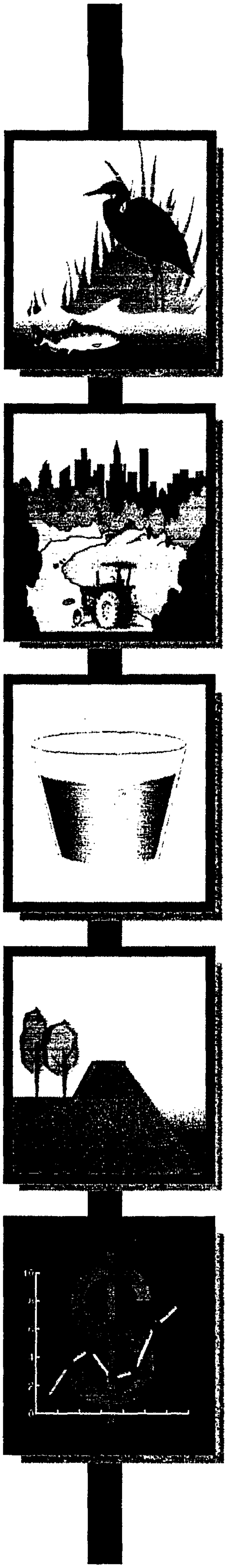


CALFED
BAY-DELTA
PROGRAM

Affected Environment and Environmental Impacts

Noise

Draft Technical Report
September 1997

CALFED/701

Noise - Affected Environment

TABLE OF CONTENTS

1.0 SUMMARY

The Affected Environment section of the Noise report describes regulations governing noise levels for certain land uses, appropriate noise levels, and fundamentals of noise concepts. This discussion is intended to characterize the existing conditions of the CALFED study area. Several environmental codes exist at the federal and State level that address procedures for assessing and reducing noise levels in noise-sensitive areas. In addition, counties and cities have general plans that typically contain a noise element that dictates appropriate noise levels for a given land use. Because the geographical extent of the CALFED project area is quite large, the existing conditions include descriptions of noise environments associated with every type of land use and human activity.

2.0. INTRODUCTION

This report describes the affected environment in terms of existing levels of environmental noise. A companion report identifies the general potential for significant noise impacts associated with development of alternative methods to satisfy project objectives and identifies reasonable and feasible mitigation measures that may be implemented where necessary. More detailed noise impact assessment will be conducted when project-specific and location-specific activities are defined.

In order to understand the technical descriptions of noise and to appreciate the degree to which the project may affect the noise environment it is essential that the reader have some familiarity with noise mathematics and terminology, including "decibels", "A-weighting", and noise descriptors; and a basic understanding of the relationship of perceived loudness to decibel changes in noise level. The reader is encouraged to refer to the Noise Technical Appendix.

3.0 SOURCES OF INFORMATION

Information regarding environmental ("community") noise is contained in reference books, governmental planning guides and handbooks, and previously published environmental studies. Information for this report was obtained from each of these sources. A listing of the source documents is provided in Section VI of this report.

The data provided in the above sources are typically of a general nature with broad applicability to all areas of the State, including the Regions potentially affected by the CALFED project. Land use is described in terms of development type (e.g., residential) and "intensity" (e.g., rural), while noise environments are variously described using descriptors of hourly noise (i.e., L_{eq}) or time-weighted, 24-hour/annual noise level (i.e., L_{dn}).

The data are based on average values of noise level, types and distribution of noise-sensitive development, and expected community reactions to levels of environmental noise and noise sources. This data limitation is not of concern for the detail of noise analysis required for this environmental document. However, more detailed site-specific noise and receptor data may be required when assessing local implementation of program features.

4.0 ENVIRONMENTAL SETTING

4.1 Regulatory Setting

There are a number of laws and guidelines at the federal government level that direct the consideration of environmental noise/land use compatibility. These include:

* National Environmental Policy Act (42 U.S.C. 4321, et. seq.) (PL-91-190) (40 C.F.R. 1506.5);
* Noise Control Act of 1972 (42 U.S.C. 4910);
* FHWA Noise Abatement Procedures (23 C.F.R. Part 772);
* HUD Environmental Standards (24 C.F.R. Part 51);

There are also several State of California codes that address environmental noise. The most relevant among these are the Government Code requiring Noise Elements of the General Plan (65302. f) and the Noise Insulation Standards (Title 24 California Code of Regulations) for multifamily dwellings. Other provisions at the state level include the Airport Noise Regulations (Title 21 California Code of Regulations), several sections of the Public Utilities Code, and the California Department of Transportation (Caltrans) laws, guidelines and procedures for regulating, assessing and reducing noise levels associated with motor vehicles (California Vehicle Code) and some railroad train activity.

In addition to the federal and state regulations, all local jurisdictions (counties and cities) are mandated by California law to have a Noise Element as part of its General

Plan. The Noise Element contains the jurisdiction's land use/noise compatibility planning standards. The planning standards contained in the various Noise Elements are relatively uniform (typically within +/- 5 decibels for the same land use category) among jurisdictions. Environmental noise levels generally considered compatible with noise-sensitive use (e.g., residential) typically range up to 60 dBA L_{dn}, with an upper bound at 65 dBA L_{dn}. Noise levels below 55 dBA L_{dn} are almost universally considered acceptable, however especially quiet existing environments require special consideration.

Many jurisdictions have also adopted local nuisance-noise-control ordinances as an exercise of their police powers. However, nuisance-noise ordinances are not as uniform as the Noise Elements. They take many forms and exhibit wide variations in the allowable noise limits placed on noise-sources as they affect different types of land use.

4.2 Community Noise Levels

The amount of noise in an environment may be characterized in many ways. Existing noise may be measured or calculated ("modeled") using various methods and procedures. Future environmental noise levels expected to result from different land use or project activities may be modeled and predicted.

Many studies of environmental noise have resulted in the establishment of consistent relationships between various "intensities" of human oriented development (based on population density) and their associated noise environments. The following table presents the generally accepted correspondence between generic intensities of development and the expected level of environmental noise expressed in terms of Day-Night Average Level (L_{dn}).

Because the geographical extent of the CALFED project is potentially quite large, the affected environment includes all of the development intensity categories listed in the table and the range of noise environments shown (plus even noisier commercial and industrial land uses, and areas next to freeways, railroads, airports, etc.). Although single numbers are listed for each land use category noise value, they actually represent average points on a continuous range of noise from very quiet to very noisy. Table 4-1 lists noise levels associated with varying land use densities.

