

# Supplementary materials: Size-Segregated Elemental Profile and Associated Health Risk Assessment of Road Dust along Major Traffic Corridors in Kolkata Mega City

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**Table S1.** Summary of non-cumulative particle size distribution of road dust (<106 µm particle size range)\*.

Size range (µ)	Alipore	Rabindra Sadan	Hazra	Esplanade	Shyambazar	Ruby Square	Jadavpur	Picnic Garden	College Street	Khidirpur	Ultadanga
<4.5	5.69	5.13	6.19	5.69	4.53	5.95	4.80	10.42	8.73	6.87	5.09
4.5–5.5	1.14	1.08	1.4	1.40	0.93	1.22	0.96	2.32	1.79	1.57	1.26
5.5–6.5	1.06	1.02	1.35	1.39	0.86	1.14	0.88	2.19	1.61	1.51	1.24
6.5–7.5	0.98	0.96	1.29	1.36	0.83	1.07	0.85	2.05	1.47	1.45	1.23
7.5–9	1.34	1.35	1.84	2.00	1.17	1.50	1.22	2.88	1.99	2.05	1.81
9–11	1.62	1.65	2.27	2.51	1.48	1.82	1.65	3.55	2.43	2.51	2.31
11–13	1.52	1.52	2.10	2.35	1.41	1.68	1.72	3.29	2.29	2.3	2.21
13–15.5	1.82	1.82	2.44	2.69	1.73	2.00	2.31	3.85	2.85	2.65	2.65
15.5–18.5	2.23	2.16	2.76	2.99	2.05	2.34	2.98	4.35	3.59	3.02	3.08
18.5–21.5	2.40	2.32	2.71	2.87	2.10	2.45	3.15	4.16	3.91	3.05	3.12
21.5–25	3.18	3.09	3.30	3.47	2.58	3.19	3.78	4.73	4.99	3.88	3.88
25–30	5.40	5.48	5.32	5.65	4.18	5.49	5.50	6.66	7.76	6.53	6.36
30–37.5	10.12	10.76	9.71	10.50	7.96	10.61	8.59	9.95	12.25	12.04	11.54
37.5–45	11.83	12.81	11.32	11.95	10.64	12.37	9.69	9.69	11.77	13.21	12.91
45–52.5	12.18	13.07	11.63	11.96	12.32	12.55	10.78	8.84	10.18	12.63	12.68
52.5–62.5	14.78	15.44	13.97	13.88	16.51	14.84	14.51	9.38	10.13	12.6	13.92
62.5–75	12.87	12.48	11.72	10.89	16.01	11.88	14.67	7.10	7.27	8.35	9.76
75–90	7.05	6.13	6.04	5.14	8.87	5.65	8.96	3.54	3.55	2.82	3.82
90–106	2.17	1.73	1.85	1.31	2.72	1.61	3.00	1.05	1.08	0.46	8.50

\* Higher degree of uncertainty is expected in finer particle ranges as compared to coarse ranges due to possible loss of fine particles during sampling

**Table S2.** Volumetric mean diameter (VMD), Sauter Mean Diameter (SMD), surface area to volume ratio ( $S_v$ ) and specific surface ( $S_m$ ) area of road dust (<106  $\mu\text{m}$  road dust).

Site	SMD	VMD	$S_v$ ( $\text{m}^2 \text{cm}^{-3}$ )	$S_m$ ( $\text{cm}^2 \text{g}^{-1}$ )
Alipore	18.59	44.35	0.32	1190.73
Rabindra Sadan	19.33	43.58	0.31	1145.13
Hazra	16.93	42.02	0.35	1307.95
Esplanade	17.08	40.20	0.35	1296.32
Shyambazar	21.32	48.28	0.28	1038.27
Ruby Square	17.86	42.76	0.34	1239.98
Jadavpur	19.96	45.51	0.30	1109.26
Picnic Garden	11.79	32.58	0.51	1877.33
College Street	13.69	35.46	0.44	1617.04
Khidirpur	15.49	37.05	0.39	1429.71
Ultadanga	17.91	39.51	0.33	1236.14

