



Baseline Environmental Audit Report

**Apache Egypt Western Desert Assets
(acquired 2010)**

Final Report

15 March 2012

www.erm.com

Apache

Baseline Environmental Audit Report:
Apache Egypt Western Desert Assets
(acquired 2010)

March 2011

Reference 0143887

Prepared by: Tim Flower and Don MacIntyre

For and on behalf of
Environmental Resources Management

Approved by: Don MacIntyre

Signed:



Position: Partner

Date: 15 March 2012

This report has been prepared by Environmental Resources Management the trading name of Environmental Resources Management Limited, with all reasonable skill, care and diligence within the terms of the Contract with the client, incorporating our General Terms and Conditions of Business and taking account of the resources devoted to it by agreement with the client.

We disclaim any responsibility to the client and others in respect of any matters outside the scope of the above.

This report is confidential to the client and we accept no responsibility of whatsoever nature to third parties to whom this report, or any part thereof, is made known. Any such party relies on the report at their own risk.

CONTENTS

1	<i>EXECUTIVE SUMMARY</i>	1
2	<i>INTRODUCTION</i>	3
2.1	<i>THIS REPORT</i>	3
2.2	<i>APACHE'S ASSETS IN EGYPT</i>	3
2.3	<i>SCOPE AND LIMITATIONS OF THIS BASELINE ENVIRONMENTAL REVIEW</i>	4
2.4	<i>STRUCTURE OF THIS REPORT</i>	5
3	<i>APACHE'S ASSETS IN EGYPT</i>	6
3.1	<i>APACHE CORPORATION IN EGYPT PRE-NOVEMBER 2010</i>	6
3.2	<i>APACHE CORPORATION IN EGYPT POST-NOVEMBER 2010</i>	7
4	<i>RELEVANT STANDARDS, GUIDELINES AND COMMITMENTS</i>	11
4.1	<i>INTRODUCTION</i>	11
4.2	<i>EGYPTIAN LEGISLATION FOR ENVIRONMENTAL PERFORMANCE AND PROTECTION</i>	11
4.3	<i>INTERNATIONAL CONVENTIONS, PROTOCOLS AND AGREEMENTS</i>	22
4.4	<i>WORLD BANK AND IFC ENVIRONMENTAL STANDARDS AND GUIDELINES</i>	23
4.5	<i>APACHE CORPORATION ENVIRONMENTAL, HEALTH & SAFETY POLICIES</i>	30
5	<i>ENVIRONMENTAL PERFORMANCE</i>	32
5.1	<i>ENVIRONMENTAL PERFORMANCE OF DASHOUR ASSETS</i>	32
5.2	<i>ENVIRONMENTAL PERFORMANCE OF EAST OF QATARA DEPRESSION WD ASSETS</i>	39
5.3	<i>GREENHOUSE GAS EMISSIONS</i>	50
5.4	<i>ENVIRONMENTAL MONITORING AND COMPLIANCE IN 2011</i>	50
6	<i>CONCLUSIONS</i>	55

This Report has been prepared for *Apache Egypt Companies (Apache)* by *Environmental Resources Management Limited (ERM)*. It comprises the Baseline Environmental Audit Report for Apache's oil and gas assets in Egypt acquired in 2010.

Apache is the largest producer of liquid hydrocarbons and natural gas in the Western Desert and the second largest in Egypt. In November 2010, Apache closed on the purchase of BP assets in Egypt's Western Desert, acquiring four development leases and one exploration concession as well as strategically-positioned infrastructure. The assets covered by this Baseline Environmental Audit comprise the Dashour Gas Plant and the following operating concessions and assets in the Western Desert: Abu el Gharadig (AG), WD-33, Razzak Fields (RZK) and El Alamein Pumping Station (Alamein).

OPIC has been providing insurance cover of Apache's Egypt assets for a number of years and Apache is now seeking to extend the scope of this cover to include the assets purchased in 2010. This Baseline Environmental Audit Report has been prepared specifically for the purpose of addressing OPIC's requirements for Apache's securing environmental clearance. The scope of work upon which this Baseline Environmental Audit Report is based is discussed further in *Sections 2.3*.

Under OPIC's Environmental and Social Policy Statement of 15 October 2010, project sponsors seeking OPIC support must meet the requirements of the IFC Performance Standards and the associated World Bank group (WBG) environmental, health and safety guidelines. This Report summarises these Performance Standards and the pertinent guidelines to which they defer as well as relevant Egyptian regulatory requirements.

The report concludes with ERM's observations on the Environmental, Health and Safety (EHS) performance of the assets acquired from BP in 2010 based principally on a review of Apache's 2011 Annual Environmental Self-Monitoring Report, submitted to OPIC on January 31, 2012. Pertinent findings are as follows:

- Based on our review of results of spot sampling surveys undertaken in 2011, the indication is that the former GUPCO facilities purchased by Apache in 2010 remain in broad regulatory compliance across the board with respect to the occupational health environment, stack emissions, vehicular emissions, treated produced water and sanitary effluent discharges, other than in certain limited cases where workplace noise levels exceed the regulatory limits.
- While the produced water sampled downstream of the oil skimmer in the evaporation ponds in both Razzak and AG fields meets the regulatory

(and WBG) standard of 10 ppm oil & grease, the levels of BOD, COD and TSS exceed the relevant WBG guideline values. This is primarily a result of a particularly high naturally occurring BOD, COD and TSS content in the incoming produced water in these fields; the reduction achieved across the API Separator reflects close to the upper end of what is expected to be achieved via primary treatment in an evaporation pond. We note also that the WBG guideline does not distinguish between discharges to surface waters or to land; in this instance the discharge is to a land area that is remote from any surface water or identified ground water abstraction and we understand that this regime has been the established practice since commissioning of these facilities several years prior to Apache's acquisition of these assets.

- The extent of ambient air quality sampling and noise sampling at or beyond the boundary fence is insufficient to demonstrate full compliance with either the applicable regulatory or WBG standards. However, given that the results of stack emissions sampling indicates broad compliance across all facilities and given the relative absence of sensitive receptors (or significant offsite emission sources) due to the remote location of all facilities (even in the case of Dashour), it is unlikely that ambient air quality is of significant concern with respect to the Apache facilities. Similarly it is unlikely that Apache's activities are giving rise to significant off-site noise impacts. Nevertheless, Apache may wish to consider expanding their self-monitoring programme in 2012 to confirm their compliance in regard to these two aspects of their operations.

2.1 THIS REPORT

This Report has been prepared for *Apache Egypt Companies (Apache)* by *Environmental Resources Management Limited (ERM)*. It comprises the Baseline Environmental Audit Report for those of Apache's oil and gas assets in Egypt that were acquired in 2010. The Report has been prepared specifically to support Apache's application to the Overseas Private Investment Corporation (OPIC) for an extension of the existing insurance cover for Apache's Egyptian Western Desert assets to include also the assets acquired in 2010.

2.2 APACHE'S ASSETS IN EGYPT

Egypt hosts Apache's largest national acreage position with more than 11 million gross acres in 21 separate concessions (18 producing). Apache is the largest producer of liquid hydrocarbons and natural gas in the Western Desert and the second largest in Egypt. Apache's production is operated under two joint ventures, the Khalda Petroleum Company and the Qarun Petroleum Company. In addition, Apache has production from non-operated properties at Northeast Abu Gharadig (NEAG).

Apache's commitment to Egypt began in 1994 with its first Qarun discovery well. Today, Apache controls 11.3 million gross acres, making Apache the largest acreage holder in Egypt's Western Desert. Only 15 percent of Apache's gross acreage in Egypt has been developed. That 15 percent produced an average of 189,000 barrels per day and 799 million cubic feet per day (MMcf/d) in 2010, 99,000 barrels per day and 375 MMcf/d net to Apache, making Apache the largest producer of liquid hydrocarbons and natural gas in the Western Desert and the third largest in all of Egypt. The remaining 85 percent of Apache's acreage is undeveloped, which provides the company with considerable exploration and development potential for the future. Apache has 3-D seismic covering over 12,000 square miles, or 68 percent of its acreage.

Apache's Egyptian operations had another year of growth in 2010: gross daily production increased 16 percent, and net daily production increased 6 percent. The company maintained an active drilling and development program, drilling 204 wells, including 10 new field discoveries, and conducted 662 workovers and recompletions. In addition, Apache achieved a goal it had set itself in 2005 to double gross equivalent production from its operated concessions by the end of 2010.

In November 2010, Apache closed on the purchase of BP assets in Egypt's Western Desert, acquiring four development leases and one exploration concession as well as strategically-positioned infrastructure – a natural gas

processing plant, a liquefied petroleum gas plant and oil and gas export lines that will enable Apache to increase production from existing fields in the Western Desert.

2.3

SCOPE AND LIMITATIONS OF THIS BASELINE ENVIRONMENTAL REVIEW

This Baseline Environmental Audit Report has been prepared specifically for the purpose of meeting OPIC's requirements for Apache securing environmental clearance.

Apache's operations (including the assets acquired from BP in 2010) are all established facilities that have been operational for periods of several years, augmented by a programme of ongoing asset replacement, upgrading and maintenance and production drilling and well workovers, all entirely within the confines of Apache's designated license areas.

This Baseline Environmental Audit Report describes the environmental performance and management of the Apache assets that were acquired from BP in 2010. The Report has been prepared by ERM, drawing entirely on the following sources of information:

- Observations gained from a five day visit made by two ERM consultants in September 2010 to the Dashour Gas Plant and the Western Desert assets of Abu el Gharadig (AG), WD-33, Razzak (RZK) and the El Alemein Pumping Station. This visit was made specifically for the purpose of providing environmental due diligence support to Apache following the acquisition by Apache of these assets.
- ERM's *Review of Apache's Operations in Egypt: Environmental Monitoring and Waste Management November 2007*. This report was prepared specifically for the purposes of securing OPIC political risk insurance cover at that time and was based on a one week duration visit by an ERM consultant to a cross section of Apache assets (as defined at that time).
- ERM's *Apache's Operations in Egypt: Environmental Monitoring and Waste Management April 2005*. This report was prepared by ERM to provide Apache with an *Environmental Monitoring Plan, Waste Management Plan and Compliance Assurance Protocols* specifically focussed at Apache's operations in Egypt. The plans and protocols were developed to enable Apache to assure itself that its operations were in compliance with all applicable Egyptian legal and regulatory requirements and joint venture concession agreements and were in conformance with published guidelines of IFC and World Bank for oil and gas developments at that time.
- Petrosafe's *Environmental Impact Assessment of RZK-45 Injection Well, Razaak Concession, May 2010* prepared for Gulf of Suez Petroleum Company (GUPCO).

- Apache's 2011 Annual Environmental Self-Monitoring Report (dated January 2012) and certain other reports and information made available to ERM by Apache.
- Information in the public domain drawn principally from internet searches and literature reviews.

In this regard, ERM has not revisited any of the newly acquired Apache sites specifically for the purposes of compiling this report, although we have been able to draw on observations made during the 2007 and 2010 visits to the Western Desert assets.

2.4

STRUCTURE OF THIS REPORT

The remainder of this Report is structured as follows:

- *Chapter 3 Description of Apache's Assets* presents a brief outline description of the principal assets that are subject to this baseline environmental audit.
- *Chapter 4 Relevant Standards, Guidelines and Commitments* summarizes relevant Egyptian legislation and policy; relevant international conventions and agreements; relevant environmental guidelines of the OPIC and the World Bank Group and Apache Corporation's Environmental Health and Safety Policy.
- *Chapter 5 Environmental Performance* describes environmental performance and identified environmental risks and sensitivities.
- *Chapter 6 Conclusions* presents the pertinent findings of this Baseline Environmental Review.

This chapter describes the principal assets that are subject to Apache's application for OPIC insurance cover.

3.1 APACHE CORPORATION IN EGYPT PRE-NOVEMBER 2010

Apache Corporation is the largest oil and gas producer in Egypt's Western Desert. Output has increased significantly since 2001, after the company acquired *Repsol's* interests in the Western Desert and became operator of the *Khalda* Concession.

The *Khalda* complex is spread across nearly 2 million acres, approximately 250 miles west of Cairo, and holds two dozen oil and gas fields producing from 58 sandstone reservoir units in seven formations located from one mile to three miles below the desert surface.

In 2003, *Apache* replaced 217 percent of production on the strength of several discoveries, including *Qasr*, *Alexandrite*, *Atoun*, *Emerald*, *JG-2*, *Matruh* and 13 discoveries in *East Bahariya*. The successful drilling program pushed daily gross production to highs of 102,052 barrels of oil per day (bpd) and 258 million cubic feet per day (mmscfd) in December 2003.

The *Qasr* discovery in the *Khalda* offset acreage is the most significant gas discovery in the Western Desert in the last decade. The *Qasr-1X* and *Qasr-2X* wells confirmed a 700-foot gas condensate column with estimated recoverable reserves of between 1 and 3 trillion cubic feet. The *Qasr-1X* well was brought on production in December 2003.

Apache also owns a 75 percent interest in the *Qarun* Concession, which it acquired from *Phoenix Resources* in 1996. In addition to the *Khalda/Khalda Offset* Concession and the *Qarun* Concessions, *Apache* also holds interests in the *East Beni Suef* Concession, the *WD-19* Concession and three other blocks in the Western Desert:

- The *Matrouh* Development Lease;
- The *North East Abu Gharadig* Concession; and
- The *East Bahariya* Concession.

In 2001, *Apache* acquired all of *Repsol's* interests in the *Khalda* Concession, the *Ras Kanayes* Concession, the *Ras El Hekma* Concession and the *North East Abu Gharadig* Concession. Included in the transaction was *Repsol's* interest in the *Umbarka* Development Lease, and in the *South Umbarka* Concession. *Apache* has become operator in all of these areas except *North East Abu Gharadig*. *Apache Corporation's* interests in the *Khalda* Concession and the *Qarun* fields are shown in *Figure 3.1*.

The assets described in *Section 3.1* above were augmented in November 2010 with the acquisition of certain GUPCO assets from BP. These comprise principally of the Dashour Gas Plant and a number of operating concessions and assets in the Western Desert, namely Abu el Gharadig (AG), WD-33, Razzak Fields (RZK), El Alamein Pumping Station (Alamein) and certain interconnecting in-country pipelines.

3.2.1

Dashour Gas Plant

The former GUPCO Dashour assets are situated on the edge of the Nile valley fertile strip at Dashour, approximately 35 km south of Cairo. Assets present on the site comprise the Dashour Gas Plant (the Gas Plant) and Fleet Maintenance Workshops. Approximately 400 personnel are employed at the site, either by Apache's joint venture KPC or by the main contractor 'Apesco'.

The Gas Plant is a conventional natural gas processing plant (cryogenic fractionation) which receives feedstock from the Western Desert via a 24 inch pipeline (also a former GUPCO asset that was acquired by Apache, see *Section 3.2.2*) from Abu El Gharadig (AG) and produces a methane rich sales gas exported via a 36" diameter line to the Gasco Low Pressure Grid, and LPG which is exported via a 6" diameter pipeline to two local third party bottling companies. The plant was constructed in 1978 and has a nameplate capacity of 135 MMSCFD, but is currently operating at 40 MMSCFD.

