12. Summary of Comparative Analysis of Alternatives & Rationale for Selected Alternative

This section of the ROD presents EPA's comparison of alternatives, and documents the rationale for other elements of EPA's decision. The reader should also consult the Response Summary of this ROD for further documentation of how EPA addressed issues related to the selection of the remedial action.

The NCP requires that EPA utilize nine criteria in comparing and selecting remedial alternatives. These are:

- Protectiveness of Human Health and the Environment
- Compliance with Applicable or Relevant and Appropriate Requirements (ARARs)
- Long Term Effectiveness
- Short-Term Effectiveness
- Reduction of Mobility, Toxicity and Volume of Contaminants Through Treatment
- Implementability
- Cost
- State Acceptance
- Community Acceptance

[40 C.F.R. §300.430(f)(1)(i)]

The first two criteria are usually referred to as threshold criteria; the next five criteria are usually referred to as balancing criteria; and the last two are referred to as modifying criteria. The following evaluates the five alternatives discussed in Section 11 of this ROD in terms of these criteria.

As with the previous section, the following discussion does not focus on elements that are

common to all alternatives. The cost estimates in the following discussion are based on the JGWFS and are approximate values intended to be within +50%/-30% of the actual values.[1] We note that this section does not repeat analyses included in previous sections of this ROD, including but not limited to the basis for using a dual-site approach and the context of this remedial action, the rationale for imposing a containment zone, rationale for the size and extent of the TI waiver zone, etc. Discussions of these matters can be found in the earlier sections.

12.1 Protectiveness of Human Health and the Environment

Protectiveness of Human Health and the Environment is generally considered a threshold criterion [40 C.F.R. §300.430(f)(1)(i)(A)]. EPA has addressed this criterion in two ways. Presently, and as a matter of threshold, all alternatives other than the No Action Alternative would be protective of human health and the environment. However, while each of the alternatives, except for the No Action Alternative, has the potential to attain remedial action objectives, it would be misleading to represent that the alternatives are certain to attain, or have equal certainty of attaining, the objectives of (1) reducing the concentrations of contaminants to ISGS levels at all points outside the containment zone, and of (2) maintaining the containment or contaminants within the containment zone. Because the time frame of the remedy is so long, there cannot be absolute certainty that these objectives will be met in the long term. The degree of certainty varies with the length of time the remedial action will take, the degree of early time performance, and the magnitude and distribution of pore volume flushing rates . Therefore, in addition making a threshold statement, EPA also compared the alternatives in balancing fashion with respect to the *degree* of certainty that, at the conclusion of the remedial action, all remedial action objectives will have been attained, and that the remedial action will remain protective over the long term.

In general, in dealing with extensive time frames, the longer the time required for a remedial alternative to meet remedial action objectives, the greater is the uncertainty that it will ultimately and fully meet those objectives at all. This is true because of the enormous degree of change that can occur in human (e.g. social, demographic, resource use, etc.) and natural (e.g. groundwater gradients, flow, water levels) conditions over the course of such time periods. As an example, demographic and in turn, water use patterns and distributions may change. The demand for water and the nature of water use may shift with social, economic, or political factors. It is not

[1] Cost values given below differ slightly from those in the JGWFS because they have been corrected after a spreadsheet error was discovered in the JGWFS during the public comment period. The cost estimates change by the following amounts due to this error: Alternative 2, 2.4 percent; Alternative 3, 2.0 percent; Alternative 4, 1.7 percent; and Alternative 5, 1.6 percent. These amounts are not considered significant relative to the -30%/+50% cost estimating used for feasibility study purposes. For more information on this error, see the Response Summary.

possible to reliably predict the manner in and degree to which these factors will change over the course of a century or more. This point can be illustrated by considering a comparison of 1999 to 1899 with respect to population and resource use patterns, or considering the capability of a person in 1899 to predict such patterns as they exist today. The assumptions of the analyses of a feasibility study, both written and implicit, assume generally greater uncertainty as the intervening time frame becomes very long. Accordingly, in this case, EPA considered alternatives likely to have shorter cleanup times to be characterized by greater certainty of meeting long-term remedial action objectives, and hence greater certainty of long term protectiveness of human health and the environment.

Likewise, because uncertainty in meeting remedial objectives increases as time to cleanup increases, an alternative with good early time performance achieves most of its progress in the early period that is associated with relatively high certainty. When more of the plume is removed relatively early in the remedial action process, the majority of the plume is removed within the range of time in which the model is a reasonable predictive tool, and this also affords greater certainty that the remedial objectives ultimately will be attained. In contrast, alternatives with poor early time performance do most of the removal of contamination late, when uncertainties as to future conditions are larger, and at points in time which cannot be simulated accurately by the model.

An additional benefit of early time performance is that more of the restored groundwater resource is usable sooner. The larger the area of groundwater that has been restored to drinking water standards, and the sooner this area grows in size, the less opportunity there is over time for use to be made of water that would pose an unacceptable health risk. Early time performance therefore affords greater certainty of long-term protectiveness.

Finally, alternatives which produce greater flushing rates, and have an even and complete, rather than sporadic and/or incomplete, coverage of the plume in terms of pore volume flushing, provide better long-term certainty of protectiveness than alternatives which do not. Such alternatives have better ability to remove contaminants throughout the plume, and hence provide (1) faster cleanup rates, (2) higher certainty that ARARs and remedial objectives will ultimately be achieved at all points in the plume, and in turn superior protection of human health in the long term.

In light of the foregoing discussion, the No Action Alternative would not be protective of human health and the environment either presently or in the long term.[2] Alternative 2 has the least degree of certainty as to long-term protectiveness, followed by Alternative 3, Alternative 4, and Alternative 5, in that order. Issues related to certainty of long-term protectiveness fall largely in two categories: (1) regarding reduction of the chlorobenzene plume outside the containment zone, and (2) regarding certainty of long-term containment of the benzene plume, which lies entirely within the containment zone. Clearly, the greater the uncertainty that ISGS levels will ultimately be attained at all points in the chlorobenzene plume outside the containment zone, the greater the uncertainty in the long term protectiveness of the remedial action. Similarly, the greater the uncertainty that long-term containment of the benzene plume can be maintained, the greater is the chance that contaminants will escape the zone, thwarting efforts to clean groundwater outside the containment zone to ISGS levels. This also would result in greater uncertainty of long-term protectiveness.

It is noted that all alternatives (other than No Action) perform similarly with respect to long term containment of the portion of the *chlorobenzene* plume that lies within the containment zone.

