

## West Kitsap Addendum

To: East Kitsap County Nearshore Habitat Assessment and Restoration  
Prioritization Framework

Chaeli Judd

Battelle Marine Sciences Laboratory,  
Sequim, Washington

*Part of:*

Battelle Memorial Institute, Pacific Northwest Division  
Richland, Washington 99352

Prepared for:

Kitsap County, Department of Community Development  
Port Orchard, Washington 98367

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## Errata

The purpose of this revision is to provide corrected figures for site scores. Buoys and pilings were standardized based on percent shoreline in West Kitsap, but were reported as count per 1000 ft in East Kitsap. The same cutoffs for group categories were used, leading to an interpreted lower level of disturbance for some nearshore assessment units (NAUs). This revision provides updated figures, including the standardized number as a count per 1000 ft. These changes impact NAU controlling factor ranks for 13 NAUs and recommended site restoration for processes for 9 NAUs as well as slightly altering averages and counts of NAUs in each class.

A summary of changes in this revision is provided in the table below, updated scores for individual sites are reported in the appendices.

Page	Revision
10	Average scores reported for controlling factors and processes in first and second paragraph updated. Wave Energy, Fluvial Deposition and Sediment Transport reported as having the lowest process disturbance score.
11	Table I-4. NAU disturbance for controlling factors and dominant processes averages and ranges updated.
16	Last bullet updated with new percentages.
Appendices	Update reporting tables and maps. NAU site ID with change in controlling factor group: 787, 797, 817, 828, 840, 892, 912, 923, 924, 935, 954, 956 and 969  NAU site ID with change in recommended restoration of site processes: 797, 809, 836, 840, 853, 878, 881, 892, and 969

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Addendum Appendix A: Tables of Edits

Addendum Appendix B: Tables of Processed Data & Scoring Results

Addendum Appendix C: Maps of Score Results

Addendum Appendix D: Maps of Recommended Management Options

Addendum Appendix E: West Kitsap Restoration Projects and Scoring Results

## 1.0 Introduction

Through the East Kitsap County Nearshore Assessment, a methodology was developed to evaluate nearshore disturbances and ecological health and prioritize restoration decision-making along the shorelines of East Kitsap. The purpose of this follow-on project is to extend the Nearshore Assessment methodology to West Kitsap County. Geospatial field data collected by the Kitsap County Department of Community Development (KCDCD) were used as a primary basis for quantifying nearshore habitat modification and habitat structural attributes (KCDCD 2008).

As the premise and methods are described in the main section of this report, this addendum will document:

- 1) Initial considerations of differences between East Kitsap and West Kitsap shorelines
- 2) Changes in methodology or data sources for West Kitsap Assessment
- 3) Results for West Kitsap County
- 4) Recommendations for future consideration.

For ease of reference, the structure of this addendum will follow the structure of the East Kitsap County Nearshore Assessment Report (Borde et al. 2009).

### 1.1 Study Area

The area examined in the West Kitsap Assessment includes the Hood Canal region of Kitsap County, from Foulweather Bluff near Admiralty Inlet south to the county line (Figure I-1).

