TYPES OF SHORELINE
&
SHORELINE CLEAN-UP

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OBJECTIVE

To promptly remove oil from contaminated beach and to reduce /avoid further environmental and economical damage

SHORELINE TYPES

- Impermeable
  - *no surface sediment, stable and oil will not penetrate below the surface*
- Permeable
  - *contains organic or inorganic sediment, are mobile and oil can penetrate into or be buried below the surface.*

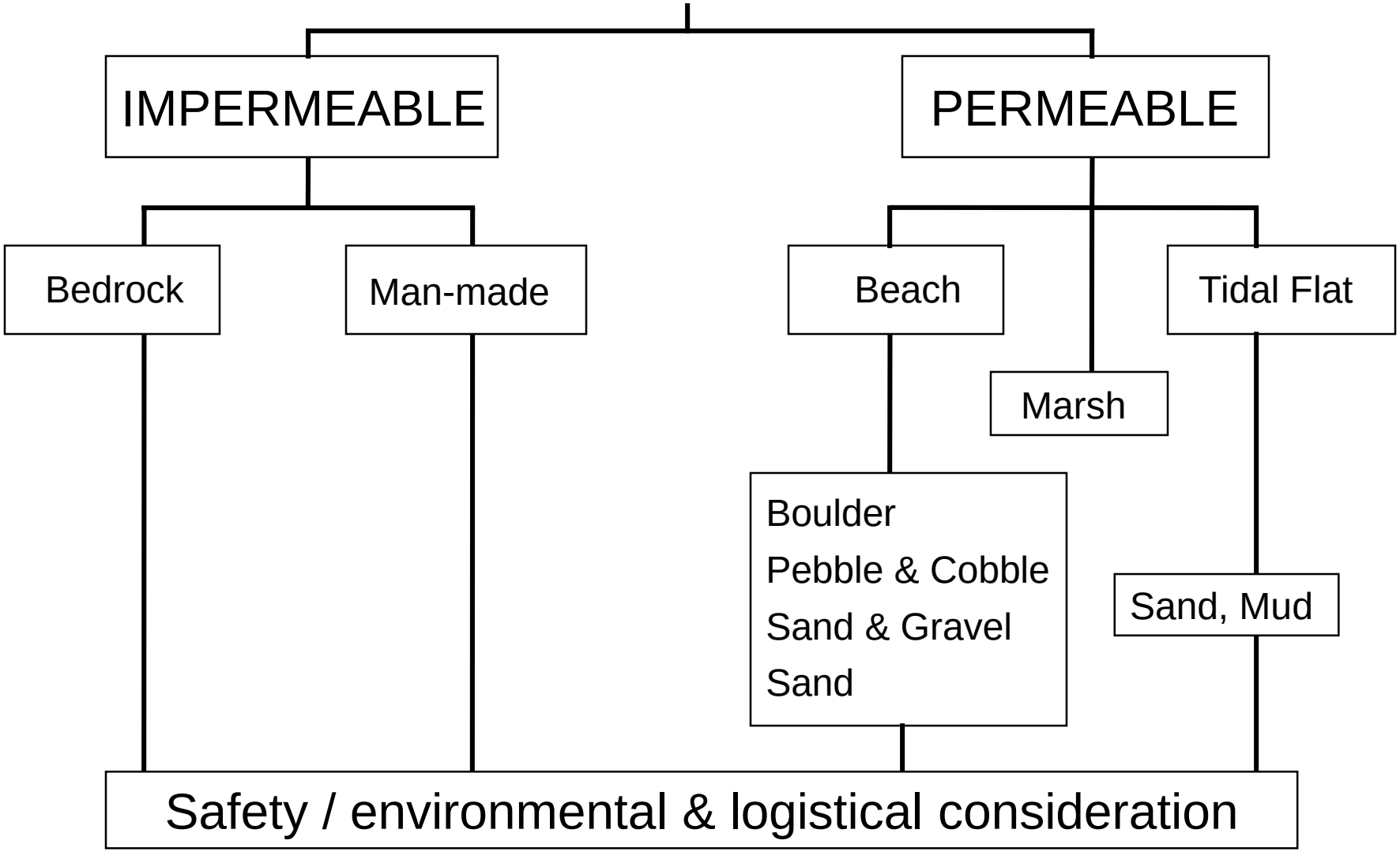
IMPERMEABLE SHORELINE

- Bedrock
- Cliffs
- Man-made

PERMEABLE SHORELINE

- Beach
  - *boulder*
  - *pebble & cobble*
  - *mixed sand, gravel*
  - *sand*
- Tidal flat
  - *sand*
  - *mud*
- Marsh /mangrove

SHORELINE TYPE CHART



ENVIRONMENTAL SENSITIVE INDEX (ESI)