**Table S3** Metal concentration ( $\text{mg kg}^{-1}$ ) in size-segregated road dust at different sites in Kolkata

		<i>Cd</i>	<i>Cr</i>	<i>Co</i>	<i>Pb</i>	<i>Mn</i>	<i>Ni</i>	<i>Sr</i>	<i>Zn</i>	<i>Fe</i>	<i>Mg</i>	<i>Li</i>	<i>Ti</i>	<i>Cu</i>	<i>Ba</i>
<b>Earth Crust Reference values [35]</b>		<b>0.20</b>	<b>100.00</b>	<b>25.00</b>	<b>12.50</b>	<b>950.00</b>	<b>75.00</b>	<b>375.00</b>	<b>70.00</b>	<b>56300.00</b>	<b>23300.00</b>	<b>20.00</b>	<b>5700.00</b>	<b>55.00</b>	<b>425.00</b>
<i>Shyambazar</i>	<28 $\mu\text{m}$	3.68	115.49	9.96	4.97	511.21	44.08	61.12	396.42	24503.62	10929.94	395.81	475.04	186.85	459.21
<i>Khidirpur</i>		2.95	97.97	10.85	4.17	522.22	38.39	53.17	271.94	20556.71	6433.45	460.16	568.71	81.39	284.64
<i>Ruby</i>		2.32	70.71	9.37	3.19	340.89	42.58	54.03	245.17	14551.34	8168.63	430.42	587.30	55.45	270.95
<i>College St.</i>		2.85	85.96	10.36	3.48	378.26	57.35	61.91	288.62	15043.41	8361.94	441.72	425.64	61.72	350.91
<i>Ultadanga</i>		2.59	86.82	10.21	3.90	369.95	57.80	58.92	293.26	17493.63	7195.18	444.23	423.07	64.38	441.36
<i>R. Sadan</i>		2.68	71.27	9.11	3.53	402.19	38.85	66.32	297.16	14736.23	8102.92	433.91	475.50	55.66	305.29
<i>Hazra</i>		2.48	67.35	11.01	3.32	389.26	44.87	56.06	289.00	16191.09	7893.53	460.01	355.44	72.39	324.79
<i>Alipore</i>		2.16	65.53	9.30	3.07	407.09	53.20	61.19	266.41	15079.15	7662.83	441.07	476.77	57.36	451.28
	<b>Mean</b>	<b>2.68</b>	<b>71.27</b>	<b>9.11</b>	<b>3.53</b>	<b>402.19</b>	<b>38.85</b>	<b>66.32</b>	<b>297.16</b>	<b>14736.23</b>	<b>8102.92</b>	<b>433.91</b>	<b>475.50</b>	<b>55.66</b>	<b>305.29</b>
	<b>SD</b>	<b>0.47</b>	<b>17.49</b>	<b>0.72</b>	<b>0.63</b>	<b>66.02</b>	<b>7.89</b>	<b>4.45</b>	<b>45.02</b>	<b>3543.82</b>	<b>1304.46</b>	<b>20.32</b>	<b>76.35</b>	<b>44.34</b>	<b>78.11</b>
	<b>CV(%)</b>	<b>17.62</b>	<b>24.54</b>	<b>7.85</b>	<b>17.74</b>	<b>16.42</b>	<b>20.30</b>	<b>6.71</b>	<b>15.15</b>	<b>24.05</b>	<b>16.10</b>	<b>4.68</b>	<b>16.06</b>	<b>79.65</b>	<b>25.59</b>
<i>Shyambazar</i>	>28–<45 $\mu\text{m}$	5.07	143.97	8.59	6.15	600.93	48.99	48.34	428.50	30531.94	10806.29	421.63	475.79	247.30	376.04
<i>Khidirpur</i>		1.98	57.43	9.63	2.78	349.61	40.50	48.45	260.45	14960.27	7629.34	440.46	480.95	57.05	447.93

