

The Use of Post-Dredge Monitoring Data to Distinguish Between Impacts of Dredge Residuals and Ongoing Sources

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Phase 1 Dredging

- Dredging conducted over two dredging seasons in 2005 and 2006
- Removed 260,000 cy of sediment over ~20 ac
- New surface sediment sampled 48 hrs after completion of dredging
- Mercury and polychlorinated biphenyls (PCBs) primary contaminants of concern in surface sediment
- Dredge plan included contingency action to place sand cover materials in areas where surface sediment concentrations exceeded Washington State Sediment Management Standards (SMS)

Datasets

- Two sampling events prior to placement of sand cover material
 - 2005 post-dredge monitoring – 68 locations sampled immediately following completion of dredging
 - 2005 pre-sand placement – 37 locations re-occupied following additional 1 ft of dredging

Datasets

- Three sampling events following the placement of sand cover material
 - 2006 recontamination monitoring – 30 locations sampled
 - 2007 recontamination monitoring – 23 locations sampled
 - 2008 recontamination monitoring – 9 locations sampled

Mercury Concentrations in Surface Sediment Immediately after Dredging (PDM)

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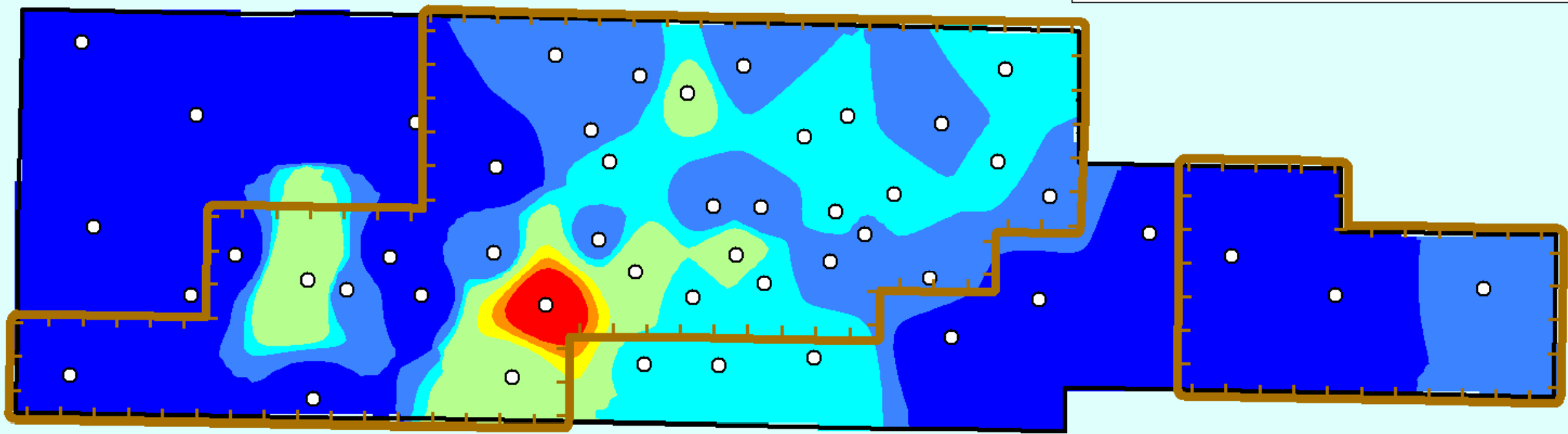
2005 Post-Dredge Monitoring

Mercury (mg/kg dw)



○ Surface sediment sampling location

□ Sand cover placement area



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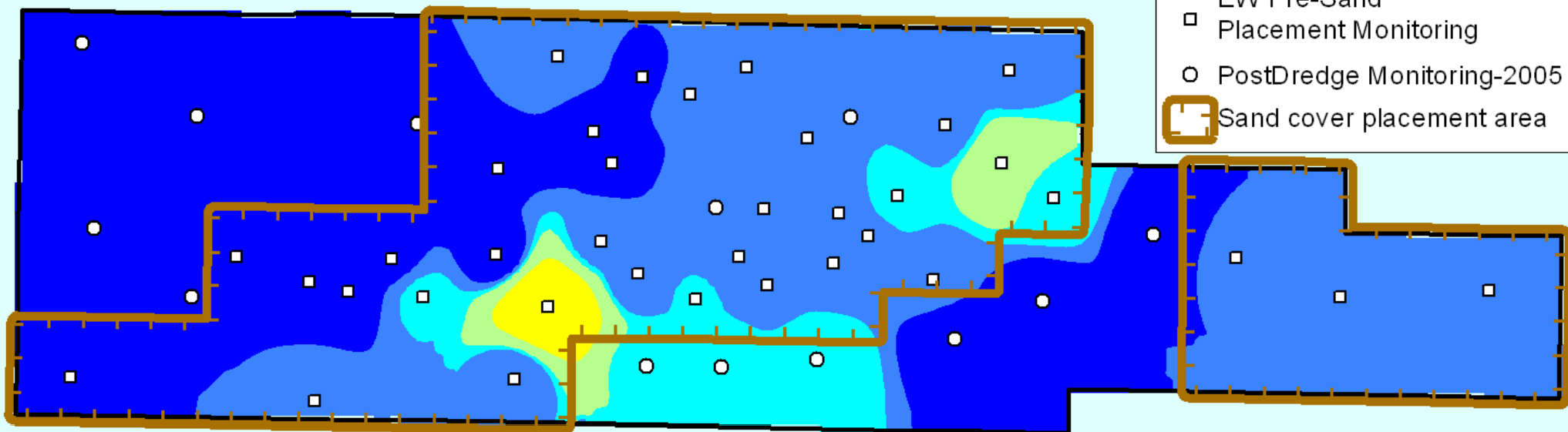
Mercury Concentrations in Surface Sediment after 1 ft Additional Dredging (PSP)

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2005 Pre-Sand Placement
Mercury (mg/kg dw)

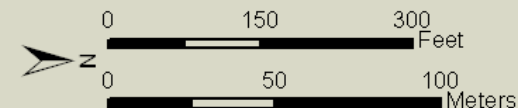


Surface sediment
sampling location



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Mercury Concentrations in Surface Sediment 1 year after Placement of Sand Cover

