

**REPORT ON AMBIENT AIR QUALITY MONITORING CONDUCTED IN THE KMA  
FEBRUARY 6-13 2012**



Prepared by:  
National Environment and Planning Agency  
March 2012

### LIST OF ACRONYMS

- AQHI- Air Quality Health Index
- AQI -Air Quality Index
- KMA- Kingston Metropolitan Area
- MET- meteorological
- MOH - Ministry of Health
- NEPA - National Environment and Planning Agency
- NO<sub>2</sub> - Nitrogen Dioxide
- PAPs-Priority Air Pollutants
- PM<sub>10</sub> - Particulate Matter less than 10 microns
- PM<sub>2.5</sub> -Particulate Matter less than 2.5 microns
- POPs - Persistent Organic Pollutants
- SO<sub>2</sub> -Sulphur Dioxide
- TSP - Total Suspended Particulate Matter
- Ug/M<sup>3</sup> – Micrograms per meter cube
- m/s – meters per second
- USEPA - United States Environment Protection Agency
- VOC - Volatile Organic Compounds
- WHO-World Health Organization

## **EXECUTIVE SUMMARY**

Ambient air quality monitoring exercise was conducted in response to the air pollution incident, resulting from a fire at the Riverton Solid Waste Disposal facility during the period February 6 to February 13 2012. The monitoring exercise was conducted jointly by the Ministry of Health and the National Environment and Planning Agency. The report provides an outline of the monitoring sites that were used to assess the impact of the Riverton waste disposal site's emissions from the fire, the site location and the pollutants that were tested.

The detailed results for all the monitoring exercise are provided both graphically and in tabular form and a comparison is made with the average site conditions based on historical data and the Jamaica Ambient Air Quality Standards. Each graph is analyzed and the important points highlighted.

The general conclusion based on the results of the monitoring exercise is that the subject fire at the Riverton Solid Waste Disposal Site created a negative impact on the ambient air quality in Kingston and St. Andrew and Portmore regions. The data collected gives a reasonable indication of the impact and provides a good baseline to make decisive actions and inform the public on the risk if an event of this magnitude should reoccur. The basis of the conclusion is as follows:

1. The data showed ambient air quality with respect to PM<sub>10</sub>, within a 1km radius of the site, to be "Very High Risk" according to the USEPA and Canadian Air Quality Index definition.
2. At distances up to a 2km radius the air quality with respect to PM<sub>10</sub> was "High Risk" according to the same Canadian and USEPA Air Quality Index
3. Based on the data gathered during the fire one exceedance of the of the National Jamaica Ambient Air Quality Standard for PM<sub>10</sub> 24 Hour averaging was recorded for Friday, 10 February 2012. The recorded average for PM<sub>10</sub> was 167ug/m<sup>3</sup>.
4. VOC Samples have been collected and analyzed. However assessment of the impact of these VOCs is being determined by the Ministry of Health
5. High 24 Hour particulate matter (PM<sub>10</sub>) readings were recorded during the event at two sites monitored at Spanish Town Road and Washington Gardens.
6. Although only one data set was gathered for stations in the northerly direction from the dump. Data from the Southerly region of dump suggest that averages remained in the same range during the event. Sites located at Cross Roads and Marcus Garvey drive showed basically the same average on Tuesday and Saturday. Hence the probability is that the same trend is expected for the sites in the northerly direction.

## BACKGROUND

On Tuesday the 7<sup>th</sup> February 2012 the National Environment and Planning Agency observed the Riverton Disposal Site on fire. The Agency contacted the National Solid Waste Authority who confirmed sections of the site were on fire and they had started to use material to cover the area and contacted the fire department for support. The following day the Agency contacted the Ministry of Health to procure additional support to conduct a response monitoring exercise to the fire at the Riverton disposal site. A request was sent to each private licensed facility which operates permanent ambient air monitoring sites in the Kingston and St. Andrew region to provide their data. The private industry responded positively and the Agency began receiving preliminary data on Wednesday evening. On Thursday 9<sup>th</sup> February 2012 equipment from the MOH along with in house equipment were calibrated, maintained and repaired for deployment. Contact was also made with MOH and they informed the Agency that they had procured an additional monitor for deployment. Deployment were made on 10 Friday 2012.

