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Analysis of soil and groundwater samples in Bhopal:

(Results of Ground Water and Soil Samples Collected from UCIL Premises, Bhopal in November, 2012)

Final Report

Submitted
to

Central Pollution Control Board
Parivesh Bhawan, East Arjun Nagar
Delhi-110032

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Genesis:

CPCB, New Delhi funded this project to IITR, Lucknow vide letter No. A-14011/1/2011-Mon/5870 dated 13/10/2011 to carry out the analysis of groundwater, soil and sub-soil samples from UCIL, Bhopal premises and in the nearby vicinity with particular reference to some selected physico-chemical parameters, heavy metals and organics. The survey and analysis of soil and ground water samples in and around UCIL premises were carried out by CSIR-IITR as per the terms of reference of the and subsequently under the directives of the Hon'ble Supreme Court of India.

Background Information:

M/s. Union Carbide India Ltd. (UCIL), manufactured carbamate pesticides and the associated intermediate chemicals at their Bhopal unit from 1969 to 1984. The unit was closed down in December 1984 as a result of the infamous accident of leakage of methyl iso-cyanate gas (MIC) *(Source: NEERI Report of June 2010).*

The solid, semi-solid, liquid and tarry wastes generated during the manufacture of pesticides and associated chemicals were dumped by UCIL within their premises from 1969 to 1984 *(Source: NEERI Report of June 2010).*

The unscientific disposal of these wastes could have resulted in contamination of land and water environment in and around plant premises of UCIL. and may require remediation, in case the contamination levels exceed the permissible limits delineated by national/international regulations *(Source: NEERI Report of June 2010).*

Considering the background data/information generated by the past studies carried out by NEERI, and apprehensions/issues raised by various agencies/organizations, the field studies (survey, sampling and analysis) were carried out by CSIR-IITR in the month of February to December, 2012.

Work done by CSIR-IITR:

CSIR-IITR team made their first sampling visit to the area in the month of August, 2012 and collected 27 ground water samples from outside the UCIL premises. The samples were analyzed for all the parameters and the report was submitted to CPCB, Delhi. However, on the 28th of August, 2012, Hon. Supreme Court of India directed that the water samples should be collected in the presence of the NGO (Bhopal Group for Information and Action).

The CSIR-IITR team jointly with the officials of the NGO, CPCB Bhopal, MPPCB, Nagar Nigam Bhopal and Gas Rahat and Rehabilitation Bhopal again collected 30 ground water samples outside the UCIL premises on 13th September, 2012. The report was submitted to the court on the 25.09.2012. On the 25th of September, Hon. Supreme Court of India again directed that the sampling be done from the same locations in the month of October, 2012 in the presence of officials of NGO.

Accordingly CSIR-IITR team went to Bhopal and collected 26 water and 10 soil samples from outside the UCIL premises on the 12th of October, 2012 in the presence of officials from NGO and other agencies. Out of the 30 water sampling sites identified earlier (in September, 2012), 4 water sources were permanently sealed by Bhopal Municipal Corporation and no sample could be collected from those 4 sources. All the analysis reports have been submitted to the Hon. Supreme Court of India from time to time.

CSIR-IITR team visited the UCIL site in Bhopal in the month of November, 2012 and collected 24 soil and sub-soil samples in the UCIL premises in the presence of the officials of the NGO, CPCB Bhopal, MPPCB, Nagar Nigam Bhopal and Gas Rahat and Rehabilitation Bhopal. Five bore wells were also dug at the locations identified by NEERI, Nagpur in 2010 and soil sample were collected from various depths. The drilling operations were coordinated by CPA (Capital Project Authority). The drilling was done till water level was reached and one sample from each well was also collected. The collected water and soil samples were transported to IITR, Lucknow for processing and analysis using standard protocols.

Methodologies:

General layout of the UCIL plant in Bhopal, sampling locations for surface and sub-soil samples, locations of the different sectors in the UCIL plant and the locations of the five bore wells dug inside the UCIL plant are given in the figures in this report (source NEERI report). The sampling sites were chosen as close to the sites identified by the NEERI team as possible. Two sites were identified by the officials of the NGO (site 6A and 7A).

Soil samples in the UCIL premises were collected from the surface and also from the depth of 30 cm from the surface (details as given in Table 1). Soil samples from five dug well were collected from the surface and also from various depths (details given in Tables 2-6). One water sample from each dug well was collected when the water strata was reached. GPS coordinates for each sampling site were recorded and the data is depicted in each table. All the sampling was witnessed by the officials from various organizations as mentioned above.

Soil samples were air dried, ground in a manual pestle mortar and sieved using a nylon mesh. All the physico-chemical parameters, heavy metals and organics in the water samples were analyzed following the standard procedures (APHA, 2005). Heavy metals (lead, cadmium, nickel, cobalt, copper, zinc and chromium) were analyzed on Flame Atomic Absorption Spectrometer (AAnalyst 300 from Perkin Elmer, USA) while mercury was analyzed on AAnalyst 300 with a FIAS-100 system. Samples for organics were processed by liquid –liquid extraction method and subjected to instrumental analysis. Aldicarb, carbaryl and alpha-naphthol were analyzed on a LC-MS-MS (Model API-4000 from ABSiex, USA) while isomers of HCH and dichlorobenzene were analyzed on a GC with micro ECD (Agilent 5890A).

Soil organics were extracted by the QUCHERS method and analysed on GC and LCMS-MS. Non volatile metals from the soil were extracted by the method 3051A (USEPA) and mercury by method 7471b (USEPA) and analysed on Atomic Absorption Spectrometer (Flame and FIAS-100).

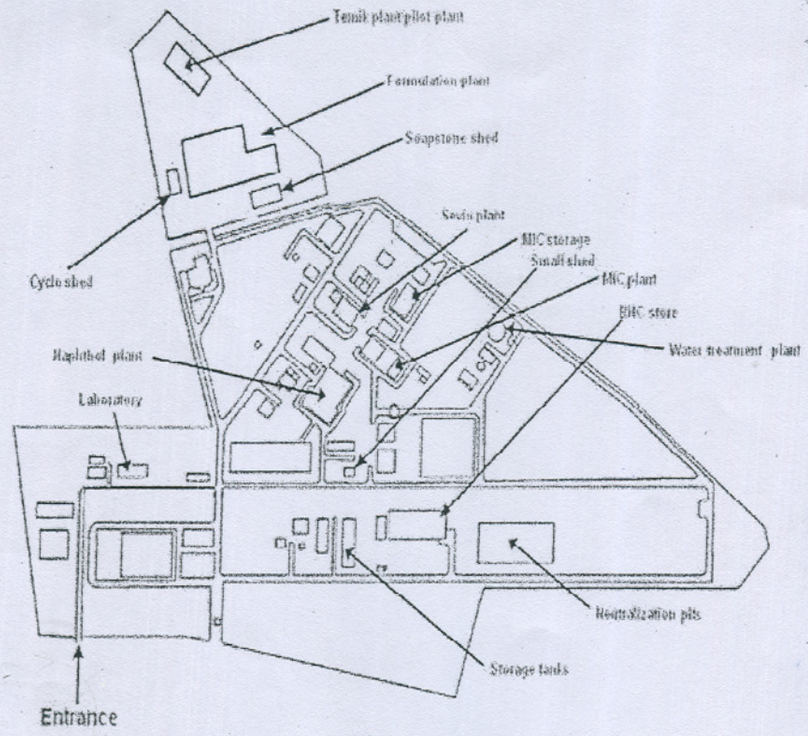
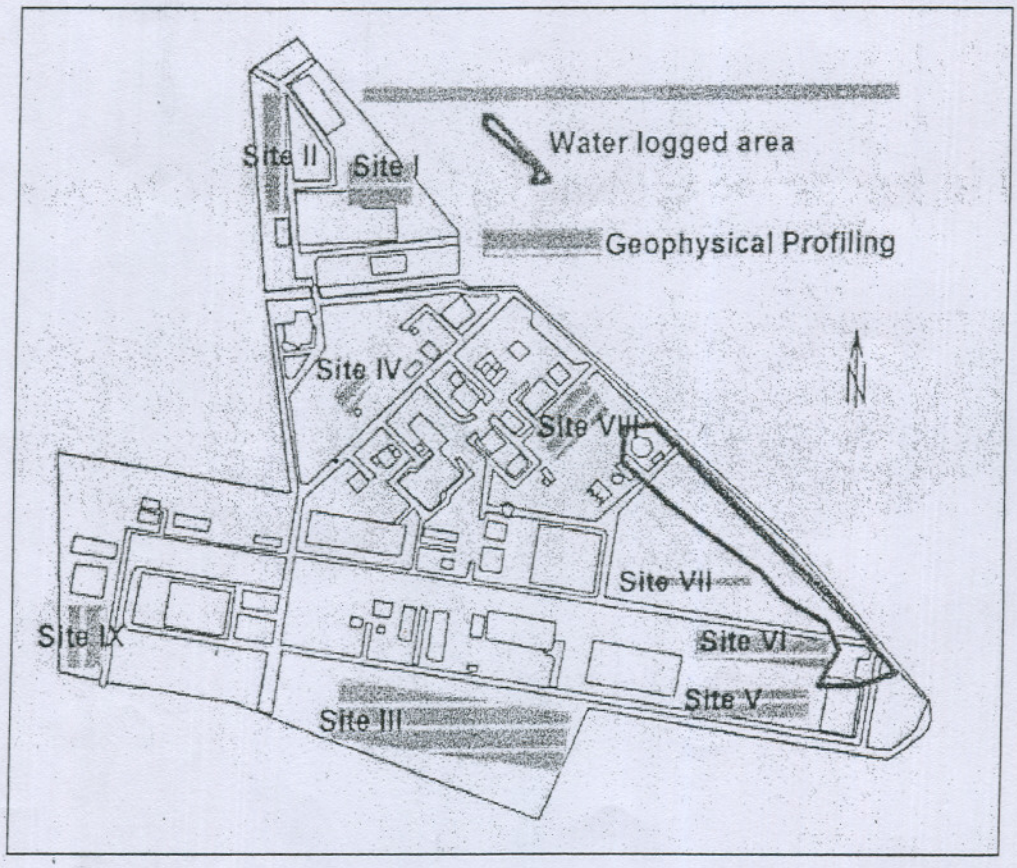
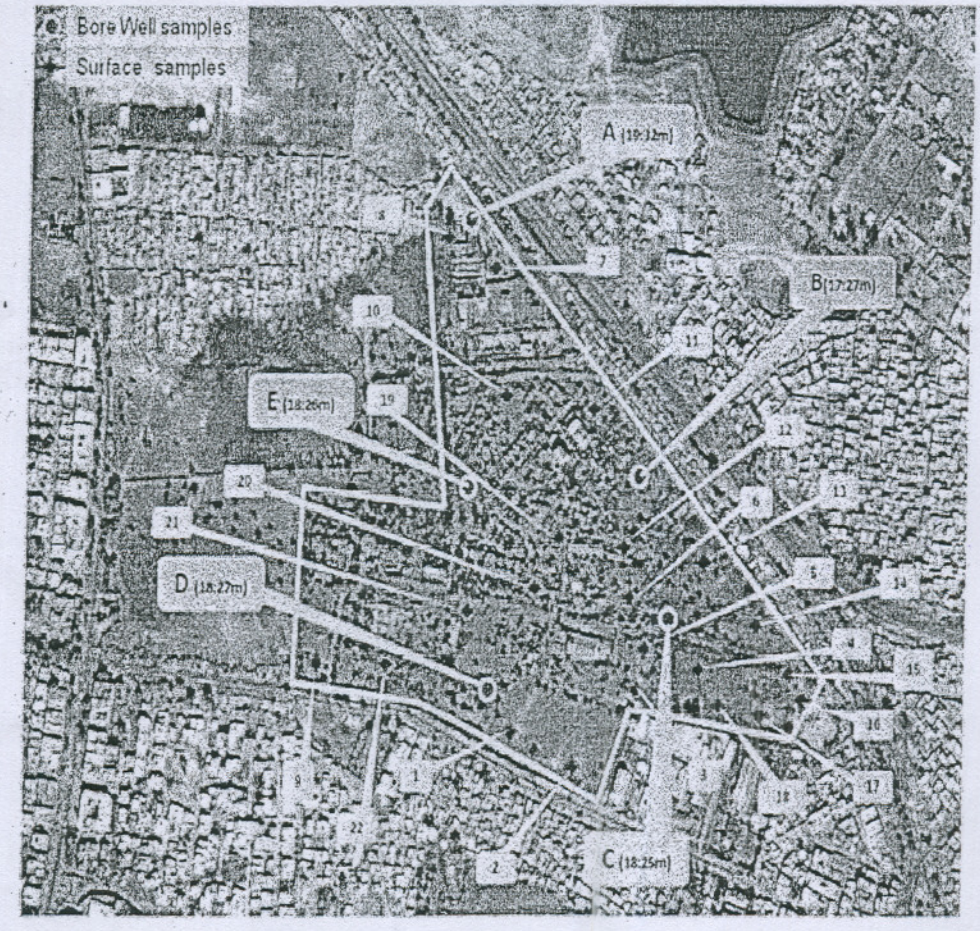


Figure showing general layout of UCIL plant (Source: NEERI report)



Figures showing the different sectors in UCIL plant (Above) and location of sampling points (below) (Source NEERI report)



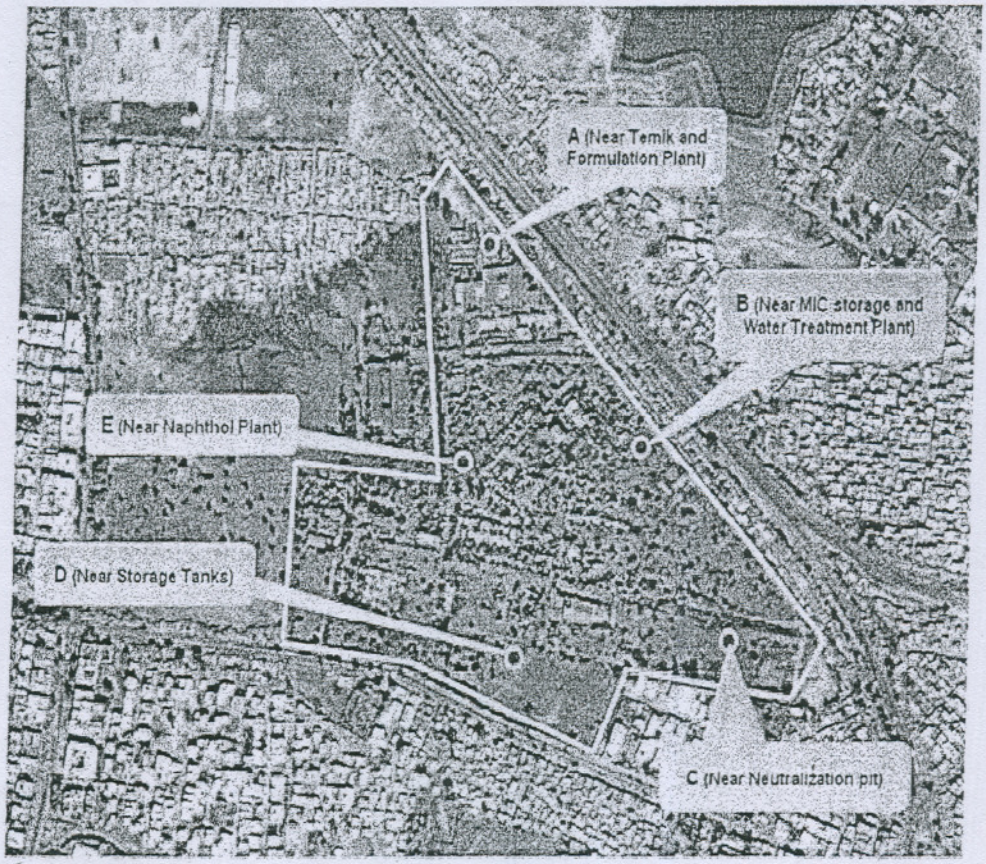


Figure showing the locations of the deep bore holes in the UCIL premises (source NEERI report)

Results of the studies carried out by CSIR-IITR:

In order to assess vertical as well as lateral extent of contamination, soil and groundwater samples were collected by CSIR-IITR from various locations (as identified by NEERI), in and around UCIL premises. First round of water sampling (outside the UCIL premises in August, 2012) was carried out in the presence of CPCB-Bhopal officials, whereas the other two rounds (September and October, 2012) were carried out from the same locations but different from the locations of the first round in the presence of officials of the NGO, MPPCB, CPCB-Bhopal, Bhopal Nagar Nigam, Bhopal Gas Rahat and Rehabilitation Department (CPA) as per the directives of the Hon'ble Supreme Court of India. The standard international sampling and analysis protocols as delineated in the report, were followed during the monitoring of soil and groundwater.