Ruby		2.63	66.03	9.31	3.24	330.76	46.30	54.18	262.03	13968.23	8182.39	462.41	404.30	50.60	275.47
College St.		1.83	44.73	6.88	2.34	258.74	31.26	40.29	172.25	12013.79	7507.64	462.22	419.21	36.70	177.07
Ultadanga		3.28	100.80	9.62	3.89	357.55	67.11	48.00	281.66	18353.41	6928.87	448.28	351.08	73.68	270.91
R.Sadan		2.14	52.62	7.40	2.78	343.83	26.45	49.54	235.03	13935.24	7380.53	452.82	420.64	38.63	225.50
Hazra		3.00	86.25	9.37	3.70	484.72	35.25	38.26	236.34	21135.34	6067.40	470.37	526.54	74.75	206.23
Alipore		1.89	48.90	8.19	2.49	339.57	38.74	49.43	235.22	12847.99	7102.53	463.78	370.91	42.17	320.96
	Mean	2.14	52.62	7.40	2.78	343.83	26.45	49.54	235.03	13935.24	7380.53	452.82	420.64	38.63	225.50
	SD	1.09	33.88	1.05	1.23	107.70	12.61	5.21	73.91	6170.33	1396.06	15.83	59.27	70.12	90.84
	CV(%)	50.88	64.39	14.20	44.42	31.32	47.68	10.52	31.45	44.28	18.92	3.50	14.09	181.50	40.28
Shyambazar	45–<63 µm	3.54	115.74	8.37	4.84	489.85	32.33	35.18	329.44	31239.96	10435.81	443.58	468.78	199.21	300.54
Khidirpur		2.89	107.55	9.07	4.15	531.44	30.91	34.67	224.08	22887.42	5657.78	470.34	538.27	78.99	301.13
Ruby		1.74	46.33	7.38	2.74	270.63	24.89	39.61	173.91	13060.48	7485.32	476.68	453.22	29.98	169.30
College St.		2.99	60.02	9.87	3.73	331.42	47.77	51.48	270.46	13973.32	7963.55	473.27	427.68	49.03	457.04
Ultadanga		2.39	122.36	9.16	2.86	309.40	63.79	38.22	238.77	16715.03	5932.63	465.40	355.02	54.24	204.12
R.Sadan		2.23	55.99	7.64	2.93	339.75	24.82	48.70	237.82	13774.71	6981.17	446.99	375.98	34.48	204.77
Hazra		2.24	58.05	9.59	2.91	343.22	40.39	43.62	260.43	15111.55	7572.23	468.99	375.60	63.00	341.24
Alipore		1.88	47.50	8.36	2.66	330.60	27.85	45.95	218.47	13592.80	6787.39	457.29	405.02	42.22	285.02
Picnic garden		1.52	32.60	5.25	1.96	217.05	19.72	33.73	96.23	10609.18	5278.75	481.20	254.55	BDL	288.35
	Mean	2.24	58.05	9.59	2.91	343.22	40.39	43.62	260.43	15111.55	7572.23	468.99	375.60	63.00	341.24
	SD	0.65	33.76	1.42	0.88	99.34	13.85	6.49	64.95	6404.68	1545.65	13.01	80.23	54.95	86.33
	CV(%)	29.23	58.16	14.78	30.22	28.95	34.28	14.87	24.94	42.38	20.41	2.77	21.36	87.23	25.30
Shyambazar	63–<106 µm	2.93	65.04	5.39	3.66	360.00	41.39	32.87	230.82	21981.97	9599.56	464.65	238.53	125.09	215.02
Khidirpur		1.84	48.11	6.83	2.32	265.29	29.38	33.73	194.20	13940.21	6056.22	487.44	245.71	53.42	200.00
Ruby		1.86	31.67	5.67	2.29	219.72	47.38	32.88	139.38	11228.55	6264.96	481.23	250.97	25.92	121.58
College St.		0.85	9.74	2.62	0.97	79.22	14.16	9.19	67.45	4015.22	2126.98	501.18	99.07	BDL	67.48
Ultadanga		1.52	33.26	3.79	1.60	135.46	13.24	25.84	84.82	8788.50	3078.98	496.07	92.51	2.89	120.33

