

FINAL REPORT

**CLOSURE PLAN FOR THE AMERICAN
AIRLINESLANDFARM
IN THE PARISH OF KINGSTON, JAMAICA**

Submitted to

AMERICAN AIRLINES
4333 Amon Carter Boulevard
Fort Worth, Texas 76155



Taking Care of You and Your Environment.

FEBRUARY 2011

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1.0 EXECUTIVE SUMMARY

American Airlines as a partial requirement of the fulfillment of Environmental Permit # 2010-01017-EP00045 and Specific Condition 19 the development of this Closure Plan outlines the activities and timelines associated with the proper closure of the American Airlines Landfarm.

The site is presently being used as a landfarm to facilitate the biodegradation of the impacted material from the AA 331 accident which occurred on Tuesday, December 22, 2009.

Structures onsite include;

- i. Constructed landfarm with a total area of approximately 5,261 m² (\approx 1.3 acres) with a work area of 2,771 m² (595 m² for storage area and 2,176 m² treatment area) surrounded by a berm 3m (\approx 9.84 ft.) wide and a varying height (\approx 1.38m - 1.93m) (4.52 ft. - 6.33 ft.) above existing elevation, consisting of marl, clay, shingle and sand.
- ii. 1 Concrete Collection Box
- iii. Chain link Fence and Shade Cloth of approximately 133m (436 ft)
- iv. 1 Submersible Pump
- v. 1 Storage Shed
- vi. 1 Weather Station
- vii. 1 Hi Volume Sampler
- viii. PVC Pipes and Sprinklers
- ix. 2 Ground Water Wells
- x. Electric Connections

The Closure Plan calls for the following activities and estimated timelines. These are:

- i. Traffic Management Plan and Solid Waste Ticketing System
- ii. Notification to neighbours
- iii. Removal of irrigation infrastructure (**1/2 day**)

- iv. Removal of Material (shingle and sand-100 truckloads; clay-130 truckloads; marl-190 truckloads) - **7 days**
- v. Relocation of Hi Vol. Sampler and weather station
- vi. Removal of 133m (\approx 436ft) of chain link fence and shade cloth (**1/2 day**)
- vii. Grading, fertilization and re-vegetation of site (**3 days**)
- viii. Watering of re-vegetated site (done over a **two (2) month** period)
- ix. Removal of storage shed (**1 day**)
- x. Post Closure site monitoring of groundwater quality, air quality, meteorological data and vegetation (over a **two (2) month** period)

It is anticipated that the entire site closure process will take approximately 46 days (\approx 2 months) to be completed.

2.0 BACKGROUND

The American Airlines Landfarm is located on Caribbean Maritime Institute (CMI) property located along the Palisadoes. It is bordered to the north by CMI's football field, to the east and south by the Palisadoes to Royal Jamaica Yacht Club access road and to the west by the Royal Jamaica Yachts Club.

The landfarm was built in May 2010 to facilitate the biodegradation of the impacted material from the AA 331 accident which occurred on Tuesday, December 22, 2009.

It covers a land area of approximately 5,261 m² (\approx 1.3 acres) with a work area of 2,771 m² (595 m² for storage area and 2,176 m² treatment area) and 0.5% slopes (Figures 1 and 2).

It is surrounded by a berm 3m (\approx 9.84 ft.) wide and a varying height (\approx 1.38m - 1.93m) (4.52 ft. - 6.33 ft.) above existing elevation. The varying height of the berms resulted in the height of all being 3.17 m (\approx 0.97) above mean sea level (Figure 3).

The materials/structures presently on the site are;

1. Shingle and Sand (**100 truckloads**)
2. Clay (**130 truckloads**)
3. Marl (**190 truckloads**)
4. Concrete Collection Box (**1**)
5. Chain link Fence and Shade Cloth (**133m** (\approx **436ft**))
6. Submersible Pump (**1**)
7. Storage Shed (**1**)
8. Weather Station (**1**)
9. Hi Volume Sampler (**1**)
10. PVC Pipes and Sprinklers
11. Ground Water Wells (**2**)
12. Electric Connections