With the cooperation and help of Capital Project Authority (CPA) Bhopal, surface, sub-surface soil samples from 24 locations and depth-wise soil samples from five different locations (as identified by NEERI earlier) were collected in the month of November, 2012. The drilling at these five locations (A, B, C, D and E) was done till the groundwater strata was reached and one water sample from each of these five locations was also collected. All the sampling was carried out in the presence of officials from the NGO, MPPCB, CPCB-Bhopal, Bhopal Nagar Nigam, Bhopal Gas Rahat and Rehabilitation Department (CPA). The samples for processing analysis were transported to CSIR-IITR, Lucknow.

All these ground water, soil and sub-soil samples were analysed for the parameters outlined by the CPCB, New Delhi (TOR of the project) following the International Standard Protocols. These parameters included: volatiles /semi volatiles (Carbaryl, aldicarb, α-naphthol, α, β, γ, δ isomers of hexachlorocychlohexane (HCH) and dichlorobenzene), heavy metals (mercury, cadmium, nickel, chromium, cobalt, lead, zinc, and copper) and physico-chemical parameters (pH, Electrical Conductivity, Total Organic Carbon, Fluoride, Chloride, Nitrate, Phosphate, Sulphate, Sodium and Potassium).

1.0 Groundwater outside the UCIL premises:

1.1 August, 2012: Except levels of nitrate (5 samples), lead (4 samples) and nickel (12 samples) of the 26 samples, levels of all other contaminants/ parameters were well within their respective permissible limits (BIS 10500: 2012; WHO, 2004; USEPA, 2004). (Detailed report submitted earlier).

1.2 September, 2012: The sampling locations were different from those in August, 2012. Except the levels of nitrate (9 samples), lead (24 samples) and nickel (2 samples) among the 30 samples, levels of the none of the physico-chemical/metal exceeded their respective permissible limits. In case of only two samples each, the levels of α, β, and δ-HCH marginally exceeded their respective BIS limits (BIS 10500:2012). (Detailed report submitted earlier).

1.3 October, 2012:

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1.3.1 **Water:** Water sampling locations were the same as those in September 2012 but four of the water sources were permanently sealed by Nagar Nigam Bhopal. Except the levels of nitrate (7 samples) and lead (22 samples) among the 26 samples, levels of none of the physico-chemical/metal exceeded their respective permissible limits. However, levels of α-HCH (11 samples), β-HCH (2 samples), and δ-HCH (8 samples) exceeded their respective BIS permissible limits (BIS 10500:2012). (Detailed report submitted earlier).

1.3.2 **Soil:** Among the four soil samples collected upstream and six soil samples downstream of UCIL (outside the premises), in few of the samples moderate levels of organic contaminants and less than 0.563 mg/kg (maximum level) of mercury (Detailed report submitted earlier) were detected.

2.0 Soil, sub-soil and groundwater quality within the UCIL premises (November, 2012)

2.1 Soil and sub soil samples:

2.1.1 Organics: (Table 7 & 8)

- Aldicarb was below detection limit (< 0.01 mg/kg) in all the surface and sub-surface soil samples collected from 24 locations within the UCIL premises.
- Concentration of carbaryl ranged from < 0.01 to 0.720 mg/kg except in one sample of surface and sub-surface soil which showed concentration of 1.004 mg/kg.
- Concentration of α-naphthol ranged from < 0.01 to 5.576 mg/kg in the surface and sub-surface soil samples.
- α-HCH ranged from < 0.01 to 8.48 mg/kg. (However, two of the samples showed levels of 19.996 and 33.458 mg/kg)
- β-HCH ranged from < 0.01 to 7.20 mg/kg. (However, one of the samples showed levels of 14.968 mg/kg)
- γ-HCH ranged from < 0.04 to 2.591 mg/kg.
- δ-HCH ranged from < 0.06 to 3.405 (However, two of the samples showed levels of 8.365 and 15.356 mg/kg)
- At one of the spots 7A (identified by the NGO), the maximum levels of α, β, γ and δ isomers of HCH in the surface and sub-surface soil were 815.0, 828.207, 380.37 and 1099.5 mg/kg. The CSIR-IITR team during sampling observed that this place was smelling like pesticides.

2.1.2 Metals: (Table 14 & 15)

- Lead levels in the surface and sub-soil ranged from 3.25 to 102.9 mg/kg.
- Cadmium levels ranged from 0.21 to 1.487 mg/kg.
- Nickel levels ranged from 31.142 to 179.0 mg/kg

- Cobalt levels ranged from 10.14 to 199 mg/kg
- Copper levels ranged from 17.49 to 253 mg/kg
- Zinc levels ranged from 21.85 to 354 mg/kg
- Chromium levels ranged from 7.96 to 145.1 mg/kg
- Mercury levels ranged from < 0.05 to 3.57. Mercury could be detected in all the 24 surface soil samples and only 13 of the sub-surface soil samples.

2.1.3 Physico-chemical parameters: (Table 21 & 22)

- pH of the surface and sub-soil varied in the range of 6.74 to 8.85.
- Fluoride ranged from 1.67 to 32.45 mg/kg
- Total organic carbon level ranged from 1.17 to 10.13 %.
- Chloride levels were in the range of 18.57 to 1661 mg/kg.
- Nitrate levels were between 1.53 to 126.95 mg/kg.
- Phosphate level was between 1.02 to 501.8 mg/kg
- Sulphate level was between 15.17 to 1208 mg/kg. However, at two of the points, levels of 16420 and 30655 were found.
- Sodium levels were found between 30 to 1244 mg/kg
- Potassium levels were between 128 to 1680 mg/kg.
- Values of all the physico-chemical parameters in soil samples collected from inside the UCIL premises and outside the UCIL premises are almost in the same range.

2.2 Soil samples from different depths of bore wells

2.2.1 Organics: (Tables 9 to 13)

- Aldicarb levels were below detection limits in all the samples.
- DCB level was also found below detection limit in bore well A, B, C and D. However, it was detected in well E at upper soil only.
- Maximum level of Carbaryl was detected at bore well C i.e. 3.941 mg/kg. However, there was a decreasing trend in the level with the depth.
- Maximum level of α-Naphthol was found at bore well E i.e. 0.295 mg/kg which decreased successively with the depth.
- α-HCH was in maximum concentration at bore well B i.e. 11.15 which successively decreased with the depth to the extent of below detection limit.
- Similarly β, γ and δ- HCH were found in the maximum concentration at well A i.e. 0.74, 0.499 and 0.461 mg/kg respectively which also successively decreased to the lowest extent of detection.
- Analysis of soil (collected during drilling of 5 bore holes) indicated contamination of soil up to a depth of about 2 m with organics. However, at the lower depths also, traces of some of the organics could be detected.
- There are no permissible limits of organics in soil as per the literature available to us.

2.2.2 Metals: (Tables 16 to 20)

- All the metals except mercury could be detected in soil samples from all the depths in all the bore wells. Mercury could be detected in soil samples up to a maximum of 2 meters only. There are no permissible limits for metals in soil as per the literature available to us.

2.2.3 Physico-chemical parameters: (23 to 27)

- The range of physico-chemical parameters is given in Table 29 and 30 and it appears that there is a wide variation which is but natural. There are no permissible limits of physic-chemical parametrs in soil as per the literature available to us.

2.3 Groundwater quality in the five deep bore holes within the UCIL premises

2.3.1 Organics: (Table 28)

- Aldicarb was found to be below detection limits in all the five water samples.
- Carbaryl could only be detected in water from bore well D and E i.e. 0.071 and 0.018 µg/L respectively.
- α-Naphthol was detected between 0.20 to 0.456 µg/L in all the five wells. However, there are no guideline values for this chemical in water.
- The levels of all the four isomers of HCH were below the detection limit.
- DCB levels were detected to be between 13.805 and 26.62 µg/L in water from all the five wells which is well within the permissible limits for water.
- The monitoring of groundwater samples collected from the five bore wells indicated that some of the volatiles and semi-volatile organics are present in these samples. However, these levels are well within the permissible limits as prescribed by Regulatory agencies (BIS, USEPA and WHO).

2.3.2 Metals: (Table 29)

- The levels of all the metals analysed in the water samples of all the five bore wells were within the permissible limits except lead and nickel.
- Lead levels was between 0.023 and 0.058 mg/L (above permissible limit of 0.01 mg/L; BIS. IS:10500.2012).
- Nickel was found slightly above permissible limit in two bore well water samples (B and C) to the extent of 0.021 and 0.023 mg/L (above permissible limit of 0.02 mg/L; BIS. IS:10500.2012).
- Mercury was below the detection limit in all the water samples.

2.3.3 Physico-Chemical parameters: (Table 30)

- All the physico-chemical parameters in the water samples from the bore wells were within the permissible limits (BIS: IS:10500:2012)

- For sodium and potassium the level ranged between 75.4 to 165.9 and 3.40 to 4.1 mg/L respectively. There are no guideline values for these parameters.

Comparison of the results of CSIR-NEERI, 2010 and CSIR-IITR, 2012

A comparative statement of the results of NEERI and IITR are depicted in Tables 31 to 36 in all the samples of soil and water collected from outside and within the UCIL premises. Major points derived from the comparison are:

1.0 Water from outside the UCIL premises:

- In CSIR-IITR study, Aldicarb levels in water were found in the range from < 0.01 to 0.32 µg/L whereas NEERI reported the levels ranging from ND to 3.7 mg/L. It appears that mg/L unit of NEERI might be a typographical error as according to the literature; the maximum solubility of aldicarb in water is 17 µg/L at 25°C. Further, the permissible limit of aldicarb in drinking water is 10 µg/L (WHO, 2004).
- Carbaryl could not be detected in the water samples in both these studies.
- None of the other organics could be detected in water samples as per the CSIR-NEERI report (indicated as ND). In CSIR-IITR study, few of the water samples showed the levels of isomers of HCH above the permissible limits (BIS, IS:10500:2012). It is to be mentioned here that γ-HCH being the most toxic isomer of HCH was found to be within the permissible limit.
- α-Naphthol and DCB were found in few of the water samples in CSIR-IITR study. However, there are no permissible limits prescribed for α-Naphthol and the permissible limit for DCB (Total) in water is 675 µg/L (USEPA, 2004) and 1300 µg/L (WHO, 2004).
- Lead could not be detected in water samples by CSIR-NEERI. However, in CSIR-IITR study, some of the samples showed lead levels higher than the permissible limits (BIS, IS:10500:2012).
- Nickel levels in both the reports are in close agreement and very close to permissible limits.
- Mercury and all other physico-chemical parameters were comparable in both the reports.

2.0 Water from the deep bore wells in the UCIL premises

- In the NEERI study, physico-chemical parameters and metals were not reported and none of the organics could be detected (ND). In CSIR-IITR study, though some of the organics could be detected in the water samples, the levels were within the permissible limits.
- In CSIR-IITR study, lead levels were found to be above permissible limits in water samples from all the wells (BIS, IS:10500:2012). Nickel levels were slightly higher than the permissible limits in two of the bore well samples. Both these parameters were not reported (NR) in NEERI report.

- Levels of mercury, other metals and physico-chemical parameters were found well within the permissible limits in the present study. NEERI study reported mercury as Not Detectable (ND) and did not report any of the other parameters.

3.0 Soil samples from outside the UCIL and inside the UCIL premises

- The reports of CSIR-NEERI (2010) and CSIR-IITR (2012) showed the presence of various organics, metals and physico-chemical parameters in the surface, sub-surface and soil samples from different depths of five bore wells. However, there are no permissible limits for any of these parameters as per the available literature. Analysis of soil (collected during drilling of 5 bore holes) indicated contamination of soil up to a depth of about 2 m with organics. However, at the lower depths also, traces of some of the organics could be detected in CSIR-IITR report.

Overall Conclusion of the CSIR-IITR study

- Surface and sub-surface soil from only one point (7A, near formulation point in UCIL premises) identified by the NGO revealed high levels of isomers of HCH. The place was smelling like pesticide during site visit by CSIR-IITR team.
- Most of the water samples from outside the UCIL premises and all the samples from the five bore wells in the UCIL showed lead levels above the permissible limits for drinking water (BIS, IS:10500:2012).
- The levels of three isomers of HCH (α, β, δ) were found to be higher than the permissible limits in some of the water samples collected from outside the UCIL. γ-HCH (the most toxic isomer of the HCH) levels were within the permissible limits for drinking water (BIS, IS:10500:2012) in all the samples. However, the water from the five bore wells inside the UCIL premises did not reveal the presence of any of the four HCH isomers.
- Although DCB and α-naphthol were detected in water samples from outside the UCIL premises and from the bore wells, the levels of DCB were within the permissible limits and there are no guidelines for α-naphthol.
- Similarly nitrate levels exceed their permissible limits in some of the water samples from outside UCIL premises. However, the levels were within the permissible limits in the water from the five bore wells inside the UCIL premises.
- The presence of inorganics in the groundwater samples outside the UCIL premises have no relation with the past UCIL activity. Presence of organics as detected in some of the groundwater samples may be due to the past UCIL activities as well as due to the usage of HCH in other agricultural/horticultural practices in the surrounding areas.
- In view of the above, the water can be used for other purposes like cleaning, bathing, gardening etc.