<i>R.Sadan</i>		2.59	43.79	6.47	2.98	275.71	25.94	36.47	207.48	12347.38	5950.22	471.60	272.22	23.39	180.65
<i>Hazra</i>		1.45	30.21	3.47	1.74	237.62	15.37	11.89	94.82	10965.18	2749.98	502.46	188.52	11.08	66.87
<i>Alipore</i>		1.91	36.82	5.99	3.06	296.89	28.49	43.57	171.89	12235.43	5716.08	480.85	259.70	35.30	208.05
<i>Picnic garden</i>		1.01	16.56	2.93	1.70	156.68	13.27	28.88	63.00	6898.51	3366.22	479.36	113.07	BDL	96.14
<i>Jadavpur</i>		0.83	8.10	2.44	1.26	84.92	32.47	10.99	22.11	4647.44	2167.06	506.88	114.31	BDL	172.68
	<b>Mean</b>	<b>1.45</b>	<b>30.21</b>	<b>3.47</b>	<b>1.74</b>	<b>237.62</b>	<b>15.37</b>	<b>11.89</b>	<b>94.82</b>	<b>10965.18</b>	<b>2749.98</b>	<b>502.46</b>	<b>188.52</b>	<b>11.08</b>	<b>66.87</b>
	<b>SD</b>	<b>0.70</b>	<b>17.71</b>	<b>1.68</b>	<b>0.86</b>	<b>93.94</b>	<b>12.16</b>	<b>11.94</b>	<b>71.02</b>	<b>5192.17</b>	<b>2406.81</b>	<b>14.08</b>	<b>74.65</b>	<b>41.09</b>	<b>57.35</b>
	<b>CV(%)</b>	<b>48.43</b>	<b>58.62</b>	<b>48.51</b>	<b>49.51</b>	<b>39.53</b>	<b>79.12</b>	<b>100.43</b>	<b>74.90</b>	<b>47.35</b>	<b>87.52</b>	<b>2.80</b>	<b>39.60</b>	<b>370.88</b>	<b>85.77</b>

**Table S4.** Slope of decline in metal concentration with increasing particle size in size-segregated road dust.

<b>Metal</b>	<b>Slope of decreasing linear trend</b>	<b>Best fit linear equation</b>
Pb	-0.487	$y = -0.487x + 4.3375$ $R^2 = 0.8678$
Fe	-2013.8	$y = -2013.8x + 20526$ $R^2 = 0.6605$
Cd	-0.3447	$y = -0.3447x + 3.2359$ $R^2 = 0.8237$
Cr	-15.422	$y = -15.422x + 104.02$ $R^2 = 0.7796$
Co	-1.6708	$y = -1.6708x + 12.053$ $R^2 = 0.8544$
Mn	-64.368	$y = -64.368x + 501.16$ $R^2 = 0.8544$
Zn	-53.39x	$y = -53.39x + 361.67$ $R^2 = 0.91$
Ni	-7.0202	$y = -7.0202x + 54.999$ $R^2 = 0.9891$
Sr	-10.319	$y = -10.319x + 69.304$ $R^2 = 0.9763$
Ba	-65.253	$y = -65.253x + 432.37$ $R^2 = 0.8714$
Mg	-1073.7	$y = -1073.7x + 9590.1$ $R^2 = 0.8328$
Li	15.838	$y = 15.838x + 421.2$ $R^2 = 0.9815$
Ti	-88.308	$y = -88.308x + 595.29$ $R^2 = 0.7961$
Cu	-12.817	$y = -12.817x + 98.413$ $R^2 = 0.8052$