## SAMPLING

### Locations

The sites chosen were based on impact zones, complaints, high density areas, known general wind direction from dump and availability of host for equipment. The sites used are shown in Table 1 below:

**Table 1: Showing Site Locations**

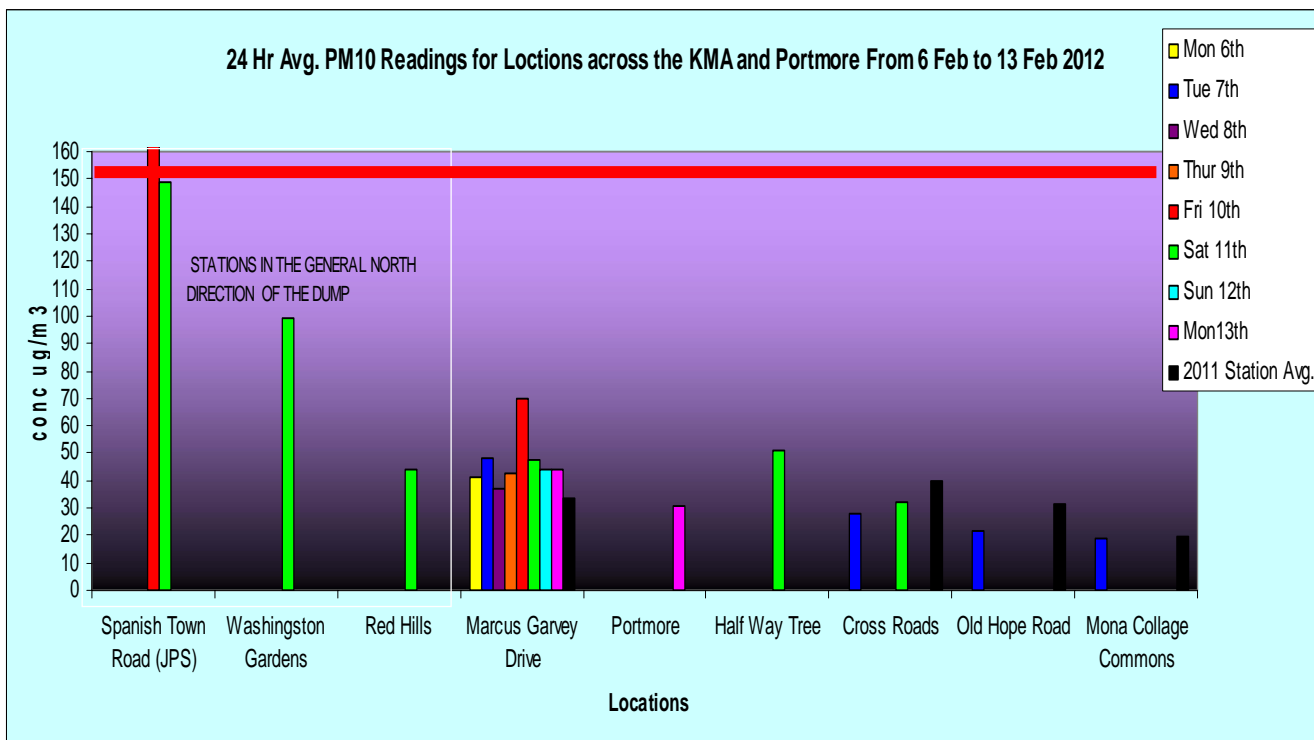
<b>SITE LOCATIONS</b>	<b>BASIS FOR SELECTION</b>
1. Half Way Tree Fire Station	Temporary Response Monitoring Site
2. Home on Garfield Avenue, Washington Gardens	Temporary Response Monitoring Site
3. JPS Offices, Spanish Town Road	Temporary Response Monitoring Site
4. Home on Belvedere Road, Red Hills	Temporary Response Monitoring Site
5. Water Ford Fire Station, Portmore	Temporary Response Monitoring Site
6. Crossroads	Permanent Routine Ambient Monitoring Site
7. 191 Old Hope Road	Permanent Routine Ambient Monitoring Site
8. Garmex, Marcus Garvey Drive	Permanent Private Ambient Monitoring Site
9. Petrojam, Marcus Garvey Drive	Permanent Private Ambient Monitoring Site
10. College Commons, Mona	Permanent Private Ambient Monitoring Site

Thirty five (35) pollutants were assessed during the period (Appendix I).

## PRESENTATION OF RESULTS

The data was manipulated and presented in the form of graphs and tables. The graphs will represent data gathered over the subject monitoring period i.e. 6 – 13 February to 2012 while the tables will indicate the data gathered daily from each sampling location for each pollutant.