Summary of Comparison of CSIR-NEERI (2010) results with CSIR-IITR results (2012)

The details of comparison between CSIR-NEERI and CSIR-IITR results are enumerated in Tables 31- 36. The main points of these tables are:

- IITR report shows that the lead levels are above the permissible limits (BIS: IS:10500:2012) in some of the ground water samples outside the UCIL premises and from the five bore wells inside the UCIL premises. However, NEERI could not detect lead in any of these water samples. This is to be mentioned here that the permissible limits for lead have been brought down from 0.05 to 0.01 µg/L by BIS in 2012.
- IITR report shows that the levels of three isomers of HCH (α, β, δ) were higher than the permissible limits in some of the water samples collected from outside the UCIL. γ-HCH (the most toxic isomer of the HCH) levels were within the permissible limits for drinking water (BIS, IS:10500:2012) in all the samples. However, NEERI report shows all the four isomers of HCH as Not Detected in all the water samples outside and inside the UCIL premises. It is to be mentioned here that earlier, BIS didn't have any guideline values for HCH isomers, which were introduced only in their 2012 edition.
- IITR report shows the presence of α-naphthol and DCB in some of the water samples which were within the permissible limits of USEPA/WHO. BIS has not yet assigned any limits for these parameters. NEERI study could not detect these analytes in any of the water samples.
- IITR study could detect mercury only in two samples of water that too within the BIS permissible limits. Mercury was not reported in any of the water samples by NEERI.
- The levels of Aldicarb and Carbaryl in water samples were within the permissible limits in the NEERI and IITR reports.
- IITR study found the presence of high levels of isomers of HCH in soil at one point (site 7A) which was pointed out by the NGO and included by CSIR-IITR as additional sampling point. NEERI study reported much lower levels of HCH isomers in the same area. There is a possibility that this specific area was not covered by NEERI in their study.

Table 1: Sampling Locations for soil inside UCIL campus in November, 2012

Surface soil Sample Code	Sub-soil * sample code	Location of Sample/Source	GPS Coordinates
SS-1	S-1	Disposal site III	N-23°16.670 E-77°24.583
SS-2	S-2	Disposal site III	N-23°16.657 E-77°24.616
SS-3	S-3	Near neutralization pit outer boundary	N-23°16.696 E-77°24.651
SS-4	S-4	Near neutralization pit inner side of the plant	N-23°16.717 E-77°24.760
SS-5	S-5	In between the neutralization pit and BHC store	N-23°16.715 E-77°24.746
SS-6	S-6	Near BHC store	N-23°16.821 E-77°24.666
SS-6A	S-6A	Near BHC store	N-23°16.812 E-77°24.655
SS-7	S-7	Near formulation plant area	N-23°16.974 E-77°24.559
SS-7A	S-7A	Near formulation plant area	N-23°16.971 E-77°24.551
SS-8	S-8	Near Temik plant area	N-23°17.012 E-77°24.496
SS-9	S-9	Disposal site IX near the entrance gate	N-23°16.725 E-77°24.407
SS-10	S-10	Near soapstone shed	N-23°16.905 E-77°24.557
SS-11	S-11	Near SEVIN plant area	N-23°16.927 E-77°24.583
SS-12	S-12	Near Water treatment plant	N-23°16.843 E-77°24.647
SS-13	S-13	Near disposal site VIII adjacent to the water treatment plant	N-23°16.852 E-77°24.710
SS-14	S-14	Adjacent to the boundary wall at disposal site VII	N-23°16.757 E-77°24.784
SS-15	S-15	Near the disposal site VI	N-23°16.716 E-77°24.827
SS-16	S-16	Near the security post at the east side of the plant	N-23°16.665 E-77°24.798
SS-17	S-17	Near the disposal site V	N-23°16.684 E-77°24.806
SS-18	S-18	Near the disposal site V approx. 5 meters away from S-17	N-23°16.680 E-77°24.795
SS-19	S-19	Near MIC Plant	N-23°16.841 E-77°24.567
SS-20	S-20	Near Naphthol plant	N-23°16.784 E-77°24.579
SS-21	S-21	In front of the Naphthol Plant	N-23°16.775 E-77°24.516
SS-22	S-22	In front of the laboratory at a distance of approx five meters	N-23°16.695 E-77°24.525

Note: * Sub soil sample were collected from the depth of 30 cm.

Table 2: Details of Dug Well-A inside UCIL Bhopal
Site: Near Temik and Formulation Plant area
GPS Coordinates: N-23°16.992 E-77°24.558
Sampling date: 06.11.2012

Dug well details for soil and water samples

Soil Sample code	Ground water sample code	Depth (meters)
AS	-	0.0
AS-1	-	0.3
AS-2	-	0.6
AS-3	-	0.9
AS-4	-	1.2
AS-5	-	2.0
AS-6	-	3.0
AS-7	-	4.0
AS-8	-	5.0
AS-9	-	6.0
AS-10	-	7.0
AS-11	-	8.0
AS-12	-	9.0
AS-13	-	11.0
AS-14	-	13.0
AS-15	-	15.0
AS-16	-	17.0
AS-17	-	22.0
AS-18	-	27.00
AS-19	AW	32.00

Table 3: Details of Dug Well-B inside UCIL Bhopal
Site: Near MIC Storage and Water Treatment Plant
GPS Coordinates: N-23°16.842 E-77°24.647
Sampling date: 06.11.2012

Dug well details for soil and water samples

Soil Sample code	Ground water sample code	Depth (meters)
BS	-	0.0
BS-1	-	0.3
BS-2	-	0.6
BS-3	-	0.9
BS-4	-	2.0
BS-5	-	3.0
BS-6	-	4.0
BS-7	-	5.0
BS-8	-	6.0
BS-9	-	7.0
BS-10	-	8.0
BS-11	-	10.0
BS-12	-	14.0
BS-13	-	16.0
BS-14	-	18.0
BS-15	-	20.0
BS-16	-	22.0
BS-17	BW	27.0

Table 3: Details of Dug Well-B inside UCIL Bhopal
Site: Near MIC Storage and Water Treatment Plant
GPS Coordinates: N-23°16.842 E-77°24.647
Sampling date: 06.11.2012

Dug well details for soil and water samples

Soil Sample code	Ground water sample code	Depth (meters)
BS	-	0.0
BS-1	-	0.3
BS-2	-	0.6
BS-3	-	0.9
BS-4	-	2.0
BS-5	-	3.0
BS-6	-	4.0
BS-7	-	5.0
BS-8	-	6.0
BS-9	-	7.0
BS-10	-	8.0
BS-11	-	10.0
BS-12	-	14.0
BS-13	-	16.0
BS-14	-	18.0
BS-15	-	20.0
BS-16	-	22.0
BS-17	BW	27.0

Table 4: Details of Dug Well-C inside UCIL Bhopal
Site: Disposal Area II on the Eastern Side of the Plant
GPS Coordinates: N-23°16.724 E-77°24.754
Sampling date: 06.11.2012

Dug well details for soil and water samples

Soil Sample code	Ground water sample code	Depth (meters)
CS	-	0.0
CS-1	-	0.3
CS-2	-	0.6
CS-3	-	0.9
CS-4	-	2.0
CS-5	-	3.0
CS-6	-	4.0
CS-7	-	5.0
CS-8	-	6.0
CS-9	-	7.0
CS-10	-	8.0
CS-11	-	9.0
CS-12	-	10.0
CS-13	-	12.0
CS-14	-	14.0
CS-15	-	16.0
CS-16	-	18.0
CS-17	-	20.0
CS-18	CW	25.0

Table 5: Details of Dug Well-D inside UCIL Bhopal
Site: Near Storage Tanks
GPS Coordinates: N-23°16.706 E-77°24.595
Sampling date: 06.11.2012

Dug well details for soil and water samples

Soil Sample code	Ground water sample code	Depth (meters)
DS	-	0.0
DS-1	-	0.3
DS-2	-	0.6
DS-3	-	0.9
DS-4	-	2.0
DS-5	-	3.0
DS-6	-	4.0
DS-7	-	5.0
DS-8	-	6.0
DS-9	-	7.0
DS-10	-	8.0
DS-11	-	9.0
DS-12	-	10.0
DS-13	-	12.0
DS-14	-	14.0
DS-15	-	16.0
DS-16	-	18.0
DS-17	-	22.0
DS-18	DW	27.0

Table 6: Details of Dug Well-E inside UCIL Bhopal
Site: Near Naphthol Plant
GPS Coordinates: N-23°16.829 E-77°24.520
Sampling date: 06.11.2012

Dug well details for soil and water samples

Soil Sample code	Ground water sample code	Depth (meters)
ES	-	0.0
ES-1	-	0.3
ES-2	-	0.6
ES-3	-	0.9
ES-4	-	2.0
ES-5	-	3.0
ES-6	-	4.0
ES-7	-	5.0
ES-8	-	6.0
ES-9	-	7.0
ES-10	-	8.0
ES-11	-	9.0
ES-12	-	11.0
ES-13	-	13.0
ES-14	-	15.0
ES-15	-	17.0
ES-16	-	19.0
ES-17	-	21.0
ES-18	EW	26.0

Table 7: Organic toxicants concentration in the surface soil samples inside UCIL, Bhopal
Sampling date- 03.11.2012

Sample code	Aldicarb (mg/kg)	Carbaryl (mg/kg)	α-Naphthol (mg/kg)	α-HCH (mg/kg)	β-HCH (mg/kg)	γ-HCH (mg/kg)	δ-HCH (mg/kg)	Dicholorobenzene (Total) (mg/kg)
SS-1	< 0.01	0.720	2.304	0.055	< 0.01	< 0.04	< 0.06	0.142
SS-2	< 0.01	0.207	1.020	0.279	0.226	0.138	0.090	0.299
SS-3	< 0.01	0.047	1.588	0.011	0.021	< 0.04	0.012	0.203
SS-4	< 0.01	0.084	0.097	0.058	< 0.01	1.308	< 0.06	< 0.20
SS-5	< 0.01	< 0.01	< 0.01	0.725	0.545	0.295	0.214	< 0.20
SS-6	< 0.01	0.075	3.195	< 0.01	< 0.01	< 0.04	< 0.06	< 0.20
SS-6A	< 0.01	0.014	0.021	0.073	0.051	< 0.04	< 0.06	0.918
SS-7	< 0.01	0.036	0.046	6.448	5.480	1.391	2.112	< 0.20
SS-7A	< 0.01	0.074	0.088	752.09	828.207	380.37	612.00	< 0.20
SS-8	< 0.01	0.366	0.921	0.092	0.159	0.069	0.099	< 0.20
SS-9	< 0.01	0.040	0.050	4.723	0.873	0.100	0.077	< 0.20
SS-10	< 0.01	0.021	0.027	0.667	0.594	0.069	0.101	0.209
SS-11	< 0.01	0.040	0.044	0.264	0.129	0.044	< 0.06	0.281
SS-12	< 0.01	< 0.01	5.612	0.754	0.459	1.722	1.798	2.449
SS-13	< 0.01	< 0.01	0.615	0.293	0.244	0.125	0.123	< 0.20
SS-14	< 0.01	0.071	1.837	0.133	0.091	0.056	0.069	< 0.20
SS-15	< 0.01	< 0.01	< 0.01	3.924	3.311	0.978	2.100	< 0.20
SS-16	< 0.01	0.040	0.046	0.119	0.041	0.021	< 0.06	0.211
SS-17	< 0.01	0.016	0.020	8.480	2.465	2.591	3.405	< 0.20
SS-18	< 0.01	0.397	1.344	0.015	< 0.01	0.033	< 0.06	< 0.20
SS-19	< 0.01	< 0.01	3.549	0.103	0.127	0.080	0.066	0.661
SS-20	< 0.01	0.098	1.677	0.044	0.033	0.012	< 0.06	< 0.20
SS-21	< 0.01	< 0.01	3.549	0.103	0.127	0.080	0.066	0.661
SS-22	< 0.01	0.098	1.677	0.044	0.033	< 0.04	< 0.06	< 0.20
LOQ	**0.01**	**0.01**	**0.01**	**0.01**	**0.01**	**0.04**	**0.06**	**0.20**

LOQ- Limit of quantitation (Detection Limit) of the method adopted for the particular analyte

Table 8: Organic toxicants concentration in the sub- soil samples (30 cm depth) within the UCIL site

Sampling date: 04.11.2012

Sample code	Aldicarb (mg/kg)	Carbaryl (mg/kg)	α-Naphthol (mg/kg)	α-HCH (mg/kg)	β-HCH (mg/kg)	γ-HCH (mg/kg)	δ-HCH (mg/kg)	Dicholorobenzene (Total) (mg/kg)
S-1	< 0.01	0.730	0.857	0.071	0.017	< 0.04	< 0.06	< 0.20
S-2	< 0.01	< 0.01	< 0.01	0.121	0.100	< 0.04	0.060	< 0.20
S-3	< 0.01	0.504	0.502	< 0.01	< 0.01	< 0.04	< 0.06	< 0.20
S-4	< 0.01	0.149	0.217	< 0.01	< 0.01	< 0.04	< 0.06	< 0.20
S-5	< 0.01	0.356	0.361	0.010	< 0.01	< 0.04	< 0.06	< 0.05
S-6	< 0.01	0.593	0.659	19.996	14.968	0.383	1.436	< 0.05
S-6A	< 0.01	1.004	1.608	0.101	0.064	< 0.02	< 0.06	0.918
S-7	< 0.01	0.295	2.500	6.988	5.636	1.717	8.365	< 0.20
S-7A	< 0.01	0.243	3.774	815.0	25.36	364.9	1099.5	< 0.20
S-8	< 0.01	0.126	0.120	0.590	0.219	< 0.04	< 0.06	0.324
S-9	< 0.01	0.154	3.166	< 0.01	< 0.01	< 0.04	< 0.06	< 0.20
S-10	< 0.01	0.201	2.186	0.531	0.623	0.071	< 0.06	0.209
S-11	< 0.01	0.172	0.150	0.214	0.130	0.046	< 0.06	0.281
S-12	< 0.01	0.588	0.576	0.638	0.233	< 0.04	< 0.06	0.295
S-13	< 0.01	0.283	5.215	33.458	7.294	0.823	< 0.06	0.316
S-14	< 0.01	< 0.01	5.576	0.014	< 0.01	< 0.04	< 0.06	< 0.20
S-15	< 0.01	< 0.01	3.504	1.312	0.967	0.151	0.338	< 0.20
S-16	< 0.01	0.430	0.687	0.062	0.029	< 0.04	< 0.06	0.211
S-17	< 0.01	< 0.01	5.176	6.745	1.955	2.130	15.356	< 0.20
S-18	< 0.01	0.786	2.186	1.283	0.270	< 0.04	< 0.06	< 0.20
S-19	< 0.01	0.286	3.419	0.018	< 0.01	< 0.04	< 0.06	0.215
S-20	< 0.01	0.196	2.046	0.554	0.204	0.123	0.256	< 0.20
S-21	< 0.01	0.098	0.084	5.827	2.666	0.146	0.340	< 0.20
S-22	< 0.01	0.127	0.109	5.851	3.039	0.145	0.333	< 0.20
LOQ	0.01	0.01	0.01	0.01	0.01	0.04	0.06	0.20