**Table S5.** Enrichment factors of metals and degree of pollution in road dust with respect to size range.

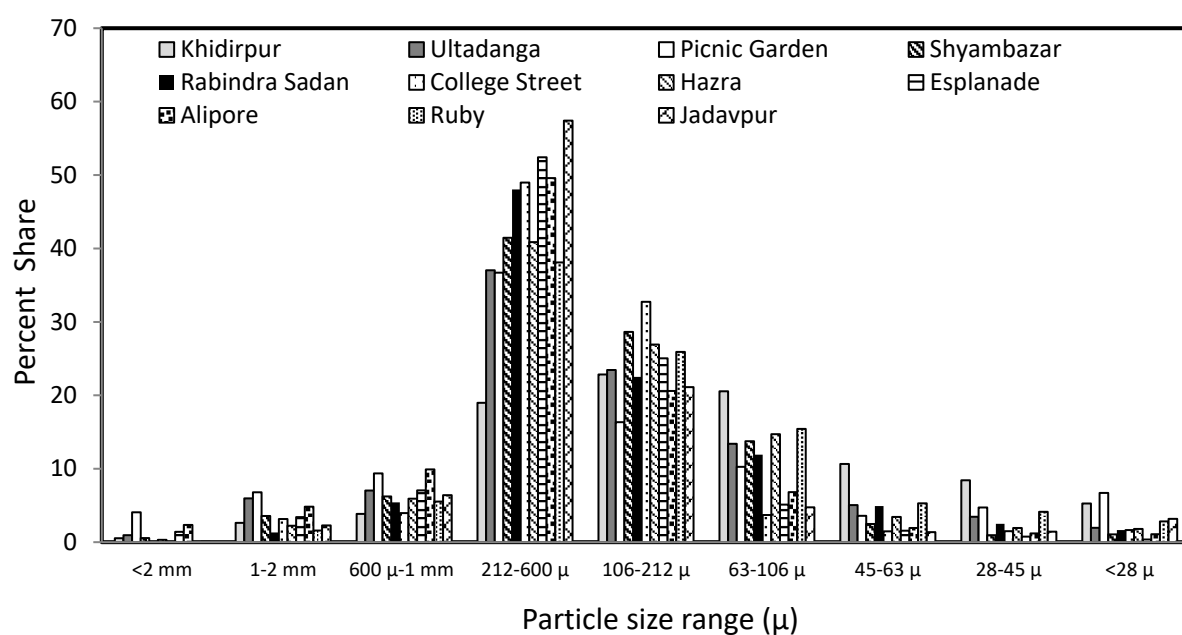
	<b>Enrichment Factor (EF)</b>												
<b>Size range/Degree of pollution</b>	<b>Cd</b>	<b>Cr</b>	<b>Co</b>	<b>Pb</b>	<b>Mn</b>	<b>Ni</b>	<b>Sr</b>	<b>Zn</b>	<b>Fe</b>	<b>Mg</b>	<b>Li</b>	<b>Cu</b>	<b>Ba</b>
<b>&lt;28 µm</b>	112–221	7–14	4–7	2.5–4.8	3.5–6.6	5.1–10.4	1.4–2.4	34–68	2.5–5.2	2.8–5.6	208.9–368.8	9.8–40.8	6.2–14
<b>Degree of metal pollution</b>	<i>Extremely High</i>	<i>Significant</i>	<i>Moderate-Significant</i>	<i>Moderate</i>	<i>Moderate-Significant</i>	<i>Significant</i>	<i>Depletion to minimal-Moderate</i>	<i>Very high-Extremely high</i>	<i>Moderate-Significant</i>	<i>Moderate-Significant</i>	<i>Extremely High</i>	<i>Significant-very high-extremely high</i>	<i>Significant</i>
<b>&gt;28-&lt;45 µm</b>	117–304	6–17	4–6	2.6–5.9	3.7–7.6	4.8–14.5	1.1–2.1	33.5–73.3	2.9–6.5	2.8–5.6	252.6–363.9	9.1–53.9	5.2–12.5
<b>Degree of metal pollution</b>	<i>Extremely High</i>	<i>Significant</i>	<i>Moderate-Significant</i>	<i>Moderate-Significant</i>	<i>Moderate-Significant</i>	<i>Moderate-Significant</i>	<i>Depletion to minimal-Moderate</i>	<i>Very high-Extremely high</i>	<i>Moderate-Significant</i>	<i>Moderate-Significant</i>	<i>Extremely High</i>	<i>Significant-very high-extremely high</i>	<i>Significant</i>
<b>45-&lt;63 µm</b>	109–215	6–20	3.7–5.9	2.8–4.7	3.6–6.3	4.2–13.7	1–2	30.8–57.2	2.9–6.7	2.6–5.4	249–538.8	6.9–54.3	5–15.2
<b>Degree of metal pollution</b>	<i>Extremely High</i>	<i>Significant</i>	<i>Moderate-Significant</i>	<i>Moderate</i>	<i>Moderate-Significant</i>	<i>Moderate-Significant</i>	<i>Depletion to minimal-Moderate</i>	<i>Very high-Extremely high</i>	<i>Moderate-Significant</i>	<i>Moderate-Significant</i>	<i>Extremely High</i>	<i>Significant-Extremely high</i>	<i>Significant</i>
<b>63-&lt;106 µm</b>	208–469	4–21	4.2–9.3	4.2–7.9	4.5–9.1	6.2–21.6	1–4.2	15.8–78.8	4.1–9.6	3.6–9.8	493.7–1528.3	3.2–22.5	4.8–20.3
<b>Degree of metal pollution</b>	<i>Extremely High</i>	<i>Significant</i>	<i>Moderate-Significant</i>	<i>Moderate-Significant</i>	<i>Moderate-Significant</i>	<i>Significant</i>	<i>Depletion to minimal-Moderate</i>	<i>Significant-extremely high</i>	<i>Moderate-Significant</i>	<i>Moderate-Significant</i>	<i>Extremely High</i>	<i>Moderate-significant-very high</i>	<i>Significant-very high</i>