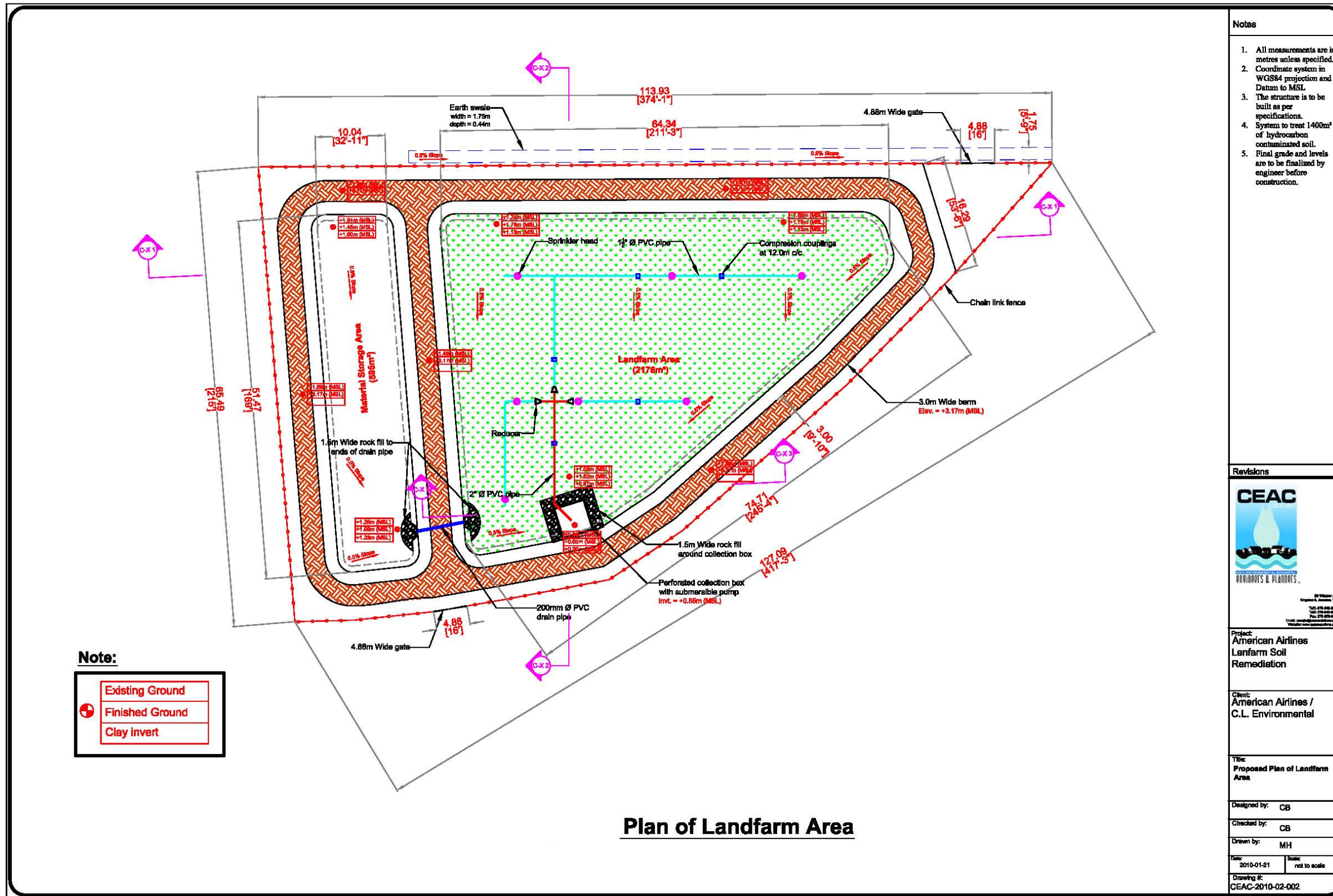


Figure 1 Plan of the Landfarm



Figure 2 Plan of the Landfarm

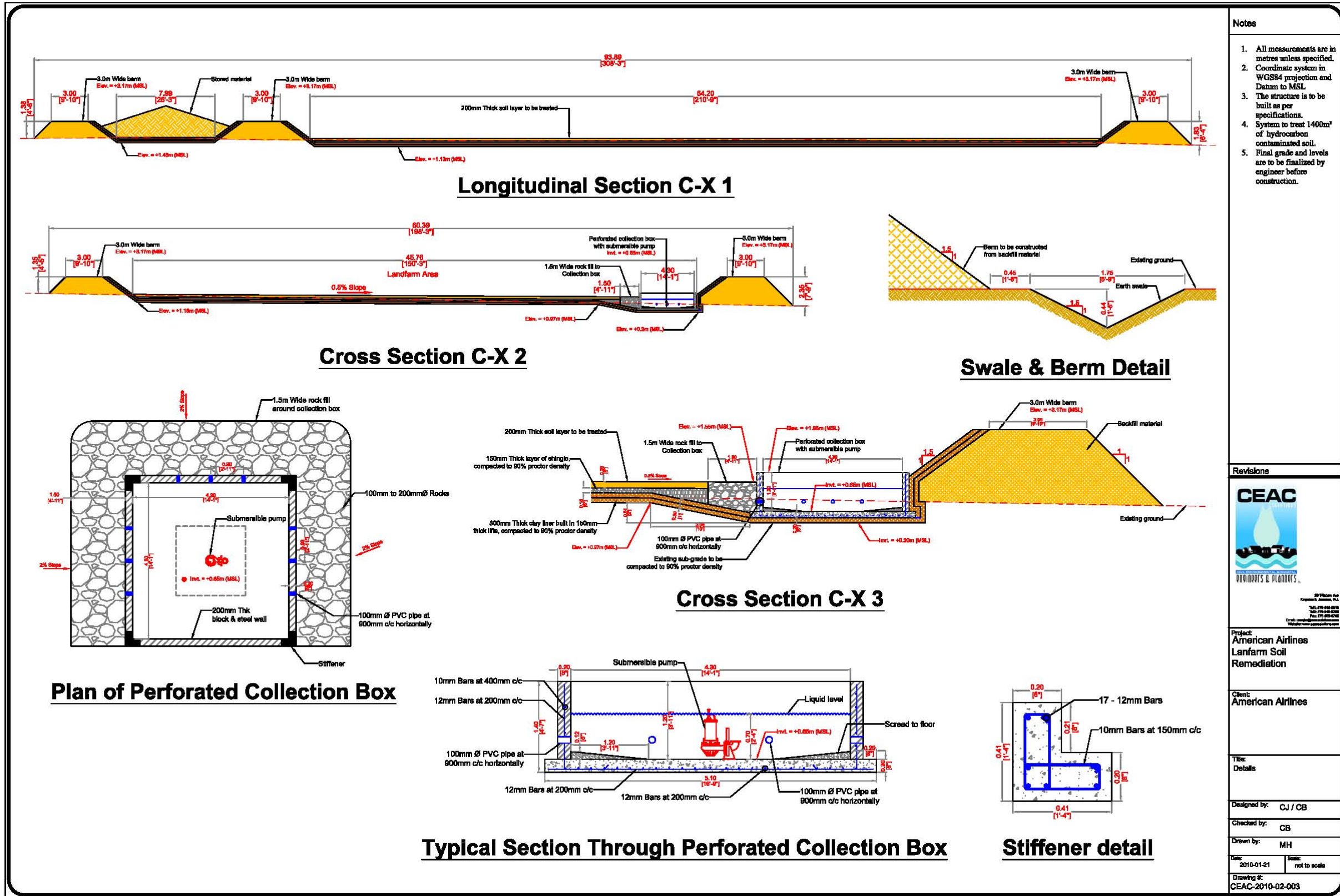


Figure 3 Cross Sections of the Landfarm structures
 American Airlines Lanfarm
 Closure Plan

2.1 BASELINE

2.1.1 Zoning

The site is zoned for public/private open spaces as depicted in the Kingston Development Plan. Other areas around it are zoned government purposes and statutory undertakings and residential (Figure 4).

2.1.2 Topography

A topographic survey pre Landfarm development was conducted by the CEAC team to determine the slope of the site and to aid in the design of drainage structures.

The contour data obtained revealed that the topography of the site is gently sloping toward the southern boundary. The site had a maximum elevation of 2.24m at the northern end and a minimum elevation of 0.81m at the southern end resulting in an average slope of 1.1% (Figure 5).

