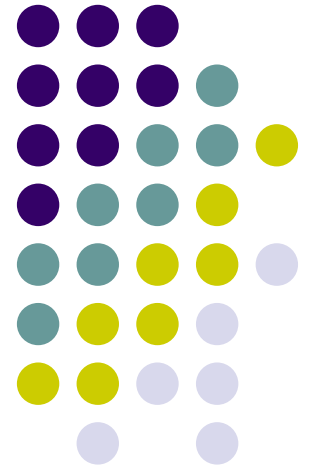
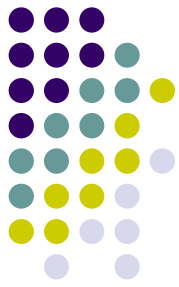


Risk Assessment Based Environmental Management Systems for Petroleum Retail Stores

**NATO/CCMS Pilot Study
Prevention and Remediation In Selected
Industrial Sectors: Small Sites in Urban Areas**

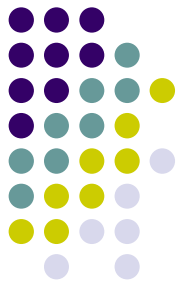
Prof. Cem B. Avci
Bosphorus University
Civil Engineering Department
Istanbul Turkey





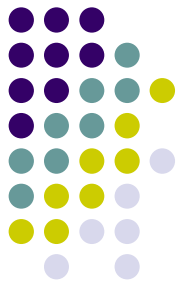
GASOLINE RETAIL STORE SECTOR

- 10,000 Retail Stores
- Multinationals (BP, Shell, Total %15)
- 45,000 Underground Storage Tanks
- Mature Sector
- Privately Owned Licenses (95%)
- Standards for Retail Store Construction & Operations Upgraded in 2005
- Low Focus of Public Authority for Environmental Concerns
- Urban Settings
 - Concern for Safety
 - Challenges for Remediation (expensive-effectiveness)



ENVIRONMENTAL MANAGEMENT SYSTEMS

- Environmental Management System (EMS): planning tool that may prevent unacceptable operational risks associated with the activities undertaken.
- Risk management tool in Petroleum Retail Stores with “prevention is better than cure” philosophy
- Enhancement to existing environmental protections and planning presently implemented at the retail sites.
- Flexibility taking into account specific industry initiatives as well as site conditions ensuring that company based minimum environmental considerations could be integrated into business decisions in a systematic way.



POLICY

Environmental Policy is the basis for the EMS implementation and the approach to environmental performance:

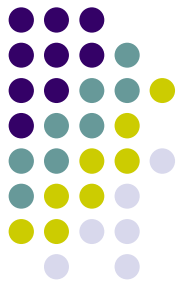
- To conduct activities in manner that is environmentally responsible with the aspiration of “no damage to the environment”.
- Seek to drive down the environmental impact of its operations by reducing waste, emissions and discharges and by using energy efficiently.



OBJECTIVES

Policy forms the framework of the Environmental Objectives. Likely objectives would be:

- Compliance with all local environmental laws, regulations and site specific conditions of authorization, together with the setting of self-imposed responsible standards to achieve higher standards
- Continuous control, assessment and review of environmental risks associated with all performances and subsequent improvements
- Continuously improve the environmental awareness of employees, contractors and customers
- Reduce waste, emissions and discharges and improve efficiency of natural resources and energy usage.

