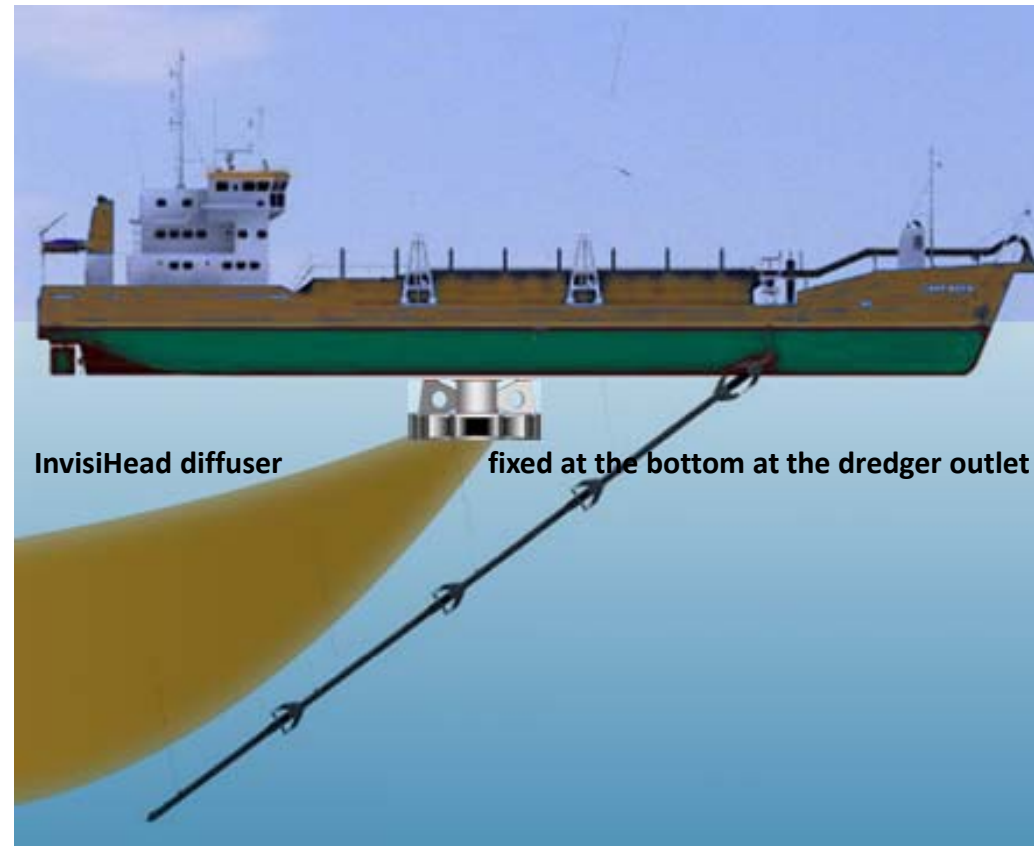


Turbidity Diffusion and Decay Modeling using US EPA VP UM3

By nature of the design, the InvisiHead diffuser releases effluent in a spatial and temporal fashion or in a 4-D (space plus time) domain that makes the flow funnel out in a 360° round surround, 180° up, sideways, straight, and down. It discharges, funnels out and disperses, spreads, mixes and dilutes effluents to reach the required dilution within the vicinity of the diffuser early in the mixing zones; radial diffusion of effluents with multi directionality is what the InvisiHead exactly made to do.

Efficient turbidity diffusion can be achieved by an InvisiHead diffuser fixed at the bottom of the dredger to operate as an outlet to the dredged material. The 5m IH diffuses, disperses, spreads, mixes and dilutes turbidly as shown in the US EPA VP UM3 model below.