Long Term Certainty of Protectiveness in Relation to Reduction of the Chlorobenzene Plume Outside the Containment Zone

Because of its relatively low total groundwater extraction rate and lower number of extraction wells, Alternative 2 would take the longest of all the alternatives to reach cleanup standards. This long time frame results in the least certainty that ISGS levels ultimately will be attained at all points in the plume. Alternative 2's performance (percent of plume removed) at 25 years is the poorest of the alternatives. In addition, in simulations of Alternative 2, the magnitude of the increase in pore volume flushing is very small, and the area where increased pore volume flushing occurs covers only about 50 percent of the chlorobenzene plume. This greatly decreases the certainty that ISGS levels would be attained at all points in the plume in the long term. Alternative 2 has poor early time performance, again resulting in lower certainty of long-term protectiveness. Very little of the plume is removed during the time in which the model is an acceptable predictive tool. In addition, much more of the plume remains over the course of the remedial action, implying a larger contaminated area as time progresses, which in turn increases the chance that contaminated groundwater could be used over a long time frame. Alternative 3 has the same characteristics as Alternative 2 with respect to the characteristics just discussed.

[2]EPA finds the basis for action sufficiently compelling in this case, and also finds it feasible based on the JGWFS to take action in a manner which will not pose unacceptable short-term problems, to reject the No Action Alternative. However, EPA did evaluate it fully in the JGWFS as required by the NCP as a benchmark of comparison.

Alternative 4, and to a greater extent, Alternative 5, because of their higher groundwater extraction rates and greater numbers of wells, imply much shorter cleanup times. Performance in terms of percent of the plume removed at 25 years for Alternative 4 more than double that for Alternatives 2 and 3. In simulations of Alternatives 4 and 5, pore volume flushing rates are much higher, more consistent, and more evenly- and completely-distributed over the chlorobenzene plume than for Alternatives 2 and 3. The early-time performance of Alternative 4 is much better than Alternatives 2 and 3, and still better in Alternative 5. These aspects lend much greater certainty that ISGS levels will be attained throughout the plume outside the containment zone, end hence, greater certainty of protectiveness in the long-term. Moreover, because more of the groundwater is restored sooner, users see a smaller area of contamination over time and there is less chance of exposure to contaminated groundwater. The certainty of protectiveness in the long term is therefore greater with Alternative 4 and greatest with Alternative 5, in this regard.

Long Term Certainty of Protectiveness in Relation to Certainty of Long-Term Containment of the Benzene Plume

Alternative 2 relies on intrinsic biodegradation entirely to contain the benzene plume. Hydraulic extraction is not used under Alternative 2 to contain the benzene in the MBFC Sand. There is significant uncertainty as to whether intrinsic biodegradation will reliably contain the benzene plume in the MBFC Sand, once the pumping of the chlorobenzene plume starts. This is because pumping the chlorobenzene plume may pull on the benzene and may move it. In relying solely on intrinsic biodegradation, the risk of this movement is greater for a number of reasons discussed further below in this section in more detail. Therefore, once again in this respect, Alternative 2 provides the least certainty of long-term protectiveness.

Rather than relying on intrinsic biodegradation to contain the entire benzene plume, Alternatives 3, 4 and 5 alike use active hydraulic extraction and treatment to contain the benzene plume in the MBFC Sand. Because intrinsic biodegradation is merely a pre-existing condition in the soil, it cannot be controlled. However, hydraulic extraction and treatment can be designed and controlled directly to provide better, adjustable, and more reliable control of the possible movement of benzene in the MBFC Sand. The risks and implications of adverse benzene plume movement in the MBFC Sand (particularly movement into the Gage Aquifer) during the course of the remedial action, if the benzene plume is not actively contained, are substantial. Of particular concern are: (1) the higher permeability of the MBFC Sand compared to the UBF and MBFB Sand, (2) uncertainties related to the sources of benzene and preferential flow paths in the MBFC Sand, and (3) uncertainties in contaminant migration pathways within the LBF. These factors are due to a number of factors including uncertainties and limitations of the model, inability to effectively monitor the LBF, which separates the MBFC Sand from the Gage Aquifer, and the inability to effectively characterize small-scale contaminant migration pathways within the MBFC Sand and LBF. These and other issues related to benzene movement in the MBFC

Sand are further discussed later in this section under EPA's Rationale for the Selected Alternative and Section 5 of the JGWFS.

The active hydraulic containment of the benzene plume in the MBFC Sand, found in Alternatives 3, 4, and 5 increases the certainty that the benzene plume will remain contained and will not move downward or sideways in response to hydraulic extraction (pumping) that is primarily targeted to containment and reduction of the chlorobenzene plume. Lack of reliable benzene containment could result in benzene migration outside the containment zone, which could slow the progress in restoring groundwater outside the containment zone to drinking water standards in either the short or the long term. The JGWFS concluded that it is feasible to adequately contain the benzene plume in the MBFC Sand under Alternatives 3, 4 or 5 provided active hydraulic containment is used.

Alternatives 3, 4 and 5 provide more certainty with respect to long-term containment of the benzene plume than does Alternative 2, and hence, more certainty of long-term protectiveness in this regard.

12.2 Compliance with ARARs

As a matter of comparison, it is attaining ISGS levels (which embody in-situ groundwater chemical-specific ARARs) at all points in the groundwater outside the containment zone that is of concern. All other ARARs can be attained by any of the alternatives, with the exception of the No Action Alternative. The No-Action alternative would not attain ARARs.

As with protectiveness of human health and the environment, compliance with ARARs is considered as a threshold criterion [40 C.F.R. §300.430(f)(1)(i)(A)]. All of the alternatives, except for No Action, meet a threshold in that they have an reasonable potential to ultimately attain ISGS levels throughout the groundwater outside of the containment zone. Nonetheless, because of the long time frames associated with this remedial action, the alternatives differ widely in terms of the *certainty* of this over the long term. Therefore, for purposes of comparison, EPA also has discussed the alternatives in terms of degrees of this certainty.

Long-term certainty with respect to compliance with ARARs, in terms of attaining ISGS levels for all groundwater outside the containment zone, varies among the alternatives in exactly the same way and for the same reasons provided in the discussion of long-term certainty of *Protectiveness of Human Health and the Environment.* As discussed under Section 12.1, the shorter the cleanup time, the greater is the potential that the cleanup will ultimately attain ARARs in the long-term, as anticipated.

The National Contingency Plan (NCP), the regulations for Superfund, requires that remedial actions attain ARARs (in this case, drinking water standards in-situ) in a reasonable time frame. In the case of the Joint Site groundwater, EPA believes that an alternative should be considered more "reasonable" with respect to time frame if it restores a major portion of the aquifer to drinking water standards in a relatively more certain and short time frame, as compared to an alternative that restores very little of the aquifer until late in the long remedial action. As previously discussed, in this ROD EPA refers to this concept as early time performance of the alternative. Because uncertainty in meeting remedial objectives increases as time to cleanup increases, an alternative with good early time performance achieves most of its progress in the early period associated with relatively high certainty. When more of the plume is removed relatively early in the remedial action process, there is greater certainty that the remedial objectives ultimately will be attained, particularly if the majority of the plume is removed within the range of time in which the model is a reasonable predictive tool.