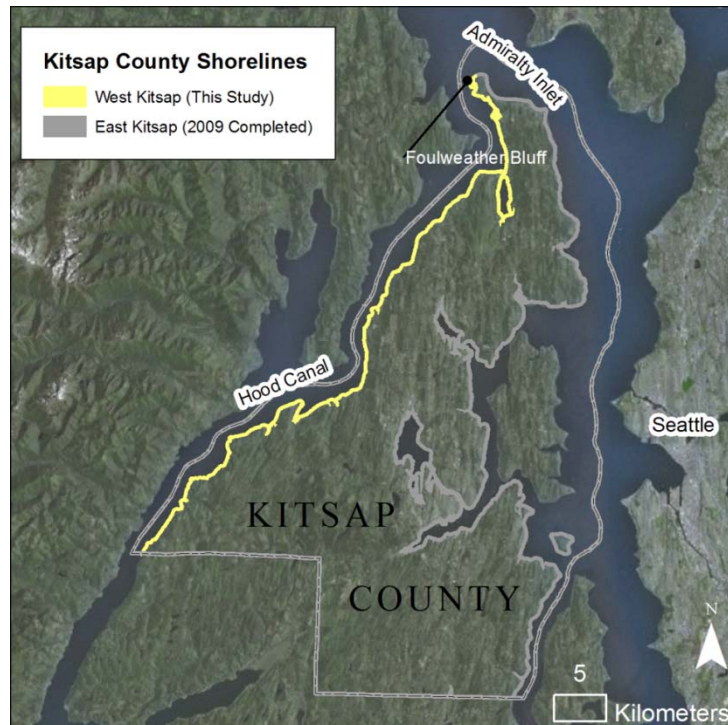


Figure I-1. West Kitsap County Study Area. Project focuses on Hood Canal facing shoreline, highlighted in yellow.

## 2.0 Methods

The assessment approach was originally developed for East Kitsap County in 2008, and through this study, the approach was applied to West Kitsap County in 2009. Scoring of level of disturbance occurs on two scales, a site scale and a landscape scale, wherein individual units are rated from Low to High based on the assessed level of disturbance to *controlling factors* and *processes*. In all cases, the same controlling factors and processes are evaluated, using the same stressors to evaluate level of disturbance as were used for East Kitsap County. However, in three cases, the source for the datasets changed. In addition, interpretation of how to evaluate military lands was refined for West Kitsap shorelines.

In East Kitsap County, assessment units are grouped into quintiles based on the dominance of a stressor relative to the levels of that stressor in other sites within the study area. East Kitsap County contains more urban and developed areas than West Kitsap County, so if quintiles were to be calculated over the entire study area, the range in each group would change slightly. However, for the purpose of consistency, the same quintile groupings were used on both sides (Sec 3.1, Table 8, East Kitsap County Nearshore Assessment Report) (Borde et al. 2009). The following provides further details on methods for West Kitsap County.

### 2.1 Spatial Scale

As with the East Kitsap County Assessment, we used two spatial units in our West Kitsap analysis: drift cell and nearshore assessment unit (NAU). Dimensions and processes for creation of these units are documented in the main report (Borde et al. 2009). By 2009, a separate work effort had been completed on creating drift definitions across Puget Sound. Rather than create separate drift definitions, the completed version was acquired from the Puget Sound Nearshore Partnership (PSNERP) ([ftp://ftp.usace.army.mil/pub/nws/PSNERP\\_CA/](ftp://ftp.usace.army.mil/pub/nws/PSNERP_CA/)) and used to identify drift boundaries. Further edits, both in attributes and geometry, are summarized in Addendum Appendix A, Table A-1. Watershed units also were used to evaluate impervious surface on uplands, as with East Kitsap County. Watershed boundaries were determined from Kitsap County Salmonid Refugia Study (May and Peterson 2003).

A total of 217 NAUs and 35 drift cell units were created. In addition, sixty watershed units were identified for use in this analysis.

### 2.2 Defining Dominant Physical Processes

In East Kitsap County, a draft version of dominant process developed by the Point No Point Treat Council (PNPTC) and Aundrea McBride and modified for use in PSNERP was used to define dominant physical processes in each NAU. By the time this assessment began, a final version had been developed and distributed by PSNERP (Anchor QEA 2009). Between our earlier implementation in East Kitsap and this implementation, there were some slight differences in distribution of Beach Seeps and definition of Modified areas.

#### *Beach Seeps*

Unlike the East Kitsap shoreline, in West Kitsap five NAUs are solely classified as beach seeps. According to the PNPTC classification, zones identified as beach seeps are sediment source beaches that contain streams (Todd et al. 2008). Theoretically, dominant processes should be the same as those used for sediment source beaches as the beach seeps, only with the addition of fluvial deposition. Therefore, these five units were classified for this project as *Sediment Source and Transport* with *Beach Seeps* present.