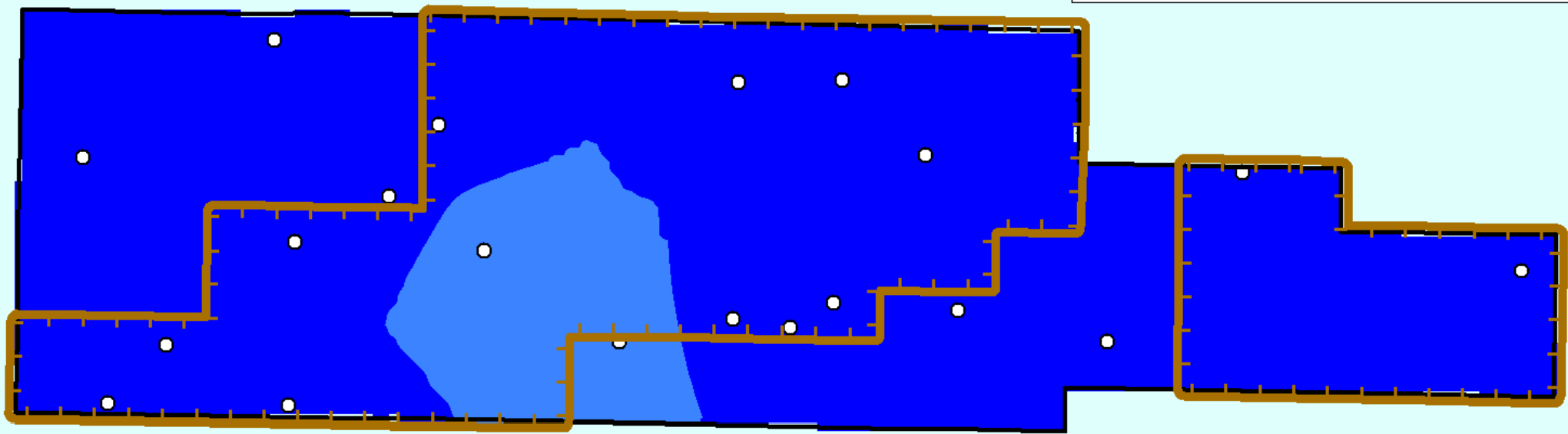
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2006

Mercury (mg/kg dw)

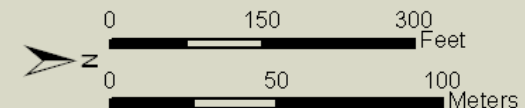


- Surface sediment sampling location
- Sand cover placement area



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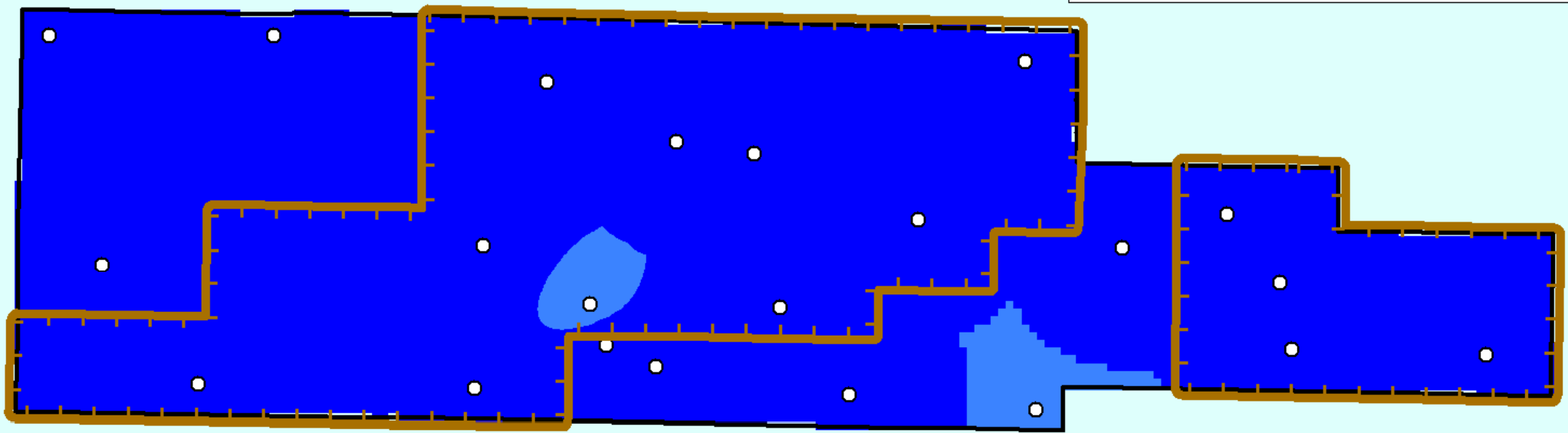
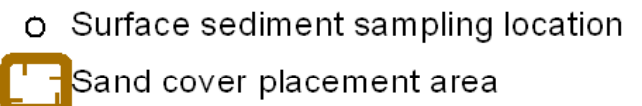
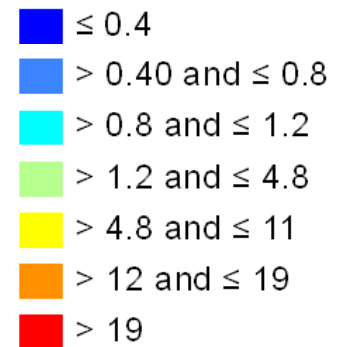


Mercury Concentrations in Surface Sediment 2 yrs after Placement of Sand Cover

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2007

Mercury (mg/kg dw)



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Mercury Concentrations in Surface Sediment 3 yrs after Placement of Sand Cover

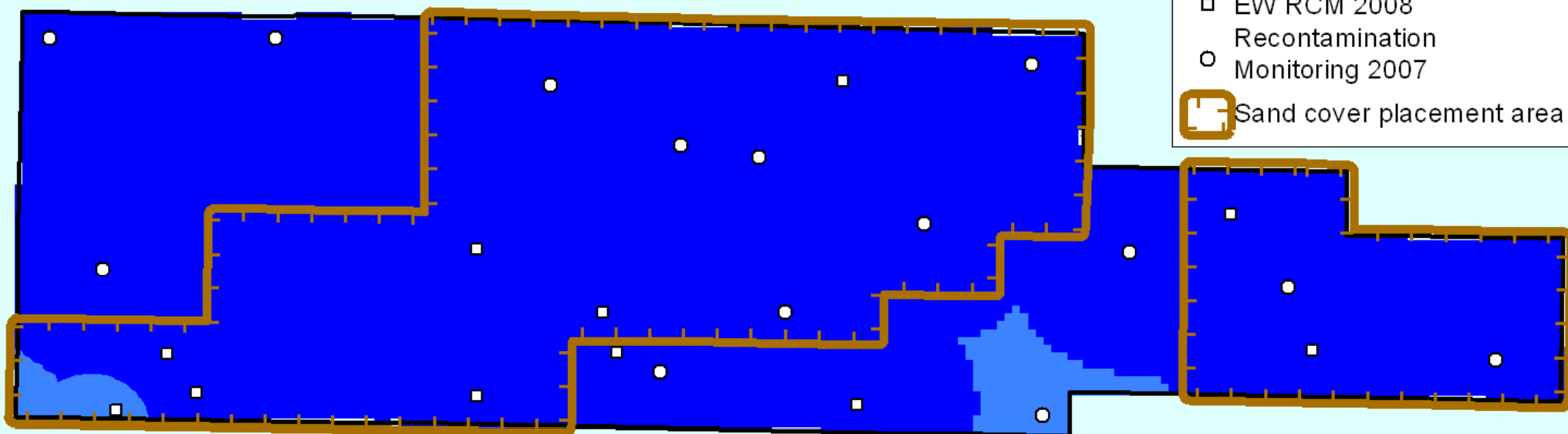
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2008