Also as with certainty of long-term protectiveness, alternatives which produce greater flushing rates, and have an even and complete, rather than sporadic and/or incomplete, coverage of the plume in terms of the increase in pore volume flushing, provide greater certainty of attaining ARARs in the long term, than alternatives which do not. Such alternatives have better ability to remove contaminants throughout the plume, and hence provide higher certainty that ARARs and remedial objectives will ultimately be achieved at all points in the plume outside the containment zone.

Overall, Alternative 2 provides the least certainty of long term compliance with ARARs, followed by Alternative 3, Alternative 4, and Alternative 5, in that order.

With respect to ultimately complying with ARARs (i.e.attaining ISGS levels at all points in the chlorobenzene plume outside the containment zone), Alternatives 2 and 3 are the poorest (and about the same relative to each other) with respect to certainty of attaining ARARs in the long term. Alternative 4 ranks above Alternatives 2 and 3, and Alternative 5 ranks above Alternative 4. The reasons for this are the same as those discussed above in Section 12.1 with respect to long term certainty of protectiveness with respect to attaining ISGS levels at all points in the chlorobenzene plume.

Alternatives which provide a lower certainty of containing the benzene plume also have a lower potential for attaining ISGS levels in the long term, because there is a greater chance that benzene contamination may move outside the containment zone, thwarting or lengthening the efforts to attain the concentration reductions necessary to attain ISGS levels there. With respect to this aspect, Alternatives 3, 4 and 5 are about the same, and superior to Alternative 2.

12.3 Long-Term Effectiveness

In the case of the Joint Site and the nature of the alternatives being considered, most of the arguments and factors related to long-term effectiveness parallel those related to certainty of protectiveness in the long-term, presented in Section 12.1. To some extent, these are repeated here for maximum clarity, although some of the discussion also differs.

In general, in dealing with extensive time frames, the longer the time required for a remedial alternative to meet remedial action objectives, the greater is the uncertainty that it will ultimately and fully meet those objectives at all. This is true because of the enormous degree of change that can occur in human (e.g. social, demographic, resource use, etc.) and natural (e.g. groundwater gradients, flow, water levels) conditions over the course of such time periods. As an example, demographic and in turn, water use patterns and distributions may change. The demand for water and the nature of water use may shift with social, economic, or political factors. It is not possible to reliably predict the manner in and degree to which these factors will change over the course of a century or more. This point can be illustrated by considering a comparison of 1999 to 1899 with respect to population and resource use patterns, or considering the capability of a person in 1899 to predict such patterns as they exist today. The assumptions of the analyses of a feasibility study, both written and implicit, assume generally greater uncertainty as the intervening time frame becomes very long. Accordingly, in this case, EPA considered alternatives likely to have shorter cleanup times to be characterized by greater certainty of meeting long-term remedial action objectives, and hence greater long-term effectiveness.

Likewise, because uncertainty in meeting remedial objectives increases as time to cleanup increases, an alternative with good early time performance achieves most of its progress in the early period that is associated with relatively high certainty. When more of the plume is removed relatively early in the remedial action process, the majority of the plume is removed within the range of time in which the model is a reasonable predictive tool, and this also affords greater certainty that the remedial objectives ultimately will be attained. In contrast, alternatives with poor early time performance do most of the removal of contamination late, when uncertainties as to future conditions are larger, and at times which cannot be predicted accurately by the model.

An additional benefit of early time performance is that more of the restored groundwater resource is usable sooner. The larger the area of groundwater that has been restored to drinking water standards, and the sooner this area grows in size, the less opportunity there is over time for use to be made of water that would pose an unacceptable health risk. Early time performance therefore affords greater long-term effectiveness.

Finally, alternatives which produce greater flushing rates, and have an even and complete, rather than sporadic and/or incomplete, coverage of the plume in terms of pore volume flushing, provide better long-term effectiveness than alternatives which do not. Such alternatives have better ability to remove contaminants throughout the plume, and hence provide faster cleanup

rates and a greater chance that all contamination throughout the plume will be addressed. Because contaminants will have been more evenly and completely flushed from the aquifer system, there is less chance that contaminant levels will rebound above ISGS levels and therefore greater chance in the long term that the remedy will remain permanent; hence, greater long-term effectiveness.

In light of the foregoing discussion, the No Action Alternative would not be effective or long-term effective. Alternative 2 has the least degree of certainty as to long-term protectiveness, followed by Alternative 3, Alternative 4, and Alternative 5, in that order. Issues related to long-term effectiveness fall largely in two categories: (1) regarding reduction of the chlorobenzene plume outside the containment zone and the permanence of that action, and (2) regarding the certainty of long-term containment of the benzene plume, which lies entirely within the containment zone. Clearly, the greater the uncertainty that ISGS levels will ultimately be attained at all points in the chlorobenzene plume outside the containment zone, and the greater that this action is permanent, the greater the uncertainty in the long term protectiveness of the remedial action. Also, the greater the uncertainty that long-term containment of the benzene plume can be maintained, the greater is the chance that contaminants will escape the zone, thwarting efforts to clean groundwater outside the containment zone to ISGS levels. This would result in less long-term protectiveness.

It is noted that all alternatives (other than No Action) perform similarly with respect to long term containment of the portion of the *chlorobenzene* plume that lies within the containment zone.

Long-Term Effectiveness in Relation to Reduction of the Chlorobenzene Plume Outside the Containment Zone

Because of its relatively low total groundwater extraction rate and lower number of extraction wells, Alternative 2 would take the longest of all the alternatives to reach cleanup standards. This long time frame results in the least certainty that ISGS levels ultimately will be attained at all points in the plume. Alternative 2's performance (percent of plume removed) at 25 years is the poorest of the alternatives. In addition, in simulations of Alternative 2, the magnitude of the increase in pore volume flushing is very small, and the area where increased pore volume flushing occurs covers only about 50 percent of the chlorobenzene plume. This greatly decreases the certainty that ISGS levels would be attained at all points in the plume in the long term.. Alternative 2 has poor early time performance, again resulting in lower long-term effectiveness. Very little of the plume is removed during the time in which the model is an acceptable predictive tool. In addition, much more of the plume remains over the course of the remedial action, implying a larger contaminated area as time progresses, which in turn increases the chance that contaminated groundwater could be used over a long time frame. Alternative 3 has the same characteristics as Alternative 2 with respect to the characteristics just discussed.