### ***Modified***

Some units contain a geomorphic classification of *Modified*, which can be interpreted that the original dominant processes of the shoreline unit have been altered to the extent that they no longer function as they did historically. However, it must be remembered that though they do not function as they did historically, processes such as sediment transport and fluvial deposition still occur at these sites. In the East Kitsap assessment, one of the uses of the modified classification was to indicate areas that could not be reached with a field assessment and with highly altered geomorphology.

In this assessment, each unit with a *Modified* classification was reviewed to judge whether the *Modified* category should stand. The 11 modified units fall within two areas: Coon Bay and the entrance to Port Gamble Bay (Figure I-2). The entrance to Port Gamble Bay is classified as modified, and is the location of sites 830-834. While armoring is identified in Kitsap Nearshore Inventory, no nearshore features, such as overwater structures, are marked. On the other hand, Coon Bay is classified as *Modified* and nearshore features as well as armored structures are identified in the inventory. Units classified as *Modified* within the embayment were re-classified as *Tidal Channel Lagoon*, the same classification as the adjoining sites in the bay, while one NAU, located outside the embayment, was re-classified as *Barrier Beach*.

Changes to these units are documented in Table A-2 in Addendum Appendix A.

### ***Multiple Geomorphic Types per Unit***

Sites with multiple geomorphic types per unit were decided on a case-by-case basis. Table A-1 in Addendum Appendix A summarizes these decisions. In some cases, the unit was split to create a new unit, or edited to adjust the boundary. In other cases, the dominant-type process was used.

However, 10 units were kept intact and are represented classified as containing the processes of two geomorphic classifications. This decision occurred when dividing the unit did not make sense, either the new units would be very small or there was one classification on either side of a second classification. Therefore, in these units, there may be a unit defined as having both a sediment source beach (dominant processes of wave erosion, sediment transport) and depositional beach (dominant processes of wave deposition). All three dominant processes would be attributed to the unit.



Figure I-2. Shoreline oblique imagery (Ecology) of units with *Modified* geomorphic classification. Entrance to Port Gamble Bay (left) and Coon Bay (right).

## 2.3 Data Compilation and Processing for Stressors

Under data compilation and processing, datasets which represent stressors are compiled, evaluated and the presence, count, area, or length of the stressor present in each NAU is recorded. A full discussion can be found in Borde et al. 2009, Sec 2.4. New data from the Nearshore Inventory was reviewed and edited to assure data quality. Similarly, data from outside sources and assumptions were reviewed. A summary of changes from outside sources can be found in Table I-1. Finally, representation of three stressors was modified based on new data sources. These features include Outfalls, Water Quality, and Impervious Surfaces.

Table I-1. Summary of dataset changes for assessment.

<b>Dataset</b>	<b>Action</b>	<b>Explanation of Change</b>
Agriculture	Eliminated	These were recorded but not used in the final assessment for East Kitsap County (Borde et al. 2009), and thus were eliminated from the West Kitsap County Assessment.
Areas of Lost Historical Streams and Marshes	Eliminated	
Heavily Modified	Redefined into two classifications	In East Kitsap, the Heavily Modified classification was used to provide a way to score sites that the field crew was unable to access such as the Bremerton urban center with naval shipyards. Similarly, in West Kitsap County, there were heavily developed areas that the field crew was unable to access, as mentioned above. In addition, there were portions of military zones that were also difficult to access. These areas often had large overwater structures and few other structures. Many features could be captured through digitizing the features from aerial photos. However, capturing other features was more difficult. To capture this discrepancy between East and West Kitsap, the heavily modified classification was divided between two new classifications: a Heavily Modified classification, which represented both the developed modified areas and the military facilities, and a Developed Modified classification, which represented only the developed modified areas.
Fish Barriers	Added, but not used in scoring	These datasets provide additional information at the watershed level and were recorded for each watershed of interest as ancillary information.
Fish Presence	Added, but not used in scoring	
303d Stream Water Quality	Added, but not used in scoring	
Outfalls	New data source	An additional validation step was incorporated into outfall selection. In the East Kitsap Assessment, only outfalls that exceeded a certain diameter were counted. In this assessment, we used the Kitsap County's Surface and Storm Water Management (SSWM) outfall database to validate those selected. We included all outfalls above the size criteria and included outfalls in the inventory, which fell