Mercury (mg/kg dw)

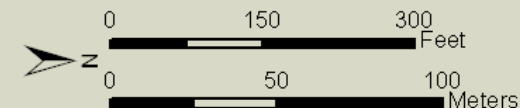


Surface sediment
sampling location

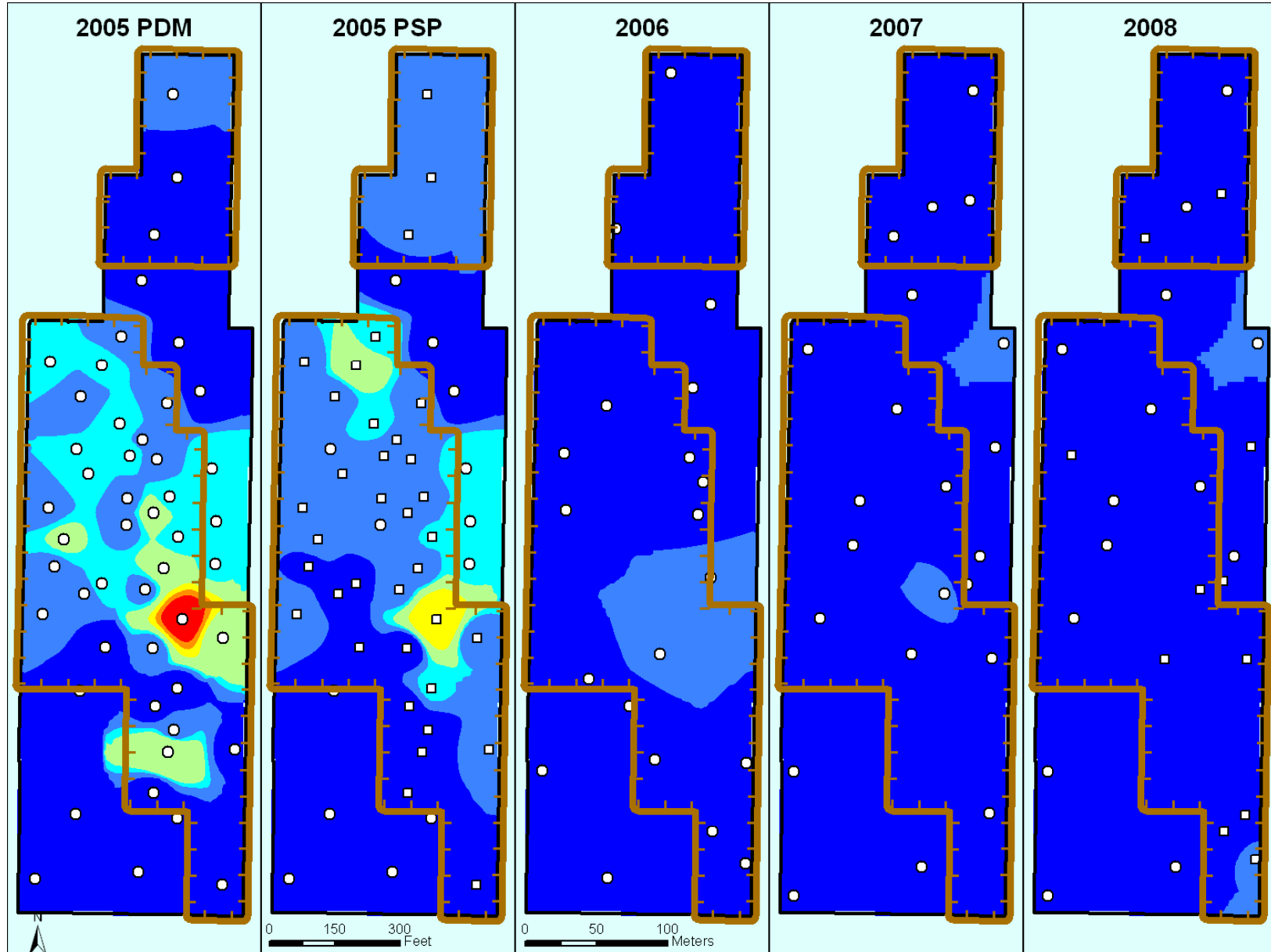


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Mercury Concentrations Over Time



Total PCB Concentrations in Surface Sediment Immediately after Dredging

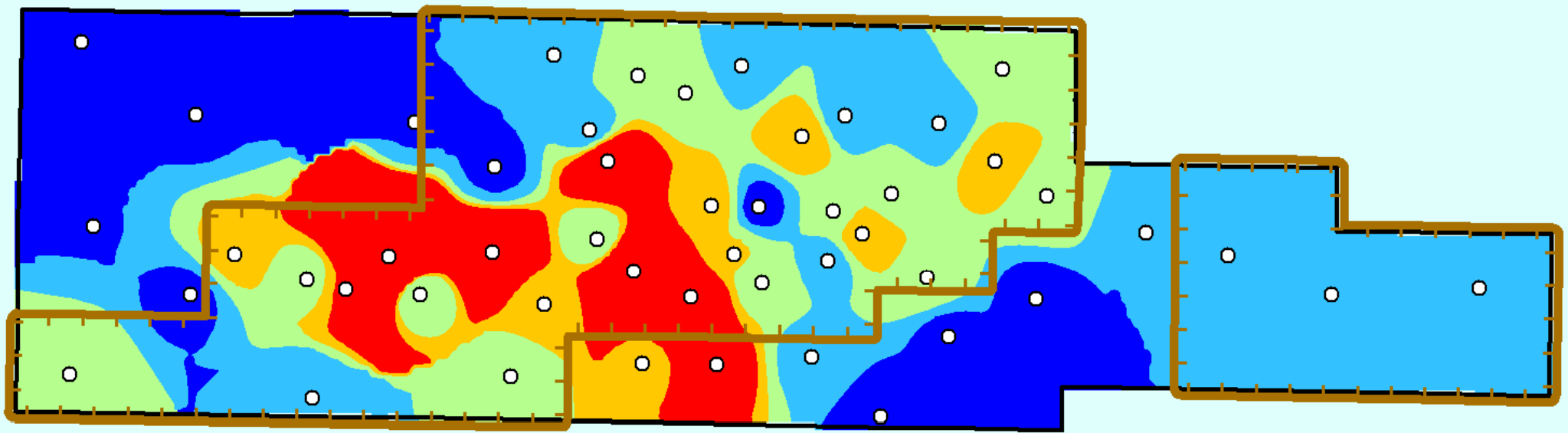
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2005 Post-Dredge Monitoring