LOQ- Limit of quantitation (Detection Limit) of the method adopted for the particular analyte

Table 9: Organic toxicants concentration in the soil samples from well - A within the UCIL site

Location: Near Temik and Formulation plant

Sample code	Aldicarb (mg/kg)	Carbaryl (mg/kg)	α-Naphthol (mg/kg)	α-HCH (mg/kg)	β-HCH (mg/kg)	γ-HCH (mg/kg)	δ-HCH (mg/kg)	Dicholorobenzene (Total) (mg/kg)
AS	< 0.01	0.095	0.124	10.374	0.574	0.499	0.461	< 0.20
AS-1	< 0.01	0.088	0.088	9.136	0.599	0.310	0.248	< 0.20
AS-2	< 0.01	0.070	0.076	10.676	0.801	0.206	0.124	< 0.20
AS-3	< 0.01	0.040	0.043	0.286	0.023	< 0.04	< 0.06	< 0.20
AS-4	< 0.01	0.054	0.054	0.054	0.049	< 0.04	< 0.06	< 0.20
AS-5	< 0.01	0.061	0.018	0.053	< 0.01	< 0.04	< 0.06	< 0.20
AS-6	< 0.01	0.062	0.062	0.024	< 0.01	< 0.04	< 0.06	< 0.20
AS-7	< 0.01	0.010	0.016	0.025	< 0.01	< 0.04	< 0.06	< 0.20
AS-8	< 0.01	0.020	0.026	0.023	< 0.01	< 0.04	< 0.06	< 0.20
AS-9	< 0.01	0.082	0.077	0.022	0.025	< 0.04	< 0.06	< 0.20
AS-10	< 0.01	0.015	0.020	0.017	< 0.01	< 0.04	< 0.06	< 0.20
AS-11	< 0.01	0.054	0.053	0.041	0.042	< 0.04	< 0.06	< 0.20
AS-12	< 0.01	0.028	0.032	0.032	< 0.01	< 0.04	< 0.06	< 0.20
AS-13	< 0.01	0.017	0.021	0.025	0.020	< 0.04	< 0.06	< 0.20
AS-14	< 0.01	0.014	0.018	0.020	0.025	< 0.04	< 0.06	< 0.20
AS-15	< 0.01	0.024	0.028	0.028	0.030	< 0.04	< 0.06	< 0.20
AS-16	< 0.01	0.014	0.020	0.037	0.033	< 0.04	< 0.06	< 0.20
AS-17	< 0.01	0.014	0.021	0.063	< 0.01	< 0.04	< 0.06	< 0.20
AS-18	< 0.01	0.010	0.023	0.022	< 0.01	< 0.04	< 0.06	< 0.20
AS-19	< 0.01	0.010	0.019	0.029	< 0.01	< 0.04	< 0.06	< 0.20
LOQ	0.01	0.01	0.01	0.01	0.01	0.04	0.06	0.20

LOQ- Limit of quantitation (Detection Limit) of the method adopted for the particular analyte

Table 10: Organic toxicants concentration in the soil samples from well - B within the UCIL site

Location: Near MIC storage and Water Treatment Plant

Sample code	Aldicarb (mg/kg)	Carbaryl (mg/kg)	α-Naphthol (mg/kg)	α-HCH (mg/kg)	β-HCH (mg/kg)	γ-HCH (mg/kg)	δ-HCH (mg/kg)	Dicholorobenzene (Total) (mg/kg)
BS	< 0.01	0.098	0.088	11.150	0.495	0.351	0.318	< 0.20
BS-1	< 0.01	0.086	0.061	0.840	0.063	< 0.04	< 0.06	< 0.20
BS-2	< 0.01	0.051	0.061	0.641	0.062	< 0.04	< 0.06	< 0.20
BS-3	< 0.01	0.048	0.055	0.490	0.057	< 0.04	< 0.06	< 0.20
BS-4	< 0.01	0.047	0.061	0.713	0.021	< 0.04	< 0.06	< 0.20
BS-5	< 0.01	0.033	0.064	0.036	0.035	< 0.04	< 0.06	< 0.20
BS-6	< 0.01	0.026	0.037	0.046	0.052	< 0.04	< 0.06	< 0.20
BS-7	< 0.01	0.054	0.069	0.093	0.076	< 0.04	< 0.06	< 0.20
BS-8	< 0.01	0.054	0.069	0.028	0.042	< 0.04	< 0.06	< 0.20
BS-9	< 0.01	0.018	0.025	0.030	0.083	< 0.04	< 0.06	< 0.20
BS-10	< 0.01	0.029	0.025	0.015	0.048	< 0.04	< 0.06	< 0.20
BS-11	< 0.01	0.028	0.024	0.024	0.048	< 0.04	< 0.06	< 0.20
BS-12	< 0.01	0.023	0.032	0.026	0.065	< 0.04	< 0.06	< 0.20
BS-13	< 0.01	0.022	0.032	0.020	0.084	< 0.04	< 0.06	< 0.20
BS-14	< 0.01	0.038	0.047	0.029	0.012	< 0.04	< 0.06	< 0.20
BS-15	< 0.01	0.043	0.048	0.013	0.016	< 0.04	< 0.06	< 0.20
BS-16	< 0.01	0.014	0.020	0.023	0.024	< 0.04	< 0.06	< 0.20
BS-17	< 0.01	0.011	0.025	0.029	0.029	< 0.04	< 0.06	< 0.20
LOQ	0.01	0.01	0.01	0.01	0.01	0.04	0.06	0.20

LOQ- Limit of quantitation (Detection Limit) of the method adopted for the particular analyte

Table 11: Organic toxicants concentration in the soil samples from well - C within the UCIL site

Location: Disposal Area II on the Eastern Side of Plant

Sample code	Aldicarb (mg/kg)	Carbaryl (mg/kg)	α-Naphthol (mg/kg)	α-HCH (mg/kg)	β-HCH (mg/kg)	γ-HCH (mg/kg)	δ-HCH (mg/kg)	Dicholorobenzene (Total) (mg/kg)
CS	< 0.01	3.941	0.093	0.828	0.373	0.324	0.211	< 0.20
CS-1	< 0.01	3.164	0.071	0.624	0.246	0.291	0.144	< 0.20
CS-2	< 0.01	3.976	0.086	0.519	0.128	0.210	0.099	< 0.20
CS-3	< 0.01	3.641	0.082	0.129	0.042	< 0.04	< 0.06	< 0.20
CS-4	< 0.01	1.595	0.037	< 0.01	0.021	< 0.04	< 0.06	< 0.20
CS-5	< 0.01	1.708	0.029	0.071	0.042	< 0.04	< 0.06	< 0.20
CS-6	< 0.01	1.777	0.069	0.046	0.048	< 0.04	< 0.06	< 0.20
CS-7	< 0.01	1.418	0.033	< 0.01	0.012	< 0.04	< 0.06	< 0.20
CS-8	< 0.01	1.481	0.102	< 0.01	< 0.01	< 0.04	< 0.06	< 0.20
CS-9	< 0.01	1.071	0.031	0.029	< 0.01	< 0.04	< 0.06	< 0.20
CS-10	< 0.01	0.055	0.050	0.010	< 0.01	< 0.04	< 0.06	< 0.20
CS-11	< 0.01	0.746	0.020	0.030	< 0.01	< 0.04	< 0.06	< 0.20
CS-12	< 0.01	0.323	0.039	0.013	< 0.01	< 0.04	< 0.06	< 0.20
CS-13	< 0.01	0.064	0.071	0.017	< 0.01	< 0.04	< 0.06	< 0.20
CS-14	< 0.01	0.033	0.036	0.010	< 0.01	< 0.04	< 0.06	< 0.20
CS-15	< 0.01	0.043	0.045	0.082	< 0.01	< 0.04	< 0.06	< 0.20
CS-16	< 0.01	0.037	0.039	0.044	< 0.01	< 0.04	< 0.06	< 0.20
CS-17	< 0.01	0.037	0.038	0.053	< 0.01	< 0.04	< 0.06	< 0.20
CS-18	< 0.01	0.020	0.021	0.060	< 0.01	< 0.04	< 0.06	< 0.20
LOQ	0.01	0.01	0.01	0.01	0.01	0.04	0.06	0.20

LOQ- Limit of quantitation (Detection Limit) of the method adopted for the particular analyte

Table 12: Organic toxicants concentration in the soil samples from well – D (description) within the UCIL site.

Location: Near Storage Tanks

Sample code	Aldicarb (mg/kg)	Carbaryl (mg/kg)	α-Naphthol (mg/kg)	α-HCH (mg/kg)	β-HCH (mg/kg)	γ-HCH (mg/kg)	δ-HCH (mg/kg)	Dicholorobenzene (Total) (mg/kg)
DS	< 0.01	0.129	0.095	1.281	0.047	< 0.04	< 0.06	< 0.20
DS-1	< 0.01	0.084	0.082	0.036	0.026	< 0.04	< 0.06	< 0.20
DS-2	< 0.01	0.086	0.072	0.026	< 0.01	< 0.04	< 0.06	< 0.20
DS-3	< 0.01	0.086	0.072	0.017	< 0.01	< 0.04	< 0.06	< 0.20
DS-4	< 0.01	0.074	0.073	0.014	< 0.01	< 0.04	< 0.06	< 0.20
DS-5	< 0.01	0.060	0.069	0.010	< 0.01	< 0.04	< 0.06	< 0.20
DS-6	< 0.01	0.049	0.069	< 0.01	< 0.01	< 0.04	< 0.06	< 0.20
DS-7	< 0.01	0.048	0.037	< 0.01	< 0.01	< 0.04	< 0.06	< 0.20
DS-8	< 0.01	0.028	0.044	< 0.01	< 0.01	< 0.04	< 0.06	< 0.20
DS-9	< 0.01	0.043	0.067	< 0.01	< 0.01	< 0.04	< 0.06	< 0.20
DS-10	< 0.01	0.089	0.053	< 0.01	< 0.01	< 0.04	< 0.06	< 0.20
DS-11	< 0.01	0.041	0.040	0.011	< 0.01	< 0.04	< 0.06	< 0.20
DS-12	< 0.01	0.040	0.057	0.011	< 0.01	< 0.04	< 0.06	< 0.20
DS-13	< 0.01	0.028	0.034	< 0.01	< 0.01	< 0.04	< 0.06	< 0.20
DS-14	< 0.01	0.064	0.065	0.014	< 0.01	< 0.04	< 0.06	< 0.20
DS-15	< 0.01	0.039	0.045	< 0.01	< 0.01	< 0.04	< 0.06	< 0.20
DS-16	< 0.01	0.032	0.033	< 0.01	< 0.01	< 0.04	< 0.06	< 0.20
DS-17	< 0.01	0.010	0.014	< 0.01	< 0.01	< 0.04	< 0.06	< 0.20
DS-18	< 0.01	0.034	0.010	< 0.01	< 0.01	< 0.04	< 0.06	< 0.20
LOQ	0.01	0.01	0.01	0.01	0.01	0.04	0.06	0.20

LOQ- Limit of quantitation (Detection Limit) of the method adopted for the particular analyte

Table 13: Organic toxicants concentration in the soil samples from well - E within the UCIL site in Bhopal

Location: Near Naphthol Plant

Sample code	Aldicarb (mg/kg)	Carbaryl (mg/kg)	α-Naphthol (mg/kg)	α-HCH (mg/kg)	β-HCH (mg/kg)	γ-HCH (mg/kg)	δ-HCH (mg/kg)	Dicholorobenzene (Total) (mg/kg)
ES	< 0.01	0.216	0.294	0.858	0.048	0.184	< 0.06	0.319
ES-1	< 0.01	0.129	0.295	0.754	0.041	< 0.04	< 0.06	0.231
ES-2	< 0.01	0.086	0.344	0.614	0.038	< 0.04	< 0.06	< 0.20
ES-3	< 0.01	0.060	0.189	< 0.01	< 0.01	< 0.04	< 0.06	< 0.20
ES-4	< 0.01	0.076	0.110	0.031	< 0.01	< 0.04	< 0.06	< 0.20
ES-5	< 0.01	0.074	0.117	< 0.01	< 0.01	< 0.04	< 0.06	< 0.20
ES-6	< 0.01	0.070	0.098	0.019	0.012	< 0.04	< 0.06	< 0.20
ES-7	< 0.01	0.062	0.097	0.010	< 0.01	< 0.04	< 0.06	< 0.20
ES-8	< 0.01	0.062	0.107	< 0.01	< 0.01	< 0.04	< 0.06	< 0.20
ES-9	< 0.01	0.068	0.057	0.042	0.011	< 0.04	< 0.06	< 0.20
ES-10	< 0.01	0.086	0.060	< 0.01	< 0.01	< 0.04	< 0.06	< 0.20
ES-11	< 0.01	0.022	0.038	< 0.01	< 0.01	< 0.04	< 0.06	< 0.20
ES-12	< 0.01	0.089	0.038	0.023	< 0.01	< 0.04	< 0.06	< 0.20
ES-13	< 0.01	0.031	0.085	0.012	< 0.01	< 0.04	< 0.06	< 0.20
ES-14	< 0.01	0.017	0.024	< 0.01	< 0.01	< 0.04	< 0.06	< 0.20
ES-15	< 0.01	0.037	0.072	0.019	0.011	< 0.04	< 0.06	< 0.20
ES-16	< 0.01	0.023	0.033	0.047	0.011	< 0.04	< 0.06	< 0.20
ES-17	< 0.01	0.016	0.024	0.022	0.012	< 0.04	< 0.06	< 0.20
ES-18	< 0.01	0.017	0.022	0.022	0.011	< 0.04	< 0.06	< 0.20
LOQ	0.01	0.01	0.01	0.01	0.01	0.04	0.06	0.20

LOQ- Limit of quantitation (Detection Limit) of the method adopted for the particular analyte

Table 14: Metal concentration in the Surface soil samples within the UCIL site.