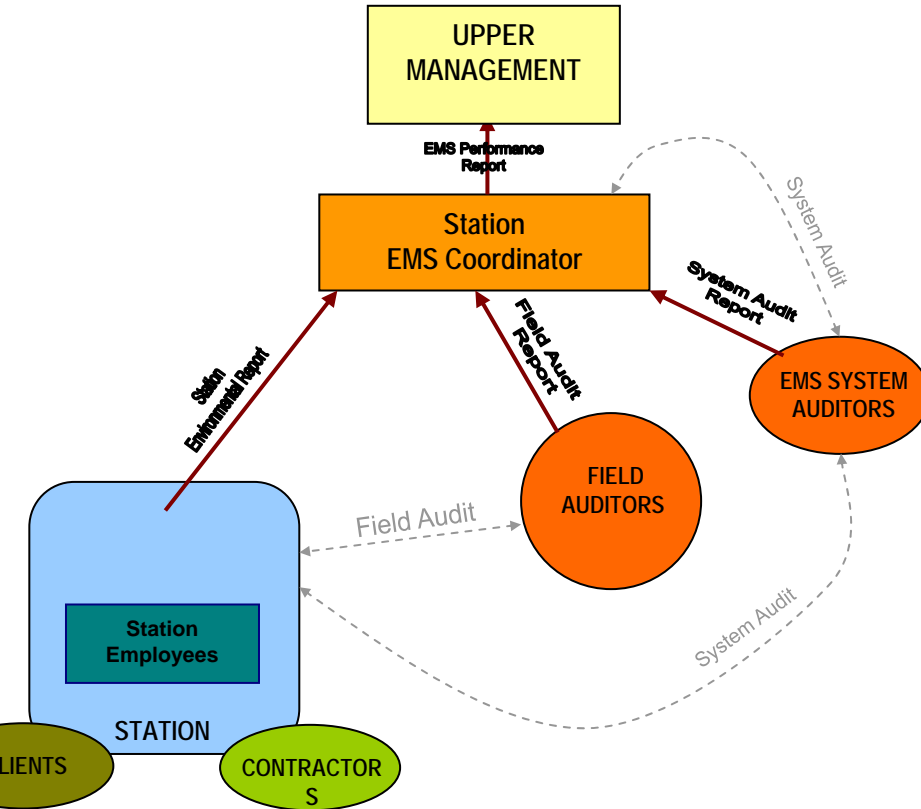
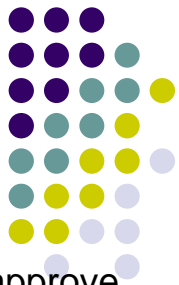


TARGETS

Environmental Targets identified to achieve the environmental objectives. Actions should be taken and subsequently followed up, assessed to achieve these targets. Likely targets would be:

- Prevent unacceptable environmental risks associated with operational facilities
- Minimize unwanted events
- Complete actions related to environmental risk prevention in time
- Complete the planned maintenance and training in time
- Maintain costs for energy for every 1000 liters of product below _____
- Maintain water usage for every 1000 liters of product sold below _____

ORGANIZATION



Retail Upper Management: Identify and approve the Environmental Policy and Objectives.

Retail Stations EMS Coordinator Keep risk assessments up-to-date. Compare the risk-control mechanisms for the station Responsible for starting and following up actions. Plan and implement six month station field audits.

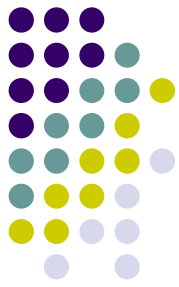
Designated Station Personnel Responsible for the Environment (Station EMS Personnel) Review the implementation of the requirements of an EMS. Perform spot training. Follow unwanted actions and undertake the necessary improvements

Field Auditors Field auditors to undertake and prepare reports for audits under the supervision of the EMS coordinator once every six months

EMS System Auditors EMS system auditors to undertake and prepare reports for EMS audit under the coordination of the EMS coordinators once every six months

Station Employees Responsible for following procedures for activities based on written documentation and internal training, inform the clients and contractors

Contractors Responsible for following procedures related to their work as written in the Contractor HSE Requirements for company



IMPLEMENTATION

- Environmental Regulations and Legislative Changes
- Activities Performed (normal and unwanted events)
- Environmental Risk Assessment (ERA)
 - Identifying potential impacts for soil, ground water, surface water and air quality of operating a petroleum retail store using source pathway receptor point of view
 - Preventative measures taken for unacceptable risks (include the training, inspection and level of readiness of the personnel).
- Audits
- Assessments



ERA – Zone Segregation

STATION ZONES

1. Fuel Forecourt Area
2. LPG Forecourt Area
3. Fuel tank area
4. LPG tank area
5. Car Wash
6. Market-offices
7. Support facilities
8. Waste storage area





ERA-Unwanted Events

AREAS	UNWANTED EVENT	Large Scale	Medium Scale	Small Scale Operational
Fuel Forecourt Area	Spill During Vehicle Dispensing	200 lt	20 lt	2 lt
	Spill During Tanker Loading into Tank	1,000 lt	100 lt	10 lt
	Oil Spill From Vehicles	-	-	2 lt
	Fuel Additive Spills	-	-	1 lt
	Cleaning Wash Water Discharge	-	-	100 lt
	VOC Emissions during Car Fuelling			
	VOC Emissions Tanker Loading			
	Fire / Explosion Event Conditions-contaminated water-product	10,000 lt	2,000 lt	200 lt

