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# Annex Module

# SAND DISPOSAL

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- *Conversion*

# INTRODUCTION

Sand disposal is the last stage in a sand management program

Environmental regulations require that prior to its disposal sand particles must be cleaned to remove any potential contaminants (mainly oil) that might have remained attached to the particles.

For instance, there are two particular requirements enforced today particularly for offshore environments, these are:

- Ensure that sand particles are free of LSA (Radioactive) minerals, scale
- Oil remaining in the sand particles does not exceed 1% by volume

# DISPOSAL METHODS

There are four (4) common methods of disposing of produced sand, these are:

1. ***Dumping***(Offshore) the produced sand into the sea
2. ***Skip & Ship*** involves ”packing” and shipping the produced sand
3. ***Re-injection*** of the produced sand into suitable geological strata
4. ***Conversion*** of the produced sand into material that can be used for other applications

All have advantages and limitations, cost is a very important issue for all of them

# DUMPING (Offshore)

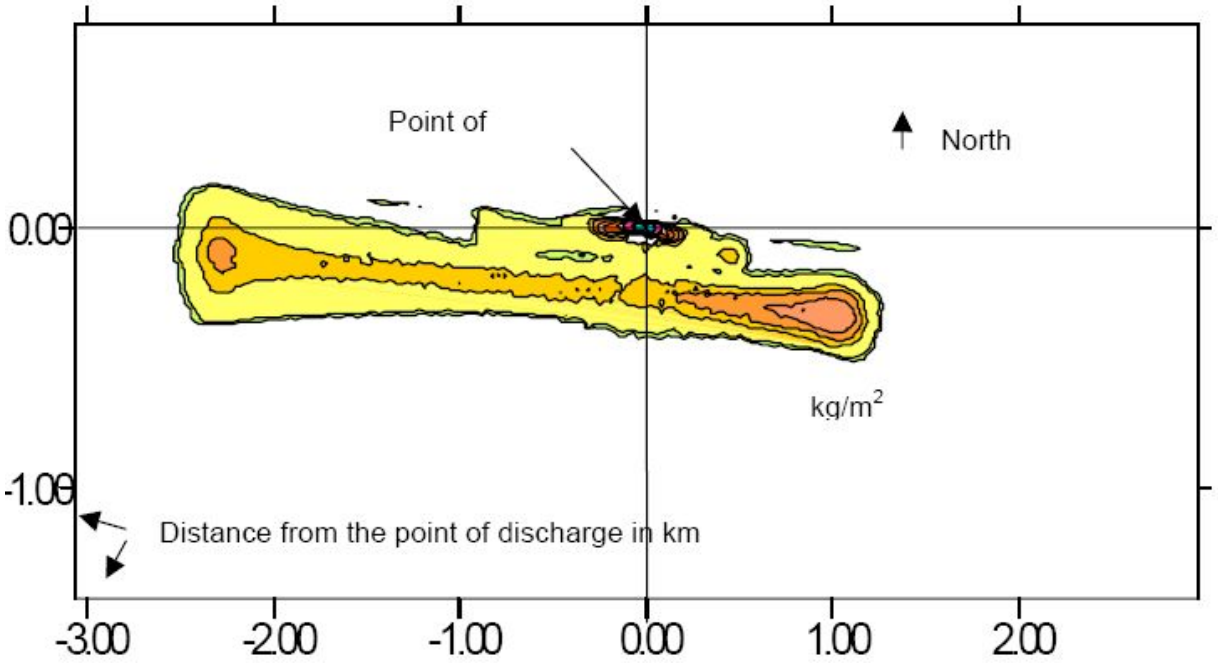
Dropping the produced and separated sand into the ocean or sea. As the sand grains fall into the sea the initial momentum depends upon the discharge rate or concentration. Initially, the relative buoyancy and/or the relative speed of the sand particles discharged will be responsible for the initial mixing and dilution. The behaviour of such a discharge is controlled by a series of parameters, the most important in this case being:

- Buoyancy
- Density of the fluid where particles are discharged
- Sand particle shape and density
- Distance from where the solids are discharged to the sea surface

Sand particles travel through at least three (3) zones: the splash zone, surface currents and the zone of deep currents.