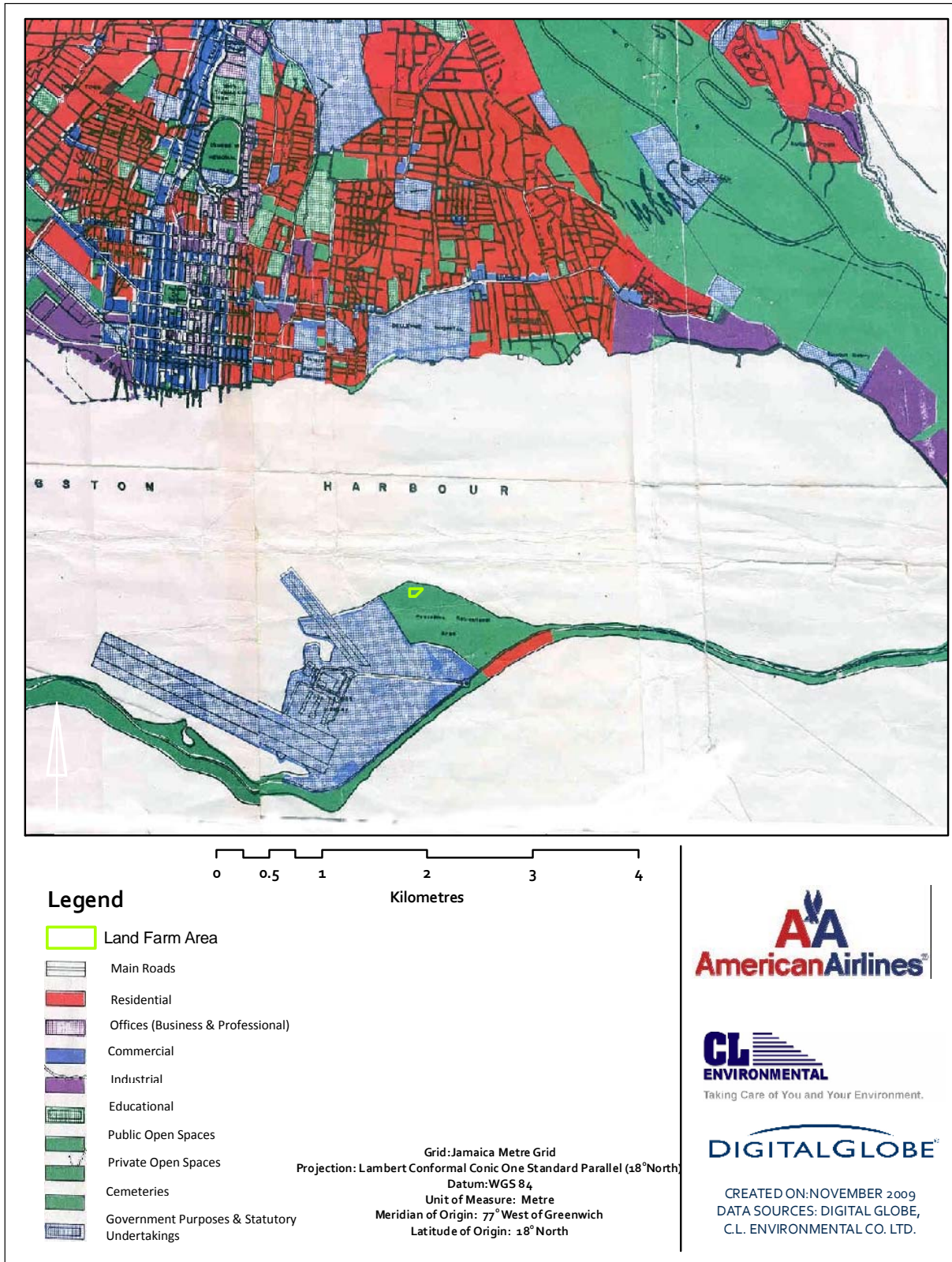


Figure 4 Kingston Development Plan

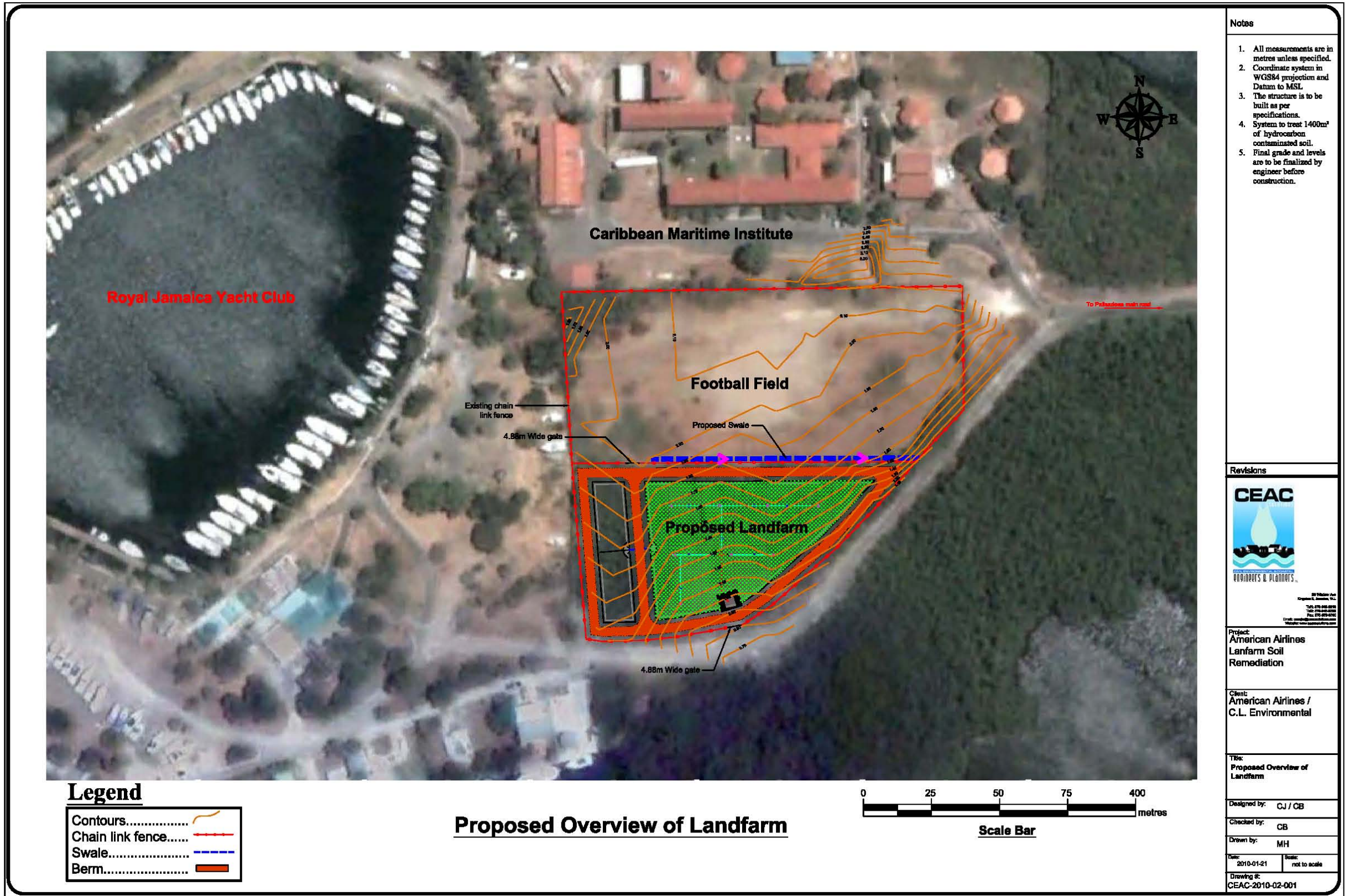


Figure 5 Topographic map

2.1.3 Soils

In the development of the wells, the soils were determined to be sandy loam with a trace of peat. This peat was formed from the breakdown of organic matter. There is also some gravel present.