Alternative 4, and to a greater extent, Alternative 5, because of their higher pumping rates, imply much shorter cleanup times. Performance in terms of percent of the plume removed at 25 years for Alternative 4 more than double that for Alternatives 2 and 3. Pore volume flushing rates are much higher, more consistent, and well-distributed than for Alternatives 2 and 3. The early-time performance of Alternative 4 is much better than Alternatives 2 and 3, and still better in Alternative 5. These aspects lend much greater certainty that ISGS levels will be attained throughout the plume outside the containment zone, end hence, greater long-term effectiveness. Because the plume is more efficiently and completely addressed by the remedial action under Alternative 4 and 5, there is greater chance it will be permanent and therefore long-term effective. Moreover, because more of the groundwater is restored sooner, users see a smaller area of contamination over time and there is less chance of exposure to contaminated groundwater. The certainty of protectiveness in the long term is therefore greater with Alternative 4 and greatest with Alternative 5, in this regard. While the pore volume flushing of Alternative 5 is greater in magnitude than that of Alternative 4, both Alternative 4 and Alternative 5 provide complete and well-distributed coverage of the plume with respect to pore-volume flushing.

Long-Term Effectiveness in Relation to Certainty of Long-Term Containment of the Benzene Plume

Alternative 2 relies on intrinsic biodegradation entirely to contain the benzene plume. Hydraulic extraction is not used under Alternative 2 to contain the benzene in the MBFC Sand. There is significant uncertainty as to whether intrinsic biodegradation will reliably contain the benzene plume in the MBFC Sand, once the pumping of the chlorobenzene plume starts. This is because pumping the chlorobenzene plume may pull on the benzene and may move it. In relying solely on intrinsic biodegradation, the risk of this movement is greater for a number of reasons discussed further below in this section in more detail. Therefore, in this respect, Alternative 2 provides the least long-term protectiveness.

Rather than relying on intrinsic biodegradation to contain the entire benzene plume, Alternatives 3, 4 and 5 alike use active hydraulic extraction and treatment to contain the benzene plume in the MBFC Sand. Because intrinsic biodegradation is merely a pre-existing condition in the soil, it cannot be controlled. However, hydraulic extraction and treatment can be designed and controlled directly to provide better, adjustable, and more reliable control of the possible movement of benzene in the MBFC Sand. The risks and implications of adverse benzene plume movement in the MBFC Sand during the course of the remedial action, if the benzene plume is not actively contained, are substantial. Of particular concern are: (1) the higher permeability of the MBFC Sand compared to the UBF and MBFB Sand, (2) uncertainties related to the sources of benzene and preferential flow paths in the MBFC Sand, and (3) uncertainties in contaminant migration pathways within the LBF. These factors are due to a number of factors including

uncertainties and limitations of the model, inability to effectively monitor the LBF, which separates the MBFC Sand from the Gage Aquifer, and the inability to effectively characterize small-scale contaminant migration pathways within the MBFC Sand and LBF. These and other issues related to benzene movement in the MBFC Sand are further discussed later in this section under EPA's Rationale for the Selected Alternative.

The active hydraulic containment of the benzene plume in the MBFC Sand, found in Alternatives 3, 4, and 5 increases the certainty that the benzene plume will remain contained and will not move downward or sideways in response to pumping primarily targeted to the chlorobenzene plume. Lack of reliable benzene containment could result in benzene migration outside the containment zone, which could slow the progress in restoring groundwater outside the containment zone to drinking water standards in either the short or the long term. The JGWFS concluded that it is feasible to adequately contain the benzene plume in the MBFC Sand under Alternatives 3, 4 or 5 provided active hydraulic containment is used.

Alternatives 3, 4 and 5 provide more certainty with respect to long-term containment of the benzene plume than does Alternative 2, and hence, more long-term effectiveness in this regard.

12.4 Short-Term Effectiveness

Short-term effectiveness is generally attributed to the time during which the remedial action is ongoing but has not yet attained remedial action objectives. In the case of the Joint Site, this time period is greatly extended, and so this characterization of "short term" is actually long-term in its implications, and therefore is somewhat blended in nature with long-term effectiveness. Therefore, the same aspects noted for long-term effectiveness and with respect to certainty of long-term protectiveness are, in this sense, applicable to short-term effectiveness. Alternatives 2 and 3 provide relatively poor short-term effectiveness compared to Alternative 4, and in turn, Alternative 5, in relation to removing the chlorobenzene plume outside the containment zone during the course of the remedial action. Alternatives 3, 4, and 5 provide superior (and roughly equal) short-term effectiveness in terms of containing the benzene plume during the course of the remedial action.

It is noted that all alternatives, other than the No Action Alternative, the condition of containment of the containment zone is attained relatively quickly. In addition, all of the alternatives, other than the No Action Alternative, would arrest the outward migration of the chlorobenzene plume soon after implementation, although the certainty of containment is higher with for Alternatives 4, and 5, sequentially, than for Alternatives 2 and 3, which espouse the lower 350 gpm pump rate.

Alternatives which provide better early-time performance clearly provide short-term effectiveness; that is, over the course of the remedial action, a greater portion of the contamination is removed in a shorter time frame. The public also thereby realizes the benefit of clean groundwater over a larger area sooner under such alternatives. In this regard, Alternatives 2 and 3 provide the poorest short-term performance, Alternative 4 much better short-term performance, and Alternative 5 the greatest short-term performance.

The alternatives do not differ much in terms of short-term issues such as dangers that may exist to the public or workers during construction. There is little risk in this regard and standard, excepted engineering practices are available to mitigate such risks. Any of the alternatives could be implemented safely with respect to the public and to workers.

12.5 Reduction of Mobility, Toxicity and Volume of Contaminants Through Treatment

Alternative 1, No Action, would not reduce the mobility, toxicity, or volume of contaminants through treatment.

In all alternatives other than No Action, treatment is employed in the form of hydraulic extraction and treatment of contaminants, to the majority of the groundwater, as presented in Section 11 of this ROD. The efficiency and rate at which the alternatives reduce the mobility, toxicity, and volume of contaminants, differs widely by alternative, however.

Reduction in Volume of Contaminants In-Situ

Because the volume of the containment zone will remain fixed indefinitely, the primary factor for comparison with respect to volume in-situ is the ability of the alternative to reduce the volume of contaminated groundwater outside the containment zone. At the end of the remedial action, assuming all remedial objectives have been achieved, all of the alternatives other than No Action would result in the same reduction in the volume of contamination. However, the efficiency of the alternative in producing this reduction increases as: (1) the pump rate of the chlorobenzene plume outside the containment zone increases, (2) the early-time performance increases, and the pore volume flushing increases or becomes more completely- and evenly-distributed under an alternative. Alternatives with superior pore volume flushing and early time performance result in greater volume reduction, and a greater percentage of the groundwater resource becoming usable, sooner.

Alternatives 2 and 3 have the least pump rate, early time performance, and poorest poor volume flushing, and therefore are the least effective at reducing the volume of contamination over time, followed in order by Alternatives 4 and 5.

Reduction in Mobility of Contaminants In-Situ

All alternatives would be roughly equally effective in containing the DNAPL at the Montrose Chemical Site. Likewise, all alternatives would be effective at stopping the outward expansion of the chlorobenzene plume.