The feed received is a sweet, dry gas comprising natural gas and associated gas fed forward from the AG gas processing plant, and as such includes a component of BABEPCO and GPC produced gas. The feed gas is filtered, cooled against a returning cold gas flow from the flash drum on the first fractionation column (depropaniser) and fed forward to a chiller, from which the gas phase (containing primarily C1-C2) is taken together with the cold gas from the heat exchanger through a turbo-expander where expansion causes further cooling. The gas phase exiting the turbo-expander is compressed and exported as sales gas. C2+ product from the turbo-expander enters the top of the depropanizer column whilst the liquid phase from the chiller enters the column towards the base. Light products are taken off overhead to a flash drum as described above whilst the C3 + bottoms are taken forward for further fractionation on a second fractionation column (debutanizer) column. There is reflux on the top of this column with C3 - C4 LPG product taken from the bottom of the column to storage spheres.

Process heating for the depropanizer re-boiler is by a hot oil system with the oil heater fired by gas. Other ancillaries serving the plant include two turbo generators, 2MW in total, two 400kW diesel generators, two air compressors, supplying instrument air, and four fire fighting pumps.

The Fleet Maintenance Workshop facility comprises a fully equipped vehicle servicing complex including mechanical workshops, spray booth, brakes and

tyres bays and body shops serving Apache's fleet of cars and buses. The facility also includes a wash bay and fuel station (although this is the property of Misr Petroleum and is not an Apache asset)

3.2.2 *Western Desert Operations*

The Abu el Gharadig (AG), WD-33, Razzak Fields (RZK) and El Alamein Pumping Station (Alamein) assets are situated in the Western Desert, approximately 300km west of Cairo.

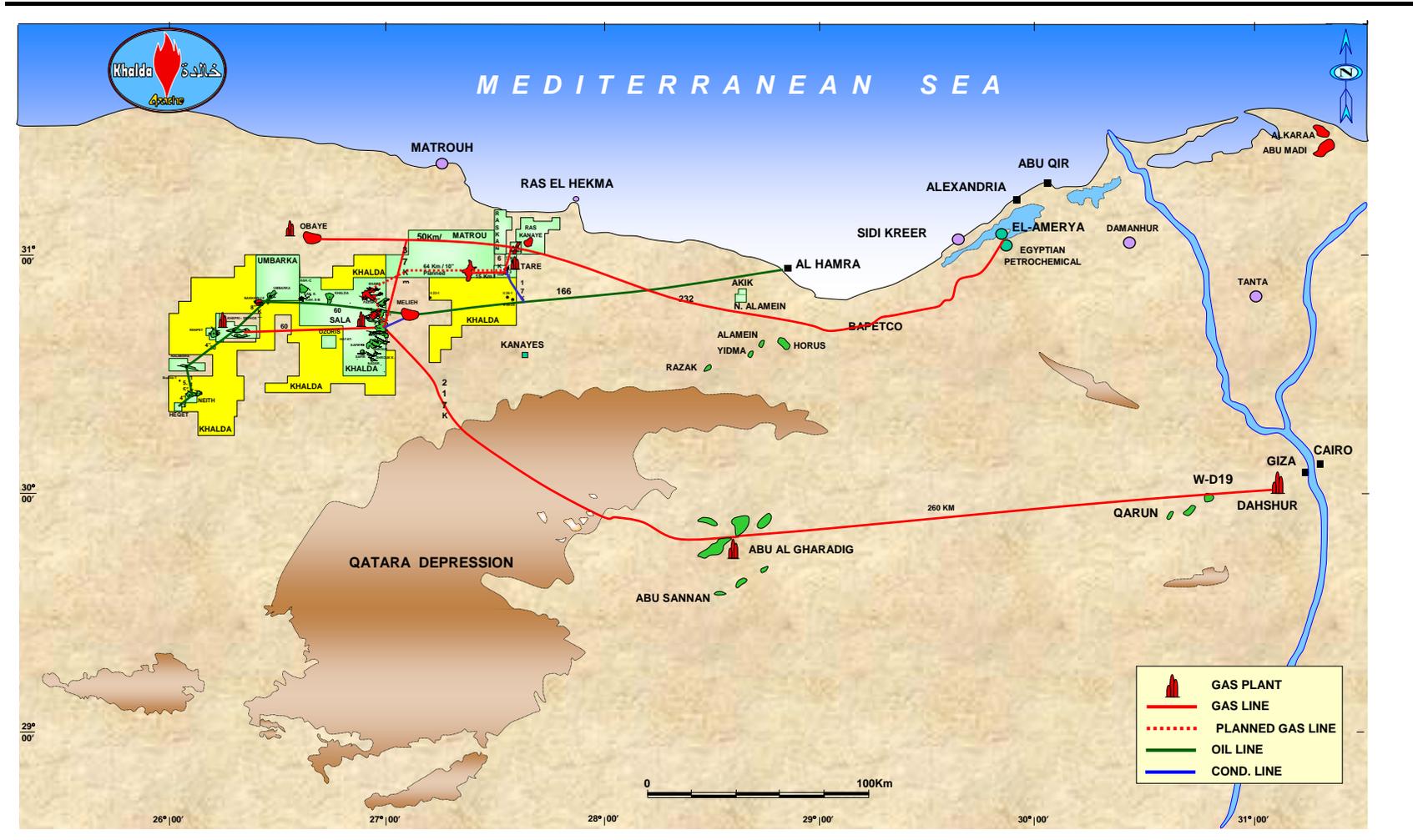
- The AG field is linked directly to the Dashour Gas Plant via a 24" gas pipeline (see *Section 3.2.1* above) of approximately 260km in length.
- The WD33 field is situated approximately 90km southeast of the AG camp, while the RZK fields (RZK Main, RZK East, RZK North and RZK West) are situated approximately 90km north of the AG base.
- Produced crude from the AG, WD-33 and RZK fields is pumped via a 12" oil pipeline to a terminal located at El Alamein, approximately 120 km north of AG. From there it is pumped via a 12" line to the El Hembra export terminal on the Mediterranean Sea coast (this latter pipeline is not actually owned or operated by Apache, but by the Hamra Petroleum Company).
- While associated gas from the AG field is separated, compressed and dried at AG (then processed to sales gas standard at Dashour), associated gas at both WD33 and RZK is flared to atmosphere (due to the reported low production volumes and current infrastructure setup at each field).
- The 24" AG-Dashour gas pipeline and the 12" oil pipeline linking WD33, AG and RZK with the Alamein terminal are both owned by Apache (along with additional test lines and flow lines linking the three fields). The El Alamein Terminal is owned and operated by Western Egyptian Petroleum Company (WEPCO). As identified above, the 12" pipeline linking the El Alamein terminal and the El Hamra export terminal is understood by ERM to be owned and operated by the Hamra Petroleum Company (although Apache owns the diesel generator for the pump station) and is used to transport the production of Apache and the four other regional operators, with each operator paying a price per barrel for its use to the Government.

The Western Desert assets acquired from BP/GUPCO were established in the mid to late 1970s, following the first Concession Agreement being signed by GUPCO in 1975. At the time of ERM's September 2010 site visit, the production capacity of crude at each asset was identified as follows:

- AG - 5.5 Thousand Barrels of Oil Per Day (MBOPD);
- WD33 - 3.3 MBOPD; and
- RZK fields - 12 MBOPD.

Oil from the Western Desert assets is shipped for export and domestic consumption by pipeline and sea (at El Hamra) only. No road transportation of crude oil occurred either at the time of the ERM visit, or historically.

Figure 3.1 Map Showing the Facilities Associated with the Khalda Concession and Qarun Fields



4.1 INTRODUCTION

This chapter summarises those aspects of Egyptian environmental law and regulations and World Bank Group guidelines that are of direct relevance to Apache's operations in Egypt.

The two sets of standards (Egyptian regulatory and World Bank Group) are generally not directly comparable since they utilise different bases (such as averaging periods for example) hence they are reviewed separately in *Sections 4.1 and 4.3* respectively. Nevertheless, commentary is provided in terms of how they broadly compare.

4.2 EGYPTIAN LEGISLATION FOR ENVIRONMENTAL PERFORMANCE AND PROTECTION

4.2.1 Introduction

This section summarises those aspects of Egyptian environmental law and regulations that are of direct relevance to Apache's operations in Egypt.

The Arab Republic of Egypt has, for some time, had in place various laws and regulations related to the environment. *Presidential Decree No. 631, 1982* led to the establishment of the Egyptian Environmental Affairs Agency (EEAA). The *Egyptian Law Concerning the Environment, Law No. 4, 1994* was Egypt's first modern and comprehensive law regulating the environment as a whole. *Law 4* regulates air, water, earth, biodiversity and the anthropogenic activities which may impact upon these resources and receptors.

Law 4 was promulgated on January 27th, 1994 and provides that companies are required to conform to the Law and the requirements of the Executive Regulations, promulgated under *Prime Ministerial Decree No. 338 of 1995*. *Law 4* repeals and replaces all laws and regulations contrary to its provisions, but specifically maintains in force the provisions of the *Law Concerning the Protection of the River Nile and Water Courses from Pollution, Law 48 of 1982*. Certain Articles of *Law 4* were amended in 2009, as outlined in *Law No. 9, 2009 on the Amendment of Some Provisions of the Law on Environment Promulgated by Law No. 4, 1994*; and then further amended as outlined in *Prime Ministerial Decree No.1095 for 2011*. For the purposes of this report the regulations referred to do not include the changes made by the latest *Prime Ministerial Decree of 2011*.

The provisions of *Law 4* can usefully be considered to address two categories of environmental regulation. The first category concerns legislation that regulates environmental performance, i.e. limits for discharges/emissions to the environment to which companies such as Apache must comply. The second category concerns legislation aimed at protecting the quality of the

receiving environment, e.g. legislation on acceptable ambient air quality, acceptable received noise levels, protection of sensitive habitats.

Both of these categories of regulation are discussed in the sections which follow, covering the following:

- air quality;
- protection of water resources;
- noise;
- the production of hazardous waste;
- biodiversity protection; and
- antiquities.

4.2.2 *Legislation Applicable to Air Quality*

Egyptian Law No 4 of 1994 Concerning the Protection of the Environment provides the basis for regulating impacts to the atmospheric environment. Annex 5 of Law 4 defines the standards for ambient air quality, which for convenience are presented in *Table 4.1* below.

Table 4.1 *Ambient Air Quality Guidelines ($\mu\text{g m}^{-3}$)*

Pollutant	Averaging Period	Egyptian Standards ($\mu\text{g/m}^3$)
Nitrogen dioxide (NO ₂)	1 hour	400
	24 hours	150
Sulphur dioxide (SO ₂)	1 hour	350
	24 hours	150
	1 year	60
Carbon monoxide (CO)	1 hour	30,000
	8 hours	10,000
Ozone	1 hour	200
	8 hours	120
Lead	24 hours	0.5 (urban areas)
	24 hours	1.5 (industrial areas)
Respirable particles (PM ₁₀)	24 hours	150
	1 year	70
Suspended Particles (measured as black smoke)	24 hours	150
	1 year	60
Total suspended particles	24 hours	230
	1 year	90

Note: These ambient air quality standards are distinct from work place (occupational health) air quality standards which are defined under Annex 8 to Law 4.

In addition to the ambient air quality standards presented above, *Law 4* requires the developer to ensure that pollution concentrations in emissions from combustion sources during construction and operation do not exceed the limits shown in *Table 4.2*.

Table 4.2 *Air Emissions Standards for Fuel Burning and Flaring at the Stacks Exhaust (Annex 6 of ER of Law4/1994)*

Pollutant	Permissible Limits (mg/m3)
Total Particulates	100
Aldehydes (measured as Formaldehyde)	20
Antimony	20
Carbon Monoxide	500 Existing Establishments 250 New Establishments
Sulphur Dioxide	4000 Existing Establishments 2500 New Establishments
Nitrogen Oxides	300
Hydrogen Sulphide	10
Organic Compounds (Burning of organic liquids)	50
Lead	2
Mercury	3
Cadmium	10
Chlorine	20
Copper	20
Nickel	20
Heavy Metals (total)	25

Law 4 (specifically Article 42 and Table 5 of Annex 6 to the Law) also establishes specific conditions for the combustion of fuels, as follows:

- Fuel/air mixtures and the combustion process should be such as to provide for complete combustion of the fuel.
- The use of mazoot and heavy fuel oil is prohibited in residential areas.
- The sulphur content of fuels is restricted to equal or less than 1.5% in or near urban and residential areas. The use of higher sulphur content fuels is permissible in regions remote from inhabited urban areas, provided that suitable atmospheric factors are prevalent and adequate distances are observed to prevent these emissions from significantly impacting residential and agricultural areas and watercourses.
- Opacity of emissions from diesel engines shall not exceed 30%.

4.2.3 *Legislation Applicable to the Protection of Water Resources*

The principle for protection of water resources in Egypt is largely related to the nature of the receiving water. The appropriate standards for protection of the River Nile and waterways against pollution are contained in *Law 48* and the *Executive Regulations to Law 48* (as amended by *Decree 402/2009*). *Law 48* pertains to discharges to inland waters, while *Law 4* covers the marine environment.

4.2.3.1

Discharges to Inland Waters Used for Potable Supply

Decree 402/2009, Article 61 specifies the limits for the discharge of treated industrial fluid wastes into the River Nile and its two branches, and underground water reservoirs. The standards for discharge into the River Nile and its branches are presented in *Table 4.3*.

Table 4.3 *Standards for Discharges of Treated Industrial Wastewater* ⁽¹⁾

Parameter	Maximum Limits and Specifications [(mg/l) - unless otherwise indicated]	
	The River Nile from the High Dam to the Delta Barrages	The River Nile Branches (Damietta- Rosetta)
Temperature	Not more than 3°C over the average	Not more than 3°C over the average
pH	6 - 9	6 - 9
Biochemical Oxygen Demand	30	20
Chemical Oxygen Demand (Dichromate)	40	20
Total Dissolved Solids	1200	800
Suspended Solids	30	30
Sulphide (as H ₂ S)	1	1
Oil and Grease	5	5
Phosphate	1	1
Nitrates (as NO ₃)	30	30
Phenols	0.002	0.001
Fluorides	0.5	0.5
Residual Chlorine	1	1
Mercury	0.001	0.001
Lead	0.001	0.001
Cadmium	0.003	0.003
Arsenic	0.01	0.01
Chromium	0.01	0.01
Copper	1	1
Nickel	0.02	0.02
Iron	1	1
Manganese	0.5	0.5
Zinc	1	1
Silver	0.05	0.05
Faecal Coliform Count (No. in 100 cm ³)	1000	1000
Insecticides (total)	Nil	Nil

According to *Decree 402/2009, Article 64* drainage water (as distinct from industrial wastewater discussed above) discharged to potable surface water bodies must meet the specifications set out in *Table 4.4*.