TABLE 4-1
RELATIONSHIP BETWEEN POPULATION DENSITY AND AVERAGE DAY-NIGHT NOISE LEVELS

Location	Person/sq. km	L_{dn} (dBA)
Rural		
Undeveloped	8	35
Partially Developed	23	40
Suburban		
Quiet	77	45
Normal	230	50
Urban		
Normal	770	55
Noisy	2,300	60
Very Noisy	7,700	65

Source: National Research Council, USA.

TECHNICAL APPENDIX
Fundamentals and Characteristics of Noise

This technical information is provided to facilitate understanding of the effect of noise expected to be generated by the Bay Delta project. It describes the fundamentals of noise, how noise is measured and expressed, and how noise is perceived by the human ear. A simple definition of "noise" is unwanted sound.

Most of the sounds that we hear in the environment do not consist of a single frequency, but rather a broad band of frequencies, with each frequency differing in sound level. The intensities of each frequency add together to generate a sound. Airborne sound is a rapid fluctuation of air pressure above and below atmospheric pressure. Sound levels are usually measured and expressed in units of decibels (dB). Decibels and other technical acoustical terms are defined and more fully described in the following Glossary and discussion.

GLOSSARY

DEFINITIONS OF ACOUSTICAL TERMS

TERM	DEFINITION
A-Weighted Sound Level, dBA	The sound pressure level in decibels as measured on a sound level meter using the A-weighting filter network. The A-weighting filter de-emphasizes the very low and very high frequency components of the sound in a manner similar to the frequency response of the human ear, and correlates well with subjective reactions to noise. All sound levels discussed in this report are A-weighted (dBA).
Ambient Noise Level	The composite of noise from all sources near and far. The normal or existing level of environmental noise at a given location.
Average Day-Night Sound Level, L_{dn}	A 24-hour based, annual descriptor of community noise, in units of dBA, where a ten decibel penalty is added to the hourly L_{eq} of noise occurring between the hours of 10:00 p.m. and 7:00 a.m.
Decibel, dB	A unit describing the amplitude of sound, equal to 20 times the logarithm to the base 10 of the ratio of the pressure of the sound measured to the reference pressure, which is 20 micropascals (20 dynes per square centimeter).

Equivalent Noise Level, L_{eq}	The (energy) average noise level during the measurement period. L_{eq} is defined as the continuous steady state noise level that would have the same total acoustic energy as the real fluctuating noise measured over the same time period.
Frequency, Hz	The number of complete pressure fluctuations per second above and below atmospheric pressure.
Maximum Noise Level, L_{max}	The noise level with the highest root-mean-square amplitude occurring during a measurement period.

The method commonly used to quantify environmental sounds consists of evaluating all of the frequencies of a sound in accordance with a weighting that reflects the fact that human hearing is less sensitive at low frequencies and extreme high frequencies, but is more sensitive in the mid-range frequencies. The weighting filter used is called "A" weighting, and the decibel level so measured is called the A-weighted sound level (dBA). In practice, the level of a sound source is conveniently measured using a sound level meter that includes an electrical filter corresponding to the A-weighting curve.

Although the A-weighted noise level may adequately indicate the level of environmental noise at any instant in time, community noise levels vary continuously and comprise the long-term acoustical environment. Most environmental noise includes a mixture of sounds from many sources which create a relatively steady background noise where no particular source is identifiable. To describe the time-varying character of environmental noise, a single number descriptor called the L_{eq} is widely used. The L_{eq} is the energy average A-weighted noise level during a stated period of time. The L_{eq} descriptor is used as the basic noise level descriptor in this analysis.

In determining the daily and annual level of environmental noise, it is important to account for the difference in response of people to daytime and nighttime noises. During the nighttime, exterior background noise levels are generally lower than the daytime levels. Also, most household noise also decreases at night and intrusive exterior noise becomes relatively more noticeable. Further, most people sleep at night and are very sensitive to noise intrusion. The sound level that just begins to cause sleep disturbance is about 35 dBA inside a sleeping room. To account for increased human perception of nighttime environmental noise levels, a descriptor, L_{dn} (day/night average sound level), was developed by the U.S. Environmental Protection Agency and has been adopted as a land use planning tool by most local jurisdictions and states including California. The L_{dn} divides the 24-hour day into “daytime” hours from 7:00 am to 10:00 pm and “nighttime” hours from 10:00 pm to 7:00 am. The nighttime noise level is weighted 10 dB higher than the daytime noise level. In order to describe long-term noise environments, this analysis will use the L_{dn} noise level descriptor.

The effects of noise on people can be listed in three general categories:

* Subjective effects of annoyance, nuisance, dissatisfaction
* Interference with activities such as speech, sleep, learning
* Physiological effects such as startling hearing loss

The levels associated with environmental noise, in almost every case, produce effects only in the first two categories. Workers in industrial plants can experience noise in the last category.

Unfortunately, there is as yet no completely satisfactory way to measure the subjective effects of noise, or the corresponding individual reactions of annoyance and dissatisfaction. This is primarily because of the wide variation in individual thresholds of annoyance, and differing individual past experiences with noise. As a group, however, a community will exhibit typical reactions to various levels of environmental noise based upon the absolute noise level, the change in noise level, or a combination of these two factors.

Thus, an important way of determining a person's subjective reaction to a new noise is to compare the new source to the existing noise environment. In general, the more a new noise exceeds the previously existing ambient noise level, the less acceptable the new noise will be judged by the hearers.

With regard to increases in A-weighted noise levels, knowledge of the following relationships of noise energy, noise perception, and the decibel scale are helpful in understanding this report.

Decibel noise rating units are convenient, but they may also be confusing because their mathematical behavior is not necessarily intuitive.

Decibels are convenient because they numerically compress a very large range of sound pressures (to which the ear is sensitive) into a smaller range of values between 0 dBA (threshold of hearing), 120 dBA (pain) to 140 dBA (hearing damage). Decibels may be confusing because a doubling of sound energy is expressed by an increase of three dB units from the initial dB value that existed before the increase. For example, 63 dB represents twice as much sound energy as does 60 dB, 76 dB is twice as much energy as 73 dB, etc. Following our example, two equally noisy sources, each of which produce 60 dBA of sound pressure level (SPL) at a distance of three feet away, when added together (i.e., 60 dBA + 60 dBA) will result in a combined SPL of 63 dBA at the same reference distance of three feet from the sources. Increases of less than double the sound energy may also be represented (by a number smaller than 3 dB units) and decreases in sound energy may be similarly represented by a minus sign before the decibel value.