# DUMPING (Continued)

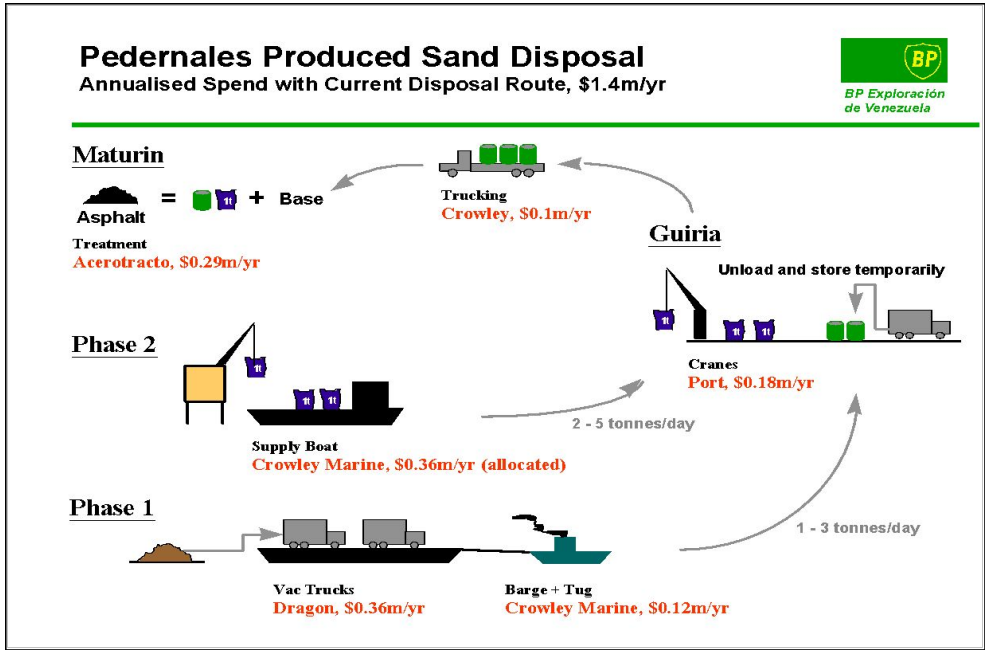
- Graph illustrates a solid's "plume" at the sea bed
- Particle shape and concentrations will vary according to the currents and point of discharge
- Example is from Block 47 in the SNS



# SKIP & SHIP

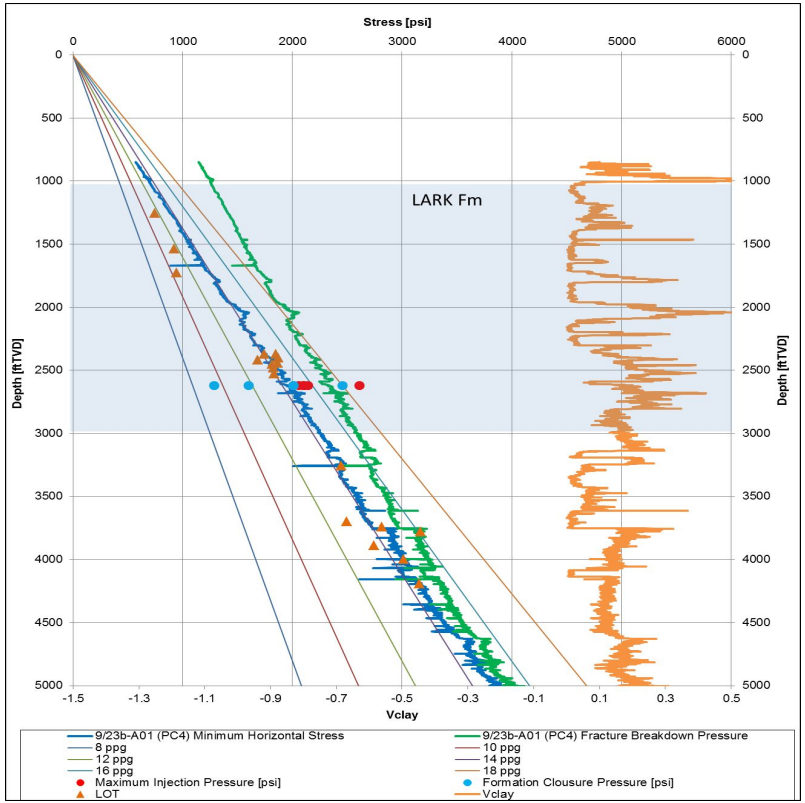
The Skip & Ship method involves the collection of the separated sand and “packaged” to be shipped to a processing location (Onshore, service company base…) where cleaning and further use will take place

- Example of process utilized by BP when it operated the Pedernales field in Eastern Venezuela.
- Field located in the Orinoco delta, swamp and shallow water depth
- Expensive and logistically complex disposal alternatives



