In-Situ Remediation (ISR-MT3DMS^{TM}) Redox Zone Visualization

October 5, 2015

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Introduction

- ISR-MT3DMS^{TM} utilizes a unique visualization concept which makes it very easy to illustrate how redox zones are distributed in an aquifer

    - Typical models require plotting individual contour maps for each electron acceptor

    - This unique visualization approach uses only one contour map to illustrate relative concentrations of all electron acceptors and the outlines of each redox zone

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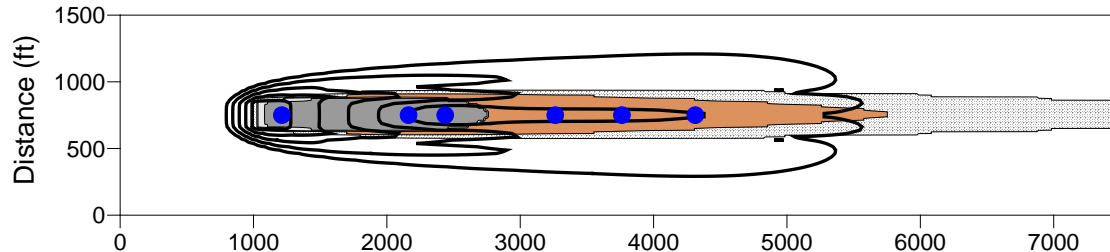# Simulated TCE and Redox Zones: Plattsburgh AFB

a) Simulation time = 5 years
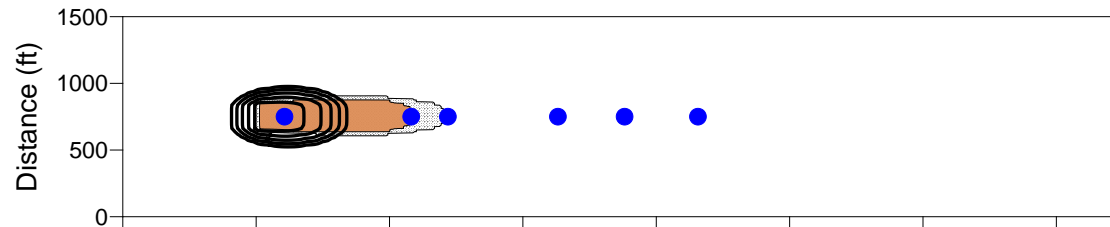
b) Simulation time = 10 years
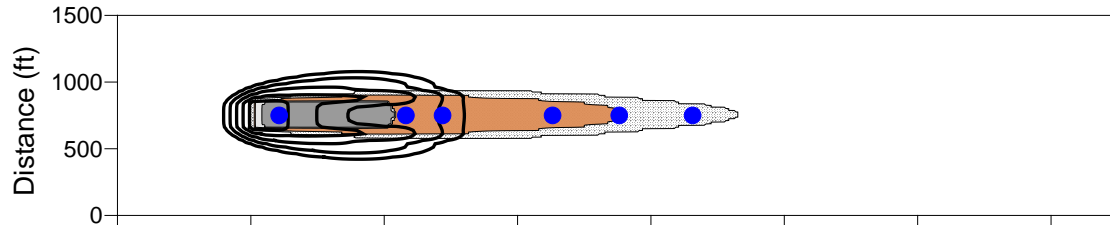
c) Simulation time = 40 years