(1) Decree 402/2009 amending Executive Regulations of Law 48.

Table 4.4 Standards for Discharges of Water from Drains to Potable Water Surfaces

Parameter	Maximum Limits and Specifications[(mg/l) - unless otherwise indicate]
Total Solids	500
Temperature	Not more than 3°C over the average
Dissolved Oxygen	Not less than 5
Hydrogen exponent	Not less than 7, and not more than 8.5
Biochemical Oxygen Demand	Not more than 10
Chemical Oxygen Demand (Dichromate)	Not more than 15
Ammonia (NH ₃)	Not more than 0.5
Oil and grease	Not more than 1
Mercury	Not more than 0.001
Iron	Not more than 1
Manganese	Not more than 0.5
Copper	Not more than 1
Zinc	Not more than 1
Nitrate (NO ₃)	Not more than 45
Fluoride	Not more than 0.05
Phenol	Not more than 0.002
Arsenic	Not more than 0.01
Cadmium	Not more than 0.003
Chromate	Not more than 0.05
Cyanide	Not more than 0.5
Lead	Not more than 0.001
Nickel	Not more than 0.02
Silver	Not more than 0.05
Selenium	Not more than 0.01
Phosphate	Not more than 1
Faecal Coliform Count (No. in 100 cm ³)	2500

4.2.3.2 Discharges to Inland Waters Not Used for Potable Supply

According to Decree 402/2009 amending the executive regulations of Law 48, Article 66, discharges to inland waters not used for potable supply may not exceed the concentration limits presented in Table 4.5.

In addition, Decree 402/2009 amending the executive regulations of Law 48 provides further for the protection of inland water bodies, particularly potable water sources, as follows:

- It is prohibited to discharge any industrial effluents or untreated sanitary drainage water into waterways or underground water reservoirs.
- Cooling water may not be discharged into inland waters, unless the water is extracted from the same body to which it is being discharged, or at least from a similar source (with respect to water quality). In such cases, cooling systems should be closed, and the discharge not mixed with any other effluent wastes of any industrial operations. In such case, it shall not be stipulated as a term of its conformity with the specifications and standard measures regarding the discharge of industrial wastes into

potable or non-potable water surfaces, except with respect to temperature, oil standard measure and greases.

- The outfall pipe for the discharge of treated effluents discharged to an inland waterway must be located visibly and positioned above the highest water level of the waterway.
- It is provided, in case of authorization, to discharge the treated industrial fluid into waterways, that the discharge sources (pipe/floating or fixed establishment) should be at a distance not less than three kilometres, in front of the source of potable water, or at one kilometre behind it, according to the requirements and specifications specified in the present regulations regarding the organizing standards.

Table 4.5 Standards for Discharges to Inland Waters (Not Used for Potable Supply)

Parameter	Maximum Limits and Specifications [(mg/l) - unless otherwise indicated]	
	Treated Sanitary Drainage Water	Treated Industrial Effluent
pH	6 - 9	Specifications as stated in Article 61 (ie Table 4.3 above) shall apply
Biochemical Oxygen Demand	60	
Chemical Oxygen Demand (Dichromate)	80	
Oil and grease	10	
Suspended Substances	50	
Sulphides (as H ₂ S)	1	
Cyanide	Nil	
Phosphates	2	
Total Nitrogen (N ₂)	10	
Phenols	Nil	
Insecticides	Nil	
Mercury	0.001	
Lead	0.001	
Cadmium	0.003	
Arsenic	0.01	
Chromium	0.01	
Copper	1	
Nickel	0.02	
Zinc	1	
Faecal Coliform Count (No. in 100 cm ³)	5,000	
Warm ova (ascaris) at 5% concentration	1 alive ova/100 ml	

4.2.3.3 Drainage of Liquid Wastes (Discharges to Sewer)

Egyptian Law Number 93 of 1962 Concerning the Drainage of Liquid Wastes (as amended by Decree 44 of 2000) prohibits drainage of liquid wastes except by virtue of a licence from the department responsible for sewage. The drainage technique employed must fulfil all requirements and specifications and criteria stipulated by the Ministry of Health. The limits and specifications for discharging wastewater into public sewer networks are presented in Table 4.6.

Table 4.6 *Limits and Specifications for Discharging Wastewater to Public Sewer Networks*

Item	Maximum limits
Temperature	43°C
PH	6 – 9.5
Biochemical Oxygen Demand (BOD)	600 ppm
Chemical Oxygen Demand (COD)	1100 ppm
Suspended materials	800 ppm
Oil and Grease	100 ppm
Dissolved Sulfides	10 ppm
Total Nitrogen	100 ppm
Total Phosphates	25 ppm
Cyanide	0.2 ppm
Phenols	0.05 ppm
Settleable materials/litre	
After 10 minutes	8 cm3
After 30 minutes	15 cm3
Heavy Metals (Total not to exceed 5 mg/litre)	
Chromium (hexavalent)	0.5 mg/l
Cadmium	0.2 mg/l
Lead	1 mg/l
Mercury	0.2 mg/l
Silver	0.5 mg/l
Copper	1.5 mg/l
Nickel	1 mg/l
Tin	2 mg/l
Arsenic	2 mg/l
Boron	1 mg/l

4.2.3.4 *Drainage of Liquid Wastes (Treated Sanitary Wastewater used for Irrigation)*

Article 15 of Egyptian Law Number 93 of 1962 Concerning the Drainage of Liquid Wastes (as amended by Decree 44 of 2000) deals with conditions and criteria to be fulfilled with regard to treated sanitary drainage water that is re-used for agricultural (ie irrigation) purposes.

The Decree specifies the level of treatment (ie primary, secondary, tertiary) required and the quality of treated sanitary effluent depending on the soil type and the nature of the crops to be irrigated. The lands into which the treated effluent is discharged must be located at least 3 km from built up quarters or a village cordon.

For primary treatment such as that employed at Apache’s Razzak and AG fields, the treated effluent may only be applied to non-edible and non-commercial vegetation, such as gardens and trees. The limits and specifications for such treated sanitary waste discharged to land are presented in Table4.7.

Table 4.7 *Limits and Specifications for Discharging Primary Treated Sanitary Effluent to Land*

Item	Maximum limits
Biochemical Oxygen Demand (BOD)	300 ppm
Chemical Oxygen Demand (COD)	600 ppm
Total Suspended Solids (TSS)	350 ppm
Total Dissolved Solids (TDS)	2500 ppm
Number of enteric nematode cells or eggs	5 per l
Chlorides	350 ppm
Boron	5 ppm
Cadmium	0.05 ppm
Lead	10 ppm
Nickel	0.5 ppm
Manganese	0.2 ppm

4.2.4 *Legislation Applicable to Noise*

Law 4 provides the basis for regulating noise emissions. The regulations pertain principally to noise limits in the workplace and *Table 4.8* presents the maximum permissible noise levels inside the workplace.

Table 4.8 *Maximum Permissible Noise Levels Inside the Workplace (dB(A))* ⁽¹⁾

Type of Place and Activity	Maximum Permissible Noise Level
Workplace with up to 8 hour shifts and aiming to limit noise hazards on hearing	90
Workplace where acoustic signals and good audibility are required	80
Work rooms for computers, typewriters and similar equipment	70
Work rooms for the follow up, measurement and adjustment of high performance operations	65
Work rooms for activities requiring routine mental concentration	60

Maximum noise intensity should not exceed 90 dB(A) during a daily 8 hour work shift. However, if noise intensities do exceed 90 dB(A), the periods of exposure must be reduced according to the levels and exposure periods presented in *Table 4.9*.

Table 4.9 *Maximum Exposure Periods to Different Noise Levels (dB(A))* ⁽²⁾

Noise Intensity Level	95	100	105	110	115
Period of Exposure (hours)	4	2	1	0.5	0.25

Noise intensity levels may at no time exceed 135 dB(A). For semi-continuous noise events such as those associated with operation of machinery, where the

(1) Annex 7 Executive Regulations of Law 4, 1994.

(2) Annex 7 Executive Regulations of Law 4, 1994.

period between noise events is one second or more, the frequency of noise events may not exceed the number of events detailed in *Table 4.10*. If there is less than one second between noise events, then the noise shall be considered as a continuous noise source and levels shall be as per the criteria specified in *Table 4.10*.

Table 4.10 *Frequency of Noise Events at Different Intensities* ⁽¹⁾

Noise Intensity (dB)	Number of Permissible Impacts During the Working Day
135	300
130	1,000
125	3,000
120	10,000
115	30,000

Limits are also given for ambient noise levels, according to the type of area the source is located in, as presented in *Table 4.11*.

Table 4.11 *Maximum Permissible Limits for Noise Intensity (dB(A))* ⁽²⁾

Type Of Area	Day	Evening	Night
Residential rural areas, hospitals and gardens	45	40	35
Residential suburbs with low traffic	50	45	40
Residential areas in the city	55	50	45
Residential with some workshops or commercial establishments or which are located on a main road	60	55	50
Commercial, administrative and downtown areas	65	60	55
Industrial areas (heavy industries)	70	65	60

NOTE : "Day" means from 07:00 to 18:00; "Evening" from 18:00 to 22:00; "Night" from 22:00 to 07:00

4.2.5 *Legislation Applicable to Hazardous Substances and Waste*

Article 29 of Law 4/1994 prohibits handling hazardous substances without obtaining a license from the competent authority. Thus, the operator (Apache's Joint Venture KPC) must first obtain such a license from the Ministries of Health, Petroleum, Industry or Interior depending on the type of substance (see below).

Article 28 of the Executive Regulations of Law 4/1994 sets requirements for hazardous waste identification, minimization, segregation, storage, transportation and on-site treatment.

According to *Article 31 of the Executive Regulations of Law 4/1994*, companies using hazardous chemicals such as acids, alkalis must construct storage areas for such hazardous chemicals according to proper engineering norms and equipped with needed safety equipment. Related emergency plans must be prepared.

(1) Annex 7 Executive Regulations of Law 4, 1994.

(2) Annex 7 Executive Regulations of Law 4, 1994.

Article 33 of Law 4/1994 specifies that all precautions must be taken when handling hazardous material either gaseous, liquid, or solid form to avoid any environmental damage including storage.

Articles 34 to 37 address the responsibility of companies in ensuring safety of workers against chemical risks including proper packaging, storage, labelling of hazardous chemicals and maintaining records and hazardous substance register.

Decree 211/2003, Articles 26 and 31 set conditions for the storage of flammable material including fuel. Article 36 of that same decree specifies that workers need to be made aware of the hazards related to the chemicals they are handling through written or oral instructions; workers must also be trained on the protection methods and handling procedures

The categories of hazardous wastes that might be generated by the Project and the relevant competent authorities for their disposal are:

- hazardous industrial substances - Ministry of Industry;
- hazardous pharmaceutical, hospital and laboratory substances and domestic insecticides - Ministry of Health;
- hazardous petroleum substances and waste - Ministry of Petroleum; and
- hazardous inflammable and explosive substances - Ministry of Interior.

With respect to non-hazardous materials, the *Executive Regulations* state that:

"...respective bodies competent to issue a licence for their disposal shall be designated by a decree of the Minister for Environmental Affairs on the basis of a proposal by the CEO of the EEAA."

Further, that:

"...an emergency plan is in place to confront any potential accidents which may occur during the production, storage, transportation or handling of such substances, provided the plan is reviewed and approved by the licensing authority after consulting the EEAA and the Civil Defence Department".

4.2.6 Legislation Applicable to Biodiversity Protection

Law 4 and its *Executive Regulations* are also concerned with the protection of biodiversity. Article 28, as amended by Law 9 of 2009, states that:

"The following acts shall be completely prohibited:

First: Hunting, killing, catching, possessing, transferring, importing, exporting or trading in whole or part of alive or dead birds, wild animals, aquatic living beings or products thereof, ravaging wildlife, changing the characteristics of the said or their wildlife, destructing nests or destroying eggs or hatches of the abovementioned creatures.

The executive regulation implementing the present law shall define the kinds of such living organisms and areas on which the provisions of the previous paragraph apply.

Second: Cutting, damaging, possession, transferring, importing, exporting or trading in whole or part of the plants or products thereof, ravaging their wildlife, changing the characteristics of the said or their wildlife.

Third: Collecting, possessing, transferring or trading in fossils- animals or plants- changing their shape, damaging their geological structure or distinctive environmental characteristics or affecting the aesthetics at the natural reserve areas.

Fourth: Trading in all endangered species- animals or plants- breeding or cultivating the same apart from their wildlife, without obtaining the necessary license from Environmental Affairs Agency.

The executive regulations implementing the present law shall identify the types of such living organisms and license prerequisites."

Article 23 of the Executive Regulations states that:

"All methods of hunting, killing or catching the birds and wild animals referred to in Annex (4) of these Executive Regulations are prohibited. It is also forbidden to possess, transport, circulate with, sell or offer to sell such birds and animals, either dead or alive, or to destroy the nests or eggs of the birds. The provisions of this Article shall apply to all Nature Reserves as well as to areas where animals and birds are threatened with extinction, as designated in a decree to be issued by the Minister of Agriculture or the governors in coordination with the EEAA."

Annex 4 of the Executive Regulations defines the wild animals prohibited from being hunted, killed or captured, as follows:

- *The birds and animals listed in the table attached to the Minister of Agricultural Decree No. 28 of 1967, issued in implementation of the provisions of Article 117 of Agriculture Law No. 53 of 1966.*
- *Any other birds or animals determined in the international conventions to which the Arab Republic of Egypt adheres.*
- *Any other birds or animals designated in a decree to be issued by the Minister of Agriculture in agreement with the EEAA.*

4.2.7

Legislation Applicable to Antiquities

Antiquities in Egypt are protected under *Law 117 of 1983 concerning the Protection of Antiquities*:

- *Article 13: prohibits the demolition of an archaeological ruin or area recorded as archaeological site. Areas adjacent to archaeological sites can be expropriated after approval of the Minister of Culture.*

- *Article 20*: prohibits the use of designated archaeological land for building and cultivation purposes. The article prohibits the removal of ruins without the permission of the Supreme Council for Antiquities and under its supervision.
- *Article 23*: requires the notification of the concerned authority in case an unrecorded ruin is found by any person.

Law 86 of 1956 concerning the Protection of Antiquities requires that the concessionaire notifies the concerned authorities if artefacts or ruins are found within the concession (*Article 83*).

4.3

INTERNATIONAL CONVENTIONS, PROTOCOLS AND AGREEMENTS

There are a number of international and regional conventions, protocols and agreements dealing with the environment to which the Government of the Arab Republic of Egypt is a signatory. While it is incumbent upon the Government to transpose the provisions of these agreements into national law, it is nevertheless prudent for operators (such as Apache) to be aware of these agreements and to take due cognisance of their implications (to the extent that they apply) for onshore oil and gas operations.

Those of greatest relevance to onshore oil and gas operations are the following.