Sampling date: 3.11.2012

Sample code	Lead (mg/kg)	Cadmium (mg/kg)	Nickel (mg/kg)	Cobalt (mg/kg)	Copper (mg/kg)	Zinc (mg/kg)	Chromium (mg/kg)	Mercury (mg/kg)
SS-1	18.638	0.957	48.699	13.105	39.690	84.394	23.652	2.109
SS-2	26.052	1.024	57.111	15.453	49.989	119.59	28.499	0.614
SS-3	16.697	1.427	46.470	13.019	41.229	61.153	25.546	0.098
SS-4	16.692	1.026	47.659	28.492	253.02	82.263	8.960	0.081
SS-5	19.476	1.124	44.464	11.487	56.495	151.24	21.939	0.580
SS-6	19.389	1.064	48.386	14.021	63.823	58.939	29.587	3.541
SS-6A	25.458	0.925	60.17	24.903	67.126	87.845	30.012	2.541
SS-7	20.393	0.997	42.841	21.893	33.912	32.229	24.329	1.124
SS-7A	26.031	0.897	57.737	23.240	68.661	95.534	32.391	3.568
SS-8	88.583	0.913	38.291	10.137	56.497	299.20	22.602	0.084
SS-9	16.913	0.461	35.061	20.435	27.729	28.412	15.695	0.945
SS-10	20.750	0.816	47.768	18.501	54.680	77.893	26.186	1.547
SS-11	24.156	0.766	56.335	22.989	57.821	82.653	24.977	0.088
SS-12	22.219	0.486	31.621	11.665	31.193	36.523	20.224	0.242
SS-13	29.337	0.627	43.626	16.015	53.611	72.823	24.779	0.198
SS-14	30.431	0.537	65.317	32.456	92.345	96.422	27.582	0.674
SS-15	102.964	0.891	93.822	15.923	112.11	354.96	66.894	0.076
SS-16	10.927	0.572	38.782	25.159	108.75	55.035	14.564	0.542
SS-17	24.172	0.786	55.627	24.648	68.225	91.427	23.714	0.064
SS-18	26.524	0.526	46.842	20.485	253.01	88.681	22.416	0.214
SS-19	31.751	0.527	44.010	16.540	67.810	104.44	25.808	0.365
SS-20	24.466	0.411	31.141	13.824	59.208	68.015	18.881	0.255
SS-21	23.205	0.329	46.808	16.516	56.980	72.238	24.702	0.095
SS-22	40.547	0.429	44.206	14.924	75.041	278.40	32.835	0.089
LOQ	**1.00**	**0.25**	**0.50**	**0.50**	**0.50**	**0.25**	**1.00**	**0.05**

LOQ- Limit of quantitation (Detection Limit) of the method adopted for the particular analyte

Table 15: Metal concentration in the sub soil samples (30 cm depth) within the UCIL site.

Sampling date: 4.11.2012

Sample code	Lead (mg/kg)	Cadmium (mg/kg)	Nickel (mg/kg)	Cobalt (mg/kg)	Copper (mg/kg)	Zinc (mg/kg)	Chromium (mg/kg)	Mercury (mg/kg)
S-1	20.957	0.648	54.732	16.668	38.199	64.813	30.402	0.325
S-2	25.683	0.883	55.125	199.779	40.315	78.865	31.006	0.075
S-3	20.438	0.889	48.439	17.899	34.714	50.337	26.104	0.064
S-4	20.309	0.821	52.310	18.694	34.981	21.851	29.106	< 0.05
S-5	20.908	0.394	50.857	17.539	36.267	52.666	23.583	0.129
S-6	23.317	0.763	52.514	18.677	34.501	48.086	24.380	0.642
S-6A	19.957	0.720	52.577	19.134	35.591	50.621	28.193	0.984
S-7	10.571	0.220	95.411	15.669	35.598	91.648	7.965	0.641
S-7A	23.420	0.437	179.81	17.237	68.089	44.488	145.08	1.145
S-8	23.992	0.535	53.086	18.102	37.959	65.298	29.614	< 0.05
S-9	3.253	0.205	40.528	11.673	17.496	33.748	9.075	< 0.05
S-10	24.047	0.494	53..646	21.419	71.969	61.066	26.182	0.248
S-11.	30.545	0.445	52.690	17.425	37.507	82.004	20.675	< 0.05
S-12	25.263	1.290	60.628	20.680	41.909	55.019	37.197	< 0.05
S-13	28.566	0.347	46.709	19.622	41.498	55.371	26.905	< 0.05
S-14	53.877	0.445	59.147	14.155	147.95	336.97	43.284	0.215
S-15	48.428	0.479	57.243	22.130	88.566	297.82	65.302	< 0.05
S-16	30.923	0.132	45.932	18.795	44.359	198.01	40.904	0.121
S-17	40.000	1.487	41.617	13.885	50.325	186.16	19.182	< 0.05
S-18	24.597	0.952	55.860	20.458	38.782	86.712	31.685	< 0.05
S-19	21.930	0.518	56.052	17.204	50.120	75.886	32.435	0.084
S-20	30.926	0.797	59.315	16.969	41.696	104.65	38.811	0.068
S-21	20.856	0.654	53.041	18.248	34.027	51.585	27.663	< 0.05
S-22	23.379	1.009	55.684	18.661	36.958	52.656	34.745	< 0.05
LOQ	1.00	0.25	0.50	0.50	0.50	0.25	1.00	0.05

LOQ- Limit of quantitation (Detection Limit) of the method adopted for the particular analyte

Table 16: Metal concentration in the soil samples from well – A within the UCIL site

Location: Near Temik and Formulation plant

Sample code	Lead (mg/kg)	Cadmium (mg/kg)	Nickel (mg/kg)	Cobalt (mg/kg)	Copper (mg/kg)	Zinc (mg/kg)	Chromium (mg/kg)	Mercury (mg/kg)
AS	26.584	1.056	58.471	20.642	41.527	60.942	42.543	0.351
AS-1	27.409	0.976	61.844	19.387	38.164	59.205	33.026	0.254
AS-2	24.103	1.201	69.306	18.314	35.618	61.032	49.426	0.129
AS-3	22.949	0.806	71.12	21.031	43.510	68.349	41.705	< 0.05
AS-4	27.037	1.370	67.241	18.851	36.454	61.750	37.796	< 0.05
AS-5	24.700	0.833	64.871	19.370	44.086	62.369	34.912	< 0.05
AS-6	24.628	1.239	60.216	20.384	33.562	48.207	25.577	< 0.05
AS-7	24.343	1.047	63.666	20.942	37.662	61.435	30.161	< 0.05
AS-8	25.555	0.914	64.533	22.146	32.427	61.435	32.314	< 0.05
AS-9	31.158	1.098	59.395	20.679	50.917	51.773	27.101	< 0.05
AS-10	27.509	0.996	3.987	24.723	43.423	58.902	38.653	< 0.05
AS-11	18.921	0.746	3.969	22.969	58.436	56.750	31.825	< 0.05
AS-12	22.096	1.614	4.044	41.688	186.79	109.03	44.026	< 0.05
AS-13	18.600	1.351	4.598	36.999	179.26	113.69	37.560	< 0.05
AS-14	19.989	1.283	2.976	32.954	239.46	95.08	16.248	< 0.05
AS-15	18.614	1.239	2.745	28.846	269.04	78.221	8.252	< 0.05
AS-16	12.490	0.947	2.532	25.186	305.15	69.386	4.213	< 0.05
AS-17	12.588	0.782	3.526	33.616	163.14	68.260	17.892	< 0.05
AS-18	15.366	0.735	2.037	21.700	140.69	56.212	13.650	< 0.05
AS-19	16.849	0.734	0.946	11.484	33.872	6.104	14.478	< 0.05
LOQ	**1.00**	**0.25**	**0.50**	**0.50**	**0.50**	**0.25**	**1.00**	**0.05**

LOQ- Limit of quantitation (Detection Limit) of the method adopted for the particular analyte

Table 17: Metal concentration in the soil samples from well - B within the UCIL site.

Location: Near MIC storage and Water Treatment Plant

Sample code	Lead (mg/kg)	Cadmium (mg/kg)	Nickel (mg/kg)	Cobalt (mg/kg)	Copper (mg/kg)	Zinc (mg/kg)	Chromium (mg/kg)	Mercury (mg/kg)
BS	28.425	0.649	58.499	23.516	42.842	55.656	28.422	0.361
BS-1	22.618	0.471	50.615	19.164	43.302	51.448	32.681	0.321
BS-2	26.547	0.516	65.807	20.626	39.136	60.840	38.466	0.216
BS-3	23.054	0.787	58.072	19.927	44.499	52.634	28.704	0.088
BS-4	22.549	0.577	58.033	21.659	31.539	49.854	30.607	< 0.05
BS-5	23.284	0.988	60.012	20.277	43.548	52.994	39.012	< 0.05
BS-6	23.791	0.702	62.420	20.235	35.835	56.735	32.486	< 0.05
BS-7	27.382	1.248	69.175	21.521	35.219	59.463	35.846	< 0.05
BS-8	24.039	0.830	60.690	19.021	34.575	52.112	25.535	< 0.05
BS-9	20.493	0.399	60.738	17.379	32.051	53.258	25.580	< 0.05
BS-10	21.222	0.303	60.127	20.565	33.380	57.365	29.912	< 0.05
BS-11	20.247	0.291	56.112	17.458	31.036	51.439	27.229	< 0.05
BS-12	13.172	0.257	25.090	13.373	23.578	21.852	15.585	< 0.05
BS-13	13.531	0.892	36.469	21.789	100.42	47.178	13.896	< 0.05
BS-14	13.918	0.604	25.627	16.976	72.741	21.268	12.869	< 0.05
BS-15	16.885	0.503	28.066	17.761	62.084	15.284	14.499	< 0.05
BS-16	16.809	0.827	28.143	19.126	51.047	16.239	16.851	< 0.05
BS-17	10.487	0.096	11.904	7.587	16.413	10.249	6.719	< 0.05
LOQ	**1.00**	**0.25**	**0.50**	**0.50**	**0.50**	**0.25**	**1.00**	**0.05**

LOQ- Limit of quantitation (Detection Limit) of the method adopted for the particular analyte

Table 18: Metal concentration in the soil samples from well - C within the UCIL site.

Location: Disposal Area II on the Eastern Side of Plant

Sample code	Lead (mg/kg)	Cadmium (mg/kg)	Nickel (mg/kg)	Cobalt (mg/kg)	Copper (mg/kg)	Zinc (mg/kg)	Chromium (mg/kg)	Mercury (mg/kg)
CS	25.511	1.212	59.886	20.546	38.994	54.212	38.425	0.215
CS-1	24.441	1.253	62.613	21.725	37.698	52.581	36.187	0.124
CS-2	22.882	0.931	55.880	18.754	40.348	52.930	35.719	0.084
CS-3	21.741	0.740	54.537	16.981	38.546	55.324	30.388	0.076
CS-4	23.108	1.044	61.709	22.428	36.217	51.104	30.514	< 0.05
CS-5	24.518	1.176	54.567	17.515	30.830	53.143	26.870	< 0.05
CS-6	21.676	1.083	53.342	19.000	29.558	49.949	29.450	< 0.05
CS-7	22.821	0.879	58.297	17.967	33.709	60.156	38.150	< 0.05
CS-8	21.683	0.604	54.675	16.431	29.726	50.183	30.156	< 0.05
CS-9	22.449	0.994	60.250	19.453	33.592	54.855	30.143	< 0.05
CS-10	21.817	0.584	49.785	16.102	28.854	44.299	26.143	< 0.05
CS-11	19.915	0.339	43.655	17.617	27.857	38.709	25.925	< 0.05
CS-12	26.932	0.423	42.378	17.471	34.011	22.229	23.509	< 0.05
CS-13	23.170	1.062	47.804	21.721	31.857	36.695	25.875	< 0.05
CS-14	22.683	0.425	45.587	18.260	28.390	82.240	27.289	< 0.05
CS-15	21.550	1.077	63.951	51.020	143.298	19.100	41.001	< 0.05
CS-16	12.741	0.805	33.955	19.005	90.114	24.218	17.971	< 0.05
CS-17	15.439	1.311	41.376	23.972	107.02	70.417	26.644	< 0.05
CS-18	19.298	1.294	61.242	43.600	125.18	52.930	35.667	< 0.05
LOQ	**1.00**	**0.25**	**0.50**	**0.50**	**0.50**	**0.25**	**1.00**	**0.05**

LOQ- Limit of quantitation (Detection Limit) of the method adopted for the particular analyte

Table 19: Metal concentration in the soil samples from well - D within the UCIL site.

Location: Near Storage Tanks

Sample code	Lead (mg/kg)	Cadmium (mg/kg)	Nickel (mg/kg)	Cobalt (mg/kg)	Copper (mg/kg)	Zinc (mg/kg)	Chromium (mg/kg)	Mercury (mg/kg)
DS	17.854	0.689	46.842	18.425	29.991	47.523	21.624	0.359
DS-1	17.572	0.736	47.590	15.609	27.769	48.831	16.672	0.311
DS-2	12.536	0.253	52.828	16.390	37.088	53.147	20.604	0.222
DS-3	13.067	0.379	50.802	14.354	34.112	48.845	21.651	0.084
DS-4	21.430	1.141	51.088	18.147	33.533	51.638	18.316	< 0.05
DS-5	18.349	0.286	47.190	13.295	32.592	48.835	20.521	< 0.05
DS-6	24.743	0.464	47.126	14.772	27.236	50.773	12.915	< 0.05
DS-7	21.520	0.491	45.788	15.201	31.318	52.612	19.847	< 0.05
DS-8	13.807	0.448	53.347	16.746	31.238	53.953	21.554	< 0.05
DS-9	22.345	0.452	48.611	15.605	29.058	45.859	20.164	< 0.05
DS-10	17.519	0.065	43.333	12.571	23.669	42.803	14.832	< 0.05
DS-11	24.679	0.381	47.590	16.058	29.438	47.712	26.351	< 0.05
DS-12	23.794	0.266	49.797	15.450	27.534	46.031	16.488	< 0.05
DS-13	12.513	0.492	36.920	26.012	142.24	57.579	16.581	< 0.05
DS-14	13.556	0.574	44.897	20.053	28.205	34.422	18.586	< 0.05
DS-15	19.704	0.259	38.152	21.201	35.184	32.670	22.329	< 0.05
DS-16	14.784	0.601	55.382	34.308	143.85	81.664	14.436	< 0.05
DS-17	14.375	0.459	34.614	24.283	98.281	54.237	19.871	< 0.05
DS-18	9.117	0.244	30.331	18.125	80.885	41.702	18.708	< 0.05
LOQ	**1.00**	**0.25**	**0.50**	**0.50**	**0.50**	**0.25**	**1.00**	0.05

LOQ- Limit of quantitation (Detection Limit) of the method adopted for the particular analyte

Table 20: Metal concentration in the soil samples from well - E within the UCIL site.

