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MEMORANDUM

TO: Great Bay Municipal Coalition

FROM: John Hall, Bill Hall, Ben Kirby

DATE: March 4, 2015

RE: Annual Variation in Eelgrass Cover by Region in Great Bay

The spatial variability of eelgrass cover in Great Bay Estuary has been identified as an area for assessment by the peer review panel that evaluated the draft numeric nutrient criteria for the Estuary. This memorandum presents an evaluation of eelgrass spatial variability in Great Bay based on the mapping data provided by Dr. Fred Short for the period from 1986 through 2013. These data were provided as ArcGIS polygons illustrating the areas of measurable eelgrass growth as determined from aerial photography. Each polygon identifies the location of the bed and its associated acreage.

The bathymetry of Great Bay reveals the estuary's drowned ancient river beds (see Figs. 1, 2). Typical patterns of eelgrass cover are separated by these deep channels, where eelgrass cannot grow. As such, these channels made convenient boundaries to analyze eelgrass cover variability in distinct geographic regions of Great Bay. These regions, of approximately equal area, were designated the West, South, and East sectors (see Fig. 3). Individual ArcGIS polygons were categorized by geographical sector to evaluate annual change in eelgrass cover for each of the sectors. The total eelgrass area for each sector was summed and plotted by year to visualize localized variations in eelgrass coverage (see Fig. 4).

Eelgrass cover in the West sector has ranged from 817-544 acres over the period from 1990-2013, following a major outbreak of wasting disease from 1987-1989. Eelgrass in this sector has remained relatively stable, with several downturns followed by recovery. The declines in 1995 and 2002 totaled 27% and 28% of the pre-decline cover, with recovery the following year. Since 2006 this sector has had the most eelgrass cover of the three sectors. In 2006, when the other two

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sectors experienced a dramatic decline, the West sector remained stable and increased slightly (6%). The reduced cover in 2002-2003, when the sector was reduced to its minimum cover, was attributed to an outbreak of wasting disease.

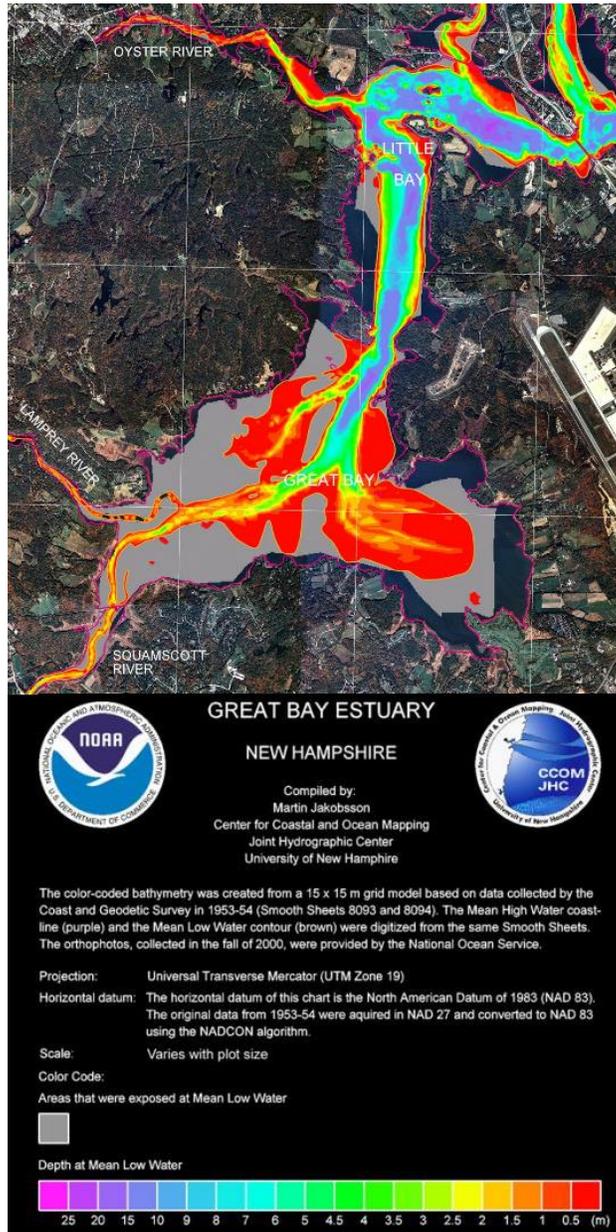
Eelgrass cover in the South section has ranged from 886-301 acres over the period of record (1990-2013). Eelgrass cover was very stable from 1990-2005, ranging from 750-886 acres. In 2006, the South sector experienced a steep decline to 301 acres (63% loss), coinciding with a period of high rainfall and regional flooding. Over the next three years, eelgrass cover increased to 561 acres. Since 2009, eelgrass cover has declined to 500 acres or less. An inspection of the annual eelgrass maps shows that an area along the coast which previously supported eelgrass has remained free of measurable eelgrass cover since 2006 (see Fig. 5). The area of this void was estimated in ArcGIS to be 150 acres. Eelgrass maps from 1998-2005 indicate that this area was previously covered by eelgrass (see Fig. 6). The prolonged period of no measurable eelgrass cover since 2006 suggests that the area may no longer be suitable as eelgrass habitat.