Dataset	Action	Explanation of Change
		below that criteria but were monitored by the SSWM as well. All features were reviewed and edited for the above conditions; duplicate values were eliminated. A total of 14 new outfalls were added to the dataset
Water Quality (Marine & Stream)	New data source	New 303d and 305b datasets were created by the Washington State Department of Ecology (Ecology) in 2009. These datasets encompass marine water quality, sediment quality, and stream water quality. Instead of recording these as one attribute, they are recorded separately.
Impervious Surface	New data source	In the East Kitsap Assessment, the National Land Cover Dataset (NLCD) classification of impervious surface was used. This classification has a resolution of 30m, which is large for assessing impervious surface in a 200ft (~61m) buffer. The Hood Canal Coordinating Council (HCCC) dataset was selected for this assessment. It was recently completed (PetersonGIS), and has a slightly higher resolution and has minimal misinterpretation of nearshore bare earth as impervious surface.

## 2.4 Assessment Scoring and Weighting

The same controlling factors and dominant physical processes were considered in West Kitsap County as East Kitsap County (refer to Section 2.5 of East Kitsap County Final Report) (Borde et al. 2009). Likewise, the same quintile limits were used for scoring stressor disturbance (East County Final Report, Table 8) (Borde et al. 2009); however, there were some minor adjustments in the weighting of stressors.

Heavily Modified Areas on East Kitsap County represented a unique area of the heavily developed Bremerton downtown and Naval Shipyard Shoreline. While the military and modified shorelines on West Kitsap County introduce areas of intense industrial development overwater, the impact on water quality is less certain. The new Ecology 303d dataset used provides information on water quality specific to these areas. Therefore, Heavily Modified Areas were not negatively scored for water quality (Table I-2).

Though there is no change in the scoring of site disturbance processes, the classification of “modified unreachable” was applied to areas with a geomorphic classification of *Modified*. Similarly, there were no changes in the drift cell scoring.

**Table I-2. New Weighting – Controlling Factors for West Kitsap County. Low (L) = 1, Medium (M) =2 and High (H) = 3. Wave Energy was scored depending on whether a unit was classified as an estuary (E), Open shoreline (O), or Rocky shoreline (R) (Borde et al. 2009). The only element that differed was how Heavily Modified Areas were interpreted to impact Water Quality.**

Direct Disturbance	Substrate Type	Wave Energy (E)	Wave Energy (O)	Wave Energy (R)	Depth / Slope	Light	Frequency of Disturbance	Water Quality
Stairs to Beach							L	
Paths							L	
Access Areas							L	
Armoring	L	L	H	L				
Boat Launches	L		L					
Buoys	L						L	
Outfalls on Beach	L				L	L		L
Culverts								L
Floats & Docks w/ Floats						M		
Piers & Docks (platform only)						L		
Pilings (includes piers with pilings)		L	M	M			M	
Marinas		L	H	H	M	H	H	M
Overhanging Structures			L	L		M	M	
Groins			L	M				
Heavily Modified Areas		H	M	H	M	M	H	Differ <sup>1</sup>
Net Pens	L		L	M				M
Water Quality								H
Impervious Surface 200 ft								L
Navigation Channel	H	H	M	L	M			
<b>Total Potential Score<sup>2</sup></b>	40	45	80	75	35	55	70	50

<sup>1</sup> Heavily modified areas were not used in assessing Water Quality in the West-side assessment. These areas are defined to include both urban and modified military areas. The level of stress in these areas differ from those in the East-side assessment. There is less land-based development, and the recently updated 303d data provides more information on both water quality and sediment quality. Thus, it was eliminated as a factor for Water Quality.