ERA-Unwanted Events



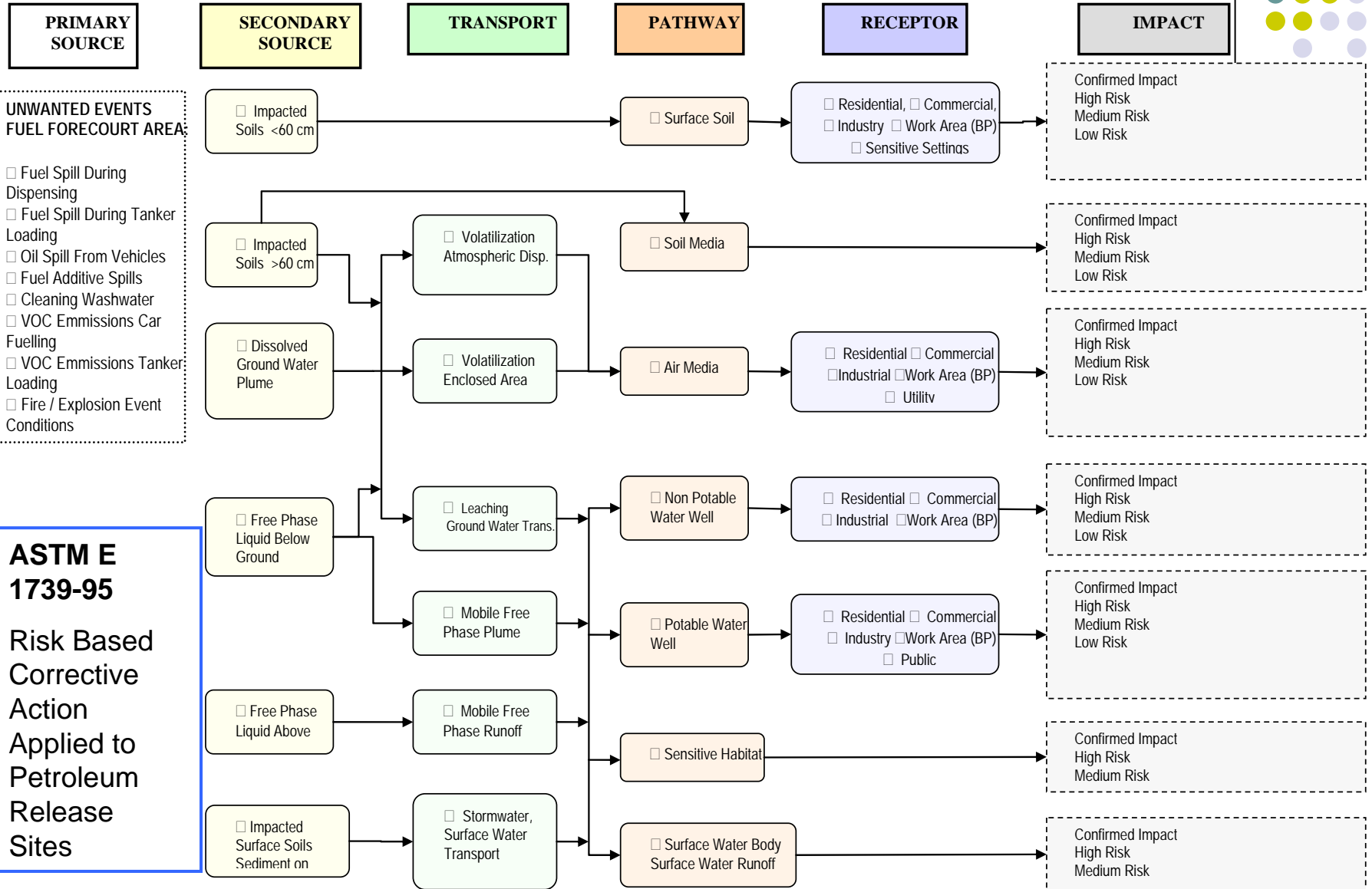
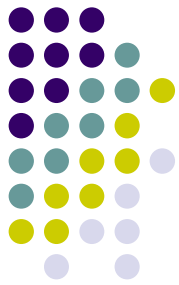
A 25 year old, 20,000 It capacity single skin tank with no corrosion protection, no automated tank gaging system in place located within a highly corrosive soil environment is very likely to have a catastrophic leak occurrence resulting in loss of greater than 10,000 It of product.