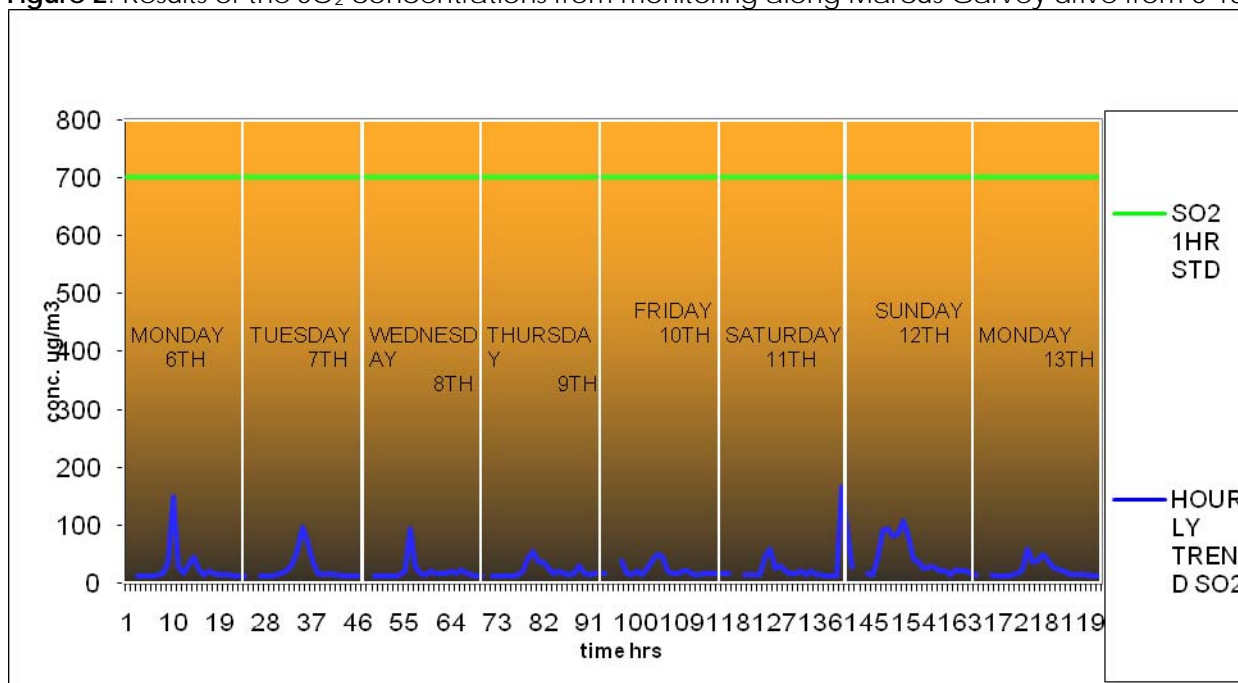
Figure 1: Showing PM10 Data recorded at various locations across the KMA and Portmore from 6 February to 13 February 2012



**Table 1:** Showing 24 hour average PM10 (ug/m3) measures during dump fire 6 February – 13 February 2012

	Spanish Town Road (JPS)	Washington Gardens	Red Hills	Marcus Garvey Drive	Portmore	Half Way Tree	Cross Roads	Old Hope Road	Mona College Commons
Mon 6th				41.08					
Tue 7th				48.17			28	22	19
Wed 8th				37.29					
Thur 9th				42.41					
Fri 10th	167			70.20					
Sat 11th	149	99	44	47.83		51	32		
Sun 12th				44.125					
Mon 13th				44.125	31				
<b>2011 Station Avg.</b>	N/A	N/A		<b>33.53</b>	N/A	N/A	<b>40.14</b>	<b>31.20</b>	<b>19.32</b>

