INTERMEDIATE (60%) DESIGN REPORT

MANAGEMENT OF MIGRATION

RESOLVE SUPERFUND SITE
NORTH DARTMOUTH, MASSACHUSETTS

APPENDICES

July, 1994

Prepared by:

Metcalf & Eddy

REPORT

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Appendix A

COMMENTS & RESPONSES ON "PRELIMINARY (30%) DESIGN REPORT MANAGEMENT OF MIGRATION"

ReSolve Superfund Site, North Dartmouth, MA

GENERAL COMMENTS

Comment

I. The MOM 30% Design Report proposed a series of groundwater extraction well designs, and recommended Case 4A. EPA conditionally agrees with the recommendation of Case 4A because it is the best design proposed for capturing contamination migrating from the source area. In particular, the design locates extraction wells downgradient along the WMA boundary and Copicut River. However the Case 4A design is deficient at accomplishing the following Remedial Action (RA) objectives, outlined in the RD/RA SOW: "Prevent or mitigate the continued release of hazardous substances, pollutants and contaminants to the overburden and bedrock groundwater aquifers; ... Reduce the volume, toxicity or mobility of hazardous substances, pollutants and contaminants." The primary source area of the VOC plume is located in the northwest corner of the site as indicated in Figure 2.25 of the design report. Therefore, groundwater extraction wells should be located in this area to optimize the recovery of the most contaminated groundwater. The Case 4A extraction well design does not include wells in this area. It is recommended that the source area groundwater be pumped in an effort to (1) recover the greatest mass of contaminant (i.e. greatest concentration) over a short time frame, (2) prevent migration of contaminants downgradient, and (3) reach cleanup goals at the WMA boundary. In order to accomplish the RA objectives, the most appropriate design would be a combination of Case 3A and Case 4A. In particular, the two extraction wells located in the source area of extraction well design Case 3A, adjacent to wells CE/CW and south/southeast of SB-27D, should be incorporated into extraction well design Case 4A. These extraction wells should be incorporated into the MOM 60% Design report.

<u>Response</u>: The effect of the proposed additional wells has been evaluated using the ReSolve Site groundwater flow model. Three cases were evaluated: one well pumping at 5 gpm, 2 wells pumping at 3 gpm each and 2 wells pumping at 5 gpm each. The capture zones under each of these modeled scenarios are depicted on attached Figures 1 through 3. As can be seen, the overall capture zone is approximately the same in all three cases as it is in the base case, i.e. Case 4A, which is illustrated on Figure 4. The cases differ in the presence and size of an internal, or third, shell of capture in the northwest area, and in the overall pumping rates. The pumping of additional wells does not permit a reduction in pumping of the wells along the WMA boundary. If the pumping rates for the wells along the WMA boundary were reduced, a failure in the capture zone at the boundary would result. Therefore, the total pumping rate increases by approximately the amount of pumping from the additional wells. This amount ranges from 5 to 10 gpm in the cases evaluated, for a total pumping rate of 45 to 50 gpm, as compared to the base rate of 40 gpm.

With regard to the remedial objectives, all of the cases (including the base case, Case 4A) satisfy the remedial objectives. That is, under any case, the migration of contaminants beyond the source area (defined as within the WMA boundary) is prevented. The volume, toxicity and mobility of contaminants is reduced as the dissolved contaminants in ground water are pumped and treated.

EPA suggested that the additional wells may also have other advantages. These are addressed below.

- <u>Draw Contaminants within the WMA back towards the additional wells.</u> As can be seen from Figures 1 through 3, the additional pumping wells in the northern part of the source area primarily collect water from upgradient areas. Thus, they have little influence on contaminants downgradient of their locations. The dissolved contaminants associated with DNAPL in the area between the additional wells and the WMA boundary will, for the most part, be intercepted by the WMA boundary wells for both the base case and the modified scenarios depicted in Figures 1 through 3. Therefore, the prevention of downgradient migration of contaminants past the additional wells does not decrease the flux of contaminants reaching the WMA boundary and reduce the time required for clean-up. The DNAPL present in the area between the additional wells and the WMA boundary wells will still require many decades for dissolution and removal, regardless of whether the DNAPL has been removed from upgradient areas (see bullet below).

- <u>Increase mass removal rates and reduce remediation time.</u> It is important to keep in mind that mass removal rates at DNAPL sites such as ReSolve are determined by groundwater flow conditions (permeability and water balance) and the dissolution rate of the DNAPL. Based on available data on aquifer permeability and operational information on pumping, it is not feasible to move large amounts of water through the DNAPL source area. The limited nature of groundwater flow at the Site is indicated by the relatively low total pumping rates required to provide capture over the entire site area (i.e., 40 gpm). Even if it were possible to move large amounts of water through the areas where DNAPL is present, the mass removal rate would be limited by the rate of DNAPL dissolution. In other words, incremental increases in pumping would not necessarily result in corresponding increases in mass removal. This is discussed in detail in Section 2.4 of the February 1993 report prepared by the ReSolve Executive Committee for the EPA on DNAPL issues. Thus, adding pumping wells to the northern source area would not significantly increase the total mass removal rate relative to the mass of DNAPL present in the system. Although the additional pumping wells may hasten the clean-up of areas immediately adjacent or upgradient of the wells, it will still require many decades for the entire groundwater flow system to be remediated and to meet the clean-up levels at the WMA boundary.

In summary, there appears to be virtually no advantage to including additional wells in the design. Potential disadvantages of additional wells in this area are:

1) Risk of re-mobilizing DNAPL during the drilling of the additional wells,

2) Risk of additional impacts on the ponded area and wetlands to the north,

3) Additional capital, operation and maintenance costs with virtually no additional benefit.

Therefore, on the basis of the additional modeling analyses, it is recommended that the base case, Case 4A, be retained as the optimal configuration for the preliminary (30%) extraction well system design.

<u>Comment</u>

II. The ReSolve Site Group's proposed groundwater monitoring frequency is inadequate, and does not comply with the ROD, CD, and RD/RA SOW. According to the SOW, groundwater and surface water monitoring shall be conducted on a quarterly basis, not annually (see comment page 6-4; paragraph 3). Groundwater monitoring wells should sufficiently monitor layers 1 (upper overburden, layer 2 (lower overburden), layer 3 (shallow bedrock) and layer 4 (deep bedrock) zones of groundwater quality. They shall be sampled quarterly for at least the first two (2) years of MOM remedial action. At a minimum, the list of monitoring wells should include the following: Existing Wells: CE, FC, W-1, W-2, W-3D, W-3S, W-4D, W-4S, W-5D, W-5S, W-6D, W-6S, EN, ES, IN, IS, ON, and OS; Replacement Wells: SB-25S, SB-25D, SB-30S, SB-27D, KN, KS, HS and HN; Proposed Wells: RW-1, RW-2, RW-3, RW-4, RW-5, RW-6, RW-7, and RW-8; and New Wells: RW-2BD (bedrock monitoring well near RW-2), RW-3BD (bedrock monitoring well near RW-3), RW-9 (extraction well just south of CE), RW-10 (extraction well just south/southeast of SB-27D), Overburden and Bedrock Wells in the North Access Road (near previous Well A), and Overburden and Bedrock Wells north/northwest of RW-8. Total number of wells to be monitored quarterly is forty-two (42) wells. One quarterly sampling round per year should incorporate a comprehensive sampling effort of all wells in existence at the Resolve Site, including the ones mentioned above, and be analyzed for full TAL/TCL. The other three quarterly sampling rounds per year should include at a minimum the forty-two (42) wells mentioned above, and be analyzed for indicator compounds (trichloroethylene, tetrachloroethylene, and methylene chloride). At the end of the second year of MOM remedy full implementation, the Resolve Site Group shall review the analytical results, and make recommendations to the Agency for modifying the quarterly groundwater monitoring, if necessary. The Agency shall review the Group's recommendations, and make a final determination of the number of quarterly groundwater monitoring wells, if any modifications are deemed appropriate. This comprehensive quarterly monitoring is required within, at the perimeter and beyond the WMA to maintain the protectiveness of the remedy, assess the performance and effectiveness of the remedy, and evaluate the need for remedy enhancements or application of new technologies. The comprehensive quarterly monitoring shall also include the submittal of an annual Evaluation Report on the progress of the implemented MOM remedy. This Evaluation Report should evaluate the following: performance and progress of groundwater restoration; restoration trends; activities conducted during the year; activities proposed for the following year; deviation from remedial design models, assumptions, anticipated outcomes; identify MOM remedy enhancements, modifications, amendments and/or application of new technologies; identify additional characterization efforts.

<u>Response:</u> It is the Group's opinion that the proposed Monitoring Plan presented in the 30% Design Report <u>does</u> comply with the ROD, CD and SOW in that it <u>does</u> include quarterly groundwater and surface water monitoring of both water levels and water quality. Particular wells to be monitored quarterly are not specified in the ROD or SOW as this comment implies. Therefore, monitoring points and frequency were chosen based on technical needs for demonstrating system effectiveness and performance. Monitoring of residential wells has also been added.

The Group has agreed to include additional wells for quarterly monitoring to address EPA's concerns. The monitoring plan has been modified to include 20 wells for quarterly monitoring and 35 wells for annual monitoring. In addition, 9 replacement wells have been added within the WMA boundary for sampling purposes to replace wells SB-25S, SB-25D, SB-30S, 2B-27D, CW/CE, FC/FW, SB-04S.

The Group maintains that the most useful gage of extraction system effectiveness is capture zones characterized by water levels. Furthermore, since the rate of clean-up is dictated by the dissolution rate of DNAPL, very little change in water quality is expected from quarter to quarter. The Group believes that the changes in water quality will be sufficiently documented by a smaller set of quarterly monitoring points and the more comprehensive set of annual points. An assessment of the rate and magnitude of change of water quality will be made on an annual basis at which time the frequency of water quality measurements can be re-assessed.

<u>Comment</u>

III. EPA requires one comprehensive groundwater sampling round to be collected and analyzed for full TAL/TCL prior to the start-up of the MOM remedy, in order to establish a baseline pre-remedial action groundwater quality profile to evaluate the performance and effectiveness of the remedy. In addition, the data from these wells may be useful for evaluating any adjustments to the MOM remedy. Currently, many of the monitoring wells within the WMA, as well as a few wells outside of the WMA, have been either removed, damaged or vandalized. EPA requires any of those monitoring wells removed, damaged or vandalized, which are related to the MOM comprehensive monitoring plan, be replaced. In addition, other wells may be required to be installed to adequately monitor the MOM remedy (see above). These wells should be installed as soon as excavation and treatment of contaminated soils for Source Control remedy is complete, so that the comprehensive groundwater sampling round can be collected prior to start-up of the remedy. These wells should sufficiently monitor layers 1 (upper overburden), layer 2 (lower overburden), layer 3 (shallow bedrock) and layer 4 (deep bedrock) zones of groundwater quality.

Response: The monitoring plan in the 30% Design Report does include an initial comprehensive sampling event to be performed prior to system start-up. The samples will be analyzed for TAL/TCL analytes. The Group will install some replacement wells to achieve performance monitoring objectives. Not all wells destroyed during Source Control activities will be replaced however, to minimize the risk of DNAPL re-mobilization. The replacement wells include both overburden and bedrock wells. It should be understood that the separation of the alluvium into two layers and the bedrock into two layers reflects a modeling need and was not undertaken on the basis of lithologic and contaminant differences. Therefore, wells will not be screened at depths corresponding to model layers. Wells will be screened either through the entire overburden or the top 20 feet of bedrock.

Comment

IV. With regard to the presence of DNAPLs on-site, since the implementation of the Source Control Remedy, DNAPLs have been discovered at two locations within the WMA area. The first location was discovered in November 1992, during source control pilot study excavation of Phase 1, situated within the northeast corner of the X*TRAX pad area. During excavation, a one (1) to two (2) gallon seep of black liquid flowed into the excavation area at the low seasonal groundwater elevation. The material had a specific gravity of 1.025 g/cm and contained PCBs (476 ppm), chlorinated solvents (TCE @ 37 ppm and PCE @ 143 ppm), and hydrocarbons (262 ppm), according to the Resolve Site Group's analytical results. EPA agreed that DNAPLs were encountered, but questioned the mass balance of the sample's analytical results. No other black liquid was uncovered from the seep.

The second location was discovered in December 1993, during the source control excavation of Phase 4, situated approximately 50 feet south/southeast of the X*TRAX pad area. During Phase 4 dewatering activities, a dewatering well point began to pump up a black liquid. Note: the depth of the well point was 20'; the well point screen (2' length) was located from 18' to 20'; and the depth to bedrock was estimated at 26'). The Settling Defendants collected a sample of the black liquid for laboratory analysis, and determined the liquid contained 57% of the solubility of PCE, 13% of TCE, 12% of PCBs, and 13% of Toluene. It was estimated that approximately 6 to 8 gallons of black liquid was recovered from the well. During a December 12, 1993, Monthly Progress Meeting, EPA examined a sample of the black liquid in a clear glass jar. The liquid was of a dark brown color, resembling used motor oil. The density of the black liquid was much greater than water, based upon the fact that when the bottle was vigorously shaken, the black liquid settled to the bottom of the jar in a matter of seconds. In addition, the black liquid appeared to have a low viscosity, based upon the fact that when the bottle was vigorously shaken, the black liquid did not adhere to the sides of the bottle and/or slowly drip down the sides. On December 17, 1993, EPA oversight contractor (BEI) and the Settling Defendants source control contractor (RUST), at the request of EPA, utilized an interface probe to detect the presence of DNAPLs prior to pumping the well point dry, twice. Both times DNAPL was detected at the 18' to 20' range, even after the well column was cleared, indicating the presence of DNAPLs flowing into the well point. BEI also collected a sample of the black liquid for laboratory analysis. The analytical results resembled the Settling Defendants results. Therefore, DNAPL was detected at this location, and interface probe/pumping results indicate the presence of a DNAPL pool. EPA requested the Settling Defendants contractor, ENSR, to notify their MOM subcontractor, M&E/Pappadopolus Assoc., and request their recommendation on possible actions.

As mentioned in the cover letter, the MOM 60% Design report must adequately address the Agency's DNAPL concerns. The enclosed guidance document recommends approaches for remediating sites contaminated with DNAPLs, and should be applied at the Re-Solve, Inc. Superfund Site. Specifically, the guidance document states,

> "the long-term remediation objectives for a DNAPL zone should be to remove the free-phase, residual, and vapor phase DNAPL to the extent practicable and contain DNAPL sources that cannot be removed. EPA recognizes that it may be difficult to locate and remove all of the subsurface DNAPL within a DNAPL zone. Removal of DNAPL mass should be pursued wherever practicable and, in general, where significant reduction of current or future risk will result. Where it is technically impracticable to remove subsurface DNAPLs, EPA expects to contain the DNAPL zone to minimize further release of contaminations to the surrounding ground water, wherever practicable.
>
> Where it is technically practicable to contain the long-term sources of contamination, such as the DNAPL zone, EPA expects to restore the aqueous contaminant plume outside the DNAPL zone to required cleanup levels. Effective containment of the DNAPL zone generally will be required to achieve this long-term objective because ground-water extraction remedies (e.g., pump-and-treat) or in situ treatment technologies are effective for plume restoration only where source areas have been contained or removed.
>
> Monitoring and assessing the performance of DNAPL zone containment and aquifer restoration systems, therefore, are critical to maintaining remedy protectiveness and evaluating the need for remedy enhancements or application of new technologies. ... EPA encourages consideration of innovative technologies at DNAPL sites, particularly where containment of a DNAPL zone may require costly periodic maintenance (and perhaps replacement). Innovative technologies, therefore, should be considered where DNAPL zone containment could be enhanced or where such a technology could clean up the DNAPL zone."

Wherever practicable, EPA expects the removal of DNAPL mass to be pursued at the ReSolve Site. Given the above information provided with in the guidance document, the Agency expects the ReSolve Site Group to move rapidly at removing the DNAPL mass located at the second DNAPL location described above. Currently, there is limited information available to determine the vertical or horizontal extent of this pool. However, this information can be obtained during the removal of the DNAPL mass. For example, the DNAPL pool can be pumped with a low flow rate, at the current well point screened interval. The pumping may need to be conducted in a pulse manner (e.g. every 24 hours). Once extraction of the DNAPL pool is complete, the vertical extent of the pool needs to be determined. The screen should be lowered another two (2) feet, and resume pumping. It is imperative that the DNAPL mass be removed, wherever practical, as well as any other DNAPL masses encountered during future remedial and/or characterization activities, in order to attain the aquifer restoration objectives outlined in the ROD, CD and RD/RA SOW. EPA has learned over the years that mass DNAPLs must be removed when discovered or there is a high risk of the mass migrating beyond the location where it was discovered, which reduces the chances of relocating the DNAPL mass.

In order to attain groundwater restoration, contamination sources must be identified and removed or treated. EPA expects that all reasonable efforts will be made to identify the location of source areas through historical information searches and site characterization efforts. The ReSolve Site Group may need to conduct additional characterization efforts to enhance, modify, and/or amend the MOM remedy. EPA encourages any additional site characterization efforts which will enhance the Remedial Design to attain clean-up levels as outlined in the CD, ROD and RD/RA SOW.

<u>Response:</u> The Group will make every attempt to remove DNAPL if it is encountered during SC or MOM activities. The Group will continue to remove DNAPL from the dewatering well point location discussed in this comment. The approach has and will be to pump the DNAPL from the well point at a low flow rate at the current screened interval. However, Dr. Kueper has advised the Group that it is not prudent to move the well point deeper to remove additional DNAPL once the well point is depleted of DNAPL at the current location. The reasoning for this is discussed below.

It is not likely that the discovery of DNAPL in a well point approximately 6 feet above bedrock corresponds to a pool that extends from this elevation down to bedrock. The primary reason for this is that the bedrock would have to be virtually unfractured in order to support a 6' high pool. The capillary pressure at the base of a 6' high pool of DNAPL having a density of 1300 kg/m^3, for example, would be 7,175 Pa. Such a pool would have the potential to invade a fracture as small as 2.78 microns assuming an interfacial tension of 10 dynes/cm. If this well point actually has encountered the top of a pool, it is likely that a capillary barrier such as a silt of clay seam/lens/lamination exists slightly below the well point. In this case, a lowering of the well point will puncture the capillary barrier and cause DNAPL to move downwards, and possibly into bedrock. The second possibility is that the well point is producing DNAPL that is currently leaking from an upper elevation in response to downward pumping of groundwater and/or puncturing of an upper capillary barrier as the well point was put in place. In this case as well, the well point should not be lowered since this may transfer DNAPL deeper into the subsurface. Therefore, the overall conclusion is that the existing well point should not be lowered further, since this action would carry with it a risk of transferring DNAPL deeper into the system. This is a particular concern if the well point is close to bedrock. Even small volumes of DNAPL transferred to bedrock can travel large distances because of the low fracture porosity associated with rock.

With respect to performing additional site characterization to search for DNAPL pools with the specific intent of removing mass from the subsurface, Dr. Kueper has advised the Group that this poses a risk that has little technical merit. Since pools are distributed very heterogeneously in a somewhat random manner, finding all of them is very unlikely. Furthermore, the very act of looking for them with well-points may worsen the extent of contamination at the Site because of the risk of puncturing capillary barriers. It should also be kept in mind that removing 50% of the DNAPL pools from a site may not decrease the amount of time required for the remaining 50% of the pools to dissolve away. The exact relationship between partial mass removal and amount of time required to dissolve away the remaining pools depends on the spatial orientation of pools in relation to groundwater flow directions. In general, however, very little benefit can be expected from partial pool removal with respect to the time that a pump-and-treat system will need to be operated at a site such as this.

<u>Comment</u>

V. In an April 8, 1993, correspondence to Michael Last, EPA stated, "The final MOM design could, conceptually, have zero recharge without the need for a ROD amendment. However, EPA believes that once this or any other system is up and running, fine tuning will be necessary. This could include reinjection. Thus, the design should accommodate the need for some reinjection in the future, even if the agencies were to decide to approve your proposal to forego its use initially." Within Section 3.1, the MOM 30% Design Report indicates that one criterion for the remedial evaluation is to minimize the risk of DNAPL mobilization in the bedrock. Later, in section 4.1, discussion of DNAPL mobilization continues and it is concluded that any increase in downward gradient across the overburden-bedrock interface is unacceptable. Section 4.3 indicates that reinjection of treated ground water is not recommended based on an evaluation of the critical (vertical) gradients which may potentially mobilize DNAPL. There are two points to consider regarding this observation.

a. While it is true that residually trapped DNAPL may become mobile under sufficient gradient, it is reasonable to identify areas where DNAPL presence is less likely and that reinjection may be used to help manage plume migration. For example, reinjection wells could be located downgradient of the plume to help divert the aqueous plume in an upgradient direction. In particular, the plume in the furthest downgradient area (Copicut River and Carols Brook) does not appear to be captured in the designed extraction system. It may be useful to reinject in this area to better manage this portion of the plume (i.e. direct the plume towards the extraction wells).

Plume directional management has been implemented effectively at other pump and treat sites where ground water reinjection has been used. Directional plume management is one option which may improve effectiveness and efficiency of pump and treat remedy, and should be evaluated further.

b. The theoretical calculations used to determine the hydraulic gradient necessary to mobilize DNAPL were based on several assumed parameter values. With the exception of one of the calculated gradient values (i.e. del H/L = 0.0045) reported on page G-2, the vertical gradient values in Figures 4-6 through 4-8 do not exceed these values. It is recommended that the gradient necessary to mobilize DNAPL be examined more closely and re-evaluated. Additionally, the locations where the reinjection would occur will unlikely be in the areas where DNAPL exists.

Therefore, it is recommended that future groundwater designs incorporate groundwater reinjection to improve the effectiveness and efficiency of the groundwater pump and treatment system by controlling the direction of the dissolved plume, and possibly flushing VOC from soils. Specifically, downgradient groundwater reinjection should be evaluated along Carols Brook and the Copicut River (between W-4D and the intersection of Copicut River/Carols Brook) for diverting the dissolved plume in the upgradient direction. In addition, upgradient reinjection or surface water discharge should be evaluated just north of the Northern Wetlands for diverting the dissolved plume in the downgradient direction, and possibly flushing VOC from the soils. The upgradient reinjection of treated groundwater in this northern wetland area would also help minimize the effects of pumping during low flow periods, and maintain saturated conditions in areas that would otherwise be dewatered and unaffected by groundwater movement.

<u>Response:</u> **Reinjection in the Southeast Area.** The primary concern driving the request to consider injection for plume control in the Southeast Area is the presence of low contaminant levels in this location (Figures 2-25 and 2-26 of Preliminary Design Report) which lies beyond the capture zone of the proposed well system (Figure 4-11). In preparing the figures illustrating contaminant levels, all values above "non-detect" were used to delineate the outer zone of concentrations. However, it should be noted that many of the concentrations above "non-detect" levels are actually below MCLs. The attached table (Table 1) has been prepared to illustrate the concentrations in wells beyond the capture zone. The only wells beyond the capture zone which exhibit concentrations above detection levels are W-5S and W-5D. As indicated by the tabulated data, none of the concentrations detected in the most recent sampling rounds (1989 and 1992) exceeded MCLs at either of these wells. These wells will be sampled again in 1994 to confirm these results. Assuming the wells remain below MCLs, additional remedial measures in this area will not be needed.

Considering the risk of spreading associated with injection, the probable lack of feasibility due to high water table, and the fact that the proposed capture zone (Case 4A) includes all monitoring points with recent concentrations exceeding MCLs, it is not recommended the proposed well system design be modified to include reinjection for plume control in the downgradient area.

Nonetheless, the Group has evaluated the use of injection wells for plume control in the vicinity of the confluence of Carol's Brook and the Copicut River (southeast area of the ReSolve Site). The ReSolve site model has been used for this purpose, as indicated on the attached Figure 5. Figure 5 shows modeling results for a case identical to Case 4A, with the addition of two injection wells with re-injection rates of 3 gpm each. As can be seen, some of the particles drive the plume back towards the other system wells, thus expanding the capture area towards the river confluence. However, the injection also provides a driving force to spread the contaminants in this area towards the river downgradient of the wells. The injection wells also result in a driving force vertically, resulting in spreading in the vertical direction.

The model output indicates flow paths which will result if injection is feasible. However, it does not directly address the question of feasibility of injection. The feasibility will depend in large part on the availability of some unsaturated thickness to receive the injected (or infiltrating) waters. Data indicate that the water table already exists at or near to the land surface in this area, as can be seen by the marshy conditions. Because the soils appear to be saturated, it is not likely that injection or infiltration in the Southeast Area will be feasible.

Reinjection in the Northern Wetlands. Only very minimal benefit would be realized from reinjection in the area north of the northern wetlands, because plume control is not necessary in this area and no decline of water levels due to pumping is expected.

Flushing of VOCs from soils would not be improved, as VOCs are not present in the area north of the wetlands.

Reinjection Within the Waste Management Area. From a vertical point of view, any increased downward gradient in the WMA carries with it a risk of driving DNAPL into fractures. The reason for this is that any increase in the downward flow of groundwater across a pool imparts a downward driving force. The implication of this is that groundwater reinjection should definitely be avoided in suspected DNAPL zones.

Flushing of Soils Above Seasonal Groundwater Level. There is no question that VOCs will be removed from soils treated during Source Control. Soil treatment through the X*TRAX unit is occurring at a higher temperature than that at which VOCs are volatilized. Based on a review of excavation maps, most of the soils above sgl in VOC hot spot areas will be excavated and treated. The minimal VOC contamination that remains (i.e soils above sgl not excavated) will be addressed by degradation or by natural flushing due to precipitation percolating through the porous gravel cover. Both of these mechanisms are very likely to occur faster than DNAPL pool dissolution below the water table and, therefore, are not a primary determinant with regard to Site clean-up time.

However, it should be noted that the design of the extraction/treatment system does not preclude reinjection. If it is determined that reinjection is needed in the future, modifications to the system will be considered for this purpose.

SPECIFIC COMMENTS

<u>Comment</u>

1) Page 1-1; Paragraph 1: According to page 30 of the RD/RA SOW, the following objective should be added, "data and documentation to support each component of the work." The report does refer the reader to other project documents for supporting data however, a section presenting the site geology would be very helpful. In addition, the report is intended to be a stand alone document. However, the report does not present enough information to support the statements and assumptions presented. This is particularly true with regard to the site geologic and hydrogeologic settings and modeling assumptions. This supporting information should be added. The geologic information needed to support the groundwater model includes, at a minimum, the topography of the site and site vicinity, bedrock contour map and maps which present the top and thickness of the till encountered at the Site. Geologic cross sections should be presented to show the surface water groundwater interaction at the river and water bodies. This data should be supported with the boring logs for the monitoring wells and piezometers.

   <u>Response:</u> The text in Section 3.0 will be revised to include supporting geologic information. In particular, a general site topographic map will be provided, based on the USGS topographic quadrangle. The site topography used in the model will also be provided. A map showing elevation of bedrock surface will be provided. Regarding the top and thickness of the till, the well logs do not indicate a clear distinction between till and other alluvial units. Layers 1 and 2 of the model were subdivided, as indicated in the report, at depth intervals within the alluvium, rather than according to lithologic distinctions. Therefore, these maps are not included. Geologic cross-sections will be provided. All of this information will be added to Section 3.0

<u>Comment</u>

2) Page 1-1; Paragraph 3: The text states, "Sources of this contamination exist in the overburden and bedrock as dense non-aqueous phase liquids (DNAPLS) in some areas." This statement is a unfounded generalization of the location of DNAPLs, and should be revised with specific data. According to the existing information and analytical data provided to the EPA, DNAPLs have only been detected in two locations on-site. The first location was a one to two gallon oily seep of black liquid which detected by RUST Remedial Services during the Fall 1992 Source Control (SC) pilot study at/near the seasonal-low groundwater level (SGL). RUST collected three samples from the black oily liquid. The EPA had concerns regarding the validity of the data due to poor mass balance (as documented in our 4/8/93 correspondence to

Michael Last), but acknowledged that the black oily liquid was a DNAPL with a specific gravity slightly greater than one (1.025 g/cm). The second location was discovered in December 1993, during the source control excavation of Phase 4, situated approximately 50 feet south/southeast of the X*TRAX pad area (see general comments). To date, these are the only locations where DNAPLs have been confirmed on-site. Please clarify.

<u>Response:</u> This statement is based on the discovery of DNAPL at the Site and the assessment of DNAPL existence based on percentages of effective solubility as presented in the DNAPL Report (ENSR, 1993) and described in Section 2.6 of the 30% Design Report. This assessment was made using current EPA guidance on assessing the existence of DNAPLs. Based on this, the statement is believed to have sufficient basis. To date, five DNAPL samples have been taken. The text in Section 2.6 discusses these samples, and the analytical results have been included as an appendix.

<u>Comment</u>

3) Page 1-2; paragraph 1: The text states, "DNAPL, found during excavation onsite, is believed to be present in both the overburden and bedrock and to extend beyond the Waste Management Area (WMA) boundary." Please be specific in describing where this DNAPL was found on-site during excavation (map with locations and cross-sections), and provide any site characterization data that support the DNAPL location.

<u>Response:</u> A map will be provided in Section 2.6 that shows the locations where the DNAPL has been found, and the locations will be discussed with respect to the estimated extent of DNAPL based on percentage of effective solubility.

<u>Comment</u>

4) Sect. 1.0 (pg. 1-2): A figure is needed which presents the location and extent of the WMA.

<u>Response:</u> A figure illustrating the extent of the WMA will be added to Section 1.0.

<u>Comment</u>

5) Page 1-2; paragraph 3: The Remedial Design Criteria should be to attain clean-up levels at and beyond the WMA boundary, and minimize the length of time to attain those clean-up levels. Please revise accordingly.

<u>Response:</u> Paragraph three discusses criteria used during the Remedial Design modeling effort. Regarding the first criterion (attaining clean-up levels at and beyond the WMA boundary), the Group agrees that this is an objective of the extraction system. It should be noted that this criterion will be satisfied with any system that achieves adequate capture. However, as discussed in Section 3, where DNAPL is

present (which is estimated to be inside the WMA boundary and beyond), the clean-up time is governed by DNAPL dissolution rates and, consequently, restoration could take from several decades up to hundreds of years regardless of the extraction system implemented. Cleanup time was a criterion. However, in DNAPL affected areas, all design scenarios would take a long time. In dissolved phase areas, all of the design scenarios considered would result in restoration in a reasonable time.

Comment

6) Page 1-3; paragraph 1: Define "unacceptable risk", and the criterion used for determining unacceptable risk.

Response: Unacceptable risk as used in this paragraph refers to any risk of inducing vertical migration DNAPL pools particularly near bedrock. In general, any increase in downward gradient could induce vertical movement and would be considered unacceptable. As discussed in Section 4.3, the criteria used are calculated vertical gradients. The text will be revised.

Comment

7) Page 1-4; paragraph 2: The Resolve Site Group proposes that treated groundwater be discharged to the Copicut River without some percentage of reinjection. This directly conflicts with the Consent Decree, RD/RA SOW, and ROD. Page 11, Section IV of the RD/RA SOW states, "The groundwater component of the work shall involve the design, construction and operation of an extraction and reinjection system and an on-site treatment facility. Effluent from the treatment facility will be reinjected on-site in an upgradient portion of the aquifer to the extent practicable. Soils within these areas will be flushed with treated effluent in order to reduce the level of VOC in the soils. If re-injection is not practicable due to insufficient aquifer recharge capacity, a surface water discharge of effluent from the groundwater treatment system may be necessary. Any point source discharge shall be made in full compliance with substantive requirements of the NPDES permit program." EPA does not agree with the Resolve Site Group's interpretation and application of "unacceptable risk" due to the potential of mobilization of DNAPLs, based upon the extremely limited data.

Response: As discussed in Section 4.0 of the report, reinjection within the WMA boundary would cause an increase in vertical gradient which could potentially induce vertical movement of DNAPL. Therefore, it is the Group's opinion that reinjection within the WMA boundary is not prudent. As discussed in the response to EPA Comment I, modeling was performed to evaluate reinjection for purposes of plume management. It was determined that reinjection for this purpose offers no advantage. Consequently, the 60% design will not include reinjection. A statement will be made in the 60% design report however, that if determined to be necessary in the future, the system will be modified to accommodate reinjection.

Comment

8) Page 2-3: Paragraph 2; last sentence: The gradients measured at CW/CE over the past eight years have illustrated both positive and negative gradients (12/13/85 = +.01; 4/15/86 = +.09; 7/16/86 = -.34; 5/8/90 = -.01; and 10/11/91 = -.04). Historically, the only gradients exhibiting negative gradients consistently were from wells DE/DW and EN/ES. The sentence should be modified to reflect this information, which was obtained from the Off-Site Remedial Investigation by CDM, February 1987.

Response: The text will be modified to address this comment.

Comment

9) Sect. 2.2 (pg. 2-11, 2-12): The vertical gradients presented on Figures 2-8 and 2-9 indicate that an east west zone of vertical downward gradients may exists at the Site (CW & CE, DE & DW, EN & ES). These gradients exceed the Report's calculated critical gradient for DNAPL pool mobilization, Appendix G. The ReSolve Site Group should consider evaluating the potential of a bedrock fracture zone within this area, further.

Response: The critical gradient in Appendix G is a horizontal gradient, not a vertical gradient. Although the downward gradient is likely causing downward migration of dissolved contaminants, it is likely that the DNAPL has come to equilibrium in this area under the existing gradient. As discussed in the report, the concern is increasing the vertical gradient over the existing gradient.

Comment

10) Page 2-15; paragraph 3: Please illustrate the locations of the five out of eight soil samples on Figure 2-11, as well as the high VOC areas.

Response: The locations of the five soil samples are on Fig. 2-11. The text will be modified to read SS-3 through SS-7, instead of locations 3 through 7 to clarify.

Comment

11) Sect. 2.3.3 (pg. 2-15): The text indicates that soil sampling locations 3 - 7 were selected in areas with high soil gas readings. Since there were no soil gas points anywhere near SS-3 (Figure 2-11) please explain what other information was used to locate that soil sample.

Response: The SS-3 location was chosen to provide more complete coverage of the Site. The text will be revised.

Comment

12) Table 2-6: Why were only 4 out of the 34 overburden wells sampled during the 1992 sampling round? What was the criteria used for selecting these wells? Why were only 12 out of the 18 bedrock wells sampled during the 1992 sampling round? What was the criteria used for selecting these wells? In addition, indicate within the text that the 1992 groundwater sampling rounds was not comprehensive, and explain why.

<u>Response:</u> As described in the DRWP, the rationale for the proposed sampling was to provide more recent contaminant data for treatment design, to examine the possible presence of NAPLs and to verify the continued decline in VOCs. In order to fulfill these objectives, it was most prudent to sample the wells that historically had the highest contamination. Therefore, a comprehensive sampling round was not performed. The reason that some of the proposed wells were not sampled was that they had been destroyed during Source Control activities. The text will indicate that the 1992 sampling round was not comprehensive.

Comment

13) Sect. 2.3.2 (pg. 2-17): Please provide the detection limits for chemicals reported as ND (Not Detected) in Table 2-2.

<u>Response:</u> The soil gas survey was used as a field screening technique. Therefore, no detection limits were set on the GC instrument.

Comment

14) Sect. 2.3.3 (pg. 2-18): According to the Design Refinement Work Plan (DRWP), groundwater samples were to be collected from seven overburden and six bedrock wells both prior to or early in pilot excavation activities and after pilot excavation is complete. The text (pg. 2-18) and Table 2-5 indicate only nine wells were sampled, just once, in April 1992. Please explain this divergence from the DRWP.

<u>Response:</u> See the response to Comment 12. The original reason for proposing the second round of sampling on these wells was to observe the effect on groundwater of remediating a large volume of on-site soil during Pilot Scale soils remediation. However, it was subsequently determined that the Pilot Excavation Area was not large enough to demonstrate such an effect. The text will be revised to explain this.

Comment

15) Sect. 2.3.2 (pg. 2-20): Unsaturated soil sample locations are not shown on Figure 2-11 as noted on Table 2-4.

<u>Response:</u> Unsaturated soil sampling locations are the same as saturated soil sampling locations. A note will be added to the text to clarify.

Comment

16) Sect. 2.3.3, (pg 2-21, 2-22): The groundwater data presented in Table 2-5 (DRWP-4/92) shows concentrations of lead ranging from 2.6J - 192J ppb. The target remediation level as noted in the ROD is 50 ppb. However, Tables 2-6 and 2-7 do not show any data for lead and focus exclusively on VOCs. Lead values should be included in this section and addressed in the design.

Response: This table was developed to illustrate the trend in volatile compounds identified in the SOW as indicators of aquifer clean-up plus a few additional VOCs of concern. Lead was not included in this table because it is not considered an indicator compound. It is acknowledged however, that lead is a concern, and the treatment plant has been designed to treat it.

Comment

17) Sect. 2.3.3 (pg. 2-25): Please provide the detection limits for chemicals reported as ND in Table 2-7. If the detection limit is unknown, note accordingly.

Response: A note will be added that the detection limit is unknown. Historical data (i.e. from the RI) were not reported with detection limits for non-detect data.

Comment

18) Sect. 2.3.5 (pg. 2-27): A large number of wells for which historical groundwater elevation and quality data exist, and which were sampled during the DRW in 1992, are listed in Table 2-8 as "NL". What is the current status of these wells?

Response: It is known that the following wells were destroyed during Source Control: A, SB-34S, SB-04S, SB-30S, SB-27D, SB-25S, SB-25D, KN, KS, SB-09S, HN, HS, CW, CE, FW, FE, FC. Some of these wells will be replaced as described in 60% Design Report.

Comment

19) Sect. 2.3.6 (pg. 2-29): Soil heterogeneity was observed during a single day of pilot excavation activity. Have other observations been made, as planned in the DRWP (pg. 3-2) to continue to "better define soil heterogeneities for the hydraulic portions of the remedial design"? Please elaborate.

Response: Subsequent observations are consistent with the observations described in the text. The text will be modified to discuss this.

Comment

20) Sect. 2.4 (pg. 2-29): "Evaluation of data acquired under the Design Refinement Work indicated that VOC concentrations in groundwater were not decreasing as suggested by

data collected in 1989 under the Pre-Design work." Since the DRW data contradict many of the conclusions of the Pre-Design Report, it is strongly recommended that groundwater data continue to be routinely collected to both provide further information for the design effort and confirm the apparent decline in ketone concentrations.

Response: The Group is currently planning a comprehensive sampling event to be conducted after Source Control Remedial Action is complete. Furthermore, additional samples from the SCR WTS influent were collected in May and June 1994 to further demonstrate the levels of ketones that would be expected to be treated during full-scale MOM.

Comment

21) Sect. 2.4.2 (pg. 2-30): The VLF Survey discussion indicates that this method is best suited for identifying fracture zones which are orientated in a north to northeast direction and have a dip angle of 30 degrees or greater. The report presents bedrock data which indicates the presence of both low angle and high angle fractures in the bedrock (pg. 2-32). The data and evaluation used to support the decision to use a geophysical method which will only identify high angle fractures should be presented in the report. It is implied, by using VLF, that the low angle fractures are not considered a significant feature in the bedrock. The data to support the decision to use only VLF should be presented.

Response: The VLF Survey was chosen because it had the potential to provide the most site-wide information on major fracture sets and orientation for a the most reasonable cost. Northeast is the primary fracture orientation in New England and, therefore, VLF was deemed appropriate. It was not expected that the VLF survey would provide all information necessary to characterize bedrock fractures. As discussed in the report, other methods were also used to confirm the orientation of the fractures. The text will be modified to include the reasoning for choosing VLF.

Comment

22) Sect. 2.4.2 (pg. 2-32): Data is presented which indicates that there are two fracture sets in the bedrock but the strike of these fractures is not presented. The report concludes that these fractures most likely consist of small fractures at both low and high angles. It is further concluded that the geophysical survey did not identify any major vertical fractures. These conclusions are true for the data presented and the investigation methods used however, the investigation method, VLF, is limited in its ability to identify east west fractures and fractures with low angle of dip. If additional data is available to support this conclusion, then the data should be presented. If additional data is not available, then the ReSolve Site Group should consider gathering additional data.

Response: The bedrock information was gathered to evaluate the potential for DNAPL migration in bedrock. Based on the data, there is evidence of both high and low angle fractures as well as vertical jointing which suggests that there is a strong potential for DNAPL migration in bedrock. The evidence is conclusive enough to make the design decision to prevent DNAPL migration to bedrock. It is the Group's opinion that no further data is necessary for design purposes.

<u>Comment</u>

23) Page 2-35; paragraph 2: The text states, "The surface water sampling data indicates that groundwater at Resolve is discharging to the surrounding surface water bodies." This sentence suggest upward vertical gradients, which conflicts with statements made on page 2-3 (see previous comment page 2-3; paragraph 2). Please clarify. It appears that vertical gradients at the Site are primarily upward/positive, except near wells DE/DW and EN/ES. Occasionally, there seem to be natural stresses to the aquifer which temporarily change the low positive gradients to negatives.

<u>Response:</u> The discussion will be clarified. The statement is based on the fact that volatiles from the Site have been detected in the surface water.

<u>Comment</u>

24) Page 2-51; fourth bullet: None of the 16 wells sampled during the 1992 sampling round had a VOC concentration that exceeded the 1 percent of pure solubility. Only well SB-27D with a concentration of 1,2 DCE of 64,000 ppb was slightly below the 1 percent solubility (1% solubility = 66,000 ppb).

Please note that the 1% to 10% solubility range was considered a range where characterization efforts should consider evaluating the possibility of DNAPLs being present on-site. The solubility greater than 1% was a guide for site characterization efforts to evaluate the potential existence of DNAPLs.

<u>Response:</u> The assessment is based on 1% of effective solubility not pure phase solubility. Dr. Kueper has advised the Group that the 1% guideline for concluding that DNAPL is present upstream works well and has proven successful at many sites. Although somewhat empirical, it is based on sound technical reasoning (i.e.: borehole dilution, hydrodynamic dispersion, well placement, and kinetic limitations to mass transfer).

<u>Comment</u>

25) Sect. 2.6 (pg. 2-51): The report states that it is believed the potential for DNAPL in bedrock exists; therefore, the extent of DNAPL must be defined. The data presented in Figure 2-26 implies that DNAPL may be present east of the Copicut River. Additional site characterization should be considered for evaluating the extent of bedrock contamination east of the river to assure the MOM remedy is adequately designed.

Response: As designed, the MOM remedy currently addresses bedrock contamination on the east side of the Copicut River. It is the Group's opinion that the most prudent course of action is to implement the system as designed and refine the system as operational data is gathered and evaluated.

Comment

26) Figure 2-13 through Figure 2-24: These figures should be revised to accurately reflect the 1992 groundwater analytical data in Tables 2-5 and 2-9. In particular: Figure 2-15: well SB 30-S should be 2800 ppb (diluted) not 3000 ppb, well FE should be 55,000 ppb not 53,000 ppb; well JN should be 1700 ppb not 1800 ppb; Figure 2-16: well JN should be 2700 ppb (diluted) not 2000 ppb; Figure 2-17: well SB 30S should be 1400 ppb (diluted) not 1700 ppb, and well JN should be 12,000 ppb not 11,000 ppb; Figure 2-19: well FC should have PCE concentration of 910 ppb not 1800 ppb; Figure 2-20: well FC should have a TCE concentration of 4600 ppb not 9000 ppb, well SB 27D should have a TCE concentration of 7500 ppb not 7100 ppb, and well CE should have a TCE concentration of 37 ppb not 41; Figure 2-22: well FC should have a vinyl chloride concentration of 950 ppb not 2100 ppb, and well SB 27D should have a vinyl chloride concentration of 4300 ppb not 3300 ppb; and Figure 2-23: well FC should have a toluene concentration of 260 ppb not 420 ppb, well SB 27D should have a toluene concentration of 6600 ppb not 6100 ppb, and well CE should have a toluene concentration of 2200 ppb not 2400 ppb. It is advised that the data represented in these figures be reviewed for accuracy and revised accordingly.

In addition, bedrock monitoring well JS should be illustrated on the bedrock figures not the overburden figures.

Response: The data represented in these figures will be reviewed for accuracy and revised accordingly. The completion log and elevation data for well JS suggest that it is completed within the alluvium. It is believed that boulders were encountered upon drilling, leading to its former characterization as a bedrock well.

Comment

27) Table 2-6: Revise the table to reflect groundwater analytical results illustrated on Table 2-5. In particular, the analytical results for Well G should have a 1,2 DCE concentration of 2100 ppb, not 540 ppb, and a Methylene Chloride concentration of 200(u), not 5 J. It is advised that the Table 2-6 analytical data be reviewed for accuracy and revised accordingly.

Response: Corrections will be made.

Comment

28) Table 2-7: Revise the table to reflect groundwater analytical results illustrated on Table 2-9. In particular, the analytical results for Well FC should have a 1,2 DCE

concentration of 8700 ppb, not 9000 ppb.

Response: Corrections will be made.

Comment

29) Figure 2-25: Please provide a comprehensive list of the groundwater sampling analytical results for overburden wells SB 34S, SB 46, OBD-1, OBD-2, and SB 9S. The analytical results for these wells were not provided in Table 2-5 and/or Table 2-6.

Response: Analytical data for wells SB-34S and SB-4S are provided in Table 2-6. These wells were not sampled in 1992 and are therefore not included in Table 2-5. Data does not exist for the other wells mentioned, OBD-1, OBD-2, and SB-9S.

Comment

30) Figure 2-26: Please provide a comprehensive list of the groundwater sampling analytical results for bedrock wells BED-1 and BED-2. The analytical results for these wells were not provided in Table 2-5, Table 2-8, or Table 2-9.

Response: These wells were installed during Pre-Design in 1989 as pumping test extraction wells, were never sampled and, therefore, are not included on Table 2-5 and 2-6.

Comment

31) Page 2-55; Section 2.7.2: Please explain why during Day 5, MEK concentration of 50 ppb remained the same from influent to effluent; and why during Day 12 and Day 18, MEK effluent concentration increased from undetected (10U) to 50 ppb? In addition, if any influent groundwater samples have been collected and analyzed from the Water Treatment Plant during Source Control dewatering activities (excluding the treatment of effluent from XTRAX process), then please provide a summary of these analytical results.

Response: We do not have explanations for the described data. The point of including this data was to show that the GWTP will be capable of decreasing ketone concentrations and that the concentrations of ketone in the effluent are much lower than the proposed effluent discharge limits. Any additional data will be included.

Comment

32) Page 2-61; Section 2.8; paragraph 2: The text states, "A design influent concentration was estimated for each contaminant based on the minimum and maximum concentrations and the source of the data. For instance, more emphasis was place on the 1992 DRWP, design and CWM data since it is more recent." This is not an

appropriate approach to use for determining a design influent concentration. Data from monitoring wells can not be directly compared to the design of groundwater pump and treat extraction wells. The negative pressure applied to the aquifer will draw higher concentrations of contaminants, and possibly free phase product, to the extraction well. In addition, according to Table 2-12, the maximum concentrations of Ketones, as well as most VOAs, were during the 1985 comprehensive sampling round. In 1989, all the wells were sampled again, but had very high detection limits which raises questions regarding the presence of VOAs below the detection limits. In 1992, only 16 out of the 52 wells were sampled at the site, and many of the 1985 wells that had maximum Ketone concentrations were not included in this 1992 sampling event. In addition, during source control operations, the Water Treatment Plant (WTS) has been attempting to treat influent with high concentrations of acetone. Given the analytical results of dewatering points and WTS influent, it is likely that the high acetone concentrations are a result of on-site soil and groundwater contamination. Therefore, it appears prudent to be conservative and incorporate the maximum concentrations Ketone and VOA analytical data from the wells sampled in 1985, as well as WTS influent concentrations to determine estimated design influent concentrations.

<u>Response:</u> It is the Group's opinion that the maximum concentrations detected in 1985 for each parameter should not be used as the design basis influent concentrations. The 1985 data is almost 10 years old, and it has been shown that a decrease in ketone contamination has occurred since then. High detection limits did occur for some of the wells in 1989, but the decreasing trend is still apparent in many wells. It is agreed that WTS influent data more closely represents data which will be obtained during full-scale groundwater remediation than individual well data. This has been taken into account in the MOM Design. As inferred by Specific Comment 31, the high acetone concentration in the WTS influent was detected only when the WTS was treating X*TRAX condensate. This data is not applicable to the MOM Design.

All of the recent ketone data collected from 1990 to 1994 is presented in Tables 2-12 through 2-14 in the MOM 60% Design Report. WTS influent and effluent data collected when X*TRAX condensate was being treated has not been included in these tables. All of the data in these tables, with one exception, are below the following discharge standards:

- Acetone - 3000 ug/L
- 2-Butanone (MEK) - 350 ug/L
- 4-Methyl-2-Pentanone (MIBK) - 350 ug/L

The exception is 2-Butanone detected in the influent at 500 ug/L during CWM's monitoring in February 1992. This was the only compound in the raw groundwater detected above the standard. All effluent concentrations during these sampling rounds were well below the standards.

In summary, the Group believes that it is not necessary to consider ketones as contaminants of concern during the design of the groundwater treatment plant for the following reasons:

1) Out of 42 samples, no ketones were present in the untreated groundwater in recent applicable data above the discharge standards, with one exception. No ketones were present above the discharge standards in the effluent samples.

2) The effluent sampled during the 1990 pilot-scale study and CWM/RUST's pilot- and full-scale operations contained significantly fewer ketones than the influent, indicating that the ketone concentrations are reduced in the treatment system. The unit operations in both the pilot-scale and CWM/RUST systems are very similar to those proposed for the MOM groundwater remediation system. In particular, the air strippers used in these systems were operated at ambient temperature similar to the proposed stripper in the MOM Design.

3) After many months of SCR operations, the only time acetone problems were encountered was when the XTRAX system generated it. All influent and effluent that was not impacted by XTRAX did not contain significant levels of acetone or other ketones.

The Group confirmed the absence of high levels of ketones in the groundwater by collecting several influent samples in May and June, 1994. These results are included on Table 2-14 in the report. Finally, if, during full-scale operations, it is determined that ketones are present and are not being treated to effluent discharge standards, the groundwater treatment plant can and will be modified to treat ketones.

<u>Comment</u>

33) Sect. 2.8 (pg. 2-61): The last paragraph states that "the design influent concentrations are not calculated average concentrations; rather, they are estimates which are considered conservative." What is the basis for the estimates? It is difficult to see a pattern for estimating design influent concentration based on the recent data from Table 2-15. The U.S. EPA practice is to use all the validated data available, and use a conservative basis (the highest detected value or the upper 95% confidence limit of the arithmetic mean) for estimating the representative concentration (Reference: Risk Assessment Guidance for Superfund Sites, Volume I, EPA/540/1-89/002).

<u>Response:</u> The Risk Assessment Guidance is applicable to determining input to risk assessments and does not include practical considerations for the design of a groundwater treatment plant. The design influent concentrations were estimated using good engineering practice.

<u>Comment</u>

34) Sect. 2.8 (pg. 2-61): It may be useful to see a table of data validation qualifiers with a description for each qualifier, and whether the data with a particular qualifier could

be utilized for estimating design influent concentration.

Response: Data validation qualifiers are defined on Tables 2-5 and 2-6. Any data not considered useful is rejected during data validation (qualified with an R). The rejected data have not presented or used. Data qualified with a J (estimated) or a D (diluted sample) are included.

Comment

35) Sect. 2.8 (pg. 2-62): Include the maximum detection limit for chemicals reported as ND in Table 2-15, and note accordingly in the table.

Response: The table is for use in estimating influent concentrations. The maximum detection limits would not change the estimates. Therefore, the table will not be modified.

Comment

36) Page 3-1: The primary criteria for the groundwater modeling is attaining clean-up levels. This should be added to the criteria list.

Response: This criterion is directly applicable to the overall approach to MOM remediation but not directly applicable to modeling because transport modeling was not performed. Therefore, the text will not be modified.

Comment

37) Page 3-2; paragraph 2: One of the Agency's primary criteria for groundwater restoration is minimizing the clean-up time. Therefore, the Resolve Site Group is required to incorporate the criteria of minimizing clean-up time in the MOM design.

The Resolve Site Group's estimated clean-up time for DNAPLs is on the order of hundreds of years. This estimate is unacceptable when applied to primary criteria of minimizing clean-up time. The Resolve Site Groups's MOM remedy must be designed to attain clean-up levels and minimize the length of clean-up time, as well as other objectives and standards outlined in the ROD, CD, and RD/RA SOW. The MOM Remedy must be flexible so it can be enhanced, modified, and/or amended. It may also be necessary to conduct additional site characterization to identify and locate the DNAPLs which may be acting as a continual source to the aqueous plume. Wherever practicable, these DNAPLs must be removed or treated. These activities would assist in minimizing the clean-up time.

Response: The estimate of hundreds of years is based on the physics of pool dissolution, and applies to a pumping situation (e.g. pump-and-treat system in place). Currently there is no other technology that has proven itself in a field situation for conditions similar to that at ReSolve. See the response to General Comment IV.

Comment

38) **Page 3-2; Clean-up time of on the order of Hundreds of Years (ENSR, 1993):** It is stated that "where DNAPL is present in the aquifer at ReSolve, the clean-up time is estimated to be on the order of <u>hundreds of years</u> (ENSR, 1993).". Considering the identified DNAPL hot spots, DNAPL <u>recovery well methods near the hot spot area</u> such as cooling pond area and old oil spreading area (See also Figures 2-25 and 2-26) should be evaluated in addition to the development of a hydraulic containment barrier by the pumping of ground water. Without removal of DNAPLs at hot spots, a containment system alone can not be an effective remedy over time.

<u>Response:</u> See the Response to General Comment I.

Comment

39) Page 3-2; paragraph 3; bullets: The three bullets listed on this page are considerations not criteria. The text's primary criteria for evaluating remedial scenarios is **attaining groundwater clean-up levels**. Please amend accordingly.

In addition, PTC should model the mass transport of contaminants to determine the effectiveness of restoring the groundwater aquifers to the appropriate clean-up levels.

<u>Response:</u> These three bullets are criteria for the modeling effort. Use of these criteria will result in a system that contains the DNAPL area and restores the dissolved phase plume to clean-up levels. PTC can not model DNAPL migration and remediation and, therefore, will not be used.

Comment

40) Page 3-4; paragraph 2: The description of these two overburden layers (1 & 2) should be based upon the Site boring logs and the distinctive subsurface geologic stratifications (see Figure 4-5 Geologic Profile Section C-W5, of CDMs "Review of the Off-site Remedial Investigation", February 1987). It appears rational that layer 1 would consist of gray/gray-green/brown sand, silt & gravel, and layer 2 would consist of Dense gray/brown sand, gravel & silt (note: layer 2 also had boulders present). Please amend accordingly.

<u>Response:</u> The text will be supplemented to describe the nature of the alluvial material. However, it should be understood that the separation of the alluvium into two layers reflects a modeling need and was not undertaken on the basis of distinct lithologic differences.

Comment

41) Sect. 3.2 (pg. 3-4): The elevation of the bottom and top of the layers in the model is not clearly presented in the report. For example, does the upper water table aquifer

pinch out away from the central, Resolve Site, portion of the model? The narrative does not present how this type of geologic variation was incorporated into the model. The top and bottom elevations presented in the model input files, Appendix L, are of limited use to the reviewer when the Site topography is not known.

Response: The text discusses the base of layer 2 (the bedrock surface), the base of layer 1 (halfway between the bedrock surface and land surface), the base of layer 3 in the Site area (15 feet below the bedrock surface), and the base of layer 4 (9 feet MSL). The base of layer 3 outside the Site area is not fully discussed. To the north, south, and east of the site area, the base of layer 3 remains virtually horizontal at an elevation of about 50 feet MSL. To the west it rises gradually, reaching an elevation of about 80 feet MSL at the western boundary of the mesh. This will be added to the text.

As noted in the text, layer 1 is simulated as a water table layer, and layers 2 and 3 as convertible layers. During the simulations, calculated water levels in the outer columns of the mesh fell below the base of the layer in layers 1 and 2, so that these layers became inactive in those areas. Thus, the calculated results indicate that the water table falls within the bedrock in the upland areas to the east and west of the site, and in that sense the glacial aquifer pinches out. However, the thickness of overburden is represented as constant (23 feet) in the outer parts of the mesh, and the calculation is allowed to determine what part, if any, of this thickness is saturated.

Comment

42) Sect. 3.3 (pg. 3-8): The assumption that all the boundaries of the model are "no flow" needs further support and discussion. The surficial deposits at the Site and the site vicinity may have no flow boundaries along the east and west edge of the model. However, the north and south boundaries may not be a no flow condition. The water table map of the Site indicates that groundwater enters and exits the study area from the north and south, respectively. The groundwater model should reflect this observed condition. The representation of the bedrock unit in the model needs additional data. Groundwater flow directions in the bedrock will be controlled by the orientation and degree of connection of the fractures. The report states on page 2-33, "The orientation of the fractures is not known.". Without any information presented on the orientation of the fractures, the assumption of a no flow boundary in the bedrock layers cannot be supported. If additional information is available it should be presented.

The report does state that the external boundaries of the model have little effect on the central and primary portion of the model. The concern is that there may be boundaries in the field which are adjacent or within the central portion of the model which are not represented in the model. This cannot be evaluated with the data presented. The report should be revised to address this concern.

Response: 42a) **Northern and Southern Boundaries**
Other boundary conditions were tried along the northern and southern edges of the mesh during the initial model runs, and had no influence on conditions within the Site area. The effect of these boundaries was absorbed by the simulated evapotranspiration and recharge in the outer parts of the mesh, by the effect of marshlands as represented using the MODFLOW Drain option, and by the effect of surface water bodies as represented using the MODFLOW River option. The primary purpose in extending the model over a large map area was to insure that uncertainties regarding the boundaries would have no influence on calculations in the central fine-mesh area, and on the evaluation of remedial options.

42b) **Fracture Orientation**
Hydraulic conductivity in a fractured aquifer is controlled by the number, interconnection and size of the fractures. Fracture orientation, on the other hand, influences the degree to which the aquifer is a really anisotropic, i.e., the degree to which it exhibits higher hydraulic conductivity in certain map directions than in others. The available data on water levels and solute distributions, in relation to surface water features and solute source areas, show no indication that the bedrock at the Resolve Site is consistently higher in hydraulic conductivity in one direction than in any other. Therefore, we do not believe that data on fracture orientation is critical to an adequate representation of hydraulic conditions in the bedrock.

The use of no-flow boundaries is discussed above. The decision to use no-flow boundaries was not based on inference or assumptions regarding hydraulic conductivity at the boundaries.

42c) **Effect of Boundaries Within the Central Model Area**
There is no evidence that hydraulic conductivity within the site area shows major and consistent areal variations, which could be classified as hydraulic boundaries, in either the bedrock or the overburden.

Comment

43) Page 3-10: The text is not clear why recharge was applied to model cells underlying surface-water bodies. If the surface-water body does not cover the area of a model cell, application of a recharge rate is reasonable. However, the area of the cell covered by the surface-water body should be taken into consideration when applying recharge. If ground-water flow is to the surface-water body, precipitation that falls on the surface water body would become stream flow. If the stream is a source of recharge, the stream and river packages used will provide the necessary flow. Perhaps these factors have been considered, but the description is not clear.

Response: The model uses the USGS stream-aquifer option, in which flow and storage in surface water bodies and flow between surface streams and the aquifer are calculated through a water balance approach. The objective of applying recharge to the cells containing surface water bodies was to include recharge in the water balance of the stream reaches represented by the stream-aquifer option. This could have been done by modifying the surface water simulation routine. However, because stream-aquifer conductances in the Resolve model are relatively high, the same effect can be achieved by adding recharge to the model cell underlying the stream reach. This approach eliminated the need to revise the surface-water calculation routine, while providing a reasonable representation of recharge effects on surface-water bodies. For surface streams represented by the MODFLOW River option, rather than the stream-aquifer option, the addition of recharge to the underlying cell had no measurable effect on calculated results.

<u>Comment</u>

44) Page 3-12; Section 3.5: The text states, "This approach was used under the assumption that the water levels in the Copicut River and Cornell Pond would be unaffected by operations at the site." Because the approach utilizes extraction wells along the river, the Agency does not believe it is reasonable to assume that the water levels will be unaffected. Please provide additional evaluations/studies/models to support the assumption.

<u>Response:</u> A well pumping at 5 gpm near a river flowing at 10 cfs (4500 gpm) will not have a significant impact on the river's water level.

<u>Comment</u>

45) Page 3-16; paragraph 1: The text states, "The hydraulic conductivity of the stream bed layer was taken as 0.28 ft/day initially, but was increased to 28 ft/day in the fine mesh area and in areas south of the site during model calibration." Please explain why these conductivities are so different. In addition, please explain why you consider these values "consistent"?

<u>Response</u> (45, 47 and 48): During model calibrations, the initial streambed hydraulic conductivity was taken arbitrarily as 0.28 feet/day for all streams, whether represented by the MODFLOW River option or the stream-aquifer calculation procedure. The streambed conductivity value was adjusted as necessary in calibration to achieve agreement between observed and calculated ground-water levels, while retaining aquifer hydraulic conductivities consistent with field test results and a recharge value consistent with regional climatological data.

The discussion in the last paragraph on page 3-12, continuing to the top of page 3-16, refers to the streambed hydraulic conductivity of the Copicut River and Cornell Pond. For these features, the streambed conductivity was increased in calibration by two orders of magnitude in the fine mesh area and in the area south of the site, and was left unadjusted north of the fine mesh area. No adjustment was made to the conductivity of the Copicut River north of the fine mesh area because calculated water levels in that area were at reasonable depth below land surface using the initial estimate (depth to water represents the only available calibration criterion in that area, as no water-level measurements exist).

The discussion in the last paragraph of page 3-18 refers to the conventional stream channels represented using the stream-aquifer routine. These include the unnamed tributary, the connector channel and Carol's Brook. In these stream reaches the streambed hydraulic conductivity was adjusted to 15 feet/day during calibration. The discussion in the first paragraph on page 3-19 refers to the ponded area to the north of the Site, which was also represented using the stream-aquifer option. For this feature the streambed conductivity was reduced in calibration to 0.15 feet/day. The lower value is consistent with the fact that this feature is a pond rather than a flowing stream, and would be characterized by fine sediment and organic materials, rather than by coarse streambed materials.

The various estimates of streambed hydraulic conductivity are described as "consistent" in the report for two reasons. First, they produce agreement with observed water levels and are therefore consistent with the other hydrologic inputs to the model. Second, the range of variation involved, approximately two orders of magnitude, is actually very small when compared with the potential variability of streambed sediments.

The text will be revised to incorporate the above comments.

Comment

46) Page 3-16: Inflow to the stream-simulated reaches on Carol's Brook is not discussed.

Response: As stated in lines 22-23, inflow at the upstream ends of all stream segments represented by the stream-aquifer routine was taken as zero, except for the connector channel.

Comment

47) Page 3-18; paragraph 3: On page 3-16, paragraph 1, the conductivity of the stream bed layer was increased to 28 ft/day. Why is this stream bed layer estimated at 15 ft/day? Shouldn't it be 28 ft/day? Please clarify.

Response: See above response to 45).

Comment

48) Page 3-19; paragraph 2: On page 3-16, paragraph 1, the conductivity of the stream bed layer was increased to 28 ft/day, and on Page 3-18, paragraph 3, the stream bed layer conductivity was estimated at 15 ft/day. Why is this stream bed layer for the ponded area estimated at .15 ft/day? Please clarify.

Response: See above response to 45).

Comment

49) **Page 3-20; Anisotropy of Hydraulic Conductivity:** The anisotropy, or ratio of vertical to horizontal hydraulic conductivity, was taken as 0.1 for all model layers. This anisotropy ratio may be reasonable for overburden layers, but unreasonable for fractured bedrock layers (i.e. Layers 3 and 4). Page 2-32 described variable fracture angles and orientation of the bedrock. It is believed that the anisotropy ratio (K_v/K_h) in most igneous/metamorphic formations is greater than 0.1. Provide information to support your assumption on the selected anisotropy ratio of the bedrock layers.

Response: The anisotropy ratio was a calibration parameter in the radial flow analysis of the aquifer tests in the overburden and bedrock wells. Many values of anisotropy were evaluated in the analysis of the tests. The selected value enabled a good fit of observed to calculated water levels in both overburden and bedrock observation wells for both tests, as is indicated in Figure 3-9 and 3-10. Similarly, the selected value allowed a good match of steady-state water levels. The water level data is the best and only data available to evaluate this parameter. The selected value is considered reasonable because it is consistent with these data. The available data for evaluating this parameter are more abundant than at many sites, and lend confidence to the estimate. The text will be clarified.

Comment

50) Page 3-20; paragraph 3/page 3-21; Table 3-1: The hydraulic conductivities assigned for Layer 1, upper overburden, at 20 ft/day and Layer 2, lower overburden, at 25 ft/day appear to be inappropriate hydraulic conductivities for the given subsurface geological stratification. In particular, layer 1 comprises of gray/gray-green/brown sand, silt & gravel, while layer 2 comprises of **Dense** gray/brown sand, gravel & silt with boulders (see comment page 3-4, paragraph 2). It does not appear reasonable for Layer 2, being more **Dense**, to have a higher hydraulic conductivity then Layer 1. In addition, a hydraulic conductivity of 25 ft/day for a dense silty, sand and gravel appears high for this type of formation. Please clarify.

Responses: The values for hydraulic conductivity were calibration parameters in the radial flow analysis of the aquifer test and the steady state calibration with the site model. As described in the answer to comment 49, the successful matching of water level data for both transient and steady state conditions provides confidence in the selected values. The selected values are not inconsistent with the observed lithologies. As discussed previously, our examination of logs does not support a conceptual model of two distinctly different layers within the alluvium characterized by markedly different hydraulic properties. While the selected values resulted in the best match of measured conditions, we do not consider a value of 20 to be significantly different from a value of 25 feet per day. In fact, these parameters will likely be modified somewhat when operational data become available. The text will be clarified.

__Comment__

51) Page 3-22: Presumably the drawdown data used to determine hydraulic properties were from the end or near the end of aquifer tests after partial penetration and delayed drainage effects were surpassed. The pumping duration for the drawdown data used for the analysis should be given.

__Response:__ Drawdown used in the distance-drawdown evaluation of the bedrock test (BED-1) was after one day of pumping. Drawdown used in the distance-drawdown evaluation of the overburden test (OBD-2) was following one day of pumping (rainfall events occurred later in the test). Partial penetration and delayed drainage effects were not a concern in selecting the time of evaluation, because both of these processes are explicitly represented in the radial flow model. The text will be revised.

__Comment__

52) Page 3-23; Figure 3-9: Please define the Upper Overburden and Lower Overburden Layers, and illustrate the layers on cross-sectional maps.

__Response__: As described above in Comment No. 40, it is not believed that lithologic differences are sufficient to subdivide the overburden other than by general depth intervals.

__Comment__

53) Following the rationale of previous comments, it appears that the upper layer (layer 1) is bound by the gray/gray-green/brown sand, silt & gravel zone and the lower overburden (layer 2) is bound by the **Dense** gray/brown sand, gravel & silt with boulders. This appears the most logical approach. Therefore, upper overburden and lower overburden well selection should be re-evaluated in determining which well is in which zone. For example, Well FE is located on a topographical high and its well screen is situated within the upper overburden, not the lower overburden. In addition, Well OW-7S should be situated in the upper overburden, not both the upper and lower overburden. The hydraulic conductivities selected for the upper and lower overburden layers need to be revised, accordingly.

__Response__: See response to 52).

__Comment__

54) Page 3-25; paragraph 3: The hydraulic gradients estimated for the regional flow for layers 1 and 2 were revised to 1 ft/day, based upon model calibration and literature information, which the text states "are consistent with the presence of low permeability glacial drift." These values for layers 1 and 2 significantly differ from on-site hydraulic conductivities on Table 3-1. Please explain the reason for such a variance.

Response: According to Willey, et al (USGS Hydrologic Atlas 275), the overburden in the Copicut River valley consists of glacial sand and gravel having good water-bearing properties, whereas the overburden on the uplands bordering the valley consists of glacial till or drift with little potential for groundwater development. For this reason, the overburden in the upland areas was assigned a lower conductivity value than that in the valley. The text will be revised.

Comment

55) **Page 3-28; Sheet Piles**: Explain how sheet piling installed around the perimeter of the XTRAX pad area did not constitute a significant barrier to flow. It is believed that practically, aquifer test results at overburden well OBD-1 (not at bedrock well BED-1) should be used to evaluate the effects of sheet piling installed around the perimeter of this area. In fact, test results at overburden well OBD-1 were not amenable to evaluation because OBD-1 was screened within a boulder and could not sustain a reasonable pumping rate. The presence of a big boulder and/or of sheet piles might cause adverse impacts on the proposed long term extraction well system due to local flow boundary conditions. As long as two new extraction wells (RW-2 and RW-3) near the existing sheet-piling are proposed, a detailed analysis of any effects of the existing sheet piles on the ground-water extraction system should be provided.

In addition, provide all calculations, assumptions, and any other data/figures on how the simulation was conducted and it associated results. What model was used to perform this simulation?

Response: The effect of sheet-piling on Site hydraulics was evaluated by modifying the model to simulate dewatering from within the sheet-piling as occurred during excavation. For this simulation, the hydraulic conductivity of model cells along the sheet-piling location was decreased to simulate a continuous barrier. Estimated dewatering rates from within the sheet-piling were simulated, and calculated water level declines outside the sheet-piling were evaluated against reported information. Observed water level declines could not be matched with boundary conditions representing the presence of the hydraulic barrier, (i.e., model calculated drawdowns were lower than observed beyond the sheet-piling and higher than observed inside the sheet-piling) under the assumption that the sheet-piling was intact. Observed water levels indicated that the sheet piling does not represent a significant flow barrier. This simulation was conducted using the MODFLOW site model described in the report.

In general, the presence of sheet piling and boulders will not have significant impacts on groundwater recovery, because neither are continuous barriers. The sheet piling is not keyed in to an impervious layer, and the boulders are typically not larger than 5 to 10 feet in diameter. Flow paths will change to conform to these features, but groundwater flow and recovery will still occur.

Comment

56) Page 3-28: Water levels measured on May 8, 1990, were used for model calibration. Water level data for Bristol County, Mass., published by the USGS (Socolow and others, 1990: U.S. Geological Survey Water-Data Report MA-RI-90-11) indicate that water levels during May in the region that encompasses the ReSolve site were relatively high and exceeded average water levels. The report should include a discussion of the representativeness of water levels used for calibration and the consequences if the water levels used do not reflect average conditions.

Response: If the water levels used in calibration were actually higher than average, the only possible impact on the simulations would be to make the evaluation of remedial options more conservative. To the extent that the water levels matched by the simulations were above average, the calculated groundwater flows away from the site would also be above average. Thus, remedial designs and pumping rates developed through simulation to control those flows would apply to above average flow rates.

Comment

57) Sect. 3.9 (pg. 3-35): This section recommends the collection of water level, stream elevation, stream flow and aquifer test data to update the model. Specifics are needed regarding plans for, and the frequency of collection of any additional data.

Response: Sections 6.3.1 and 6.3.2 describe the plans for and frequency of collection of additional data.

Comment

58) Page 3-36: Consideration should be given to monitoring water levels continuously in several wells for several months to observe responses to natural stresses, specifically recharge pulses. The magnitude of a water-level rise and the nature of the recession after a rise should be useful for model testing and refinement prior to installation of the remedial systems. Water level data collected during the aquifer test indicate that the aquifer is highly responsive to recharge pulses. Water level responses to stream-stage changes near the Copicut River would also be useful for model testing and refinement.

Response: See response to 57).

Comment

59) Sect. 4.1 (pg. 4-1): The contaminants were found in bedrock on both sides of the river, Figure 2-26, not just west of the river as stated. The text should be corrected to read "...isolated areas of bedrock east of the river...".

Response: The comment notes a typographical error which will be corrected.

Comment

60) **Page 4-2; Critical horizontal gradient:** It is stated that the critical horizontal gradient, above which a risk of DNAPL re-mobilization is a concern, is on the order of 0.005 to 0.010. It appears that the critical horizontal gradient is mainly dependent upon pool length assuming other parameters are reasonably selected. Current site data does not indicate a DNAPL pool length was ever encountered and/or measured. Explain how a pool length of 0.2 meter was selected to determine the range of critical horizontal gradient.

Response: The pool lengths are rarely known in practice and are not known for the ReSolve Site. Therefore, the analysis was performed for a range of possible pool lengths (0.2 m to 2.0 m)

Comment

61) Page 4-6; paragraph 1: Reinjection also considers the VOC remaining above the SGL level. How will these contaminants be addressed if reinjection is not implemented (see comment page 1-4; paragraph 2)?

Response: There is no question that a significant mass of VOCs were removed from soils treated during Source Control Remedial Action. It is also true that most soils in VOC hot spot areas were treated. What little VOC contamination remains (i.e soils not excavated) will either be degraded or will be removed by natural flushing due to precipitation both of which will likely occur much faster than DNAPL pool dissolution below the water table.

Comment

62) **Page 4-15; Group 4; WMA Boundary Wells:** It is stated that "Disadvantages to this system are the higher pumping rate than is solely required for containment, with larger impacts on surface water features and an overall increase in gradient.". Has the Group considered/evaluated adding more extraction wells at lower pumping rates to overcome this disadvantage?

Response: The text was referring to total pumping rates for the system. The number of wells would have no bearing on this.

Comment

63) Page 4-21: The statement is made that reductions in stream flow by pumping will be low in comparison to measured flow rates in streams. A summary of measured flow rates in streams would support this statement.

Response: A statement will be added.

Comment

64) Page 4-21; paragraph 3; last sentence: What is the extent of the DNAPLs plume? What is the estimated clean-up time of the VOC plume where DNAPLs are not present?

Response: The extent of DNAPL is discussed in Section 2.6. The time frame for clean-up was not predicted, because transport modeling was not performed due to the inability to model DNAPLs.

Comment

65) Section 5.3.1: According to this section, the discharge limit for carcinogenic compounds based on fish consumption was calculated using an annual flow rate of the Copicut River. This section assumes that this flow rate is more conservation since it is based upon actual Copicut River flow measurements. It is requested that the discharge limit for carcinogenic compounds be calculated using the 7Q10 flow values, rather then the average annual flow rate (reference EPA's October 13, 1992, correspondence from Lorenzo Thantu, regarding SC and MOM remedy discharge limits).

Response: EPA's October 13, 1992 letter states that "When developing limits based on human health criteria, dilution should be based on the average annual river flow for carcinogens and on the 7Q10 flow for noncarcinogens." This requirement has been followed.

Comment

66) Sect. 5.3.1 (pgs. 5-3, 5-5): In Tables 5-1 and 5-2, the fish consumption effluent discharge limit for chlorobenzene is reported as NC though AWQC for fish consumption is known to be 21,000 UG/L. Please clarify.

Response: Agreed. Text will be clarified.

Comment

67) Sect. 5.3.1 (pg. 5-3): 2-Hexanone (MBK) is not a chemical of concern based on Table 2-16, Design Influent Concentrations. Why is it included in the Tables 5-1 through 5-7?

Response: 2-Hexanone will be deleted from these tables.

Comment

68) Section 6: According to this section, no provisions have been made to monitor the nearby residential wells during MOM remedy. The residential wells immediately surrounding the Site should be monitored on a quarterly basis with the other MOM

remedial action monitoring wells. The design plans should outline the residential well-monitoring activities.

Response: Residential well monitoring will be added to the Monitoring Plan.

Comment

69) Page 6-1; paragraph 2: Clearly state who is responsible for monitoring the wetlands restoration during the MOM remedy, and evaluating any MOM impacts to the wetland restoration. Please refer to EPA's July 30, 1993, correspondence, from Joseph F. LeMay, to Michael Last, Esq., incorporating the Agency's comments to the Wetland Restoration Plan, Revision 1. Specifically, these comments in relation to the MOM remedy (i.e. General Comment, paragraph 1; Specific Comment # 11; and Specific Comment # 18).

Response: The monitoring plan will be modified to address this comment.

Comment

70) Page 6-4; paragraph 3: The primary objective is to monitor the effectiveness and performance of the MOM remedy to attain the groundwater clean-up levels at the boundary of the WMA and beyond. Please amend accordingly.

The text states, "In the area impacted by DNAPL which is assumed to be much of the Waste Management Area (ENSR, 1993), pumping will likely be required for an indefinite time period to reduce groundwater concentrations to MCLs." The sentence should be revised to "area possibly impacted ..." Please also refer to previous general comments, as well as specific comments Page 3-1, and Page 3-2 (paragraph 2).

The text also states, "therefore, it is proposed to perform quarterly groundwater sampling (as required by the SOW) at select wells located at the Waste Management Area Boundary rather than at wells throughout the entire site." The proposed quarterly monitoring of "select wells" is inappropriate, and does not comply with the SOW. Monitoring wells within, along and downgradient of the WMA boundary shall be monitored quarterly for the duration of the MOM remedy. Monitoring wells within and downgradient of the WMA boundary will evaluate effectiveness of plume capture and progress of restoration, monitoring wells along and downgradient of the WMA boundary will determine compliance of attaining clean-up levels.

Response: See response to General Comment II.

Comment

71) Sect. 6.3 (pg. 6-4): It is recommended that upgradient surface water station(s) also be monitored quarterly to allow for a comparison with data collected from the

downgradient station(s).

Response: The plan will be revised to include the upgradient surface water station to be monitored quarterly.

Comment

72) Page 6-5; paragraph 1: According to the ROD, CD, and RD/RA SOW, surface water stations shall be monitored quarterly, not annually.

Response: As stated in the MOM 30% Design, quarterly surface water monitoring will be performed.

Comment

73) Sect. 6.3 (pg. 6-5): Sampling Parameters. While the SOW identifies VOCs as indicators of groundwater cleanup, the SOW also identifies a cleanup level for lead as the MCL (now 50 ppb). Lead should be included as a parameter for quarterly and annual monitoring of both surface water and groundwater.

Response: The SOW does not state that samples should be analyzed for all parameters on a quarterly basis. The proposed approach was to monitor quarterly for VOCs only, and once VOC clean-up levels are attained, analyze samples for all compounds including lead to demonstrate compliance. We believe that this is consistent with the SOW, because on page 14 it states that "Treatment to 5 ppb for TCE, PCE, and methylene chloride is expected to reduce other compounds identified in groundwater to non-detectable levels".

Comment

74) Sect. 6.3 (pg. 6-5): The existing monitoring wells "available for use" and shown in Figure 6-1 exclude many of the on-site wells containing the highest historic VOC concentrations. Please explain why these wells (e.g. SB-25D, SB-27D, SB-30S) are excluded?

Response: These wells were abandoned during soil remediation. Some of these wells will be replaced for the MOM Remedial Action. See responses to general Comments II and IV.

Comment

75) Sect. 6.3 (pg.6-5): The groundwater component of the monitoring plan cannot be evaluated without information on the Site geology and hydrogeology. The report does not indicate the saturated thickness or the geologic materials that the existing wells are located within. The confirmation of hydraulic containment requires monitoring the vertical components of flow within the aquifers. The plan as presented does not

present the details of the existing wells or the proposed piezometers. It does appear that additional piezometers will be needed and that these piezometers may need to be installed in clusters. These additional monitoring points may be needed east of the river in the overburden and bedrock and between the proposed extraction wells and the river, as indicated in the report. The report should be revised to include a presentation of the Site geologic and hydrogeologic conditions which support the proposed monitoring wells and piezometer locations.

Response: A discussion of geology and hydrogeology will be added to Section 3.0. Table 2-1 in Section 2.0 of the report lists depths and screened aquifer units of existing wells. Screened units of replacement wells have been added to Section 6.0.

Comment

76) Page 6-7; paragraph 1: The monitoring wells removed or destroyed during the Source Control operations, which will be used for MOM groundwater monitoring, must be replaced (see previous general comments).

Response: See responses to General Comments II and IV.

Comment

77) Page 6-12: Consideration should be given to collecting a continuous record of water levels in one or more background locations to observe responses to natural stresses. Because this aquifer system apparently responds quickly to recharge pulses, a continuous record of water levels may be needed to interpret periodic measurements in other areas. As indicated above, continuous records of water levels would also be useful for model refinement.

Response: Several wells could be considered background wells (e.g. NN, NS, SW, SE) and will be monitored quarterly. Quarterly monitoring is expected to provide ample data for evaluating recharge events.

Comment

78) Page 6-15; paragraph 3: According to the SOW, following demonstration of compliance, groundwater will be monitored quarterly for at least three years, not annually. Please amend accordingly.

Response: The SOW does not specify quarterly monitoring after the demonstration of compliance, only that monitoring be performed for three years.

Comment

79) Section 6.5: The monitoring plan as outlined in this section should be expanded to discuss the coordination of the monitoring activities during the transition from Source

Control Activities to MOM Activities.

It is unclear whether the northern wetland will be monitored during groundwater remediation. According to the groundwater restoration design as presented, the northern wetland may not be adversely impacted during the restoration activities. However, this wetland should be monitored to ensure that it is not impacted. The monitoring plan for the northern wetlands should include the following:

a. Surface water monitoring
b. Groundwater monitoring
c. Transect station monitoring as described in section 6.5.3
d. Furthermore, rainfall information should be included in the progress reports for both northern and eastern wetlands.
e. The monitoring results for the northern wetlands should be submitted to the agencies in the progress report as described in section 6.5.4.

<u>Response:</u> A discussion of coordination of monitoring activities during the transition from Source Control activities to MOM activities has been added to Section 6.0. Section 6.0 has also been modified to include monitoring of the northern wetlands.

<u>Comment</u>
80) Sect. 7.2.2 (pg. 7-12): The volume of sludge holding tank T-6 is listed as 2,500 gal in one paragraph and 2,000 gal in the next paragraph. Please verify the correct size of tank T-6 and revise both the text on page 7-12 and Table 7-4 accordingly.

<u>Response:</u> The values will be corrected.

<u>Comment</u>
81) Sect. 7.2.2 (pg. 7-16): What is the packing material to be used for the air stripper column?

<u>Response:</u> The stripper design has changed. A low-profile stripper will be used instead of a packed tower.

<u>Comment</u>
82) Sect. 7.2.2 (pg. 7-17): In Table 7-6, the media volume is 40 ft^3 per filter (and not 20 ft^3 per filter).

<u>Response:</u> This table is correct - 20 ft^3 for each of the 3 filters.

<u>Comment</u>
83) Sect. 7.2.2 (pg. 7-20): The section that discusses catalytic oxidation unit CT-1

includes combined air streams from the air stripper, aeration tank exhaust, and process tank ventilation system. Specify which process tank ventilation system, and show them on the process and instrumentation diagrams in Appendix B.

<u>Response:</u> The P&IDs will be revised accordingly.

<u>Comment</u>

84) Sect. 7.3 (pg. 7-27): The first line under Filter Feed Tank section should read as "Controls for the **feed tank will** consist..." The third line under Filter Feed Tank section should read as "The low level float switch will serve to stop the **filter feed** pumps."

<u>Response:</u> The text will be revised.

<u>Comment</u>

85) Sect. 7.3 (pg. 7-29): The last line of second paragraph under Air Stripper section should read as "Low level in the stripper sump will stop the **stripper** effluent pumps."

<u>Response:</u> The text will be revised.

<u>Comment</u>

86) Sect. 7.3 (pg. 7-32): The last paragraph discusses the annual operating cost based "...on average influent TOC and total metals concentration of 50 ppm". Is the concentration of 50 ppm each for influent TOC and total metals, or combined?

<u>Response:</u> The concentration is for each. The text will be revised.

<u>Comment</u>

87) <u>Appendix B - Process Flow Diagram</u>: Note the following:

a. pH of 10.0 from aeration/oxidation tank
b. Filter feed tank (and not equalization)
c. The effluent from the bottom of the air stripper is pumped to the liquid phase activated carbon adsorber, and is not pumped to the filter effluent.
d. The effluent equalization tank is 3,000 gal (and not 2,000 gal)

<u>Response:</u> The diagrams will be revised.

Comment
88) Appendix B - Symbols and General Notes: Show sample port symbol on the legend sheet.

Response: The sheet will be revised.

Comment
89) Appendix B - Filtration P&ID: Show equipment no. M-5 for static mixer downstream of filter feed pumps.

Response: The P&ID will be revised.

Comment
90) Appendix B - VOC Treatment P&ID: Note the following:

a. Interlock schedule 11: Stop pumps **P-9 A & B** on low levels in tanks. Manual restart.
b. Show equipment no. CT-1 for catalytic oxidation vendor package.
c. The effluent equalization tank is 3,000 gal (and not 2,000 gal)
d. The discharge from effluent pumps to equalization tank and potassium permanganate dilution water is not shown in the PI-2 and PI-5 respectively.
e. Should there be a sample port connection after the effluent pumps?

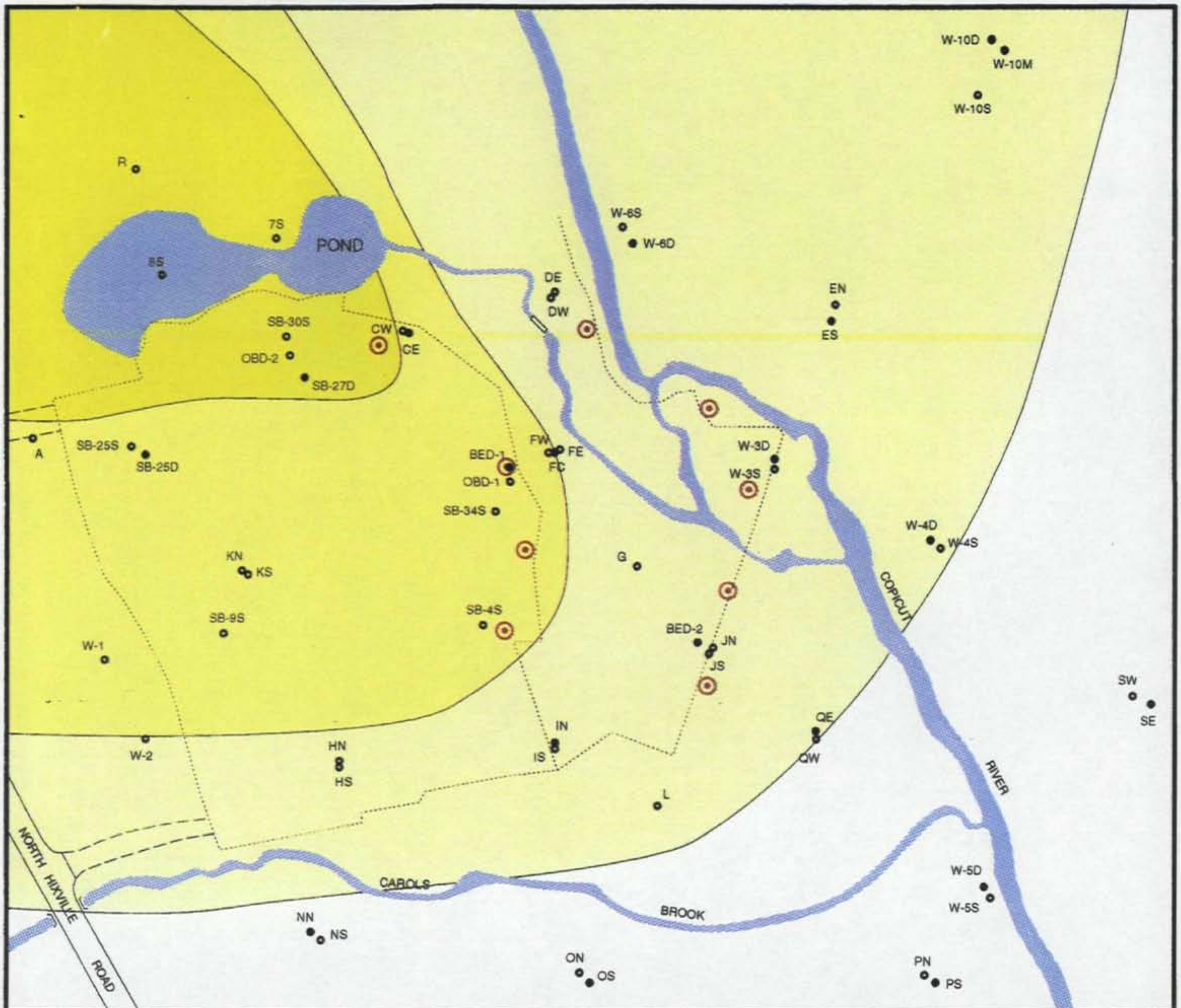
Response: The P&ID will be revised.

Comment
91) **Appendix H; Model Results:** It appears that extraction well RW-4 captures from the WMA area and extraction well RW-7 may induce more water from the east of the Copicut river. Please provide projection of the flow paths on the cross section (E-W) and a three-dimensional view of the capture zone delineated by flow paths to better evaluate Case 4A extraction well system.

Response: Cross-sections will be provided.

TABLE 1
VOC CONCENTRATIONS (in ug/L) AT MONITORING WELLS W5S AND W5D

WELL NAME	DATE	PCE	TCE	1,2-DCE	VINYL CHLORIDE	TOULENE	TOTAL KETONES
W5S	1983	NA	NA	NA	NA	NA	
	1984	5	5	5	ND	ND	
	1985	ND	14	6	21	ND	
	1989	ND	ND	ND	ND	5.3	
	1992	NA	NA	NA	NA	NA	
W5D	1983	NA	NA	NA	NA	NA	
	1984	ND	5	18	10	ND	
	1985	ND	11	18	15	ND	
	1989	ND	ND	ND	ND	ND	
	12/22/92	ND	ND	11	trace	ND	ND
MCL		5	5	70 (cis), 100 (trans)	2	1000	none found



Explanation

Fence

Overburden well

Bedrock well

Proposed extraction well

Capture zone of upgradient wells

Capture zone of WMA wells

Capture zone of downgradient wells

Total pumping rate of 45 gpm

N

0 150 300

Scale feet

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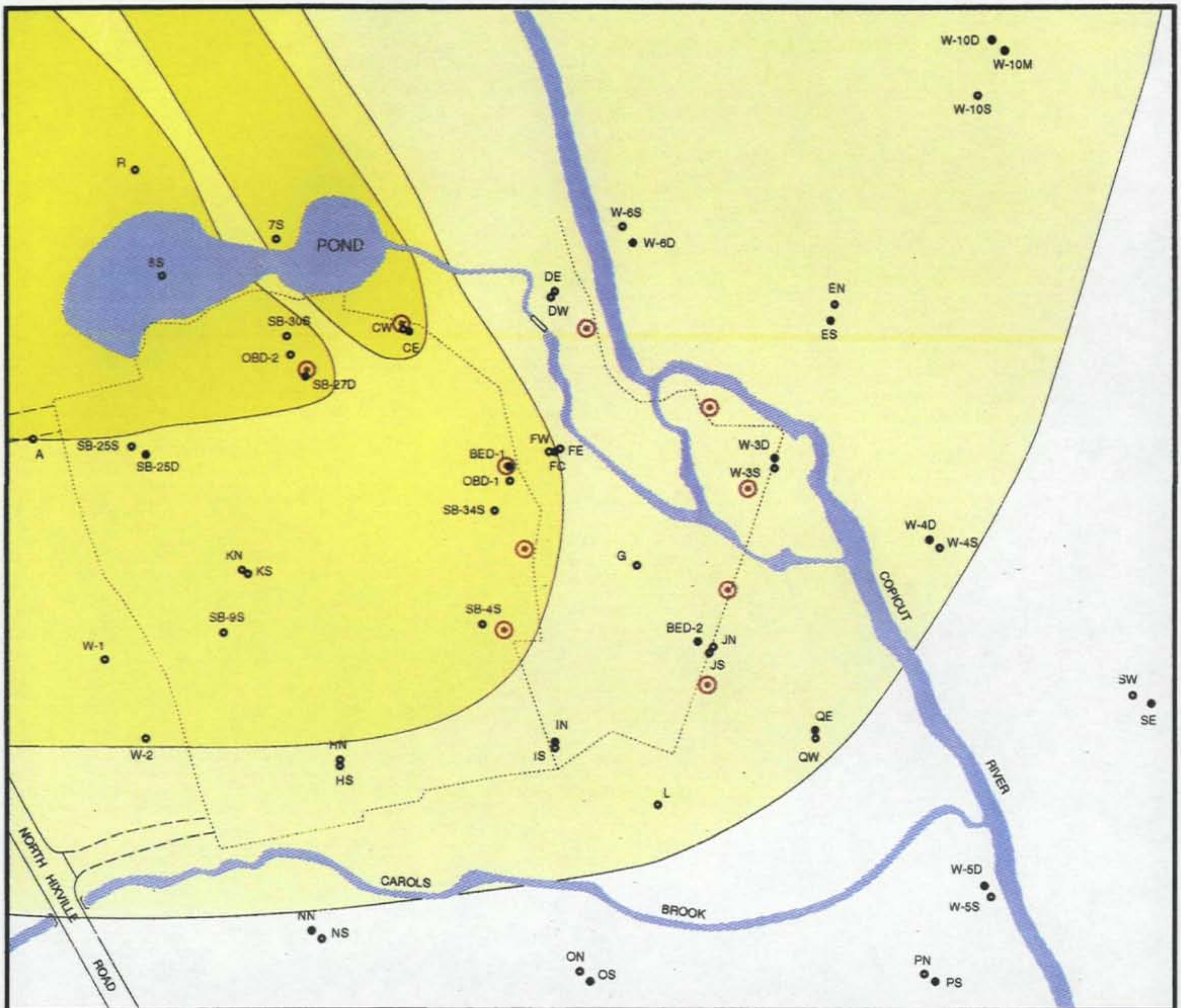
CAPTURE ZONES WITH ONE ADDITIONAL EXTRACTION WELL (5 gpm)

FIGURE 1



Explanation

- Fence
- Overburden well
- Bedrock well
- Proposed extraction well
- Capture zone of upgradient wells
- Capture zone of WMA wells
- Capture zone of downgradient wells

Total pumping rate of 46 gpm

N

0 150 300
Scale feet

$\Sigma^2\Pi$
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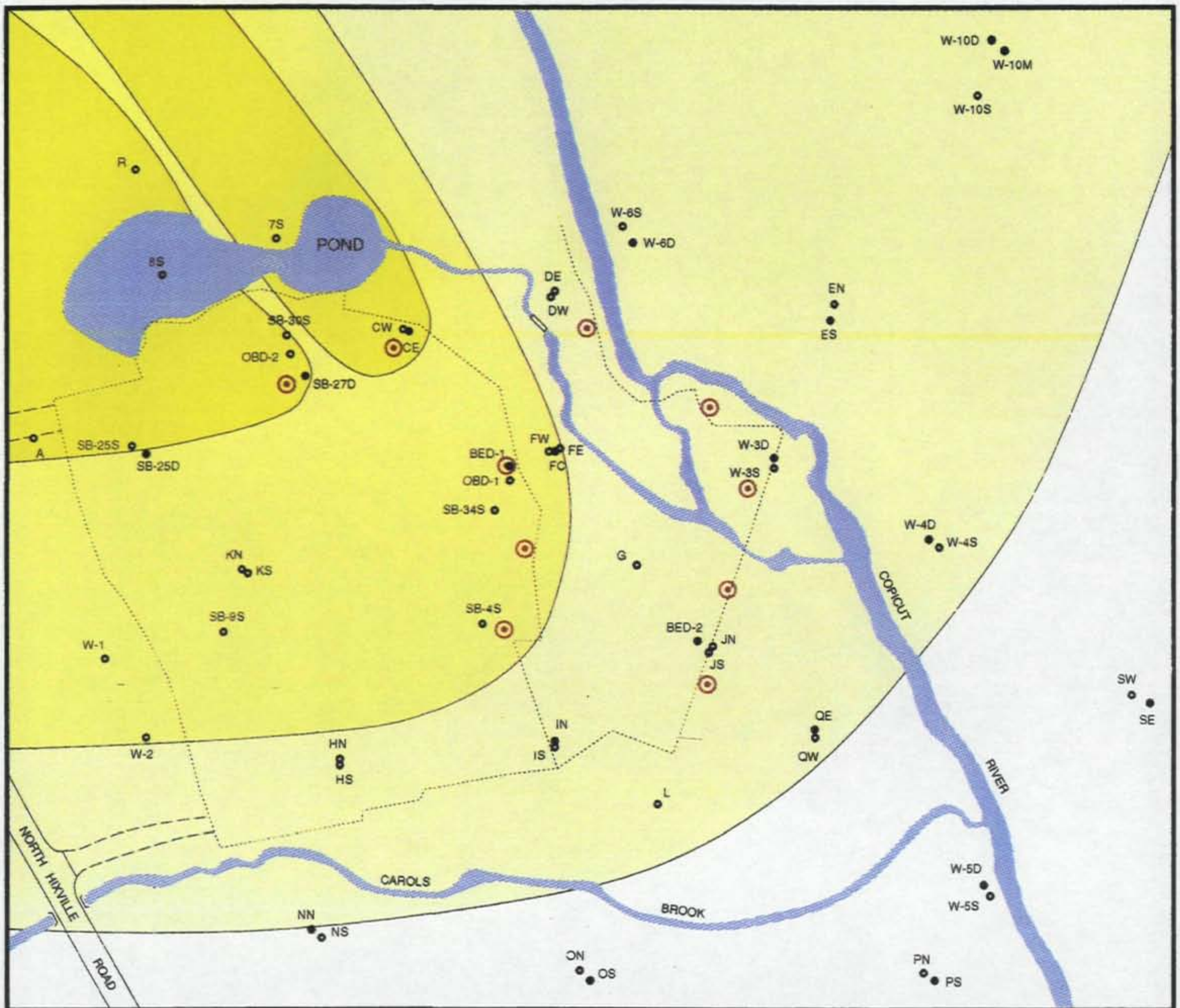
CAPTURE ZONES WITH TWO ADDITIONAL EXTRACTION WELLS (3 gpm each)

FIGURE 2



Explanation

- Fence
- Overburden well
- Bedrock well
- Proposed extraction well
- Capture zone of upgradient wells
- Capture zone of WMA wells
- Capture zone of downgradient wells

Total pumping rate of 50 gpm

N

0 150 300
Scale feet

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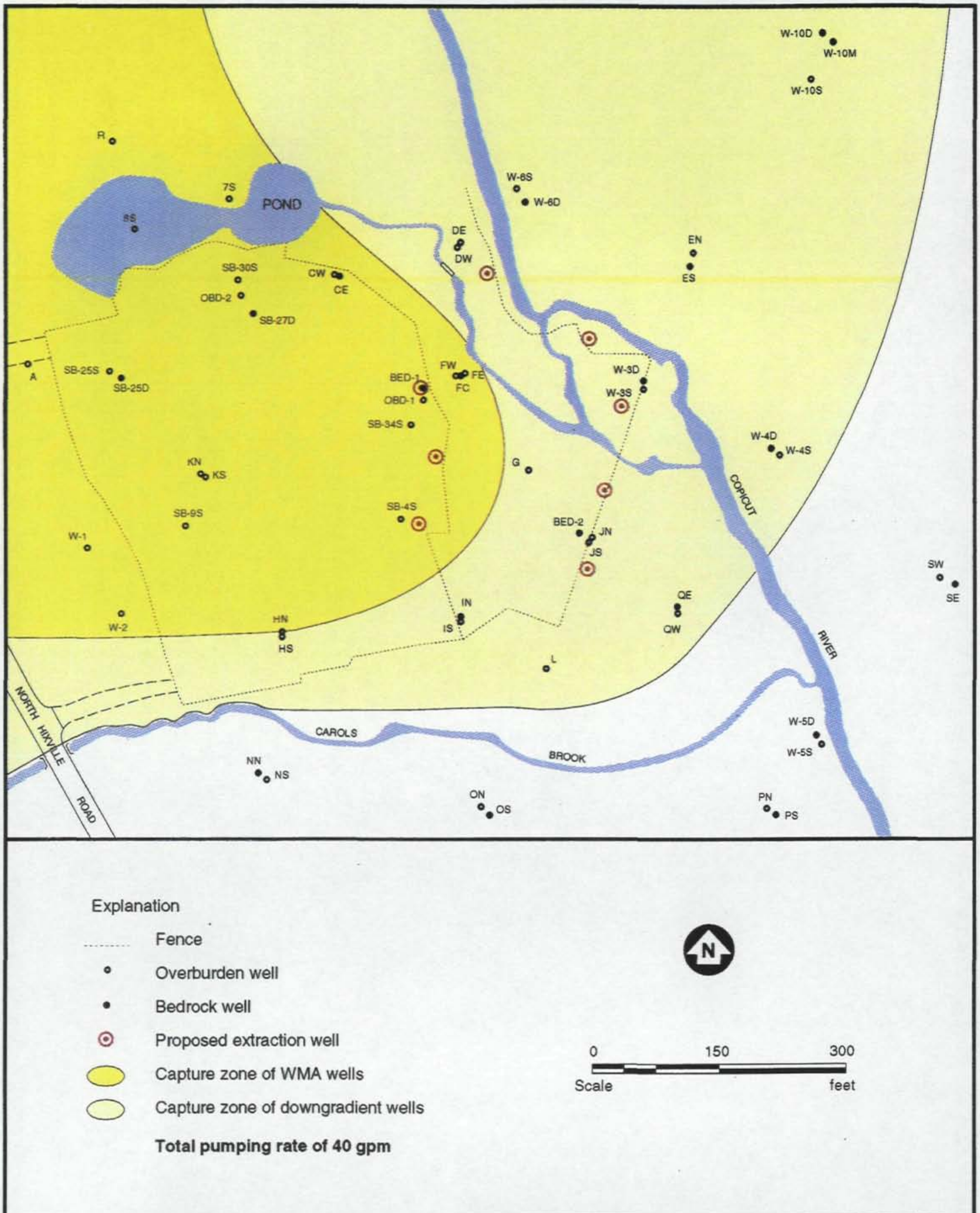
ENVIRONMENTAL & WATER-RESOURCE CONSULTANTS

CAPTURE ZONES WITH TWO ADDITIONAL EXTRACTION WELLS (5 gpm each)

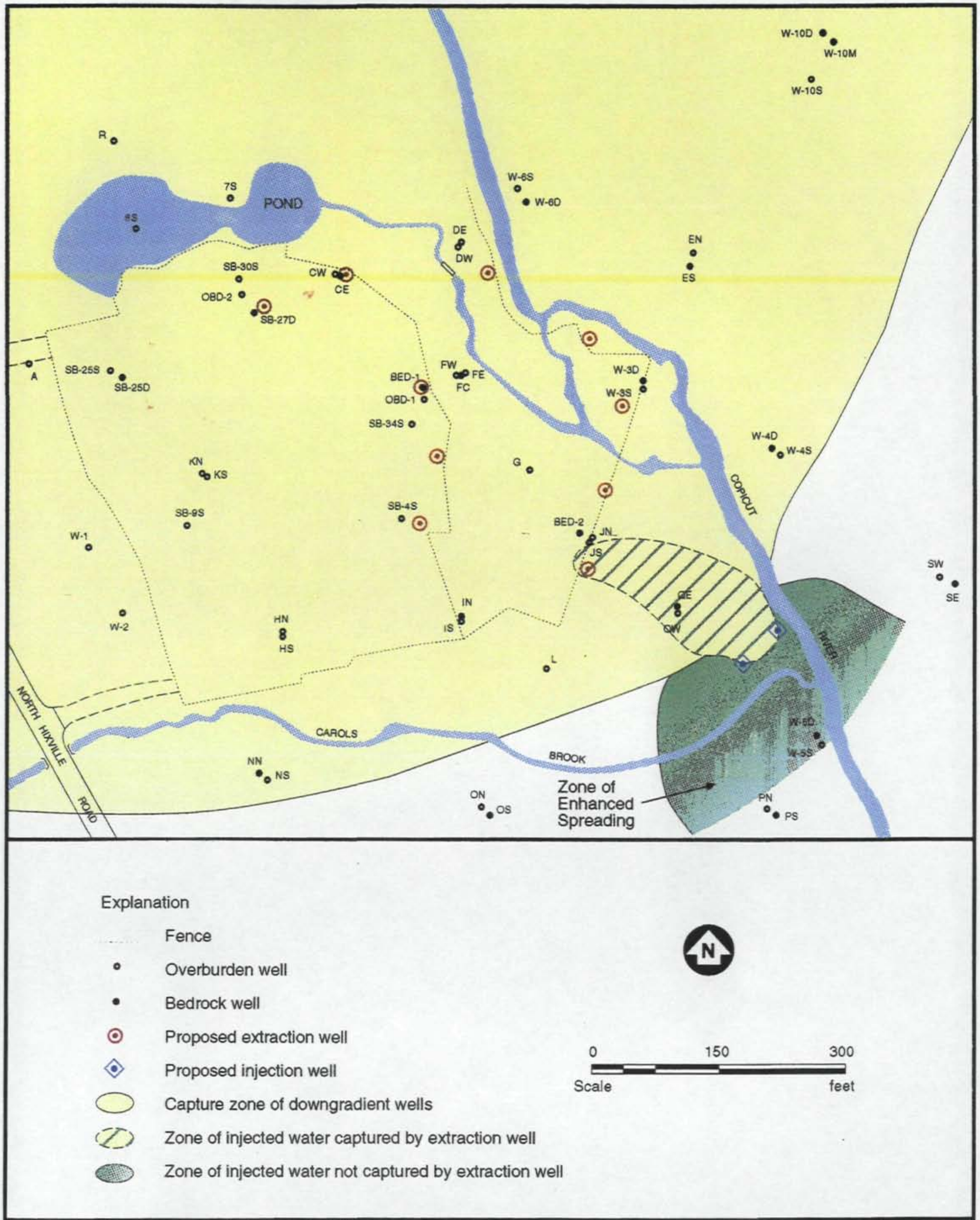
FIGURE 3



S.S. PAPADOPULOS & ASSOCIATES, INC.
ENVIRONMENTAL & WATER-RESOURCE CONSULTANTS

CAPTURE ZONES WITH BASE CASE
(CASE 4A EXTRACTION WELL SYSTEM)

FIGURE
4



S.S. PAPADOPULOS & ASSOCIATES, INC.
ENVIRONMENTAL & WATER-RESOURCE CONSULTANTS

CAPTURE AND SPREADING ZONES WITH INJECTION WELLS

FIGURE 5

Appendix B

Appendix B

APPENDIX B
DESIGN DRAWINGS

(See set of drawings under separate cover)

Appendix C

APPENDIX C

DISCIPLINE DESIGN CRITERIA

APPENDIX C

DISCIPLINE DESIGN CRITERIA

C.1 CIVIL

Site Preparation

- Compaction under buildings, structures, tanks and roadways will be to 95% density at optimum moisture content.

- In the case where the X-TRAX pad is used for the groundwater treatment building, site grading and drainage will be designed to accommodate the existing pad.

Underground Piping

- Depth of cover will be minimum required for surface loadings and to prevent freezing

- Piping will be sized so that the liquid or steam will flow at optimum velocities for maximum flow conditions

Roadways and Parkway

- All paving will be bituminous asphalt except where noted otherwise. The thickness of the paving will be based on H-20 truck loading

C.2 STRUCTURAL

Reuse of Existing XTRAX Building

- The foundation construction and building condition of the XTRAX building will be evaluated for reuse as the groundwater treatment plant building.

C.3 ARCHITECTURAL

Water Treatment Building

- Building will be a preengineered structure

- Approximate size 80'x80'x20' high (clear)
- Mass. building code classification is use group F-2, 5B type construction
- Roof will be metal panel with insulation and metal liner panel
- Walls will be metal panel with poured-in-place insulation and metal liner
- All structural main and subframe systems will be primed and painted
- Doors, frames and other components will be primed and painted
- All exterior doors will be insulated hollow metal doors and pressed metal framed, galvanized, primed and painted
- Roll-up doors to be electrically operated

Interior

- Interior wall will be painted CMU or Gypsum board on metal studs
- Ceilings - Control room, sample prep room and toilet will have 2'x2' suspended acoustical ceiling
- Chemical containment areas will be concrete with epoxy based coating
- Floors will be concrete with dust proof sealer

Miscellaneous Steel

- Platforms and gratings will be steel, galvanized, primed and painted

Re-Use of Existing XTRAX Building

- The existing XTRAX building is being reused for the groundwater treatment building. This building is being modified to meet the Massachusetts State Building Code as shown on the drawings.

C.4 PLUMBING/FIRE PROTECTION

Potable Water

- Type and quantity of fixtures and drains will be in accordance with the national standard plumbing code

- A potable water tank will be located onsite

- An under the counter water heater will be provided in the control room

Washdown Water

- A washdown water system will be provided using water from the effluent tank T-7

Reuse of Existing XTRAX Building

- Since the existing XTRAX building is being reused for the groundwater treatment building, containment curbs, drainage and sumps will have to be integrated into the existing building slab

Sanitary

- Sanitary drainage from the toilet room will discharge to a septic tank located outside the building. The tank will have to be pumped out periodically

Fire Protection

- Fire extinguishers will be wall mounted in locations and sizes as required by NFPA 10

C.5 MECHANICAL H.V.A.C.

Criteria and Design Conditions

- Outdoor Design Conditions
  Summer: 89 deg.F d.b., 73 deg.F w.b. (1%)
  Winter: 5 deg.F d.b. (99%)

- Indoor Design Conditions
  Summer: Process area - 104 deg.F
  Control room - 72 deg.F d.b., 50% R.H.

Winter: Process area - 55 deg.F
Control room - 68 deg.F

- Ventilation Rate
  Process area: Two air changes per hour in summer (or as required to dissipate heat)
  One air change per hour in winter
  Bathroom: 2 CFM per sq. ft.
  Control Room: 20 CFM outside air per person (min.) (or as required to dissipate heat)

Ventilation

- Ventilating systems will consist of exhaust fans and dampers for air distribution. Motor operated dampers will interlock with the corresponding fans

- Air conditioning will be provided for the control room only

- Exhaust fans will be designed for summer/winter operation

- Air will be exhausted from the toilet area by a separate exhaust fan

Heating

- Since natural gas is not available at the site the thermal oxidizer will require propane for operation. The propane on site will also be used for the unit heaters in the process areas

- The air conditioners in the control room will also be capable of providing supplemental heat in the control room

- Unit heaters will be automatically controlled by room thermostats

C.6 ELECTRICAL

Codes

- All electrical design will conform to the requirements of the Massachusetts state building code, national electrical society code and OSHA

High Voltage Power

- Electrical service will be obtained from the existing 13,000 volt overhead power source available at the site currently powering the CWM equipment

Low Voltage Power

- New transformers and connections to the 13,000 volt line will be provided to distribute 480 volt power

Illumination

Light Fixture Schedule

Rm Name and Number	Description	Lamp Type	Design Foot Candles
Process Area	Pendant Mounted	High Pressure Sodium	30
Electrical/Control	Recessed 2x2	Fluorescent	50
Toilets	Recessed 2x2	Fluorescent	20

- Egress illumination will be provided in accordance with NFPA 101

- Exterior building lighting to consist of wall mounted high pressure sodium fixtures. Exterior lights to be controlled by an "HOA" switch located at the nearest door. In the automatic position the light will be operated by a photoelectric cell

Panelboards

- Lighting and appliance branch-circuit panelboards will be circuit breaker type

Motors

- All motors smaller than ½ horsepower will be 120 volt, single phase, 60 Hz

- All motors ½ horsepower or larger will be 460 volt, three phase, 60 Hz

- All 460 volts, 3-phase motors will be energy efficient type

Fire Alarm

- The fire alarm system will consist of:

  - Central alarm control panel
  - Smoke detectors
  - Fixed temperature type detectors

Grounding

- A grounding system will be provided for all electrical equipment

Lightning Protection

- A lightning protection system will be provided for the water treatment building

Appendix D

Appendix D

APPENDIX D
PRELIMINARY DESIGN CALCULATIONS

APPENDIX D

INDEX

D.1 ESTIMATION OF LIQUID-PHASE GAC COLUMN PERFORMANCE

TABLE D–1.: ESTIMATION OF LIQUID–PHASE GAC COLUMN PERFORMANCE

Project: RESOLVE J–004907–0004–001 | Path & Filename: A:\GACUSE.WK1

PURPOSE:	Worksheet estimates the service life of a liquid phase granular activated carbon column based on feed flowrate and concentrations; In addition, key sizing parameters such as loading rate and bed contact time are evaluated.	Developed by: Daniel Peters, M&E; Scott Thibault, M&E. Version: 21–Apr–93. Estimate Prepared by: Scott Thibault, Daniel Peters D.P. SKT. Run Date: 26–Apr–93
REFERENCES:	(1) U.S.Environmental Protection Agency, "Carbon Adsorption Isotherms for Toxic Organics", Municipal Environmental Research Laboratory, Office of Research & Development, Cincinnati, OH, EPA–600/8–80–023; April 1980. (3) Calgon Carbon Corporation, Pittsburgh, PA; data for activated carbon isotherms.	(2) Eckenfelder, W.W., Jr., Chapter 8: Adsorption, "Industrial Water Pollution Control", 2nd Edition, McGraw–Hill Book Company, New York, NY, 1989.
PROCEDURE FOR USE:	1) Input wastewater flowrate and concentrations (in mg/L) 2) Input component isotherm data (Freundlich coefficients); If data doesn't exist for some component, revise formula for Ctot' so that this component is not included. 3) Input assumed carbon column size: diameter (D_c) and bed depth (Z_c). 4) Spreadsheet calculates isotherm parameters for the total wastewater by a concentration–weighted average using Ctot'.	5) Compare outputs for liquid loading rate (u_{LR}) and empty bed contact time (EBCT) to the rules–of–thumb listed; if column undersized increase bed size or divide flow into 2 or more columns in parallel. 6) Examine bed service time (t_B); if too low then follow same approach as undersized column in step 5. 7) Use of the Alt "S" Macro allows the user to compare bed service life at different carbon adsorption efficiencies.
ASSUMPTIONS:	1) Multi–component adsorption effects are ignored. 2) Contaminant breakthrough wavefront assumed to be a "step" function and not typical "S" shape. 3) Adsorption efficiency = 95%	4) One month or better bed service time required. 5) Freundlich isotherm model used; overall isotherm parameters calculated using concentration–weighted average.