LEGEND

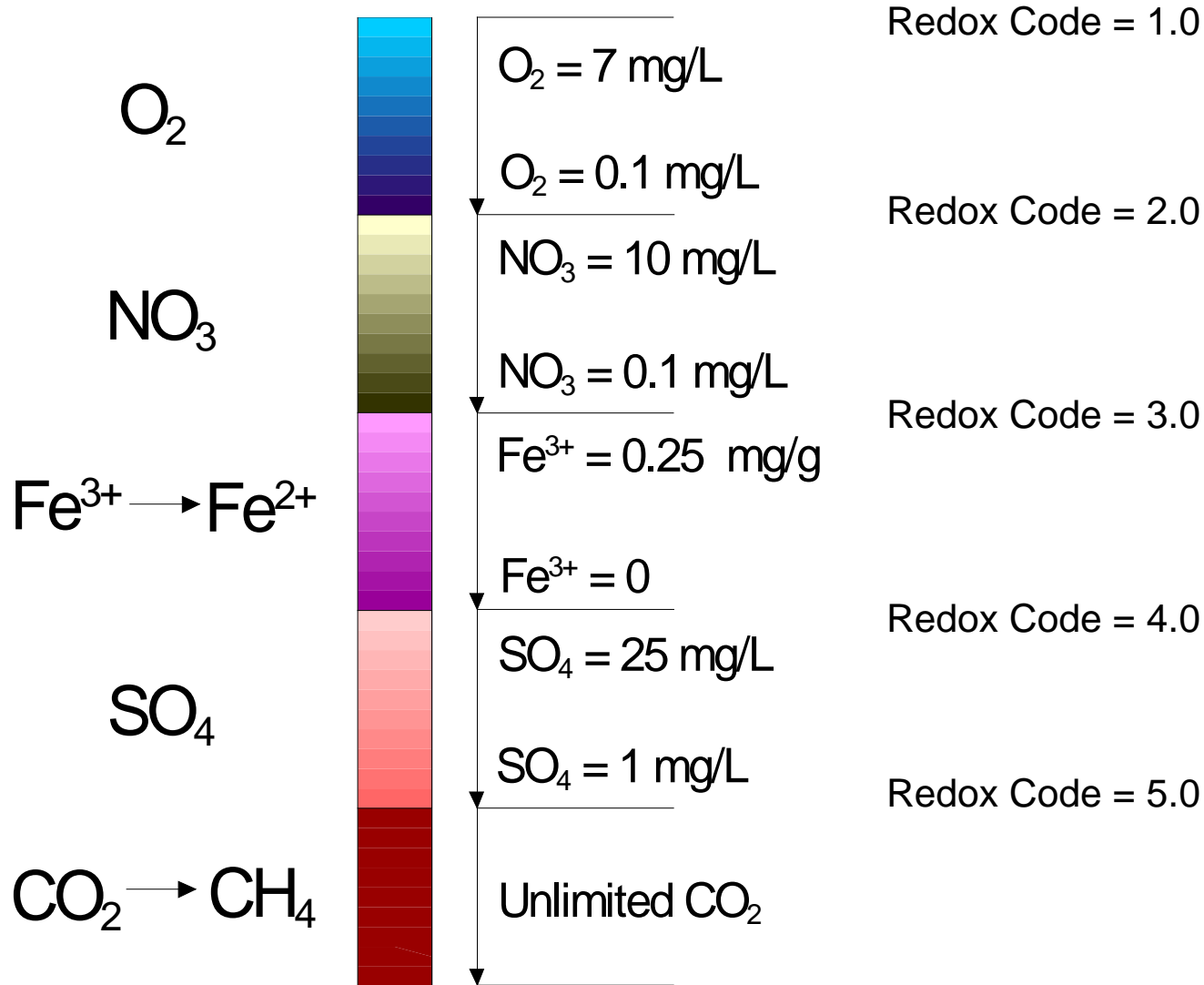● Primary Monitoring Well ——— TCE Contours: 0.001, 0.01, 0.1, 1, and 10 mg/L

Methanogenic | Sulfate-Reducing | Iron-Reducing | Nitrate-Reducing | Aerobic

Carey (2007)

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Redox Zone Visualization

Note – variation in colors reflects change from background to low electron acceptor conc.