There is an important additional factor which also contributes to confusion when discussing impact or significance of decibel changes. This factor is the subjective human perception of loudness as it relates to our assessment of "noise" (or sound). In general, for common sounds, a reasonable person of normal sensibilities will exhibit the following correspondence:

Change of	Perception
Plus 1 dB	Barely noticeable
Plus 2-3 dB	Somewhat louder
Plus 5 dB	Distinctly louder
Plus 8-9 dB	Twice as loud

As indicated above, a change in level of at least 5 dB is perceived as distinctly louder and may elicit a community response while a 10 dB change is perceived as approximately a doubling in loudness, and would almost certainly cause an adverse community response if the increased noise level were to be sustained for an extended period or it permanently raises the environmental noise level.

Determinations of "significance" of environmental noise increase are generally based upon the perceived changes in loudness in addition to absolute noise levels that are predicted to occur as a long-term result of the project.

Project noise may be quantified and expressed using various noise descriptors. However, the long-term noise effects of a project are usually expressed in terms of Day-Night Level (L_{dn}) so that a comparison to adopted community standards may be made.

Noise - Environmental Impacts/Consequences

TABLE OF CONTENTS

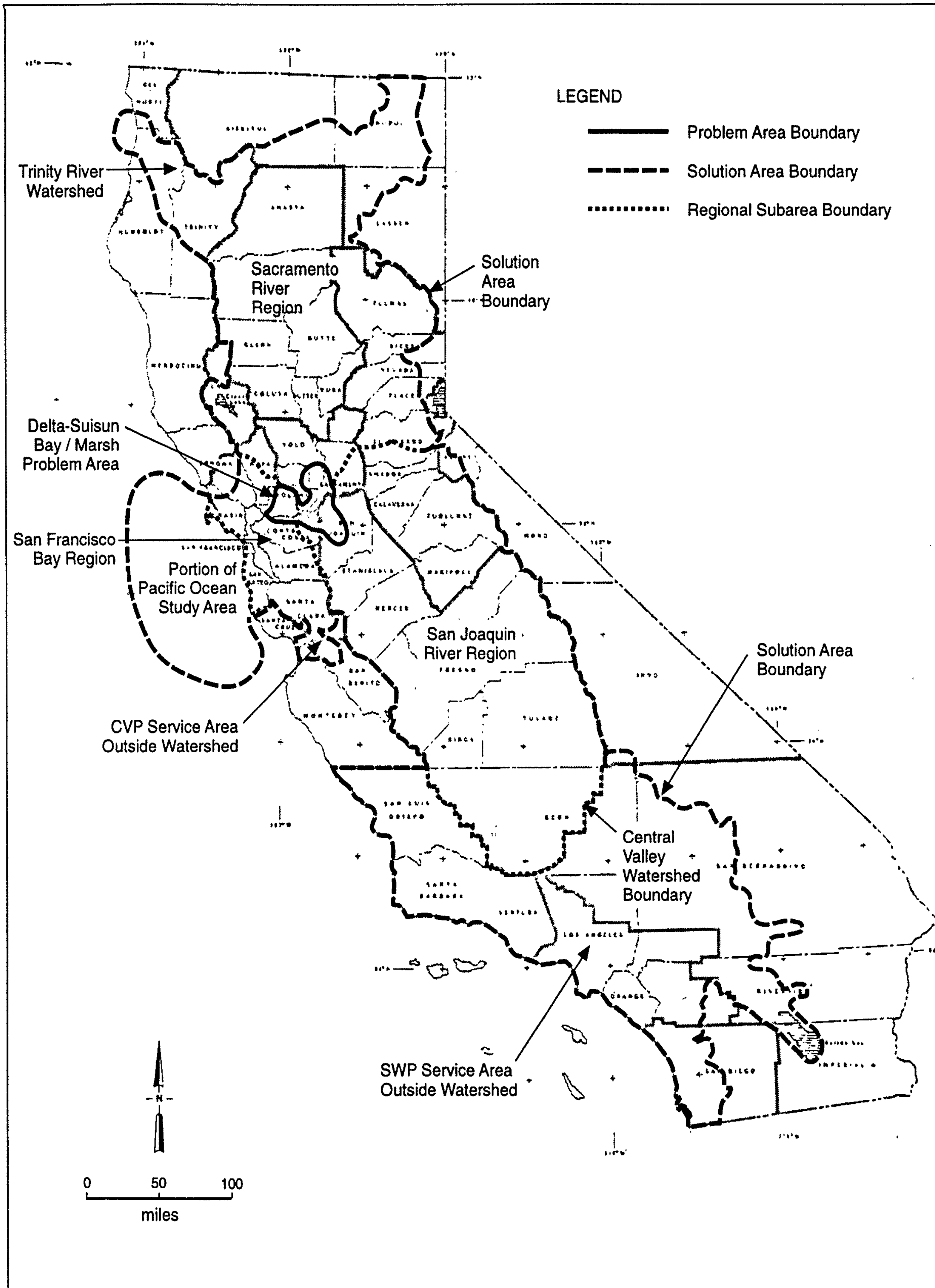
1.0 INTRODUCTION

This report presents the evaluation of impacts for noise for the CALFED Bay-Delta Program Environmental Impact Report/Environmental Impact Statement (EIR/EIS). The results of this evaluation are summarized in this report and in the EIR/EIS.

Following the summary of impacts presented in this technical appendix, the assessment methods and significance criteria used to evaluate impacts are discussed. These sections identify assessment tools, methods for impact assessment and the significance criteria used to satisfy California Environmental Quality Act (CEQA) guidelines for establishment of thresholds for impact significance.

The CALFED Bay-Delta Program has developed three comprehensive solution alternatives that meet the program goals. Each alternative is composed of a set of four common programs (ecosystem quality, water quality, levee system vulnerability, and water supply reliability), a relative constant within each alternative, and a set of features unique to each alternative variations. All of the features were developed independently of the alternatives to meet specific goals. Physical differences between the alternatives lie mainly in the method of transporting water through or around the Delta (conveyance), and the amount of additional water storage included in each alternative. Each of the three alternatives includes a variety of potential combinations, or variations of conveyance and storage consistent with the fundamental differences between the three concept constructs (i.e., Variations 1A-1C, 2A-2E, and 3A-3I). While the basic composition of the common programs remains relatively constant in each alternative, they may perform somewhat differently depending on the storage and conveyance components included within a specific alternative formulation. This programmatic approach results in descriptions of alternatives that include various levels of detail. In most cases the physical components are described in some detail while the locations are described in more general terms. Because the specific location for most of the alternative features is not known, a site-specific impact analysis cannot be made.