2.1.4 Springs/Wells

There are only two wells and no springs within 1km of the Landfarm area. These were developed as monitoring wells for the Landfarm activities (Figure 6).

2.1.5 Solid Waste Disposal

The National Solid Waste Management Authority is responsible for domestic solid waste collection within the study area. The waste is transported to the Riverton City landfill located in St. Andrew, approximately 22 km (≈14 miles) west of Landfarm site.



Figure 6 Wells within 1km of the landfarm
American Airlines Landfarm
Closure Plan

2.1.6 Security of Facility/Area

The site presently has a perimeter chain link fence with appropriate signage and is secure (Plate 1).



Plate 1 Photos depicting chain link fence with signage and shade cloth around the Landfarm

3.0 INVESTIGATIONS

The last monitoring of leachate and soil at the Land Farm was conducted in October and September 2010 respectively, at which point it was established that the levels of pollutants were below the NEPA standards (stipulated in the Permit# 2010-01017-EP00045) and as such deemed adequately remediated (Table 1).

Table 1 NEPA Standards according to Permit# 2010-01017-EP00045

Parameter	Soil Concentration (mg/kg)
Total Petroleum Hydrocarbons	1000
BTEX	135
Benzene	5
Toluene	30
Ethyl Benzene	50
Xylene	50
Tricresylphosphate	NC
Diethylene Glycol Monobutyl Ether	NC
Tributyl Phosphate	NC

NC - No Criteria set for this parameter

Due to excess rainwater associated with a Tropical Storm in September, and the associated flooding of the landfarm, soil sampling could not be conducted for the month of October. These photos can be viewed in Monitoring Reports for September and October, 2010.

All water quality results can be seen in the AA331 Remediation Monitoring Reports for May, June, July, August, September and October, 2010. Landfarm soil sampling results can be seen in AA331 Remediation Monitoring Reports for August and September, 2010.

The landfarm must be completely dry before any material removal process takes place. Intermittent rainfall from October 2010 to January 2011 has resulted in this delay of the closure plan.

Summarized monthly results for leachate water quality and soil sampling can be seen in Tables 2 and 3.

Table 2 Landfarm leachate water quality values for May 2010 to October 2010.

Parameter	Monthly Leachate Values								NEPA Standard
	May 7	June 9	June 21	July 5	July 27	August 11	September 20	October 20	
Temperature (oC)	-	32.88	31	31.78	30.46	31.15	32.36	31.99	-
Conductivity (mS/cm)	-	2.66	3.402	2.7	3.13	0.0137	56.6	1.564	-
Salinity (ppt)	-	1.43	1.84	1.46	1.69	0	37.71	0.81	-
pH	-	8.64	8.45	8.75	8.79	8.15	8.15	8.9	-
Dissolved Oxygen (mg/l)	-	7.9	5.96	8.96	7.68	9.8	8.14	8.33	-
Turbidity (NTU)	-	0	0	0	0	60.3	11.1	5.8	-
TDS (g/l)	-	1.699	2.177	1.734	2	0.006	36.24	1	-
GRO (mg/l)	ND	ND	ND	ND	ND	ND	ND	ND	50
DRO (mg/l)	0.92	2.5	2.6	0.92	0.86	0.59	0.27	0.13	50
Tot. Phosphorus (mg/l)	0.11	0.44	ND	0.11	0.21	0.17	0.15	ND	-
Tot. Nitrogen (mg/l)	1.1	ND	0.51	1.1	0.88	1.9	2.2	1.5	-
Tot. Organic Carbon (mg/l)	6.9	9.9	9.7	6.9	8.5	11	1.5	2.2	-
Benzene (mg/l)	ND	ND	ND	ND	ND	ND	ND	ND	-
Toluene (mg/l)	ND	ND	ND	ND	ND	ND	ND	ND	-
Ethylbenzene (mg/l)	ND	ND	ND	ND	ND	ND	ND	ND	-
Tot. Xylene (mg/l)	ND	ND	ND	ND	ND	ND	ND	ND	-
Methyl tert-butyl ether (mg/l)	ND	ND	ND	ND	ND	ND	ND	ND	-