*Degree of metal pollution: Extremely High*

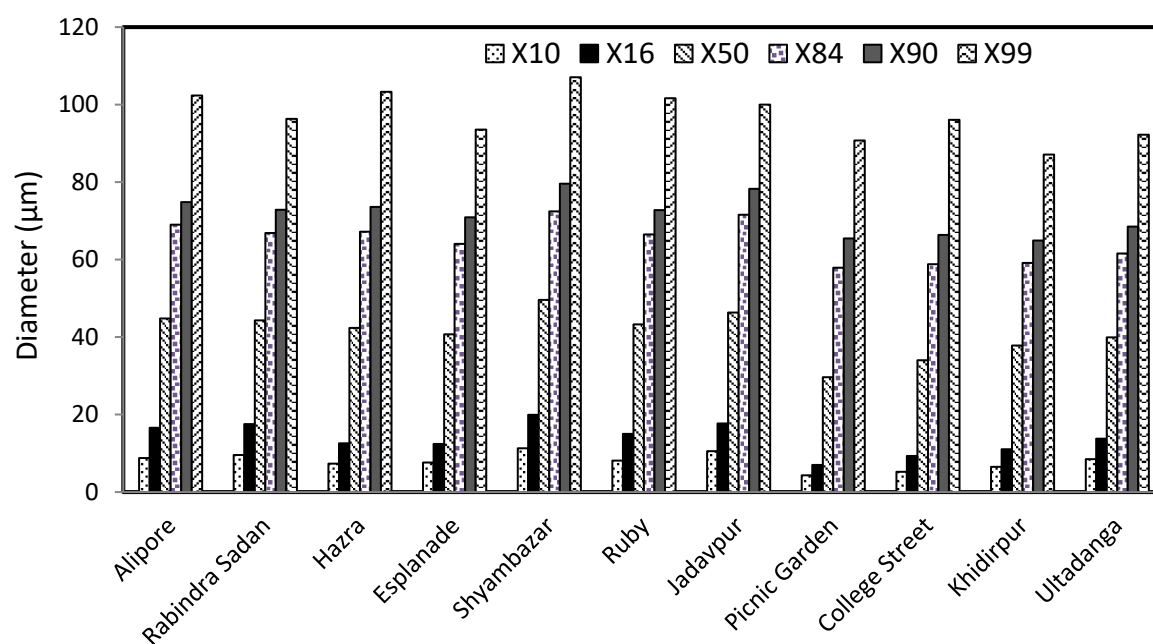
**Table S6.** Range of Ecological Risk Values (Ei) of individual metals in different size groups in road dust of various sites in Kolkata.

<b>Metal</b>	<b>&lt;28 µm</b>	<b>Ecological Risk</b>	<b>&gt;28–&lt;45 µm</b>	<b>Ecological Risk</b>	<b>45&gt;–&lt;63 µm</b>	<b>Ecological Risk</b>	<b>&gt;63–&lt;106 µm</b>	<b>Ecological Risk</b>
Cu	5.04–16.99	Low	3.34–22.48	Low	1.2–18.11	Low	0.26–11.37	Low
Pb	1.23–1.99	Low	0.94–2.46	Low	0.79–1.94	Low	0.39–1.46	Low
Cr	1.31–2.31	Low	0.89–2.88	Low	0.65–2.45	Low	0.16–1.3	Low
Ni	2.56–3.85	Low	1.31–4.25	Low	1.31–4.25	Low	0.88–3.16	Low
Cd	323.27–552.32	Very high risk	273.76–760.17	Very high risk	227.45–530.66	Very high risk	124.84–440.17	Very high risk
Zn	3.5–5.66	Low	2.46–6.12	Low	1.37–4.71	Low	0.32–3.30	Low