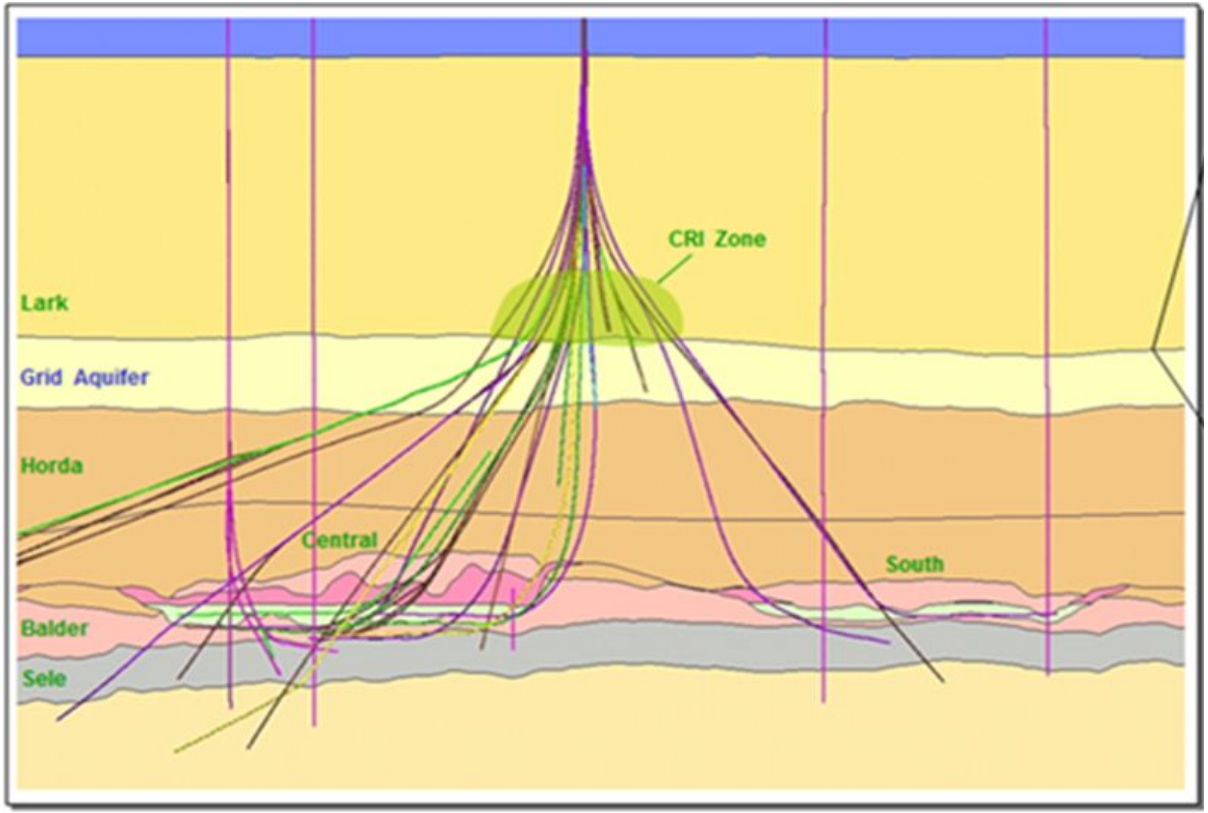
# RE-INJECTION

- A suitable (Isolated, non-permeable) strata must be found
- Injection takes place using pressures above fracturing pressures
- Requires HP equipment/services on location a number of times a year
- A combination of cuttings, produced sand and sometimes slops are disposed off using this option
- Requires robust design & planning



# RE-INJECTION (Continued)

- Lark formation in the Central North Sea in the UKCS
- CRI and produced sand is re-injected
- Process required carrier fluids for efficient transport
- Fracture propagation is required every time a new batch is injected



# RE-INJECTION (Continued)

General guidelines focus on the selection of the geological strata, pressures and fluid's path for re-injection

| CONSIDERATION | GUIDELINE | REMARKS |
|---|---|---|
| Type of rock | Non-porous | Porous/permeable rocks also suitable |
| Zonal isolation | Upper and lower barriers for zones to be fractured | Preferably shales or intervals with sufficient strength contrast |
| | Casing / cement / rock bond | Preferably higher density cement > 14 PPG. |
| | Minimise risk of contamination | Proximity becomes a critical issue to avoid possible contamination of other reservoirs/rocks |
| Injection path | Annular side preferred | Perforated casing also used |
| Injection pressures | Limited by casing rating for casing/casing option | Specific wells (disposal ones) are used |
| | Limited by fracture gradient for matrix injection | Can be affected by plugging |

# CONVERSION

Conversion of produced sand into materials or components for other applications included

- Road and building construction
- Filling material
- Filtration material

Process is complex and expensive, sometimes it is the last step in the skip & ship disposal option. Chemical cleaning and conditioning needs to be completed according to the local/country regulations

# CONVERSION (Continued)

Conversion while ideal in terms of further use for the produced sand it has not been economically viable so far. Also

- Very large volumes of sand are produced and need to be stored
- It has a large environmental impact
- It can be used with the skip & ship method
- The cleaning of the produced sand requires high energy type of process

Source iStock

# SUMMARY

Disposal of the produced sand in an environmentally and efficient manner is critical in any sand management program. Local, internal and/or government regulations must be met continuously

- The oil and gas industry utilises a number of disposal options
- These options tend to vary depending on the environment (Field/wells location), type of crude and local/regional regulations
- All options involve costly services and equipment that require complex logistics and planning
- Four (4) methods are currently utilized: dumping, re-injection, skip & ship and conversion

# SUMMARY (Continued)

- Dumping is carried out mostly offshore and requires processing and cleaning of the produced sand prior to offloading the material overboard.
- Skip & Ship involves the collection and transporting of the produced sand to a facility where cleaning and preparation for further disposal can be carried out
- For re-injection the produced sand is converted into a slurry and pumped into a suitable geological strata. This requires the creation of hydraulic fractures
- Conversion of produced sand into a material that can be used for other applications such as road building and in the construction industry
- Sand disposal must comply with all the environmental and legal regulations of the area/company/country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