The East sector has fluctuated widely throughout the period of record, ranging from 851-207 acres. Eelgrass cover in this sector was relatively stable in the early 1990s, when eelgrass cover averaged about 800 acres. This period of stability has been followed by rapid change beginning in 1999 with eelgrass cover experiencing steep declines or rapid recovery during subsequent years. The periods of decline have been most severe in this sector, with significant multi-year eelgrass losses in 1999-2000 (44%), 2002-2003 (65%) and 2006-2007 (69%). As with the South sector, this sector experienced a sharp decline in 2006. An area devoid of measurable eelgrass appeared in 2006 (see Fig. 5). This void covers approximately 15 acres and may represent an area no longer suitable as eelgrass habitat.

These observations suggest that the South and East sectors deserve additional attention to assess the reasons why eelgrass no longer appears able to establish measurable stands in the areas identified in Figure 5. Moreover, eelgrass cover in the East sector is highly variable, with large annual shifts in cover. The cause for these changes is worthy of additional investigation.

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Figure 1: Great Bay Bathymetry



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Figure 2: Great Bay - August 8, 2006 (Google Earth)



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Figure 3: Great Bay Sectors (Map of 1996 Eelgrass)

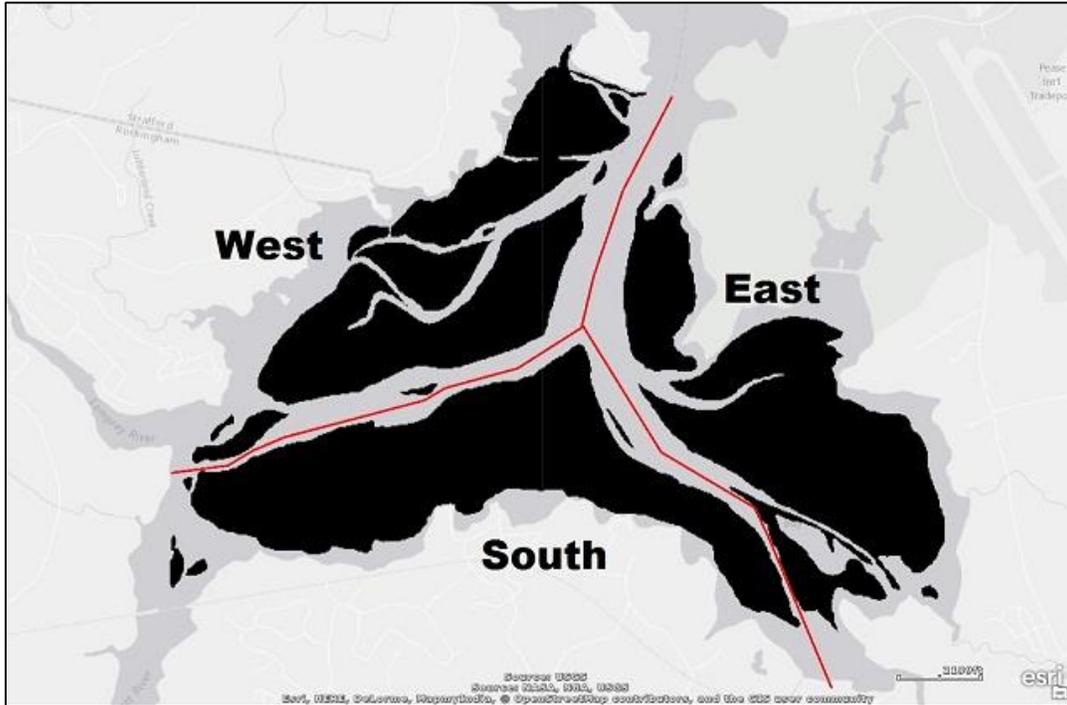
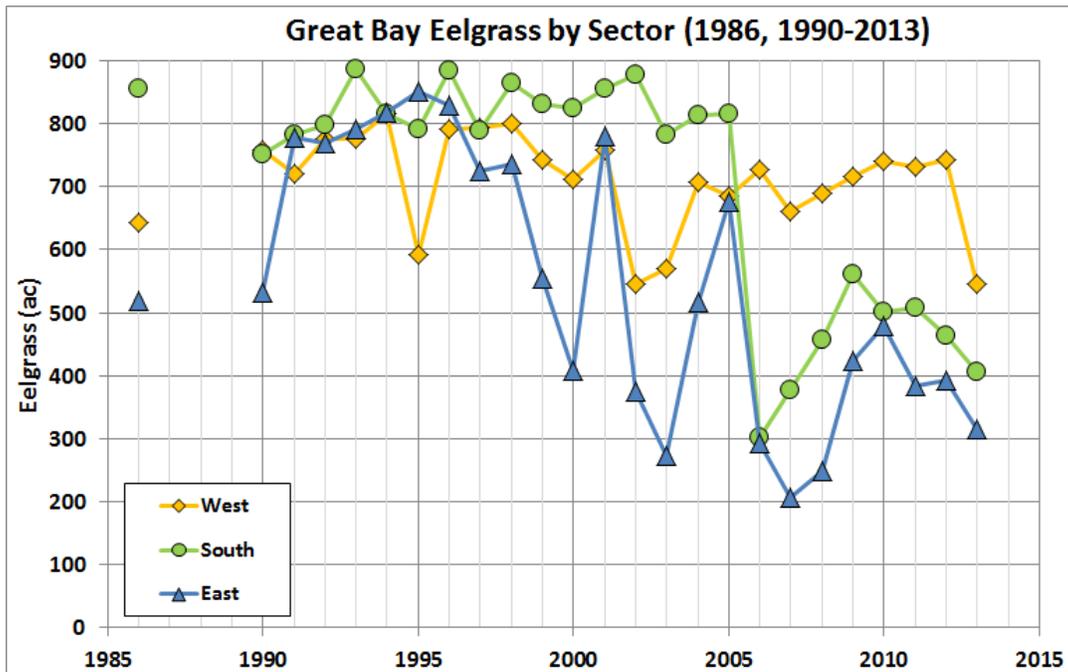