On the other hand, a double skinned 10 year old tank with an interstitial monitoring system and automated gaging system will be unlikely to have a large leakage occurrence.

ERA-Unwanted Events

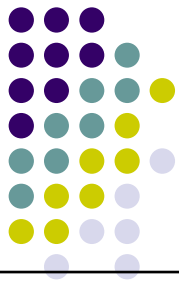


ERA-Source Pathway Receptor



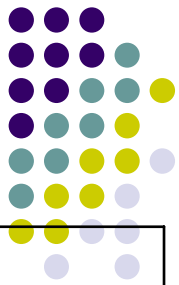
ASTM E 1739-95
 Risk Based Corrective Action Applied to Petroleum Release Sites

ERA-Impact Classification



Impact Scenario	Confirmed Impact	High Risk Impact	Medium Risk Impact	Low Risk Impact
Air Media	<p>Explosive levels or acute health effects in residential or other buildings</p> <p>Ambient levels exceed concentrations of concern from acute exposure or safety viewpoint</p> <p>Explosive levels are present in subsurface utility</p>	<p>Potential explosive levels or acute health effects in residential or other building</p>	<p>Toxic levels for receptors in residential or other buildings</p>	<p>Non toxic levels for receptors in residential or other Buildings</p>

ERA-Impact Classification



Impact Scenario	Confirmed Impact	High Risk Impact	Medium Risk Impact	Low Risk Impact
Subsurface Soil	Soil Contaminant large enough to cause air media confirmed impact classification	Soil Contaminant large enough to cause air media high risk impact classification	Soil contaminant large enough to create toxic levels for receptors in residential and other buildings Subsurface > 60 cm below ground is significantly impacted and first potable aquifer less than 15 m	Soil contaminant below levels to cause non toxic levels for receptors in residential and other buildings Subsurface > 60 cm below ground is significantly impacted and first potable aquifer is 15 m and above condition valid
Surface Water Bodies-Utilities	Free product on surface of water body and utilities	Impacted surface water, storm water, or ground water discharges < 150 m from surface water body used for drinking water supply	Impacted surface water, storm water, or ground water discharges < 450 m from surface water body used for drinking water Supply	
Sensitive Habitat	A sensitive habitat or sensitive resources are impacted and affected	Impacted surface water, storm water, or ground water discharges within 150 m from sensitive habitat	Impacted surface water, storm water, or ground water discharges within 1500 m from sensitive Habitat	
Surface Soil	Free product on surface soil	Contaminated soil open to public access and dwellings, parks, playgrounds, day care centers schools or similar use are within 150 m from soils	Contaminated soil open to public access and dwellings, parks, playgrounds, day care centers schools or similar use are within 450 m from soils	

ERA-Impact Classification



Impact Scenario	Confirmed Impact	High Risk Impact	Medium Risk Impact	Low Risk Impact
Air Media	<p>Explosive levels or acute health effects in residential or other building</p> <p>Ambient levels exceed concentrations of concern from acute exposure or safety viewpoint</p> <p>Explosive levels are present in subsurface utility</p>	<p>Potential explosive levels or acute health effects in residential or other building</p>	<p>Toxic levels for receptors in residential or other buildings</p>	<p>Non toxic levels for receptors in residential or other buildings</p>
Ground water	<p>Active public water supply well line is impacted or threatened immediately</p> <p>Free product present in non supply well in or outside of the property</p> <p>Potable and nonpotable water supply well impacted or immediately threatened to cause acute effect on receptors</p>	<p>Groundwater impacted and public water supply well from the aquifer is located within 2 year projection</p> <p>Ground water impacted and water supply well from the aquifer is located within 2 year projection with potentially acute levels on receptors</p> <p>Groundwater impacted and public-domestic potable water supply well from the aquifer is located in different interval within plume</p> <p>Potable and non potable water supply well is impacted to cause toxic levels on receptors or immediately threatened</p>	<p>Groundwater impacted and public water supply well from the aquifer is located greater than 2 year projection</p> <p>Groundwater impacted and water supply well from the aquifer is located greater than 2 year projection with toxic levels on receptors</p> <p>Groundwater impacted and non potable producing well from the aquifer is located in different interval within plume</p>	<p>Non potable aquifer with no existing local use impacted</p> <p>Groundwater impacted and non potable wells located wells are located down gradient outside the known extent of chemicals of concern and they produce from non impacted zone</p> <p>Water supply well impacted not above toxic levels on receptors</p>