However, Alternatives 3, 4, and 5 are more effective at containing the benzene plume over the long term, and hence are more effective at limiting the mobility of the benzene plume. This is because these alternatives employ active hydraulic extraction and treatment to contain the benzene plume in the MBFC Sand. Alternative 2, in contrast, relies on intrinsic biodegradation for this purpose. With the hydraulic effects of pumping the chlorobenzene plume, reliance on intrinsic biodegradation provides less control and less certainty of containing the benzene plume in the MBFC Sand, and hence less control on benzene mobility.

Reduction in Toxicity of Contaminants In-Situ

At the conclusion of the remedial action, if all remedial objectives have been met, the total reduction toxicity in-situ would be the same for all alternatives. However, as discussed, Alterative 2 and 3 are the poorest in terms of the efficiency with which they would reduce the toxicity of groundwater and the size of the area of groundwater which would pose a toxicity. Alternative 4 is superior to Alternatives 2 and 3 in this regard, and Alternative 5 is superior to Alternative 4.

Reduction in Toxicity, Mobility and Volume of Contaminants That Are Removed From Ground

In terms of mobility, toxicity, and volume of contaminants *that are removed from the ground*, all alternatives would be similar in that the volume of contaminants would be greatly reduced, from the great extent of contaminated groundwater to a treatment stream of much smaller volume. With any of the technologies or treatment trains used, the contaminant is ultimately destroyed (either off site, as in regeneration of activated carbon, or directly in the treatment process, such as in fluidized bed reactor). Hence, the mobility, toxicity, and volume of the contaminant is reduced ultimately to zero.

12.6 Implementability

Alternative 2 is the easiest to implement of the alternatives. This is in part because it implies the least number of extraction wells and injection wells, and the smallest injection rate. Injection presents more engineering challenges as the required injection rates increase, although these

challenges typically do not make injection infeasible at any of the pumping rates considered for this remedial selection. Alternative 2 would imply the smallest number of properties which would have to be accessed for purposes of installing wells and water conveyance lines for the treatment system. Alternative 2 would require a smaller treatment system, which may provide some implementability benefits, but these are not expected to be highly significant.

Alternative 3 presents a few more implementability issues than does Alternative 2, because a separate system must be built and designed to implement the pumping and treatment of the MBFC Sand. Because the water quality near the benzene plume is different than in the chlorobenzene plume in terms of parameters such as total dissolved solids (TDS), the need to extract and discharge treated water from this plume forces additional design and engineering considerations. However, Alternative 3 is still highly implementable.

Alternative 4 would be somewhat more difficult to implement compared to Alternative 3 due to the greater number of extraction wells and equipment required. Alternative 4 will require access to more properties to install wells and conveyance lines. The treatment systems would have to be larger and more sophisticated under Alternative 4 than under Alternative 3. Alternative 4 also would likely pose additional engineering challenges associated with aquifer injection. As aquifer injection rates increase, the potential for well plugging and fouling also tends to increase. However, at the 700 gpm pump rate considered, these issues should not be inordinately difficult nor insurmountable. Alternative 4 is highly implementable.

Alternative 5 is somewhat more difficult to implement than Alternative 4 due to the greater number of extraction wells and equipment required. Alternative 5 also would likely pose greater engineering challenges associated with the doubled rate of aquifer injection over Alternative 4. As aquifer injection rates increase, the potential for well plugging and fouling also tends to increase. Alternative 5 would require access to the greatest number of properties for installation of wells and conveyances. The treatment systems would have to be larger and more sophisticated under Alternative 5 than under Alternative 4. At the 1400 gpm pump rate considered, these issues would not be insurmountable, however, they become much more significant than with Alternative 4. Alternative 5 is still implementable.

12.7 Cost

The costs of the remedial alternatives were presented in Section 11. Tables 11-2 shows the capital, operation and maintenance (O&M), and out-year O&M costs on a 30-year present worth basis. While it is recognized that the remedial action will take considerably in excess of 30 years, because of the depreciation rate in the value of future dollars when measured in present worth, the costs associated with time beyond 30 years is negligible. Approximate calculations performed during the JGWFS revealed that, if 100 years were used instead of 30 years, the

present worth cost estimates would be only approximately 10 percent higher. Likewise, if 200 years were used instead of 100 years, the present worth cost estimates would be only 1 percent higher.

It is useful to examine what each increase among the alternatives cost "buys," starting from the minimal Alternative 2, which addresses the chlorobenzene plume with hydraulic extraction at 350 gpm and uses intrinsic biodegradation to contain the entire benzene plume.

Alternative 3 has hybrid containment of the MBFC Sand benzene plume, whereas Alternative 2 does not. The cost of obtaining this is approximately $5 million.

Alternative 4 has hybrid containment of the benzene plume and also addresses the chlorobenzene plume with hydraulic extraction at 700 gpm, double the rate of Alternative 3. It removes double the volume of the contaminated chlorobenzene plume at 25 years as does Alternative 3. Alternative 4 costs $4 million more than alternative 3, and $9 million more than Alternative 2.

Alternative 5 has hybrid containment of the benzene plume and also addresses the chlorobenzene plume with hydraulic extraction at 1400 gpm, double the rate of Alternative 5 and approximately 4 times the rate of Alternative 3. It removes about 1.5 times the volume of the contaminated chlorobenzene plume at 25 years as does Alternative 4, and about 3 times as much as Alternative 3. Alternative 5 costs $10 million more than Alternative 4, $15 million more than Alternative 3, and $19 million more than Alternative 2.

From this, it can be seen that while Alternative 5 offers superior performance in all respects (long and short term effectiveness, early time performance, pore volume flushing), the doubling of the extraction rate from Alternative 4 to Alternative 5 does not provide a doubling of the effectiveness as it does from Alternative 3 to Alternative 4. At the same time, the cost difference between Alternative 4 and 5 is more than double the cost difference between Alternative 3 and 4.

12.8 State Acceptance

The State of California has provided EPA with its written concurrence and acceptance of the remedy selected by this ROD.

12.9 Community Acceptance

Having held a public comment period and hearing and responded to all pertinent comments as required by law, EPA believes that the degree of community acceptance of the selected alternative is high.

12.10 Rationale for EPA's Selected Alternative

After consideration of the comments received during the public comment period and based on the administrative record, EPA is selecting ***Alternative 4,*** referred to in the JGWFS as *Benzene Hybrid Containment / Chlorobenzene Plume Reduction 2 (700 gpm).*

As discussed in earlier sections, the groundwater, should it ever be used, would present an unacceptable risk. Because the groundwater continues to move, new portions of the resource can become impacted by contamination in the future. The NAPL itself serves as a principal threat which continues to contaminate groundwater. The regulations direct EPA to restore this groundwater to drinking water standards in a reasonable time frame where it is practicable to do so (i.e. these standards are ARARs where not waived). The alternative EPA is selecting to remedy the groundwater contamination at the Joint Site eliminates the dissolved phase contamination outside the containment zone, meets ARARs where practicable, contains the principal threat, and safely contains contamination with a significant degree of certainty where it is not practicable to meet ARARs. ***Alternative 4*** represents an appropriate balance between performance and practicability, and also between long-term certainty of effectiveness and cost.