Location: Near Naphthol Plant

Sample code	Lead (mg/kg)	Cadmium (mg/kg)	Nickel (mg/kg)	Cobalt (mg/kg)	Copper (mg/kg)	Zinc (mg/kg)	Chromium (mg/kg)	Mercury (mg/kg)
ES	21.249	0.219	49.482	16.942	29.621	40.213	18.883	3.216
ES-1	15.546	0.151	50.126	14.907	27.379	43.857	16.664	2.051
ES-2	24.600	0.159	56.342	18.068	34.968	54.736	25.012	0.194
ES-3	22.342	0.154	55.271	16.670	34.520	55.348	24.780	0.084
ES-4	21.257	0.053	54.816	17.482	33.224	52.861	24.389	< 0.05
ES-5	23.895	0.592	52.559	16.224	31.308	48.549	21.859	< 0.05
ES-6	21.905	0.201	56.660	34.849	178.940	112.92	26.009	< 0.05
ES-7	18.007	0.094	51.171	15.853	29.137	47.237	17.043	< 0.05
ES-8	18.236	0.083	57.177	16.123	34.029	52.132	20.969	< 0.05
ES-9	21.508	0.091	58.237	20.945	34.961	50.037	24.643	< 0.05
ES-10	19.925	0.175	56.606	19.507	38.204	46.239	24.697	< 0.05
ES-11	19.617	0.126	45.817	31.201	134.77	94.400	29.499	< 0.05
ES-12	15.969	0.275	52.827	33.186	179.89	93.968	24.780	< 0.05
ES-13	24.319	0.099	53.276	18.785	35.270	56.090	25.561	< 0.05
ES-14	25.489	0.787	36.763	28.708	42.942	47.512	23.834	< 0.05
ES-15	19.587	0.782	40.873	26.236	106.788	25.824	15.619	< 0.05
ES-16	25.757	0.152	45.658	16.081	41.959	49.370	27.593	< 0.05
ES-17	14.681	0.347	28.631	16.732	63.112	24.687	15.762	< 0.05
ES-18	3.900	0.257	8.883	4.702	16.889	6.903	7.315	< 0.05
LOQ	**1.00**	**0.25**	**0.50**	**0.50**	**0.50**	**0.25**	**1.00**	**0.05**

LOQ- Limit of quantitation (Detection Limit) of the method adopted for the particular analyte

Table 21: Some Physico-chemical parameters in the Surface soil samples within the UCIL site.
Sampling date: 3.11.2012

Sample Code	pH -	EC (µs/cm)	Fluoride (mg/kg)	Chloride (mg/kg)	Nitrate-NO_3 (mg/kg)	Phosphate (mg/kg)	Sulphate (mg/kg)	TOC (%)	Sodium (mg/kg)	Potassium (mg/kg)
SS-1	7.36	173.70	10.13	41.43	68.56	2.91	36.12	1.70	60.00	386.00
SS-2	7.59	202.00	13.85	61.54	54.61	6.35	49.40	2.63	76.00	554.00
SS-3	7.49	127.30	14.70	23.57	10.56	2.46	27.95	1.20	68.00	222.00
SS-4	7.46	248.00	8.68	49.84	15.98	5.64	56.88	2.22	84.00	254.00
SS-5	7.01	754.00	8.07	498.97	126.95	39.27	705.25	6.44	566.00	724.00
SS-6	7.36	140.30	8.70	22.30	10.51	1.50	15.20	2.05	44.00	270.00
SS-6A	7.58	210.00	11.26	52.46	1.86	9.28	46.66	1.55	38.00	180.00
SS-7	8.05	284.00	29.15	18.57	6.84	7.58	168.90	1.38	58.00	195.00
SS-7A	6.74	1759.0	32.45	824.52	46.84	178.90	30655.0	3.84	48.00	350.00
SS-8	7.65	438.00	6.71	193.05	69.17	36.57	201.93	8.90	330.00	1154.00
SS-9	8.06	562.00	5.84	54.75	1.53	9.50	188.42	4.12	67.00	395.00
SS-10	7.95	182.00	10.29	21.64	10.59	6.35	20.68	1.62	80.00	385.00
SS-11	7.95	238.00	10.64	31.38	8.64	5.95	95.46	1.59	75.00	420.00
SS-12	7.02	285.00	12.17	38.44	10.99	6.54	33.64	4.80	34.00	442.00
SS-13	7.49	340.00	13.65	131.95	84.76	32.15	116.30	3.25	304.00	446.00
SS-14	7.54	367.00	7.18	101.51	7.54	5.03	29.84	5.03	48.00	878.00
SS-15	7.39	482.00	20.22	487.19	17.39	8.04	347.66	7.26	378.00	556.00
SS-18	7.56	118.40	17.09	27.76	6.65	1.00	28.61	2.11	56.00	176.00
SS-19	7.39	289.00	8.87	44.46	36.35	13.94	154.29	6.15	100.00	526.00
SS-20	7.10	501.00	3.06	178.84	21.81	9.92	81.61	11.77	54.00	726.00
SS-21	7.17	319.00	7.38	34.63	2.09	1.11	24.40	4.39	38.00	618.00
SS-22	7.23	2640.0	5.00	1661.80	24.20	501.80	16420.80	8.25	1244.00	1680.00

Note: 1. EC = Electrical Conductivity. 2. TOC = Total Organic Carbon.

Table 22: Some Physico-chemical parameters in the sub soil samples (30 cm depth) within the UCIL site.
Sampling date: 4.11.2012

Sample Code	pH -	EC (µs/cm)	Fluoride (mg/kg)	Chloride (mg/kg)	Nitrate-NO_3 (mg/kg)	Phosphate (mg/kg)	Sulphate (mg/kg)	TOC (%)	Sodium (mg/kg)	Potassium (mg/kg)
S-1	8.05	209.00	8.31	39.91	27.80	7.44	36.46	1.23	46.00	274.00
S-2	7.92	238.00	11.24	49.06	67.57	13.04	58.75	2.08	66.00	484.00
S-3	7.97	270.00	9.42	33.29	10.69	6.48	121.39	1.32	66.00	180.00
S-4	7.89	258.00	9.44	54.28	16.41	4.93	52.67	1.29	82.00	168.00
S-5	7.96	203.00	8.80	29.42	15.91	5.68	47.15	1.17	52.00	182.00
S-6	7.78	194.00	7.35	23.47	12.79	4.14	15.17	1.29	38.00	206.00
S-6 A	7.92	200.00	10.60	46.55	1.91	8.90	40.64	1.43	38.00	168.00
S-7	7.94	246.00	25.29	20.04	6.90	6.51	163.23	1.32	58.00	230.00
S-7 A	6.95	1635.0	30.14	719.00	48.00	186.50	28381.8	3.78	44.00	174.00
S-8	7.98	246.00	19.14	49.12	11.29	5.50	81.10	1.38	142.00	408.00
S-9	7.55	465.00	6.84	52.42	1.36	9.66	178.78	3.60	66.00	388.00
S-10	7.91	170.60	9.42	25.59	10.59	6.21	19.91	1.29	48.00	178.00
S-11	7.91	230.00	9.55	33.58	8.15	6.31	89.83	1.29	90.00	176.00
S-12	7.80	198.20	7.05	34.47	2.49	7.55	19.10	1.26	30.00	176.00
S-13	7.87	275.00	9.99	59.45	23.74	23.11	68.41	2.17	258.00	346.00
S-14	7.64	731.00	6.53	166.11	53.33	95.73	481.52	10.13	412.00	896.00
S-15	7.93	299.00	19.18	84.09	4.90	8.62	79.74	2.20	206.00	194.00
S-16	8.85	940.00	1.67	141.92	12.87	2.88	1208.00	1.32	228.00	884.00
S-17	7.82	400.00	8.74	110.84	40.28	7.57	204.18	1.17	140.00	586.00
S-18	7.83	595.00	10.70	246.13	43.57	10.88	328.48	1.35	758.00	1458.00
S-19	7.89	204.00	13.95	44.70	3.61	6.68	59.08	1.32	222.00	182.00
S-20	7.79	277.00	7.26	50.60	13.51	9.56	74.98	1.87	54.00	246.00
S-21	7.84	221.00	15.63	70.43	4.14	7.89	70.17	2.69	56.00	128.00
S-22	7.74	387.00	13.61	88.01	7.92	1.48	497.82	1.35	60.00	144.00

Note: 1. EC = Electrical Conductivity. 2. TOC = Total Organic Carbon.

Table 23: Some Physico-chemical parameters in the soil samples from well – A within the UCIL site
Location: Near Temik and Formulation plant

Sample Code	pH -	EC (µs/cm)	Fluoride (mg/kg)	Chloride (mg/kg)	Nitrate-NO_3 (mg/kg)	Phosphate (mg/kg)	Sulphate (mg/kg)	TOC (%)	Sodium (mg/kg)	Potassium (mg/kg)
AS	7.54	205.00	19.26	28.94	53.14	8.88	307.44	1.38	70.00	186.00
AS-1	8.11	240.00	16.88	25.99	30.13	2.91	217.10	0.50	104.00	194.00
AS-2	7.79	885.00	13.01	32.92	23.64	33.50	1973.80	0.23	102.00	200.00
AS-3	7.74	1243.0	14.35	38.97	39.30	27.00	4089.80	0.44	222.00	194.00
AS-4	7.70	1224.0	32.33	96.38	44.40	31.90	4394.60	0.03	342.00	190.00
AS-5	7.94	724.00	51.35	267.88	40.64	11.28	715.04	0.15	314.00	180.00
AS-6	8.17	306.00	35.39	128.41	16.59	3.50	164.81	0.15	308.00	174.00
AS-7	8.04	383.00	31.50	60.51	32.72	2.08	200.33	0.15	322.00	196.00
AS-8	8.05	382.00	33.48	65.28	41.08	4.63	294.78	0.12	332.00	188.00
AS-9	7.81	707.00	46.31	123.58	9.11	1.68	1152.70	0.15	292.00	200.00
AS-10	7.93	475.00	2.49	7.13	3.20	0.25	19.74	0.15	280.00	214.00
AS-11	8.05	316.00	35.92	77.52	3.94	2.45	117.15	0.15	288.00	200.00
AS-12	7.95	542.00	39.54	70.21	46.42	5.14	628.33	0.15	484.00	148.00
AS-13	7.96	323.00	31.52	254.90	19.55	11.12	205.24	0.15	464.00	122.00
AS-14	8.13	298.00	10.24	131.50	41.44	5.71	135.75	0.15	366.00	112.00
AS-15	8.23	206.00	5.99	105.42	5.67	2.72	92.92	0.15	320.00	102.00
AS-16	8.30	205.00	6.50	118.16	8.68	4.29	93.97	0.15	284.00	88.00
AS-17	7.95	400.00	11.89	195.96	19.62	5.92	156.31	0.12	392.00	106.00
AS-18	7.84	562.00	16.64	427.88	12.75	5.70	323.10	0.18	514.00	102.00
AS-19	8.11	276.00	15.86	218.02	1.61	12.18	143.02	0.12	132.00	54.00

Note: 1. EC = Electrical Conductivity. 2. TOC = Total Organic Carbon.

Table 24: Some Physico-chemical parameters in the soil samples from well - B within the UCIL site.
Location: Near MIC storage and Water Treatment Plant

Sample Code	pH -	EC (µs/cm)	Fluoride (mg/kg)	Chloride (mg/kg)	Nitrate-NO_3 (mg/kg)	Phosphate (mg/kg)	Sulphate (mg/kg)	TOC (%)	Sodium (mg/kg)	Potassium (mg/kg)
BS	7.44	114.20	23.76	18.41	18.84	5.08	48.09	1.08	116.00	196.00
BS-1	7.97	233.00	17.20	81.56	21.89	5.28	116.78	0.41	90.00	166.00
BS-2	7.93	326.00	10.18	56.55	66.32	7.34	155.52	0.47	108.00	178.00
BS-3	7.95	296.00	21.15	52.00	42.94	4.40	185.61	0.50	170.00	188.00
BS-4	7.64	338.00	17.56	79.82	39.33	5.98	260.64	0.50	140.00	182.00
BS-5	8.06	372.00	49.44	131.45	28.72	5.72	273.63	0.44	428.00	186.00
BS-6	7.99	442.00	55.82	133.32	56.75	5.05	164.27	0.09	690.00	188.00
BS-7	8.11	418.0	35.90	140.36	30.87	7.08	156.68	0.15	682.00	192.00
BS-8	8.12	356.00	28.66	139.30	39.07	6.78	125.02	0.23	670.00	202.00
BS-9	7.98	450.00	24.11	148.34	35.19	3.76	203.21	0.15	618.00	204.00
BS-10	8.15	398.00	24.13	163.30	29.62	0.37	112.58	0.23	642.00	242.00
BS-11	8.07	380.0	22.06	139.73	29.15	1.82	112.72	0.09	598.00	242.00
BS-12	7.92	312.00	9.72	120.48	32.08	0.28	98.47	0.18	274.00	86.00
BS-13	8.12	319.00	9.51	144.90	20.86	1.73	19.75	0.18	440.00	74.00
BS-14	8.07	277.00	9.30	97.74	16.18	4.19	31.56	0.15	568.00	90.00
BS-15	7.79	355.00	8.16	103.41	20.39	1.03	56.80	0.15	438.00	88.00
BS-16	7.91	398.00	6.63	170.80	1.07	26.40	56.15	0.20	314.00	74.00
BS-17	7.96	252.00	10.19	99.98	32.97	13.27	41.83	0.23	210.00	60.00

Note: 1. EC = Electrical Conductivity. 2. TOC = Total Organic Carbon.