Total PCBs ($\mu\text{g}/\text{kg dw}$)

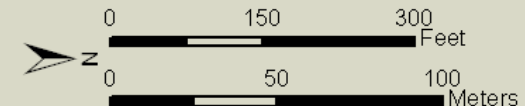
- ≤ 260
- > 260 and ≤ 800
- > 800 and $\leq 1,500$
- $> 1,500$ and $\leq 2,200$
- $> 2,200$

- Surface sediment sampling location
- Sand cover placement area



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Total PCB Concentrations in Surface Sediment after 1 ft Additional Dredging

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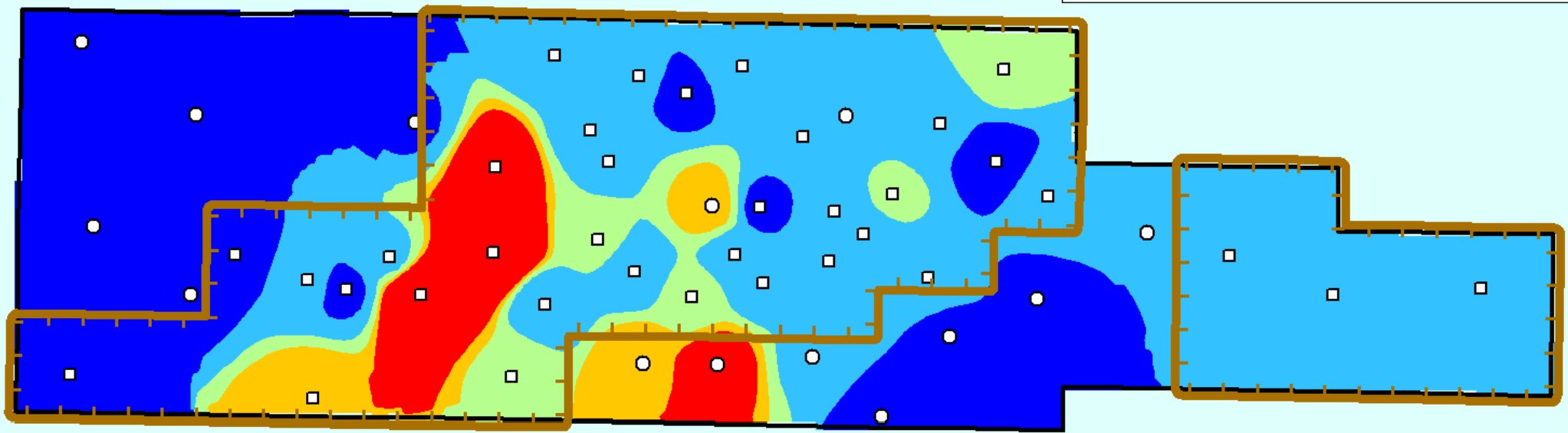
2005 Pre-Sand Placement

Total PCBs ($\mu\text{g}/\text{kg dw}$)

- ≤ 260
- > 260 and ≤ 800
- > 800 and $\leq 1,500$
- $> 1,500$ and $\leq 2,200$
- $> 2,200$

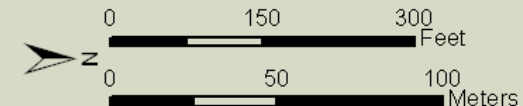
Surface sediment sampling location

- EW Pre-Sand Placement Monitoring
- PostDredgeMonitoring-2005
- Sand cover placement area



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Total PCB Concentrations in Surface Sediment 1 yr after Placement of Sand Cover

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2006

Total PCBs ($\mu\text{g}/\text{kg dw}$)

■ ≤ 260

■ > 260 and ≤ 800

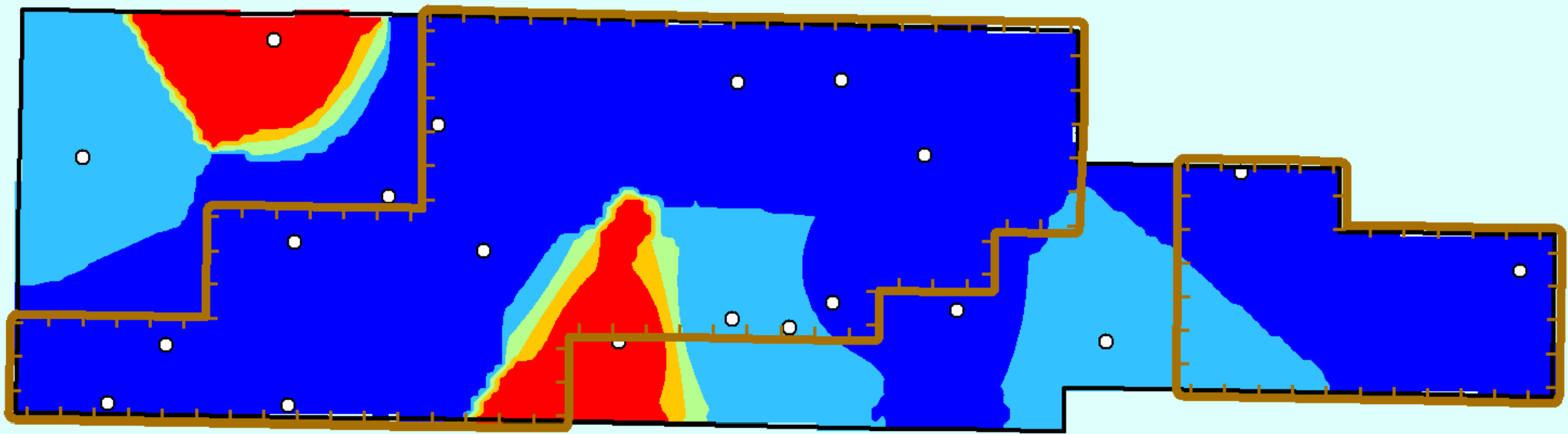
■ > 800 and $\leq 1,500$

■ $> 1,500$ and $\leq 2,200$

■ $> 2,200$

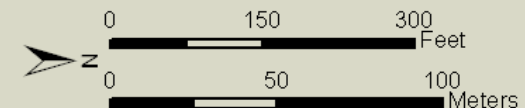
○ Surface sediment sampling location

□ Sand cover placement area



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Total PCB Concentrations in Surface Sediment 2 yrs after Placement of Sand Cover