TABLE D-1.: ESTIMATION OF LIQUID-PHASE GAC COLUMN PERFORMANCE

Project: RESOLVE J-004907-0004-001 Path & Filename: A:\GACUSE.WK1

ITEM	DESCRIPTION/ EQUATION	INFLUENT CONC.	SI UNITS	EQUIV. VALUE	U.S. UNITS
A. INPUT PARAMETERS:					
1. Feed Water					
Q_f	Feed Water Flowrate (from extraction wells)	0.002523	m^3/sec	40.0	gallons/minute
	Feed Water Components & Concentrations:				
C_1	1,1,1-Trichloroethane (1,1,1-TCA)	0.18800	mg/L	---	
C_2	1,1,2-Trichloroethane (1,1,2-TCA)	0.00820	mg/L	---	
C_3	1,1-Dichloroethane (1,1-DCA)	0.01120	mg/L	---	
C_4	1,1-Dichloroethene (1,1-DCE)	0.00640	mg/L	---	
C_5	1,2-Dichloroethane (1,2-DCA)	0.00190	mg/L	---	
C_6	1,2-Dichloroethene (1,2-DCE)	0.25484	mg/L	---	
C_7	2-Butanone (methyl ethyl ketone)	0.01000	mg/L	---	
C_8	4-Methyl-2-Pentanone (methyl isobutyl ketone)	0.00200	mg/L	---	
C_9	Acetone	0.00260	mg/L	---	
C_{10}	Benzene	0.00176	mg/L	---	
C_{11}	Carbon Disulfide	0.00024	mg/L	---	
C_{12}	Chlorobenzene	0.00062	mg/L	---	
C_{13}	Chloroethane	0.01064	mg/L	---	
C_{14}	Ethylbenzene	0.00760	mg/L	---	
C_{15}	Methylene Chloride	0.00772	mg/L	---	
C_{16}	Tetrachloroethene	0.03600	mg/L	---	
C_{17}	Toluene	0.24000	mg/L	---	
C_{18}	Trichloroethene	0.15000	mg/L	---	
C_{19}	Vinyl Chloride	0.08600	mg/L	---	
C_{20}	Xylene (total)	0.05600	mg/L	---	
Ctot	Total VOCs:	1.0817	mg VOCs/L		

TABLE D-1.: ESTIMATION OF LIQUID-PHASE GAC COLUMN PERFORMANCE

Project: RESOLVE J-004907-0004-001 Path & Filename: A:\GACUSE.WK1

ITEM	DESCRIPTION/ EQUATION	FREUNDLICH PARAMETERS VALUE "K"	SI UNITS	VALUE "n"	
2. Component Isotherm Data	Assumes Freundlich Isotherm: $X/m = K_i \cdot (C_i)$ ^ $1/(n_i)$				
	Source of Coefficients: (1) (3)				
K_1, n_1	1,1,1-Trichloroethane (1,1,1-TCA)	2.48	mg/g GAC	2.94	
K_2, n_2	1,1,2-Trichloroethane (1,1,2-TCA)	5.8	mg/g GAC	1.67	
K_3, n_3	1,1-Dichloroethane (1,1-DCA)	1.8	mg/g GAC	1.89	
K_4, n_4	1,1-Dichloroethene (1,1-DCE)	4.91	mg/g GAC	1.85	
K_5, n_5	1,2-Dichloroethane (1,2-DCA)	3.57	mg/g GAC	1.20	
K_6, n_6	1,2-Dichloroethene (1,2-DCE)	13.2	mg/g GAC	3.85	
K_7, n_7	2-Butanone (methyl ethyl ketone)	2.05	mg/g GAC	1.61	
K_8, n_8	4-Methyl-2-Pentanone (methyl isobutyl ketone)	35.6	mg/g GAC	3.13	
K_9, n_9	Acetone	0.70	mg/g GAC	1.61	
K_{10}, n_{10}	Benzene	1.0	mg/g GAC	0.63	
K_{11}, n_{11}	Carbon Disulfide	No Data Available		No Data Available	
K_{12}, n_{12}	Chlorobenzene	91	mg/g GAC	1.01	
K_{13}, n_{13}	Chloroethane	0.59	mg/g GAC	1.05	
K_{14}, n_{14}	Ethylbenzene	53	mg/g GAC	1.27	
K_{15}, n_{15}	Methylene Chloride	1.3	mg/g GAC	0.86	
K_{16}, n_{16}	Tetrachloroethene	50.8	mg/g GAC	1.79	
K_{17}, n_{17}	Toluene	26.1	mg/g GAC	2.27	
K_{18}, n_{18}	Trichloroethene	28	mg/g GAC	1.61	
K_{19}, n_{19}	Vinyl Chloride	1.72	mg/g GAC	1.61	
K_{20}, n_{20}	Xylene (total) (Assume p-Xylene)	85.0	mg/g GAC	5.26	
	Total Concentration of Components with Isotherm Data				
Ctot'	= Ctot - [C_i's with no data]	1.0815	mg VOCs/L		
3. Carbon Column Size	Dimensions for Calgon Carbon Model 7.5 Vessel:				
	(Nominal Carbon Capacity: 10,000 lbs)				
D_c	Carbon Bed Diameter	2.29	m	7.50	feet
Z_c	Carbon Bed Depth	2.44	m	8.00	feet
4. Carbon Properties	Adsorption Efficiency (i.e. fraction of equilibrium isotherm				
E_{ADS}	concentration achieved within bed contact time	0.95	---	0.95	---
ρ_c	Carbon bulk density	4.52E+05	g/m^3	28.1	lb/ft^3

TABLE D-1.: ESTIMATION OF LIQUID-PHASE GAC COLUMN PERFORMANCE

Project: RESOLVE J-004907-0004-001 Path & Filename: A:\GACUSE.WK1

ITEM	DESCRIPTION/ EQUATION	VALUE	SI UNITS	EQUIV. VALUE	U.S. UNITS
B. SYSTEM CALCULATIONS					
1. Average Isotherm Parameters	Calculates Concentration-Weighted Average for Freundlich Parameters				
K_{AVG}	$= [(C_1/Ctot')\cdot K_1+(C_2/Ctot')\cdot K_2+....+(C_i/Ctot')\cdot K_i]$	20.07	mg/g GAC	---	
n_{AVG}	$= [(C_1/Ctot')\cdot n_1+(C_2/Ctot')\cdot n_2+....+(C_i/Ctot')\cdot n_i]$	2.703	---	---	
C. OUTPUT PARAMETERS					
1. Loading Rate	Calculates Loading Rate to Column (flow per x-sectional area of column). Typical Range ~5 gpm/ft² but no more than 10 gpm/ft²				
u_{LR}	$= (4\cdot Qf)/(\pi\cdot Dc^2)$	0.000615	m³/sec•m²	0.91	gpm/ft²
2. Empty Bed Contact Time	Calculates residence time in carbon bed; Typical range should be at least ~10-15 minutes				
EBCT	$= (\pi\cdot Dc^2\cdot Zc)/(60\cdot 4\cdot Qf)$	66.1	minutes	66.1	minutes
3. Average Carbon Capacity	Calculates Average Capacity of the Activated Carbon, $(X/m)_{AVG}$ based on K_{AVG} and n_{AVG} which are based on concentration weighted averages.				
$(X/m)_{AVG}$	$= K_{AVG}\cdot(Ctot)\wedge 1/(n_{AVG})$	20.7	mg VOCs/g GAC	0.0207	lb VOCs/lb GAC
4. Average Carbon Usage	Calculates Average Usage Rate of Activated Carbon (GAC)				
R_{GAC}	Per Day Basis: $= [Ctot\cdot Q_f\cdot 86{,}400]/(X/m)_{AVG}$	11.41	kg GAC/day	25.16	lb GAC/day
	Per Unit Flowrate Basis: $= [R_{GAC}\cdot 86{,}400]/Q_f$	0.0523	kg GAC/m³	0.4362	lb GAC/1,000 gal
5. Expected Bed Service Life	Calculates Operating Life of Carbon Column Until Replacement is required (single column only); Source: Ref(2), Bohart & Adams Equation (1st term only - "step" function breakthrough wavefront)				
t_B	$= \dfrac{[p_c\cdot E_{ADS}\cdot(X/m)_{AVG}]\cdot Z_c}{[Ctot\cdot u_{LR}\cdot 1{,}000\cdot 86{,}400]}$	376	days	376	days

TABLE D-1.: ESTIMATION OF LIQUID-PHASE GAC COLUMN PERFORMANCE

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ITEM	DESCRIPTION/ EQUATION	INFLUENT CONC.	SI UNITS	EQUIV. VALUE	U.S. UNITS
A. INPUT PARAMETERS:					
1. Feed Water					
Q_f	Feed Water Flowrate (from extraction wells)	0.005046	m^3/sec	80.0	gallons/minute
	Feed Water Components & Concentrations:				
C_1	1,1,1-Trichloroethane (1,1,1-TCA)	0.18800	mg/L	---	
C_2	1,1,2-Trichloroethane (1,1,2-TCA)	0.00820	mg/L	---	
C_3	1,1-Dichloroethane (1,1-DCA)	0.01120	mg/L	---	
C_4	1,1-Dichloroethene (1,1-DCE)	0.00640	mg/L	---	
C_5	1,2-Dichloroethane (1,2-DCA)	0.00190	mg/L	---	
C_6	1,2-Dichloroethene (1,2-DCE)	0.25484	mg/L	---	
C_7	2-Butanone (methyl ethyl ketone)	0.01000	mg/L	---	
C_8	4-Methyl-2-Pentanone (methyl isobutyl ketone)	0.00200	mg/L	---	
C_9	Acetone	0.00260	mg/L	---	
C_{10}	Benzene	0.00176	mg/L	---	
C_{11}	Carbon Disulfide	0.00024	mg/L	---	
C_{12}	Chlorobenzene	0.00062	mg/L	---	
C_{13}	Chloroethane	0.01064	mg/L	---	
C_{14}	Ethylbenzene	0.00760	mg/L	---	
C_{15}	Methylene Chloride	0.00772	mg/L	---	
C_{16}	Tetrachloroethene	0.03600	mg/L	---	
C_{17}	Toluene	0.24000	mg/L	---	
C_{18}	Trichloroethene	0.15000	mg/L	---	
C_{19}	Vinyl Chloride	0.08600	mg/L	---	
C_{20}	Xylene (total)	0.05600	mg/L	---	
Ctot	Total VOCs:	1.0817	mg VOCs/L		

TABLE D-1.: ESTIMATION OF LIQUID-PHASE GAC COLUMN PERFORMANCE

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ITEM	DESCRIPTION/ EQUATION	FREUNDLICH PARAMETERS VALUE "K"	SI UNITS	VALUE "n"	
2. Component Isotherm Data	Assumes Freundlich Isotherm: $X/m = K_i \bullet (C_i)^{1/(n_i)}$				
	Source of Coefficients: (1) (3)				
K_1, n_1	1,1,1-Trichloroethane (1,1,1-TCA)	2.48	mg/g GAC	2.94	
K_2, n_2	1,1,2-Trichloroethane (1,1,2-TCA)	5.8	mg/g GAC	1.67	
K_3, n_3	1,1-Dichloroethane (1,1-DCA)	1.8	mg/g GAC	1.89	
K_4, n_4	1,1-Dichloroethene (1,1-DCE)	4.91	mg/g GAC	1.85	
K_5, n_5	1,2-Dichloroethane (1,2-DCA)	3.57	mg/g GAC	1.20	
K_6, n_6	1,2-Dichloroethene (1,2-DCE)	13.2	mg/g GAC	3.85	
K_7, n_7	2-Butanone (methyl ethyl ketone)	2.05	mg/g GAC	1.61	
K_8, n_8	4-Methyl-2-Pentanone (methyl isobutyl ketone)	35.6	mg/g GAC	3.13	
K_9, n_9	Acetone	0.70	mg/g GAC	1.61	
K_{10}, n_{10}	Benzene	1.0	mg/g GAC	0.63	
K_{11}, n_{11}	Carbon Disulfide	No Data Available		No Data Available	
K_{12}, n_{12}	Chlorobenzene	91	mg/g GAC	1.01	
K_{13}, n_{13}	Chloroethane	0.59	mg/g GAC	1.05	
K_{14}, n_{14}	Ethylbenzene	53	mg/g GAC	1.27	
K_{15}, n_{15}	Methylene Chloride	1.3	mg/g GAC	0.86	
K_{16}, n_{16}	Tetrachloroethene	50.8	mg/g GAC	1.79	
K_{17}, n_{17}	Toluene	26.1	mg/g GAC	2.27	
K_{18}, n_{18}	Trichloroethene	28	mg/g GAC	1.61	
K_{19}, n_{19}	Vinyl Chloride	1.72	mg/g GAC	1.61	
K_{20}, n_{20}	Xylene (total) (Assume p-Xylene)	85.0	mg/g GAC	5.26	
	Total Concentration of Components with Isotherm Data				
Ctot'	= Ctot - [C_i's with no data]	1.0815	mg VOCs/L		
3. Carbon Column Size	Dimensions for Calgon Carbon Model 7.5 Vessel:				
	(Nominal Carbon Capacity: 10,000 lbs)				
D_c	Carbon Bed Diameter	2.29	m	7.50	feet
Z_c	Carbon Bed Depth	2.44	m	8.00	feet
4. Carbon Properties	Adsorption Efficiency (i.e. fraction of equilibrium isotherm				
E_{ADS}	concentration achieved within bed contact time	0.95	---	0.95	---
p_c	Carbon bulk density	4.52E+05	g/m^3	28.1	lb/ft^3

TABLE D–1.: ESTIMATION OF LIQUID–PHASE GAC COLUMN PERFORMANCE

Project: RESOLVE J–004907–0004–001 Path & Filename: A:\GACUSE.WK1

ITEM	DESCRIPTION/ EQUATION	VALUE	SI UNITS	EQUIV. VALUE	U.S. UNITS
B. SYSTEM CALCULATIONS					
1. Average Isotherm Parameters	Calculates Concentration–Weighted Average for Freundlich Parameters				
K_{AVG}	$= [(C_1/Ctot')\bullet K_1+(C_2/Ctot')\bullet K_2+....+(C_i/Ctot')\bullet K_i]$	20.07	mg/g GAC	---	
n_{AVG}	$= [(C_1/Ctot')\bullet n_1+(C_2/Ctot')\bullet n_2+....+(C_i/Ctot')\bullet n_i]$	2.703	---	---	
C. OUTPUT PARAMETERS					
1. Loading Rate	Calculates Loading Rate to Column (flow per x–sectional area of column). Typical Range ~5 gpm/ft² but no more than 10 gpm/ft²				
u_{LR}	$= (4\bullet Qf)/(\pi\bullet Dc^2)$	0.001230	$m^3/sec\bullet m^2$	1.81	gpm/ft^2
2. Empty Bed Contact Time	Calculates residence time in carbon bed; Typical range should be at least ~10–15 minutes				
EBCT	$= (\pi\bullet Dc^2\bullet Zc)/(60\bullet 4\bullet Qf)$	33.0	minutes	33.0	minutes
3. Average Carbon Capacity	Calculates Average Capacity of the Activated Carbon, $(X/m)_{AVG}$ based on K_{AVG} and n_{AVG} which are based on concentration weighted averages.				
$(X/m)_{AVG}$	$= K_{AVG}\bullet(Ctot)$ ^ $1/(n_{AVG})$	20.7	mg VOCs/g GAC	0.0207	lb VOCs/lb GAC
4. Average Carbon Usage	Calculates Average Usage Rate of Activated Carbon (GAC)				
R_{GAC}	Per Day Basis: $= [Ctot\bullet Q_f\bullet 86{,}400]/(X/m)_{AVG}$	22.82	kg GAC/day	50.32	lb GAC/day
	Per Unit Flowrate Basis: $= [R_{GAC}\bullet 86{,}400]/Q_f$	0.0523	$kg\ GAC/m^3$	0.4362	lb GAC/1,000 gal
5. Expected Bed Service Life	Calculates Operating Life of Carbon Column Until Replacement is required (single column only); Source: Ref(2), Bohart & Adams Equation (1st term only – "step" function breakthrough wavefront)				
t_B	$= \dfrac{[\rho_c\bullet E_{ADS}\bullet(X/m)_{AVG}]\bullet Z_c}{[Ctot\bullet u_{LR}\bullet 1{,}000\bullet 86{,}400]}$	188	days	188	days

TABLE D–1.: ESTIMATION OF LIQUID–PHASE GAC COLUMN PERFORMANCE

Project: RESOLVE J–004907–0004–001 Path & Filename: A:\GACUSE.WK1

ITEM	DESCRIPTION/ EQUATION	INFLUENT CONC.	SI UNITS	EQUIV. VALUE	U.S. UNITS
A. INPUT PARAMETERS:					
1. Feed Water					
Q_f	Feed Water Flowrate (from extraction wells)	0.006308	m^3/sec	100.0	gallons/minute
	Feed Water Components & Concentrations:				
C_1	1,1,1–Trichloroethane (1,1,1–TCA)	0.18800	mg/L	---	
C_2	1,1,2–Trichloroethane (1,1,2–TCA)	0.00820	mg/L	---	
C_3	1,1–Dichloroethane (1,1–DCA)	0.01120	mg/L	---	
C_4	1,1–Dichloroethene (1,1–DCE)	0.00640	mg/L	---	
C_5	1,2–Dichloroethane (1,2–DCA)	0.00190	mg/L	---	
C_6	1,2–Dichloroethene (1,2–DCE)	0.25484	mg/L	---	
C_7	2–Butanone (methyl ethyl ketone)	0.01000	mg/L	---	
C_8	4–Methyl–2–Pentanone (methyl isobutyl ketone)	0.00200	mg/L	---	
C_9	Acetone	0.00260	mg/L	---	
C_{10}	Benzene	0.00176	mg/L	---	
C_{11}	Carbon Disulfide	0.00024	mg/L	---	
C_{12}	Chlorobenzene	0.00062	mg/L	---	
C_{13}	Chloroethane	0.01064	mg/L	---	
C_{14}	Ethylbenzene	0.00760	mg/L	---	
C_{15}	Methylene Chloride	0.00772	mg/L	---	
C_{16}	Tetrachloroethene	0.03600	mg/L	---	
C_{17}	Toluene	0.24000	mg/L	---	
C_{18}	Trichloroethene	0.15000	mg/L	---	
C_{19}	Vinyl Chloride	0.08600	mg/L	---	
C_{20}	Xylene (total)	0.05600	mg/L	---	
Ctot	Total VOCs:	1.0817	mg VOCs/L		

TABLE D-1.: ESTIMATION OF LIQUID-PHASE GAC COLUMN PERFORMANCE

Project: RESOLVE J-004907-0004-001 Path & Filename: A:\GACUSE.WK1

ITEM	DESCRIPTION/ EQUATION	FREUNDLICH PARAMETERS VALUE "K"	SI UNITS	VALUE "n"
2. Component Isotherm Data	Assumes Freundlich Isotherm: $X/m = K_i \cdot (C_i)$ ^ $1/(n_i)$			
	Source of Coefficients: (1) (3)			
K_1, n_1	1,1,1-Trichloroethane (1,1,1-TCA)	2.48	mg/g GAC	2.94
K_2, n_2	1,1,2-Trichloroethane (1,1,2-TCA)	5.8	mg/g GAC	1.67
K_3, n_3	1,1-Dichloroethane (1,1-DCA)	1.8	mg/g GAC	1.89
K_4, n_4	1,1-Dichloroethene (1,1-DCE)	4.91	mg/g GAC	1.85
K_5, n_5	1,2-Dichloroethane (1,2-DCA)	3.57	mg/g GAC	1.20
K_6, n_6	1,2-Dichloroethene (1,2-DCE)	13.2	mg/g GAC	3.85
K_7, n_7	2-Butanone (methyl ethyl ketone)	2.05	mg/g GAC	1.61
K_8, n_8	4-Methyl-2-Pentanone (methyl isobutyl ketone)	35.6	mg/g GAC	3.13
K_9, n_9	Acetone	0.70	mg/g GAC	1.61
K_{10}, n_{10}	Benzene	1.0	mg/g GAC	0.63
K_{11}, n_{11}	Carbon Disulfide	No Data Available		No Data Available
K_{12}, n_{12}	Chlorobenzene	91	mg/g GAC	1.01
K_{13}, n_{13}	Chloroethane	0.59	mg/g GAC	1.05
K_{14}, n_{14}	Ethylbenzene	53	mg/g GAC	1.27
K_{15}, n_{15}	Methylene Chloride	1.3	mg/g GAC	0.86
K_{16}, n_{16}	Tetrachloroethene	50.8	mg/g GAC	1.79
K_{17}, n_{17}	Toluene	26.1	mg/g GAC	2.27
K_{18}, n_{18}	Trichloroethene	28	mg/g GAC	1.61
K_{19}, n_{19}	Vinyl Chloride	1.72	mg/g GAC	1.61
K_{20}, n_{20}	Xylene (total) (Assume p-Xylene)	85.0	mg/g GAC	5.26
	Total Concentration of Components with Isotherm Data			
Ctot'	= Ctot - [C_i's with no data]	1.0815	mg VOCs/L	
3. Carbon Column Size	Dimensions for Calgon Carbon Model 7.5 Vessel:			
	(Nominal Carbon Capacity: 10,000 lbs)			
D_c	Carbon Bed Diameter	2.29	m	7.50 feet
Z_c	Carbon Bed Depth	2.44	m	8.00 feet
4. Carbon Properties	Adsorption Efficiency (i.e. fraction of equilibrium isotherm			
E_{ADS}	concentration achieved within bed contact time	0.95	---	0.95 ---
p_c	Carbon bulk density	4.52E+05	g/m³	28.1 lb/ft³

TABLE D-1.: ESTIMATION OF LIQUID-PHASE GAC COLUMN PERFORMANCE

Project: RESOLVE J-004907-0004-001 Path & Filename: A:\GACUSE.WK1

ITEM	DESCRIPTION/ EQUATION	VALUE	SI UNITS	EQUIV. VALUE	U.S. UNITS
B. SYSTEM CALCULATIONS					
1. Average Isotherm Parameters	Calculates Concentration-Weighted Average for Freundlich Parameters				
K_{AVG}	$= [(C_1/Ctot')\cdot K_1+(C_2/Ctot')\cdot K_2+....+(C_i/Ctot')\cdot K_i]$	20.07	mg/g GAC	---	
n_{AVG}	$= [(C_1/Ctot')\cdot n_1+(C_2/Ctot')\cdot n_2+....+(C_i/Ctot')\cdot n_i]$	2.703	---	---	
C. OUTPUT PARAMETERS					
1. Loading Rate	Calculates Loading Rate to Column (flow per x-sectional area of column). Typical Range ~ 5 gpm/ft² but no more than 10 gpm/ft²				
u_{LR}	$= (4\cdot Qf)/(\pi\cdot Dc^2)$	0.001537	$m^3/sec\cdot m^2$	2.26	gpm/ft^2
2. Empty Bed Contact Time	Calculates residence time in carbon bed; Typical range should be at least ~ 10-15 minutes				
EBCT	$= (\pi\cdot Dc^2\cdot Zc)/(60\cdot 4\cdot Qf)$	26.4	minutes	26.4	minutes
3. Average Carbon Capacity	Calculates Average Capacity of the Activated Carbon, $(X/m)_{AVG}$ based on K_{AVG} and n_{AVG} which are based on concentration weighted averages.				
$(X/m)_{AVG}$	$= K_{AVG}\cdot(Ctot)\wedge 1/(n_{AVG})$	20.7	mg VOCs/g GAC	0.0207	lb VOCs/lb GAC
4. Average Carbon Usage	Calculates Average Usage Rate of Activated Carbon (GAC)				
R_{GAC}	Per Day Basis: $= [Ctot\cdot Q_f\cdot 86{,}400]/(X/m)_{AVG}$	28.53	kg GAC/day	62.90	lb GAC/day
	Per Unit Flowrate Basis: $= [R_{GAC}\cdot 86{,}400]/Q_f$	0.0523	kg GAC/m³	0.4362	lb GAC/1,000 gal
5. Expected Bed Service Life	Calculates Operating Life of Carbon Column Until Replacement is required (single column only); Source: Ref(2), Bohart & Adams Equation (1st term only -- "step" function breakthrough wavefront)				
t_B	$= \dfrac{[\rho_c\cdot E_{ADS}\cdot(X/m)_{AVG}]\cdot Z_c}{[Ctot\cdot u_{LR}\cdot 1{,}000\cdot 86{,}400]}$	150	days	150	days

LIQUID-PHASE CARBON ONLY - NO STRIPPER

TABLE D-1.: ESTIMATION OF LIQUID-PHASE GAC COLUMN PERFORMANCE

Project: RESOLVE J-004907-0004-001 Path & Filename: B:\GACONLY.WK1

PURPOSE:	Worksheet estimates the service life of a liquid phase granular activated carbon column based on feed flowrate and concentrations; In addition, key sizing parameters such as loading rate and bed contact time are evaluated.	Developed by: Daniel Peters, M&E; Scott Thibault, M&E. Version: 21-Apr-93. Estimate Prepared by: Scott Thibault. Run Date: 11-May-93
REFERENCES:	(1) U.S.Environmental Protection Agency, "Carbon Adsorption Isotherms for Toxic Organics", Municipal Environmental Research Laboratory, Office of Research & Development, Cincinnati, OH, EPA-600/8-80-023; April 1980. (3) Calgon Carbon Corporation, Pittsburgh, PA; data for activated carbon isotherms.	(2) Eckenfelder, W.W., Jr., Chapter 8: Adsorption, "Industrial Water Pollution Control", 2nd Edition, McGraw-Hill Book Company, New York, NY, 1989.
PROCEDURE FOR USE:	1) Input wastewater flowrate and concentrations (in mg/L) 2) Input component isotherm data (Freundlich coefficients); If data doesn't exist for some component, revise formula for Ctot' so that this component is not included. 3) Input assumed carbon column size: diameter (D_c) and bed depth (Z_c). 4) Spreadsheet calculates isotherm parameters for the total wastewater by a concentration-weighted average using Ctot'.	5) Compare outputs for liquid loading rate (u_{LR}) and empty bed contact time (EBCT) to the rules-of-thumb listed; if column undersized increase bed size or divide flow into 2 or more columns in parallel. 6) Examine bed service time (t_B); if too low then follow same approach as undersized column in step 5. 7) Use of the Alt "S" Macro allows the user to compare bed service life at different carbon adsorption efficiencies.
ASSUMPTIONS:	1) Multi-component adsorption effects are ignored. 2) Contaminant breakthrough wavefront assumed to be a "step" function and not typical "S" shape. 3) Adsorption efficiency = 95%	4) One month or better bed service time required. 5) Freundlich isotherm model used; overall isotherm parameters calculated using concentration-weighted average.

LIQUID-PHASE CARBON ONLY - NO STRIPPER

TABLE D-1.: ESTIMATION OF LIQUID-PHASE GAC COLUMN PERFORMANCE

Project: RESOLVE J-004907-0004-001 Path & Filename: B:\GACONLY.WK1

ITEM	DESCRIPTION/ EQUATION	INFLUENT CONC.	SI UNITS	EQUIV. VALUE	U.S. UNITS
A. INPUT PARAMETERS:					
1. Feed Water					
Q_f	Feed Water Flowrate (from extraction wells)	0.002523	m^3/sec	40.0	gallons/minute
	Feed Water Components & Concentrations:				
C_1	1,1,1-Trichloroethane (1,1,1-TCA)	9.40000	mg/L	---	
C_2	1,1,2-Trichloroethane (1,1,2-TCA)	0.41000	mg/L	---	
C_3	1,1-Dichloroethane (1,1-DCA)	0.56000	mg/L	---	
C_4	1,1-Dichloroethene (1,1-DCE)	0.32000	mg/L	---	
C_5	1,2-Dichloroethane (1,2-DCA)	0.09500	mg/L	---	
C_6	1,2-Dichloroethene (1,2-DCE)	12.74200	mg/L	---	
C_7	2-Butanone (methyl ethyl ketone)	0.50000	mg/L	---	
C_8	4-Methyl-2-Pentanone (methyl isobutyl ketone)	0.10000	mg/L	---	
C_9	Acetone	0.13000	mg/L	---	
C_{10}	Benzene	0.08800	mg/L	---	
C_{11}	Carbon Disulfide	0.01200	mg/L	---	
C_{12}	Chlorobenzene	0.03100	mg/L	---	
C_{13}	Chloroethane	0.53200	mg/L	---	
C_{14}	Ethylbenzene	0.38000	mg/L	---	
C_{15}	Methylene Chloride	0.38600	mg/L	---	
C_{16}	Tetrachloroethene	1.80000	mg/L	---	
C_{17}	Toluene	12.00000	mg/L	---	
C_{18}	Trichloroethene	7.50000	mg/L	---	
C_{19}	Vinyl Chloride	4.30000	mg/L	---	
C_{20}	Xylene (total)	2.80000	mg/L	---	
Ctot	Total VOCs:	54.0860	mg VOCs/L		

LIQUID-PHASE CARBON ONLY - NO STRIPPER

TABLE D-1.: ESTIMATION OF LIQUID-PHASE GAC COLUMN PERFORMANCE

Project: RESOLVE J-004907-0004-001 Path & Filename: B:\GACONLY.WK1

ITEM	DESCRIPTION/ EQUATION	FREUNDLICH PARAMETERS VALUE "K"	SI UNITS	VALUE "n"
2. Component Isotherm Data	Assumes Freundlich Isotherm: $X/m = K_i \cdot (C_i)$ ^ $1/(n_i)$			
	Source of Coefficients: (1) (3)			
K_1, n_1	1,1,1-Trichloroethane (1,1,1-TCA)	2.48	mg/g GAC	2.94
K_2, n_2	1,1,2-Trichloroethane (1,1,2-TCA)	5.8	mg/g GAC	1.67
K_3, n_3	1,1-Dichloroethane (1,1-DCA)	1.8	mg/g GAC	1.89
K_4, n_4	1,1-Dichloroethene (1,1-DCE)	4.91	mg/g GAC	1.85
K_5, n_5	1,2-Dichloroethane (1,2-DCA)	3.57	mg/g GAC	1.20
K_6, n_6	1,2-Dichloroethene (1,2-DCE)	13.2	mg/g GAC	3.85
K_7, n_7	2-Butanone (methyl ethyl ketone)	2.05	mg/g GAC	1.61
K_8, n_8	4-Methyl-2-Pentanone (methyl isobutyl ketone)	35.6	mg/g GAC	3.13
K_9, n_9	Acetone	0.70	mg/g GAC	1.61
K_{10}, n_{10}	Benzene	1.0	mg/g GAC	0.63
K_{11}, n_{11}	Carbon Disulfide	No Data Available		No Data Available
K_{12}, n_{12}	Chlorobenzene	91	mg/g GAC	1.01
K_{13}, n_{13}	Chloroethane	0.59	mg/g GAC	1.05
K_{14}, n_{14}	Ethylbenzene	53	mg/g GAC	1.27
K_{15}, n_{15}	Methylene Chloride	1.3	mg/g GAC	0.86
K_{16}, n_{16}	Tetrachloroethene	50.8	mg/g GAC	1.79
K_{17}, n_{17}	Toluene	26.1	mg/g GAC	2.27
K_{18}, n_{18}	Trichloroethene	28	mg/g GAC	1.61
K_{19}, n_{19}	Vinyl Chloride	1.72	mg/g GAC	1.61
K_{20}, n_{20}	Xylene (total) (Assume p-Xylene)	85.0	mg/g GAC	5.26
	Total Concentration of Components with Isotherm Data			
Ctot'	= Ctot - [C_i's with no data]	54.0740	mg VOCs/L	
3. Carbon Column Size	Dimensions for Calgon Carbon Model 7.5 Vessel:			
	(Nominal Carbon Capacity: 10,000 lbs)			
D_c	Carbon Bed Diameter	2.29	m	7.50 feet
Z_c	Carbon Bed Depth	2.44	m	8.00 feet
4. Carbon Properties	Adsorption Efficiency (i.e. fraction of equilibrium isotherm			
E_{ADS}	concentration achieved within bed contact time	0.95	---	0.95 ---
p_c	Carbon bulk density	4.52E+05	g/m³	28.1 lb/ft³

LIQUID-PHASE CARBON ONLY – NO STRIPPER

TABLE D–1.: ESTIMATION OF LIQUID–PHASE GAC COLUMN PERFORMANCE

Project: RESOLVE J–004907–0004–001 Path & Filename: B:\GACONLY.WK1

ITEM	DESCRIPTION/ EQUATION	VALUE	SI UNITS	EQUIV. VALUE	U.S. UNITS
B. SYSTEM CALCULATIONS					
1. Average Iso–therm Parameters	Calculates Concentration–Weighted Average for Freundlich Parameters				
K_{AVG}	$= [(C_1/Ctot')\cdot K_1+(C_2/Ctot')\cdot K_2+....+(C_i/Ctot')\cdot K_i]$	20.07	mg/g GAC	---	
n_{AVG}	$= [(C_1/Ctot')\cdot n_1+(C_2/Ctot')\cdot n_2+....+(C_i/Ctot')\cdot n_i]$	2.703	---	---	
C. OUTPUT PARAMETERS					
1. Loading Rate	Calculates Loading Rate to Column (flow per x–sectional area of column). Typical Range ~5 gpm/ft² but no more than 10 gpm/ft²				
u_{LR}	$= (4\cdot Qf)/(\pi\cdot Dc^2)$	0.000615	m³/sec•m²	0.91	gpm/ft²
2.Empty Bed Contact Time	Calculates residence time in carbon bed; Typical range should be at least ~10–15 minutes				
EBCT	$= (\pi\cdot Dc^2\cdot Zc)/(60\cdot 4\cdot Qf)$	66.1	minutes	66.1	minutes
3. Average Carbon Capacity	Calculates Average Capacity of the Activated Carbon, $(X/m)_{AVG}$ based on K_{AVG} and n_{AVG} which are based on concentration weighted averages.				
$(X/m)_{AVG}$	$= K_{AVG}\cdot(Ctot)^{\wedge}1/(n_{AVG})$	87.9	mg VOCs/g GAC	0.0879	lb VOCs/lb GAC
4. Average Carbon Usage	Calculates Average Usage Rate of Activated Carbon (GAC)				
	Per Day Basis:				
R_{GAC}	$= [Ctot\cdot Q_f\cdot 86{,}400]/(X/m)_{AVG}$	134.19	kg GAC/day	295.84	lb GAC/day
	Per Unit Flowrate Basis:				
	$= [R_{GAC}\cdot 86{,}400]/Q_f$	0.6155	kg GAC/m³	5.1295	lb GAC/1,000 gal
5. Expected Bed Service Life	Calculates Operating Life of Carbon Column Until Replacement is required (single column only); Source: Ref(2), Bohart & Adams Equation (1st term only – "step" function breakthrough wavefront)				
t_B	$= \dfrac{[\,p_c\cdot E_{ADS}\cdot(X/m)_{AVG}\,]\cdot Z_c}{[\,Ctot\cdot u_{LR}\cdot 1{,}000\cdot 86{,}400\,]}$	32	days	32	days

LIQUID-PHASE CARBON ONLY - NO STRIPPER

TABLE D-1.: ESTIMATION OF LIQUID-PHASE GAC COLUMN PERFORMANCE

Project: RESOLVE J-004907-0004-001 Path & Filename: B:\GACONLY.WK1

ITEM	DESCRIPTION/ EQUATION	INFLUENT CONC.	SI UNITS	EQUIV. VALUE	U.S. UNITS
A. INPUT PARAMETERS:					
1. Feed Water					
Q_f	Feed Water Flowrate (from extraction wells)	0.005046	m^3/sec	80.0	gallons/minute
	Feed Water Components & Concentrations:				
C_1	1,1,1-Trichloroethane (1,1,1-TCA)	9.40000	mg/L	---	
C_2	1,1,2-Trichloroethane (1,1,2-TCA)	0.41000	mg/L	---	
C_3	1,1-Dichloroethane (1,1-DCA)	0.56000	mg/L	---	
C_4	1,1-Dichloroethene (1,1-DCE)	0.32000	mg/L	---	
C_5	1,2-Dichloroethane (1,2-DCA)	0.09500	mg/L	---	
C_6	1,2-Dichloroethene (1,2-DCE)	12.74200	mg/L	---	
C_7	2-Butanone (methyl ethyl ketone)	0.50000	mg/L	---	
C_8	4-Methyl-2-Pentanone (methyl isobutyl ketone)	0.10000	mg/L	---	
C_9	Acetone	0.13000	mg/L	---	
C_{10}	Benzene	0.08800	mg/L	---	
C_{11}	Carbon Disulfide	0.01200	mg/L	---	
C_{12}	Chlorobenzene	0.03100	mg/L	---	
C_{13}	Chloroethane	0.53200	mg/L	---	
C_{14}	Ethylbenzene	0.38000	mg/L	---	
C_{15}	Methylene Chloride	0.38600	mg/L	---	
C_{16}	Tetrachloroethene	1.80000	mg/L	---	
C_{17}	Toluene	12.00000	mg/L	---	
C_{18}	Trichloroethene	7.50000	mg/L	---	
C_{19}	Vinyl Chloride	4.30000	mg/L	---	
C_{20}	Xylene (total)	2.80000	mg/L	---	
Ctot	Total VOCs:	54.0860	mg VOCs/L		

LIQUID-PHASE CARBON ONLY – NO STRIPPER

TABLE D–1.: ESTIMATION OF LIQUID–PHASE GAC COLUMN PERFORMANCE

Project: RESOLVE J–004907–0004–001 | Path & Filename: B:\GACONLY.WK1

ITEM	DESCRIPTION/ EQUATION	FREUNDLICH PARAMETERS VALUE "K"	SI UNITS	VALUE "n"	
2. Component Isotherm Data	Assumes Freundlich Isotherm: $X/m = K_1 \bullet (C_1)$ ^ $1/(n_1)$				
	Source of Coefficients: (1) (3)				
K_1, n_1	1,1,1–Trichloroethane (1,1,1–TCA)	2.48	mg/g GAC	2.94	
K_2, n_2	1,1,2–Trichloroethane (1,1,2–TCA)	5.8	mg/g GAC	1.67	
K_3, n_3	1,1–Dichloroethane (1,1–DCA)	1.8	mg/g GAC	1.89	
K_4, n_4	1,1–Dichloroethene (1,1–DCE)	4.91	mg/g GAC	1.85	
K_5, n_5	1,2–Dichloroethane (1,2–DCA)	3.57	mg/g GAC	1.20	
K_6, n_6	1,2–Dichloroethene (1,2–DCE)	13.2	mg/g GAC	3.85	
K_7, n_7	2–Butanone (methyl ethyl ketone)	2.05	mg/g GAC	1.61	
K_8, n_8	4–Methyl–2–Pentanone (methyl isobutyl ketone)	35.6	mg/g GAC	3.13	
K_9, n_9	Acetone	0.70	mg/g GAC	1.61	
K_{10}, n_{10}	Benzene	1.0	mg/g GAC	0.63	
K_{11}, n_{11}	Carbon Disulfide	No Data Available		No Data Available	
K_{12}, n_{12}	Chlorobenzene	91	mg/g GAC	1.01	
K_{13}, n_{13}	Chloroethane	0.59	mg/g GAC	1.05	
K_{14}, n_{14}	Ethylbenzene	53	mg/g GAC	1.27	
K_{15}, n_{15}	Methylene Chloride	1.3	mg/g GAC	0.86	
K_{16}, n_{16}	Tetrachloroethene	50.8	mg/g GAC	1.79	
K_{17}, n_{17}	Toluene	26.1	mg/g GAC	2.27	
K_{18}, n_{18}	Trichloroethene	28	mg/g GAC	1.61	
K_{19}, n_{19}	Vinyl Chloride	1.72	mg/g GAC	1.61	
K_{20}, n_{20}	Xylene (total) (Assume p–Xylene)	85.0	mg/g GAC	5.26	
	Total Concentration of Components with Isotherm Data				
Ctot'	= Ctot – [C_i's with no data]	54.0740	mg VOCs/L		
3. Carbon Column Size	Dimensions for Calgon Carbon Model 7.5 Vessel:				
	(Nominal Carbon Capacity: 10,000 lbs)				
D_c	Carbon Bed Diameter	2.29	m	7.50	feet
Z_c	Carbon Bed Depth	2.44	m	8.00	feet
4. Carbon Properties					
	Adsorption Efficiency (i.e. fraction of equilibrium isotherm				
E_{ADS}	concentration achieved within bed contact time	0.95	---	0.95	---
p_c	Carbon bulk density	4.52E+05	g/m³	28.1	lb/ft³

LIQUID-PHASE CARBON ONLY — NO STRIPPER

TABLE D-1.: ESTIMATION OF LIQUID-PHASE GAC COLUMN PERFORMANCE

Project: RESOLVE J-004907-0004-001 — Path & Filename: B:\GACONLY.WK1

ITEM	DESCRIPTION/ EQUATION	VALUE	SI UNITS	EQUIV. VALUE	U.S. UNITS
B. SYSTEM CALCULATIONS					
1. Average Isotherm Parameters	Calculates Concentration-Weighted Average for Freundlich Parameters				
K_{AVG}	$= [(C_1/Ctot')\bullet K_1+(C_2/Ctot')\bullet K_2+....+(C_i/Ctot')\bullet K_i]$	20.07	mg/g GAC	---	
n_{AVG}	$= [(C_1/Ctot')\bullet n_1+(C_2/Ctot')\bullet n_2+....+(C_i/Ctot')\bullet n_i]$	2.703	---	---	
C. OUTPUT PARAMETERS					
1. Loading Rate	Calculates Loading Rate to Column (flow per x-sectional area of column). Typical Range ~5 gpm/ft² but no more than 10 gpm/ft²				
u_{LR}	$= (4\bullet Qf)/(\pi\bullet Dc^2)$	0.001230	$m^3/sec\bullet m^2$	1.81	gpm/ft^2
2. Empty Bed Contact Time	Calculates residence time in carbon bed; Typical range should be at least ~10-15 minutes				
EBCT	$= (\pi\bullet Dc^2\bullet Zc)/(60\bullet 4\bullet Qf)$	33.0	minutes	33.0	minutes
3. Average Carbon Capacity	Calculates Average Capacity of the Activated Carbon, $(X/m)_{AVG}$ based on K_{AVG} and n_{AVG} which are based on concentration weighted averages.				
$(X/m)_{AVG}$	$= K_{AVG}\bullet(Ctot)\,\hat{}\,1/(n_{AVG})$	87.9	mg VOCs/g GAC	0.0879	lb VOCs/lb GAC
4. Average Carbon Usage	Calculates Average Usage Rate of Activated Carbon (GAC)				
R_{GAC}	Per Day Basis: $= [Ctot\bullet Q_f\bullet 86{,}400]/(X/m)_{AVG}$	268.38	kg GAC/day	591.68	lb GAC/day
	Per Unit Flowrate Basis: $= [R_{GAC}\bullet 86{,}400]/Q_f$	0.6155	$kg\ GAC/m^3$	5.1295	lb GAC/1,000 gal
5. Expected Bed Service Life	Calculates Operating Life of Carbon Column Until Replacement is required (single column only); Source: Ref(2), Bohart & Adams Equation (1st term only - "step" function breakthrough wavefront)				
t_B	$= \dfrac{[\,p_c\bullet E_{ADS}\bullet(X/m)_{AVG}\,]\bullet Z_c}{[\,Ctot\bullet u_{LR}\bullet 1{,}000\bullet 86{,}400\,]}$	16	days	16	days

LIQUID-PHASE CARBON ONLY - NO STRIPPER

TABLE D-1.: ESTIMATION OF LIQUID-PHASE GAC COLUMN PERFORMANCE

Project: RESOLVE J-004907-0004-001 Path & Filename: B:\GACONLY.WK1

ITEM	DESCRIPTION/ EQUATION	INFLUENT CONC.	SI UNITS	EQUIV. VALUE	U.S. UNITS
A. INPUT PARAMETERS:					
1. Feed Water					
Q_f	Feed Water Flowrate (from extraction wells)	0.006308	m^3/sec	100.0	gallons/minute
	Feed Water Components & Concentrations:				
C_1	1,1,1-Trichloroethane (1,1,1-TCA)	9.40000	mg/L	---	
C_2	1,1,2-Trichloroethane (1,1,2-TCA)	0.41000	mg/L	---	
C_3	1,1-Dichloroethane (1,1-DCA)	0.56000	mg/L	---	
C_4	1,1-Dichloroethene (1,1-DCE)	0.32000	mg/L	---	
C_5	1,2-Dichloroethane (1,2-DCA)	0.09500	mg/L	---	
C_6	1,2-Dichloroethene (1,2-DCE)	12.74200	mg/L	---	
C_7	2-Butanone (methyl ethyl ketone)	0.50000	mg/L	---	
C_8	4-Methyl-2-Pentanone (methyl isobutyl ketone)	0.10000	mg/L	---	
C_9	Acetone	0.13000	mg/L	---	
C_{10}	Benzene	0.08800	mg/L	---	
C_{11}	Carbon Disulfide	0.01200	mg/L	---	
C_{12}	Chlorobenzene	0.03100	mg/L	---	
C_{13}	Chloroethane	0.53200	mg/L	---	
C_{14}	Ethylbenzene	0.38000	mg/L	---	
C_{15}	Methylene Chloride	0.38600	mg/L	---	
C_{16}	Tetrachloroethene	1.80000	mg/L	---	
C_{17}	Toluene	12.00000	mg/L	---	
C_{18}	Trichloroethene	7.50000	mg/L	---	
C_{19}	Vinyl Chloride	4.30000	mg/L	---	
C_{20}	Xylene (total)	2.80000	mg/L	---	
Ctot	Total VOCs:	54.0860	mg VOCs/L		

LIQUID-PHASE CARBON ONLY? - NO STRIPPER

TABLE D-1.: ESTIMATION OF LIQUID-PHASE GAC COLUMN PERFORMANCE

Project: RESOLVE J-004907-0004-001 | Path & Filename: B:\GACONLY.WK1

ITEM		DESCRIPTION/ EQUATION	FREUNDLICH PARAMETERS VALUE "K"	SI UNITS	VALUE "n"	
2. Component Isotherm Data		Assumes Freundlich Isotherm: $X/m = K_1 \cdot (C_1)$ ^ $1/(n_1)$				
		Source of Coefficients: (1) (3)				
	K_1 , n_1	1,1,1-Trichloroethane (1,1,1-TCA)	2.48	mg/g GAC	2.94	
	K_2 , n_2	1,1,2-Trichloroethane (1,1,2-TCA)	5.8	mg/g GAC	1.67	
	K_3 , n_3	1,1-Dichloroethane (1,1-DCA)	1.8	mg/g GAC	1.89	
	K_4 , n_4	1,1-Dichloroethene (1,1-DCE)	4.91	mg/g GAC	1.85	
	K_5 , n_5	1,2-Dichloroethane (1,2-DCA)	3.57	mg/g GAC	1.20	
	K_6 , n_6	1,2-Dichloroethene (1,2-DCE)	13.2	mg/g GAC	3.85	
	K_7 , n_7	2-Butanone (methyl ethyl ketone)	2.05	mg/g GAC	1.61	
	K_8 , n_8	4-Methyl-2-Pentanone (methyl isobutyl ketone)	35.6	mg/g GAC	3.13	
	K_9 , n_9	Acetone	0.70	mg/g GAC	1.61	
	K_{10} , n_{10}	Benzene	1.0	mg/g GAC	0.63	
	K_{11} , n_{11}	Carbon Disulfide	No Data Available		No Data Available	
	K_{12} , n_{12}	Chlorobenzene	91	mg/g GAC	1.01	
	K_{13} , n_{13}	Chloroethane	0.59	mg/g GAC	1.05	
	K_{14} , n_{14}	Ethylbenzene	53	mg/g GAC	1.27	
	K_{15} , n_{15}	Methylene Chloride	1.3	mg/g GAC	0.86	
	K_{16} , n_{16}	Tetrachloroethene	50.8	mg/g GAC	1.79	
	K_{17} , n_{17}	Toluene	26.1	mg/g GAC	2.27	
	K_{18} , n_{18}	Trichloroethene	28	mg/g GAC	1.61	
	K_{19} , n_{19}	Vinyl Chloride	1.72	mg/g GAC	1.61	
	K_{20} , n_{20}	Xylene (total) (Assume p-Xylene)	85.0	mg/g GAC	5.26	
		Total Concentration of Components with Isotherm Data				
	Ctot'	= Ctot - [C_i's with no data]	54.0740	mg VOCs/L		
3. Carbon Column Size		Dimensions for Calgon Carbon Model 7.5 Vessel:				
		(Nominal Carbon Capacity: 10,000 lbs)				
	D_c	Carbon Bed Diameter	2.29	m	7.50	feet
	Z_c	Carbon Bed Depth	2.44	m	8.00	feet
4. Carbon Properties		Adsorption Efficiency (i.e. fraction of equilibrium isotherm				
	E_{ADS}	concentration achieved within bed contact time	0.95	---	0.95	---
	p_c	Carbon bulk density	4.52E+05	g/m³	28.1	lb/ft³

LIQUID-PHASE CARBON ONLY - NO STRIPPER

TABLE D-1.: ESTIMATION OF LIQUID-PHASE GAC COLUMN PERFORMANCE

Project: RESOLVE J-004907-0004-001 | Path & Filename: B:\GACONLY.WK1

ITEM	DESCRIPTION/ EQUATION	VALUE	SI UNITS	EQUIV. VALUE	U.S. UNITS
B. SYSTEM CALCULATIONS					
1. Average Isotherm Parameters	Calculates Concentration-Weighted Average for Freundlich Parameters				
K_{AVG}	$= [(C_1/Ctot')\cdot K_1+(C_2/Ctot')\cdot K_2+....+(C_i/Ctot')\cdot K_i]$	20.07	mg/g GAC	---	
n_{AVG}	$= [(C_1/Ctot')\cdot n_1+(C_2/Ctot')\cdot n_2+....+(C_i/Ctot')\cdot n_i]$	2.703	---	---	
C. OUTPUT PARAMETERS					
1. Loading Rate	Calculates Loading Rate to Column (flow per x-sectional area of column). Typical Range ~5 gpm/ft² but no more than 10 gpm/ft²				
u_{LR}	$= (4\cdot Qf)/(\pi\cdot Dc^2)$	0.001537	$m^3/sec\cdot m^2$	2.26	gpm/ft^2
2. Empty Bed Contact Time	Calculates residence time in carbon bed; Typical range should be at least ~10-15 minutes				
EBCT	$= (\pi\cdot Dc^2\cdot Zc)/(60\cdot 4\cdot Qf)$	26.4	minutes	26.4	minutes
3. Average Carbon Capacity	Calculates Average Capacity of the Activated Carbon, $(X/m)_{AVG}$ based on K_{AVG} and n_{AVG} which are based on concentration weighted averages.				
$(X/m)_{AVG}$	$= K_{AVG}\cdot(Ctot)^{\wedge}1/(n_{AVG})$	87.9	mg VOCs/g GAC	0.0879	lb VOCs/lb GAC
4. Average Carbon Usage	Calculates Average Usage Rate of Activated Carbon (GAC)				
R_{GAC}	Per Day Basis: $= [Ctot\cdot Q_f\cdot 86{,}400]/(X/m)_{AVG}$	335.48	kg GAC/day	739.60	lb GAC/day
	Per Unit Flowrate Basis: $= [R_{GAC}\cdot 86{,}400]/Q_f$	0.6155	$kg\ GAC/m^3$	5.1295	lb GAC/1,000 gal
5. Expected Bed Service Life	Calculates Operating Life of Carbon Column Until Replacement is required (single column only); Source: Ref(2), Bohart & Adams Equation (1st term only - "step" function breakthrough wavefront)				
t_B	$= \dfrac{[\,p_c\cdot E_{ADS}\cdot(X/m)_{AVG}\,]\cdot Z_c}{[\,Ctot\cdot u_{LR}\cdot 1{,}000\cdot 86{,}400\,]}$	13	days	13	days

D.2 CATALYTIC OXIDATION UNIT INFLUENT CONCENTRATIONS

Table D.2 Catalytic Oxidation Unit Influent Concentrations

System Parameters:

Operating Pressure (Atm):	1.0
Stripper Operating Temperature (C):	12.7
Air to Water Ratio (100:1):	100
Gas Constant (L–Atm/Mol–K):	0.0821
Molar Density (gmol/L) n/V = P/RT:	0.0426
Air Stripper Blower Rate (cfm):	534 @ 40 GPM, 1070 @ 80 GPM, 1337 @ 100 GPM
Oxidation Tank Blower Rate (cfm):	70

Use this column assuming [illegible] air to water ratio → 900 cfm + 70 cfm from aeration + 100 cfm from other tanks

Compound	Molecular Weight (g/mol)	Estimated Average Influent Conc. (ug/L)	Catalytic Oxidizer Feed (g/min) Assuming 99% removal in Air Stripper			Catalytic Oxidizer Feed (ppmv) At 100:1 Air/Water Ratio		
			40 GPM	80 GPM	100 GPM	40 GPM	80 GPM	100 GPM
VOLATILE ORGANICS								
Acetone	58.08	130	0.0195	0.0389	0.0486	0.46	0.49	0.49
Benzene	78.11	15	0.0022	0.0045	0.0056	0.04	0.04	0.04
2–Butanone (MEK)	72.1	241	0.0361	0.0721	0.0902	0.69	0.73	0.74
Carbon Disulfide	76.14	12	0.0018	0.0036	0.0045	0.03	0.03	0.03
Chlorobenzene	112.56	31	0.0046	0.0093	0.0116	0.06	0.06	0.06
Chloroethane	64.52	532	0.0796	0.1593	0.1991	1.69	1.79	1.82
Chloroform	119.39	50	0.0075	0.0150	0.0187	0.09	0.09	0.09
1,1–Dichloroethane	98.96	560	0.0838	0.1677	0.2096	1.16	1.23	1.25
1,1–Dichloroethene	96.94	320	0.0479	0.0958	0.1198	0.68	0.72	0.73
1,2–Dichloroethane	98.96	95	0.0142	0.0284	0.0356	0.20	0.21	0.21
1,2–Dichloroethene (total)	96.94	12742	1.9073	3.8146	4.7683	26.95	28.60	28.96
Ethylbenzene	106.1	380	0.0569	0.1138	0.1422	0.73	0.78	0.79
4–Methyl–2–Pentanone (MIBK)	100.16	183	0.0274	0.0548	0.0685	0.37	0.40	0.40
Methylene Chloride	84.93	386	0.0578	0.1156	0.1444	0.93	0.99	1.00
Tetrachloroethene	167.85	1800	0.2694	0.5389	0.6736	2.20	2.33	2.36
Toluene	92.13	12000	1.7963	3.5925	4.4906	26.70	28.35	28.70
Trichloroethene	131.39	7500	1.1227	2.2453	2.8067	11.70	12.42	12.58
1,1,1–Trichloroethane	133.4	9400	1.4071	2.8141	3.5177	14.45	15.33	15.53
1,1,2–Trichloroethane	133.4	410	0.0614	0.1227	0.1534	0.63	0.67	0.68
Vinyl Chloride	62.5	4300	0.6437	1.2873	1.6091	14.11	14.97	15.16
Xylene (total)	106.16	2800	0.4191	0.8383	1.0478	5.41	5.74	5.81

Project	Resolve	Acct. No.		Page	1 of
Subject	Estimated Influent Concentrations	Comptd. By	S. Thibault	Date	4/26/93
Detail	to Catalytic oxidation unit	Ck'd. By	J. Levengood	Date	4/26

Example Calculation:

Compound: Acentone Mol. wt: 58.08 g/mol

Influent concentration to stripper: 130 ug/L

System Flow Rate: 40 GPM

- Assume 99% removal in Stripper:

$$.99\,(130\ \text{ug/L}) = 128.7\ \text{ug/L}$$

$$128.7\ \frac{\text{ug}}{\text{L}} \times 3.78\ \frac{\text{L}}{\text{gal}} \times 40\ \frac{\text{gal}}{\text{min}} \times \frac{\text{g}}{10^6\ \text{ug}} \times \frac{\text{mol}}{58.08\ \text{g}} = \boxed{3.35 \times 10^{-4}\ \frac{\text{mol Acetone}}{\text{min}}}$$

- out of Stripper

- Assume Ideal Gas Law is valid:

$$PV = nRT$$

System Parameters:
Stripper pressure: 1 atm
Stripper Temperature: 12.7°C = 285.7
(55 F)

Calculate molar Density:

$$\frac{n}{V} = \frac{P}{RT} = \frac{1\ \text{atm}}{\left(.0821\ \frac{\ell\ \text{atm}}{\text{mol}\cdot\text{K}}\right)(285.7\ \text{K})} = .0426\ \frac{\text{gmol}}{\ell}$$

$$.0426\ \frac{\text{gmol}}{\ell} \times \frac{28.317\ \ell}{\text{ft}^3} = 1.21\ \frac{\text{gmol}}{\text{ft}^3}$$

Calculate Volumetric Flow Rate of Acetone:

$$3.35 \times 10^{-4}\ \frac{\text{gmol Acetone}}{\text{min}} \times \frac{\text{ft}^3}{1.21\ \text{gmol}} = \boxed{2.76 \times 10^{-4}\ \frac{\text{ft}^3\ \text{Acetone}}{\text{min}}}$$

Project	Resolve	Acct. No.		Page	2 of
Subject		Comptd. By	S. Thibault	Date	1/30/93
Detail		Ck'd. By	JL	Date	

Calculate Volumetric Flow Rate of Air:

- Assume 100 : 1 Air to Water Ratio in Stripper

$$40 \frac{gal}{min} \times \frac{ft^3}{7.48\ gal} \times \frac{100\ ft^3/min\ Air}{1\ ft^3/min\ water} = 535 \frac{ft^3}{min} \text{ Air from stripper}$$

- Assume 70 cfm from Aeration Tank
- Assume Air Flow from ventilation of Process tanks is negligible

$$\text{Total Air Flow Rate} = 535 \frac{ft^3}{min} + 70 \frac{ft^3}{min} = \boxed{605\ ft^3/min}$$

Calculate Airborne concentration (PPM_v) of Acetone

$$\frac{2.76 \times 10^{-4}\ ft^3\ Acetone/min}{605\ ft^3\ Air/min} = 4.57 \times 10^{-7} \frac{ft^3\ Acetone}{ft^3\ Air}$$

$$4.57 \times 10^{-7} \frac{ft^3\ Acetone}{ft^3\ Air} \times \frac{10^6\ parts\ Air}{1\ part\ Acetone} = \boxed{.457\ ppmv\ Acetone}$$

D.3 CATALYTIC OXIDATION EFFLUENT REQUIREMENTS

TABLE D.3 CATALYTIC OXIDATION EFFLUENT REQUIREMENTS

Compound	Inlet Concentration (ppmv) 40 gpm GW flow	Inlet Concentration (ppmv) 80 gpm GW flow	Inlet Concentration (ppmv) 100 gpm GW flow	Outlet Concentration with 95% DRE (ppmv) 40 gpm GW flow	Outlet Concentration with 95% DRE (ppmv) 80 gpm GW flow	Outlet Concentration with 95% DRE (ppmv) 100 gpm GW flow	Mass per time in effluent with 95% DRE (lb/hr) 40 gpm GW flow	Mass per time in effluent with 95% DRE (lb/hr) 80 gpm GW flow	Mass per time in effluent with 95% DRE (lb/hr) 100 gpm GW flow	Detection Limits (ppmv)
Acetone	0.46	0.49	0.49	0.023	0.025	0.025	0.00013	0.00026	0.00032	0.001
Benzene	0.04	0.04	0.04	0.002	0.002	0.002	0.00001	0.00003	0.00004	0.001
2-Butanone	0.69	0.73	0.74	0.034	0.037	0.037	0.00024	0.00048	0.00060	0.005
Carbon Disulfide	0.03	0.03	0.03	0.002	0.002	0.002	0.00001	0.00002	0.00003	0.001
Chlorobenzene	0.06	0.06	0.06	0.003	0.003	0.003	0.00003	0.00006	0.00008	0.001
Chloroethane	1.69	1.79	1.82	0.085	0.090	0.091	0.00053	0.00105	0.00132	0.001
Chloroform	0.09	0.09	0.09	0.005	0.005	0.005	0.00005	0.00010	0.00012	0.001
1,1-Dichloroethane	1.16	1.23	1.25	0.058	0.062	0.063	0.00042	0.00111	0.00139	0.001
1,1-Dichloroethene	0.68	0.72	0.73	0.034	0.036	0.037	0.00032	0.00063	0.00079	0.001
1,2-Dichloroethane	0.2	0.21	0.21	0.010	0.011	0.011	0.00009	0.00019	0.00024	0.001
1,2-Dichloroethene (total)	26.95	28.6	28.96	1.348	1.430	1.448	0.01260	0.02521	0.03151	0.001
Ethylbenzene	0.73	0.78	0.79	0.037	0.039	0.040	0.00038	0.00075	0.00094	0.001
4-Methyl-2-Pentanone	0.37	0.4	0.4	0.019	0.020	0.020	0.00018	0.00036	0.00045	0.005
Methylene Chloride	0.93	0.99	1	0.047	0.050	0.050	0.00038	0.00076	0.00095	0.001
Tetrachloroethene	2.2	2.33	2.36	0.110	0.117	0.118	0.00178	0.00356	0.00445	0.001
Toluene	26.7	28.35	28.7	1.335	1.418	1.435	0.01187	0.02374	0.02967	0.001
Trichloroethene	11.7	12.42	12.58	0.585	0.621	0.629	0.00742	0.01484	0.01855	0.001
1,1,1-Trichloroethane	14.45	15.33	15.53	0.723	0.767	0.777	0.00930	0.01860	0.02324	0.001
1,1,2-Trichloroethane	0.63	0.67	0.68	0.032	0.034	0.034	0.00041	0.00081	0.00101	0.001
Vinyl Chloride	14.11	14.97	15.16	0.706	0.749	0.758	0.00425	0.00851	0.01063	0.001
Xylenes (total)	5.41	5.74	5.81	0.271	0.287	0.291	0.00277	0.00554	0.00692	0.001
Totals							0.05317	0.10660	0.13325	

Notes:

Detection limits are typical of Method TO-14

95% DRE or an organic emission limit of 3 lb/hr (3.1 ton/yr) required according to 40 CFR 264.1032

No federal regulations exist for HCL emissions from air stripper off-gas treatment; incineration emission limit of < 4 lb/hr assumed (40 CFR 264.345)

Organic mass emission rates are less than 0.7 lb/hr which is equal to 3.1 ton/yr assuming full-time operation

D.4 AIR STRIPPING BACKUP

ShallowTray
low profile air strippers

March 25, 1993

Scott Thibault
Metcalf & Eddy
30 Harvard Mill Square
Wakefield, MA

RE: Proposal #393583
SITE ID: J#004907-0004-001

Dear Scott,

I have selected our **four-tray Model 3641** ShallowTray low profile air stripper for the remediation application we discussed.

I understand that the treatment flow rate is **30-80 gpm** and the water temperature is 50°F. ShallowTray systems are more tolerant of inorganics than other types of aeration equipment, however, high concentrations can cause operational difficulties if proper precautions are not taken. To assist you with your remediation planning we offer, free of charge, a water analysis to check for the presence of iron, hardness, and manganese. Please contact us if this is of interest to you.

Expected performance for the **Model 3641** ShallowTray air stripper operating at **30 & 80 gpm** (normal operation range is 1-90 gpm) and 50°F is attached.

The price for the ShallowTray Model 3641, with optional components, is listed below:

Basic System Model 3641	
Sump tank & 1 tray, 304L stainless steel	
3 Additional tray(s), 304L stainless steel	
Blower, 4 tray, 7.5 hp, 900 cfm @ 18 " wc, 1 phase, 230V, TEFC	
Inlet screen and damper, 304L stainless steel demister, air pressure gauge, spray nozzle, sight tube, gaskets, stainless steel latches, Schedule 80 PVC piping, tray cleanout ports, steel frame.	
Basic System Price	**$24,810**

Options		
Feed pump	0	$0
Discharge pump	0	$0
Additional blower	0	$0
Blower start/stop panel	0	$0
NEMA 3R main disconnect switch	1	$100
Standard NEMA 3R control panel with alarm interlocks, motor starter, panel light (UL Listed)	1	$2,124
NEMA 3R control panel with pump level controls, alarm interlocks, motor starter, panel light (UL Listed)	0	$0
Control panel IS components	0	$0
Intermittent operation	0	$0
Strobe alarm light	0	$0
Alarm horn	0	$0
Power loss indicator	0	$0
Low air pressure alarm switch	1	$175
High water level alarm switch	1	$72
Discharge pump level switch	0	$0
Water pressure gauges	0	$0
Digital water flow indicator & totalizer	0	$0
Air flow meter	0	$0
Temperature gauges	0	$0
Line sampling ports	2	$53
Air blower silencer	0	$0
Washer wand	0	$0
Iron settler	0	$0
Auto dialer	0	$0
Oil/Water Separator	0	$0
Other	0	$0
Other	0	$0
Options Cost		$2,524
Price With Options		$27,333

The system is 8'3" high, 6'2" long and 5' wide and weighs approximately 1,840 lbs.

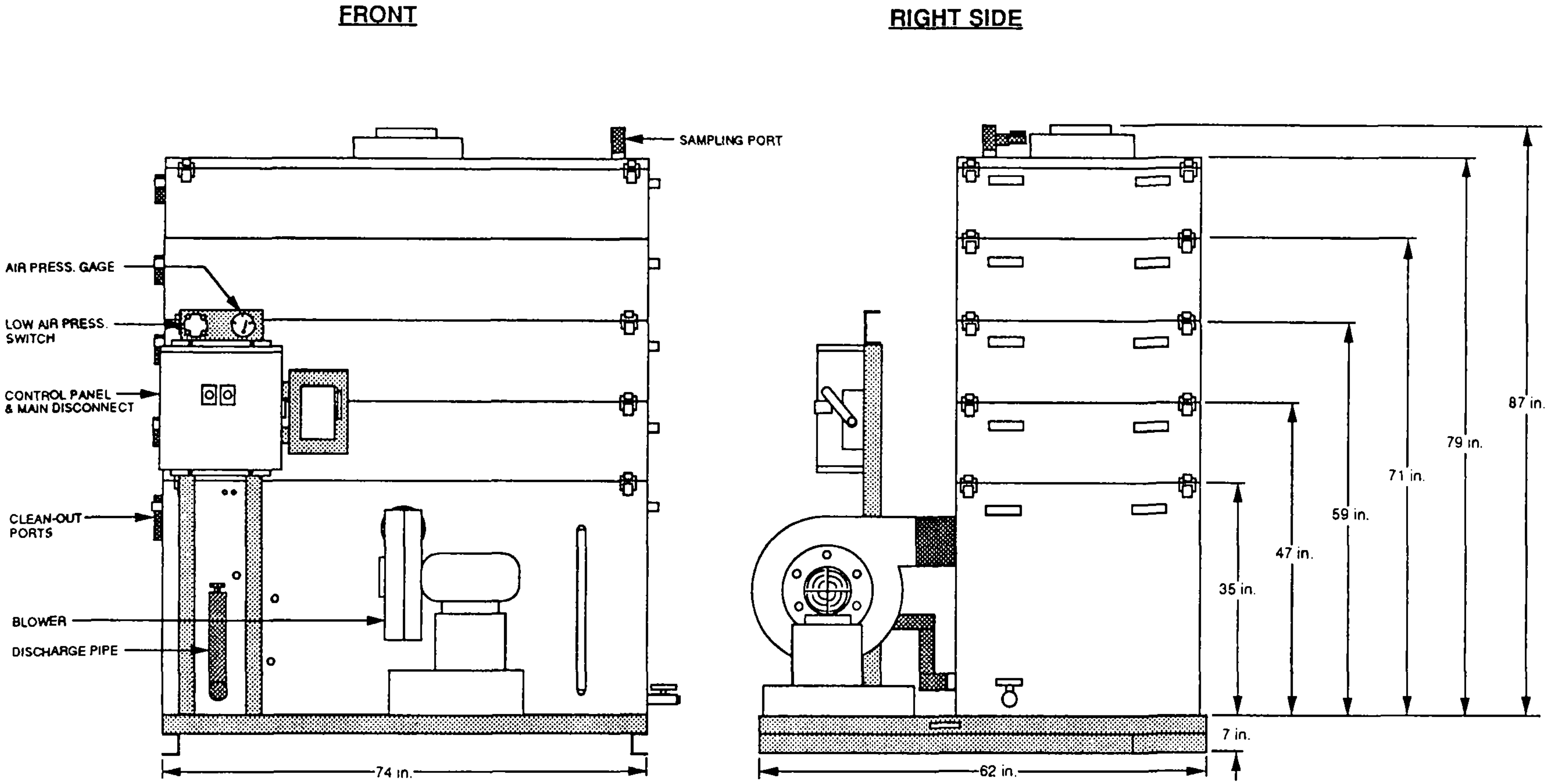
All systems are shipped pre-assembled and factory tested. Normal shipment is approximately 4 weeks from receipt of order. Purchase terms are 30% with the order, 70% net 30 days from delivery. Prices are valid for 90 days only. I look forward to working with you on this project. Once again, thank you for your interest in our products.

Sincerely,

David Steele

David Steele
Customer Service

File: Metcalf & Eddy



BASIC SYSTEM

- ✓ SUMP TANK
- ✓ AERATION TRAYS
- ✓ BLOWER
- ✓ AIR PRESSURE GAGE
- ✓ DEMISTER PAD
- ✓ PIPING
- ✓ SPRAY NOZZLE
- ✓ WATER LEVEL SIGHT TUBE
- ✓ GASKETS
- ✓ LATCHES
- ✓ FRAME

OPTIONAL ITEMS

- ___ DISCHARGE PUMP
- ___ FEED PUMP
- ___ ADDITIONAL BLOWER
- ___ EXP MOTORS
- ___ BLOWER START/STOP PANEL
- ✓ CONTROL PANEL
- ✓ MAIN DISCONNECT SWITCH
- ___ IS COMPONENTS/REMOTE MOUNT
- ___ INTERMITTENT OPERATION
- ___ STROBE LIGHT
- ___ ALARM HORN
- ___ POWER LOSS INDICATOR
- ✓ LOW AIR PRESSURE ALARM SWITCH
- ✓ HIGH WATER LEVEL ALARM SWITCH
- ___ DISCHARGE PUMP LEVEL SWITCH
- ___ WATER PRESSURE GAGES
- ___ DIGITAL WATER FLOW INDICATOR
- ___ AIR FLOW METER
- ___ TEMPERATURE GAGES
- ✓ LINE SAMPLING PORTS
- ___ AIR BLOWER SILENCER
- ___ WASHER WAND
- ___ AUTO DIALER

NOTE:

1. DRAWING REPRESENTS A UNIT TYPICAL TO THE SPECIFICATION YOU REQUESTED. MINOR CHANGES MAY RESULT IN THE MANUFACTURING PROCESS

CONNECTION INFORMATION

ITEM	SIZE
GRAVITY DISCHARGE	3 in. Ø FEMALE SLIP JOINT, PVC80
DISCHARGE PUMP	2 in. Ø FEMALE SLIP JOINT, PVC80
WATER INLET	2 in. Ø FEMALE SLIP JOINT, PVC80
AIR EXHAUST NOZZLE	8 in. Ø FLANGE

POWER: 1Ø, 230volt, 3 WIRE and GROUND

*CONSULT N.E.E.P. FOR AMPACITIES AND OTHER VOLTAGE OPTIONS

MINIMUM CLEARANCE

FRONT	1.5 ft.
TOP	34 in.
REAR	N/A
LEFT	3.5 ft.
RIGHT	1 ft.

NORTH EAST ENVIRONMENTAL PRODUCTS, INC.
17 TECHNOLOGY DRIVE
WEST LEBANON, NH 03784
(603) 298-7061

TOLERANCES UNLESS OTHERWISE SPECIFIED ± 1 in.	DRAWING NAME: 3641	
	DRAWING #: PROPOSAL #393583	
DRAWN: DS	CUSTOMER: Metcalf & Eddy	
DATE: 3/25/93	SCALE:	SIZE: A SHEET: OF:

ShallowTray
low profile air strippers

System Performance Estimate

Client & Proposal Information:

Metcalf & Eddy

Model chosen: 3600
Water Flow Rate: 30.0 gpm
Air Flow Rate: 900 cfm
Water Temp: 50.0 F
Air temp: 50.0 F
A/W Ratio: 224.4 cu. ft/ cu. ft
Safety Factor 25%

Contaminant	Untreated Influent	Model 3611 Effluent Water Air(lbs/hr) % removal	Model 3621 Effluent Water Air(lbs/hr) % removal	Model 3631 Effluent Water Air(lbs/hr) % removal	Model 3641 Effluent Water Air(lbs/hr) % removal
1,1,1-Trichloroethane	**9400 ppb**	**258 ppb** 0.137190 97.2607%	**6 ppb** 0.140972 99.9400%	**<1 ppb** 0.141060 99.9987%	**<1 ppb** 0.141062 100.0000%
1,1,2-Trichloroethane	**410 ppb**	**131 ppb** 0.004187 68.1573%	**34 ppb** 0.005642 91.8883%	**9 ppb** 0.006018 97.9336%	**3 ppb** 0.006108 99.4736%
1,1-Dichloroethane	**560 ppb**	**35 ppb** 0.007878 93.8237%	**2 ppb** 0.008374 99.6948%	**<1 ppb** 0.008402 99.9849%	**<1 ppb** 0.008404 99.9993%
1,1-Dichloroethylene	**320 ppb**	**23 ppb** 0.004457 93.1001%	**2 ppb** 0.004772 99.6191%	**<1 ppb** 0.004801 99.9790%	**<1 ppb** 0.004802 99.9988%
1,2- Dichloroethane	**95 ppb**	**19 ppb** 0.001141 80.5859%	**3 ppb** 0.001381 96.9847%	**1 ppb** 0.001411 99.5317%	**<1 ppb** 0.001425 99.9273%
Acetone	**130 ppb**	**72 ppb** 0.000870 45.2603%	**32 ppb** 0.001471 76.0286%	**14 ppb** 0.001741 89.5025%	**6 ppb** 0.001861 95.4030%
Benzene	**88 ppb**	**4 ppb** 0.001261 96.0342%	**<1 ppb** 0.001319 99.8742%	**<1 ppb** 0.001321 99.9960%	**<1 ppb** 0.001321 99.9999%
c-1,2-Dichloroethylene	**12742 ppb**	**569 ppb** 0.182675 95.5390%	**21 ppb** 0.190899 99.8408%	**1 ppb** 0.191199 99.9943%	**<1 ppb** 0.191214 99.9998%
Chlorobenzene	**31 ppb**	**2 ppb** 0.000435 94.3426%	**<1 ppb** 0.000464 99.7439%	**<1 ppb** 0.000465 99.9884%	**<1 ppb** 0.000465 99.9995%
Chloroethane	**532 ppb**	**13 ppb** 0.007788 97.6220%	**<1 ppb** 0.007980 99.9548%	**<1 ppb** 0.007983 99.9991%	**<1 ppb** 0.007984 100.0000%
Chloroform	**103 ppb**	**9 ppb** 0.001411 91.3994%	**1 ppb** 0.001531 99.4082%	**<1 ppb** 0.001545 99.9593%	**<1 ppb** 0.001546 99.9972%
Ethyl Benzene	**380 ppb**	**13 ppb** 0.005507 96.6164%	**1 ppb** 0.005688 99.9084%	**<1 ppb** 0.005702 99.9975%	**<1 ppb** 0.005703 99.9999%

Methylene Chloride	**386 ppb**	**146 ppb** 0.003602 62.2060%	**45 ppb** 0.005117 88.5729%	**14 ppb** 0.005582 96.5450%	**5 ppb** 0.005718 98.9554%
p-Xylene	**2800 ppb**	**89 ppb** 0.040683 96.8474%	**3 ppb** 0.041973 99.9205%	**<1 ppb** 0.042018 99.9980%	**<1 ppb** 0.042018 99.9999%
Tetrachloroethylene	**1800 ppb**	**48 ppb** 0.026292 97.3798%	**1 ppb** 0.026997 99.9451%	**<1 ppb** 0.027012 99.9988%	**<1 ppb** 0.027012 100.0000%
Toluene	**12000 ppb**	**576 ppb** 0.171435 95.2072%	**23 ppb** 0.179734 99.8162%	**1 ppb** 0.180064 99.9930%	**<1 ppb** 0.180079 99.9997%
Trichloroethylene	**7500 ppb**	**288 ppb** 0.108228 96.1615%	**9 ppb** 0.112415 99.8821%	**1 ppb** 0.112535 99.9964%	**<1 ppb** 0.112549 99.9999%
Vinyl Chloride	**4300 ppb**	**25 ppb** 0.064153 99.4282%	**<1 ppb** 0.064527 99.9974%	**<1 ppb** 0.064528 100.0000%	**<1 ppb** 0.064528 100.0000%

This report has been generated by ShallowTray Modeler software version 1.2.0. This software is designed to assist a skilled operator in predicting the performance of a ShallowTray air stripping system. The software will accurately predict the system performance when both the equipment and the software are operated according to the written documentation and standard operation.
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ShallowTray™

low profile air strippers

System Performance Estimate

Client & Proposal Information:

Metcalf & Eddy

Model chosen:	3600
Water Flow Rate:	80.0 gpm
Air Flow Rate:	900 cfm
Water Temp:	50.0 F
Air temp:	50.0 F
A/W Ratio:	84.1 cu. ft/ cu. ft
Safety Factor	25%

Contaminant	Untreated Influent	Model 3611 Effluent Water Air(lbs/hr) % removal	Model 3621 Effluent Water Air(lbs/hr) % removal	Model 3631 Effluent Water Air(lbs/hr) % removal	Model 3641 Effluent Water Air(lbs/hr) % removal
1,1,1-Trichloroethane	**9400 ppb**	**438 ppb** 0.358638 95.3452%	**17 ppb** 0.375485 99.8267%	**1 ppb** 0.376126 99.9935%	**<1 ppb** 0.376165 99.9998%
1,1,2-Trichloroethane	**410 ppb**	**158 ppb** 0.010084 61.5028%	**49 ppb** 0.014446 88.1437%	**15 ppb** 0.015807 96.3485%	**5 ppb** 0.016207 98.8754%
1,1-Dichloroethane	**560 ppb**	**53 ppb** 0.020289 90.6245%	**4 ppb** 0.022250 99.2968%	**1 ppb** 0.022370 99.9473%	**<1 ppb** 0.022409 99.9960%
1,1-Dichloroethylene	**320 ppb**	**34 ppb** 0.011445 89.6859%	**3 ppb** 0.012686 99.1490%	**<1 ppb** 0.012797 99.9298%	**<1 ppb** 0.012805 99.9942%
1,2- Dichloroethane	**95 ppb**	**24 ppb** 0.002841 74.8604%	**5 ppb** 0.003602 94.9440%	**1 ppb** 0.003762 98.9832%	**<1 ppb** 0.003794 99.7955%
Acetone	**130 ppb**	**130 ppb** <.000001 0.0000%	**130 ppb** <.000001 0.0000%	**130 ppb** <.000001 0.0000%	**130 ppb** <.000001 0.0000%
Benzene	**88 ppb**	**19 ppb** 0.002761 78.7494%	**4 ppb** 0.003361 96.3873%	**1 ppb** 0.003482 99.3858%	**<1 ppb** 0.003518 99.8956%
c-1,2-Dichloroethylene	**12742 ppb**	**903 ppb** 0.473769 92.9155%	**52 ppb** 0.507824 99.5985%	**3 ppb** 0.509784 99.9772%	**<1 ppb** 0.509898 99.9987%
Chlorobenzene	**31 ppb**	**8 ppb** 0.000920 74.4966%	**2 ppb** 0.001161 94.7966%	**1 ppb** 0.001201 98.9384%	**<1 ppb** 0.001238 99.7834%
Chloroethane	**532 ppb**	**22 ppb** 0.020409 95.8790%	**1 ppb** 0.021249 99.8641%	**<1 ppb** 0.021288 99.9955%	**<1 ppb** 0.021289 99.9999%
Chloroform	**103 ppb**	**13 ppb** 0.003602 87.5308%	**2 ppb** 0.004042 98.7561%	**<1 ppb** 0.004117 99.8759%	**<1 ppb** 0.004121 99.9876%
Ethyl Benzene	**380 ppb**	**75 ppb** 0.012205 80.4132%	**12 ppb** 0.014726 96.9309%	**2 ppb** 0.015127 99.5191%	**1 ppb** 0.015167 99.9246%

Methylene Chloride	**386 ppb**	**386 ppb** <.000001 0.0000%	**386 ppb** <.000001 0.0000%	**386 ppb** <.000001 0.0000%	**386 ppb** <.000001 0.0000%
p-Xylene	**2800 ppb**	**529 ppb** 0.090880 81.1116%	**80 ppb** 0.108848 97.1458%	**13 ppb** 0.111529 99.5687%	**2 ppb** 0.111969 99.9348%
Tetrachloroethylene	**1800 ppb**	**81 ppb** 0.068790 95.5200%	**3 ppb** 0.071912 99.8394%	**<1 ppb** 0.072028 99.9942%	**<1 ppb** 0.072032 99.9998%
Toluene	**12000 ppb**	**2811 ppb** 0.367722 76.5787%	**527 ppb** 0.459122 95.6116%	**99 ppb** 0.476250 99.1777%	**19 ppb** 0.479451 99.8459%
Trichloroethylene	**7500 ppb**	**467 ppb** 0.281444 93.7756%	**24 ppb** 0.299172 99.6901%	**2 ppb** 0.300052 99.9846%	**<1 ppb** 0.300130 99.9992%
Vinyl Chloride	**4300 ppb**	**52 ppb** 0.169995 98.7923%	**1 ppb** 0.172036 99.9883%	**<1 ppb** 0.172076 99.9999%	**<1 ppb** 0.172076 100.0000%

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D.5 METALS REMOVAL AND SLUDGE GENERATION CALCULATION

METCALF & EDDY, ENGINEERS

NONREPRODUCIBLE GRID FORM 145

Project: Resolve — Acct. No. ____ — Page 1 of 2

Subject: Sludge Generation — Comptd. By: S. Thibault — Date: 5/18/93

Detail: ____ — Ck'd. By: J. Langford — Date: 5/19/93

Sludge Generation

At 80 gpm flow rate = 302.4 L/min

Iron

influent concentration = $35 \frac{mg\ Fe}{L}$

$$302.4 \frac{L}{min} \times \frac{35\ mg}{L} \times \frac{g}{1000\ mg} = 10.58 \frac{g\ Fe}{min}$$

Assume 100% removal in clarifier (conservative)

$$10.58 \frac{g\ Fe}{min} \times \frac{mol\ Fe}{55.8\ g\ Fe} \times \frac{mol\ Fe(OH)_3}{1\ mol\ Fe} \times \frac{106\ g\ Fe(OH)_3}{mol\ Fe(OH)_3} \times \frac{kg}{1000\ g} \times \frac{2.2\ lb}{kg}$$

$$= 0.044 \frac{lb\ Fe(OH)_3}{min} \times 60 \frac{min}{hr} \times 24 \frac{hr}{day} = \boxed{63.67 \frac{lb\ Fe(OH)_3}{day}}$$

Dry Solids Basis

Manganese

Influent concentration = 9.2 mg/L

$$302.4 \frac{L}{min} \times 9.2 \frac{mg\ Mn}{L} \times \frac{g}{1000\ mg} = 2.78 \frac{g}{min}\ Mn$$

$$2.78 \frac{g\ Mn}{min} \times \frac{mol\ Mn}{54.9\ g\ Mn} \times \frac{mol\ MnO_2}{1\ mol\ Mn} \times \frac{86.9\ g\ MnO_2}{mol\ MnO_2} \times \frac{kg}{1000\ g} \times \frac{2.2\ lb}{kg}$$

$$= .0096 \frac{lb\ MnO_2}{min} \times 60 \frac{min}{hr} \times 24 \frac{hr}{day} = \boxed{13.94 \frac{lb}{day}\ MnO_2}$$

Dry Solids Basis

Assume 20 % extra mass for other sludge particles

$$(63.67\ lb + 13.94\ lb)\ 1.2 = \boxed{93.12\ \frac{lb}{day}\ \text{Dry Solids Basis}}$$

Sludge Generation + Filter Press Sizing

Assume 30 % cake solids

Assume hydroxide sludge density of 70 lb/ft³

$$\text{Filter Press Size} = \frac{\text{lbs Dry Solids}}{(\text{cake Density})(\text{wt \% solids})}$$

$$= \frac{93.12\ lb/day}{(70\ lb/ft^3)(0.3)}$$

$$\boxed{\approx 4.4\ ft^3/day} \Rightarrow \text{use } 6\ ft^3 \text{ press expandable to } 8\ ft^3$$

$$4.4\ \frac{ft^3}{dy} \times \frac{yd^3}{27\ ft^3} = \boxed{0.162\ yd^3/day} = \boxed{59.4\ yd^3/yr}$$

Project Resolve | Acct. No. | Page 1 of 2
Subject oxidation of manganese | Comptd. By S. Thibault | Date 5/18/93
Detail | Ck'd. By J. [illegible] | Date 5/19/93

Oxidation of Manganese

Retention time in metals removal system:

Aeration / oxidation Tank $\quad V = 2{,}000$ gal

Flocculation Tank $\quad V = 1{,}000$ gal

At 40 gpm retention time $= 3{,}000 \text{ gal} \times \frac{\text{min}}{40 \text{ gal}} = 75$ minutes

80 gpm ⇒ 37.5 minutes
100 gpm ⇒ 30.0 minutes

Aeration / oxidation system will operate at a pH of 10.0.

* Assume 90% removal of manganese in aeration / flocculation system

From graph on pg 2 ∴

$\log\left[[Mn^{2+}_{final}] / [Mn^{2+}_{initial}]\right]$

$\log\left[1.67\times10^{-5} / 1.67\times10^{-4}\right]$

$\log[0.1]$

$\boxed{= -1}$

$Mn^{2+}_{initial} = 9.2 \frac{mg}{l} \times \frac{g}{1000 mg} \times \frac{mol}{54.93 g}$

$\boxed{Mn^{2+}_{initial} = 1.67 \times 10^{-4} \frac{mol}{l} Mn^{2+}}$

$Mn^{2+}_{final} = 0.1(1.67\times10^{-4} mol/l)$

$\boxed{Mn^{2+}_{final} = 1.67\times10^{-5} mol/l}$

From graph on pg 2, required retention time at pH 9.5 = 49 minutes

If graph is extrapolated for pH 10.0, required reaction time is estimated to be approximately 20 minutes.

Pg 2 of 2

activa-
eaction

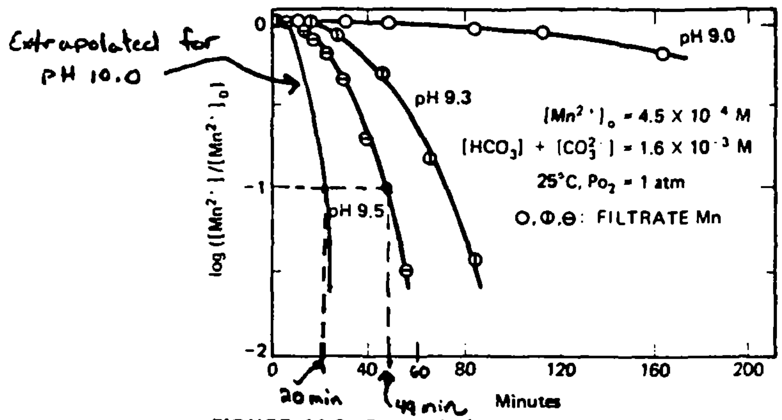

FIGURE 14-9 Removal of manganese (II) by oxygenation (after Morgan, 1967b).

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for the manganese(II) oxidation and removal process were consistent with an autocatalytic kinetic model.

In Chapter 5 an integrated rate law for an autocatalytic reaction is presented, which has the following form:

$$\ln\left[\frac{C_{A_0}(C_T - C_A)}{C_A(C_T - C_{A_0})}\right] = (C_{A_0} - C_{P_0})k_a t \tag{5-63}$$

where C_{A_0} = initial reactant concentration (moles/ℓ)

C_{P_0} = initial product concentration (moles/ℓ)

C_T = moles/ℓ of reactant plus moles/ℓ of product at any time during the course of the reaction (moles/ℓ)

C_A = reactant concentration at any time during the course of the reaction (moles/ℓ)

k_a = autocatalytic reaction rate constant.

Since C_{A_0}, C_T, and C_{P_0} are constants, equation 5-63 can be written as

$$\log\left[A\left(\frac{C_T - C_A}{C_A}\right)\right] = K_1 t \tag{14-35}$$

or

$$\log\left[A\left(\frac{C_T}{C_A} - 1\right)\right] = K_1 t \tag{14-36}$$

where
$$A = \frac{C_{A_0}}{(C_T - C_{A_0})}$$
$$K_1 = \frac{(C_{A_0} + C_{P_0})k_a}{2.3}$$

240

From: Process Chemistry for Water and Wastewater Treatment, Benefield, Judkins, Weand

D.6 HYDRAULIC LOADING CALCULATION

Project Resolve Acct. No. Page 1 of 1
Subject Filter Design Spec Comptd. By S. Thibault Date 4/20/93
Detail Hydraulic Loads Ck'd. By J. Levangie Date 4/27/93

Hydraulic Loading

System Flow rate = 100 gpm max
40 gpm Avg

Filter vessel Diameter = 48"

Available surface area $= \left(48\,in \times \frac{ft}{12\,in}\right)^2 \times \frac{\pi}{4} = \boxed{12.56\ ft^2}$

- Calculate Hydraulic Loading

* Assume only 1 vessel operating

max loading $= \frac{100\ gpm}{12.56\ ft^2} = 8\ gpm/ft^2$

Max expected loading = 80 gpm/12.56 ft² = 6.3 gpm/ft²

Avg loading $= \frac{40\ gpm}{12.56\ ft^2} = 3.18\ gpm/ft^2$

* Assume 2 vessels operating in parallel (i.e. split flow equally)

max loading: $= \frac{100\ gpm}{(2)(12.56\ ft^2)} = 4\ gpm/ft^2$

max expected loading: 80 gpm/2(12.56) = 3.18 gpm/ft²

Avg loading: $= \frac{40\ gpm}{2(12.56\ ft^2)} = 1.59\ gpm/ft^2$

D.7 FILTER BACKWASH CALCULATIONS

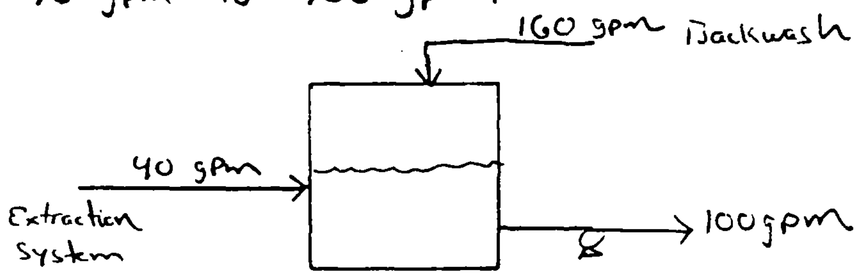
Backwash Cycle

Back wash water is sent to 10,000 gallon equalization tank.

From Venders Backwash cycle = 160 gpm for 26 minutes
60 gpm for 15 minutes
Total Backwash water = 5060 gal over 41 minutes

Operation

Begin backwash cycle, equalization tank (T-1) effluent pumps P1A + P2B increase pumping rate from 40 gpm to 100 gpm.



Assume Equalization Tank is half full at start of cycle. (i.e 5,000 gal available volume in T-1)

- During 1st phase of backwash: $m_{in} = 200$ gpm
  $m_{out} = 100$ gpm
  accumulation = 100 gpm

100 gpm x 26 minutes = 2600 gal.

— During 2nd phase of backwash: m_{in} = 100 gpm

m_{out} = 100 gpm

Accumulation = 0

water level in equalization Tank remains constant

— After backwash is complete: m_{in} = 40 gpm

m_{out} = 100 gpm

Accumulation = −60 gpm

To return to original water level:

$$2600 \text{ gal accumulated} \times \frac{\text{min}}{60 \text{ gal}} = \boxed{43 \text{ minutes}}$$

— Pumps P2A + P2B then return to 40 gpm operation

Total Backwash cycle Time = $\boxed{41 \text{ minutes}}$

Total operation time at 100 gpm = 41 + 43 = $\boxed{84 \text{ minutes}}$

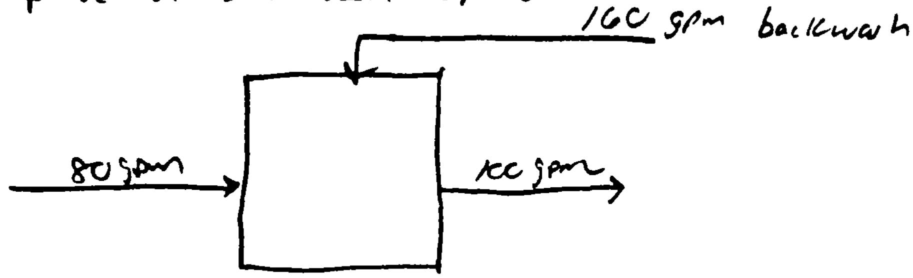
Project: Resolve GWTP | Acct. No. | Page of
Subject: Backwash @ 80 gpm influent | Comptd. By: S. Thibault | Date: 4/15/93
Detail: | Ck'd. By: J. Levaggi | Date: 4/27/93

NONREPRODUCIBLE GRID FORM 148

METCALF & EDDY, ENGINEERS

Assume 80 gpm into plant (worst case)

1st phase of backwash cycle

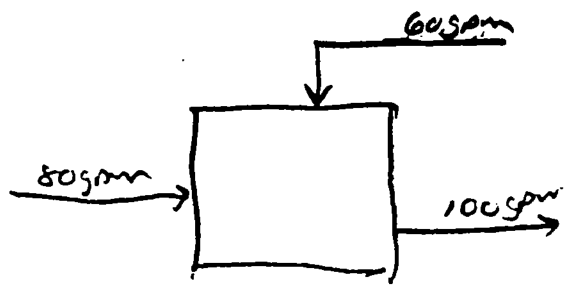


min = 240 gpm
mout = 100 gpm

phase I duration

Accumulation = 140 gpm x 20 minutes = 3640 gal

2nd phase

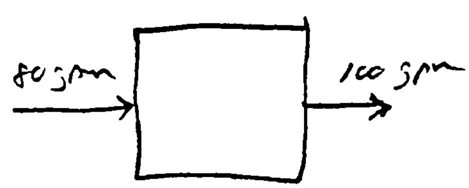


min = 140 gpm
mout = 100 gpm

phase II duration

Accumulation = 40 gpm x 15 minutes = 600 gal

After backwash is complete



min = 80 gpm
mout = 100 gpm
Accumulation = -20 gpm

3640 + 600 accumulated = 4200 gal

To return to original water level = 4200 gal × min/... = 210 min ≅ 3.5 hrs

Subject Backwash @ ?? gpm influent Comptd. By S. Thibault Date 4/19/93
Detail ________ Ck'd. By J. Levingood Date 4/27/93

Total backwash cycle time = 41 minutes

Total operation time at 100 gpm = 41 min + 210 min

= 261 min = $\boxed{4.35 \text{ hrs}}$

Project ______ Acct. No. ______ Page ___ of ___
Subject Backwash frequency Comptd. By S. Thibault Date 4/10/93
Detail ______ Ck'd. By J. Levergood Date 4/27/93

Rule of Thumb for solids capacity in downflow pressure filters is 1-3 lbs per square foot of top surface area.

For FG-48 filters Diam = 50 in

Top surface area $= \frac{\pi (50\text{ in}/12)^2}{4} = 13.63 \text{ ft}^2$

Solids loading on filters

iron $35 \frac{mg}{L} \times 3.78 \frac{L}{gal} \times \frac{40 \text{ gal}}{min} = 5292 \frac{mg}{min}$

Manganese

$9.2 \frac{mg}{L} \times 3.78 \times 40 \frac{gal}{min} = 1391 \frac{mg}{min}$

Assume 70% of $Fe(OH)_3$ + MnO_2 get removed in clarifier.

Fe $.3(5292) = 1587 \frac{mg}{min}$

Mn $.3(1391) = 417$ mg/min

$1587 \frac{mg\,Fe}{min} \times \frac{g}{1000 mg\,Fe} \times \frac{mol\,Fe}{55.8 g\,Fe} \times \frac{mol\,Fe(OH)_3}{1 mol\,Fe} \times \frac{106 g\,Fe(OH)_3}{mol\,Fe(OH)_3} = 3.01 \frac{g\,Fe(OH)_3}{min}$

$3.01 \frac{g\,Fe(OH)_3}{min} \times \frac{1 kg}{1000 g} \times \frac{2.2 lb}{kg} = \boxed{.0066 \text{ lb } Fe(OH)_3/min}$

$417 \frac{mg\,Mn}{min} \times \frac{g}{1000 mg} \times \frac{mol\,Mn}{54.9 g\,Mn} \times \frac{mol\,MnO_2}{1 mol\,Mn} \times \frac{86.9 g\,MnO_2}{mol\,MnO_2} = .660 \frac{g\,MnO_2}{min}$

$.660 \frac{g\,MnO_2}{min} \times \frac{1 kg}{1000 g} \times \frac{2.2 lb}{kg} = \boxed{.0015 \text{ lb } MnO_2/min}$

Project ____ Acct. No. ____ Page ____ of ____

Subject ____ Comptd. By S. Thibault Date ____

Detail ____ Ck'd. By J.L. Date ____

Use 2 lb solids / ft^2 area

Filters can tolerate:

$$13.63 \text{ ft}^2 \times \frac{2 \text{ lbs}}{\text{ft}^2} = 27.26 \text{ lb of solids}$$

Time before backwash is needed:

$$.0066 + .00145 = .00805 \frac{\text{lb}}{\text{min}} \text{ total}$$

$$27.26 \text{ lb} \times \frac{\text{min}}{.00805 \text{ lb}} = 3386 \text{ min} \times \frac{\text{hr}}{60 \text{ min}} = 56 \text{ hrs}$$

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D.8 CHEMICAL USAGE CALCULATIONS

Project	Resolve	Acct. No.		Page	1 of 1
Subject	Polymer Usage	Comptd. By	S. Thibault	Date	4/1/93
Detail		Ck'd. By	J. Leonard	Date	4/9/93

Polymer Usage

Calculate Required Dose:

Typical polymer dosage to treat metallic hydroxide precipitates and sludges $= 2 \frac{\text{mg polymer}}{L_{H_2O}}$

$$\frac{2\ \text{mg polymer}}{L_{H_2O}} \times \frac{3.78\ L}{\text{gal}} \times \frac{40\ \text{gal}}{\text{min}} = 302 \frac{\text{mg polymer}}{\text{min}}$$

System Flow rate

$$\boxed{\text{Polymer Solution mg/ml} = \frac{(\text{Polymer \%})(10{,}000\ \text{mg/L/\%})}{1000\ \text{mL/L}}}$$

* Using 1% stock solution

$$\frac{(1\%)(10{,}000\ \text{mg/L/\%})}{1000\ \text{mL/L}} = \boxed{10\ \text{mg/ml polymer solution}}$$

Polymer Feed Rate:

$$302 \frac{\text{mg polymer}}{\text{min}} \times \frac{\text{ml soln}}{10\ \text{mg polymer}} = 30.2 \frac{\text{ml soln}}{\text{min}}$$

$$30.2 \frac{\text{ml soln}}{\text{min}} \times 60 \times 24 = 43488\ \text{ml/day}$$

$$43488 \frac{\text{ml}}{\text{day}} \times \frac{l}{1000\ \text{ml}} \times \frac{\text{gal}}{3.78\ l} = \boxed{11.5\ \text{gal/day of 1\% polym soln}}$$

For 100 gpm system, polymer usage = 28.8 gal/day 1% soln

Project Resolve | Acct. No. | Page of
Subject $KMnO_4$ usage | Comptd. By S. Thibault | Date 5/19/93
Detail | Ck'd. By J. Lavigne | Date 5/19/93

Estimated $KMnO_4$ Usage

(1) For Continuous regeneration of Greensand filters.

* Assume 70% of metals removed in clarifier

Iron $0.3(35.0\ mg/L) = 10.5\ mg/L$ Fe

Mn $0.3(9.2\ mg/L) = 2.76\ mg/L$ Mn

Iron

Permanganate requirement for Fe^{2+}: $\dfrac{0.6\ mg/L\ KMnO_4}{1.0\ mg/L\ iron}$

System flow = 80 gpm

$$\frac{80\ gal}{min} \times \frac{3.78\ L}{gal} \times \frac{10.5\ mg\ Fe}{L} \times \frac{0.6\ mg\ KMnO_4}{1.0\ mg\ Fe} \times \frac{60\ min}{hr} \times \frac{24\ hr}{day} \times \frac{kg}{10^6\ mg} \times \frac{2.2\ lb}{kg}$$

$$= \boxed{6.03\ \frac{lb}{day}\ KMnO_4}$$

Manganese

Permanganate demand for Manganese = $\dfrac{2\ mg/L\ KMnO_4}{1\ mg/L\ Mn}$

$$\frac{80\ gal}{min} \times \frac{3.78\ L}{gal} \times \frac{2.76\ mg\ Mn}{L} \times \frac{2\ mg/L\ KMnO_4}{1\ mg/L\ Mn} \times \frac{60\ min}{hr} \times \frac{24\ hr}{day} \times \frac{kg}{10^6\ mg} \times \frac{2.2\ lb}{kg}$$

$$\boxed{= 5.28\ lb/day\ KMnO_4}$$

Project Resolve Acct. No. Page of
Subject KMnO4 Usage Comptd. By S. Thibault Date 5/15/53
Detail Ck'd. By C.L. Date 5-9

(2) For intermittent addition to oxidation tank at high flow rates.

* Assume operation at 80 gpm or higher 10% of the time (i.e. 2.4 hrs/day)

Iron

$$\frac{80\ gal}{min} \times \frac{60\ min}{hr} \times \frac{2.4\ hrs}{day} \times \frac{25.0\ mg\ Fe}{L} \times \frac{0.6\ mg/L\ KMnO_4}{1.0\ mg/L\ Fe} \times \frac{kg}{10^6\ mg} \times \frac{2.2\ lb}{kg} \times \frac{3.78\ L}{gal}$$

$$\boxed{= 2.01\ lb/day\ KMnO_4}$$

Manganese

$$\frac{80\ gal}{min} \times \frac{3.78\ L}{gal} \times \frac{60\ min}{hr} \times \frac{2.4\ hrs}{day} \times \frac{9.2\ mg}{L} \times \frac{2\ mg/L\ KMnO_4}{1.0\ mg/L\ Fe} \times \frac{kg}{10^6\ mg} \times \frac{2.2\ lb}{kg} = \boxed{1.76\ lb/day\ KMnO_4}$$

Total KMnO4 usage:

6.03 + 5.28 + 2.01 + 1.76 = 15.08 lb/day

Add 20% for oxidation of other metals + organics

$$15.08 \times 1.2 = \boxed{18\ \frac{lbs}{day}\ KMnO_4}$$

NONREPRODUCIBLE GRID FORM 148

METCALF & EDDY, ENGINEERS

Project	Resolve	Acct. No.		Page	1 of 6
Subject	Chemical Usage – H_2SO_4	Comptd. By	S. Thibault	Date	5/10/93
Detail	pH Adjustment	Ck'd. By	D. Peters	Date	5/11/93

H_2SO_4 Usage

Determine the amount of H_2SO_4 required to adjust the pH of process water from 10.0 to 6.5.

System Flow rate = 100 gpm

Process water Alkalinity = 28 mg/L as $CaCO_3$ (From Radian Pre-Design Report, Feb 91 p. 8-10

* Assume Buffer intensity does not vary over the given pH range.

Assume that the pH is controlled by the carbonic acid system; The applicable equilibrium reactions are;

$$CO_{2(g)} + H_2O_{(l)} \rightleftharpoons (H_2CO_3)_{aq} \rightleftharpoons H^+_{aq} + HCO^-_{aq} \quad (1)$$

$$HCO_3^-{}_{aq} \rightleftharpoons H^+_{aq} + CO_3^{2-}{}_{aq} \quad (2)$$

$$H_2O_l \rightleftharpoons H^+_{aq} + OH^-_{aq} \quad (3)$$

- Equilibrium constants for these reactions are:

At 25°C [1]

$$K_1 = \frac{[H^+][HCO_3^-]}{[H_2CO_3]} \qquad K_1 = 5.01 \times 10^{-7}$$

$$K_2 = \frac{[H^+][CO_3^{2-}]}{[HCO_3^-]} \qquad K_2 = 5.01 \times 10^{-11}$$

$$K_w = \frac{[H^+][OH^-]}{[H_2O]} \qquad K_w = 1 \times 10^{-14}$$

[1] From Water Chemistry, Snoeyink + Jenkins, 1980, P.A 157

- must Adjust the equilibrium constants for temperature by applying the following relationships: [2] From Process Chem. for H_2O + waste H_2O Treatment, 1982 Benefield + Judkins. P.P. 84

$$pK_1 = 17{,}052/T + 215.21(\log T) - 0.12675(T) - 545.56$$

$$pK_2 = 2902.39/T + .02379(T) - 6.498$$

$$pK = 4787.3/T + 7.1321(\log T) + 0.01036(T) - 22.801$$

where T in the above relationships is in degrees Kelvin.

- calculate adjusted equilibrium constant values

System Temperature = 55° F = 12.7°C = 285.7 K

$$pK_1 = \frac{17052}{285.7} + 215.21(\log(285.7)) - 0.12675(285.7) - 545.56$$

$$pK_1 = 6.448 \Rightarrow \boxed{K_1 \doteq 10^{-6.448} = 3.56 \times 10^{-7}}$$

$$pK_2 = \frac{2902.39}{285.7} + 0.02379(285.7) - 6.498$$

$$pK_2 = 10.457 \Rightarrow \boxed{K_2 \doteq 10^{-10.457} = 3.49 \times 10^{-11}}$$

$$pK_w = \frac{4787.3}{285.7} + 7.1321(\log(285.7)) + 0.010365(285.7) - 22.801$$

$$pK_w = 14.43 \Rightarrow \boxed{K_w \doteq 10^{-14.43} = 3.71 \times 10^{-15}}$$

- Calculate the total Alkalinity of the system in equivalents/liter.:

From Radian, Alkalinity = 28 mg/L as $CaCO_3$

$CaCO_3$ ⇒ molecular wt = 100.08

Valence or "replaced Hydrogens" = 2

Equivalent wt of $CaCO_3$ = $\frac{100.08}{2}$ = 50 g/equivalent

$$[Alk.]_e = \frac{.028\ g/l}{eq.\ wt.\ of\ CaCO_3\ [g/equiv]} = \frac{0.028}{50} = 5.6 \times 10^{-4}\ eq./l$$

Project		Acct. No.		Page 3 of 6	
Subject		Comptd. By	S. Thibault	Date	5/10/93
Detail		Ck'd. By	D. Peters	Date	5/11/93

– Calculate the Hydrogen ion concentration of the process water.:

$$[H^+] = 10^{-pH} = 10^{-10.0} = 1 \times 10^{-10.0} \text{ [mols/l]}$$

– Calculate the Hydroxyl ion concentration of the process water.:

$$[OH^-] = \frac{K_w}{[H^+]} = \frac{3.71 \times 10^{-15}}{1 \times 10^{-10}} = 3.71 \times 10^{-5} \text{ [mols/l]}$$

– Calculate Buffer intensity of the process water.:

From Benefield + Jenkins, pp. 97, also in Weber + Stumm, 1963

$$\beta = 2.3\left[C_T \frac{\alpha_1^2}{K_1}\left([H^+] + \frac{K_1 K_2}{[H^+]} + 4K_2\right) + [H^+] + [OH^-]\right] \quad \text{Eqn (1)}$$

$$C_T = [H_2CO_3^*] + [HCO_3^-] + [CO_3^{2-}]$$

Eqn (1) can also be expressed in terms of alkalinity.:

$$\beta = 2.3\left[\frac{\alpha_1\left([Alk]_e - [OH^-] + [H^+]\right)\left([H^+] + \frac{K_1K_2}{[H^+]} + 4K_2\right)}{K_1\left(1 + \frac{2K_2}{[H^+]}\right)} + [H^+] + [OH^-]\right] \quad \text{eqn (2)}$$

$$\text{where } \alpha_1 = \frac{K_1}{[H^+] + K_1 + \frac{K_1K_2}{[H^+]}} \quad \text{eqn (3)}$$

β = buffer intensity (equivalents required per unit pH change per liter of soln)

$[OH^-]$ = hydroxyl ion concentration [moles/l]

$[H^+]$ = hydrogen ion concentration [moles/l]

$[Alk]_e$ = total alkalinity [eq./l]

Project ______ Acct. No. ______ Page 4 of 6

Subject ______ Comptd. By S. Thibault Date 5/10/93

Detail ______ Ck'd. By D. Peters Date 5/11/93

– Determine the value of α_1 using eqn (3):

$$\alpha_1 = \frac{3.56 \times 10^{-7}}{1\times10^{-10} + 3.56\times10^{-7} + \left(\frac{(3.56\times10^{-7})(3.49\times10^{-11})}{1\times10^{-10}}\right)}$$

$$\boxed{\alpha_1 = 0.741}$$

– Estimate the Buffer intensity of the process water using eqn (2)

$$\beta = 2.3\left[\frac{.741(5.6\times10^{-4} - 3.71\times10^{-5} + 1\times10^{-10})\left(1\times10^{-10} + \frac{(3.56\times10^{-7})(3.49\times10^{-11})}{1\times10^{-10}} + 4(3.49\times10^{-11})\right)}{3.56\times10^{-7}\left(1 + \frac{2(3.49\times10^{-11})}{1\times10^{-10}}\right)}\right.$$

$$\left. + 1\times10^{-10} + 3.71\times10^{-5}\right]$$

$$\beta = 2.3\left[\frac{.741\,(5.22\times10^{-4})(1.24\times10^{-7})}{6.04\times10^{-7}} + 1\times10^{-10} + 3.71\times10^{-5}\right]$$

$$\boxed{\beta = 2.67\times10^{-4}\ \text{eq./}\ell}$$

$$\beta = 2.67\times10^{-4}\ \frac{\text{eq.}}{\ell} \times 3.78\frac{\ell}{\text{gal}} \times 80\frac{\text{gal}}{\text{min}} \times 60\frac{\text{min}}{\text{hr}} \times 24\frac{\text{hr}}{\text{day}} = \boxed{117.0\ \text{eq./day}}$$

– Calculate the amount of Hydrogen ions required for the pH adjustment:

By definition $\beta = \frac{dC}{dpH} = \frac{\Delta C}{\Delta pH} = \frac{\Delta[H^+]}{\Delta pH}$

$\Delta pH = 10.0 - 6.5 = 3.5$

$\beta = 117.0$ eq/day

$\Delta[H^+] = \beta \, \Delta pH$

$= 117.0 \frac{eq}{day}(3.5)$

$\boxed{\Delta C \text{ or } \Delta[H^+] \text{ required} = 409.50 \text{ eq/day}}$

– Calculate Amount of H_2SO_4 required:

H_2SO_4 mol wt = 98.06 g/mol

Valence or "replaceable hydrogens" = 2

equivalent wt $= \frac{98.06}{2} = 49.03$ g/equivalent

$\frac{98.06 \text{ g/mol}}{49.03 \text{ g/equivalent}} = 2$ equivalents H_2SO_4/mol H_2SO_4

* Assume using concentrated (18 M) H_2SO_4 for pH adjustment

$H_2SO_4 \text{ required} = 409.50 \frac{eq.}{day} \times \frac{49.03 \text{ g } H_2SO_4}{eq \; H_2SO_4} \times \frac{mol \; H_2SO_4}{98.06 \text{ g } H_2SO_4} = 204.75 \frac{mol \; H_2SO_4}{day}$

Using 18 M soln

$204.75 \text{ mol } H_2SO_4 \times \frac{l}{18 \text{ mol } H_2SO_4} \times \frac{gal}{3.78 \, l} = \boxed{3.00 \frac{gal}{day} \; 18 \, M \; H_2SO_4}$

Project		Acct. No.		Page 6 of 6
Subject		Comptd. By	S. Thibault	Date 5/10/93
Detail		Ck'd. By	D. Peters	Date 5/11/93

Alternate way of calculating H_2SO_4 usage :.

$$H_2SO_4 \text{ required} = 409.5 \frac{eq}{day} \times \frac{\text{mol } H_2SO_4}{2 \text{ equiv } H_2SO_4} \times \frac{l}{18 \text{ mol } H_2SO_4} \times \frac{gal}{3.78\, l} = \boxed{3.00 \text{ gal/d}}$$ ✓

H_2SO_4 usage Summary Table

Commercially Available concentrations	usage rate
77.7 % (14 M)	3.86 gal/d
93.2 % (17.4 M)	3.11 gal/d
98 % (18 M)	3.0 gal/d

Project Resolve	Acct. No.	Page 1 of 3
Subject NaOH Usage	Comptd. By [illegible]	Date 5/21/93
Detail	Ck'd. By D. Peters	Date 5/23/93

NONREPRODUCIBLE GRID FORM 145

METCALF & EDDY, ENGINEERS

NaOH Usage

Influent pH of groundwater = 6.7

Need to raise pH to 10.0 in oxidation Tank

System flow rate = 80 gpm, System Temp = 55 F = 12.7 C

Process water Alkalinity = 28 mg/l as $CaCO_3$

From H_2SO_4 usage calculation:

$K_1 = 3.56 \times 10^{-7}$

$K_2 = 3.49 \times 10^{-11}$

$K_w = 3.71 \times 10^{-15}$

$[Alk]_e = 5.6 \times 10^{-4}$ eq/l

- Calculate the Hydrogen ion concentration of the process water.

$$[H^+] = 10^{-pH} = 10^{-6.7} = 1.99 \times 10^{-7} \text{ mol/l}$$

- calculate $[OH^-]$ concentration

$$[OH] = \frac{K_w}{[H^+]} = \frac{3.71 \times 10^{-15}}{1.99 \times 10^{-7}} = 1.86 \times 10^{-8} \text{ mol/l}$$

- Calculate Buffer intensity of Process water

$$\beta = 2.3 \left[\frac{\alpha_1([Alk]_e - [OH^-] + [H^+])([H^+] + \frac{K_1 K_2}{[H^+]} + 4K_2)}{K_1 \left(1 + \frac{2K_2}{[H^+]}\right)} + [H^+] + [OH^-] \right]$$

$$\alpha_1 = \frac{K_1}{[H^+] + K_1 + \frac{K_1 K_2}{[H^+]}}$$

Project	Roche	Acct. No		Page	2 of 3
Subject	NaOH usage	Comptd By	S. Thibault	Date	5/21/93
Detail		Ck'd By	D. Peters	Date	5/23/93

$$\alpha_1 = \frac{3.56\times10^{-7}}{1.99\times10^{-7} + 3.56\times10^{-7} + \frac{(3.56\times10^{-7})(3.49\times10^{-11})}{1.99\times10^{-7}}}$$

$$\boxed{\alpha_1 = 0.641}$$

– Calculate β

$$\beta = 2.3\left[.641\frac{(5.64\times10^{-4} - 1.86\times10^{-8} + 1.99\times10^{-7})\left(1.99\times10^{-7} + \frac{(3.56\times10^{-7})(3.49\times10^{-11})}{1.99\times10^{-7}} + 4(3.49\times10^{-11}\right.}{3.56\times10^{-7}\left(1 + \frac{2(3.49\times10^{-11})}{1.99\times10^{-7}}\right)}\right.$$

$$\left. + 1.99\times10^{-7} + 1.86\times10^{-8}\right]$$

$$\beta = 2.3\left[.641\frac{(5.641\times10^{-4})(1.99\times10^{-7})}{3.561\times10^{-7}} + 1.99\times10^{-7} + 1.86\times10^{-8}\right]$$

$$\boxed{\beta = 4.65\times10^{-4}\ eq/l}$$

$$\beta = 4.65\times10^{-4}\frac{eq}{l}\times\frac{3.78\ l}{gal}\times\frac{80\ gal}{min}\times\frac{60\ min}{hr}\times\frac{24\ hr}{day} = \boxed{202.59\ eq/day}$$

– Calculate the amount of hydroxyl ions needed for the pH adjustment:

$$\beta = \frac{d\alpha}{dpH} = \frac{\Delta\alpha}{\Delta pH} = \frac{\Delta[OH^-]}{\Delta pH}$$

$$\Delta pH = 10.0 - 6.7 = 3.3$$

$$\Delta[OH^-] = \beta\,\Delta pH = 202.59\ eq/day\,(3.3) = \boxed{668.54\ eq/day}$$

Project Resolve   Acct. No.   Page 3 of 7
Subject NaOH usage   Comptd. By S. Thivan   Date 5/21/93
Detail   Ck'd. By D. Peters   Date 5/23/93

– Calculate the amount of NaOH required:

NaOH mol wt = 39.98 g/mol

Valence or "replaced hydrogens" = 1

$$\text{equivalent wt} = \frac{39.98}{1} = 39.98 \text{ g/equivalent}$$

1 equivalent NaOH / mol NaOH

– Using 50 wt % soln $\rho_{NaOH} \approx \rho_{H_2O} = 1 g/cm^3$

$$\frac{50 \text{ g NaOH}}{100 \text{ g soln}} \times \frac{\text{mol NaOH}}{39.98 \text{ g NaOH}} \times \frac{1 \text{ g soln}}{\text{cm}^3 \text{ soln}} \times \frac{1000 \text{ cm}^3}{L} = 12.5 \frac{\text{mol NaOH}}{l} = 12.5$$

$$668.54 \frac{eq}{day} \times \frac{\text{mol NaOH}}{1 \text{ equiv NaOH}} \times \frac{l}{12.5 \text{ mol NaOH}} \times \frac{\text{gal}}{3.78\ l} = \boxed{14 \frac{\text{gal}}{\text{day}} \text{ NaOH}}$$

at 50 wt %

At 20% (5m) = 35 gal/day

* Assumes buffer capacity will not change

D.9 CLARIFIER SIZING AND DESIGN

Project	Resolve	Acct. No.		Page	1 of 3
Subject	Clarifier Sizing + Design	Comptd. By	S. Thibault	Date	5/5/93
Detail		Ck'd. By	J. [illegible]	Date	[illegible]

Clarifier Sizing + Design

Light particles such as metal hydroxides require a design parameter of 0.25 gpm/ft^2 of horizontal projected area.

- Calculate required settling area

  System flow rate = 100 gpm

$$100 \text{ gpm} \times \frac{\text{ft}^2}{0.25 \text{ gpm}} = 400 \text{ ft}^2 \text{ settling area}$$

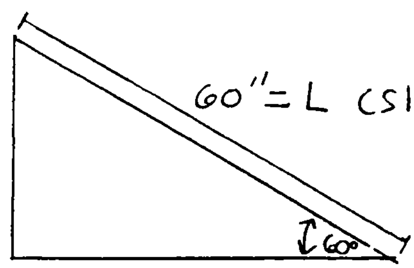
* Size the clarifier such that the required settling area does not exceed 80% of total horizontal projected area.