ERA-Risk Matrix



Unlikely Likely Very Likely LIKELIHOOD	Low Risk	Medium Risk	High Risk	Confirmed Impact
	Low Risk	Medium Risk	High Risk	Confirmed Impact
	Low Risk	Medium Risk	High Risk	Confirmed Impact
	IMPACT LEVELS			

Environmental targets should have following basis:

- Take necessary control against confirmed impact independent of the likelihood class
- Take necessary control against medium and high risk impacts for very likely and likely unwanted events
- Take necessary control against high risk impact and unlikely unwanted events

ERA-Control Mitigation



Available controls based on the following hierarchy:

- Prevent the occurrence of unacceptable unwanted events
- Monitor-measure whether the unwanted event has occurred
- Mitigation measures following the occurrence of unwanted events.

The control group means:

- Presence of written procedures/Implementation effectiveness
- Training - Maintenance
- Infrastructure / Equipment: standards for prevention and detection systems based on operational practices for tank release prevention and detection, product pipework, vapor pipework, sumps and chambers (European standards for Leak Detection system prEN 13160 regulations)



ERA – Case Study



Station construction :1996

Surface area : 3258 m²

Location: Commercial district / Istanbul

Site energy usage: Electricity

Water supply: Public water main and on site

caisson well: total of 4 tons/day

Chemical use :

- Car wash detergents

- Surface wash detergents

- Anti freeze products

- Fuel additive products

- Engine oil (small plastic containers)

Chemicals stored in enclosed room

- MSDS sheets not available

- Secondary containment not present

ERA – Case Study



- Generated wastes:
 - Nonhazardous: packaging, organic waste
 - Hazardous: waste oil, tank bottom cleaning waste, oil water separator gloves-rags
- Waste Storage :
 - Waste oil contained in 60 liter plastic containers
 - Rags stored in containers
 - Inappropriate storage without secondary containment
 - Poor waste management procedures
- Wastewater Generated:
 - Wash water, domestic, surface runoff
 - Domestic discharged directly to sewer; car wash water recycled and surface runoff partially conveyed to oil water separator but mostly direct treatment
- Wastewater Discharge :
 - Municipal sewer line
- Oil water separator:
 - Three compartment system-linked directly to sewer line
 - Collects liquids formed in the fuel dispensing area
 - Accumulated sludge not emptied regularly-poor maintenance
- Discharge Permit: Approved for wash water cleaning
 - Not tested for oil water separator discharge
- Surface water Drainage: Not properly designed; Fuel forecourt drains to separator