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2007

Total PCBs ($\mu\text{g}/\text{kg dw}$)

Blue ≤ 260

Light Blue > 260 and ≤ 800

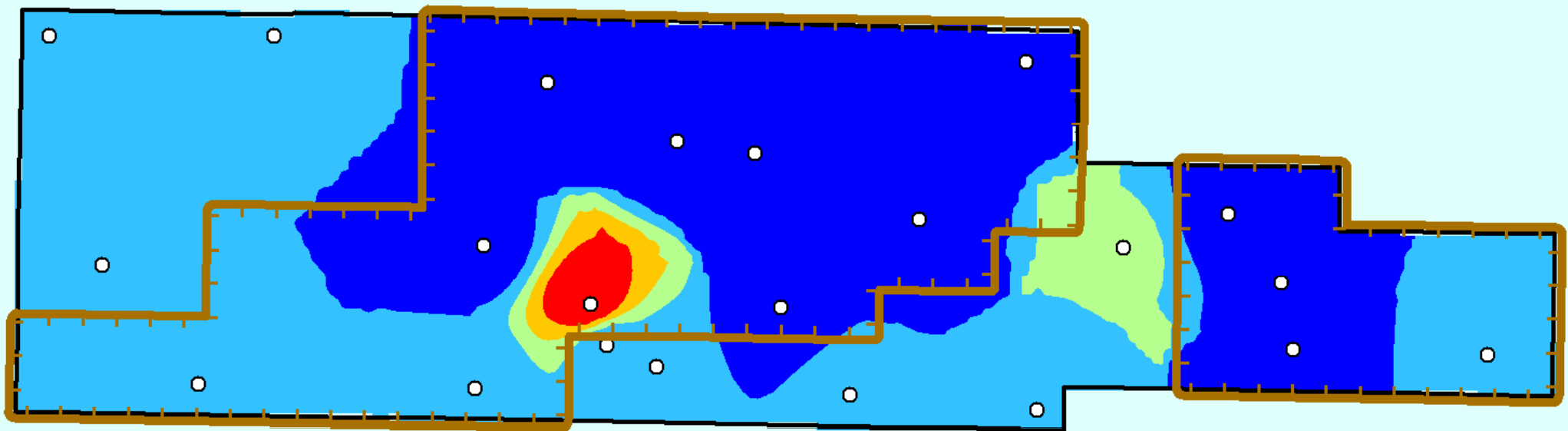
Light Green > 800 and $\leq 1,500$

Yellow $> 1,500$ and $\leq 2,200$

Red $> 2,200$

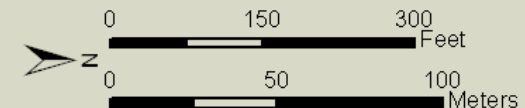
○ Surface sediment sampling location

□ Sand cover placement area



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Total PCB Concentrations in Surface Sediment 3 yrs after Placement of Sand Cover

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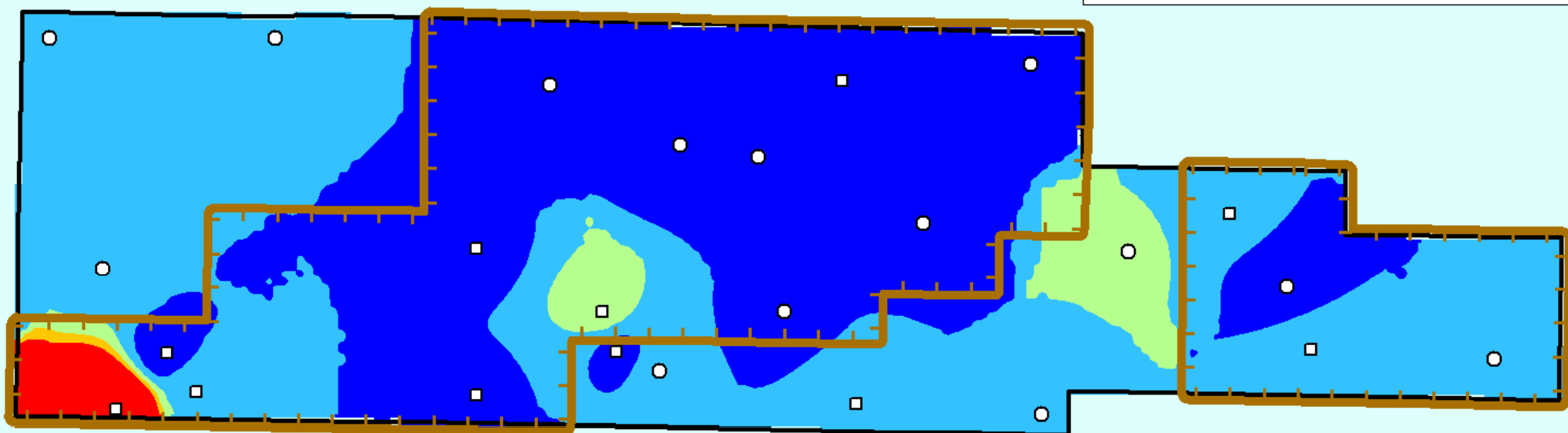
2008

Total PCBs ($\mu\text{g}/\text{kg dw}$)

- ≤ 260
- > 260 and ≤ 800
- > 800 and $\leq 1,500$
- $> 1,500$ and $\leq 2,200$
- $> 2,200$

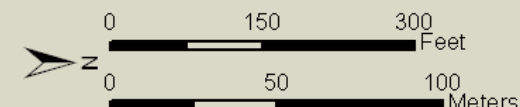
Surface sediment sampling location

- Recontamination Monitoring 2008
- Recontamination Monitoring 2007
- Sand cover placement area