- Use ACS inclined plate clarifier with inverted pyramid bottom, Model 500/60/SB

  500 = 500 ft^2 horizontal projected area

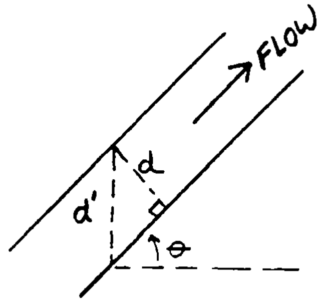
  60 = angle of inclination of plates

  SB = Sloped bottom, slope length of settling plate - 60''



60'' = L (Slope length of settling plate)

Project	Resolve	Acct. No.		Page	2 of 3
Subject	Clarifier Sizing	Comptd. By	S. Thibault	Date	5/5/93
Detail		Ck'd. By	J. Levangel	Date	5/10/93

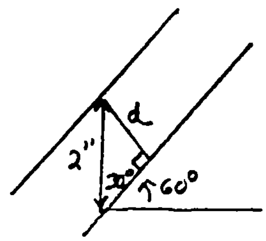


d = distance (normal) between plates

d' = verticle settling distance for particle

θ = Angle of inclination for plates

- From Vendor (ACS) $d' = 2.0''$
  - calculate plate spacing d at a 60° inclined angle



$$\sin 30° = \frac{d}{2''} \implies \boxed{d = 1.0'' = \text{plate spacing}}$$

- Calculate maximum velocity at which clarifier may be operated sucessfully ∴

$$\boxed{V_{max} = \frac{L}{d/\cos\theta}(s) = \frac{L\cos\theta}{d}(s)}$$

where (s) = particle settling velocity

Project: Resolve	Acct. No.	Page 3 of 3	
Subject: Clarifier Sizing	Comptd. By: S. Thibault	Date: 5/5/93	
Detail	Ck'd. By: J. Levangal	Date: 5/10/93	

- From pilot scale tests conducted by Radian, the particle settling velocity (s) for metal hydroxide particles = $0.9 \frac{ft}{min}$

$$S = 0.9 \frac{ft}{min} \times \frac{min}{60 s} = .015 \frac{ft}{s}$$

$$L = 60'' = 5.0 \text{ ft}$$

$$\theta = 60^\circ$$

$$d = 1'' = .083 \text{ ft}$$

$$\boxed{V_{max} = \frac{(5.0 \text{ ft})(\cos 60^\circ)}{(.083 \text{ ft})} (.015 \text{ ft/s}) = 0.45 \text{ ft/s}}$$

Angle of plate inclination	Plate Separation (d)	Vmax
60°	1.0"	0.45 fps
55°	1.14"	0.449 fps
50°	1.28"	0.45 fps
45°	1.41"	0.45 fps

* Above table assumes particle settling distance (d') remains constant at 2.0"

D.10 AVERAGE ANNUAL COPICUT RIVER FLOW CALCULATION

Project ReSolve Acct. No. 4901-4-1 Page 1 of 2
Subject Average yearly flow of Copicut River Comptd. By J. Levergood Date
Detail Ck'd. By Date

① From supplemental RI (2/87) - Table 5-2A, p. 5-10
1985 - 1986 data collected in Copicut River

12/5	2199 gpm
12/10	1839
12/23	1773
1/21	2101
4/15	6724
7/16	1728

Assume
Winter 1773
Spring 6724
Summer 1728
Fall 1773
} Average = 3000 gp

② Using yearly averages in USGS gaging stations at a nearby location with similar drainage basin area

From USGS Water Resources Data for Mass + RI
1989 water Year ⇒ 10/88 - 9/89

From Supplemental RI →
Copicut River Drainage Basin = 8.11 sq. mi

Massachusetts location 109070 - Taunton River Basin
Segreganset River near Dighton, MA
Drainage Area = 10.6 sq. mi.
Mean for 1989 Water Year = 17.6 cfs

$$\frac{17.6\ ft^3}{sec}\left|\frac{8.11\ mi^2}{10.6\ mi^2}\right|\frac{7.48\ gal}{ft^3}\left|\frac{60\ sec}{min}\right. = 6043\ gpm$$

Rhode Island location 117350 - Pawcatuck River Basin
Chipuxet River at West Kingston, RI
Drainage Area = 9.99 sq. mi
Mean for 1989 water Year = 22.8 cfs

$$\frac{22.8\ ft^3}{sec}\left|\frac{8.11\ mi^2}{9.99\ mi^2}\right|\frac{7.48\ gal}{ft^3}\left|\frac{60\ sec}{min}\right. = 8307\ gpm$$

Project	Resolve	Acct. No.	004907-4-1	Page	2 of 2
Subject	Average Flow Rate of Copicut River	Comptd. By	J. Levergood	Date	
Detail		Ck'd. By	[illegible]	Date	

(3) From CWM QA/QC Reports
Flow Rate measured in Copicut River

2/4/92 - 3204 gpm
2/12/92 - 1753
2/17/92 - 1870
2/24/92 - 1373

} avg for month = 2050 gpm

7/15/92 - 2590 gpm

10/8/92 - 2177 gpm
10/16/92 - 2361
10/22/92 - 2526
10/29/92 - 2698

} avg for month = 2441 gpm

11/24/92 - 4425 gpm

Average for 1992 = $\frac{2050 + 2590 + 2441 + 4425}{4} = 2877$ gpm

---

Use more conservative value of 2877 gpm
since it results in more stringent limit
and since it is based on actual measurements

Appendix E

Appendix E

APPENDIX E

DRWP AND REMEDIAL DESIGN DATA

APPENDIX E

INDEX

E.1 DRWP VALIDATED DATA

Groundwater
Saturated Soil
Unsaturated Soil

RESOLVE - VALIDATED DATA

COMPOUND	SAMPLE ID:	EB-S1	SS-1	SS-2	SS-3	SS-4	SS-5	SS-6	SS-7	SS-7D	SS-8
	UNITS:	UG/L	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG
	MATRIX:	WATER	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
ETHYLBENZENE		10 U	13 U	12 U	12 U	7300	11 U	11 U	11 U	11 U	11 U
STYRENE		10 U	13 U	12 U	12 U	2200 U	11 U	11 U	11 U	11 U	11 U
CIS-1,3-DICHLOROPROPENE		10 U	13 U	12 U	12 U	2200 U	11 U	11 U	11 U	11 U	11 U
TRANS-1,3-DICHLOROPROPENE		10 U	13 U	12 U	12 U	2200 U	11 U	11 U	11 U	11 U	11 U
1,2-DICHLOROETHANE		10 U	13 U	12 U	12 U	2200 U	11 U	11 U	11 U	11 U	11 U
4-METHYL-2-PENTANONE		10 U	13 U	12 U	12 U	2200 U	11 U	11 U	11 U	11 U	11 U
TOLUENE		2 J	13 U	12 U	12 U	320 J	11 U	11 U	11 U	11 U	11 U
CHLOROBENZENE		10 U	13 U	12 U	12 U	2200 U	11 U	11 U	1 J	2 J	11 U
DIBROMOCHLOROMETHANE		10 U	13 U	12 U	12 U	2200 U	11 U	11 U	11 U	11 U	11 U
TETRACHLOROETHENE		10 U	13 U	8 J	12 U	2200 U	11 U	41	80	140	11 U
XYLENE (TOTAL)		10 U	13 U	12 U	12 U	40000	11 U	11 U	4 J	3 J	11 U
1,2-DICHLOROETHENE (TOTAL)		3 J	13 U	12 U	12 U	2200 U	11 U	11 U	11 U	11 U	11 U
CARBON TETRACHLORIDE		10 U	13 U	12 U	12 U	2200 U	11 U	11 U	11 U	11 U	11 U
2-HEXANONE		10 U	13 U	12 U	12 U	2200 U	11 U	11 U	11 U	11 U	11 U
ACETONE		10 U	13 U	12 U	12 U	3600	11 U	11 U	11 U	11 U	12 U
CHLOROFORM		10 U	13 U	12 U	12 U	2200 U	11 U	11 U	11 U	11 U	11 U
BENZENE		10 U	13 U	12 U	12 U	2200 U	11 U	11 U	11 U	11 U	11 U
1,1,1-TRICHLOROETHANE		10 U	13 U	12 U	12 U	2200 U	11 U	6 J	11 U	9 J	11 U
BROMOMETHANE		10 U	13 U	12 U	12 U	2200 U	11 U	11 U	11 U	11 U	11 U
CHLOROMETHANE		10 U	13 U	12 U	12 U	2200 U	11 U	11 U	11 U	11 U	11 U
CHLOROETHANE		10 U	13 U	12 U	12 U	2200 U	11 U	11 U	11 U	11 U	11 U
VINYL CHLORIDE		10 U	13 U	12 U	12 U	2200 U	11 U	11 U	11 U	11 U	11 U
METHYLENE CHLORIDE		10 U	13 U	10 U	12 U	2200 U	11 U	11 U	11 U	11 U	11 U
CARBON DISULFIDE		10 U	13 U	12 U	12 U	2200 U	11 U	11 U	11 U	11 U	11 U
BROMOFORM		10 U	13 U	12 U	12 U	2200 U	11 U	11 U	11 U	11 U	11 U
BROMODICHLOROMETHANE		10 U	13 U	12 U	12 U	2200 U	11 U	11 U	11 U	11 U	11 U
1,1-DICHLOROETHANE		10 U	13 U	12 U	12 U	2200 U	11 U	11 U	11 U	11 U	11 U
1,1-DICHLOROETHENE		10 U	13 U	12 U	12 U	2200 U	11 U	11 U	11 U	11 U	11 U
1,2-DICHLOROPROPANE		10 U	13 U	12 U	12 U	2200 U	11 U	11 U	11 U	11 U	11 U
2-BUTANONE		10 U	13 UJ	12 UJ	12 U	2200 U	11 UJ	11 U	11 U	11 U	11 U
1,1,2-TRICHLOROETHANE		10 U	13 U	12 U	12 U	2200 U	11 U	11 U	11 U	1 J	11 U
TRICHLOROETHENE		10 U	13 U	12 U	12 U	2200 U	11 U	51	4 J	18	11 U
1,1,2,2-TETRACHLOROETHANE		10 U	13 U	12 U	12 U	2200 U	11 U	11 U	11 U	11 U	11 U
LEAD			4.8 J	3.8 J	7 J	11.5 J	5 J	3.2 J	2.4 J	3.9 J	3.8 J

RESOLVE - VALIDATED DATA

SAMPLE ID:	US-1	US-2	US-3	US-4	US-5	US-6	US-7	US-7D	US-8
UNITS:	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG
MATRIX:	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
COMPOUND									
ETHYLBENZENE	13 U	13 U	11 U	11 U	11 U	11 U	11 U	11 U	1 U
STYRENE	13 U	13 U	11 U	11 U	11 U	11 U	11 U	11 U	11 UJ
CIS-1,3-DICHLOROPROPENE	13 U	13 U	11 U	11 U	11 U	11 U	11 U	11 U	11 U
TRANS-1,3-DICHLOROPROPENE	13 U	13 U	11 U	11 U	11 U	11 U	11 U	11 U	11 U
1,2-DICHLOROETHANE	13 U	13 U	11 U	11 U	11 U	11 U	11 U	11 U	11 U
4-METHYL-2-PENTANONE	13 U	13 U	11 U	11 U	11 U	11 U	11 U	11 U	11 U
TOLUENE	13 U	13 U	11 U	11 U	11 U	11 U	11 U	11 U	11 U
CHLOROBENZENE	13 U	13 U	11 U	11 U	11 U	11 U	2 J	11 U	11 U
DIBROMOCHLOROMETHANE	13 U	13 U	11 U	11 U	11 U	11 U	11 U	11 U	11 U
TETRACHLOROETHENE	13 U	34	11 U	130	11 U	11 U	160	11	13 U
XYLENE (TOTAL)	13 U	13 U	11 U	2 J	11 U	11 U	3 J	11 U	11 U
1,2-DICHLOROETHENE (TOTAL)	13 U	13 U	11 U	11 U	11 U	11 U	11 U	11 U	11 U
CARBON TETRACHLORIDE	13 U	13 U	11 U	11 U	11 U	11 U	11 U	11 U	11 U
2-HEXANONE	13 U	13 U	11 U	11 U	11 U	11 U	11 U	11 U	11 U
ACETONE	13 U	16 U	11 U	11 U	11 U	11 U	11 U	11 U	11 J
CHLOROFORM	13 U	13 U	11 U	11 U	11 U	11 U	11 U	11 U	11 U
BENZENE	13 U	13 U	11 U	11 U	11 U	11 U	11 U	11 U	11 U
1,1,1-TRICHLOROETHANE	13 U	13 U	11 U	11 U	11 U	11 U	5 J	2 J	11 U
BROMOMETHANE	13 U	13 U	11 U	11 U	11 U	11 U	11 U	11 U	11 U
CHLOROMETHANE	13 U	13 U	11 U	11 U	11 U	11 U	11 U	11 U	11 U
CHLOROETHANE	13 U	13 U	11 U	11 U	11 U	11 U	11 U	11 U	11 U
VINYL CHLORIDE	13 U	13 U	11 U	11 U	11 U	11 U	11 U	11 U	11 U
METHYLENE CHLORIDE	13 U	13 U	11 U	11 U	11 U	11 U	11 U	11 U	11 U
CARBON DISULFIDE	13 U	13 U	11 U	11 U	11 U	11 U	11 U	11 U	11 U
BROMOFORM	13 U	13 U	11 U	11 U	11 U	11 U	11 U	11 U	11 U
BROMODICHLOROMETHANE	13 U	13 U	11 U	11 U	11 U	11 U	11 U	11 U	11 U
1,1-DICHLOROETHANE	13 U	13 U	11 U	11 U	11 U	11 U	11 U	11 U	11 U
1,1-DICHLOROETHENE	13 U	13 U	11 U	11 U	11 U	11 U	11 U	11 U	11 U
1,2-DICHLOROPROPANE	13 U	13 U	11 U	11 U	11 U	11 U	11 U	11 U	11 U
2-BUTANONE	13 U	13 UJ	11 UJ	11 U	11 U	11 U	11 U	11 U	11 U
1,1,2-TRICHLOROETHANE	13 U	13 U	11 U	11 U	11 U	11 U	11 U	11 U	11 U
TRICHLOROETHENE	13 U	13 U	11 U	11 U	11 U	11 U	9 J	2 J	11 U
1,1,2,2-TETRACHLOROETHANE	13 U	13 U	11 U	11 U	11 U	11 U	11 U	11 U	11 U
LEAD	4.1 J	4.9 J	18.2 J	10.3 J	9.6 J	3.3 J	7.4 J	4.7 J	10.4 J

RESOLVE - VALIDATED DATA

SAMPLE ID:	CE	CE-D	EB-30S	FC	FE	FE-EB	G	JN	JS	OW-SB-25D
UNITS:	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L
MATRIX:	WATER	WATER	WATER	WATER	WATER	WATER	WATER	WATER	WATER	WATER
COMPOUND										
ETHYLBENZENE	180	180	10 U	1000 U	530	10 U	200 U	500	50 U	58
STYRENE	50 U	50 U	10 U	1000 U	200 U	10 U	200 U	50 U	50 U	50 U
CIS-1,3-DICHLOROPROPENE	50 U	50 U	10 U	1000 U	200 U	10 U	200 U	50 U	50 U	50 U
TRANS-1,3-DICHLOROPROPENE	50 U	50 U	10 U	1000 U	200 U	10 U	200 U	50 U	50 U	50 U
1,2-DICHLOROETHANE	50 U	50 U	10 U	1000 U	120 J	10 U	200 U	50 U	50 U	50 U
4-METHYL-2-PENTANONE	50 U	50 U	10 U	1000 U	300	10 U	200 U	50 U	50 U	50 U
TOLUENE	2200 D	1700 D	10 U	260 J	9000 D	10 U	150 J	12000 D	900	74
CHLOROBENZENE	5 J	6 J	10 U	1000 U	31 J	10 U	200 U	50 U	50 U	50 U
DIBROMOCHLOROMETHANE	50 U	50 U	10 U	1000 U	200 U	10 U	200 U	50 U	50 U	50 U
TETRACHLOROETHENE	50 U	6 J	10 U	910 J	94 J	10 U	58 J	34 J	34 J	50 U
XYLENE (TOTAL)	1500 D	1200 D	10 U	1000 U	2200	10 U	140 J	2300 D	190	200
1,2-DICHLOROETHENE (TOTAL)	540	600	10 U	8700	55000 D	10 U	2100	1700 D	840	580
CARBON TETRACHLORIDE	50 U	50 U	10 U	1000 U	200 U	10 U	200 U	50 U	50 U	50 U
2-HEXANONE	50 UJ	50 UJ	10 UJ	1000 U	200 U	10 U	200 U	50 UJ	50 UJ	50 UJ
ACETONE	50 U	51	10 U	1000 U	200 U	10 U	200 U	78	50 U	50 U
CHLOROFORM	5 J	5 J	10 U	1000 U	64 J	10 U	200 U	50 U	50 U	50 U
BENZENE	5 J	50 U	10 U	1000 U	27 J	10 U	200 U	14 J	50 U	50 U
1,1,1-TRICHLOROETHANE	250	280	10 U	1800	9400 D	10 U	300	870	380	15 J
BROMOMETHANE	50 U	50 U	10 U	1000 U	200 U	10 U	200 U	50 U	50 U	50 U
CHLOROMETHANE	50 U	50 U	10 U	1000 U	200 U	10 U	200 U	50 U	50 U	50 U
CHLOROETHANE	230	220	10 U	1000 U	200 U	10 U	200 U	250	50 U	50 U
VINYL CHLORIDE	900	850	10 U	950 J	3400	10 U	480	2700 D	1000 E	750
METHYLENE CHLORIDE	5 J	50 U	10 U	1000 U	110 J	10 U	200 U	8 J	50 U	50 U
CARBON DISULFIDE	50 U	50 U	10 U	1000 U	200 U	10 U	200 U	50 U	50 U	12 J
BROMOFORM	50 U	50 U	10 U	1000 U	200 U	10 U	200 U	50 U	50 U	50 U
BROMODICHLOROMETHANE	50 U	50 U	10 U	1000 U	200 U	10 U	200 U	50 U	50 U	50 U
1,1-DICHLOROETHANE	260	280	10 U	1000 U	560	10 U	34 J	530	200	21 J
1,1-DICHLOROETHENE	6 J	8 J	10 U	1000 U	320	10 U	200 U	24 J	25 J	50 U
1,2-DICHLOROPROPANE	50 U	50 U	10 U	1000 U	200 U	10 U	200 U	50 U	50 U	50 U
2-BUTANONE	50 U	50 U	10 U	1000 U	200 U	10 U	200 U	50 U	50 U	50 U
1,1,2-TRICHLOROETHANE	50 U	50 U	10 U	99 J	410	10 U	200 U	10 J	50 U	50 U
TRICHLOROETHENE	37 J	41 J	10 U	4600	2400	10 U	690	280	290	50 U
1,1,2,2-TETRACHLOROETHANE	50 U	50 U	10 U	1000 U	200 U	10 U	200 U	50 U	50 U	50 U
LEAD	17.4 J	7.2 J		2.6 J	2 UJ		122 J	69.5 J	10.6 J	59.5 J

RESOLVE - VALIDATED DATA

COMPOUND	SAMPLE ID:	OW-SB-27D		OW-SB-30S		OW-SB-30SD	
	UNITS:	UG/L		UG/L		UG/L	
	MATRIX:	WATER		WATER		WATER	
ETHYLBENZENE		450		220		200	
STYRENE		50	U	50	U	50	U
CIS-1,3-DICHLOROPROPENE		50	U	50	U	50	U
TRANS-1,3-DICHLOROPROPENE		50	U	50	U	50	U
1,2-DICHLOROETHANE		50	U	50	U	50	U
4-METHYL-2-PENTANONE		50	U	50	U	50	U
TOLUENE		6600	D	1400	D	1500	D
CHLOROBENZENE		7	J	50	U	50	U
DIBROMOCHLOROMETHANE		50	U	50	U	50	U
TETRACHLOROETHENE		600		50	U	50	U
XYLENE (TOTAL)		2800	D	880		790	
1,2-DICHLOROETHENE (TOTAL)		64000	D	2800	D	3300	D
CARBON TETRACHLORIDE		50	U	50	U	50	U
2-HEXANONE		50	UJ	50	UJ	50	UJ
ACETONE		50	U	110		87	
CHLOROFORM		52		50	U	50	U
BENZENE		21	J	5	J	5	J
1,1,1-TRICHLOROETHANE		3700	D	600		590	
BROMOMETHANE		50	U	50	U	50	U
CHLOROMETHANE		50	U	50	U	50	U
CHLOROETHANE		50	U	110		95	
VINYL CHLORIDE		4300	D	640		580	
METHYLENE CHLORIDE		12	J	50	U	50	U
CARBON DISULFIDE		50	U	50	U	50	U
BROMOFORM		50	U	50	U	50	U
BROMODICHLOROMETHANE		50	U	50	U	50	U
1,1-DICHLOROETHANE		180		210		200	
1,1-DICHLOROETHENE		160		11	J	10	J
1,2-DICHLOROPROPANE		50	U	50	U	50	U
2-BUTANONE		50	U	50	U	50	U
1,1,2-TRICHLOROETHANE		50	U	50	U	50	U
TRICHLOROETHENE		7500	D	50	U	50	U
1,1,2,2-TETRACHLOROETHANE		50	U	50	U	50	U
LEAD		40.4	J	192	J	139	J

RESOLVE LEAD DATA

SAMPLE ID	CONCENTRATI	QUALIFIER	UNITS	MATRIX
FC	2.6000	J	UG/L	WATER
FE	2.0000	UJ	UG/L	WATER
G	122.0000	J	UG/L	WATER
JN	69.5000	J	UG/L	WATER
JNF	2.0000	UJ	UG/L	WATER
JS	10.6000	J	UG/L	WATER
OWSB25D	59.5000	J	UG/L	WATER
OWSB27D	40.4000	J	UG/L	WATER
OWSB30S	192.0000	J	UG/L	WATER
OWSB30SD	139.0000	J	UG/L	WATER
CE	17.4000	J	UG/L	WATER
CED	7.2000	J	UG/L	WATER
SS1	4.8000	J	MG/KG	SOIL
SS2	3.8000	J	MG/KG	SOIL
SS3	7.0000	J	MG/KG	SOIL
SS4	11.5000	J	MG/KG	SOIL
SS5	5.0000	J	MG/KG	SOIL
SS6	3.2000	J	MG/KG	SOIL
SS7	0.0000	U	MG/KG	SOIL
SS7D	3.9000	J	MG/KG	SOIL
SS8	3.8000	J	MG/KG	SOIL
US1	4.1000	J	MG/KG	SOIL
US2	4.9000	J	MG/KG	SOIL
US3	18.2000	J	MG/KG	SOIL
US4	10.3000	J	MG/KG	SOIL
US5	9.6000	J	MG/KG	SOIL
US6	3.3000	J	MG/KG	SOIL
US7	7.4000	J	MG/KG	SOIL
US7D	4.7000	J	MG/KG	SOIL
US8	10.4000	J	MG/KG	SOIL

E.2 REMEDIAL DESIGN VALIDATED DATA

Groundwater

SAMPLE TABLE

CLIENT ID.	MATRIX	PACE #	PARAMETERS
10D	WATER	34404-001	GC/MS VOA
3D	WATER	34404-002	GC/MS VOA
4D	WATER	34404-003	GC/MS VOA
5D	WATER	34404-004	GC/MS VOA
6D	WATER	34404-005	GC/MS VOA

pace. INCORPORATED THE ASSURANCE OF QUALITY

Laboratory number: 34404 -001
Sample Designation: 10D
Date Analyzed: 12/22/92
Matrix: WATER

Instrument File Name: >C5338

VOLATILE ORGANICS	CONCENTRATION (ug/L)	DETECTION LIMIT (ug/L)
Chloromethane	BDL	10
Bromomethane	BDL	10
Vinyl chloride	BDL	10
Chloroethane	BDL	5
Methylene chloride	BDL	10
Acetone	BDL	25
Carbon disulfide	BDL	5
Trichlorofluoromethane	BDL	5
1,1-Dichloroethene	BDL	5
Tetrahydrofuran	BDL	25
1,1-Dichloroethane	BDL	5
1,2-Dichloroethene (total)	BDL	5
Chloroform	BDL	5
Methyl ethyl ketone	BDL	25
1,2-Dichloroethane	BDL	5
1,1,1-Trichloroethane	BDL	5
Carbon Tetrachloride	BDL	5
Vinyl acetate	BDL	10
Bromodichloromethane	BDL	5
cis-1,3-Dichloropropene	BDL	5
trans-1,3-Dichloropropene	BDL	5
Trichloroethene	BDL	5
Benzene	BDL	5
Dibromochloromethane	BDL	5
1,1,2-Trichloroethane	BDL	5
1,2-Dichloropropane	BDL	5
2-Chloroethyl vinyl ether	BDL	5
Bromoform	BDL	5
Methyl isobutyl ketone	BDL	25
2-Hexanone	BDL	25
1,1,2,2-Tetrachloroethane	BDL	5
Tetrachloroethene	BDL	5
Toluene	BDL	5
Chlorobenzene	BDL	5
Ethylbenzene	BDL	5
m-Xylene	BDL	5
o,p-Xylene	BDL	5
Styrene	BDL	5

METHOD REFERENCE: 40 CFR PART 136, FRIDAY, OCTOBER 26, 1984
METHOD 624

BDL = Below detection limit

pace INCORPORATED
THE ASSURANCE OF QUALITY

Laboratory number: 34404 -002
Sample Designation: 3D
Date Analyzed: 12/22/92
Matrix: WATER

Instrument File Name: >C5339

VOLATILE ORGANICS	CONCENTRATION (ug/L)	DETECTION LIMIT (ug/L)
Chloromethane	BDL	10
Bromomethane	BDL	10
Vinyl chloride	BDL	10
Chloroethane	BDL	5
Methylene chloride	BDL	10
Acetone	BDL	25
Carbon disulfide	BDL	5
Trichlorofluoromethane	BDL	5
1,1-Dichloroethene	BDL	5
Tetrahydrofuran	BDL	25
1,1-Dichloroethane	BDL	5
1,2-Dichloroethene (total)	BDL	5
Chloroform	BDL	5
Methyl ethyl ketone	BDL	25
1,2-Dichloroethane	BDL	5
1,1,1-Trichloroethane	BDL	5
Carbon Tetrachloride	BDL	5
Vinyl acetate	BDL	10
Bromodichloromethane	BDL	5
cis-1,3-Dichloropropene	BDL	5
trans-1,3-Dichloropropene	BDL	5
Trichloroethene	BDL	5
Benzene	BDL	5
Dibromochloromethane	BDL	5
1,1,2-Trichloroethane	BDL	5
1,2-Dichloropropane	BDL	5
2-Chloroethyl vinyl ether	BDL	5
Bromoform	BDL	5
Methyl isobutyl ketone	BDL	25
2-Hexanone	BDL	25
1,1,2,2-Tetrachloroethane	BDL	5
Tetrachloroethene	BDL	5
Toluene	BDL	5
Chlorobenzene	BDL	5
Ethylbenzene	BDL	5
m-Xylene	BDL	5
o,p-Xylene	BDL	5
Styrene	BDL	5

METHOD REFERENCE: 40 CFR PART 136, FRIDAY, OCTOBER 26, 1984
METHOD 624

BDL = Below detection limit

pace.
INCORPORATED
THE ASSURANCE OF QUALITY

Laboratory number: 34404 -003
Sample Designation: 4D
Date Analyzed: 12/22/92
Matrix: WATER

Instrument File Name: >C5340

VOLATILE ORGANICS	CONCENTRATION (ug/L)	DETECTION LIMIT (ug/L)
Chloromethane	BDL	10
Bromomethane	BDL	10
Vinyl chloride	BDL	10
Chloroethane	BDL	5
Methylene chloride	BDL	10
Acetone	BDL	25
Carbon disulfide	BDL	5
Trichlorofluoromethane	BDL	5
1,1-Dichloroethene	7	5
Tetrahydrofuran	BDL	25
1,1-Dichloroethane	15	5
1,2-Dichloroethene (total)	25	5
Chloroform	BDL	5
Methyl ethyl ketone	BDL	25
1,2-Dichloroethane	BDL	5
1,1,1-Trichloroethane	22	5
Carbon Tetrachloride	BDL	5
Vinyl acetate	BDL	10
Bromodichloromethane	BDL	5
cis-1,3-Dichloropropene	BDL	5
trans-1,3-Dichloropropene	BDL	5
Trichloroethene	310	5
Benzene	BDL	5
Dibromochloromethane	BDL	5
1,1,2-Trichloroethane	BDL	5
1,2-Dichloropropane	BDL	5
2-Chloroethyl vinyl ether	BDL	5
Bromoform	BDL	5
Methyl isobutyl ketone	BDL	25
2-Hexanone	BDL	25
1,1,2,2-Tetrachloroethane	BDL	5
Tetrachloroethene	56	5
Toluene	BDL	5
Chlorobenzene	BDL	5
Ethylbenzene	BDL	5
m-Xylene	BDL	5
o,p-Xylene	BDL	5
Styrene	BDL	5

METHOD REFERENCE: 40 CFR PART 136, FRIDAY, OCTOBER 26, 1984
METHOD 624

BDL = Below detection limit

pace INCORPORATED THE ASSURANCE OF QUALITY

Laboratory number: 34404 -004
Sample Designation: 5D
Date Analyzed: 12/22/92
Matrix: WATER

Instrument File Name: >C5341

VOLATILE ORGANICS	CONCENTRATION (ug/L)	DETECTION LIMIT (ug/L)
Chloromethane	BDL	10
Bromomethane	BDL	10
Vinyl chloride	TRACE	10
Chloroethane	BDL	5
Methylene chloride	BDL	10
Acetone	BDL	25
Carbon disulfide	BDL	5
Trichlorofluoromethane	BDL	5
1,1-Dichloroethene	BDL	5
Tetrahydrofuran	BDL	25
1,1-Dichloroethane	BDL	5
1,2-Dichloroethene (total)	11	5
Chloroform	BDL	5
Methyl ethyl ketone	BDL	25
1,2-Dichloroethane	BDL	5
1,1,1-Trichloroethane	BDL	5
Carbon Tetrachloride	BDL	5
Vinyl acetate	BDL	10
Bromodichloromethane	BDL	5
cis-1,3-Dichloropropene	BDL	5
trans-1,3-Dichloropropene	BDL	5
Trichloroethene	BDL	5
Benzene	BDL	5
Dibromochloromethane	BDL	5
1,1,2-Trichloroethane	BDL	5
1,2-Dichloropropane	BDL	5
2-Chloroethyl vinyl ether	BDL	5
Bromoform	BDL	5
Methyl isobutyl ketone	BDL	25
2-Hexanone	BDL	25
1,1,2,2-Tetrachloroethane	BDL	5
Tetrachloroethene	BDL	5
Toluene	BDL	5
Chlorobenzene	BDL	5
Ethylbenzene	BDL	5
m-Xylene	BDL	5
o,p-Xylene	BDL	5
Styrene	BDL	5

METHOD REFERENCE: 40 CFR PART 136, FRIDAY, OCTOBER 26, 1984
METHOD 624

BDL = Below detection limit

"TRACE" denotes probable presence below listed detection limit.

pace. INCORPORATED THE ASSURANCE OF QUALITY

Laboratory number: 34404 -005
Sample Designation: 6D
Date Analyzed: 12/28/92
Matrix: WATER

Instrument File Name: >D3811

VOLATILE ORGANICS	CONCENTRATION (ug/L)	DETECTION LIMIT (ug/L)
Chloromethane	BDL	67
Bromomethane	BDL	67
Vinyl chloride	BDL	67
Chloroethane	BDL	33
Methylene chloride	BDL	67
Acetone	BDL	170
Carbon disulfide	BDL	33
Trichlorofluoromethane	BDL	33
1,1-Dichloroethene	BDL	33
Tetrahydrofuran	BDL	170
1,1-Dichloroethane	BDL	33
1,2-Dichloroethene (total)	BDL	33
Chloroform	BDL	33
Methyl ethyl ketone	BDL	170
1,2-Dichloroethane	BDL	33
1,1,1-Trichloroethane	140	33
Carbon Tetrachloride	BDL	33
Vinyl acetate	BDL	67
Bromodichloromethane	BDL	33
cis-1,3-Dichloropropene	BDL	33
trans-1,3-Dichloropropene	BDL	33
Trichloroethene	700	33
Benzene	BDL	33
Dibromochloromethane	BDL	33
1,1,2-Trichloroethane	BDL	33
1,2-Dichloropropane	BDL	33
2-Chloroethyl vinyl ether	BDL	33
Bromoform	BDL	33
Methyl isobutyl ketone	BDL	170
2-Hexanone	BDL	170
1,1,2,2-Tetrachloroethane	BDL	33
Tetrachloroethene	130	33
Toluene	BDL	33
Chlorobenzene	BDL	33
Ethylbenzene	BDL	33
m-Xylene	BDL	33
o,p-Xylene	BDL	33
Styrene	BDL	33

METHOD REFERENCE: 40 CFR PART 136, FRIDAY, OCTOBER 26, 1984
METHOD 624

BDL = Below detection limit

This sample required dilution to bring a high target analyte concentration into the calibration range.
Detection limits were elevated accordingly.

Laboratory number: 34476 -002
Sample Designation: PS
Date Analyzed: 12/29/92
Matrix: WATER

Instrument File Name: >C5407

VOLATILE ORGANICS	CONCENTRATION (ug/L)	DETECTION LIMIT (ug/L)
Chloromethane	BDL	10
Bromomethane	BDL	10
Vinyl chloride	BDL	10
Chloroethane	BDL	5
Methylene chloride	BDL	10
Acetone	BDL	25
Carbon disulfide	BDL	5
Trichlorofluoromethane	BDL	5
1,1-Dichloroethene	BDL	5
Tetrahydrofuran	BDL	25
1,1-Dichloroethane	BDL	5
1,2-Dichloroethene (total)	BDL	5
Chloroform	BDL	5
Methyl ethyl ketone	BDL	25
1,2-Dichloroethane	BDL	5
1,1,1-Trichloroethane	BDL	5
Carbon Tetrachloride	BDL	5
Vinyl acetate	BDL	10
Bromodichloromethane	BDL	5
cis-1,3-Dichloropropene	BDL	5
trans-1,3-Dichloropropene	BDL	5
Trichloroethene	BDL	5
Benzene	BDL	5
Dibromochloromethane	BDL	5
1,1,2-Trichloroethane	BDL	5
1,2-Dichloropropane	BDL	5
2-Chloroethyl vinyl ether	BDL	5
Bromoform	BDL	5
Methyl isobutyl ketone	BDL	25
2-Hexanone	BDL	25
1,1,2,2-Tetrachloroethane	BDL	5
Tetrachloroethene	BDL	5
Toluene	BDL	5
Chlorobenzene	BDL	5
Ethylbenzene	BDL	5
m-Xylene	BDL	5
o,p-Xylene	BDL	5
Styrene	BDL	5

METHOD REFERENCE: 40 CFR PART 136, FRIDAY, OCTOBER 26, 1984
METHOD 624

BDL = Below detection limit

pace INCORPORATED

Laboratory number: 34476 -001
Sample Designation: QE
Date Analyzed: 12/29/92
Matrix: WATER

Instrument File Name: >C5406

VOLATILE ORGANICS	CONCENTRATION (ug/L)	DETECTION LIMIT (ug/L)
Chloromethane	BDL	10
Bromomethane	BDL	10
Vinyl chloride	59	10
Chloroethane	24	5
Methylene chloride	BDL	10
Acetone	BDL	25
Carbon disulfide	BDL	5
Trichlorofluoromethane	BDL	5
1,1-Dichloroethene	BDL	5
Tetrahydrofuran	BDL	25
1,1-Dichloroethane	120	5
1,2-Dichloroethene (total)	BDL	5
Chloroform	BDL	5
Methyl ethyl ketone	BDL	25
1,2-Dichloroethane	BDL	5
1,1,1-Trichloroethane	10	5
Carbon Tetrachloride	BDL	5
Vinyl acetate	BDL	10
Bromodichloromethane	BDL	5
cis-1,3-Dichloropropene	BDL	5
trans-1,3-Dichloropropene	BDL	5
Trichloroethene	BDL	5
Benzene	BDL	5
Dibromochloromethane	BDL	5
1,1,2-Trichloroethane	BDL	5
1,2-Dichloropropane	BDL	5
2-Chloroethyl vinyl ether	BDL	5
Bromoform	BDL	5
Methyl isobutyl ketone	BDL	25
2-Hexanone	BDL	25
1,1,2,2-Tetrachloroethane	BDL	5
Tetrachloroethene	BDL	5
Toluene	91	5
Chlorobenzene	BDL	5
Ethylbenzene	65	5
m-Xylene	14	5
o,p-Xylene	34	5
Styrene	BDL	5

METHOD REFERENCE: 40 CFR PART 136, FRIDAY, OCTOBER 26, 1984
METHOD 624

BDL = Below detection limit

pace. INCORPORATED THE ASSURANCE OF QUALITY

E.3 REMEDIAL DESIGN VALIDATED DATA

Surface Water

Volatile Organic Aqueous Analysis
ug/L
EPA Method 8240

SITE: RESOLVE
ENSECO CASE NO.: 013592

METCALF & EDDY SAMPLE NUMBER:		SWR-1	SWR-2	SWD-1	SWR-3	SWT-1	SWT-2
ENSECO SAMPLE NUMBER:		92-01-SA	92-03-SA	92-04-SA	92-08-SA	92-02-SA	92-05-SA
COMPOUND	QL						
Chloromethane	10	10 U	10 U	10 U	10 U	10 U	10 U
Bromomethane	10	10 U	10 U	10 U	10 U	10 U	10 U
Vinyl Chloride	10	10 U	10 U	10 U	10 U	10 U	35
Chloroethane	10	10 U	10 U	10 U	10 U	10 U	10 U
Methylene Chloride	5	5 U	5 U	5 U	5 U	5 U	5 U
Acetone	10	10 U	10 U	10 U	10 U	10 U	10 U
Carbon Disulfide	5	5 U	5 U	5 U	9.2	5 U	5 U
1,1-Dichloroethene	5	5 U	5 U	5 U	5 U	5 U	5 U
1,1-Dichloroethane	5	5 U	5 U	5 U	5 U	5 U	6.9
1,2-Dichloroethene(total)	5	5 U	10	8.1	31	6.8	240
Chloroform	5	5 U	5 U	5 U	5 U	5 U	5 U
1,2-Dichloroethane	5	5 U	5 U	5 U	5 U	5 U	5 U
2-Butanone	10	10 U	10 U	10 U	10 U	10 U	10 U
1,1,1-Trichloroethane	5	5 U	5 U	5 U	5.6	5 U	44
Carbon Tetrachloride	5	5 U	5 U	5 U	5 U	5 U	5 U
Vinyl Acetate	10	10 U	10 U	10 U	10 U	10 U	10 U
Bromodichloromethane	5	5 U	5 U	5 U	5 U	5 U	5 U
1,2-Dichloropropane	5	5 U	5 U	5 U	5 U	5 U	5 U
trans-1,3-Dichloropropene	5	5 U	5 U	5 U	5 U	5 U	5 U
Trichloroethene	5	5 U	5 U	5 U	5 U	5 U	6.9 J
Dibromochloromethane	5	5 U	5 U	5 U	5 U	5 U	5 U
1,1,2-Trichloroethane	5	5 U	5 U	5 U	5 U	5 U	5 U
Benzene	5	5 U	5 U	5 U	5 U	5 U	5 U
cis-1,3-Dichloropropene	5	5 U	5 U	5 U	5 U	5 U	5 U
Bromoform	5	5 U	5 U	5 U	5 U	5 U	5 U
4-Methyl-2-pentanone	10	10 U	10 U	10 U	10 U	10 U	10 U
2-Hexanone	10	10 U	10 U	10 U	10 U	10 U	10 U
1,1,2,2-Tetrachloroethane	5	5 U	5 U	5 U	5 U	5 U	5 U
Tetrachloroethene	5	5 U	5 U	5 U	5 U	5 U	5 U
Toluene	5	5 U	5 U	5 U	15	5 U	18
Chlorobenzene	5	5 U	5 U	5 U	5 U	5 U	5 U
Ethylbenzene	5	5 U	5 U	5 U	5 U	5 U	5 U
Styrene	5	5 U	5 U	5 U	5 U	5 U	5 U
Total Xylenes	5	5 U	5 U	5 U	5 U	5 U	5.3
DILUTION FACTOR:		1	1	1	1	1	1
DATE SAMPLED:		2-18-92	2-18-92	2-18-92	2-19-92	2-18-92	2-18-92
DATE ANALYZED:		2-25-92	2-26-92	2-26-92	2-26-92	2-25-92	2-26-92
REMARKS:				Duplicate of SWR-2			

Footnotes:
- QL - Quantitation Limit.
- J - Quantitation is approximate due to limitations identified in the quality control review.
- U - Value reported is the sample detection limit.
- R - Value is rejected.
- UJ - Sample detection limit is approximate due to limitations identified in the quality control review.

Volatile Organic Aqueous Analysis
ug/L
EPA Method 8240

SITE: RESOLVE
ENSECO CASE NO.: 013592

METCALF & EDDY SAMPLE NUMBER:		SWB-1	SWB-2	TB-1
ENSECO SAMPLE NUMBER:		92-06-SA	92-07-SA	92-09-SA
COMPOUND	QL			
Chloromethane	10	10 U	10 U	10 U
Bromomethane	10	10 U	10 U	10 U
Vinyl Chloride	10	10 U	10 U	10 U
Chloroethane	10	10 U	10 U	10 U
Methylene Chloride	5	5 U	5 U	5 U
Acetone	10	10 U	10 U	10 U
Carbon Disulfide	5	5 U	5 U	5 U
1,1-Dichloroethene	5	5 U	5 U	5 U
1,1-Dichloroethane	5	5 U	5 U	5 U
1,2-Dichloroethene(total)	5	5 U	5 U	5 U
Chloroform	5	5 U	5 U	5 U
1,2-Dichloroethane	5	5 U	5 U	5 U
2-Butanone	10	10 U	10 U	10 U
1,1,1-Trichloroethane	5	5 U	5 U	5 U
Carbon Tetrachloride	5	5 U	5 U	5 U
Vinyl Acetate	10	10 U	10 U	10 U
Bromodichloromethane	5	5 U	5 U	5 U
1,2-Dichloropropane	5	5 U	5 U	5 U
trans-1,3-Dichloropropene	5	5 U	5 U	5 U
Trichloroethene	5	5 U	5 U	5 U
Dibromochloromethane	5	5 U	5 U	5 U
1,1,2-Trichloroethane	5	5 U	5 U	5 U
Benzene	5	5 U	5 U	5 U
cis-1,3-Dichloropropene	5	5 U	5 U	5 U
Bromoform	5	5 U	5 U	5 U
4-Methyl-2-pentanone	10	10 U	10 U	10 U
2-Hexanone	10	10 U	10 U	10 U
1,1,2,2-Tetrachloroethane	5	5 U	5 U	5 U
Tetrachloroethene	5	5 U	5 U	5 U
Toluene	5	5 U	5 U	5 U
Chlorobenzene	5	5 U	5 U	5 U
Ethylbenzene	5	5 U	5 U	5 U
Styrene	5	5 U	5 U	5 U
Total Xylenes	5	5 U	5 U	5 U
DILUTION FACTOR:		1	1	1
DATE SAMPLED:		2-18-92	2-19-92	2-20-92
DATE ANALYZED:		2-26-92	2-26-92	2-26-92
REMARKS:				

Footnotes:
- QL - Quantitation Limit.
- J - Quantitation is approximate due to limitations identified in the quality control review.
- U - Value reported is the sample detection limit.
- R - Value is rejected.
- UJ - Sample detection limit is approximate due to limitations identified in the quality control review.

Semivolatile Organic Aqueous Analysis
ug/L
EPA Method 8270

SITE: RESOLVE
ENSECO CASE NO.: 013592

METCALF & EDDY SAMPLE NUMBER:		SWR-1	SWR-2	SWD-1	SWR-3	SWT-1	SWT-2	SWB-1	SWB-2
ENSECO SAMPLE NUMBER:	QL	92-01-SA	92-03-SA	92-04-SA	92-08-SA	92-02-SA	92-05-SA	92-06-SA	92-07-SA
Phenol	10	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
bis(2-Chloroethyl) ether	10	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
2-Chlorophenol	10	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
1,3-Dichlorobenzene	10	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
1,4-Dichlorobenzene	10	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Benzyl Alcohol	10	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
1,2-Dichlorobenzene	10	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
2-Methylphenol	10	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
bis(2-Chloroisopropyl) ether	10	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
4-Methylphenol	10	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
N-Nitroso-di-n-propylamine	10	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Hexachloroethane	10	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Nitrobenzene	10	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Isophorone	10	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
2-Nitrophenol	10	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
2,4-Dimethylphenol	10	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Benzoic Acid	50	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U
bis(2-Chloroethoxy)methane	10	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
2,4-Dichlorophenol	10	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
1,2,4-Trichlorobenzene	10	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Naphthalene	10	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
4-Chloroaniline	10	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Hexachlorobutadiene	10	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
4-Chloro-3-Methylphenol	10	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
2-Methylnaphthalene	10	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Hexachlorocyclopentadiene	10	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
2,4,6-Trichlorophenol	10	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
2,4,5-Trichlorophenol	50	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U
2-Chloronaphthalene	10	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
2-Nitroaniline	50	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U
Dimethylphthalate	10	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Acenaphthylene	10	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
3-Nitroaniline	50	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U
Acenaphthene	10	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
2,4-Dinitrophenol	50	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U
4-Nitrophenol	50	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U
Dibenzofuran	10	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
2,4-Dinitrotoluene	10	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
2,6-Dinitrotoluene	10	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Diethylphthalate	10	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
4-Chlorophenyl phenyl ether	10	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Fluorene	10	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
4-Nitroaniline	50	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U
4,6-Dinitro-2-Methylphenol	50	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U
N-Nitrosodiphenylamine	10	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
4-Bromophenyl phenyl ether	10	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U

Semivolatile Organic Aqueous Analysis
ug/L
EPA Method 8270

SITE: RESOLVE
ENSECO CASE NO.: 013592

METCALF & EDDY SAMPLE NUMBER:		SWR-1	SWR-2	SWD-1	SWR-3	SWT-1	SWT-2	SWB-1	SWB-2
ENSECO SAMPLE NUMBER:	QL	92-01-SA	92-03-SA	92-04-SA	92-08-SA	92-02-SA	92-05-SA	92-06-SA	92-07-SA
Hexachlorobenzene	10	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Pentachlorophenol	50	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U
Phenanthrene	10	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Anthracene	10	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Di-n-butylphthalate	10	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Fluoranthene	10	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Pyrene	10	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Butylbenzylphthalate	10	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
3,3'-Dichlorobenzidine	20	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U
Benzo(a)anthracene	10	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
bis(2-Ethylhexyl)phthalate	10	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Chrysene	10	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Di-n-octylphthalate	10	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Benzo(b)fluoranthene	10	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Benzo(k)fluoranthene	10	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Benzo(a)pyrene	10	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Indeno(1,2,3-cd)pyrene	10	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Dibenz(a,h)anthracene	10	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Benzo(g,h,i)perylene	10	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
DILUTION FACTOR:		1	1	1	1	1	1	1	1
DATE SAMPLED:		2-18-92	2-18-92	2-18-92	2-19-92	2-18-92	2-18-92	2-18-92	2-19-92
DATE EXTRACTED:		2-23-93	2-23-93	2-23-93	2-23-93	2-23-93	2-23-93	2-23-93	2-23-93
DATE ANALYZED:		3-1-93	3-1-93	3-1-93	3-1-93	3-1-93	3-1-93	3-1-93	3-1-93
REMARKS:				Duplicate of SWR-2					

Footnotes:

QL - Quantitation Limit
J - Quantitation is approximate due to limitations identified in the quality control review.
U - Value reported is the sample detection limit.
R - Value is rejected.
UJ - Sample detection limit is approximate due to limitations identified in the quality control review.

Aqueous PCB Analysis
ug/L
EPA Method 8080

SITE: RESOLVE
ENSECO CASE NO.: 013592

METCALF & EDDY SAMPLE NUMBER:		SWR-1	SWR-2	SWD-1	SWR-3	SWT-1	SWT-2	SWB-1	SWB-2
ENSECO SAMPLE NUMBER:		92-01-SA	92-03-SA	92-04-SA	92-08-SA	92-02-SA	92-05-SA	92-06-SA	92-07-SA
COMPOUND	QL								
Aroclor-1016	0.50	0.50 UJ	0.50 U	0.50 UJ	0.50 U	0.50 U	0.56 U	0.50 U	0.50 U
Aroclor-1221	0.50	0.50 UJ	0.50 U	0.50 UJ	0.50 U	0.50 U	0.56 U	0.50 U	0.50 U
Aroclor-1232	0.50	0.50 UJ	0.50 U	0.50 UJ	0.50 U	0.50 U	0.56 U	0.50 U	0.50 U
Aroclor-1242	0.50	0.50 UJ	0.50 U	0.50 UJ	0.50 U	0.50 U	0.56 U	0.50 U	0.50 U
Aroclor-1248	0.50	0.50 UJ	0.50 U	0.50 UJ	0.50 U	0.50 U	0.56 U	0.50 U	0.50 U
Aroclor-1254	0.50	0.50 UJ	0.50 U	0.50 UJ	0.50 U	0.50 U	0.56 U	0.50 U	0.50 U
Aroclor-1260	0.50	0.50 UJ	0.50 U	0.50 UJ	0.50 U	0.50 U	0.56 U	0.50 U	0.50 U
DILUTION FACTOR:		1	1	1	1	1	1	1	1
SAMPLE VOLUME (ml):		1000	1000	1000	1000	1000	900	1000	1000
DATE SAMPLED:		2-18-93	2-18-93	2-18-93	2-19-93	2-18-93	2-18-93	2-18-93	2-19-93
DATE EXTRACTED:		2-22-93	2-22-93	2-22-93	2-22-93	2-22-93	2-22-93	2-22-93	2-22-93
DATE ANALYZED:		3-02-93	3-02-93	3-02-93	3-02-93	3-02-93	3-02-93	3-02-93	3-02-93
REMARKS:				Duplicate of SWR-2					

Footnotes:

QL - Quantitation Limit.
J - The quantitation is approximate due to limitations identified in the quality control review.
U - The value is the sample detection limit.
R - The value is rejected.
UJ - The sample detection limit is approximate due to limitations identified in the quality control review.

Aqueous Inorganic Analysis
ug/L

SITE: RESOLVE
ENSECO CASE NO.: 013592

METCALF & EDDY SAMPLE NUMBER:			SWR-1	SWR-2	SWD-1	SWR-3	SWT-1	SWT-2
ENSECO SAMPLE NUMBER:			92-01-SA	92-03-SA	92-04-SA	92-08-SA	92-02-SA	92-05-SA
ANALYTES	Method	IDL (ug/L)						
Antimony	P	50	50 U	50 U	50 U	50 U	50 U	50 U
Arsenic	F	5	5 U	5 U	5 U	5 U	5 U	5 U
Beryllium	P	2	2 U	2 U	2 U	2 U	2 U	2 U
Cadmium	P	5	5 U	5 U	5 U	5 U	5 U	5 U
Chromium	P	10	10 U	10 U	10 U	10 U	10 U	10 U
Copper	P	10	10 U	10 U	10 U	10 U	10 U	10 U
Iron	P	100	2700	2300	2400	3400	200	1200
Lead	F	5	14	12	12	8.8	5 U	5 U
Manganese	P	10	770	710	740	750	82	570
Mercury	CV	0.2	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
Nickel	P	40	40 U	40 U	40 U	40 U	40 U	40 U
Selenium	F	5	5 U	5 U	5 U	5 U	5 U	5 U
Silver	P	10	10 U	10 U	10 U	10 U	10 U	10 U
Thallium	F	10	10 U	10 U	10 U	10 U	10 U	10 U
Zinc	P	20	20 U	20 U	22 U	23 U	64 U	36 U
Remarks:					Duplicate of SWR-2			

Footnotes:

F - Furnace Atomic Absorption
P - ICP/Flame AE
CV - Cold Vapor Atomic Absorption
J - Quantitation is approximate due to limitations identified in the quality control review.
U - The value reported is the sample detection limit.
R - The value is rejected.
UJ - The sample detection limit is approximate due to limitations identified in the quality control review.
IDL - Instrument Detection Limit

Aqueous Inorganic Analysis
ug/L

SITE: RESOLVE
ENSECO CASE NO.: 013592

METCALF & EDDY SAMPLE NUMBER:			SWB-1	SWB-2
ENSECO SAMPLE NUMBER:			92-06-SA	92-07-SA
ANALYTES	Method	IDL (ug/L)		
Antimony	P	50	50 U	50 U
Arsenic	F	5	5 U	5 U
Beryllium	P	2	2 U	2 U
Cadmium	P	5	5 U	5 U
Chromium	P	10	10 U	10 U
Copper	P	10	10 U	10 U
Iron	P	100	140	230
Lead	F	5	5 U	5 U
Manganese	P	10	31	31
Mercury	CV	0.2	0.2 U	0.2 U
Nickel	P	40	40 U	40 U
Selenium	F	5	5 U	5 U
Silver	P	10	10 U	10 U
Thallium	F	10	10 U	10 U
Zinc	P	20	21 U	20 U

Remarks:

Footnotes:
F - Furnace Atomic Absorption
P - ICP/Flame AE
CV - Cold Vapor Atomic Absorption
J - Quantitation is approximate due to limitations identified in the quality control review.
U - The value reported is the sample detection limit.
R - The value is rejected.
UJ - The sample detection limit is approximate due to limitations identified in the quality control review.
IDL - Instrument Detection Limit

E.4 REMEDIAL DESIGN DATA

Surface Water Flow Calculation

FLOW RATES FOR THE COPICUT RIVER, CAROL'S BROOK AND THE UNNAMED TRIBUTARY MEASURED FEBRUARY 18 AND 19, 1993

SWR-1 20.2 ft wide 2/18/93

Section	Depth (ft)	Time/3' (sec)	Velocity (ft/sec)	Avg Vel. (ft/sec)	Area (ft²)	Flow (cfs)
0	0	0	0			
1	0.52	12.3	0.24	0.12	0.26	0.03
2	0.82	6.8	0.44	0.34	0.67	0.23
4	1.10	6.2	0.48	0.46	1.92	0.89
6	1.23	5.1	0.59	0.54	2.33	1.25
8	1.27	5.7	0.53	0.56	2.50	1.39
10	1.27	5.1	0.59	0.56	2.54	1.42
12	1.15	5.4	0.56	0.57	2.42	1.38
14	0.90	4.6	0.65	0.60	2.05	1.24
16	0.81	3.9	0.77	0.71	1.71	1.22
18	0.77	5.2	0.58	0.67	1.58	1.06
19	0.77	14.9	0.20	0.39	0.77	0.30
20.2	0.00	0		0.10	0.46	0.05
					Total	10.45 cfs
					=	4691.64 gpm

SWR-2 13 ft wide 2/18/93

Section	Depth (ft)	Time/3' (sec)	Velocity (ft/sec)	Avg Vel. (ft/sec)	Area (ft²)	Flow (cfs)
0	0	0	0			
1	0.77	6.2	0.48	0.24	0.39	0.09
3	1.08	4.1	0.73	0.61	1.85	1.12
5	1.42	2.8	1.07	0.90	2.50	2.25
7	1.33	2.06	1.46	1.26	2.75	3.48
9	1.17	2.27	1.32	1.39	2.50	3.47
11	1.00	2.25	1.33	1.33	2.17	2.88
12	0.77	5.76	0.52	0.93	0.89	0.82
13	0.00	0	0.00	0.26	0.39	0.10
					Total	14.21 cfs
					=	6377.42 gpm

FLOW RATES FOR THE COPICUT RIVER, CAROL'S BROOK AND THE UNNAMED TRIBUTARY MEASURED FEBRUARY 18 AND 19, 1993

SWR-3 34.0 ft wide 2/19/93

Section	Depth (ft)	Time/3' (sec)	Velocity (ft/sec)	Avg Vel. (ft/sec)	Area (ft^2)	Flow (cfs)
0	0	0	0			
2	2.50	0	0.00	0.00	2.50	0.00
4	3.25	0	0.00	0.00	5.75	0.00
6	3.25	0	0.00	0.00	6.50	0.00
8	3.21	0	0.00	0.00	6.46	0.00
10	3.25	20.3	0.15	0.07	6.46	0.48
12	3.17	14.1	0.21	0.18	6.42	1.16
14	3.17	9.5	0.32	0.26	6.34	1.68
16	3.17	6.7	0.45	0.38	6.34	2.42
18	3.17	7.6	0.39	0.42	6.34	2.67
20	3.33	4.8	0.63	0.51	6.50	3.31
22	3.33	6.2	0.48	0.55	6.66	3.69
24	3.50	7.8	0.38	0.43	6.83	2.97
26	3.58	7.8	0.38	0.38	7.08	2.72
28	3.50	5.5	0.55	0.47	7.08	3.29
30	3.42	4.9	0.61	0.58	6.92	4.01
32	1.92	5.4	0.56	0.58	5.34	3.12
34	0.00	0		0.28	1.92	0.53

Total 32.05 cfs
= 14382.46 gpm

SWB-1 8.5 ft wide 2/18/93

Section	Depth (ft)	Time/3' (sec)	Velocity (ft/sec)	Avg Vel. (ft/sec)	Area (ft^2)	Flow (cfs)
0	0	0	0			
0.5	1.58	0	0.00	0.00	0.40	0.00
1.5	1.33	4.29	0.70	0.35	1.46	0.51
2.5	1.58	3.6	0.83	0.77	1.46	1.11
3.5	1.58	5.1	0.59	0.71	1.58	1.12
4.5	1.42	6.8	0.44	0.51	1.50	0.77
5.5	1.33	2.5	1.20	0.82	1.38	1.13
6.5	1.42	2.21	1.36	1.28	1.38	1.76
7.5	1.25	0	0.00	0.68	1.34	0.91
8.5	0.92	0	0.00	0.00	1.09	0.00

Total 7.31 cfs
= 3281.40 gpm

FLOW RATES FOR THE COPICUT RIVER, CAROL'S BROOK AND THE UNNAMED TRIBUTARY MEASURED FEBRUARY 18 AND 19, 1993

SWB-2 7.0 ft wide 2/19/93

Section	Depth (ft)	Time/3' (sec)	Velocity (ft/sec)	Avg Vel. (ft/sec)	Area (ft²)	Flow (cfs)
0.00		0.00	0.00			
0.50	3.02		0.00	0.00	0.76	0.00
1.00	3.17	9.40	0.32	0.16	1.55	0.25
1.50	2.75					
2.00	2.88	6.80	0.44	0.38	2.89	1.10
2.50	3.46					
3.00	2.67	4.40	0.68	0.56	3.12	1.75
3.50	2.79					
4.00	2.83	5.70	0.53	0.60	2.77	1.67
4.50	2.67	0.00	0.00	0.26	1.37	0.36
5.00	2.67	0.00	0.00	0.00	1.33	
5.50	2.42	0.00	0.00	0.00	1.27	
6.00	2.00	0.00	0.00	0.00	1.11	
6.50	1.67	0.00	0.00	0.00	0.92	
7.00	1.67	0.00	0.00	0.00	0.83	

Total 5.13 cfs (1)
= 2302.33 gpm

SWT-1 3.0 ft wide 2/18/93

Section	Depth (ft)	Time/3' (sec)	Velocity (ft/sec)	Avg Vel. (ft/sec)	Area (ft²)	Flow (cfs)
0.00	0.00	0.00	0.00			
0.50	0.31		0.00	0.00	0.08	0.00
1.00	0.35	3.50	0.29	0.14	0.17	0.02
1.50	0.35	2.90	0.34	0.32	0.18	0.06
2.00	0.35	1.80	0.56	0.45	0.18	0.08
2.50	0.33		0.00	0.28	0.17	0.05
3.00	0.00	0.00		0.00	0.08	0.00

Total 0.20 cfs
= 91.92 gpm

FLOW RATES FOR THE COPICUT RIVER, CAROL'S BROOK AND THE UNNAMED TRIBUTARY MEASURED FEBRUARY 18 AND 19, 1993

SWT-2 3.0 ft wide 2/18/93

Section	Depth (ft)	Time/3' (sec)	Velocity (ft/sec)	Avg Vel. (ft/sec)	Area (ft²)	Flow (cfs)
0.00	0.00	0.00	0.00			
0.50	0.44	1.62	1.85	0.93	0.11	0.10
1.00	0.48	1.57	1.91	1.88	0.23	0.43
1.50	0.48	1.50	2.00	1.96	0.24	0.47
2.00	0.48	2.30	1.30	1.65	0.24	0.40
2.50	0.48	3.57	0.84	1.07	0.24	0.26
3.00	0.00	0.00		0.42	0.12	0.05
				Total		1.71 cfs
					=	766.62 gpm

NOTES: (1) A higher flowrate than measured is likely because of mini-tributaries existing at the outlet

Appendix F

Appendix F

APPENDIX F
GEOPHYSICAL INVESTIGATION REPORT

Weston Geophysical
CORPORATION

March 3, 1993

Mr. Donald Dwight
METCALF & EDDY, INC.
P.O. Box 4043
Woburn, MA 01888-4043

Subject: Draft Geophysical Survey Results
ReSolve Superfund Site
North Dartmouth, Massachusetts
M&E Subcontract No.: 93-004907-4

Dear Don:

In accordance with Metcalf & Eddy's authorization, Weston Geophysical has completed borehole logging and VLF surveys at the ReSolve Site (Figure 1). The geophysical survey objective was to identify bedrock fractures that might facilitate migration of dense non-aqueous phase liquids within the bedrock. Information regarding interpreted fractures may be used by Metcalf & Eddy during groundwater remedial design for the ReSolve Site.

The geophysical field surveys were performed between February 16 and 19, and on February 24, 1993. Prospective VLF traverses and boreholes to be logged were identified during a site visit by Metcalf & Eddy and Weston Geophysical on February 9, 1993.

METHODS OF INVESTIGATION

Survey Control

Weston Geophysical located the VLF traverses using tape and compass measurements referenced to on-site buildings and fences, North Hixville Road, and Cornell Pond (Figure 2). All compass bearings were adjusted for local magnetic declination, and a non-conductive fiberglass measuring tape was utilized to assure reliable VLF data measurements. Each VLF traverse was flagged at 100-foot intervals for subsequent identification by others.

The location of boring BED-2 (Figure 2) was obtained from plans available at Chemical Waste Management's on-site field office. Maps showing accurate positions of borings OW-11M and OW-11D (both located east of Cornell Pond) were unavailable at the time of this survey.

Borehole Geophysical Logging

Borehole logging was completed in three bedrock wells (BED-2, OW- 11M, and OW-11D) to identify the depths and attitudes of water- bearing fractures intersected by those wells. The contracted logging suite consisted of video, caliper, and fluid temperature measurements. Weston elected to also acquire natural gamma, single point resistance (SPR), and spontaneous potential (SP) logs to provide additional data for correlation in case poor water clarity hindered video log interpretation. General background information regarding geophysical borehole logging is provided in Appendix A.

Geophysical logging instrumentation included a digital Mount Sopris model MGX winch/data acquisition system and ancillary probes. All geophysical logging data were recorded on magnetic media for subsequent playback at suitable scales. Video logs were recorded on VHS-format magnetic tape using a Geo-Tec Systems model GeoVision borehole camera and recording system. Video images were recorded using axial (downward) and side views to provide detailed assessment of visible bedrock fractures; a compass mounted within the side-looking camera's field of view enabled fracture strike and dip angle estimations. A copy of each VHS-format videotape will be provided to Metcalf & Eddy with Weston's final report.

VLF Profiling

This VLF survey was designed to serve as a reconnaissance for north or northeast-striking bedrock fractures that were not encountered by previous bedrock borings. The survey was designed to identify fractures with these strike directions due to available VLF radio reception in southern New England, and also due to the trend of nearby mapped faults.

The Bedrock Geologic Map of Massachusetts (Zen, 1983) indicates a northeast-striking faulted contact between granite of the Fall River pluton (vicinity of the ReSolve Site) and gneiss and schist to the southeast. That fault is intersected by another roughly north-south striking fault that passes through Cornell Pond, located 1,000 feet southeast of the ReSolve Site. VLF survey traverses were positioned approximately perpendicular to these mapped faults and to the VLF transmitter (Cutler, Maine) used during this survey. North or northeast-striking water-bearing fractures with dip angles of at least 30 degrees should be detectable using this survey traverse/receiver geometry.

VLF data were acquired at 20-foot intervals along each traverse using a digital VLF meter (ABEM model Wadi). Background information regarding the VLF survey technique is provided in Appendix B.

RESULTS

Borehole Geophysical Logging

A total of approximately 400 feet of geophysical logs were obtained from the three wells surveyed during this assignment (Figures 3 through 5). In addition, approximately 105 feet of video logs were obtained in wells BED-2 and OW-11M. Although video logging was attempted at well OW-11D, an obstruction within the casing at a depth of about 35 feet (apparently an upside-down sapling placed in the well by vandals) prevented video inspection of the cored section of that well. The OW-11D caliper log showed that this obstruction locally reduced the borehole diameter to less than the borehole camera's diameter.

Summaries of interpreted results from each boring are provided in Tables 1 through 3. As an aside, the annotated well caps at the OW-11 casings had been interchanged sometime prior to Weston's arrival. The deeper well (OW-11D) is the northernmost of the two wells. Weston placed the annotated well caps on the correct wells prior to departing from the site.

Most fractures identified during this logging program are approximately horizontal, with the exception of well OW-11M at a depth of 45 feet where the video log disclosed a fracture that strikes northeast and exhibits a 50 degree dip towards the northwest. The fluid temperature log exhibits a change in slope at this location, indicating groundwater flow through this fracture.

VLF Profiling

A total of approximately 6,200 feet of VLF (very low frequency) electromagnetic profiling was accomplished along the traverses shown on Figure 2. Annotated data profiles from each traverse are shown on Figures 6 and 7; each profile displays two components of VLF data that were recorded during this survey. The "real" (also known as "in-phase") and "imaginary" (also known as "quadrature phase") components recorded during this survey are depicted for each traverse. Excellent conductors such as metal pipelines or fences are typically represented by coincident peaks or troughs on both the real and imaginary components. Poorer conductors, such as the water-bearing fracture zones that were the objective of this survey, are typically represented by peaks on the real component and little change in the imaginary component.

In general, the VLF data profiles do not indicate the presence of significant water-bearing fractures with north or northeast strike directions and dip angles of at least 30 degrees. As shown on Figures 6 and 7, the most prominent VLF anomalies are associated with power lines and the Algonquin Gas pipeline. One minor fracture zone may have been detected at Line VLF-3 Station 10+00E, at the west side of a local topographic ridge that strikes approximately north-south. The real component of this VLF anomaly is nearly symmetrical about Station 10+00E; if the anomaly is due to a fracture zone, then that fracture would likely exhibit a near-vertical dip angle, or possibly dip steeply towards the east.

SUMMARY AND CONCLUSIONS

Most bedrock fractures interpreted from this borehole logging survey exhibit approximately horizontal dip angles. One exception was noted at well OW-11M at a depth of 45 feet where a water-bearing fracture is interpreted with a northeast strike and a 50 degree dip towards the northwest. Dip angles of deeper water-bearing fractures interpreted from geophysical logs in the adjacent well (OW-11D) can be determined by additional video logging if the obstruction at a depth of 35 feet can be removed from that well.

VLF data acquired in the vicinity of the ReSolve site indicate a general absence of the north or northeast striking water-bearing fractures that this survey was designed to detect. The only minor fracture zone tentatively identified from this VLF survey is located at Line VLF-3 Station 10+00E, approximately 700 feet east of the ReSolve site. A near-vertical or steep eastward dip angle is indicated for this VLF anomaly source.

Based on correlation of the borehole logging and VLF survey results, bedrock fractures in the vicinity of the ReSolve site appear to be generally horizontal. Assuming relatively flat bedrock surface topography (particularly the absence of a bedrock trough), these fractures would therefore be expected to have limited interaction with saturated overburden.

Mr. Donald Dwight
METCALF & EDDY, INC.

March 3, 1993
Page Four

We appreciate the opportunity to provide geophysical services to Metcalf & Eddy, and we welcome questions or comments regarding this report. In accordance with the agreement between Weston Geophysical and Metcalf & Eddy, we will be pleased to submit a final report upon receipt of comments from Metcalf & Eddy.

Sincerely,

WESTON GEOPHYSICAL CORPORATION

M. Blackey

Mark E. Blackey
Project Geophysicist

MEB:lmc-20374-03
Enclosures

Reference

Zen, E-an (editor), 1983. Bedrock Geologic Map of Massachusetts, Department of the Interior, United States Geological Survey.

TABLE 1

SUMMARY OF GEOPHYSICAL LOG INTERPRETATIONS WELL BED-2

Depth (feet)	Interpretation
2	Groundwater surface.
28	Bottom of casing. Breakout below casing is indicated on caliper log.
32 - 34	Horizontal fractures, apparently partly filled with clay or similar material based on correlation of video logs with caliper enlargement, and a SPR decrease. Abrupt decrease in fluid temperature below this zone indicates groundwater flow through these fractures.
44 - 45	Observed horizontal fracture, approximately 5 inches in thickness. Little change in fluid temperature indicates minimal groundwater flow. A decrease in SPR may represent some infilling with clay.
49 - 58.8	Video image obstructed by suspended materials.
50 - 51	Possible fracture, indicated by small increase in borehole diameter and subtle change in slope of the fluid temperature log.
58.8	Bottom of boring.

Table 2

SUMMARY OF GEOPHYSICAL LOG INTERPRETATION WELL OW-11M

Depth(Feet)	Interpretation
4	Groundwater surface
18	Bottom of casing. Casing observed in video log to be poorly seated in rock, possibly caused by "wandering" of casing along the rock surface during drilling. Water flow into the borehole may also occur at this location.
23	Horizontal fracture, possibly water bearing, indicated by caliper enlargement over a 6 inch range, and deviations in each of the electrical logs over the same range. Temperature logs indicate a change in slope at this point which is indicative of water flow.
31-36	Several horizontal fractures, possibly water-bearing, and partly filled with clay or other fine-grained material, based on correlation of video logs with deviations in borehole diameter and changes in the nature of electrical logs over the 31'-36' range. Abrupt variations in the temperature profile are consistent with water-bearing fractures exhibiting high permeability.
45	Fracture striking roughly NE and dipping 50 degrees NW. This feature may be partly filled with fine grained material, and is coincident with a change in slope of the fluid temperature log, indicating possible groundwater flow.
52'	Bottom of boring.

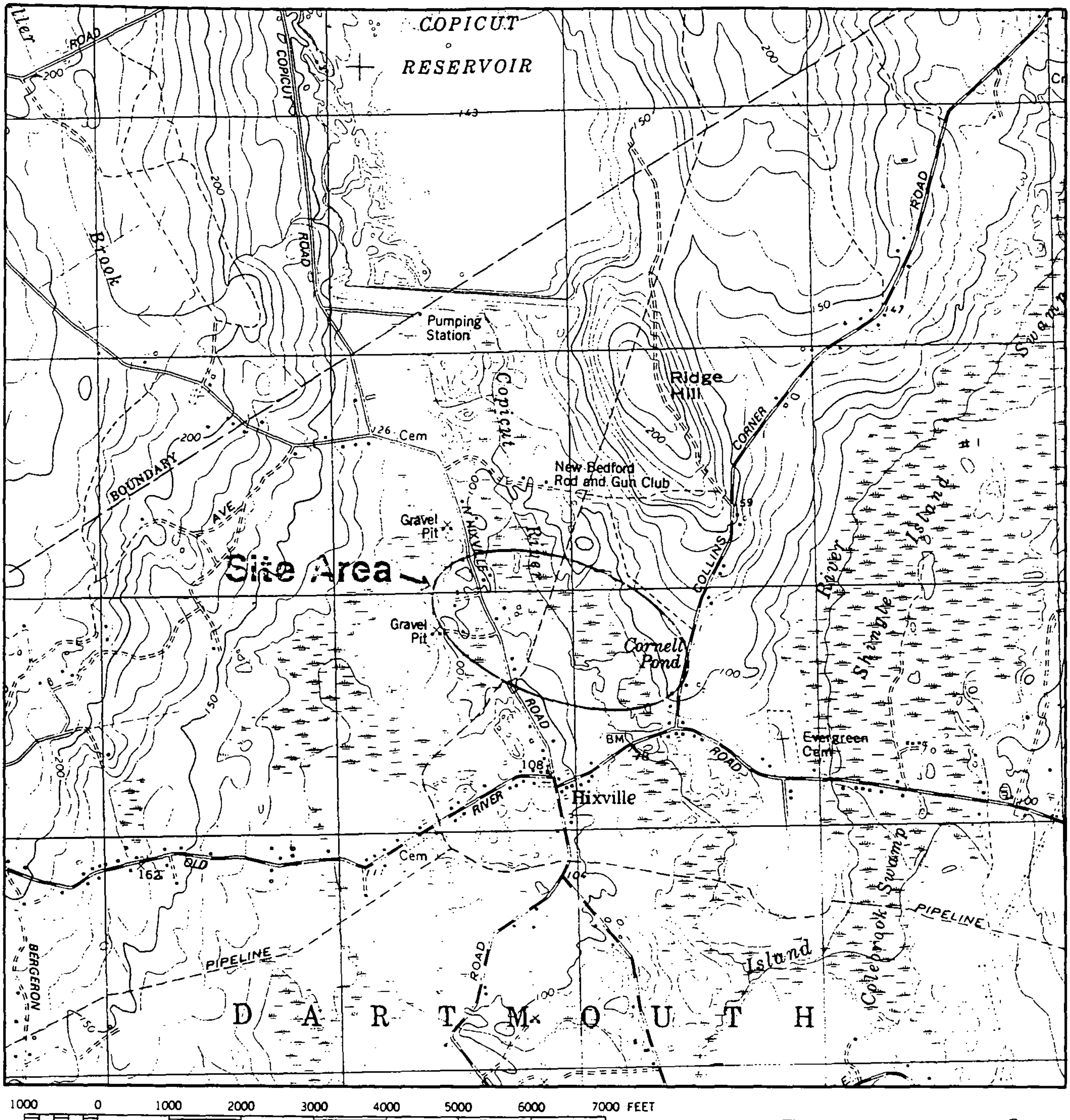
Table 3

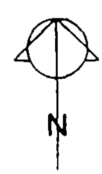
SUMMARY OF GEOPHYSICAL LOG INTERPRETATIONS
WELL OW-11D

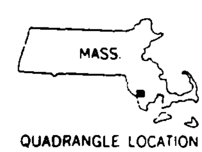
Depth(Feet)	Interpretation
4	Groundwater surface
35	Obstruction in borehole prevented video logging beyond this point.
52	Bottom of casing
52-105	Possible thin-bedded bedrock formation, as indicated by highly irregular borehole geometry observed on the caliper log.
105	Possible lithologic contact, indicated on logs by a change in the nature the caliper log, and baseline shifts in electrical logs. The temperature log did not exhibit characteristics indicative of water flow.
115	Lithologic contact, indicated by changes in baseline levels of all logs except temperature.
125	Fracture, possibly water bearing, as indicated by abrupt changes in electrical and fluid temperature logs, and an increase in borehole diameter over a 2 foot range. Orientation of the fracture could not be determined due to the lack of video logs at this depth.
135	Lithologic contact, indicated by baseline level changes on all electrical logs. There is no change in the temperature log, indicating that there is no water flow at this contact.
200	Possible drilling artifact, indicated by an increase in borehole diameter only. Other logs indicate no change in the nature of the rock at this depth.
215	Possible fracture or lithologic contact, indicated by a change in borehole diameter over a 2 foot range, and slight changes in electrical logs. Temperature logs do not indicate water flow through this feature.

215-265	Possible thinly bedded bedrock formation, as indicated by highly irregular borehole geometry observed on the caliper log.
265	Possible lithologic contact, as indicated by changes in baseline levels of electrical logs, and a slight decrease in borehole diameter. Temperature logs do not indicate water flow.
297	Possible water bearing fracture indicated by an increase in borehole diameter over a 2 foot range, and changes in each of the electrical logs. In addition, a local temperature log decrease indicates possible water flow at this level.
299	Bottom of boring

FIGURES





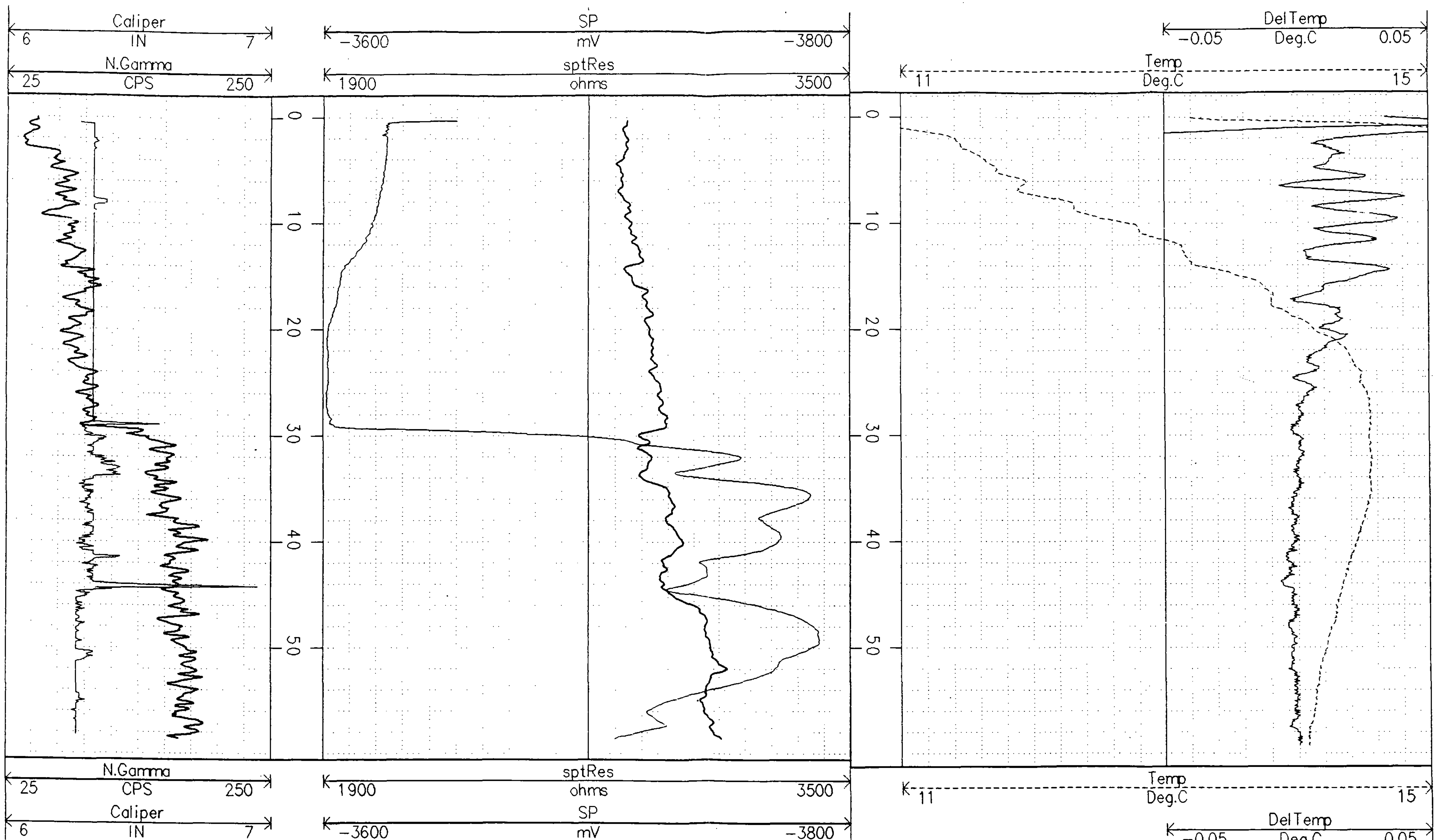


Basemap: U.S.G.S. 7.5 Minute Series (Topographic)
Fall River East, Mass. Quadrangle, 1978.
Contour Interval: 10 Feet

prepared by MRS	GEOPHYSICAL INVESTIGATION RESOLVE SUPERFUND SITE NORTH DARTMOUTH, MASS. prepared for METCALF & EDDY, INC.	Area of Investigation	
checked by MB			
reviewed by MB		Weston Geophysical	Figure 1

3/93

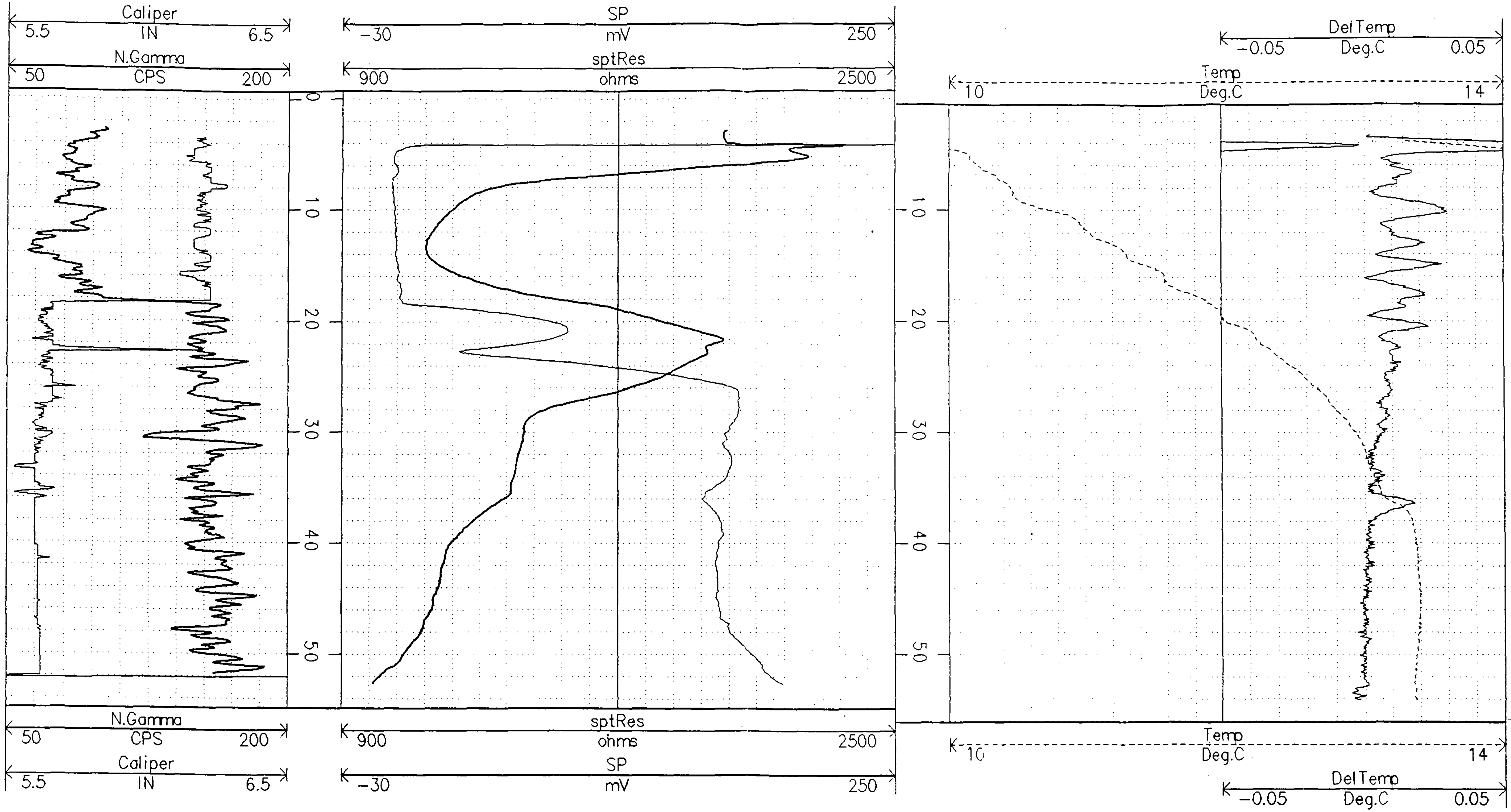
Borehole BED-2



prepared by MRS	GEOPHYSICAL INVESTIGATION RESOLVE SUPERFUND SITE NORTH DARTMOUTH, MASS. prepared for METCALF & EDDY, INC.	Borehole Geophysical Logs Well BED-2	
checked by MB		Weston Geophysical	Figure 3
reviewed by MB			

3/93

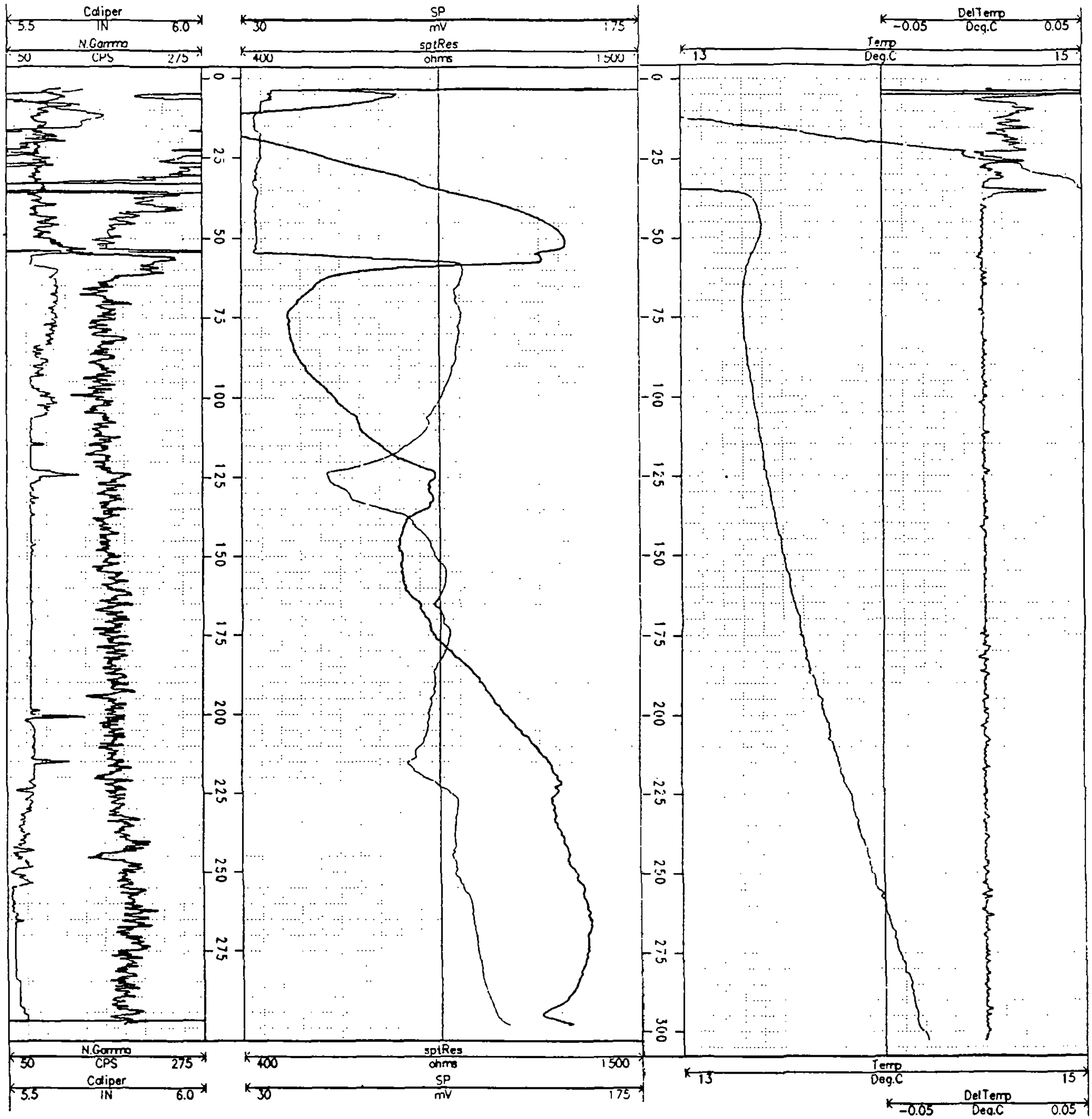
Borehole OW-11M



prepared by MRS checked by MB reviewed by MB	GEOPHYSICAL INVESTIGATION RESOLVE SUPERFUND SITE NORTH DARTMOUTH, MASS. prepared for METCALF & EDDY, INC.	**Borehole Geophysical Logs** **Well OW-11M**	
		Weston Geophysical	Figure 4

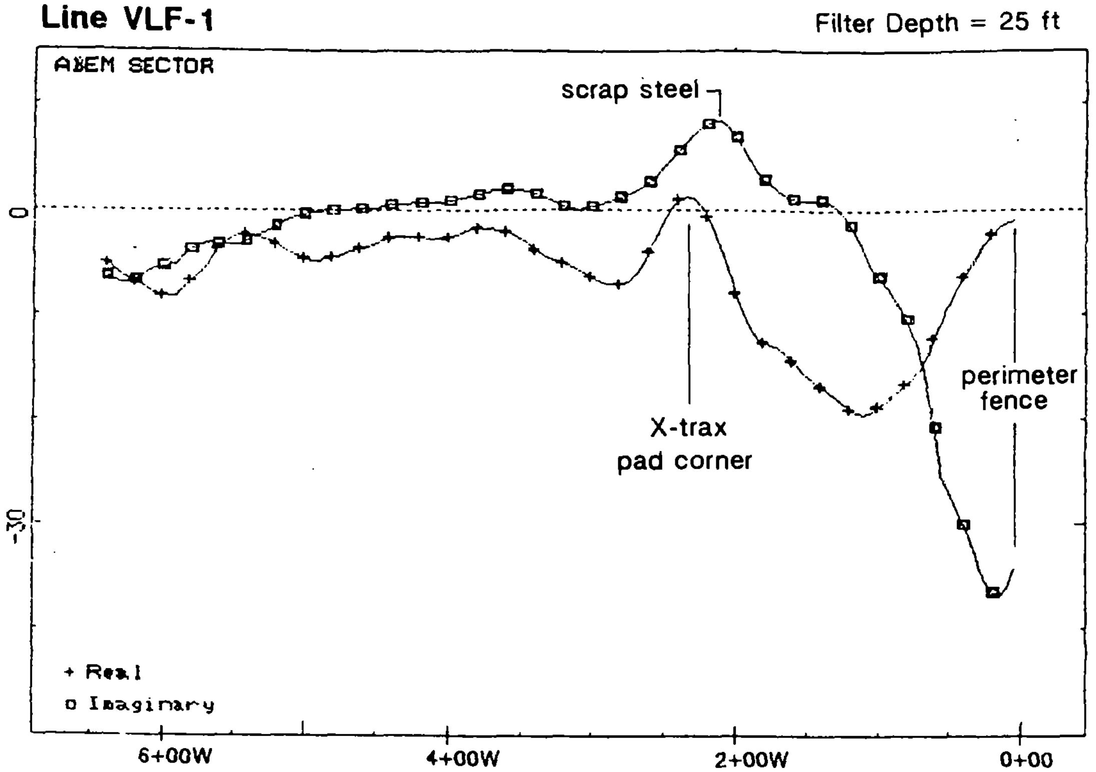
3/93

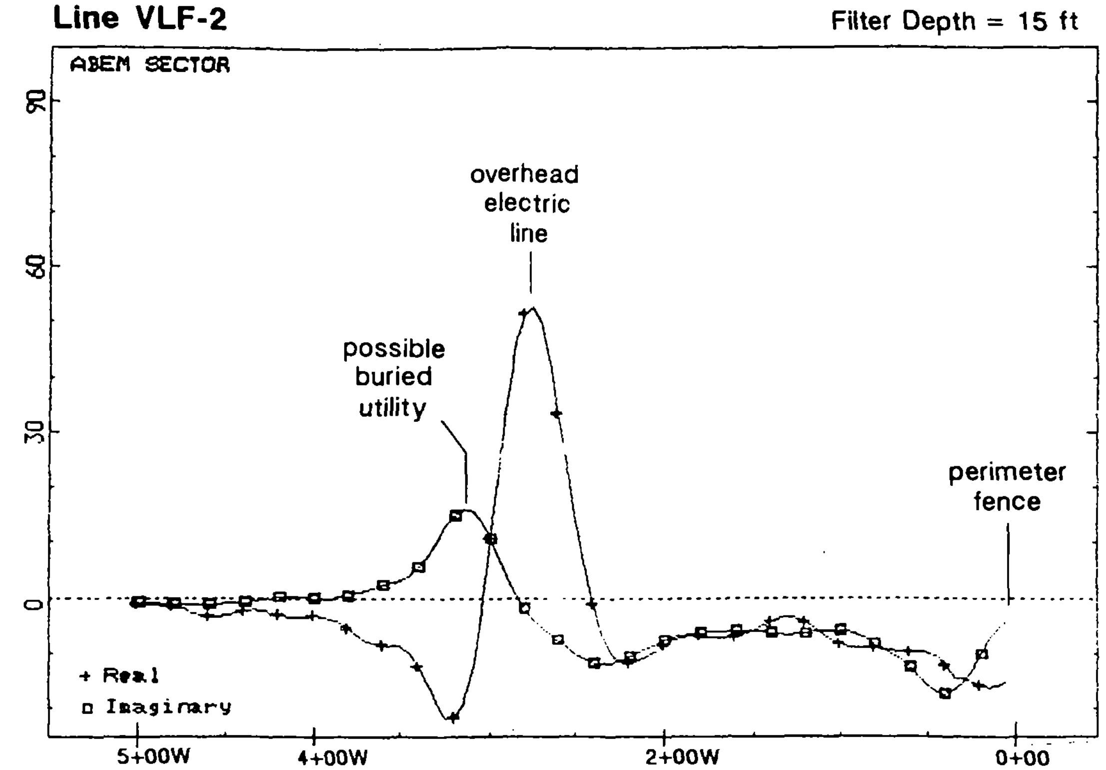
Borehole OW-11D

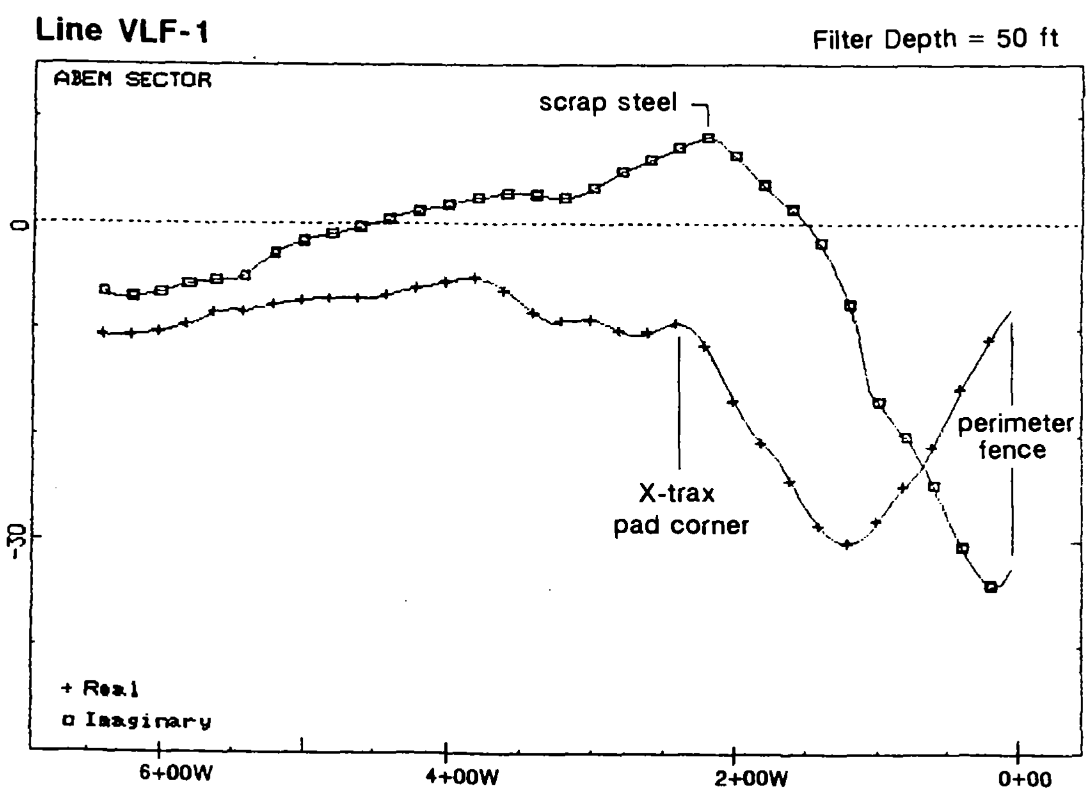


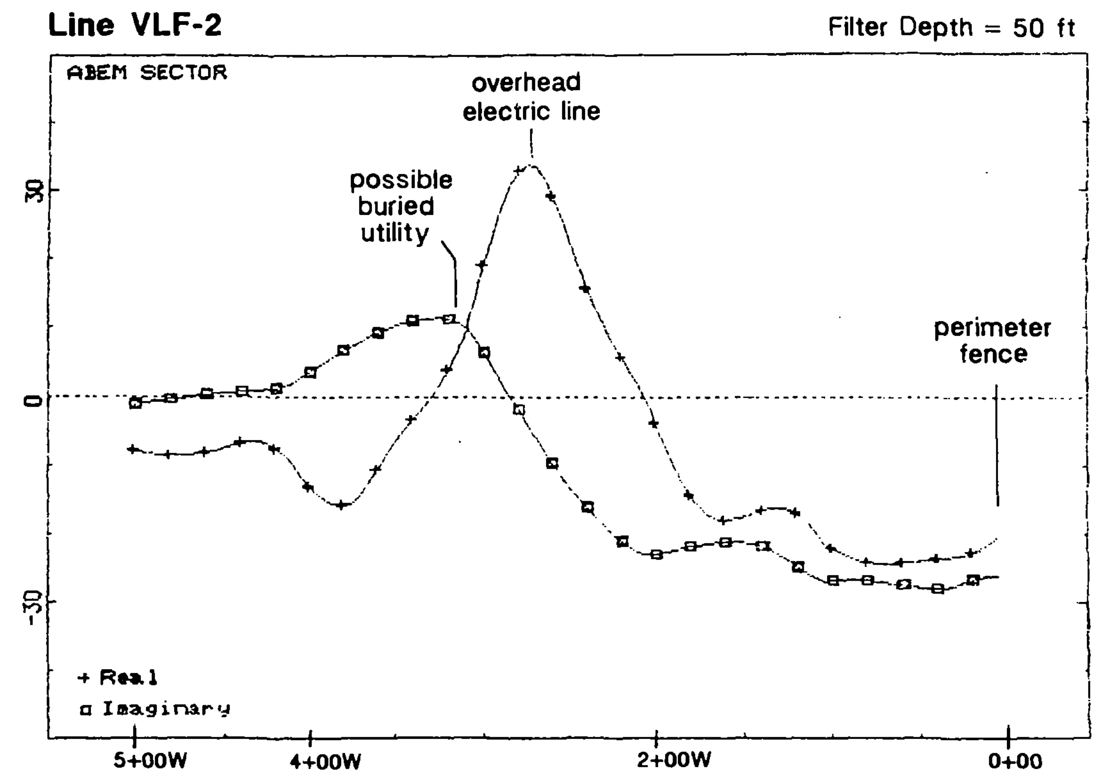
prepared by MRS	GEOPHYSICAL INVESTIGATION RESOLVE SUPERFUND SITE NORTH DARTMOUTH, MASS. prepared for METCALF & EDDY, INC.	**Borehole Geophysical Logs** **Well OW-11D**	
checked by MB		Weston Geophysical	Figure 5
reviewed by MB			

3/93



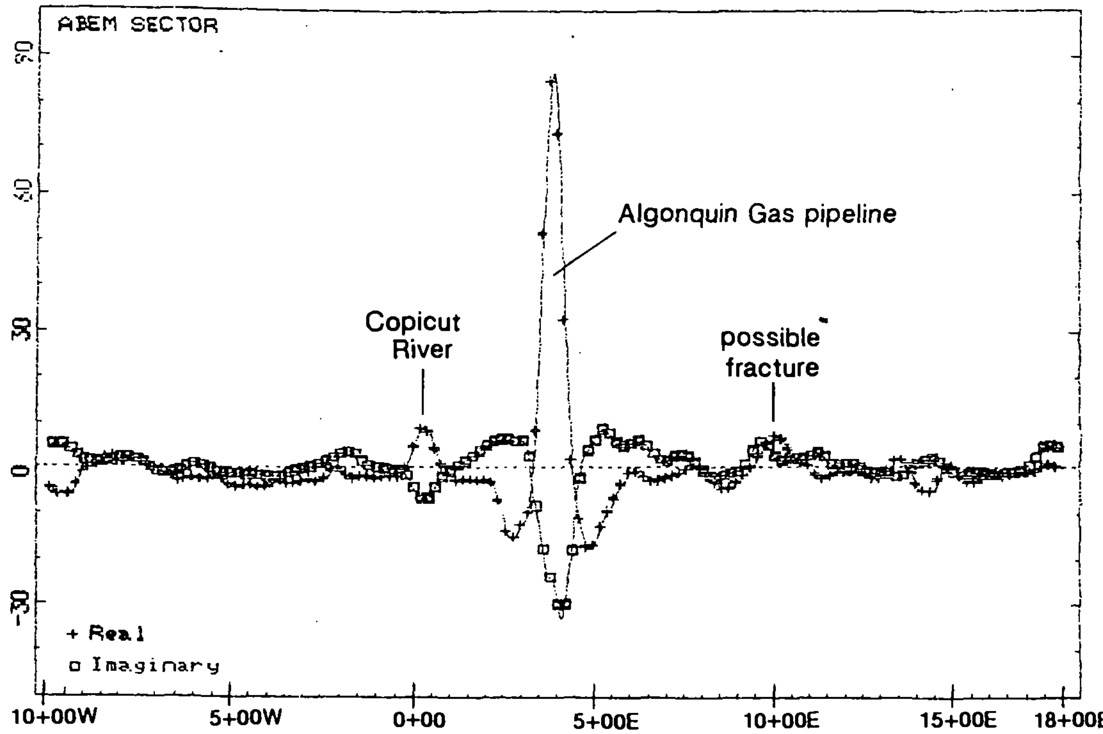


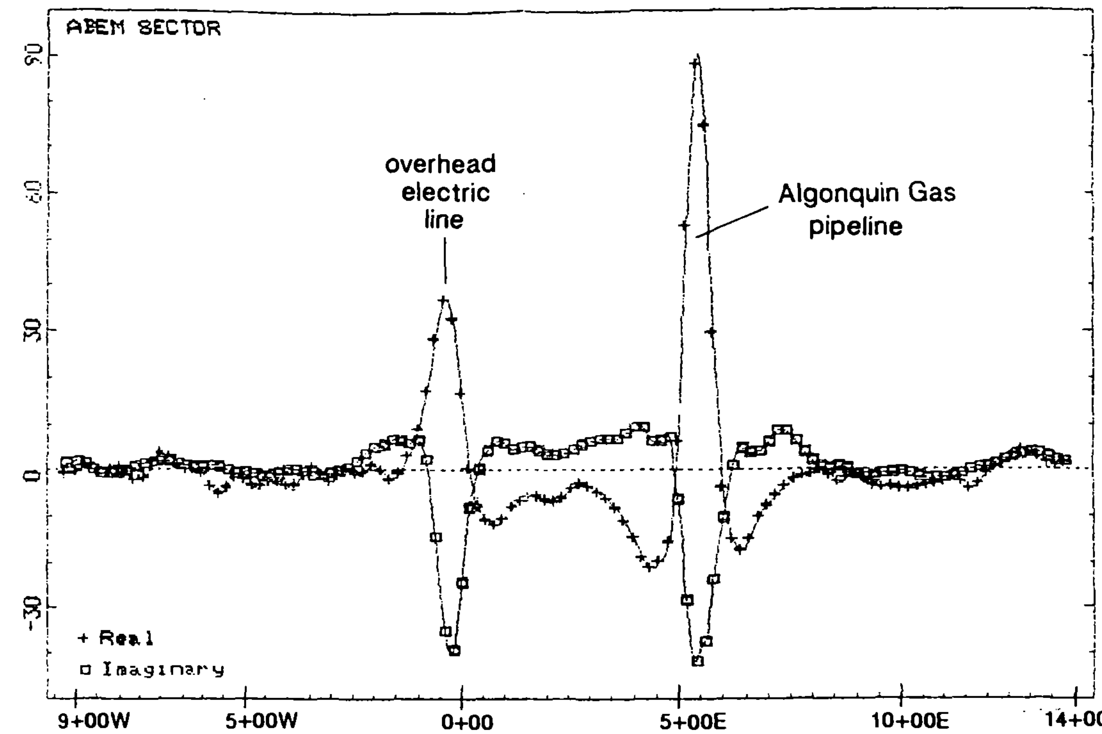


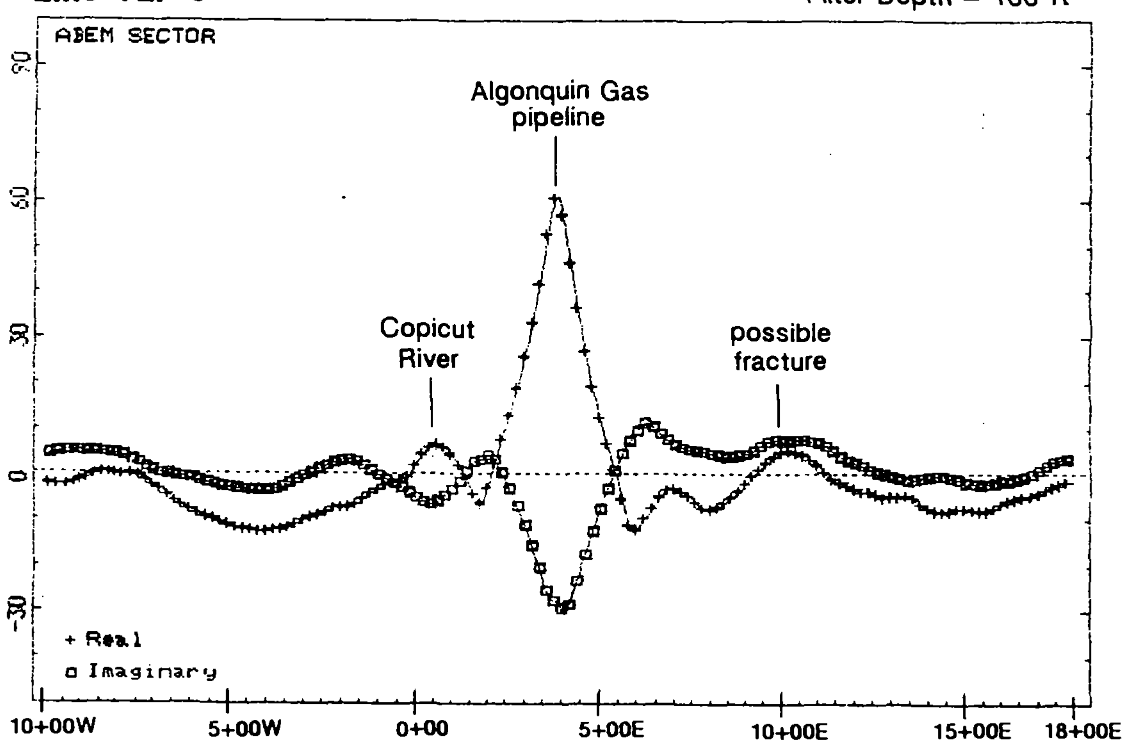


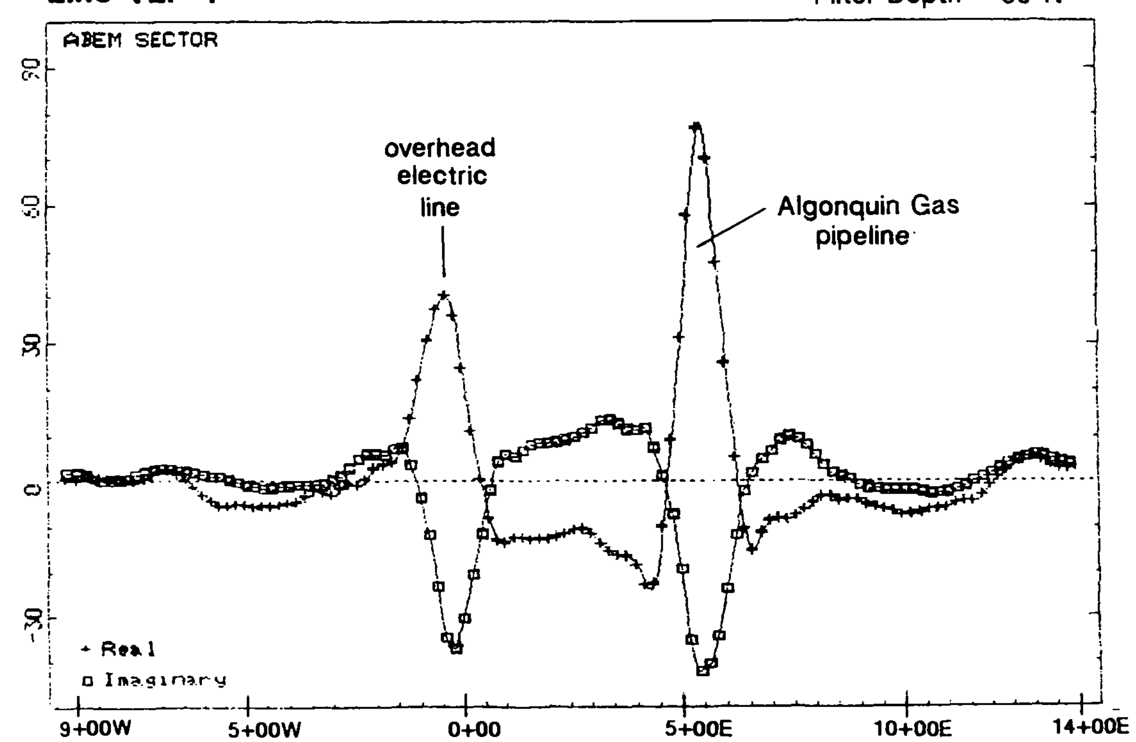
prepared by MRS checked by MB reviewed by MB	GEOPHYSICAL INVESTIGATION RESOLVE SUPERFUND SITE NORTH DARTMOUTH, MASS. prepared for METCALF & EDDY, INC.	VLF Data Profiles Lines VLF-1 and VLF-2 Weston Geophysical — Figure 6

3/93









prepared by MRS checked by MR reviewed by MR	GEOPHYSICAL INVESTIGATION RESOLVE SUPERFUND SITE NORTH DARTMOUTH, MASS. prepared for METCALF & EDDY, INC.	**VLF Data Profiles** **Lines VLF-3 and VLF-4** Weston Geophysical	Figure 7

3/93

APPENDIX A

GEOPHYSICAL BOREHOLE LOGGING METHOD OF INVESTIGATION

Borehole Geophysical Methods

Borehole geophysical logging techniques are a group of active and passive geophysical methods used to provide detailed measurements of soil, rock and water properties. Geophysical logging involves lowering tools into a borehole to measure the electrical, acoustical or radioactive properties of the materials surrounding a borehole.

More than one logging technique is generally used to determine soil and water properties in the borehole. For example, caliper, fluid temperature and conductivity, resistivity, and SP logs can be obtained to identify fracture zones in rock. Because each tool has a different non-unique response to fractures, these logs are interpreted together to determine the characteristics of the rock and fractures. Individual tool responses and interpretations can often be verified using other borehole tools, split spoon or core samples, or surface geophysical methods.

Fluid Logging

Fluid logging includes those techniques that measure characteristics related to the fluid column in the borehole; no direct signal is derived from the surrounding rocks and their contained fluids. Temperature and fluid conductivity are useful in locating depth intervals that accept water (e.g., along possible fractures in bedrock). Measuring probes for both techniques are lowered at a slow rate (less than 15 feet per minute) in an unmixed fluid column to assure accurate fluid profiles.

Fluid logging probes are "open-ended" to allow direct contact of borehole fluid with : a thermistor for temperature readings, and a multi-electrode system for conductivity measurements.

Caliper Logging

The caliper tool measures variations in minimum borehole diameter using a spring-loaded three-arm system. The tool responds to borehole enlargements due to fractures and poor rock quality, as well as reductions in borehole size due to obstructions from rock breakout or scale build-up. It can resolve borehole deviations of less than one quarter inch.

Caliper logs are run at a logging speed of about 15 feet per minute. Calibrations are performed using metal rings (of known diameter) that are both larger and smaller than the borehole to be logged.

Electric Logging

Electric logging refers to logs where potential differences due to the flow of electric current in and adjacent to the well are measured. Electric logging techniques include electromagnetic (EM) induction, spontaneous potential (SP), single-point resistance (SPR), and normal resistivity.

The SP method measures the naturally-occurring voltage potentials, in millivolts, in the borehole. Of primary interest to bedrock fracture investigations are voltage potentials generated electrokinetically when an electrolyte (groundwater) flows through a permeable medium (fractured bedrock). Zones of water gain or loss are often identified by these "streaming potentials" on a log. Streaming potentials are generally negative and have a spikey, irregular character.

SP logs are also used in conjunction with resistivity and gamma logs to identify clays and permeable zones in overburden or bedrock. The SPR method measures the electrical resistance, in ohms, in the borehole. Fractures typically show up on SPR logs as resistance lows. "Normal" resistivity logging entails measurement of changes in bulk resistivity of the surrounding formation. EM induction logs measure the electrical conductivity of the formation.

Natural Gamma-Ray Logging

The natural gamma-ray log is a measure of naturally-occurring gamma radiation in a formation. Natural gamma radiation is produced by the radioactive decay of potassium, thorium, and uranium atoms. A fractured bedrock schist with migrating water may become chemically altered into clay minerals which promote the adsorption of positive ions, such as $Th+$ and $U+$, because of their open crystal lattice structure and net negative charges. Fractured or weathered zones may appear as peaks on natural gamma-ray logs.

Natural gamma-ray measurements in counts per second (CPS), are typically made with the same probe as SP and SPR measurements. Internal logger circuitry provides an electrical check on the gamma-ray scaling, and logging speed is approximately 15 feet per minute.

APPENDIX A

GEOPHYSICAL BOREHOLE LOGGING METHOD OF INVESTIGATION

APPENDIX B

VERY LOW FREQUENCY (VLF) METHOD OF INVESTIGATION

VERY LOW FREQUENCY METHOD

Introduction

The Very Low Frequency (VLF) method is a geophysical prospecting technique based on the principle of radio wave transmission and reception. The VLF method is a walk-over technique utilizing lightweight and highly portable instrumentation which primarily detects elongated, steeply dipping, low-resistivity bodies such as water-filled fracture zones and metallic ore bodies.

Instrumentation

VLF field instrumentation consists of a radio receiver which detects transmissions in the very low frequency range, 15 to 30 kHz. VLF signals are transmitted by vertical radio antennae several hundred feet high with signal outputs ranging from 300 to 1,000 kWatts. A worldwide network of VLF stations has been established in such varied locations as Bordeaux, France (15.1 kHz), Moscow, USSR (17.1 kHz), and Cutler, Maine (24.0 kHz).

Theoretical Considerations

The field emitted by VLF antennae is horizontal, and its magnetic lines comprise concentric rings that "ripple" out from the transmitter. When this magnetic field encounters an electrically conductive structure on the surface or underground, weak secondary currents are generated around the structure. These currents create a secondary magnetic field that is opposed to the original field emitted from the transmitter. This process is called induction and is illustrated schematically on Figure 1. The VLF receiver measures the current density due to these primary and secondary magnetic fields. From these measurements, structures such as water-saturated fracture zones, metallic ore bodies, and mineralized zones may be detected.

In order for the VLF method to be effective, an underground structure must have:

1) the direction of its long axis within 30 degrees of the direction of the transmitter (to initiate induction),

2) minimum dimensions of approximately 50 meters in length, 10 meters in depth, and about one meter in thickness,

3) a dip angle not less than 30 degrees from horizontal, and

4) higher electrical conductivity than the surrounding material.