- The *Vienna Convention for the Protection of the Ozone Layer* and the *Montreal Protocol on Substances that Deplete the Ozone Layer* require strict controls on the use of, inter alia, CFCs, HCFs and Halons.
- International agreements relating to the preservation of biodiversity and the protection of flora and fauna include the *Convention on Biodiversity*, *Bonn Convention on the Conservation of Migratory Species of Animals*, *Convention on the International Trade in Endangered Species (CITES)* and the *Ramsar Convention (Convention on Wetlands of International Importance especially as Waterfowl Habitat)*.

Regional agreements relating to protection of the Mediterranean Sea that have been ratified by Egypt are of less direct relevance to Apache since it is ERM's understanding that Apache does not own or directly operate any coastal facilities.

The *Mediterranean Action Plan (MAP)* has been established under the framework of the *Barcelona Convention of 1976*. The MAP has been promulgated as a comprehensive regional cooperation mechanism on environmental issues for the Mediterranean. It aims to tackle environmental pollution in the region, focusing mainly on the sustainable management of natural marine and coastal resources, as well as on coastal land use policies.

The *Horizon 2020 Programme*, through which Euro-Mediterranean governments aim to tackle the top sources of Mediterranean pollution by the year 2020 by implementing projects aimed at reducing the most significant pollution sources (focussing on industrial emissions, municipal waste and urban waste water) and on capacity building measures to help neighbouring countries (such as Egypt) strengthen national environmental administrations such that they are able to effectively develop and police environmental laws.

4.4 WORLD BANK AND IFC ENVIRONMENTAL STANDARDS AND GUIDELINES

4.4.1 IFC Performance Standards

The International Finance Corporation (IFC) has developed a set of Performance Standards directed at the management of environmental and social risks in projects ⁽¹⁾. For projects where the IFC contributes finance or insurance, the project owner ⁽²⁾ is required to apply the Performance Standards for the duration of the IFC's investment. In this regard, the Performance Standards define IFC expectations for managing the environmental and social aspects of their projects and for disclosing information as a condition for receiving and retaining IFC support.

There are eight Performance Standards as follows:

- *Performance Standard 1: Social and Environmental Assessment and Management System;*
- *Performance Standard 2: Labour and Working Conditions;*
- *Performance Standard 3: Pollution Prevention and Abatement;*
- *Performance Standard 4: Community Health, Safety and Security;*
- *Performance Standard 5: Land Acquisition and Involuntary Resettlement;*
- *Performance Standard 6: Biodiversity Conservation and Sustainable Natural Resource Management;*
- *Performance Standard 7: Indigenous Peoples; and*
- *Performance Standard 8: Cultural Heritage.*

Performance Standard 1 establishes the importance of: (i) integrated assessment to identify the social and environmental impacts, risks, and opportunities of projects; (ii) effective community engagement through disclosure of project-related information and consultation with local communities on matters that directly affect them; and (iii) the project owners' management of social and environmental performance throughout the life of the project.

Performance Standards 2 through 8 establish requirements to avoid, reduce, mitigate or compensate for impacts on people and the environment, and to improve conditions where appropriate. While all relevant social and environmental risks and potential impacts should be considered as part of the project's assessment, *Performance Standards 2-8* describe potential social and

(1) In this context, 'project' refers to a development project or a set of existing assets in which the IFC is an investor or to which IFC contributes finance.

(2) Depending on the context, the project owner is the party responsible for implementing and/or operating the project that is being financed or the recipient of the financing.

environmental impacts that require particular attention (to the extent that they are relevant to the project's setting and context. Where social or environmental impacts are anticipated, the project owner is required to manage them through a Social and Environmental Management System consistent with *Performance Standard 1*.

In addition to meeting the expectations under the Performance Standards, projects must comply with applicable national laws, including those laws implementing host country obligations under international law.

A set of Guidance Notes, corresponding to the Performance Standards, offers helpful guidance (and reference materials) on the requirements contained in the Performance Standards and on good sustainability practices to help project owners improve project performance.

4.4.2 *World Bank Group Environmental Guidelines*

The World Bank Group (WBG) has published two sets of relevant guidelines (known collectively as the WBG EHS Guidelines):

- *General Environmental Health and Safety (EHS) Guidelines (2007)*. The EHS Guidelines contain the performance levels and measures that are generally considered to be achievable in new facilities at reasonable costs by the application of existing technology. Application of the EHS Guidelines to existing facilities (such as those of Apache) where the guidelines cannot be achieved at the outset may involve the establishment of site-specific targets with an appropriate timetable for achieving them. When host country regulations differ from the levels and measures presented in the EHS Guidelines, projects are expected to achieve whichever is more stringent. If less stringent levels or measures are appropriate in view of specific project circumstances, a full and detailed justification for any proposed alternatives is needed as part of the site-specific environmental assessment. This justification should demonstrate that the choice for any alternate performance levels is protective of human health and the environment.
- *Sector-specific EHS Guidelines for Onshore Oil and Gas Developments (2007)*. These Oil and Gas industry sector EHS guidelines are to be used in conjunction with the General EHS guidelines referenced above. The guidelines cover all aspects of upstream oil and gas operations, including seismic exploration; exploration and production drilling; development and production activities; transportation activities including pipelines; other facilities including pump stations, metering stations, pigging stations, compressor stations and storage facilities; ancillary and support operations; and decommissioning. Unlike the General EHS Guidelines, the industry specific guidelines focus mainly on qualitative performance measures and contain few quantitative performance measures, with the notable exception of effluent discharges and emissions to atmosphere of H₂S.

These two sets of guidelines are referenced in *IFC Performance Standard 3 on Pollution Prevention and Abatement* as the reference standards that should be achieved in order to comply with the objectives of the Performance Standard.

Hereafter, in *Sections 4.4.2.1 – 4.4.2.5*, we extract the most pertinent provisions from these World Bank Group EHS guidelines in the context of Apache's operations in Egypt.

4.4.2.1 *World Bank Group Guidelines for Air Emissions and Ambient Air Quality*

Projects with significant sources of air emissions, and potential for significant impacts to ambient air quality, should prevent or minimize impacts by ensuring that:

- Emissions do not result in pollutant concentrations that reach or exceed relevant ambient quality guidelines and standards by applying national legislated standards, or in their absence, the current WHO Air Quality Guidelines (see *Table 4.12*), or other internationally recognized sources. Hence, subject to meeting the criterion below, achievement of the Egyptian regulatory ambient air quality standards set out in *Table 4.1* above would meet the requirements of *IFC Performance Standard 3* (ie there would be no requirement to also meet the WHO guidelines).
- Emissions do not contribute a significant portion to the attainment of relevant ambient air quality guidelines or standards. As a general rule, this Guideline suggests 25% of the applicable air quality standards to allow additional, future sustainable development in the same air shed.

Table 4.12 WHO Ambient Air Quality Guidelines ^{(1) (2)}

	Averaging Period	Guideline value in ug/ m ³
Sulfur dioxide (SO ₂)	24-hour	125 (Interim target-1) 50 (Interim target-2) 20 (guideline)
	10 minute	500 (guideline)
Nitrogen dioxide (NO ₂)	1-year	40 (guideline)
	1-hour	200 (guideline)
Particulate Matter PM ₁₀	1-year	70 (Interim target-1) 50 (Interim target-2) 30 (Interim target-3) 20 (guideline)
	24-hour	150 (Interim target-1) 100 (Interim target-2) 75 (Interim target-3) 50 (guideline)
	1-year	35 (Interim target-1) 25 (Interim target-2) 15 (Interim target-3) 10 (guideline)
	24-hour	75 (Interim target-1) 50 (Interim target-2) 37.5 (Interim target-3) 25 (guideline)
Particulate Matter PM _{2.5}	1-year	35 (Interim target-1) 25 (Interim target-2) 15 (Interim target-3) 10 (guideline)
	24-hour	75 (Interim target-1) 50 (Interim target-2) 37.5 (Interim target-3) 25 (guideline)
Ozone	8-hour daily maximum	160 (Interim target-1) 100 (guideline)

4.4.2.2 World Bank Group Noise Level Guidelines

Noise impacts should not exceed the levels presented in *Table 4.13*, or result in an increase in background levels of more than 3 dB at the nearest receptor location off-site. It should be noted that although not directly comparable, Egyptian standards for noise are generally more stringent than the World Bank/IFC noise level guidelines and adherence to the Egyptian standards would substantively meet these requirements.

Table 4.13 Noise Level Guidelines

Receptor	One Hour LAeq (dBA)	
	Daytime 07:00 - 22:00	Nighttime 22:00 - 07:00
Residential; institutional ;Educational	55	45
Industrial; commercial	70	70

(1) World Health Organization (WHO). Air Quality Guidelines Global Update, 2005. PM 24-hour value is the 99th percentile.

(2) Interim targets are provided in recognition of the possible need for a staged approach to achieving the recommended guidelines.

4.4.2.3

World Bank Group Indicative Values for Treated Sanitary Sewage Discharges

If sewage from an industrial facility is to be discharged to surface water, treatment is required to meet national or local standards for sanitary wastewater discharges or, in their absence, the indicative guideline values applicable to sanitary wastewater discharges shown in *Table 4.14*.

It should be noted that Egyptian standards for effluent discharges to freshwater vary depending on the nature of the receiving water. However, as a general rule the Egyptian national standards for sewage discharge are comparable or more stringent than those of the World Bank Group guidelines for effluent discharges; hence adherence to the Egyptian standards would meet the substantive provisions of the World Bank Group guidelines.

Table 4.14 *Indicative Values for Treated Sanitary Sewage Discharge*

Pollutants	Units	Guideline Value
pH	pH	6 – 9
BOD	mg/l	30
COD	mg/l	125
Total nitrogen	mg/l	10
Total phosphorus	mg/l	2
Oil and grease	mg/l	10
Total suspended solids	mg/l	50
Total coliform bacteria	MPNb/ 100 ml	400a

Notes:

a. Not applicable to centralized, municipal, wastewater treatment systems which are included in EHS Guidelines for Water and Sanitation.

b. MPN = Most Probable Number

4.4.2.4

World Bank Group Guidelines for Emissions, Discharges and Waste Levels from Onshore Oil and Gas Development

Table 4.15 presents effluent and waste guidelines for onshore oil and gas development from the sector-specific World Bank Group guideline. Effluent guidelines are applicable for direct discharges of treated effluents to surface waters for general use. Site-specific discharge levels may be established based on the availability and conditions in use of publicly operated sewage collection and treatment systems or, if discharged directly to surface waters, on the receiving water use classification as described in the General EHS Guidelines.

Combustion source emissions guidelines associated with steam- and power-generation activities from sources with a capacity equal to or lower than 50 MWth are addressed in the General EHS Guidelines (with larger power source emissions addressed in the Thermal Power EHS Guidelines which have not been referenced elsewhere in this report). Guidance on ambient considerations based on the total load of emissions is provided in the General EHS Guidelines.

As noted in *Section 4.2.3*, Egyptian standards for effluent discharges to freshwater vary depending on the nature of the receiving water. However, as a general rule, the Egyptian national standards for effluent discharge are comparable or more stringent than those of the World Bank Group guidelines for effluent discharges; hence adherence to the Egyptian standards would meet the substantive provisions of the World Bank Group guidelines.

Table 4.15 Emissions, Effluent and Waste Levels from Onshore Oil Gas Development

Parameter	Guideline Value
Produced water	Treatment and disposal as per guidance in Section 1.1 of this document. For discharge to surface waters or to land: o Total hydrocarbon content: 10 mg/L o pH: 6 - 9 o BOD: 25 mg/L o COD: 125 mg/L o TSS: 35 mg/L o Phenols: 0.5 mg/L o Sulphides: 1 mg/L o Heavy metals (total) ^a : 5 mg/L o Chlorides: 600 mg/l (average), 1200 mg/L (maximum)
Hydrotest water	Treatment and disposal as per guidance in section 1.1 of this document. For discharge to surface waters or to land, see parameters for produced water in this table.
Completion and well workover fluids	Treatment and disposal as per guidance in Section 1.1 of this document. For discharge to surface waters or to land: : o Total hydrocarbon content: 10 mg/L. o pH: 6 - 9
Stormwater drainage	Stormwater runoff should be treated through an oil/water separation system able to achieve oil & grease concentration of 10 mg/L.
Cooling water	The effluent should result in a temperature increase of no more than 3° C at edge of the zone where initial mixing and dilution take place. Where the zone is not defined, use 100 m from point of discharge
Sewage	Treatment as per guidance in the General EHS Guidelines, including discharge requirements.
Air Emissions	Treatment as per guidance in Section 1.1 of this document. Emission concentrations as per General EHS Guidelines, and: o H ₂ S: 5 mg/Nm ³

Notes: a. Heavy metals include: Arsenic, cadmium, chromium, copper, lead, mercury, nickel, silver, vanadium, and zinc.

An environmental monitoring programme should be implemented to address all activities that have been identified to have potentially significant impacts on the environment, during normal operations and upset conditions.

Environmental monitoring activities should be based on direct or indirect indicators of emissions, effluents, and resource use applicable to the particular project. Monitoring frequency should be sufficient to provide representative data for the parameter being monitored.

Monitoring should be conducted by trained individuals following monitoring and record-keeping procedures and using properly calibrated and maintained equipment. Monitoring data should be analysed and reviewed at regular intervals and compared with the operating standards so that any necessary corrective actions can be taken. Additional guidance on applicable sampling and analytical methods for emissions and effluents is provided in the General EHS Guidelines.

4.4.3

Relevance of the IFC Performance Standards and EHS Guidelines to Apache's Egyptian Operations

As discussed in *Section 4.4.1*, the IFC Performance Standards (and for that matter, the World Bank Group EHS Guidelines) have been developed by the IFC primarily for purpose of defining IFC expectations of project owners for managing the environmental and social aspects of their projects and for disclosing information as a condition for receiving and retaining IFC support. Nevertheless, the IFC's Policy and Performance Standards on Social and Environmental Sustainability have become globally recognized as good practice in dealing with environmental and social risk management (even for projects not subject to IFC financing). In this regard:

- Nearly 70 banks and financial institutions, including over 10 from emerging markets, have adopted the Equator Principles, which are based on IFC's Performance Standards.
- 32 export credit agencies of the OECD countries benchmark private sector projects against IFC's Performance Standards.
- The Overseas Private Investigation Corporation (OPIC) and the Multilateral Investment Guarantee Agency (MIGA¹) each benchmark private sector
- projects against the IFC's Performance Standards.

(1) http://www.miga.org/documents/performance_standards_social_and_env_sustainability.pdf

4.5 APACHE CORPORATION ENVIRONMENTAL, HEALTH & SAFETY POLICIES

4.5.1 Introduction to Apache's EHS Philosophy

Apache's Environmental Health & Safety group coordinates the company's environmental and safety programs around the world. Apache recognizes that it is incumbent on a company that derives its benefits from the Earth's resources to take responsibilities to the environment seriously. Apache's operations have been recognized in several countries for its protection of natural resources.