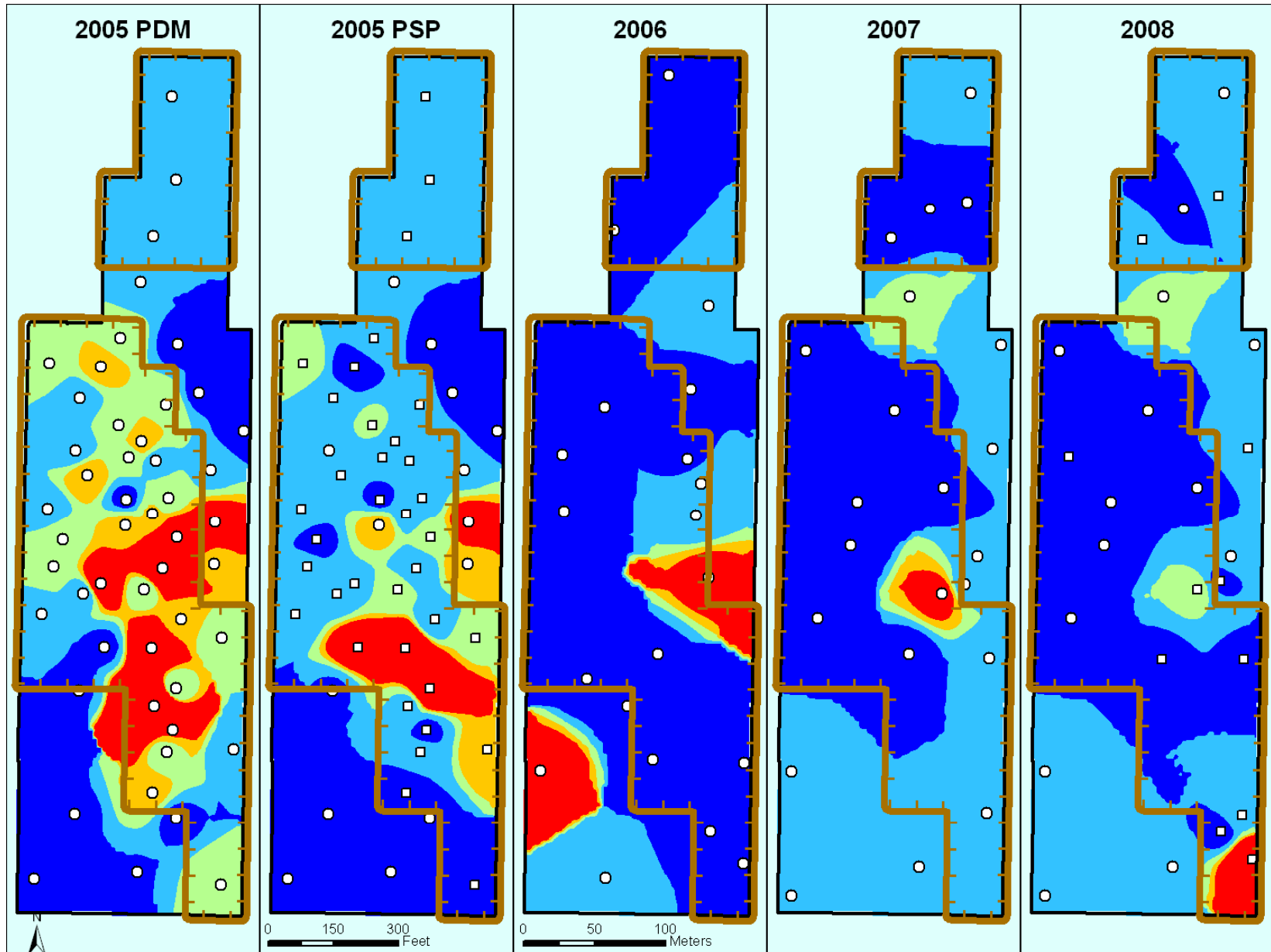


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PCB Concentrations Over Time



1,4-Dichlorobenzene Concentrations in Surface Sediment Immediately after Dredging

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2005

1,4-Dichlorobenzene ($\mu\text{g}/\text{kg dw}$)

■ ≤ 19

■ > 19 and ≤ 63

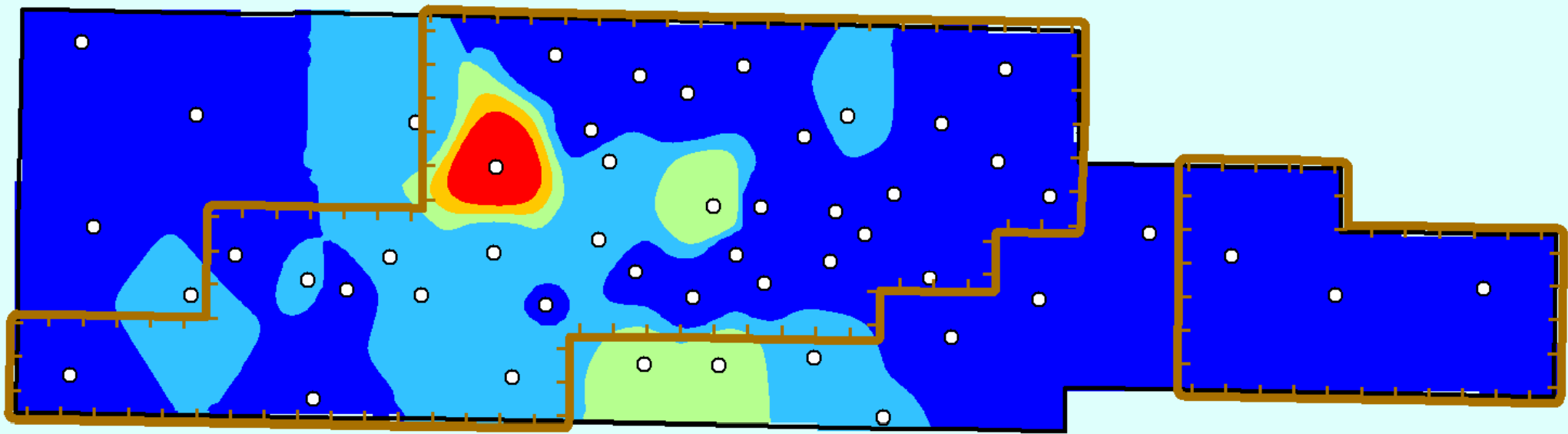
■ > 63 and ≤ 150

■ > 150 and ≤ 290

■ > 290

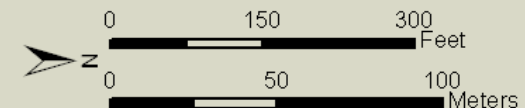
○ Surface sediment sampling location

□ Sand cover placement area



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1,4-Dichlorobenzene Concentrations in Surface Sediment 1 yr after Placement of Sand Cover