Table 25: Some Physico-chemical parameters in the soil samples from well - C within the UCIL site.
Location: Disposal Area II on the Eastern Side of Plant -

Sample Code	pH -	EC (µs/cm)	Fluoride (mg/kg)	Chloride (mg/kg)	Nitrate-NO_3 (mg/kg)	Phosphate (mg/kg)	Sulphate (mg/kg)	TOC (%)	Sodium (mg/kg)	Potassium (mg/kg)
CS	7.28	141.10	13.29	43.30	42.42	2.08	40.29	1.32	94.00	172.00
CS-1	7.27	277.00	9.38	38.18	46.85	3.03	68.00	0.76	104.00	202.00
CS-2	7.51	237.00	7.80	10.67	39.35	3.57	97.40	0.56	88.00	178.00
CS-3	7.58	240.00	11.13	45.23	33.40	2.68	43.24	0.53	104.00	190.00
CS-4	7.62	186.9	10.96	30.64	11.80	2.34	30.71	0.53	106.00	182.00
CS-5	7.98	706.00	18.12	489.16	20.76	3.31	57.80	0.29	238.00	162.00
CS-6	8.03	506.00	22.02	330.82	35.96	5.78	37.86	0.70	182.00	180.00
CS-7	8.17	465.00	21.20	268.20	62.81	4.97	76.99	0.23	190.00	192.00
CS-8	8.04	466.00	20.43	173.66	39.89	34.11	307.10	0.12	166.00	216.00
CS-9	8.16	318.00	23.56	141.15	20.37	7.19	66.89	0.15	160.00	194.00
CS-10	8.26	285.00	17.28	141.48	31.66	6.09	63.59	0.15	144.00	160.00
CS-11	7.97	266.00	16.32	92.68	22.51	10.87	66.13	0.18	120.00	108.00
CS-12	7.98	257.00	15.01	89.31	14.20	3.08	58.63	0.20	126.00	118.00
CS-13	8.01	295.00	16.25	165.41	19.86	2.59	62.58	0.18	140.00	136.00
CS-14	8.09	284.00	13.94	85.09	25.78	1.71	69.89	0.20	134.00	134.00
CS-15	7.85	265.00	19.65	88.55	16.85	5.20	50.81	0.15	342.00	102.00
CS-16	8.14	283.00	15.72	113.68	24.02	7.82	46.17	0.06	362.00	96.00
CS-17	8.01	370.00	11.28	121.97	38.21	6.33	66.26	0.15	442.00	94.00
CS-18	7.95	395.00	9.54	251.36	6.03	6.22	61.45	0.15	152.00	68.00

Note: 1. EC = Electrical Conductivity. 2. TOC = Total Organic Carbon.

Table 26: Some Physico-chemical parameters in the soil samples from well - D within the UCIL site.
Location: Near Storage Tanks

Sample Code	pH -	EC (µs/cm)	Fluoride (mg/kg)	Chloride (mg/kg)	Nitrate-NO_3 (mg/kg)	Phosphate (mg/kg)	Sulphate (mg/kg)	TOC (%)	Sodium (mg/kg)	Potassium (mg/kg)
DS	7.55	108.20	13.78	33.20	26.71	2.33	25.53	1.00	70.00	194.00
DS-1	7.47	140.80	6.06	14.69	15.66	7.60	13.15	0.47	78.00	140.00
DS-2	7.49	131.80	9.59	14.70	18.26	0.62	15.03	0.47	86.00	144.00
DS-3	7.82	240.00	12.46	16.04	19.10	2.58	98.79	0.29	96.00	154.00
DS-4	8.20	167.00	23.95	20.77	24.30	1.02	44.46	0.23	116.00	148.00
DS-5	7.80	208.0	19.22	54.36	27.93	2.06	23.20	0.12	234.00	360.00
DS-6	7.99	278.0	19.86	96.25	10.78	1.57	37.59	0.06	128.00	220.00
DS-7	7.95	246.00	19.89	107.04	10.34	0.84	34.29	0.03	124.00	186.00
DS-8	8.00	250.00	17.31	90.24	18.16	2.88	34.73	0.03	128.00	204.00
DS-9	8.02	236.00	17.07	79.68	11.37	1.44	39.15	0.06	116.00	170.00
DS-10	8.06	225.00	17.68	74.35	32.22	1.83	23.81	0.09	118.00	196.00
DS-11	8.08	200.00	17.62	62.10	19.87	0.58	24.96	0.06	128.00	204.00
DS-12	7.97	220.00	18.19	83.45	13.97	0.73	24.18	0.15	124.00	206.00
DS-13	8.04	222.00	13.19	43.75	16.82	0.59	15.74	0.06	138.00	210.00
DS-14	8.10	226.00	15.40	80.03	20.24	0.62	17.99	0.09	140.00	134.00
DS-15	7.99	260.00	13.25	84.58	33.48	1.18	37.54	0.03	138.00	98.00
DS-16	8.01	303.00	25.58	159.31	38.62	0.97	23.12	0.06	334.00	116.00
DS-17	8.06	360.00	19.29	172.00	35.43	2.67	41.32	0.06	198.00	88.00
DS-18	7.88	375.00	15.96	216.23	28.21	1.69	37.38	0.06	204.00	80.00

Note: 1. EC = Electrical Conductivity. 2. TOC = Total Organic Carbon.

Table 27: Some Physico-chemical parameters in the soil samples from well - E within the UCIL site.
Location: Near Naphthol Plant

Sample Code	pH -	EC (µs/cm)	Fluoride (mg/kg)	Chloride (mg/kg)	Nitrate-NO_3 (mg/kg)	Phosphate (mg/kg)	Sulphate (mg/kg)	TOC (%)	Sodium (mg/kg)	Potassium (mg/kg)
ES	7.27	118.40	11.74	30.66	27.93	1.60	39.05	1.08	66.00	132.00
ES-1	7.75	337.00	14.64	69.42	76.07	3.50	177.59	0.64	144.00	178.00
ES-2	7.72	169.00	11.32	46.16	25.72	1.36	35.45	0.29	142.00	188.00
ES-3	7.67	220.00	12.76	47.31	35.77	0.78	41.15	0.35	198.00	184.00
ES-4	7.92	363.00	16.83	56.40	56.50	2.19	147.31	0.38	220.00	178.00
ES-5	8.15	269.00	47.64	53.51	28.30	2.62	60.19	0.18	298.00	148.00
ES-6	8.16	439.00	36.91	165.21	66.42	3.71	100.36	0.12	570.00	188.00
ES-7	8.07	414.00	30.38	83.28	125.34	22.17	374.41	0.09	520.00	180.00
ES-8	8.12	253.00	33.55	83.41	33.40	4.06	100.03	0.06	418.00	198.00
ES-9	8.08	293.00	26.33	56.99	30.41	2.38	32.92	0.12	336.00	194.00
ES-10	8.12	356.00	29.07	78.84	100.90	12.46	140.18	0.03	374.00	198.00
ES-11	8.00	292.00	22.88	46.10	38.14	11.03	118.66	0.12	528.00	90.00
ES-12	8.06	194.70	30.63	47.34	5.17	1.06	10.97	0.03	486.00	76.00
ES-13	8.09	235.00	26.94	56.87	17.02	1.17	17.57	0.03	432.00	74.00
ES-14	8.11	239.00	30.63	69.06	20.95	4.56	36.77	0.03	426.00	74.00
ES-15	8.06	294.00	10.38	59.44	40.86	5.24	66.90	0.09	348.00	86.00
ES-16	7.94	356.00	16.09	100.24	58.95	5.10	70.64	0.03	360.00	98.00
ES-17	7.97	338.00	20.26	222.02	6.98	8.85	39.42	0.06	362.00	66.00
ES-18	7.99	209.00	8.20	67.48	12.51	4.85	28.88	0.06	148.00	70.00

Note: 1. EC = Electrical Conductivity. 2. TOC = Total Organic Carbon

Table 28: Organic toxicants concentration in the water samples collected from the five wells bored within the UCIL premises in Bhopal on 06.11.2012

Sample code	Aldicarb (µg/L)	Carbaryl (µg/L)	α-Naphthol (µg/L)	α-HCH (µg/L)	β-HCH (µg/L)	γ-HCH (µg/L)	δ-HCH (µg/L)	Dicholorobenzene (Total) (µg/L)
AW	< 0.01	< 0.01	0.085	< 0.01	< 0.02	< 0.02	< 0.02	15.848
BW	< 0.01	< 0.01	0.020	< 0.01	< 0.02	< 0.02	< 0.02	13.805
CW	< 0.01	< 0.01	0.456	< 0.01	< 0.02	< 0.02	< 0.02	25.165
DW	< 0.01	0.071	0.106	< 0.01	< 0.02	< 0.02	< 0.02	26.620
EW	< 0.01	0.018	0.151	< 0.01	< 0.02	< 0.02	< 0.02	16.456
LOQ	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.50
BIS limits*	--	--	--	0.01	0.04	2.0	0.04	--
WHO limits**	10.0	-	-	-	-	2.0	-	1300
USEPA limits ***	-	-	-	-	-	-	-	675
APVMA#	-	30.0	-	-	-	-	-	-

LOQ- Limit of quantitation (Detection Limit) of the method adopted for the particular analyte

* BIS limits (IS:10500:2012)

** WHO, 2004 (Guidelines for Drinking Water Quality)

*** USEPA, 2004 (Referred in Toxicological Profile for DCB)

- APVMA, 2004 (Australian Pesticides & Veterinary Medicnes Authority.)

Table 29: Metal concentration in the water samples collected from the five wells bored within the UCIL premises in Bhopal on 06.11.2012

Sample code	Lead (mg/L)	Cadmium (mg/L)	Nickel (mg/L)	Cobalt (mg/L)	Copper (mg/L)	Zinc (mg/L)	Chromium (mg/L)	Mercury (mg/L)
AW	0.023	< 0.003	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.001
BW	0.058	< 0.003	0.021	< 0.02	< 0.02	< 0.02	< 0.02	< 0.001
CW	0.054	< 0.003	0.023	< 0.02	< 0.02	< 0.02	0.021	< 0.001
DW	0.055	< 0.003	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.001
EW	0.043	< 0.003	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.001
LOQ	0.01	0.003	0.02	0.02	0.02	0.02	0.02	0.001
BIS limits*	0.01	0.003	0.02	NS	0.05	5.0	0.05	0.001

LOQ- Limit of quantitation (Detection Limit) of the method adopted for the particular analyte

- BIS limits (IS:10500:2012)

Table 30: Some physico-chemical parameters in the water samples collected from the five wells bored within the UCIL premises in Bhopal on 06.11.2012

Sample Code	pH	Fluoride (mg/L)	Chloride (mg/L)	Nitrate-NO_3 (mg/L)	Phosphate (µg/L)	Sulphate (mg/L)	Sodium (mg/L)	Potassium (mg/L)
AW	7.17	0.39	150.87	8.57	<10	15.89	85.2	3.4
BW	7.25	0.56	483.26	18.4	<10	21.92	165.9	4.1
CW	7.06	0.33	878.74	3.24	<10	39.17	115.7	3.6
DW	7.11	0.34	678.22	20.02	<10	15.52	83.8	3.4
EW	7.31	0.89	158.32	7.84	<10	20.84	75.4	3.6
Desirable limits	6.5-8.5	1.00	250.00	45.00	NS	200.00	NS	NS
Permissible limits	1.50	1000.00	100.00	NS	400.00	NS	NS	NS

BIS Limits are as per IS:10500:2012

NS- Not specified

Table 31: Comparison of range of various parameters/contaminants in water samples around UCIL premises as reported by NEERI, Nagpur (2010) and CSIR-IITR (September & October, 2012)

Sl. No	Parameters	CSIR-NEERI Report	CSIR-IITR, Lucknow	
			September, 2012	October, 2012
1	pH	7.52 – 8.70	7.03 – 8.05	7.07 – 8.20
2	Fluoride	ND – 0.54	0.15 – 0.59	0.12 – 0.58
3	Chloride	84 - 529	74.06 – 652.18	101.22 – 512.66
4	Nitrate	ND – 2.63	1.137 – 112.2	2.18 – 205.74
5	Phosphate	0.01 – 9.42	< 10	< 10
6	Sulphate	17.2 – 380.4	1.73 – 112.08	5.58 – 152.28
7	Sodium	99 - 863	55.8 – 376.0	52.3 – 315.1
8	Potassium	5.4 - 144	1.60 – 23.40	1.40 – 24.70
9	Lead	ND	< 0.01 – 0.065	< 0.01 – 0.051
10	Cadmium	ND – 0.008	< 0.003	< 0.003
11	Nickel	ND – 0.024	< 0.02 – 0.026	< 0.02
12	Cobalt	ND – 0.047	< 0.02	< 0.02 – 0.021
13	Copper	ND – 0.045	< 0.05	< 0.02 – 0.032
14	Zinc	ND – 1.257	< 0.02 – 1.058	< 0.02 – 0.748
15	Chromium	0.01 – 0.038	< 0.05	< 0.05
16	Mercury	NR	< 0.001	< 0.001 – 0.001
17	Aldicarb	ND – 3.7	< 0.01 – 0.032	< 0.01
18	Carbaryl	ND	< 0.01	< 0.01
19	α-Naphthol	ND	< 0.01 – 1.834	0.01 – 0.182
20	α-HCH	ND	< 0.01 – 0.02	< 0.01 – 0.039
21	β-HCH	ND	< 0.02 – 0.09	< 0.02 – 0.050
22	γ-HCH	ND	< 0.02 – 0.08	< 0.02 – 0.182
23	δ-HCH	ND	< 0.02 – 0.09	< 0.02 – 0.588
24	DCB	ND – 0.0003	< 0.05 – 13.84	0.723 – 9.917

EC in µS/cm; TOC in %; phosphate and organics in ug/L; All other values (except pH) are in mg/L. NR- Not reported

Table 32: Comparison of various parameters/contaminants in water samples from the five deep bore wells dug in UCIL premises as reported by NEERI, Nagpur (2010) and CSIR-IITR (November, 2012)

Sl No	Parameter	Deep Bore well-A		Deep Bore well-B		Deep Bore well-C		Deep Bore well-D		Deep Bore well-E	
		NEERI	IITR	NEERI	IITR	NEERI	IITR	NEERI	IITR	NEERI	IITR
1	pH	NR	7.17	NR	7.25	NR	7.06	NR	7.18	NR	7.31
2	Fluoride	NR	0.39	NR	0.56	NR	0.33	NR	0.35	NR	0.89
3	Chloride	NR	150.87	NR	483.26	NR	878.74	NR	694.18	NR	158.32
4	Nitrate	NR	8.57	NR	18.40	NR	3.24	NR	20.02	NR	7.84
5	Phosphate	NR	< 10	NR	< 10	NR	< 10	NR	< 10	NR	< 10
6	Sulphate	NR	15.89	NR	21.92	NR	39.17	NR	16.00	NR	20.84
7	Sodium	NR	85.2	NR	165.90	NR	115.7	NR	85.50	NR	75.40
8	Potassium	NR	3.40	NR	4.10	NR	3.60	NR	3.60	NR	3.60
9	Lead	NR	0.023	NR	0.058	NR	0.054	NR	0.055	NR	0.043
10	Cadmium	NR	< 0.003	NR	< 0.003	NR	< 0.003	NR	< 0.003	NR	< 0.003
11	Nickel	NR	< 0.02	NR	0.021	NR	0.023	NR	< 0.02	NR	< 0.02
12	Cobalt	NR	< 0.02	NR	< 0.02	NR	< 0.02	NR	< 0.02	NR	< 0.02
13	Copper	NR	< 0.02	NR	< 0.02	NR	< 0.02	NR	< 0.02	NR	< 0.02
14	Zinc	NR	< 0.02	NR	< 0.02	NR	< 0.02	NR	< 0.02	NR	< 0.02
15	Chromium	NR	< 0.02	NR	< 0.02	NR	0.021	NR	< 0.02	NR	< 0.02
16	Mercury	ND	< 0.001	ND	< 0.001	ND	< 0.001	ND	< 0.001	ND	< 0.001
17	Aldicarb	ND	< 0.01	ND	< 0.01	ND	< 0.01	ND	< 0.01	ND	< 0.01
18	Carbaryl	ND	< 0.01	ND	< 0.01	ND	< 0.01	ND	0.071	ND	0.018
19	α-Naphthol	ND	0.085	ND	0.020	ND	0.456	ND	0.106	ND	0.151
20	α-HCH	ND	< 0.01	ND	< 0.01	ND	< 0.01	ND	< 0.01	ND	< 0.01
21	β-HCH	ND	< 0.02	ND	< 0.02	ND	< 0.02	ND	< 0.02	ND	< 0.02
22	γ-HCH	ND	< 0.02	ND	< 0.02	ND	< 0.02	ND	< 0.02	ND	< 0.02
23	δ-HCH	ND	< 0.02	ND	< 0.02	ND	< 0.02	ND	< 0.02	ND	< 0.02
24	DCB	ND	15.848	ND	13.805	ND	25.165	ND	26.620	ND	16.456