If an underground "structure" meets the above criteria, the effect of VLF signals propagating through earth materials must be considered. Depth of penetration of VLF signals varies approximately as four times the square root of the material's resistivity. For example, VLF signals propagating through granite (a highly resistive material) can penetrate to depths greater than 300 meters. However, a material such as salt water may limit depth of penetration to one to five meters.

The VLF Survey – Field Considerations

At the start of a VLF survey, the receiver is tuned to a properly oriented VLF station and data is acquired perpendicular to the strike of the target structure. If the target body's strike direction is unknown, a survey grid is established to assure appropriate coverage. Visible structures such as cables, power lines, metal pipes, and electric fences (which would generate their own VLF anomalies) are carefully documented to simplify data interpretation. After the survey, the data is ready for processing and interpretation.

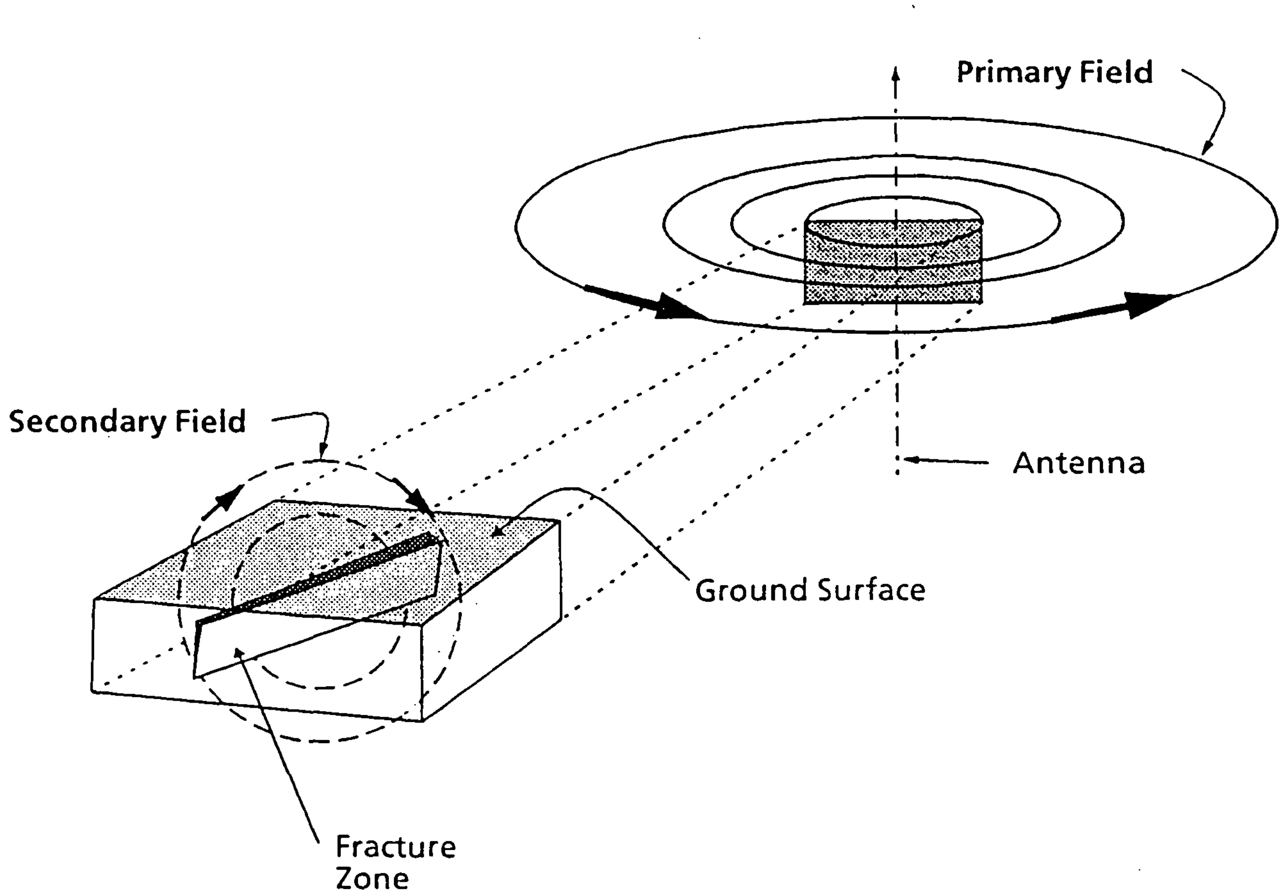
Data Reduction and Interpretation

VLF field data are filtered to smooth random noise and enhance data quality. Figure 2 shows typical VLF data before and after filtering. These plots show current density plotted against distance along the survey traverse. VLF data are presented as two curves, often referred to as the in-phase and quadrature phase components of the VLF measurement. For filtered data, anomalies are typefied by a peak in the in-phase component above the zero line.

The shape of the in-phase component yields information about the dip angle of a structure. A symmetrical in-phase component indicates a near vertical dip for the structure. Anomaly asymmetry increases as a structure's dip angle deviates from the vertical as illustrated for the nearly vertical fracture zone on Figure 2. The maximum peak of the anomaly ovserved on unfiltered data (farthest removed from the zero-line) represents the downdip side of the structure. The effect of dip angle on anomaly shape has been documented for many different structures of varying dimensions; therefore, VLF anomaly shape can be related to the approximate dip angle of a given structure.

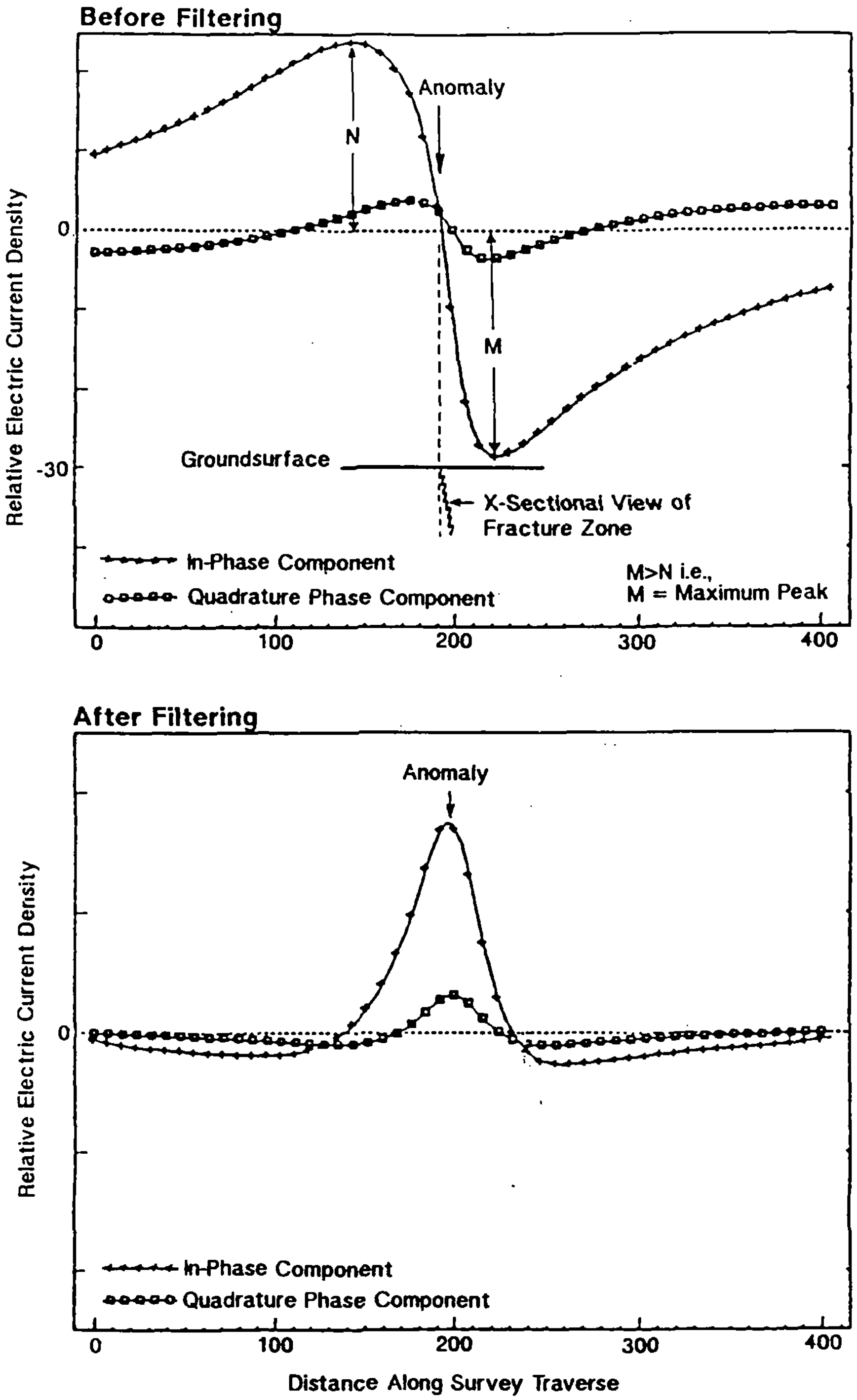
The quadrature phase component yields information about the electrical conductivity of the structure. For materials with lower conductivity, the quadrature phase component is stable and appears relatively flat. For materials with higher conductivity such as overhead power lines, the quadrature phase component closely mimics the in-phase component.

Anomalies associated with a water-filled fracture zone and overhead power lines are shown on Figure 3. Since the water-filled fracture zone has much lower conductivity than the power lines, the quadrature phase component is relatively flat compared to the in-phase component. However, the quadrature phase component of the power line anomaly mimics the in-phase component. This data interpretation represents two of the more common natural and man-made sources of VLF anomalies encountered in the field.



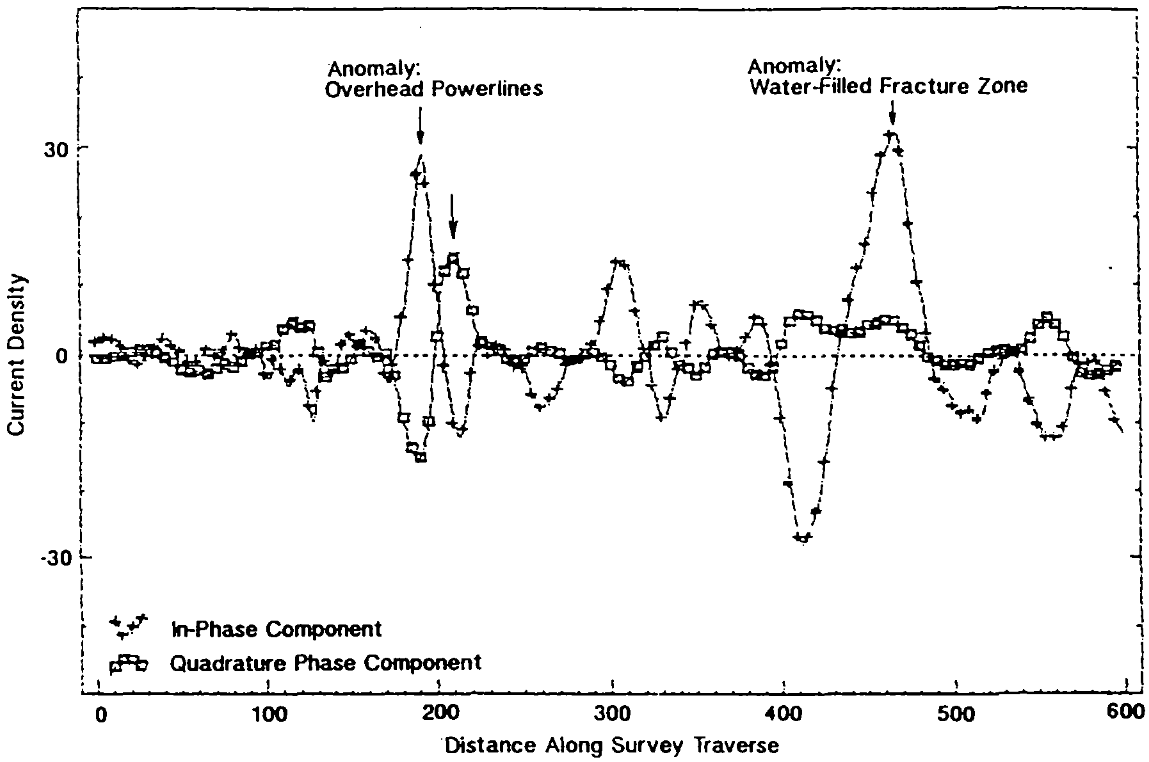
Schematic Diagram of the VLF Principle

Figure 1



Anomaly from a Nearly-Vertical Water-Filled Fracture Zone
Before and After Filtering

Figure 2



Anomalies Demonstrating
Relative Conductivity of Materials

Figure 3

prepared by MRS
checked by MB
reviewed by MB

GEOPHYSICAL INVESTIGATION
RESOLVE SUPERFUND SITE
NORTH DARTMOUTH, MASS.
prepared for
METCALF & EDDY, INC.

Geophysical Survey Coverage

Weston Geophysical

Figure 2

Appendix G

Appendix G

APPENDIX G
CALCULATION OF CRITICAL GRADIENTS FOR POOL MOBILIZATION IN FRACTURES

APPENDIX G
CALCULATION OF CRITICAL GRADIENT FOR POOL MOBILIZATION IN FRACTURES

Bernard Kueper
Queen's University

For parallel, evenly-spaced fractures:

$$K = \frac{we^2 \rho g}{12\mu} \qquad \textbf{(1)}$$

$$w = \frac{e}{s} \qquad \textbf{(2)}$$

e	=	*aperture*
w	=	*porosity*
s	=	*spacing*
ρ	=	*density*
g	=	*gravity*
μ	=	*viscosity*
K	=	*hydraulic conductivity*

Given K = 2 ft/day (assumed average horizontal hydraulic conductivity for upper bedrock at ReSolve Site)

= 7.056×10^{-6} m/s,

Calculate e, assuming s:

s (m)	e (μm)
0.1	95.2
1.0	205.2

From a one-dimensional force balance, it can be shown that a pool will be mobilized if:

$$\frac{\Delta\rho L \sin\alpha}{\rho w} + \Delta h > \frac{P_d(L) - P_c(0)}{\rho w g} n \tag{3}$$

$\Delta\rho$	=	ρ_{nw} - ρ_w	$\Delta h = h(o) - h(L)$
L	=	*pool length*	$P_d(L)$=*entry pressure @ L*
α	=	*dip of fracture*	$P_c(0) = P_c$ @ 0

Calculate fracture entry pressure under assumed conditions:

$$P_d = \frac{2\sigma \cos\theta}{e} \tag{4}$$

$$\text{assume } \theta = 0^o$$

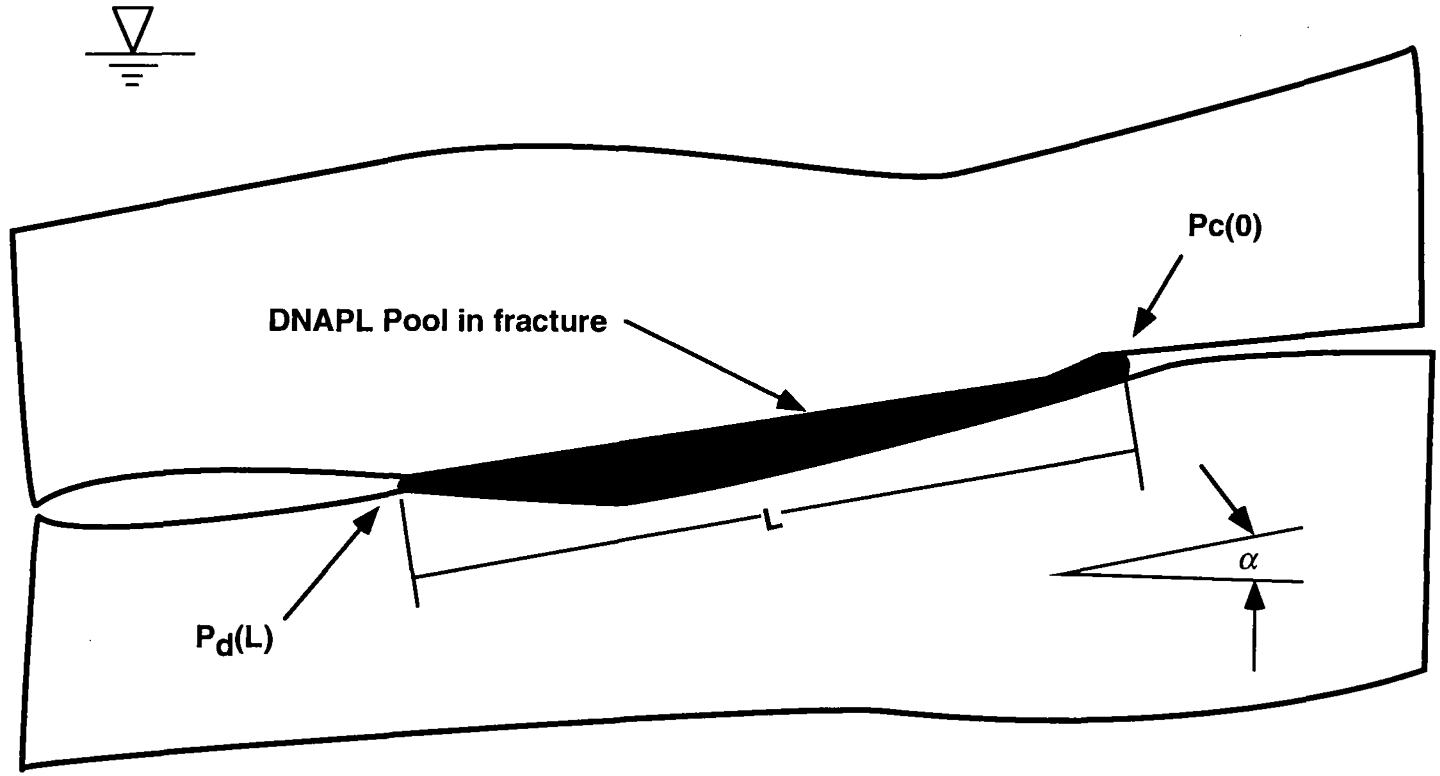
$$\text{use } \sigma = 0.009 \ N/m$$

e (μm)	P_d (Pa)
95.2	189.1
205.2	87.7

Calculate critical gradient (Δh)/L across pool from (3) (gradient above which pools can be mobilized)
assuming pool length:

Pd (Pa)	L (m)	Δh/L
189.1	0.2	0.0964
	2.0	0.0096
87.7	0.2	0.0447
	2.0	0.0045

assuming Pc (0) = 0 & α = 0



$\Sigma^2\Pi$

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POOL MOBILIZATION IN ROUGH-WALLED FRACTURES

FIGURE
1A

Appendix H

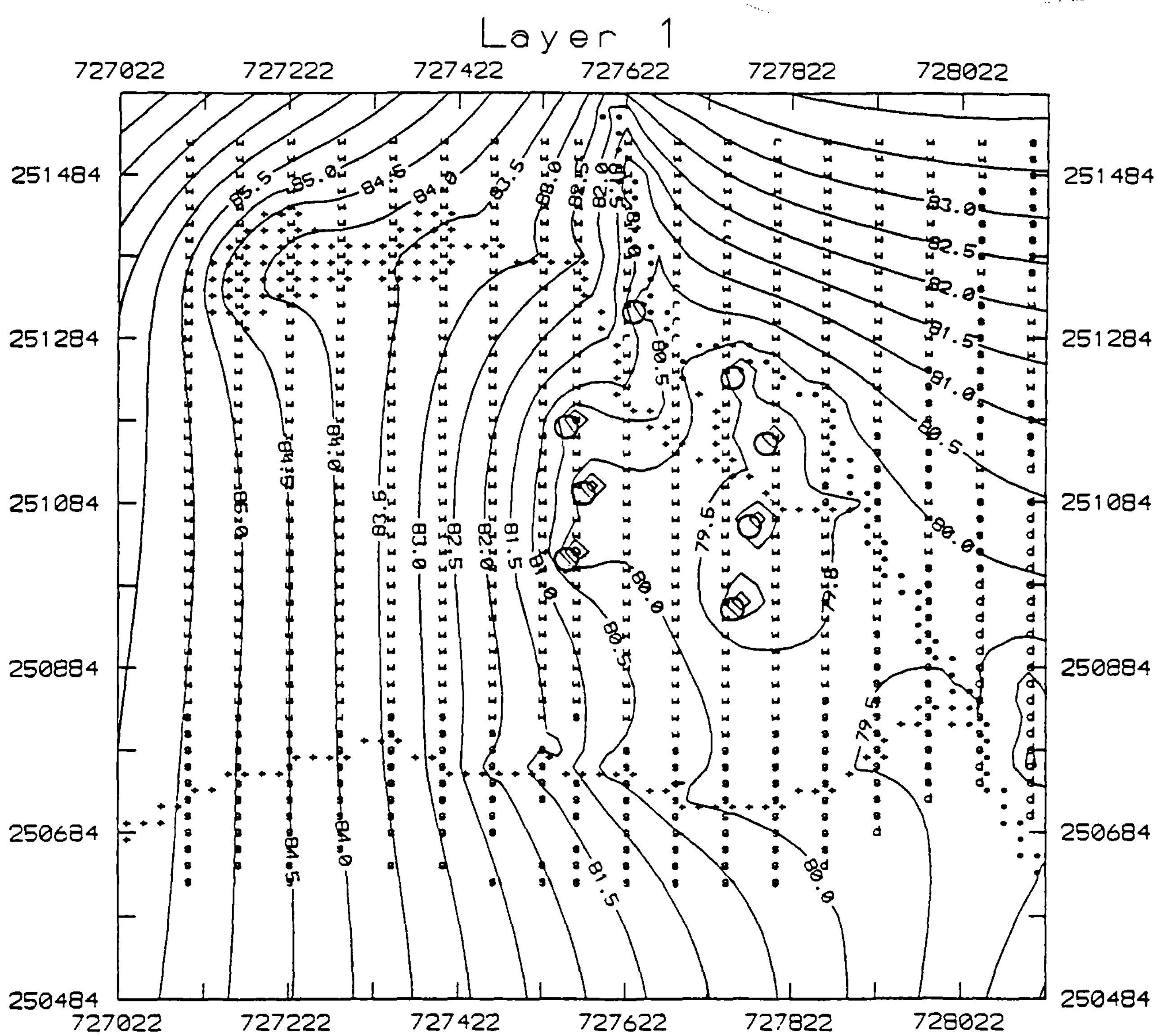
APPENDIX H

SAMPLE MODEL RESULTS

Model Output: Case 4A

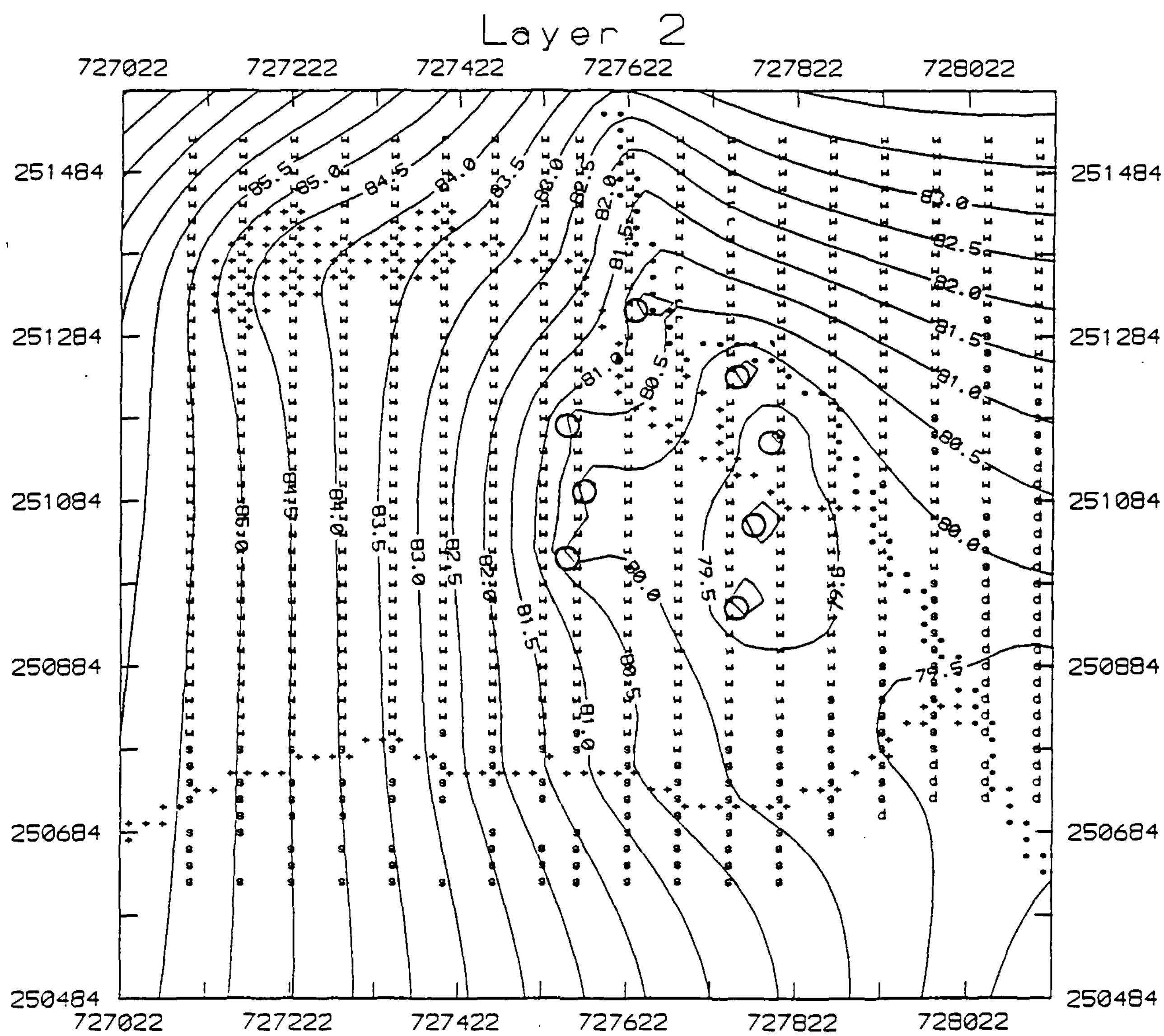
r - captured by rive
s - captured by stre
w - captured by well
d - captured by drai

se 7, NO injection, starting positions of particles captured



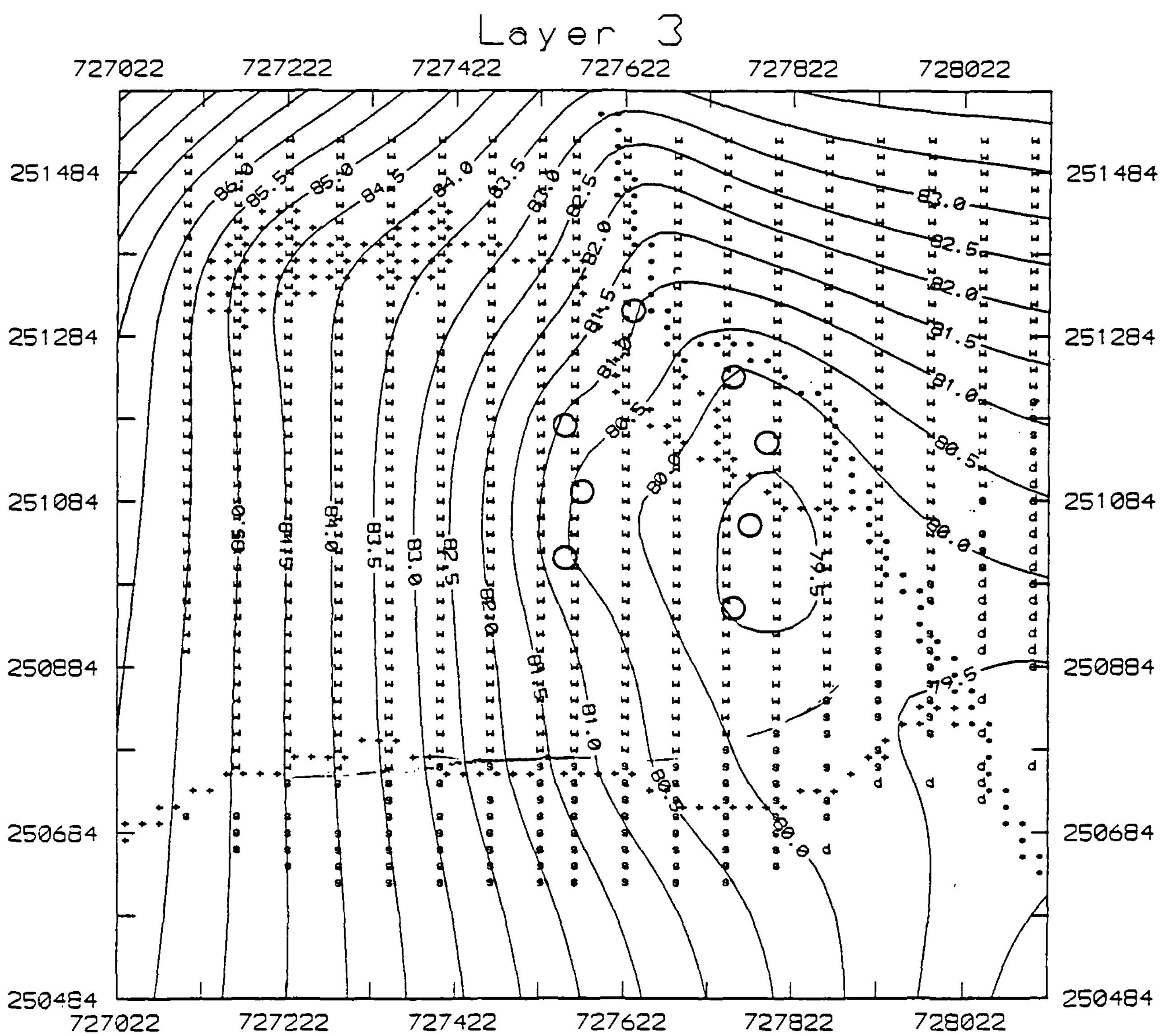
r - captured by river
s - captured by stree
w - captured by well
d - captured by drain

se 7, NO injection, starting positions of particles captured



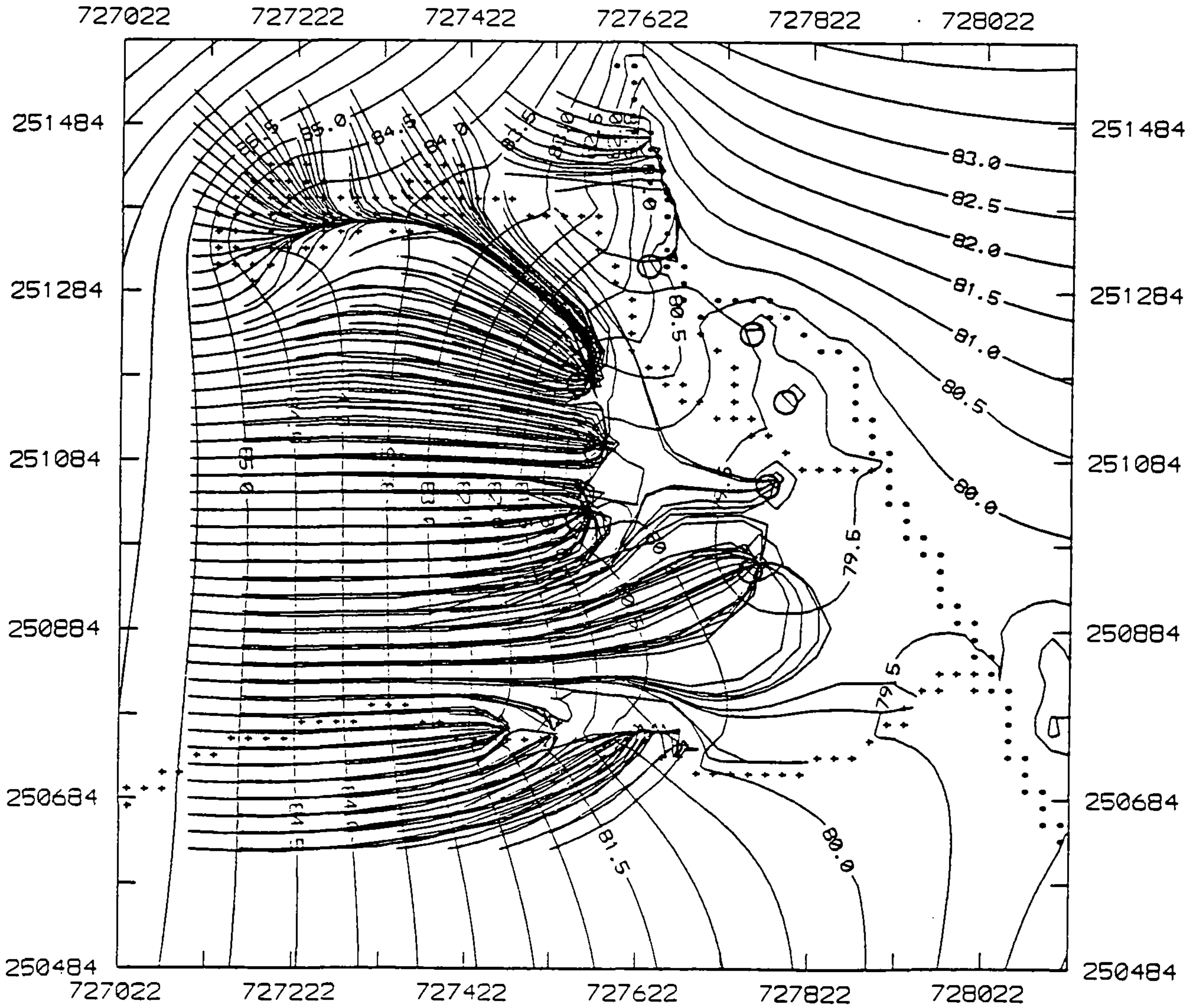
r - captured by river
s - captured by stree
w - captured by well
d - captured by drain

se 7, NO injection, starting positions of particles captured

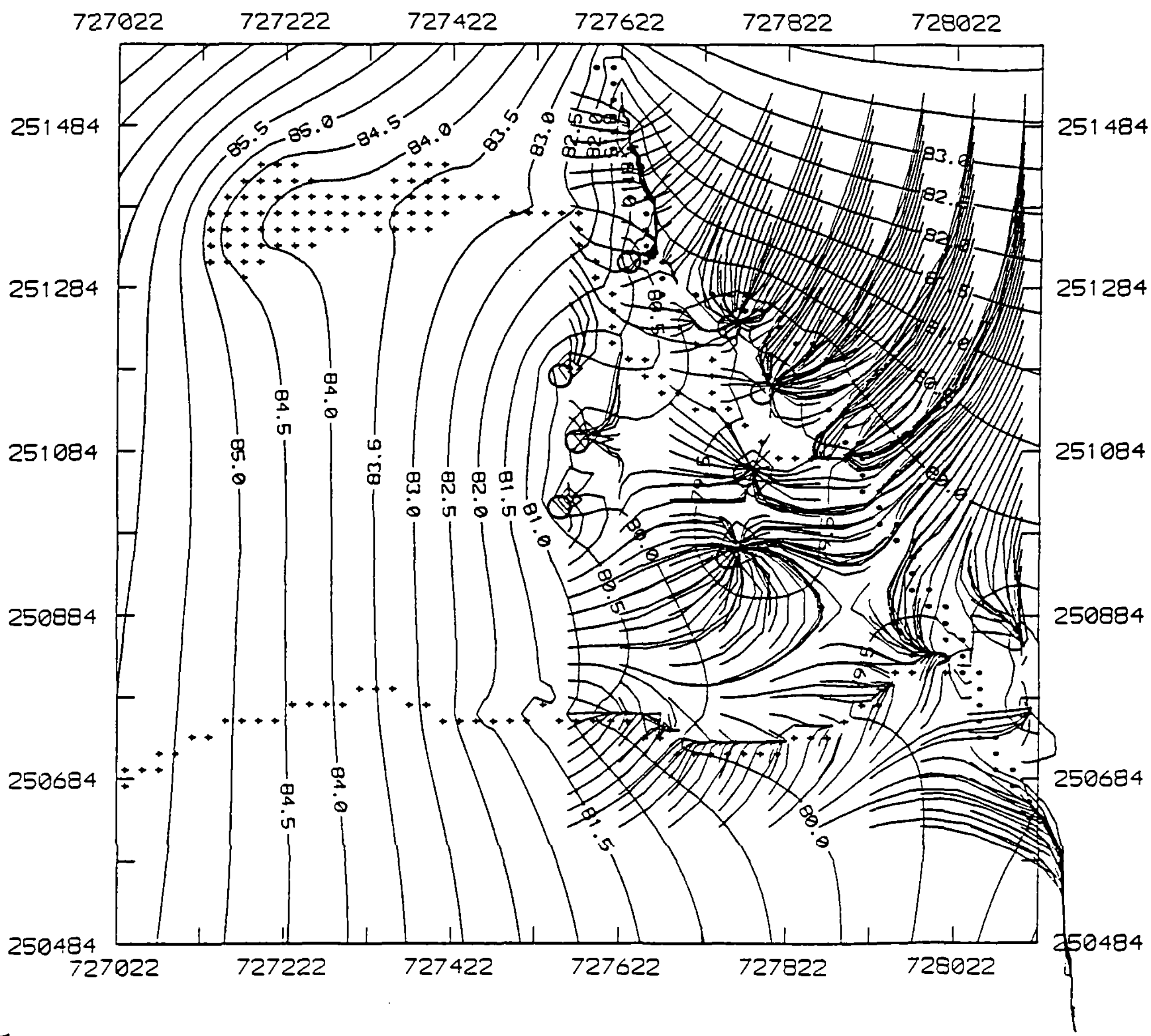


Case 7 Revision 3 3/31/93

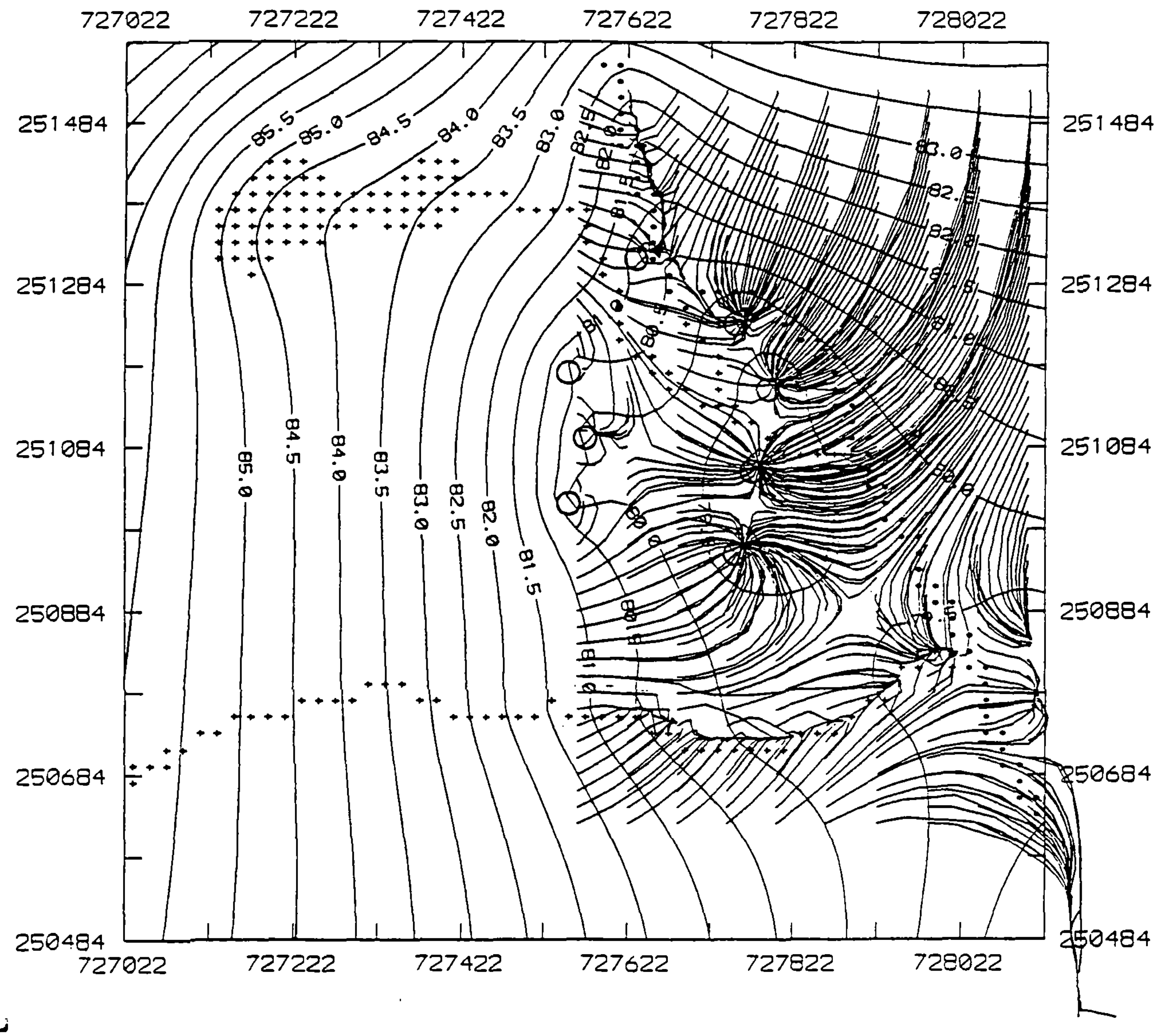
Case 7 Particles started in Layer 1 all wells @ 5gpm



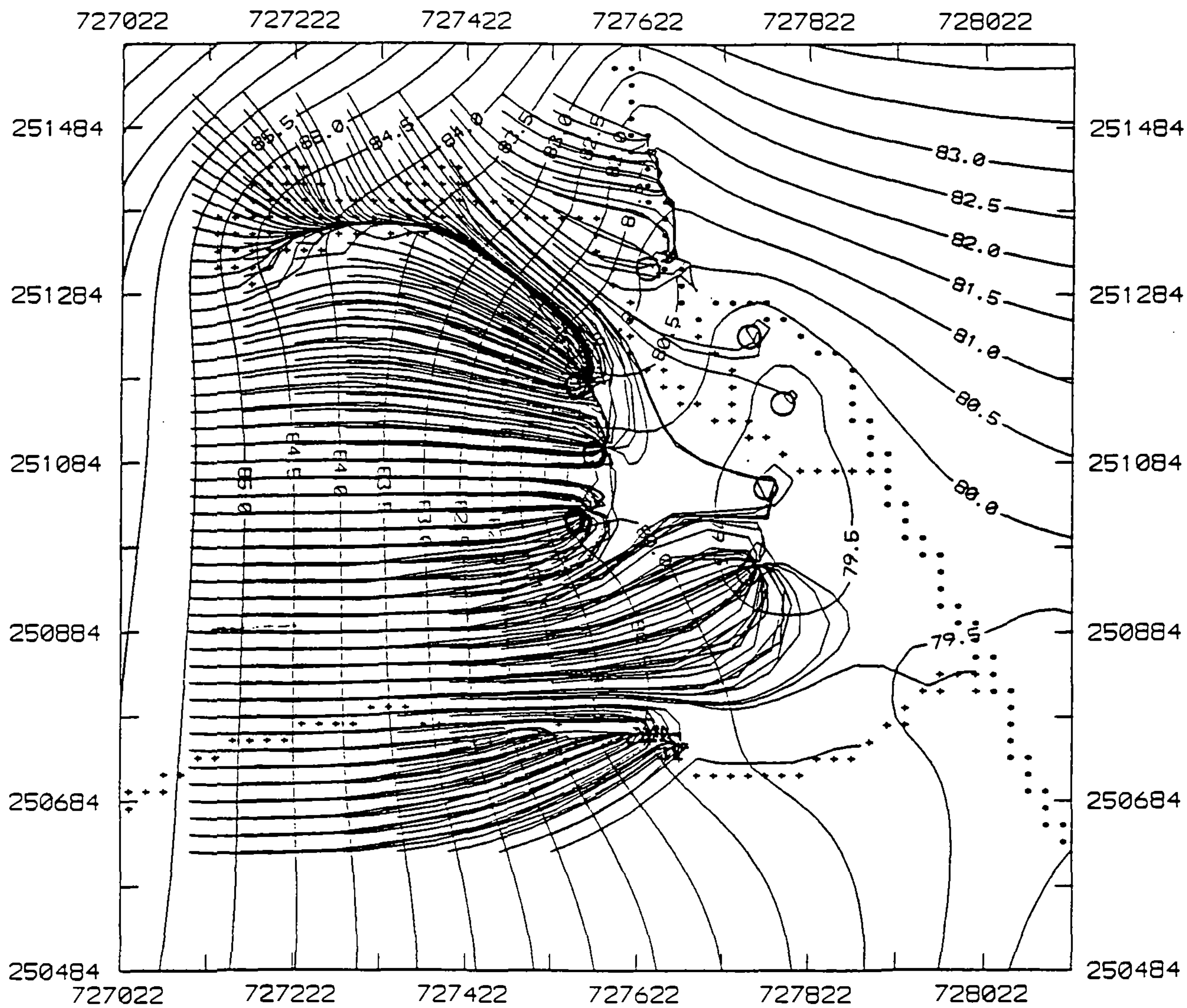
Case 7 Particles started in Layer 1



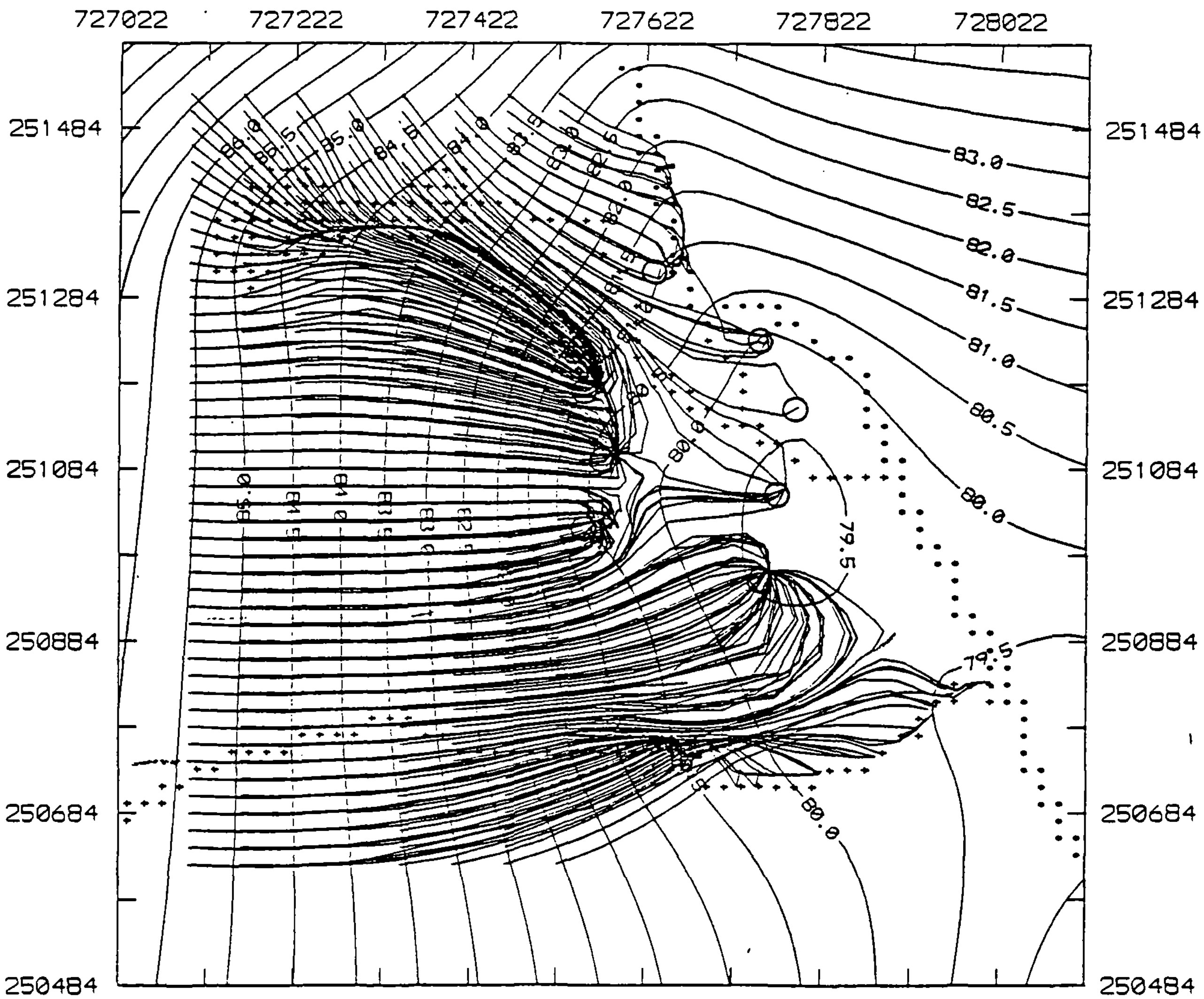
Case 7 Particles started in Layer 2



Case 7 Particles started in Layer 2

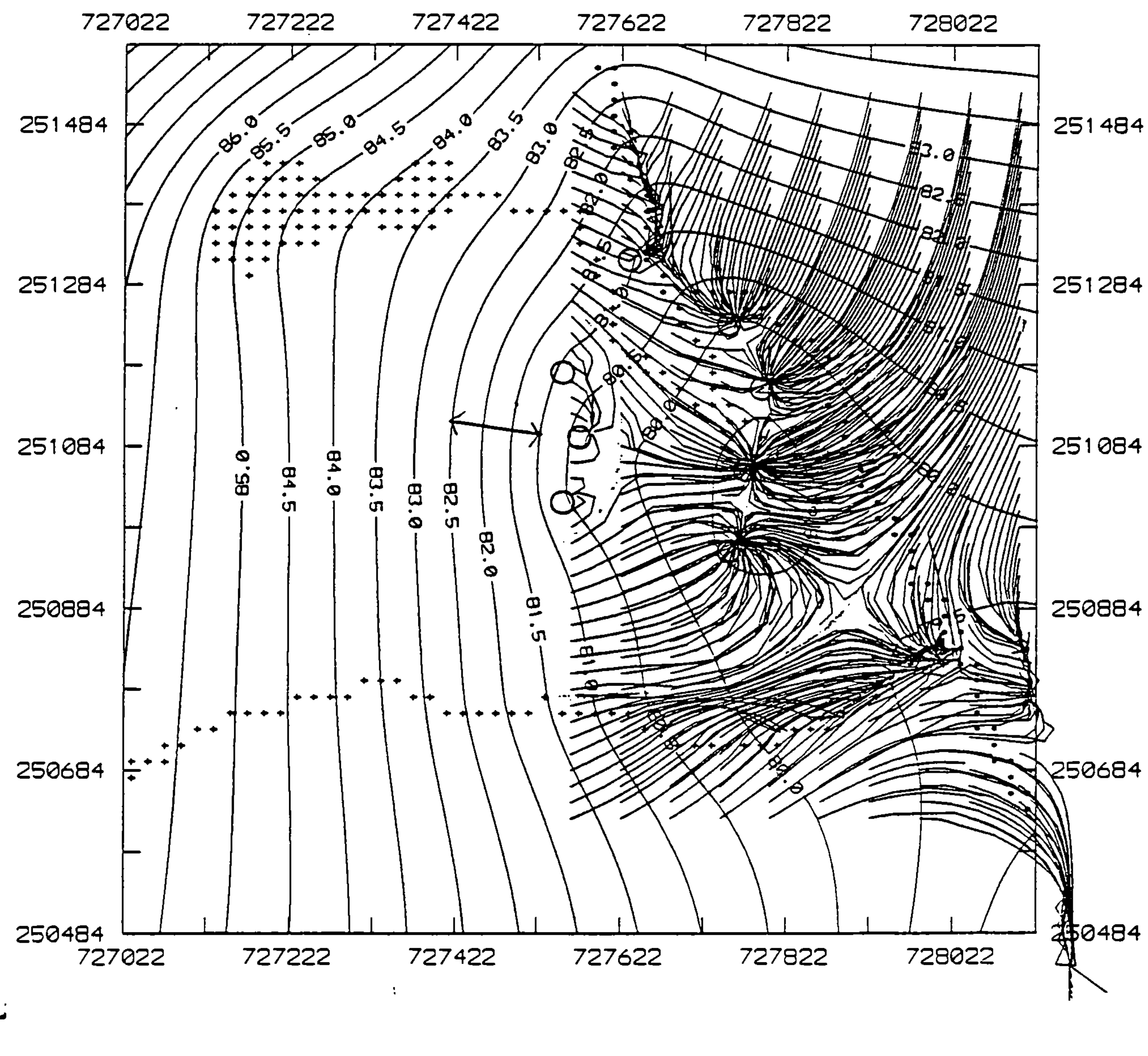


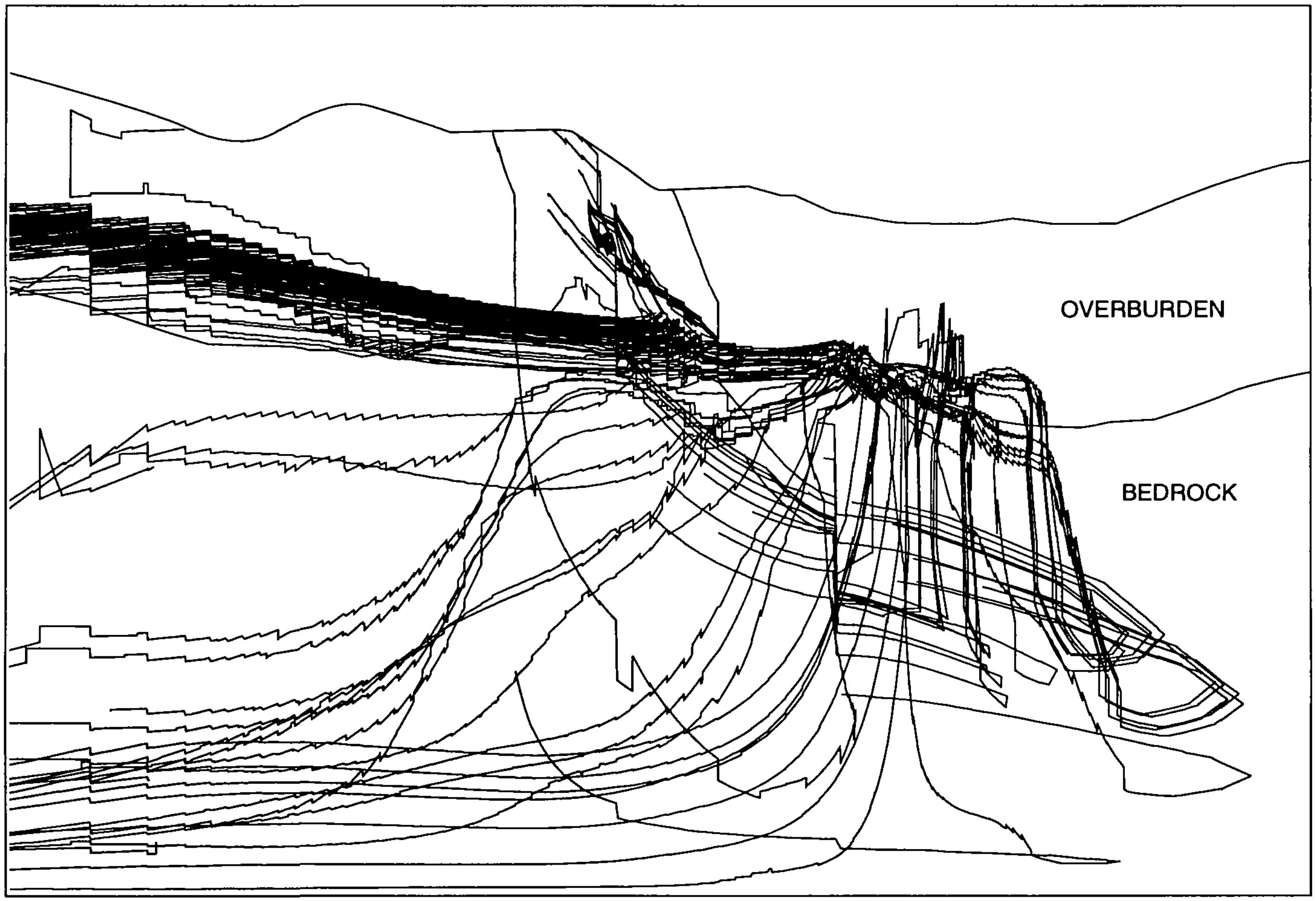
Case 7 Particles started in Layer 3



$\frac{1.5 \text{ ft}}{110 \text{ ft}} = .0136$

Case 7 Particles started in Layer 3





Vertical Exaggeration 10X

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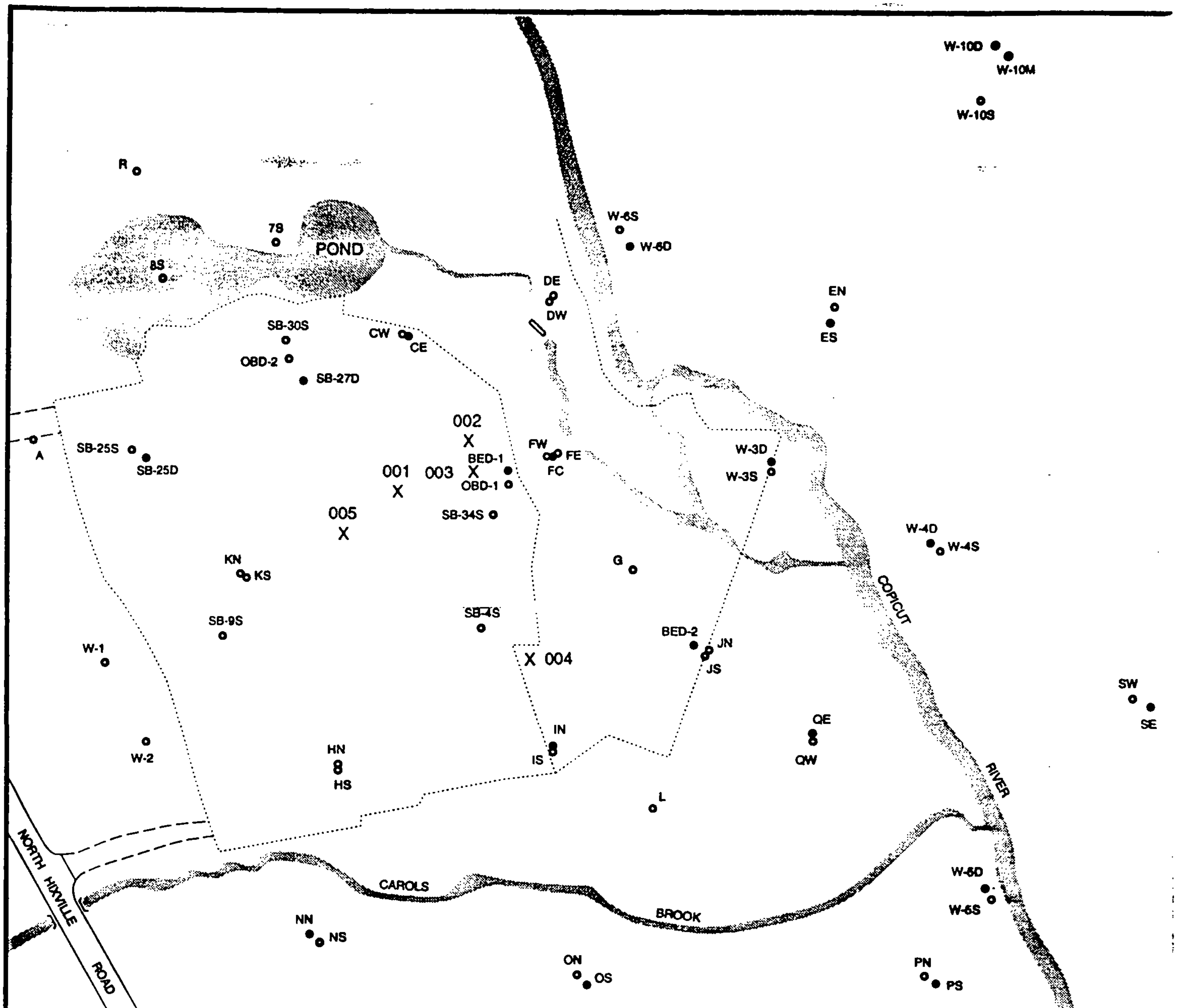
PARTICLE TRACKING CROSS-SECTION,
ROW 30 FINE MESH AREA

FIGURE

Appendix I

APPENDIX I
DNAPL DATA



Explanation

....	Fence
o	Overburden well
•	Bedrock well
X	DNAPL Sample

0 150 300

Scale feet

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LOCATION OF DNAPL SAMPLES

FIGURE 2-27

ANALYTICAL RESULTS

OF DNAPL SAMPLES

FROM 1992

SCR EXCAVATION

(001, 002, 003 ON MAP)

Sample AL-41

Lab Id. 33831-001

001 on Map

Laboratory number: 33831 -001
Sample Designation: AL-41
Date Analyzed: 11/16/92
Matrix: OIL

Instrument File Name: >E2687

Results are expressed on an as received basis.

VOLATILE ORGANICS	CONCENTRATION (ug/g)	DETECTION LIMIT (ug/g)
Chloromethane	BDL	13000
Bromomethane	BDL	13000
Vinyl chloride	BDL	13000
Chloroethane	BDL	6700
Methylene chloride	BDL	13000
Acetone	BDL	33000
Carbon disulfide	BDL	6700
1,1-Dichloroethene	BDL	6700
Tetrahydrofuran	BDL	33000
1,1-Dichloroethane	BDL	6700
1,2-Dichloroethene (total)	BDL	6700
Chloroform	BDL	6700
Methyl ethyl ketone	BDL	33000
1,2-Dichloroethane	BDL	6700
1,1,1-Trichloroethane	9900	6700
Carbon Tetrachloride	BDL	6700
Vinyl acetate	BDL	13000
Bromodichloromethane	BDL	6700
cis-1,3-Dichloropropene	BDL	6700
trans-1,3-Dichloropropene	BDL	6700
Trichloroethene	49000	6700
Benzene	BDL	6700
Dibromochloromethane	BDL	6700
1,1,2-Trichloroethane	BDL	6700
1,2-Dichloropropane	BDL	6700
2-Chloroethyl vinyl ether	BDL	6700
Bromoform	BDL	6700
Methyl isobutyl ketone	BDL	33000
2-Hexanone	BDL	33000
1,1,2,2-Tetrachloroethane	BDL	6700
Tetrachloroethene	190000	6700
Toluene	63000	6700
Chlorobenzene	BDL	6700
Ethylbenzene	BDL	6700
m-Xylene	44000	6700
o,p-Xylene	30000	6700
Styrene	BDL	6700

METHOD REFERENCE: EPA SW 846, 3rd Edition
METHOD 8240

BDL = Below detection limit

This sample required dilution to bring a high target analyte concentration into the calibration range.
Detection limits were elevated accordingly.

pace.
INCORPORATED
THE ASSURANCE OF QUALITY

Laboratory number: 33831 -001
Sample Designation: AL-41
Date Extracted: 11/11/92
Date Analyzed: 11/19/92
Matrix: OIL

Instrument File Name: >F2385

Results are expressed on an as received basis.

ACID/BASE/NEUTRAL EXTRACTABLES	CONCENTRATION (ug/g)	DETECTION LIMIT (ug/g)
N-Nitrosodimethylamine	BDL	40
Phenol	BDL	40
Aniline	BDL	40
Bis(2-chloroethyl)ether	BDL	40
2-Chlorophenol	BDL	40
1,3-Dichlorobenzene	BDL	40
1,4-Dichlorobenzene	BDL	40
Benzylalcohol	BDL	40
1,2-Dichlorobenzene	BDL	40
2-Methylphenol	BDL	40
Bis(2-chloroisopropyl)ether	BDL	40
4-Methylphenol	BDL	40
N-Nitroso-di-N-propylamine	BDL	40
Hexachloroethane	BDL	40
Nitrobenzene	BDL	40
Isophorone	BDL	40
2-Nitrophenol	BDL	40
2,4-Dimethylphenol	BDL	40
Benzoic acid	BDL	200
Bis(2-chloroethoxy)methane	BDL	40
2,4-Dichlorophenol	BDL	40
1,2,4-Trichlorobenzene	73	40
Naphthalene	BDL	40
4-Chloroaniline	BDL	40
Hexachlorobutadiene	BDL	40
4-Chloro-3-methylphenol	BDL	40
2-Methylnaphthalene	BDL	40
Hexachlorocyclopentadiene	BDL	40
2,4,6-Trichlorophenol	BDL	40
2,4,5-Trichlorophenol	BDL	200
2-Chloronaphthalene	BDL	40
2-Nitroaniline	BDL	200
Dimethylphthalate	BDL	40
Acenaphthylene	BDL	40
2,6-Dinitrotoluene	BDL	40

METHOD REFERENCE: EPA SW 846, 3rd Edition
METHOD 8270

BDL = Below detection limit

ACID/BASE/NEUTRAL EXTRACTABLES	CONCENTRATION (ug/g)	DETECTIC LIMIT (ug/g)
3-Nitroaniline	BDL	200
Acenaphthene	BDL	40
2,4-Dinitrophenol	BDL	200
4-Nitrophenol	BDL	200
Dibenzofuran	BDL	40
2,4-Dinitrotoluene	BDL	40
Diethylphthalate	BDL	40
4-Chlorophenyl-phenylether	BDL	40
Fluorene	BDL	40
4-Nitroaniline	BDL	200
4,6-Dinitro-2-methylphenol	BDL	200
N-Nitrosodiphenylamine	BDL	40
Azobenzene	BDL	40
4-Bromophenyl-phenylether	BDL	40
Hexachlorobenzene	BDL	40
Pentachlorophenol	BDL	40
Phenanthrene	BDL	40
Anthracene	BDL	40
Di-N-butylphthalate	BDL	40
Fluoranthene	BDL	40
Benzidine	BDL	200
Pyrene	BDL	40
Butylbenzylphthalate	BDL	40
3,3'-Dichlorobenzidine	BDL	80
Benzo(A)anthracene	BDL	40
Chrysene	BDL	40
Bis(2-ethylhexyl)phthalate	98	40
Di-N-octylphthalate	BDL	40
Benzo(B)fluoranthene	BDL	40
Benzo(K)fluoranthene	BDL	40
Benzo(A)pyrene	BDL	40
Indeno(1,2,3,-CD)pyrene	BDL	40
Dibenz(A,H)anthracene	BDL	40
Benzo(G,H,I)perylene	BDL	40

Detection limit raised by the presence of non-listed compounds.

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Laboratory number: 33831 -001
Sample Designation: AL-41
Date Analyzed: 11/23/92
Matrix: OIL

PCB'S	CONCENTRATION (ug/g)	DETECTION LIMIT (ug/g)
PCB-1242	540000	30000
PCB-1254	94000	30000
PCB-1221	BDL	30000
PCB-1232	BDL	30000
PCB-1248	BDL	30000
PCB-1260	BDL	30000
PCB-1016	BDL	30000

METHOD REFERENCE: EPA SW846, 3RD EDITION
MODIFIED METHOD 3580 AND 8080

BDL = Below detection limit
This sample required dilution to bring a high target analyte concentration into the calibration range.
Detection limits were elevated accordingly.

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Laboratory Number: 33831-001
Sample Designation: AL-41
Date Analyzed: 11/18/92
Matrix: Oil

CARBON RANGE	CONCENTRATION (ug/g)
n-C_8 to n-C_{10}	27800
n-C_{11} to n-C_{13}	10400
n-C_{14} to n-C_{17}	89800
n-C_{18} to n-C_{21}	88700
n-C_{22} to n-C_{25}	71500
n-C_{26} to n-C_{29}	39300
n-C_{30} to n-C_{33}	21200

Results expressed on a weight as received basis.

METHOD REFERENCE: EPA SW-846, 3RD EDITION METHOD 8100
and ASTM D 3328-78

Sample 33491-001

Lab Id 33831-002

002 on Map.

Laboratory number: 33831 -002
Sample Designation: 33491-001
Date Analyzed: 11/16/92
Matrix: OIL

Instrument File Name: >E2688

Results are expressed on an as received basis.

VOLATILE ORGANICS	CONCENTRATION (ug/g)	DETECTION LIMIT (ug/g)
Chloromethane	BDL	1000
Bromomethane	BDL	1000
Vinyl chloride	BDL	1000
Chloroethane	BDL	500
Methylene chloride	BDL	1000
Acetone	BDL	2500
Carbon disulfide	BDL	500
1,1-Dichloroethene	BDL	500
Tetrahydrofuran	BDL	2500
1,1-Dichloroethane	BDL	500
1,2-Dichloroethene (total)	BDL	500
Chloroform	BDL	500
Methyl ethyl ketone	BDL	2500
1,2-Dichloroethane	BDL	500
1,1,1-Trichloroethane	TRACE	500
Carbon Tetrachloride	BDL	500
Vinyl acetate	BDL	1000
Bromodichloromethane	BDL	500
cis-1,3-Dichloropropene	BDL	500
trans-1,3-Dichloropropene	BDL	500
Trichloroethene	4800	500
Benzene	BDL	500
Dibromochloromethane	BDL	500
1,1,2-Trichloroethane	BDL	500
1,2-Dichloropropane	BDL	500
2-Chloroethyl vinyl ether	BDL	500
Bromoform	BDL	500
Methyl isobutyl ketone	BDL	2500
2-Hexanone	BDL	2500
1,1,2,2-Tetrachloroethane	BDL	500
Tetrachloroethene	18000	500
Toluene	710	500
Chlorobenzene	BDL	500
Ethylbenzene	TRACE	500
m-Xylene	TRACE	500
o,p-Xylene	1100	500
Styrene	BDL	500

METHOD REFERENCE: EPA SW 846, 3rd Edition
METHOD 8240

BDL = Below detection limit

"TRACE" denotes probable presence below listed detection limit.

This sample required dilution to bring a high target analyte concentration into the calibration range.
Detection limits were elevated accordingly.

pace INCORPORATED
THE ASSURANCE OF QUALITY

Laboratory number: 33831 -002
Sample Designation: 33491-001
Date Extracted: 11/11/92
Date Analyzed: 11/19/92
Matrix: OIL

Instrument File Name: >F2386

Results are expressed on an as received basis.

ACID/BASE/NEUTRAL EXTRACTABLES	CONCENTRATION (ug/g)	DETECTION LIMIT (ug/g)
N-Nitrosodimethylamine	BDL	20
Phenol	BDL	20
Aniline	BDL	20
Bis(2-chloroethyl)ether	BDL	20
2-Chlorophenol	BDL	20
1,3-Dichlorobenzene	BDL	20
1,4-Dichlorobenzene	BDL	20
Benzylalcohol	BDL	20
1,2-Dichlorobenzene	BDL	20
2-Methylphenol	BDL	20
Bis(2-chloroisopropyl)ether	BDL	20
4-Methylphenol	BDL	20
N-Nitroso-di-N-propylamine	BDL	20
Hexachloroethane	BDL	20
Nitrobenzene	BDL	20
Isophorone	BDL	20
2-Nitrophenol	BDL	20
2,4-Dimethylphenol	BDL	20
Benzoic acid	BDL	100
Bis(2-chloroethoxy)methane	BDL	20
2,4-Dichlorophenol	BDL	20
1,2,4-Trichlorobenzene	TRACE	20
Naphthalene	BDL	20
4-Chloroaniline	BDL	20
Hexachlorobutadiene	BDL	20
4-Chloro-3-methylphenol	BDL	20
2-Methylnaphthalene	BDL	20
Hexachlorocyclopentadiene	BDL	20
2,4,6-Trichlorophenol	BDL	20
2,4,5-Trichlorophenol	BDL	100
2-Chloronaphthalene	BDL	20
2-Nitroaniline	BDL	100
Dimethylphthalate	BDL	20
Acenaphthylene	BDL	20
2,6-Dinitrotoluene	BDL	20

METHOD REFERENCE: EPA SW 846, 3rd Edition
METHOD 8270

ACID/BASE/NEUTRAL EXTRACTABLES	CONCENTRATION (ug/g)	DETECTION LIMIT (ug/g)
3-Nitroaniline	BDL	100
Acenaphthene	BDL	20
2,4-Dinitrophenol	BDL	100
4-Nitrophenol	BDL	100
Dibenzofuran	BDL	20
2,4-Dinitrotoluene	BDL	20
Diethylphthalate	BDL	20
4-Chlorophenyl-phenylether	BDL	20
Fluorene	BDL	20
4-Nitroaniline	BDL	100
4,6-Dinitro-2-methylphenol	BDL	100
N-Nitrosodiphenylamine	BDL	20
Azobenzene	BDL	20
4-Bromophenyl-phenylether	BDL	20
Hexachlorobenzene	BDL	20
Pentachlorophenol	BDL	20
Phenanthrene	BDL	20
Anthracene	BDL	20
Di-N-butylphthalate	BDL	20
Fluoranthene	BDL	20
Benzidine	BDL	100
Pyrene	BDL	20
Butylbenzylphthalate	BDL	20
3,3'-Dichlorobenzidine	BDL	40
Benzo(A)anthracene	BDL	20
Chrysene	BDL	20
Bis(2-ethylhexyl)phthalate	BDL	20
Di-N-octylphthalate	BDL	20
Benzo(B)fluoranthene	BDL	20
Benzo(K)fluoranthene	BDL	20
Benzo(A)pyrene	BDL	20
Ideno(1,2,3,-CD)pyrene	BDL	20
Dibenz(A,H)anthracene	BDL	20
Benzo(G,H,I)perylene	BDL	20

BDL = Below detection limit
"TRACE" denotes probable presence below listed detection limit.

Detection limit raised by the presence of non-listed compounds.

Laboratory Number:	33831-002
Sample Designation:	33491-001
Date Analyzed:	11/18/92
Matrix:	Oil

CARBON RANGE	CONCENTRATION (ug/g)
n-C_8 to n-C_{10}	3920
n-C_{11} to n-C_{13}	1360
n-C_{14} to n-C_{17}	21310
n-C_{18} to n-C_{21}	22830
n-C_{22} to n-C_{25}	15470
n-C_{26} to n-C_{29}	8290
n-C_{30} to n-C_{33}	4900

Results expressed on a weight as received basis.

METHOD REFERENCE: EPA SW-846, 3RD EDITION METHOD 8100 and ASTM D 3328-78

PCB (from CWM)

PCB-1242 140,000 ug/g

PCB-1254 20,000 ug/g

SAMPLE TABLE

CLIENT ID.	MATRIX	PACE #	PARAMETERS
AL-41	OIL	33831-001	ACID EXTRACTABLES BASE/NEUTRAL EXTRACTABLES PCBS PETROLEUM HYDROCARBONS BY GC GC/MS VOA
33491-001	OIL	33831-002	ACID EXTRACTABLES BASE/NEUTRAL EXTRACTABLES PETROLEUM HYDROCARBONS BY GC GC/MS VOA
33479	OIL	33831-003	ACID EXTRACTABLES BASE/NEUTRAL EXTRACTABLES PCBS PETROLEUM HYDROCARBONS BY GC

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SAMPLE TABLE

CLIENT ID.	MATRIX	PACE #	PARAMETERS
ENSR-2	WATER	33830-001	GC/MS VOA
		33830-002	ACID EXTRACTABLES
			BASE/NEUTRAL EXTRACTABLES
			PCBS
		33830-003	PETROLEUM HYDROCARBONS BY GC

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Sample 33479

Lab Id. 33831-003

003 on Map.

DEPARTMENT OF CIVIL ENGINEERING
ELLIS HALL

Queen's University
Kingston, Canada
K7L 3N6
Tel 613 545-2122
Fax 613 545-2128

December 23, 1992

Sample 003
on Map

Joseph Charbonnier
ENSR Consulting and Engineering
35 Nagog Park
Acton, MA

Dear Joseph:

I have completed the measurements of NAPL-water interfacial tension and NAPL density for the sample of oil obtained from the ReSolve Site. All measurements were completed at 20 degrees C. The interfacial tension measurements were performed using a platinum ring tensiometer with distilled, deionized water as the aqueous phase. Following are the results:

Interfacial Tension . . . 8.7 dynes/cm (average of 5 measurements, range 8.5-8.8 dynes/cm)

Density . . . . 1.025 grams/cc

As you will notice, the sample is a dense, non-aqueous phase liquid (DNAPL) since it is more dense than water, and because it is immiscible in water (finite interfacial tension).

I have retained the samples in my lab should we require them for future analysis. If you have any questions regarding the above measurements, please do not hesitate to give me a call at (613) 545-6834, or send a FAX to (613) 545-2128.

Sincerely yours,

Bernard H. Kueper, Ph.D., P.Eng.

Laboratory number: 33831 -003
Sample Designation: 33479
Date Extracted: 11/11/92
Date Analyzed: 11/18/92
Matrix: OIL

Instrument File Name: >F2380

Results expressed on an as received basis.

ACID/BASE/NEUTRAL EXTRACTABLES	CONCENTRATION (ug/g)	DETECTION LIMIT (ug/g)
N-Nitrosodimethylamine	BDL	10
Phenol	BDL	10
Aniline	BDL	10
Bis(2-chloroethyl)ether	BDL	10
2-Chlorophenol	BDL	10
1,3-Dichlorobenzene	BDL	10
1,4-Dichlorobenzene	BDL	10
Benzylalcohol	BDL	10
1,2-Dichlorobenzene	BDL	10
2-Methylphenol	BDL	10
Bis(2-chloroisopropyl)ether	BDL	10
4-Methylphenol	BDL	10
N-Nitroso-di-N-propylamine	BDL	10
Hexachloroethane	BDL	10
Nitrobenzene	BDL	10
Isophorone	BDL	10
2-Nitrophenol	BDL	10
2,4-Dimethylphenol	BDL	10
Benzoic acid	BDL	50
Bis(2-chloroethoxy)methane	BDL	10
2,4-Dichlorophenol	BDL	10
1,2,4-Trichlorobenzene	BDL	10
Naphthalene	BDL	10
4-Chloroaniline	BDL	10
Hexachlorobutadiene	BDL	10
4-Chloro-3-methylphenol	BDL	10
2-Methylnaphthalene	BDL	10
Hexachlorocyclopentadiene	BDL	10
2,4,6-Trichlorophenol	BDL	10
2,4,5-Trichlorophenol	BDL	50
2-Chloronaphthalene	BDL	10
2-Nitroaniline	BDL	50
Dimethylphthalate	BDL	10
Acenaphthylene	BDL	10
2,6-Dinitrotoluene	BDL	10

METHOD REFERENCE: EPA SW 846, 3rd Edition
METHOD 8270

BDL = Below detection limit

ACID/BASE/NEUTRAL EXTRACTABLES	CONCENTRATION (ug/g)	DETECTION LIMIT (ug/g)
3-Nitroaniline	BDL	50
Acenaphthene	BDL	10
2,4-Dinitrophenol	BDL	50
4-Nitrophenol	BDL	50
Dibenzofuran	BDL	10
2,4-Dinitrotoluene	BDL	10
Diethylphthalate	BDL	10
4-Chlorophenyl-phenylether	BDL	10
Fluorene	BDL	10
4-Nitroaniline	BDL	50
4,6-Dinitro-2-methylphenol	BDL	50
N-Nitrosodiphenylamine	BDL	10
Azobenzene	BDL	10
4-Bromophenyl-phenylether	BDL	10
Hexachlorobenzene	BDL	10
Pentachlorophenol	BDL	10
Phenanthrene	BDL	10
Anthracene	BDL	10
Di-N-butylphthalate	BDL	10
Fluoranthene	BDL	10
Benzidine	BDL	50
Pyrene	BDL	10
Butylbenzylphthalate	BDL	10
3,3'-Dichlorobenzidine	BDL	20
Benzo(A)anthracene	BDL	10
Chrysene	BDL	10
Bis(2-ethylhexyl)phthalate	BDL	10
Di-N-octylphthalate	BDL	10
Benzo(B)fluoranthene	BDL	10
Benzo(K)fluoranthene	BDL	10
Benzo(A)pyrene	BDL	10
Indeno(1,2,3,-CD)pyrene	BDL	10
Dibenz(A,H)anthracene	BDL	10
Benzo(G,H,I)perylene	BDL	10

pace INCORPORATED
THE ASSURANCE OF QUALITY

Laboratory number: 33831 -003
Sample Designation: 33479
Date Analyzed: 11/23/92
Matrix: OIL

PCB'S	CONCENTRATION (ug/g)	DETECTION LIMIT (ug/g)
PCB-1242	3800	500
PCB-1254	BDL	500
PCB-1221	BDL	500
PCB-1232	BDL	500
PCB-1248	BDL	500
PCB-1260	BDL	500
PCB-1016	BDL	500

METHOD REFERENCE: EPA SW846, 3RD EDITION
MODIFIED METHOD 3580 AND 8080

BDL = Below detection limit
This sample required dilution to bring a high target analyte concentration into the calibration range.
Detection limits were elevated accordingly.

pace. INCORPORATED THE ASSURANCE OF QUALITY

Laboratory Number: 33831-003
Sample Designation: 33479
Date Analyzed: 11/18/92
Matrix: Oil

CARBON RANGE	CONCENTRATION (ug/g)
n-C_8 to n-C_{10}	920
n-C_{11} to n-C_{13}	630
n-C_{14} to n-C_{17}	7910
n-C_{18} to n-C_{21}	8860
n-C_{22} to n-C_{25}	6420
n-C_{26} to n-C_{29}	3290
n-C_{30} to n-C_{33}	1970

Results expressed on a weight as received basis.

METHOD REFERENCE: EPA SW-846, 3RD EDITION METHOD 8100
and ASTM D 3328-78

pace. INCORPORATED
THE ASSURANCE OF QUALITY

RUST, ENSR AND EPA

ANALYTICAL RESULTS

FROM DNAPL WELLPOINT

FEBRUARY, 1994

(004 ON MAP)

CEIMIC CORPORATION

"Analytical Chemistry for Environmental Management"

TARGET COMPOUND LIST

VOLATILE ORGANICS

EPA Method 8240

DNAPL SAMPLE
(OILY LIQUID)
RUST SAMPLE
at Location 004

Client: Rust Remedial Services, Inc.

Client Sample ID: WP31203S

Laboratory ID: 930899-03
Oil Phase

Date Sample Received: 12/03/93

Date Sample Prepared: 12/03/93

Date Sample Analyzed: 12/03/93

Concentration in: µg/L (ppb)

Target Analyte	Sample Concentration	Method Reporting Limits
Chloromethane	ND	25,000,000
Bromomethane	ND	25,000,000
Vinyl chloride	ND	25,000,000
Chloroethane	ND	25,000,000
Methylene chloride	ND	12,500,000
Acetone	ND	25,000,000
Carbon disulfide	ND	12,500,000
1,1-Dichloroethene	ND	12,500,000
1,1-Dichloroethane	ND	12,500,000
1,2-Dichloroethene (total)	ND	12,500,000
Chloroform	ND	12,500,000
1,2-Dichloroethane	ND	12,500,000
2-Butanone	ND	25,000,000
1,1,1-Trichloroethane	14,000,000	12,500,000
Carbon tetrachloride	ND	12,500,000
Bromodichloromethane	ND	12,500,000
1,2-Dichloropropane	ND	12,500,000
cis-1,3-Dichloropropene	ND	12,500,000
Trichloroethene	570,000,000	12,500,000
Dibromochloromethane	ND	12,500,000
1,1,2-Trichloroethane	ND	12,500,000
Benzene	ND	12,500,000

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CEIMIC
CORPORATION
"Analytical Chemistry for Environmental Management"

TARGET COMPOUND LIST

VOLATILE ORGANICS

EPA Method 8240

DNAPL SAMPLE
(OILY LIQUID)
RUST SAMPLE

Client: Rust Remedial Services

Client Sample ID: WP31203S

Laboratory ID: 930899-03
Oil Phase

Target Analyte	Sample Concentration	Method Reporting Limits
trans-1,3-Dichloropropene	ND	12,500,000
Bromoform	ND	12,500,000
4-Methyl-2-pentanone	ND	25,000,000
2-Hexanone	ND	25,000,000
1,1,2,2-Tetrachloroethane	ND	12,500,000
Tetrachloroethene	130,000,000	12,500,000
Toluene	130,000,000	12,500,000
Chlorobenzene	ND	12,500,000
Ethyl benzene	20,000,000	12,500,000
Styrene	ND	12,500,000
Xylene (total)	85,000,000	12,500,000

ND = Not detected

Reported by: LDF

Approved by: [illegible]

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CEIMIC
CORPORATION

"Analytical Chemistry for Environmental Management"

POLYCHLORINATED BIPHENYL (PCBs)
EPA Method 608/8080

PCB Data
(OILY LIQUID)
RUST SAMPLE

Client: Rust Remedial Services Inc.
Date Sample Received: 12/03/93
Date Sample Analyzed: 12/03/93

Date Sample Prepared: 12/03/93
Concentration in: µg/L (ppb)

Client Sample ID Laboratory ID	Method Blank P1203-B2		Laboratory Control Spike P1203-LCS2		WP31203NS Aqueous Phase 930899-02		WP31203NS Oil Phase 930899-02	
Target Analyte	µg/L	MRL	µg/L	MRL	µg/L	MRL	µg/L	MRL
Aroclor-1016	ND	50	ND	50	ND	500	ND	500
Aroclor-1221	ND	100	ND	100	ND	1,000	ND	1,000
Aroclor-1232	ND	50	ND	50	ND	500	ND	500
Aroclor-1242	ND	50	ND	50	10,400	5,000	96,000,000	10,000,000
Aroclor-1248	ND	50	270	50	ND	500	ND	500
Aroclor-1254	ND	50	ND	50	2,500	500	26,000,000	10,000,000
Aroclor-1260	ND	50	ND	50	ND	500	ND	500
QA/QC Recoveries %								
TCX (surrogate)	93%		107%		117%		68%	
DCB (surrogate)	92%		98%		117%		Coelution	
Aroclor-1248 (spike)	NA		108%		NA		NA	

ND = Not Detected
NA = Not Applicable

Reported by HL

Approved by: [signature]

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Inchcape Testing Services
Aquatec Laboratories

Laboratory Locations
55 South Park Drive
Colchester, VT 05446

75 Green Mountain Drive
South Burlington, VT 05403

150 Herman Melville Boulevard
New Bedford, MA 02740

Analytical Report

ENSR Consulting & Engineering
35 Nagog Park
Acton, MA 01720

Attention : Joe Charbonnier

Date : 03/24/94
ETR Number : 42793
Project No.: 92027
No. Samples: 4
Arrived : 03/08/94
P.O. Number: 5681-015-863

Standard analyses were performed in accordance with Methods for Analysis of Water and Wastes, EPA-600/4/79-020, Test Methods for Evaluating Solid Waste, SW-846, or Standard Methods for the Examination of Water and Wastewater. All results are in mg/l unless otherwise noted.

Lab No./ Method No.	Sample Description/ Parameter	Result
213529	1,2,3 Composite:(DNAPL)	
8080_PCB	Aroclor 1016	10000 U e
8080_PCB	Aroclor 1221	10000 U e
8080_PCB	Aroclor 1232	10000 U e
8080_PCB	Aroclor 1242	110000 e
8080_PCB	Aroclor 1248	10000 U e
8080_PCB	Aroclor 1254	21000 e
8080_PCB	Aroclor 1260	10000 U e

ENSR SAMPLE at Location
2-24-94 004 on Map

Comments/Notes

e = mg/Kg as received

< Last Page > Submitted By : Karen R. Chiguri Aquatec Inc.

Inchcape Testing Services
Aquatec Laboratories

Laboratory Locations
55 South Park Drive
Colchester, VT 05446

75 Green Mountain Drive
South Burlington, VT 05403

150 Herman Melville Boulevard
New Bedford, MA 02740

Analytical Report

ENSR SAMPLE
2-24-94 004 on NOP

Date: 23 March 1994
Aquatec Lab No.: 213529
ETR No.: 42793, Project No.: 92027
Sample Received On: 08 March 1994; Analyzed On: 16 March 1994
Sample Identification: ENSR Consulting & Engineering, composite of the non-aqueous phase of three samples collected 02/25/94.

Volatile Organic Compounds in mg/l
EPA Method 8240

benzene	1000 U	chloromethane	2000 U
carbon tetrachloride	1000 U	bromomethane	2000 U
chlorobenzene	1000 U	bromoform	1000 U
1,2-dichloroethane	1000 U	bromodichloromethane	1000 U
1,1,1-trichloroethane	770J	dibromochloromethane	1000 U
1,1-dichloroethane	1000 U	tetrachloroethene	9600
1,1,2-trichloroethane	1000 U	toluene	8300
1,1,2,2-tetrachloroethane	1000 U	trichloroethene	44000
chloroethane	2000 U	vinyl chloride	2000 U
chloroform	1000 U	acetone	2000 U
1,1-dichloroethene	1000 U	2-butanone	2000 U
1,2-dichloroethenes	1000 U	carbon disulfide	1000 U
1,2-dichloropropane	1000 U	2-hexanone	2000 U
trans-1,3-dichloropropene	1000 U	4-methyl-2-pentanone	2000 U
cis-1,3-dichloropropene	1000 U	styrene	1000 U
ethylbenzene	1600	vinyl acetate	2000 U
methylene chloride	1000 U	total xylenes	5800

The composite sample was diluted 200,000 fold for analysis; results are in mg/l.

Key to the letters used to qualify the results of the analysis:

U - The compound was analyzed for but not detected. The number is the method specified reporting limit.

J - The mass spectrum indicates the presence of the compound, but the calculated result is less than the method specified reporting limit.

LCB - Compound was found but at low concentration, comparable to that in the blank. Quantitation is not possible.

C - The result has been corrected for the presence of the compound in the blank.

Quality controls were analyzed with the sample as part of Aquatec's standard analytical procedures. The results of these are maintained on file at Aquatec.

DNAPL WELLPOINT
EPA SAMPLE (12/20/93)

004 a
(1st sample at location 004)

VOLATILE ANALYSIS IN OIL (ug/kg)
SITE: RE-SOLVE INC.
CASE: 00090 SAS 7555HQ SDG: QA0675

SAMPLE LOCATION: RS-WELLPT1220
SAMPLE NUMBER: QA0675
QC DESIGNATION: CRQL

VINYL CHLORIDE	400	40000 U
1,1-DICHLOROETHENE	400	33000 J
trans-1,2-DICHLOROETHENE	400	40000 U
1,1-DICHLOROETHANE	400	40000 U
cis-1,2-DICHLOROETHENE	400	30000 J
CHLOROFORM	400	3800 J
1,1,1-TRICHLOROETHANE	400	4600000 J
CARBON TETRACHLORIDE	400	40000 U
BENZENE	400	28000 J
1,2-DICHLOROETHANE	400	40000 U
TRICHLOROETHENE	400	2400000 J
BROMODICHLOROMETHANE	400	40000 U
TOLUENE	400	26000000 J
TETRACHLOROETHENE	400	36000000 J
CHLOROBENZENE	400	40000 U
1,1,2,2-TETRACHLOROETHANE	400	40000 U
ETHYLBENZENE	400	5100000 J
BROMOFORM	400	40000 U
m,p-XYLENE	400	14000000 J
o-XYLENE	400	3500000 J

DILUTION FACTOR: 100
DATE SAMPLED: 12/20/93
DATE ANALYZED: 12/24/93

DNAPL WELLPOINT
EPA SAMPLE (12/20/93)

PCB ANALYSIS IN OIL (ug/kg)
SITE: RE-SOLVE INC.
CASE: Q0090 SAS 7555HQ SDG: QA0675

SAMPLE LOCATION: RS-WELLPT1220
SAMPLE NUMBER: QA0675
QC DESIGNATION: CRQL

TOXAPHENE	5000	10000000 U
AROCLOR 1016	1000	36000000
AROCLOR 1221	2000	4000000 U
AROCLOR 1232	1000	2000000 U
AROCLOR 1242	1000	2000000 U
AROCLOR 1248	1000	2000000 U
AROCLOR 1254	1000	2000000 U
AROCLOR 1260	1000	2000000 U

DILUTION FACTOR: 2000
DATE SAMPLED: 12/20/93
DATE EXTRACTED: 12/22/93
DATE ANALYZED: 12/27/93

ENVR

QUEEN'S UNIVERSITY
COMMERCIAL TESTING RESULTS

Sample 004
RUST 12/93 Sample

DATE: May 5, 1994

SAMPLES: ReSolve DNAPL

TESTS PERFORMED BY: Richard Morrison
Department of Civil Engineering

SAMPLE: DNAPL wellpoint collected 12/3/93 by RRS

DNAPL-water interfacial tension measured using ring tensiometer (ASTM D971); triplicate average . . . . 11.9 dynes/cm

Sample color . . . . Dark brown

Density . . . . 1.185 g/cc

Viscosity measured using Cannon Fenske Routine Viscometer 25 (#294) at 23.5 C; triplicate average . . . . 1.024 centistokes

Dr. B.H. Kueper, P.Eng.

QUEEN'S UNIVERSITY
COMMERCIAL TESTING RESULTS

ENSR
Sample 004
(on Map)
(second sample
of location 004)

DATE: May 5, 1994

SAMPLES: ReSolve DNAPL

TESTS PERFORMED BY: Dr. B.H. Kueper, P.Eng.

SAMPLE 1 (sampled 2/25/94)

DNAPL-water interfacial tension measured using ring tensiometer (ASTM D971) . . . . 12.1 dynes/cm

Sample color . . . . Dark brown

Density . . . . 1.2 g/cc

ANALYTICAL RESULTS

OF DNAPL SAMPLE

FROM SCR EXCAVATION

APRIL, 1994

(005 ON MAP)

QUEEN'S UNIVERSITY
COMMERCIAL TESTING RESULTS

ENSR
Sample 005
(on Map)

DATE: May 5, 1994

SAMPLES: ReSolve DNAPL

TESTS PERFORMED BY: Dr. B.H. Kueper, P.Eng.

SAMPLE 2 (dated 4/6/94)

DNAPL-water interfacial tension measured using ring
tensiometer (ASTM D971) . . . . 7.5 dynes/cm

Sample color . . . . Amber

Density 1.23

B.H. Kueper

Inchcape Testing Services
Aquatec Laboratories

Laboratory Locations
55 South Park Drive
Colchester, VT 05446

75 Green Mountain Drive
South Burlington, VT 05403

150 Herman Melville Boulevard
New Bedford, MA 02740

Analytical Report

Date: 11 May 1994
Aquatec Lab No.: 218837
ETR No.: 43729, Project No.: 92027
Sample Received On: 22 April 1994; Analyzed On: 05 May 1994
Sample Identification: ENSR Consulting & Engineering, composite of two DNAPL samples labeled Block AI-50, 04/06/94. 005 En Mo

Volatile Organic Compounds in mg/Kg as Received
EPA Method 8240

benzene	25000 U	chloromethane	50000 U
carbon tetrachloride	25000 U	bromomethane	50000 U
chlorobenzene	25000 U	bromoform	25000 U
1,2-dichloroethane	25000 U	bromodichloromethane	25000 U
1,1,1-trichloroethane	40000	dibromochloromethane	25000 U
1,1-dichloroethane	25000 U	tetrachloroethene	520000
1,1,2-trichloroethane	25000 U	toluene	130000
1,1,2,2-tetrachloroethane	25000 U	trichloroethene	100000
chloroethane	50000 U	vinyl chloride	50000 U
chloroform	25000 U	acetone	50000 U
1,1-dichloroethene	25000 U	2-butanone	50000 U
1,2-dichloroethenes	25000 U	carbon disulfide	25000 U
1,2-dichloropropane	25000 U	2-hexanone	50000 U
trans-1,3-dichloropropene	25000 U	4-methyl-2-pentanone	50000 U
cis-1,3-dichloropropene	25000 U	styrene	25000 U
ethylbenzene	25000 U	vinyl acetate	50000 U
methylene chloride	25000 U	total xylenes	40000

The sample was diluted 5,000,000 fold for analysis. Results are in mg/Kg (ppm).

Key to the letters used to qualify the results of the analysis:

U - The compound was analyzed for but not detected. The number is the method specified reporting limit.

J - The mass spectrum indicates the presence of the compound, but the calculated result is less than the method specified reporting limit.

LCB - Compound was found but at low concentration, comparable to that in the blank. Quantitation is not possible.

C - The result has been corrected for the presence of the compound in the blank.

Quality controls were analyzed with the sample as part of Aquatec's standard analytical procedures. The results of these are maintained on file at Aquatec.

Inchcape Testing Services
Aquatec Laboratories

Laboratory Locations
55 South Park Drive
Colchester, VT 05446

75 Green Mountain Drive
South Burlington, VT 05403

150 Herman Melville Boulevard
New Bedford, MA 02740

Analytical Report

ENSR Consulting & Engineering
35 Nagog Park
Acton, MA 01720

Attention : Joe Charbonnier

Date : 05/26/94
ETR Number : 43729
Project No.: 92027
No. Samples: 9
Arrived : 04/22/94
P.O. Number: *

Job:5681-015-863

Standard analyses were performed in accordance with Methods for Analysis of Water and Wastes, EPA-600/4/79-020, Test Methods for Evaluating Solid Waste, SW-846, or Standard Methods for the Examination of Water and Wastewater. All results are in mg/l unless otherwise noted.

Lab No./ Method No.	Sample Description/ Parameter		Result
218837	Block AI-50 composite:(DNAPL)	005 (on Map)	
8080_PCB	Aroclor 1016		<50 e
8080_PCB	Aroclor 1221		<50 e
8080_PCB	Aroclor 1232		<50 e
8080_PCB	Aroclor 1242		330 e
8080_PCB	Aroclor 1248		<50 e
8080_PCB	Aroclor 1254		49J e
8080_PCB	Aroclor 1260		<50 e
218840	Wellpoint 1 composite:(DNAPL)	004 (on Map)	
8080_PCB	Aroclor 1016		<20000 e
8080_PCB	Aroclor 1221		<20000 e
8080_PCB	Aroclor 1232		<20000 e
8080_PCB	Aroclor 1242		120000 e
8080_PCB	Aroclor 1248		<20000 e
8080_PCB	Aroclor 1254		24000 e
8080_PCB	Aroclor 1260		<20000 e
218843	Wellpoint 2 composite:(DNAPL)	004 on map (resampled)	
8080_PCB	Aroclor 1016		<20000 e
8080_PCB	Aroclor 1221		<20000 e
8080_PCB	Aroclor 1232		<20000 e
8080_PCB	Aroclor 1242		100000 e

Comments/Notes

e = mg/Kg as received
J = Compound reported at an estimated concentration less than the adjusted quantitation limit.
For Lab No. 218837, Aroclor 1254 quantitation limit is 50 mg/kg.

< Cont. Next Page >

Inchcape Testing Services
Aquatec Laboratories

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Lab No./ Method No.	Sample Description/ Parameter		Result
218843	Wellpoint 2 composite:(DNAPL)		
8080_PCB	Aroclor 1248	004 on Map	<20000 e
8080_PCB	Aroclor 1254	(resampled)	20000 e
8080_PCB	Aroclor 1260		<20000 e

Comments/Notes

e = mg/Kg as received

< Last Page >   Submitted By : R. Mason McNeer   Aquatec Inc.

Appendix J

APPENDIX J

EPA'S OCTOBER 13, 1992 LETTER

PROJECT FILE COPY
EPA Misc. Corresp.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION I

J.F. KENNEDY FEDERAL BUILDING, BOSTON, MASSACHUSETTS 02203-2211

RECEIVED
OCT 19 1992
By 7MCa

October 13, 1992

Michael Worthy
ENSR Consulting and Engineering
35 Nagog Park
Acton, MA 01720

Ref: Re-Solve, Inc. Superfund Site: NPDES Equivalency Requirements for Source Control Remedy (SCR) and Management of Migration (MOM) Full-Scale Remediation Activities

Dear Mr. Worthy:

The purpose of this letter is to transmit a list of NPDES equivalency requirements that must be complied with for the upcoming SCR and MOM full-scale remediation activities. Please see Attachment A for these NPDES equivalency requirements.

Many of these NPDES equivalency requirements have already been provided to you and have been complied with for the previous MOM and SCR temporary pilot test activities by the respective contractors. Now that the full-scale remediation activities, especially the SCR, are within sight, EPA is providing the attached list of substantive NPDES requirements to be complied with for the upcoming full-scale remediation activities. For example, two of the NPDES requirements that have yet to be complied with are the performance of bioassays or the effluent toxicity testing, and setting of monthly discharge limitations. These requirements were not imposed on the previous MOM and SCR pilot test activities due to the temporary nature of those activities.

If you have any questions, please contact me at (617) 223-5500.

Sincerely,

Lorenzo Thantu

Lorenzo Thantu
Remedial Project Manager

Attachments

cc: Richard Cavagnero, EPA
Phoebe Call, BEI
Debra Darby, DEP
Michael Last, Mintz Levin
Steve Mangion, EPA
David Pincumbe, EPA
Lorenzo Thantu, EPA

ATTACHMENT A

NPDES EQUIVALENCY REQUIREMENTS FOR SOURCE CONTROL REMEDY (SCR)
AND MANAGEMENT OF MIGRATION (MOM)
RESOLVE SUPERFUND SITE
NORTH DARTMOUTH, MA

1) For Source Control Remedy full-scale remediation, effluent samples must be collected daily for the first two weeks of start-up for complete analysis of parameters provided in Table 5 of Chemical Waste Management, Inc.'s (CWM's) December 23, 1991 Wastewater Treatment System Permit Equivalency Submittal; and weekly thereafter for the analysis for indicator chemicals provided in Section 4.6.2, page 16, of the document, referenced above. If after examination of the results of the above weekly monitoring of contaminants there is a change in discharge conditions or change in trend of the concentrations, EPA will re-evaluate the performance of the system and the frequency for sampling. In addition, subsequent to the start-up of the treatment system, a complete analysis of parameters provided in Table 5 of the document, referenced above, will be conducted monthly. (Note: CWM's December 23, 1991 Wastewater Treatment System Permit Equivalency Submittal was approved by EPA in a letter dated January 6, 1992.)

For Management of Migration full-scale remediation, effluent samples must be collected daily for the first two weeks of start-up, and weekly for the first three months for the chemicals of interest. After three months EPA will evaluate the performance of the system and re-evaluate the frequency for sampling. Semi-annual analysis of contaminants on the TCL/TAL list would be required. The use of method 524.2 is acceptable for the VOAs. For TCL/TAL contaminants not covered by method 524.2, EPA reference methods that correspond with the lower detection limits for each chemical listed on the February 25, 1991 "criteria chart" should be used. The February 25, 1991 "criteria chart" set forth federal ambient water quality criteria (AWQC) for toxic pollutants and was provided to ENSR and to Chemical Waste Management, Inc. in the fall of 1991.

2) Bioassays or the effluent toxicity testing should be conducted semi-annually. The first of the semi-annually effluent toxicity testing will be conducted prior to the commencement of the full-scale remediation. Both "acute" and "chronic" effluent toxicity testing would be required. **Attachment B** provides "chronic" toxicity test procedures and protocol for Daphnid (Ceriodaphnia dubia) and the Fathead Minnow (Pimephales promelas). **Attachment C** provides 48-hour "acute" toxicity test procedures and protocol for Daphnids (Ceriodaphnia dubia and Daphnia pulex) and the Fathead Minnow (Pimephales promelas).

Please note that if after examination of the results of the periodic monitoring of contaminants there is a change in discharge conditions, EPA may increase the frequency of toxicity testing from semi-annually. If after examination of

the results of the periodic monitoring of contaminants there is no change in discharge conditions and the results of the semi-annual toxicity testing show no toxic effects on the organisms, EPA may reduce the frequency of toxicity testing from semi-annual to annual.

3) Data results for effluent must be made available to the Agencies within a week's time.

4) There will be two discharge limits that will have to be met by the treatment system: daily and monthly discharge limitations. The monthly or the 30-day discharge limit will be based on the chronic AWQC and the dilution factor; and the daily (maximum) discharge limit will be based on the acute AWQC and the dilution factor.

Please note that there will be cases where the treatment system will be able to treat certain contaminants to levels well below the limitations derived based on the previous approach. In these cases, the lower limits will be used as the final discharge limits. This is consistent with EPA's policy which selects the lowest of the two limits, one based on the Best Available Technology economically achievable (BAT) and the other based on the dilution factor approach, as the final discharge limitation.

5) It is recommended that site specific hardness data be used or in the absence of site specific data that 50 mg/l be used.

6) Limits based on aquatic life protection should be developed using the 7Q10 flow of the Copicut River for dilution. A 1984 USGS Gazetteer estimates the drainage area of the Copicut River near Hixville to be approximately 8.68 square miles. For a drainage area of this type and this size, a 7Q10 flowrate of approximately 1.6 cfs would be estimated and should be used. The equivalent of the 1.6 cfs in gpm would be 718 gpm.

Therefore, the flowrate of 718 gpm should be used to compute the discharge limitations for the organics and inorganics (metals). Based on this 718 gpm flowrate, the dilution factor would be ≈ 8.0.

Please note that the methodology, provided above, for computation of organic and inorganic discharge limitations would be used for discharge of all treated effluent from the Source Control full-scale operation of the Water Treatment Plant. CWM has been permitted to discharge all of the treated effluent from the Water Treatment Plant to the Copicut river. However, with respect to the full-scale MOM remediation, EPA does <u>not</u> believe that one hundred per cent off-site discharge of treated effluent to a surface water body is a likely outcome. Some water must be injected in a way that promotes flushing of the disposal site; "flushing" is considered a design goal for at least part of the treated effluent. For more specific details, please see EPA's October 1, 1992 letter from Lorenzo Thantu of EPA to Michael Last of Mintz, Levin, Cohn, Ferris, Glovsky & Popeo. That October 1, 1992 letter formally disapproved the ReSolve Site Group's August 14, 1992 MOM Remedial Design Work Plan.

7) Limits should also be developed using the human health criteria for fish consumption or the human health criteria for water and fish consumption if the Copicut River is used for drinking water. When developing limits based on human health criteria dilution should be based on the average annual river flow for carcinogens and on the 7Q10 flow for noncarcinogens. The more stringent of the two sets of limits developed (aquatic life or human health) should be met. Also, for carcinogens the EPA recommended risk factor of 0.000001 should be used.