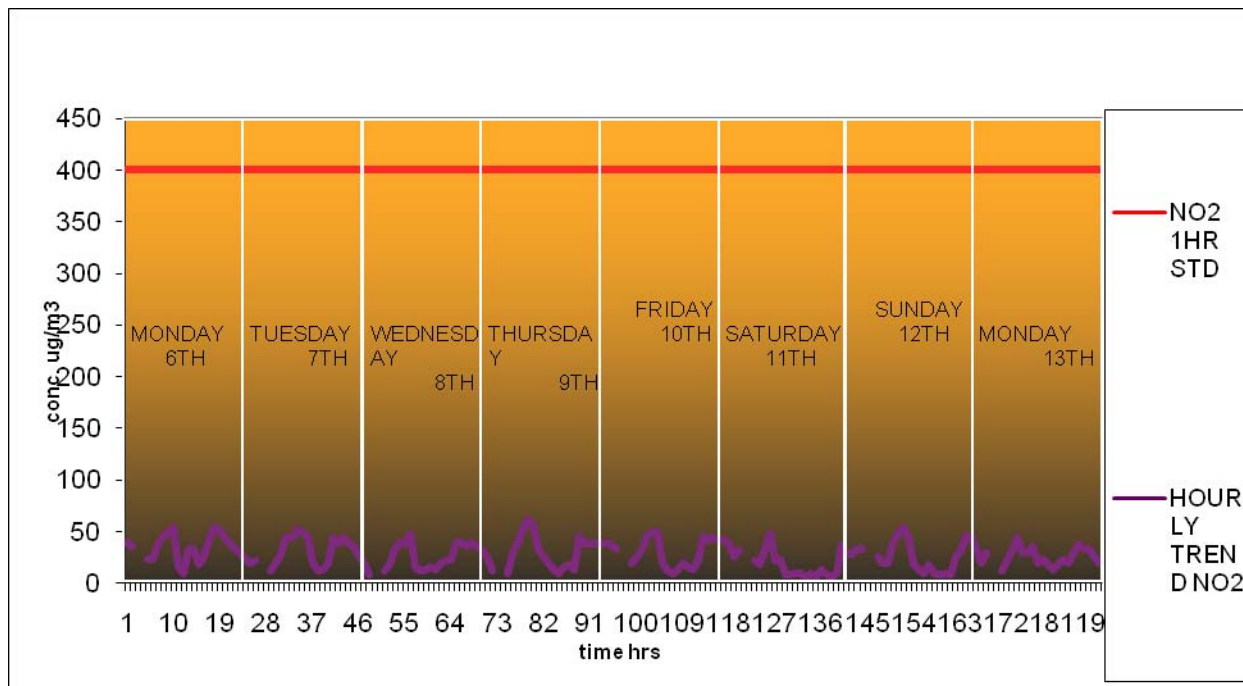
**Figure 2:** Results of the SO<sub>2</sub> concentrations from monitoring along Marcus Garvey drive from 6-13 Feb 2012



**Table 2:** Showing 24Hr and Maximum 1Hr recorded conc. for SO<sub>2</sub> during the fire from 6 Feb to 13 Feb 2012 (all readings in ug/m<sup>3</sup>)

Date	Readings	
	Max 1hr SO <sub>2</sub>	24Hr Avg. SO <sub>2</sub>
Mon 6th	149.08	23.53
Tue 7th	96.77	23.53
Wed 8th	94.14	18.31
Thur 9th	54.92	20.93
Fri 10th	49.69	20.92
Sat 11th	167.39	28.77
Sun 12th	107.23	39.23
Mon 13th	60.15	20.92
<b>2010 Station Annual Average</b>	n.a	<b>24.23</b>
<b>National Standard</b>	<b>700</b>	<b>280</b>

**Figure 3:** Results of the NO<sub>2</sub> concentrations from monitoring along Marcus Garvey drive from 6-13 Feb 2012



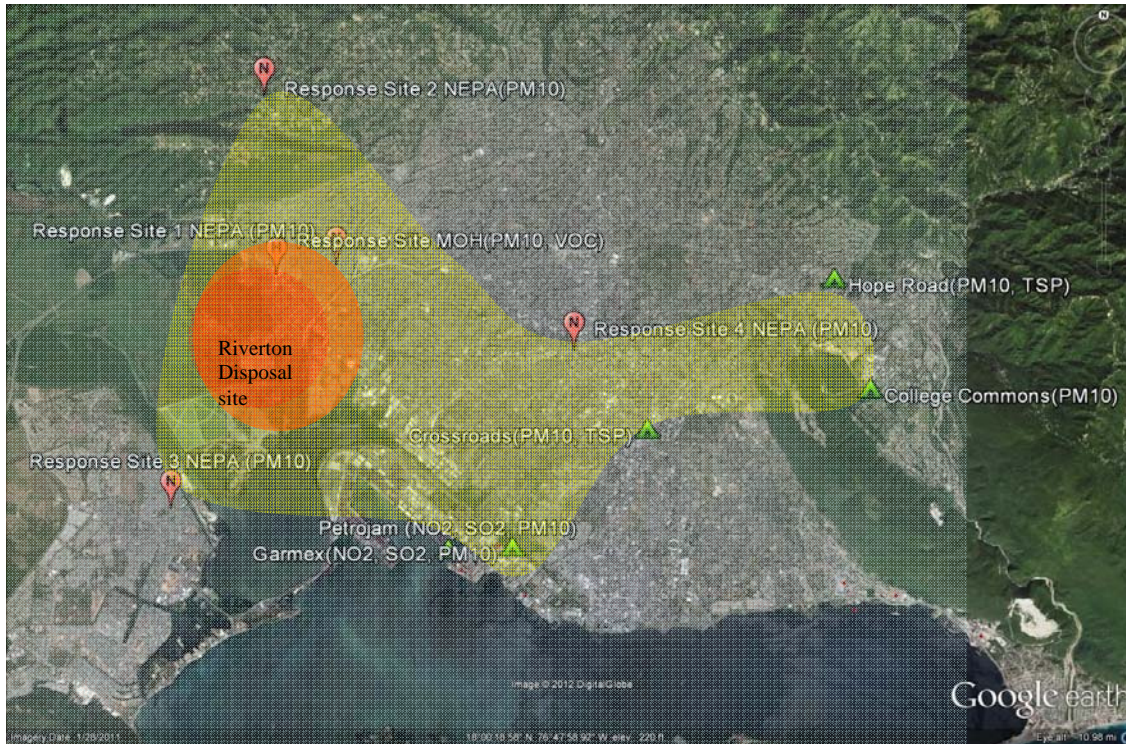
Report on Ambient Air Quality Monitoring in the KMA 6 – 13 February 2012