ND – None Detected

Table 3 Landfarm soil sampling values for August 2010 and September 2010

	DRO (mg/kg)	DRO Std. (mg/kg)	GRO (mg/kg)	GRO Std. (mg/kg)	TOC (mg/kg)	% moisture	% moisture Std.	BTEX	BTEX Standard (mg/kg)
AUGUST									
Cell 1	4.2	1000	ND	1000	1400	17	40-85	ND	135
Cell 2	ND	1000	ND	1000	1500	18	40-85	ND	135
Cell 3	270	1000	15	1000	1700	15	40-85	ND	135
Cell 4	ND	1000	ND	1000	1000	16	40-85	ND	135
Cell 5	ND	1000	ND	1000	ND	18	40-85	ND	135
Cell 6	ND	1000	ND	1000	1200	18	40-85	ND	135
Cell 7	ND	1000	ND	1000	ND	17	40-85	ND	135
Cell 8	ND	1000	0.55	1000	ND	19	40-85	ND	135
Cell 9	ND	1000	ND	1000	ND	19	40-85	ND	135
SEPTEMBER									
Cell 1	21	1000	ND	1000	ND	16	40-85	ND	135
Cell 2	12	1000	ND	1000	ND	17	40-85	ND	135
Cell 3	53	1000	ND	1000	ND	17	40-85	ND	135
Cell 4	24	1000	ND	1000	ND	16	40-85	ND	135
Cell 5	26	1000	ND	1000	ND	16	40-85	ND	135
Cell 6	ND	1000	ND	1000	ND	16	40-85	ND	135
Cell 7	12	1000	ND	1000	ND	17	40-85	ND	135
Cell 8	5.9	1000	ND	1000	ND	17	40-85	ND	135
Cell 9	ND	1000	ND	1000	ND	17	40-85	ND	135

ND - None Detected

4.0 CLOSURE PLAN

4.1 INTRODUCTION

A Closure Plan is the document that is used to establish the procedures that will be employed during 'closure' of a facility. The use of the term 'closure' in reference to any hazardous waste treatment, storage or disposal facility signifies the process by which the establishment is secured in order to prevent and/or minimize any future impacts to human health or the environment. This can be done by complete decontamination or sanitization of the site in order that exposure to any remaining contaminants is minimized.

Closure of a contaminated site may occur via two (2) processes, clean closure and dirty closure. Clean closure or closure by removal occurs when all contaminants at the facility are removed that laboratory analysis indicates that the contaminants are below the detection limits and are in no danger to human health or the environment. Dirty closure or closure-in-place occurs when the contaminants remain in place at the site either in the soil, groundwater or both.

In the case of the Landfarm, the method to be employed will be clean closure. This report serves to outline the measures that will be undertaken to address the environmental issues and bring closure to the site in order to restore the area to its previous condition.

4.2 CLOSURE PLAN –MATERIAL/EQUIPMENTREMOVAL PROCEDURES

Before commencement of the removal of material/equipment from the Landfarm and the ultimate closure of the facility, the Traffic Management Plan will be finalized.

In addition, the landfarm must be completely dry before any material removal process takes place. Intermittent rainfall from October to February has resulted in this delay of the closure plan.

4.2.1 Traffic Management Plan and Ticketing System

The removal of materials will be done by 20 trucks at an estimated 425 truckloads of materials over a 7 day period. This indicates a significant number of truck trips per day (≈ 60 trips/day) and as such a traffic management system must be in place.

No trucks will be allowed to park along the secondary road leading into the Caribbean Maritime Institute from the Palisadoes main road. The plan is to accommodate 5-10 trucks in proximity to Landfarm. The other trucks will be scheduled to arrive in a “just in time” fashion.

Flagmen will be employed at the major points (such as at the intersection of the Palisadoes main road and the Riverton /Spanish Town intersection. Also signage will be employed along the secondary road leading to CMI.

A ticketing system will be employed to ensure that the material removed are transported to and disposed of at the Riverton landfill.

This system will have tickets done in triplicate. It will be signed by authorized agents of C.L. Environmental Co. Ltd. at the dispatch location (Landfarm) and at the disposal location (Riverton Landfill). Upon successful delivery of material to the landfill the driver of the truck will receive one signed copy of the ticket as proof of successful delivery.

4.2.2 Notification to Neighbours

Prior to commencement of the activities related to the closure of the Landfarm, notification will be sent to the Royal Yacht Club and CMI at least one (1) week before the start of activities.