The impact assessment begins with a description of the No Action Alternative. Then, impacts from each of the three alternatives is discussed. Each of these discussions is done separately for each of the geographic regions, e.g., Delta, that comprise the CALFED solution area (Figure 1.1). Under the analysis for each alternative, all four common programs are addressed as well as the storage and conveyance components that vary by alternative.



Project No. S9634	CALFED BAY-DELTA PROGRAM Environmental Impact/ Consequences Technical Report	CALFED STUDY AREA AND REGIONS	Figure 1-1
Woodward-Clyde			

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2.0 EXECUTIVE SUMMARY

2.1 Summary Of Potential Significant Impacts

The following discussion addresses a general combination of factors that is necessary to produce a potentially significant noise impact. The level of analysis is commensurate with a programmatic, environmental analysis and reflects the degree of project definition available at this time. The analysis concludes that for a given intensity of project activity (construction and operations) the generation of project noise will be equivalent. Thus, with respect to the Common Programs there is no difference among the action alternatives. Further, while the Common Programs do include noise producing features (e.g. construction of facilities, processing, distribution, facilities repair, dredging) the noise produced is not likely to be in such close proximity to noise-sensitive uses that significant impacts will necessarily result. If subsequent, location-specific project analysis reveals a possibility of a significant noise impact the implementation of the previously discussed mitigation measures will reduce project noise levels to less than significant. This conclusion includes an evaluation of the expected increase in existing noise levels and the absolute level of noise resulting from project development.

There are some differences among the alternatives with respect to Alternative-Specific Program features. In general, an alternative with some pumping activity south of the Delta would be the least noisy; an alternative with conjunctive-use, construction, and some pumping would generate somewhat more noise; and finally alternatives with groundwater or surface impoundment banking, reservoir construction, In-Delta island conversion, levee reconstruction, and pumping activities would generate the most noise. A summary of effects for each alternative and region is provided in Table 2-1.

2.2 Summary Of Mitigation Strategies

Based upon the noise emissions expected to result from implementing project alternatives that have associated construction and operations noise-generating potential, the following mitigation strategies should be considered where subsequent, more detailed local noise impact analysis shows a need for mitigation.

It is expected that implementation of the following standard mitigation practices prior to project construction, as necessary for each project component, would reduce potential construction noise impacts or operational impacts to a less-than-significant level:

- * All noise-producing project equipment and vehicles using internal combustion engines shall be equipped with mufflers, and air-inlet silencers where appropriate, in good operating condition that meet or exceed original factory specification. Mobile or fixed "package" equipment (e.g., arc-welders, air compressors) and stationary equipment (e.g., extraction well pump) shall be equipped with enclosures, shrouds and/or other noise control features as necessary to meet the community noise criteria.

* All mobile or fixed noise-producing equipment used on the project, which is regulated for noise output by a local, state, or federal agency, shall comply with such regulation while in the course of project activity.

* Electrically-powered equipment instead of pneumatic or internal combustion powered equipment shall be used, where feasible.

* Material stockpiles and mobile equipment staging, parking, and maintenance areas shall be located as far as practicable from noise-sensitive receptors.

* Construction site, haul-road, and maintenance road speed limits shall be established and enforced during construction and operation of the project.

* The hours of construction including noisy maintenance activities and all spoils and material transport shall be restricted to the periods and days permitted by the local noise or other applicable ordinance. The only exception to this mitigation should be inaudible underground tunneling activity. Noise-producing project activity shall comply with local noise control regulations affecting construction activity or obtain exemptions therefrom.

* The use of noise-producing signals, including horns, whistles, alarms, and bells shall be for safety warning purposes only.

* No project-related temporary or permanent public address or music system shall be audible at any adjacent receptor.

* The construction contractor shall develop a construction noise control plan, which shall have been approved and implemented prior to commencement of any construction activity.

* Project noise control features and plans shall be required and reviewed/approved by a noise control engineering professional.

* The emplacement of berms or erection of soundwall barriers shall be considered where project activity is unavoidably close to noise-sensitive receptors.

* Planting of trees and shrubbery while useful for visual screening is not an effective noise control mechanism and is not considered a mitigation measure for project noise.

2.3 Summary Of Potential Significant Unavoidable Impacts

None of the project alternatives including the no action alternative has a potential for creating a significant unavoidable impact. Where location-specific project noise analyses indicate that a potentially significant noise impact might occur, the implementation of the previously discussed mitigation measures will reduce the project noise levels of concern to less than significant.

TABLE 2-1
SUMMARY OF POTENTIAL NOISE IMPACTS FOR ALL PROGRAMS

Region	No Action	Alternative 1			Alternative 2					Alternative 3								
		1a	1b	1c	2a	2b	2c	2d	2e	3a	3b	3c	3d	3e	3f	3g	3h	3i
Delta	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bay	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No
Sacramento River	No	No	No	Yes	No	Yes	No	No	Yes	No	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes
San Joaquin River	No	No	No	No	No	Yes	No	No	Yes	No	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes
SWP-CVP Service Areas	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No

Yes: Temporary - short term impacts.
No: No significant impacts.

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3.0 ASSESSMENT METHODS

The procedure used to evaluate and assess the relative environmental effects of project alternatives is based upon the number of persons or noise-sensitive uses potentially affected by project noise and the degree to which such persons or sensitive land uses might be affected. The net change in the noise level and the resulting environmental noise characteristics that are due to the project are also considered. The procedure used is consistent with *Guidelines for Preparing Environmental Impact Statements on Noise* prepared (for US Environmental Protection Agency by National Academy of Sciences 1977).

The use of L_{dn} as a noise descriptor is consistent with the State of California and local guidelines related to noise-compatible land use planning and for compliance with the California Environmental Quality Act.

The project's potential for generating noise is related to project construction activities and project operations. Only general assumptions may be made about these two components of potential project noise at this stage of project definition.

For purposes of this assessment, standardized levels of construction and operations noise were assumed. Two other factors need to be considered in the assessment of potential project noise impacts. One factor is the proximity to project construction/operations activity of noise-sensitive uses (primarily residential, but which may include schools, hospitals, nursing homes, churches, and parks). The other factor is the intensity or density of such noise-sensitive use in an area of potential effect. Because details about implementation of the various alternatives is not yet known, it was assumed that proximity of noise-sensitive uses to project activity is equally likely for each alternative, and that population densities and land use mix are also equivalent in areas of potential effects.

Thus, the remaining independent variable concerning potential project noise effects is the relative amount of construction activity, and extent of construction of facilities associated with each alternative.

4.0 SIGNIFICANCE CRITERIA

The severity of an environmental noise impact, and thus its significance, is often based upon the response magnitude (physiological, physical, social, political) which is expected to be or is actually elicited from one or more reasonable persons of normal sensibilities affected by the noise.