**Table 3:** Showing 24Hr and Maximum 1Hr recorded concentration for NO<sub>2</sub> during the fire from 6 Feb to 13 Feb 2012 (all readings in ug/m<sup>3</sup>)







Date	Readings	
	Max 1hr NO <sub>2</sub>	24Hr Avg. NO <sub>2</sub>
Mon 6th	52.96	33.34
Tue 7th	172.61	27.46
Wed 8th	47.07	23.54
Thur 9th	60.80	27.46
Fri 10th	49.03	29.42
Sat 11th	47.07	19.61
Sun 12th	52.96	25.50
Mon 13th	43.15	23.54
<b>2010 Station Annual Average</b>		<b>21.63</b>
<b>National Standard</b>	<b>400</b>	<b>none</b>



Map1: Showing existing and temporary (response sites) in the KMA and Portmore as well as the estimated PM<sub>10</sub> impact level

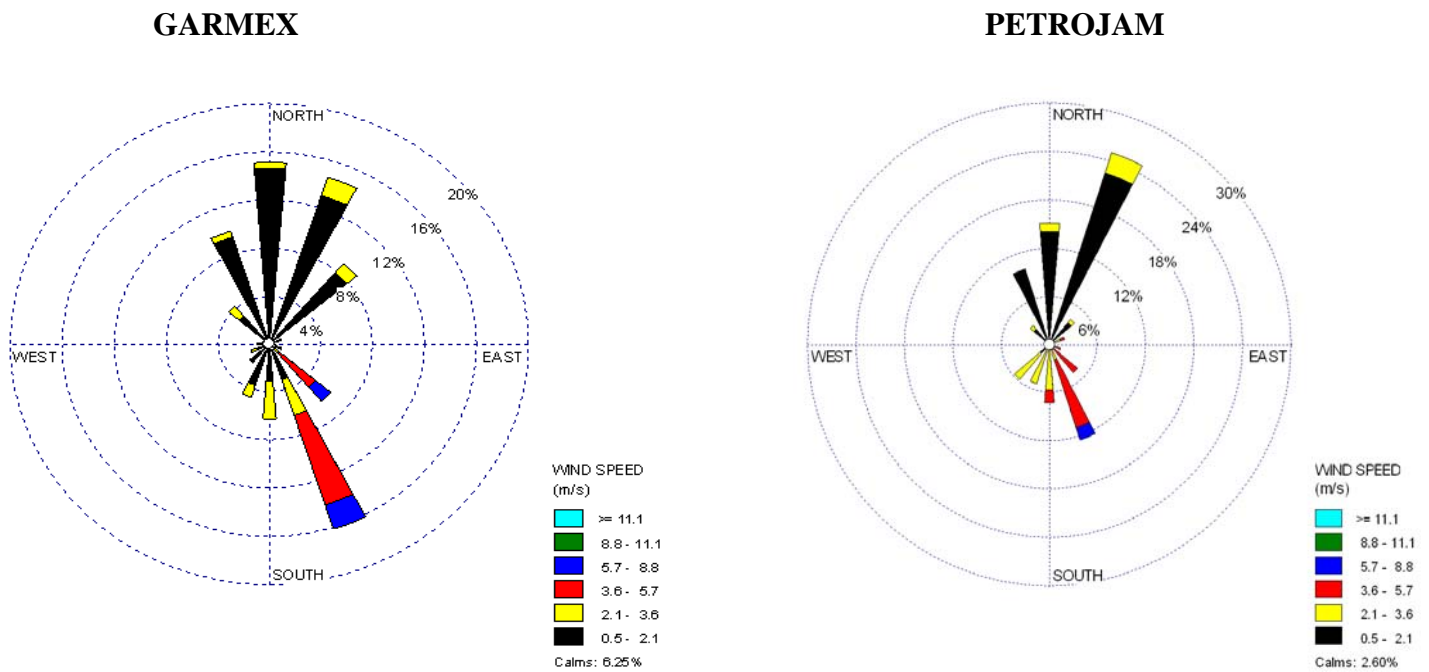


**Key**

	CONC. PM10 = >148ug/m3		CONC. PM10 = 99-148ug/m3		CONC. PM10 = 19-98ug/m3		Possible further Impact
<b>INDEX RATING: VERY HIGH</b>		<b>INDEX RATING: HIGH RISK*</b>		<b>INDEX RATING: MODERATE-LOW RISK*</b>		<b>Index ratings were based on USEPA &amp; Canadian air quality indices</b>	
	- Permanent Ambient Monitoring Stations				- Response Sites		