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2006

1,4-Dichlorobenzene ($\mu\text{g}/\text{kg dw}$)

■ ≤ 19

■ > 19 and ≤ 63

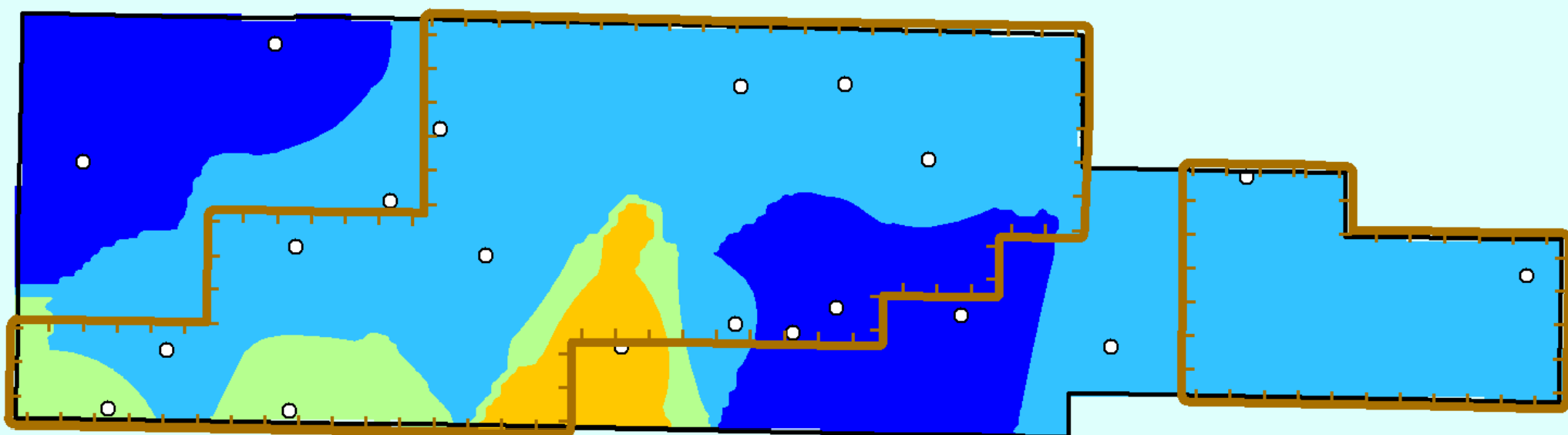
■ > 63 and ≤ 150

■ > 150 and ≤ 290

■ > 290

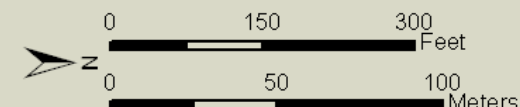
○ Surface sediment sampling location

□ Sand cover placement area



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1,4-Dichlorobenzene Concentrations in Surface Sediment 2 yrs after Placement of Sand Cover

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2007

1,4-Dichlorobenzene ($\mu\text{g}/\text{kg dw}$)

■ ≤ 19

■ > 19 and ≤ 63

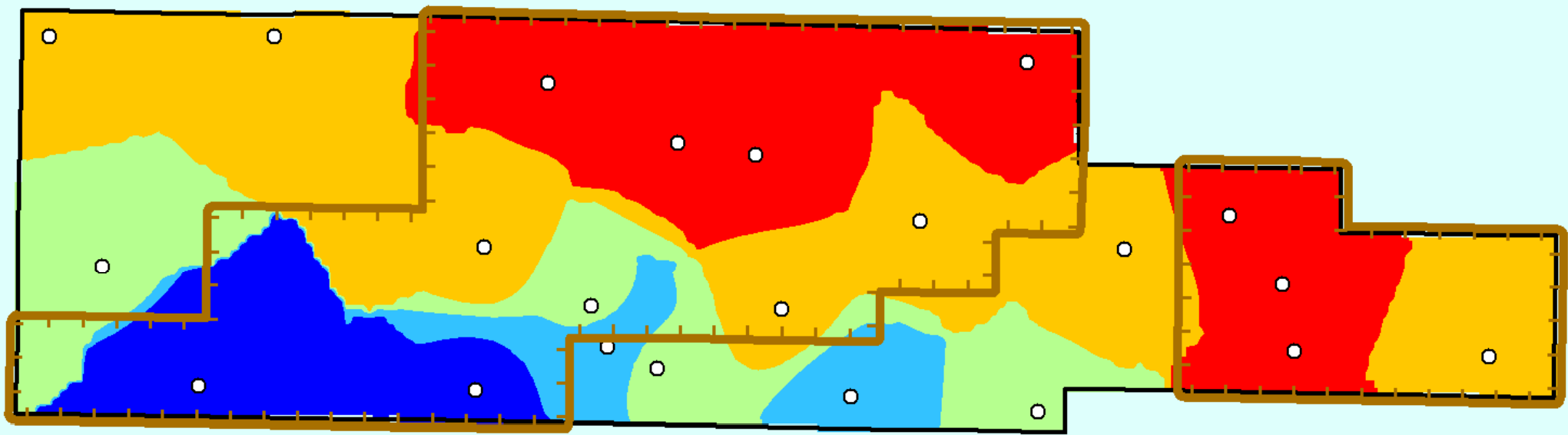
■ > 63 and ≤ 150

■ > 150 and ≤ 290

■ > 290

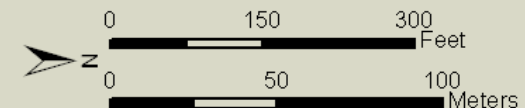
○ Surface sediment sampling location

□ Sand cover placement area



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1,4-Dichlorobenzene Concentrations in Surface Sediment 3 yrs after Placement of Sand Cover

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2008

1,4-Dichlorobenzene ($\mu\text{g}/\text{kg dw}$)