Not content with a safety record that is consistent with that of its peers, Apache's EH&S group constantly looks for areas for improvement. As a corporate goal, employee safety is on the same level as all business goals. Current objectives include:

- Making an already strong management commitment to EH&S more visible to the entire company.
- Implementing performance measures as a means of tracking and monitoring the effectiveness of Apache's safety programs.
- Formalizing environmental and safety compliance auditing.
- Enhancing contractor safety through revisions to master service agreements.
- Energizing the safety-training meeting curriculum.

4.5.2 Apache's Environmental Policy

Apache's environmental policy is reproduced in Box 4.1.

Box 4.1 Apache's Environmental Policy

One of Apache's Core Values is conducting our business with honesty and integrity which means that we will conduct our business in an environmentally responsible manner. Conducting our business in an environmentally responsible manner means that we shall:

- Comply with all Federal, State and local environmental laws and regulations in all its operations.
- Continually endeavor to manage environmental risk through contingency planning and training of its employees in environmental compliance.
- Conduct periodic audits of our operations to ensure compliance.
- Expect that all contractors and other parties engaged in activities on our operated properties will abide by our environmental policies as well as Federal, State and local environmental laws and regulations.
- Recognize that our management believes that every employee is responsible for the environmental compliance for the company.

4.5.3 *Apache's Safety Policy*

Apache's safety policy is reproduced as *Box 4.2*.

Box 4.2 *Apache's Safety Policy*

- One of Apache's core values is conducting our business with honesty and integrity, which means that we will conduct our business safely. Apache Corporation is committed to conducting our business in a manner that protects the health and safety of our employees, contractors and the general public. We believe that work-related injury and illness are preventable and we strive to continuously improve our safety and health performance.
- To meet these commitments, Apache and its contractors shall:
- Recognize that no business objective is so important that it will be pursued at the sacrifice of safety.
- Recognize that each of us has the responsibility to make the safety of our co-workers and ourselves a primary concern.
- Comply with all federal, state, local and industry safety and health regulations and laws.
- Identify and eliminate potential hazards. Control and safely manage those hazards that cannot be eliminated.
- Set quantifiable safety objectives and targets that result in continual improvement. Regularly monitor and report performance against those targets.
- Hold employees, supervisors, management and contractors accountable for their safety and the safety of personnel in their charge.

This chapter presents ERM's assessment of environmental performance of the former GUPCO assets at the time of their acquisition from BP in 2010, supplemented by additional information provided by Apache with regard to performance since the time of that site visit (see *Section 5.3* and *Section 5.4*).

Owing to the significant geographical spread of these assets, for the purposes of this review of environmental performance, assets are grouped into two geographical clusters as follows:

- Dashour Assets; and
- Western Desert Assets located East of Qatara Depression;

5.1 ENVIRONMENTAL PERFORMANCE OF DASHOUR ASSETS

5.1.1 *Dashour: General*

Apache's Dashour assets comprise the Dashour Gas Plant and the Fleet Maintenance Workshop which are both located near Dashour, approximately 35 km due south of Cairo, and the Abu el Gharadig (AG) cross-country gas pipeline. As discussed in more detail under *Section 3.2.1* above:

- The 260 km 24" AG pipeline transfers natural gas and associated gas from Apache's (and certain other operators') hydrocarbon fields located in the vicinity of Abu el Gharadig in the Western Desert to the Dashour Gas Plant.
- The Dashour Gas Plant treats the raw gas to yield sales specification pipeline gas and liquefied petroleum gas (LPG).
- The Fleet Maintenance Workshops service the fleet of cars and buses which underpin Apache's operations in Egypt.

The Dashour assets were purchased from BP/GUPCO in 2010. The observations of environmental performance discussed below are largely based on observations made by ERM during the due diligence review of the Dashour assets in September 2010, immediately following Apache's acquisition of these assets.

5.1.2 *Dashour: Air Quality*

Given the nature of the processing undertaken at Dashour there are few sources of emissions to air. The principal point source emissions on the Gas Plant comprise the hot oil fired heater system and the turbo generators, while the various diesel support generators, water well pumps and fire pumps

constitute minor sources. Limits established under the *Environmental Law 4/94, Executive Regulation 1741/2005* (see Section 4.3.2 above) for combustion products (CO, SO₂, NO_x and total particulates) are applicable to all of these sources. Stack monitoring is undertaken annually by the officially recognised Energy and Environmental Research Centre (E2RC) of the Tabbin Institute. Results from the most recent (October 2009) round of monitoring available to ERM were reviewed in August 2010 and it was confirmed that all sources were in compliance with the limits.

With respect to potential fugitive emissions of hydrocarbons, site management informed ERM that they undertake a programme of regular area by area gas monitoring using hand held equipment in close proximity to pumps, valves and flanges. Although not specifically identified as such, this programme appeared to have most of the elements of a Leak Detection and Repair (LDAR) programme, as positive readings required an entry on the maintenance tracking database, *Maximo*.

The site also operates a flare. Reportedly the purpose of the flare is for de-inventorying of the process unit under process upset conditions, and is maintained with a lit pilot. There is no steam injection to the flare, however it burns only light products and management confirmed that there are typically no issues regarding smoky flaring.

There is also a burn pit, to which heavy end hydrocarbons and condensate from the flare KO (knock-out) drum can be diverted under process upset or emergency by-pass conditions.

The only identified emission source within the Fleet Maintenance Workshop area is from a vehicle spray booth. The booth is of modern design with ceiling extraction through a plenum equipped with a fabric filter. The booth is operated only as required and is not in constant use.

5.1.3 *Dashour: Water and Wastewater Discharges*

Industrial water supply to the site, principally for the spheres cooling / deluge system and for fire water, is supplied from three artesian wells. The water is pumped to a pit located in the surplus materials storage area from which it is pumped to two firewater tanks (30,000 bbl and 7,000 bbl respectively).

There are no process (industrial) wastewaters arising from the Gas Plant. Industrial wastewaters arise from the Fleet Maintenance Workshop facility and can be summarised as follows:

- the vehicle washbay; and
- potentially oil contaminated runoff and floor washings from workshop areas.

The workshop areas drain to an open interceptor drain (covered with steel grating) which discharges to a sump, into which drainage from the washbay is also routed. Management reported that formerly this sump discharged under

gravity to the local municipal sewer system, resulting in non-compliance (BOD, COD, Total Suspended Solids and oil/grease) with respect to the site's industrial waste water discharges (as identified in the 2009 E2RC, Tabbin Institute report). However this industrial waste water stream is now periodically emptied by vacuum tanker and transferred by road to the municipal wastewater treatment works at Badrashin Town, Cairo.

5.1.4 *Dashour: Waste Disposal*

Both non-hazardous and hazardous waste arisings are generated at the Dashour asset. Solid waste streams (hazardous and non-hazardous), with the exception of general waste, have been stored at one location at Dashour between 1978 and the present, identified as the surplus material storage area and situated approximately 100m south of the fleet management area. Based on observations made during the September 2010 site visit, solid waste streams are segregated and clearly labelled as per the requirements of Law 4/1994, ER28. Stored waste streams consist of redundant 205l drums (owned by EGPC and awaiting collection by the supplier), end of life vehicles, waste electronic equipment, paint spray booth filter units, metal scrap and redundant equipment/plant. With the exception of waste drums, the surplus material storage area is situated on an unsealed sand surface, therefore the potential exists for surface water to cross-contaminate with hazardous waste streams (i.e. waste batteries) and leach to the subsurface.

It was also observed during the visit that a large number of end of life vehicles – ELVs - (including associated spare parts and batteries), owned by Egyptian General Petroleum Company (EGPC) were stored within a separated and fenced off area of the surplus material storage area. Vehicles had been stored in the same location since 1978 and management reported that there were no plans to remove this waste stream.

General Waste (i.e. office and food waste) is collected, on an as required basis, and disposed to the municipal landfill.

Liquid wastes (i.e. waste oil, oily sediment collected in the vehicle wash bay) are discharged via an in ground drainage system and are stored within two underground collection tanks, within the Fleet Management area. Liquid wastes are removed as required by an approved contractor for off-site disposal.

The Dashour asset maintains a valid permission, issued by EGPC, for storage of eleven hazardous wastes at Dashour as per the requirement under Law 4/1994, ER25 and ER26. A copy of the permission was observed by ERM during the September 2010 visit and was noted to be valid until 30th October 2012.

Naturally Occurring Radioactive Materials (NORM) is present within the underlying geology of the Western Desert, primarily at AG and WG33. As such drill pipe from these wells can be contaminated with low specific activity

(LSA) scale and is required to be managed as NORM contaminated scrap. The Dashour plant receives gas product from the AG concession area (refer to *Section 5.2* below). As a result, during pipeline repair work on the sections owned/managed by Dashour, potentially NORM impacted pipeline waste is generated. NORM impacted material is stored in a segregated and labelled location within the Dashour surplus material storage area, prior to categorisation by the Egyptian Atomic Energy Authority. Management reported that the agency visits the site every two years, or once a significant volume of material has been collected. Apache reported that there is currently no NORM stored at the site. Once tested and if confirmed as NORM waste, the material can then be transported to a locked, signed and enclosed NORM storage yard which is situated within the surplus material storage area. This waste then becomes the responsibility of the Agency. A copy of the most recent inspection report was observed by ERM during the September/October 2010 site visit and no non-compliances or significant improvement notices, or similar, were issued to the Dashour facility. ERM understands that the next EAEA inspection will be undertaken in late 2011 and that NORM impacted material is not expected to be identified.

5.1.5 *Dashour: Asbestos*

The Dashour Gas Plant asset was established in 1978, a period when asbestos containing materials were widely used in construction and in the process industries. Therefore the risk of asbestos containing material (ACM) being present at Dashour cannot be discounted.

Management reported that there is no asbestos containing lagging or insulation, or CAF gaskets present within the process plant. They did however report that ACM was present within the Fleet Maintenance Workshops portion of the Dashour site, in the form of building fabric materials. Although minor quantities of ACM were observed by ERM during the inspection (in the form of roofing materials, in good condition, at the exploration core sample store building) at the Fleet Management area, ACM (in building fabric) was not visually observed at the Gas Plant and none was reported present at this location by site management.

Site management reported that on two previous occasions, damaged ACM roofing material (estimated to be <250m² in total) had been removed from the exploration core sample store building and visitor car park shelter (both situated at the northeast east of the plant) and buried with sand directly north of the exploration core sample building. The removal activities were reported to have occurred in 2006 (core sample storage building) and 1995 (car park shelter).

This is acceptable under Egyptian regulations and there is no regulatory driver for excavation and removal unless the condition of the material deteriorates such as to present a hazard, or as part of ongoing remediation / refurbishment works.

5.1.6 *Dashour: PCBs*

A small number of transformer units are present at the Apache Fleet Management area, however no units were observed or reported to be present at the gas plant. The transformer units present onsite are oil filled but were reported by management to be free from PCBs. It was reported by management that a survey of the transformer units was previously undertaken (by GUPCO) and that those units containing PCB insulation oils, were drained and the oils were replaced with PCB-free insulation oil.

5.1.7 *Dashour: Ozone Depleting Substances*

In September 2010 sources of potentially ozone depleting refrigerant gases were limited to wall mounted A/C units at various administration buildings at the Dashour asset. Based on reports by management and spot checks by ERM, the main gas used in these units was R134a (HFC) and therefore non ozone depleting.

The Dashour facility historically operated a halon gas (ozone depleting potential) fire suppression system. In 2009 the facility undertook a system of halon identification, removal, storage and finally disposal to the 'Halon Bank' (Helwan Company) for official disposal. According to the Ministry of State for Environmental Affairs Decree No. 77/2000, halon sources must be disposed and replaced with non-halon containing gases prior to 1st January 2010. Although disposal documentation could not be located for review during the inspection, management reported that all halon sources were removed and disposed to the Halon Bank in 2009. At the time of the ERM visit, the facility was fitted with a 'water mist' fire suppression system, with water storage situated adjacent to and west of the surplus material storage area.

5.1.8 *Dashour: Contaminated Land, Groundwater and Surface Water*

The Dashour Gas Plant has been in operation since 1978, an operating period in excess of 30 years. The Dashour site also maintains a Fleet Maintenance Workshop area, which includes a paint-shop, vehicle wash and engine servicing. Areas of potential environmental contamination identified are summarised below:

- *Waste storage area* (surplus material storage area) has been used to store redundant vehicles, waste chemical containers, scrap metal and used drums. Vehicles and scrap metal are currently stored on open ground while drums and containers are provided with secondary containment and shelter.
- *Vehicle maintenance* has occurred on an industrial scale for the past 30 years. Oily water and vehicle wash water are directed to separate underground concrete storage tanks. The integrity of these tanks was not established during the ERM site visit.

- *Fuel Station*, owned and operated by *Misr* operates two 26,000litre underground fuel storage tanks (USTs), one for diesel and one for petrol. The condition and maintenance of these USTs that are situated within Apache's site boundary was also not established during the ERM site visit.

5.1.9 *Dashour: Operation of Bulk Storage Facilities*

Bulk storage at the site is limited to two 1090 tonne capacity LPG spheres (one on production duty, one on export) and a 150 tonne capacity bullet for off specification LPG destined for rework. A third 1090 tonne sphere is present but has been taken out of service (reportedly isolated with a slip plate) and held under nitrogen. The spheres are situated on a concrete kerbed area equipped with radar tank gauging.

Management confirmed that a major plant inspection was performed in 2007/8. Both the internal and external condition of all process vessels was reportedly found to be excellent (with fabrication markings still evident in some vessels apparently) reflecting the dry desert climate and sweet dry gas processed.

Other bulk storage of hazardous materials at the site is limited to several above ground diesel tanks serving the fire pumps, emergency generators and emergency instrument air compressor. These are provided with appropriate secondary containment.

The *Fuel Station*, owned and operated by *Misr*, is located within the Dashour site boundary. There are two 26,000 litre underground storage tanks, one for diesel and one for petrol.

5.1.10 *Dashour: Operation of Cross Country Pipelines*

Gas is supplied to the Dashour Gas Plant via a 262 km, 24" diameter export pipeline from AG. The line has a design pressure of 891 psi but a maximum allowable operating pressure (MAOP) of 680 psi is imposed due to ESD constraints. The line, which is buried for some of its length but is above ground for much of its length, was installed in 1973 and first operated in 1974. The line is tape wrapped, but is not provided with cathodic protection.

Reportedly there have been no failures or leaks on the line. An intelligent pigging inspection in 2003 identified some external deterioration due to corrosion (in areas of high groundwater), abrasion due to sand and thermal deformation. Identified defects were reportedly prioritised for staged repair in accordance with an ongoing repair programme.

5.1.11

Dashour: Environmental Regulation and Management

Environmental Regulation

The EEAA sets the legal framework for operations in Egypt. As discussed under *Section 4.3* above, the primary Law for the Environment, Law 4 was issued in 1994.