ESI INDEX	SHORELINE TYPE
1	*Exposed rocky shores*
2	*Exposed rocky platforms*
3	*Fine grained sand beaches*
4	*Coarse-grained sand beaches*
5	*Mixed sand and gravel beaches*
6	*Gravel beaches*
7	*Exposed tidal flats*
8	*Sheltered rocky shores*
9	*Sheltered tidal flats*
10	*Marshes and mangroves*

FACTOR TO CONSIDER

- Type of shoreline
  - *environmental sensitivity index (esi)*
  - *accessibility*
- Environment
  - *weather*
  - *tidal sequence*
  - *season*
  - *wildlife*
- Impact
  - *flora /fauna*
  - *commercial*

FACTOR TO CONSIDER

- Logistic
  - *food*
  - *transportation*
  - *accommodation*
- Man power
  - *labor*
  - *trained*
  - *expert*
- Storage
  - *erected /fabricated tank*
  - *pit*

FACTOR TO CONSIDER

- Equipment
  - *manual*
  - *specialise*
    - *motorise*
    - *non-motorise*
  - *familiarisation*
  - *size*
- Oil
  - *type*
  - *fresh /weathered*
  - *amount*
  - *toxicity*

FACTOR TO CONSIDER

- Safety
  - *personal protective device*
  - *handling /operating the equipment*
  - *work site*
- Communication
  - *verbal*
  - *written*
  - *electronic*
- Authority
  - *private owner*
  - *local /public*

CLEAN-UP TECHNIQUES

THREE STAGES

Stage 1 – Removal of heavy contamination and floating oil

Stage 2 – Removal of moderate contamination, stranded oil and oiled beach materials

Stage 3 – Removal of final traces of oil

CLEAN-UP TECHNIQUES

SHORELINE TYPE : Rocks, boulders & man-made

Stage 1 :

- Mechanical recovery
- Manual recovery

Stage 2 & 3 :

- Left to weather
- High pressure washer and collect released oil

CLEAN-UP TECHNIQUES

SHORELINE TYPE : Cobbles, pebbles & shingles

Stage 1 :

- Containment
- Mechanical recovery
- Manual recovery

Stage 2 & 3 :

- Left to weather
- Low pressure flushing and collect released oil
- Removal of stones

CLEAN-UP TECHNIQUES

SHORELINE TYPE : Sandy beaches

Stage 1 :
- Containment
- Mechanical recovery
- Manual recovery

Stage 2 :
- Removal of contaminated oily sand & debris
- Mechanical grab

Stage 3 :
- Ploughing
- Flooding
- Sand replenishment
- Sorbents

CLEAN-UP TECHNIQUES

SHORELINE TYPE : Muddy shores & mangroves

- Leave oil to weather and degrade naturally
- Oil damage/impact vs. clean-up damage/impact
- Low pressure flushing
- Vegetation cutting

CLEAN - UP METHODS

- Natural recovery
- Barrier /berm
- Physical herding
- Manual oil removal /cleaning
- Mechanical oil removal
- Sorbents
- Vacuum
- Debris removal
- Sediment reworking /tilling
- Vegetation cutting
- Flooding
- Low - pressure flushing
- High - pressure flushing
- High - pressure hot ater flushing

1. NATURAL RECOVERY

No attempt is made to remove any stranded oil when there is no effective method for clean - up or to minimise impact to the environment.

Oil is left to degrade naturally.

2. BARRIER / BERMS

To prevent entry of oil into a sensitive area or to divert oil to a collection area.

3. PHYSICAL HERDING

To free any oil trapped in debris or vegetation on-water.

To direct the movement of floating oil towards containment & recovery device or to divert oil away from sensitive areas.

4. MANUAL OIL REMOVAL / CLEANING

To remove oil with hand tools and manual labour.

5. MECHANICAL OIL REMOVAL

To remove oil from shorelines and bottom sediments with mechanical equipment.

6. SORBENTS

To remove surface oil by absorption onto oleophilic material placed in water or at the waterline.

7. VACUUM

To remove oil pooled on a shoreline substrate or subtidal sediments.

8. DEBRIS REMOVAL

To remove contaminated debris from the shore line or water surface.

9. SEDIMENT REWORKING/TILLING

To enhance the rate of degradation, by breaking up oily sediments and surface oil deposits, increasing the surface area, and mixing deep subsurface oil layers to the surface.

10. VEGETATION CUTTING / REMOVAL

To remove portions of oiled vegetation or oil trapped in vegetation to prevent oiling of wildlife or secondary oil releases.

11. FLOODING

To wash oil stranded on the land surface to the water’s edge for collection.

12. HIGH-PRESSURE FLUSHING

To remove oil that has adhered to hard substrates of man-made structures.