PERMANENT STATIONARY SITES	RESPONSE STATIONS
Garmex, Marcus Garvey Drive (SO <sub>2</sub> , NO <sub>2</sub> , PM <sub>10</sub> )	Spanish Town Road (JPS) (PM <sub>10</sub> , VOC)
Petrojam (SO <sub>2</sub> , NO <sub>2</sub> , PM <sub>10</sub> )	Washington Gardens (Garfield Avenue) (PM <sub>10</sub> )
Crossroads (PM <sub>10</sub> , TSP)	Red Hills (Belvedere Rd) (PM <sub>10</sub> )
191 Old Hope Road (PM <sub>10</sub> TSP)	Portmore, (Waterford) (PM <sub>10</sub> )
Harbour View (PM <sub>10</sub> )	Half Way Tree (PM <sub>10</sub> )
College Commons, Mona (PM <sub>10</sub> )	

Figure 4: Showing Wind Rose Plots using Data from Marcus Garvey Drive Meteorological Stations from 6-13 February 2012



## **ANALYSIS OF FINDINGS**

The analysis focuses mainly on the PM<sub>10</sub> data as the results showed that ambient air quality with respect to PM<sub>10</sub>, within 1km radius of the site was ranked as “very high risk” while at distance over 1 km it was ranked as “high risk”.

### **PM Data Analysis**

The 24 hour Standard of 150ug/m<sup>3</sup> for PM<sub>10</sub> was exceeded once on Friday 10 February 2012 at the Spanish Town Road site. The value recorded was 167ug/m<sup>3</sup>. The data revealed that on 11 February 2012 all monitoring locations to the North of the site were impacted by PM<sub>10</sub> (Table 1 & Figure 1).

The PM<sub>10</sub> concentration 1km away from the disposal site in the north direction recorded the highest value. At 1.5 -2km, the second highest concentration was recorded while the lowest concentration was recorded at 4.5km (Map1). The data gathered from the stations on Marcus Garvey Drive showed elevated levels of PM<sub>10</sub> above the normal 24 hr average for 2010 while Hope Road and College Commons, Mona stations showed data averages similar to 24 hr averages in 2010 and 2011.

Permanent stations that recorded annual averages for PM<sub>10</sub> during 2011 showed no impact from PM<sub>10</sub> fallout at the Cross Roads, Old Hope Road and Mona sites. The Marcus Garvey station, which is the closest of the four permanent stations, showed some impact. The greatest impact (37ug/m<sup>3</sup>) was recorded on 10 February 2012. Background data for the other stations was unavailable for the other stations so the impact from fallout will have to be determined from data gathered after the fire

### **SO<sub>2</sub>**

The maximum hourly average of SO<sub>2</sub>, recorded at Marcus Garvey Drive, was 167ug/m<sup>3</sup>. This was recorded on Saturday 11 February 2012 (Table 2 and Figure 2). The highest 24 hour average for SO<sub>2</sub> (39ug/m<sup>3</sup>) was recorded on Sunday, 12 February 2012. The 24 hour average for these stations is usually in the mid 20's, based on data collected in 2010 and 2011.

### **NO<sub>2</sub>**

The maximum hourly average of NO<sub>2</sub> recorded at the same sites was 172ug/m<sup>3</sup>. This was recorded on Tuesday 7 February 2012 (Table 3 and Figure 3). The highest 24 hour average for NO<sub>2</sub> (33ug/m<sup>3</sup>) was recorded on Monday, 6 February 2012. The 24 hour average for these stations also averaged in the mid 20's, based on data collected in 2010 and 2011.

### **VOC**

VOC was sampled at the monitoring station located at the JPS Offices on Spanish Town Road. The assessment of the impact is being determined by the Ministry of Health.

### **Meteorological Data Analysis**

The two plots show that during the period of the fire approximately 56% of the winds were blowing from a northerly direction, while 38% were from a southerly direction. Winds with the highest speeds were from the South East.