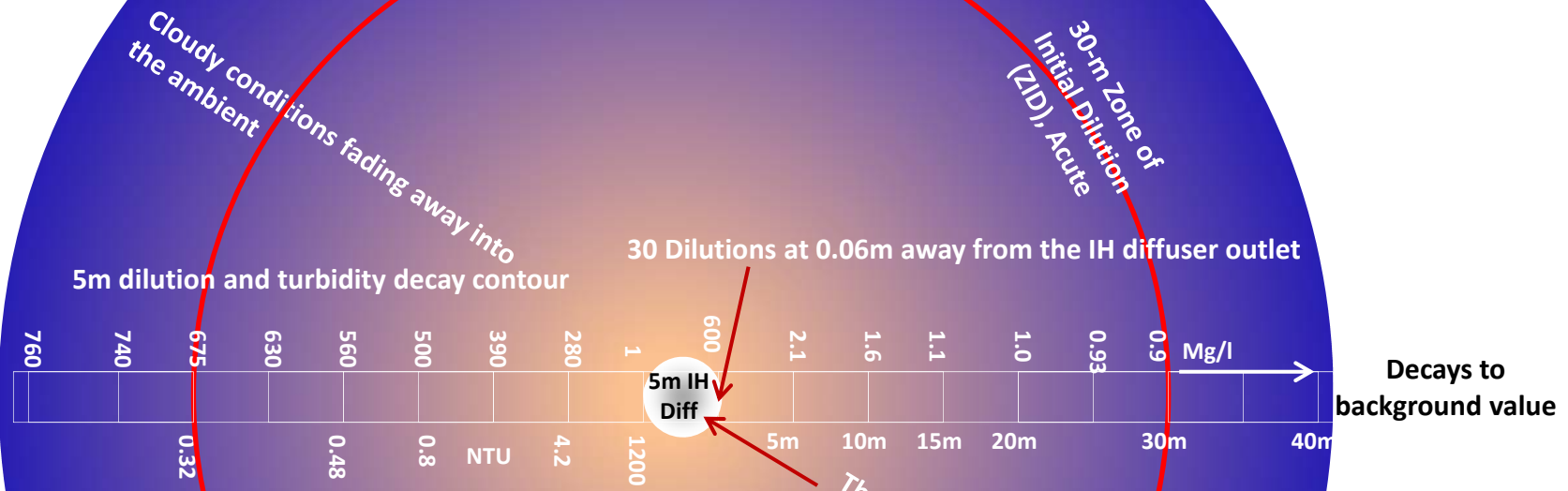


Turbidity decays from 1200 NTU to 30-the required level just after leaving the diffuser, and reaches 0.8 NTU at the edge of the ZID or acute zone

THE INVISIHEAD

DIFFUSER

Turbidity reaches a dilution of 17 and drops from 600mg/l to 15mg/l or 30NTU at 0.02m from the diffuser outlet in full compliance with the environmental and CMC requirements



Meeting the Regulatory Mixing Zone (RMZ) distance from outfall diffuser

- Acute criteria met (CMC values) at the edge of ZID, acute mixing zone is 10% of chronic zone;
- Chronic criteria met (CCC values) at the AIZ or CMZ.

Meeting the CMC values

Dilution within the 300m Allocated Impact Zone (AIZ):

- 30 at 0.06m ppm 20.3 down from 600;
- 52 at 0.19m ppm 11;
- 390 at 10m ppm 1.6;
- 636 at 27.5m ppm 0.94;
- 675 at 30.9 m ppm 0.89 at edge of ZID;
- 2047 at 284m ppm 0.29.

The InvisiHead retrofitted to the dredge outlet to manage turbidity diffusion

Turbidity Diffusion and Decay Modeling using US EPA VP UM3

/ Windows UM3. 8/24/2018 8:45:47 PM

Case 1: ambient file C:\Plumes\Turbidity Decay.001.db; Diffuser table record 1: -----