- Law 4/1994 imposes restrictions on: hazardous substances; hazardous and non-hazardous waste; emissions to air; waste water; and noise.
- Developments commissioned prior to this date are exempt from holding an environmental impact assessment (EIA) – as is the case for GUPCO assets at Dashour. However all major developments or significant extensions to facilities implemented after 1994 require an EIA.
- ER17 and 18 of Law 4/1994 require facilities to prepare and implement a self-monitoring plan. The plan, methodologies and results must be documented in the environmental register; each establishment must prepare and maintain an environmental register in which the following data shall be recorded:
 - emissions;
 - specifications of discharges after the treatment process, and the efficiency of the treatment units used;
 - follow-up and environmental safety procedures applied in the establishment;
 - periodical tests and measures and their results; and
 - the name of the person in charge of follow-up.

The facility operator is required to notify EEAA in writing, of any deviation in the criteria and specifications of emitted or discharged pollutants and the procedures taken to rectify such deviations.

The Egyptian Atomic Energy Authority (EAEA) is the regulatory authority for management and handling of Naturally Occurring Radioactive Material (NORM) contaminated equipment. Site management initially segregate equipment suspected of being impacted with NORM, while EAEA periodically visits the site to survey the equipment, classify it and remove all confirmed NORM waste. This practice is in line with EAEA recommendations

According to management, the EEAA had (as of September 2010) not undertaken any audits or inspections at Dashour and no improvement notices or enforcement actions had been imposed on Dashour site operations. ERM understands that the next EAEA inspection will be undertaken in late 2011 and that NORM impacted material is not expected to be identified.

Environmental Management

Apache inherited from GUPCO and continues to maintain an ISO14001 certified Environmental Management System (EMS). The EMS covers all

operations at Dashour Gas Plant. This was certified by DNV in 2006 and certification is valid through to 2011. Prior to Apache's acquisition, GUPCO operations also obtained certification to the occupational health and safety management system OHSAS18001 in 2006. This was last verified in August 2009 and is valid through to September 2012.

Environmental Monitoring

Energy & Environmental Research Centre (E2RC), an independent government consultancy falling under the Tabbin Institute for Metallurgical Studies (Tabbin), conduct annual monitoring for GUPCO at Dashour. A *Self-Monitoring Plan* (described above) is produced on an annual basis, reporting on water supply quality, waste water quality and monitoring of emissions to air. This is submitted annually to the Egyptian Environmental Affairs Agency (EEAA).

5.2 ENVIRONMENTAL PERFORMANCE OF EAST OF QATARA DEPRESSION WD ASSETS

5.2.1 EQD WD: General

Apache's East of Qatara Depression Western Desert (EQD WD) assets comprise principally the Abu el Gharadig (AR) and WD-33 oil fields which are located approximately 260 km due west of Dashour; the Razzak (RZK) concession (which comprises a grouping of four oil fields North RZK, West RZK, East RZK and Main RZK) and the El Alamein pump Station. As discussed in more detail under *Section 3.2.2* above:

- AG - Gas Plant and control room, Oil Separation Plant and control room, accommodation (Villas) and camp administration buildings; airfield; mechanic's building and associated workshop; chemical storage yard; refuelling station ; waste storage location (surplus material storage area); waste incineration pit (Abousaman Road), main bioremediation area (adjacent to surplus material storage area) and bioremediation area (SWAG 1).
- WD-33 - inclusive of the following:
 - WD33/1 redundant and non-operational facility including - oil separation plant and oil skimmer unit with unlined disposal pond (last operated in 2001), non-operational generation units; and three non-producing wells;
 - WD33/15 operational facility including - oil separation plant, skimmer unit and two ponds, generation units; bulk storage tanks (3 owned plus a further tank owned by 'Oasis'); associated gas ground flare;
 - operational well WD33/15 number 5; and
 - non-producing well WD33/15 number 4.
- RZK concession area, inclusive of the following:
 - North RZK field - including generation units, 12" line to Main RZK, 6" test line to Main RZK, high voltage room;

- West RZK field – including power plant (currently under construction), production manifold, generation units, 14” line to Main RZK and 6” test line to Main RZK;
 - East RZK field – including RZK15 well site, bulk storage tanks (3), generation units, redundant generation units; 12” line to Main RZK and transfer water line to El Alamein and Main RZK;
 - Main RZK – including waste storage location (surplus material storage area); oil separation plant and associated off-gas header and flare, power house, fire water pit, produced water treatment plant (two skimmer units and associated ponds), and RZK Lake.
- El Alamein Terminal – the Apache assets are limited to a shipping pump, two bulk storage tanks and biocide storage unit. The portion of the terminal occupied by Apache is leased from the government.

The EQD WD assets were purchased from BP/GUPCO in 2010. The observations of environmental performance discussed below are largely based on observations made by ERM when undertaking a due diligence review of the EQD WD assets in September 2010, immediately following Apache’s acquisition of these assets.

5.2.2 *EQD WD: Air Quality*

The principal point source emissions to atmosphere from EQD WD oilfield operations are associated principally with the central gathering and oil / gas processing plant. As such principal emission sources are as follows:

- AG – Gas Plant & Oil Processing Plant;
- WD 33 – Separators; and
- RZK – Oil Processing Plant.

Exhausts from diesel generators at certain well heads comprise a minor source. Hence the focus remains on the central gathering and processing facilities present at AG, RZK, and to a lesser extent, WD 33.

- At AG, major point source stack emissions have been identified as the five turbo-generators on the Gas Plant and the fired heaters on the Oil Processing Plant. Lesser sources are associated with generators and shipping pumps.
- At RZK the principal point source emission is the fired heater on the Oil Process. As per AG above, minor sources are generators at North RZK (4 of), East RZK (2 of) and West RZK (2 of) as well as at Main RZK (2 of). In addition there is a diesel fire water pump at Main RZK (mainly for emergency use only).
- There is a shipping pump at El Alamein which constitutes a minor source.

Limits established under the *Environmental Law 4/94, Executive Regulation 1741/2005* (see *Section 4.3.2* above) for combustion products (CO, SO₂, NO_x and total particulates) are applicable to all of these sources. Stack monitoring is

undertaken annually by the officially recognised Energy and Environmental Research Centre (E2RC) of the Tabbin Institute. Results from the most recent (October 2009) round of monitoring were reviewed by ERM in 2010 and it was confirmed that all sources were in compliance with the limits.

In addition to point source emissions, *Environmental Law 4/94* establishes concentration limits on certain pollutant gases and respirable particulates, in the vicinity of oil and gas processing plants. As such, limits are established for benzene, xylenes, toluene, methane, butane and methanol. Air samples taken in close proximity to specified plant items at the AG Gas Plant and Oil Process Plant, WD 33, RZK and El Alamein were analysed by E2RC as part of the annual environmental and occupational hygiene monitoring campaign referred to above, and it was confirmed that all were in compliance with the limits.

There is flaring from AG, RZK and WD33:

- At AG there is an elevated flare to take gas in excess of the capacity of the compressors on the gas plant. This is supplemented by a ground flare.
- At Main RZK there is an elevated flare to take the limited quantities of associated gas present with the produced oil.
- Flaring at WD33 is limited to a small ground flare.

As is typical for oil field flares in the Western Desert, these flares tend not to be clean burning; however, *Environmental Law 4/94* does not set specific emission limits for flaring.

5.2.3

EQD WD: Water and Wastewater Discharges

Potable Water

Potable water for the AG camp is obtained from deep wells (1000 ft) and treated by reverse osmosis (RO) prior to supply.

Potable water for the RZK camp is currently tankered in from Alexandria, however work is currently underway on a project to drill a water abstraction well and to install an RO plant and new potable water tank.

During the September 2010 site visit, management reported that there is a daily programme of chemical and microbiological testing for potable water systems at both camps. Annual third party sampling and testing is undertaken by E2RC. Results from the October 2009 monitoring undertaken by E2RC were reviewed by ERM and confirmed that the parameters to be analysed for potable water were in accordance with the *Environmental Law No 108/1995* concerning the permissible limits for potable water.

Sanitary Wastewater

Sanitary wastewater arising from the AG camp is routed to three septic tanks of concrete construction. Settled solids are periodically dug out from the

tanks and disposed by burial in the desert outside the camps, whilst the water phase is used for irrigation of trees and landscaping in the vicinity of the camp and the adjacent airfield.

Sanitary wastewater arising from the RZK camp is similarly discharged to septic tanks, however there is no reuse of liquid for irrigation purposes. Management reported that it is planned to upgrade the septic tanks at RZK, however details of when the upgrades are to be implemented or whether they have been incorporated into existing CAPEX plans have not been determined.

Industrial Wastewater

Industrial wastewater arising at both AG and RZK comprises produced water only.

- At AG, produced water arising from the Oil Processing Plant (reportedly approximately 1,500 bbl / day) is routed via a box skimmer to a plastic lined pond, equipped with a skimmer pump, prior to ultimate discharge in the desert. Oily water from the AG Gas Plant (essentially moisture removed in the KO drum and regeneration of the beds in the mole sieve drying package) is taken through the Oil Processing Plant.

There is recovery of oil phase from the pond back to the skimmer box inlet and recovery from the oil compartment of the skimmer box back through the oil separation process. The regulatory limit imposed on final discharge to the desert is 10 ppm oil in water. Management reported that discharge from the AG process is generally compliant with the 10 ppm limit, and this was confirmed by ERM's review of independent monitoring undertaken by E2RC during their then most recent (October 2009) monitoring visit.

- The RZK field is characterised by significantly higher rates (than those of AG) of water production. Currently the Main RZK Oil Processing Plant is sized to handle 17,500 bbl/day oil + 60,000 bbl / day water production with three separators, a heater and desalter. The current arrangements for produced water disposal comprise two box skimmers operating in parallel with disposal to two plastic lined ponds with oil skimmers, and ultimately to a large unlined evaporation impoundment (RZK lake). The regulatory limit imposed on discharge to the evaporation impoundment is 10 ppm oil in water. At the time of the ERM site visit, GUPCO (the operator at that time) was unable to meet this limit, with discharge consistently at approximately 15 - 25 ppm oil in water (as confirmed by a review of the then most recent E2RC monitoring dating from October 2009).

Going forward, produced water generation at RZK is anticipated to increase still further if a proposed water flood oil recovery enhancement scheme is implemented. In anticipation of this, a project has been underway to upgrade produced water disposal at RZK (the Produced Water Disposal Project) to handle 180,000 bbl / day. The project includes installation of new free water knock-out drum (FWKOD) within the oil process, provision of two additional box skimmers and lined ponds. The

new ponds will be larger than the existing ponds which in turn are also being re-sized. Ultimate disposal will still be to the existing “lake”. At the time of ERM’s 2010 visit, the works were observed to be nearing completion and only awaiting installation of pumps and other mechanical equipment. Apache have subsequently reported that the work is now completed. Management also reported that the regulator was comfortable with the actions being undertaken (and significant investment deployed) to bring oil concentrations in discharged produced water at RZK into compliance within the 10 ppm limit.

5.2.4 *EQD WD: Waste Disposal*

Both non-hazardous and hazardous waste streams are generated at the EQD WD assets. The sites collectively do not transfer any waste streams off-site for disposal to a third party operated landfill, treatment centre or transfer station.

From the time of start-up in the mid-seventies until 2008, solid waste and waste oil were stored at two locations, identified as surplus material storage area, at AG and RZK Main respectively. Although the AG surplus material storage area, situated west of the camp area and covering an area of approximately 2ha, has been largely sorted and material transported to the new surplus material storage area (refer below), a large quantity of 205l drums (owned by EGPC and awaiting collection by the supplier), waste metal and general scrap material remains across this area. According to management, RZK ceased disposal of waste streams at the RZK surplus material storage area in 2008, however the process of segregation and transportation to the new surplus material storage area had not been completed at the time of the ERM visit and large quantities of non-hazardous and hazardous waste streams remained present at the ‘historic’ surplus material storage area.

Between 2008 and 2010, two new surplus material storage area have been established where waste streams are now segregated and clearly labelled as per the requirements of Law 4/1994, ER28. However, it should be noted that the new surplus material storage areas (situated at RZK Main and AG) are situated on the surrounding unsealed surface, therefore the potential exists for surface water to cross-contaminate with hazardous waste arisings and leach to the subsurface.

The EQD WD assets maintain two burn pits, at AG and RZK respectively, for incineration of general and food wastes. Medical wastes are incinerated, as required, in small clinical waste incinerators located at the AG and RZK medical treatment centres.

No camp facilities are present at WD33 and El Alamein and none were reported to have historically existed, therefore significant waste generation and associated disposal activities were never undertaken at these two sites.

Apache’s joint venture maintains a valid permission, issued by EGPC, for storage of eleven hazardous wastes at AG, WD33 and RZK as per the

requirement under Law 4/1994, ER25, ER26. A copy of the permission was observed by ERM during the visit and was noted to be valid until 30th July 2012. The eleven hazardous waste streams are identified as:

- batteries containing lead;
- unsorted waste batteries potentially containing mercury, cadmium and nickel;
- waste electrical equipment;
- waste mineral oils unfit for further use;
- waste organic phosphorous compounds;
- waste non-halogenated organic solvents;
- waste halogenated organic solvents;
- waste oil;
- waste acidic or alkaline liquids;
- drilling mud cuttings; and
- NORM waste material.

Naturally Occurring Radioactive Material (NORM) is naturally present within the underlying geology of the Western Desert, primarily at AG and WG33. NORM waste is managed centrally at the AG field, with potential NORM impacted material (i.e. pipelines, sludge from tanks, etc) stored in a segregated and labelled location adjacent to the old surplus material storage area, prior to categorisation by the Egyptian Atomic Energy Authority (EAEA).

Management reported that the Agency visits the site every two years, or once a significant volume of material has been collected. Once tested and confirmed as NORM waste, the material is then transported to a locked, signed and enclosed NORM storage yard which is situated west of the AG site and adjacent to the new surplus material storage area. This waste then becomes the responsibility of the Agency. A copy of the most recent inspection report was observed by ERM during the 2010 site visit and no non-compliances or significant improvement notices, or similar, were issued to the AG facility. It should be noted that NORM is not present in the RZK concession area.

5.2.5 *EQD WD: Asbestos*

The EQD WD assets were established in the 1970s, a period when asbestos containing materials (ACMs) were widely used in construction and in the process industries. Therefore the presence of ACM at any of the EQD WD assets would not be unexpected.

No ACM was reported to exist within the infrastructure facilities present at WD33 and none were observed by ERM during the site visit.

No ACM was reported to exist within the infrastructure and camp facilities at the RZK fields and none were observed by ERM during the site visit. However, based on the age of the camp's Villas (2) and a visual inspection of the construction materials, it should be noted that the risk of ACM being present within their construction materials (i.e. internal walls, vinyl flooring,

internal backing behind 'wet areas' and/or insulation materials) cannot be discounted.