MSS I:MWMB:WMD:RO I:L.THANTU:LT:DISK "C":RESOLVE\WORTHY27.LTR

Appendix K

APPENDIX K
CAPITAL AND OPERATING COST BACKUP

08:01 AM

METCALF & EDDY, INC.
60% DESIGN COST ESTIMATE

JOB NO : 004907-0004-001
DATE : June, 1994
LOCATION : Wakefield, MA
PREPARED BY: M&E

CLIENT : Resolve Site Group
PROJECT : Resolve
ACCURACY: ± 20 %

GRAND SUMMARY

ACCOUNT	DESCRIPTION		MANHOURS	MATERIAL	LABOR	EQUIPMENT	TOTAL
2.	SITE WORK		2,141	$142,885	$81,364	$0	$224,249
3.	FOUNDATIONS & CONCRETE		105	$3,401	$3,997	$0	$7,399
5.	METALS		339	$14,272	$12,897	$1,843	$29,012
6.	WOOD & PLASTICS		50	$61	$1,900	$0	$1,961
7.	MOISTURE THERMAL PROTECTION		387	$66,606	$14,717	$382	$81,706
8.	DOORS, WINDOWS & GLASS		68	$12,162	$2,584	$0	$14,746
9.	FINISHES		380	$13,956	$14,447	$0	$28,402
10.	SPECIALTIES		7	$1,401	$270	$0	$1,671
11.	EQUIPMENT		1,476	$536,529	$56,088	$0	$592,617
12.	FURNISHINGS		4	$500	$152	$40	$692
13.	INSTRUMENTATION		1,169	$180,170	$44,422	$0	$224,592
15 b.	PLUMBING		108	$8,293	$4,108	$0	$12,401
15 c.	HVAC		226	$18,878	$8,584	$7	$27,470
15 d.	PROCESS PIPE		1,004	$22,560	$38,158	$0	$60,718
16.	ELECTRICAL		1,596	$91,670	$60,637	$0	$152,307
	SUBTOTAL DIRECT COSTS		9,061	$1,113,344	$344,325	$2,273	$1,459,941
	CONTRACTOR OVERHEAD & PROFIT	17.00%					$248,190
	SUBTOTAL						$1,708,131
	CONTINGENCY	15.00%					$256,220
	SUBTOTAL DIRECT & INDIRECT COSTS						**$1,964,351**

08:01 AM
JOB # 004907-0004-001
DATE June, 1994
LOCATION Wakefield, MA
PREPARED BY M&E

METCALF & EDDY ENGINEERS
60% DESIGN COST ESTIMATE

CLIENT : Resolve Site Group
PROJECT : Resolve
ACCURACY: ± 20 %

ACCOUNT NO.	DESCRIPTION	QUANTITY	UN	MANHOURS MHR/UNIT	TOTAL MH	MATERIAL UNIT COST	TOTAL MATL	LABOR WAGE RATE	TOTAL LABOR	EQUIPMENT UNIT RATE	TOTAL EQUIP	TOTAL DIRECT COST
-2-	SITE WORK											
	Site Grading & Restoration	1	LS	100.00	100	5,000.00	5,000	$38.00	3,800		0	$8,800
	Propane Tank	1	EA	20.00	20	33,000.00	33,000	$38.00	760		0	$33,760
	Miscellaneous – piping, pads, road	1	LS	200.00	200	60,000.00	60,000	$38.00	7,600		0	$67,600
	Ductbank 3 Horizontal 3"	50	LF	0.65	33	15.40	770	$38.00	1,235		0	$2,005
	Wooden Pole 40' w/HPS Fixture	5	EA	20.00	100	1,200.00	6,000	$38.00	3,800		0	$9,800
	Cable No. 2 15KV	1,350	LF	0.02	27	2.40	3,240	$38.00	1,026		0	$4,266
	Cable No. 12	900	LF	0.08	72	0.01	9	$38.00	2,736		0	$2,745
	Terminations	6	EA	0.45	3	5.80	35	$38.00	103		0	$137
	WELLS/PUMPS											
	Recovery Wells in Overburden	180	LF	2.25	405	50.00	9,000	$38.00	15,390		0	$24,390
	Submersible Pumps	8	EA	6.00	48	1,200.00	9,600	$38.00	1,824		0	$11,424
	Monitoring Wells in Overburden	180	LF	2.25	405	50.00	9,000	$38.00	15,390		0	$24,390
	Monitoring Wells in Bedrock	60	LF	3.00	180	50.00	3,000	$38.00	6,840		0	$9,840
	Trenching For Electrical	900	LF	0.05	45	0.00	0	$38.00	1,710		0	$1,710
	Conduit 1" RGS	900	LF	0.11	99	2.52	2,268	$38.00	3,762		0	$6,030
	Cable No. 12	2,700	LF	0.01	27	0.08	216	$38.00	1,026		0	$1,242
	Cable 2/0 No. 16	900	LF	0.01	9	0.25	225	$38.00	342		0	$567
	Terminations	80	EA	0.20	16	0.40	32	$38.00	608		0	$640
	PIPING											
	Trenching for Piping	1,200	LF	0.05	60	0.00	0	$38.00	2,280		0	$2,280
	HDPE Pipe 3"	320	LF	0.32	102	2.32	742	$38.00	3,891		0	$4,634
	HDPE Pipe 2"	300	LF	0.29	87	1.06	318	$38.00	3,306		0	$3,624
	HDPE Pipe 1"	500	LF	0.18	90	0.39	195	$38.00	3,420		0	$3,615
	Elbow 90° 3"	1	EA	1.14	1	27.00	27	$38.00	43		0	$70
	Elbow 90° 1"	2	EA	0.53	1	7.60	15	$38.00	40		0	$55
	Elbow 45° 3"	2	EA	1.14	2	27.00	54	$38.00	87		0	$141
	Elbow 45° 2"	1	EA	0.73	1	34.30	34	$38.00	28		0	$62
	Elbow 45° 1"	2	EA	0.53	1	7.60	15	$38.00	40		0	$55
	TEE 2"x2"x2"	2	EA	1.14	2	14.70	29	$38.00	87		0	$116
	TEE 2"x2"x1"	2	EA	1.14	2	14.70	29	$38.00	87		0	$116
	TEE 2"x1"x1"	1	EA	1.14	1	14.70	15	$38.00	43		0	$58
	TEE 1"x1"x1"	2	EA	0.80	2	7.60	15	$38.00	61		0	$76
	SUBTOTAL SITE WORK				2,141		142,885		81,364		0	$224,249

08:01 AM
JOB # 004907-0004-001
DATE June, 1994
LOCATION Wakefield, MA
PREPARED BY M&E

METCALF & EDDY ENGINEERS
60% DESIGN COST ESTIMATE

CLIENT : Resolve Site Group
PROJECT : Resolve
ACCURACY: ± 20 %

ACCOUNT NO.	DESCRIPTION	QUANTITY	UN	MANHOURS MHR/ UNIT	TOTAL MH	MATERIAL UNIT COST	TOTAL MATL	LABOR WAGE RATE	TOTAL LABOR	EQUIPMENT UNIT RATE	TOTAL EQUIP	TOTAL DIRECT COST
-3-	FOUNDATIONS & CONCRETE											
	Propane Tank Foundation	17	CY	4.00	66	140.00	2,323	$38.00	2,522		0	$4,845
	Miscellaneous Small Pads (Interior)	4	CY	6.00	24	140.00	560	$38.00	912		0	$1,472
	Propane Tank Pad	4	CY	4.00	15	140.00	519	$38.00	563		0	$1,081
	SUBTOTAL FOUNDATIONS & CONCRETE				105		3,401		3,997		0	$7,399
-5-	METALS											
	Aluminum Grating	170	SF	0.12	20	17.20	2,924	$38.00	775	1.39	236	$3,936
	Aluminum Stair Treads	12	EA	0.50	6	20.00	240	$38.00	228	1.39	17	$485
	Aluminum Railing	65	LF	0.20	13	55.50	3,608	$38.00	494	1.39	90	$4,192
	Building Frame	1	LS	300.00	300	7,500.00	7,500	$38.00	11,400	1,500.00	1,500	$20,400
	SUBTOTAL METALS				339		14,272		12,897		1,843	$29,012
-6-	WOODS & PLASTICS											
	Treated Wood Blocking	100	BF	0.50	50	0.61	61	$38.00	1,900	0.00	0	$1,961
	SUBTOTAL WOODS & PLASTICS				50		61		1,900		0	$1,961

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-7-	MOISTURE & THERMAL PROTECTION											
	Insulated Metal Roof	6,400	SF	0.03	166	5.50	35,200	$38.00	6,323	0.03	192	$41,715
	Insulated Metal Siding	6,347	SF	0.03	203	4.90	31,098	$38.00	7,717	0.03	190	$39,006
	Gutter (Aluminum)	160	LF	0.06	10	1.00	160	$38.00	365	0.00	0	$525
	Downspouts	80	LF	0.04	3	0.60	48	$38.00	122	0.00	0	$170
	Caulking & Sealants	1	LS	5.00	5	100.00	100	$38.00	190	0.00	0	$290
	SUBTOTAL MOISTURE & THERMAL PROTECTION				387		66,606		14,717		382	$81,706
-8-	DOORS, WINDOWS, GLASS											
	Door, Hollow Metal 3' x 7' Type F	3	EA	1.00	3	225.00	675	$38.00	114	0.00	0	$789
	Door, Hollow Metal 3' x 7' Type G	1	EA	1.00	1	275.00	275	$38.00	38	0.00	0	$313
	Door, Roll-Up 14' x 16' Type R	1	EA	18.00	18	4,500.00	4,500	$38.00	684	0.00	0	$5,184
	Door, Roll-Up 16' x 16' Type R	1	EA	18.00	18	5,000.00	5,000	$38.00	684	0.00	0	$5,684
	Hardware Set Type F Doors	3	EA	1.00	3	178.00	534	$38.00	114	0.00	0	$648
	Hardware Set Type G Doors	1	EA	1.00	1	178.00	178	$38.00	38	0.00	0	$216
	Hardware Set Type R Doors	2	EA	12.00	24	500.00	1,000	$38.00	912	0.00	0	$1,912
	SUBTOTAL DOORS, WINDOWS, GLASS				68		12,162		2,584		0	$14,746
-9-	FINISHES											
	Paint, Doors	1,128	SF	0.01	10	0.34	384	$38.00	384	0.00	0	$767
	Paint Partition Walls	2,436	SF	0.04	106	2.00	4,872	$38.00	4,019	0.00	0	$8,891
	Ceiling Suspended Accoustic	500	SF	0.03	15	1.00	500	$38.00	575	0.00	0	$1,075
	Vinyl Wall Base	75	LF	0.02	2	0.80	60	$38.00	62	0.00	0	$122
	Dustproof Protective Coating	6,400	SF	0.03	185	1.00	6,400	$38.00	7,040	0.00	0	$13,440
	Gypsum Board/Metal Studs/Insulation	1,160	SF	0.05	62	1.50	1,740	$38.00	2,366	0.00	0	$4,106
	SUBTOTAL FINISHES				380		13,956		14,447		0	$28,402

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ACCOUNT NO.	DESCRIPTION	QUANTITY	UN	MANHOURS MHR/ UNIT	TOTAL MH	MATERIAL UNIT COST	TOTAL MATL	LABOR WAGE RATE	TOTAL LABOR	EQUIPMENT UNIT RATE	TOTAL EQUIP	TOTAL DIRECT COST
-10-	SPECIALTIES											
	Mirror	1	EA	0.40	0	150.00	150	$38.00	15	0.00	0	$165
	Soap Dispenser	1	EA	0.20	0	50.00	50	$38.00	8	0.00	0	$58
	Towel Dispenser	1	EA	0.30	0	130.00	130	$38.00	11	0.00	0	$141
	Waste Receptacle	1	EA	0.00	0	50.00	50	$38.00	0	0.00	0	$50
	Sanitary Napkin Dispenser	1	EA	0.30	0	200.00	200	$38.00	11	0.00	0	$211
	Robe Hook	1	EA	0.30	0	6.00	6	$38.00	11	0.00	0	$17
	Safety First Aid Equipment	1	LS	2.00	2	500.00	500	$38.00	76	0.00	0	$576
	Interior Signs	1	LS	2.00	2	150.00	150	$38.00	76	0.00	0	$226
	Fixed Louver 4' x 4'	1	EA	0.80	1	75.00	75	$38.00	30	0.00	0	$105
	Fixed Louver 2'8" x 2'8"	1	EA	0.40	0	50.00	50	$38.00	15	0.00	0	$65
	Fixed Louver 2'4" x 2'2"	1	EA	0.40	0	40.00	40	$38.00	15	0.00	0	$55
	SUBTOTAL SPECIALTIES				7		1,401		270		0	$1,671

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ACCURACY: ± 20 %

ACCOUNT NO.	DESCRIPTION	QUANTITY	UN	MANHOURS		MATERIAL		LABOR		EQUIPMENT		TOTAL DIRECT COST
				MHR/ UNIT	TOTAL MH	UNIT COST	TOTAL MATL	WAGE RATE	TOTAL LABOR	UNIT RATE	TOTAL EQUIP	
-11-	EQUIPMENT											
	Air stripper	1	EA	80.00	80	27,333.00	27,333	$38.00	3,040		0	$30,373
	Filter Press	1	EA	80.00	80	29,525.00	29,525	$38.00	3,040		0	$32,565
	Inclined Plate Clarifier	1	EA	100.00	100	24,000.00	24,000	$38.00	3,800		0	$27,800
	Greensand Filtration Units	3	EA	20.00	60	11,837.00	35,511	$38.00	2,280		0	$37,791
	Catalytic Oxidation Unit	1	EA	60.00	60	125,000.00	125,000	$38.00	2,280		0	$127,280
AC-1	Air Compressor	1	EA	24.00	24	14,000.00	14,000	$38.00	912		0	$14,912
B-1	Aeration Tank Blower	1	EA	20.00	20	3,000.00	3,000	$38.00	760		0	$3,760
	Polymer Feed System	1	EA	10.00	10	8,300.00	8,300	$38.00	380		0	$8,680
M-1	Equalization Tank Mixer 1-1/2 hp 10,000 GAL	1	EA	4.00	4	6,500.00	6,500	$38.00	152		0	$6,652
M-2	Flocculation Tank Mixer 1/2 HP 1,000GAL	1	EA	2.00	2	4,500.00	4,500	$38.00	76		0	$4,576
M-3,4	Potassium Permanganate Tank Mixer 1/3 HP 275 (	2	EA	2.00	4	1,300.00	2,600	$38.00	152		0	$2,752
M-5	Filter Feed Tank Mixer 1/3 HP 1,000 GAL	1	EA	2.00	2	2,600.00	2,600	$38.00	76		0	$2,676
M-6	Effluent Tank Mixer 1 hp, 3,000 gal	1	EA	2.00	2	4,600.00	4,600	$38.00	76		0	$4,676
	Carbon Vessels	2	EA	40.00	80	66,000.00	132,000	$38.00	3,040		0	$135,040
P1 A,B	Metal Precipitation Pumps	2	EA	30.00	80	3,560.00	7,120	$38.00	2,280		0	$9,400
P2 A,B	Filter Feed Pumps	2	EA	30.00	60	5,600.00	11,200	$38.00	2,280		0	$13,480
P3 A,B	Backwash Pumps	2	EA	30.00	60	2,375.00	4,750	$38.00	2,280		0	$7,030
P4 A,B	Sulfuric Acid Feed Pumps	2	EA	20.00	40	700.00	1,400	$38.00	1,520		0	$2,920
P5 A,B	Filter Press Feed Pumps	2	EA	30.00	60	1,870.00	3,740	$38.00	2,280		0	$6,020
P6 A,B	Caustic Feed Pumps	2	EA	20.00	40	700.00	1,400	$38.00	1,520		0	$2,920
P7 A-D	Permanganate Feed Pumps	4	EA	20.00	80	700.00	2,800	$38.00	3,040		0	$5,840
P8 A,B	Stripper Effluent Pumps	2	EA	30.00	60	3,770.00	7,540	$38.00	2,280		0	$9,820
P9 A,B	Effluent Pumps	2	EA	30.00	60	3,770.00	7,540	$38.00	2,280		0	$9,820
P10 A,B	Carbon Slurry Pump	1	EA	30.00	30	2,100.00	2,100	$38.00	1,140		0	$3,240
P11 A,B	Sludge Transfer Pumps	2	EA	30.00	60	1,300.00	2,600	$38.00	2,280		0	$4,880
P12 A,B	Filtrate Transfer Pumps	2	EA	30.00	60	2,200.00	4,400	$38.00	2,280		0	$6,680

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PROJECT : Resolve
ACCURACY: ± 20 %

ACCOUNT NO.	DESCRIPTION	QUANTITY	UN	MANHOURS MHR/UNIT	MANHOURS TOTAL MH	MATERIAL UNIT COST	MATERIAL TOTAL MATL	LABOR WAGE RATE	LABOR TOTAL LABOR	EQUIPMENT UNIT RATE	EQUIPMENT TOTAL EQUIP	TOTAL DIRECT COST
T-1	Influent Equalization Tank (10,000 GAL, FRP)	1	EA	40.00	40	12,000.00	12,000	$38.00	1,520		0	$13,520
T-2	Aeration/Oxidation Tank (2,000 GAL, FRP)	1	EA	20.00	20	3,830.00	3,830	$38.00	760		0	$4,590
T-3	Flocculation Tank (1,000 GAL, FRP)	1	EA	20.00	20	3,250.00	3,250	$38.00	760		0	$4,010
T-4	Filter Feed Tank (1,000 GAL, FRP)	1	EA	20.00	20	3,250.00	3,250	$38.00	760		0	$4,010
T-5	Filter Backwash Tank (5,000 GAL, FRP)	1	EA	32.00	32	10,300.00	10,300	$38.00	1,216		0	$11,516
T-6	Sludge Holding Tank (2,500 GAL, FRP)	1	EA	32.00	32	9,860.00	9,860	$38.00	1,216		0	$11,076
T-7	Effluent Tank (3,000 GAL, FRP)	1	EA	32.00	32	9,860.00	9,860	$38.00	1,216		0	$11,076
T-8	Caustic Soda Tank (500 GAL, FRP)	1	EA	8.00	8	1,800.00	1,800	$38.00	304		0	$2,104
T-9 & 10	Potassium Permanganate Tank (275 GAL, FRP)	2	EA	6.00	12	1,560.00	3,120	$38.00	456		0	$3,576
T-11	Filtrate Tank (150 GAL, FRP)	1	EA	4.00	4	1,200.00	1,200	$38.00	152		0	$1,352
	Chemical Tank Dikes	1	EA	40.00	40	2,000.00	2,000	$38.00	1,520		0	$3,520
	2-Inch Root Zone Monitoring Wells	6	EA	3.00	18	0.00	0	$38.00	684		0	$684
	SUBTOTAL EQUIPMENT				1,476		536,529		56,088		0	$592,617

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-12-	FURNISHINGS											
	Vanity Under Service Sink	1	EA	4.00	4	500.00	500	$38.00	152	40.00	40	$692
	SUBTOTAL FURNISHINGS				4		500		152		40	$692
-13-	INSTRUMENTATION											
	Level Transmitter w/Level Element	10	EA	20.00	200	1,645.00	16,450	$38.00	7,600	0.00	0	$24,050
	Level Switch	11	EA	5.00	55	400.00	4,400	$38.00	2,090	0.00	0	$6,490
	Magnetic Flow Meter 3"	2	EA	25.00	50	3,300.00	6,600	$38.00	1,900	0.00	0	$8,500
	Magnetic Flow Meter 2-1/2"	1	EA	20.00	20	2,800.00	2,800	$38.00	760	0.00	0	$3,560
	Pressure Indicator	10	EA	5.00	50	150.00	1,500	$38.00	1,900	0.00	0	$3,400
	PH Analyzer	3	EA	16.00	48	1,720.00	5,160	$38.00	1,824	0.00	0	$6,984
	Batchmeter 2"	1	EA	10.00	10	2,540.00	2,540	$38.00	380	0.00	0	$2,920
	Flow Control Valve M.O. 3"	2	EA	8.00	16	2,500.00	5,000	$38.00	608	0.00	0	$5,608
	Plant & Extraction Well Computer System	1	EA	100.00	100	75,000.00	75,000	$38.00	3,800	0.00	0	$78,800
	Remote PLC's	8	EA	6.00	48	1,500.00	12,000	$38.00	1,824	0.00	0	$13,824
	Calibration & Testing	1	EA	268.00	268	0.00	0	$38.00	10,184	0.00	0	$10,184
	EXTRACTION WELLS											
	Level Switch	8	EA	5.00	40	800.00	6,400	$38.00	1,520	0.00	0	$7,920
	Turbine Meter 2"	8	EA	7.00	56	600.00	4,800	$38.00	2,128	0.00	0	$6,928
	Flow Control Valve 2"	8	EA	8.00	64	1,950.00	15,600	$38.00	2,432	0.00	0	$18,032
	Local Control Panel	8	EA	18.00	144	2,740.00	21,920	$38.00	5,472	0.00	0	$27,392
	SUBTOTAL INSTRUMENTATION				1,169		180,170		44,422		0	$224,592

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-15.b.-	PLUMBING											
	SANITARY STORAGE TANK	1	EA	20.00	20	3,000.00	3,000	$38.00	760		0	$3,760
P-1	WATERCLOSET HANDICAPPED	1	EA	5.50	6	505.00	505	$38.00	209		0	$714
P-2	LAVATORY, HANDICAPPED	1	EA	6.00	6	280.00	280	$38.00	228		0	$508
P-3	COUNTER SINK	1	EA	6.00	6	275.00	275	$38.00	228		0	$503
WH-1	WATER HEATER, 6 GAL, ELECTRIC	1	EA	4.00	4	1,425.00	1,425	$38.00	152		0	$1,577
	WATER STORAGE TANK, 1,000 GAL	1	EA	4.00	4	1,500.00	1,500	$38.00	152		0	$1,652
	VENT SYSTEM											
	PIPE, 3"	20	LF	0.25	5	4.08	82	$38.00	190		0	$272
	PIPE, 2"	10	LF	0.25	3	3.79	38	$38.00	95		0	$133
	PIPE, 1 1/2"	10	LF	0.20	2	2.85	29	$38.00	76		0	$105
	ELBOW, 90 DEG, 2"	1	EA	0.89	1	12.30	12	$38.00	34		0	$46
	ELBOW, 90 DEG, 1 1/2"	1	EA	0.80	1	8.25	8	$38.00	30		0	$39
	TEE, 1 1/2 x 1 1/2	1	EA	1.23	1	11.20	11	$38.00	47		0	$58
	SANITARY SYSTEM											
	PIPE, 4"	20	LF	0.28	6	5.30	106	$38.00	213		0	$319
	PIPE, 2"	5	LF	0.25	1	3.79	19	$38.00	48		0	$66
	PIPE, 1 1/2"	20	LF	0.20	4	2.85	57	$38.00	152		0	$209
	ELBOW, 45 DEG, 4"	4	EA	0.80	3	9.36	37	$38.00	122		0	$159
	ELBOW, 45 DEG, 2"	2	EA	0.89	2	12.30	25	$38.00	68		0	$92
	ELBOW, 45 DEG, 1 1/2"	4	EA	0.80	3	8.25	33	$38.00	122		0	$155
	WYE, 4"	2	EA	1.20	2	12.24	24	$38.00	91		0	$116
	WYE, 2"	2	EA	1.45	3	14.80	30	$38.00	110		0	$140
	WYE, 1 1/2"	2	EA	1.23	2	11.20	22	$38.00	93		0	$116
	P TRAP, 1 1/2"	2	EA	1.23	2	14.50	29	$38.00	93		0	$122
	WATER SUPPLY											
	PIPE, 2"	10	LF	0.20	2	4.70	47	$38.00	76		0	$123
	PIPE, 1 1/2"	20	LF	0.16	3	3.13	63	$38.00	122		0	$184
	PIPE, 1"	30	LF	0.12	4	1.87	56	$38.00	137		0	$193
	ELBOW, 90 DEG, 2"	5	EA	0.73	4	7.55	38	$38.00	139		0	$176
	ELBOW, 90 DEG, 1 1/2"	4	EA	0.62	2	3.88	16	$38.00	94		0	$110
	ELBOW, 90 DEG, 1"	4	EA	0.50	2	1.70	7	$38.00	76		0	$83
	BALL VALVE, 2"	2	EA	1.40	3	180.00	360	$38.00	106		0	$466
	BALL VALVE, 1 1/2"	1	EA	1.20	1	160.00	160	$38.00	46		0	$206
	SUBTOTAL PLUMBING				108		8,293		4,108		0	$12,401

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-15.c.-	HVAC											
RCU 1,2	Room Conditioning (Heat Pump) Units	2	EA	27.00	54	3,100.00	6,200	$38.00	2,052	3.50	7	$8,259
UH 1-5	Unit Heaters Gas Fired	5	EA	4.00	20	745.00	3,725	$38.00	760	0.00	0	$4,485
EF 1-3	Exhaust Fan 4460CFM	3	EA	4.00	12	550.00	1,650	$38.00	456	0.00	0	$2,106
EF 4,5	Exhaust Fan 150CFM	2	EA	1.00	2	150.00	300	$38.00	76	0.00	0	$376
	Louver w/damper 10" x 6"	1	EA	1.00	1	40.00	40	$38.00	38	0.00	0	$78
	Louver w/M.O. Damper 4' x 4'	4	EA	8.00	32	940.00	3,760	$38.00	1,216	0.00	0	$4,976
	Thermostat	5	EA	1.00	5	90.00	450	$38.00	190	0.00	0	$640
	Switch Single Pole	2	EA	0.50	1	15.00	30	$38.00	38	0.00	0	$68
	GAS											
	PIPE, 3/4"	150	LF	0.15	23	1.54	231	$38.00	855		0	$1,086
	PIPE, 1"	150	LF	0.17	26	1.86	279	$38.00	969		0	$1,248
	PIPE, 1 1/4"	60	LF	0.20	12	2.26	136	$38.00	456		0	$592
	ELBOW, 90 DEG, 3/4"	12	EA	0.62	7	1.85	22	$38.00	283		0	$305
	ELBOW, 90 DEG, 1"	8	EA	0.70	6	2.40	19	$38.00	213		0	$232
	ELBOW, 90 DEG, 1 1/4"	4	EA	0.80	3	3.60	14	$38.00	122		0	$136
	TEE, 3/4"	0	EA	0.90	0	3.00	0	$38.00	0		0	$0
	TEE, 1"	3	EA	1.00	3	4.10	12	$38.00	114		0	$126
	TEE, 1 1/4"	2	EA	1.23	2	4.80	10	$38.00	93		0	$103
	PLUG VALVE, 3/4"	6	EA	1.10	7	90.00	540	$38.00	251		0	$791
	PLUG VALVE, 1 1/4"	4	EA	1.40	6	140.00	560	$38.00	213		0	$773
	GAS PRESSURE REGULATOR	2	EA	2.50	5	450.00	900	$38.00	190		0	$1,090
	SUBTOTAL HVAC				226		18,878		8,584		7	$27,470

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-15.d.-	PROCESS PIPING											
	LF pricing includes couplings & hangers.											
	Vent PVC Schd 40											
	4"	80	LF	0.33	26	4.82	386	$38.00	1,003	0.00	0	$1,389
	6"	20	LF	0.41	8	8.15	163	$38.00	312	0.00	0	$475
	8"	70	LF	0.50	35	12.05	844	$38.00	1,330	0.00	0	$2,174
	12"	20	LF	0.57	11	46.00	920	$38.00	433	0.00	0	$1,353
	Elbow 90° 12"	2	EA	3.00	6	80.00	160	$38.00	228	0.00	0	$388
	Elbow 90° 8"	4	EA	2.67	11	62.00	248	$38.00	406	0.00	0	$654
	Elbow 90° 4"	3	EA	1.23	4	5.90	18	$38.00	140	0.00	0	$158
	Tee 4"x4"x6"	1	EA	2.50	3	35.00	35	$38.00	95	0.00	0	$130
	Tee 6"x6"x4"	1	EA	3.00	3	50.00	50	$38.00	114	0.00	0	$164
	Tee 8"x8"x4"	1	EA	4.00	4	115.00	115	$38.00	152	0.00	0	$267
	Reducer 8" x 6"	1	EA	1.50	2	25.00	25	$38.00	57	0.00	0	$82
	Reducer 8" x 12"	1	EA	1.90	2	125.00	125	$38.00	72	0.00	0	$197
	OV Overflow PVC Schd 40											
	4"	130	LF	0.33	43	4.82	627	$38.00	1,630	0.00	0	$2,257
	Elbow 90° 4"	9	EA	1.23	11	5.90	53	$38.00	421	0.00	0	$474
	Elbow 45° 4"	6	EA	1.23	7	14.00	84	$38.00	280	0.00	0	$364
	GW Groundwater PVC Schd 80											
	2 1/2"	175	LF	0.31	54	3.41	597	$38.00	2,062	0.00	0	$2,658
	3"	65	LF	0.32	21	4.56	296	$38.00	790	0.00	0	$1,087
	Elbow 90° 2-1/2"	7	EA	0.95	7	4.00	28	$38.00	253	0.00	0	$281
	Elbow 45° 3"	1	EA	1.14	1	14.00	14	$38.00	43	0.00	0	$57
	Elbow 90° 3"	18	EA	1.14	21	5.90	106	$38.00	780	0.00	0	$886
	Tee 3"x3"x3"	5	EA	1.78	9	10.55	53	$38.00	338	0.00	0	$391
	Tee 3"x3"x2-1/2"	1	EA	1.75	2	10.00	10	$38.00	67	0.00	0	$77
	Ball Valve 3"	12	EA	0.67	8	127.00	1,524	$38.00	306	0.00	0	$1,830
	Check Valve 3"	4	EA	0.67	3	150.00	600	$38.00	102	0.00	0	$702
	Wall Sleeve 2-1/2"	1	EA	1.00	1	40.00	40	$38.00	38	0.00	0	$78
	SL Sludge PVC Schd 80											
	2 1/2"	240	LF	0.31	74	3.41	818	$38.00	2,827	0.00	0	$3,646
	Elbow 90° 2-1/2"	25	EA	0.95	24	4.00	100	$38.00	903	0.00	0	$1,003
	Elbow 45° 2-1/2"	1	EA	0.95	1	9.75	10	$38.00	36	0.00	0	$46
	Tee 2-1/2"x2-1/2"x2-1/2"	5	EA	1.50	8	9.00	45	$38.00	285	0.00	0	$330
	Ball Valve 2-1/2"	7	EA	0.62	4	70.00	490	$38.00	165	0.00	0	$655

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	BW Backwash PVC Schd 80											
	3"	150	LF	0.32	48	4.56	684	$38.00	1,824	0.00	0	$2,508
	Elbow 90° 3"	18	EA	1.14	21	5.90	106	$38.00	780	0.00	0	$886
	Tee 3"x3"x3"	6	EA	1.78	11	10.55	63	$38.00	406	0.00	0	$469
	Ball Valve 3"	11	EA	0.67	7	127.00	1,397	$38.00	280	0.00	0	$1,677
	Check Valve 3"	2	EA	0.67	1	150.00	300	$38.00	51	0.00	0	$351
	FIL Filtrate PVC Schd 80											
	1-1/2"	20	LF	0.24	5	2.31	46	$38.00	182	0.00	0	$229
	2-1/2"	40	LF	0.31	12	3.41	136	$38.00	471	0.00	0	$608
	Elbow 90° 1-1/2"	3	EA	0.61	2	1.85	6	$38.00	70	0.00	0	$75
	Elbow 90° 2-1/2"	8	EA	0.95	8	4.00	32	$38.00	289	0.00	0	$321
	Elbow 45° 2-1/2"	1	EA	0.95	1	9.75	10	$38.00	36	0.00	0	$46
	Tee 2-1/2"x2-1/2"x2-1/2"	3	EA	1.50	5	9.00	27	$38.00	171	0.00	0	$198
	Ball Valve 1-1/2"	1	EA	0.40	0	21.50	22	$38.00	15	0.00	0	$37
	Ball Valve 2-1/2"	5	EA	0.62	3	70.00	350	$38.00	118	0.00	0	$468
	SA Sulphuric Acid Polyethyene Schd 80											
	1/2"	20	LF	0.16	3	1.55	31	$38.00	122	0.00	0	$153
	2-1/2"	40	LF	0.31	12	3.41	136	$38.00	471	0.00	0	$608
	Elbow 90° 1/2"	3	EA	0.44	1	0.63	2	$38.00	50	0.00	0	$52
	Elbow 90° 2-1/2"	1	EA	0.95	1	4.00	4	$38.00	36	0.00	0	$40
	Ball Valve 1/2"	1	EA	0.31	0	8.40	8	$38.00	12	0.00	0	$20
	Ball Valve 2-1/2"	2	EA	0.62	1	70.00	140	$38.00	47	0.00	0	$187
	Tee 2-1/2"x2-1/2"x2-1/2"	1	EA	1.50	2	9.00	9	$38.00	57	0.00	0	$66
	FIN Finished Water PVC Schd 80											
	3"	80	LF	0.32	26	4.56	365	$38.00	973	0.00	0	$1,338
	Elbow 90° 3"	8	EA	1.14	9	5.90	47	$38.00	347	0.00	0	$394
	Tee 3"x3"x3"	2	EA	1.78	4	10.55	21	$38.00	135	0.00	0	$156
	Ball Valve 3"	4	EA	0.67	3	127.00	508	$38.00	102	0.00	0	$610
	Ball Valve 3" M.O.	1	EA	4.00	4	300.00	300	$38.00	152	0.00	0	$452
	Back Pressure Valve 3"	1	EA	0.90	1	157.00	157	$38.00	34	0.00	0	$191
	SEFF Stripper Effluent PVC Schd 80											
	3"	90	LF	0.32	29	4.56	410	$38.00	1,094	0.00	0	$1,505
	Elbow 90° 3"	16	EA	1.14	18	5.90	94	$38.00	693	0.00	0	$788
	Elbow 45° 3"	1	EA	1.14	1	14.00	14	$38.00	43	0.00	0	$57
	Tee 3"x3"x3"	5	EA	1.78	9	10.55	53	$38.00	338	0.00	0	$391
	Ball Valve 3"	11	EA	0.67	7	127.00	1,397	$38.00	280	0.00	0	$1,677
	Check Valve 3"	2	EA	0.67	1	150.00	300	$38.00	51	0.00	0	$351

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METCALF & EDDY ENGINEERS
60% DESIGN COST ESTIMATE

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PROJECT : Resolve
ACCURACY: ± 20 %

ACCOUNT NO.	DESCRIPTION	QUANTITY	UN	MANHOURS		MATERIAL		LABOR		EQUIPMENT		TOTAL DIRECT COST
				MHR/ UNIT	TOTAL MH	UNIT COST	TOTAL MATL	WAGE RATE	TOTAL LABOR	UNIT RATE	TOTAL EQUIP	
	EFF Effluent PVC Schd 80											
	3"	170	LF	0.32	54	4.56	775	$38.00	2,067	0.00	0	$2,842
	Elbow 90° 3"	12	EA	1.14	14	5.90	71	$38.00	520	0.00	0	$591
	Elbow 45° 3"	1	EA	1.14	1	14.00	14	$38.00	43	0.00	0	$57
	Tee 3"x3"x3"	7	EA	1.78	12	10.55	74	$38.00	473	0.00	0	$547
	Ball Valve 3"	9	EA	0.67	6	127.00	1,143	$38.00	229	0.00	0	$1,372
	Check Valve 3"	2	EA	0.67	1	150.00	300	$38.00	51	0.00	0	$351
	Wall Casting 3"	1	EA	1.00	1	50.00	50	$38.00	38	0.00	0	$88
	Service Water PVC Schd 80											
	2"	120	LF	0.29	35	2.63	316	$38.00	1,322	0.00	0	$1,638
	1-1/2"	90	LF	0.24	22	2.31	208	$38.00	821	0.00	0	$1,029
	1"	20	LF	0.19	4	1.89	38	$38.00	144	0.00	0	$182
	1/2"	15	LF	0.16	2	1.55	23	$38.00	91	0.00	0	$114
	Elbow 90° 2"	1	EA	0.72	1	2.25	2	$38.00	27	0.00	0	$30
	Elbow 90° 1-1/2"	3	EA	0.62	2	1.85	6	$38.00	71	0.00	0	$76
	Elbow 90° 1/2"	6	EA	0.44	3	0.63	4	$38.00	100	0.00	0	$104
	Tee 2"x2"x2"	2	EA	1.14	2	7.90	16	$38.00	87	0.00	0	$102
	Tee 2"x2"x1-1/2"	1	EA	1.10	1	7.60	8	$38.00	42	0.00	0	$49
	Tee 1/2"x1/2"x1/2"	2	EA	0.67	1	1.75	4	$38.00	51	0.00	0	$54
	Ball Valve 2"	2	EA	0.47	1	28.00	56	$38.00	36	0.00	0	$92
	Hose Rack w/50' 1-1/4" Hose	2	EA	1.00	2	50.00	100	$38.00	76	0.00	0	$176
	Reducing Coupling 2 x 1/2"	1	EA	0.50	1	1.00	1	$38.00	19	0.00	0	$20
	Reducing Coupling 2 x 1"	1	EA	0.50	1	1.10	1	$38.00	19	0.00	0	$20
	Reducing Coupling 1 x 1/2"	1	EA	0.40	0	0.80	1	$38.00	15	0.00	0	$16
	Air PVC Schd 80											
	3"	30	LF	0.32	10	4.56	137	$38.00	365	0.00	0	$502
	Elbow 90° 3"	2	EA	1.14	2	5.90	12	$38.00	87	0.00	0	$98
	Ball Valve 3"	1	EA	0.67	1	127.00	127	$38.00	25	0.00	0	$152

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ACCOUNT NO.	DESCRIPTION	QUANTITY	UN	MANHOURS MHR/ UNIT	MANHOURS TOTAL MH	MATERIAL UNIT COST	MATERIAL TOTAL MATL	LABOR WAGE RATE	LABOR TOTAL LABOR	EQUIPMENT UNIT RATE	EQUIPMENT TOTAL EQUIP	TOTAL DIRECT COST
	CA Compressed Air											
	2"	60	LF	0.29	17	2.63	158	$38.00	661	0.00	0	$819
	1-1/2"	20	LF	0.24	5	2.31	46	$38.00	182	0.00	0	$229
	1" Copper Type L	160	LF	0.12	19	2.55	408	$38.00	730	0.00	0	$1,138
	3/4" Copper Type L	90	LF	0.11	10	1.90	171	$38.00	376	0.00	0	$547
	1/2" Copper Type L	100	LF	0.10	10	1.31	131	$38.00	380	0.00	0	$511
	Tee 2"x2"x2"	1	EA	1.14	1	7.90	8	$38.00	43	0.00	0	$51
	Tee 2"x1-1/2"x1"	1	EA	1.10	1	7.60	8	$38.00	42	0.00	0	$49
	Tee 1"x1"x1" Copper Type L	1	EA	0.80	1	3.37	3	$38.00	30	0.00	0	$34
	Tee 2"x1"x1/2"	1	EA	1.10	1	7.60	8	$38.00	42	0.00	0	$49
	Tee 1/2"x1/2"x1/2" Copper Type L	1	EA	0.62	1	0.48	0	$38.00	24	0.00	0	$24
	Tee 1"x1"x1/2" Copper Type L	1	EA	0.80	1	3.35	3	$38.00	30	0.00	0	$34
	Tee 1"x3/4"x1/2" Copper Type L	1	EA	0.80	1	3.35	3	$38.00	30	0.00	0	$34
	Elbow 90° 2"	1	EA	0.72	1	2.25	2	$38.00	27	0.00	0	$30
	Elbow 90° 1-1/2"	1	EA	0.62	1	1.85	2	$38.00	24	0.00	0	$25
	Elbow 90° 1" Copper Type L	5	EA	0.50	3	1.52	8	$38.00	95	0.00	0	$103
	Elbow 90° 3/4" Copper Type L	2	EA	0.42	1	0.63	1	$38.00	32	0.00	0	$33
	Elbow 90° 1/2" Copper Type L	6	EA	0.40	2	0.29	2	$38.00	91	0.00	0	$93
	Pressure Reducing Valve 1"	1	EA	0.42	0	113.00	113	$38.00	16	0.00	0	$129
	Carbon Slurry From Tank Truck											
	3"	40	LF	0.32	13	4.56	182	$38.00	486	0.00	0	$669
	Elbow 90° 3"	12	EA	1.14	14	5.90	71	$38.00	520	0.00	0	$591
	Ball Valve 3"	4	EA	0.67	3	127.00	508	$38.00	102	0.00	0	$610
	Quick Disconnect 3"	4	EA	0.50	2	120.00	480	$38.00	76	0.00	0	$556
	Chemical Feed System Flex Hose/Fittings	1	LS	50.00	50	1,000.00	1,000	$38.00	1,900	0.00	0	$2,900
	SUBTOTAL PROCESS PIPING				1,004		22,560		38,158		0	$60,718

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-16.-	ELECTRICAL											
	MCC-1 to include:	1	LS	85.00	85	42,220.00	42,220	$38.00	3,230	0.00	0	$45,450
	Size 2 RVNR Starter 2 EA											
	Size 1 FVNR Starter 7 EA											
	Size 1 FVTS Starter 1 EA											
	Circuit Breaker 400A 1 EA											
	Circuit Breaker 150A 2 EA											
	Circuit Breaker 100A 7 EA											
	Metering 1 LS											
	Vertical Sections 6 EA											
	Dry Transformer 45KVA,3PH,4W,120/208	2	EA	23.00	46	2,375.00	4,750	$38.00	1,748	0.00	0	$6,498
	Panelboard PA 20 Circuits	1	EA	17.00	17	600.00	600	$38.00	646	0.00	0	$1,246
	Panelboard PB 20 Circuits	1	EA	17.00	17	600.00	600	$38.00	646	0.00	0	$1,246
	Distribution Panel 18 Circuit,480V,100A,3ph,3W	1	EA	15.00	15	890.00	890	$38.00	570	0.00	0	$1,460
	LIGHTING											
	HPS Fixture Pendent 150W	24	EA	3.00	72	470.00	11,280	$38.00	2,736	0.00	0	$14,016
	HPS Fixture Wall 100W	3	EA	3.00	9	440.00	1,320	$38.00	342	0.00	0	$1,662
	Fluorescent Fixture Recessed 2-34	9	EA	1.00	9	70.00	630	$38.00	342	0.00	0	$972
	Emergency Fixtures	3	EA	1.00	3	460.00	1,380	$38.00	114	0.00	0	$1,494
	Exit Sign	4	EA	1.00	4	56.00	224	$38.00	152	0.00	0	$376
	Simplex Receptacle	16	EA	0.50	8	20.00	320	$38.00	304	0.00	0	$624
	Switch 3-Way	2	EA	0.50	1	20.00	40	$38.00	38	0.00	0	$78
	Switch Single Pole	5	EA	0.50	3	15.00	75	$38.00	95	0.00	0	$170
	Switch H.O.A.	2	EA	1.00	2	50.00	100	$38.00	76	0.00	0	$176
	Local Hand Switches	21	EA	1.00	21	50.00	1,050	$38.00	798	0.00	0	$1,848
	Conduit 3/4" RGS	1,500	LF	0.09	132	1.68	2,520	$38.00	5,016	0.00	0	$7,536
	Cable No. 12	4,500	LF	0.01	45	0.08	360	$38.00	1,710	0.00	0	$2,070
	CONDUIT											
	Conduit 3" RGS	50	LF	0.31	16	11.04	552	$38.00	593	0.00	0	$1,145
	Conduit 2" RGS	160	LF	0.20	32	5.10	816	$38.00	1,204	0.00	0	$2,020
	Conduit 1-1/4" RGS	265	LF	0.14	37	3.18	843	$38.00	1,390	0.00	0	$2,232
	Conduit 1" RGS	550	LF	0.11	59	2.52	1,386	$38.00	2,257	0.00	0	$3,643
	Conduit 3/4" RGS	5,430	LF	0.09	478	1.68	9,122	$38.00	18,158	0.00	0	$27,280

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ACCOUNT NO.	DESCRIPTION	QUANTITY	UN	MANHOURS MHR/ UNIT	TOTAL MH	MATERIAL UNIT COST	TOTAL MATL	LABOR WAGE RATE	TOTAL LABOR	EQUIPMENT UNIT RATE	TOTAL EQUIP	TOTAL DIRECT COST
	CABLE											
	350 MCM	150	LF	0.05	7	3.55	533	$38.00	274	0.00	0	$806
	2/0	120	LF	0.03	4	1.51	181	$38.00	137	0.00	0	$318
	NO. 2	50	LF	0.02	1	0.84	42	$38.00	44	0.00	0	$86
	NO. 4	835	LF	0.02	15	0.50	418	$38.00	571	0.00	0	$989
	NO. 8	265	LF	0.01	3	0.24	64	$38.00	131	0.00	0	$195
	NO. 12	8,280	LF	0.01	83	0.08	662	$38.00	3,146	0.00	0	$3,809
	NO. 14	8,960	LF	0.01	90	0.06	538	$38.00	3,405	0.00	0	$3,942
	NO. 16 2/C	2,070	LF	0.01	21	0.25	518	$38.00	787	0.00	0	$1,304
	TERMINATIONS											
	350 MCM	6	EA	1.35	8	13.25	80	$38.00	308	0.00	0	$387
	2/0	12	EA	0.65	8	5.60	67	$38.00	296	0.00	0	$364
	NO. 2	2	EA	0.45	1	2.90	6	$38.00	34	0.00	0	$40
	NO. 4	28	EA	0.30	8	1.25	35	$38.00	319	0.00	0	$354
	NO. 8	8	EA	0.20	2	1.25	10	$38.00	61	0.00	0	$71
	NO. 12 – 16	586	EA	0.20	117	0.40	234	$38.00	4,454	0.00	0	$4,688
	FIRE PROTECTION											
	Fire Alarm Control Panel	1	EA	10.00	10	3,000.00	3,000	$38.00	380	0.00	0	$3,380
	Smoke Detectors	1	EA	1.50	2	110.00	110	$38.00	57	0.00	0	$167
	Heat Detector	21	EA	1.50	32	110.00	2,310	$38.00	1,197	0.00	0	$3,507
	Fire Alarm Horn	2	EA	1.50	3	120.00	240	$38.00	114	0.00	0	$354
	Manual Station	2	EA	2.00	4	115.00	230	$38.00	152	0.00	0	$382
	Conduit 3/4" RGS	700	LF	0.09	62	1.68	1,176	$38.00	2,341	0.00	0	$3,517
	Cable	700	LF	0.01	7	0.20	140	$38.00	266	0.00	0	$406
	SUBTOTAL ELECTRICAL				1,596		91,670		60,637		0	$152,307

Resolve MOM

Summary of Annual Operating Costs (1994 basis)

Description	Unit	Quantity	Unit Cost	Annual Cost
Utilities				
Electric Power	Kwh	375000	$0.10	$37,500
Propane (process)	Gal	61000	$0.75	$45,750
Oil (heat)	Gal	24000	$0.90	$21,600
Telephone	LS	1	$500	$500
			Subtotal	$105,350
Chemicals and Carbon				
Permanganate	Lb	6600	$1.50	$9,900
Caustic	Gal	13000	$1	$13,000
Acid	Gal	200	$4	$800
Polymer	Gal	4200	$0.25	$1,050
GAC	Lb	10000	$1.00	$10,000
			Subtotal	$34,750
Sludge Disposal	CY	60	$300	$18,000
Labor				
Operator	Hr	2300	$35	$80,500
Technical Support	Hr	500	$50	$25,000
			Subtotal	$105,500
Sampling and Analysis				
Treatment Plant	LS	1	$35,000	$35,000
GW, SW, Fish, Wetlands	LS	1	$85,000	$85,000
			Subtotal	$120,000
Maintenance	LS	1	$34,600	$34,600
			Subtotal	$418,200
			Contingency (10%)	$41,820
			Total	$460,020

Note: Costs are based on continuous operation at an average flow rate of 40 gpm and average TOC and metals concentrations of 50 ppm each. As the system is operated, influent concentrations will vary, and most likely decrease over time.

Resolve MOM
Operating Cost Estimate Backup

1. UTILITIES

Description	Quantity	Number Oper.	Flow (gpm)	TDH (ft)	Calc HP	Est HP	% Oper	kwh/yr
A. Electric Power								
Ppt. Feed	2	1	40	25	1	1	100%	8760
Filter Feed	2	1	100	150	5.5	10	100%	87600
Filter BW	2	1	100	150	5.5	10	5%	4380
Caustic Feed	2	1	–	–	0.125	0.125	100%	1095
Permanganate Feed	4	2	–	–	0.125	0.125	100%	1095
Stripper Effluent	2	1	40	50	2	2	100%	17520
Effluent	2	1	40	50	2	2	100%	17520
Carbon Slurry	1	1	–	–	10	10	1%	876
Acid Feed	1	1	–	–	0.125	0.125	100%	1095
Extraction Wells	8	8	5	200	0.36	0.5	100%	4380
Compressor	1	1	–	–	20	20	5%	8760
Stripper Blower	1	1	–	–	5	5	100%	43800
Eq. Tank Mixer	1	1	–	–	5	5	100%	43800
Final pH Mixer	1	1	–	–	0.5	0.5	100%	4380
Floc Tank Mixer	1	1	–	–	0.5	0.5	100%	4380
Permanganate Mix Tank	1	1	–	–	0.5	0.5	50%	2190
Poly Blend	1	1	–	–	0.125	0.125	100%	1095
Aeration Blower	1	1	–	–	5	5	100%	43800
Exhaust Fans						5	25%	10950
AC Units						5	25%	10950
Total Motors								318426
Lighting & Miscellaneous	6400 sf at 3 w/sf @ 8 hrs/day							56064
Total Electric Power								374490
Carry in estimate								375000

B. Propane (Estimates from Demtrol – vendor)

Air Flow Rate	1100 scfm
Inlet Air Temp	50 F
Operating temp	750 F
Energy Use	6.2 therm/hr
	54312 therm/yr
	60314 gal/yr
Carry in estimate	61000 gal/yr

Resolve MOM
Operating Cost Estimate Backup

C. Fuel Oil for heating

Annual BTU = (BTU x 24 x degree day)/temp diff

BTU (max)	800000
Degree day	5600
Temp Difference	40
Annual BTU	2.70E+09
Boiler Efficiency	80%
Gal Fuel Oil	24000
Carry in estimate	24000 gal

D. Telephone

Use allowance of $500/yr

2. CHEMICALS	Usage rate	Carry in estimate
Permanganate	18 lb/day = 6570 lb/yr	6600 lb/yr
Caustic	35 gal/day = 12775 gal/yr of 20% soln	13000 gal/yr of 20% soln
Acid	182 gal/yr of 98% soln	200 gal/yr of 98% soln
Polymer	At 2 mg/l dosage, 4197 gal/yr of 1% soln	4200 gal/yr of 1% soln
GAC	25 lb/day = 9125 lb/yr	10000 lb/yr

3. SLUDGE DISPOSAL

Fe & Mn (lb/day)	93
Cake Solids (%)	30%
Cake density (lb/ft3)	70
Cake (cy/day)	0.16
Cake (cy/year)	59.4
Carry in estimate	60 cy/yr

4. LABOR

Assumptions: Operating concept is to have system manned 8 hr/day, 5 days/week
10% allowance for overtime is included

Operator

Hours/year	2300
Direct hourly rate	$15
Multiplier	2.1
Rate	$32
Say	$35
Yearly cost	$80,500

Technical Support

Allowance (hours/yr)	500
Rate	$50
Yearly cost	$25,000

Total Labor	$105,500

5. SAMPLING & ANALYSIS

Unit Prices:

Indicator Compounds		TAL/TCL Analysis	
8240 VOA	$225	TCL VOA	$225
8270 SVOA	$400	TCL SVOA	$450
8080 PCB	$130	TCL Pest/PCB	$200
PP Metals + Fe,Mn	$220	TAL Metals	$250
Total	$975	Total	$1,125

A. Treatment Plant Influent/Effluent Sampling & Analysis

Assumptions: Operator will take samples for analysis by outside lab
Influent and effluent samples collected monthly and analyzed for VOCs, SVOCs, PCBs, Metals
Semi-annual TAL/TCL analysis and chronic and acute toxicity testing on effluent samples
Normal 3-week turnaround time

Description	No/yr	Unit Cost	Annual Cost
Influent	12	$975	$11,700
Effluent	12	$975	$11,700
Effluent for TCL/TAL	2	$1,125	$2,250
Toxicity – Acute	2	$2,500	$5,000
Toxicity – Chronic	2	$800	$1,600
QA/QC	2	$975	$1,950
		Total	$34,200
		Carry	$35,000

B. Groundwater, Surface Water, and Fish Sampling & Analysis

Assumptions: 36 wells monitored annually for TCL VOCs
10 residential well samples collected annually for TCL VOCs
20 wells monitored quarterly for indicator VOCs
5 surface water samples collected annually for TCL VOCs
2 surface water samples collected quarterly for indicator VOCs
2 QA/QC samples collected quarterly for indicator VOCs
2 fish samples collected annually with 6 tissue samples per fish
Wetlands monitoring – well monitoring performed by operator
transect monitoring performed quarterly – 1 person x 10 hrs/day
Water level monitoring performed quarterly – 1 person x 10 hrs/day x 2 days

Resolve MOM
Operating Cost Estimate Backup

Analytical Costs

Description	No. samples	No./yr	Unit Cost	Annual Cost
Annual wells	36	1	$225	$8,100
Quarterly wells	20	3	$225	$13,500
Residential wells	10	1	$225	$2,250
All surface water locations	5	1	$225	$1,125
2 surface water locations	2	3	$225	$1,350
QA/QC	2	4	$225	$1,800
Fish	12	1	$1,000	$12,000
			Total	$40,125
			Carry	$41,000

Labor Costs

Description	Hours	No./yr	Rate	Annual Cost
Quarterly water level monitoring	20	4	$50	$4,000
Annual gw, sw, fish sampling	160	1	$50	$8,000
Quarterly gw & sw sampling	80	3	$50	$12,000
Annual Residential Well Samplir	30	1	$50	$1,500
Wetlands monitoring	10	4	$50	$2,000
Data handling/reporting	80	3	$50	$12,000
Data handling/reporting	80	1	$50	$4,000
			Total	$43,500
			Carry	$44,000

Total Groundwater, Surface Water, Fish & Wetlands Sampling & Analysis Cost $85,000

6. MAINTENANCE

For routine maintenance assume a percentage of capital equipment costs

Estimated capital equipment cost	$1,730,000
Percentage	2%
Annual Maintenance	$34,600

This does not include capital replacement costs

Resolve MOM
Startup Cost Estimate

Description	Labor Hours	Hourly Rate	Equip Cost	Total Price
Labor				
Pump Test	520	$50	$4,000	$30,000
Pre–startup water levels/flows	160	$50		$8,000
Water Level Measurements	140	$50		$7,000
Baseline Well Sampling	140	$50		$7,000
Baseline SW, Fish, Sampling & Flows	60	$50		$3,000
Wetlands Monitoring	60	$50		$3,000
Office/Data Reporting	140	$50		$7,000
Treatment Plant				
Operator	176	$35		$6,160
Tech. Specialist	80	$50		$4,000
	Labor Subtotal			$75,160

Description	No. of Samples	Cost per Sample	Premium Factor	Total Price
Analytical				
Baseline Wells	36	$975		$35,100
Baseline SW	5	$975		$4,875
Baseline Fish	12	$1,000		$12,000
QA/QC	4	$975		$3,900
Treatment Plant Startup				
Influent	4	$975		$3,900
Effluent – 1st 2 weeks	14	$975	2	$27,300
Effluent – 1st 3 months	12	$975	2	$23,400
QA/QC	3	$975		$2,925
Internal Control	63	$150		$9,450
	Analytical Subtotal			$122,850
Miscellaneous (Includes chemicals, power, telephone, etc. for first month of operation)				$8,000
TOTAL STARTUP				$206,010

Startup Assumptions

GW/SW Monitoring Labor
- Pump Test Operations – 2 people x 24 hrs/day x 10 days = 480 hrs
- Pump Test Analysis – 1 person x 40 hrs
- Pre–startup Water Level Monitoring/Flow Measurements
  - Quarterly for 1 year – 2 people x 10 hrs/day x 2 days x 4 quarters = 160 hrs
- Water Level Monitoring –
  - Daily for first week – 1 person x 10 hrs/day x 7 days = 70 hrs
  - Weekly for first month – 1 person x 10 hrs/day x 4 days = 40 hrs
  - Monthly for first quarter – 1 person x 10 hrs/day x 3 days = 30 hrs
  - Total = 140 hrs
- Baseline Well Sampling – 2 people x 10 hrs/day x 7 days = 140 hrs
- Baseline SW, Fish Sampling & Flows – 2 people x 10 hrs/day x 3 days = 60 hrs

Wetlands Monitoring –
- Transect monitoring – 2 people x 10 hrs/day x 2 days = 40 hrs
- Well monitoring – 2 people x 10 hrs/day x 1 day = 20 hrs
- Total = 60 hrs

Treatment Plant Labor
- 1 Month needed for startup and shakedown

GW/SW Sampling
- Baseline Well Sampling – 36 wells analyzed for VOA, SVOA, PCBs, Metals
- Baseline SW Sampling – 5 locations analyzed for VOA, SVOA, PCBs, Metals
- Fish Sampling – 2 fish x 6 tissues/fish = 12 samples for VOA, PCBs, Metals

Treatment Plant Sampling
- Influent samples collected weekly for first 3 months
- Effluent samples collected daily for first 2 weeks and weekly for first 3 months (2–day turnaround time)

Analytical Prices
- 8240 VOAs – $225/sample
- 8270 SVOAs – $400/sample
- 8080 PCBs – $130/sample
- PP Metals + Fe, Mn – $220/sample
- Fish sampling – $1000/sample
- Premium factor for 2–day turnaround time = 2 times price

Appendix L

Appendix L

APPENDIX L
MODEL INPUT FILES

APPENDIX L

MODEL INPUT FILES

The steady-state flow model for the ReSolve Site was developed using a version of the USGS finite difference flow model MODFLOW. The input files (BAS.DAT, BCF.DAT, DRN.DAT, RIV.DAT, EVT.DAT, RCH.DAT, SIP.DAT, OPC.DAT, STR.DAT) used to model existing conditions (based on data for May 8, 1990) are provided in this appendix and on diskette, with instructions for executing the program. It is assumed that the user has access to and familiarity with MODFLOW (McDonald and Harbaugh, 1988) and the Stream-Aquifer Package (Prudic, 1989), both of which are distributed by the U.S. Geological Survey. To simulate various extraction well scenarios, the model was run in steady-state mode with well input files representing the various extraction/re-injection well configurations. These simulations provided the head files used as input to the particle tracking model used to determine zones of capture.

The particle tracking model PATH3D was used to define capture zones for the extraction wells. The input files needed by PATH3D include those used for the MODFLOW simulation, as well as an additional file called the particle tracking input file. Additionally, for the purposes of running PATH3D, several lines need to be added to MODFLOW's BCF package input file. The data files needed to run PATH3D (BAS.DAT, BCF.DAT, WEL.DAT, P3D1A.IN) are described in this appendix, with instructions for execution. This material follows the input files provided for MODFLOW. Copies of input files for Case 4a (the selected scenario) are provided in this appendix and on diskette.

It is assumed that the user has not previously used PATH3D. A copy of the program, with documentation, is provided under separate cover. The compiled version of the program assumes a math co-processor is not available. An alternate, more efficient, version is available for computers with a math co-processor. PATH3D comes with several utility programs which can be used to process output files genterated by PATH3D and the unformatted head file generated by MODFLOW for plotting purposes. These plotting programs work in conjunction with the well-known and commercially available software package SURFER (Golden Software).

The Resolve Site Steady-State Flow Model
April, 1993
S. S. Papadopulos & Associates

The steady-state flow model for the Resolve site was developed using a version of the USGS finite difference flow model MODFLOW. The input files used for the model are described below.

BAS.DAT: This file is used as input for MODFLOW's Basic Package. Starting heads are read from unit number 35, which corresponds to the external ASCII file shead.dat.

BCF.DAT: This file is used as input for MODFLOW's Block-Centered Flow Package. Unit 42 corresponds to the external ASCII file cond.dat. This file contains the following arrays: vertical conductance between layers 2 and 3, vertical conductance between layers 3 and 4, and transmissivity of layer 4.

DRN.DAT: This file is used as input for MODFLOW's Drain Package.

RIV.DAT: This file is used as input for MODFLOW's River Package.

EVT.DAT: This file is used as input for MODFLOW's Evapotranspiration Package. The land surface elevation array, surf, is read from unit 32, which corresponds to the external ASCII file lltop.grd.

RCH.DAT: This file is used as input for MODFLOW's Recharge Package.

SIP.DAT: This file is used as input for MODFLOW's Strongly Implicit Procedure solver package.

OPC.DAT: This file is used as input for MODFLOW's Output Control Package.

STR.DAT: This file is used as input for MODFLOW's Stream-Aquifer Package by Dave Prudic.

During execution of MODFLOW, the following responses should be entered at the questions which are directed to the screen. Responses which are the choice of the user are given as "arbitrary".

Enter name for standard output file: arbitrary

Enter name for BAS package input file: bas.dat

Enter name for BCF package input file: bcf.dat

Enter name for DRN package input file: drn.dat

Enter name for RIV package input file: riv.dat

Enter name for STR package input file: str.dat

Enter name for EVT package input file: evt.dat

Enter name for RCH package input file: rch.dat

Enter name for SIP package input file: sip.dat

Enter name for OPC package input file: opc.dat

Enter name for formatted file for unit number 35: shead.dat

Enter name for formatted file for unit number 42: cond.dat

Enter name for unformatted head file: arbitrary

Enter name for unformatted flow file: arbitrary

Enter name for formatted file for unit number 32: lltop.grd

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Resolve Site, Massachusetts
SSP246     March 1993      Jane Houlihan
         4         76         77          1          4
 11 00 13 14 15 00 00 18 19 00 00 22 00 24 00 00 00 00 00 00 00 00 00 00
         0          0     IAPART,ISTRT
       101          0()                              2    IBOUND-layer 1
 2
 1  76  1  77  1
 1   1  4  12  1
         0          1    (fmtin not used)           2    IBOUND-layer 2
         0          1    (fmtin not used)           2    IBOUND-layer 3
         0          1    (fmtin not used)           2    IBOUND-layer 4
      999.                                               HNOFLO
        35         0.           (20f11.2)           4    starting head-layer 1 -- l1top.grd
        35         0.           (20f11.2)           4    starting head-layer 2 -- l1top.grd
        35         0.            (12f9.2)           4    starting head-layer 3 -- l3top.grd
        35         0.            (12f9.2)           4    starting head-layer 4 -- l3top.grd
        1.          1       1.1                          PERLEN,NSTP,TSMULT 1st sp
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```
         1        37                      */ISS,IBCFCB
 1 3 3 0                                  */LAYCON
        0  1.00                                             */TRPY
       11        0.          (8f10.2)          4            */delr
  1743.81   1499.29   1153.30    768.87    512.58    341.72    227.81    151.88
   101.25     67.50     45.00     30.00     20.00     20.00     20.00     20.00
    20.00     20.00     20.00     20.00     20.00     20.00     20.00     20.00
    20.00     20.00     20.00     20.00     20.00     20.00     20.00     20.00
    20.00     20.00     20.00     20.00     20.00     20.00     20.00     20.00
    20.00     20.00     20.00     20.00     20.00     20.00     20.00     20.00
    20.00     20.00     20.00     20.00     20.00     20.00     20.00     20.00
    20.00     20.00     20.00     20.00     20.00     20.00     20.00     20.00
    20.00     20.00     20.00     20.00     30.00     45.00     67.50    101.25
   151.88    227.81    296.16    355.39    388.02
       11        0.          (8f10.2)          4            */delc
   715.14    676.60    615.09    512.58    341.72    227.81    151.88    101.25
    67.50     45.00     30.00     20.00     20.00     20.00     20.00     20.00
    20.00     20.00     20.00     20.00     20.00     20.00     20.00     20.00
    20.00     20.00     20.00     20.00     20.00     20.00     20.00     20.00
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    20.00     20.00     20.00     20.00     20.00     20.00     20.00     20.00
    20.00     20.00     20.00     20.00     20.00     20.00     20.00     20.00
    20.00     20.00     20.00     30.00     45.00     67.50    101.25    151.88
   227.81    341.72    444.23    490.61
      102        0.         (4x,77f2.0)        4           */hydraulic cond for Layer 1
        2
       1.        20.
   1 1 1 1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
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   9 1 1 1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 1 1 1
60 0 1 1 1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 1 1 1
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   2 1 1 1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 1 1 1
   3 1 1 1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 1 1 1
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   6 1 1 1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 1 1 1
   7 1 1 1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 1 1 1
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70 0 1 1 1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 1 1 1
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   2 1 1 1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 1 1 1
   3 1 1 1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 1 1 1
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   5 1 1 1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2
   6 1 1 1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2
        11       0.0         (12f9.2)         4       */bottom elev for Layer 1 -- 12top.grd
   241.50   209.49   180.51   136.51   116.51   106.51   105.50   105.51   108.53   110.73   112.28   113.35
   114.07   114.66   115.26   115.87   116.48   117.10   117.73   118.37   119.01   119.65   120.31   120.97
   121.63   122.30   122.97   123.65   124.34   125.03   125.72   126.42   127.12   127.83   128.54   129.25
   129.96   130.68   131.41   132.14   132.37   132.12   131.87   131.62   131.37   131.13   130.90   130.66
   130.43   130.21   129.98   129.77   129.55   129.34   129.14   128.94   128.74   128.55   128.37   128.19
   128.01   127.84   127.68   127.52   127.37   127.22   127.08   126.95   126.79   126.58   126.29   126.30
   136.12   155.87   180.44   180.41   145.98
   241.50   205.02   177.16   136.15   106.63   103.33   100.05    98.41    96.77    98.71   100.07   101.01
   101.64   102.16   102.67   103.20   103.72   104.25   104.79   105.32   105.86   106.40   106.94   107.48
   108.02   108.57   109.11   109.66   110.20   110.75   111.29   111.83   112.38   112.92   113.46   114.01
   114.55   115.09   115.63   116.18   116.54   116.72   116.91   117.10   117.29   117.48   117.69   117.89
   118.11   118.34   118.57   118.82   119.08   119.36   119.65   119.95   120.28   120.62   120.98   121.37
   121.78   122.22   122.68   123.18   123.70   124.26   124.84   125.46   126.29   127.91   129.56   132.86
   136.13   160.79   185.39   208.30   195.19
   244.40   205.02   160.76   126.30   106.62   101.69    96.78    96.77    96.11    96.50    96.82    97.05
    97.22    97.36    97.50    97.65    97.80    97.96    98.12    98.28    98.45    98.62    98.79    98.96
    99.14    99.31    99.48    99.66    99.83   100.01   100.18   100.35   100.52   100.68   100.85   101.01
   101.17   101.32   101.47   101.62   101.74   101.83   101.92   102.00   102.08   102.16   102.24   102.32
   102.39   102.46   102.53   102.60   102.68   102.75   102.83   102.90   102.98   103.07   103.16   103.25
   103.35   103.46   103.58   103.70   103.84   103.98   104.14   104.31   104.54   104.93   105.63   106.63
   111.53   136.22   173.92   198.49   208.31
   244.40   193.55   160.75   126.30   106.62   101.69    96.78    96.77    96.44    95.37    94.85    94.59
    94.46    94.37    94.29    94.24    94.20    94.17    94.16    94.16    94.18    94.20    94.25    94.30
    94.37    94.44    94.53    94.63    94.74    94.86    95.00    95.14    95.29    95.46    95.63    95.82
    96.01    96.22    96.43    96.66    96.71    96.59    96.48    96.37    96.28    96.19    96.12    96.05
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95.99	95.94	95.90	95.86	95.84	95.82	95.80	95.80	95.80	95.80	95.82	95.84
95.86	95.89	95.93	95.98	96.03	96.08	96.15	96.21	96.31	96.47	96.77	96.78
100.05	106.67	126.39	170.62	185.37							
241.12	191.90	155.83	123.02	101.71	96.78	95.13	90.19	86.93	87.34	87.52	87.60
87.65	87.69	87.72	87.75	87.78	87.80	87.83	87.86	87.89	87.92	87.96	87.99
88.03	88.08	88.12	88.16	88.21	88.26	88.31	88.35	88.40	88.44	88.48	88.51
88.54	88.55	88.56	88.57	88.71	89.01	89.29	89.57	89.85	90.12	90.38	90.65
90.91	91.18	91.45	91.73	92.02	92.31	92.61	92.91	93.23	93.56	93.89	94.24
94.59	94.96	95.33	95.72	96.11	96.52	96.93	97.35	97.89	98.73	100.04	100.05
100.05	103.33	106.67	136.19	165.67							
234.56	185.33	155.83	121.38	103.34	98.42	97.09	93.48	90.20	88.40	87.44	86.89
86.55	86.29	86.05	85.82	85.60	85.40	85.21	85.04	84.87	84.73	84.60	84.48
84.39	84.31	84.25	84.22	84.21	84.23	84.28	84.36	84.48	84.64	84.84	85.09
85.39	85.75	86.16	86.64	86.77	86.56	86.41	86.32	86.29	86.31	86.39	86.51
86.68	86.89	87.15	87.43	87.76	88.11	88.50	88.92	89.36	89.83	90.33	90.85
91.39	91.95	92.52	93.10	93.70	94.30	94.90	95.49	96.20	97.20	98.41	99.39
100.05	103.31	106.60	126.29	152.50							
234.56	182.06	155.82	121.38	103.34	100.05	96.78	93.49	90.21	88.82	87.57	86.69
86.09	85.62	85.16	84.71	84.26	83.83	83.41	83.01	82.62	82.24	81.88	81.53
81.20	80.88	80.57	80.28	79.99	79.72	79.45	79.18	78.92	78.67	78.42	78.16
77.91	77.66	77.42	77.18	77.24	77.60	77.96	78.33	78.70	79.08	79.46	79.86
80.25	80.66	81.09	81.52	81.98	82.45	82.95	83.47	84.01	84.58	85.17	85.79
86.44	87.11	87.81	88.54	89.29	90.08	90.90	91.77	92.91	94.83	98.37	98.39
100.02	96.76	93.52	116.47	136.12							
233.90	182.06	154.18	121.38	104.31	100.05	96.78	95.12	93.49	90.12	87.99	86.63
85.76	85.08	84.42	83.79	83.17	82.58	82.02	81.47	80.95	80.46	79.99	79.53
79.10	78.69	78.29	77.90	77.53	77.16	76.81	76.46	76.12	75.79	75.46	75.13
74.82	74.51	74.22	73.94	73.93	74.20	74.48	74.78	75.08	75.40	75.72	76.05
76.39	76.74	77.11	77.48	77.88	78.29	78.73	79.19	79.68	80.20	80.75	81.34
81.96	82.60	83.27	83.94	84.61	85.26	85.86	86.39	86.92	87.31	86.93	88.57
91.85	96.76	93.49	116.47	126.30							
233.89	185.01	149.25	121.38	103.35	100.06	96.79	95.14	93.49	90.21	87.75	86.16
85.13	84.34	83.58	82.85	82.14	81.48	80.84	80.25	79.68	79.16	78.66	78.20
77.77	77.36	76.97	76.61	76.27	75.94	75.62	75.32	75.04	74.77	74.52	74.30
74.11	73.96	73.85	73.80	73.75	73.70	73.71	73.77	73.86	73.99	74.14	74.31
74.51	74.72	74.95	75.19	75.46	75.74	76.05	76.40	76.78	77.21	77.70	78.25
78.89	79.60	80.39	81.26	82.18	83.13	84.09	85.04	86.13	87.38	86.96	90.23
93.50	96.73	86.95	116.47	119.72							
231.26	185.34	145.99	121.38	104.97	101.69	98.41	96.77	93.49	89.89	87.26	85.55
84.45	83.60	82.78	82.00	81.25	80.54	79.88	79.27	78.70	78.17	77.69	77.26
76.86	76.49	76.15	75.84	75.54	75.26	74.99	74.73	74.49	74.26	74.06	73.89
73.76	73.67	73.60	73.52	73.45	73.38	73.31	73.26	73.24	73.26	73.31	73.39
73.49	73.61	73.75	73.90	74.06	74.24	74.43	74.65	74.90	75.20	75.58	76.05
76.65	77.41	78.34	79.44	80.67	82.02	83.46	84.98	87.00	90.35	96.75	96.78
96.77	93.48	86.94	116.46	118.09							
229.64	185.34	145.99	121.37	104.98	101.69	98.41	96.76	93.49	89.51	86.80	85.03
83.88	83.00	82.14	81.33	80.55	79.83	79.15	78.53	77.96	77.45	76.99	76.59
76.23	75.91	75.62	75.36	75.11	74.87	74.63	74.39	74.16	73.94	73.74	73.57
73.45	73.38	73.36	73.42	73.33	73.12	72.96	72.86	72.80	72.78	72.80	72.85
72.91	72.99	73.08	73.18	73.29	73.40	73.51	73.63	73.77	73.94	74.16	74.48
74.97	75.70	76.73	78.01	79.48	81.08	82.78	84.57	86.94	90.82	96.75	96.77
96.77	93.47	86.95	116.45	118.09							
229.17	185.14	145.86	121.29	105.14	101.58	98.36	96.42	93.02	89.19	86.45	84.64
82.12	81.43	80.76	80.11	79.49	78.91	78.37	77.82	77.25	76.69	76.21	75.79
75.44	75.17	74.96	74.79	74.65	74.51	74.37	74.21	74.05	73.90	73.75	73.62
73.51	73.43	73.38	73.36	73.36	73.35	73.33	73.32	73.31	73.28	73.25	73.21
73.16	73.15	73.23	73.35	73.47	73.57	73.68	73.76	73.85	73.93	74.04	74.21
74.53	75.04	75.82	76.76	77.76	78.81	79.87	80.94	86.45	90.22	95.14	96.33
96.20	92.93	87.88	114.79	117.79							
228.80	184.99	145.76	121.23	105.26	101.49	98.28	96.11	92.64	88.89	86.14	84.31
81.90	81.18	80.46	79.76	79.08	78.43	77.82	77.22	76.65	76.12	75.65	75.26
74.96	74.72	74.55	74.43	74.33	74.25	74.15	74.03	73.89	73.75	73.62	73.50
73.40	73.34	73.30	73.29	73.31	73.32	73.33	73.35	73.35	73.35	73.34	73.32
73.30	73.31	73.36	73.43	73.51	73.60	73.67	73.73	73.79	73.86	73.94	74.07
74.26	74.63	75.49	76.53	77.58	78.65	79.73	80.81	85.86	89.43	93.84	95.68

95.65	92.52	88.52	113.54	117.52							
228.42	184.83	145.67	121.16	105.38	101.40	98.18	95.80	92.26	88.57	85.83	83.97
81.69	80.92	80.15	79.38	78.65	77.93	77.26	76.61	76.02	75.49	75.04	74.69
74.42	74.24	74.12	74.06	74.03	74.00	73.94	73.86	73.75	73.62	73.49	73.38
73.29	73.24	73.22	73.23	73.26	73.30	73.35	73.39	73.43	73.46	73.47	73.47
73.48	73.49	73.51	73.56	73.61	73.67	73.72	73.76	73.82	73.88	73.94	74.06
74.21	74.50	75.40	76.42	77.47	78.54	79.59	80.65	85.16	88.50	92.56	94.84
95.02	92.11	89.08	112.37	117.24							
228.05	184.67	145.57	121.10	105.48	101.30	98.04	95.47	91.88	88.25	85.51	83.64
81.48	80.67	79.83	79.00	78.19	77.41	76.67	75.99	75.37	74.82	74.39	74.07
73.85	73.72	73.67	73.68	73.73	73.78	73.79	73.73	73.62	73.49	73.36	73.26
73.18	73.14	73.14	73.18	73.22	73.29	73.38	73.46	73.54	73.60	73.64	73.66
73.67	73.68	73.69	73.72	73.75	73.79	73.82	73.85	73.89	73.96	74.04	74.17
74.40	74.82	75.54	76.44	77.43	78.44	79.46	80.47	84.40	87.52	91.30	93.88
94.32	91.71	89.55	111.28	116.94							
227.68	184.51	145.48	121.04	105.57	101.19	97.89	95.13	91.51	87.94	85.21	83.31
81.31	80.43	79.52	78.62	77.74	76.89	76.08	75.34	74.68	74.13	73.71	73.42
73.24	73.18	73.20	73.30	73.44	73.59	73.68	73.64	73.51	73.38	73.24	73.14
73.07	73.04	73.06	73.11	73.20	73.31	73.43	73.56	73.67	73.77	73.83	73.86
73.88	73.88	73.89	73.90	73.91	73.93	73.96	73.99	74.02	74.09	74.18	74.35
74.63	75.07	75.71	76.51	77.42	78.37	79.34	80.31	83.63	86.52	90.09	92.86
93.59	91.31	89.95	110.26	116.62							
227.32	184.35	145.39	120.98	105.66	101.08	97.71	94.79	91.16	87.64	84.92	83.00
81.16	80.22	79.25	78.27	77.30	76.36	75.50	74.70	74.01	73.40	73.00	72.73
72.61	72.61	72.72	72.90	73.15	73.43	73.64	73.58	73.43	73.27	73.12	73.01
72.94	72.93	72.97	73.05	73.18	73.32	73.49	73.65	73.82	73.96	74.05	74.08
74.08	74.08	74.07	74.07	74.08	74.10	74.11	74.13	74.18	74.24	74.35	74.54
74.83	75.26	75.85	76.57	77.40	78.29	79.22	80.15	82.85	85.54	88.92	91.81
92.82	90.91	90.26	109.30	116.29							
226.95	184.19	145.30	120.92	105.73	100.97	97.52	94.45	90.82	87.37	84.66	82.73
81.06	80.05	79.01	77.94	76.89	75.86	74.90	74.06	73.34	72.78	72.29	72.03
71.96	72.04	72.23	72.50	72.82	73.18	73.50	73.46	73.33	73.18	73.03	72.90
72.84	72.83	72.88	72.99	73.15	73.34	73.54	73.76	73.99	74.17	74.27	74.31
74.29	74.26	74.24	74.24	74.25	74.26	74.27	74.29	74.32	74.38	74.49	74.68
74.96	75.38	75.92	76.58	77.35	78.19	79.07	79.97	82.08	84.59	87.79	90.76
92.02	90.51	90.51	108.41	115.94							
226.59	184.02	145.21	120.87	105.80	100.85	97.31	94.11	90.50	87.12	84.45	82.50
81.01	79.93	78.81	77.66	76.52	75.39	74.33	73.41	72.62	71.97	71.51	71.29
71.30	71.48	71.78	72.12	72.49	72.83	73.12	73.28	73.29	73.16	72.97	72.83
72.76	72.74	72.79	72.93	73.13	73.37	73.61	73.88	74.15	74.40	74.52	74.51
74.45	74.40	74.37	74.38	74.39	74.41	74.43	74.44	74.47	74.51	74.60	74.76
75.03	75.40	75.90	76.51	77.22	78.02	78.88	79.76	81.32	83.66	86.72	89.71
91.22	90.10	90.69	107.56	115.58							
226.23	183.86	145.12	120.81	105.86	100.73	97.09	93.78	90.21	86.92	84.28	82.33
80.99	79.85	78.68	77.46	76.24	75.00	73.82	72.82	71.93	71.18	70.69	70.53
70.67	71.00	71.41	71.85	72.24	72.57	72.87	73.25	73.48	73.35	73.01	72.87
72.77	72.68	72.71	72.87	73.12	73.39	73.65	73.93	74.26	74.64	74.75	74.63
74.52	74.46	74.44	74.46	74.51	74.56	74.58	74.59	74.58	74.60	74.65	74.78
75.00	75.34	75.79	76.36	77.03	77.78	78.59	79.46	80.58	82.77	85.69	88.69
90.41	89.69	90.81	106.77	115.21							
225.87	183.69	145.04	120.76	105.91	100.60	96.86	93.46	89.94	86.75	84.17	82.23
80.96	79.82	78.61	77.36	76.07	74.77	73.51	72.38	71.35	70.47	69.87	69.79
70.15	70.67	71.21	71.76	72.22	72.57	72.76	73.56	74.14	74.07	73.20	73.24
72.96	72.66	72.61	72.81	73.11	73.43	73.70	73.87	74.15	74.66	74.79	74.58
74.45	74.40	74.41	74.49	74.58	74.67	74.71	74.71	74.66	74.62	74.63	74.71
74.90	75.18	75.60	76.12	76.74	77.43	78.19	78.98	79.84	81.92	84.70	87.70
89.61	89.28	90.88	106.02	114.83							
225.52	183.53	144.96	120.70	105.96	100.47	96.62	93.14	89.69	86.62	84.13	82.21
80.99	79.86	78.65	77.38	76.06	74.71	73.39	72.13	71.00	69.97	69.10	69.22
69.90	70.64	71.33	71.97	72.53	73.00	73.51	74.32	75.26	76.03	75.32	74.22
73.38	72.67	72.54	72.79	73.13	73.53	73.77	73.78	73.83	74.17	74.31	74.25
74.19	74.21	74.28	74.42	74.60	74.76	74.84	74.80	74.69	74.58	74.53	74.55
74.68	74.93	75.30	75.78	76.35	77.01	77.70	78.41	79.13	81.09	83.77	86.74
88.81	88.87	90.89	105.31	114.45							
225.16	183.36	144.87	120.65	105.99	100.34	96.37	92.83	89.45	86.54	84.16	82.28

81.12	80.00	78.79	77.52	76.20	74.85	73.47	72.12	71.00	70.06	69.26	69.43
70.19	70.97	71.73	72.43	73.07	73.64	74.26	75.06	76.05	77.17	76.56	75.01
73.90	73.11	72.82	72.88	73.10	73.62	73.90	73.64	73.55	73.63	73.71	73.76
73.79	73.86	74.01	74.24	74.52	74.79	74.94	74.86	74.65	74.46	74.33	74.29
74.37	74.58	74.92	75.37	75.91	76.51	77.16	77.81	78.43	80.30	82.88	85.82
88.04	88.45	90.86	104.64	114.05							
224.81	183.19	144.79	120.60	106.02	100.21	96.13	92.52	89.23	86.49	84.27	82.47
81.36	80.26	79.06	77.81	76.52	75.21	73.86	72.50	71.51	70.78	70.33	70.40
70.93	71.62	72.36	73.07	73.72	74.29	74.82	75.43	76.04	76.39	75.95	75.08
74.30	73.69	73.29	73.07	72.95	73.30	73.42	73.15	73.02	73.03	73.09	73.17
73.26	73.40	73.62	73.91	74.29	74.73	75.05	74.79	74.46	74.20	74.02	73.93
73.96	74.12	74.45	74.88	75.41	75.98	76.59	77.20	77.76	79.55	82.03	84.94
87.28	88.02	90.79	104.00	113.66							
224.46	183.02	144.71	120.55	106.05	100.07	95.87	92.22	89.02	86.47	84.45	82.77
81.72	80.64	79.45	78.22	77.03	75.80	74.57	73.39	72.46	71.80	71.45	71.48
71.85	72.43	73.10	73.76	74.43	74.89	75.21	75.57	75.83	75.78	75.21	74.92
74.57	74.19	73.81	73.43	73.08	72.82	72.58	72.37	72.31	72.35	72.43	72.53
72.65	72.83	73.08	73.42	73.83	74.33	74.75	74.42	74.08	73.80	73.60	73.48
73.46	73.58	73.91	74.36	74.88	75.43	76.01	76.59	77.11	78.83	81.23	84.10
86.54	87.60	90.69	103.38	113.25							
224.11	182.85	144.63	120.50	106.06	99.93	95.62	91.92	88.82	86.47	84.69	83.21
82.22	81.18	79.97	78.76	77.71	76.59	75.44	74.39	73.51	72.88	72.54	72.51
72.77	73.26	73.85	74.35	74.88	75.22	75.43	75.64	75.75	75.62	75.29	75.11
74.96	74.72	74.40	73.92	73.24	72.42	71.74	71.47	71.51	71.67	71.76	71.85
71.99	72.18	72.43	72.76	73.14	73.51	73.75	73.68	73.48	73.28	73.10	72.97
72.90	72.96	73.37	73.83	74.33	74.87	75.43	75.99	76.50	78.15	80.48	83.30
85.82	87.17	90.54	102.80	112.85							
223.77	182.68	144.56	120.46	106.08	99.78	95.36	91.63	88.61	86.47	84.96	83.75
82.85	81.89	80.79	79.65	78.59	77.50	76.40	75.38	74.53	73.90	73.54	73.44
73.60	73.93	74.36	74.74	75.08	75.32	75.54	75.74	75.83	75.79	75.65	75.54
75.46	75.33	75.10	74.62	73.65	72.15	70.78	70.57	70.74	70.96	71.07	71.19
71.32	71.49	71.74	72.01	72.32	72.59	72.78	72.83	72.77	72.67	72.57	72.49
72.46	72.57	72.90	73.34	73.82	74.33	74.86	75.40	75.92	77.51	79.77	82.54
85.13	86.73	90.37	102.23	112.45							
223.42	182.51	144.48	120.41	106.08	99.64	95.11	91.33	88.39	86.44	85.23	84.37
83.56	82.71	81.71	80.67	79.60	78.48	77.36	76.32	75.46	74.82	74.41	74.25
74.30	74.50	74.79	75.07	75.32	75.51	75.72	75.93	76.04	76.07	76.03	75.99
75.97	75.94	75.88	75.62	74.60	72.50	70.36	70.12	70.17	70.29	70.43	70.58
70.72	70.86	71.07	71.29	71.49	71.69	71.89	72.04	72.08	72.07	72.03	72.01
72.04	72.19	72.49	72.88	73.32	73.81	74.32	74.83	75.37	76.91	79.10	81.83
84.46	86.30	90.17	101.69	112.04							
223.08	182.34	144.40	120.37	106.09	99.50	94.85	91.03	88.16	86.36	85.42	84.94
84.29	83.51	82.57	81.62	80.60	79.43	78.24	77.16	76.26	75.58	75.15	74.93
74.90	75.00	75.19	75.42	75.63	75.83	76.03	76.21	76.32	76.38	76.39	76.39
76.39	76.42	76.48	76.61	76.04	73.40	71.35	70.27	69.86	69.81	69.93	70.09
70.26	70.39	70.53	70.65	70.76	70.86	71.12	71.35	71.46	71.51	71.51	71.54
71.62	71.79	72.07	72.42	72.84	73.30	73.79	74.29	74.87	76.35	78.47	81.15
83.81	85.86	89.94	101.17	111.64							
222.74	182.17	144.33	120.32	106.09	99.35	94.59	90.74	87.91	86.22	85.46	85.28
84.85	84.10	83.18	82.38	81.52	80.22	78.96	77.84	76.90	76.20	75.76	75.51
75.42	75.44	75.57	75.75	75.96	76.17	76.36	76.53	76.63	76.69	76.71	76.69
76.67	76.62	76.57	76.41	75.54	73.60	71.79	70.35	69.61	69.46	69.57	69.76
69.93	70.04	70.10	70.18	70.29	70.24	70.64	70.85	70.96	71.00	71.03	71.08
71.18	71.36	71.62	71.96	72.38	72.82	73.29	73.78	74.39	75.83	77.89	80.51
83.19	85.42	89.69	100.66	111.24							
222.40	182.00	144.26	120.28	106.08	99.21	94.34	90.44	87.63	86.00	85.30	85.14
84.67	84.07	83.32	82.63	81.86	80.64	79.43	78.35	77.40	76.68	76.28	75.99
75.85	75.83	75.92	76.07	76.29	76.51	76.71	76.85	76.95	76.99	76.98	76.93
76.82	76.61	76.29	75.74	74.70	73.19	72.02	70.26	69.38	69.26	69.38	69.61
69.82	69.85	69.82	69.82	70.24	70.61	70.57	70.55	70.54	70.56	70.58	70.64
70.74	70.92	71.18	71.52	71.93	72.36	72.84	73.33	73.96	75.35	77.35	79.91
82.59	84.99	89.43	100.16	110.84							
222.07	181.83	144.18	120.24	106.07	99.06	94.09	90.14	87.33	85.69	84.94	84.63
84.13	83.64	83.04	82.39	81.62	80.66	79.65	78.69	77.86	77.19	76.73	76.40
76.21	76.15	76.21	76.36	76.58	76.83	77.05	77.19	77.25	77.26	77.22	77.11

76.92	76.54	75.97	75.18	74.17	72.94	71.85	70.60	69.70	69.31	69.37	69.63
69.81	69.82	69.71	69.58	70.18	70.86	70.49	70.28	70.18	70.16	70.18	70.22
70.31	70.47	70.74	71.09	71.49	71.94	72.42	72.92	73.55	74.90	76.85	79.35
82.02	84.55	89.14	99.68	110.44							
221.73	181.66	144.11	120.20	106.06	98.92	93.84	89.85	87.02	85.32	84.43	83.93
83.49	83.06	82.55	81.96	81.29	80.53	79.72	78.93	78.20	77.59	77.10	76.74
76.49	76.39	76.43	76.58	76.83	77.13	77.40	77.51	77.53	77.50	77.43	77.29
77.04	76.55	75.72	74.78	73.89	72.95	72.00	71.08	70.30	69.72	69.73	69.93
70.03	70.00	69.88	69.76	70.04	70.35	70.15	69.91	69.81	69.79	69.82	69.85
69.89	70.03	70.30	70.68	71.10	71.56	72.04	72.54	73.18	74.49	76.39	78.82
81.46	84.11	88.84	99.21	110.05							
221.40	181.48	144.04	120.16	106.04	98.78	93.60	89.55	86.68	84.89	83.83	83.15
82.81	82.40	81.96	81.47	80.93	80.33	79.70	79.07	78.46	77.90	77.42	77.00
76.70	76.56	76.57	76.72	77.00	77.35	77.75	77.76	77.73	77.67	77.57	77.43
77.20	76.76	75.62	74.43	73.79	73.09	72.36	71.67	71.07	70.67	70.52	70.51
70.48	70.39	70.21	70.00	69.93	69.92	69.75	69.48	69.45	69.48	69.54	69.58
69.56	69.57	69.92	70.33	70.76	71.21	71.68	72.18	72.83	74.11	75.96	78.33
80.93	83.67	88.52	98.75	109.66							
221.07	181.31	143.97	120.12	106.02	98.63	93.36	89.25	86.34	84.44	83.20	82.34
82.08	81.71	81.32	80.94	80.54	80.12	79.65	79.17	78.67	78.18	77.71	77.26
76.88	76.68	76.64	76.78	77.07	77.43	77.74	77.85	77.85	77.79	77.66	77.49
77.25	76.85	75.75	74.65	73.96	73.37	72.81	72.30	71.90	71.62	71.42	71.23
71.04	70.85	70.67	70.08	69.85	69.70	69.51	69.31	69.22	69.25	69.35	69.47
69.51	69.39	69.73	70.08	70.47	70.89	71.34	71.84	72.50	73.76	75.58	77.87
80.41	83.23	88.19	98.30	109.28							
220.74	181.14	143.90	120.08	106.00	98.50	93.12	88.96	85.99	83.98	82.57	81.55
81.35	80.97	80.67	80.41	80.18	79.92	79.61	79.27	78.88	78.46	78.01	77.57
77.15	76.82	76.64	76.78	77.10	77.44	77.71	77.87	77.90	77.85	77.70	77.46
77.12	76.59	75.79	74.94	74.26	73.72	73.26	72.91	72.68	72.54	72.33	71.96
71.59	71.21	70.69	70.02	69.85	69.65	69.42	69.20	69.04	69.05	69.19	69.42
69.72	69.69	69.71	69.92	70.22	70.60	71.03	71.52	72.19	73.45	75.24	77.44
79.91	82.79	87.85	97.86	108.90							
220.41	180.97	143.83	120.04	105.98	98.36	92.89	88.68	85.64	83.53	81.98	80.82
80.63	80.25	80.00	79.89	79.84	79.76	79.62	79.40	79.12	78.78	78.38	77.94
77.49	77.04	76.60	76.82	77.18	77.51	77.76	77.92	77.96	77.89	77.71	77.42
76.99	76.44	75.78	75.10	74.51	74.04	73.67	73.40	73.28	73.28	73.15	72.57
72.07	71.55	70.96	70.41	70.03	69.71	69.42	69.15	68.96	68.93	69.04	69.23
69.44	69.54	69.58	69.72	69.97	70.31	70.72	71.21	71.89	73.17	74.93	77.03
79.43	82.35	87.49	97.43	108.52							
220.08	180.79	143.76	120.01	105.96	98.22	92.67	88.40	85.31	83.12	81.48	80.23
79.99	79.54	79.32	79.45	79.60	79.69	79.70	79.62	79.43	79.15	78.79	78.38
77.93	77.48	77.15	77.18	77.42	77.67	77.86	78.01	78.04	77.96	77.74	77.38
76.90	76.34	75.74	75.16	74.68	74.27	73.96	73.75	73.64	73.57	73.37	72.94
72.46	71.93	71.35	70.79	70.28	69.85	69.47	69.15	68.93	68.83	68.86	68.98
69.12	69.25	69.35	69.50	69.72	70.03	70.43	70.90	71.60	72.93	74.67	76.65
78.96	81.91	87.13	97.01	108.16							
219.76	180.62	143.70	119.97	105.93	98.09	92.45	88.12	84.99	82.75	81.09	79.84
79.52	79.07	78.87	79.21	79.51	79.73	79.87	79.90	79.82	79.60	79.27	78.87
78.43	78.04	77.75	77.66	77.73	77.87	78.01	78.12	78.15	78.07	77.79	77.37
76.84	76.25	75.65	75.17	74.76	74.42	74.15	73.94	73.80	73.67	73.47	73.17
72.78	72.31	71.74	71.12	70.51	69.99	69.53	69.16	68.88	68.71	68.67	68.73
68.84	68.96	69.08	69.24	69.46	69.75	70.13	70.60	71.33	72.74	74.45	76.28
78.50	81.48	86.76	96.59	107.79							
219.43	180.45	143.63	119.94	105.90	97.96	92.24	87.86	84.68	82.43	80.82	79.68
79.32	79.07	79.03	79.26	79.57	79.88	80.13	80.28	80.28	80.10	79.80	79.40
78.96	78.56	78.26	78.08	78.04	78.07	78.14	78.21	78.26	78.21	77.85	77.35
76.79	76.18	75.55	75.16	74.81	74.49	74.22	74.01	73.85	73.70	73.53	73.31
73.05	72.67	72.08	71.37	70.69	70.08	69.56	69.14	68.82	68.57	68.44	68.50
68.60	68.71	68.85	69.01	69.21	69.47	69.86	70.38	71.09	72.62	74.26	75.92
78.04	81.04	86.38	96.18	107.44							
219.11	180.28	143.56	119.90	105.87	97.84	92.04	87.61	84.40	82.16	80.63	79.68
79.31	79.18	79.21	79.42	79.74	80.09	80.43	80.71	80.79	80.65	80.34	79.90
79.43	79.00	78.65	78.41	78.28	78.22	78.22	78.23	78.24	78.18	77.80	77.30
76.76	76.19	75.64	75.20	74.83	74.51	74.23	74.00	73.82	73.67	73.51	73.35
73.20	73.02	72.33	71.51	70.76	70.10	69.54	69.08	68.73	68.47	68.34	68.34

68.41	68.51	68.64	68.80	69.01	69.25	69.62	70.32	70.92	72.59	74.10	75.57
77.60	80.61	86.00	95.77	107.09							
218.79	180.10	143.50	119.87	105.85	97.72	91.84	87.37	84.14	81.92	80.51	79.74
79.35	79.29	79.35	79.57	79.89	80.28	80.71	81.10	81.30	81.21	80.86	80.35
79.82	79.32	78.92	78.62	78.41	78.29	78.21	78.16	78.09	77.93	77.61	77.18
76.69	76.18	75.68	75.22	74.82	74.46	74.17	73.92	73.72	73.56	73.40	73.25
73.08	72.85	72.23	71.44	70.70	70.02	69.44	68.98	68.64	68.40	68.26	68.23
68.27	68.35	68.47	68.64	68.87	69.18	69.65	70.38	70.83	72.64	73.92	75.20
77.16	80.17	85.60	95.37	106.74							
218.47	179.93	143.43	119.84	105.82	97.60	91.65	87.14	83.89	81.72	80.42	79.80
79.39	79.35	79.43	79.65	79.97	80.38	80.86	81.35	81.74	81.77	81.31	80.66
80.03	79.49	79.03	78.68	78.43	78.25	78.12	78.01	77.88	77.69	77.40	77.03
76.60	76.14	75.66	75.19	74.75	74.35	74.03	73.76	73.56	73.38	73.20	73.02
72.79	72.44	71.90	71.23	70.53	69.86	69.29	68.83	68.52	68.31	68.18	68.14
68.15	68.22	68.34	68.51	68.76	69.12	69.67	70.42	70.72	72.79	73.69	74.82
76.72	79.74	85.21	94.98	106.40							
218.16	179.76	143.37	119.81	105.79	97.48	91.47	86.92	83.67	81.53	80.32	79.80
79.37	79.34	79.42	79.62	79.94	80.35	80.83	81.38	81.97	82.32	81.49	80.71
80.04	79.46	78.98	78.60	78.32	78.12	77.96	77.81	77.64	77.44	77.18	76.86
76.49	76.07	75.62	75.13	74.64	74.18	73.82	73.54	73.33	73.14	72.95	72.73
72.45	72.07	71.57	70.96	70.31	69.66	69.07	68.65	68.40	68.22	68.11	68.06
68.07	68.12	68.22	68.38	68.64	69.01	69.56	70.31	70.45	72.49	73.34	74.43
76.29	79.30	84.81	94.59	106.07							
217.84	179.58	143.30	119.78	105.76	97.37	91.30	86.72	83.46	81.36	80.21	79.74
79.29	79.26	79.32	79.50	79.78	80.15	80.59	81.07	81.52	81.62	81.09	80.43
79.81	79.24	78.76	78.38	78.08	77.86	77.70	77.55	77.38	77.17	76.93	76.67
76.35	75.99	75.55	75.04	74.50	73.96	73.54	73.28	73.07	72.88	72.68	72.43
72.12	71.74	71.26	70.71	70.11	69.49	68.86	68.48	68.31	68.17	68.07	68.01
68.01	68.04	68.12	68.25	68.48	68.81	69.32	70.02	70.01	71.71	72.86	74.01
75.85	78.87	84.40	94.20	105.75							
217.53	179.41	143.24	119.75	105.73	97.27	91.14	86.53	83.27	81.19	80.07	79.61
79.17	79.10	79.13	79.27	79.50	79.81	80.15	80.49	80.72	80.68	80.37	79.90
79.37	78.86	78.40	78.01	77.71	77.49	77.35	77.23	77.04	76.82	76.62	76.43
76.20	75.90	75.49	74.96	74.36	73.75	73.29	73.01	72.79	72.60	72.39	72.14
71.83	71.45	71.00	70.50	69.96	69.40	68.89	68.53	68.31	68.17	68.06	67.99
67.96	67.98	68.03	68.12	68.29	68.55	68.94	69.60	69.50	70.99	72.32	73.58
75.43	78.44	83.99	93.82	105.43							
217.22	179.24	143.18	119.72	105.70	97.17	90.98	86.35	83.09	81.02	79.91	79.42
79.00	78.90	78.88	78.95	79.12	79.36	79.61	79.82	79.93	79.87	79.63	79.25
78.81	78.34	77.90	77.51	77.20	76.99	76.88	76.90	76.58	76.36	76.22	76.11
76.01	75.82	75.44	74.86	74.21	73.59	73.09	72.74	72.49	72.29	72.11	71.89
71.57	71.19	70.79	70.33	69.86	69.40	68.97	68.62	68.39	68.21	68.08	68.01
67.96	67.93	67.95	68.00	68.12	68.29	68.62	69.12	69.01	70.36	71.77	73.14
75.00	78.01	83.57	93.45	105.12							
216.91	179.07	143.12	119.69	105.67	97.07	90.84	86.19	82.93	80.86	79.73	79.19
78.80	78.66	78.57	78.56	78.69	78.87	79.03	79.15	79.18	79.10	78.89	78.57
78.18	77.75	77.32	76.92	76.57	76.32	76.17	76.07	75.90	75.75	75.68	75.68
75.74	75.75	75.41	74.71	73.95	73.29	72.76	72.38	72.12	71.96	71.84	71.64
71.32	70.96	70.59	70.21	69.81	69.42	69.05	68.74	68.49	68.30	68.16	68.06
67.99	67.94	67.92	67.93	67.96	68.07	68.28	68.63	68.58	69.81	71.24	72.70
74.59	77.59	83.15	93.08	104.81							
216.60	178.90	143.06	119.67	105.64	96.98	90.71	86.04	82.78	80.71	79.54	78.95
78.60	78.43	78.28	78.20	78.29	78.38	78.46	78.51	78.49	78.38	78.19	77.90
77.55	77.14	76.69	76.25	75.85	75.53	75.32	75.18	75.08	75.00	74.99	75.06
75.25	75.56	75.29	74.33	73.51	72.82	72.29	71.92	71.67	71.54	71.49	71.37
71.03	70.72	70.42	70.10	69.79	69.46	69.14	68.85	68.61	68.42	68.27	68.16
68.10	68.03	67.95	67.92	67.88	67.86	67.94	68.14	68.21	69.34	70.76	72.28
74.17	77.16	82.73	92.72	104.51							
216.29	178.73	142.99	119.64	105.61	96.89	90.58	85.91	82.64	80.56	79.35	78.70
78.42	78.22	78.07	77.96	77.94	77.94	77.93	77.90	77.83	77.72	77.54	77.29
76.96	76.54	76.08	75.60	75.10	74.68	74.43	74.29	74.22	74.18	74.17	74.23
74.37	74.53	74.26	73.53	72.82	72.20	71.70	71.35	71.13	71.02	70.96	70.86
70.67	70.45	70.25	70.03	69.79	69.53	69.25	68.99	68.77	68.60	68.44	68.32
68.30	68.26	68.16	68.02	67.85	67.74	67.72	67.79	67.91	68.95	70.32	71.87
73.77	76.74	82.30	92.36	104.22							

215.99	178.55	142.93	119.62	105.59	96.81	90.47	85.79	82.53	80.43	79.18	78.47
78.24	78.04	77.87	77.74	77.64	77.56	77.46	77.35	77.24	77.14	76.98	76.75
76.43	76.03	75.56	75.02	74.43	73.86	73.61	73.48	73.43	73.36	73.31	73.29
73.24	73.12	72.85	72.49	72.01	71.50	71.04	70.72	70.55	70.47	70.43	70.37
70.28	70.18	70.09	69.99	69.86	69.65	69.39	69.14	68.95	68.82	68.72	68.65
68.65	68.65	68.53	68.25	67.89	67.67	67.60	67.64	67.67	68.64	69.95	71.48
73.38	76.33	81.88	92.00	103.94							
215.68	178.38	142.87	119.60	105.56	96.74	90.36	85.68	82.43	80.32	79.02	78.25
78.09	77.88	77.69	77.53	77.38	77.23	77.04	76.85	76.71	76.64	76.52	76.32
76.01	75.61	75.14	74.61	74.02	73.45	73.10	72.88	72.83	72.68	72.52	72.43
72.25	71.86	71.59	71.56	71.31	70.88	70.39	70.11	70.01	69.97	69.97	69.96
69.93	69.93	69.97	70.00	70.00	69.82	69.55	69.29	69.16	69.11	69.10	69.10
69.12	69.14	69.07	68.62	67.93	67.66	67.57	67.65	67.53	68.42	69.63	71.12
73.00	75.91	81.44	91.66	103.66							
215.38	178.21	142.81	119.57	105.54	96.67	90.27	85.59	82.34	80.23	78.90	78.07
77.94	77.73	77.54	77.35	77.17	76.98	76.74	76.47	76.29	76.29	76.19	75.99
75.69	75.32	74.87	74.38	73.87	73.42	73.06	72.79	72.57	72.26	71.90	71.90
71.69	71.29	71.04	71.10	70.93	70.55	70.04	69.78	69.68	69.62	69.65	69.67
69.66	69.74	69.89	70.03	70.14	70.02	69.74	69.46	69.42	69.50	69.56	69.60
69.62	69.62	69.61	69.16	68.11	67.82	67.69	67.76	67.51	68.27	69.36	70.78
72.63	75.50	81.01	91.31	103.39							
215.08	178.04	142.76	119.55	105.52	96.60	90.18	85.51	82.28	80.17	78.82	77.96
77.85	77.63	77.43	77.23	77.02	76.81	76.57	76.34	76.18	76.10	76.00	75.79
75.48	75.11	74.71	74.28	73.85	73.50	73.19	72.89	72.64	72.35	72.02	71.83
71.62	71.37	71.23	71.11	70.90	70.60	70.24	69.95	69.68	69.52	69.60	69.58
69.49	69.64	69.90	70.10	70.22	70.21	70.06	69.83	69.91	70.06	70.10	70.14
70.10	70.00	69.82	69.38	68.68	68.21	67.99	67.95	67.59	68.19	69.14	70.47
72.27	75.10	80.57	90.98	103.12							
214.78	177.87	142.70	119.53	105.50	96.54	90.11	85.44	82.23	80.13	78.79	77.95
77.84	77.60	77.38	77.15	76.94	76.71	76.49	76.29	76.12	75.99	75.87	75.65
75.33	74.99	74.62	74.26	73.92	73.68	73.38	73.06	72.85	72.71	72.38	72.04
71.78	71.59	71.50	71.33	71.11	70.88	70.64	70.40	70.13	69.94	69.86	69.78
69.72	69.82	70.05	70.26	70.42	70.51	70.56	70.62	70.79	70.93	70.86	70.79
70.60	70.32	69.99	69.52	68.99	68.55	68.27	68.15	67.73	68.17	68.97	70.18
71.93	74.71	80.13	90.65	102.87							
214.48	177.70	142.64	119.51	105.48	96.49	90.04	85.39	82.20	80.12	78.80	77.99
77.85	77.58	77.35	77.12	76.89	76.67	76.45	76.25	76.07	75.91	75.74	75.51
75.22	74.92	74.60	74.28	73.99	73.74	73.45	73.19	73.00	72.84	72.57	72.25
71.99	71.81	71.68	71.54	71.40	71.26	71.14	71.00	70.76	70.51	70.31	70.17
70.11	70.17	70.32	70.51	70.69	70.88	71.08	71.37	71.74	72.11	71.96	71.51
71.07	70.62	70.17	69.69	69.21	68.79	68.49	68.32	67.89	68.17	68.82	69.92
71.60	74.32	79.68	90.32	102.62							
214.18	177.53	142.58	119.49	105.46	96.44	89.99	85.35	82.19	80.13	78.83	78.05
77.86	77.60	77.35	77.12	76.88	76.66	76.44	76.24	76.04	75.85	75.65	75.43
75.16	74.88	74.59	74.30	74.03	73.78	73.53	73.29	73.10	72.89	72.65	72.40
72.18	72.01	71.89	71.78	71.71	71.67	71.68	71.69	71.43	71.07	70.77	70.59
70.50	70.52	70.62	70.78	70.98	71.22	71.51	71.90	72.46	73.24	72.74	72.00
71.39	70.85	70.32	69.83	69.36	68.96	68.64	68.43	68.03	68.19	68.69	69.68
71.28	73.94	79.23	90.00	102.37							
213.89	177.37	142.52	119.47	105.44	96.40	89.94	85.33	82.19	80.16	78.89	78.13
77.89	77.63	77.38	77.13	76.90	76.67	76.44	76.24	76.03	75.82	75.61	75.38
75.13	74.86	74.60	74.33	74.08	73.83	73.60	73.38	73.17	72.96	72.76	72.54
72.36	72.21	72.08	72.01	71.97	71.98	72.06	72.19	71.90	71.48	71.17	70.96
70.85	70.83	70.90	71.03	71.22	71.46	71.76	72.15	72.59	72.91	72.68	72.10
71.51	70.94	70.41	69.92	69.46	69.06	68.73	68.49	68.14	68.19	68.57	69.46
70.98	73.56	78.78	89.69	102.14							
213.60	177.20	142.47	119.46	105.43	96.36	89.90	85.31	82.21	80.21	78.97	78.22
77.93	77.67	77.40	77.16	76.93	76.69	76.47	76.25	76.04	75.82	75.60	75.37
75.12	74.88	74.62	74.38	74.13	73.90	73.68	73.46	73.25	73.06	72.86	72.67
72.51	72.38	72.26	72.20	72.17	72.18	72.21	72.19	72.01	71.71	71.44	71.25
71.13	71.10	71.13	71.23	71.38	71.60	71.85	72.14	72.40	72.52	72.35	71.94
71.44	70.92	70.42	69.93	69.49	69.11	68.77	68.50	68.20	68.18	68.47	69.25
70.70	73.20	78.33	89.39	101.91							
213.30	177.03	142.41	119.44	105.42	96.33	89.87	85.31	82.24	80.28	79.06	78.32
77.98	77.71	77.45	77.20	76.96	76.74	76.51	76.29	76.06	75.84	75.62	75.39

75.15	74.91	74.67	74.43	74.19	73.97	73.75	73.54	73.34	73.15	72.96	72.80
72.64	72.51	72.42	72.35	72.31	72.29	72.26	72.19	72.04	71.83	71.62	71.44
71.33	71.28	71.29	71.36	71.48	71.64	71.83	72.00	72.14	72.15	72.00	71.68
71.26	70.81	70.35	69.90	69.49	69.11	68.78	68.50	68.23	68.15	68.36	69.05
70.43	72.85	77.86	89.09	101.68							
213.01	176.86	142.36	119.42	105.41	96.30	89.86	85.32	82.29	80.35	79.16	78.43
78.01	77.76	77.50	77.26	77.01	76.79	76.55	76.32	76.10	75.88	75.65	75.42
75.19	74.96	74.72	74.49	74.26	74.04	73.83	73.62	73.43	73.25	73.07	72.91
72.76	72.65	72.54	72.46	72.40	72.35	72.29	72.20	72.07	71.90	71.73	71.58
71.47	71.41	71.40	71.43	71.51	71.61	71.72	71.82	71.86	71.82	71.65	71.39
71.03	70.64	70.23	69.82	69.44	69.09	68.78	68.52	68.21	68.10	68.25	68.87
70.18	72.51	77.40	88.80	101.47							
212.72	176.70	142.30	119.41	105.40	96.28	89.84	85.34	82.35	80.44	79.27	78.55
78.07	77.81	77.56	77.32	77.07	76.84	76.61	76.39	76.16	75.93	75.71	75.47
75.25	75.01	74.79	74.56	74.33	74.12	73.92	73.71	73.53	73.35	73.18	73.02
72.88	72.76	72.64	72.56	72.47	72.40	72.32	72.22	72.08	71.94	71.79	71.65
71.55	71.49	71.45	71.46	71.48	71.53	71.57	71.60	71.58	71.50	71.33	71.09
70.79	70.44	70.08	69.72	69.37	69.05	68.77	68.53	68.15	68.03	68.14	68.70
69.94	72.19	76.93	88.52	101.25							
212.43	176.53	142.24	119.40	105.39	96.26	89.84	85.37	82.41	80.54	79.38	78.67
78.12	77.87	77.62	77.38	77.15	76.91	76.68	76.46	76.22	75.99	75.76	75.54
75.31	75.08	74.85	74.63	74.42	74.21	74.01	73.81	73.62	73.44	73.28	73.12
72.98	72.85	72.74	72.63	72.54	72.44	72.33	72.22	72.10	71.96	71.82	71.69
71.59	71.51	71.46	71.43	71.42	71.42	71.41	71.38	71.32	71.21	71.04	70.81
70.54	70.23	69.91	69.58	69.28	69.00	68.74	68.53	68.06	67.93	68.02	68.54
69.72	71.88	76.45	88.25	101.05							
212.15	176.36	142.19	119.38	105.39	96.25	89.85	85.41	82.49	80.65	79.51	78.81
78.18	77.93	77.68	77.44	77.21	76.99	76.76	76.53	76.30	76.07	75.84	75.60
75.38	75.15	74.93	74.71	74.50	74.29	74.09	73.90	73.71	73.53	73.36	73.21
73.07	72.93	72.82	72.69	72.58	72.47	72.36	72.24	72.10	71.97	71.83	71.71
71.60	71.51	71.43	71.38	71.33	71.29	71.25	71.17	71.08	70.94	70.75	70.54
70.29	70.02	69.74	69.46	69.18	68.92	68.68	68.50	67.95	67.81	67.91	68.39
69.52	71.58	75.97	87.99	100.85							
211.86	176.20	142.14	119.37	105.39	96.25	89.86	85.46	82.58	80.76	79.64	78.94
78.24	77.99	77.75	77.52	77.29	77.06	76.84	76.61	76.38	76.15	75.92	75.68
75.46	75.23	75.01	74.79	74.58	74.38	74.18	73.99	73.80	73.62	73.45	73.30
73.15	73.01	72.89	72.75	72.63	72.50	72.38	72.24	72.11	71.97	71.83	71.69
71.57	71.47	71.38	71.31	71.24	71.16	71.08	70.97	70.85	70.69	70.51	70.29
70.06	69.82	69.56	69.31	69.07	68.83	68.62	68.45	67.81	67.68	67.80	68.26
69.34	71.31	75.48	87.73	100.65							
211.58	176.03	142.08	119.36	105.39	96.25	89.88	85.52	82.67	80.88	79.77	79.08
78.29	78.05	77.82	77.59	77.37	77.15	76.92	76.70	76.47	76.24	76.00	75.76
75.54	75.31	75.09	74.88	74.67	74.46	74.27	74.07	73.88	73.71	73.53	73.38
73.22	73.08	72.94	72.81	72.68	72.54	72.40	72.25	72.10	71.97	71.82	71.68
71.54	71.43	71.32	71.22	71.13	71.03	70.92	70.79	70.64	70.46	70.26	70.05
69.84	69.62	69.40	69.18	68.96	68.74	68.55	68.39	67.65	67.54	67.70	68.13
69.17	71.05	74.98	87.48	100.46							
211.30	175.87	142.03	119.35	105.39	96.25	89.91	85.58	82.77	81.00	79.91	79.23
78.35	78.12	77.89	77.66	77.44	77.22	77.01	76.79	76.56	76.32	76.08	75.85
75.62	75.39	75.18	74.96	74.76	74.56	74.35	74.15	73.96	73.79	73.62	73.45
73.30	73.15	73.00	72.86	72.71	72.57	72.42	72.26	72.11	71.96	71.80	71.65
71.51	71.36	71.25	71.14	71.02	70.90	70.77	70.62	70.46	70.26	70.04	69.83
69.64	69.45	69.25	69.06	68.85	68.66	68.49	68.32	67.47	67.40	67.62	68.02
69.03	70.80	74.47	87.23	100.28							
210.94	175.66	141.96	119.34	105.40	96.26	89.95	85.68	82.91	81.17	80.09	79.42
78.99	78.66	78.34	78.04	77.74	77.46	77.18	76.92	76.66	76.42	76.18	75.94
75.72	75.50	75.28	75.07	74.86	74.66	74.47	74.28	74.09	73.91	73.73	73.56
73.40	73.24	73.08	72.93	72.77	72.62	72.46	72.30	72.13	71.96	71.79	71.62
71.45	71.29	71.14	70.98	70.83	70.69	70.53	70.37	70.20	70.01	69.80	69.58
69.34	69.08	68.82	68.55	68.28	68.01	67.76	67.52	67.24	67.24	67.57	67.90
68.88	70.53	73.82	86.93	100.05							
210.42	175.36	141.86	119.33	105.41	96.30	90.04	85.84	83.13	81.43	80.37	79.71
79.28	78.96	78.64	78.33	78.03	77.75	77.47	77.20	76.94	76.68	76.44	76.20
75.96	75.74	75.51	75.30	75.08	74.88	74.68	74.48	74.28	74.10	73.91	73.73
73.56	73.38	73.21	73.04	72.87	72.70	72.53	72.35	72.18	72.00	71.82	71.64

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   71.46     71.28     71.11     70.93     70.75     70.58     70.39     70.20     70.00     69.79     69.57     69.34
   69.10     68.86     68.60     68.35     68.09     67.85     67.62     67.42     67.24     67.24     67.57     67.90
   68.88     70.52     73.81     86.93    100.05
  209.64    174.90    141.72    119.32    105.45     96.38     90.21     86.11     83.49     81.85     80.82     80.17
   79.75     79.42     79.11     78.80     78.50     78.21     77.92     77.65     77.38     77.11     76.86     76.61
   76.37     76.13     75.90     75.67     75.45     75.23     75.02     74.81     74.60     74.40     74.20     74.00
   73.81     73.61     73.42     73.23     73.04     72.85     72.66     72.46     72.27     72.07     71.87     71.67
   71.47     71.27     71.07     70.86     70.66     70.45     70.23     70.02     69.79     69.57     69.34     69.10
   68.86     68.62     68.39     68.15     67.93     67.72     67.54     67.38     67.24     67.24     67.57     67.90
   68.88     70.52     73.81     86.93    100.05
  208.50    174.23    141.51    119.31    105.54     96.56     90.54     86.60     84.10     82.53     81.53     80.90
   80.48     80.16     79.85     79.54     79.24     78.94     78.66     78.37     78.10     77.83     77.56     77.30
   77.04     76.79     76.55     76.30     76.07     75.83     75.60     75.37     75.14     74.92     74.69     74.47
   74.25     74.03     73.81     73.59     73.38     73.15     72.93     72.71     72.49     72.26     72.03     71.80
   71.57     71.34     71.10     70.87     70.63     70.39     70.15     69.90     69.66     69.42     69.17     68.93
   68.70     68.47     68.25     68.04     67.84     67.66     67.50     67.37     67.24     67.24     67.24     67.24
   68.88     70.52     73.80     83.65    100.05
  206.82    173.24    141.20    119.34    105.75     96.96     91.19     87.47     85.12     83.64     82.69     82.07
   81.68     81.36     81.05     80.75     80.45     80.15     79.86     79.57     79.29     79.01     78.74     78.47
   78.20     77.93     77.67     77.41     77.15     76.90     76.64     76.39     76.14     75.89     75.64     75.39
   75.13     74.88     74.63     74.38     74.12     73.87     73.61     73.35     73.09     72.83     72.56     72.30
   72.03     71.76     71.48     71.21     70.93     70.66     70.38     70.10     69.83     69.56     69.29     69.03
   68.78     68.53     68.30     68.08     67.88     67.69     67.52     67.38     67.24     67.24     67.24     67.24
   68.88     68.89     68.90     77.11    100.05
  204.40    171.79    140.77    119.45    106.21     97.79     92.40     88.99     86.84     85.48     84.59     84.02
   83.64     83.35     83.05     82.76     82.47     82.19     81.90     81.62     81.34     81.07     80.79     80.52
   80.25     79.98     79.71     79.44     79.18     78.91     78.64     78.38     78.11     77.84     77.57     77.30
   77.03     76.76     76.49     76.21     75.93     75.65     75.36     75.07     74.78     74.48     74.19     73.88
   73.58     73.26     72.95     72.63     72.31     71.99     71.66     71.33     71.00     70.67     70.34     70.02
   69.69     69.37     69.05     68.74     68.43     68.13     67.85     67.57     67.24     67.24     67.24     67.24
   68.87     68.88     67.24     67.29     96.77
  200.97    169.74    140.18    119.74    107.16     99.36     94.54     91.56     89.70     88.52     87.76     87.26
   86.93     86.68     86.42     86.17     85.92     85.67     85.42     85.18     84.93     84.69     84.45     84.22
   83.98     83.75     83.51     83.28     83.05     82.82     82.59     82.36     82.13     81.90     81.66     81.43
   81.20     80.96     80.73     80.49     80.25     80.00     79.76     79.51     79.25     79.00     78.73     78.46
   78.19     77.91     77.62     77.33     77.03     76.71     76.39     76.06     75.72     75.37     75.00     74.63
   74.24     73.84     73.42     72.99     72.55     72.09     71.63     71.15     70.53     70.53     70.53     68.89
   68.88     67.24     67.23     67.26     96.75
  196.60    167.11    139.49    120.34    108.73    101.79     97.66     95.20     93.70     92.77     92.18     91.81
   91.56     91.37     91.18     91.00     90.82     90.64     90.47     90.30     90.13     89.97     89.81     89.65
   89.50     89.35     89.21     89.07     88.93     88.80     88.67     88.54     88.42     88.30     88.19     88.08
   87.97     87.87     87.77     87.68     87.59     87.50     87.42     87.34     87.27     87.20     87.13     87.07
   87.02     86.96     86.92     86.87     86.83     86.80     86.77     86.75     86.73     86.71     86.70     86.70
   86.70     86.70     86.72     86.73     86.76     86.79     86.82     86.87     86.91     83.69     80.38     77.08
   73.81     67.24     67.24     70.52     77.07
  191.91    164.30    138.80    121.16    110.63    104.49    100.93     98.83     97.58     96.81     96.33     96.02
   95.82     95.67     95.52     95.37     95.22     95.08     94.94     94.81     94.68     94.55     94.43     94.30
   94.19     94.07     93.96     93.85     93.75     93.65     93.55     93.45     93.36     93.27     93.19     93.10
   93.02     92.94     92.87     92.80     92.72     92.66     92.59     92.52     92.46     92.39     92.33     92.27
   92.21     92.14     92.08     92.01     91.95     91.88     91.80     91.73     91.65     91.56     91.48     91.38
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        11        0.0          (12f9.2)         4      */bottom elev for Layer 2 -- 13top.grd
   230.00   197.99   169.01   125.01   105.01    95.01    94.00    94.01    97.03    99.23   100.78   101.85
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   118.93   118.71   118.48   118.27   118.05   117.84   117.64   117.44   117.24   117.05   116.87   116.69
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   124.62   144.37   168.94   168.91   134.48
   230.00   193.52   165.66   124.65    95.13    91.83    88.55    86.91    85.27    87.21    88.57    89.51
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    96.52    97.07    97.61    98.16    98.70    99.25    99.79   100.33   100.88   101.42   101.96   102.51
   103.05   103.59   104.13   104.68   105.04   105.22   105.41   105.60   105.79   105.98   106.19   106.39
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   124.63   149.29   173.89   196.80   183.69
   232.90   193.52   149.26   114.80    95.12    90.19    85.28    85.27    84.61    85.00    85.32    85.55
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    87.64    87.81    87.98    88.16    88.33    88.51    88.68    88.85    89.02    89.18    89.35    89.51
    89.67    89.82    89.97    90.12    90.24    90.33    90.42    90.50    90.58    90.66    90.74    90.82
    90.89    90.96    91.03    91.10    91.18    91.25    91.33    91.40    91.48    91.57    91.66    91.75
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   100.03   124.72   162.42   186.99   196.81
   232.90   182.05   149.25   114.80    95.12    90.19    85.28    85.27    84.94    83.87    83.35    83.09
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    88.52    85.26    82.02   104.97   124.62
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222.40	170.56	142.68	109.88	92.81	88.55	85.28	83.62	81.99	78.62	76.49	75.13
74.26	73.58	72.92	72.29	71.67	71.08	70.52	69.97	69.45	68.96	68.49	68.03
67.60	67.19	66.79	66.40	66.03	65.66	65.31	64.96	64.62	64.29	63.96	63.63
63.32	63.01	62.72	62.44	62.43	62.70	62.98	63.28	63.58	63.90	64.22	64.55
64.89	65.24	65.61	65.98	66.38	66.79	67.23	67.69	68.18	68.70	69.25	69.84
70.46	71.10	71.77	72.44	73.11	73.76	74.36	74.89	75.42	75.81	75.43	77.07
80.35	85.26	81.99	104.97	114.80							
222.39	173.51	137.75	109.88	91.85	88.56	85.29	83.64	81.99	78.71	76.25	74.66
73.63	72.84	72.08	71.35	70.64	69.98	69.34	68.75	68.18	67.66	67.16	66.70
66.27	65.86	65.47	65.11	64.77	64.44	64.12	63.82	63.54	63.27	63.02	62.80
62.61	62.46	62.35	62.30	62.25	62.20	62.21	62.27	62.36	62.49	62.64	62.81
63.01	63.22	63.45	63.69	63.96	64.24	64.55	64.90	65.28	65.71	66.20	66.75
67.39	68.10	68.89	69.76	70.68	71.63	72.59	73.54	74.63	75.88	75.46	78.73
82.00	85.23	75.45	104.97	108.22							
219.76	173.84	134.49	109.88	93.47	90.19	86.91	85.27	81.99	78.39	75.76	74.05
72.95	72.10	71.28	70.50	69.75	69.04	68.38	67.77	67.20	66.67	66.19	65.76
65.36	64.99	64.65	64.34	64.04	63.76	63.49	63.23	62.99	62.76	62.56	62.39
62.26	62.17	62.10	62.02	61.95	61.88	61.81	61.76	61.74	61.76	61.81	61.89
61.99	62.11	62.25	62.40	62.56	62.74	62.93	63.15	63.40	63.70	64.08	64.55
65.15	65.91	66.84	67.94	69.17	70.52	71.96	73.48	75.50	78.85	85.25	85.28
85.27	81.98	75.44	104.96	106.59							
218.14	173.84	134.49	109.87	93.48	90.19	86.91	85.26	81.99	78.01	75.30	73.53
72.38	71.50	70.64	69.83	69.05	68.33	67.65	67.03	66.46	65.95	65.49	65.09
64.73	64.41	64.12	63.86	63.61	63.37	63.13	62.89	62.66	62.44	62.24	62.07
61.95	61.88	61.86	61.92	61.83	61.62	61.46	61.36	61.30	61.28	61.30	61.35
61.41	61.49	61.58	61.68	61.79	61.90	62.01	62.13	62.27	62.44	62.66	62.98
63.47	64.20	65.23	66.51	67.98	69.58	71.28	73.07	75.44	79.32	85.25	85.27
85.27	81.97	75.45	104.95	106.59							
217.67	173.64	134.36	109.79	93.64	90.08	86.86	84.92	81.52	77.69	74.95	73.14
69.26	68.81	68.35	67.89	67.45	67.02	66.61	66.15	65.57	64.96	64.42	63.96
63.60	63.33	63.14	63.02	62.95	62.89	62.81	62.73	62.65	62.58	62.51	62.44
62.37	62.30	62.24	62.23	62.31	62.43	62.53	62.60	62.63	62.60	62.52	62.40
62.25	62.17	62.25	62.41	62.57	62.71	62.84	62.95	63.05	63.15	63.27	63.46
63.78	64.18	64.59	65.00	65.38	65.74	66.07	66.36	74.95	78.72	83.64	84.83
84.70	81.43	76.38	103.29	106.29							
217.30	173.49	134.26	109.73	93.76	89.99	86.78	84.61	81.14	77.39	74.64	72.81
69.18	68.67	68.13	67.59	67.05	66.51	65.98	65.42	64.83	64.25	63.73	63.31
62.98	62.75	62.61	62.54	62.51	62.51	62.50	62.49	62.48	62.46	62.45	62.44
62.42	62.42	62.43	62.49	62.59	62.72	62.84	62.94	63.00	63.00	62.96	62.88
62.78	62.73	62.76	62.83	62.93	63.04	63.14	63.24	63.34	63.46	63.61	63.82
64.12	64.48	64.86	65.26	65.64	66.00	66.33	66.63	74.36	77.93	82.34	84.18
84.15	81.02	77.02	102.04	106.02							
216.92	173.33	134.17	109.66	93.88	89.90	86.68	84.30	80.76	77.07	74.33	72.47
69.12	68.53	67.91	67.27	66.62	65.97	65.32	64.67	64.04	63.46	62.96	62.57
62.29	62.11	62.03	62.02	62.06	62.12	62.19	62.25	62.31	62.36	62.40	62.45
62.49	62.55	62.63	62.74	62.88	63.04	63.20	63.33	63.43	63.47	63.46	63.41
63.35	63.29	63.28	63.30	63.34	63.41	63.48	63.56	63.66	63.79	63.95	64.17
64.45	64.78	65.15	65.53	65.91	66.28	66.61	66.91	73.66	77.00	81.06	83.34
83.52	80.61	77.58	100.87	105.74							
216.55	173.17	134.07	109.60	93.98	89.80	86.54	83.97	80.38	76.75	74.01	72.14
69.07	68.41	67.69	66.94	66.18	65.40	64.64	63.91	63.22	62.61	62.12	61.75
61.52	61.42	61.42	61.49	61.62	61.76	61.90	62.04	62.16	62.27	62.38	62.47
62.58	62.69	62.82	62.99	63.17	63.37	63.58	63.76	63.90	63.99	64.01	63.98
63.92	63.85	63.79	63.77	63.76	63.79	63.83	63.89	63.98	64.11	64.27	64.48
64.75	65.07	65.42	65.79	66.18	66.55	66.90	67.20	72.90	76.02	79.80	82.38
82.82	80.21	78.05	99.78	105.44							
216.18	173.01	133.98	109.54	94.07	89.69	86.39	83.63	80.01	76.44	73.71	71.81
69.07	68.31	67.49	66.63	65.74	64.85	63.96	63.12	62.36	61.71	61.21	60.87
60.71	60.69	60.79	60.97	61.19	61.42	61.65	61.86	62.04	62.21	62.36	62.51
62.66	62.82	63.00	63.21	63.45	63.70	63.96	64.21	64.41	64.54	64.59	64.56
64.48	64.38	64.29	64.21	64.17	64.15	64.16	64.21	64.28	64.40	64.55	64.76
65.02	65.32	65.66	66.04	66.43	66.82	67.18	67.51	72.13	75.02	78.59	81.36
82.09	79.81	78.45	98.76	105.12							
215.82	172.85	133.89	109.48	94.16	89.58	86.21	83.29	79.66	76.14	73.42	71.50
69.11	68.26	67.33	66.35	65.34	64.31	63.30	62.33	61.47	60.75	60.23	59.92