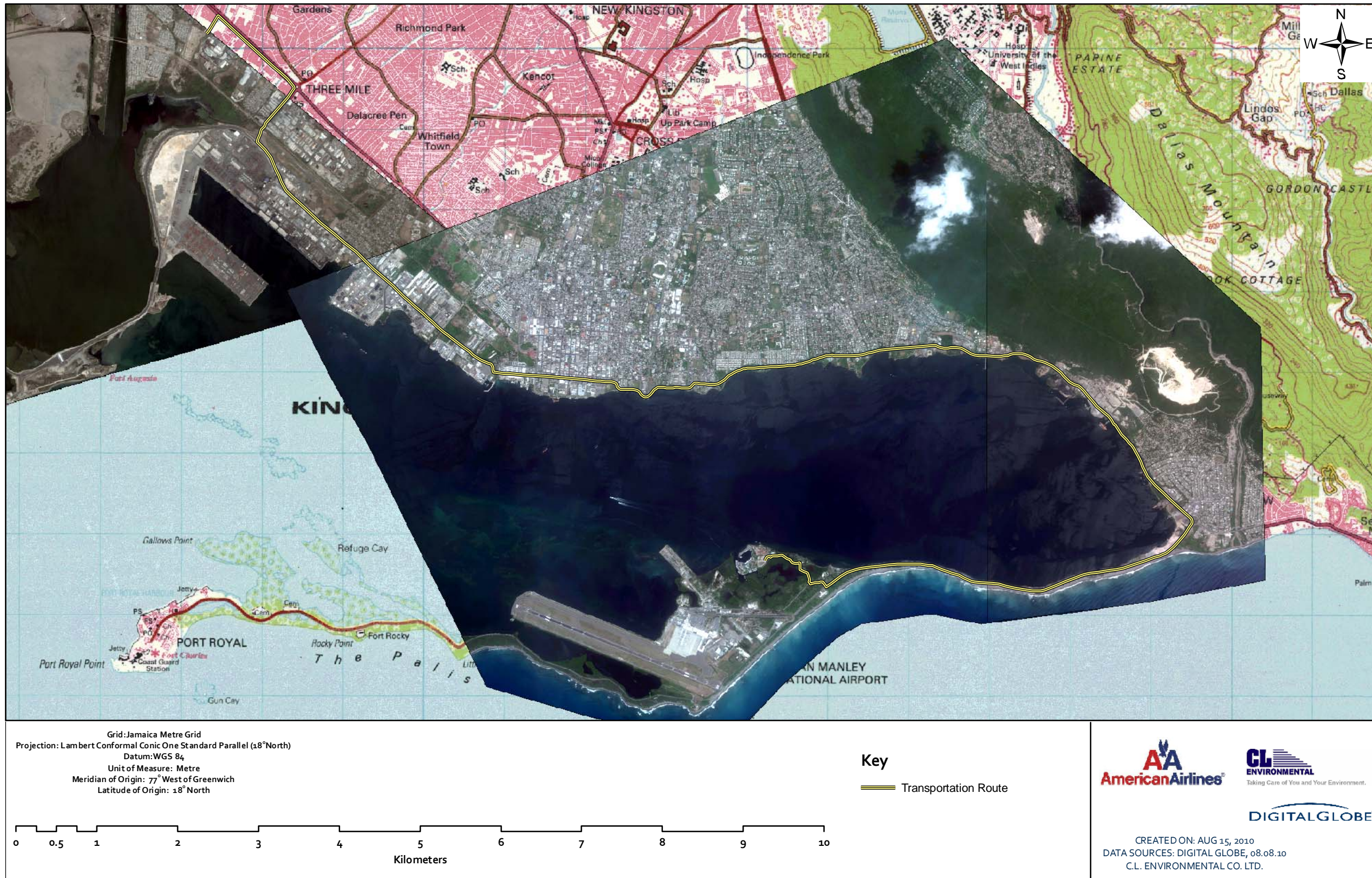


Figure 7 Transportation route to Riverton landfill

4.2.3 Removal of Irrigation Infrastructure

First the disconnection of the electrical supply and wiring to submersible pump will be done.

Next will be the removal of the submersible pump, irrigation pipes and sprinklers (Plate 2). The submersible pump, PVC pipes and sprinklers will be kept and reused during the re-vegetation activity for the watering of the area.

This activity is expected to take half (1/2) day.



Plate 2 Photo showing irrigation pipes and sprinklers

4.2.4 Removal of Material

The removal of the materials in/at the Landfarm will be done in a particular order. The following steps will be taken;

- i. The remediated material and shingle will be pushed up towards the north eastern corner where it will be loaded into the trucks which will park on the ramp for loading (Figure 8). This is estimated to be **one hundred (100)** truck loads.

- ii. The clay liner will then be removed and loaded into the trucks. An estimated **one hundred and thirty (130)** truck loads will be removed.
- iii. Removal of the marl base will then be removed and loaded into the trucks. An estimated **one hundred and ninety (190)** truck loads will be removed.

This activity is expected to take seven (7) days.

4.2.5 Relocation of Hi Vol Sampler and Weather Station

These instruments will be relocated to outside of the work area when the marl base of the north western corner of the storage area is being removed (Plate 3).



Plate 3 Photo showing weather station and high volume air sampler



Figure 8 Map showing direction in which impacted material will be moved and loaded into trucks

4.2.6 Removal of Chain Link Fence and Shade Cloth

The chain link fence and the shade cloth on the northern boundary will be removed and stored. Approximately **133m (≈ 436ft)** of fence and shade cloth will be removed.

This activity is expected to take half (1/2) day.



Plate 4 Photo showing chain link fence and shade cloth

4.2.7 Grading, Fertilizing and Revegetation

The area will then be graded and the topsoil that was stored re-spread and fertilized. Grass seeds will also be planted.

This activity is expected to take three (3) days.

4.2.8 Watering

Watering of the re graded area will be done by reusing the exiting irrigation system. It will be done daily for a half an hour period until vegetation is seen to sprout at which time the frequency will be reduced.

This activity is expected to take place over a two (2) month period.

4.2.9 Removal of Storage Shed

The storage shed will be removed at the end of the re vegetation exercise and either donated to the CMI or some other Institution (Plate 5). Failure to find a recipient then it will be dismantled and sent to Riverton landfill.

This activity is expected to take one (1) day.