O_2

NO_3

$Fe^{3+} \longrightarrow Fe^{2+}$

SO_4

$CO_2 \longrightarrow CH_4$

$O_2 = 7$ mg/L

$O_2 = 0.1$ mg/L

$NO_3 = 10$ mg/L

$NO_3 = 0.1$ mg/L

$Fe^{3+} = 0.25$ mg/g

$Fe^{3+} = 0$

$SO_4 = 25$ mg/L

$SO_4 = 1$ mg/L

Unlimited CO_2

Redox Code = 1.0

Redox Code = 2.0

Redox Code = 3.0

Redox Code = 4.0

Redox Code = 5.0

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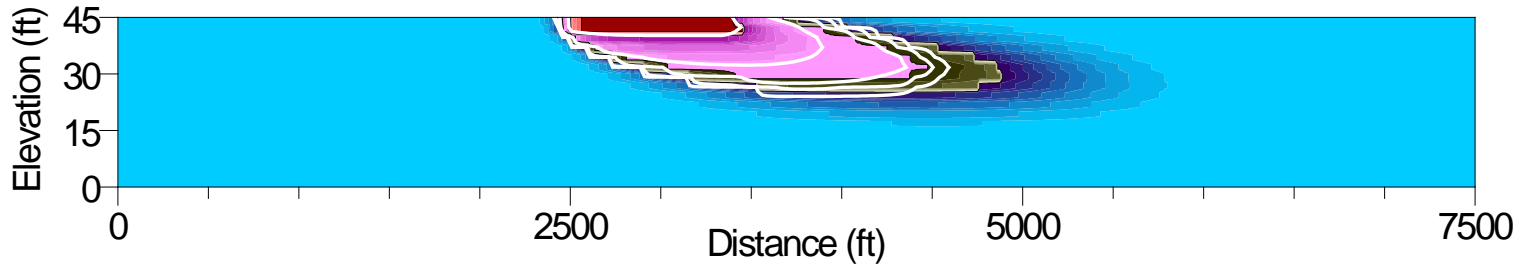ISR-MT3DMS Redox Zone Visualization

Carey (2001)

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Example – Plattsburgh AFB (BTEX)
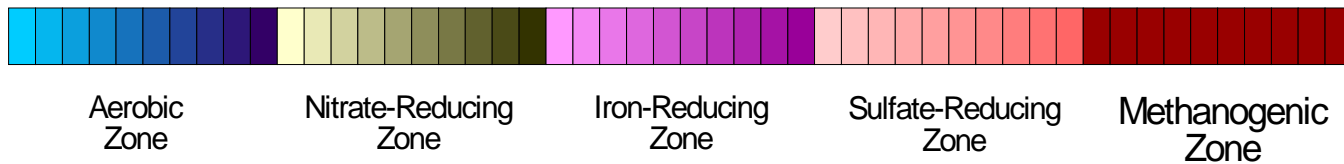

(a) Integrated-Depth Model
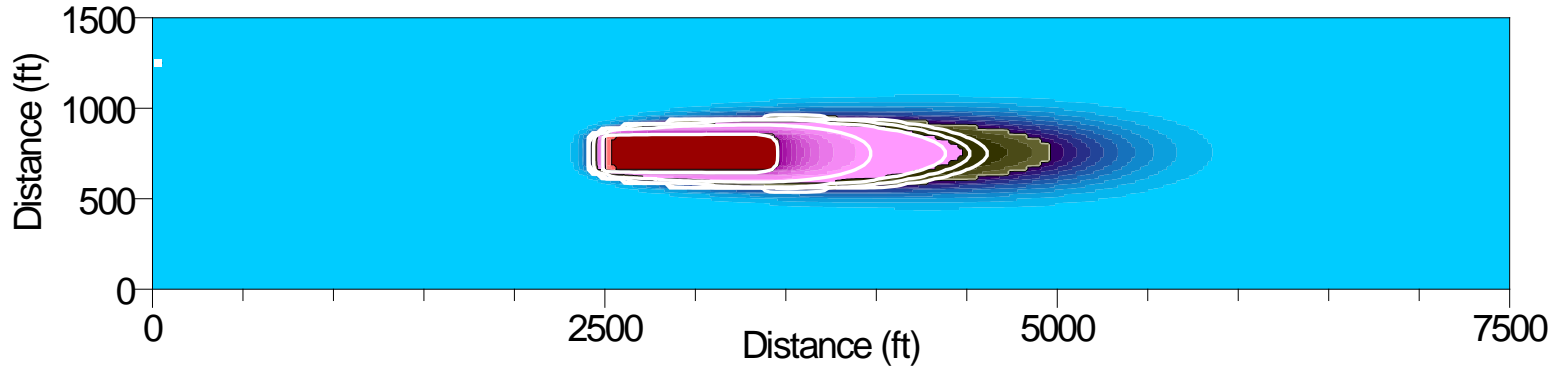
(b) Cross-Section Model