ERA – Case Study



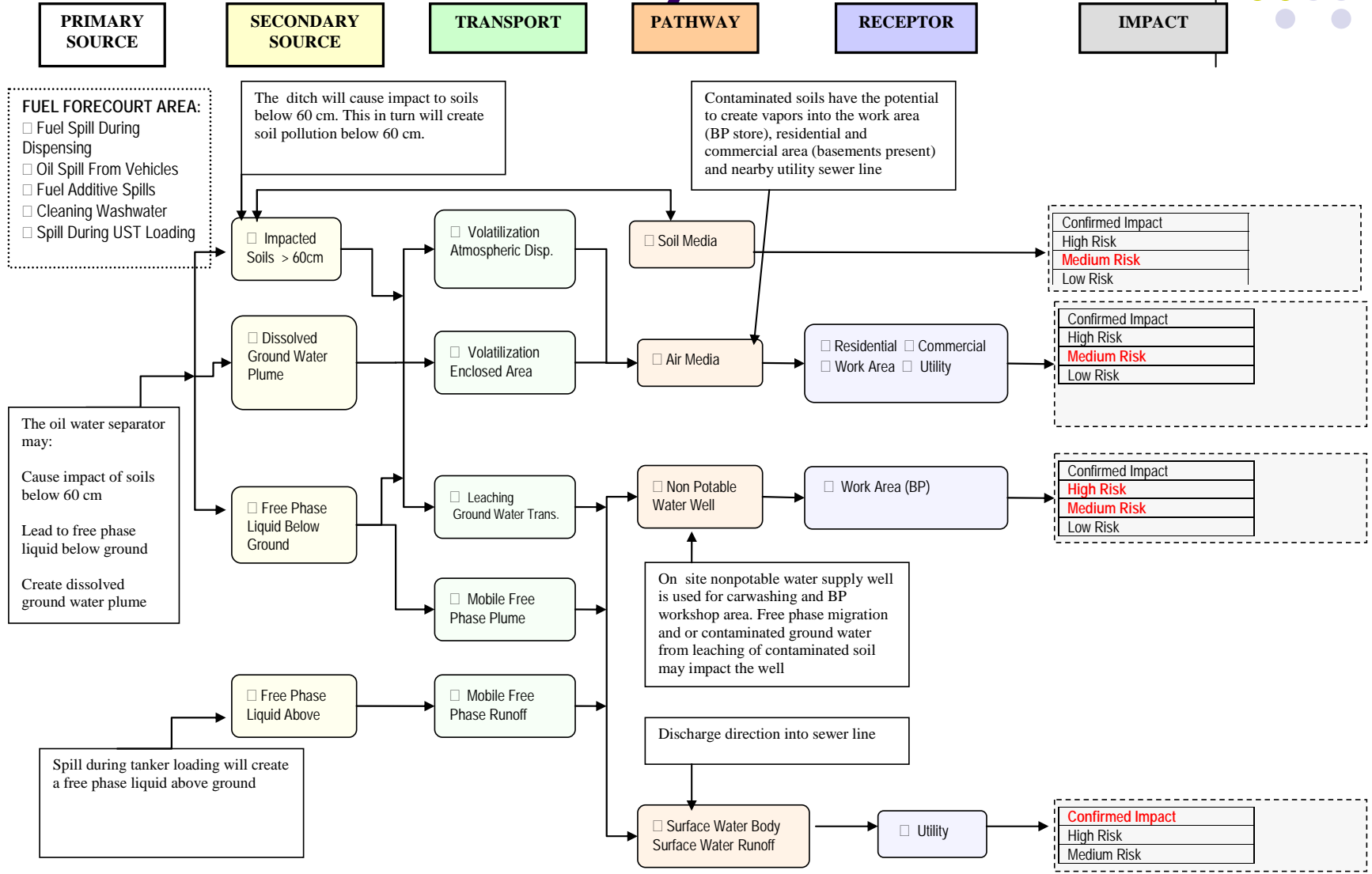
- Soil-geology :
 - Fill granular material 0-0.5m; Weathered greywacke 0.5-5.0m
 - Less weathered greywacke 5-8 m; competent greywacke 8 m-15 m;
 - Ground water; Non potable water supply well on site
 - Depth to water 6 m; Yield moderate K estimated at 1×10^{-4} cm/sec
 - Water table aquifer-not used for drinking water supply by site or near site vicinity; water quality not tested; Location of well 10 m from oil water separator
 - Risk management measures and procedures not present
 - Emergency procedures present but no training
- Sensitive Habitat : Not present
- Setting : Commercial-residential setting;
 - Multistory buildings with basements < 30m from site boundaries;
 - Basement present in retail store-gas detection system in place ;
 - Basements in adjacent surrounding buildings

ERA – Case Study



- Fuel Tanks-dispensing system:
 - Four 20,000 lt double skin 5 year old steel tanks
 - Interstitial space continuously monitored
 - Tanks installed in a concrete vault with monitoring well
 - ATG system in place; checks on ATG system output measured
 - Flexile double skinned pipelines installed 3 years ago
 - Dispenser containment system-checked weekly
 - Overfill prevention valves in place for tanks
 - HDPE manhole sumps present
 - HDPE overspill bucket present in offline filling island
 - Cathodic protection present
 - Dispenser feeding suction and fitting with nozzle shut off valves
 - Vapor recovery systems not present
- Plans and training
 - On-site hazards and risks training present
 - Risk management measures and procedures not present
 - Emergency procedures present but no training

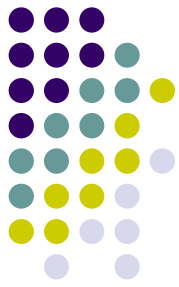
ERA – Case Study



ERA – Case Study



Unlikely Likely Very Likely LIKELIHOOD		Fuel dispensing spill accumulation in leaking oil water separator: Impact on air Impact on soil	Fuel dispensing spill accumulation in leaking oil water separator: Impact on ground water	
				Tanker spill during loading: Impact on utility
	Low	Medium	High	Confirmed
	IMPACT			



PREVENTION IS BETTER THAN THE CURE

THANK YOU!