Management reported that ACM was present within the camp facility at the AG asset. An asbestos survey was undertaken at AG in December 2009, covering the camp, oil processing plant and gas processing plant only (i.e. drilling activities/locations were not covered). According to a review of the survey ACM was identified in the following locations:

- carpentry workshop (120m²) – good condition;
- support services workshop (32m²) – good condition;
- support services store (140²) – good condition;
- recreation/sport hall building (480²) – approximately 4m² was noted in poor condition;
- recreation/sport hall building (320m²) – good condition;
- oil processing plant, old shipping pump house (36m²) – good condition;
- maintenance building, slings store area of transport garage (100m²) – good condition; and
- gas processing plant, power plant house (140m²) – good condition.

The above mentioned ACM sources were all observed to be in the form of asbestos cement sheeting. Management reported that damaged ACM at the sport hall was removed in 2010 and disposed to the hazardous storage area of the new segregated surplus material storage area.

This is acceptable under Egyptian regulations and there is no regulatory driver for removal unless the condition of the material deteriorates such as to present a hazard, or as part of ongoing remediation / refurbishment works.

5.2.6 EQD WD: PCBs

A large number of transformer units are present at each of the EQD WD assets. The transformer units were reported by management to utilise a mineral oil which is free of PCBs. It was reported by management that a survey of the transformer units was undertaken in 2000 for PCB containing insulation oils; those transformers identified as containing PCB oil were reported to have had the oils removed, disposed and replaced with mineral oils.

The Site maintains a valid permission, issued by EGPC and CEAA (Regulator), for storage of eleven hazardous wastes, including PCBs, as per the requirement under Law 4/1994, ER25, ER26. A copy of the permission was observed by ERM during the visit and was noted to be valid until 30th July 2012.

5.2.7 EQD WD: Ozone Depleting Substances

In September 2010, sources of potentially ozone depleting refrigerant gases were limited to wall mounted A/C units at various administration and accommodation buildings at AG, WD33 or RZK. Based on reports by

management and spot checks by ERM during the visit, the main gas used in these units was R134a (HFC) and therefore non ozone depleting.

The gas separation plant at AG historically operated a halon gas (ozone depleting potential) fire suppression system, involving 75 halon containing cylinders that were associated with the gas plant turbine packages (total of 4,500kg) and 20 portable halon extinguishers (total of 40kg). Between 2008 and 2009 the AG facility undertook a system of halon identification, removal, storage and finally disposal to the 'Halon Bank' (Helwan Company) for official disposal. According to the Ministry of State for Environmental Affairs Decree No. 77/2000, halon sources needed to be disposed and replaced with non-halon containing gases prior to 1st January 2010. According to documentation made available to ERM during the visit, all halon sources at AG were removed and disposed to the Halon Bank by 5th June 2009, therefore demonstrating compliance with the Ministerial Decree 77/2000.

Halon fire suppression systems are not present at WD33 or RZK, nor were they reported to have previously existed.

5.2.8 *EQD WD: Potential for Contaminated Land, Groundwater and Surface Water*

The EQD WD oil fields (AG, RZK and WD33) have been in operation since the mid-1970s with wells having been installed over the past 40 years.

In common with oil fields of this age, areas of potential environmental contamination include the following:

- well locations;
- mud pits;
- associated oily water ponds;
- underground bulk fuel (petrol and diesel) storage at RZK;
- bulk storage of hydrocarbons (bunds of earth construction and unsurfaced floors) around tankage; and
- identified historical and current hydrocarbon losses.

Hydrocarbon losses are reported on an 'as and when' basis and these are recorded. Reports include the time, location, source and action required to remediate the incident. The 2010 records inspected by ERM indicated no significant concerns. Losses in 2010 resulted from internal corrosion of flow lines, seepage on the well head, external corrosion of tanks and decommissioning of bulk storage tanks.

Hydrocarbon losses are reported and tracked and repairs are documented for AG, RZK and WD33. The date of repair and follow-up inspection are recorded.

Based on visual observations made by ERM in 2010 and discussions with management, the flow lines are in good condition and where these have suffered corrosion they are isolated and replaced. Where there are releases of

hydrocarbons these are covered with sand until they can be collected and transported to one of the bioremediation cells located at AG and RZK respectively.

Historically (prior to Apache's acquisition) at AG, RZK and WD33, drilling muds were oil based and were placed within unlined pits adjacent to each well head. In 2006 (again prior to Apache's acquisition) GUPCO commenced a bioremediation project and contracted to United Environmental, to remediate all former well locations. The oil based muds (once the water phase had evaporated) from the three fields, were excavated and transported to a number of bio-remediation cells located at both AG and RZK. Management reported that all historical well locations have been remediated and that to date, 54,000 tonnes of oil based mud is contained within the above mentioned bio-cells.

It should be noted that bioremediation of the produced water pond (approximately 800m²), for storage of separated water post skimmer treatment, at the WD33/1 field has not been remediated under the above mentioned contract.

In September 2010, AG, RZK, and WD33 all used water based drilling muds. Therefore water based drilling muds are stored adjacent to well head locations within lined pits. Once the water phase has evaporated, the lining material is removed and the pits are backfilled to return to approximately pre-drilling condition. Any minor quantities of oil remaining on the mud surface, is taken to the bioremediation storage areas.

5.2.9

EQD WD: Operation of Bulk Storage Facilities

Apache maintains a number of above ground bulk storage tanks associated with intermediate storage of production from the three fields, AG, RZK and WD33 as detailed below:

- *AG Oil Separation Plant*
 - 2 x 30,000 barrel (bbl - 1 under repair at the time of the visit); and
 - 1 x 10,000 bbl.

- *WD33/1*
 - 5 x 1,500 bbl (redundant); and
 - 2,000 bbl (redundant).

- *WD33/15*
 - 3 x 2,000 bbl (2 redundant);
 - 2 x 2,000 bbl (being installed as replacements);
 - 1 x 3,000 bbl (owned and operated by neighbouring oil company Oasis).

- *Main RZK*
 - 2 x 35,000 bbl.

- *East RZK*
 - 3 x 5,000 bbl.
- *West RZK*
 - 4 x bulk ASTS (capacity unknown).
- *El Alamein*
 - 1 x 30,000 bbl; and
 - 1 x 100,000 bbl.

The bulk storage tanks date back to the commencement of operations in the 1970s and are generally in adequate to good condition. Bulk storage tanks at AG are situated within a concrete bund, however bulk tanks at RZK and WD33 are situated within earth bunds only. Tank gauging is undertaken by manual dipping and reconciliation. Slops are routed to the produced water treatment system. There are certain redundant tanks at WD33/1, WD33/15 and West RZK.

5.2.10 *EQD WD: Operation of Cross Country Pipelines*

Apache's EQD WD assets operate both trunk export lines to El Alamein and Dashour and also local flow lines and gathering networks (i.e. situated within each field area). Internal flow lines are constructed from plastic High Density Polyethylene (HDPE). Management reported that no major breaches of integrity with respect to internal flow lines and export lines had occurred over the previous three years.

5.2.11 *EQD WD: Environmental Regulation and Management*

5.2.11.1 *Environmental Regulation*

The EEAA sets the legal framework for operations in Egypt. As discussed under *Section 4.3* above, the primary Law for the Environment, Law 4 was issued in 1994.

- Law 4/1994 imposes restrictions on: hazardous substances; hazardous and non-hazardous waste; emissions to air; waste water; and noise.
- Developments commissioned prior to 1994 are exempt from holding an environmental impact assessment (EIA) – as is the case for the primary EQD WD assets. However all major developments or significant extensions to facilities implemented after 1994 require an EIA. In this regard, Apache are required to develop an EIA for each new drill site and field development project. By way of example, ERM was provided with a copy of an EIA for the RZK-45 Injection Well, prepared by Petroleum Safety & Environmental Services Company (Petrosafe) in May 2010. This EIA has been approved by EEAA. In addition, site management reported that EIAs have been developed for all well sites and construction of assets installed post 1994.

- ER17 and 18 of Law 4/1994 require facilities to prepare and implement a self-monitoring plan. The plan, methodologies and results must be documented in the environmental register; each establishment must prepare and maintain an environmental register in which the following data shall be recorded:
 - emissions;
 - specifications of discharges after the treatment process, and the efficiency of the treatment units used;
 - follow-up and environmental safety procedures applied in the establishment;
 - periodical tests and measures and their results; and
 - the name of the person in charge of follow-up.
- The facility operator is required to notify EEAA in writing, of any deviation in the criteria and specifications of emitted or discharged pollutants and the procedures taken to rectify such deviations.

The Egyptian Atomic Energy Authority (EAEA) is the regulatory authority for management and handling of Naturally Occurring Radioactive Material (NORM) contaminated equipment. Site management at AG and WD33 initially segregate drill pipe and equipment suspected of being impacted with NORM (RZK, owing to its local geology, typically does not generate NORM waste) while EAEA periodically visits the site to survey the equipment, classify it and remove all confirmed NORM waste. This practice is in line with EAEA recommendations.

According to management, the EAEA had (as of August/September 2010) last visited the fields in August 2010 and no improvement notices or enforcement actions had been imposed on site operations at these assets.

5.2.11.2 *Environmental Management*

Apache inherited from GUPCO, and continues to maintain, an ISO14001 certified Environmental Management System (EMS). The EMS covers all operations at AG, WD33 and RZK. This was certified by DNV in 2001 and a recertification audit was completed in June 2010. Prior to Apache's acquisition, GUPCO operations also obtained certification to the occupational health and safety management system OHSAS18001 in 2005. This was last verified in October 2009 and is valid through to September 2012.

5.2.11.3 *Environmental Monitoring*

Energy & Environmental Research Centre (E2RC), an independent government consultancy falling under the Tabbin Institute for Metallurgical Studies (Tabbin), conduct annual monitoring for Apache at both AG and RZK (WD33 operations do not generate significant emissions and are therefore not included in the monitoring programme). Two Self-monitoring Plans are produced on an annual basis, one reporting on water and waste water quality

and the other reporting the monitoring of emissions to air. These are submitted annually to the Egyptian Environmental Affairs Agency (EEAA).

5.3 GREENHOUSE GAS EMISSIONS

Apache provided the following data on Greenhouse Gas (GHG) emissions to ERM in January 2012:

'Apache acquired Abu Gharadiq, Razzak & Dashour properties from BP in the 4th quarter of 2010. The calculated GHG emissions of all fields for the 4th Q of 2010 is 110,686 tonnes CO₂e (see Table 5.1 below). Accordingly, the estimated amount of GHG emissions in 2011 is 442,744 tonnes CO₂e.'

Table 5.1 Sources of Greenhouse Gas Emissions for Apache Egypt Companies 2010

Activity	Tonnes CO ₂ -e
Gas Treatment (CO ₂ removal) plus Production Flaring	24,540
Combustion	50,626
Crude oil produced water flash gas	8,440
Fugitive emissions and venting	22,190
Crude oil handling and transportation	4,889
Dehydration and venting	1
TOTAL	110,686

Note: Apache Egypt GHG total emissions in 2010 didn't include the GHG emissions for the newly acquired Abu Gharadiq, Razzak & Dashour properties.

5.4 ENVIRONMENTAL MONITORING AND COMPLIANCE IN 2011

5.4.1 Introduction

ERM has been provided a copy of Apache's 2011 Annual Self-Monitoring Report (dated January 2012) which includes the report *Environmental Measurements of Khalda Petroleum Company (Field/District Operations) – December 2011* produced by the Energy and Environment Research Centre (E2RC) of the Tabbin Institute for Metallurgical Studies (TIMS); the report is based on measurement made at facilities of the Khalda Petroleum Company (including the former BP/GUPCO assets ie AG, Razzak, WD33, Al Alamein and Dashour) during 2011. The Apache Self-Monitoring Report also includes observations made by the Egyptian Atomic Energy Authority (AEA) while undertaking radiation surveys of certain Apache assets.

5.4.2 Scope of Monitoring Reported

The E2RC report (which forms part of the Apache Environmental Self-Monitoring Report) presents the results of measurements of various emissions, ambient environmental concentrations and other occupational health and hygiene related parameters including those described as:

- Air quality parameters:
 - total suspended particulates (TSP);
 - respirable particulates (PM₁₀);
 - gaseous air pollutants (SO₂, CO, CO₂, total hydrocarbons (as methane - CH₄) xylene, toluene, butane, propane and methanol).
- Certain other occupational health parameters, such as noise intensity, light intensity, heat stress and indoor work space ventilation.
- Exhaust stack emissions.
- Vehicle exhaust emissions.

The E2RC Report also presents the results of certain manual grab spot samples of water and effluent streams. Of particular relevance to this baseline review of the former BP/GUPCO assets are the following:

- Samples taken of produced water discharged to the AG and Razzak oilfield evaporation ponds. For each of these two fields, samples were taken on 28 October 2011 of the produced water discharge before and after the skimmer at the inlet to the evaporation pond in each field.
- Single spot samples were also taken (on the same day) of the treated sanitary effluent discharge from the septic tanks in each of these two fields (AG and Razzak).

5.4.3 *Results of Data Review*

From a review of the Apache Environmental Self-Monitoring Report ERM is able to make certain observations.

5.4.3.1 *Ambient Air, Stack Emissions and Occupational Hygiene*

We note the following conclusions reached by E2RC regarding the Khalda Petroleum Company assets that we quote verbatim from the E2RC report (which forms the substantial part of Apache's Environmental Self-Monitoring Report).

- *"Measurements of air contaminates (TSP, PM10, some heavy metals, Pollutant gases, Heat stress, and Noise), light intensity, exhaust stack emissions and emissions due to flares were conducted at oil and gas production fields ABU ELGHRADEEK, RAZAK, SALAM, UMBARKA, South UMBARKA, KALABSHA, TAREK, QASR, Northern Gas Compression Station, OBAYIED Tie- in Gas Facility and AKIK Field."*
- *"Most of results showed that air quality in residential and work places area (Process and administration area) and exhaust stack emission are within the permissible limit according to Egyptian Environment Laws 04/1994 and its modification Oct. 2005."*

- “The exception parameters exceed the permissible limit are noise level measurements in some places.”

The sampling methods and results in the E2RC report are not always presented in sufficient detail or clarity to enable ERM to conclusively and consistently attribute all individual recorded measurements to specific plant items or to determine whether all the E2RC measurement/sampling/analytical methods, QA/QC procedures and calibration techniques are in all instances appropriate for ascertaining compliance with the applicable regulations and standards. We are however, able to make the following observations.

- E2RC’s analysis of pollutant gases (CO, CO₂, SO₂, xylene, methane, toluene, butane and propane), respirable particulates and (in the case of Dashour) total suspended particulates refers to occupational exposures as regulated under Annex 8 of Law No 4 and its subsequent amendments and regulations, rather ambient air quality as regulated under Annex 5 of the same law (see *Section 4.2.2 Table 4.1* above).
- In the case of Razzak, the total suspended particulates sampling does however appear to have been sampled according to (and the result is in compliance with) ambient air quality standards set out in Annex 5.
- With regard to stack gas sampling, 10 stacks were sampled in Dashour, five in Razzak process area, four in North Razzak, one in East Razzak, three in West Razzak and one at Al Alamein pump station. All stack emissions are reported to be in compliance with the emission limits defined under Table 5 of Annex 6 of Egyptian Law No 4 and its subsequent amendments and regulations.