■ ≤ 19

■ > 19 and ≤ 63

■ > 63 and ≤ 150

■ > 150 and ≤ 290

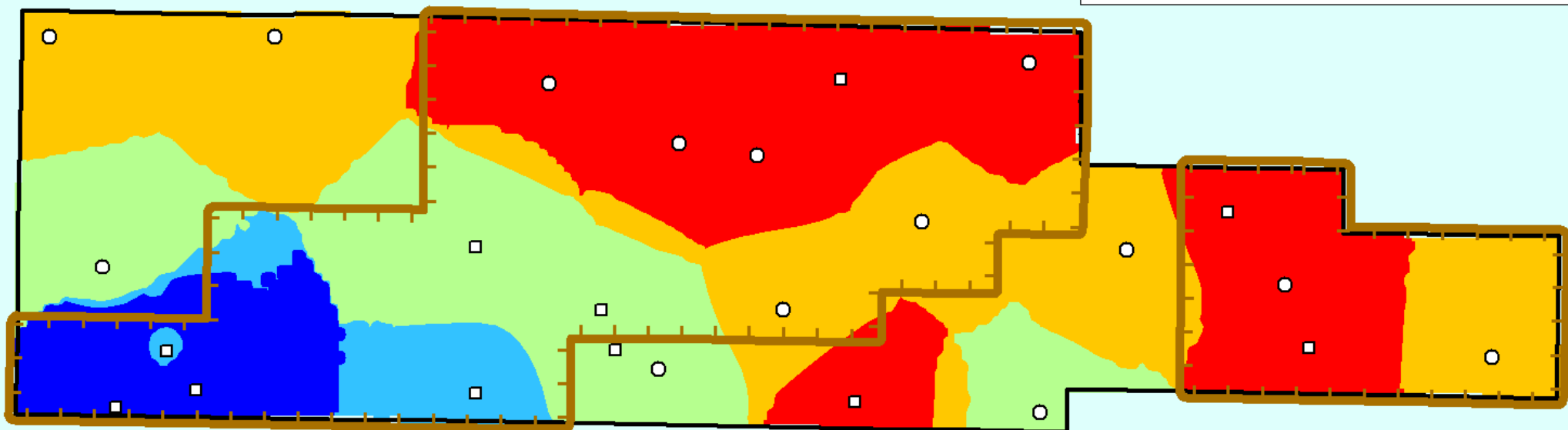
■ > 290

Surface sediment sampling location

□ EW RCM 2008

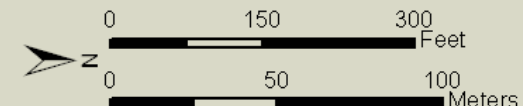
○ Recontamination Monitoring 2007

□ Sand cover placement area

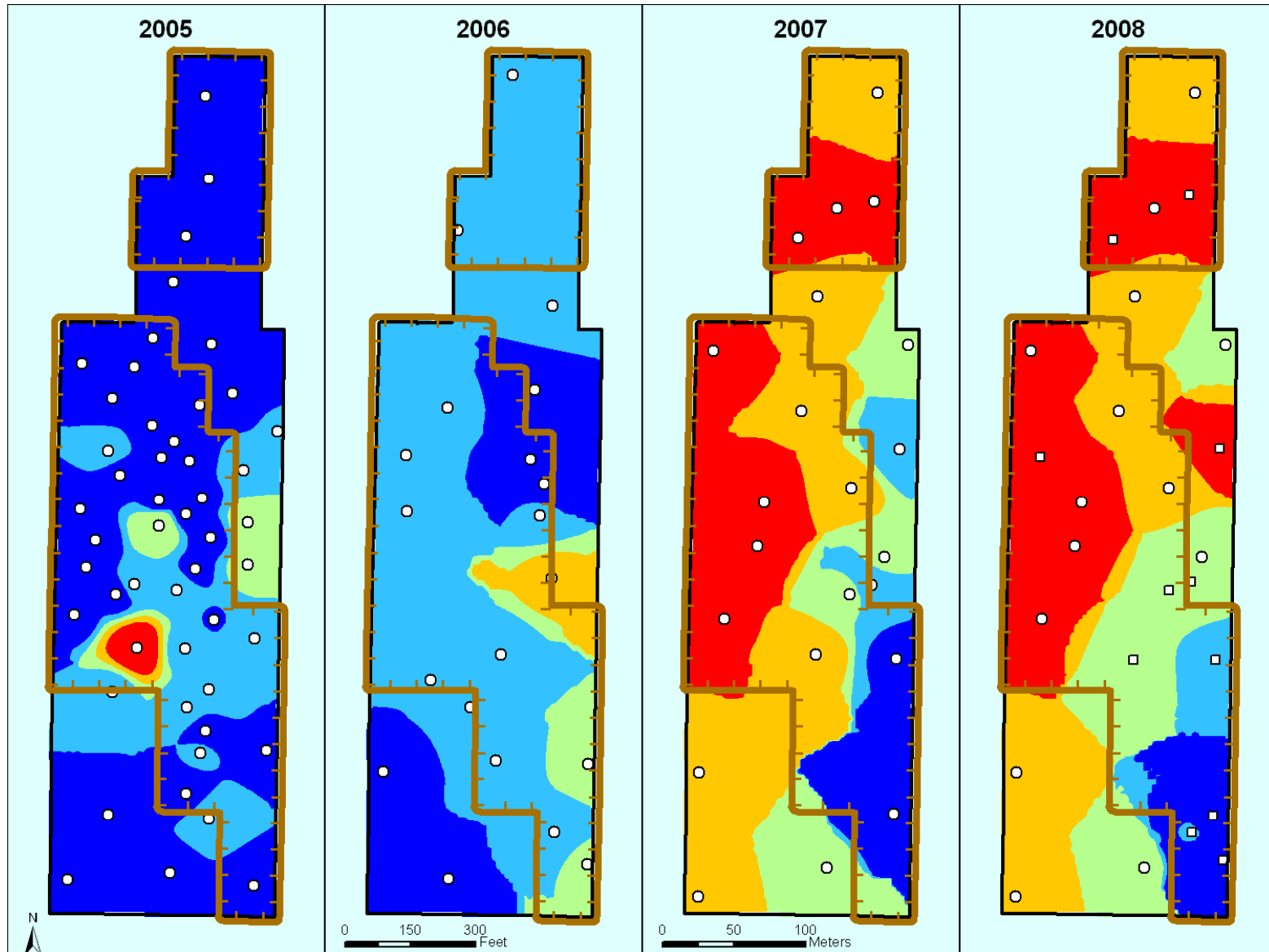


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1,4-Dichlorobenzene Concentrations Over Time



Conclusions

- Inclusion of contingency action in dredge plan enabled effective response to address contaminants in post-dredge surface sediment
- Sand cover material placement reduced surface sediment concentrations of PCBs and mercury
- Recontamination monitoring data show
 - Minimal recontamination for mercury
 - Total PCB concentrations were elevated at a few locations
 - 1,4-dichlorobenzene concentrations increased over time

Acknowledgements

- Ravi Sanga, EPA project manager
- Craig Hanson, Windward Environmental LLC