This section discusses EPA's rationale for this selection. It is noted that the rationale for the aspects of the proposed TI Waiver Zone were provided in Section 10. Also, the rationale for the approach to the TCE plume was provided in Section 11.

In April 1997, EPA's National Remedy Review Board (NRRB) reviewed EPA's intended proposed remedial action for the Joint Site groundwater and supported it.

All of the alternatives considered, except for Alternative 1, No Action, imply the presence of a hydraulic containment zone for NAPL for an indefinite duration, perhaps centuries. Such time frames are far beyond our present capabilities to model or anticipate. While not losing sight of cost effectiveness, EPA has placed a premium of value on actions that will reduce the long-term uncertainty in the remedy. It is difficult to assess whether, for instance, EPA or the responsible parties will exist in 500 years to ensure the remedy remains effective and protective. It is true that presently it is not possible to clean all groundwater at the Joint Site to drinking water standards. While this must be accepted, it is for the same reason appropriate to deal with long-term uncertainties conservatively. In many ways which are discussed in the JGWFS, the duration of this remedial action is directly related to the uncertainty as to its long-term success. Therefore, when more of the plume is removed early, less of the plume remains subject to large long-term uncertainties. This means it is appropriate to value the alternatives which provide early time performance and take less time to implement. Likewise, alternatives with more certainty of maintaining reliable containment of the NAPL zones are favored by EPA over those

providing less certainty, because the containment must be in place and effective for such a long time.

Alternative 4 (as Alternatives 2, 3 and 5) hydraulically isolates the NAPL so that the largest reasonable portion of the contaminated groundwater can be restored to drinking water standards and to limit the potential for human exposure to contaminated groundwater. The selected action also arrests the further lateral and vertical movement of all plumes.

While addressing NAPL isolation (both by hydraulic containment and by intrinsic biodegradation), Alternative 4 (as well as 2, 3, and 5) also mitigates drawdowns and reduction in interstitial pore pressures near the NAPL, factors which could otherwise induce NAPL to migrate downward. EPA has soundly and consistently considered the issues of adverse migration and plume interactions (NAPL movement and the inducement of movement of one plume due to actions focused on another plume). The potential for such factors has been addressed and modeled in detail by the feasibility study. EPA's evaluation and consideration of potential adverse migration and plume interactions is manifest in the very design of the alternatives (e.g. the pump rates considered), is a principal factor in the selection among the alternatives, and plays a prominent role among the ROD requirements in Section 13 of this ROD. Alternative 4 strikes a good balance between (1) reducing the size of the plume outside the containment zone at an acceptable rate, with significant early time performance and substantial and well-distributed pore volume flushing, on the one hand, and (2) avoiding movements of contaminants and other situations which might make the contamination worse or cause net delays in the cleanup effort.

Finally, as discussed, EPA assumes for the purposes of this analysis that NAPL is recovered (removed) from, and/or immobilized at, these sites to the extent determined appropriate by a separate remedial action selection process. This NAPL removal has the potential to limit the degree to which the NAPL can move, increasing the long-term certainty of effectiveness of this proposed groundwater remedy.

Rationale With Respect To The Chlorobenzene Plume

As discussed, with respect to the chlorobenzene plume, Alternative 4 provides greater and better-distributed pore volume flushing, stronger early time performance, and a shorter overall cleanup time as compared to Alternatives 2 and 3. This means overall uncertainties of long-term remedy performance and of meeting the remedial action objectives are lower, including ultimate attainment of drinking water standards. While the performance of Alternative 4 is markedly superior to that of Alternatives 2 and 3, the cost of Alternative 4 is only $4 million more than the cost of Alternative 3. EPA therefore favors Alternative 4 over Alternatives 2 and 3 for the reasons discussed at the beginning of this section.

EPA does not believe that the low rate of cleanup provided by Alternatives 2 and 3 provides for too much uncertainty that remedial objectives, including ARARs, will ultimately be achieved and that the remedial action will be fully protective of human health for the long term. The poor and sporadic pore volume flushing adds to this conclusion. Also, because these alternatives provide poor early-time performance with respect to the chlorobenzene plume, it would take much longer under these alternatives to realize any environmental gains (in terms of usability of the aquifer resource) and it is much less certain that the cleanup time frame can be considered "reasonable."

Based on the findings in the JGWFS, there is no reason to accept the low degree of aggressiveness and cleanup rate posed by Alternatives 2 and 3, as it is feasible to design the remedy at the higher pump rates posed by Alternative 4 without incurring significant additional risk of adverse contaminant migration or plume interaction. It is noted that this ROD requires that the remedial action be designed in such a way that such adverse migration is limited and that containment of the containment zone is accomplished. Hence, the wellfields used in the JGWFS can be adjusted in the remedial design as necessary to accomplish this objective. At the same time, as discussed in Section 11.1, this ROD requires that limiting of adverse migration take place within the context of meeting all other remedial action objectives and requirements in this ROD, rather than take preeminence over these.

The performance of Alternative 5 is clearly superior to that of Alternative 4. In fact, the model predicts that almost all of the chlorobenzene plume is removed in 25 years. Alternative 5 provides higher, but roughly as-well-distributed pore volume flushing rates compared to Alternative 4. However, Alternative 5 costs $10 million more than Alternative 4, and the relative increase in performance is less than the increase of Alternative 4 over Alternative 3. In addition, Alternative 5 poses some issues with implementability which would likely be of lesser prominence than with Alternative 4. While EPA does not believe these issues would be insurmountable, it is possible that the true costs of Alternative 5 could be higher in dealing with such issues (e.g. plugging of re-injection wells at higher injection rates).

In this ROD, EPA has specified other performance criteria in addition to the approximate pumping rate to be used with respect to reduction of the chlorobenzene plume outside the containment zone. While the pumping rate was the primary basis for distinguishing among wellfields and alternatives in the JGWFS, it was chosen because of its ability to produce an expected result. Hence, this ROD specifies not only that the remedial action primarily targeting the chlorobenzene plume be constructed and operated at approximately 700 gpm, but that it be designed to remove 33 percent of the plume in 15 years, 66 percent of the plume in 25 years, and 99 percent of the plume in 50 years, as measured by a refined computer model during the remedial design phase of the remedial action, and that progress toward these targets be monitored during the course of the remedial action. It is recognized that the model will not predict actual cleanup times, but progress can be tracked on a relative basis. The ROD also requires that a

basic minimum average pore volume flushing rate be achieved by the remedial system. These requirements are provided in Section 13 of this ROD.