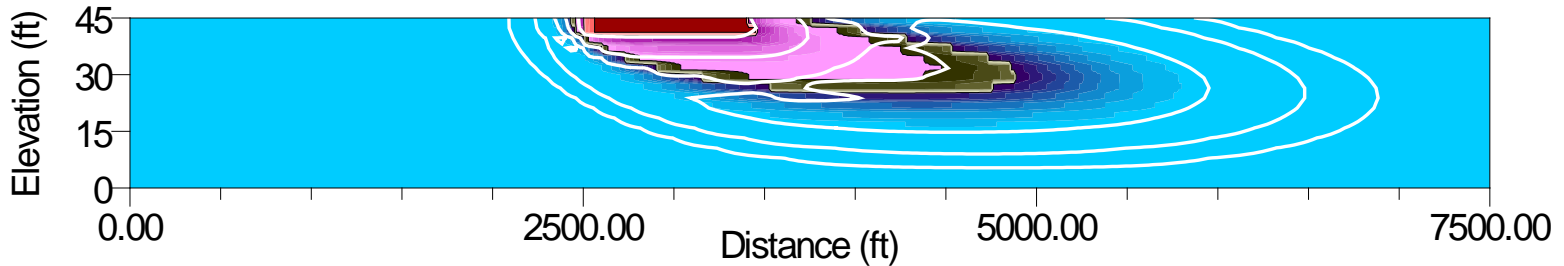Note - BTEX concentration contours of 0.001, 0.01, 0.1, 1, and 10 mg/L.

Aerobic Zone | Nitrate-Reducing Zone | Iron-Reducing Zone | Sulfate-Reducing Zone | Methanogenic Zone

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ISR-MT3DMS Redox Zone Visualization
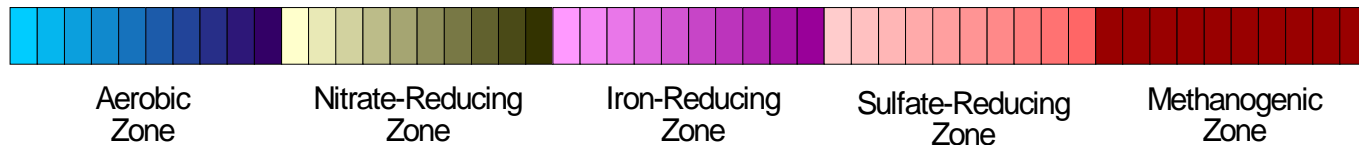
Carey et al. (1998)

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Example – Plattsburgh AFB (TCE)