59.84	59.93	60.16	60.46	60.80	61.13	61.44	61.72	61.96	62.18	62.37	62.55
62.73	62.93	63.15	63.40	63.68	64.00	64.33	64.64	64.92	65.11	65.18	65.14
65.02	64.88	64.73	64.61	64.53	64.48	64.46	64.49	64.55	64.64	64.79	64.98
65.23	65.52	65.86	66.24	66.64	67.05	67.45	67.81	71.35	74.04	77.42	80.31
81.32	79.41	78.76	97.80	104.79							
215.45	172.69	133.80	109.42	94.23	89.47	86.02	82.95	79.32	75.87	73.16	71.23
69.21	68.26	67.22	66.12	64.98	63.81	62.66	61.55	60.55	59.74	59.18	58.91
58.93	59.17	59.55	60.01	60.47	60.91	61.30	61.64	61.93	62.18	62.39	62.60
62.80	63.01	63.26	63.54	63.86	64.23	64.63	65.05	65.42	65.68	65.77	65.69
65.51	65.30	65.11	64.95	64.83	64.75	64.71	64.72	64.76	64.84	64.97	65.15
65.38	65.66	66.00	66.37	66.79	67.23	67.67	68.09	70.58	73.09	76.29	79.26
80.52	79.01	79.01	96.91	104.44							
215.09	172.52	133.71	109.37	94.30	89.35	85.81	82.61	79.00	75.62	72.95	71.00
69.36	68.30	67.16	65.95	64.69	63.39	62.08	60.81	59.64	58.68	58.05	57.83
58.00	58.43	59.02	59.64	60.25	60.79	61.25	61.64	61.95	62.21	62.44	62.64
62.84	63.06	63.31	63.60	63.95	64.37	64.84	65.36	65.87	66.26	66.36	66.19
65.91	65.62	65.37	65.18	65.04	64.95	64.90	64.88	64.91	64.97	65.08	65.24
65.46	65.73	66.05	66.42	66.85	67.31	67.80	68.30	69.82	72.16	75.22	78.21
79.72	78.60	79.19	96.06	104.08							
214.73	172.36	133.62	109.31	94.36	89.23	85.59	82.28	78.71	75.42	72.78	70.83
69.51	68.37	67.15	65.86	64.50	63.08	61.62	60.16	58.77	57.59	56.84	56.68
57.07	57.78	58.60	59.42	60.16	60.79	61.31	61.72	62.04	62.29	62.50	62.68
62.86	63.06	63.29	63.58	63.93	64.37	64.89	65.51	66.18	66.80	66.90	66.53
66.12	65.77	65.50	65.30	65.15	65.06	65.00	64.98	64.98	65.03	65.11	65.25
65.45	65.70	66.01	66.38	66.79	67.26	67.77	68.33	69.08	71.27	74.19	77.19
78.91	78.19	79.31	95.27	103.71							
214.37	172.19	133.54	109.26	94.41	89.10	85.36	81.96	78.44	75.25	72.67	70.73
69.59	68.45	67.21	65.87	64.44	62.92	61.33	59.70	58.06	56.56	55.53	55.49
56.26	57.31	58.39	59.40	60.26	60.96	61.50	61.90	62.19	62.40	62.57	62.72
62.85	63.01	63.20	63.45	63.78	64.20	64.73	65.37	66.13	66.99	67.07	66.52
66.06	65.71	65.45	65.27	65.15	65.08	65.03	65.00	64.98	65.00	65.07	65.18
65.36	65.59	65.88	66.22	66.62	67.06	67.54	68.02	68.34	70.42	73.20	76.20
78.11	77.78	79.38	94.52	103.33							
214.02	172.03	133.46	109.20	94.46	88.97	85.12	81.64	78.19	75.12	72.63	70.71
69.68	68.58	67.35	66.00	64.53	62.97	61.30	59.55	57.72	55.85	54.19	54.45
55.81	57.20	58.49	59.64	60.60	61.32	61.83	62.17	62.39	62.55	62.66	62.74
62.81	62.90	63.02	63.21	63.48	63.85	64.32	64.90	65.54	66.12	66.27	66.00
65.68	65.41	65.21	65.09	65.03	65.00	64.98	64.94	64.90	64.89	64.93	65.02
65.17	65.38	65.64	65.96	66.32	66.72	67.13	67.52	67.63	69.59	72.27	75.24
77.31	77.37	79.39	93.81	102.95							
213.66	171.86	133.37	109.15	94.49	88.84	84.87	81.33	77.95	75.04	72.66	70.78
69.86	68.81	67.60	66.27	64.81	63.24	61.57	59.81	57.98	56.11	54.46	54.74
56.14	57.57	58.94	60.18	61.19	61.88	62.29	62.51	62.64	62.71	62.75	62.75
62.73	62.73	62.76	62.86	63.04	63.32	63.70	64.16	64.65	65.05	65.22	65.18
65.03	64.89	64.79	64.76	64.78	64.83	64.85	64.80	64.72	64.68	64.69	64.76
64.89	65.08	65.32	65.61	65.93	66.28	66.63	66.95	66.93	68.80	71.38	74.32
76.54	76.95	79.36	93.14	102.55							
213.31	171.69	133.29	109.10	94.52	88.71	84.63	81.02	77.73	74.99	72.77	70.97
70.14	69.14	67.98	66.69	65.27	63.75	62.14	60.48	58.83	57.32	56.32	56.33
57.20	58.40	59.70	60.96	62.02	62.63	62.82	62.87	62.87	62.87	62.84	62.75
62.62	62.50	62.41	62.40	62.47	62.64	62.91	63.25	63.62	63.94	64.14	64.22
64.22	64.20	64.21	64.27	64.38	64.55	64.65	64.55	64.43	64.36	64.36	64.41
64.53	64.69	64.91	65.17	65.46	65.76	66.07	66.35	66.26	68.05	70.53	73.44
75.78	76.52	79.29	92.50	102.16							
212.96	171.52	133.21	109.05	94.55	88.57	84.37	80.72	77.52	74.97	72.95	71.27
70.52	69.57	68.48	67.25	65.90	64.45	62.95	61.44	60.01	58.82	58.08	58.00
58.53	59.44	60.57	61.81	63.03	63.45	63.28	63.14	63.05	62.97	62.90	62.72
62.45	62.21	62.00	61.86	61.80	61.84	62.00	62.24	62.54	62.83	63.06	63.22
63.32	63.41	63.50	63.63	63.81	64.06	64.29	64.12	63.99	63.92	63.91	63.97
64.08	64.23	64.43	64.67	64.93	65.20	65.47	65.73	65.61	67.33	69.73	72.60
75.04	76.10	79.19	91.88	101.75							
212.61	171.35	133.13	109.00	94.56	88.43	84.12	80.42	77.32	74.97	73.19	71.71
70.99	70.10	69.07	67.92	66.65	65.30	63.90	62.54	61.29	60.29	59.67	59.52
59.82	60.48	61.36	62.39	63.42	63.68	63.43	63.25	63.12	62.99	62.83	62.58
62.23	61.88	61.54	61.25	61.05	60.96	61.01	61.18	61.43	61.72	61.99	62.21

62.39	62.54	62.69	62.86	63.06	63.28	63.43	63.43	63.38	63.36	63.38	63.44
63.55	63.71	63.90	64.11	64.35	64.60	64.85	65.10	65.00	66.65	68.98	71.80
74.32	75.67	79.04	91.30	101.35							
212.27	171.18	133.06	108.96	94.58	88.28	83.86	80.13	77.11	74.97	73.46	72.25
71.51	70.69	69.74	68.66	67.48	66.22	64.92	63.67	62.55	61.66	61.08	60.85
60.98	61.39	61.99	62.65	63.18	63.29	63.25	63.21	63.11	62.95	62.72	62.40
62.00	61.54	61.07	60.62	60.24	60.01	59.95	60.08	60.33	60.65	60.96	61.24
61.47	61.66	61.84	62.01	62.21	62.40	62.55	62.63	62.67	62.71	62.77	62.86
62.98	63.13	63.32	63.53	63.75	63.99	64.23	64.46	64.42	66.01	68.27	71.04
73.63	75.23	78.87	90.73	100.95							
211.92	171.01	132.98	108.91	94.58	88.14	83.61	79.83	76.89	74.94	73.73	72.87
72.06	71.28	70.41	69.44	68.36	67.16	65.93	64.74	63.70	62.87	62.29	62.00
61.98	62.18	62.52	62.88	63.13	63.15	63.18	63.20	63.11	62.93	62.65	62.28
61.81	61.25	60.64	60.00	59.43	59.01	58.86	58.97	59.27	59.65	60.02	60.34
60.61	60.81	60.98	61.15	61.32	61.51	61.68	61.82	61.93	62.02	62.12	62.23
62.36	62.52	62.71	62.92	63.14	63.37	63.60	63.82	63.87	65.41	67.60	70.33
72.96	74.80	78.67	90.19	100.54							
211.58	170.84	132.90	108.87	94.59	88.00	83.35	79.53	76.66	74.86	73.92	73.44
72.56	71.80	71.02	70.19	69.23	68.07	66.85	65.71	64.71	63.91	63.32	62.97
62.83	62.87	63.01	63.18	63.29	63.32	63.31	63.28	63.17	62.97	62.67	62.26
61.73	61.08	60.32	59.48	58.64	57.99	57.73	57.90	58.31	58.78	59.22	59.58
59.86	60.05	60.18	60.30	60.45	60.64	60.85	61.04	61.19	61.33	61.45	61.58
61.73	61.90	62.09	62.30	62.52	62.75	62.98	63.20	63.37	64.85	66.97	69.65
72.31	74.36	78.44	89.67	100.14							
211.24	170.67	132.83	108.82	94.59	87.85	83.09	79.24	76.41	74.72	73.96	73.78
72.84	72.13	71.46	70.82	70.06	68.84	67.61	66.50	65.55	64.77	64.18	63.78
63.56	63.47	63.48	63.52	63.55	63.55	63.52	63.45	63.31	63.10	62.79	62.36
61.80	61.09	60.22	59.17	58.02	56.97	56.58	56.95	57.56	58.15	58.64	59.02
59.27	59.42	59.48	59.52	59.62	59.84	60.09	60.32	60.51	60.66	60.80	60.94
61.09	61.27	61.46	61.68	61.92	62.16	62.39	62.62	62.89	64.33	66.39	69.01
71.69	73.92	78.19	89.16	99.74							
210.90	170.50	132.76	108.78	94.58	87.71	82.84	78.94	76.13	74.50	73.80	73.64
72.76	72.17	71.59	71.05	70.39	69.26	68.12	67.09	66.20	65.46	64.87	64.45
64.17	64.00	63.92	63.88	63.86	63.82	63.76	63.67	63.53	63.31	63.01	62.61
62.06	61.35	60.43	59.25	57.82	56.20	55.56	56.42	57.20	57.84	58.34	58.70
58.91	59.00	58.96	58.85	58.86	59.15	59.46	59.71	59.90	60.05	60.18	60.31
60.46	60.64	60.85	61.08	61.33	61.59	61.86	62.12	62.46	63.85	65.85	68.41
71.09	73.49	77.93	88.66	99.34							
210.57	170.33	132.68	108.74	94.57	87.56	82.59	78.64	75.83	74.19	73.44	73.13
72.42	71.95	71.44	70.89	70.21	69.32	68.37	67.47	66.66	65.97	65.42	64.99
64.68	64.46	64.32	64.23	64.17	64.10	64.03	63.94	63.80	63.61	63.34	62.98
62.51	61.87	61.01	59.86	58.42	56.89	56.24	56.74	57.37	57.92	58.35	58.65
58.81	58.84	58.73	58.49	58.36	58.73	59.03	59.25	59.40	59.52	59.62	59.72
59.86	60.03	60.25	60.51	60.78	61.07	61.36	61.67	62.05	63.40	65.35	67.85
70.52	73.05	77.64	88.18	98.94							
210.23	170.16	132.61	108.70	94.56	87.42	82.34	78.35	75.52	73.82	72.93	72.43
71.97	71.57	71.11	70.59	69.96	69.23	68.45	67.68	66.97	66.35	65.83	65.41
65.09	64.85	64.68	64.56	64.47	64.39	64.31	64.23	64.11	63.96	63.75	63.47
63.10	62.61	61.95	60.96	59.66	58.44	57.77	57.75	58.03	58.37	58.66	58.87
58.97	58.95	58.82	58.64	58.56	58.67	58.82	58.94	59.02	59.07	59.11	59.16
59.27	59.45	59.68	59.96	60.26	60.58	60.91	61.25	61.68	62.99	64.89	67.32
69.96	72.61	77.34	87.71	98.55							
209.90	169.98	132.54	108.66	94.54	87.28	82.10	78.05	75.18	73.39	72.33	71.65
71.46	71.11	70.70	70.22	69.68	69.06	68.41	67.76	67.15	66.59	66.12	65.72
65.41	65.17	64.98	64.85	64.75	64.67	64.60	64.52	64.44	64.33	64.19	64.00
63.74	63.43	63.05	62.34	61.04	59.93	59.22	58.93	58.93	59.06	59.21	59.32
59.36	59.30	59.16	58.99	58.86	58.80	58.79	58.78	58.75	58.71	58.67	58.65
58.71	58.88	59.15	59.46	59.79	60.13	60.48	60.86	61.33	62.61	64.46	66.83
69.43	72.17	77.02	87.25	98.16							
209.57	169.81	132.47	108.62	94.52	87.13	81.86	77.75	74.84	72.94	71.70	70.84
70.90	70.60	70.24	69.83	69.36	68.85	68.30	67.75	67.22	66.74	66.31	65.95
65.65	65.41	65.23	65.09	64.99	64.91	64.86	64.81	64.76	64.71	64.63	64.52
64.37	64.15	63.84	63.21	62.17	61.21	60.50	60.08	59.90	59.87	59.91	59.94
59.92	59.82	59.65	59.44	59.22	59.03	58.87	58.73	58.59	58.45	58.31	58.19
58.16	58.37	58.69	59.02	59.37	59.72	60.09	60.49	61.00	62.26	64.08	66.37

68.91	71.73	76.69	86.80	97.78							
209.24	169.64	132.40	108.58	94.50	87.00	81.62	77.46	74.49	72.48	71.07	70.05
70.33	70.06	69.76	69.42	69.03	68.60	68.14	67.68	67.23	66.81	66.43	66.10
65.82	65.60	65.42	65.29	65.19	65.12	65.08	65.06	65.05	65.05	65.04	65.01
64.94	64.77	64.45	63.87	63.07	62.25	61.57	61.10	60.84	60.72	60.68	60.66
60.60	60.47	60.25	59.96	59.64	59.32	59.02	58.75	58.50	58.27	58.07	57.88
57.75	58.01	58.34	58.67	59.01	59.37	59.74	60.15	60.69	61.95	63.74	65.94
68.41	71.29	76.35	86.36	97.40							
208.91	169.47	132.33	108.54	94.48	86.86	81.39	77.18	74.14	72.03	70.48	69.32
69.75	69.53	69.29	69.00	68.68	68.33	67.95	67.56	67.18	66.82	66.48	66.19
65.93	65.72	65.56	65.43	65.34	65.29	65.26	65.27	65.29	65.34	65.39	65.44
65.45	65.36	65.07	64.54	63.83	63.08	62.44	61.96	61.66	61.51	61.46	61.43
61.36	61.20	60.92	60.53	60.08	59.62	59.19	58.80	58.46	58.17	57.94	57.76
57.71	57.85	58.11	58.41	58.73	59.07	59.43	59.83	60.39	61.67	63.43	65.53
67.93	70.85	75.99	85.93	97.02							
208.58	169.29	132.26	108.51	94.46	86.72	81.17	76.90	73.81	71.62	69.98	68.73
69.18	69.01	68.83	68.61	68.35	68.06	67.74	67.41	67.09	66.77	66.48	66.22
65.99	65.79	65.64	65.52	65.44	65.40	65.38	65.41	65.46	65.54	65.65	65.78
65.89	65.92	65.72	65.20	64.47	63.72	63.09	62.62	62.34	62.20	62.18	62.19
62.16	62.00	61.65	61.13	60.53	59.91	59.35	58.85	58.44	58.10	57.86	57.71
57.67	57.77	57.97	58.23	58.53	58.84	59.18	59.55	60.10	61.43	63.17	65.15
67.46	70.41	75.63	85.51	96.66							
208.26	169.12	132.20	108.47	94.43	86.59	80.95	76.62	73.49	71.25	69.59	68.34
68.63	68.54	68.41	68.24	68.03	67.79	67.53	67.25	66.97	66.69	66.43	66.20
65.99	65.81	65.67	65.56	65.48	65.44	65.44	65.47	65.54	65.64	65.79	65.97
66.19	66.40	66.38	65.75	64.90	64.12	63.50	63.06	62.81	62.73	62.78	62.89
62.97	62.85	62.42	61.72	60.92	60.14	59.44	58.86	58.39	58.03	57.79	57.65
57.63	57.71	57.88	58.11	58.39	58.69	59.00	59.32	59.83	61.24	62.95	64.78
67.00	69.98	75.26	85.09	96.29							
207.93	168.95	132.13	108.44	94.40	86.46	80.74	76.36	73.18	70.93	69.32	68.18
68.19	68.15	68.05	67.92	67.75	67.54	67.32	67.08	66.83	66.59	66.36	66.14
65.95	65.78	65.65	65.54	65.47	65.43	65.42	65.45	65.52	65.62	65.77	65.97
66.22	66.53	66.88	65.93	64.99	64.21	63.62	63.23	63.04	63.04	63.19	63.44
63.72	63.75	63.18	62.21	61.19	60.24	59.43	58.78	58.28	57.92	57.69	57.58
57.57	57.65	57.82	58.04	58.32	58.62	58.94	59.25	59.59	61.12	62.76	64.42
66.54	69.54	74.88	84.68	95.94							
207.61	168.78	132.06	108.40	94.37	86.34	80.54	76.11	72.90	70.66	69.13	68.18
67.93	67.86	67.77	67.64	67.49	67.31	67.11	66.90	66.68	66.46	66.25	66.05
65.87	65.72	65.58	65.48	65.40	65.35	65.34	65.35	65.40	65.48	65.59	65.74
65.91	66.06	65.98	65.41	64.65	63.96	63.44	63.13	63.02	63.10	63.33	63.70
64.19	64.67	63.76	62.44	61.22	60.16	59.27	58.58	58.08	57.75	57.56	57.48
57.50	57.60	57.77	58.00	58.29	58.63	59.02	59.45	59.42	61.09	62.60	64.07
66.10	69.11	74.50	84.27	95.59							
207.29	168.60	132.00	108.37	94.35	86.22	80.34	75.87	72.64	70.42	69.01	68.24
67.77	67.66	67.54	67.42	67.27	67.10	66.92	66.72	66.52	66.32	66.12	65.94
65.77	65.61	65.48	65.37	65.28	65.22	65.19	65.18	65.19	65.23	65.28	65.34
65.37	65.32	65.09	64.60	63.99	63.41	62.99	62.77	62.75	62.89	63.17	63.55
63.97	64.21	63.45	62.19	60.96	59.85	58.93	58.24	57.79	57.53	57.40	57.38
57.43	57.55	57.73	57.98	58.29	58.68	59.15	59.74	59.33	61.14	62.42	63.70
65.66	68.67	74.10	83.87	95.24							
206.97	168.43	131.93	108.34	94.32	86.10	80.15	75.64	72.39	70.22	68.92	68.30
67.65	67.50	67.36	67.23	67.08	66.91	66.74	66.55	66.36	66.17	65.98	65.80
65.63	65.48	65.34	65.22	65.12	65.04	64.98	64.94	64.91	64.90	64.87	64.83
64.74	64.55	64.21	63.73	63.16	62.64	62.30	62.19	62.26	62.47	62.74	63.04
63.26	63.18	62.58	61.58	60.44	59.34	58.41	57.77	57.43	57.28	57.24	57.27
57.36	57.50	57.70	57.96	58.29	58.70	59.24	59.93	59.22	61.29	62.19	63.32
65.22	68.24	73.71	83.48	94.90							
206.66	168.26	131.87	108.31	94.29	85.98	79.97	75.42	72.17	70.03	68.82	68.30
67.54	67.37	67.21	67.06	66.91	66.74	66.57	66.39	66.20	66.01	65.83	65.65
65.48	65.32	65.17	65.04	64.93	64.83	64.74	64.66	64.59	64.52	64.42	64.29
64.10	63.81	63.40	62.87	62.27	61.73	61.44	61.46	61.65	61.91	62.18	62.39
62.46	62.26	61.72	60.87	59.84	58.74	57.76	57.20	57.06	57.06	57.12	57.20
57.32	57.48	57.67	57.92	58.24	58.66	59.21	59.92	58.95	60.99	61.84	62.93
64.79	67.80	73.31	83.09	94.57							
206.34	168.08	131.80	108.28	94.26	85.87	79.80	75.22	71.96	69.86	68.71	68.24

67.43	67.25	67.08	66.92	66.75	66.58	66.41	66.23	66.04	65.85	65.67	65.49
65.31	65.14	64.98	64.84	64.71	64.58	64.47	64.36	64.25	64.12	63.97	63.77
63.50	63.15	62.68	62.10	61.43	60.75	60.47	60.71	61.04	61.35	61.60	61.75
61.74	61.50	61.01	60.27	59.34	58.27	57.13	56.69	56.83	56.96	57.08	57.20
57.33	57.47	57.65	57.87	58.15	58.53	59.03	59.69	58.51	60.21	61.36	62.51
64.35	67.37	72.90	82.70	94.25							
206.03	167.91	131.74	108.25	94.23	85.77	79.64	75.03	71.77	69.69	68.57	68.11
67.33	67.14	66.96	66.79	66.62	66.44	66.26	66.07	65.88	65.69	65.50	65.31
65.13	64.95	64.78	64.62	64.47	64.32	64.18	64.04	63.89	63.73	63.53	63.29
62.98	62.59	62.10	61.52	60.84	60.08	59.79	60.19	60.56	60.87	61.09	61.19
61.15	60.92	60.48	59.85	59.06	58.16	57.30	56.90	56.94	57.06	57.17	57.28
57.39	57.51	57.64	57.80	58.02	58.31	58.71	59.26	58.00	59.49	60.82	62.08
63.93	66.94	72.49	82.32	93.93							
205.72	167.74	131.68	108.22	94.20	85.67	79.48	74.85	71.59	69.52	68.41	67.92
67.23	67.03	66.85	66.67	66.49	66.31	66.12	65.93	65.73	65.54	65.34	65.14
64.94	64.75	64.57	64.39	64.21	64.05	63.88	63.72	63.54	63.35	63.13	62.86
62.54	62.15	61.68	61.15	60.58	60.07	59.86	60.02	60.28	60.52	60.70	60.77
60.71	60.50	60.14	59.62	58.99	58.32	57.74	57.39	57.30	57.33	57.39	57.46
57.52	57.58	57.65	57.74	57.86	58.03	58.29	58.67	57.51	58.86	60.27	61.64
63.50	66.51	72.07	81.95	93.62							
205.41	167.57	131.62	108.19	94.17	85.57	79.34	74.69	71.43	69.36	68.23	67.69
67.13	66.94	66.75	66.56	66.37	66.18	65.99	65.79	65.59	65.38	65.17	64.96
64.76	64.55	64.35	64.15	63.96	63.77	63.59	63.41	63.21	63.01	62.77	62.50
62.18	61.81	61.40	60.95	60.51	60.15	59.98	60.02	60.16	60.32	60.44	60.48
60.42	60.25	59.95	59.56	59.09	58.60	58.18	57.90	57.76	57.71	57.71	57.71
57.72	57.71	57.71	57.70	57.71	57.74	57.82	57.99	57.08	58.31	59.74	61.20
63.09	66.09	71.65	81.58	93.31							
205.10	167.40	131.56	108.17	94.14	85.48	79.21	74.54	71.28	69.21	68.04	67.45
67.04	66.84	66.65	66.46	66.26	66.07	65.87	65.66	65.45	65.23	65.01	64.79
64.57	64.35	64.13	63.91	63.70	63.50	63.30	63.11	62.91	62.69	62.46	62.19
61.90	61.57	61.21	60.84	60.50	60.23	60.09	60.06	60.12	60.21	60.29	60.31
60.25	60.12	59.90	59.61	59.27	58.92	58.62	58.39	58.24	58.15	58.09	58.04
57.98	57.90	57.81	57.71	57.60	57.48	57.38	57.30	56.71	57.84	59.26	60.78
62.67	65.66	71.23	81.22	93.01							
204.79	167.23	131.49	108.14	94.11	85.39	79.08	74.41	71.14	69.06	67.85	67.20
66.96	66.76	66.57	66.37	66.17	65.96	65.75	65.54	65.32	65.09	64.86	64.63
64.39	64.15	63.91	63.68	63.45	63.23	63.03	62.82	62.62	62.41	62.19	61.94
61.68	61.39	61.08	60.78	60.51	60.30	60.17	60.13	60.14	60.18	60.22	60.23
60.19	60.09	59.94	59.74	59.51	59.27	59.06	58.89	58.75	58.64	58.53	58.42
58.29	58.14	57.97	57.78	57.56	57.33	57.09	56.81	56.41	57.45	58.82	60.37
62.27	65.24	70.80	80.86	92.72							
204.49	167.05	131.43	108.12	94.09	85.31	78.97	74.29	71.03	68.93	67.68	66.97
66.89	66.69	66.49	66.29	66.08	65.87	65.65	65.43	65.20	64.97	64.72	64.48
64.22	63.97	63.71	63.46	63.21	62.98	62.76	62.56	62.36	62.17	61.96	61.74
61.50	61.26	61.00	60.76	60.54	60.37	60.25	60.20	60.19	60.20	60.22	60.22
60.20	60.14	60.05	59.93	59.79	59.64	59.51	59.39	59.27	59.15	59.01	58.85
58.65	58.43	58.19	57.92	57.62	57.31	57.00	56.72	56.17	57.14	58.45	59.98
61.88	64.83	70.38	80.50	92.44							
204.18	166.88	131.37	108.10	94.06	85.24	78.86	74.18	70.93	68.82	67.52	66.75
66.83	66.63	66.42	66.22	66.00	65.79	65.56	65.33	65.10	64.85	64.60	64.34
64.07	63.80	63.52	63.24	62.98	62.73	62.50	62.31	62.13	61.96	61.77	61.58
61.37	61.16	60.95	60.75	60.57	60.43	60.33	60.27	60.25	60.25	60.26	60.27
60.26	60.24	60.20	60.14	60.08	60.02	59.96	59.89	59.81	59.69	59.52	59.30
59.05	58.76	58.45	58.12	57.75	57.40	57.08	56.85	56.03	56.92	58.13	59.62
61.50	64.41	69.94	80.16	92.16							
203.88	166.71	131.31	108.07	94.04	85.17	78.77	74.09	70.84	68.73	67.40	66.57
66.78	66.57	66.37	66.15	65.94	65.72	65.49	65.25	65.01	64.75	64.49	64.22
63.94	63.65	63.35	63.05	62.76	62.49	62.26	62.08	61.93	61.78	61.62	61.46
61.28	61.10	60.92	60.76	60.61	60.49	60.40	60.34	60.32	60.32	60.32	60.34
60.35	60.36	60.37	60.37	60.38	60.39	60.40	60.40	60.36	60.25	60.06	59.79
59.46	59.09	58.73	58.33	57.91	57.53	57.22	57.00	56.01	56.77	57.86	59.28
61.13	64.00	69.51	79.81	91.89							
203.58	166.54	131.26	108.05	94.02	85.10	78.68	74.01	70.78	68.67	67.32	66.46
66.73	66.53	66.32	66.10	65.88	65.66	65.42	65.18	64.93	64.67	64.40	64.12
63.83	63.53	63.22	62.89	62.57	62.26	62.03	61.89	61.77	61.65	61.51	61.37

61.22	61.06	60.91	60.77	60.65	60.54	60.47	60.42	60.39	60.39	60.40	60.42
60.45	60.49	60.54	60.59	60.66	60.74	60.82	60.89	60.92	60.84	60.62	60.27
59.86	59.41	58.96	58.51	58.07	57.67	57.35	57.14	56.09	56.69	57.64	58.97
60.77	63.60	69.07	79.48	91.62							
203.28	166.37	131.20	108.03	94.00	85.04	78.61	73.94	70.73	68.63	67.29	66.45
66.69	66.49	66.28	66.06	65.84	65.61	65.37	65.13	64.87	64.61	64.33	64.05
63.75	63.44	63.12	62.79	62.44	62.08	61.84	61.76	61.67	61.56	61.44	61.32
61.18	61.05	60.92	60.80	60.69	60.60	60.53	60.49	60.46	60.46	60.48	60.51
60.55	60.61	60.69	60.78	60.90	61.03	61.19	61.35	61.47	61.45	61.19	60.74
60.22	59.68	59.16	58.66	58.20	57.79	57.46	57.23	56.23	56.67	57.47	58.68
60.43	63.21	68.63	79.15	91.37							
202.98	166.20	131.14	108.01	93.98	84.99	78.54	73.89	70.70	68.62	67.30	66.49
66.66	66.45	66.24	66.03	65.80	65.57	65.33	65.09	64.83	64.56	64.29	64.00
63.70	63.39	63.07	62.74	62.41	62.08	61.85	61.73	61.63	61.53	61.42	61.30
61.18	61.06	60.94	60.83	60.73	60.65	60.59	60.55	60.53	60.53	60.55	60.58
60.64	60.71	60.81	60.93	61.08	61.26	61.47	61.72	61.97	62.09	61.74	61.13
60.50	59.89	59.31	58.78	58.30	57.87	57.53	57.28	56.39	56.67	57.32	58.42
60.10	62.82	68.18	78.82	91.12							
202.68	166.03	131.08	107.99	93.96	84.94	78.49	73.85	70.69	68.63	67.33	66.55
66.63	66.43	66.22	66.00	65.78	65.55	65.31	65.06	64.80	64.54	64.26	63.98
63.68	63.38	63.07	62.75	62.44	62.16	61.94	61.78	61.66	61.54	61.42	61.31
61.19	61.08	60.97	60.87	60.78	60.71	60.65	60.61	60.59	60.59	60.60	60.64
60.70	60.78	60.88	61.02	61.18	61.38	61.61	61.89	62.21	62.57	62.04	61.31
60.63	59.99	59.39	58.85	58.35	57.91	57.55	57.28	56.53	56.69	57.19	58.18
59.78	62.44	67.73	78.50	90.87							
202.39	165.87	131.02	107.97	93.94	84.90	78.44	73.83	70.69	68.66	67.39	66.63
66.61	66.41	66.20	65.98	65.76	65.53	65.29	65.05	64.79	64.53	64.26	63.98
63.69	63.39	63.09	62.80	62.51	62.26	62.04	61.86	61.71	61.58	61.46	61.34
61.23	61.12	61.01	60.92	60.83	60.76	60.70	60.66	60.64	60.63	60.64	60.68
60.73	60.81	60.91	61.04	61.20	61.39	61.60	61.84	62.06	62.14	61.81	61.22
60.59	59.97	59.39	58.85	58.36	57.91	57.53	57.23	56.64	56.69	57.07	57.96
59.48	62.06	67.28	78.19	90.64							
202.10	165.70	130.97	107.96	93.93	84.86	78.40	73.81	70.71	68.71	67.47	66.72
66.59	66.39	66.18	65.97	65.75	65.53	65.29	65.05	64.80	64.54	64.27	63.99
63.71	63.43	63.14	62.86	62.60	62.35	62.14	61.95	61.79	61.65	61.52	61.39
61.28	61.17	61.06	60.97	60.88	60.81	60.75	60.70	60.67	60.66	60.67	60.69
60.74	60.81	60.90	61.01	61.14	61.30	61.46	61.62	61.71	61.67	61.40	60.95
60.41	59.86	59.32	58.80	58.32	57.88	57.49	57.16	56.70	56.68	56.97	57.75
59.20	61.70	66.83	77.89	90.41							
201.80	165.53	130.91	107.94	93.92	84.83	78.37	73.81	70.74	68.78	67.56	66.82
66.58	66.38	66.17	65.96	65.75	65.53	65.30	65.06	64.81	64.56	64.30	64.03
63.75	63.48	63.21	62.94	62.69	62.45	62.24	62.05	61.88	61.73	61.59	61.46
61.34	61.22	61.12	61.02	60.93	60.85	60.78	60.73	60.69	60.67	60.67	60.68
60.71	60.76	60.83	60.92	61.02	61.13	61.24	61.31	61.32	61.22	60.98	60.61
60.16	59.68	59.19	58.72	58.26	57.85	57.46	57.11	56.73	56.65	56.86	57.55
58.93	61.35	66.36	77.59	90.18							
201.51	165.36	130.86	107.92	93.91	84.80	78.36	73.82	70.79	68.85	67.66	66.93
66.55	66.36	66.16	65.96	65.75	65.54	65.31	65.08	64.84	64.59	64.33	64.07
63.81	63.54	63.28	63.02	62.78	62.55	62.34	62.15	61.97	61.81	61.67	61.53
61.40	61.28	61.17	61.07	60.98	60.89	60.82	60.75	60.71	60.67	60.65	60.65
60.66	60.69	60.74	60.79	60.86	60.92	60.97	60.98	60.94	60.81	60.58	60.26
59.87	59.46	59.03	58.60	58.19	57.81	57.46	57.15	56.71	56.60	56.75	57.37
58.68	61.01	65.90	77.30	89.97							
201.22	165.20	130.80	107.91	93.90	84.78	78.34	73.84	70.85	68.94	67.77	67.05
66.53	66.35	66.16	65.96	65.76	65.55	65.34	65.11	64.88	64.63	64.38	64.12
63.87	63.61	63.36	63.11	62.87	62.65	62.44	62.25	62.07	61.90	61.75	61.61
61.47	61.35	61.23	61.12	61.02	60.93	60.84	60.77	60.71	60.66	60.62	60.60
60.59	60.60	60.61	60.64	60.66	60.68	60.68	60.65	60.56	60.41	60.19	59.91
59.58	59.22	58.85	58.48	58.12	57.78	57.48	57.23	56.65	56.53	56.64	57.20
58.44	60.69	65.43	77.02	89.75							
200.93	165.03	130.74	107.90	93.89	84.76	78.34	73.87	70.91	69.04	67.88	67.17
66.50	66.33	66.15	65.97	65.78	65.58	65.37	65.15	64.92	64.68	64.43	64.18
63.93	63.68	63.43	63.19	62.96	62.74	62.54	62.34	62.16	61.99	61.83	61.68
61.54	61.41	61.29	61.17	61.06	60.96	60.86	60.78	60.70	60.63	60.58	60.53
60.50	60.48	60.47	60.46	60.45	60.43	60.39	60.32	60.21	60.05	59.83	59.58

59.29	58.98	58.66	58.34	58.04	57.76	57.50	57.30	56.56	56.43	56.52	57.04
58.22	60.38	64.95	76.75	89.55							
200.65	164.86	130.69	107.88	93.89	84.75	78.35	73.91	70.99	69.15	68.01	67.31
66.48	66.32	66.15	65.97	65.79	65.60	65.40	65.19	64.97	64.73	64.49	64.24
64.00	63.75	63.51	63.28	63.05	62.83	62.63	62.43	62.25	62.07	61.91	61.76
61.61	61.48	61.35	61.22	61.10	60.99	60.88	60.78	60.68	60.60	60.52	60.46
60.40	60.36	60.32	60.28	60.24	60.19	60.12	60.01	59.88	59.70	59.49	59.26
59.01	58.74	58.48	58.22	57.96	57.73	57.52	57.36	56.45	56.31	56.41	56.89
58.02	60.08	64.47	76.49	89.35							
200.36	164.70	130.64	107.87	93.89	84.75	78.36	73.96	71.08	69.26	68.14	67.44
66.46	66.30	66.14	65.98	65.81	65.63	65.44	65.24	65.02	64.79	64.55	64.30
64.06	63.82	63.58	63.36	63.14	62.92	62.71	62.52	62.33	62.15	61.98	61.83
61.68	61.54	61.41	61.27	61.14	61.02	60.89	60.78	60.66	60.56	60.46	60.37
60.29	60.22	60.16	60.10	60.04	59.96	59.86	59.73	59.57	59.39	59.18	58.96
58.74	58.52	58.30	58.09	57.89	57.70	57.53	57.40	56.31	56.18	56.30	56.76
57.84	59.81	63.98	76.23	89.15							
200.08	164.53	130.58	107.86	93.89	84.75	78.38	74.02	71.17	69.38	68.27	67.58
66.43	66.28	66.13	65.98	65.82	65.66	65.48	65.29	65.08	64.84	64.60	64.36
64.12	63.88	63.65	63.43	63.21	63.00	62.80	62.59	62.40	62.22	62.05	61.89
61.74	61.60	61.46	61.32	61.18	61.04	60.90	60.77	60.64	60.52	60.40	60.29
60.18	60.09	60.00	59.93	59.84	59.74	59.62	59.47	59.30	59.10	58.88	58.67
58.48	58.31	58.14	57.98	57.82	57.67	57.54	57.43	56.15	56.04	56.20	56.63
57.67	59.55	63.48	75.98	88.96							
199.80	164.37	130.53	107.85	93.89	84.75	78.41	74.08	71.27	69.50	68.41	67.73
66.40	66.26	66.12	65.97	65.83	65.68	65.53	65.35	65.13	64.89	64.64	64.40
64.16	63.93	63.71	63.49	63.28	63.08	62.87	62.66	62.47	62.28	62.11	61.95
61.80	61.65	61.51	61.37	61.22	61.06	60.91	60.76	60.62	60.48	60.34	60.20
60.07	59.95	59.86	59.77	59.67	59.55	59.42	59.25	59.06	58.85	58.61	58.40
58.25	58.13	58.01	57.89	57.76	57.65	57.55	57.46	55.97	55.90	56.12	56.52
57.53	59.30	62.97	75.73	88.78							
199.44	164.16	130.46	107.84	93.90	84.76	78.45	74.18	71.41	69.67	68.59	67.92
67.49	67.16	66.84	66.54	66.24	65.96	65.68	65.42	65.16	64.92	64.68	64.44
64.22	64.00	63.78	63.57	63.36	63.16	62.97	62.78	62.59	62.41	62.23	62.06
61.90	61.74	61.58	61.43	61.27	61.12	60.96	60.80	60.63	60.46	60.29	60.12
59.95	59.79	59.64	59.48	59.33	59.19	59.03	58.87	58.70	58.51	58.30	58.08
57.84	57.58	57.32	57.05	56.78	56.51	56.26	56.02	55.74	55.74	56.07	56.40
57.38	59.03	62.32	75.43	88.55							
198.92	163.86	130.36	107.83	93.91	84.80	78.54	74.34	71.63	69.93	68.87	68.21
67.78	67.46	67.14	66.83	66.53	66.25	65.97	65.70	65.44	65.18	64.94	64.70
64.46	64.24	64.01	63.80	63.58	63.38	63.18	62.98	62.78	62.60	62.41	62.23
62.06	61.88	61.71	61.54	61.37	61.20	61.03	60.85	60.68	60.50	60.32	60.14
59.96	59.78	59.61	59.43	59.25	59.08	58.89	58.70	58.50	58.29	58.07	57.84
57.60	57.36	57.10	56.85	56.59	56.35	56.12	55.92	55.74	55.74	56.07	56.40
57.38	59.02	62.31	75.43	88.55							
198.14	163.40	130.22	107.82	93.95	84.88	78.71	74.61	71.99	70.35	69.32	68.67
68.25	67.92	67.61	67.30	67.00	66.71	66.42	66.15	65.88	65.61	65.36	65.11
64.87	64.63	64.40	64.17	63.95	63.73	63.52	63.31	63.10	62.90	62.70	62.50
62.31	62.11	61.92	61.73	61.54	61.35	61.16	60.96	60.77	60.57	60.37	60.17
59.97	59.77	59.57	59.36	59.16	58.95	58.73	58.52	58.29	58.07	57.84	57.60
57.36	57.12	56.89	56.65	56.43	56.22	56.04	55.88	55.74	55.74	56.07	56.40
57.38	59.02	62.31	75.43	88.55							
197.00	162.73	130.01	107.81	94.04	85.06	79.04	75.10	72.60	71.03	70.03	69.40
68.98	68.66	68.35	68.04	67.74	67.44	67.16	66.87	66.60	66.33	66.06	65.80
65.54	65.29	65.05	64.80	64.57	64.33	64.10	63.87	63.64	63.42	63.19	62.97
62.75	62.53	62.31	62.09	61.88	61.65	61.43	61.21	60.99	60.76	60.53	60.30
60.07	59.84	59.60	59.37	59.13	58.89	58.65	58.40	58.16	57.92	57.67	57.43
57.20	56.97	56.75	56.54	56.34	56.16	56.00	55.87	55.74	55.74	55.74	55.74
57.38	59.02	62.30	72.15	88.55							
195.32	161.74	129.70	107.84	94.25	85.46	79.69	75.97	73.62	72.14	71.19	70.57
70.18	69.86	69.55	69.25	68.95	68.65	68.36	68.07	67.79	67.51	67.24	66.97
66.70	66.43	66.17	65.91	65.65	65.40	65.14	64.89	64.64	64.39	64.14	63.89
63.63	63.38	63.13	62.88	62.62	62.37	62.11	61.85	61.59	61.33	61.06	60.80
60.53	60.26	59.98	59.71	59.43	59.16	58.88	58.60	58.33	58.06	57.79	57.53
57.28	57.03	56.80	56.58	56.38	56.19	56.02	55.88	55.74	55.74	55.74	55.74
57.38	57.39	57.40	65.61	88.55							

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  192.90   160.29   129.27   107.95    94.71    86.29    80.90    77.49    75.34    73.98    73.09    72.52
   72.14    71.85    71.55    71.26    70.97    70.69    70.40    70.12    69.84    69.57    69.29    69.02
   68.75    68.48    68.21    67.94    67.68    67.41    67.14    66.88    66.61    66.34    66.07    65.80
   65.53    65.26    64.99    64.71    64.43    64.15    63.86    63.57    63.28    62.98    62.69    62.38
   62.08    61.76    61.45    61.13    60.81    60.49    60.16    59.83    59.50    59.17    58.84    58.52
   58.19    57.87    57.55    57.24    56.93    56.63    56.35    56.07    55.74    55.74    55.74    55.74
   57.37    57.38    55.74    55.79    85.27
  189.47   158.24   128.68   108.24    95.66    87.86    83.04    80.06    78.20    77.02    76.26    75.76
   75.43    75.18    74.92    74.67    74.42    74.17    73.92    73.68    73.43    73.19    72.95    72.72
   72.48    72.25    72.01    71.78    71.55    71.32    71.09    70.86    70.63    70.40    70.16    69.93
   69.70    69.46    69.23    68.99    68.75    68.50    68.26    68.01    67.75    67.50    67.23    66.96
   66.69    66.41    66.12    65.83    65.53    65.21    64.89    64.56    64.22    63.87    63.50    63.13
   62.74    62.34    61.92    61.49    61.05    60.59    60.13    59.65    59.03    59.03    59.03    57.39
   57.38    55.74    55.73    55.76    85.25
  185.10   155.61   127.99   108.84    97.23    90.29    86.16    83.70    82.20    81.27    80.68    80.31
   80.06    79.87    79.68    79.50    79.32    79.14    78.97    78.80    78.63    78.47    78.31    78.15
   78.00    77.85    77.71    77.57    77.43    77.30    77.17    77.04    76.92    76.80    76.69    76.58
   76.47    76.37    76.27    76.18    76.09    76.00    75.92    75.84    75.77    75.70    75.63    75.57
   75.52    75.46    75.42    75.37    75.33    75.30    75.27    75.25    75.23    75.21    75.20    75.20
   75.20    75.20    75.22    75.23    75.26    75.29    75.32    75.37    75.41    72.19    68.88    65.58
   62.31    55.74    55.74    59.02    65.57
  180.41   152.80   127.30   109.66    99.13    92.99    89.43    87.33    86.08    85.31    84.83    84.52
   84.32    84.17    84.02    83.87    83.72    83.58    83.44    83.31    83.18    83.05    82.93    82.80
   82.69    82.57    82.46    82.35    82.25    82.15    82.05    81.95    81.86    81.77    81.69    81.60
   81.52    81.44    81.37    81.30    81.22    81.16    81.09    81.02    80.96    80.89    80.83    80.77
   80.71    80.64    80.58    80.51    80.45    80.38    80.30    80.23    80.15    80.06    79.98    79.88
   79.78    79.68    79.56    79.44    79.32    79.18    79.04    78.89    78.69    77.08    75.43    72.14
   68.86    55.74    55.74    55.74    55.75
      42        0.            (12g9.3)         1      */vcond for Layer 2
      11       0.0            (12f9.2)         4      */top elev for Layer 2 -- 12top.grd
  241.50   209.49   180.51   136.51   116.51   106.51   105.50   105.51   108.53   110.73   112.28   113.35
  114.07   114.66   115.26   115.87   116.48   117.10   117.73   118.37   119.01   119.65   120.31   120.97
  121.63   122.30   122.97   123.65   124.34   125.03   125.72   126.42   127.12   127.83   128.54   129.25
  129.96   130.68   131.41   132.14   132.37   132.12   131.87   131.62   131.37   131.13   130.90   130.66
  130.43   130.21   129.98   129.77   129.55   129.34   129.14   128.94   128.74   128.55   128.37   128.19
  128.01   127.84   127.68   127.52   127.37   127.22   127.08   126.95   126.79   126.58   126.29   126.30
  136.12   155.87   180.44   180.41   145.98
  241.50   205.02   177.16   136.15   106.63   103.33   100.05    98.41    96.77    98.71   100.07   101.01
  101.64   102.16   102.67   103.20   103.72   104.25   104.79   105.32   105.86   106.40   106.94   107.48
  108.02   108.57   109.11   109.66   110.20   110.75   111.29   111.83   112.38   112.92   113.46   114.01
  114.55   115.09   115.63   116.18   116.54   116.72   116.91   117.10   117.29   117.48   117.69   117.89
  118.11   118.34   118.57   118.82   119.08   119.36   119.65   119.95   120.28   120.62   120.98   121.37
  121.78   122.22   122.68   123.18   123.70   124.26   124.84   125.46   126.29   127.91   129.56   132.86
  136.13   160.79   185.39   208.30   195.19
  244.40   205.02   160.76   126.30   106.62   101.69    96.78    96.77    96.11    96.50    96.82    97.05
   97.22    97.36    97.50    97.65    97.80    97.96    98.12    98.28    98.45    98.62    98.79    98.96
   99.14    99.31    99.48    99.66    99.83   100.01   100.18   100.35   100.52   100.68   100.85   101.01
  101.17   101.32   101.47   101.62   101.74   101.83   101.92   102.00   102.08   102.16   102.24   102.32
  102.39   102.46   102.53   102.60   102.68   102.75   102.83   102.90   102.98   103.07   103.16   103.25
  103.35   103.46   103.58   103.70   103.84   103.98   104.14   104.31   104.54   104.93   105.63   106.63
  111.53   136.22   173.92   198.49   208.31
  244.40   193.55   160.75   126.30   106.62   101.69    96.78    96.77    96.44    95.37    94.85    94.59
   94.46    94.37    94.29    94.24    94.20    94.17    94.16    94.16    94.18    94.20    94.25    94.30
   94.37    94.44    94.53    94.63    94.74    94.86    95.00    95.14    95.29    95.46    95.63    95.82
   96.01    96.22    96.43    96.66    96.71    96.59    96.48    96.37    96.28    96.19    96.12    96.05
   95.99    95.94    95.90    95.86    95.84    95.82    95.80    95.80    95.80    95.80    95.82    95.84
   95.86    95.89    95.93    95.98    96.03    96.08    96.15    96.21    96.31    96.47    96.77    96.78
  100.05   106.67   126.39   170.62   185.37
  241.12   191.90   155.83   123.02   101.71    96.78    95.13    90.19    86.93    87.34    87.52    87.60
   87.65    87.69    87.72    87.75    87.78    87.80    87.83    87.86    87.89    87.92    87.96    87.99
   88.03    88.08    88.12    88.16    88.21    88.26    88.31    88.35    88.40    88.44    88.48    88.51
   88.54    88.55    88.56    88.57    88.71    89.01    89.29    89.57    89.85    90.12    90.38    90.65
   90.91    91.18    91.45    91.73    92.02    92.31    92.61    92.91    93.23    93.56    93.89    94.24
   94.59    94.96    95.33    95.72    96.11    96.52    96.93    97.35    97.89    98.73   100.04   100.05
  100.05   103.33   106.67   136.19   165.67
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234.56	185.33	155.83	121.38	103.34	98.42	97.09	93.48	90.20	88.40	87.44	86.89
86.55	86.29	86.05	85.82	85.60	85.40	85.21	85.04	84.87	84.73	84.60	84.48
84.39	84.31	84.25	84.22	84.21	84.23	84.28	84.36	84.48	84.64	84.84	85.09
85.39	85.75	86.16	86.64	86.77	86.56	86.41	86.32	86.29	86.31	86.39	86.51
86.68	86.89	87.15	87.43	87.76	88.11	88.50	88.92	89.36	89.83	90.33	90.85
91.39	91.95	92.52	93.10	93.70	94.30	94.90	95.49	96.20	97.20	98.41	99.39
100.05	103.31	106.60	126.29	152.50							
234.56	182.06	155.82	121.38	103.34	100.05	96.78	93.49	90.21	88.82	87.57	86.69
86.09	85.62	85.16	84.71	84.26	83.83	83.41	83.01	82.62	82.24	81.88	81.53
81.20	80.88	80.57	80.28	79.99	79.72	79.45	79.18	78.92	78.67	78.42	78.16
77.91	77.66	77.42	77.18	77.24	77.60	77.96	78.33	78.70	79.08	79.46	79.86
80.25	80.66	81.09	81.52	81.98	82.45	82.95	83.47	84.01	84.58	85.17	85.79
86.44	87.11	87.81	88.54	89.29	90.08	90.90	91.77	92.91	94.83	98.37	98.39
100.02	96.76	93.52	116.47	136.12							
233.90	182.06	154.18	121.38	104.31	100.05	96.78	95.12	93.49	90.12	87.99	86.63
85.76	85.08	84.42	83.79	83.17	82.58	82.02	81.47	80.95	80.46	79.99	79.53
79.10	78.69	78.29	77.90	77.53	77.16	76.81	76.46	76.12	75.79	75.46	75.13
74.82	74.51	74.22	73.94	73.93	74.20	74.48	74.78	75.08	75.40	75.72	76.05
76.39	76.74	77.11	77.48	77.88	78.29	78.73	79.19	79.68	80.20	80.75	81.34
81.96	82.60	83.27	83.94	84.61	85.26	85.86	86.39	86.92	87.31	86.93	88.57
91.85	96.76	93.49	116.47	126.30							
233.89	185.01	149.25	121.38	103.35	100.06	96.79	95.14	93.49	90.21	87.75	86.16
85.13	84.34	83.58	82.85	82.14	81.48	80.84	80.25	79.68	79.16	78.66	78.20
77.77	77.36	76.97	76.61	76.27	75.94	75.62	75.32	75.04	74.77	74.52	74.30
74.11	73.96	73.85	73.80	73.75	73.70	73.71	73.77	73.86	73.99	74.14	74.31
74.51	74.72	74.95	75.19	75.46	75.74	76.05	76.40	76.78	77.21	77.70	78.25
78.89	79.60	80.39	81.26	82.18	83.13	84.09	85.04	86.13	87.38	86.96	90.23
93.50	96.73	86.95	116.47	119.72							
231.26	185.34	145.99	121.38	104.97	101.69	98.41	96.77	93.49	89.89	87.26	85.55
84.45	83.60	82.78	82.00	81.25	80.54	79.88	79.27	78.70	78.17	77.69	77.26
76.86	76.49	76.15	75.84	75.54	75.26	74.99	74.73	74.49	74.26	74.06	73.89
73.76	73.67	73.60	73.52	73.45	73.38	73.31	73.26	73.24	73.26	73.31	73.39
73.49	73.61	73.75	73.90	74.06	74.24	74.43	74.65	74.90	75.20	75.58	76.05
76.65	77.41	78.34	79.44	80.67	82.02	83.46	84.98	87.00	90.35	96.75	96.78
96.77	93.48	86.94	116.46	118.09							
229.64	185.34	145.99	121.37	104.98	101.69	98.41	96.76	93.49	89.51	86.80	85.03
83.88	83.00	82.14	81.33	80.55	79.83	79.15	78.53	77.96	77.45	76.99	76.59
76.23	75.91	75.62	75.36	75.11	74.87	74.63	74.39	74.16	73.94	73.74	73.57
73.45	73.38	73.36	73.42	73.33	73.12	72.96	72.86	72.80	72.78	72.80	72.85
72.91	72.99	73.08	73.18	73.29	73.40	73.51	73.63	73.77	73.94	74.16	74.48
74.97	75.70	76.73	78.01	79.48	81.08	82.78	84.57	86.94	90.82	96.75	96.77
96.77	93.47	86.95	116.45	118.09							
229.17	185.14	145.86	121.29	105.14	101.58	98.36	96.42	93.02	89.19	86.45	84.64
82.12	81.43	80.76	80.11	79.49	78.91	78.37	77.82	77.25	76.69	76.21	75.79
75.44	75.17	74.96	74.79	74.65	74.51	74.37	74.21	74.05	73.90	73.75	73.62
73.51	73.43	73.38	73.36	73.36	73.35	73.33	73.32	73.31	73.28	73.25	73.21
73.16	73.15	73.23	73.35	73.47	73.57	73.68	73.76	73.85	73.93	74.04	74.21
74.53	75.04	75.82	76.76	77.76	78.81	79.87	80.94	86.45	90.22	95.14	96.33
96.20	92.93	87.88	114.79	117.79							
228.80	184.99	145.76	121.23	105.26	101.49	98.28	96.11	92.64	88.89	86.14	84.31
81.90	81.18	80.46	79.76	79.08	78.43	77.82	77.22	76.65	76.12	75.65	75.26
74.96	74.72	74.55	74.43	74.33	74.25	74.15	74.03	73.89	73.75	73.62	73.50
73.40	73.34	73.30	73.29	73.31	73.32	73.33	73.35	73.35	73.35	73.34	73.32
73.30	73.31	73.36	73.43	73.51	73.60	73.67	73.73	73.79	73.86	73.94	74.07
74.26	74.63	75.49	76.53	77.58	78.65	79.73	80.81	85.86	89.43	93.84	95.68
95.65	92.52	88.52	113.54	117.52							
228.42	184.83	145.67	121.16	105.38	101.40	98.18	95.80	92.26	88.57	85.83	83.97
81.69	80.92	80.15	79.38	78.65	77.93	77.26	76.61	76.02	75.49	75.04	74.69
74.42	74.24	74.12	74.06	74.03	74.00	73.94	73.86	73.75	73.62	73.49	73.38
73.29	73.24	73.22	73.23	73.26	73.30	73.35	73.39	73.43	73.46	73.47	73.47
73.48	73.49	73.51	73.56	73.61	73.67	73.72	73.76	73.82	73.88	73.94	74.06
74.21	74.50	75.40	76.42	77.47	78.54	79.59	80.65	85.16	88.50	92.56	94.84
95.02	92.11	89.08	112.37	117.24							
228.05	184.67	145.57	121.10	105.48	101.30	98.04	95.47	91.88	88.25	85.51	83.64
81.48	80.67	79.83	79.00	78.19	77.41	76.67	75.99	75.37	74.82	74.39	74.07

73.85	73.72	73.67	73.68	73.73	73.78	73.79	73.73	73.62	73.49	73.36	73.26
73.18	73.14	73.14	73.18	73.22	73.29	73.38	73.46	73.54	73.60	73.64	73.66
73.67	73.68	73.69	73.72	73.75	73.79	73.82	73.85	73.89	73.96	74.04	74.17
74.40	74.82	75.54	76.44	77.43	78.44	79.46	80.47	84.40	87.52	91.30	93.88
94.32	91.71	89.55	111.28	116.94							
227.68	184.51	145.48	121.04	105.57	101.19	97.89	95.13	91.51	87.94	85.21	83.31
81.31	80.43	79.52	78.62	77.74	76.89	76.08	75.34	74.68	74.13	73.71	73.42
73.24	73.18	73.20	73.30	73.44	73.59	73.68	73.64	73.51	73.38	73.24	73.14
73.07	73.04	73.06	73.11	73.20	73.31	73.43	73.56	73.67	73.77	73.83	73.86
73.88	73.88	73.89	73.90	73.91	73.93	73.96	73.99	74.02	74.09	74.18	74.35
74.63	75.07	75.71	76.51	77.42	78.37	79.34	80.31	83.63	86.52	90.09	92.86
93.59	91.31	89.95	110.26	116.62							
227.32	184.35	145.39	120.98	105.66	101.08	97.71	94.79	91.16	87.64	84.92	83.00
81.16	80.22	79.25	78.27	77.30	76.36	75.50	74.70	74.01	73.40	73.00	72.73
72.61	72.61	72.72	72.90	73.15	73.43	73.64	73.58	73.43	73.27	73.12	73.01
72.94	72.93	72.97	73.05	73.18	73.32	73.49	73.65	73.82	73.96	74.05	74.08
74.08	74.08	74.07	74.07	74.08	74.10	74.11	74.13	74.18	74.24	74.35	74.54
74.83	75.26	75.85	76.57	77.40	78.29	79.22	80.15	82.85	85.54	88.92	91.81
92.82	90.91	90.26	109.30	116.29							
226.95	184.19	145.30	120.92	105.73	100.97	97.52	94.45	90.82	87.37	84.66	82.73
81.06	80.05	79.01	77.94	76.89	75.86	74.90	74.06	73.34	72.78	72.29	72.03
71.96	72.04	72.23	72.50	72.82	73.18	73.50	73.46	73.33	73.18	73.03	72.90
72.84	72.83	72.88	72.99	73.15	73.34	73.54	73.76	73.99	74.17	74.27	74.31
74.29	74.26	74.24	74.24	74.25	74.26	74.27	74.29	74.32	74.38	74.49	74.68
74.96	75.38	75.92	76.58	77.35	78.19	79.07	79.97	82.08	84.59	87.79	90.76
92.02	90.51	90.51	108.41	115.94							
226.59	184.02	145.21	120.87	105.80	100.85	97.31	94.11	90.50	87.12	84.45	82.50
81.01	79.93	78.81	77.66	76.52	75.39	74.33	73.41	72.62	71.97	71.51	71.29
71.30	71.48	71.78	72.12	72.49	72.83	73.12	73.28	73.29	73.16	72.97	72.83
72.76	72.74	72.79	72.93	73.13	73.37	73.61	73.88	74.15	74.40	74.52	74.51
74.45	74.40	74.37	74.38	74.39	74.41	74.43	74.44	74.47	74.51	74.60	74.76
75.03	75.40	75.90	76.51	77.22	78.02	78.88	79.76	81.32	83.66	86.72	89.71
91.22	90.10	90.69	107.56	115.58							
226.23	183.86	145.12	120.81	105.86	100.73	97.09	93.78	90.21	86.92	84.28	82.33
80.99	79.85	78.68	77.46	76.24	75.00	73.82	72.82	71.93	71.18	70.69	70.53
70.67	71.00	71.41	71.85	72.24	72.57	72.87	73.25	73.48	73.35	73.01	72.87
72.77	72.68	72.71	72.87	73.12	73.39	73.65	73.93	74.26	74.64	74.75	74.63
74.52	74.46	74.44	74.46	74.51	74.56	74.58	74.59	74.58	74.60	74.65	74.78
75.00	75.34	75.79	76.36	77.03	77.78	78.59	79.46	80.58	82.77	85.69	88.69
90.41	89.69	90.81	106.77	115.21							
225.87	183.69	145.04	120.76	105.91	100.60	96.86	93.46	89.94	86.75	84.17	82.23
80.96	79.82	78.61	77.36	76.07	74.77	73.51	72.38	71.35	70.47	69.87	69.79
70.15	70.67	71.21	71.76	72.22	72.57	72.76	73.56	74.14	74.07	73.20	73.24
72.96	72.66	72.61	72.81	73.11	73.43	73.70	73.87	74.15	74.66	74.79	74.58
74.45	74.40	74.41	74.49	74.58	74.67	74.71	74.71	74.66	74.62	74.63	74.71
74.90	75.18	75.60	76.12	76.74	77.43	78.19	78.98	79.84	81.92	84.70	87.70
89.61	89.28	90.88	106.02	114.83							
225.52	183.53	144.96	120.70	105.96	100.47	96.62	93.14	89.69	86.62	84.13	82.21
80.99	79.86	78.65	77.38	76.06	74.71	73.39	72.13	71.00	69.97	69.10	69.22
69.90	70.64	71.33	71.97	72.53	73.00	73.51	74.32	75.26	76.03	75.32	74.22
73.38	72.67	72.54	72.79	73.13	73.53	73.77	73.78	73.83	74.17	74.31	74.25
74.19	74.21	74.28	74.42	74.60	74.76	74.84	74.80	74.69	74.58	74.53	74.55
74.68	74.93	75.30	75.78	76.35	77.01	77.70	78.41	79.13	81.09	83.77	86.74
88.81	88.87	90.89	105.31	114.45							
225.16	183.36	144.87	120.65	105.99	100.34	96.37	92.83	89.45	86.54	84.16	82.28
81.12	80.00	78.79	77.52	76.20	74.85	73.47	72.12	71.00	70.06	69.26	69.43
70.19	70.97	71.73	72.43	73.07	73.64	74.26	75.06	76.05	77.17	76.56	75.01
73.90	73.11	72.82	72.88	73.10	73.62	73.90	73.64	73.55	73.63	73.71	73.76
73.79	73.86	74.01	74.24	74.52	74.79	74.94	74.86	74.65	74.46	74.33	74.29
74.37	74.58	74.92	75.37	75.91	76.51	77.16	77.81	78.43	80.30	82.88	85.82
88.04	88.45	90.86	104.64	114.05							
224.81	183.19	144.79	120.60	106.02	100.21	96.13	92.52	89.23	86.49	84.27	82.47
81.36	80.26	79.06	77.81	76.52	75.21	73.86	72.50	71.51	70.78	70.33	70.40
70.93	71.62	72.36	73.07	73.72	74.29	74.82	75.43	76.04	76.39	75.95	75.08
74.30	73.69	73.29	73.07	72.95	73.30	73.42	73.15	73.02	73.03	73.09	73.17

73.26	73.40	73.62	73.91	74.29	74.73	75.05	74.79	74.46	74.20	74.02	73.93
73.96	74.12	74.45	74.88	75.41	75.98	76.59	77.20	77.76	79.55	82.03	84.94
87.28	88.02	90.79	104.00	113.66							
224.46	183.02	144.71	120.55	106.05	100.07	95.87	92.22	89.02	86.47	84.45	82.77
81.72	80.64	79.45	78.22	77.03	75.80	74.57	73.39	72.46	71.80	71.45	71.48
71.85	72.43	73.10	73.76	74.43	74.89	75.21	75.57	75.83	75.78	75.21	74.92
74.57	74.19	73.81	73.43	73.08	72.82	72.58	72.37	72.31	72.35	72.43	72.53
72.65	72.83	73.08	73.42	73.83	74.33	74.75	74.42	74.08	73.80	73.60	73.48
73.46	73.58	73.91	74.36	74.88	75.43	76.01	76.59	77.11	78.83	81.23	84.10
86.54	87.60	90.69	103.38	113.25							
224.11	182.85	144.63	120.50	106.06	99.93	95.62	91.92	88.82	86.47	84.69	83.21
82.22	81.18	79.97	78.76	77.71	76.59	75.44	74.39	73.51	72.88	72.54	72.51
72.77	73.26	73.85	74.35	74.88	75.22	75.43	75.64	75.75	75.62	75.29	75.11
74.96	74.72	74.40	73.92	73.24	72.42	71.74	71.47	71.51	71.67	71.76	71.85
71.99	72.18	72.43	72.76	73.14	73.51	73.75	73.68	73.48	73.28	73.10	72.97
72.90	72.96	73.37	73.83	74.33	74.87	75.43	75.99	76.50	78.15	80.48	83.30
85.82	87.17	90.54	102.80	112.85							
223.77	182.68	144.56	120.46	106.08	99.78	95.36	91.63	88.61	86.47	84.96	83.75
82.85	81.89	80.79	79.65	78.59	77.50	76.40	75.38	74.53	73.90	73.54	73.44
73.60	73.93	74.36	74.74	75.08	75.32	75.54	75.74	75.83	75.79	75.65	75.54
75.46	75.33	75.10	74.62	73.65	72.15	70.78	70.57	70.74	70.96	71.07	71.19
71.32	71.49	71.74	72.01	72.32	72.59	72.78	72.83	72.77	72.67	72.57	72.49
72.46	72.57	72.90	73.34	73.82	74.33	74.86	75.40	75.92	77.51	79.77	82.54
85.13	86.73	90.37	102.23	112.45							
223.42	182.51	144.48	120.41	106.08	99.64	95.11	91.33	88.39	86.44	85.23	84.37
83.56	82.71	81.71	80.67	79.60	78.48	77.36	76.32	75.46	74.82	74.41	74.25
74.30	74.50	74.79	75.07	75.32	75.51	75.72	75.93	76.04	76.07	76.03	75.99
75.97	75.94	75.88	75.62	74.60	72.50	70.36	70.12	70.17	70.29	70.43	70.58
70.72	70.86	71.07	71.29	71.49	71.69	71.89	72.04	72.08	72.07	72.03	72.01
72.04	72.19	72.49	72.88	73.32	73.81	74.32	74.83	75.37	76.91	79.10	81.83
84.46	86.30	90.17	101.69	112.04							
223.08	182.34	144.40	120.37	106.09	99.50	94.85	91.03	88.16	86.36	85.42	84.94
84.29	83.51	82.57	81.62	80.60	79.43	78.24	77.16	76.26	75.58	75.15	74.93
74.90	75.00	75.19	75.42	75.63	75.83	76.03	76.21	76.32	76.38	76.39	76.39
76.39	76.42	76.48	76.61	76.04	73.40	71.35	70.27	69.86	69.81	69.93	70.09
70.26	70.39	70.53	70.65	70.76	70.86	71.12	71.35	71.46	71.51	71.51	71.54
71.62	71.79	72.07	72.42	72.84	73.30	73.79	74.29	74.87	76.35	78.47	81.15
83.81	85.86	89.94	101.17	111.64							
222.74	182.17	144.33	120.32	106.09	99.35	94.59	90.74	87.91	86.22	85.46	85.28
84.85	84.10	83.18	82.38	81.52	80.22	78.96	77.84	76.90	76.20	75.76	75.51
75.42	75.44	75.57	75.75	75.96	76.17	76.36	76.53	76.63	76.69	76.71	76.69
76.67	76.62	76.57	76.41	75.54	73.60	71.79	70.35	69.61	69.46	69.57	69.76
69.93	70.04	70.10	70.18	70.29	70.24	70.64	70.85	70.96	71.00	71.03	71.08
71.18	71.36	71.62	71.96	72.38	72.82	73.29	73.78	74.39	75.83	77.89	80.51
83.19	85.42	89.69	100.66	111.24							
222.40	182.00	144.26	120.28	106.08	99.21	94.34	90.44	87.63	86.00	85.30	85.14
84.67	84.07	83.32	82.63	81.86	80.64	79.43	78.35	77.40	76.68	76.28	75.99
75.85	75.83	75.92	76.07	76.29	76.51	76.71	76.85	76.95	76.99	76.98	76.93
76.82	76.61	76.29	75.74	74.70	73.19	72.02	70.26	69.38	69.26	69.38	69.61
69.82	69.85	69.82	69.82	70.24	70.61	70.57	70.55	70.54	70.56	70.58	70.64
70.74	70.92	71.18	71.52	71.93	72.36	72.84	73.33	73.96	75.35	77.35	79.91
82.59	84.99	89.43	100.16	110.84							
222.07	181.83	144.18	120.24	106.07	99.06	94.09	90.14	87.33	85.69	84.94	84.63
84.13	83.64	83.04	82.39	81.62	80.66	79.65	78.69	77.86	77.19	76.73	76.40
76.21	76.15	76.21	76.36	76.58	76.83	77.05	77.19	77.25	77.26	77.22	77.11
76.92	76.54	75.97	75.18	74.17	72.94	71.85	70.60	69.70	69.31	69.37	69.63
69.81	69.82	69.71	69.58	70.18	70.86	70.49	70.28	70.18	70.16	70.18	70.22
70.31	70.47	70.74	71.09	71.49	71.94	72.42	72.92	73.55	74.90	76.85	79.35
82.02	84.55	89.14	99.68	110.44							
221.73	181.66	144.11	120.20	106.06	98.92	93.84	89.85	87.02	85.32	84.43	83.93
83.49	83.06	82.55	81.96	81.29	80.53	79.72	78.93	78.20	77.59	77.10	76.74
76.49	76.39	76.43	76.58	76.83	77.13	77.40	77.51	77.53	77.50	77.43	77.29
77.04	76.55	75.72	74.78	73.89	72.95	72.00	71.08	70.30	69.72	69.73	69.93
70.03	70.00	69.88	69.76	70.04	70.35	70.15	69.91	69.81	69.79	69.82	69.85
69.89	70.03	70.30	70.68	71.10	71.56	72.04	72.54	73.18	74.49	76.39	78.82

81.46	84.11	88.84	99.21	110.05							
221.40	181.48	144.04	120.16	106.04	98.78	93.60	89.55	86.68	84.89	83.83	83.15
82.81	82.40	81.96	81.47	80.93	80.33	79.70	79.07	78.46	77.90	77.42	77.00
76.70	76.56	76.57	76.72	77.00	77.35	77.75	77.76	77.73	77.67	77.57	77.43
77.20	76.76	75.62	74.43	73.79	73.09	72.36	71.67	71.07	70.67	70.52	70.51
70.48	70.39	70.21	70.00	69.93	69.92	69.75	69.48	69.45	69.48	69.54	69.58
69.56	69.57	69.92	70.33	70.76	71.21	71.68	72.18	72.83	74.11	75.96	78.33
80.93	83.67	88.52	98.75	109.66							
221.07	181.31	143.97	120.12	106.02	98.63	93.36	89.25	86.34	84.44	83.20	82.34
82.08	81.71	81.32	80.94	80.54	80.12	79.65	79.17	78.67	78.18	77.71	77.26
76.88	76.68	76.64	76.78	77.07	77.43	77.74	77.85	77.85	77.79	77.66	77.49
77.25	76.85	75.75	74.65	73.96	73.37	72.81	72.30	71.90	71.62	71.42	71.23
71.04	70.85	70.67	70.08	69.85	69.70	69.51	69.31	69.22	69.25	69.35	69.47
69.51	69.39	69.73	70.08	70.47	70.89	71.34	71.84	72.50	73.76	75.58	77.87
80.41	83.23	88.19	98.30	109.28							
220.74	181.14	143.90	120.08	106.00	98.50	93.12	88.96	85.99	83.98	82.57	81.55
81.35	80.97	80.67	80.41	80.18	79.92	79.61	79.27	78.88	78.46	78.01	77.57
77.15	76.82	76.64	76.78	77.10	77.44	77.71	77.87	77.90	77.85	77.70	77.46
77.12	76.59	75.79	74.94	74.26	73.72	73.26	72.91	72.68	72.54	72.33	71.96
71.59	71.21	70.69	70.02	69.85	69.65	69.42	69.20	69.04	69.05	69.19	69.42
69.72	69.69	69.71	69.92	70.22	70.60	71.03	71.52	72.19	73.45	75.24	77.44
79.91	82.79	87.85	97.86	108.90							
220.41	180.97	143.83	120.04	105.98	98.36	92.89	88.68	85.64	83.53	81.98	80.82
80.63	80.25	80.00	79.89	79.84	79.76	79.62	79.40	79.12	78.78	78.38	77.94
77.49	77.04	76.60	76.82	77.18	77.51	77.76	77.92	77.96	77.89	77.71	77.42
76.99	76.44	75.78	75.10	74.51	74.04	73.67	73.40	73.28	73.28	73.15	72.57
72.07	71.55	70.96	70.41	70.03	69.71	69.42	69.15	68.96	68.93	69.04	69.23
69.44	69.54	69.58	69.72	69.97	70.31	70.72	71.21	71.89	73.17	74.93	77.03
79.43	82.35	87.49	97.43	108.52							
22C.08	180.79	143.76	120.01	105.96	98.22	92.67	88.40	85.31	83.12	81.48	80.23
79.99	79.54	79.32	79.45	79.60	79.69	79.70	79.62	79.43	79.15	78.79	78.38
77.93	77.48	77.15	77.18	77.42	77.67	77.86	78.01	78.04	77.96	77.74	77.38
76.90	76.34	75.74	75.16	74.68	74.27	73.96	73.75	73.64	73.57	73.37	72.94
72.46	71.93	71.35	70.79	70.28	69.85	69.47	69.15	68.93	68.83	68.86	68.98
69.12	69.25	69.35	69.50	69.72	70.03	70.43	70.90	71.60	72.93	74.67	76.65
78.96	81.91	87.13	97.01	108.16							
219.76	180.62	143.70	119.97	105.93	98.09	92.45	88.12	84.99	82.75	81.09	79.84
79.52	79.07	78.87	79.21	79.51	79.73	79.87	79.90	79.82	79.60	79.27	78.87
78.43	78.04	77.75	77.66	77.73	77.87	78.01	78.12	78.15	78.07	77.79	77.37
76.84	76.25	75.65	75.17	74.76	74.42	74.15	73.94	73.80	73.67	73.47	73.17
72.78	72.31	71.74	71.12	70.51	69.99	69.53	69.16	68.88	68.71	68.67	68.73
68.84	68.96	69.08	69.24	69.46	69.75	70.13	70.60	71.33	72.74	74.45	76.28
78.50	81.48	86.76	96.59	107.79							
219.43	180.45	143.63	119.94	105.90	97.96	92.24	87.86	84.68	82.43	80.82	79.68
79.32	79.07	79.03	79.26	79.57	79.88	80.13	80.28	80.28	80.10	79.80	79.40
78.96	78.56	78.26	78.08	78.04	78.07	78.14	78.21	78.26	78.21	77.85	77.35
76.79	76.18	75.55	75.16	74.81	74.49	74.22	74.01	73.85	73.70	73.53	73.31
73.05	72.67	72.08	71.37	70.69	70.08	69.56	69.14	68.82	68.57	68.44	68.50
68.60	68.71	68.85	69.01	69.21	69.47	69.86	70.38	71.09	72.62	74.26	75.92
78.04	81.04	86.38	96.18	107.44							
219.11	180.28	143.56	119.90	105.87	97.84	92.04	87.61	84.40	82.16	80.63	79.68
79.31	79.18	79.21	79.42	79.74	80.09	80.43	80.71	80.79	80.65	80.34	79.90
79.43	79.00	78.65	78.41	78.28	78.22	78.22	78.23	78.24	78.18	77.80	77.30
76.76	76.19	75.64	75.20	74.83	74.51	74.23	74.00	73.82	73.67	73.51	73.35
73.20	73.02	72.33	71.51	70.76	70.10	69.54	69.08	68.73	68.47	68.34	68.34
68.41	68.51	68.64	68.80	69.01	69.25	69.62	70.32	70.92	72.59	74.10	75.57
77.60	80.61	86.00	95.77	107.09							
218.79	180.10	143.50	119.87	105.85	97.72	91.84	87.37	84.14	81.92	80.51	79.74
79.35	79.29	79.35	79.57	79.89	80.28	80.71	81.10	81.30	81.21	80.86	80.35
79.82	79.32	78.92	78.62	78.41	78.29	78.21	78.16	78.09	77.93	77.61	77.18
76.69	76.18	75.68	75.22	74.82	74.46	74.17	73.92	73.72	73.56	73.40	73.25
73.08	72.85	72.23	71.44	70.70	70.02	69.44	68.98	68.64	68.40	68.26	68.23
68.27	68.35	68.47	68.64	68.87	69.18	69.65	70.38	70.83	72.64	73.92	75.20
77.16	80.17	85.60	95.37	106.74							
218.47	179.93	143.43	119.84	105.82	97.60	91.65	87.14	83.89	81.72	80.42	79.80

79.39	79.35	79.43	79.65	79.97	80.38	80.86	81.35	81.74	81.77	81.31	80.66
80.03	79.49	79.03	78.68	78.43	78.25	78.12	78.01	77.88	77.69	77.40	77.03
76.60	76.14	75.66	75.19	74.75	74.35	74.03	73.76	73.56	73.38	73.20	73.02
72.79	72.44	71.90	71.23	70.53	69.86	69.29	68.83	68.52	68.31	68.18	68.14
68.15	68.22	68.34	68.51	68.76	69.12	69.67	70.42	70.72	72.79	73.69	74.82
76.72	79.74	85.21	94.98	106.40							
218.16	179.76	143.37	119.81	105.79	97.48	91.47	86.92	83.67	81.53	80.32	79.80
79.37	79.34	79.42	79.62	79.94	80.35	80.83	81.38	81.97	82.32	81.49	80.71
80.04	79.46	78.98	78.60	78.32	78.12	77.96	77.81	77.64	77.44	77.18	76.86
76.49	76.07	75.62	75.13	74.64	74.18	73.82	73.54	73.33	73.14	72.95	72.73
72.45	72.07	71.57	70.96	70.31	69.66	69.07	68.65	68.40	68.22	68.11	68.06
68.07	68.12	68.22	68.38	68.64	69.01	69.56	70.31	70.45	72.49	73.34	74.43
76.29	79.30	84.81	94.59	106.07							
217.84	179.58	143.30	119.78	105.76	97.37	91.30	86.72	83.46	81.36	80.21	79.74
79.29	79.26	79.32	79.50	79.78	80.15	80.59	81.07	81.52	81.62	81.09	80.43
79.81	79.24	78.76	78.38	78.08	77.86	77.70	77.55	77.38	77.17	76.93	76.67
76.35	75.99	75.55	75.04	74.50	73.96	73.54	73.28	73.07	72.88	72.68	72.43
72.12	71.74	71.26	70.71	70.11	69.49	68.86	68.48	68.31	68.17	68.07	68.01
68.01	68.04	68.12	68.25	68.48	68.81	69.32	70.02	70.01	71.71	72.86	74.01
75.85	78.87	84.40	94.20	105.75							
217.53	179.41	143.24	119.75	105.73	97.27	91.14	86.53	83.27	81.19	80.07	79.61
79.17	79.10	79.13	79.27	79.50	79.81	80.15	80.49	80.72	80.68	80.37	79.90
79.37	78.86	78.40	78.01	77.71	77.49	77.35	77.23	77.04	76.82	76.62	76.43
76.20	75.90	75.49	74.96	74.36	73.75	73.29	73.01	72.79	72.60	72.39	72.14
71.83	71.45	71.00	70.50	69.96	69.40	68.89	68.53	68.31	68.17	68.06	67.99
67.96	67.98	68.03	68.12	68.29	68.55	68.94	69.60	69.50	70.99	72.32	73.58
75.43	78.44	83.99	93.82	105.43							
217.22	179.24	143.18	119.72	105.70	97.17	90.98	86.35	83.09	81.02	79.91	79.42
79.00	78.90	78.88	78.95	79.12	79.36	79.61	79.82	79.93	79.87	79.63	79.25
78.81	78.34	77.90	77.51	77.20	76.99	76.88	76.90	76.58	76.36	76.22	76.11
76.01	75.82	75.44	74.86	74.21	73.59	73.09	72.74	72.49	72.29	72.11	71.89
71.57	71.19	70.79	70.33	69.86	69.40	68.97	68.62	68.39	68.21	68.08	68.01
67.96	67.93	67.95	68.00	68.12	68.29	68.62	69.12	69.01	70.36	71.77	73.14
75.00	78.01	83.57	93.45	105.12							
216.91	179.07	143.12	119.69	105.67	97.07	90.84	86.19	82.93	80.86	79.73	79.19
78.80	78.66	78.57	78.56	78.69	78.87	79.03	79.15	79.18	79.10	78.89	78.57
78.18	77.75	77.32	76.92	76.57	76.32	76.17	76.07	75.90	75.75	75.68	75.68
75.74	75.75	75.41	74.71	73.95	73.29	72.76	72.38	72.12	71.96	71.84	71.64
71.32	70.96	70.59	70.21	69.81	69.42	69.05	68.74	68.49	68.30	68.16	68.06
67.99	67.94	67.92	67.93	67.96	68.07	68.28	68.63	68.58	69.81	71.24	72.70
74.59	77.59	83.15	93.08	104.81							
216.60	178.90	143.06	119.67	105.64	96.98	90.71	86.04	82.78	80.71	79.54	78.95
78.60	78.43	78.28	78.20	78.29	78.38	78.46	78.51	78.49	78.38	78.19	77.90
77.55	77.14	76.69	76.25	75.85	75.53	75.32	75.18	75.08	75.00	74.99	75.06
75.25	75.56	75.29	74.33	73.51	72.82	72.29	71.92	71.67	71.54	71.49	71.37
71.03	70.72	70.42	70.10	69.79	69.46	69.14	68.85	68.61	68.42	68.27	68.16
68.10	68.03	67.95	67.92	67.88	67.86	67.94	68.14	68.21	69.34	70.76	72.28
74.17	77.16	82.73	92.72	104.51							
216.29	178.73	142.99	119.64	105.61	96.89	90.58	85.91	82.64	80.56	79.35	78.70
78.42	78.22	78.07	77.96	77.94	77.94	77.93	77.90	77.83	77.72	77.54	77.29
76.96	76.54	76.08	75.60	75.10	74.68	74.43	74.29	74.22	74.18	74.17	74.23
74.37	74.53	74.26	73.53	72.82	72.20	71.70	71.35	71.13	71.02	70.96	70.86
70.67	70.45	70.25	70.03	69.79	69.53	69.25	68.99	68.77	68.60	68.44	68.32
68.30	68.26	68.16	68.02	67.85	67.74	67.72	67.79	67.91	68.95	70.32	71.87
73.77	76.74	82.30	92.36	104.22							
215.99	178.55	142.93	119.62	105.59	96.81	90.47	85.79	82.53	80.43	79.18	78.47
78.24	78.04	77.87	77.74	77.64	77.56	77.46	77.35	77.24	77.14	76.98	76.75
76.43	76.03	75.56	75.02	74.43	73.86	73.61	73.48	73.43	73.36	73.31	73.29
73.24	73.12	72.85	72.49	72.01	71.50	71.04	70.72	70.55	70.47	70.43	70.37
70.28	70.18	70.09	69.99	69.86	69.65	69.39	69.14	68.95	68.82	68.72	68.65
68.65	68.65	68.53	68.25	67.89	67.67	67.60	67.64	67.67	68.64	69.95	71.48
73.38	76.33	81.88	92.00	103.94							
215.68	178.38	142.87	119.60	105.56	96.74	90.36	85.68	82.43	80.32	79.02	78.25
78.09	77.88	77.69	77.53	77.38	77.23	77.04	76.85	76.71	76.64	76.52	76.32
76.01	75.61	75.14	74.61	74.02	73.45	73.10	72.88	72.83	72.68	72.52	72.43

72.25	71.86	71.59	71.56	71.31	70.88	70.39	70.11	70.01	69.97	69.97	69.96
69.93	69.93	69.97	70.00	70.00	69.82	69.55	69.29	69.16	69.11	69.10	69.10
69.12	69.14	69.07	68.62	67.93	67.66	67.57	67.65	67.53	68.42	69.63	71.12
73.00	75.91	81.44	91.66	103.66							
215.38	178.21	142.81	119.57	105.54	96.67	90.27	85.59	82.34	80.23	78.90	78.07
77.94	77.73	77.54	77.35	77.17	76.98	76.74	76.47	76.29	76.29	76.19	75.99
75.69	75.32	74.87	74.38	73.87	73.42	73.06	72.79	72.57	72.26	71.90	71.90
71.69	71.29	71.04	71.10	70.93	70.55	70.04	69.78	69.68	69.62	69.65	69.67
69.66	69.74	69.89	70.03	70.14	70.02	69.74	69.46	69.42	69.50	69.56	69.60
69.62	69.62	69.61	69.16	68.11	67.82	67.69	67.76	67.51	68.27	69.36	70.78
72.63	75.50	81.01	91.31	103.39							
215.08	178.04	142.76	119.55	105.52	96.60	90.18	85.51	82.28	80.17	78.82	77.96
77.85	77.63	77.43	77.23	77.02	76.81	76.57	76.34	76.18	76.10	76.00	75.79
75.48	75.11	74.71	74.28	73.85	73.50	73.19	72.89	72.64	72.35	72.02	71.83
71.62	71.37	71.23	71.11	70.90	70.60	70.24	69.95	69.68	69.52	69.60	69.58
69.49	69.64	69.90	70.10	70.22	70.21	70.06	69.83	69.91	70.06	70.10	70.14
70.10	70.00	69.82	69.38	68.68	68.21	67.99	67.95	67.59	68.19	69.14	70.47
72.27	75.10	80.57	90.98	103.12							
214.78	177.87	142.70	119.53	105.50	96.54	90.11	85.44	82.23	80.13	78.79	77.95
77.84	77.60	77.38	77.15	76.94	76.71	76.49	76.29	76.12	75.99	75.87	75.65
75.33	74.99	74.62	74.26	73.92	73.68	73.38	73.06	72.85	72.71	72.38	72.04
71.78	71.59	71.50	71.33	71.11	70.88	70.64	70.40	70.13	69.94	69.86	69.78
69.72	69.82	70.05	70.26	70.42	70.51	70.56	70.62	70.79	70.93	70.86	70.79
70.60	70.32	69.99	69.52	68.99	68.55	68.27	68.15	67.73	68.17	68.97	70.18
71.93	74.71	80.13	90.65	102.87							
214.48	177.70	142.64	119.51	105.48	96.49	90.04	85.39	82.20	80.12	78.80	77.99
77.85	77.58	77.35	77.12	76.89	76.67	76.45	76.25	76.07	75.91	75.74	75.51
75.22	74.92	74.60	74.28	73.99	73.74	73.45	73.19	73.00	72.84	72.57	72.25
71.99	71.81	71.68	71.54	71.40	71.26	71.14	71.00	70.76	70.51	70.31	70.17
70.11	70.17	70.32	70.51	70.69	70.88	71.08	71.37	71.74	72.11	71.96	71.51
71.07	70.62	70.17	69.69	69.21	68.79	68.49	68.32	67.89	68.17	68.82	69.92
71.60	74.32	79.68	90.32	102.62							
214.18	177.53	142.58	119.49	105.46	96.44	89.99	85.35	82.19	80.13	78.83	78.05
77.86	77.60	77.35	77.12	76.88	76.66	76.44	76.24	76.04	75.85	75.65	75.43
75.16	74.88	74.59	74.30	74.03	73.78	73.53	73.29	73.10	72.89	72.65	72.40
72.18	72.01	71.89	71.78	71.71	71.67	71.68	71.69	71.43	71.07	70.77	70.59
70.50	70.52	70.62	70.78	70.98	71.22	71.51	71.90	72.46	73.24	72.74	72.00
71.39	70.85	70.32	69.83	69.36	68.96	68.64	68.43	68.03	68.19	68.69	69.68
71.28	73.94	79.23	90.00	102.37							
213.89	177.37	142.52	119.47	105.44	96.40	89.94	85.33	82.19	80.16	78.89	78.13
77.89	77.63	77.38	77.13	76.90	76.67	76.44	76.24	76.03	75.82	75.61	75.38
75.13	74.86	74.60	74.33	74.08	73.83	73.60	73.38	73.17	72.96	72.76	72.54
72.36	72.21	72.08	72.01	71.97	71.98	72.06	72.19	71.90	71.48	71.17	70.96
70.85	70.83	70.90	71.03	71.22	71.46	71.76	72.15	72.59	72.91	72.68	72.10
71.51	70.94	70.41	69.92	69.46	69.06	68.73	68.49	68.14	68.19	68.57	69.46
70.98	73.56	78.78	89.69	102.14							
213.60	177.20	142.47	119.46	105.43	96.36	89.90	85.31	82.21	80.21	78.97	78.22
77.93	77.67	77.40	77.16	76.93	76.69	76.47	76.25	76.04	75.82	75.60	75.37
75.12	74.88	74.62	74.38	74.13	73.90	73.68	73.46	73.25	73.06	72.86	72.67
72.51	72.38	72.26	72.20	72.17	72.18	72.21	72.19	72.01	71.71	71.44	71.25
71.13	71.10	71.13	71.23	71.38	71.60	71.85	72.14	72.40	72.52	72.35	71.94
71.44	70.92	70.42	69.93	69.49	69.11	68.77	68.50	68.20	68.18	68.47	69.25
70.70	73.20	78.33	89.39	101.91							
213.30	177.03	142.41	119.44	105.42	96.33	89.87	85.31	82.24	80.28	79.06	78.32
77.98	77.71	77.45	77.20	76.96	76.74	76.51	76.29	76.06	75.84	75.62	75.39
75.15	74.91	74.67	74.43	74.19	73.97	73.75	73.54	73.34	73.15	72.96	72.80
72.64	72.51	72.42	72.35	72.31	72.29	72.26	72.19	72.04	71.83	71.62	71.44
71.33	71.28	71.29	71.36	71.48	71.64	71.83	72.00	72.14	72.15	72.00	71.68
71.26	70.81	70.35	69.90	69.49	69.11	68.78	68.50	68.23	68.15	68.36	69.05
70.43	72.85	77.86	89.09	101.68							
213.01	176.86	142.36	119.42	105.41	96.30	89.86	85.32	82.29	80.35	79.16	78.43
78.01	77.76	77.50	77.26	77.01	76.79	76.55	76.32	76.10	75.88	75.65	75.42
75.19	74.96	74.72	74.49	74.26	74.04	73.83	73.62	73.43	73.25	73.07	72.91
72.76	72.65	72.54	72.46	72.40	72.35	72.29	72.20	72.07	71.90	71.73	71.58
71.47	71.41	71.40	71.43	71.51	71.61	71.72	71.82	71.86	71.82	71.65	71.39

71.03	70.64	70.23	69.82	69.44	69.09	68.78	68.52	68.21	68.10	68.25	68.87
70.18	72.51	77.40	88.80	101.47							
212.72	176.70	142.30	119.41	105.40	96.28	89.84	85.34	82.35	80.44	79.27	78.55
78.07	77.81	77.56	77.32	77.07	76.84	76.61	76.39	76.16	75.93	75.71	75.47
75.25	75.01	74.79	74.56	74.33	74.12	73.92	73.71	73.53	73.35	73.18	73.02
72.88	72.76	72.64	72.56	72.47	72.40	72.32	72.22	72.08	71.94	71.79	71.65
71.55	71.49	71.45	71.46	71.48	71.53	71.57	71.60	71.58	71.50	71.33	71.09
70.79	70.44	70.08	69.72	69.37	69.05	68.77	68.53	68.15	68.03	68.14	68.70
69.94	72.19	76.93	88.52	101.25							
212.43	176.53	142.24	119.40	105.39	96.26	89.84	85.37	82.41	80.54	79.38	78.67
78.12	77.87	77.62	77.38	77.15	76.91	76.68	76.46	76.22	75.99	75.76	75.54
75.31	75.08	74.85	74.63	74.42	74.21	74.01	73.81	73.62	73.44	73.28	73.12
72.98	72.85	72.74	72.63	72.54	72.44	72.33	72.22	72.10	71.96	71.82	71.69
71.59	71.51	71.46	71.43	71.42	71.42	71.41	71.38	71.32	71.21	71.04	70.81
70.54	70.23	69.91	69.58	69.28	69.00	68.74	68.53	68.06	67.93	68.02	68.54
69.72	71.88	76.45	88.25	101.05							
212.15	176.36	142.19	119.38	105.39	96.25	89.85	85.41	82.49	80.65	79.51	78.81
78.18	77.93	77.68	77.44	77.21	76.99	76.76	76.53	76.30	76.07	75.84	75.60
75.38	75.15	74.93	74.71	74.50	74.29	74.09	73.90	73.71	73.53	73.36	73.21
73.07	72.93	72.82	72.69	72.58	72.47	72.36	72.24	72.10	71.97	71.83	71.71
71.60	71.51	71.43	71.38	71.33	71.29	71.25	71.17	71.08	70.94	70.75	70.54
70.29	70.02	69.74	69.46	69.18	68.92	68.68	68.50	67.95	67.81	67.91	68.39
69.52	71.58	75.97	87.99	100.85							
211.86	176.20	142.14	119.37	105.39	96.25	89.86	85.46	82.58	80.76	79.64	78.94
78.24	77.99	77.75	77.52	77.29	77.06	76.84	76.61	76.38	76.15	75.92	75.68
75.46	75.23	75.01	74.79	74.58	74.38	74.18	73.99	73.80	73.62	73.45	73.30
73.15	73.01	72.89	72.75	72.63	72.50	72.38	72.24	72.11	71.97	71.83	71.69
71.57	71.47	71.38	71.31	71.24	71.16	71.08	70.97	70.85	70.69	70.51	70.29
70.06	69.82	69.56	69.31	69.07	68.83	68.62	68.45	67.81	67.68	67.80	68.26
69.34	71.31	75.48	87.73	100.65							
211.58	176.03	142.08	119.36	105.39	96.25	89.88	85.52	82.67	80.88	79.77	79.08
78.29	78.05	77.82	77.59	77.37	77.15	76.92	76.70	76.47	76.24	76.00	75.76
75.54	75.31	75.09	74.88	74.67	74.46	74.27	74.07	73.88	73.71	73.53	73.38
73.22	73.08	72.94	72.81	72.68	72.54	72.40	72.25	72.10	71.97	71.82	71.68
71.54	71.43	71.32	71.22	71.13	71.03	70.92	70.79	70.64	70.46	70.26	70.05
69.84	69.62	69.40	69.18	68.96	68.74	68.55	68.39	67.65	67.54	67.70	68.13
69.17	71.05	74.98	87.48	100.46							
211.30	175.87	142.03	119.35	105.39	96.25	89.91	85.58	82.77	81.00	79.91	79.23
78.35	78.12	77.89	77.66	77.44	77.22	77.01	76.79	76.56	76.32	76.08	75.85
75.62	75.39	75.18	74.96	74.76	74.56	74.35	74.15	73.96	73.79	73.62	73.45
73.30	73.15	73.00	72.86	72.71	72.57	72.42	72.26	72.11	71.96	71.80	71.65
71.51	71.36	71.25	71.14	71.02	70.90	70.77	70.62	70.46	70.26	70.04	69.83
69.64	69.45	69.25	69.06	68.85	68.66	68.49	68.32	67.47	67.40	67.62	68.02
69.03	70.80	74.47	87.23	100.28							
210.94	175.66	141.96	119.34	105.40	96.26	89.95	85.68	82.91	81.17	80.09	79.42
78.99	78.66	78.34	78.04	77.74	77.46	77.18	76.92	76.66	76.42	76.18	75.94
75.72	75.50	75.28	75.07	74.86	74.66	74.47	74.28	74.09	73.91	73.73	73.56
73.40	73.24	73.08	72.93	72.77	72.62	72.46	72.30	72.13	71.96	71.79	71.62
71.45	71.29	71.14	70.98	70.83	70.69	70.53	70.37	70.20	70.01	69.80	69.58
69.34	69.08	68.82	68.55	68.28	68.01	67.76	67.52	67.24	67.24	67.57	67.90
68.88	70.53	73.82	86.93	100.05							
210.42	175.36	141.86	119.33	105.41	96.30	90.04	85.84	83.13	81.43	80.37	79.71
79.28	78.96	78.64	78.33	78.03	77.75	77.47	77.20	76.94	76.68	76.44	76.20
75.96	75.74	75.51	75.30	75.08	74.88	74.68	74.48	74.28	74.10	73.91	73.73
73.56	73.38	73.21	73.04	72.87	72.70	72.53	72.35	72.18	72.00	71.82	71.64
71.46	71.28	71.11	70.93	70.75	70.58	70.39	70.20	70.00	69.79	69.57	69.34
69.10	68.86	68.60	68.35	68.09	67.85	67.62	67.42	67.24	67.24	67.57	67.90
68.88	70.52	73.81	86.93	100.05							
209.64	174.90	141.72	119.32	105.45	96.38	90.21	86.11	83.49	81.85	80.82	80.17
79.75	79.42	79.11	78.80	78.50	78.21	77.92	77.65	77.38	77.11	76.86	76.61
76.37	76.13	75.90	75.67	75.45	75.23	75.02	74.81	74.60	74.40	74.20	74.00
73.81	73.61	73.42	73.23	73.04	72.85	72.66	72.46	72.27	72.07	71.87	71.67
71.47	71.27	71.07	70.86	70.66	70.45	70.23	70.02	69.79	69.57	69.34	69.10
68.86	68.62	68.39	68.15	67.93	67.72	67.54	67.38	67.24	67.24	67.57	67.90
68.88	70.52	73.81	86.93	100.05							

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  208.50  174.23  141.51  119.31  105.54   96.56   90.54   86.60   84.10   82.53   81.53   80.90
   80.48   80.16   79.85   79.54   79.24   78.94   78.66   78.37   78.10   77.83   77.56   77.30
   77.04   76.79   76.55   76.30   76.07   75.83   75.60   75.37   75.14   74.92   74.69   74.47
   74.25   74.03   73.81   73.59   73.38   73.15   72.93   72.71   72.49   72.26   72.03   71.80
   71.57   71.34   71.10   70.87   70.63   70.39   70.15   69.90   69.66   69.42   69.17   68.93
   68.70   68.47   68.25   68.04   67.84   67.66   67.50   67.37   67.24   67.24   67.24   67.24
   68.88   70.52   73.80   83.65  100.05
  206.82  173.24  141.20  119.34  105.75   96.96   91.19   87.47   85.12   83.64   82.69   82.07
   81.68   81.36   81.05   80.75   80.45   80.15   79.86   79.57   79.29   79.01   78.74   78.47
   78.20   77.93   77.67   77.41   77.15   76.90   76.64   76.39   76.14   75.89   75.64   75.39
   75.13   74.88   74.63   74.38   74.12   73.87   73.61   73.35   73.09   72.83   72.56   72.30
   72.03   71.76   71.48   71.21   70.93   70.66   70.38   70.10   69.83   69.56   69.29   69.03
   68.78   68.53   68.30   68.08   67.88   67.69   67.52   67.38   67.24   67.24   67.24   67.24
   68.88   68.89   68.90   77.11  100.05
  204.40  171.79  140.77  119.45  106.21   97.79   92.40   88.99   86.84   85.48   84.59   84.02
   83.64   83.35   83.05   82.76   82.47   82.19   81.90   81.62   81.34   81.07   80.79   80.52
   80.25   79.98   79.71   79.44   79.18   78.91   78.64   78.38   78.11   77.84   77.57   77.30
   77.03   76.76   76.49   76.21   75.93   75.65   75.36   75.07   74.78   74.48   74.19   73.88
   73.58   73.26   72.95   72.63   72.31   71.99   71.66   71.33   71.00   70.67   70.34   70.02
   69.69   69.37   69.05   68.74   68.43   68.13   67.85   67.57   67.24   67.24   67.24   67.24
   68.87   68.88   67.24   67.29   96.77
  200.97  169.74  140.18  119.74  107.16   99.36   94.54   91.56   89.70   88.52   87.76   87.26
   86.93   86.68   86.42   86.17   85.92   85.67   85.42   85.18   84.93   84.69   84.45   84.22
   83.98   83.75   83.51   83.28   83.05   82.82   82.59   82.36   82.13   81.90   81.66   81.43
   81.20   80.96   80.73   80.49   80.25   80.00   79.76   79.51   79.25   79.00   78.73   78.46
   78.19   77.91   77.62   77.33   77.03   76.71   76.39   76.06   75.72   75.37   75.00   74.63
   74.24   73.84   73.42   72.99   72.55   72.09   71.63   71.15   70.53   70.53   70.53   68.89
   68.88   67.24   67.23   67.26   96.75
  196.60  167.11  139.49  120.34  108.73  101.79   97.66   95.20   93.70   92.77   92.18   91.81
   91.56   91.37   91.18   91.00   90.82   90.64   90.47   90.30   90.13   89.97   89.81   89.65
   89.50   89.35   89.21   89.07   88.93   88.80   88.67   88.54   88.42   88.30   88.19   88.08
   87.97   87.87   87.77   87.68   87.59   87.50   87.42   87.34   87.27   87.20   87.13   87.07
   87.02   86.96   86.92   86.87   86.83   86.80   86.77   86.75   86.73   86.71   86.70   86.70
   86.70   86.70   86.72   86.73   86.76   86.79   86.82   86.87   86.91   83.69   80.38   77.08
   73.81   67.24   67.24   70.52   77.07
  191.91  164.30  138.80  121.16  110.63  104.49  100.93   98.83   97.58   96.81   96.33   96.02
   95.82   95.67   95.52   95.37   95.22   95.08   94.94   94.81   94.68   94.55   94.43   94.30
   94.19   94.07   93.96   93.85   93.75   93.65   93.55   93.45   93.36   93.27   93.19   93.10
   93.02   92.94   92.87   92.80   92.72   92.66   92.59   92.52   92.46   92.39   92.33   92.27
   92.21   92.14   92.08   92.01   91.95   91.88   91.80   91.73   91.65   91.56   91.48   91.38
   91.28   91.18   91.06   90.94   90.82   90.68   90.54   90.39   90.19   88.58   86.93   83.64
   80.36   67.24   67.24   67.24   67.25
     102         0.         (4x,77f2.0)         4      */hydraulic cond for Layer 3
       3
     1.         2.      20.
   1 1 1 1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
   2 1 1 1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
   3 1 1 1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
   4 1 1 1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
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10 0 1 1 1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 1 1 1 1 1 1 1 1 1
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   8 1 1 1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 1 1 1 1 1 1 1
   9 1 1 1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 1 1 1 1 1 1 1
20 0 1 1 1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 1 1 1 1 1 1 1
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        11        0.        (12f9.2)         1       */bottom elev layer 3
    90.00     90.00     90.00     80.00     85.00     80.01     79.00     79.01     82.03     84.23     85.78     86.85
    87.57     88.16     88.76     89.37     89.98     90.60     91.23     91.87     92.51     93.15     93.81     94.47
    80.00     70.00     70.00     70.00     70.00     70.00     70.00     70.00     70.00     70.00     70.00     70.00
    60.00     60.00     60.00     60.00     60.00     60.00     60.00     60.00     60.00     60.00     60.00     60.00
    60.00     50.00     50.00     50.00     50.00     50.00     50.00     50.00     50.00     50.00     50.00     50.00
    50.00     50.00     50.00     50.00     50.00     50.00     50.00     50.00     50.00     50.00     50.00     40.00
    45.00     45.00     45.00     45.00     40.00
    90.00     90.00     90.00     80.00     75.00     76.83     73.55     71.91     70.27     72.21     73.57     74.51
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75.14	75.66	76.17	76.70	77.22	77.75	78.29	78.82	79.36	79.90	80.44	80.98
81.52	82.07	82.61	83.16	83.70	84.25	70.00	70.00	70.00	70.00	70.00	70.00
60.00	60.00	60.00	60.00	60.00	60.00	60.00	60.00	60.00	60.00	60.00	60.00
60.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00
50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00	40.00
45.00	45.00	45.00	45.00	40.00							
90.00	90.00	90.00	80.00	75.00	75.19	70.28	70.27	69.61	70.00	70.32	70.55
70.72	70.86	71.00	71.15	71.30	71.46	71.62	71.78	71.95	72.12	72.29	72.46
72.64	72.81	72.98	73.16	73.33	73.51	73.68	73.85	74.02	74.18	74.35	74.51
60.00	60.00	60.00	60.00	60.00	60.00	60.00	60.00	60.00	60.00	60.00	60.00
60.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00
50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00	40.00
45.00	45.00	45.00	45.00	40.00							
90.00	90.00	90.00	80.00	75.00	75.19	70.28	70.27	69.94	68.87	68.35	68.09
67.96	67.87	67.79	67.74	67.70	67.67	67.66	67.66	67.68	67.70	67.75	67.80
67.87	67.94	68.03	68.13	68.24	68.36	68.50	68.64	68.79	68.96	69.13	69.32
69.51	69.72	69.93	70.16	70.21	70.09	60.00	60.00	60.00	60.00	60.00	60.00
60.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00
50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00	40.00
45.00	45.00	45.00	45.00	40.00							
90.00	90.00	90.00	80.00	75.21	70.28	68.63	63.69	60.43	60.84	61.02	61.10
61.15	61.19	61.22	61.25	61.28	61.30	61.33	61.36	61.39	61.42	61.46	61.49
61.53	61.58	61.62	61.66	61.71	61.76	61.81	61.85	61.90	61.94	61.98	62.01
62.04	62.05	62.06	62.07	62.21	62.51	62.79	63.07	63.35	63.62	63.88	64.15
60.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00
50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00	40.00
45.00	45.00	45.00	45.00	40.00							
90.00	90.00	90.00	80.00	76.84	71.92	70.59	66.98	63.70	61.90	60.94	60.39
60.05	59.79	59.55	59.32	59.10	58.90	58.71	58.54	58.37	58.23	58.10	57.98
57.89	57.81	57.75	57.72	57.71	57.73	57.78	57.86	57.98	58.14	58.34	58.59
58.89	59.25	59.66	60.14	60.27	60.06	59.91	59.82	59.79	59.81	59.89	60.01
60.18	60.39	60.65	60.93	61.26	61.61	50.00	50.00	50.00	50.00	50.00	50.00
50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00	40.00
45.00	45.00	45.00	45.00	40.00							
90.00	90.00	90.00	80.00	76.84	73.55	70.28	66.99	63.71	62.32	61.07	60.19
59.59	59.12	58.66	58.21	57.76	57.33	56.91	56.51	56.12	55.74	55.38	55.03
54.70	54.38	54.07	53.78	53.49	53.22	52.95	52.68	52.42	52.17	51.92	51.66
51.41	51.16	50.92	50.68	50.74	51.10	51.46	51.83	52.20	52.58	52.96	53.36
53.75	54.16	54.59	55.02	55.48	55.95	56.45	56.97	57.51	58.08	58.67	59.29
50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00	40.00
45.00	45.00	45.00	45.00	40.00							
90.00	90.00	90.00	80.00	77.81	73.55	70.28	68.62	66.99	63.62	61.49	60.13
59.26	58.58	57.92	57.29	56.67	56.08	55.52	54.97	54.45	53.96	53.49	53.03
52.60	52.19	51.79	51.40	51.03	50.66	50.31	49.96	49.62	49.29	48.96	48.63
48.32	48.01	47.72	47.44	47.43	47.70	47.98	48.28	48.58	48.90	49.22	49.55
49.89	50.24	50.61	50.98	51.38	51.79	52.23	52.69	53.18	53.70	54.25	54.84
55.46	56.10	56.77	57.44	58.11	58.76	50.00	50.00	50.00	50.00	50.00	40.00
45.00	45.00	45.00	45.00	40.00							
90.00	90.00	90.00	80.00	76.85	73.56	70.29	68.64	66.99	63.71	61.25	59.66
58.63	57.84	57.08	56.35	55.64	54.98	54.34	53.75	53.18	52.66	52.16	51.70
51.27	50.86	50.47	50.11	49.77	49.44	49.12	48.82	48.54	48.27	48.02	47.80
47.61	47.46	47.35	47.30	47.25	47.20	47.21	47.27	47.36	47.49	47.64	47.81
48.01	48.22	48.45	48.69	48.96	49.24	49.55	49.90	50.28	50.71	51.20	51.75
52.39	53.10	53.89	54.76	55.68	56.63	57.59	50.00	50.00	50.00	50.00	40.00
45.00	45.00	45.00	45.00	40.00							
90.00	90.00	90.00	80.00	78.47	75.19	71.91	70.27	66.99	63.39	60.76	59.05
57.95	57.10	56.28	55.50	54.75	54.04	53.38	52.77	52.20	51.67	51.19	50.76
50.36	49.99	49.65	49.34	49.04	48.76	48.49	48.23	47.99	47.76	47.56	47.39
47.26	47.17	47.10	47.02	46.95	46.88	46.81	46.76	46.74	46.76	46.81	46.89
46.99	47.11	47.25	47.40	47.56	47.74	47.93	48.15	48.40	48.70	49.08	49.55
50.15	50.91	51.84	52.94	54.17	55.52	56.96	58.48	50.00	50.00	50.00	40.00
45.00	45.00	45.00	45.00	40.00							
90.00	90.00	90.00	80.00	78.48	75.19	71.91	70.26	66.99	63.01	60.30	58.53
57.38	56.50	55.64	54.83	54.05	53.33	52.65	52.03	51.46	50.95	50.49	50.09
49.73	49.41	49.12	48.86	48.61	48.37	48.13	47.89	47.66	47.44	47.24	47.07

46.95	46.88	46.86	46.92	46.83	46.62	46.46	46.36	46.30	46.28	46.30	46.35
46.41	46.49	46.58	46.68	46.79	46.90	47.01	47.13	47.27	47.44	47.66	47.98
48.47	49.20	50.23	51.51	52.98	54.58	56.28	58.07	60.44	50.00	50.00	40.00
45.00	45.00	45.00	45.00	40.00							
90.00	90.00	90.00	80.00	78.64	75.08	71.86	69.92	66.52	62.69	59.95	58.14
54.26	53.81	53.35	52.89	52.45	52.02	51.61	51.15	50.57	49.96	49.42	48.96
48.60	48.33	48.14	48.02	47.95	47.89	47.81	47.73	47.65	47.58	47.51	47.44
47.37	47.30	47.24	47.23	47.31	47.43	47.53	47.60	47.63	47.60	47.52	47.40
47.25	47.17	47.25	47.41	47.57	47.71	47.84	47.95	48.05	48.15	48.27	48.46
48.78	49.18	49.59	50.00	50.38	50.74	51.07	51.36	59.95	63.72	50.00	40.00
45.00	45.00	45.00	45.00	40.00							
90.00	90.00	90.00	80.00	78.76	74.99	71.78	69.61	66.14	62.39	59.64	57.81
54.18	53.67	53.13	52.59	52.05	51.51	50.98	50.42	49.83	49.25	48.73	48.31
47.98	47.75	47.61	47.54	47.51	47.51	47.50	47.49	47.48	47.46	47.45	47.44
47.42	47.42	47.43	47.49	47.59	47.72	47.84	47.94	48.00	48.00	47.96	47.88
47.78	47.73	47.76	47.83	47.93	48.04	48.14	48.24	48.34	48.46	48.61	48.82
49.12	49.48	49.86	50.26	50.64	51.00	51.33	51.63	59.36	62.93	50.00	40.00
45.00	45.00	45.00	45.00	40.00							
90.00	90.00	90.00	80.00	78.88	74.90	71.68	69.30	65.76	62.07	59.33	57.47
54.12	53.53	52.91	52.27	51.62	50.97	50.32	49.67	49.04	48.46	47.96	47.57
47.29	47.11	47.03	47.02	47.06	47.12	47.19	47.25	47.31	47.36	47.40	47.45
47.49	47.55	47.63	47.74	47.88	48.04	48.20	48.33	48.43	48.47	48.46	48.41
48.35	48.29	48.28	48.30	48.34	48.41	48.48	48.56	48.66	48.79	48.95	49.17
49.45	49.78	50.15	50.53	50.91	51.28	51.61	51.91	58.66	62.00	50.00	40.00
45.00	45.00	45.00	45.00	40.00							
90.00	90.00	90.00	80.00	78.98	74.80	71.54	68.97	65.38	61.75	59.01	57.14
54.07	53.41	52.69	51.94	51.18	50.40	49.64	48.91	48.22	47.61	47.12	46.75
46.52	46.42	46.42	46.49	46.62	46.76	46.90	47.04	47.16	47.27	47.38	47.47
47.58	47.69	47.82	47.99	48.17	48.37	48.58	48.76	48.90	48.99	49.01	48.98
48.92	48.85	48.79	48.77	48.76	48.79	48.83	48.89	48.98	49.11	49.27	49.48
49.75	50.07	50.42	50.79	51.18	51.55	51.90	52.20	57.90	61.02	50.00	40.00
45.00	45.00	45.00	45.00	40.00							
90.00	90.00	90.00	80.00	79.07	74.69	71.39	68.63	65.01	61.44	58.71	56.81
54.07	53.31	52.49	51.63	50.74	49.85	48.96	48.12	47.36	46.71	46.21	45.87
45.71	45.69	45.79	45.97	46.19	46.42	46.65	46.86	47.04	47.21	47.36	47.51
47.66	47.82	48.00	48.21	48.45	48.70	48.96	49.21	49.41	49.54	49.59	49.56
49.48	49.38	49.29	49.21	49.17	49.15	49.16	49.21	49.28	49.40	49.55	49.76
50.02	50.32	50.66	51.04	51.43	51.82	52.18	52.51	57.13	60.02	50.00	40.00
45.00	45.00	45.00	45.00	40.00							
90.00	90.00	90.00	80.00	79.16	74.58	71.21	68.29	64.66	61.14	58.42	56.50
54.11	53.26	52.33	51.35	50.34	49.31	48.30	47.33	46.47	45.75	45.23	44.92
44.84	44.93	45.16	45.46	45.80	46.13	46.44	46.72	46.96	47.18	47.37	47.55
47.73	47.93	48.15	48.40	48.68	49.00	49.33	49.64	49.92	50.11	50.18	50.14
50.02	49.88	49.73	49.61	49.53	49.48	49.46	49.49	49.55	49.64	49.79	49.98
50.23	50.52	50.86	51.24	51.64	52.05	52.45	52.81	56.35	59.04	50.00	40.00
45.00	45.00	45.00	45.00	40.00							
90.00	90.00	90.00	80.00	79.23	74.47	71.02	67.95	64.32	60.87	58.16	56.23
54.21	53.26	52.22	51.12	49.98	48.81	47.66	46.55	45.55	44.74	44.18	43.91
43.93	44.17	44.55	45.01	45.47	45.91	46.30	46.64	46.93	47.18	47.39	47.60
47.80	48.01	48.26	48.54	48.86	49.23	49.63	50.05	50.42	50.68	50.77	50.69
50.51	50.30	50.11	49.95	49.83	49.75	49.71	49.72	49.76	49.84	49.97	50.15
50.38	50.66	51.00	51.37	51.79	52.23	52.67	53.09	55.58	58.09	50.00	40.00
45.00	45.00	45.00	45.00	40.00							
90.00	90.00	90.00	80.00	79.30	74.35	70.81	67.61	64.00	60.62	57.95	56.00
54.36	53.30	52.16	50.95	49.69	48.39	47.08	45.81	44.64	43.68	43.05	42.83
43.00	43.43	44.02	44.64	45.25	45.79	46.25	46.64	46.95	47.21	47.44	47.64
47.84	48.06	48.31	48.60	48.95	49.37	49.84	50.36	50.87	51.26	51.36	51.19
50.91	50.62	50.37	50.18	50.04	49.95	49.90	49.88	49.91	49.97	50.08	50.24
50.46	50.73	51.05	51.42	51.85	52.31	52.80	53.30	54.82	57.16	50.00	40.00
45.00	45.00	45.00	45.00	40.00							
90.00	90.00	90.00	80.00	79.36	74.23	70.59	67.28	63.71	60.42	57.78	55.83
54.51	53.37	52.15	50.86	49.50	48.08	46.62	45.16	43.77	42.59	41.84	41.68
42.07	42.78	43.60	44.42	45.16	45.79	46.31	46.72	47.04	47.29	47.50	47.68
47.86	48.06	48.29	48.58	48.93	49.37	49.89	50.51	51.18	51.80	51.90	51.53
51.12	50.77	50.50	50.30	50.15	50.06	50.00	49.98	49.98	50.03	50.11	50.25

