, a 24–48-hour illness characterized by chills, fever, aching muscles, dryness in the mouth and throat, and headache, in workers exposed to copper dust or fumes (Armstrong et al. 1983; Gleason 1968). Gleason (1968) reported airborne copper dust concentrations of 0.075–0.12 mg/m^3. It has been suggested that other metals present in the workplace may have been the causative agent for the metal fume fever, rather than copper. This is supported by the small number of reports of metal fume fever despite the extensive use of copper in many industries (Borak et al. 2000).

3.2.1.3 Immunological and Lymphoreticular Effects

No studies were located regarding immunological effects in humans following inhalation exposure to copper.

An acute exposure study in mice reported an impaired immune response following exposure to copper sulfate and a bacterial challenge (Drummond et al. 1986). Increased mortality and decreased survival time were observed in CD-1 mice challenged by an aerosol of *Streptococcus zooepidemicus* following 0.56 mg Cu/m^3 for 3 hours or 0.13 mg Cu/m^3 for 3 hours/day, 5 days/week for 2 weeks. Decreased bactericidal activity of alveolar macrophages was also observed in mice exposed to 3.3 mg Cu/m^3 for 3 hours or 0.12 mg Cu/m^3 for 3 hours/day, 5 days/week for 2 weeks following exposure to an aerosol of *Klebsiella pneumonia*.

These LOAEL values for immunological effects are recorded in Table 3-1 and plotted in Figure 3-1.

3.2.1.4 Neurological Effects

Only one study examining neurological effects was located. Headache, vertigo, and drowsiness were reported in factory workers exposed to 111–434 mg/m^3 copper dust (Suciu et al. 1981).

3.2.1.5 Reproductive Effects

Sexual impotence was reported in 16% of workers (75–100 workers examined) exposed to 111– 434 mg/m^3 copper dust during grinding and sieving operations (Suciu et al. 1981). The significance of this finding is difficult to assess because a control group was not used.

No studies were located regarding reproductive effects in animals following inhalation exposure to copper. 3.3 15 17 0.12 1.21 16 3.3 0.13 18 118 0.12 0.13 14 3.3 0.56 **Table 3-1 Levels of Significant Exposure to Copper -Inhalation**

aKey to figure	**Exposure/ Duration/ Frequency (Specific Route)**	**Species (Strain)**	**System**	**NOAEL (mg/m.)**	**Less Serious (mg/m.)**	**LOAEL**	**Serious (mg/m.)**
	ACUTE EXPOSURE						
	Systemic 1 3 hr	Mouse	Resp	3.3			
2	1-2 wk 5d/wk 3hr/d	Mouse	Resp	0.12	(alveoli thickening)	Drummond et al. 1986	
3	3 hr	Hamster	Resp	1.21	3.3 (decr cilia beating frequency)	Drummond et al. 1986	
4	1-2 wk 5d/wk 3hr/d	Hamster	Resp	0.13	Drummond et al. 1986		
5	**Immuno/ Lymphoret** 1-2 wk 5d/wk 3hr/d	Mouse	0.12	(decr bactericidal activity)	0.13	(decr mean survival time)	Drummond et al. 198
6	3 hr	Mouse	3.3 (decr bactericidal activity)		0.56	(decr mean survival time)	Drummond et al. 198