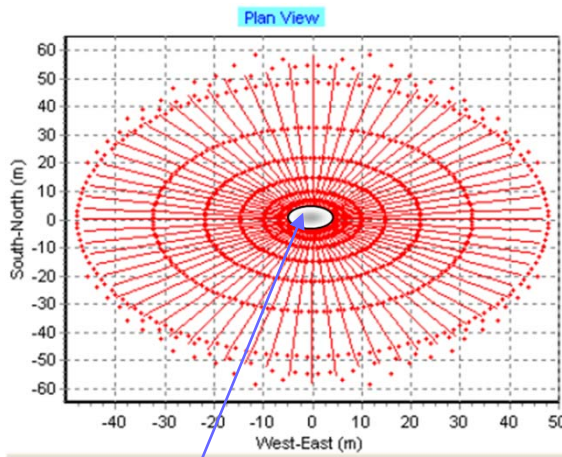
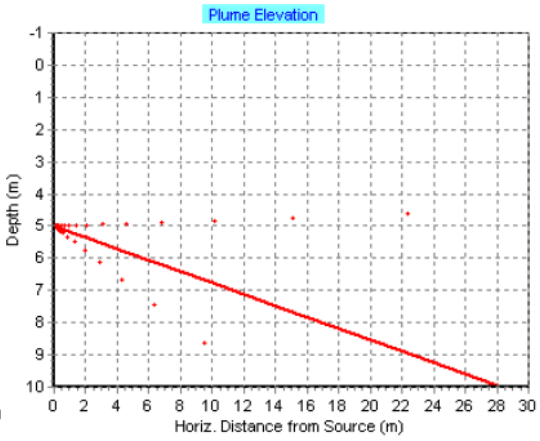
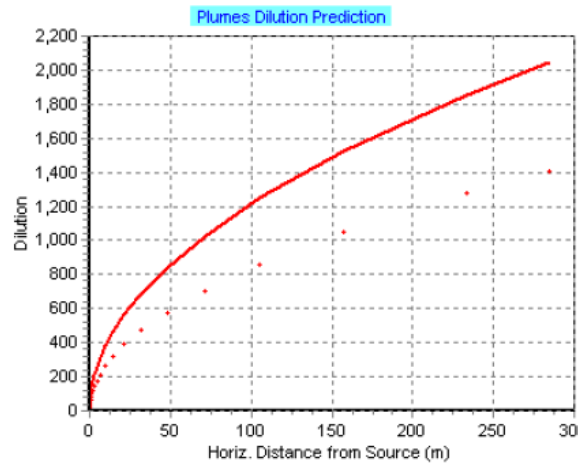
| Depth | Amb-cur | Amb-dir | Amb-sal | Amb-tem | Amb-pol | Solar rad | Far-spd | Far-dir | Disprsn |
|-------|---------|---------|---------|---------|---------|-----------|---------|---------|----------|
| m | m/s | deg | psu | C | kg/kg | s-1 | m/s | deg | m0.67/s2 |
| 0.0 | 0.05 | 90.0 | 38.0 | 25.0 | 0.0 | 0.000632 | 0.01 | 0.0 | 0.0003 |
| 12.0 | 0.05 | 90.0 | 38.0 | 25.0 | 0.0 | 0.000632 | 0.01 | 0.0 | 0.0003 |

| P-dia | P-elev | V-angle | H-angle | Ports | Spacing | AcuteMZ | ChrnMZ | P-depth | Ttl-flo | Eff-sal | Temp | Polutnt |
|---------|--------|---------|---------|---------|---------|---------|--------|---------|---------|---------|------|----------------|
| (m) | (m) | (deg) | (deg) | () | (m) | (m) | (m) | (m) | (m3/s) | (psu) | (C) | (ppm) Or about |
| 6.00E-7 | 10.0 | -10.0 | 90.0 | 1.68E+7 | 9.96E-9 | 30.0 | 300.0 | 5.0 | 2.04 | 38.0 | 25.0 | 600.0 1200 NTU |

Froude number: pure jet

| Step | Amb-cur | Amb-dir | Amb-pol | P-dia | Temp | Polutnt | 4/3Eddy | Dilutn | x-posn | y-posn |
|-----------------------------|---------|---------|---------|----------|------|---------|---------|--------|--------|---------|
| | (m/s) | (deg) | (ppm) | (m) | (C) | (ppm) | (ppm) | () | (m) | (m) |
| 0 | 0.05 | 90.0 | 0.0 | 6.000E-7 | 25.0 | 600.0 | 600.0 | 1.0 | 0.0 | 0.0 |
| Potential for more dilution | | | | | | | | | | |
| 100 | 0.05 | 90.0 | 0.0 | 0.0014 | 25.0 | 82.82 | 82.82 | 7.245 | 0.0 | 0.00349 |
| 171 | 0.05 | 90.0 | 0.0 | 0.0234 | 25.0 | 20.3 | 20.3 | 29.55 | 0.0 | 0.0592 |
| 200 | 0.05 | 90.0 | 0.0 | 0.0737 | 25.0 | 11.43 | 11.43 | 52.48 | 0.0 | 0.187 |
| 300 | 0.05 | 90.0 | 0.0 | 3.867 | 25.0 | 1.578 | 1.578 | 380.2 | 0.0 | 9.808 |
| 326 | 0.05 | 90.0 | 0.0 | 10.83 | 25.0 | 0.943 | 0.943 | 636.3 | 0.0 | 27.47 |
| 329 | 0.05 | 90.0 | 0.0 | 12.2 | 25.0 | 0.889 | 0.889 | 675.2 | 0.0 | 30.93 |
| 385 | 0.05 | 90.0 | 0.0 | 112.0 | 25.0 | 0.293 | 0.293 | 2046.8 | 0.0 | 284.2 |

max dilution reached
bottom hit,
acute zone,
surface.



The InvisiHead diffuser discharges effluent in a round surround, side ways, up, straight, and down funneling out flow, and efficiently manages effluent diffusion and dispersion

The InvisiHead diffuser

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