(a) Integrated-Depth Model
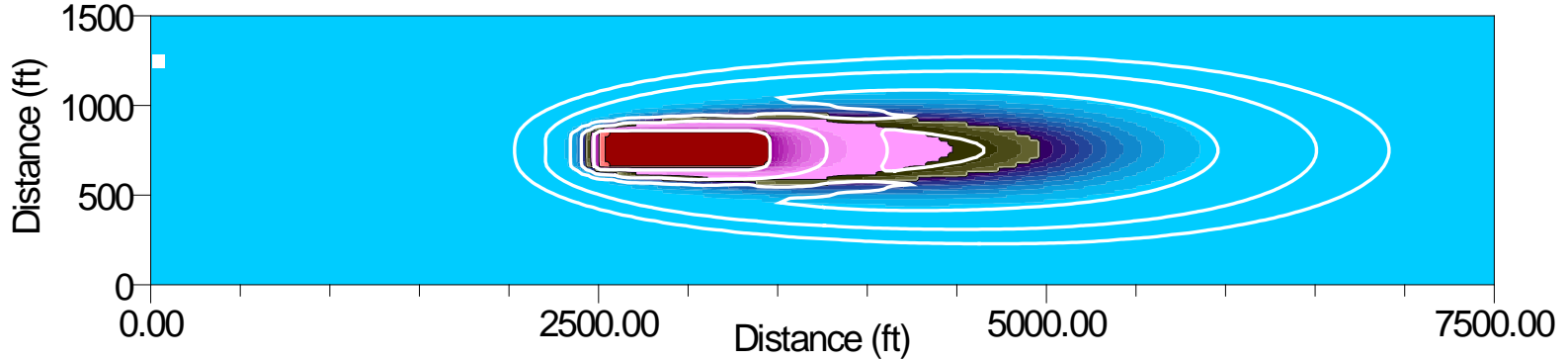
(b) Cross-Section Model

Note - TCE concentration contours of 0.001, 0.01, 0.1, 1, and 10 mg/L.

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Carey et al. (1998)

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Transient Bioattenuation Capacity

Vejen Landfill, Denmark

t = 1 year

t = 5 years

t = 15 years

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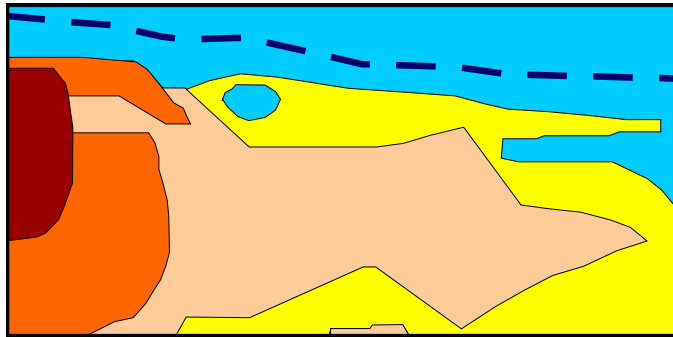ISR-MT3DMS Redox Zone Visualization