The higher speed winds from the southeast direction on Saturday, 11 February 2012 may have resulted in a higher concentration of PM<sub>10</sub> in the vicinity and to the north and north-west of the disposal site. The lower wind speeds blowing from the north could explain why sections of the city to the south-southeast of the disposal site were not impacted greatly by the pollutants measured. (This is represented in the data shown by the stations located to the south of the disposal site: Marcus Garvey Drive and Halfway Tree).

Winds speeds in the 0.5-2.1 (m/s) range existed for 55-60% of the time in all directions which would result in the fallout of the heavier air pollutants closer to the disposal site.

## CATEGORIZATION OF RISK

The areas which experienced the greatest impact of the fire are shown in Table 4. The wind factor, discussed previously, would have influenced the areas of greatest impact.

Table 4: Showing the areas determined to have received the greatest impact

	ZONES	
	VERY HIGH RISK	HIGH RISK
<b>Communities and Places</b>	<ul style="list-style-type: none"> <li>• Riverton Meadows</li> <li>• Berger Paints facility</li> <li>• JPSCO Office</li> <li>• Seaview Gardens</li> <li>• Cooreville Gardens</li> <li>• Cooreville Basic School</li> <li>• Lower Sections of Weymouth Drive</li> <li>• Riverton Community Center</li> <li>• Riverton surrounding communities</li> <li>• All Facilities up to 1Km along Spanish Town Road in the North and Northwest direction of the dump</li> </ul>	<ul style="list-style-type: none"> <li>• Washington Gardens</li> <li>• Duhaney Park Primary</li> <li>• Edith Dalton James High</li> <li>• Hendricks Basic School</li> <li>• Duhaney Park Police Station</li> <li>• Lower sections of Duhaney Park Drive</li> <li>• All facilities along the Spanish Town Road up to 2 km in the East and South East direction of the dump</li> </ul>

## **CONCLUSION**

The general conclusion based on the results of the monitoring exercise is that the fire at the Riverton Solid Waste Disposal Site had a negative impact on the ambient air quality in Kingston and St. Andrew and Portmore regions. The data collected gives a reasonable indication of the impact and provides a good baseline to make decisive actions and inform the public on the risk if an event of this magnitude should reoccur.

The basis of the conclusion is as follows:

1. The data showed ambient air quality with respect to PM<sub>10</sub>, within a 1km radius of the site, to be Very High Risk according to the USEPA and Canadian Air Quality Index definition.
2. At distances up to a 2km radius the air quality with respect to PM<sub>10</sub> was "High Risk" according to the same Canadian and USEPA Air Quality Index
3. Based on the data gathered during the fire one exceedance of the National Jamaica Ambient Air Quality Standard for PM<sub>10</sub> 24 Hour averaging was recorded Friday, 10 February 2012. The recorded average for PM<sub>10</sub> was 167ug/m<sup>3</sup>.
4. VOC Samples have been collected and analyzed. However assessment of the impact of these VOCs is being determined by the Ministry of Health
5. High 24 Hour particulate matter (PM<sub>10</sub>) readings were recorded during the event at two sites monitored at Spanish Town Road and Washington Gardens.
6. Although only one data set was gathered for stations in the northerly direction from the dump. Data from the Southerly region of dump suggest that averages remained in the same range during the event. Sites located at Cross Roads and Marcus Garvey drive showed basically the same average on Tuesday and Saturday. Hence the probability is that the same trend is expected for the sites in the northerly direction.

## **LIMITATIONS OF RESPONSE MONITORING PROGRAMME**

1. NEPA has no permanent monitoring stations to the north, northwest or southwest of the disposal site.
2. NEPA & MOH had to deploy Mini-Vol PM<sub>10</sub> Samplers and a Hi-Vol PM<sub>10</sub> to four additional sites in the general location of observed greatest impact during 11-13 Feb when the intensity of fire had decreased in comparison to the 8-10 Feb. This was due to procurement, preparation and setting up of equipment.
3. Appropriate site locations for deployment of the additional Mini-Vol samplers were not readily available.
4. Mini-Vol Devices used for response had a four day turn around time for results.
5. NEPA and MOH does not have adequate equipment for sampling and testing for additional pollutants such as those categorized as persistent organic pollutants (POPs)

## **RECOMMENDATIONS**

1. The NSWMA should improve its management at all solid waste disposal sites inclusive of the Riverton Solid Waste Disposal Site to prevent the reoccurrence of major fires.
2. The monitoring at all PM<sub>10</sub> response sites established during this event, should to continue for at least 1 year.
3. Permanent air monitoring sites should be installed by the NSWMA, around the Riverton Solid Waste Disposal Site based on modeled air dispersion data for worse-case fire event
4. New PM<sub>10</sub> and PM<sub>2.5</sub> monitoring devices should be procured by the NRCA for deployment in other KMA locations.
5. Monitoring equipment should be procured and further deployed for the sampling of additional pollutants especially those in the category of POPs.
6. A dispersion model should be done using the best data available for similar events in order to obtain a more accurate estimate of the zones of greatest impact. Monitoring devices should also be deployed in those zones.