Our review of the results presented in the E2RC report has therefore not identified any reason for us to challenge the conclusions reached by E2RC (as quoted above), other than our observation that while fairly wide-ranging sampling has been performed to ascertain compliance with occupational hygiene and stack emission limits, only very limited sampling appears to have been undertaken with respect to ambient air quality as mandated under Annex 5 of Law No 4 (see *Table 4.1* above). In addition it appears no sampling has been carried out to demonstrate compliance with the requirements of Annex 7 (Table 4) of Law 4 of 1994, “*Maximum Limits of Noise Intensity in Different Areas*” (see *Table 4.11* above), although Apache reported that no sensitive receptors are located within a distance from the perimeter of their facilities that are likely to be impacted by the noise levels from their operations, and hence lead to a non-compliance with Law 4..

5.4.3.2 *Produced Water Discharges*

The E2RC conclusion statement makes no reference to the produced water samples that were taken at the AG and Razzak field facilities on 28 October 2011 (see *Section 5.4.2* above). We comment as follows:

- As discussed in *Section 5.2.3*, produced water from the Razzak and AG fields is routed to an in-field evaporation pond fitted with an oil skimmer prior to discharge to the desert. In terms of produced water discharge standards, none of the Egyptian regulatory standards quoted in *Section 4.2.3* above refer to treated produced water discharged to land. However, ERM was informed by GUPCO personnel during our October 2010 site visit that the effluent discharge from the evaporation ponds in the two fields is subject to a regulatory limit of 10mg/l oil in water (see *Section 5.2.3*). This limit is consistent with the 10 ppm oil and grease limit established under Decree 402/209 for discharges to inland waters not used for potable supply (see *Table 4.5*) and the 10 ppm oil and grease guideline for discharge of produced water to surface water or to land established under the World Bank Group (WBG) industry specific guidelines for Onshore Oil & Gas Developments (see *Table 4.15*).
- Grab sampling on 28 October 2011 by E2RC of produced water in the evaporation ponds at the outlet of the oil skimmer in Razzak and AG fields indicated oil and grease levels of 8 ppm and 7 ppm respectively, thereby inferring compliance with the regulatory standard (and equivalent WBG guideline value), as per tabulated summary below.
- While the BOD, COD and TSS levels of both (Razzak and AG) discharges exceed the equivalent WBG guideline values, we note that the concentrations of these parameters in the influent produced water are at the high end of the range normally found in produced water and that the analysis of samples upstream and downstream of the skimmer indicates a significant reduction in the value of these parameters as a result of primary treatment. Further, it is our understanding that these parameters are not regulated by the Egyptian authorities.

Determinend (all ppm)	Egyptian Regulatory Limit	WBG Guideline Value	Razzak Produced Water prior to Oil Skimmer	Razzak Produced Water after Oil Skimmer (prior to discharge)	AG Produced Water prior to Oil Skimmer	AG Produced Water after Oil Skimmer (prior to discharge)
Oil & Grease	10 mg/l	10 mg/l	60	8	45	7
pH		6-9	6.7	6.6	6.43	6.6
BOD		25 mg/l	1806	840	1400	810
COD		125 mg/l	5022	2232	3906	1116
TSS		35 mg/l	120	70	130	60
Chlorides ave		600 mg/l	Not measured	not measured	Not measured	Not measured
Chlorides max		1200 mg/l	Not measured	Not measured	Not measured	Not measured
Phenols		0.5 mg/l	UD	UD	UD	UD
Sulphides		1 mg/l	UD	UD	UD	UD
Hvy Metals		5 mg/l	0.9	0.5	1.2	0.4

Note: UD = Under Detection Limit

5.4.3.3

Sanitary Effluent Discharges

The E2RC conclusion statement makes no reference to the treated sanitary effluent samples that were taken at the AG and Razzak field facilities on 28 October 2011 (see *Section 5.4.2* above). We comment as follows:

- As discussed in *Section 5.2.3*, sanitary waste water from the Razzak and AG fields is routed to in-field septic tanks. The treated liquid effluent is used to irrigate trees and for landscaping in the Razzak camp, whereas at AG it is routed directly to the desert floor. These discharges are therefore subject to the provisions of Egyptian Decree 44 of 2000 as described in *Section 4.2.3.4* and the limits in *Table 4.7* apply. The WBG industry specific guidelines for Onshore Oil & Gas Developments (see *Table 4.15*) defer to the equivalent WBG EHS guidelines for discharges of sanitary effluent (see *Table 4.14*), but these are intended to apply to discharges to surface waters and there are no equivalent WBG guidelines for discharges to irrigation and land in an isolated desert environment (such as that at Razzak and AG).
- As per tabulated summary below, grab sampling on 28 October 2011 by E2RC of treated sanitary water discharges from the septic tanks in Razzak and AG camps indicated full compliance with Egyptian Decree 2000/44 for the parameters undertaken (no analysis is presented for Nematode Cells count).

Item	Egyptian Decree 2000/44	Razzak Treated Effluent	AG Treated Effluent
BOD	300 ppm	90	35
COD	600 ppm	225	89
TSS	350 ppm	70	90
TDS	2500 ppm	1069	899
Nematode No	5 per l	Not determined	Not determined
Chlorides	350 ppm	155	298
Boron	5 ppm	UD	UD
Cadmium	0.05 ppm	UD	UD
Lead	10 ppm	UD	UD
Nickel	0.5 ppm	UD	0.02
Manganese	0.2 ppm	0.1	0.03

Note: UD = Under Detection Limit

5.4.3.4

Radiation Surveys

The E2RC conclusion statement also makes no reference to the radiation surveys undertaken by the Atomic Energy Authority (AEA) of selected locations, including the Razzak field, in October 2011. Although the presentation of results of the surveys in the AEA Report is such that ERM is unable to attribute all survey findings to particular plant and facilities or to ascertain the completeness of the surveys undertaken, the results that are presented in the report do imply that radiation levels were in each case “normal”.

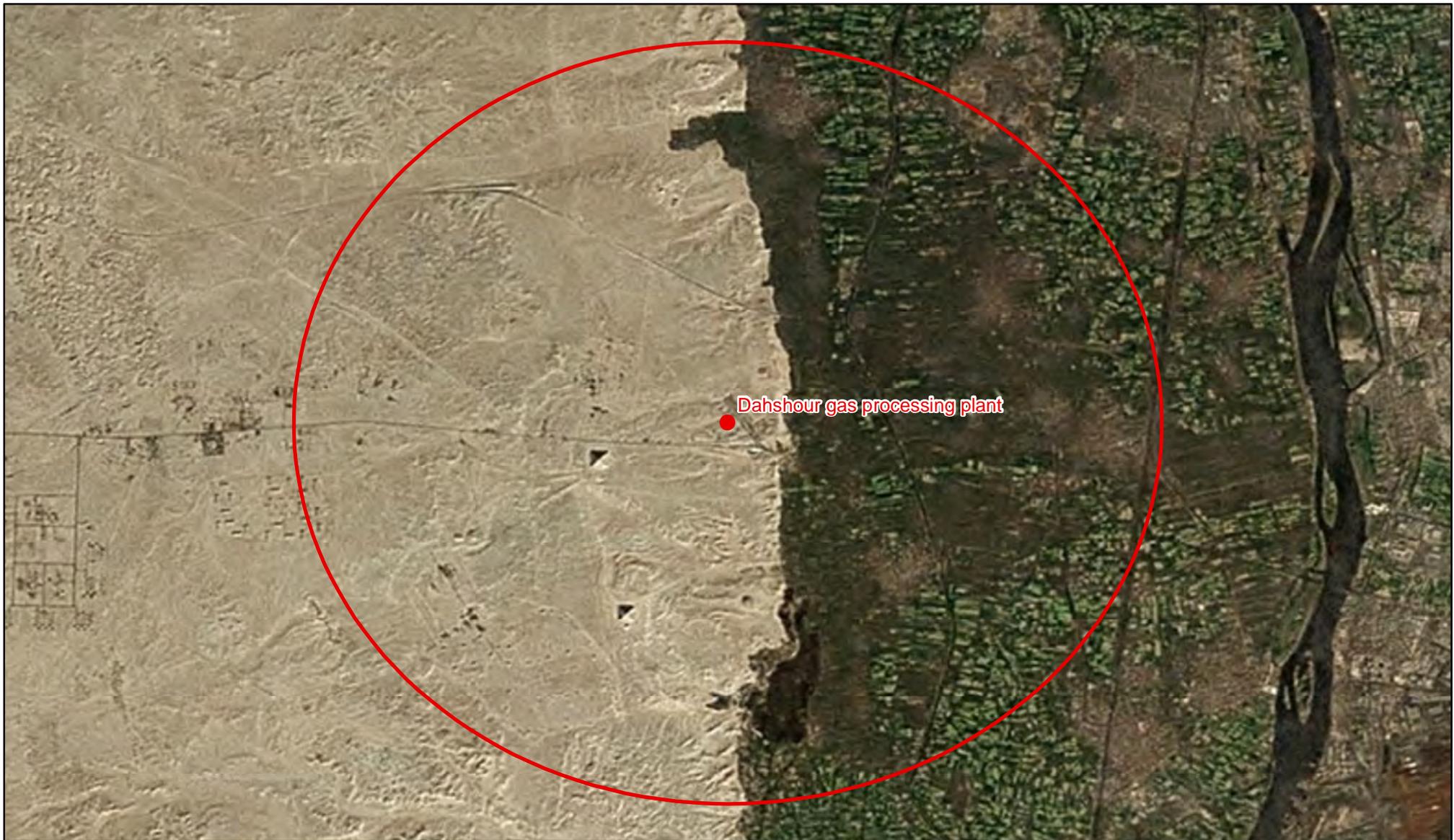
Based on our review of results of spot sampling surveys undertaken in 2011, the indication is that the former GUPCO facilities purchased by Apache in 2010 remain in broad regulatory compliance across the board with respect to the occupational health environment, stack emissions, vehicular emissions, treated produced water and sanitary effluent discharges, other than in certain limited cases where workplace noise levels exceed the regulatory limits.

While the produced water sampled downstream of the oil skimmer in the evaporation ponds in both Razzak and AG fields meets the regulatory standard of 10 ppm oil & grease, the levels of BOD, COD and TSS exceed the relevant WBG guideline values. This is primarily a result of a particularly high naturally occurring BOD, COD and TSS content in the incoming produced water in these fields; the reduction achieved across the skimmer reflects close to the upper end of what is expected to be achieved via primary treatment in an evaporation pond. We note also that the WBG guideline does not distinguish between discharges to surface waters or to land; in this instance the discharge is to a land area that is remote from any surface water or identified ground water abstraction and we understand that this regime has been the established practice since commissioning of these facilities.

The extent of ambient air quality sampling and noise sampling at or beyond the boundary fence is insufficient to demonstrate full compliance with either the applicable regulatory or WBG standards. However, given that the results of stack emissions sampling indicates broad compliance across all facilities and given the relative absence of sensitive receptors (or significant offsite emission sources) due to the remote location of all facilities (even in the case of Dashour), it is unlikely that ambient air quality is of significant concern with respect to the Apache facilities. Similarly it is unlikely that Apache's activities are giving rise to significant off-site noise impacts. Nevertheless, Apache may wish to consider expanding their self-monitoring programme in 2012 to confirm their compliance in regard to these two aspects of their operations.

Annex A

Site Facility Location



- KEY:
- Facilities
 - 5km buffer



CLIENT:
Apache Egypt Companies

SIZE:
A4

TITLE:
Figure A.1
Dahshour Gas Processing Plant

ERM
Eaton House
Wallbrook Court
North Hinksey Lane
Oxford OX2 0QS
Telephone: 01865 384800
Facsimile: 01865 204982

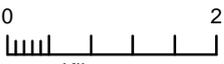


DATE: 21/11/2011	CHECKED: TGF	PROJECT: 0143887
DRAWN: JL	APPROVED: DMI	SCALE: As Scale Bar

SOURCE: Bing Maps Aerial
PROJECTION: GCS WGS 1984

DRAWING: Dahshour_GasPlant.mxd	REV: 0
-----------------------------------	-----------



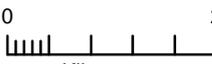
KEY:  Facilities  5km buffer	  Kilometres	CLIENT: Apache Egypt Companies	SIZE: A4	TITLE: Figure A.2 Abu Gharadig Base (South)	
				DATE: 21/11/2011 DRAWN: JL	CHECKED: TGF APPROVED: DMI
SOURCE: Bing Maps Aerial PROJECTION: GCS WGS 1984			DRAWING: AbuGharadig_Base.mxd		REV: 0

File: 0143887_ApacheEGPT/GIS_JL_TGR/Mapes/AbuGharadig_Base.mxd

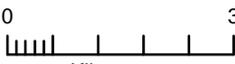


KEY:  Facilities  5km buffer	  Kilometres	CLIENT: Apache Egypt Companies	SIZE: A4	TITLE: Figure A.3 Razzak Field Base	
				DATE: 21/11/2011 CHECKED: TGF PROJECT: 0143887	
SOURCE: Bing Maps Aerial PROJECTION: GCS WGS 1984			DRAWN: JL APPROVED: DMI SCALE: As Scale Bar	DRAWING: Razzak_FieldBase.mxd	
					REV: 0



KEY:  Facilities  5km buffer	  Kilometres	CLIENT: Apache Egypt Companies	SIZE: A4	TITLE: Figure A.4 WD33	
				DATE: 21/11/2011 DRAWN: JL	CHECKED: TGF APPROVED: DMI
SOURCE: Bing Maps Aerial PROJECTION: GCS WGS 1984			DRAWING: WD33.mxd		REV: 0



KEY:  Facilities  5km buffer	  Kilometres	CLIENT: Apache Egypt Companies	SIZE: A4	TITLE: Figure A.5 El Alamein Pumping Station	
				DATE: 15/12/2011 CHECKED: TGF PROJECT: 0143887	
SOURCE: Bing Maps Aerial PROJECTION: GCS WGS 1984			DRAWN: JL APPROVED: DMI SCALE: As Scale Bar	DRAWING: ElAlamein_PumpingStation.mxd REV: 0	

**ERM has 130 offices
across the following
countries worldwide**

Argentina	The Netherlands
Australia	New Zealand
Belgium	Panama
Brazil	Peru
Canada	Poland
China	Portugal
Colombia	Puerto Rico
France	Romania
Germany	Russia
Hong Kong	Singapore
Hungary	South Africa
India	Spain
Indonesia	Sweden
Ireland	Taiwan
Italy	Thailand
Japan	United Arab Emirates
Kazakhstan	UK
Korea	US
Malaysia	Vietnam
Mexico	

ERM's Oxford Office

Eaton House
Wallbrook House
North Hinksey Lane
Oxford
OX2 0QS
UK

T: +44(0)1865 384800
F: +44(0)1865 384848

www.erm.com