Carey (2001)
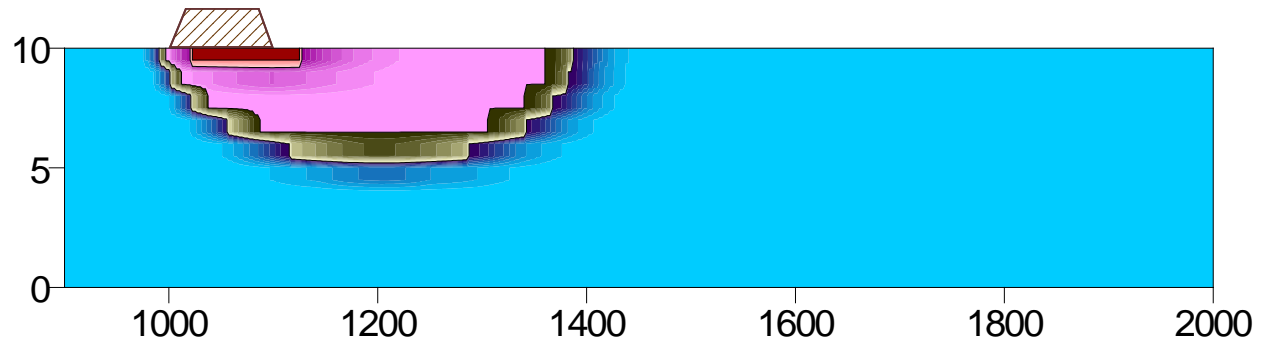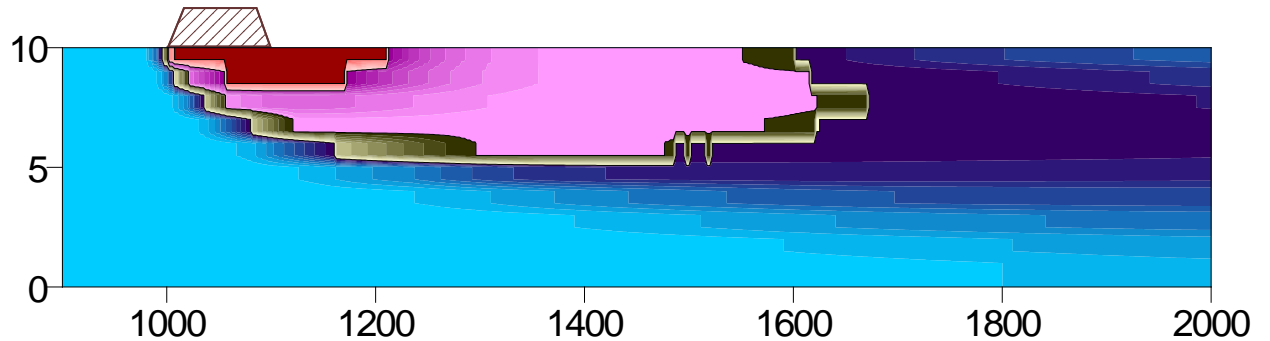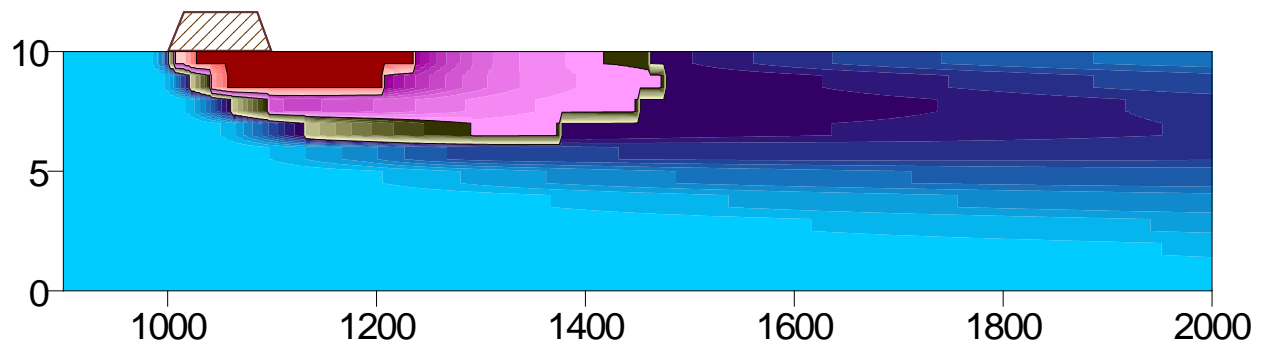
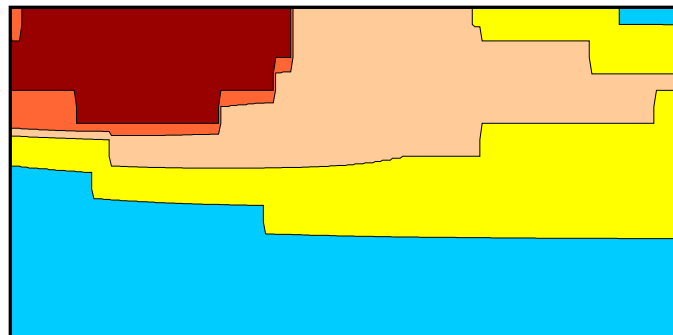# Example – Vejen Landfill, Denmark

Vertical dispersivity = 0.008 m
rate = 7.6e-3 per day
TOC degrades when TOC > 0.1 mg/L

Observed:

Model:

aerobic zone

nitrate-reducing zone

iron(III)-reducing zone

sulfate-reducing zone

methanogenic zone

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Carey (2001)