Because of the wide diversity of an individual's response to noise, it is nearly impossible to predict how any one individual will be affected by and respond to noise within the commonly occurring range of noise intensities associated with environmental noise. However, groups of persons, acting independently or in-concert, do tend to behave as a community and many studies have documented the substantially consistent relationship between the nature of noise impact and the intensity of response. One manifestation of this knowledge is the establishment of noise level guidelines and legal limits associated with the generation of noise which could affect a noise-sensitive receptor. These guidelines and limits are usually established on a local basis by local government bodies and are considered to reflect common concerns and goals regarding a desirable environment.

Because these guidelines and limits have been established by and for society, their use in evaluating the significance of project environmental noise impacts is appropriate. Planning and regulatory documents generally direct that long-term or permanent project effects should be evaluated against noise/land use compatibility planning criteria and short-to-medium-term temporary effects are appropriately evaluated against noise ordinance limits, or equivalent limits where statutory ordinances do not exist.

Therefore, project noise would be considered to result in a significant impact if one or more of the following were to occur:

* The project's long-term or permanent noise will exceed the appropriate planning guidelines for the affected land use. This criterion, however, should be evaluated in conjunction with Criterion C below.

* The project's temporary construction noise exceeds the local noise regulation ordinance or criteria equivalent to that contained in noise ordinances typical of the geographical area.

An additional criterion is:

* The project would cause substantial, or potentially substantial, adverse changes in the ambient noise conditions within the area affected by the project. Potentially substantial changes are defined as:

1. Increasing the existing noise level by 3 dBA or more L_{dn} where the existing noise level exceeds the L_{dn} considered normally acceptable for the type of land use affected.

2. Increasing the noise level to within 5 dBA of the normally acceptable L_{dn} criteria where the existing L_{dn} is 15 dBA or more below the normally acceptable L_{dn} or the type of land use affected.

3. Increasing the existing noise level by 5 dBA or more L_{dn} where the existing noise level is within 5 dBA to 15 dBA of the existing normally acceptable criteria L_{dn} for the type of land use affected.

These significance criteria take into account local noise environments, local regulations based upon statewide planning guidelines, and consider the expected community group reaction to new sources of community noise.

5.0 ENVIRONMENTAL IMPACTS

This section describes the noise impacts for each of the alternatives by region. A summary of noise is listed in.

5.1 Description of No-Action Resource Conditions

5.1.1. Delta Region-Resource Conditions

Generally, the no action alternative is not expected to have an adverse effect on the noise environment in the Delta Region, nor any of the other potentially affected regions. The implementation of land retirement, where existing agricultural lands would be retired and presumably left fallow, might result in a noise reduction to nearby land uses. This effect would be associated with the cessation of agricultural practices, such as preparation of fields, harvesting, etc., where noise is generated from the use of heavy farm equipment.

There are no significant changes anticipated in the noise environment within the Delta Region under the No Action alternative.

5.1.2 Bay Region - Resource Conditions

There are no significant changes anticipated in the noise environment within the Bay Region under the No Action alternative.

5.1.3 Sacramento River Region - Resource Conditions

There are no significant changes anticipated in the noise environment within the Sacramento River Region under the No Action alternative.

5.1.4 San Joaquin River Region - Resource Conditions

One of the actions anticipated within the San Joaquin Region is land retirement, where existing agricultural lands would be retired and presumably left fallow to improve water quality. This action might result in a noise reduction to nearby land uses. This effect would be associated with the cessation of agricultural practices, such as preparation of fields, harvesting, etc., where noise is generated from the use of heavy farm equipment.

5.1.5 SWP and CVP Service Areas Outside Central Valley - Resource Conditions

There are no significant changes anticipated in the noise environment within the SWP and CVP Service Areas under the No Action alternative.

5.2 Phase II Program Alternatives - Delta Region

The potential noise impacts and mitigation at a programmatic level generally apply to all of the alternatives, and differ in the level of magnitude and location. Hence, the section below covers impacts and mitigation common to all alternatives, and their programs and common facilities. Differences in impacts specific to the Delta Region are discussed and are compared to impacts associated with other regions discussed in later sections.

5.2.1 Summary of Regional Effects

Summary of Potential Significant Impacts

The potentially significant noise effects of the project are the same for each of the alternatives in each of the Regions. These effects would occur where direct project-related construction or operations noise or indirect noise is of sufficient magnitude and is generated close enough to a noise-sensitive receptor such that state or local land use/noise compatibility guidelines or local noise control ordinance regulations are exceeded.

Summary of Mitigation Strategies

Mitigation strategies include planning (e.g., selecting construction haul routes that avoid or minimize travel near residential communities), administrative controls (e.g., limiting hours of construction, requiring silencers, shielding, or enclosures on noisy construction equipment), and engineering controls (e.g., specifying quiet operations machinery such as pumps and valves, constructing noise-rated structures where necessary to contain noise, considering noise effects when designing or specifying noise-generating processes).

Summary of Potential Significant Unavoidable Impacts

It is believed that all potentially significant project noise effects can be reasonably and feasibly avoided by incorporating the mitigation strategies summarized above and included in more detail elsewhere in this Technical Report. Thus, the project's common and alternative-specific programs are not expected to create significant unavoidable impacts in any of the identified Regions.

5.2.2 Evaluation of Program Actions with No Action Conditions for Alternatives I, II, and III

Direct and Construction Related Noise Impacts

The common programs and each of the various alternative-specific programs contain one or more of the following noise-generating elements. Each of the Program Actions will increase the existing noise environment to some limited extent. In general, the intensity of construction activity and the number and/or size of operational facilities will determine the degree to which the existing noise environments will be increased. The other important factor is the level of environmental noise associated with a particular noise-sensitive receptor.

General Construction

Because project construction noise is the primary project noise effect and because some construction will occur over an extended period, an evaluation of the generation of construction noise is appropriate. Construction phase noise would result primarily from the use of construction equipment. Examples of project activities that would generate noise include:

* Reconstruction, setback, or enlargement of levees
* New or enlarged water storage and conveyance facilities

* Reconstruction or relocation of bridges or other facilities that cross modified canals
* Installation of water control and discharge facilities

Other short-term impacts from construction noise could result from construction traffic and the use of haul routes. Noise impacts would be most noticeable in residential areas in the vicinity of project construction locations. Noise levels would vary depending on the type of equipment used, how it is operated and how well it is maintained. A detailed explanation of construction-related noise levels associated with different phases of construction activity is presented in the technical appendix of this impact report. The following discussion is a summary of potential construction noise effects.