50.45	50.70	51.01	51.38	51.79	52.26	52.77	53.33	54.08	56.27	50.00	40.00
45.00	45.00	45.00	45.00	40.00							
90.00	90.00	90.00	80.00	79.41	74.10	70.36	66.96	63.44	60.25	57.67	55.73
54.59	53.45	52.21	50.87	49.44	47.92	46.33	44.70	43.06	41.56	40.53	40.49
41.26	42.31	43.39	44.40	45.26	45.96	46.50	46.90	47.19	47.40	47.57	47.72
47.85	48.01	48.20	48.45	48.78	49.20	49.73	50.37	51.13	51.99	52.07	51.52
51.06	50.71	50.45	50.27	50.15	50.08	50.03	50.00	49.98	50.00	50.07	50.18
50.36	50.59	50.88	51.22	51.62	52.06	52.54	53.02	53.34	55.42	50.00	40.00
45.00	45.00	45.00	45.00	40.00							
90.00	90.00	90.00	80.00	79.46	73.97	70.12	66.64	63.19	60.12	57.63	55.71
54.68	53.58	52.35	51.00	49.53	47.97	46.30	44.55	42.72	40.85	39.19	39.45
40.81	42.20	43.49	44.64	45.60	46.32	46.83	47.17	47.39	47.55	47.66	47.74
47.81	47.90	48.02	48.21	48.48	48.85	49.32	49.90	50.54	51.12	51.27	51.00
50.68	50.41	50.21	50.09	50.03	50.00	49.98	49.94	49.90	49.89	49.93	50.02
50.17	50.38	50.64	50.96	51.32	51.72	52.13	52.52	52.63	54.59	50.00	40.00
45.00	45.00	45.00	45.00	40.00							
90.00	90.00	90.00	80.00	79.49	73.84	69.87	66.33	62.95	60.04	57.66	55.78
54.86	53.81	52.60	51.27	49.81	48.24	46.57	44.81	42.98	41.11	39.46	39.74
41.14	42.57	43.94	45.18	46.19	46.88	47.29	47.51	47.64	47.71	47.75	47.75
47.73	47.73	47.76	47.86	48.04	48.32	48.70	49.16	49.65	50.05	50.22	50.18
50.03	49.89	49.79	49.76	49.78	49.83	49.85	49.80	49.72	49.68	49.69	49.76
49.89	50.08	50.32	50.61	50.93	51.28	51.63	51.95	51.93	53.80	50.00	40.00
45.00	45.00	45.00	45.00	40.00							
90.00	90.00	90.00	80.00	79.52	73.71	69.63	66.02	62.73	59.99	57.77	55.97
55.14	54.14	52.98	51.69	50.27	48.75	47.14	45.48	43.83	42.32	41.32	41.33
42.20	43.40	44.70	45.96	47.02	47.63	47.82	47.87	47.87	47.87	47.84	47.75
47.62	47.50	47.41	47.40	47.47	47.64	47.91	48.25	48.62	48.94	49.14	49.22
49.22	49.20	49.21	49.27	49.38	49.55	49.65	49.55	49.43	49.36	49.36	49.41
49.53	49.69	49.91	50.17	50.46	50.76	51.07	51.35	51.26	53.05	50.00	40.00
45.00	45.00	45.00	45.00	40.00							
90.00	90.00	90.00	80.00	79.55	73.57	69.37	65.72	62.52	59.97	57.95	56.27
55.52	54.57	53.48	52.25	50.90	49.45	47.95	46.44	45.01	43.82	43.08	43.00
43.53	44.44	45.57	46.81	48.03	48.45	48.28	48.14	48.05	47.97	47.90	47.72
47.45	47.21	47.00	46.86	46.80	46.84	47.00	47.24	47.54	47.83	48.06	48.22
48.32	48.41	48.50	48.63	48.81	49.06	49.29	49.12	48.99	48.92	48.91	48.97
49.08	49.23	49.43	49.67	49.93	50.20	50.47	50.73	50.61	52.33	50.00	40.00
45.00	45.00	45.00	45.00	40.00							
90.00	90.00	90.00	80.00	79.56	73.43	69.12	65.42	62.32	59.97	58.19	56.71
55.99	55.10	54.07	52.92	51.65	50.30	48.90	47.54	46.29	45.29	44.67	44.52
44.82	45.48	46.36	47.39	48.42	48.68	48.43	48.25	48.12	47.99	47.83	47.58
47.23	46.88	46.54	46.25	46.05	45.96	46.01	46.18	46.43	46.72	46.99	47.21
47.39	47.54	47.69	47.86	48.06	48.28	48.43	48.43	48.38	48.36	48.38	48.44
48.55	48.71	48.90	49.11	49.35	49.60	49.85	50.10	50.00	51.65	50.00	40.00
45.00	45.00	45.00	45.00	40.00							
90.00	90.00	90.00	80.00	79.58	73.28	68.86	65.13	62.11	59.97	58.46	57.25
56.51	55.69	54.74	53.66	52.48	51.22	49.92	48.67	47.55	46.66	46.08	45.85
45.98	46.39	46.99	47.65	48.18	48.29	48.25	48.21	48.11	47.95	47.72	47.40
47.00	46.54	46.07	45.62	45.24	45.01	44.95	45.08	45.33	45.65	45.96	46.24
46.47	46.66	46.84	47.01	47.21	47.40	47.55	47.63	47.67	47.71	47.77	47.86
47.98	48.13	48.32	48.53	48.75	48.99	49.23	49.46	49.42	51.01	53.27	40.00
45.00	45.00	45.00	45.00	40.00							
90.00	90.00	90.00	80.00	79.58	73.14	68.61	64.83	61.89	59.94	58.73	57.87
57.06	56.28	55.41	54.44	53.36	52.16	50.93	49.74	48.70	47.87	47.29	47.00
46.98	47.18	47.52	47.88	48.13	48.15	48.18	48.20	48.11	47.93	47.65	47.28
46.81	46.25	45.64	45.00	44.43	44.01	43.86	43.97	44.27	44.65	45.02	45.34
45.61	45.81	45.98	46.15	46.32	46.51	46.68	46.82	46.93	47.02	47.12	47.23
47.36	47.52	47.71	47.92	48.14	48.37	48.60	48.82	48.87	50.41	52.60	40.00
45.00	45.00	45.00	45.00	40.00							
90.00	90.00	90.00	80.00	79.59	73.00	68.35	64.53	61.66	59.86	58.92	58.44
57.56	56.80	56.02	55.19	54.23	53.07	51.85	50.71	49.71	48.91	48.32	47.97
47.83	47.87	48.01	48.18	48.29	48.32	48.31	48.28	48.17	47.97	47.67	47.26
46.73	46.08	45.32	44.48	43.64	42.99	42.73	42.90	43.31	43.78	44.22	44.58
44.86	45.05	45.18	45.30	45.45	45.64	45.85	46.04	46.19	46.33	46.45	46.58
46.73	46.90	47.09	47.30	47.52	47.75	47.98	48.20	48.37	49.85	51.97	40.00
45.00	45.00	45.00	45.00	40.00							

90.00	90.00	90.00	80.00	79.59	72.85	68.09	64.24	61.41	59.72	58.96	58.78
57.84	57.13	56.46	55.82	55.06	53.84	52.61	51.50	50.55	49.77	49.18	48.78
48.56	48.47	48.48	48.52	48.55	48.55	48.52	48.45	48.31	48.10	47.79	47.36
46.80	46.09	45.22	44.17	43.02	41.97	41.58	41.95	42.56	43.15	43.64	44.02
44.27	44.42	44.48	44.52	44.62	44.84	45.09	45.32	45.51	45.66	45.80	45.94
46.09	46.27	46.46	46.68	46.92	47.16	47.39	47.62	47.89	49.33	51.39	40.00
45.00	45.00	45.00	45.00	40.00							
90.00	90.00	90.00	80.00	79.58	72.71	67.84	63.94	61.13	59.50	58.80	58.64
57.76	57.17	56.59	56.05	55.39	54.26	53.12	52.09	51.20	50.46	49.87	49.45
49.17	49.00	48.92	48.88	48.86	48.82	48.76	48.67	48.53	48.31	48.01	47.61
47.06	46.35	45.43	44.25	42.82	41.20	40.56	41.42	42.20	42.84	43.34	43.70
43.91	44.00	43.96	43.85	43.86	44.15	44.46	44.71	44.90	45.05	45.18	45.31
45.46	45.64	45.85	46.08	46.33	46.59	46.86	47.12	47.46	48.85	50.85	40.00
45.00	45.00	45.00	45.00	40.00							
90.00	90.00	90.00	80.00	79.57	72.56	67.59	63.64	60.83	59.19	58.44	58.13
57.42	56.95	56.44	55.89	55.21	54.32	53.37	52.47	51.66	50.97	50.42	49.99
49.68	49.46	49.32	49.23	49.17	49.10	49.03	48.94	48.80	48.61	48.34	47.98
47.51	46.87	46.01	44.86	43.42	41.89	41.24	41.74	42.37	42.92	43.35	43.65
43.81	43.84	43.73	43.49	43.36	43.73	44.03	44.25	44.40	44.52	44.62	44.72
44.86	45.03	45.25	45.51	45.78	46.07	46.36	46.67	47.05	48.40	50.35	40.00
45.00	45.00	45.00	45.00	40.00							
90.00	90.00	90.00	80.00	79.56	72.42	67.34	63.35	60.52	58.82	57.93	57.43
56.97	56.57	56.11	55.59	54.96	54.23	53.45	52.68	51.97	51.35	50.83	50.41
50.09	49.85	49.68	49.56	49.47	49.39	49.31	49.23	49.11	48.96	48.75	48.47
48.10	47.61	46.95	45.96	44.66	43.44	42.77	42.75	43.03	43.37	43.66	43.87
43.97	43.95	43.82	43.64	43.56	43.67	43.82	43.94	44.02	44.07	44.11	44.16
44.27	44.45	44.68	44.96	45.26	45.58	45.91	46.25	46.68	47.99	49.89	40.00
45.00	45.00	45.00	45.00	40.00							
90.00	90.00	90.00	80.00	79.54	72.28	67.10	63.05	60.18	58.39	57.33	56.65
56.46	56.11	55.70	55.22	54.68	54.06	53.41	52.76	52.15	51.59	51.12	50.72
50.41	50.17	49.98	49.85	49.75	49.67	49.60	49.52	49.44	49.33	49.19	49.00
48.74	48.43	48.05	47.34	46.04	44.93	44.22	43.93	43.93	44.06	44.21	44.32
44.36	44.30	44.16	43.99	43.86	43.80	43.79	43.78	43.75	43.71	43.67	43.65
43.71	43.88	44.15	44.46	44.79	45.13	45.48	45.86	46.33	47.61	49.46	40.00
45.00	45.00	45.00	45.00	40.00							
90.00	90.00	90.00	80.00	79.52	72.13	66.86	62.75	59.84	57.94	56.70	55.84
55.90	55.60	55.24	54.83	54.36	53.85	53.30	52.75	52.22	51.74	51.31	50.95
50.65	50.41	50.23	50.09	49.99	49.91	49.86	49.81	49.76	49.71	49.63	49.52
49.37	49.15	48.84	48.21	47.17	46.21	45.50	45.08	44.90	44.87	44.91	44.94
44.92	44.82	44.65	44.44	44.22	44.03	43.87	43.73	43.59	43.45	43.31	43.19
43.16	43.37	43.69	44.02	44.37	44.72	45.09	45.49	46.00	47.26	49.08	40.00
45.00	45.00	45.00	45.00	40.00							
90.00	90.00	90.00	80.00	79.50	72.00	66.62	62.46	59.49	57.48	56.07	55.05
55.33	55.06	54.76	54.42	54.03	53.60	53.14	52.68	52.23	51.81	51.43	51.10
50.82	50.60	50.42	50.29	50.19	50.12	50.08	50.06	50.05	50.05	50.04	50.01
49.94	49.77	49.45	48.87	48.07	47.25	46.57	46.10	45.84	45.72	45.68	45.66
45.60	45.47	45.25	44.96	44.64	44.32	44.02	43.75	43.50	43.27	43.07	42.88
42.75	43.01	43.34	43.67	44.01	44.37	44.74	45.15	45.69	46.95	48.74	40.00
45.00	45.00	45.00	45.00	40.00							
90.00	90.00	90.00	80.00	79.48	71.86	66.39	62.18	59.14	57.03	55.48	54.32
54.75	54.53	54.29	54.00	53.68	53.33	52.95	52.56	52.18	51.82	51.48	51.19
50.93	50.72	50.56	50.43	50.34	50.29	50.26	50.27	50.29	50.34	50.39	50.44
50.45	50.36	50.07	49.54	48.83	48.08	47.44	46.96	46.66	46.51	46.46	46.43
46.36	46.20	45.92	45.53	45.08	44.62	44.19	43.80	43.46	43.17	42.94	42.76
42.71	42.85	43.11	43.41	43.73	44.07	44.43	44.83	45.39	46.67	48.43	50.53
45.00	45.00	45.00	45.00	40.00							
90.00	90.00	90.00	80.00	79.46	71.72	66.17	61.90	58.81	56.62	54.98	53.73
54.18	54.01	53.83	53.61	53.35	53.06	52.74	52.41	52.09	51.77	51.48	51.22
50.99	50.79	50.64	50.52	50.44	50.40	50.38	50.41	50.46	50.54	50.65	50.78
50.89	50.92	50.72	50.20	49.47	48.72	48.09	47.62	47.34	47.20	47.18	47.19
47.16	47.00	46.65	46.13	45.53	44.91	44.35	43.85	43.44	43.10	42.86	42.71
42.67	42.77	42.97	43.23	43.53	43.84	44.18	44.55	45.10	46.43	48.17	50.15
45.00	45.00	45.00	45.00	40.00							
90.00	90.00	90.00	80.00	79.43	71.59	65.95	61.62	58.49	56.25	54.59	53.34
53.63	53.54	53.41	53.24	53.03	52.79	52.53	52.25	51.97	51.69	51.43	51.20

50.99	50.81	50.67	50.56	50.48	50.44	50.44	50.47	50.54	50.64	50.79	50.97
51.19	51.40	51.38	50.75	49.90	49.12	48.50	48.06	47.81	47.73	47.78	47.89
47.97	47.85	47.42	46.72	45.92	45.14	44.44	43.86	43.39	43.03	42.79	42.65
42.63	42.71	42.88	43.11	43.39	43.69	44.00	44.32	44.83	46.24	47.95	49.78
45.00	45.00	45.00	45.00	40.00							
90.00	90.00	90.00	80.00	79.40	71.46	65.74	61.36	58.18	55.93	54.32	53.18
53.19	53.15	53.05	52.92	52.75	52.54	52.32	52.08	51.83	51.59	51.36	51.14
50.95	50.78	50.65	50.54	50.47	50.43	50.42	50.45	50.52	50.62	50.77	50.97
51.22	51.53	51.88	50.93	49.99	49.21	48.62	48.23	48.04	48.04	48.19	48.44
48.72	48.75	48.18	47.21	46.19	45.24	44.43	43.78	43.28	42.92	42.69	42.58
42.57	42.65	42.82	43.04	43.32	43.62	43.94	44.25	44.59	46.12	47.76	49.42
45.00	45.00	45.00	45.00	40.00							
90.00	90.00	90.00	80.00	79.37	71.34	65.54	61.11	57.90	55.66	54.13	53.18
52.93	52.86	52.77	52.64	52.49	52.31	52.11	51.90	51.68	51.46	51.25	51.05
50.87	50.72	50.58	50.48	50.40	50.35	50.34	50.35	50.40	50.48	50.59	50.74
50.91	51.06	50.98	50.41	49.65	48.96	48.44	48.13	48.02	48.10	48.33	48.70
49.19	49.67	48.76	47.44	46.22	45.16	44.27	43.58	43.08	42.75	42.56	42.48
42.50	42.60	42.77	43.00	43.29	43.63	44.02	44.45	44.42	46.09	47.60	49.07
45.00	45.00	45.00	45.00	40.00							
90.00	90.00	90.00	80.00	79.35	71.22	65.34	60.87	57.64	55.42	54.01	53.24
52.77	52.66	52.54	52.42	52.27	52.10	51.92	51.72	51.52	51.32	51.12	50.94
50.77	50.61	50.48	50.37	50.28	50.22	50.19	50.18	50.19	50.23	50.28	50.34
50.37	50.32	50.09	49.60	48.99	48.41	47.99	47.77	47.75	47.89	48.17	48.55
48.97	49.21	48.45	47.19	45.96	44.85	43.93	43.24	42.79	42.53	42.40	42.38
42.43	42.55	42.73	42.98	43.29	43.68	44.15	44.74	44.33	46.14	47.42	48.70
45.00	45.00	45.00	45.00	40.00							
90.00	90.00	90.00	80.00	79.32	71.10	65.15	60.64	57.39	55.22	53.92	53.30
52.65	52.50	52.36	52.23	52.08	51.91	51.74	51.55	51.36	51.17	50.98	50.80
50.63	50.48	50.34	50.22	50.12	50.04	49.98	49.94	49.91	49.90	49.87	49.83
49.74	49.55	49.21	48.73	48.16	47.64	47.30	47.19	47.26	47.47	47.74	48.04
48.26	48.18	47.58	46.58	45.44	44.34	43.41	42.77	42.43	42.28	42.24	42.27
42.36	42.50	42.70	42.96	43.29	43.70	44.24	44.93	44.22	46.29	47.19	48.32
45.00	45.00	45.00	45.00	40.00							
90.00	90.00	90.00	80.00	79.29	70.98	64.97	60.42	57.17	55.03	53.82	53.30
52.54	52.37	52.21	52.06	51.91	51.74	51.57	51.39	51.20	51.01	50.83	50.65
50.48	50.32	50.17	50.04	49.93	49.83	49.74	49.66	49.59	49.52	49.42	49.29
49.10	48.81	48.40	47.87	47.27	46.73	46.44	46.46	46.65	46.91	47.18	47.39
47.46	47.26	46.72	45.87	44.84	43.74	42.76	42.20	42.06	42.06	42.12	42.20
42.32	42.48	42.67	42.92	43.24	43.66	44.21	44.92	43.95	45.99	46.84	47.93
45.00	45.00	45.00	45.00	40.00							
90.00	90.00	90.00	80.00	79.26	70.87	64.80	60.22	56.96	54.86	53.71	53.24
52.43	52.25	52.08	51.92	51.75	51.58	51.41	51.23	51.04	50.85	50.67	50.49
50.31	50.14	49.98	49.84	49.71	49.58	49.47	49.36	49.25	49.12	48.97	48.77
48.50	48.15	47.68	47.10	46.43	45.75	45.47	45.71	46.04	46.35	46.60	46.75
46.74	46.50	46.01	45.27	44.34	43.27	42.13	41.69	41.83	41.96	42.08	42.20
42.33	42.47	42.65	42.87	43.15	43.53	44.03	44.69	43.51	45.21	46.36	47.51
45.00	45.00	45.00	45.00	40.00							
90.00	90.00	90.00	80.00	79.23	70.77	64.64	60.03	56.77	54.69	53.57	53.11
52.33	52.14	51.96	51.79	51.62	51.44	51.26	51.07	50.88	50.69	50.50	50.31
50.13	49.95	49.78	49.62	49.47	49.32	49.18	49.04	48.89	48.73	48.53	48.29
47.98	47.59	47.10	46.52	45.84	45.08	44.79	45.19	45.56	45.87	46.09	46.19
46.15	45.92	45.48	44.85	44.06	43.16	42.30	41.90	41.94	42.06	42.17	42.28
42.39	42.51	42.64	42.80	43.02	43.31	43.71	44.26	43.00	44.49	45.82	47.08
45.00	45.00	45.00	45.00	40.00							
90.00	90.00	90.00	80.00	79.20	70.67	64.48	59.85	56.59	54.52	53.41	52.92
52.23	52.03	51.85	51.67	51.49	51.31	51.12	50.93	50.73	50.54	50.34	50.14
49.94	49.75	49.57	49.39	49.21	49.05	48.88	48.72	48.54	48.35	48.13	47.86
47.54	47.15	46.68	46.15	45.58	45.07	44.86	45.02	45.28	45.52	45.70	45.77
45.71	45.50	45.14	44.62	43.99	43.32	42.74	42.39	42.30	42.33	42.39	42.46
42.52	42.58	42.65	42.74	42.86	43.03	43.29	43.67	42.51	43.86	45.27	46.64
48.50	45.00	45.00	45.00	40.00							
90.00	90.00	90.00	80.00	79.17	70.57	64.34	59.69	56.43	54.36	53.23	52.69
52.13	51.94	51.75	51.56	51.37	51.18	50.99	50.79	50.59	50.38	50.17	49.96
49.76	49.55	49.35	49.15	48.96	48.77	48.59	48.41	48.21	48.01	47.77	47.50
47.18	46.81	46.40	45.95	45.51	45.15	44.98	45.02	45.16	45.32	45.44	45.48

45.42	45.25	44.95	44.56	44.09	43.60	43.18	42.90	42.76	42.71	42.71	42.71
42.72	42.71	42.71	42.70	42.71	42.74	42.82	42.99	42.08	43.31	44.74	46.20
48.09	45.00	45.00	45.00	40.00							
90.00	90.00	90.00	80.00	79.14	70.48	64.21	59.54	56.28	54.21	53.04	52.45
52.04	51.84	51.65	51.46	51.26	51.07	50.87	50.66	50.45	50.23	50.01	49.79
49.57	49.35	49.13	48.91	48.70	48.50	48.30	48.11	47.91	47.69	47.46	47.19
46.90	46.57	46.21	45.84	45.50	45.23	45.09	45.06	45.12	45.21	45.29	45.31
45.25	45.12	44.90	44.61	44.27	43.92	43.62	43.39	43.24	43.15	43.09	43.04
42.98	42.90	42.81	42.71	42.60	42.48	42.38	42.30	41.71	42.84	44.26	45.78
47.67	45.00	45.00	45.00	40.00							
90.00	90.00	90.00	80.00	79.11	70.39	64.08	59.41	56.14	54.06	52.85	52.20
51.96	51.76	51.57	51.37	51.17	50.96	50.75	50.54	50.32	50.09	49.86	49.63
49.39	49.15	48.91	48.68	48.45	48.23	48.03	47.82	47.62	47.41	47.19	46.94
46.68	46.39	46.08	45.78	45.51	45.30	45.17	45.13	45.14	45.18	45.22	45.23
45.19	45.09	44.94	44.74	44.51	44.27	44.06	43.89	43.75	43.64	43.53	43.42
43.29	43.14	42.97	42.78	42.56	42.33	42.09	41.81	41.41	42.45	43.82	45.37
47.27	45.00	45.00	45.00	40.00							
90.00	90.00	90.00	80.00	79.09	70.31	63.97	59.29	56.03	53.93	52.68	51.97
51.89	51.69	51.49	51.29	51.08	50.87	50.65	50.43	50.20	49.97	49.72	49.48
49.22	48.97	48.71	48.46	48.21	47.98	47.76	47.56	47.36	47.17	46.96	46.74
46.50	46.26	46.00	45.76	45.54	45.37	45.25	45.20	45.19	45.20	45.22	45.22
45.20	45.14	45.05	44.93	44.79	44.64	44.51	44.39	44.27	44.15	44.01	43.85
43.65	43.43	43.19	42.92	42.62	42.31	42.00	41.72	41.17	42.14	43.45	44.98
46.88	45.00	45.00	45.00	40.00							
90.00	90.00	90.00	80.00	79.06	70.24	63.86	59.18	55.93	53.82	52.52	51.75
51.83	51.63	51.42	51.22	51.00	50.79	50.56	50.33	50.10	49.85	49.60	49.34
49.07	48.80	48.52	48.24	47.98	47.73	47.50	47.31	47.13	46.96	46.77	46.58
46.37	46.16	45.95	45.75	45.57	45.43	45.33	45.27	45.25	45.25	45.26	45.27
45.26	45.24	45.20	45.14	45.08	45.02	44.96	44.89	44.81	44.69	44.52	44.30
44.05	43.76	43.45	43.12	42.75	42.40	42.08	41.85	41.03	41.92	43.13	44.62
46.50	45.00	45.00	45.00	40.00							
90.00	90.00	90.00	80.00	79.04	70.17	63.77	59.09	55.84	53.73	52.40	51.57
51.78	51.57	51.37	51.15	50.94	50.72	50.49	50.25	50.01	49.75	49.49	49.22
48.94	48.65	48.35	48.05	47.76	47.49	47.26	47.08	46.93	46.78	46.62	46.46
46.28	46.10	45.92	45.76	45.61	45.49	45.40	45.34	45.32	45.32	45.32	45.34
45.35	45.36	45.37	45.37	45.38	45.39	45.40	45.40	45.36	45.25	45.06	44.79
44.46	44.09	43.73	43.33	42.91	42.53	42.22	42.00	41.01	41.77	42.86	44.28
46.13	45.00	45.00	45.00	40.00							
90.00	90.00	90.00	80.00	79.02	70.10	63.68	59.01	55.78	53.67	52.32	51.46
51.73	51.53	51.32	51.10	50.88	50.66	50.42	50.18	49.93	49.67	49.40	49.12
48.83	48.53	48.22	47.89	47.57	47.26	47.03	46.89	46.77	46.65	46.51	46.37
46.22	46.06	45.91	45.77	45.65	45.54	45.47	45.42	45.39	45.39	45.40	45.42
45.45	45.49	45.54	45.59	45.66	45.74	45.82	45.89	45.92	45.84	45.62	45.27
44.86	44.41	43.96	43.51	43.07	42.67	42.35	42.14	41.09	41.69	42.64	43.97
45.77	45.00	45.00	45.00	40.00							
90.00	90.00	90.00	80.00	79.00	70.04	63.61	58.94	55.73	53.63	52.29	51.45
51.69	51.49	51.28	51.06	50.84	50.61	50.37	50.13	49.87	49.61	49.33	49.05
48.75	48.44	48.12	47.79	47.44	47.08	46.84	46.76	46.67	46.56	46.44	46.32
46.18	46.05	45.92	45.80	45.69	45.60	45.53	45.49	45.46	45.46	45.48	45.51
45.55	45.61	45.69	45.78	45.90	46.03	46.19	46.35	46.47	46.45	46.19	45.74
45.22	44.68	44.16	43.66	43.20	42.79	42.46	42.23	41.23	41.67	42.47	43.68
45.43	45.00	45.00	45.00	40.00							
90.00	90.00	90.00	80.00	78.98	69.99	63.54	58.89	55.70	53.62	52.30	51.49
51.66	51.45	51.24	51.03	50.80	50.57	50.33	50.09	49.83	49.56	49.29	49.00
48.70	48.39	48.07	47.74	47.41	47.08	46.85	46.73	46.63	46.53	46.42	46.30
46.18	46.06	45.94	45.83	45.73	45.65	45.59	45.55	45.53	45.53	45.55	45.58
45.64	45.71	45.81	45.93	46.08	46.26	46.47	46.72	46.97	47.09	46.74	46.13
45.50	44.89	44.31	43.78	43.30	42.87	42.53	42.28	41.39	41.67	42.32	43.42
45.10	45.00	45.00	45.00	40.00							
90.00	90.00	90.00	80.00	78.96	69.94	63.49	58.85	55.69	53.63	52.33	51.55
51.63	51.43	51.22	51.00	50.78	50.55	50.31	50.06	49.80	49.54	49.26	48.98
48.68	48.38	48.07	47.75	47.44	47.16	46.94	46.78	46.66	46.54	46.42	46.31
46.19	46.08	45.97	45.87	45.78	45.71	45.65	45.61	45.59	45.59	45.60	45.64
45.70	45.78	45.88	46.02	46.18	46.38	46.61	46.89	47.21	47.57	47.04	46.31
45.63	44.99	44.39	43.85	43.35	42.91	42.55	42.28	41.53	41.69	42.19	43.18

44.78	45.00	45.00	45.00	40.00							
90.00	90.00	90.00	80.00	78.94	69.90	63.44	58.83	55.69	53.66	52.39	51.63
51.61	51.41	51.20	50.98	50.76	50.53	50.29	50.05	49.79	49.53	49.26	48.98
48.69	48.39	48.09	47.80	47.51	47.26	47.04	46.86	46.71	46.58	46.46	46.34
46.23	46.12	46.01	45.92	45.83	45.76	45.70	45.66	45.64	45.63	45.64	45.68
45.73	45.81	45.91	46.04	46.20	46.39	46.60	46.84	47.06	47.14	46.81	46.22
45.59	44.97	44.39	43.85	43.36	42.91	42.53	42.23	41.64	41.69	42.07	42.96
44.48	47.06	45.00	45.00	40.00							
90.00	90.00	90.00	80.00	78.93	69.86	63.40	58.81	55.71	53.71	52.47	51.72
51.59	51.39	51.18	50.97	50.75	50.53	50.29	50.05	49.80	49.54	49.27	48.99
48.71	48.43	48.14	47.86	47.60	47.35	47.14	46.95	46.79	46.65	46.52	46.39
46.28	46.17	46.06	45.97	45.88	45.81	45.75	45.70	45.67	45.66	45.67	45.69
45.74	45.81	45.90	46.01	46.14	46.30	46.46	46.62	46.71	46.67	46.40	45.95
45.41	44.86	44.32	43.80	43.32	42.88	42.49	42.16	41.70	41.68	41.97	42.75
44.20	46.70	45.00	45.00	40.00							
90.00	90.00	90.00	80.00	78.92	69.83	63.37	58.81	55.74	53.78	52.56	51.82
51.58	51.38	51.17	50.96	50.75	50.53	50.30	50.06	49.81	49.56	49.30	49.03
48.75	48.48	48.21	47.94	47.69	47.45	47.24	47.05	46.88	46.73	46.59	46.46
46.34	46.22	46.12	46.02	45.93	45.85	45.78	45.73	45.69	45.67	45.67	45.68
45.71	45.76	45.83	45.92	46.02	46.13	46.24	46.31	46.32	46.22	45.98	45.61
45.16	44.68	44.19	43.72	43.26	42.85	42.46	42.11	41.73	41.65	41.86	42.55
43.93	46.35	45.00	45.00	40.00							
90.00	90.00	90.00	80.00	78.91	69.80	63.36	58.82	55.79	53.85	52.66	51.93
51.55	51.36	51.16	50.96	50.75	50.54	50.31	50.08	49.84	49.59	49.33	49.07
48.81	48.54	48.28	48.02	47.78	47.55	47.34	47.15	46.97	46.81	46.67	46.53
46.40	46.28	46.17	46.07	45.98	45.89	45.82	45.75	45.71	45.67	45.65	45.65
45.66	45.69	45.74	45.79	45.86	45.92	45.97	45.98	45.94	45.81	45.58	45.26
44.87	44.46	44.03	43.60	43.19	42.81	42.46	42.15	41.71	41.60	41.75	42.37
43.68	46.01	45.00	45.00	40.00							
90.00	90.00	90.00	80.00	78.90	69.78	63.34	58.84	55.85	53.94	52.77	52.05
51.53	51.35	51.16	50.96	50.76	50.55	50.34	50.11	49.88	49.63	49.38	49.12
48.87	48.61	48.36	48.11	47.87	47.65	47.44	47.25	47.07	46.90	46.75	46.61
46.47	46.35	46.23	46.12	46.02	45.93	45.84	45.77	45.71	45.66	45.62	45.60
45.59	45.60	45.61	45.64	45.66	45.68	45.68	45.65	45.56	45.41	45.19	44.91
44.58	44.22	43.85	43.48	43.12	42.78	42.48	42.23	41.65	41.53	41.64	42.20
43.44	45.69	45.00	45.00	40.00							
90.00	90.00	90.00	80.00	78.89	69.76	63.34	58.87	55.91	54.04	52.88	52.17
51.50	51.33	51.15	50.97	50.78	50.58	50.37	50.15	49.92	49.68	49.43	49.18
48.93	48.68	48.43	48.19	47.96	47.74	47.54	47.34	47.16	46.99	46.83	46.68
46.54	46.41	46.29	46.17	46.06	45.96	45.86	45.78	45.70	45.63	45.58	45.53
45.50	45.48	45.47	45.46	45.45	45.43	45.39	45.32	45.21	45.05	44.83	44.58
44.29	43.98	43.66	43.34	43.04	42.76	42.50	42.30	41.56	41.43	41.52	42.04
43.22	45.38	45.00	45.00	40.00							
90.00	90.00	90.00	80.00	78.89	69.75	63.35	58.91	55.99	54.15	53.01	52.31
51.48	51.32	51.15	50.97	50.79	50.60	50.40	50.19	49.97	49.73	49.49	49.24
49.00	48.75	48.51	48.28	48.05	47.83	47.63	47.43	47.25	47.07	46.91	46.76
46.61	46.48	46.35	46.22	46.10	45.99	45.88	45.78	45.68	45.60	45.52	45.46
45.40	45.36	45.32	45.28	45.24	45.19	45.12	45.01	44.88	44.70	44.49	44.26
44.01	43.74	43.48	43.22	42.96	42.73	42.52	42.36	41.45	41.31	41.41	41.89
43.02	45.08	45.00	45.00	40.00							
90.00	90.00	90.00	80.00	78.89	69.75	63.36	58.96	56.08	54.26	53.14	52.44
51.46	51.30	51.14	50.98	50.81	50.63	50.44	50.24	50.02	49.79	49.55	49.30
49.06	48.82	48.58	48.36	48.14	47.92	47.71	47.52	47.33	47.15	46.98	46.83
46.68	46.54	46.41	46.27	46.14	46.02	45.89	45.78	45.66	45.56	45.46	45.37
45.29	45.22	45.16	45.10	45.04	44.96	44.86	44.73	44.57	44.39	44.18	43.96
43.74	43.52	43.30	43.09	42.89	42.70	42.53	42.40	41.31	41.18	41.30	41.76
42.84	44.81	45.00	45.00	40.00							
90.00	90.00	90.00	80.00	78.89	69.75	63.38	59.02	56.17	54.38	53.27	52.58
51.43	51.28	51.13	50.98	50.82	50.66	50.48	50.29	50.08	49.84	49.60	49.36
49.12	48.88	48.65	48.43	48.21	48.00	47.80	47.59	47.40	47.22	47.05	46.89
46.74	46.60	46.46	46.32	46.18	46.04	45.90	45.77	45.64	45.52	45.40	45.29
45.18	45.09	45.00	44.93	44.84	44.74	44.62	44.47	44.30	44.10	43.88	43.67
43.48	43.31	43.14	42.98	42.82	42.67	42.54	42.43	41.15	41.04	41.20	41.63
42.67	44.55	45.00	45.00	40.00							
90.00	90.00	90.00	80.00	78.89	69.75	63.41	59.08	56.27	54.50	53.41	52.73

51.40	51.26	51.12	50.97	50.83	50.68	50.53	50.35	50.13	49.89	49.64	49.40
49.16	48.93	48.71	48.49	48.28	48.08	47.87	47.66	47.47	47.28	47.11	46.95
46.80	46.65	46.51	46.37	46.22	46.06	45.91	45.76	45.62	45.48	45.34	45.20
45.07	44.95	44.86	44.77	44.67	44.55	44.42	44.25	44.06	43.85	43.61	43.40
43.25	43.13	43.01	42.89	42.76	42.65	42.55	42.46	40.97	40.90	41.12	41.52
42.53	44.30	45.00	45.00	40.00							
90.00	90.00	90.00	80.00	78.90	69.76	63.45	59.18	56.41	54.67	53.59	52.92
52.49	52.16	51.84	51.54	51.24	50.96	50.68	50.42	50.16	49.92	49.68	49.44
49.22	49.00	48.78	48.57	48.36	48.16	47.97	47.78	47.59	47.41	47.23	47.06
46.90	46.74	46.58	46.43	46.27	46.12	45.96	45.80	45.63	45.46	45.29	45.12
44.95	44.79	44.64	44.48	44.33	44.19	44.03	43.87	43.70	43.51	43.30	43.08
42.84	42.58	42.32	42.05	41.78	41.51	41.26	41.02	40.74	40.74	41.07	41.40
42.38	44.03	45.00	45.00	40.00							
90.00	90.00	90.00	80.00	78.91	69.80	63.54	59.34	56.63	54.93	53.87	53.21
52.78	52.46	52.14	51.83	51.53	51.25	50.97	50.70	50.44	50.18	49.94	49.70
49.46	49.24	49.01	48.80	48.58	48.38	48.18	47.98	47.78	47.60	47.41	47.23
47.06	46.88	46.71	46.54	46.37	46.20	46.03	45.85	45.68	45.50	45.32	45.14
44.96	44.78	44.61	44.43	44.25	44.08	43.89	43.70	43.50	43.29	43.07	42.84
42.60	42.36	42.10	41.85	41.59	41.35	41.12	40.92	40.74	40.74	41.07	41.40
42.38	44.02	45.00	45.00	40.00							
90.00	90.00	90.00	80.00	78.95	69.88	63.71	59.61	56.99	55.35	54.32	53.67
53.25	52.92	52.61	52.30	52.00	51.71	51.42	51.15	50.88	50.61	50.36	50.11
49.87	49.63	49.40	49.17	48.95	48.73	48.52	48.31	48.10	47.90	47.70	47.50
47.31	47.11	46.92	46.73	46.54	46.35	46.16	45.96	45.77	45.57	45.37	45.17
44.97	44.77	44.57	44.36	44.16	43.95	43.73	43.52	43.29	43.07	42.84	42.60
42.36	42.12	41.89	41.65	41.43	41.22	41.04	40.88	40.74	40.74	41.07	41.40
42.38	44.02	45.00	45.00	40.00							
90.00	90.00	90.00	80.00	79.04	70.06	64.04	60.10	57.60	56.03	55.03	54.40
53.98	53.66	53.35	53.04	52.74	52.44	52.16	51.87	51.60	51.33	51.06	50.80
50.54	50.29	50.05	49.80	49.57	49.33	49.10	48.87	48.64	48.42	48.19	47.97
47.75	47.53	47.31	47.09	46.88	46.65	46.43	46.21	45.99	45.76	45.53	45.30
45.07	44.84	44.60	44.37	44.13	43.89	43.65	43.40	43.16	42.92	42.67	42.43
42.20	41.97	41.75	41.54	41.34	41.16	41.00	40.87	40.74	40.74	40.74	40.74
42.38	44.02	45.00	45.00	40.00							
90.00	90.00	90.00	80.00	79.25	70.46	64.69	60.97	58.62	57.14	56.19	55.57
55.18	54.86	54.55	54.25	53.95	53.65	53.36	53.07	52.79	52.51	52.24	51.97
51.70	51.43	51.17	50.91	50.65	50.40	50.14	49.89	49.64	49.39	49.14	48.89
48.63	48.38	48.13	47.88	47.62	47.37	47.11	46.85	46.59	46.33	46.06	45.80
45.53	45.26	44.98	44.71	44.43	44.16	43.88	43.60	43.33	43.06	42.79	42.53
42.28	42.03	41.80	41.58	41.38	41.19	41.02	40.88	40.74	40.74	40.74	40.74
42.38	42.39	45.00	45.00	40.00							
90.00	90.00	90.00	80.00	79.71	71.29	65.90	62.49	60.34	58.98	58.09	57.52
57.14	56.85	56.55	56.26	55.97	55.69	55.40	55.12	54.84	54.57	54.29	54.02
53.75	53.48	53.21	52.94	52.68	52.41	52.14	51.88	51.61	51.34	51.07	50.80
50.53	50.26	49.99	49.71	49.43	49.15	48.86	48.57	48.28	47.98	47.69	47.38
47.08	46.76	46.45	46.13	45.81	45.49	45.16	44.83	44.50	44.17	43.84	43.52
43.19	42.87	42.55	42.24	41.93	41.63	41.35	41.07	40.74	40.74	40.74	40.74
42.37	42.38	45.00	45.00	40.00							
90.00	90.00	90.00	80.00	80.66	72.86	68.04	65.06	63.20	62.02	61.26	60.76
60.43	60.18	59.92	59.67	59.42	59.17	58.92	58.68	58.43	58.19	57.95	57.72
57.48	57.25	57.01	56.78	56.55	56.32	56.09	55.86	55.63	55.40	55.16	54.93
54.70	54.46	54.23	53.99	53.75	53.50	53.26	53.01	52.75	52.50	52.23	51.96
51.69	51.41	51.12	50.83	50.53	50.21	49.89	49.56	49.22	48.87	48.50	48.13
47.74	47.34	46.92	46.49	46.05	45.59	45.13	44.65	44.03	44.03	44.03	42.39
42.38	40.74	40.73	40.76	70.25							
90.00	90.00	90.00	80.00	82.23	75.29	71.16	68.70	67.20	66.27	65.68	65.31
65.06	64.87	64.68	64.50	64.32	64.14	63.97	63.80	63.63	63.47	63.31	63.15
63.00	62.85	62.71	62.57	62.43	62.30	62.17	62.04	61.92	61.80	61.69	61.58
61.47	61.37	61.27	61.18	61.09	61.00	60.92	60.84	60.77	60.70	60.63	60.57
60.52	60.46	60.42	60.37	60.33	60.30	60.27	60.25	60.23	60.21	60.20	60.20
60.20	60.20	60.22	60.23	60.26	60.29	60.32	60.37	60.41	57.19	53.88	50.58
47.31	40.74	40.74	44.02	50.57							
90.00	90.00	90.00	80.00	84.13	77.99	74.43	72.33	71.08	70.31	69.83	69.52
69.32	69.17	69.02	68.87	68.72	68.58	68.44	68.31	68.18	68.05	67.93	67.80
67.69	67.57	67.46	67.35	67.25	67.15	67.05	66.95	66.86	66.77	66.69	66.60

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   66.52    66.44    66.37    66.30    66.22    66.16    66.09    66.02    65.96    65.89    65.83    65.77
   65.71    65.64    65.58    65.51    65.45    65.38    65.30    65.23    65.15    65.06    64.98    64.88
   64.78    64.68    64.56    64.44    64.32    64.18    64.04    63.89    63.69    62.08    60.43    57.14
   53.86    40.74    40.74    40.74    40.75
      42        0.          (12g9.3)          1      */vert cond layer 3
      11        0.          (12f9.2)          1      */top elev layer 3
  230.00   197.99   169.01   125.01   105.01    95.01    94.00    94.01    97.03    99.23   100.78   101.85
  102.57   103.16   103.76   104.37   104.98   105.60   106.23   106.87   107.51   108.15   108.81   109.47
  110.13   110.80   111.47   112.15   112.84   113.53   114.22   114.92   115.62   116.33   117.04   117.75
  118.46   119.18   119.91   120.64   120.87   120.62   120.37   120.12   119.87   119.63   119.40   119.16
  118.93   118.71   118.48   118.27   118.05   117.84   117.64   117.44   117.24   117.05   116.87   116.69
  116.51   116.34   116.18   116.02   115.87   115.72   115.58   115.45   115.29   115.08   114.79   114.80
  124.62   144.37   168.94   168.91   134.48
  230.00   193.52   165.66   124.65    95.13    91.83    88.55    86.91    85.27    87.21    88.57    89.51
   90.14    90.66    91.17    91.70    92.22    92.75    93.29    93.82    94.36    94.90    95.44    95.98
   96.52    97.07    97.61    98.16    98.70    99.25    99.79   100.33   100.88   101.42   101.96   102.51
  103.05   103.59   104.13   104.68   105.04   105.22   105.41   105.60   105.79   105.98   106.19   106.39
  106.61   106.84   107.07   107.32   107.58   107.86   108.15   108.45   108.78   109.12   109.48   109.87
  110.28   110.72   111.18   111.68   112.20   112.76   113.34   113.96   114.79   116.41   118.06   121.36
  124.63   149.29   173.89   196.80   183.69
  232.90   193.52   149.26   114.80    95.12    90.19    85.28    85.27    84.61    85.00    85.32    85.55
   85.72    85.86    86.00    86.15    86.30    86.46    86.62    86.78    86.95    87.12    87.29    87.46
   87.64    87.81    87.98    88.16    88.33    88.51    88.68    88.85    89.02    89.18    89.35    89.51
   89.67    89.82    89.97    90.12    90.24    90.33    90.42    90.50    90.58    90.66    90.74    90.82
   90.89    90.96    91.03    91.10    91.18    91.25    91.33    91.40    91.48    91.57    91.66    91.75
   91.85    91.96    92.08    92.20    92.34    92.48    92.64    92.81    93.04    93.43    94.13    95.13
  100.03   124.72   162.42   186.99   196.81
  232.90   182.05   149.25   114.80    95.12    90.19    85.28    85.27    84.94    83.87    83.35    83.09
   82.96    82.87    82.79    82.74    82.70    82.67    82.66    82.66    82.68    82.70    82.75    82.80
   82.87    82.94    83.03    83.13    83.24    83.36    83.50    83.64    83.79    83.96    84.13    84.32
   84.51    84.72    84.93    85.16    85.21    85.09    84.98    84.87    84.78    84.69    84.62    84.55
   84.49    84.44    84.40    84.36    84.34    84.32    84.30    84.30    84.30    84.30    84.32    84.34
   84.36    84.39    84.43    84.48    84.53    84.58    84.65    84.71    84.81    84.97    85.27    85.28
   88.55    95.17   114.89   159.12   173.87
  229.62   180.40   144.33   111.52    90.21    85.28    83.63    78.69    75.43    75.84    76.02    76.10
   76.15    76.19    76.22    76.25    76.28    76.30    76.33    76.36    76.39    76.42    76.46    76.49
   76.53    76.58    76.62    76.66    76.71    76.76    76.81    76.85    76.90    76.94    76.98    77.01
   77.04    77.05    77.06    77.07    77.21    77.51    77.79    78.07    78.35    78.62    78.88    79.15
   79.41    79.68    79.95    80.23    80.52    80.81    81.11    81.41    81.73    82.06    82.39    82.74
   83.09    83.46    83.83    84.22    84.61    85.02    85.43    85.85    86.39    87.23    88.54    88.55
   88.55    91.83    95.17   124.69   154.17
  223.06   173.83   144.33   109.88    91.84    86.92    85.59    81.98    78.70    76.90    75.94    75.39
   75.05    74.79    74.55    74.32    74.10    73.90    73.71    73.54    73.37    73.23    73.10    72.98
   72.89    72.81    72.75    72.72    72.71    72.73    72.78    72.86    72.98    73.14    73.34    73.59
   73.89    74.25    74.66    75.14    75.27    75.06    74.91    74.82    74.79    74.81    74.89    75.01
   75.18    75.39    75.65    75.93    76.26    76.61    77.00    77.42    77.86    78.33    78.83    79.35
   79.89    80.45    81.02    81.60    82.20    82.80    83.40    83.99    84.70    85.70    86.91    87.89
   88.55    91.81    95.10   114.79   141.00
  223.06   170.56   144.32   109.88    91.84    88.55    85.28    81.99    78.71    77.32    76.07    75.19
   74.59    74.12    73.66    73.21    72.76    72.33    71.91    71.51    71.12    70.74    70.38    70.03
   69.70    69.38    69.07    68.78    68.49    68.22    67.95    67.68    67.42    67.17    66.92    66.66
   66.41    66.16    65.92    65.68    65.74    66.10    66.46    66.83    67.20    67.58    67.96    68.36
   68.75    69.16    69.59    70.02    70.48    70.95    71.45    71.97    72.51    73.08    73.67    74.29
   74.94    75.61    76.31    77.04    77.79    78.58    79.40    80.27    81.41    83.33    86.87    86.89
   88.52    85.26    82.02   104.97   124.62
  222.40   170.56   142.68   109.88    92.81    88.55    85.28    83.62    81.99    78.62    76.49    75.13
   74.26    73.58    72.92    72.29    71.67    71.08    70.52    69.97    69.45    68.96    68.49    68.03
   67.60    67.19    66.79    66.40    66.03    65.66    65.31    64.96    64.62    64.29    63.96    63.63
   63.32    63.01    62.72    62.44    62.43    62.70    62.98    63.28    63.58    63.90    64.22    64.55
   64.89    65.24    65.61    65.98    66.38    66.79    67.23    67.69    68.18    68.70    69.25    69.84
   70.46    71.10    71.77    72.44    73.11    73.76    74.36    74.89    75.42    75.81    75.43    77.07
   80.35    85.26    81.99   104.97   114.80
  222.39   173.51   137.75   109.88    91.85    88.56    85.29    83.64    81.99    78.71    76.25    74.66
   73.63    72.84    72.08    71.35    70.64    69.98    69.34    68.75    68.18    67.66    67.16    66.70
   66.27    65.86    65.47    65.11    64.77    64.44    64.12    63.82    63.54    63.27    63.02    62.80
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62.61	62.46	62.35	62.30	62.25	62.20	62.21	62.27	62.36	62.49	62.64	62.81
63.01	63.22	63.45	63.69	63.96	64.24	64.55	64.90	65.28	65.71	66.20	66.75
67.39	68.10	68.89	69.76	70.68	71.63	72.59	73.54	74.63	75.88	75.46	78.73
82.00	85.23	75.45	104.97	108.22							
219.76	173.84	134.49	109.88	93.47	90.19	86.91	85.27	81.99	78.39	75.76	74.05
72.95	72.10	71.28	70.50	69.75	69.04	68.38	67.77	67.20	66.67	66.19	65.76
65.36	64.99	64.65	64.34	64.04	63.76	63.49	63.23	62.99	62.76	62.56	62.39
62.26	62.17	62.10	62.02	61.95	61.88	61.81	61.76	61.74	61.76	61.81	61.89
61.99	62.11	62.25	62.40	62.56	62.74	62.93	63.15	63.40	63.70	64.08	64.55
65.15	65.91	66.84	67.94	69.17	70.52	71.96	73.48	75.50	78.85	85.25	85.28
85.27	81.98	75.44	104.96	106.59							
218.14	173.84	134.49	109.87	93.48	90.19	86.91	85.26	81.99	78.01	75.30	73.53
72.38	71.50	70.64	69.83	69.05	68.33	67.65	67.03	66.46	65.95	65.49	65.09
64.73	64.41	64.12	63.86	63.61	63.37	63.13	62.89	62.66	62.44	62.24	62.07
61.95	61.88	61.86	61.92	61.83	61.62	61.46	61.36	61.30	61.28	61.30	61.35
61.41	61.49	61.58	61.68	61.79	61.90	62.01	62.13	62.27	62.44	62.66	62.98
63.47	64.20	65.23	66.51	67.98	69.58	71.28	73.07	75.44	79.32	85.25	85.27
85.27	81.97	75.45	104.95	106.59							
217.67	173.64	134.36	109.79	93.64	90.08	86.86	84.92	81.52	77.69	74.95	73.14
69.26	68.81	68.35	67.89	67.45	67.02	66.61	66.15	65.57	64.96	64.42	63.96
63.60	63.33	63.14	63.02	62.95	62.89	62.81	62.73	62.65	62.58	62.51	62.44
62.37	62.30	62.24	62.23	62.31	62.43	62.53	62.60	62.63	62.60	62.52	62.40
62.25	62.17	62.25	62.41	62.57	62.71	62.84	62.95	63.05	63.15	63.27	63.46
63.78	64.18	64.59	65.00	65.38	65.74	66.07	66.36	74.95	78.72	83.64	84.83
84.70	81.43	76.38	103.29	106.29							
217.30	173.49	134.26	109.73	93.76	89.99	86.78	84.61	81.14	77.39	74.64	72.81
69.18	68.67	68.13	67.59	67.05	66.51	65.98	65.42	64.83	64.25	63.73	63.31
62.98	62.75	62.61	62.54	62.51	62.51	62.50	62.49	62.48	62.46	62.45	62.44
62.42	62.42	62.43	62.49	62.59	62.72	62.84	62.94	63.00	63.00	62.96	62.88
62.78	62.73	62.76	62.83	62.93	63.04	63.14	63.24	63.34	63.46	63.61	63.82
64.12	64.48	64.86	65.26	65.64	66.00	66.33	66.63	74.36	77.93	82.34	84.18
84.15	81.02	77.02	102.04	106.02							
216.92	173.33	134.17	109.66	93.88	89.90	86.68	84.30	80.76	77.07	74.33	72.47
69.12	68.53	67.91	67.27	66.62	65.97	65.32	64.67	64.04	63.46	62.96	62.57
62.29	62.11	62.03	62.02	62.06	62.12	62.19	62.25	62.31	62.36	62.40	62.45
62.49	62.55	62.63	62.74	62.88	63.04	63.20	63.33	63.43	63.47	63.46	63.41
63.35	63.29	63.28	63.30	63.34	63.41	63.48	63.56	63.66	63.79	63.95	64.17
64.45	64.78	65.15	65.53	65.91	66.28	66.61	66.91	73.66	77.00	81.06	83.34
83.52	80.61	77.58	100.87	105.74							
216.55	173.17	134.07	109.60	93.98	89.80	86.54	83.97	80.38	76.75	74.01	72.14
69.07	68.41	67.69	66.94	66.18	65.40	64.64	63.91	63.22	62.61	62.12	61.75
61.52	61.42	61.42	61.49	61.62	61.76	61.90	62.04	62.16	62.27	62.38	62.47
62.58	62.69	62.82	62.99	63.17	63.37	63.58	63.76	63.90	63.99	64.01	63.98
63.92	63.85	63.79	63.77	63.76	63.79	63.83	63.89	63.98	64.11	64.27	64.48
64.75	65.07	65.42	65.79	66.18	66.55	66.90	67.20	72.90	76.02	79.80	82.38
82.82	80.21	78.05	99.78	105.44							
216.18	173.01	133.98	109.54	94.07	89.69	86.39	83.63	80.01	76.44	73.71	71.81
69.07	68.31	67.49	66.63	65.74	64.85	63.96	63.12	62.36	61.71	61.21	60.87
60.71	60.69	60.79	60.97	61.19	61.42	61.65	61.86	62.04	62.21	62.36	62.51
62.66	62.82	63.00	63.21	63.45	63.70	63.96	64.21	64.41	64.54	64.59	64.56
64.48	64.38	64.29	64.21	64.17	64.15	64.16	64.21	64.28	64.40	64.55	64.76
65.02	65.32	65.66	66.04	66.43	66.82	67.18	67.51	72.13	75.02	78.59	81.36
82.09	79.81	78.45	98.76	105.12							
215.82	172.85	133.89	109.48	94.16	89.58	86.21	83.29	79.66	76.14	73.42	71.50
69.11	68.26	67.33	66.35	65.34	64.31	63.30	62.33	61.47	60.75	60.23	59.92
59.84	59.93	60.16	60.46	60.80	61.13	61.44	61.72	61.96	62.18	62.37	62.55
62.73	62.93	63.15	63.40	63.68	64.00	64.33	64.64	64.92	65.11	65.18	65.14
65.02	64.88	64.73	64.61	64.53	64.48	64.46	64.49	64.55	64.64	64.79	64.98
65.23	65.52	65.86	66.24	66.64	67.05	67.45	67.81	71.35	74.04	77.42	80.31
81.32	79.41	78.76	97.80	104.79							
215.45	172.69	133.80	109.42	94.23	89.47	86.02	82.95	79.32	75.87	73.16	71.23
69.21	68.26	67.22	66.12	64.98	63.81	62.66	61.55	60.55	59.74	59.18	58.91
58.93	59.17	59.55	60.01	60.47	60.91	61.30	61.64	61.93	62.18	62.39	62.60
62.80	63.01	63.26	63.54	63.86	64.23	64.63	65.05	65.42	65.68	65.77	65.69
65.51	65.30	65.11	64.95	64.83	64.75	64.71	64.72	64.76	64.84	64.97	65.15

65.38	65.66	66.00	66.37	66.79	67.23	67.67	68.09	70.58	73.09	76.29	79.26
80.52	79.01	79.01	96.91	104.44							
215.09	172.52	133.71	109.37	94.30	89.35	85.81	82.61	79.00	75.62	72.95	71.00
69.36	68.30	67.16	65.95	64.69	63.39	62.08	60.81	59.64	58.68	58.05	57.83
58.00	58.43	59.02	59.64	60.25	60.79	61.25	61.64	61.95	62.21	62.44	62.64
62.84	63.06	63.31	63.60	63.95	64.37	64.84	65.36	65.87	66.26	66.36	66.19
65.91	65.62	65.37	65.18	65.04	64.95	64.90	64.88	64.91	64.97	65.08	65.24
65.46	65.73	66.05	66.42	66.85	67.31	67.80	68.30	69.82	72.16	75.22	78.21
79.72	78.60	79.19	96.06	104.08							
214.73	172.36	133.62	109.31	94.36	89.23	85.59	82.28	78.71	75.42	72.78	70.83
69.51	68.37	67.15	65.86	64.50	63.08	61.62	60.16	58.77	57.59	56.84	56.68
57.07	57.78	58.60	59.42	60.16	60.79	61.31	61.72	62.04	62.29	62.50	62.68
62.86	63.06	63.29	63.58	63.93	64.37	64.89	65.51	66.18	66.80	66.90	66.53
66.12	65.77	65.50	65.30	65.15	65.06	65.00	64.98	64.98	65.03	65.11	65.25
65.45	65.70	66.01	66.38	66.79	67.26	67.77	68.33	69.08	71.27	74.19	77.19
78.91	78.19	79.31	95.27	103.71							
214.37	172.19	133.54	109.26	94.41	89.10	85.36	81.96	78.44	75.25	72.67	70.73
69.59	68.45	67.21	65.87	64.44	62.92	61.33	59.70	58.06	56.56	55.53	55.49
56.26	57.31	58.39	59.40	60.26	60.96	61.50	61.90	62.19	62.40	62.57	62.72
62.85	63.01	63.20	63.45	63.78	64.20	64.73	65.37	66.13	66.99	67.07	66.52
66.06	65.71	65.45	65.27	65.15	65.08	65.03	65.00	64.98	65.00	65.07	65.18
65.36	65.59	65.88	66.22	66.62	67.06	67.54	68.02	68.34	70.42	73.20	76.20
78.11	77.78	79.38	94.52	103.33							
214.02	172.03	133.46	109.20	94.46	88.97	85.12	81.64	78.19	75.12	72.63	70.71
69.68	68.58	67.35	66.00	64.53	62.97	61.30	59.55	57.72	55.85	54.19	54.45
55.81	57.20	58.49	59.64	60.60	61.32	61.83	62.17	62.39	62.55	62.66	62.74
62.81	62.90	63.02	63.21	63.48	63.85	64.32	64.90	65.54	66.12	66.27	66.00
65.68	65.41	65.21	65.09	65.03	65.00	64.98	64.94	64.90	64.89	64.93	65.02
65.17	65.38	65.64	65.96	66.32	66.72	67.13	67.52	67.63	69.59	72.27	75.24
77.31	77.37	79.39	93.81	102.95							
213.66	171.86	133.37	109.15	94.49	88.84	84.87	81.33	77.95	75.04	72.66	70.78
69.86	68.81	67.60	66.27	64.81	63.24	61.57	59.81	57.98	56.11	54.46	54.74
56.14	57.57	58.94	60.18	61.19	61.88	62.29	62.51	62.64	62.71	62.75	62.75
62.73	62.73	62.76	62.86	63.04	63.32	63.70	64.16	64.65	65.05	65.22	65.18
65.03	64.89	64.79	64.76	64.78	64.83	64.85	64.80	64.72	64.68	64.69	64.76
64.89	65.08	65.32	65.61	65.93	66.28	66.63	66.95	66.93	68.80	71.38	74.32
76.54	76.95	79.36	93.14	102.55							
213.31	171.69	133.29	109.10	94.52	88.71	84.63	81.02	77.73	74.99	72.77	70.97
70.14	69.14	67.98	66.69	65.27	63.75	62.14	60.48	58.83	57.32	56.32	56.33
57.20	58.40	59.70	60.96	62.02	62.63	62.82	62.87	62.87	62.87	62.84	62.75
62.62	62.50	62.41	62.40	62.47	62.64	62.91	63.25	63.62	63.94	64.14	64.22
64.22	64.20	64.21	64.27	64.38	64.55	64.65	64.55	64.43	64.36	64.36	64.41
64.53	64.69	64.91	65.17	65.46	65.76	66.07	66.35	66.26	68.05	70.53	73.44
75.78	76.52	79.29	92.50	102.16							
212.96	171.52	133.21	109.05	94.55	88.57	84.37	80.72	77.52	74.97	72.95	71.27
70.52	69.57	68.48	67.25	65.90	64.45	62.95	61.44	60.01	58.82	58.08	58.00
58.53	59.44	60.57	61.81	63.03	63.45	63.28	63.14	63.05	62.97	62.90	62.72
62.45	62.21	62.00	61.86	61.80	61.84	62.00	62.24	62.54	62.83	63.06	63.22
63.32	63.41	63.50	63.63	63.81	64.06	64.29	64.12	63.99	63.92	63.91	63.97
64.08	64.23	64.43	64.67	64.93	65.20	65.47	65.73	65.61	67.33	69.73	72.60
75.04	76.10	79.19	91.88	101.75							
212.61	171.35	133.13	109.00	94.56	88.43	84.12	80.42	77.32	74.97	73.19	71.71
70.99	70.10	69.07	67.92	66.65	65.30	63.90	62.54	61.29	60.29	59.67	59.52
59.82	60.48	61.36	62.39	63.42	63.68	63.43	63.25	63.12	62.99	62.83	62.58
62.23	61.88	61.54	61.25	61.05	60.96	61.01	61.18	61.43	61.72	61.99	62.21
62.39	62.54	62.69	62.86	63.06	63.28	63.43	63.43	63.38	63.36	63.38	63.44
63.55	63.71	63.90	64.11	64.35	64.60	64.85	65.10	65.00	66.65	68.98	71.80
74.32	75.67	79.04	91.30	101.35							
212.27	171.18	133.06	108.96	94.58	88.28	83.86	80.13	77.11	74.97	73.46	72.25
71.51	70.69	69.74	68.66	67.48	66.22	64.92	63.67	62.55	61.66	61.08	60.85
60.98	61.39	61.99	62.65	63.18	63.29	63.25	63.21	63.11	62.95	62.72	62.40
62.00	61.54	61.07	60.62	60.24	60.01	59.95	60.08	60.33	60.65	60.96	61.24
61.47	61.66	61.84	62.01	62.21	62.40	62.55	62.63	62.67	62.71	62.77	62.86
62.98	63.13	63.32	63.53	63.75	63.99	64.23	64.46	64.42	66.01	68.27	71.04
73.63	75.23	78.87	90.73	100.95							

211.92	171.01	132.98	108.91	94.58	88.14	83.61	79.83	76.89	74.94	73.73	72.87
72.06	71.28	70.41	69.44	68.36	67.16	65.93	64.74	63.70	62.87	62.29	62.00
61.98	62.18	62.52	62.88	63.13	63.15	63.18	63.20	63.11	62.93	62.65	62.28
61.81	61.25	60.64	60.00	59.43	59.01	58.86	58.97	59.27	59.65	60.02	60.34
60.61	60.81	60.98	61.15	61.32	61.51	61.68	61.82	61.93	62.02	62.12	62.23
62.36	62.52	62.71	62.92	63.14	63.37	63.60	63.82	63.87	65.41	67.60	70.33
72.96	74.80	78.67	90.19	100.54							
211.58	170.84	132.90	108.87	94.59	88.00	83.35	79.53	76.66	74.86	73.92	73.44
72.56	71.80	71.02	70.19	69.23	68.07	66.85	65.71	64.71	63.91	63.32	62.97
62.83	62.87	63.01	63.18	63.29	63.32	63.31	63.28	63.17	62.97	62.67	62.26
61.73	61.08	60.32	59.48	58.64	57.99	57.73	57.90	58.31	58.78	59.22	59.58
59.86	60.05	60.18	60.30	60.45	60.64	60.85	61.04	61.19	61.33	61.45	61.58
61.73	61.90	62.09	62.30	62.52	62.75	62.98	63.20	63.37	64.85	66.97	69.65
72.31	74.36	78.44	89.67	100.14							
211.24	170.67	132.83	108.82	94.59	87.85	83.09	79.24	76.41	74.72	73.96	73.78
72.84	72.13	71.46	70.82	70.06	68.84	67.61	66.50	65.55	64.77	64.18	63.78
63.56	63.47	63.48	63.52	63.55	63.55	63.52	63.45	63.31	63.10	62.79	62.36
61.80	61.09	60.22	59.17	58.02	56.97	56.58	56.95	57.56	58.15	58.64	59.02
59.27	59.42	59.48	59.52	59.62	59.84	60.09	60.32	60.51	60.66	60.80	60.94
61.09	61.27	61.46	61.68	61.92	62.16	62.39	62.62	62.89	64.33	66.39	69.01
71.69	73.92	78.19	89.16	99.74							
210.90	170.50	132.76	108.78	94.58	87.71	82.84	78.94	76.13	74.50	73.80	73.64
72.76	72.17	71.59	71.05	70.39	69.26	68.12	67.09	66.20	65.46	64.87	64.45
64.17	64.00	63.92	63.88	63.86	63.82	63.76	63.67	63.53	63.31	63.01	62.61
62.06	61.35	60.43	59.25	57.82	56.20	55.56	56.42	57.20	57.84	58.34	58.70
58.91	59.00	58.96	58.85	58.86	59.15	59.46	59.71	59.90	60.05	60.18	60.31
60.46	60.64	60.85	61.08	61.33	61.59	61.86	62.12	62.46	63.85	65.85	68.41
71.09	73.49	77.93	88.66	99.34							
210.57	170.33	132.68	108.74	94.57	87.56	82.59	78.64	75.83	74.19	73.44	73.13
72.42	71.95	71.44	70.89	70.21	69.32	68.37	67.47	66.66	65.97	65.42	64.99
64.68	64.46	64.32	64.23	64.17	64.10	64.03	63.94	63.80	63.61	63.34	62.98
62.51	61.87	61.01	59.86	58.42	56.89	56.24	56.74	57.37	57.92	58.35	58.65
58.81	58.84	58.73	58.49	58.36	58.73	59.03	59.25	59.40	59.52	59.62	59.72
59.86	60.03	60.25	60.51	60.78	61.07	61.36	61.67	62.05	63.40	65.35	67.85
70.52	73.05	77.64	88.18	98.94							
210.23	170.16	132.61	108.70	94.56	87.42	82.34	78.35	75.52	73.82	72.93	72.43
71.97	71.57	71.11	70.59	69.96	69.23	68.45	67.68	66.97	66.35	65.83	65.41
65.09	64.85	64.68	64.56	64.47	64.39	64.31	64.23	64.11	63.96	63.75	63.47
63.10	62.61	61.95	60.96	59.66	58.44	57.77	57.75	58.03	58.37	58.66	58.87
58.97	58.95	58.82	58.64	58.56	58.67	58.82	58.94	59.02	59.07	59.11	59.16
59.27	59.45	59.68	59.96	60.26	60.58	60.91	61.25	61.68	62.99	64.89	67.32
69.96	72.61	77.34	87.71	98.55							
209.90	169.98	132.54	108.66	94.54	87.28	82.10	78.05	75.18	73.39	72.33	71.65
71.46	71.11	70.70	70.22	69.68	69.06	68.41	67.76	67.15	66.59	66.12	65.72
65.41	65.17	64.98	64.85	64.75	64.67	64.60	64.52	64.44	64.33	64.19	64.00
63.74	63.43	63.05	62.34	61.04	59.93	59.22	58.93	58.93	59.06	59.21	59.32
59.36	59.30	59.16	58.99	58.86	58.80	58.79	58.78	58.75	58.71	58.67	58.65
58.71	58.88	59.15	59.46	59.79	60.13	60.48	60.86	61.33	62.61	64.46	66.83
69.43	72.17	77.02	87.25	98.16							
209.57	169.81	132.47	108.62	94.52	87.13	81.86	77.75	74.84	72.94	71.70	70.84
70.90	70.60	70.24	69.83	69.36	68.85	68.30	67.75	67.22	66.74	66.31	65.95
65.65	65.41	65.23	65.09	64.99	64.91	64.86	64.81	64.76	64.71	64.63	64.52
64.37	64.15	63.84	63.21	62.17	61.21	60.50	60.08	59.90	59.87	59.91	59.94
59.92	59.82	59.65	59.44	59.22	59.03	58.87	58.73	58.59	58.45	58.31	58.19
58.16	58.37	58.69	59.02	59.37	59.72	60.09	60.49	61.00	62.26	64.08	66.37
68.91	71.73	76.69	86.80	97.78							
209.24	169.64	132.40	108.58	94.50	87.00	81.62	77.46	74.49	72.48	71.07	70.05
70.33	70.06	69.76	69.42	69.03	68.60	68.14	67.68	67.23	66.81	66.43	66.10
65.82	65.60	65.42	65.29	65.19	65.12	65.08	65.06	65.05	65.05	65.04	65.01
64.94	64.77	64.45	63.87	63.07	62.25	61.57	61.10	60.84	60.72	60.68	60.66
60.60	60.47	60.25	59.96	59.64	59.32	59.02	58.75	58.50	58.27	58.07	57.88
57.75	58.01	58.34	58.67	59.01	59.37	59.74	60.15	60.69	61.95	63.74	65.94
68.41	71.29	76.35	86.36	97.40							
208.91	169.47	132.33	108.54	94.48	86.86	81.39	77.18	74.14	72.03	70.48	69.32
69.75	69.53	69.29	69.00	68.68	68.33	67.95	67.56	67.18	66.82	66.48	66.19

65.93	65.72	65.56	65.43	65.34	65.29	65.26	65.27	65.29	65.34	65.39	65.44
65.45	65.36	65.07	64.54	63.83	63.08	62.44	61.96	61.66	61.51	61.46	61.43
61.36	61.20	60.92	60.53	60.08	59.62	59.19	58.80	58.46	58.17	57.94	57.76
57.71	57.85	58.11	58.41	58.73	59.07	59.43	59.83	60.39	61.67	63.43	65.53
67.93	70.85	75.99	85.93	97.02							
208.58	169.29	132.26	108.51	94.46	86.72	81.17	76.90	73.81	71.62	69.98	68.73
69.18	69.01	68.83	68.61	68.35	68.06	67.74	67.41	67.09	66.77	66.48	66.22
65.99	65.79	65.64	65.52	65.44	65.40	65.38	65.41	65.46	65.54	65.65	65.78
65.89	65.92	65.72	65.20	64.47	63.72	63.09	62.62	62.34	62.20	62.18	62.19
62.16	62.00	61.65	61.13	60.53	59.91	59.35	58.85	58.44	58.10	57.86	57.71
57.67	57.77	57.97	58.23	58.53	58.84	59.18	59.55	60.10	61.43	63.17	65.15
67.46	70.41	75.63	85.51	96.66							
208.26	169.12	132.20	108.47	94.43	86.59	80.95	76.62	73.49	71.25	69.59	68.34
68.63	68.54	68.41	68.24	68.03	67.79	67.53	67.25	66.97	66.69	66.43	66.20
65.99	65.81	65.67	65.56	65.48	65.44	65.44	65.47	65.54	65.64	65.79	65.97
66.19	66.40	66.38	65.75	64.90	64.12	63.50	63.06	62.81	62.73	62.78	62.89
62.97	62.85	62.42	61.72	60.92	60.14	59.44	58.86	58.39	58.03	57.79	57.65
57.63	57.71	57.88	58.11	58.39	58.69	59.00	59.32	59.83	61.24	62.95	64.78
67.00	69.98	75.26	85.09	96.29							
207.93	168.95	132.13	108.44	94.40	86.46	80.74	76.36	73.18	70.93	69.32	68.18
68.19	68.15	68.05	67.92	67.75	67.54	67.32	67.08	66.83	66.59	66.36	66.14
65.95	65.78	65.65	65.54	65.47	65.43	65.42	65.45	65.52	65.62	65.77	65.97
66.22	66.53	66.88	65.93	64.99	64.21	63.62	63.23	63.04	63.04	63.19	63.44
63.72	63.75	63.18	62.21	61.19	60.24	59.43	58.78	58.28	57.92	57.69	57.58
57.57	57.65	57.82	58.04	58.32	58.62	58.94	59.25	59.59	61.12	62.76	64.42
66.54	69.54	74.88	84.68	95.94							
207.61	168.78	132.06	108.40	94.37	86.34	80.54	76.11	72.90	70.66	69.13	68.18
67.93	67.86	67.77	67.64	67.49	67.31	67.11	66.90	66.68	66.46	66.25	66.05
65.87	65.72	65.58	65.48	65.40	65.35	65.34	65.35	65.40	65.48	65.59	65.74
65.91	66.06	65.98	65.41	64.65	63.96	63.44	63.13	63.02	63.10	63.33	63.70
64.19	64.67	63.76	62.44	61.22	60.16	59.27	58.58	58.08	57.75	57.56	57.48
57.50	57.60	57.77	58.00	58.29	58.63	59.02	59.45	59.42	61.09	62.60	64.07
66.10	69.11	74.50	84.27	95.59							
207.29	168.60	132.00	108.37	94.35	86.22	80.34	75.87	72.64	70.42	69.01	68.24
67.77	67.66	67.54	67.42	67.27	67.10	66.92	66.72	66.52	66.32	66.12	65.94
65.77	65.61	65.48	65.37	65.28	65.22	65.19	65.18	65.19	65.23	65.28	65.34
65.37	65.32	65.09	64.60	63.99	63.41	62.99	62.77	62.75	62.89	63.17	63.55
63.97	64.21	63.45	62.19	60.96	59.85	58.93	58.24	57.79	57.53	57.40	57.38
57.43	57.55	57.73	57.98	58.29	58.68	59.15	59.74	59.33	61.14	62.42	63.70
65.66	68.67	74.10	83.87	95.24							
206.97	168.43	131.93	108.34	94.32	86.10	80.15	75.64	72.39	70.22	68.92	68.30
67.65	67.50	67.36	67.23	67.08	66.91	66.74	66.55	66.36	66.17	65.98	65.80
65.63	65.48	65.34	65.22	65.12	65.04	64.98	64.94	64.91	64.90	64.87	64.83
64.74	64.55	64.21	63.73	63.16	62.64	62.30	62.19	62.26	62.47	62.74	63.04
63.26	63.18	62.58	61.58	60.44	59.34	58.41	57.77	57.43	57.28	57.24	57.27
57.36	57.50	57.70	57.96	58.29	58.70	59.24	59.93	59.22	61.29	62.19	63.32
65.22	68.24	73.71	83.48	94.90							
206.66	168.26	131.87	108.31	94.29	85.98	79.97	75.42	72.17	70.03	68.82	68.30
67.54	67.37	67.21	67.06	66.91	66.74	66.57	66.39	66.20	66.01	65.83	65.65
65.48	65.32	65.17	65.04	64.93	64.83	64.74	64.66	64.59	64.52	64.42	64.29
64.10	63.81	63.40	62.87	62.27	61.73	61.44	61.46	61.65	61.91	62.18	62.39
62.46	62.26	61.72	60.87	59.84	58.74	57.76	57.20	57.06	57.06	57.12	57.20
57.32	57.48	57.67	57.92	58.24	58.66	59.21	59.92	58.95	60.99	61.84	62.93
64.79	67.80	73.31	83.09	94.57							
206.34	168.08	131.80	108.28	94.26	85.87	79.80	75.22	71.96	69.86	68.71	68.24
67.43	67.25	67.08	66.92	66.75	66.58	66.41	66.23	66.04	65.85	65.67	65.49
65.31	65.14	64.98	64.84	64.71	64.58	64.47	64.36	64.25	64.12	63.97	63.77
63.50	63.15	62.68	62.10	61.43	60.75	60.47	60.71	61.04	61.35	61.60	61.75
61.74	61.50	61.01	60.27	59.34	58.27	57.13	56.69	56.83	56.96	57.08	57.20
57.33	57.47	57.65	57.87	58.15	58.53	59.03	59.69	58.51	60.21	61.36	62.51
64.35	67.37	72.90	82.70	94.25							
206.03	167.91	131.74	108.25	94.23	85.77	79.64	75.03	71.77	69.69	68.57	68.11
67.33	67.14	66.96	66.79	66.62	66.44	66.26	66.07	65.88	65.69	65.50	65.31
65.13	64.95	64.78	64.62	64.47	64.32	64.18	64.04	63.89	63.73	63.53	63.29
62.98	62.59	62.10	61.52	60.84	60.08	59.79	60.19	60.56	60.87	61.09	61.19

61.15	60.92	60.48	59.85	59.06	58.16	57.30	56.90	56.94	57.06	57.17	57.28
57.39	57.51	57.64	57.80	58.02	58.31	58.71	59.26	58.00	59.49	60.82	62.08
63.93	66.94	72.49	82.32	93.93							
205.72	167.74	131.68	108.22	94.20	85.67	79.48	74.85	71.59	69.52	68.41	67.92
67.23	67.03	66.85	66.67	66.49	66.31	66.12	65.93	65.73	65.54	65.34	65.14
64.94	64.75	64.57	64.39	64.21	64.05	63.88	63.72	63.54	63.35	63.13	62.86
62.54	62.15	61.68	61.15	60.58	60.07	59.86	60.02	60.28	60.52	60.70	60.77
60.71	60.50	60.14	59.62	58.99	58.32	57.74	57.39	57.30	57.33	57.39	57.46
57.52	57.58	57.65	57.74	57.86	58.03	58.29	58.67	57.51	58.86	60.27	61.64
63.50	66.51	72.07	81.95	93.62							
205.41	167.57	131.62	108.19	94.17	85.57	79.34	74.69	71.43	69.36	68.23	67.69
67.13	66.94	66.75	66.56	66.37	66.18	65.99	65.79	65.59	65.38	65.17	64.96
64.76	64.55	64.35	64.15	63.96	63.77	63.59	63.41	63.21	63.01	62.77	62.50
62.18	61.81	61.40	60.95	60.51	60.15	59.98	60.02	60.16	60.32	60.44	60.48
60.42	60.25	59.95	59.56	59.09	58.60	58.18	57.90	57.76	57.71	57.71	57.71
57.72	57.71	57.71	57.70	57.71	57.74	57.82	57.99	57.08	58.31	59.74	61.20
63.09	66.09	71.65	81.58	93.31							
205.10	167.40	131.56	108.17	94.14	85.48	79.21	74.54	71.28	69.21	68.04	67.45
67.04	66.84	66.65	66.46	66.26	66.07	65.87	65.66	65.45	65.23	65.01	64.79
64.57	64.35	64.13	63.91	63.70	63.50	63.30	63.11	62.91	62.69	62.46	62.19
61.90	61.57	61.21	60.84	60.50	60.23	60.09	60.06	60.12	60.21	60.29	60.31
60.25	60.12	59.90	59.61	59.27	58.92	58.62	58.39	58.24	58.15	58.09	58.04
57.98	57.90	57.81	57.71	57.60	57.48	57.38	57.30	56.71	57.84	59.26	60.78
62.67	65.66	71.23	81.22	93.01							
204.79	167.23	131.49	108.14	94.11	85.39	79.08	74.41	71.14	69.06	67.85	67.20
66.96	66.76	66.57	66.37	66.17	65.96	65.75	65.54	65.32	65.09	64.86	64.63
64.39	64.15	63.91	63.68	63.45	63.23	63.03	62.82	62.62	62.41	62.19	61.94
61.68	61.39	61.08	60.78	60.51	60.30	60.17	60.13	60.14	60.18	60.22	60.23
60.19	60.09	59.94	59.74	59.51	59.27	59.06	58.89	58.75	58.64	58.53	58.42
58.29	58.14	57.97	57.78	57.56	57.33	57.09	56.81	56.41	57.45	58.82	60.37
62.27	65.24	70.80	80.86	92.72							
204.49	167.05	131.43	108.12	94.09	85.31	78.97	74.29	71.03	68.93	67.68	66.97
66.89	66.69	66.49	66.29	66.08	65.87	65.65	65.43	65.20	64.97	64.72	64.48
64.22	63.97	63.71	63.46	63.21	62.98	62.76	62.56	62.36	62.17	61.96	61.74
61.50	61.26	61.00	60.76	60.54	60.37	60.25	60.20	60.19	60.20	60.22	60.22
60.20	60.14	60.05	59.93	59.79	59.64	59.51	59.39	59.27	59.15	59.01	58.85
58.65	58.43	58.19	57.92	57.62	57.31	57.00	56.72	56.17	57.14	58.45	59.98
61.88	64.83	70.38	80.50	92.44							
204.18	166.88	131.37	108.10	94.06	85.24	78.86	74.18	70.93	68.82	67.52	66.75
66.83	66.63	66.42	66.22	66.00	65.79	65.56	65.33	65.10	64.85	64.60	64.34
64.07	63.80	63.52	63.24	62.98	62.73	62.50	62.31	62.13	61.96	61.77	61.58
61.37	61.16	60.95	60.75	60.57	60.43	60.33	60.27	60.25	60.25	60.26	60.27
60.26	60.24	60.20	60.14	60.08	60.02	59.96	59.89	59.81	59.69	59.52	59.30
59.05	58.76	58.45	58.12	57.75	57.40	57.08	56.85	56.03	56.92	58.13	59.62
61.50	64.41	69.94	80.16	92.16							
203.88	166.71	131.31	108.07	94.04	85.17	78.77	74.09	70.84	68.73	67.40	66.57
66.78	66.57	66.37	66.15	65.94	65.72	65.49	65.25	65.01	64.75	64.49	64.22
63.94	63.65	63.35	63.05	62.76	62.49	62.26	62.08	61.93	61.78	61.62	61.46
61.28	61.10	60.92	60.76	60.61	60.49	60.40	60.34	60.32	60.32	60.32	60.34
60.35	60.36	60.37	60.37	60.38	60.39	60.40	60.40	60.36	60.25	60.06	59.79
59.46	59.09	58.73	58.33	57.91	57.53	57.22	57.00	56.01	56.77	57.86	59.28
61.13	64.00	69.51	79.81	91.89							
203.58	166.54	131.26	108.05	94.02	85.10	78.68	74.01	70.78	68.67	67.32	66.46
66.73	66.53	66.32	66.10	65.88	65.66	65.42	65.18	64.93	64.67	64.40	64.12
63.83	63.53	63.22	62.89	62.57	62.26	62.03	61.89	61.77	61.65	61.51	61.37
61.22	61.06	60.91	60.77	60.65	60.54	60.47	60.42	60.39	60.39	60.40	60.42
60.45	60.49	60.54	60.59	60.66	60.74	60.82	60.89	60.92	60.84	60.62	60.27
59.86	59.41	58.96	58.51	58.07	57.67	57.35	57.14	56.09	56.69	57.64	58.97
60.77	63.60	69.07	79.48	91.62							
203.28	166.37	131.20	108.03	94.00	85.04	78.61	73.94	70.73	68.63	67.29	66.45
66.69	66.49	66.28	66.06	65.84	65.61	65.37	65.13	64.87	64.61	64.33	64.05
63.75	63.44	63.12	62.79	62.44	62.08	61.84	61.76	61.67	61.56	61.44	61.32
61.18	61.05	60.92	60.80	60.69	60.60	60.53	60.49	60.46	60.46	60.48	60.51
60.55	60.61	60.69	60.78	60.90	61.03	61.19	61.35	61.47	61.45	61.19	60.74
60.22	59.68	59.16	58.66	58.20	57.79	57.46	57.23	56.23	56.67	57.47	58.68

60.43	63.21	68.63	79.15	91.37							
202.98	166.20	131.14	108.01	93.98	84.99	78.54	73.89	70.70	68.62	67.30	66.49
66.66	66.45	66.24	66.03	65.80	65.57	65.33	65.09	64.83	64.56	64.29	64.00
63.70	63.39	63.07	62.74	62.41	62.08	61.85	61.73	61.63	61.53	61.42	61.30
61.18	61.06	60.94	60.83	60.73	60.65	60.59	60.55	60.53	60.53	60.55	60.58
60.64	60.71	60.81	60.93	61.08	61.26	61.47	61.72	61.97	62.09	61.74	61.13
60.50	59.89	59.31	58.78	58.30	57.87	57.53	57.28	56.39	56.67	57.32	58.42
60.10	62.82	68.18	78.82	91.12							
202.68	166.03	131.08	107.99	93.96	84.94	78.49	73.85	70.69	68.63	67.33	66.55
66.63	66.43	66.22	66.00	65.78	65.55	65.31	65.06	64.80	64.54	64.26	63.98
63.68	63.38	63.07	62.75	62.44	62.16	61.94	61.78	61.66	61.54	61.42	61.31
61.19	61.08	60.97	60.87	60.78	60.71	60.65	60.61	60.59	60.59	60.60	60.64
60.70	60.78	60.88	61.02	61.18	61.38	61.61	61.89	62.21	62.57	62.04	61.31
60.63	59.99	59.39	58.85	58.35	57.91	57.55	57.28	56.53	56.69	57.19	58.18
59.78	62.44	67.73	78.50	90.87							
202.39	165.87	131.02	107.97	93.94	84.90	78.44	73.83	70.69	68.66	67.39	66.63
66.61	66.41	66.20	65.98	65.76	65.53	65.29	65.05	64.79	64.53	64.26	63.98
63.69	63.39	63.09	62.80	62.51	62.26	62.04	61.86	61.71	61.58	61.46	61.34
61.23	61.12	61.01	60.92	60.83	60.76	60.70	60.66	60.64	60.63	60.64	60.68
60.73	60.81	60.91	61.04	61.20	61.39	61.60	61.84	62.06	62.14	61.81	61.22
60.59	59.97	59.39	58.85	58.36	57.91	57.53	57.23	56.64	56.69	57.07	57.96
59.48	62.06	67.28	78.19	90.64							
202.10	165.70	130.97	107.96	93.93	84.86	78.40	73.81	70.71	68.71	67.47	66.72
66.59	66.39	66.18	65.97	65.75	65.53	65.29	65.05	64.80	64.54	64.27	63.99
63.71	63.43	63.14	62.86	62.60	62.35	62.14	61.95	61.79	61.65	61.52	61.39
61.28	61.17	61.06	60.97	60.88	60.81	60.75	60.70	60.67	60.66	60.67	60.69
60.74	60.81	60.90	61.01	61.14	61.30	61.46	61.62	61.71	61.67	61.40	60.95
60.41	59.86	59.32	58.80	58.32	57.88	57.49	57.16	56.70	56.68	56.97	57.75
59.20	61.70	66.83	77.89	90.41							
201.80	165.53	130.91	107.94	93.92	84.83	78.37	73.81	70.74	68.78	67.56	66.82
66.58	66.38	66.17	65.96	65.75	65.53	65.30	65.06	64.81	64.56	64.30	64.03
63.75	63.48	63.21	62.94	62.69	62.45	62.24	62.05	61.88	61.73	61.59	61.46
61.34	61.22	61.12	61.02	60.93	60.85	60.78	60.73	60.69	60.67	60.67	60.68
60.71	60.76	60.83	60.92	61.02	61.13	61.24	61.31	61.32	61.22	60.98	60.61
60.16	59.68	59.19	58.72	58.26	57.85	57.46	57.11	56.73	56.65	56.86	57.55
58.93	61.35	66.36	77.59	90.18							
201.51	165.36	130.86	107.92	93.91	84.80	78.36	73.82	70.79	68.85	67.66	66.93
66.55	66.36	66.16	65.96	65.75	65.54	65.31	65.08	64.84	64.59	64.33	64.07
63.81	63.54	63.28	63.02	62.78	62.55	62.34	62.15	61.97	61.81	61.67	61.53
61.40	61.28	61.17	61.07	60.98	60.89	60.82	60.75	60.71	60.67	60.65	60.65
60.66	60.69	60.74	60.79	60.86	60.92	60.97	60.98	60.94	60.81	60.58	60.26
59.87	59.46	59.03	58.60	58.19	57.81	57.46	57.15	56.71	56.60	56.75	57.37
58.68	61.01	65.90	77.30	89.97							
201.22	165.20	130.80	107.91	93.90	84.78	78.34	73.84	70.85	68.94	67.77	67.05
66.53	66.35	66.16	65.96	65.76	65.55	65.34	65.11	64.88	64.63	64.38	64.12
63.87	63.61	63.36	63.11	62.87	62.65	62.44	62.25	62.07	61.90	61.75	61.61
61.47	61.35	61.23	61.12	61.02	60.93	60.84	60.77	60.71	60.66	60.62	60.60
60.59	60.60	60.61	60.64	60.66	60.68	60.68	60.65	60.56	60.41	60.19	59.91
59.58	59.22	58.85	58.48	58.12	57.78	57.48	57.23	56.65	56.53	56.64	57.20
58.44	60.69	65.43	77.02	89.75							
200.93	165.03	130.74	107.90	93.89	84.76	78.34	73.87	70.91	69.04	67.88	67.17
66.50	66.33	66.15	65.97	65.78	65.58	65.37	65.15	64.92	64.68	64.43	64.18
63.93	63.68	63.43	63.19	62.96	62.74	62.54	62.34	62.16	61.99	61.83	61.68
61.54	61.41	61.29	61.17	61.06	60.96	60.86	60.78	60.70	60.63	60.58	60.53
60.50	60.48	60.47	60.46	60.45	60.43	60.39	60.32	60.21	60.05	59.83	59.58
59.29	58.98	58.66	58.34	58.04	57.76	57.50	57.30	56.56	56.43	56.52	57.04
58.22	60.38	64.95	76.75	89.55							
200.65	164.86	130.69	107.88	93.89	84.75	78.35	73.91	70.99	69.15	68.01	67.31
66.48	66.32	66.15	65.97	65.79	65.60	65.40	65.19	64.97	64.73	64.49	64.24
64.00	63.75	63.51	63.28	63.05	62.83	62.63	62.43	62.25	62.07	61.91	61.76
61.61	61.48	61.35	61.22	61.10	60.99	60.88	60.78	60.68	60.60	60.52	60.46
60.40	60.36	60.32	60.28	60.24	60.19	60.12	60.01	59.88	59.70	59.49	59.26
59.01	58.74	58.48	58.22	57.96	57.73	57.52	57.36	56.45	56.31	56.41	56.89
58.02	60.08	64.47	76.49	89.35							
200.36	164.70	130.64	107.87	93.89	84.75	78.36	73.96	71.08	69.26	68.14	67.44

66.46	66.30	66.14	65.98	65.81	65.63	65.44	65.24	65.02	64.79	64.55	64.30
64.06	63.82	63.58	63.36	63.14	62.92	62.71	62.52	62.33	62.15	61.98	61.83
61.68	61.54	61.41	61.27	61.14	61.02	60.89	60.78	60.66	60.56	60.46	60.37
60.29	60.22	60.16	60.10	60.04	59.96	59.86	59.73	59.57	59.39	59.18	58.96
58.74	58.52	58.30	58.09	57.89	57.70	57.53	57.40	56.31	56.18	56.30	56.76
57.84	59.81	63.98	76.23	89.15							
200.08	164.53	130.58	107.86	93.89	84.75	78.38	74.02	71.17	69.38	68.27	67.58
66.43	66.28	66.13	65.98	65.82	65.66	65.48	65.29	65.08	64.84	64.60	64.36
64.12	63.88	63.65	63.43	63.21	63.00	62.80	62.59	62.40	62.22	62.05	61.89
61.74	61.60	61.46	61.32	61.18	61.04	60.90	60.77	60.64	60.52	60.40	60.29
60.18	60.09	60.00	59.93	59.84	59.74	59.62	59.47	59.30	59.10	58.88	58.67
58.48	58.31	58.14	57.98	57.82	57.67	57.54	57.43	56.15	56.04	56.20	56.63
57.67	59.55	63.48	75.98	88.96							
199.80	164.37	130.53	107.85	93.89	84.75	78.41	74.08	71.27	69.50	68.41	67.73
66.40	66.26	66.12	65.97	65.83	65.68	65.53	65.35	65.13	64.89	64.64	64.40
64.16	63.93	63.71	63.49	63.28	63.08	62.87	62.66	62.47	62.28	62.11	61.95
61.80	61.65	61.51	61.37	61.22	61.06	60.91	60.76	60.62	60.48	60.34	60.20
60.07	59.95	59.86	59.77	59.67	59.55	59.42	59.25	59.06	58.85	58.61	58.40
58.25	58.13	58.01	57.89	57.76	57.65	57.55	57.46	55.97	55.90	56.12	56.52
57.53	59.30	62.97	75.73	88.78							
199.44	164.16	130.46	107.84	93.90	84.76	78.45	74.18	71.41	69.67	68.59	67.92
67.49	67.16	66.84	66.54	66.24	65.96	65.68	65.42	65.16	64.92	64.68	64.44
64.22	64.00	63.78	63.57	63.36	63.16	62.97	62.78	62.59	62.41	62.23	62.06
61.90	61.74	61.58	61.43	61.27	61.12	60.96	60.80	60.63	60.46	60.29	60.12
59.95	59.79	59.64	59.48	59.33	59.19	59.03	58.87	58.70	58.51	58.30	58.08
57.84	57.58	57.32	57.05	56.78	56.51	56.26	56.02	55.74	55.74	56.07	56.40
57.38	59.03	62.32	75.43	88.55							
198.92	163.86	130.36	107.83	93.91	84.80	78.54	74.34	71.63	69.93	68.87	68.21
67.78	67.46	67.14	66.83	66.53	66.25	65.97	65.70	65.44	65.18	64.94	64.70
64.46	64.24	64.01	63.80	63.58	63.38	63.18	62.98	62.78	62.60	62.41	62.23
62.06	61.88	61.71	61.54	61.37	61.20	61.03	60.85	60.68	60.50	60.32	60.14
59.96	59.78	59.61	59.43	59.25	59.08	58.89	58.70	58.50	58.29	58.07	57.84
57.60	57.36	57.10	56.85	56.59	56.35	56.12	55.92	55.74	55.74	56.07	56.40
57.38	59.02	62.31	75.43	88.55							
198.14	163.40	130.22	107.82	93.95	84.88	78.71	74.61	71.99	70.35	69.32	68.67
68.25	67.92	67.61	67.30	67.00	66.71	66.42	66.15	65.88	65.61	65.36	65.11
64.87	64.63	64.40	64.17	63.95	63.73	63.52	63.31	63.10	62.90	62.70	62.50
62.31	62.11	61.92	61.73	61.54	61.35	61.16	60.96	60.77	60.57	60.37	60.17
59.97	59.77	59.57	59.36	59.16	58.95	58.73	58.52	58.29	58.07	57.84	57.60
57.36	57.12	56.89	56.65	56.43	56.22	56.04	55.88	55.74	55.74	56.07	56.40
57.38	59.02	62.31	75.43	88.55							
197.00	162.73	130.01	107.81	94.04	85.06	79.04	75.10	72.60	71.03	70.03	69.40
68.98	68.66	68.35	68.04	67.74	67.44	67.16	66.87	66.60	66.33	66.06	65.80
65.54	65.29	65.05	64.80	64.57	64.33	64.10	63.87	63.64	63.42	63.19	62.97
62.75	62.53	62.31	62.09	61.88	61.65	61.43	61.21	60.99	60.76	60.53	60.30
60.07	59.84	59.60	59.37	59.13	58.89	58.65	58.40	58.16	57.92	57.67	57.43
57.20	56.97	56.75	56.54	56.34	56.16	56.00	55.87	55.74	55.74	55.74	55.74
57.38	59.02	62.30	72.15	88.55							
195.32	161.74	129.70	107.84	94.25	85.46	79.69	75.97	73.62	72.14	71.19	70.57
70.18	69.86	69.55	69.25	68.95	68.65	68.36	68.07	67.79	67.51	67.24	66.97
66.70	66.43	66.17	65.91	65.65	65.40	65.14	64.89	64.64	64.39	64.14	63.89
63.63	63.38	63.13	62.88	62.62	62.37	62.11	61.85	61.59	61.33	61.06	60.80
60.53	60.26	59.98	59.71	59.43	59.16	58.88	58.60	58.33	58.06	57.79	57.53
57.28	57.03	56.80	56.58	56.38	56.19	56.02	55.88	55.74	55.74	55.74	55.74
57.38	57.39	57.40	65.61	88.55							
192.90	160.29	129.27	107.95	94.71	86.29	80.90	77.49	75.34	73.98	73.09	72.52
72.14	71.85	71.55	71.26	70.97	70.69	70.40	70.12	69.84	69.57	69.29	69.02
68.75	68.48	68.21	67.94	67.68	67.41	67.14	66.88	66.61	66.34	66.07	65.80
65.53	65.26	64.99	64.71	64.43	64.15	63.86	63.57	63.28	62.98	62.69	62.38
62.08	61.76	61.45	61.13	60.81	60.49	60.16	59.83	59.50	59.17	58.84	58.52
58.19	57.87	57.55	57.24	56.93	56.63	56.35	56.07	55.74	55.74	55.74	55.74
57.37	57.38	55.74	55.79	85.27							
189.47	158.24	128.68	108.24	95.66	87.86	83.04	80.06	78.20	77.02	76.26	75.76
75.43	75.18	74.92	74.67	74.42	74.17	73.92	73.68	73.43	73.19	72.95	72.72
72.48	72.25	72.01	71.78	71.55	71.32	71.09	70.86	70.63	70.40	70.16	69.93

```
   69.70    69.46    69.23    68.99    68.75    68.50    68.26    68.01    67.75    67.50    67.23    66.96
   66.69    66.41    66.12    65.83    65.53    65.21    64.89    64.56    64.22    63.87    63.50    63.13
   62.74    62.34    61.92    61.49    61.05    60.59    60.13    59.65    59.03    59.03    59.03    57.39
   57.38    55.74    55.73    55.76    85.25
  185.10   155.61   127.99   108.84    97.23    90.29    86.16    83.70    82.20    81.27    80.68    80.31
   80.06    79.87    79.68    79.50    79.32    79.14    78.97    78.80    78.63    78.47    78.31    78.15
   78.00    77.85    77.71    77.57    77.43    77.30    77.17    77.04    76.92    76.80    76.69    76.58
   76.47    76.37    76.27    76.18    76.09    76.00    75.92    75.84    75.77    75.70    75.63    75.57
   75.52    75.46    75.42    75.37    75.33    75.30    75.27    75.25    75.23    75.21    75.20    75.20
   75.20    75.20    75.22    75.23    75.26    75.29    75.32    75.37    75.41    72.19    68.88    65.58
   62.31    55.74    55.74    59.02    65.57
  180.41   152.80   127.30   109.66    99.13    92.99    89.43    87.33    86.08    85.31    84.83    84.52
   84.32    84.17    84.02    83.87    83.72    83.58    83.44    83.31    83.18    83.05    82.93    82.80
   82.69    82.57    82.46    82.35    82.25    82.15    82.05    81.95    81.86    81.77    81.69    81.60
   81.52    81.44    81.37    81.30    81.22    81.16    81.09    81.02    80.96    80.89    80.83    80.77
   80.71    80.64    80.58    80.51    80.45    80.38    80.30    80.23    80.15    80.06    79.98    79.88
   79.78    79.68    79.56    79.44    79.32    79.18    79.04    78.89    78.69    77.08    75.43    72.14
   68.86    55.74    55.74    55.74    55.75
      42        0.          (12g9.3)         1       */trans layer 4
```

1428	37			
1428				
1	2	8	110.01	0.308E+08
1	2	9	108.37	0.206E+08
1	2	10	110.26	0.137E+08
1	2	11	111.59	0.913E+07
1	2	12	112.52	0.609E+07
1	2	13	113.14	0.406E+07
1	2	14	113.65	0.406E+07
1	2	15	114.16	0.406E+07
1	2	16	114.68	0.406E+07
1	2	17	115.20	0.406E+07
1	2	18	115.73	0.406E+07
1	2	19	116.26	0.406E+07
1	2	20	116.80	0.406E+07
1	2	21	117.33	0.406E+07
1	2	22	117.87	0.406E+07
1	2	23	118.42	0.406E+07
1	2	25	119.51	0.406E+07
1	2	26	120.05	0.406E+07
1	2	27	120.60	0.406E+07
1	2	28	121.15	0.406E+07
1	2	29	121.70	0.406E+07
1	2	30	122.25	0.406E+07
1	2	31	122.81	0.406E+07
1	2	32	123.36	0.406E+07
1	2	33	123.91	0.406E+07
1	3	6	113.29	0.631E+08
1	3	25	109.85	0.369E+07
1	3	26	110.08	0.369E+07
1	3	27	110.31	0.369E+07
1	3	28	110.54	0.369E+07
1	3	29	110.77	0.369E+07
1	3	30	111.00	0.369E+07
1	3	31	111.23	0.369E+07
1	3	32	111.45	0.369E+07
1	3	33	111.68	0.369E+07
1	3	34	111.90	0.369E+07
1	3	35	112.13	0.369E+07
1	3	36	112.35	0.369E+07
1	4	7	108.38	0.350E+08
1	4	8	108.37	0.234E+08
1	4	9	108.04	0.156E+08
1	4	10	106.75	0.104E+08
1	4	11	106.09	0.692E+07
1	4	12	105.74	0.461E+07
1	4	13	105.55	0.308E+07
1	4	14	105.41	0.308E+07
1	4	15	105.29	0.308E+07
1	4	16	105.19	0.308E+07
1	4	17	105.11	0.308E+07
1	4	18	105.04	0.308E+07
1	4	19	104.99	0.308E+07
1	4	20	104.95	0.308E+07
1	4	21	104.93	0.308E+07
1	4	22	104.93	0.308E+07
1	4	23	104.94	0.308E+07
1	4	24	104.96	0.308E+07
1	4	33	106.01	0.308E+07
1	4	34	106.29	0.308E+07
1	4	35	106.58	0.308E+07
1	4	36	106.89	0.308E+07
1	4	37	107.20	0.308E+07
1	4	38	107.52	0.308E+07
1	4	39	107.86	0.308E+07
1	4	40	108.20	0.308E+07
1	4	41	108.32	0.308E+07
1	5	5	113.31	0.525E+08
1	5	6	108.38	0.350E+08
1	5	17	98.78	0.205E+07

1	5	18	98.77	0.205E+07
1	5	19	98.76	0.205E+07
1	5	20	98.75	0.205E+07
1	5	21	98.75	0.205E+07
1	5	22	98.75	0.205E+07
1	5	23	98.75	0.205E+07
1	6	5	114.94	0.350E+08
1	6	6	110.02	0.234E+08
1	6	17	96.69	0.137E+07
1	6	18	96.45	0.137E+07
1	6	19	96.22	0.137E+07
1	6	20	96.02	0.137E+07
1	6	21	95.83	0.137E+07
1	6	22	95.66	0.137E+07
1	6	23	95.50	0.137E+07
1	6	24	95.37	0.137E+07
1	6	25	95.27	0.137E+07
1	6	26	95.19	0.137E+07
1	6	27	95.13	0.137E+07
1	6	28	95.11	0.137E+07
1	6	29	95.11	0.137E+07
1	6	30	95.16	0.137E+07
1	6	31	95.24	0.137E+07
1	6	32	95.36	0.137E+07
1	7	5	114.94	0.234E+08
1	7	6	111.65	0.156E+08
1	7	17	95.37	0.911E+06
1	7	18	94.90	0.911E+06
1	7	19	94.44	0.911E+06
1	7	20	93.99	0.911E+06
1	7	21	93.56	0.911E+06
1	7	22	93.15	0.911E+06
1	7	23	92.75	0.911E+06
1	7	24	92.36	0.911E+06
1	7	25	92.00	0.911E+06
1	7	26	91.64	0.911E+06
1	7	27	91.30	0.911E+06
1	7	28	90.97	0.911E+06
1	7	29	90.66	0.911E+06
1	7	30	90.36	0.911E+06
1	7	31	90.07	0.911E+06
1	7	32	89.78	0.911E+06
1	8	5	115.91	0.156E+08
1	8	6	111.65	0.104E+08
1	8	17	94.36	0.607E+06
1	8	18	93.73	0.607E+06
1	8	19	93.12	0.607E+06
1	8	20	92.54	0.607E+06
1	8	21	91.99	0.607E+06
1	8	22	91.45	0.607E+06
1	8	23	90.94	0.607E+06
1	8	24	90.45	0.607E+06
1	8	25	89.98	0.607E+06
1	8	26	89.53	0.607E+06
1	8	27	89.09	0.607E+06
1	8	28	88.68	0.607E+06
1	8	29	88.28	0.607E+06
1	8	30	87.90	0.607E+06
1	8	31	87.53	0.607E+06
1	8	32	87.18	0.607E+06
1	8	33	86.86	0.607E+06
1	8	34	86.56	0.607E+06
1	8	35	86.28	0.607E+06
1	9	5	114.95	0.104E+08
1	9	6	111.66	0.692E+07
1	9	17	93.42	0.405E+06
1	9	18	92.72	0.405E+06
1	9	19	92.06	0.405E+06
1	9	20	91.43	0.405E+06
1	9	21	90.83	0.405E+06

1	9	22	90.27	0.405E+06
1	9	23	89.75	0.405E+06
1	9	24	89.25	0.405E+06
1	9	25	88.79	0.405E+06
1	9	26	88.35	0.405E+06
1	9	27	87.93	0.405E+06
1	9	28	87.53	0.405E+06
1	9	29	87.16	0.405E+06
1	9	30	86.80	0.405E+06
1	9	31	86.46	0.405E+06
1	9	32	86.13	0.405E+06
1	9	33	85.81	0.405E+06
1	9	34	85.51	0.405E+06
1	9	35	85.23	0.405E+06
1	9	36	84.96	0.405E+06
1	10	5	116.57	0.692E+07
1	10	6	113.29	0.461E+07
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1	10	18	91.87	0.270E+06
1	10	19	91.19	0.270E+06
1	10	20	90.55	0.270E+06
1	10	21	89.95	0.270E+06
1	10	22	89.40	0.270E+06
1	10	23	88.90	0.270E+06
1	10	24	88.43	0.270E+06
1	10	25	88.01	0.270E+06
1	10	26	87.61	0.270E+06
1	10	27	87.25	0.270E+06
1	10	28	86.91	0.270E+06
1	10	29	86.59	0.270E+06
1	10	30	86.29	0.270E+06
1	10	31	86.00	0.270E+06
1	10	32	85.73	0.270E+06
1	10	33	85.47	0.270E+06
1	10	34	85.25	0.270E+06
1	10	35	85.06	0.270E+06
1	10	36	84.93	0.270E+06
1	10	37	84.88	0.270E+06
1	10	38	84.92	0.270E+06
1	10	39	85.02	0.270E+06
1	11	5	116.58	0.461E+07
1	11	6	113.29	0.308E+07
1	11	19	90.52	0.180E+06
1	11	20	89.88	0.180E+06
1	11	21	89.29	0.180E+06
1	11	22	88.76	0.180E+06
1	11	23	88.28	0.180E+06
1	11	24	87.85	0.180E+06
1	11	25	87.47	0.180E+06
1	11	26	87.13	0.180E+06
1	11	27	86.82	0.180E+06
1	11	28	86.54	0.180E+06
1	11	29	86.28	0.180E+06
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1	11	32	85.55	0.180E+06
1	11	33	85.32	0.180E+06
1	11	34	85.11	0.180E+06
1	11	35	84.94	0.180E+06
1	11	36	84.81	0.180E+06
1	11	37	84.75	0.180E+06
1	11	38	84.75	0.180E+06
1	11	39	84.83	0.180E+06
1	11	40	84.97	0.180E+06
1	11	41	84.74	0.180E+06
1	12	6	113.19	0.205E+07
1	12	19	90.03	0.120E+06
1	12	20	89.39	0.120E+06
1	12	21	88.81	0.120E+06
1	12	22	88.29	0.120E+06

1	12	23	87.84	0.120E+06
1	12	24	87.44	0.120E+06
1	12	25	87.10	0.120E+06
1	12	26	86.80	0.120E+06
1	12	27	86.54	0.120E+06
1	12	28	86.32	0.120E+06
1	12	29	86.10	0.120E+06
1	12	30	85.90	0.120E+06
1	12	31	85.68	0.120E+06
1	12	32	85.46	0.120E+06
1	12	33	85.24	0.120E+06
1	12	34	85.01	0.120E+06
1	12	35	84.82	0.120E+06
1	12	36	84.65	0.120E+06
1	12	37	84.53	0.120E+06
1	12	38	84.44	0.120E+06
1	12	39	84.38	0.120E+06
1	12	40	84.26	0.120E+06
1	12	41	83.92	0.120E+06
1	12	43	83.30	0.120E+06
1	12	44	83.26	0.120E+06
1	12	45	83.27	0.120E+06
1	12	46	83.33	0.120E+06
1	13	6	113.10	0.205E+07
1	13	19	89.61	0.120E+06
1	13	20	88.97	0.120E+06
1	13	21	88.40	0.120E+06
1	13	22	87.90	0.120E+06
1	13	23	87.46	0.120E+06
1	13	24	87.10	0.120E+06
1	13	25	86.79	0.120E+06
1	13	26	86.53	0.120E+06
1	13	27	86.32	0.120E+06
1	13	28	86.14	0.120E+06
1	13	29	85.98	0.120E+06
1	13	30	85.82	0.120E+06
1	13	31	85.63	0.120E+06
1	13	32	85.42	0.120E+06
1	13	33	85.18	0.120E+06
1	13	34	84.94	0.120E+06
1	13	35	84.70	0.120E+06
1	13	36	84.49	0.120E+06
1	13	37	84.30	0.120E+06
1	13	38	84.14	0.120E+06
1	13	39	83.97	0.120E+06
1	13	40	83.75	0.120E+06
1	13	41	83.42	0.120E+06
1	13	44	82.88	0.120E+06
1	13	45	82.91	0.120E+06
1	13	46	82.99	0.120E+06
1	14	6	113.01	0.205E+07
1	14	19	89.17	0.120E+06
1	14	20	88.53	0.120E+06
1	14	21	87.97	0.120E+06
1	14	22	87.48	0.120E+06
1	14	23	87.07	0.120E+06
1	14	24	86.73	0.120E+06
1	14	25	86.46	0.120E+06
1	14	26	86.25	0.120E+06
1	14	27	86.09	0.120E+06
1	14	28	85.97	0.120E+06
1	14	29	85.87	0.120E+06
1	14	30	85.77	0.120E+06
1	14	31	85.61	0.120E+06
1	14	32	85.40	0.120E+06
1	14	33	85.15	0.120E+06
1	14	34	84.86	0.120E+06
1	14	35	84.58	0.120E+06
1	14	36	84.32	0.120E+06
1	14	37	84.08	0.120E+06

1	14	38	83.85	0.120E+06
1	14	39	83.62	0.120E+06
1	14	40	83.35	0.120E+06
1	14	41	83.05	0.120E+06
1	14	42	82.77	0.120E+06
1	14	44	82.54	0.120E+06
1	14	45	82.59	0.120E+06
1	14	46	82.71	0.120E+06
1	14	47	82.85	0.120E+06
1	15	6	112.92	0.205E+07
1	15	19	88.72	0.120E+06
1	15	20	88.08	0.120E+06
1	15	21	87.52	0.120E+06
1	15	22	87.05	0.120E+06
1	15	23	86.66	0.120E+06
1	15	24	86.36	0.120E+06
1	15	25	86.12	0.120E+06
1	15	26	85.96	0.120E+06
1	15	27	85.85	0.120E+06
1	15	28	85.80	0.120E+06
1	15	29	85.78	0.120E+06
1	15	30	85.75	0.120E+06
1	15	31	85.65	0.120E+06
1	15	32	85.44	0.120E+06
1	15	33	85.14	0.120E+06
1	15	34	84.80	0.120E+06
1	15	35	84.47	0.120E+06
1	15	36	84.15	0.120E+06
1	15	37	83.87	0.120E+06
1	15	38	83.59	0.120E+06
1	15	39	83.33	0.120E+06
1	15	40	83.05	0.120E+06
1	15	41	82.76	0.120E+06
1	15	42	82.48	0.120E+06
1	15	44	82.24	0.120E+06
1	15	45	82.32	0.120E+06
1	15	46	82.47	0.120E+06
1	15	47	82.64	0.120E+06
1	16	6	112.82	0.205E+07
1	16	19	88.24	0.120E+06
1	16	20	87.61	0.120E+06
1	16	21	87.06	0.120E+06
1	16	22	86.59	0.120E+06
1	16	23	86.24	0.120E+06
1	16	24	85.97	0.120E+06
1	16	25	85.77	0.120E+06
1	16	26	85.64	0.120E+06
1	16	27	85.59	0.120E+06
1	16	28	85.60	0.120E+06
1	16	29	85.68	0.120E+06
1	16	30	85.76	0.120E+06
1	16	31	85.74	0.120E+06
1	16	32	85.51	0.120E+06
1	16	33	85.15	0.120E+06
1	16	34	84.75	0.120E+06
1	16	35	84.36	0.120E+06
1	16	36	84.01	0.120E+06
1	16	37	83.68	0.120E+06
1	16	38	83.39	0.120E+06
1	16	39	83.12	0.120E+06
1	16	40	82.85	0.120E+06
1	16	41	82.57	0.120E+06
1	16	42	82.30	0.120E+06
1	16	44	82.01	0.120E+06
1	16	45	82.13	0.120E+06
1	16	46	82.31	0.120E+06
1	16	47	82.51	0.120E+06
1	17	6	112.71	0.205E+07
1	17	19	87.75	0.120E+06
1	17	20	87.14	0.120E+06

1	17	21	86.62	0.120E+06
1	17	22	86.13	0.120E+06
1	17	23	85.85	0.120E+06
1	17	24	85.59	0.120E+06
1	17	25	85.41	0.120E+06
1	17	26	85.31	0.120E+06
1	17	27	85.29	0.120E+06
1	17	28	85.35	0.120E+06
1	17	29	85.52	0.120E+06
1	17	30	85.76	0.120E+06
1	17	31	85.93	0.120E+06
1	17	32	85.61	0.120E+06
1	17	33	85.15	0.120E+06
1	17	34	84.70	0.120E+06
1	17	35	84.27	0.120E+06
1	17	36	83.88	0.120E+06
1	17	37	83.54	0.120E+06
1	17	38	83.24	0.120E+06
1	17	39	82.98	0.120E+06
1	17	40	82.73	0.120E+06
1	17	41	82.50	0.120E+06
1	17	42	82.29	0.120E+06
1	17	45	82.05	0.120E+06
1	17	46	82.24	0.120E+06
1	17	47	82.45	0.120E+06
1	17	48	82.65	0.120E+06
1	18	6	112.61	0.205E+07
1	18	19	87.24	0.120E+06
1	18	20	86.65	0.120E+06
1	18	21	86.22	0.120E+06
1	18	22	85.92	0.120E+06
1	18	23	85.49	0.120E+06
1	18	24	85.21	0.120E+06
1	18	25	85.04	0.120E+06
1	18	26	84.95	0.120E+06
1	18	27	84.95	0.120E+06
1	18	28	85.03	0.120E+06
1	18	29	85.22	0.120E+06
1	18	30	85.52	0.120E+06
1	18	31	85.83	0.120E+06
1	18	32	85.52	0.120E+06
1	18	33	85.12	0.120E+06
1	18	34	84.68	0.120E+06
1	18	35	84.22	0.120E+06
1	18	36	83.80	0.120E+06
1	18	37	83.45	0.120E+06
1	18	38	83.15	0.120E+06
1	18	39	82.91	0.120E+06
1	18	40	82.70	0.120E+06
1	18	41	82.51	0.120E+06
1	18	42	82.34	0.120E+06
1	18	45	82.03	0.120E+06
1	18	46	82.25	0.120E+06
1	18	47	82.46	0.120E+06
1	18	48	82.65	0.120E+06
1	19	6	112.49	0.205E+07
1	19	19	86.68	0.120E+06
1	19	20	86.11	0.120E+06
1	19	21	85.70	0.120E+06
1	19	25	84.68	0.120E+06
1	19	26	84.60	0.120E+06
1	19	27	84.60	0.120E+06
1	19	28	84.67	0.120E+06
1	19	29	84.79	0.120E+06
1	19	30	84.98	0.120E+06
1	19	34	84.76	0.120E+06
1	19	35	84.25	0.120E+06
1	19	36	83.81	0.120E+06
1	19	37	83.45	0.120E+06
1	19	38	83.15	0.120E+06