## APPENDICES

### Appendix I

#### LIST OF AIR POLLUTANTS ANALYZED FROM 6-13 Feb 2012

##### CRITERIA AIR POLLUTANTS

1. Sulphur Dioxide
2. Nitrogen dioxide
3. Particulate Matter less than 10 microns

##### VOLATILE ORGANICS

- |                         |                              |                     |
|-------------------------|------------------------------|---------------------|
| 4. Dichloromethane      | 18. 1,1,2,2-Tetrchloroethane | 32. Benzene, butyl- |
| 5. Hexane               | 19. n-Decane                 | 33. Caprolactam     |
| 6. Chloroform           | 20. 1,3,5-Trimethylbenzene   | 34. Biphenyl        |
| 7. 1,2-Dichloroethane   | 21. 1,2,4-Trimethylbenzene   | 35. Diphenyl ether  |
| 8. Benzene              | 22. Pentachloroethane        |                     |
| 9. Trichloroethylene    | 23. d-Limonene               |                     |
| 10. Toluene             | 24. p-Cymene                 |                     |
| 11. Tetrachloroethylene | 25. 1,3-Dichlorobenzene      |                     |
| 12. Ethylbenzene        | 26. 1,4-Dichlorobenzene      |                     |
| 13. (m+p)-Xylene        | 27. Hexachloroethane         |                     |
| 14. o-Xylene            | 28. 1,2,4-Trichlorobenzene   |                     |
| 15. Styrene             | 29. Naphthalene              |                     |
| 16. Cumene              | 30. 1-Butanol                |                     |
| 17. a-Pinene            | 31. Benzene, chloro-         |                     |

**Appendix II**

**Comparative Ambient Air Quality Standards/Guidelines**

Parameter	Averaging time	USA Standard	Canadian Standard	WHO guideline	Jamaican Standard
PM <sub>10</sub>	Annual	n.a.	n.a.	20 µg/m <sup>3</sup>	50 µg/m <sup>3</sup>
	24hrs	150µg/m <sup>3</sup>	150 µg/m <sup>3</sup>	50 µg/m <sup>3</sup>	150 µg/m <sup>3</sup>
SO <sub>2</sub>	Annual	78 µg/m <sup>3</sup>	60 µg/m <sup>3</sup>	20 µg/m <sup>3</sup>	60 µg/m <sup>3</sup>
	24hrs	366 g/m <sup>3</sup>	300 µg/m <sup>3</sup>		280 µg/m <sup>3</sup>
	1hr	n.a.	900 µg/m <sup>3</sup>		700 µg/m <sup>3</sup>
NO <sub>2</sub>	Annual	100 µg/m <sup>3</sup>	100 µg/m <sup>3</sup>	40 µg/m <sup>3</sup>	100 µg/m <sup>3</sup>
	24hrs	n.a.	n.a.	n.a.	n.a.
	1hr	n.a.	400 µg/m <sup>3</sup>	200 µg/m <sup>3</sup>	400 µg/m <sup>3</sup>
VOC	1hr	n/a	n/a	(1-17) µg/m <sup>3</sup>	n/a



**Appendix III**  
**ESTIMATED COST**

NEPA's ESTIMATED COST OF MONITORING EXERCISE FEB 6-13 2012					
EQUIPMENT		QTY	Unit Cost (\$US)	EXR (\$JA)	Sum TOT (JA\$)
	Mini- Volume Sampler	3	3500	87	913,500
	High-Volume Sampler	1	10000	87	870,000
	1 Box of Quartz filter Paper	1	1000	87	87,000
	Desiccators	2	200	87	34,800
	Analytical Balance	1	5000	87	435,000
LABOUR		QTY	HOURS	RATE (\$JA)/hr	
	Level 6 Officer	1	48	727	34,896
	Level 7 Officer	1	48	878	42,144
TRAVELLING		QTY	DISTANCE (KM)	RATE (\$JA)/Km	
	Portmore	2	35	30	2100
	Red Hills	2	35	30	2100
	Washington Garden	2	25	30	1500
	Half Way Tree	2	15	30	900
	Old Hope Road	2	15	30	900
<b>TOTAL ESTIMATED COST OF RESPONSE MONITORING</b>					<b>2,424,840</b>