Rationale With Respect To The Benzene Plume

Alternative 4 (as do Alternatives 3 and 5) contains hybrid containment for the benzene plume, which means that biodegradation is relied upon for the UBF and the MBFB Sand, but that the benzene in the MBFC Sand is contained by active hydraulic extraction. This is an appropriate balance between cost and long-term certainty of containing the benzene plume.

The UBF and the MBFB Sand are fine-grained units in which the groundwater flow velocities are very low. While they are classified as drinking water units, their relatively low ambient water quality, low water-producing potential, and small aquifer thickness make them less-likely candidates for actual groundwater use. There is strong evidence for intrinsic biodegradation and a relatively stable benzene plume in these units under natural conditions. The risk of a failure of intrinsic biodegradation to contain the benzene plume in these units is relatively low. It is appropriate to rely on intrinsic biodegradation in this case, so long as contingent active hydraulic extraction is also required in the event that intrinsic biodegradation fails to keep the benzene plume contained. This ROD applies contingencies as part of the selected remedial action for the benzene plume.

However, the considerations for the benzene plume in the MBFC Sand are different. EPA's evaluation led to the conclusion that the risks of relying solely on intrinsic biodegradation for the benzene plume in the MBFC Sand are not acceptable if a sufficient cleanup rate is to be achieved for the chlorobenzene plume. Such risks include not only the potential for benzene movement but the implications if benzene does move. Using hydraulic extraction and injection to contain the benzene plume in the MBFC Sand, assuming such containment is properly designed and optimized, is safer and more reliable.

EPA's conclusion accounts for several other factors other than the modeling results themselves, including:

- The MBFC Sand and Gage Aquifers are thicker, more permeable, and deeper, than the UBF and MBFB Sand, and are characterized by higher groundwater flow velocities, and therefore deviations between simulations and reality are more critical (contamination is closer to water actually being used for drinking, has more production potential, and the water has the potential to move more quickly);

- The Gage Aquifer is the first significantly-water bearing unit in which the benzene plume does not occur; at the same time, it is much more likely to be used as a drinking water

source than is the MBFC Sand (noting that the State of California designates all units at the Joint Site as having potential potable beneficial use);

- Vertical migration into the Gage Aquifer is of paramount concern and protection of the Gage Aquifer critical;

- The LBF separating the MBFC Sand and the Gage Aquifer is very fine-grained and cannot be effectively monitored;

- The sources of benzene in the benzene plume of the MBFC Sand are not well understood; this was discussed earlier in this ROD in Section 7, "Summary of Site Characteristics;"

- The movements of contaminants from the MBFC Sand through the LBF into the Gage Aquifer are likely to be heavily influenced by localized phenomena such as preferential flow paths;

- The model used in the JGWFS is not appropriate for modeling vertical contaminant *transport* from the MBFC Sand through the LBF into the Gage Aquifer (See Section 7 and the Response Summary of this ROD for more discussion on this issue);

- Additional modeling optimization is unlikely to overcome the uncertainties posed by the above conditions of the hydrostratigraphic units and modeling limitations;

- The vertical transport of benzene into the Gage Aquifer can only be monitored with wells placed in the Gage Aquifer; however, if benzene arrives there, it is "too late" in that benzene has already loaded the LBF and contamination of the Gage has occurred.

The modeling simulations resulted in small movements of benzene toward the chlorobenzene plume under the various pumping rates for chlorobenzene which were simulated. This simulated movement was small, however it is precisely in the area least desirable for benzene movement. Benzene at this location would be entering the chlorobenzene plume and possibly moving downward into the Gage Aquifer.

EPA stresses that the modeling used in the JGWFS is unreliable for predicting the movement of benzene from the MBFC Sand into the Gage Aquifer. This is discussed earlier in Section 7, "Summary of Site Characteristics" as well as in detail in the Response Summary. The fact that this limitation exists does not in any way impugn the model's validity. All models have limitations. Models should be used only for the purposes which lie within their identified limitations, and should not be extended to purposes beyond.

In this case, the model is highly useful for a wide variety of JGWFS uses, but not in particular for predicting the movement of benzene from the MBFC Sand into the Gage Aquifer. Therefore, while the model predicts no vertical migration into the Gage Aquifer, EPA does not consider this result reliable, and the risks of benzene movement in response to pumping primarily targeting the chlorobenzene plume are greater than the model would imply. EPA believes that the modeling uncertainties and the higher risk factors associated with the MBFC Sand combine to make reliance on intrinsic biodegradation to contain the benzene plume for the MBFC Sand risky. It is for this reason that EPA screened out alternatives which relied on intrinsic biodegradation for the MBFC Sand at the higher 700 and 1400 gpm pump rates for chlorobenzene. For the same reasons, EPA believes that Alternative 2 presents a risk which is not warranted given the relatively small additional cost of active hydraulic containment of the MBFC Sand and therefore prefers Alternatives 3, 4 and 5 to Alternative 2 with respect to this issue.

Alternative 4 contains active hydraulic containment of the MBFC Sand, which can be designed and manipulated to provide the maximum hydraulic control and therefore the maximum certainty in the long term that the benzene plume will remain contained. It is noted that it is much easier and far less costly to establish containment by hydraulic extraction in the MBFC Sand, than in the fine-grained MBFB Sand or the UBF.

Rationale for Remedial Actions for pCBSA

Section 7, "Summary of Site Characteristics" outlined the distribution of the chemical para-chlorobenzene sulfonic acid (pCBSA) and Section 8, "Summary of Groundwater-Related Risks" discussed its toxicological status. pCBSA is a byproduct of the manufacture of DDT, created when sulfuric acid sulfonates monochlorobenzene, one of the raw materials for making DDT. The compound is highly water soluble which reduces its retardation coefficient and has resulted in its moving a greater distance in groundwater than chlorobenzene (See earlier sections). There are no promulgated standards or reliable toxicological reference values for pCBSA. While some studies have been completed with respect to pCBSA, no chronic (long-term) studies have been performed and the studies are insufficient to allow EPA to set toxicological reference values or establish health-based standards. No studies of pCBSA are planned or underway at this time.

The JGWFS has shown that treatment of pCBSA will not occur coincidentally with the treatment of the other groundwater contaminants, if the most cost-effective technology for the other contaminants is employed. An explanation follows. The JGWFS did show that concentrations of pCBSA in the extracted groundwater effluent stream could be dramatically reduced by the treatment train which includes Fluidized Bed Reactor (FBR) plus liquid-phase carbon adsorption polishing. Tests indicate that FBR would be effective at destroying 95-99 percent of the pCBSA. This treatment train is one of three that this ROD selects as available in remedial design. However, in the absence of a promulgated health-based standard for pCBSA, and in turn, an

ISGS under this ROD, there is not an established concentration to which pCBSA concentrations in-situ (concentration remaining in the ground) must be reduced that can numerically drive the analysis of the technology used. Therefore, the-situ concentration of pCBSA will be reduced only if this reduction occurs coincidentally with the treatment used to achieve ISGS levels in groundwater for all other contaminants at the Joint Site.