1	19	39	82.92	0.120E+06
1	19	40	82.76	0.120E+06
1	19	41	82.60	0.120E+06
1	19	42	82.39	0.120E+06
1	19	43	82.15	0.120E+06
1	19	45	82.05	0.120E+06
1	19	46	82.34	0.120E+06
1	19	47	82.54	0.120E+06
1	19	48	82.68	0.120E+06
1	20	6	112.38	0.205E+07
1	20	19	86.11	0.120E+06
1	20	20	85.58	0.120E+06
1	20	26	84.30	0.120E+06
1	20	27	84.30	0.120E+06
1	20	28	84.35	0.120E+06
1	20	29	84.40	0.120E+06
1	20	34	85.23	0.120E+06
1	20	35	84.46	0.120E+06
1	20	36	84.01	0.120E+06
1	20	37	83.62	0.120E+06
1	20	38	83.24	0.120E+06
1	20	39	83.02	0.120E+06
1	20	40	82.93	0.120E+06
1	20	41	82.82	0.120E+06
1	20	42	82.57	0.120E+06
1	20	43	82.19	0.120E+06
1	20	45	82.04	0.120E+06
1	20	46	82.53	0.120E+06
1	20	47	82.63	0.120E+06
1	20	48	82.68	0.120E+06
1	20	49	82.79	0.120E+06
1	21	6	112.26	0.205E+07
1	21	19	85.79	0.120E+06
1	21	37	84.13	0.120E+06
1	21	38	83.41	0.120E+06
1	21	39	83.18	0.120E+06
1	21	40	83.22	0.120E+06
1	21	41	83.24	0.120E+06
1	21	42	82.98	0.120E+06
1	21	43	82.43	0.120E+06
1	21	46	82.30	0.120E+06
1	21	47	82.51	0.120E+06
1	21	48	82.55	0.120E+06
1	21	49	82.69	0.120E+06
1	21	50	82.92	0.120E+06
1	22	6	112.13	0.205E+07
1	22	42	83.60	0.120E+06
1	22	43	83.10	0.120E+06
1	22	44	82.23	0.120E+06
1	22	46	81.89	0.120E+06
1	22	47	82.13	0.120E+06
1	22	48	82.29	0.120E+06
1	22	49	82.50	0.120E+06
1	22	50	82.78	0.120E+06
1	23	6	112.01	0.205E+07
1	23	42	84.16	0.120E+06
1	23	43	84.06	0.120E+06
1	23	44	82.77	0.120E+06
1	23	46	81.70	0.120E+06
1	23	47	81.80	0.120E+06
1	23	48	81.99	0.120E+06
1	23	49	82.24	0.120E+06
1	23	50	82.57	0.120E+06
1	24	6	111.88	0.205E+07
1	24	42	84.30	0.120E+06
1	24	43	84.07	0.120E+06
1	24	44	82.82	0.120E+06
1	24	46	81.49	0.120E+06
1	24	47	81.53	0.120E+06
1	24	48	81.70	0.120E+06

1	24	49	81.94	0.120E+06
1	24	50	82.28	0.120E+06
1	24	51	82.73	0.120E+06
1	24	52	83.34	0.120E+06
1	24	53	84.08	0.120E+06
1	24	54	84.90	0.120E+06
1	24	55	85.54	0.120E+06
1	24	56	85.14	0.120E+06
1	25	6	111.75	0.205E+07
1	25	43	83.81	0.120E+06
1	25	44	82.55	0.120E+06
1	25	47	81.33	0.120E+06
1	25	48	81.46	0.120E+06
1	25	49	81.64	0.120E+06
1	25	50	81.91	0.120E+06
1	25	51	82.33	0.120E+06
1	25	52	82.93	0.120E+06
1	25	53	83.70	0.120E+06
1	25	54	84.58	0.120E+06
1	25	55	85.30	0.120E+06
1	25	56	84.81	0.120E+06
1	26	6	111.61	0.205E+07
1	26	43	83.68	0.120E+06
1	26	44	82.37	0.120E+06
1	26	45	81.55	0.120E+06
1	26	47	81.25	0.120E+06
1	26	48	81.29	0.120E+06
1	26	49	81.38	0.120E+06
1	26	50	81.51	0.120E+06
1	26	51	81.79	0.120E+06
1	26	52	82.33	0.120E+06
1	26	53	83.01	0.120E+06
1	26	54	83.68	0.120E+06
1	26	55	84.08	0.120E+06
1	26	56	83.97	0.120E+06
1	26	57	83.62	0.120E+06
1	27	6	111.48	0.205E+07
1	27	44	82.21	0.120E+06
1	27	45	81.63	0.120E+06
1	27	47	81.28	0.120E+06
1	27	52	81.70	0.120E+06
1	27	53	82.23	0.120E+06
1	27	54	82.71	0.120E+06
1	27	55	83.01	0.120E+06
1	27	56	83.04	0.120E+06
1	27	57	82.89	0.120E+06
1	27	58	82.64	0.120E+06
1	28	6	111.34	0.205E+07
1	28	44	82.38	0.120E+06
1	28	45	81.83	0.120E+06
1	28	46	81.55	0.120E+06
1	28	48	81.30	0.120E+06
1	28	49	81.16	0.120E+06
1	28	50	81.07	0.120E+06
1	28	53	81.56	0.120E+06
1	28	54	81.89	0.120E+06
1	28	55	82.12	0.120E+06
1	28	56	82.22	0.120E+06
1	28	57	82.19	0.120E+06
1	28	58	82.08	0.120E+06
1	28	59	81.93	0.120E+06
1	29	6	111.20	0.205E+07
1	29	44	83.46	0.120E+06
1	29	45	82.21	0.120E+06
1	29	46	81.72	0.120E+06
1	29	48	81.40	0.120E+06
1	29	49	81.20	0.120E+06
1	29	50	81.07	0.120E+06
1	29	51	81.02	0.120E+06
1	29	52	81.05	0.120E+06

1	29	54	81.38	0.120E+06
1	29	55	81.46	0.120E+06
1	29	56	81.58	0.120E+06
1	29	57	81.64	0.120E+06
1	29	58	81.62	0.120E+06
1	29	59	81.55	0.120E+06
1	30	6	111.06	0.205E+07
1	30	44	84.46	0.120E+06
1	30	45	82.32	0.120E+06
1	30	46	81.65	0.120E+06
1	30	47	81.52	0.120E+06
1	30	49	81.29	0.120E+06
1	30	50	81.14	0.120E+06
1	30	51	81.04	0.120E+06
1	30	52	81.09	0.120E+06
1	30	53	81.36	0.120E+06
1	30	56	81.25	0.120E+06
1	30	57	81.29	0.120E+06
1	30	58	81.28	0.120E+06
1	30	59	81.25	0.120E+06
1	30	60	81.23	0.120E+06
1	31	6	110.93	0.205E+07
1	31	46	81.56	0.120E+06
1	31	47	81.51	0.120E+06
1	31	48	81.54	0.120E+06
1	31	50	81.31	0.120E+06
1	31	51	81.09	0.120E+06
1	31	52	81.08	0.120E+06
1	31	53	81.89	0.120E+06
1	31	54	82.38	0.120E+06
1	31	55	81.73	0.120E+06
1	31	57	81.13	0.120E+06
1	31	58	81.06	0.120E+06
1	31	59	81.02	0.120E+06
1	31	60	81.00	0.120E+06
1	32	6	110.79	0.205E+07
1	32	44	85.07	0.120E+06
1	32	47	81.80	0.120E+06
1	32	48	81.86	0.120E+06
1	32	50	81.61	0.120E+06
1	32	51	81.23	0.120E+06
1	32	52	80.91	0.120E+06
1	32	53	82.10	0.120E+06
1	32	54	83.12	0.120E+06
1	32	55	82.03	0.120E+06
1	32	57	81.01	0.120E+06
1	32	58	80.92	0.120E+06
1	32	59	80.87	0.120E+06
1	32	60	80.83	0.120E+06
1	32	61	80.82	0.120E+06
1	33	44	85.10	0.120E+06
1	33	45	83.63	0.120E+06
1	33	48	82.31	0.120E+06
1	33	50	82.02	0.120E+06
1	33	51	81.58	0.120E+06
1	33	52	81.24	0.120E+06
1	33	53	81.76	0.120E+06
1	33	54	82.28	0.120E+06
1	33	55	81.72	0.120E+06
1	33	57	80.90	0.120E+06
1	33	58	80.86	0.120E+06
1	33	59	80.81	0.120E+06
1	33	60	80.73	0.120E+06
1	33	61	80.63	0.120E+06
1	33	62	80.65	0.120E+06
1	34	45	84.20	0.120E+06
1	34	46	83.54	0.120E+06
1	34	47	83.11	0.120E+06
1	34	51	81.92	0.120E+06
1	34	52	81.53	0.120E+06

1	34	53	81.54	0.120E+06
1	34	54	81.60	0.120E+06
1	34	55	81.36	0.120E+06
1	34	58	80.90	0.120E+06
1	34	59	80.88	0.120E+06
1	34	60	80.81	0.120E+06
1	34	61	80.56	0.120E+06
1	34	62	80.35	0.120E+06
1	35	46	84.22	0.120E+06
1	35	47	83.81	0.120E+06
1	35	48	83.37	0.120E+06
1	35	49	82.98	0.120E+06
1	35	52	81.49	0.120E+06
1	35	53	81.29	0.120E+06
1	35	54	81.22	0.120E+06
1	35	55	81.10	0.120E+06
1	35	56	80.97	0.120E+06
1	35	58	80.96	0.120E+06
1	35	59	81.05	0.120E+06
1	35	60	81.14	0.120E+06
1	35	61	81.02	0.120E+06
1	35	62	80.50	0.120E+06
1	36	47	84.48	0.120E+06
1	36	48	83.83	0.120E+06
1	36	49	83.17	0.120E+06
1	36	50	82.53	0.120E+06
1	36	51	81.88	0.120E+06
1	36	53	81.07	0.120E+06
1	36	54	80.98	0.120E+06
1	36	55	80.90	0.120E+06
1	36	56	80.87	0.120E+06
1	36	59	81.18	0.120E+06
1	36	60	81.47	0.120E+06
1	36	61	81.86	0.120E+06
1	36	62	81.47	0.120E+06
1	36	63	81.17	0.120E+06
1	37	48	84.05	0.120E+06
1	37	49	83.21	0.120E+06
1	37	50	82.47	0.120E+06
1	37	51	81.80	0.120E+06
1	37	52	81.27	0.120E+06
1	37	59	81.16	0.120E+06
1	37	60	81.42	0.120E+06
1	37	61	81.63	0.120E+06
1	37	62	81.52	0.120E+06
1	37	63	81.29	0.120E+06
1	38	49	83.08	0.120E+06
1	38	50	82.34	0.120E+06
1	38	51	81.71	0.120E+06
1	38	52	81.24	0.120E+06
1	38	53	80.95	0.120E+06
1	38	54	80.78	0.120E+06
1	38	55	80.70	0.120E+06
1	38	56	80.70	0.120E+06
1	38	57	80.76	0.120E+06
1	38	59	81.02	0.120E+06
1	38	60	81.20	0.120E+06
1	38	61	81.31	0.120E+06
1	38	62	81.27	0.120E+06
1	38	63	81.14	0.120E+06
1	39	49	82.81	0.120E+06
1	39	50	82.11	0.120E+06
1	39	51	81.55	0.120E+06
1	39	52	81.15	0.120E+06
1	39	53	80.89	0.120E+06
1	39	54	80.74	0.120E+06
1	39	55	80.66	0.120E+06
1	39	56	80.66	0.120E+06
1	39	57	80.69	0.120E+06
1	39	60	80.97	0.120E+06

1	39	61	81.03	0.120E+06
1	39	62	81.00	0.120E+06
1	39	63	80.91	0.120E+06
1	39	64	80.84	0.120E+06
1	40	50	81.80	0.120E+06
1	40	51	81.32	0.120E+06
1	40	52	81.02	0.120E+06
1	40	53	80.82	0.120E+06
1	40	54	80.70	0.120E+06
1	40	55	80.64	0.120E+06
1	40	56	80.62	0.120E+06
1	40	57	80.64	0.120E+06
1	40	58	80.69	0.120E+06
1	40	60	80.81	0.120E+06
1	40	61	80.83	0.120E+06
1	40	62	80.78	0.120E+06
1	40	63	80.69	0.120E+06
1	40	64	80.59	0.120E+06
1	40	65	80.52	0.120E+06
1	40	66	80.57	0.120E+06
1	40	67	80.87	0.120E+06
1	40	68	81.53	0.120E+06
1	40	69	82.58	0.180E+06
1	40	70	84.11	0.270E+06
1	40	71	85.73	0.405E+06
1	40	72	87.36	0.607E+06
1	40	73	89.47	0.911E+06
1	40	74	92.51	0.137E+07
1	40	75	97.91	0.178E+07
1	40	76	107.75	0.213E+07
1	41	50	81.47	0.120E+06
1	41	51	81.11	0.120E+06
1	41	52	80.92	0.120E+06
1	41	53	80.78	0.120E+06
1	41	54	80.68	0.120E+06
1	41	55	80.62	0.120E+06
1	41	56	80.60	0.120E+06
1	41	57	80.61	0.120E+06
1	41	58	80.65	0.120E+06
1	41	61	80.70	0.120E+06
1	41	62	80.63	0.120E+06
1	41	63	80.51	0.120E+06
1	41	64	80.38	0.120E+06
1	41	65	80.25	0.120E+06
1	41	66	80.17	0.120E+06
1	41	67	80.32	0.120E+06
1	41	68	81.22	0.120E+06
1	41	69	82.43	0.180E+06
1	41	70	84.10	0.270E+06
1	41	71	85.59	0.405E+06
1	41	72	87.00	0.607E+06
1	41	73	89.02	0.911E+06
1	41	74	92.07	0.137E+07
1	41	75	97.52	0.178E+07
1	41	76	107.34	0.213E+07
1	42	50	81.52	0.120E+06
1	42	51	81.13	0.120E+06
1	42	52	80.93	0.120E+06
1	42	53	80.78	0.120E+06
1	42	54	80.68	0.120E+06
1	42	55	80.62	0.120E+06
1	42	56	80.60	0.120E+06
1	42	57	80.60	0.120E+06
1	42	58	80.63	0.120E+06
1	42	59	80.66	0.120E+06
1	42	62	80.55	0.120E+06
1	42	63	80.42	0.120E+06
1	42	64	80.25	0.120E+06
1	42	65	80.11	0.120E+06
1	42	66	80.06	0.120E+06

1	42	67	80.32	0.120E+06
1	42	68	81.10	0.120E+06
1	42	69	82.36	0.180E+06
1	42	70	84.19	0.270E+06
1	42	71	85.43	0.405E+06
1	42	72	86.64	0.607E+06
1	42	73	88.58	0.911E+06
1	42	74	91.64	0.137E+07
1	42	75	97.13	0.178E+07
1	42	76	106.94	0.213E+07
1	43	49	82.27	0.120E+06
1	43	50	81.69	0.120E+06
1	43	51	81.28	0.120E+06
1	43	52	81.01	0.120E+06
1	43	53	80.83	0.120E+06
1	43	54	80.71	0.120E+06
1	43	55	80.64	0.120E+06
1	43	56	80.61	0.120E+06
1	43	57	80.61	0.120E+06
1	43	58	80.63	0.120E+06
1	43	59	80.66	0.120E+06
1	43	60	80.68	0.120E+06
1	43	62	80.56	0.120E+06
1	43	63	80.39	0.120E+06
1	43	64	80.20	0.120E+06
1	43	65	80.05	0.120E+06
1	43	66	80.05	0.120E+06
1	43	67	80.35	0.120E+06
1	43	68	81.02	0.120E+06
1	43	69	82.26	0.180E+06
1	43	70	84.38	0.270E+06
1	43	71	85.21	0.405E+06
1	43	72	86.26	0.607E+06
1	43	73	88.14	0.911E+06
1	43	74	91.20	0.137E+07
1	43	75	96.74	0.178E+07
1	43	76	106.55	0.213E+07
1	44	49	82.37	0.120E+06
1	44	50	81.83	0.120E+06
1	44	51	81.41	0.120E+06
1	44	52	81.10	0.120E+06
1	44	53	80.88	0.120E+06
1	44	54	80.74	0.120E+06
1	44	55	80.66	0.120E+06
1	44	56	80.63	0.120E+06
1	44	57	80.63	0.120E+06
1	44	58	80.65	0.120E+06
1	44	59	80.68	0.120E+06
1	44	60	80.71	0.120E+06
1	44	62	80.62	0.120E+06
1	44	63	80.43	0.120E+06
1	44	64	80.20	0.120E+06
1	44	65	79.99	0.120E+06
1	44	66	79.94	0.120E+06
1	44	67	80.19	0.120E+06
1	44	68	80.80	0.120E+06
1	44	69	81.97	0.180E+06
1	44	70	84.06	0.270E+06
1	44	71	84.85	0.405E+06
1	44	72	85.85	0.607E+06
1	44	73	87.71	0.911E+06
1	44	74	90.77	0.137E+07
1	44	75	96.33	0.178E+07
1	44	76	106.16	0.213E+07
1	45	48	83.03	0.120E+06
1	45	49	82.44	0.120E+06
1	45	50	81.92	0.120E+06
1	45	51	81.49	0.120E+06
1	45	52	81.17	0.120E+06
1	45	53	80.93	0.120E+06

1	45	54	80.78	0.120E+06
1	45	55	80.68	0.120E+06
1	45	56	80.64	0.120E+06
1	45	57	80.65	0.120E+06
1	45	58	80.67	0.120E+06
1	45	59	80.71	0.120E+06
1	45	60	80.74	0.120E+06
1	45	63	80.53	0.120E+06
1	45	64	80.21	0.120E+06
1	45	65	79.88	0.120E+06
1	45	66	79.69	0.120E+06
1	45	67	79.82	0.120E+06
1	45	68	80.39	0.120E+06
1	45	69	81.48	0.180E+06
1	45	70	83.20	0.270E+06
1	45	71	84.34	0.405E+06
1	45	72	85.43	0.607E+06
1	45	73	87.28	0.911E+06
1	45	74	90.34	0.137E+07
1	45	75	95.93	0.178E+07
1	45	76	105.78	0.213E+07
1	46	48	83.03	0.120E+06
1	46	49	82.46	0.120E+06
1	46	50	81.95	0.120E+06
1	46	51	81.53	0.120E+06
1	46	52	81.20	0.120E+06
1	46	53	80.95	0.120E+06
1	46	54	80.79	0.120E+06
1	46	55	80.70	0.120E+06
1	46	56	80.66	0.120E+06
1	46	57	80.67	0.120E+06
1	46	58	80.70	0.120E+06
1	46	59	80.73	0.120E+06
1	46	60	80.77	0.120E+06
1	46	61	80.78	0.120E+06
1	46	64	80.20	0.120E+06
1	46	65	79.74	0.120E+06
1	46	66	79.37	0.120E+06
1	46	67	79.28	0.120E+06
1	46	68	79.89	0.120E+06
1	46	69	80.90	0.180E+06
1	46	70	82.41	0.270E+06
1	46	71	83.76	0.405E+06
1	46	72	84.99	0.607E+06
1	46	73	86.85	0.911E+06
1	46	74	89.91	0.137E+07
1	46	75	95.52	0.178E+07
1	46	76	105.40	0.213E+07
1	47	48	82.97	0.120E+06
1	47	49	82.42	0.120E+06
1	47	50	81.92	0.120E+06
1	47	51	81.50	0.120E+06
1	47	52	81.18	0.120E+06
1	47	53	80.94	0.120E+06
1	47	54	80.78	0.120E+06
1	47	55	80.70	0.120E+06
1	47	56	80.67	0.120E+06
1	47	57	80.69	0.120E+06
1	47	58	80.72	0.120E+06
1	47	59	80.76	0.120E+06
1	47	60	80.78	0.120E+06
1	47	61	80.78	0.120E+06
1	47	62	80.72	0.120E+06
1	47	64	80.14	0.120E+06
1	47	65	79.64	0.120E+06
1	47	66	79.19	0.120E+06
1	47	67	79.07	0.120E+06
1	47	68	79.49	0.120E+06
1	47	69	80.36	0.180E+06
1	47	70	81.72	0.270E+06

1	47	71	83.17	0.405E+06
1	47	72	84.55	0.607E+06
1	47	73	86.43	0.911E+06
1	47	74	89.49	0.137E+07
1	47	75	95.10	0.178E+07
1	47	76	105.02	0.213E+07
1	48	47	83.35	0.120E+06
1	48	48	82.85	0.120E+06
1	48	49	82.31	0.120E+06
1	48	50	81.83	0.120E+06
1	48	51	81.42	0.120E+06
1	48	52	81.10	0.120E+06
1	48	53	80.88	0.120E+06
1	48	54	80.74	0.120E+06
1	48	55	80.67	0.120E+06
1	48	56	80.67	0.120E+06
1	48	57	80.70	0.120E+06
1	48	58	80.75	0.120E+06
1	48	59	80.79	0.120E+06
1	48	60	80.81	0.120E+06
1	48	61	80.79	0.120E+06
1	48	62	80.71	0.120E+06
1	48	65	79.64	0.120E+06
1	48	66	79.10	0.120E+06
1	48	67	78.84	0.120E+06
1	48	68	79.16	0.120E+06
1	48	69	79.91	0.180E+06
1	48	70	81.14	0.270E+06
1	48	71	82.62	0.405E+06
1	48	72	84.11	0.607E+06
1	48	73	86.01	0.911E+06
1	48	74	89.06	0.137E+07
1	48	75	94.69	0.178E+07
1	48	76	104.65	0.213E+07
1	49	47	83.00	0.120E+06
1	49	48	82.62	0.120E+06
1	49	49	82.11	0.120E+06
1	49	50	81.66	0.120E+06
1	49	51	81.28	0.120E+06
1	49	52	80.98	0.120E+06
1	49	53	80.77	0.120E+06
1	49	54	80.66	0.120E+06
1	49	55	80.63	0.120E+06
1	49	56	80.67	0.120E+06
1	49	57	80.72	0.120E+06
1	49	58	80.78	0.120E+06
1	49	59	80.82	0.120E+06
1	49	60	80.84	0.120E+06
1	49	65	79.81	0.120E+06
1	49	66	79.16	0.120E+06
1	49	67	78.70	0.120E+06
1	49	68	78.96	0.120E+06
1	49	69	79.57	0.180E+06
1	49	70	80.67	0.270E+06
1	49	71	82.12	0.405E+06
1	49	72	83.68	0.607E+06
1	49	73	85.61	0.911E+06
1	49	74	88.64	0.137E+07
1	49	75	94.27	0.178E+07
1	49	76	104.29	0.213E+07
1	50	47	82.44	0.120E+06
1	50	48	82.16	0.120E+06
1	50	49	81.80	0.120E+06
1	50	50	81.44	0.120E+06
1	50	51	81.10	0.120E+06
1	50	52	80.82	0.120E+06
1	50	53	80.63	0.120E+06
1	50	54	80.55	0.120E+06
1	50	55	80.58	0.120E+06
1	50	56	80.66	0.120E+06

1	50	57	80.75	0.120E+06
1	50	58	80.83	0.120E+06
1	50	59	80.86	0.120E+06
1	50	62	80.77	0.120E+06
1	50	66	79.42	0.120E+06
1	50	67	78.90	0.120E+06
1	50	68	78.88	0.120E+06
1	50	69	79.32	0.180E+06
1	50	70	80.30	0.270E+06
1	50	71	81.69	0.405E+06
1	50	72	83.27	0.607E+06
1	50	73	85.21	0.911E+06
1	50	74	88.23	0.137E+07
1	50	75	93.84	0.178E+07
1	50	76	103.93	0.213E+07
1	51	31	85.97	0.120E+06
1	51	32	85.83	0.120E+06
1	51	33	85.81	0.120E+06
1	51	34	85.84	0.120E+06
1	51	35	85.94	0.120E+06
1	51	36	86.12	0.120E+06
1	51	37	86.33	0.120E+06
1	51	38	86.47	0.120E+06
1	51	39	86.25	0.120E+06
1	51	40	85.62	0.120E+06
1	51	41	84.87	0.120E+06
1	51	42	84.12	0.120E+06
1	51	43	83.38	0.120E+06
1	51	44	82.71	0.120E+06
1	51	45	82.20	0.120E+06
1	51	46	81.95	0.120E+06
1	51	47	81.84	0.120E+06
1	51	48	81.72	0.120E+06
1	51	49	81.50	0.120E+06
1	51	50	81.23	0.120E+06
1	51	51	80.93	0.120E+06
1	51	52	80.65	0.120E+06
1	51	53	80.46	0.120E+06
1	51	54	80.43	0.120E+06
1	51	55	80.52	0.120E+06
1	51	56	80.66	0.120E+06
1	51	57	80.80	0.120E+06
1	51	58	80.89	0.120E+06
1	51	60	80.82	0.120E+06
1	51	61	80.79	0.120E+06
1	51	62	80.77	0.120E+06
1	51	63	80.74	0.120E+06
1	51	64	80.68	0.120E+06
1	51	66	79.51	0.120E+06
1	51	67	78.84	0.120E+06
1	51	68	78.75	0.120E+06
1	51	69	79.13	0.180E+06
1	51	70	80.02	0.270E+06
1	51	71	81.33	0.405E+06
1	51	72	82.89	0.607E+06
1	51	73	84.82	0.911E+06
1	51	74	87.81	0.137E+07
1	51	75	93.42	0.178E+07
1	51	76	103.58	0.213E+07
1	52	33	84.84	0.120E+06
1	52	34	84.75	0.120E+06
1	52	35	84.76	0.120E+06
1	52	36	84.74	0.120E+06
1	52	37	84.68	0.120E+06
1	52	38	84.67	0.120E+06
1	52	40	83.99	0.120E+06
1	52	41	83.54	0.120E+06
1	52	42	83.03	0.120E+06
1	52	43	82.39	0.120E+06
1	52	44	81.70	0.120E+06

1	52	45	81.20	0.120E+06
1	52	46	81.16	0.120E+06
1	52	47	81.36	0.120E+06
1	52	48	81.41	0.120E+06
1	52	49	81.29	0.120E+06
1	52	50	81.08	0.120E+06
1	52	51	80.82	0.120E+06
1	52	52	80.53	0.120E+06
1	52	53	80.27	0.120E+06
1	52	54	80.31	0.120E+06
1	52	55	80.53	0.120E+06
1	52	56	80.70	0.120E+06
1	52	57	80.84	0.120E+06
1	52	60	80.72	0.120E+06
1	52	61	80.73	0.120E+06
1	52	62	80.73	0.120E+06
1	52	63	80.68	0.120E+06
1	52	64	80.54	0.120E+06
1	52	66	79.22	0.120E+06
1	52	67	78.47	0.120E+06
1	52	68	78.57	0.120E+06
1	52	69	79.03	0.180E+06
1	52	70	79.85	0.270E+06
1	52	71	81.04	0.405E+06
1	52	72	82.54	0.607E+06
1	52	73	84.45	0.911E+06
1	52	74	87.41	0.137E+07
1	52	75	92.99	0.178E+07
1	52	76	103.23	0.213E+07
1	53	4	130.86	0.461E+07
1	53	31	84.73	0.120E+06
1	53	32	84.50	0.120E+06
1	53	39	83.08	0.120E+06
1	53	45	80.08	0.120E+06
1	53	46	80.48	0.120E+06
1	53	47	81.21	0.120E+06
1	53	48	81.33	0.120E+06
1	53	49	81.23	0.120E+06
1	53	50	81.06	0.120E+06
1	53	51	80.85	0.120E+06
1	53	52	80.59	0.120E+06
1	53	53	80.32	0.120E+06
1	53	54	80.43	0.120E+06
1	53	55	80.71	0.120E+06
1	53	56	80.82	0.120E+06
1	53	58	80.70	0.120E+06
1	53	59	80.56	0.120E+06
1	53	60	80.59	0.120E+06
1	53	61	80.69	0.120E+06
1	53	62	80.73	0.120E+06
1	53	63	80.67	0.120E+06
1	53	64	80.49	0.120E+06
1	53	66	79.22	0.120E+06
1	53	67	78.38	0.120E+06
1	53	68	78.65	0.120E+06
1	53	69	79.08	0.180E+06
1	53	70	79.77	0.270E+06
1	53	71	80.82	0.405E+06
1	53	72	82.22	0.607E+06
1	53	73	84.08	0.911E+06
1	53	74	87.00	0.137E+07
1	53	75	92.55	0.178E+07
1	53	76	102.89	0.213E+07
1	54	4	130.84	0.461E+07
1	54	32	84.50	0.120E+06
1	54	33	84.18	0.120E+06
1	54	34	83.89	0.120E+06
1	54	35	83.64	0.120E+06
1	54	36	83.29	0.120E+06
1	54	37	82.92	0.120E+06

1	54	38	82.68	0.120E+06
1	54	39	82.40	0.120E+06
1	54	40	82.13	0.120E+06
1	54	41	81.99	0.120E+06
1	54	42	81.76	0.120E+06
1	54	43	81.28	0.120E+06
1	54	44	80.52	0.120E+06
1	54	47	81.53	0.120E+06
1	54	48	81.44	0.120E+06
1	54	49	81.29	0.120E+06
1	54	50	81.16	0.120E+06
1	54	51	81.02	0.120E+06
1	54	52	80.88	0.120E+06
1	54	53	80.79	0.120E+06
1	54	57	80.89	0.120E+06
1	54	58	80.55	0.120E+06
1	54	59	80.28	0.120E+06
1	54	60	80.55	0.120E+06
1	54	61	80.78	0.120E+06
1	54	62	80.86	0.120E+06
1	54	63	80.83	0.120E+06
1	54	64	80.71	0.120E+06
1	54	67	79.28	0.120E+06
1	54	68	79.14	0.120E+06
1	54	69	79.31	0.180E+06
1	54	70	79.78	0.270E+06
1	54	71	80.64	0.405E+06
1	54	72	81.93	0.607E+06
1	54	73	83.74	0.911E+06
1	54	74	86.61	0.137E+07
1	54	75	92.12	0.178E+07
1	54	76	102.56	0.213E+07
1	55	4	130.81	0.461E+07
1	55	36	83.25	0.120E+06
1	55	37	82.85	0.120E+06
1	55	38	82.52	0.120E+06
1	55	39	82.22	0.120E+06
1	55	40	82.04	0.120E+06
1	55	41	81.95	0.120E+06
1	55	42	81.79	0.120E+06
1	55	43	81.48	0.120E+06
1	55	44	81.05	0.120E+06
1	55	45	80.74	0.120E+06
1	55	46	81.28	0.120E+06
1	55	54	81.34	0.120E+06
1	55	55	81.46	0.120E+06
1	55	56	81.45	0.120E+06
1	55	57	81.29	0.120E+06
1	55	61	81.12	0.120E+06
1	55	62	81.13	0.120E+06
1	55	63	81.07	0.120E+06
1	55	64	80.95	0.120E+06
1	55	65	80.77	0.120E+06
1	55	67	79.98	0.120E+06
1	55	68	79.68	0.120E+06
1	55	69	79.61	0.180E+06
1	55	70	79.85	0.270E+06
1	55	71	80.51	0.405E+06
1	55	72	81.67	0.607E+06
1	55	73	83.40	0.911E+06
1	55	74	86.22	0.137E+07
1	55	75	91.68	0.178E+07
1	55	76	102.23	0.213E+07
1	56	4	130.79	0.461E+07
1	56	45	81.88	0.120E+06
1	56	46	81.94	0.120E+06
1	56	47	81.99	0.120E+06
1	56	48	81.90	0.120E+06
1	56	49	81.76	0.120E+06
1	56	50	81.67	0.120E+06

1	56	51	81.64	0.120E+06
1	56	52	81.63	0.120E+06
1	56	53	81.67	0.120E+06
1	56	54	81.77	0.120E+06
1	56	55	81.89	0.120E+06
1	56	56	81.99	0.120E+06
1	56	57	82.02	0.120E+06
1	56	61	81.67	0.120E+06
1	56	62	81.50	0.120E+06
1	56	63	81.33	0.120E+06
1	56	64	81.15	0.120E+06
1	56	65	80.95	0.120E+06
1	56	68	80.06	0.120E+06
1	56	69	79.86	0.180E+06
1	56	70	79.92	0.270E+06
1	56	71	80.40	0.405E+06
1	56	72	81.42	0.607E+06
1	56	73	83.09	0.911E+06
1	56	74	85.83	0.137E+07
1	56	75	91.24	0.178E+07
1	56	76	101.90	0.213E+07
1	57	4	130.77	0.461E+07
1	57	62	81.84	0.120E+06
1	57	63	81.55	0.120E+06
1	57	64	81.30	0.120E+06
1	57	65	81.06	0.120E+06
1	57	66	80.80	0.120E+06
1	57	68	80.26	0.120E+06
1	57	69	80.03	0.180E+06
1	57	70	79.98	0.270E+06
1	57	71	80.31	0.405E+06
1	57	72	81.20	0.607E+06
1	57	73	82.78	0.911E+06
1	57	74	85.46	0.137E+07
1	57	75	90.79	0.178E+07
1	57	76	101.59	0.213E+07
1	58	4	130.75	0.461E+07
1	58	62	82.06	0.120E+06
1	58	63	81.71	0.120E+06
1	58	64	81.40	0.120E+06
1	58	65	81.12	0.120E+06
1	58	66	80.84	0.120E+06
1	58	69	80.11	0.180E+06
1	58	70	80.00	0.270E+06
1	58	71	80.22	0.405E+06
1	58	72	81.00	0.607E+06
1	58	73	82.49	0.911E+06
1	58	74	85.09	0.137E+07
1	58	75	90.34	0.178E+07
1	58	76	101.28	0.213E+07
1	59	4	130.73	0.461E+07
1	59	63	81.77	0.120E+06
1	59	64	81.43	0.120E+06
1	59	65	81.13	0.120E+06
1	59	66	80.84	0.120E+06
1	59	67	80.58	0.120E+06
1	59	69	80.14	0.180E+06
1	59	70	79.99	0.270E+06
1	59	71	80.13	0.405E+06
1	59	72	80.80	0.607E+06
1	59	73	82.22	0.911E+06
1	59	74	84.74	0.137E+07
1	59	75	89.89	0.178E+07
1	59	76	100.98	0.213E+07
1	60	4	130.71	0.461E+07
1	60	64	81.40	0.120E+06
1	60	65	81.09	0.120E+06
1	60	66	80.80	0.120E+06
1	60	67	80.55	0.120E+06
1	60	68	80.32	0.120E+06

1	60	70	79.94	0.270E+06
1	60	71	80.03	0.405E+06
1	60	72	80.62	0.607E+06
1	60	73	81.96	0.911E+06
1	60	74	84.40	0.137E+07
1	60	75	89.44	0.178E+07
1	60	76	100.68	0.213E+07
1	61	4	130.69	0.461E+07
1	61	9	94.78	0.607E+06
1	61	10	92.95	0.405E+06
1	61	11	91.76	0.270E+06
1	61	64	81.32	0.120E+06
1	61	65	81.01	0.120E+06
1	61	66	80.73	0.120E+06
1	61	67	80.47	0.120E+06
1	61	68	80.25	0.120E+06
1	61	70	79.87	0.270E+06
1	61	71	79.92	0.405E+06
1	61	72	80.45	0.607E+06
1	61	73	81.72	0.911E+06
1	61	74	84.06	0.137E+07
1	61	75	88.97	0.178E+07
1	61	76	100.39	0.213E+07
1	62	4	130.68	0.461E+07
1	62	9	94.84	0.607E+06
1	62	10	93.02	0.405E+06
1	62	11	91.85	0.270E+06
1	62	70	79.77	0.270E+06
1	62	71	79.80	0.405E+06
1	62	72	80.29	0.607E+06
1	62	73	81.49	0.911E+06
1	62	74	83.75	0.137E+07
1	62	75	88.51	0.178E+07
1	62	76	100.12	0.213E+07
1	63	9	94.90	0.607E+06
1	63	10	93.09	0.405E+06
1	63	11	91.94	0.270E+06
1	63	70	79.64	0.270E+06
1	63	71	79.67	0.405E+06
1	63	72	80.13	0.607E+06
1	63	73	81.28	0.911E+06
1	63	74	83.44	0.137E+07
1	63	75	88.03	0.178E+07
1	63	76	99.84	0.213E+07
1	64	9	94.96	0.607E+06
1	64	10	93.17	0.405E+06
1	64	11	92.03	0.270E+06
1	64	70	79.50	0.270E+06
1	64	71	79.55	0.405E+06
1	64	72	79.99	0.607E+06
1	64	73	81.09	0.911E+06
1	64	74	83.16	0.137E+07
1	64	75	87.55	0.178E+07
1	64	76	99.58	0.213E+07
1	65	9	95.03	0.607E+06
1	65	10	93.26	0.405E+06
1	65	11	92.12	0.270E+06
1	65	70	79.35	0.270E+06
1	65	71	79.43	0.405E+06
1	65	72	79.85	0.607E+06
1	65	73	80.92	0.911E+06
1	65	74	82.89	0.137E+07
1	65	75	87.07	0.178E+07
1	65	76	99.32	0.213E+07
1	66	9	95.11	0.607E+06
1	66	10	93.35	0.405E+06
1	66	11	92.22	0.270E+06
1	66	70	79.18	0.270E+06
1	66	71	79.32	0.405E+06
1	66	72	79.73	0.607E+06

1	66	73	80.76	0.911E+06
1	66	74	82.63	0.137E+07
1	66	75	86.57	0.178E+07
1	66	76	99.07	0.213E+07
1	67	9	95.19	0.607E+06
1	67	10	93.44	0.405E+06
1	67	11	92.32	0.270E+06
1	67	70	79.02	0.270E+06
1	67	71	79.23	0.405E+06
1	67	72	79.62	0.607E+06
1	67	73	80.62	0.911E+06
1	67	74	82.40	0.137E+07
1	67	75	86.06	0.178E+07
1	67	76	98.83	0.213E+07
1	68	10	93.57	0.607E+06
1	68	11	92.46	0.405E+06
1	68	12	91.74	0.270E+06
1	68	13	91.27	0.180E+06
1	68	14	90.91	0.180E+06
1	68	71	79.17	0.607E+06
1	68	72	79.50	0.911E+06
1	68	73	80.48	0.137E+07
1	68	74	82.13	0.205E+07
1	68	75	85.42	0.267E+07
1	68	76	98.53	0.320E+07
1	69	10	93.77	0.911E+06
1	69	11	92.68	0.607E+06
1	69	12	91.97	0.405E+06
1	69	13	91.51	0.270E+06
1	69	14	91.14	0.270E+06
1	69	71	79.17	0.911E+06
1	69	72	79.50	0.137E+07
1	69	73	80.48	0.205E+07
1	69	74	82.12	0.308E+07
1	69	75	85.41	0.400E+07
1	69	76	98.53	0.480E+07
1	70	10	94.11	0.137E+07
1	70	11	93.04	0.911E+06
1	70	12	92.34	0.607E+06
1	70	13	91.89	0.405E+06
1	70	14	91.53	0.405E+06
1	70	71	79.17	0.137E+07
1	70	72	79.50	0.205E+07
1	70	73	80.48	0.308E+07
1	70	74	82.12	0.461E+07
1	70	75	85.41	0.600E+07
1	70	76	98.53	0.720E+07
1	71	9	96.29	0.308E+07
1	71	10	94.68	0.205E+07
1	71	11	93.65	0.137E+07
1	71	12	92.97	0.911E+06
1	71	13	92.53	0.607E+06
1	71	14	92.18	0.607E+06
1	71	15	91.84	0.607E+06
1	71	72	78.84	0.308E+07
1	71	73	80.48	0.461E+07
1	71	74	82.12	0.692E+07
1	71	75	85.40	0.900E+07
1	71	76	95.25	0.108E+08
1	72	9	97.19	0.461E+07
1	72	10	95.67	0.308E+07
1	72	11	94.68	0.205E+07
1	72	12	94.04	0.137E+07
1	72	13	93.62	0.911E+06
1	72	14	93.29	0.911E+06
1	72	15	92.96	0.911E+06
1	72	16	92.63	0.911E+06
1	72	17	92.31	0.911E+06
1	72	72	78.84	0.461E+07
1	72	73	80.48	0.692E+07

1	72	74	80.49	0.104E+08
1	72	75	80.50	0.135E+08
1	72	76	88.71	0.162E+08
1	73	5	117.82	0.350E+08
1	73	8	100.94	0.104E+08
1	73	9	98.78	0.692E+07
1	73	10	97.38	0.461E+07
1	73	18	93.96	0.137E+07
1	73	19	93.67	0.137E+07
1	73	20	93.37	0.137E+07
1	73	72	78.84	0.692E+07
1	74	5	118.71	0.525E+08
1	74	9	101.49	0.104E+08
1	74	10	100.30	0.692E+07
1	74	14	98.42	0.205E+07
1	74	15	98.16	0.205E+07
1	74	16	97.90	0.205E+07
1	74	17	97.64	0.205E+07
1	74	18	97.39	0.205E+07
1	74	19	97.13	0.205E+07
1	74	20	96.88	0.205E+07
1	74	21	96.63	0.205E+07
1	74	22	96.38	0.205E+07
1	74	77	108.35	0.398E+08
1	75	3	150.35	0.154E+09
1	75	5	120.20	0.683E+08
1	75	6	113.39	0.455E+08
1	75	77	88.67	0.517E+08
1	76	2	175.03	0.221E+09
1	76	4	132.36	0.113E+09

141	37				
141					
1	2	24	116.98	0.27E+04	113.98
1	3	24	108.46	0.24E+04	105.46
1	4	25	103.87	0.20E+04	100.87
1	4	26	103.94	0.20E+04	100.94
1	4	27	104.03	0.20E+04	101.03
1	4	28	104.13	0.20E+04	101.13
1	4	29	104.24	0.20E+04	101.24
1	4	30	104.36	0.20E+04	101.36
1	4	31	104.50	0.20E+04	101.50
1	4	32	104.64	0.20E+04	101.64
1	5	29	97.71	0.19E+04	94.71
1	5	30	97.76	0.19E+04	94.76
1	5	31	97.81	0.19E+04	94.81
1	5	32	97.85	0.19E+04	94.85
1	5	33	97.90	0.19E+04	94.90
1	6	33	93.98	0.89E+03	90.98
1	7	33	88.42	0.60E+03	85.42
1	7	34	88.17	0.60E+03	85.17
1	7	35	87.92	0.60E+03	84.92
1	8	36	84.63	0.40E+03	81.63
1	9	37	83.61	0.26E+03	80.61
1	9	38	83.46	0.26E+03	80.46
1	9	39	83.35	0.26E+03	80.35
1	10	40	83.02	0.18E+03	80.02
1	10	41	82.95	0.18E+03	79.95
1	11	42	82.62	0.12E+05	79.62
1	12	42	82.26	0.78E+04	79.26
1	13	42	81.91	0.78E+04	78.91
1	13	43	81.82	0.78E+04	78.82
1	14	43	81.50	0.78E+04	78.50
1	15	43	81.18	0.78E+04	78.18
1	16	43	80.89	0.78E+04	77.89
1	17	43	80.82	0.78E+04	77.82
1	17	44	80.82	0.78E+04	77.82
1	18	43	80.75	0.78E+04	77.75
1	18	44	80.75	0.78E+04	77.75
1	19	44	80.68	0.78E+04	77.68
1	20	44	80.61	0.78E+04	77.61
1	21	44	80.55	0.78E+04	77.55
1	21	45	80.55	0.78E+04	77.55
1	22	45	80.48	0.78E+04	77.48
1	23	45	80.41	0.78E+04	77.41
1	24	45	80.34	0.78E+04	77.34
1	25	45	80.27	0.78E+04	77.27
1	25	46	80.27	0.78E+04	77.27
1	26	46	80.20	0.78E+04	77.20
1	27	46	80.14	0.78E+04	77.14
1	27	48	80.14	0.78E+04	77.14
1	27	49	80.14	0.78E+04	77.14
1	27	50	80.07	0.78E+04	77.07
1	27	51	80.07	0.78E+04	77.07
1	28	47	80.07	0.78E+04	77.07
1	28	51	79.99	0.78E+04	76.99
1	28	52	79.99	0.78E+04	76.99
1	29	53	79.96	0.78E+04	76.96
1	30	54	79.93	0.78E+04	76.93
1	30	55	79.93	0.78E+04	76.93
1	31	56	79.91	0.78E+04	76.91
1	32	56	79.89	0.78E+04	76.89
1	33	56	79.86	0.78E+04	76.86
1	34	56	79.84	0.78E+04	76.84
1	34	57	79.84	0.78E+04	76.84
1	35	57	79.82	0.78E+04	76.82
1	36	57	79.80	0.78E+04	76.80
1	36	58	79.80	0.78E+04	76.80
1	37	58	79.78	0.78E+04	76.78
1	38	58	79.76	0.78E+04	76.76
1	39	58	79.74	0.78E+04	76.74

1	39	59	79.74	0.78E+04	76.74
1	40	59	79.72	0.78E+04	76.72
1	41	59	79.69	0.78E+04	76.69
1	41	60	79.69	0.78E+04	76.69
1	42	60	79.67	0.78E+04	76.67
1	42	61	79.67	0.78E+04	76.67
1	43	61	79.65	0.78E+04	76.65
1	44	61	79.63	0.78E+04	76.63
1	45	61	79.61	0.78E+04	76.61
1	45	62	79.61	0.78E+04	76.61
1	46	62	79.59	0.78E+04	76.59
1	46	63	79.59	0.78E+04	76.59
1	47	63	79.57	0.78E+04	76.57
1	48	63	79.55	0.78E+04	76.55
1	48	64	79.55	0.78E+04	76.55
1	49	64	79.53	0.78E+04	76.53
1	50	64	79.51	0.78E+04	76.51
1	50	65	79.51	0.78E+04	76.51
1	51	65	79.48	0.78E+04	76.48
1	52	65	79.46	0.78E+04	76.46
1	53	65	79.44	0.78E+04	76.44
1	54	65	79.43	0.78E+04	76.43
1	54	66	79.43	0.78E+04	76.43
1	55	66	79.42	0.78E+04	76.42
1	56	66	79.31	0.78E+04	76.31
1	56	67	79.31	0.78E+04	76.31
1	57	67	79.20	0.78E+04	76.20
1	58	67	79.09	0.78E+04	76.09
1	58	68	79.09	0.78E+04	76.09
1	59	68	78.98	0.78E+04	75.98
1	60	69	78.87	0.78E+04	75.87
1	61	69	78.76	0.78E+04	75.76
1	62	69	78.65	0.78E+04	75.65
1	63	69	78.54	0.78E+04	75.54
1	64	69	78.43	0.78E+04	75.43
1	65	69	78.32	0.78E+04	75.32
1	66	69	78.21	0.78E+04	75.21
1	67	69	78.11	0.78E+04	75.11
1	68	69	78.00	0.13E+05	73.00
1	68	70	78.00	0.19E+05	73.00
1	69	69	78.00	0.19E+05	73.00
1	69	70	78.00	0.28E+05	73.00
1	70	69	78.00	0.28E+05	73.00
1	70	70	78.00	0.43E+05	73.00
1	71	66	78.00	0.28E+04	73.00
1	71	67	78.00	0.28E+04	73.00
1	71	68	78.00	0.28E+04	73.00
1	71	70	78.00	0.64E+05	73.00
1	71	71	78.00	0.96E+05	73.00
1	72	66	78.00	0.43E+04	73.00
1	72	67	78.00	0.43E+04	73.00
1	72	68	78.00	0.43E+04	73.00
1	72	69	78.00	0.19E+05	73.00
1	72	70	78.00	0.38E+05	73.00
1	72	71	78.00	0.13E+06	73.00
1	73	69	78.00	0.29E+05	73.00
1	73	70	78.00	0.57E+05	73.00
1	73	71	78.00	0.19E+06	73.00
1	73	73	78.00	0.97E+05	73.00
1	73	74	78.00	0.15E+06	73.00
1	73	75	78.00	0.38E+06	73.00
1	73	76	78.00	0.45E+06	73.00
1	74	71	78.00	0.65E+05	73.00
1	74	72	78.00	0.97E+05	73.00
1	74	73	78.00	0.15E+06	73.00
1	74	74	78.00	0.54E+06	73.00
1	74	75	78.00	0.13E+07	73.00
1	74	76	78.00	0.34E+06	73.00
1	75	74	78.00	0.43E+06	73.00
1	75	75	78.00	0.17E+07	73.00

1	75	76	78.00	0.44E+06	73.00
1	76	75	78.00	0.41E+06	73.00
1	76	76	78.00	0.49E+06	73.00

```
     1        37     // nevtop (active layer for evt), ievtcb (flow terms)
     1         1         1         0     //insurf,inevtr,inexdp,inievt
    32         0          (20f11.2)          4     //surf:  read lltop.grd -- land surface
   102  2.28e-04          (4x,77f2.0)        1     //evtr:  max et rate
     6
   0.0      8.65      0.0       0.0       0.0       0.0
   1 6 6 6 1 1 1 1 1 1 1 1 1 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 6 6 6 6
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       15         0          (12f9.2)         4     //exdp:  extinction depth -- 3 ft below land surface
   250.00   217.99   189.01   145.01   125.01   115.01   114.00   114.01   117.03   119.23   120.78   121.85
   122.58   123.17   123.77   124.37   124.99   125.61   126.23   126.87   127.51   128.16   128.81   129.47
   130.13   130.80   131.48   132.16   132.84   133.53   134.22   134.92   135.62   136.33   137.04   137.75
   138.47   139.19   139.91   140.64   140.87   140.62   140.37   140.12   139.88   139.64   139.40   139.16
   138.93   138.71   138.49   138.27   138.06   137.85   137.64   137.44   137.24   137.05   136.87   136.69
   136.51   136.34   136.18   136.02   135.87   135.72   135.58   135.45   135.29   135.08   134.79   134.80
   144.62   164.37   188.94   188.91   154.48
   250.00   213.52   185.66   144.65   115.13   111.83   108.55   106.91   105.27   107.16   108.49   109.42
   110.04   110.55   111.06   111.58   112.10   112.63   113.16   113.70   114.23   114.77   115.32   115.86
   116.41   116.95   117.50   118.05   118.60   119.15   119.71   120.26   120.81   121.36   121.91   122.46
   123.01   123.57   124.12   124.67   125.04   125.23   125.41   125.60   125.79   125.99   126.19   126.41
   126.62   126.85   127.09   127.34   127.60   127.87   128.16   128.47   128.79   129.13   129.50   129.88
   130.30   130.73   131.19   131.69   132.21   132.76   133.35   133.97   134.79   136.41   138.06   141.36
   144.63   169.29   193.89   216.80   203.69
   252.90   213.52   169.26   134.80   115.12   110.19   105.28   105.27   104.61   104.40   104.32   104.55
   104.72   104.86   105.00   105.15   105.30   105.46   105.62   105.78   105.95   106.12   106.29   106.52
   106.75   106.98   107.21   107.44   107.67   107.90   108.13   108.35   108.58   108.80   109.03   109.25
   109.46   109.68   109.89   110.09   110.24   110.34   110.43   110.52   110.61   110.69   110.77   110.85
   110.93   111.00   111.08   111.15   111.23   111.30   111.38   111.45   111.53   111.62   111.71   111.80
   111.90   112.01   112.12   112.24   112.37   112.51   112.67   112.83   113.06   113.44   114.13   115.13
   120.03   144.72   182.42   206.99   216.81
   252.90   202.05   169.25   134.80   115.12   110.19   105.28   105.27   104.94   103.65   102.99   102.64
   102.45   102.31   102.19   102.09   102.01   101.94   101.89   101.85   101.83   101.83   101.84   101.86
   101.90   101.95   102.03   102.13   102.25   102.37   102.50   102.65   102.91   103.19   103.48   103.79
   104.10   104.42   104.76   105.10   105.22   105.10   105.00   104.91   104.83   104.75   104.68   104.62
   104.57   104.52   104.48   104.45   104.43   104.41   104.40   104.39   104.39   104.39   104.40   104.42
   104.44   104.47   104.50   104.54   104.59   104.64   104.69   104.76   104.84   104.99   105.27   105.28
   108.55   115.17   134.89   179.12   193.87
   249.62   200.40   164.33   131.52   110.21   105.28   103.63    98.69    95.43    95.67    95.73    95.74
    95.73    95.72    95.71    95.70    95.68    95.67    95.66    95.65    95.65    95.65    95.65    95.65
    95.67    95.68    95.70    95.73    95.75    95.78    95.82    95.96    96.11    96.26    96.40    96.54
    96.67    96.79    96.91    97.01    97.22    97.54    97.84    98.14    98.43    98.71    98.99    99.26
    99.54    99.81   100.09   100.37   100.65   100.95   101.24   101.55   101.86   102.18   102.52   102.86
   103.21   103.56   103.93   104.31   104.70   105.09   105.49   105.91   106.43   107.25   108.54   108.55
   108.55   111.83   115.17   144.69   174.17
   243.06   193.83   164.33   129.88   111.84   106.92   105.59   101.98    98.70    96.76    95.70    95.07
    94.68    94.39    94.10    93.84    93.59    93.35    93.12    92.92    92.73    92.56    92.40    92.27
    92.17    92.09    92.03    92.01    92.01    92.06    92.14    92.26    92.43    92.65    92.91    93.24
    93.61    94.05    94.54    95.10    95.29    95.10    94.98    94.91    94.90    94.94    95.03    95.16
    95.34    95.56    95.81    96.10    96.42    96.78    97.16    97.57    98.01    98.47    98.96    99.47
   100.00   100.55   101.12   101.69   102.28   102.87   103.46   104.04   104.74   105.72   106.91   107.89
   108.55   111.81   115.10   134.79   161.00
   243.06   190.56   164.32   129.88   111.84   108.55   105.28   101.99    98.71    97.21    95.86    94.90
    94.26    93.75    93.25    92.75    92.27    91.80    91.34    90.89    90.46    90.05    89.65    89.26
    88.90    88.54    88.20    87.87    87.56    87.26    86.97    86.68    86.41    86.29    86.17    86.06
    85.95    85.84    85.73    85.62    85.76    86.16    86.55    86.94    87.33    87.72    88.11    88.50
    88.90    89.30    89.72    90.16    90.61    91.07    91.56    92.08    92.61    93.17    93.76    94.37
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95.01	95.68	96.38	97.10	97.85	98.63	99.45	100.30	101.44	103.34	106.87	106.89
108.52	105.26	102.02	124.97	144.62							
242.40	190.56	162.68	129.88	112.81	108.55	105.28	103.62	101.99	98.53	96.32	94.90
93.98	93.27	92.58	91.91	91.26	90.63	90.02	89.44	88.89	88.35	87.84	87.35
86.88	86.43	85.99	85.58	85.18	84.80	84.43	84.08	83.76	83.46	83.18	82.95
82.75	82.59	82.47	82.35	82.45	82.76	83.05	83.35	83.65	83.96	84.27	84.59
84.93	85.27	85.63	86.00	86.40	86.81	87.25	87.71	88.20	88.72	89.28	89.87
90.48	91.13	91.79	92.47	93.14	93.78	94.38	94.91	95.43	95.82	95.43	97.07
100.36	105.26	101.99	124.97	134.80							
242.39	193.51	157.75	129.88	111.85	108.56	105.29	103.64	101.99	98.64	96.12	94.48
93.42	92.60	91.81	91.05	90.32	89.62	88.96	88.33	87.73	87.17	86.65	86.15
85.69	85.25	84.83	84.43	84.06	83.70	83.36	83.03	82.71	82.41	82.13	81.86
81.61	81.78	81.98	82.19	82.26	82.21	82.19	82.20	82.26	82.36	82.50	82.66
82.85	83.07	83.31	83.56	83.84	84.14	84.47	84.83	85.22	85.67	86.17	86.73
87.38	88.10	88.90	89.76	90.69	91.64	92.60	93.55	94.64	95.88	95.46	98.73
102.00	105.23	95.45	124.97	128.22							
239.76	193.84	154.49	129.88	113.47	110.19	106.91	105.27	101.99	98.33	95.66	93.91
92.79	91.91	91.07	90.27	89.50	88.77	88.09	87.45	86.85	86.30	85.80	85.33
84.91	84.51	84.15	83.81	83.49	83.19	82.90	82.63	82.37	82.15	81.96	81.83
81.78	81.82	81.92	81.98	81.91	81.73	81.54	81.42	81.36	81.37	81.43	81.53
81.66	81.81	81.98	82.16	82.35	82.56	82.78	83.03	83.30	83.63	84.02	84.51
85.12	85.89	86.84	87.94	89.18	90.53	91.97	93.49	95.51	98.86	105.25	105.28
105.27	101.98	95.44	124.96	126.59							
238.14	193.83	154.49	129.87	113.48	110.19	106.91	105.26	101.99	97.97	95.22	93.42
92.25	91.35	90.48	89.65	88.85	88.11	87.42	86.78	86.19	85.66	85.18	84.75
84.37	84.03	83.72	83.44	83.18	82.93	82.69	82.45	82.22	82.01	81.84	81.71
81.65	81.65	81.73	81.87	81.64	81.11	80.82	80.70	80.66	80.68	80.74	80.84
80.96	81.09	81.23	81.38	81.53	81.67	81.82	81.98	82.15	82.35	82.59	82.94
83.44	84.19	85.22	86.51	87.99	89.59	91.29	93.07	95.45	99.32	105.25	105.27
105.27	101.97	95.45	124.95	126.59							
237.66	193.35	154.23	129.78	113.64	110.09	106.87	104.92	101.52	97.65	94.87	93.04
91.86	90.93	90.04	89.19	88.38	87.63	86.93	86.29	85.71	85.19	84.74	84.34
84.00	83.70	83.44	83.22	83.00	82.80	82.58	82.36	82.14	81.91	81.72	81.55
81.43	81.34	81.28	81.16	80.82	80.26	80.20	80.16	80.17	80.23	80.31	80.43
80.55	80.69	80.82	80.96	81.08	81.20	81.31	81.41	81.51	81.62	81.74	81.93
82.25	82.90	84.03	85.51	87.15	88.87	90.67	92.53	94.95	98.72	103.63	104.83
104.69	101.43	96.37	123.29	126.29							
237.27	192.95	154.02	129.70	113.77	110.00	106.79	104.62	101.14	97.36	94.58	92.73
91.52	90.58	89.67	88.80	87.98	87.22	86.51	85.87	85.30	84.80	84.36	84.00
83.69	83.43	83.22	83.04	82.88	82.72	82.53	82.32	82.08	81.84	81.60	81.39
81.20	81.04	80.87	80.65	80.32	79.98	79.82	79.78	79.81	79.89	80.01	80.14
80.28	80.42	80.56	80.68	80.80	80.90	80.99	81.06	81.11	81.16	81.21	81.27
81.37	81.78	83.13	84.79	86.53	88.31	90.13	91.99	94.36	97.92	102.33	104.17
104.13	101.01	97.02	122.04	126.02							
236.89	192.55	153.82	129.63	113.88	109.91	106.69	104.31	100.76	97.05	94.28	92.41
91.18	90.22	89.29	88.40	87.56	86.78	86.07	85.43	84.87	84.38	83.97	83.63
83.36	83.15	82.99	82.87	82.77	82.67	82.51	82.30	82.05	81.76	81.48	81.22
80.98	80.75	80.52	80.25	79.95	79.67	79.49	79.44	79.49	79.61	79.75	79.90
80.06	80.21	80.35	80.47	80.59	80.68	80.75	80.80	80.84	80.86	80.87	80.89
80.93	81.22	82.64	84.31	86.03	87.79	89.57	91.38	93.66	96.99	101.04	103.32
103.50	100.59	97.57	120.87	125.74							
236.50	192.16	153.62	129.56	113.99	109.82	106.56	103.98	100.38	96.73	93.97	92.08
90.83	89.85	88.90	87.98	87.13	86.33	85.62	84.98	84.42	83.95	83.56	83.26
83.02	82.86	82.75	82.70	82.68	82.65	82.55	82.34	82.04	81.70	81.37	81.05
80.77	80.49	80.23	79.95	79.66	79.38	79.17	79.14	79.22	79.37	79.54	79.72
79.89	80.05	80.20	80.33	80.45	80.54	80.61	80.66	80.69	80.71	80.74	80.82
81.02	81.56	82.65	84.09	85.67	87.33	89.02	90.74	92.90	96.00	99.78	102.36
102.80	100.19	98.04	119.78	125.44							
236.12	192.00	153.41	129.48	114.08	109.72	106.41	103.65	100.02	96.43	93.67	91.77
90.49	89.49	88.51	87.56	86.68	85.87	85.14	84.51	83.96	83.49	83.14	82.87
82.67	82.54	82.49	82.50	82.58	82.66	82.64	82.41	82.05	81.65	81.26	80.91
80.58	80.29	80.02	79.75	79.47	79.20	78.89	78.91	79.03	79.21	79.41	79.60
79.78	79.95	80.11	80.25	80.38	80.48	80.55	80.60	80.64	80.68	80.76	80.91
81.22	81.82	82.76	83.99	85.40	86.92	88.50	90.10	92.11	95.00	98.56	101.33
102.06	99.78	98.43	118.75	125.12							

235.75	191.84	153.22	129.41	114.17	109.61	106.24	103.31	99.67	96.13	93.40	91.47
90.17	89.14	88.12	87.14	86.22	85.38	84.65	84.04	83.52	83.03	82.75	82.49
82.31	82.21	82.19	82.25	82.42	82.66	82.83	82.51	82.05	81.60	81.17	80.78
80.44	80.14	79.88	79.63	79.40	79.19	79.07	78.82	78.95	79.14	79.35	79.55
79.73	79.90	80.07	80.23	80.37	80.49	80.58	80.64	80.69	80.74	80.85	81.05
81.40	81.99	82.83	83.90	85.15	86.53	87.98	89.46	91.33	94.02	97.39	100.27
101.28	99.38	98.74	117.80	124.79							
235.37	191.67	153.02	129.35	114.24	109.51	106.06	102.98	99.33	95.86	93.15	91.21
89.88	88.81	87.76	86.74	85.77	84.89	84.14	83.55	83.12	82.82	82.39	82.11
81.94	81.85	81.85	81.93	82.12	82.42	82.73	82.42	82.02	81.58	81.12	80.70
80.35	80.05	79.81	79.60	79.41	79.24	79.15	78.75	78.93	79.15	79.36	79.55
79.72	79.90	80.08	80.26	80.43	80.57	80.67	80.74	80.79	80.85	80.96	81.17
81.52	82.07	82.82	83.77	84.89	86.13	87.45	88.82	90.55	93.05	96.25	99.21
100.48	98.97	98.99	116.90	124.44							
235.00	191.51	152.82	129.28	114.31	109.39	105.85	102.65	99.02	95.62	92.94	90.98
89.63	88.54	87.44	86.37	85.33	84.38	83.58	83.01	82.60	82.28	81.97	81.73
81.58	81.50	81.50	81.57	81.69	81.88	82.06	82.13	82.03	81.66	81.15	80.71
80.35	80.05	79.82	79.66	79.50	79.29	79.05	78.84	78.95	79.24	79.44	79.58
79.72	79.90	80.10	80.32	80.53	80.70	80.82	80.90	80.94	80.98	81.07	81.25
81.57	82.06	82.73	83.58	84.59	85.71	86.92	88.19	89.79	92.12	95.17	98.15
99.66	98.56	99.16	116.05	124.08							
234.63	191.34	152.63	129.21	114.37	109.28	105.64	102.32	98.73	95.42	92.77	90.82
89.44	88.32	87.18	86.06	84.96	83.91	83.01	82.48	82.08	81.78	81.55	81.37
81.26	81.20	81.20	81.25	81.30	81.35	81.50	82.01	82.40	82.13	81.36	80.91
80.52	80.14	79.92	79.83	79.72	79.47	79.09	78.78	78.94	79.43	79.53	79.58
79.69	79.88	80.13	80.40	80.66	80.88	81.03	81.10	81.11	81.11	81.14	81.28
81.54	81.96	82.56	83.33	84.24	85.26	86.38	87.54	89.03	91.23	94.13	97.12
98.85	98.15	99.28	115.26	123.71							
234.26	191.18	152.54	129.15	114.43	109.16	105.41	102.00	98.46	95.26	92.67	90.72
89.33	88.18	87.01	85.84	84.70	83.62	82.69	82.05	81.63	81.38	81.21	81.10
81.04	81.02	81.03	81.13	81.17	81.16	81.02	82.41	83.56	83.68	81.83	81.78
81.03	80.31	80.08	80.12	80.14	79.88	79.33	78.55	78.73	79.20	79.41	79.45
79.59	79.82	80.12	80.46	80.81	81.11	81.29	81.34	81.29	81.21	81.17	81.22
81.41	81.77	82.30	82.99	83.83	84.78	85.81	86.90	88.30	90.36	93.14	96.12
98.04	97.73	99.35	114.51	123.33							
233.89	191.01	152.46	129.09	114.47	109.03	105.18	101.69	98.21	95.13	92.63	90.70
89.30	88.13	86.94	85.74	84.58	83.46	82.47	81.71	81.28	81.10	81.02	80.99
80.99	81.08	81.17	81.30	81.44	81.65	82.18	83.58	85.40	87.01	85.91	83.65
81.93	80.43	80.40	80.47	80.78	80.50	80.00	79.13	78.48	78.79	79.03	79.19
79.40	79.68	80.05	80.49	80.96	81.37	81.61	81.61	81.46	81.26	81.11	81.07
81.19	81.47	81.95	82.58	83.37	84.26	85.23	86.26	87.57	89.53	92.19	95.15
97.23	97.31	99.36	113.80	122.94							
233.53	190.84	152.38	129.03	114.51	108.91	104.94	101.38	97.98	95.05	92.66	90.78
89.38	88.20	86.98	85.77	84.59	83.46	82.37	81.43	81.03	81.01	81.06	81.13
81.24	81.38	81.52	81.68	81.92	82.36	83.20	84.59	86.47	88.61	87.63	84.90
82.98	81.71	81.09	80.73	80.61	81.06	80.96	79.67	78.80	78.60	78.70	78.89
79.14	79.47	79.90	80.44	81.05	81.64	81.99	81.89	81.56	81.22	80.95	80.82
80.85	81.07	81.50	82.11	82.86	83.71	84.64	85.62	86.86	88.73	91.29	94.22
96.45	96.88	99.33	113.12	122.55							
233.16	190.67	152.30	128.97	114.54	108.78	104.70	101.08	97.77	95.01	92.77	90.97
89.59	88.38	87.14	85.92	84.78	83.67	82.58	81.54	81.18	81.24	81.34	81.48
81.65	81.84	82.01	82.16	82.41	82.92	83.77	84.91	86.13	86.85	86.16	84.79
83.64	82.75	82.05	81.31	80.53	81.20	80.97	79.72	78.73	78.39	78.43	78.60
78.84	79.18	79.63	80.24	80.98	81.80	82.44	82.04	81.50	81.03	80.67	80.44
80.39	80.55	80.97	81.58	82.32	83.15	84.05	84.98	86.18	87.96	90.43	93.33
95.68	96.45	99.25	112.48	122.15							
232.80	190.50	152.22	128.91	114.57	108.65	104.46	100.78	97.56	94.99	92.95	91.28
89.93	88.71	87.42	86.20	85.15	84.15	83.18	82.35	81.90	81.78	81.83	81.96
82.17	82.42	82.62	82.71	82.82	83.29	84.07	84.89	85.51	85.49	84.51	84.29
84.14	83.79	83.30	82.65	82.06	81.81	80.71	79.45	78.27	78.19	78.23	78.36
78.54	78.81	79.23	79.83	80.60	81.48	82.20	81.71	81.15	80.66	80.26	79.97
79.82	79.93	80.38	81.03	81.78	82.60	83.47	84.37	85.52	87.23	89.62	92.48
94.93	96.02	99.14	111.86	121.75							
232.44	190.33	152.14	128.85	114.59	108.51	104.21	100.49	97.36	94.99	93.20	91.71
90.46	89.26	87.89	86.61	85.76	84.87	83.98	83.23	82.72	82.46	82.41	82.50

82.72	83.04	83.35	83.30	83.34	83.73	84.36	84.93	85.26	85.16	84.71	84.73
84.96	85.02	84.83	84.32	83.42	82.13	80.58	79.27	78.45	78.20	78.15	78.19
78.28	78.41	78.69	79.23	79.91	80.58	80.98	80.87	80.52	80.13	79.78	79.47
79.24	79.21	79.81	80.51	81.27	82.07	82.92	83.79	84.89	86.54	88.86	91.68
94.21	95.58	98.99	111.28	121.35							
232.09	190.16	152.06	128.80	114.60	108.38	103.96	100.20	97.15	94.99	93.47	92.26
91.19	90.10	88.83	87.64	86.70	85.78	84.88	84.09	83.51	83.15	83.00	83.03
83.21	83.48	83.73	83.82	83.97	84.29	84.75	85.18	85.45	85.53	85.54	85.74
86.09	86.43	86.59	86.28	85.07	82.81	80.39	79.11	78.53	78.27	78.18	78.14
78.10	78.08	78.07	78.60	79.13	79.61	79.91	79.94	79.79	79.54	79.28	79.05
78.89	78.97	79.44	80.09	80.81	81.59	82.40	83.24	84.30	85.89	88.13	90.91
93.51	95.15	98.82	110.71	120.94							
231.73	189.99	151.98	128.74	114.61	108.24	103.71	99.91	96.94	94.96	93.74	92.87
92.06	91.14	90.02	88.89	87.83	86.79	85.79	84.91	84.22	83.76	83.53	83.50
83.61	83.82	84.04	84.24	84.49	84.81	85.20	85.58	85.88	86.12	86.36	86.71
87.21	87.80	88.40	88.66	87.47	84.17	79.86	79.28	78.73	78.45	78.34	78.20
78.06	77.97	77.99	78.17	78.46	78.79	79.02	79.12	79.09	78.98	78.83	78.70
78.67	78.81	79.19	79.75	80.41	81.14	81.92	82.72	83.74	85.28	87.46	90.18
92.83	94.71	98.61	110.17	120.54							
231.38	189.82	151.91	128.69	114.62	108.10	103.47	99.62	96.71	94.89	93.93	93.45
93.01	92.22	91.13	90.05	88.96	87.78	86.63	85.61	84.81	84.26	83.98	83.90
83.96	84.13	84.36	84.62	84.93	85.29	85.68	86.05	86.39	86.70	87.04	87.48
88.05	88.78	89.70	90.82	90.61	86.34	82.63	80.36	79.11	78.62	78.63	78.30
78.10	77.97	77.92	77.95	77.96	78.28	78.36	78.48	78.54	78.52	78.45	78.40
78.43	78.61	78.95	79.45	80.05	80.74	81.47	82.24	83.22	84.71	86.82	89.50
92.18	94.26	98.39	109.64	120.13							
231.03	189.65	151.83	128.64	114.62	107.96	103.22	99.33	96.46	94.75	93.97	93.78
93.85	93.07	91.91	90.94	89.98	88.60	87.30	86.18	85.26	84.63	84.34	84.24
84.27	84.41	84.65	84.96	85.33	85.74	86.15	86.53	86.87	87.20	87.56	87.97
88.48	89.10	89.86	90.58	90.04	87.43	84.43	81.36	79.22	78.55	78.42	78.32
78.19	78.04	77.94	77.99	78.26	78.39	77.93	78.15	78.19	78.18	78.15	78.13
78.19	78.37	78.69	79.15	79.71	80.36	81.06	81.80	82.74	84.17	86.23	88.86
91.55	93.82	98.13	109.13	119.73							
230.68	189.48	151.76	128.59	114.61	107.83	102.98	99.04	96.19	94.52	93.81	93.65
93.58	92.98	92.06	91.21	90.34	89.01	87.73	86.60	85.61	84.90	84.68	84.54
84.53	84.65	84.90	85.25	85.68	86.15	86.60	86.98	87.30	87.59	87.88	88.18
88.49	88.80	89.06	89.12	88.51	87.18	85.70	82.10	78.86	78.46	78.41	78.44
78.40	78.21	77.99	77.98	78.79	79.28	78.63	78.20	78.03	77.96	77.92	77.90
77.95	78.11	78.41	78.85	79.39	80.01	80.68	81.38	82.30	83.68	85.68	88.25
90.95	93.38	97.86	108.64	119.33							
230.33	189.31	151.69	128.54	114.60	107.69	102.74	98.75	95.90	94.22	93.45	93.14
92.84	92.34	91.65	90.89	90.02	88.99	87.92	86.92	86.04	85.41	85.04	84.81
84.74	84.83	85.08	85.47	85.98	86.53	87.03	87.40	87.65	87.85	88.03	88.18
88.24	88.14	87.84	87.42	86.85	86.02	84.68	81.97	79.70	78.69	78.70	78.76
78.81	78.51	78.13	77.81	79.00	80.02	78.93	78.20	77.91	77.82	77.77	77.73
77.72	77.84	78.12	78.55	79.08	79.68	80.33	81.01	81.89	83.23	85.17	87.68
90.37	92.93	97.58	108.16	118.94							
229.99	189.13	151.62	128.49	114.59	107.55	102.50	98.46	95.58	93.85	92.95	92.44
92.02	91.55	90.98	90.34	89.62	88.82	87.98	87.17	86.43	85.83	85.37	85.05
84.89	84.92	85.16	85.60	86.18	86.86	87.47	87.77	87.90	87.98	88.04	88.05
87.91	87.43	86.45	85.55	85.11	84.57	83.55	82.00	80.53	79.65	79.31	79.21
79.15	78.92	78.48	78.14	78.66	79.18	78.62	77.86	77.80	77.76	77.71	77.63
77.53	77.55	77.83	78.29	78.82	79.39	80.01	80.66	81.51	82.81	84.71	87.15
89.81	92.49	97.27	107.69	118.54							
229.65	188.96	151.54	128.44	114.58	107.42	102.27	98.18	95.25	93.43	92.35	91.66
91.15	90.70	90.22	89.71	89.18	88.60	87.99	87.36	86.76	86.20	85.71	85.28
84.98	84.94	85.15	85.59	86.25	87.04	87.90	88.00	88.00	87.98	87.92	87.82
87.62	87.06	85.17	83.53	83.61	83.40	82.82	81.96	81.10	80.44	80.01	79.69
79.57	79.48	78.82	78.43	78.44	78.50	78.26	77.93	77.84	77.80	77.78	77.71
77.46	77.25	77.62	78.11	78.61	79.14	79.72	80.34	81.16	82.43	84.29	86.66
89.27	92.05	96.95	107.23	118.15							
229.30	188.79	151.48	128.39	114.56	107.29	102.04	97.89	94.91	92.97	91.71	90.85
90.26	89.81	89.41	89.05	88.73	88.38	88.00	87.57	87.10	86.60	86.09	85.57
85.10	84.95	85.04	85.47	86.15	86.93	87.60	87.88	87.91	87.83	87.67	87.43
87.11	86.56	84.65	83.12	82.84	82.69	82.39	81.97	81.52	81.12	80.71	80.27

79.88	79.45	78.90	78.39	78.19	78.12	78.00	77.87	77.83	77.86	77.95	78.04
77.92	77.40	77.72	78.08	78.48	78.94	79.46	80.04	80.84	82.09	83.90	86.19
88.75	91.61	96.62	106.78	117.77							
228.96	188.62	151.41	128.35	114.54	107.16	101.81	97.61	94.57	92.52	91.08	90.05
89.37	88.89	88.57	88.40	88.32	88.23	88.08	87.85	87.52	87.10	86.59	86.04
85.48	85.04	84.86	85.26	86.01	86.76	87.35	87.67	87.74	87.62	87.34	86.90
86.30	85.41	84.14	83.05	82.53	82.31	82.15	81.99	81.85	81.73	81.38	80.73
80.07	79.43	78.78	78.09	77.97	77.88	77.80	77.77	77.80	77.90	78.08	78.37
78.76	78.37	78.07	78.14	78.38	78.74	79.21	79.76	80.53	81.78	83.56	85.76
88.25	91.17	96.28	106.34	117.39							
228.63	188.44	151.34	128.31	114.52	107.03	101.60	97.34	94.24	92.07	90.50	89.32
88.51	87.97	87.71	87.78	87.99	88.18	88.28	88.24	88.06	87.72	87.26	86.68
86.03	85.35	84.65	85.21	86.03	86.73	87.26	87.56	87.62	87.44	87.02	86.38
85.54	84.53	83.49	82.68	82.23	82.05	81.99	81.98	82.01	82.13	81.90	80.95
80.11	79.37	78.70	78.17	77.89	77.74	77.64	77.67	77.74	77.86	78.06	78.32
78.53	78.42	78.19	78.12	78.25	78.52	78.93	79.46	80.24	81.51	83.27	85.36
87.76	90.73	95.92	105.90	117.02							
228.29	188.27	151.27	128.26	114.50	106.90	101.38	97.07	93.91	91.66	90.00	88.73
87.80	87.08	86.82	87.28	87.84	88.31	88.64	88.80	88.76	88.52	88.09	87.52
86.85	86.16	85.67	85.84	86.39	86.92	87.34	87.59	87.62	87.37	86.81	85.97
84.91	83.76	82.75	82.14	81.89	81.83	81.85	81.88	81.92	81.89	81.54	80.79
79.98	79.24	78.61	78.14	77.85	77.68	77.60	77.60	77.66	77.76	77.92	78.10
78.21	78.17	78.04	77.98	78.03	78.24	78.62	79.15	79.97	81.28	83.01	84.98
87.29	90.29	95.56	105.48	116.65							
227.96	188.10	151.20	128.22	114.48	106.78	101.18	96.81	93.60	91.30	89.61	88.34
87.41	86.61	86.32	87.17	87.96	88.65	89.20	89.54	89.65	89.49	89.10	88.53
87.88	87.26	86.83	86.77	86.98	87.29	87.57	87.75	87.76	87.49	86.79	85.75
84.48	83.09	81.93	81.57	81.60	81.68	81.74	81.76	81.71	81.52	81.10	80.46
79.71	79.01	78.45	78.05	77.79	77.64	77.56	77.56	77.59	77.66	77.74	77.87
77.93	77.90	77.81	77.74	77.74	77.89	78.23	78.80	79.70	81.11	82.81	84.61
86.82	89.85	95.19	105.06	116.29							
227.62	187.92	151.13	128.18	114.45	106.66	100.98	96.56	93.30	90.98	89.33	88.18
87.43	86.98	86.98	87.58	88.39	89.20	89.92	90.46	90.71	90.61	90.23	89.64
88.97	88.34	87.87	87.63	87.61	87.71	87.85	87.96	87.99	87.81	86.93	85.72
84.35	82.83	81.22	81.36	81.57	81.70	81.74	81.70	81.54	81.24	80.77	80.13
79.40	78.70	78.22	77.92	77.72	77.60	77.54	77.52	77.54	77.59	77.65	77.71
77.73	77.68	77.59	77.49	77.42	77.47	77.77	78.43	79.48	81.01	82.63	84.26
86.37	89.41	94.81	104.65	115.93							
227.29	187.75	151.07	128.14	114.42	106.54	100.79	96.33	93.03	90.71	89.14	88.17
87.66	87.47	87.63	88.17	88.95	89.85	90.74	91.51	91.90	91.84	91.42	90.76
90.01	89.30	88.74	88.36	88.16	88.09	88.08	88.09	88.06	87.86	86.98	85.82
84.56	83.27	82.26	81.93	81.93	81.95	81.90	81.75	81.48	81.09	80.55	79.90
79.15	78.37	78.01	77.82	77.68	77.58	77.52	77.50	77.51	77.55	77.58	77.61
77.60	77.53	77.41	77.28	77.15	77.07	77.22	78.12	79.33	81.00	82.49	83.90
85.92	88.97	94.42	104.24	115.58							
226.96	187.58	151.01	128.11	114.40	106.42	100.61	96.11	92.79	90.48	89.02	88.22
87.91	87.88	88.13	88.68	89.48	90.44	91.48	92.47	93.08	93.11	92.60	91.78
90.88	90.06	89.39	88.90	88.56	88.36	88.23	88.11	87.95	87.59	86.90	85.97
84.95	83.97	83.19	82.75	82.54	82.39	82.20	81.92	81.54	81.05	80.47	79.80
79.09	78.42	78.03	77.83	77.68	77.58	77.52	77.50	77.50	77.53	77.56	77.57
77.54	77.45	77.32	77.15	77.01	76.96	77.22	78.00	79.26	81.09	82.33	83.54
85.48	88.54	94.03	103.84	115.23							
226.64	187.40	150.94	128.07	114.37	106.31	100.44	95.90	92.56	90.28	88.92	88.27
88.08	88.15	88.46	89.03	89.84	90.84	91.97	93.13	94.10	94.38	93.64	92.55
91.49	90.57	89.81	89.22	88.79	88.48	88.26	88.05	87.80	87.42	86.86	86.16
85.38	84.64	84.01	83.56	83.23	82.95	82.61	82.19	81.68	81.11	80.48	79.82
79.17	78.59	78.18	77.91	77.73	77.61	77.54	77.51	77.51	77.53	77.56	77.58
77.55	77.46	77.29	77.10	76.95	76.95	77.25	77.92	79.16	81.28	82.11	83.16
85.04	88.10	93.64	103.45	114.90							
226.31	187.23	150.87	128.03	114.34	106.21	100.27	95.70	92.35	90.11	88.82	88.27
88.15	88.26	88.59	89.16	89.95	90.95	92.11	93.38	94.74	95.63	94.17	92.85
91.71	90.74	89.94	89.30	88.82	88.45	88.17	87.92	87.64	87.30	86.86	86.35
85.79	85.23	84.72	84.28	83.91	83.54	83.08	82.50	81.86	81.20	80.53	79.88
79.27	78.73	78.31	78.00	77.78	77.64	77.56	77.53	77.53	77.55	77.58	77.61
77.63	77.52	77.33	77.10	76.89	76.84	77.09	77.70	78.87	80.96	81.75	82.75

84.61	87.67	93.23	103.06	114.56							
225.99	187.06	150.81	128.00	114.31	106.11	100.12	95.52	92.17	89.95	88.71	88.20
88.10	88.21	88.52	89.05	89.80	90.74	91.81	92.96	94.04	94.39	93.55	92.51
91.49	90.58	89.79	89.15	88.64	88.26	87.96	87.71	87.45	87.16	86.84	86.49
86.12	85.73	85.31	84.89	84.49	84.10	83.54	82.77	81.99	81.26	80.57	79.93
79.34	78.82	78.39	78.07	77.83	77.68	77.58	77.54	77.55	77.57	77.61	77.64
77.66	77.61	77.43	77.11	76.78	76.59	76.72	77.29	78.38	80.10	81.24	82.33
84.18	87.24	92.83	102.68	114.24							
225.67	186.89	150.75	127.97	114.29	106.01	99.97	95.36	92.01	89.80	88.58	88.07
87.94	88.01	88.26	88.73	89.40	90.24	91.16	92.05	92.70	92.79	92.39	91.72
90.91	90.11	89.38	88.76	88.26	87.88	87.62	87.39	87.17	86.93	86.72	86.55
86.37	86.14	85.79	85.34	84.86	84.43	83.80	82.84	81.99	81.24	80.56	79.93
79.36	78.85	78.43	78.10	77.85	77.69	77.60	77.56	77.57	77.60	77.63	77.67
77.68	77.65	77.59	77.10	76.64	76.27	76.18	76.79	77.80	79.31	80.66	81.89
83.75	86.81	92.42	102.30	113.92							
225.35	186.71	150.69	127.93	114.26	105.92	99.84	95.21	91.86	89.66	88.43	87.88
87.70	87.70	87.85	88.22	88.82	89.56	90.32	90.98	91.42	91.51	91.26	90.76
90.12	89.43	88.75	88.15	87.66	87.31	87.11	87.11	86.74	86.53	86.45	86.46
86.50	86.45	86.15	85.59	84.93	84.26	83.49	82.61	81.79	81.08	80.45	79.87
79.32	78.82	78.40	78.08	77.84	77.68	77.60	77.57	77.59	77.62	77.66	77.68
77.68	77.62	77.44	77.04	76.54	76.09	75.97	76.39	77.26	78.62	80.07	81.45
83.33	86.39	92.00	101.92	113.61							
225.03	186.54	150.63	127.90	114.23	105.83	99.71	95.08	91.74	89.53	88.27	87.66
87.42	87.33	87.34	87.57	88.14	88.80	89.43	89.94	90.26	90.33	90.15	89.76
89.22	88.61	87.97	87.38	86.88	86.51	86.28	86.15	85.98	85.88	85.93	86.13
86.43	86.68	86.42	85.61	84.68	83.80	82.95	82.12	81.38	80.76	80.25	79.75
79.21	78.73	78.32	78.00	77.78	77.64	77.57	77.57	77.60	77.65	77.69	77.71
77.69	77.61	77.41	77.05	76.54	76.00	75.74	76.06	76.81	78.04	79.52	81.01
82.91	85.96	91.59	101.55	113.30							
224.71	186.37	150.57	127.87	114.20	105.75	99.59	94.96	91.63	89.41	88.10	87.44
87.14	86.99	86.91	87.00	87.54	88.09	88.58	88.97	89.20	89.24	89.10	88.77
88.30	87.72	87.10	86.48	85.95	85.52	85.23	85.06	84.97	84.98	85.13	85.45
85.96	86.66	86.49	85.21	84.08	83.09	82.22	81.44	80.78	80.27	79.90	79.52
79.01	78.56	78.18	77.88	77.67	77.56	77.53	77.57	77.62	77.68	77.72	77.74
77.71	77.64	77.49	77.21	76.71	76.06	75.60	75.86	76.47	77.57	79.02	80.58
82.51	85.54	91.17	101.19	113.01							
224.39	186.20	150.50	127.84	114.18	105.67	99.48	94.86	91.55	89.32	87.95	87.21
86.88	86.72	86.67	86.78	87.10	87.48	87.83	88.09	88.24	88.25	88.12	87.84
87.41	86.85	86.19	85.53	84.93	84.43	84.07	83.89	83.85	83.90	84.07	84.37
84.83	85.32	85.12	84.10	83.07	82.14	81.31	80.58	80.01	79.61	79.34	79.06
78.70	78.34	78.00	77.72	77.53	77.45	77.48	77.56	77.65	77.73	77.76	77.77
77.72	77.67	77.61	77.51	77.04	76.32	75.80	75.78	76.22	77.20	78.59	80.17
82.11	85.13	90.74	100.83	112.71							
224.08	186.03	150.44	127.81	114.15	105.59	99.39	94.77	91.49	89.25	87.81	87.00
86.64	86.49	86.46	86.55	86.74	86.96	87.17	87.32	87.39	87.36	87.23	86.99
86.61	86.04	85.34	84.58	83.96	83.35	82.87	82.73	82.71	82.74	82.84	83.02
83.23	83.37	83.15	82.52	81.77	81.02	80.28	79.61	79.10	78.85	78.74	78.62
78.40	78.13	77.83	77.55	77.36	77.33	77.42	77.56	77.70	77.79	77.77	77.72
77.69	77.67	77.64	77.58	77.48	76.41	75.74	75.65	76.03	76.92	78.23	79.79
81.72	84.71	90.32	100.48	112.43							
223.77	185.86	150.38	127.79	114.13	105.53	99.30	94.70	91.45	89.22	87.72	86.81
86.40	86.28	86.28	86.34	86.43	86.53	86.61	86.65	86.63	86.55	86.41	86.21
85.94	85.30	84.60	83.87	83.17	82.47	81.71	81.79	81.74	81.65	81.66	81.64
81.58	81.57	81.35	80.89	80.44	79.93	79.29	78.60	78.10	78.06	78.26	78.31
78.19	77.98	77.72	77.43	77.17	77.21	77.43	77.60	77.74	77.90	77.70	77.62
77.63	77.63	77.58	77.44	77.02	76.12	75.37	75.47	75.93	76.75	77.94	79.44
81.35	84.31	89.89	100.13	112.15							
223.46	185.69	150.32	127.76	114.11	105.46	99.22	94.64	91.43	89.23	87.69	86.66
86.15	86.12	86.17	86.20	86.20	86.17	86.13	86.08	85.99	85.82	85.65	85.43
85.12	84.61	83.98	83.30	82.62	82.05	81.63	81.40	81.16	80.75	80.81	80.60
80.11	80.22	79.98	79.43	79.38	79.08	78.56	77.73	76.98	77.38	78.11	78.23
78.13	77.96	77.75	77.49	77.22	77.33	77.61	77.72	77.71	77.60	77.46	77.49
77.59	77.63	77.57	77.39	76.99	76.12	75.28	75.55	75.98	76.67	77.72	79.12
80.98	83.90	89.45	99.79	111.88							
223.15	185.52	150.26	127.74	114.09	105.40	99.15	94.59	91.43	89.28	87.75	86.69

86.11	86.15	86.19	86.17	86.07	85.92	85.73	85.64	85.49	85.27	85.00	84.76
84.47	84.05	83.52	82.91	82.26	81.96	81.74	81.40	81.08	80.79	80.54	80.19
79.82	79.58	79.30	79.03	78.89	78.66	78.18	77.42	76.39	78.43	78.43	78.34
78.19	78.06	77.92	77.78	77.69	77.79	78.04	77.97	77.79	77.45	77.18	77.45
77.68	77.76	77.73	77.61	77.43	76.75	76.18	76.04	76.21	76.68	77.54	78.83
80.64	83.51	89.02	99.46	111.62							
222.84	185.35	150.20	127.71	114.07	105.35	99.09	94.56	91.45	89.36	87.89	86.96
86.53	86.40	86.32	86.25	86.02	85.78	85.56	85.35	85.13	84.86	84.53	84.28
84.01	83.66	83.22	82.75	82.33	82.24	82.02	81.54	81.21	81.01	80.62	80.15
79.75	79.42	79.12	78.94	78.85	78.69	78.38	77.95	77.64	78.18	78.60	78.51
78.30	78.26	78.21	78.17	78.16	78.24	78.36	78.35	78.19	77.87	77.48	77.85
78.02	78.03	77.97	77.85	77.67	77.42	76.88	76.58	76.51	76.75	77.41	78.57
80.30	83.12	88.58	99.13	111.36							
222.54	185.18	150.14	127.69	114.05	105.30	99.04	94.53	91.47	89.48	88.07	87.27
86.88	86.72	86.46	86.23	85.98	85.70	85.44	85.18	84.91	84.62	84.31	84.03
83.74	83.42	83.06	82.70	82.42	82.25	81.96	81.59	81.28	81.02	80.65	80.22
79.83	79.52	79.28	79.15	79.09	79.04	78.97	78.86	78.78	78.84	78.89	78.80
78.66	78.57	78.54	78.53	78.57	78.67	78.79	78.89	78.92	79.16	79.06	78.76
78.57	78.40	78.23	78.05	77.85	77.60	77.31	76.96	76.76	76.82	77.30	78.32
79.99	82.73	88.14	98.80	111.11							
222.23	185.01	150.08	127.67	114.03	105.26	98.99	94.52	91.51	89.62	88.24	87.55
87.10	86.82	86.53	86.25	85.95	85.66	85.36	85.07	84.78	84.48	84.18	83.88
83.59	83.28	82.97	82.67	82.40	82.16	81.89	81.58	81.28	80.99	80.65	80.30
79.98	79.72	79.54	79.45	79.46	79.54	79.68	79.87	79.78	79.52	79.33	79.16
79.01	78.91	78.87	78.88	78.94	79.07	79.25	79.50	79.91	80.92	80.34	79.58
79.09	78.74	78.45	78.20	77.96	77.70	77.43	77.16	76.93	76.88	77.21	78.10
79.68	82.36	87.69	98.49	110.87							
221.93	184.84	150.03	127.65	114.01	105.22	98.96	94.51	91.55	89.67	88.38	87.67
87.22	86.90	86.58	86.27	85.95	85.64	85.33	85.02	84.71	84.41	84.10	83.80
83.51	83.21	82.92	82.64	82.38	82.12	81.86	81.57	81.29	81.00	80.70	80.41
80.15	79.94	79.81	79.77	79.82	79.98	80.25	80.67	80.44	80.03	79.72	79.50
79.33	79.23	79.18	79.19	79.26	79.39	79.60	79.90	80.33	80.71	80.49	79.92
79.39	78.96	78.61	78.30	78.02	77.74	77.48	77.24	77.01	76.90	77.12	77.90
79.39	81.99	87.24	98.18	110.63							
221.63	184.68	149.98	127.63	114.00	105.19	98.93	94.52	91.59	89.72	88.48	87.76
87.31	86.97	86.63	86.30	85.97	85.64	85.32	85.00	84.69	84.38	84.07	83.77
83.48	83.19	82.91	82.63	82.37	82.11	81.85	81.59	81.32	81.05	80.79	80.54
80.33	80.16	80.07	80.05	80.11	80.26	80.47	80.64	80.54	80.27	79.99	79.77
79.60	79.48	79.43	79.43	79.50	79.62	79.80	80.04	80.30	80.43	80.28	79.90
79.46	79.04	78.67	78.33	78.03	77.74	77.48	77.25	77.04	76.89	77.03	77.70
79.12	81.64	86.79	97.88	110.41							
221.33	184.51	149.92	127.61	113.99	105.16	98.91	94.53	91.64	89.78	88.58	87.85
87.39	87.03	86.68	86.34	86.00	85.67	85.34	85.02	84.70	84.39	84.08	83.78
83.48	83.20	82.92	82.65	82.39	82.13	81.88	81.62	81.37	81.13	80.89	80.68
80.50	80.36	80.28	80.27	80.32	80.42	80.53	80.60	80.53	80.35	80.14	79.94
79.79	79.68	79.62	79.61	79.66	79.74	79.87	80.02	80.15	80.17	80.03	79.74
79.38	79.00	78.64	78.30	77.99	77.70	77.45	77.22	77.01	76.84	76.93	77.52
78.86	81.30	86.34	97.58	110.18							
221.03	184.34	149.87	127.59	113.98	105.14	98.90	94.55	91.68	89.85	88.66	87.93
87.46	87.10	86.74	86.40	86.05	85.71	85.38	85.05	84.73	84.42	84.11	83.81
83.52	83.23	82.96	82.69	82.43	82.18	81.93	81.68	81.44	81.22	81.00	80.81
80.66	80.54	80.46	80.44	80.46	80.51	80.56	80.57	80.50	80.38	80.22	80.06
79.92	79.82	79.75	79.73	79.74	79.79	79.86	79.93	79.97	79.93	79.78	79.54
79.23	78.89	78.55	78.22	77.91	77.63	77.37	77.15	76.94	76.77	76.82	77.35
78.62	80.96	85.87	97.29	109.96							
220.73	184.18	149.82	127.58	113.97	105.12	98.89	94.58	91.74	89.92	88.75	88.01
87.54	87.18	86.82	86.46	86.11	85.77	85.44	85.11	84.79	84.47	84.16	83.86
83.57	83.29	83.01	82.75	82.49	82.24	82.00	81.76	81.53	81.32	81.12	80.95
80.80	80.69	80.61	80.57	80.56	80.57	80.57	80.55	80.49	80.38	80.25	80.12
80.00	79.90	79.83	79.78	79.77	79.78	79.79	79.80	79.78	79.69	79.54	79.31
79.04	78.73	78.41	78.09	77.79	77.51	77.26	77.05	76.84	76.67	76.70	77.19
78.39	80.65	85.41	97.02	109.75							
220.44	184.01	149.77	127.56	113.96	105.10	98.89	94.61	91.80	89.99	88.84	88.10
87.63	87.26	86.90	86.54	86.19	85.85	85.51	85.18	84.86	84.54	84.23	83.93
83.64	83.36	83.09	82.82	82.57	82.32	82.08	81.85	81.63	81.43	81.24	81.08

80.94	80.82	80.74	80.68	80.64	80.62	80.59	80.54	80.47	80.38	80.26	80.15
80.03	79.93	79.86	79.80	79.76	79.73	79.70	79.66	79.59	79.47	79.31	79.09
78.83	78.54	78.24	77.94	77.65	77.38	77.13	76.92	76.71	76.54	76.57	77.03
78.18	80.34	84.93	96.74	109.55							
220.14	183.85	149.72	127.55	113.96	105.09	98.90	94.65	91.86	90.07	88.93	88.19
87.72	87.35	86.99	86.63	86.28	85.93	85.59	85.26	84.94	84.63	84.32	84.02
83.73	83.45	83.18	82.91	82.66	82.41	82.18	81.95	81.74	81.54	81.36	81.20
81.06	80.94	80.85	80.77	80.71	80.66	80.61	80.55	80.47	80.37	80.26	80.15
80.04	79.94	79.85	79.78	79.71	79.65	79.59	79.51	79.40	79.27	79.09	78.87
78.62	78.35	78.06	77.77	77.49	77.22	76.97	76.76	76.56	76.40	76.45	76.89
77.99	80.06	84.45	96.48	109.35							
219.85	183.68	149.67	127.54	113.96	105.09	98.92	94.70	91.93	90.16	89.02	88.29
87.82	87.45	87.08	86.72	86.37	86.03	85.69	85.36	85.04	84.72	84.42	84.12
83.83	83.55	83.28	83.01	82.76	82.52	82.29	82.07	81.86	81.66	81.48	81.32
81.18	81.05	80.94	80.85	80.78	80.70	80.63	80.55	80.46	80.36	80.26	80.15
80.04	79.93	79.83	79.74	79.65	79.56	79.47	79.36	79.23	79.07	78.88	78.67
78.42	78.16	77.88	77.59	77.31	77.05	76.80	76.59	76.39	76.25	76.33	76.75
77.82	79.79	83.97	96.22	109.15							
219.56	183.52	149.62	127.52	113.96	105.09	98.94	94.75	92.01	90.25	89.12	88.39
87.92	87.55	87.19	86.83	86.48	86.13	85.80	85.47	85.15	84.83	84.52	84.23
83.94	83.66	83.39	83.13	82.87	82.63	82.40	82.18	81.97	81.78	81.60	81.43
81.28	81.15	81.03	80.93	80.83	80.74	80.65	80.56	80.46	80.36	80.24	80.13
80.01	79.90	79.79	79.68	79.57	79.46	79.34	79.21	79.06	78.89	78.69	78.47
78.23	77.97	77.70	77.42	77.14	76.87	76.62	76.40	76.20	76.08	76.22	76.63
77.66	79.53	83.47	95.97	108.96							
219.27	183.36	149.57	127.51	113.96	105.10	98.97	94.81	92.09	90.34	89.22	88.50
88.03	87.66	87.30	86.94	86.59	86.25	85.91	85.58	85.26	84.95	84.64	84.35
84.06	83.78	83.51	83.25	82.99	82.75	82.52	82.30	82.09	81.90	81.72	81.55
81.39	81.25	81.12	81.00	80.89	80.79	80.68	80.58	80.47	80.35	80.23	80.11
79.99	79.86	79.74	79.62	79.49	79.36	79.22	79.07	78.91	78.72	78.52	78.29
78.05	77.79	77.53	77.25	76.98	76.71	76.45	76.22	75.99	75.92	76.13	76.52
77.52	79.30	82.96	95.73	108.78							
218.91	183.15	149.51	127.50	113.97	105.11	99.01	94.89	92.20	90.47	89.36	88.64
88.17	87.81	87.45	87.09	86.74	86.40	86.07	85.74	85.42	85.11	84.80	84.51
84.22	83.94	83.67	83.41	83.15	82.91	82.68	82.46	82.25	82.05	81.86	81.69
81.52	81.37	81.23	81.09	80.97	80.84	80.72	80.60	80.47	80.35	80.22	80.09
79.95	79.82	79.68	79.54	79.39	79.24	79.08	78.91	78.73	78.53	78.32	78.09
77.85	77.60	77.33	77.07	76.80	76.53	76.27	76.03	75.74	75.74	76.07	76.40
77.38	79.03	82.32	95.43	108.55							
218.38	182.85	149.42	127.49	113.98	105.14	99.09	95.02	92.37	90.67	89.58	88.87
88.41	88.04	87.69	87.33	86.99	86.65	86.32	85.99	85.67	85.36	85.06	84.76
84.48	84.20	83.92	83.66	83.41	83.16	82.93	82.70	82.49	82.28	82.08	81.90
81.72	81.55	81.39	81.23	81.08	80.94	80.79	80.65	80.50	80.36	80.21	80.06
79.90	79.75	79.59	79.42	79.25	79.08	78.90	78.71	78.51	78.30	78.07	77.84
77.60	77.35	77.10	76.85	76.60	76.35	76.12	75.92	75.74	75.74	76.07	76.40
77.38	79.02	82.31	95.43	108.55							
217.59	182.40	149.29	127.47	114.01	105.21	99.24	95.26	92.67	91.01	89.94	89.24
88.79	88.43	88.08	87.73	87.39	87.06	86.73	86.41	86.09	85.78	85.48	85.18
84.90	84.62	84.34	84.08	83.82	83.57	83.33	83.09	82.86	82.64	82.43	82.23
82.03	81.84	81.65	81.46	81.29	81.11	80.93	80.76	80.58	80.41	80.23	80.05
79.87	79.68	79.49	79.30	79.10	78.90	78.69	78.48	78.26	78.04	77.81	77.58
77.34	77.10	76.87	76.64	76.42	76.22	76.03	75.88	75.74	75.74	76.07	76.40
77.38	79.02	82.31	95.43	108.55							
216.42	181.73	149.10	127.46	114.10	105.38	99.54	95.68	93.19	91.58	90.55	89.87
89.43	89.08	88.74	88.40	88.07	87.74	87.42	87.10	86.79	86.48	86.18	85.88
85.59	85.31	85.03	84.76	84.49	84.23	83.97	83.72	83.48	83.24	83.00	82.77
82.55	82.32	82.10	81.88	81.67	81.45	81.24	81.03	80.81	80.60	80.38	80.16
79.94	79.72	79.50	79.27	79.04	78.81	78.57	78.34	78.10	77.86	77.62	77.39
77.16	76.93	76.72	76.51	76.32	76.15	75.99	75.86	75.74	75.74	75.74	75.74
77.38	79.02	82.30	92.15	108.55							
214.71	180.75	148.82	127.48	114.29	105.75	100.12	96.45	94.09	92.57	91.58	90.94
90.52	90.19	89.86	89.53	89.21	88.89	88.57	88.26	87.96	87.65	87.35	87.06
86.76	86.48	86.19	85.91	85.63	85.36	85.09	84.82	84.55	84.29	84.03	83.77
83.51	83.25	83.00	82.74	82.48	82.23	81.97	81.71	81.46	81.20	80.94	80.67
80.41	80.14	79.88	79.61	79.34	79.07	78.80	78.53	78.26	78.00	77.74	77.48

77.23	76.99	76.77	76.55	76.35	76.17	76.01	75.88	75.74	75.74	75.74	75.74
77.38	77.39	77.40	85.61	108.55							
212.24	179.32	148.42	127.59	114.72	106.51	101.23	97.84	95.68	94.28	93.37	92.78
92.39	92.08	91.77	91.47	91.16	90.86	90.57	90.27	89.98	89.69	89.40	89.11
88.83	88.54	88.26	87.98	87.70	87.42	87.15	86.87	86.59	86.32	86.04	85.76
85.49	85.21	84.93	84.65	84.36	84.08	83.79	83.50	83.21	82.91	82.61	82.31
82.00	81.69	81.38	81.07	80.75	80.43	80.11	79.78	79.46	79.13	78.80	78.48
78.16	77.84	77.52	77.22	76.91	76.62	76.34	76.06	75.74	75.74	75.74	75.74
77.37	77.38	75.74	75.79	105.27							
208.76	177.29	147.89	127.87	115.61	107.99	103.24	100.27	98.39	97.20	96.42	95.92
95.58	95.32	95.06	94.80	94.54	94.29	94.03	93.78	93.53	93.28	93.04	92.80
92.55	92.31	92.07	91.83	91.60	91.36	91.12	90.89	90.65	90.41	90.18	89.94
89.70	89.47	89.23	88.98	88.74	88.49	88.25	87.99	87.74	87.48	87.21	86.95
86.67	86.39	86.10	85.81	85.50	85.19	84.87	84.54	84.20	83.85	83.49	83.11
82.73	82.33	81.91	81.48	81.04	80.59	80.12	79.64	79.03	79.03	79.02	77.39
77.38	75.74	75.73	75.76	105.25							
204.33	174.71	147.25	128.45	117.10	110.29	106.22	103.77	102.27	101.34	100.75	100.37
100.13	99.93	99.74	99.56	99.37	99.19	99.02	98.85	98.68	98.51	98.35	98.19
98.04	97.89	97.74	97.60	97.46	97.32	97.19	97.07	96.94	96.82	96.71	96.60
96.49	96.38	96.28	96.19	96.10	96.01	95.93	95.85	95.77	95.70	95.64	95.58
95.52	95.47	95.42	95.37	95.34	95.30	95.27	95.25	95.23	95.21	95.20	95.20
95.20	95.20	95.22	95.23	95.26	95.29	95.32	95.37	95.41	92.19	88.88	85.58
82.31	75.74	75.74	79.02	85.57							
199.60	171.93	146.61	129.26	118.93	112.89	109.37	107.30	106.06	105.29	104.81	104.51
104.31	104.15	104.00	103.86	103.71	103.57	103.43	103.30	103.17	103.04	102.91	102.79
102.68	102.56	102.45	102.34	102.24	102.14	102.04	101.94	101.85	101.76	101.68	101.59
101.51	101.43	101.36	101.29	101.21	101.15	101.08	101.01	100.95	100.88	100.82	100.76
100.70	100.63	100.57	100.51	100.44	100.37	100.30	100.22	100.14	100.06	99.97	99.88
99.78	99.67	99.56	99.44	99.31	99.18	99.04	98.89	98.69	97.08	95.43	92.14
88.86	75.74	75.74	75.74	75.75							

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      3        37          // nrchop (rch in top layer), irchcb (flow terms)
      1         0          // inrech, inirch
    102  2.28e-04        (4x,77f2.0)         1    //recharge
      7
   12.0    20.65     12.0     12.0    20.65    20.65    1.0
   1 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7
   2 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7
   3 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7
   4 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7
   5 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7
   6 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7
   7 7 7 7 7 7 7 7 7 7 7 7 7 6 6 6 6 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 3 3 3 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7
   8 7 7 7 7 7 7 7 7 7 7 7 7 6 6 6 6 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 3 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 7 7 7 7 7 7 7 7 7 7 7
   9 7 7 7 7 7 7 7 7 7 7 7 7 6 6 6 6 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 3 3 3 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 7 7 7 7 7 7 7 7 7 7
  10 0 7 7 7 7 7 7 7 7 7 7 7 7 6 6 6 6 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 3 3 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 7 7 7 7 7 7 7 7 7
   1 7 7 7 7 7 7 7 7 7 7 7 7 6 6 6 6 6 6 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 3 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 7 7 7 7 7 7 7 7
   2 7 7 7 7 7 7 7 7 7 7 7 7 6 6 6 6 6 6 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 3 2 2 2 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 7 7 7 7 7 7 7
   3 7 7 7 7 7 7 7 7 7 7 7 7 6 6 6 6 6 6 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 3 3 2 2 2 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 7 7 7 7 7 7 7
   4 7 7 7 7 7 7 7 7 7 7 7 7 6 6 6 6 6 6 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 3 2 2 2 2 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 7 7 7 7 7 7 7
   5 7 7 7 7 7 7 7 7 7 7 7 7 6 6 6 6 6 6 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 3 2 2 2 2 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 7 7 7 7 7 7 7
   6 7 7 7 7 7 7 7 7 7 7 7 7 6 6 6 6 6 6 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 3 2 2 2 2 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 7 7 7 7 7 7 7
   7 7 7 7 7 7 7 7 7 7 7 7 7 6 6 6 6 6 6 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 3 3 2 2 2 2 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 7 7 7 7 7 7 7
   8 7 7 7 7 7 7 7 7 7 7 7 7 6 6 6 6 6 6 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 3 3 2 2 2 2 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 7 7 7 7 7 7 7
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1	37	55	4	7	0.	79.82	2400.00	78.82	79.32
1	37	56	4	8	0.	79.80	2400.00	78.80	79.30
1	37	57	4	9	0.	79.78	2400.00	78.78	79.28
1	57	10	5	1	0.	91.63	2400.00	90.63	91.13
1	58	10	5	2	0.	91.66	2400.00	90.66	91.16
1	59	10	5	3	0.	91.71	2400.00	90.71	91.21
1	59	11	5	4	0.	90.47	2400.00	89.47	89.97
1	58	11	5	5	0.	90.39	2400.00	89.39	89.89
1	57	11	5	6	0.	90.33	2400.00	89.33	89.83
1	57	12	5	7	0.	89.55	3600.00	88.55	89.05
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1	57	14	5	9	0.	88.77	2400.00	87.77	88.27
1	56	14	5	10	0.	88.72	2400.00	87.72	88.22
1	56	15	5	11	0.	88.46	2400.00	87.46	87.96
1	56	16	5	12	0.	88.21	2400.00	87.21	87.71
1	55	16	5	13	0.	88.25	2400.00	87.25	87.75
1	55	17	5	14	0.	88.04	2400.00	87.04	87.54
1	54	18	5	15	0.	87.96	2400.00	86.96	87.46
1	54	19	5	16	0.	87.73	2400.00	86.73	87.23
1	53	20	5	17	0.	87.70	2400.00	86.70	87.20
1	53	21	5	18	0.	87.58	2400.00	86.58	87.08
1	53	22	5	19	0.	87.82	2400.00	86.82	87.32
1	53	23	5	20	0.	87.89	2400.00	86.89	87.39
1	52	24	5	21	0.	88.29	2400.00	87.29	87.79
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1	52	27	5	24	0.	86.77	2400.00	85.77	86.27
1	51	28	5	25	0.	86.58	2400.00	85.58	86.08
1	51	29	5	26	0.	85.64	2400.00	84.64	85.14
1	51	30	5	27	0.	84.73	2400.00	83.73	84.23
1	52	31	5	28	0.	83.71	2400.00	82.71	83.21
1	52	32	5	29	0.	83.45	2400.00	82.45	82.95

1	53	33	5	30	0.	83.22	2400.00	82.22	82.72
1	53	34	5	31	0.	82.75	2400.00	81.75	82.25
1	53	35	5	32	0.	82.18	2400.00	81.18	81.68
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1	53	38	5	35	0.	81.47	2400.00	80.47	80.97
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1	53	40	5	37	0.	81.43	2400.00	80.43	80.93
1	53	41	5	38	0.	81.24	2400.00	80.24	80.74
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1	50	63	5	63	0.	79.55	2400.00	78.55	79.05

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The Resolve Site Particle Tracking Procedure for Simulation of the Effects of Extraction Wells under Steady-State Flow Conditions
April, 1993
S. S. Papadopulos & Associates

A particle tracking model, PATH3D, was used to define capture zones for extraction wells. The program was written and is distributed by SSP&A. The program is run in conjunction with MODFLOW. The input files needed by PATH3D include those used for the MODFLOW simulation as well as an additional file called the particle tracking input file. Additionally, for the purposes of running PATH3D, several lines need to be appended to MODFLOW's block-centered flow package input file. The data files needed in addition to the MODFLOW data files are described below.

BAS.DAT: This file is used as input for MODFLOW's basic package. It is identical to that used for the original steady-state flow simulation (with no extraction wells operating) except that it specifies that the well package is used.

BCF.DAT: This file is used as input for MODFLOW's block-centered flow package. It is identical to that used for the original steady-state flow simulation, except that it is appended with the additional arrays htop and dz, as described in the PATH3D user's manual.

WEL.DAT: This file is used as input for MODFLOW's Well Package.

P3D1A.in This file is one of six particle tracking input files used for the Resolve model. Six PATH3D simulations were conducted for each MODFLOW simulation. Each PATH3D simulation tracked particles in either the east or west side of layer 1, 2, or 3. The six files used are defined as follows:

- P3D1A.in: corresponds to particles originating on the west side of layer 1
- P3D1B.in: corresponds to particles originating on the east side of layer 1
- P3D2A.in: corresponds to particles originating on the west side of layer 2
- P3D2B.in: corresponds to particles originating on the east side of layer 2
- P3D3A.in: corresponds to particles originating on the west side of layer 3
- P3D3B.in: corresponds to particles originating on the east side of layer 3

During execution of PATH3D, the following responses should be entered at the questions which are directed to the screen. Input files which were not described above correspond to the input files used for the original steady-state MODFLOW simulations (the run with no extraction wells operating). Responses which are the choice of the user are given as "arbitrary".

Enter name for standard output file: arbitrary

Enter name for particle tracking input file: p3d1a.in (for example)

Enter name of input head file: mod.luh (name of unformatted head file from MODFLOW simulation of extraction well operation)

Enter U if the head file is unformatted; otherwise, enter format of the head file: u

Print out heads for checking? (enter Y or N) n

Enter name for BAS package input file: bas.dat

Enter name for BCF package input file: bcf.dat

Enter name for WEL package input file: wel.dat

```
Enter name for DRN package input file:  drn.dat

Enter name for RIV package input file:  riv.dat

Enter name for STR package input file:  str.dat

Enter name for RCH package input file:  rch.dat

Enter name for EVT package input file:  evt.dat

Enter name for formatted file for unit number 35:  shead.dat

Enter name for formatted file for unit number 42:  cond.dat

Enter name for formatted file for unit number 43:  11top.grd

Enter name for formatted file for unit number 44:  dz1234.dat

Enter name for formatted file for unit number 32:  11top.dat
```

(Report Case 4a)

```
Resolve Site, Massachusetts
SSP246      March 1993      Jane Houlihan
          4         76         77          1          4
 11 12 13 14 15 00 00 18 19 00 00 22 00 24 00 00 00 00 00 00 00 00 00 00
          0          0     IAPART,ISTRT
        101          0()                              2     IBOUND-layer 1
 2
 1  76  1  77  1
 1   1  4  12  1
          0          1     (fmtin not used)           2     IBOUND-layer 2
          0          1     (fmtin not used)           2     IBOUND-layer 3
          0          1     (fmtin not used)           2     IBOUND-layer 4
       999.                                                 HNOFLO
         35         0.           (20f11.2)            4     starting head-layer 1 -- 11top.grd
         35         0.           (20f11.2)            4     starting head-layer 2 -- 11top.grd
         35         0.            (12f9.2)            4     starting head-layer 3 -- 13top.grd
         35         0.            (12f9.2)            4     starting head-layer 4 -- 13top.grd
         1.          1        1.1                           PERLEN,NSTP,TSMULT 1st sp
```

43	0.	(20f11.2)	*/htop, using layer 1 shead
44	0.	(12f9.2)	*/dz1
44	0.	(12f9.2)	*/dz2
44	0.	(12f9.2)	*/dz3
44	0.	(12f9.2)	*/dz4
0	0.25		*/porosity l1
0	0.25		*/porosity l2
0	0.25		*/porosity l3
0	0.25		*/porosity l4

16	37			// mxwell, iwelcb
16				// itmp
1	25	44	-481.	// lay, row, col, q
2	25	44	-481.	// lay, row, col, q
1	29	50	-481.	// lay, row, col, q
2	29	50	-481.	// lay, row, col, q
1	33	52	-481.	// lay, row, col, q
2	33	52	-481.	// lay, row, col, q
1	38	51	-481.	// lay, row, col, q
2	38	51	-481.	// lay, row, col, q
1	43	50	-481.	// lay, row, col, q
2	43	50	-481.	// lay, row, col, q
1	32	40	-481.	// lay, row, col, q
2	32	40	-481.	// lay, row, col, q
1	36	41	-481.	// lay, row, col, q
2	36	41	-481.	// lay, row, col, q
1	40	40	-481.	// lay, row, col, q
2	40	40	-481.	// lay, row, col, q

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