EC in µS/cm; TOC in %; phosphate and organics in ug/L; All other values (except pH) are in mg/L NR- Not reported; ND- Not detected

Table 33: Comparison of various parameters/contaminants in soil and sub-soil samples collected from the UCIL premises as reported by NEERI, Nagpur (2010) and CSIR-IITR (November, 2012)

Sl No	Parameter	Surface soil		Subsoil	
		NEERI	IITR	NEERI	IITR
1	pH	6.99 – 7.94	6.74 – 8.06	7.12 – 8.05	6.95 – 8.85
2	Fluoride	0.17 – 4.54	3.06 – 32.45	0.09 – 3.16	1.67 – 30.14
3	TOC	3.83 – 11.64	1.2 – 8.90	3.84 – 7.46	1.17 – 10.13
4	Chloride	164 - 3998	18.57 - 1661	304 - 2098	23.47 – 719.0
5	Nitrate	0.69 – 14.51	1.53 – 126.95	0.09 – 9.04	1.91 – 67.57
6	Phosphate	0.02 – 6.42	1.0 – 501.8	0.03 – 8.46	1.48 – 186.5
7	Sulphate	105 - 1934	15.2 - 30655	100 - 1756	15.17 - 28381
8	Sodium	86 - 431	34 - 1244	86 - 830	30 - 758
9	Potassium	38 - 153	176 - 1680	40 - 204	128 - 1458
10	Lead	0.89 – 6.87	10.92 – 102.9	0.98 – 7.58	3.25-53.87
11	Cadmium	0.41 – 1.97	0.329-1.427	0.18 – 1.76	0.21-1.487
12	Nickel	1.18 – 3.81	31.14-93.82	1.26 – 3.44	40.52-179
13	Cobalt	3.24 -15.53	10.14-32.45	2.23 – 12.35	11.67-199
14	Copper	0.17 – 3.81	27.73-253	0.34 – 3.16	17.49-147.9
15	Zinc	1.26 – 6.76	32.23-354	1.22 – 7.36	21.85-336.9
16	Chromium	1.10 – 3.97	8.96- 66.89	1.13 – 3.80	7.96- 145.1
17	Mercury	ND – 3.07	0.064-3.57	ND – 1.29	<0.05- 0.248
18	Aldicarb	ND	< 0.01	ND - 923	< 0.01
19	Carbaryl	ND - 10729	<0.01 – 0.72	ND - 486	<0.01-1.004
20	α-Naphthol	ND - 1460	<0.01-3.549	ND – 297.2	<0.01-5.576
21	α-HCH	ND – 13.96	<0.01-6.448	ND – 19.82	<0.01-33.45
22	β-HCH	ND – 6.93	<0.01-5.480	ND – 13.34	<0.01-14.96
23	γ-HCH	ND – 5.52	<0.04-2.591	ND – 16.54	<0.04-2.130
24	δ-HCH	ND	<0.06-3.405	ND	<0.06-15.36
25	DCB	ND – 0.165	<0.20-2.449	ND-0.000097	<0.20-0.918

EC in µS/cm; TOC in %; phosphate in ug/kg; All other values (except pH) are in mg/kg. NR- Not reported; ND- Not detected

Note: At site 7A (not done by NEERI) but identified by the NGO to CSIR-IITR team, the levels of α, β, γ, and δ-HCH were 752, 828, 380 and 612 mg/kg in the surface soil respectively. In the sub-surface soil these levels were 815, 25, 265, and 1099 mg/kg respectively. The site was smelling like pesticides during the site visit by IITR team.

Table 34: Comparison of various parameters/contaminants in surface soil samples collected from the outside UCIL premises (upstream and downstream) as reported by NEERI, Nagpur (2010) and CSIR-IITR (October, 2012)

Sl No	Parameter	Upstream		Downstream	
		NEERI	IITR	NEERI	IITR
1	pH	7.81-7.86	7.38-7.61	7.50-8.05	7.28-7.70
2	Fluoride	3.18-8.44	7.34- 33.17	4.51-23.35	2.39-58.65
3	TOC	5.14-13.13	1.38-2.83	5.13-6.54	0.76-4.00
4	Chloride	267-1076	13.73-82.98	163-434	17.63-1985
5	Nitrate	1.37-12.35	6.29-99.55	1.07-13.03	6.47-330.9
6	Phosphate	1.74-55.94	9.56-14.75	0.31-6.19	2.19-205.9
7	Sulphate	202-786	62.93-99.40	301-798	56.71-258.9
8	Sodium	132-278	114- 294	160-755	138- 1316
9	Potassium	45-88	184 - 398	58-96	168 - 428
10	Lead	1.23 – 2.49	7.58 – 313.4	1.18 – 3.53	12.55 – 107.1
11	Cadmium	ND- 10.88	< 0.25	0.22 – 2.86	< 0.25
12	Nickel	3.32 – 3.51	25.81-46.34	2.76 – 5.05	28.00-64.74
13	Cobalt	1.54 – 2.54	11.41-18.65	1.35 – 3.79	11.80-58.96
14	Copper	1.02 – 4.17	18.85-91.92	2.24 – 5.27	21.13-179.6
15	Zinc	7.69 – 9.02	56.52-220.4	6.27 – 7.80	67.74-371.3
16	Chromium	ND – 10.66	19.24-40.88	ND – 6.16	34.44-57.85
17	Mercury	ND	<0.05- 0.358	ND – 0.33	0.063-0.563
18	Aldicarb	ND	< 0.01	ND – 8.158	< 0.01
19	Carbaryl	ND	<0.01- 0.419	ND – 6.888	< 0.01- 0.014
20	α-Naphthol	ND	< 0.01-0.474	ND – 3.516	< 0.01-0.016
21	α-HCH	ND	< 0.01	ND	< 0.01-0.492
22	β-HCH	ND	< 0.02	ND – 2.55	< 0.02-0.506
23	γ-HCH	ND	< 0.02	ND	< 0.02-0.159
24	δ-HCH	NR	< 0.02	NR	< 0.02-0.113
25	DCB	NR	< 0.50	NR	< 0.50

EC in µS/cm; TOC in %; phosphate in ug/g; All other values (except pH) are in mg/kg
NR- Not reported; ND- Not detected

Table 35: Comparison of various parameters/contaminants in soil samples collected from various depths of five bore wells in the UCIL premises as reported by NEERI, Nagpur (2010) and CSIR-IITR (November, 2012)

Sl No	Parameter	Deep Bore well-A		Deep Bore well-B		Deep Bore well-C	
		NEERI	IITR	NEERI	IITR	NEERI	IITR
1	pH	NR	7.54 – 8.30	NR	7.44 – 8.15	NR	7.28 – 8.26
2	Fluoride	NR	2.49 – 46.31	NR	6.63 – 55.82	NR	9.54 – 23.56
3	TOC	NR	0.03 – 1.38	NR	0.09 – 1.08	NR	0.06 – 1.32
4	Chloride	NR	7.13 – 427.88	NR	18.41 – 170.80	NR	10.67 – 489.16
5	Nitrate	NR	1.61 – 46.42	NR	1.07 – 66.32	NR	6.03 – 62.81
6	Phosphate	NR	0.25 – 33.50	NR	1.03 – 26.40	NR	1.71 – 34.11
7	Sulphate	NR	19.74 – 4394.6	NR	19.75 – 273.6	NR	30.71 – 307.1
8	Sodium	NR	70.0 – 514.0	NR	90.0 – 690.0	NR	88.0 – 442.0
9	Potassium	NR	54.00- 214.0	NR	60.0 – 242.0	NR	68.0 – 216.0
10	Lead	NR	12.49 – 31.158	NR	10.487 – 28.425	NR	12.741 – 26.932
11	Cadmium	NR	0.734 – 1.351	NR	0.096 – 1.248	NR	0.339 – 1.311
12	Nickel	NR	0.946 – 69.306	NR	11.904 – 69.175	NR	33.955 – 62.613
13	Cobalt	NR	11.484 – 41.688	NR	7.587 – 23.516	NR	16.102 – 51.020
14	Copper	NR	32.427 – 305.15	NR	16.413 – 100.42	NR	27.857 – 143.29
15	Zinc	NR	6.104 – 113.69	NR	10.249 – 60.840	NR	19.100 – 82.240
16	Chromium	NR	4.213 – 49.426	NR	6.819 – 39.012	NR	17.971 – 41.00
17	Mercury	ND-0.342	< 0.05 – 0.351	ND-0.405	< 0.05 – 0.361	ND-0.176	< 0.05 - 215
18	Aldicarb	ND-6.231	< 0.01	ND-3.778	< 0.01	ND-3.770	< 0.01
19	Carbaryl	ND-3.109	0.010 – 0.095	ND-3.284	0.011 – 0.098	ND-3.708	0.02 – 3.941
20	α-Naphthol	ND-4.372	0.016 – 0.124	ND-3.754	0.02 – 0.088	ND-3.594	0.021 – 0.102
21	α-HCH	ND-0.777	0.017 – 10.676	ND-0.423	0.013 – 11.15	ND-0.392	< 0.01 – 0.828
22	β-HCH	ND-0.660	<0.01 – 0.801	ND-0.614	0.012 – 0.495	ND-0.635	< 0.01 – 0.373
23	γ-HCH	ND-0.649	< 0.04 – 0.499	ND-0.467	< 0.04 – 0.351	ND	< 0.04 – 0.324
24	δ-HCH	ND	< 0.06 – 0.461	ND	< 0.06 – 0.318	ND	< 0.06 – 0.211
25	DCB	ND-0.402	< 0.20	ND-0.000013	< 0.20	ND	< 0.20

Table 36: Comparison of various parameters/contaminants in soil samples collected from various depths of five bore wells in the UCIL premises as reported by NEERI, Nagpur (2010) and CSIR-IITR (November, 2012)

Sl No	Parameter	Deep Bore well-D		Deep Bore well-E	
		NEERI	IITR	NEERI	IITR
1	pH	NR	7.47 – 8.20	NR	7.27 – 8.16
2	Fluoride	NR	6.06 – 25.58	NR	8.20 – 47.64
3	TOC	NR	0.03 – 1.00	NR	0.03 – 1.08
4	Chloride	NR	14.69 – 107.04	NR	30.66 – 222.02
5	Nitrate	NR	10.34 – 38.62	NR	5.17 – 125.34
6	Phosphate	NR	0.59 – 7.60	NR	0.78 – 22.17
7	Sulphate	NR	13.15 – 98.79	NR	10.97 – 374.41
8	Sodium	NR	70.0 – 234.0	NR	66.0 – 570.0
9	Potassium	NR	80.0 - 360	NR	66.0 – 198.0
10	Lead	NR	9.117 – 24.743	NR	3.900 – 25.757
11	Cadmium	NR	0.065 – 1.141	NR	0.053 – 0.787
12	Nickel	NR	30.331 – 55.382	NR	8.883 – 58.237
13	Cobalt	NR	12.571 – 34.308	NR	4.702 – 34.849
14	Copper	NR	27.236 – 143.85	NR	16.889 – 179.89
15	Zinc	NR	32.670 – 81.664	NR	6.903 – 112.92
16	Chromium	NR	14.436 – 26.351	NR	7.315 – 29.499
17	Mercury	ND-0.245	< 0.05 – 0.359	ND-1.971	< 0.05 – 3.216
18	Aldicarb	ND-5.486	< 0.01	ND-3.713	< 0.01
19	Carbaryl	ND	0.01 – 0.129	ND-3.570	0.017 – 0.216
20	α-Naphthol	ND	0.01 – 0.083	ND	0.022 – 0.344
21	α-HCH	ND-0.263	< 0.01 – 1.281	ND-0.408	< 0.01 – 0.858
22	β-HCH	ND	< 0.01 – 0.047	ND	< 0.01 – 0.048
23	γ-HCH	ND	< 0.04	ND-0.614	< 0.04 – 0.184
24	δ-HCH	ND	< 0.06	ND	< 0.06
25	DCB	ND	< 0.20	ND-0.00001	< 0.20 – 0.319

Table 37: Guideline values for organic toxicants in drinking water as per National/ International Regulatory agencies

Toxicant	Guideline values (µg/L)	Reference
α-HCH	0.01	Indian Standard Drinking Water specifications (IS 10500: 2012)
β-HCH	0.04	Indian Standard Drinking Water specifications (IS 10500: 2012)
γ-HCH (Lindane)	2.0	Indian Standard Drinking Water specifications (IS 10500: 2012)
δ-HCH	0.04	Indian Standard Drinking Water specifications (IS 10500: 2012)
Aldicarb	10.0	Guidelines for Drinking Water Quality, Volume I, Recommendations, World Health Organisation, 2004
Carbaryl	30.0	Australian Pesticides & Veterinary Medicines Authority, June 2004
α-Naphthol	Not specified	---
1,2-Dichlorobenzene	600.0	USEPA, 2004 (Referred in Toxicological Profile for Dichlorobenzene, September 2004, ATSDR)
1,2-Dichlorobenzene	1000	Guidelines for Drinking Water Quality, Volume I, Recommendations, World Health Organisation, 2004
1,4-Dichlorobenzene	75.00	USEPA, 2004 (Referred in Toxicological Profile for Dichlorobenzene, September 2004, ATSDR)
1,4-Dichlorobenzene	300	Guidelines for Drinking Water Quality, Volume I, Recommendations, World Health Organisation, 2004