Noise from general construction activity is generated by the broad array of powered, noise-producing mechanical equipment used in the construction process. This equipment ranges from hand-held pneumatic tools to bulldozers, dump trucks, and front loaders. Standard excavation equipment, such as graders, backhoes, loaders and trucks, would be used for construction of most project facilities. Spoils transport trucks and materials delivery trucks may also frequent some sites. The exact complement of noise-producing equipment that would be in use at a given construction site during any particular period is difficult to predict. Therefore, except for special activities, such as construction blasting, the evaluation of project construction noise impacts that would occur during the project is based on typical noise level ranges for industrial construction sites (US Environmental Protection Agency, 1971, *Noise from Construction Equipment and Operations, Building Equipment and Home Appliances*). An analysis of this information indicates that the overall average noise levels (L_{eq}) generated on a construction site would be 83 dBA L_{eq} at a distance of 50 feet from the typical construction activity.

Noise from construction activity on project sites would decrease with distance, such that the noise levels would be six dBA lower for every doubling of distance away from the construction vehicle or activity. For example, if a particular construction activity generated average noise levels of 83 dBA at 50 feet, the L_{eq} at 100 feet would be 77 dBA, 71 dBA at 200 feet, and 65 dBA at 400 feet. This calculated reduction in noise level is based only on losses resulting from spreading of the sound wave as it leaves the source and travels outward. Noise-sensitive uses (i.e. residential) located approximately 400 feet from project construction site boundaries would experience an even lower noise level because at 400 feet an additional four dBA reduction in noise level would occur due to soft ground, vegetation and atmospheric losses between the noise source and the receptor.

The calculated average hourly construction noise level (at 400 feet) would be 61 dBA L_{eq} and, assuming 7:00 a.m. to 7:00 p.m. construction activity, would yield a project generated L_{dn} of 55 dBA. Using the L_{dn} standards, this noise level is compatible on a long-term basis with noise sensitive land use, including residential uses, within any of the project's primary or secondary areas of potential affects. Short-term exceedances of applicable noise control ordinances could occur, however, and are discussed below where the project effect would be significant.

Pipeline Construction

Previous studies of noise associated with pipeline construction report that the noise level did not exceed an L_{eq} of 75 dBA at a distance of 90 feet from the trench centerline. At a distance of 500 feet from the construction activity, the L_{eq}, based upon distance attenuation and additional attenuation due to intervening soft ground, vegetation, and atmospheric losses would be 54 dBA. This level of noise, if it were to occur between 7:00 a.m. and 10:00 p.m., would not exceed temporary or long-term noise level standards. Thus, no impacts would occur beyond 500 feet from construction of a typical pipeline trench. If noise-sensitive receptors are found to be located within 500 feet of pipe laying activity, their noise exposure should be evaluated during subsequent, more detailed environmental review to determine if short-term exceedances of local regulations would occur and result in significant impacts.

Special Construction Impacts

Blasting. If substantial hard rock formations that cannot be graded or excavated with normal construction equipment are encountered during construction, it is possible that construction blasting could be necessary. For excavation requiring blasting, the magnitude of noise impacts would depend on the type of material being excavated, the types of explosives used, the depth of the explosive charge and the proximity to noise-sensitive receptors. If blasting is necessary, blasting activities would be supervised by a specialist pyrotechnician/blasting engineer. Blasting of subsurface formations would not typically cause a significant noise disturbance. Shallow subsurface blasting is more likely to generate very short-duration noise levels that could exceed local noise standards for a few seconds. To mitigate this project effect, the blast charges should be sized so as not to produce peak acoustical overpressures exceeding 122 dB at any sensitive structure. This would preclude hearing damage or structural damage and reduce annoyance caused by blasting.

Tunnel Boring. A portion of the project may be constructed underground, requiring excavation for tunnels that will ultimately be used for water conveyance. Although the machinery used to construct the tunnels (Tunnel Boring Machine and spoils removal system) would generate considerable noise, this noise would be confined underground and would not cause noise impacts to above-ground environments except at tunnel portal locations. Tunnel portal noise would be mitigated where necessary to prevent significant noise effects.

Offsite Noise Effects

Off-site noise would be generated by the project. Outside of the immediate construction zone, project construction noise levels would not be considered loud enough to cause risk of hearing loss and no persons would be exposed to hazardous or dangerous noise levels. Noise from spoils transport trucks, delivery trucks and project worker vehicles would potentially increase highway traffic noise. Based on expected vehicle trip data for similar projects, the additional vehicle trips would typically result in very small traffic noise increases. These changes to the ambient noise level near highways would not usually be discernible and are not significant based upon the previously stated impact significance criteria. No mitigation would be required.

Indirect and Operational Noise Impacts.

Noise related to project operations would be associated with mechanical equipment used at project facilities such as treatment plants, flow-control facilities, pump stations, injection and extraction wells and from general maintenance activities. The specific descriptions and quantity of equipment proposed for use by the various alternatives have not been determined. However, the general nature of equipment used in water treatment plants, water conveyance, and storage can be assumed for the following purpose of assessing the general magnitude of impacts at a programmatic level.

The noise specifications for process equipment is often based on workplace noise exposure guidelines. Equipment is typically specified to produce a continuous sound level (L_{eq}) of no more than 85 dBA at a distance of three feet. This may be accomplished by the use of inherently quiet equipment or by sound-deadening treatment, noise barriers, and/or enclosures where necessary. Assuming that 20 noise sources at a treatment plant produce 85 dBA simultaneously, the resulting unmitigated L_{eq} from this hypothetical composite source would be approximately 93 dBA at three feet. However, most noise-producing machinery at a facility of this type would be located within an enclosed building that would provide noise reduction. A typical industrial building of tilt-up concrete construction would provide approximately 30 dBA of noise reduction. Thus, with the additional attenuation of a building plus distance, the community noise level is predicted to be less than 50 dBA L_{dn} at a distance of 30 feet from an enclosed building. This noise level is compatible with all adjacent land uses. The project would be responsible for specifying that noise-generating equipment meet the standard of producing a sound level of no more than 85 dBA at a distance of three feet and for ensuring that the planned structures provide sufficient noise reduction to comply with community noise planning criterion levels at noise-sensitive receptor locations. Any noise-producing equipment or noise source located outside of the building envelope should produce or be treated to produce no more than 78 dBA at a distance of three feet. This external noise source would produce an L_{dn} of less than 55 dBA at a distance of 100 feet.