Figure 4: Great Bay Eelgrass by Sector



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Figure 5: All Great Bay Eelgrass Coverage (2006-2013)

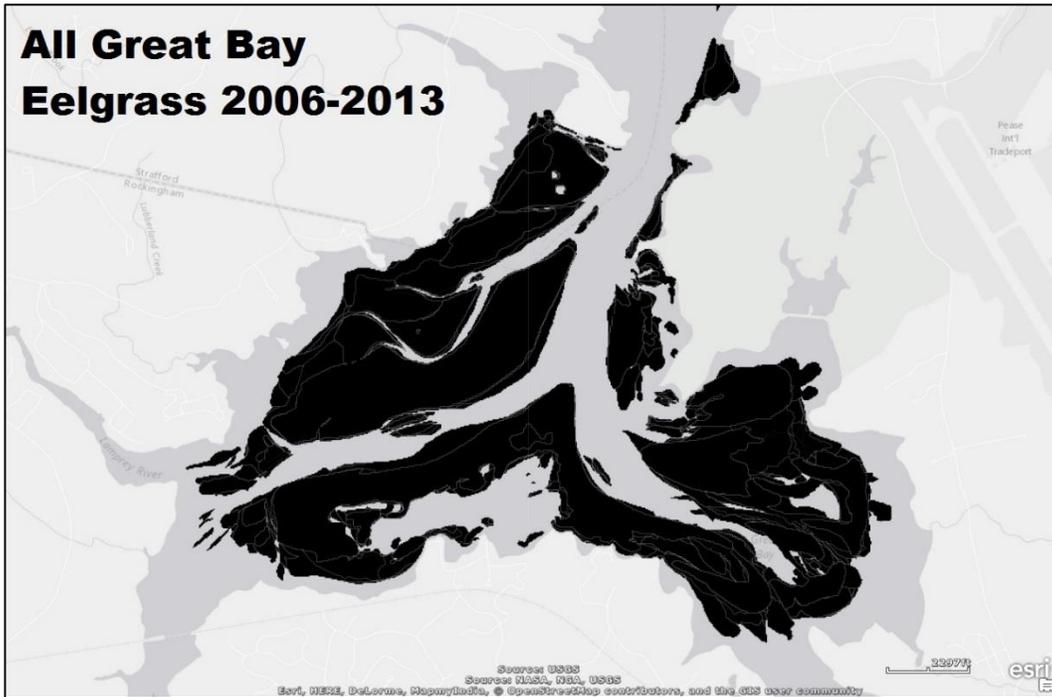


Figure 6: All Great Bay Eelgrass Coverage (1998-2005)