Ei<40: Low ecological risk, 40≤Ei<80: Moderate ecological risk; 80≤Ei<160: Considerable ecological risk; 160≤Ei<320: High ecological risk; Ei>320: Very high risk

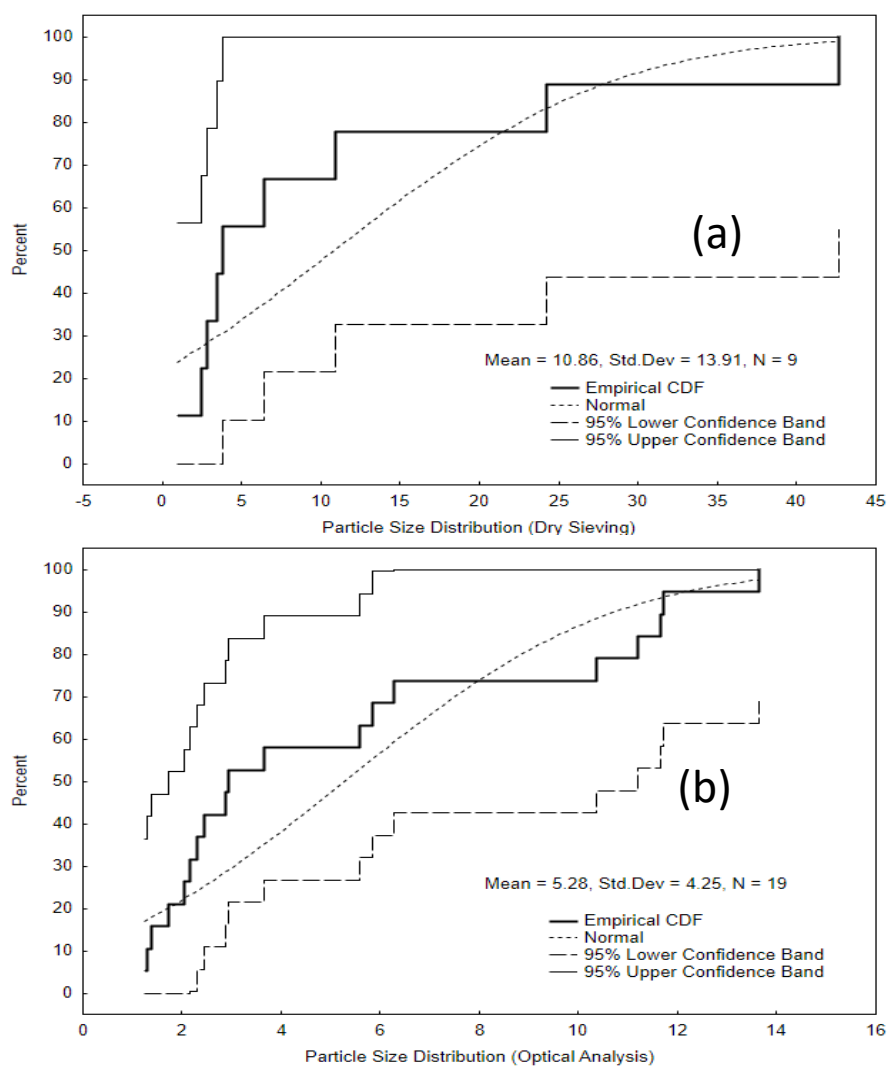


**Figure S1.** Particle size distribution of road-dust samples (<28–>2000  $\mu$ m size range) collected from different sites in Kolkata.



**Figure S2.** Percentile of particle size distribution of road-dust (<106  $\mu$ m) collected from different sites in Kolkata





**Figure S3.** Plot of empirical cumulative distribution function (CDF) of average particle size distribution of (a) road dust (<28-2000  $\mu\text{m}$ ) (b) road dust (<106  $\mu\text{m}$  size range) against a normal distribution plot