13. LOW-PRESSURE FLUSHING

To remove fluid oil that has adhered to the substrate or man-made structures, pooled on the surface, or trapped in vegetation.

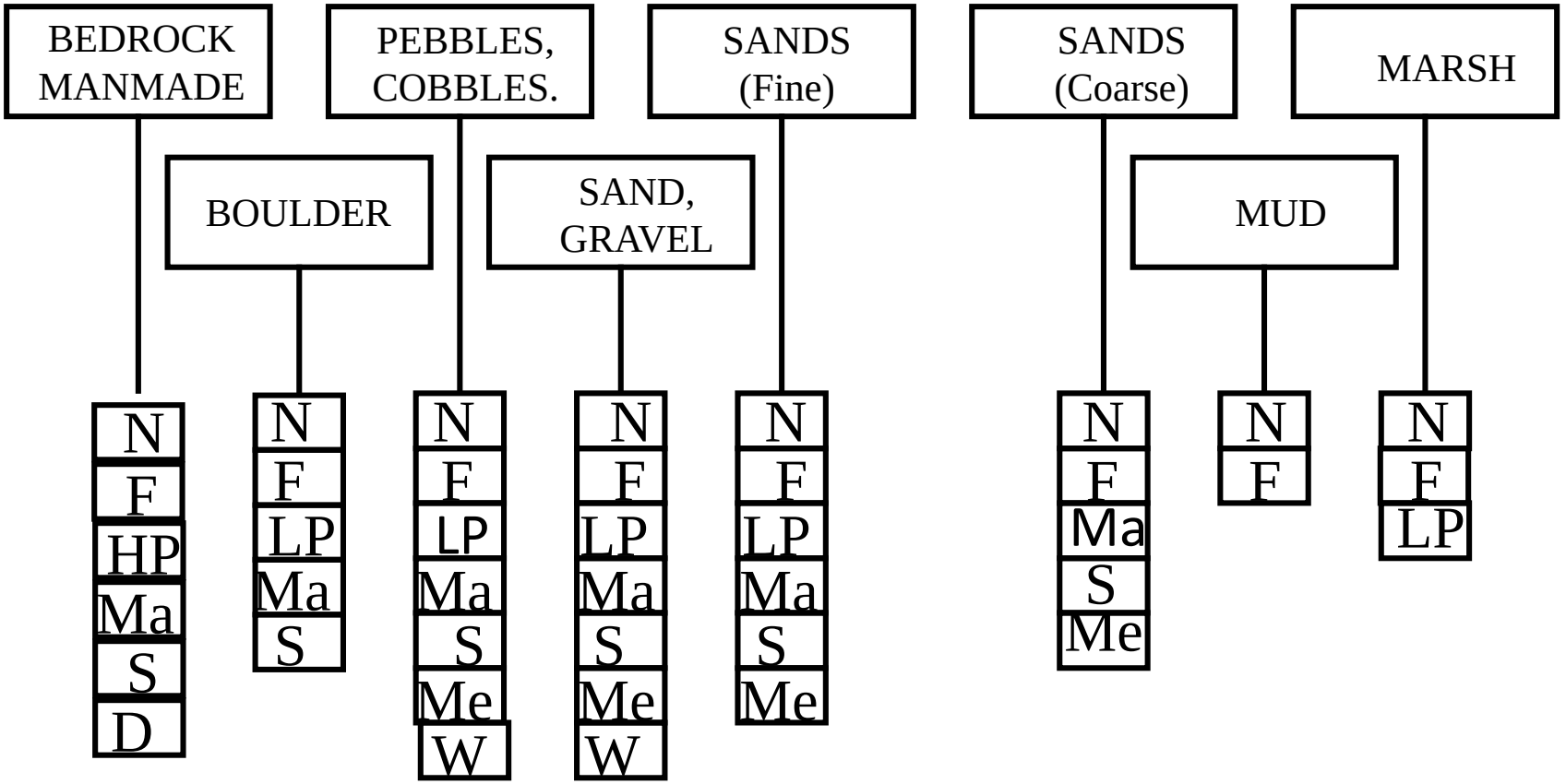
14. HIGH-PRESSURE,HOT WATER FLUSHING

To mobilise weathered and viscous oil strongly adhered to surfaces.

CLEAN - UP RESOURCES

To examine the specialised equipment which can be used in addition to the commonly available plant and agricultural machinery

RESPONSE TECHNIQUES



N - Natural, HP - High Pressure, Ma - Manual, D - Dispersant, W - Washing,
F - Flooding, LP - Low Pressure, S - Sorbent, Me - Mechanical

SUMMARY

Shoreline types

Permeable & impermeable

Response techniques

Various types, consideration of using combination of various types according to the situation

Constraints

Consider all factors before choosing the appropriate action