Plate 5 Photo showing storage shed

4.2.10 Completion of Rehabilitation

The removal of the storage shed will signal the completion of the proper closure of the Landfarm.

5.0 SCHEDULED TIMELINE

The scheduled timeline for the closure of the American Airlines Landfarm is outlined in Figure 9.

It is anticipated that the proper closure of the American Airlines Landfarm will take approximately **46 days**.

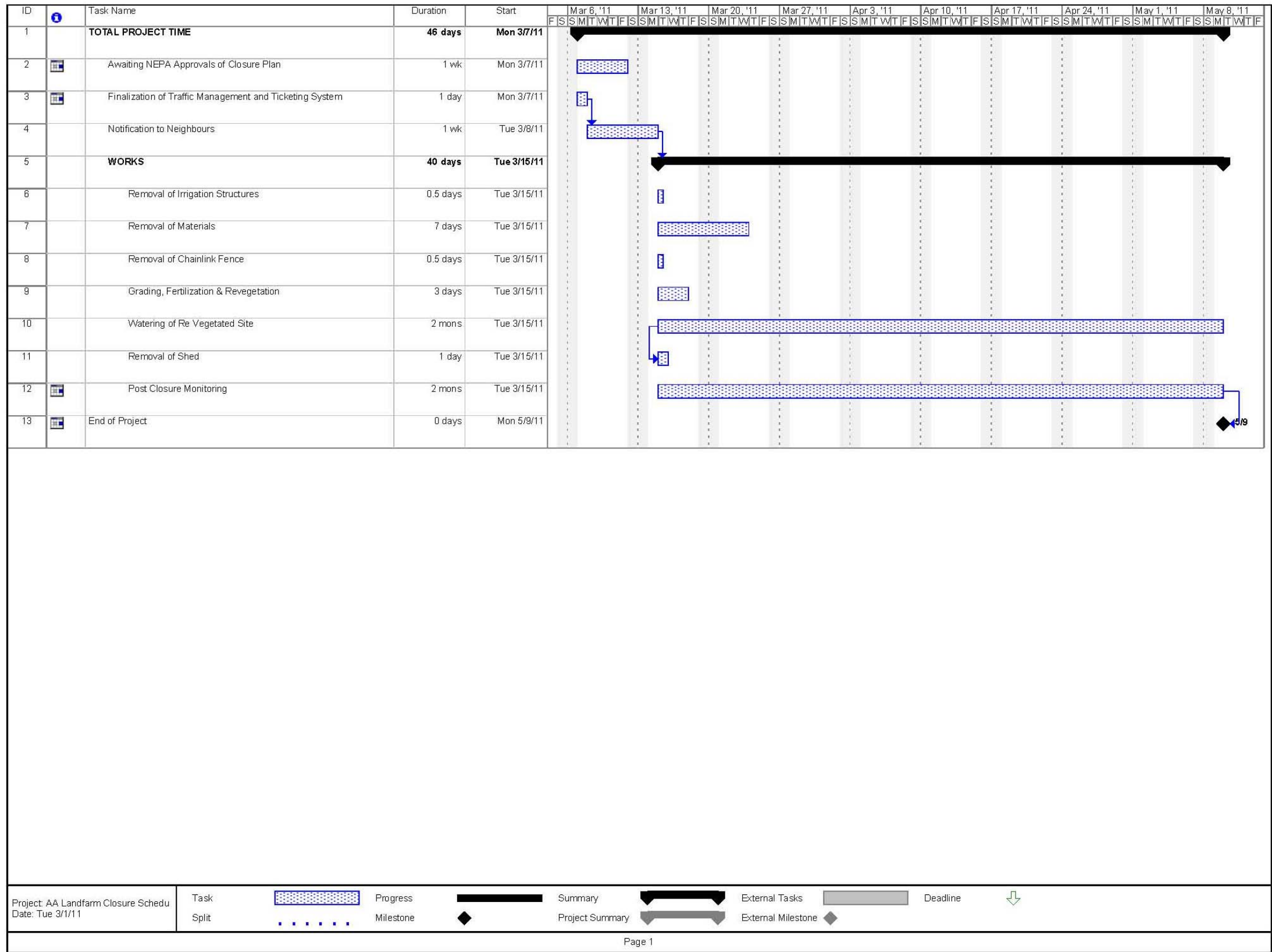


Figure 9 Closure plan schedule
American Airlines Landfarm
Closure Plan

6.0 POST CLOSURE MONITORING

Groundwater monitoring

Representative sampling will be conducted for two (2) months to determine any levels of DRO, GRO and nutrients at both monitoring wells. Physicochemical readings will also be taken at both monitoring wells.

Values will be compared with national standards.

Air Quality monitoring

Sampling will be conducted for two (2) months using Tisch Hi Volume air sampler, after re-vegetation of the area is conducted.

Vegetation monitoring

Visual inspections will be conducted to determine if growth of grass is satisfactory.

Meteorological conditions

Rainfall, temperature, relative humidity, barometric pressure and wind speed and direction will continue to be monitored for two (2) months, using a Davis Instruments weather station.