While FBR plus carbon adsorption polishing is available and effective at treating the other contaminants as well as pCBSA, it was determined that liquid phase carbon adsorption acting alone, rather than FBR, would be the most cost-effective treatment train for attaining the health-based standards of all other contaminants. Unfortunately, liquid phase carbon adsorption performs rather poorly at removing pCBSA from groundwater. While this technology does remove some pCBSA, impractically large amounts of carbon are needed to achieve significant removal over extended periods of time.

The JGWFS evaluated the additional cost of using FBR plus carbon adsorption to address the Joint Site groundwater in the case where significant active treatment of pCBSA is required. As stated earlier, no health-based value was available for pCBSA to assume as a target cleanup concentration, so 99 percent removal of pCBSA was assumed for this analysis. This is the demonstrated removal efficiency/capability of FBR. The additional cost of using FBR, with all other parameters and assumptions constant, was on the order of $5 million.

This figure, however, represents only the additional cost of treating the pCBSA that lies *within* the chlorobenzene plume. The alternatives in the JGWFS assumed capture and mass/volume reduction for the chlorobenzene plume, and treatment and discharge of the resulting extracted groundwater. But the pCBSA distribution is *larger* than the chlorobenzene plume in all directions. Hence, as the JGWFS notes, the costs of capturing and reducing the much larger pCBSA distribution (over what would be a longer time period) and treating all of the water using FBR, would be far greater than this $5 million. To obtain an accurate estimate of the full additional cost of addressing all pCBSA ***in-situ***, a wide-ranging expansion of the feasibility study and its modeling would have been necessary. While this was not performed, the JGWFS reasonably concludes that the costs for such an endeavor could be in the many tens of millions of dollars and could double the cost of the remedial action.

If carbon adsorption acting alone is used, the pCBSA will, for the most part, not be removed from the extracted groundwater, which will then be re-injected into the aquifers. The result of this aquifer injection is that in-situ concentrations of pCBSA will decrease and become more evenly-distributed overall due to dilution. However, the pCBSA will cover a somewhat larger area of groundwater in the process. Modeling suggests that after 50 years under Alternative 4, concentrations of pCBSA will average 1000-5000 ppb over the entire distribution of pCBSA.

Having found no *in-situ* standards which might apply to pCBSA, EPA evaluated whether there were other requirements that might apply to *injection* of pCBSA into the aquifer. As discussed earlier in this ROD, aquifer injection is a necessary component of this remedy in order to achieve the hydraulic control necessary to prevent adverse migration of contaminants and NAPL, and to limit the effect of the remedial action on contamination sites outside the Joint Site. While the State of California did not identify any such injection standards to EPA, the State did request that EPA consider a non-promulgated To-Be-Considered criterion (TBC) of 25,000 ppb as a limit on the concentration at which pCBSA could be injected into the aquifer. Upon consideration of this TBC, EPA has decided to make it a ROD standard for this remedial action.

In April 1997, EPA's National Remedy Review Board (NRRB) reviewed EPA's intended proposed remedial action for the Joint Site groundwater and supported it. While the NRRB had no direct recommendations, they did issue a statement that they assume that EPA can seek to address costs associated with pCBSA by various elements of the remedial design. EPA will address this in the remedial design phase. It was noted, also, that the NRRB was in accordance with EPA's proposal not to actively capture or treat the pCBSA plume at this time.

In light of the above analysis and information, EPA has selected a set of remedial actions for pCBSA separately from the other groundwater contaminants at the Joint Site. Based on the extent of knowledge at this time, *these remedial actions are protective of human health and the environment.* These actions do not require that the area of groundwater affected by pCBSA be captured or reduced in volume. We note that no one is presently drinking water contaminated by pCBSA, though as with the other contaminants at the Joint Site, the potential for future use of the groundwater resource, either from the existing contaminant distribution of after that distribution has spread to a larger area, is possible. Future toxicological studies may reveal data or results which would allow for setting a health-based standard for pCBSA, in which case the continued protectiveness of the remedial action with respect to pCBSA would have to be reassessed by EPA. While EPA does not have direct control over which chemicals are studied, EPA is informing those with influence in this regard about the pCBSA at the Joint Site so that they can prioritize it properly among all other chemicals awaiting study.

As discussed in Section 11, the following remedial actions are selected by this ROD for pCBSA:

- The concentration at which pCBSA is re-injected into the ground shall be limited to 25,000 ppb. The State of California holds that 25,000 µg/l can be considered a provisional health standard for pCBSA with respect to injected groundwater. This requirement is a non-promulgated standard of the State of California (See Section 8 of this ROD), however, it is selected by this ROD as a performance standard for injected groundwater.

- The full downgradient extent of pCBSA contamination shall be determined and the movement of pCBSA shall be routinely monitored.

- Sampling at potentially susceptible public production wells shall include analyses for pCBSA.

- Well surveys shall be routinely updated to identify any new wells which may lie within the pCBSA distribution.

- At the Superfund 5-year reviews required by law, EPA will re-evaluate whether additional toxicological studies have been performed for pCBSA, assess the extent of the pCBSA plume and make determinations as to whether the remedy remains protective with respect to pCBSA

Finalizing of the Del Amo Waste Pits ROD

On September 5, 1997, EPA issued a ROD for the Del Amo Waste pits. This ROD specified that the remedial (cleanup) standards for soils under the Waste Pits were to be considered interim pending a decision by EPA on the groundwater. This was because it was not known at that time what the joint groundwater ROD would select as groundwater standards under the Waste Pits. This ROD establishes a TI waiver zone which includes the groundwater under the Waste Pits. This means that the water under the Waste Pits will not be restored to drinking water standards by the remedial action. EPA believes, therefore, that the currently-existing soil standards in the Del Amo Waste Pits ROD will be sufficient to prevent significant additional contamination from entering the groundwater at that location, and will allow for groundwater remedial action objectives to be satisfied.

The interim soil standards in the Waste Pits ROD were not based on cleaning soil under the Waste Pits so as to achieve drinking water standards in groundwater. Rather, the goal of the interim standards was to ensure that any additional contamination coming from the Waste Pits in the future would be small relative to the existing contamination already in the groundwater. In effect, this was to control the Waste Pits as a major source of additional contamination.

While the remedy selected by this ROD places the Waste Pits in a TI waiver zone, EPA believes it is still prudent to limit the amount of additional contamination that can be added by the Waste Pits to the groundwater system. The TI waiver waives the requirement to clean groundwater to drinking water standards, but it does not preclude reasonable and appropriate source control measures to ensure that large quantities of additional contamination, NAPL or otherwise, do not arrive in the groundwater. The interim standards were set based on this goal. Accordingly, EPA

makes final the soil standards for the Del Amo Waste Pits as they currently exist in the Waste Pits ROD.