The equipment and structures planned for installation at flow control facility sites, pump stations, well sites, etc. should be specified similarly, such that noise emanating from these facilities would be no more than 78 dBA at a distance of three feet from the noise producing machines. This noise level would reduce to an L_{dn} of less than 55 dBA at a distance of 100 feet from the machinery. This noise level does not substantially exceed the typical ambient noise level in residential areas, and complies with planning and ordinance criteria for the noise-sensitive use. Noise associated with routine maintenance of water conveyance and storage facilities is expected to be of short duration and below levels of significance.

Two potential indirect noise effects that were identified during earlier project impact analysis include noise from aquatic recreation such as boating activities and noise from terrestrial recreation such as hunting activities. It is unlikely that noise from either of these activities would generate significant levels of noise that could not be reasonably mitigated. Potential effects should be evaluated in more detail when specific areas conducive to these activities and their proximity to noise-sensitive land uses can be identified.

Alternative I

Noise producing components of each of the programs are identified below:

Ecosystem Restoration Program. This program has a small construction component of medium-term duration; Riverine habitat restoration that has a larger, more intense construction component; San Joaquin River dredging and channel deepening; and, subsidence reversal with a possible construction component.

Water Quality Program. There are very slight differences in noise potential among the different alternatives and few noise concerns except perhaps local pre-discharge water treatment facilities, and a construction noise component for the 10,000 to 15,000 acres of constructed wetlands.

Water Use Efficiency Program. Noise sources are associated with the reclaimed water program processing (i.e., treatment plants) and distribution (i.e., pipelines, pump stations) which requires a separate system from the potable water system, and groundwater recharge that typically requires well or well-field pumping activity.

Levee System Integrity Program. This will require maintenance activities with heavy equipment use; stabilization, with construction and materials transport activities; subsidence reduction, with materials import; and dredging, which generates localized noise plus materials export.

Storage Facilities. These facilities, whether they are in the form of tanks, aquifers, or reservoirs will have a construction noise component and a relatively small operations noise component.

Conveyance Facilities. The noise associated with these facilities is due to pipeline and pumping station construction and operation of the pumping equipment.

Alternative I, in addition to the Common Programs, has some pumping, dredging, and storage activities and would have the least noise effects as compared to the No Action and the other two Alternatives.

Alternative II

The Common Programs of this Alternative are identical to those described above in Alternative I and thus, those noise generation characteristics are also the same. Its Alternative-Specific Program includes the potentially noisy activities of dredging, channel widening, major reconstruction of islands, levee relocations, water storage, and maximizing pump capacity. Because of this increased level of Alternative-Specific activity, this Alternative will generate more noise than Alternative I but less than Alternative III.

Alternative III

The Common Programs of this Alternative are also identical to those of Alternatives I and II and therefore have the same potential for noise generation. However, the Alternative-Specific Program is the most extensive in terms of intensity and geographical area of project-related activity. Thus, this Alternative has the potential to produce the most noise of the Alternatives and affect the greatest number of noise-sensitive land uses. Noisy activities include the construction of "isolated channels"; pipeline and aqueduct construction; and, dredging, construction of setback levees, and restructuring in the Sacramento and San Joaquin Bay areas.

It is important to reiterate the conclusions summarized previously in Section II: Although noise-generation differences exist among the Alternatives which are a result of their respective Alternative-Specific Programs, none of the Alternatives is expected to produce significant, unmitigable noise effects. Thus, there is no environmentally preferred alternative with respect to environmental noise issues.

5.3 Phase II Alternatives - Bay Region

Alternative I - No significant noise impacts are anticipated under this alternative.
Alternative II - No no significant noise impacts are anticipated under this alternative.
Alternative III - No significant impacts. There would be minor construction where the isolated facility connects to the Bay Region.

5.4 Phase II Alternatives - Sacramento River Region

Alternative I - No significant impacts. Noise impacts would be limited to construction of the 3.0 MAF of storage facilities in Alternative IC.
Alternative II - No significant impacts. Noise impacts would be limited to construction of the 3.0 MAF of storage facilities in Alternative 2B and 2E.
Alternative III - No significant impacts are expected. Noise impacts could be related to construction of up to 3.0 MAF of water storage that could include dams and pumping facilities in Alternatives 3B, 3D, 3E, 3F, 3G, 3H, and 3I.

5.5 Phase II Alternatives - San Joaquin River Region

Alternative I - No significant impacts.
Alternative II - No significant impacts. Noise impacts could be related to construction of the 500 TAF storage facilities only and in Alternatives 2B and 2E.
Alternative III - No significant impacts. Noise impacts could be related to construction of the 500 TAF storage facilities only and in Alternatives 3B, 3D, 3E, 3F, 3G, 3H, and 3I.

5.6 Phase II Alternatives - SWP and CVP Service Areas Outside Central Valley

No adverse impacts are predicted in the SWP and CVP service areas on side the Central Valley.

6.0 REFERENCES

Barry, T.M. and Reagan, J.A. 1978. *FHWA Highway Traffic Noise Prediction Model*, Report number FHWA-RD-77-108, by Federal Highway Administration. Washington, D.C.

Beranek, Leo L., ed. 1971. *Noise and Vibration Control.* McGraw-Hill, Inc. New York, NY.

Baranek, L.L. and I.L. Ver, eds. 1992. *Noise and Vibration Control Engineering.* John Wiley & Sons, Inc. New York, NY.

Bolt, Beranek, and Newman, Inc. 1973. *Fundamentals and Abatement of Highway Traffic Noise.* US Department of Transportation Contract Number DOT-FH-11-7976, Office of Environmental Policy, Federal Highway Administration.

Bolt, Beranek, and Newman, December 31, 1971., *Noise From Construction Equipment and Operations, Building Equipment, and Home Appliances,* prepared for the US Environmental Protection Agency. Washington, D.C.

California Department of Health Services. 1974. Guidelines for the Preparation of Noise Elements of the General Plan. Berkeley, CA.

Carver, B. 1978. *Planning in the Noise Environment.* Air Force Contract F49642-74-90035. Department of Defense. U.S.G.P.O. Washington, D.C.

Diehl, George M. 1973. *Machinery Acoustics.* Jon Wiley & Sons, Inc. New York, NY.

Greene, R.E. 1993. *DEIR/EA, Central Pool Augmentation and Water Quality Project.* July. Report No. 1059, Noise Section 4, p. 4-272. Metropolitan Water District of Southern California and U.S. Forest Service, Los Angeles, CA.

Harris, Cyril M., ed. 1979. *Handbook of Noise Control.* Second Edition. McGraw-Hill, Inc. New York, NY.

Harris, Cyril M., ed. 1991. *Handbook of Acoustical Measurements and Noise Control.* Third Edition. McGraw-Hill, Inc. New York, NY.

Hassall, J.R. and K. Zaveri. 1988. *Acoustic Noise Measurements.* Fifth Edition. Brüel and Kjær Instruments, Inc. Copenhagen, Denmark.

Peterson, A.P.G. and E. Gross, Jr. 1972. *Handbook of Noise Measurement.* Seventh Edition. General Radio Company. Concord, MA.

Southern California Edison Company. 1974. *Transmission Environmental Guide.*

US Department of Transportation, Federal Highway Administration, Office of Environmental Policy, Noise and Air Analysis Division, June 1995. Highway Traffic Noise Analysis and Abatement. Washington, D.C.

TECHNICAL APPENDIX
CONSTRUCTION NOISE CHARACTERISTICS

This appendix describes the general characteristics of construction noise, related to equipment, operations, and activities that might be expected to occur with the Bay Delta program.

Noise from construction activity is generated by the broad array of powered, noise-producing mechanical equipment used in the construction process. This equipment ranges from hand-held pneumatic tools to bulldozers, dump trucks, and front loaders. The exact complement of noise-producing equipment that would be in use at a given construction site during any particular period is difficult to predict. However, the maximum noise levels from construction activity during various phases of a typical construction project have been evaluated, and their use is believed to yield an acceptable prediction of a project's potential noise impacts. Therefore, except for special activities, such as construction blasting, the evaluation of project construction noise impacts that would occur during the project is based on typical noise level ranges for industrial construction sites (U.S. Environmental Protection Agency, 1971, *Noise from Construction Equipment and Operations, Building Equipment and Home Appliances*). Maximum noise level (L_{max}) ranges associated with various construction phases, where all pertinent equipment is present and operating, are (at a reference distance of 50 feet):

Ground Clearing	84±6 dBA
Excavation	89±7 dBA
Foundations	78±3 dBA
Erection	85±7 dBA
Finishing	89±6 dBA

Because of vehicle technology improvements and more-strict noise regulations enacted for licensed vehicles within the past few years, this analysis will use the midpoint noise level shown above. This information indicates that the overall noise level generated on a construction site could reach a maximum short-term noise level of 89 dBA at a distance of 50 feet. Noisy construction activities could be in progress on more than one part of the project site at a given time, although it is unlikely that noise levels on two separate construction areas would peak simultaneously. The magnitude of construction noise levels varies over time because construction activity is intermittent and power demands on construction equipment are cyclical. Assuming a cycle of 25% of time at maximum noise level and 75% of time at 10 dBA below the L_{max} level, average noise levels (L_{eq}) would be six dBA lower than the maximum noise levels.

Noise from construction activity on project sites would decrease with distance, such that the noise levels would be six dBA lower for every doubling of distance away from the construction vehicle or activity. For example, if a particular construction activity generated average noise levels of 83 dBA at 50 feet, the L_{eq} at 100 feet would be 77 dBA, 71 dBA at 200 feet, and 65 dBA at 400 feet. This calculated reduction in noise level is based only on losses resulting from spreading of the sound wave as it leaves the source and travels outward. Noise-sensitive uses (i.e. residential) located approximately 400 feet from project construction site boundaries would experience a lower noise level because at 400 feet, an additional four-dBA reduction in maximum noise level would occur due to soft ground, vegetation and atmospheric losses between the noise source and the receptor. The calculated hourly construction noise impact would be 61 dBA L_{eq} and assuming 7:00 a.m. to 7:00 p.m. operations would yield a project generated L_{dn} of 55 dBA. Using the L_{dn} standards, this noise level is compatible on a long-term basis with noise sensitive land use, including residential uses, within any of the affected jurisdictions. Short-term exceedances of applicable noise control ordinances could occur, however, and are discussed below where the project effect would be significant.

Pipeline Construction

The noise level used for analysis of pipeline segment construction noise was developed by monitoring noise levels generated by installation of buried 12-foot-diameter reinforced concrete pipe used for water conveyance. (Chambers Group, 1992). This study found that noise associated with pipeline construction did not exceed an L_{eq} of 75 dBA at a distance of 90 feet from the trench centerline. At a distance of 500 feet from the construction activity, the L_{eq}, based upon distance attenuation only, would be 60 dBA. Additional attenuation due to intervening soft ground, vegetation, and atmospheric losses would reduce the noise level by six dBA to 54 dBA. This level of noise, if it were to occur between 7:00 a.m. and 10:00 p.m., would not exceed temporary or long-term noise level standards. Thus, no impacts would occur beyond 500 feet from construction of a typical pipeline trench. Effects on noise-sensitive receptors within 500 feet of the pipe laying activity should be evaluated during subsequent, more detailed environmental review.

Special Construction Impacts

Blasting. If substantial hard rock formations that cannot be graded or excavated with normal construction equipment are encountered during construction, it is possible that construction blasting could be necessary. For excavation requiring blasting, the magnitude of noise impacts would depend on the type of material being excavated, the types of explosives used, the depth of the explosive charge and the proximity to noise-sensitive receptors. Grading in areas of shallow or exposed bedrock would require blasting, and the resulting noise levels would depend on the depth of the blasting holes. If blasting is necessary, blasting activities would be supervised by a specialist pyrotechnician/blasting engineer.

Blasting of subsurface formations would not typically cause a significant noise disturbance. Shallow subsurface blasting is more likely to generate very short-duration noise levels that could exceed local noise standards for a few seconds. To partially mitigate this project effect, the blast charges should be sized so as not to produce peak acoustical overpressures exceeding 122 dB at any sensitive structure. This would preclude hearing damage or structural damage caused by blasting. All aspects of blasting activity will be the responsibility of the construction contractor.

Tunnel Boring. A portion of the project may be constructed underground, requiring excavation for tunnels that will ultimately be used for water conveyance. Although the machinery used to construct the tunnels (TBM and spoils removal system) would generate considerable noise, this noise would be confined underground and would not cause noise impacts to above-ground environments except at tunnel portal locations. Tunnel portal noise would be mitigated where necessary to prevent significant noise impacts.

Offsite Noise Impacts

Off-site noise would be generated by the project. Outside of the immediate construction zone, project construction noise levels would not be considered loud enough to cause risk of hearing loss and no persons would be exposed to hazardous or dangerous noise levels. Noise from spoils transport trucks, delivery trucks and project worker vehicles would potentially increase highway traffic noise. Based on expected vehicle trip data for similar projects, the additional vehicle trips would typically result in very small traffic noise increases. These changes to the ambient noise level near highways would not usually be discernible and are not significant based upon the previously stated impact significance criteria. No mitigation would be required.

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