<sup>2</sup> Total Potential Controlling Factor Score for each NAU = Sum (Stressor Score \* Weighting). Stressor scores have a value of 0 – 5 based on the level of occurrence per NAU. Weighting of importance of the stressor disturbance for the controlling factor can either be Low (1), Medium (2) or High (3). Refer to Borde et al. 2009, Sec 2.5.2 for further discussion.

### 3.0 Results and Discussion

#### 3.1 Nearshore Assessment Summary

The West Kitsap County shoreline used in this assessment measures 357,060 linear feet (67.6 miles), totaling 218 miles assessed in the combined work product between East and West Kitsap. The longest shoreline unit is 13,245 linear feet (2.51 miles), located south of Bangor, and the shortest nearshore unit is only 170 linear feet (0.03 miles), near the entrance to Port Gamble (Figure I-3). The mean shoreline length is 1,645 linear feet (0.31 miles).

In West Kitsap County, 35 drift cells were evaluated, composed of 217 individual NAUs. Multiple geomorphic classifications were present, the three most common being sediment source and transport beaches, barrier beaches, and deltas. In contrast to East Kitsap County, no pocket beaches or rocky beach classifications were present (Table I-3).

Within the study area’s 200-foot riparian zone, an average of 9% of the area is impervious (e.g., paved surfaces, roofs). Approximately 25% of West Kitsap County shoreline is modified by armoring.

**Table I-3. Geomorphic Classification on West and East Kitsap County**

Landforms	East Kitsap Units	West Kitsap Units	Total
Barrier Beach	56	41	97
Beach Seep	5	15 (not classified as primary)	20
Delta	46	32	78
Delta Lagoon	8	2	10
Depositional Beach	39	16	55
Drowned Channel	16	3	19
Drowned Channel Lagoon	22	11	33
Longshore Lagoon	4	1	5
Modified	30	6	36
Pocket Beach	2	0	2
Pocket Beach Lagoon	4	0	4
Rocky Beach	23	0	23
Sediment Source/Transport Beach	204	179	383
Tidal Channel Lagoon	1	7	8
Tidal Channel Marsh	18	0	18
Tidal Delta	13	0	13
Tidal Delta Lagoon	2	8	10
Veneered Rock Platform	16	0	16



Figure I-3. Ecology Shoreline Obliques 2006. These capture both the longest NAU (top) and the shortest (bottom). Note that the longest shoreline unit is measured by the length of shoreline around the inlet, not the vertical length.

### 3.1.1 Disturbance Scoring

West Kitsap County’s shoreline is less developed than East Kitsap, but still has a diverse set of disturbances potentially affecting nearshore habitats. These disturbances range from low-density development to commercial facilities to moderate-density residential development. Appendix B has a complete list of scores.

#### *Drift Cell Process Disturbance Scores*

The average of all drift cell process disturbance scores was 1.6 on a scale of 1.0 to 3.0, representing a low-to-moderate disturbance. This was lower than the 2.1 average for East Kitsap Drift Cells. The Mean Fluvial Deposition disruption score was 1.5; the Longshore Transport mean score was 1.9 and 1.5 for Tidal and Wave processes, respectively. Drift Cells 12 and 13 near Port Gamble contain the highest level of disturbance, achieving a “High” disturbance score in Fluvial Deposition, Longshore Transport, and Tidal and Wave Processes (Figure I-4).

Nine drift cells were ranked as having the least disturbance to landscape nearshore processes (Score = 1.0). Sites ranged from Foulweather Bluff in the north to Stavis Bay in Southwest Kitsap County (Figure I-6). While more detailed maps can be found in Addendum Appendix C, Figure I-6 provides an overview of drift cell scores.

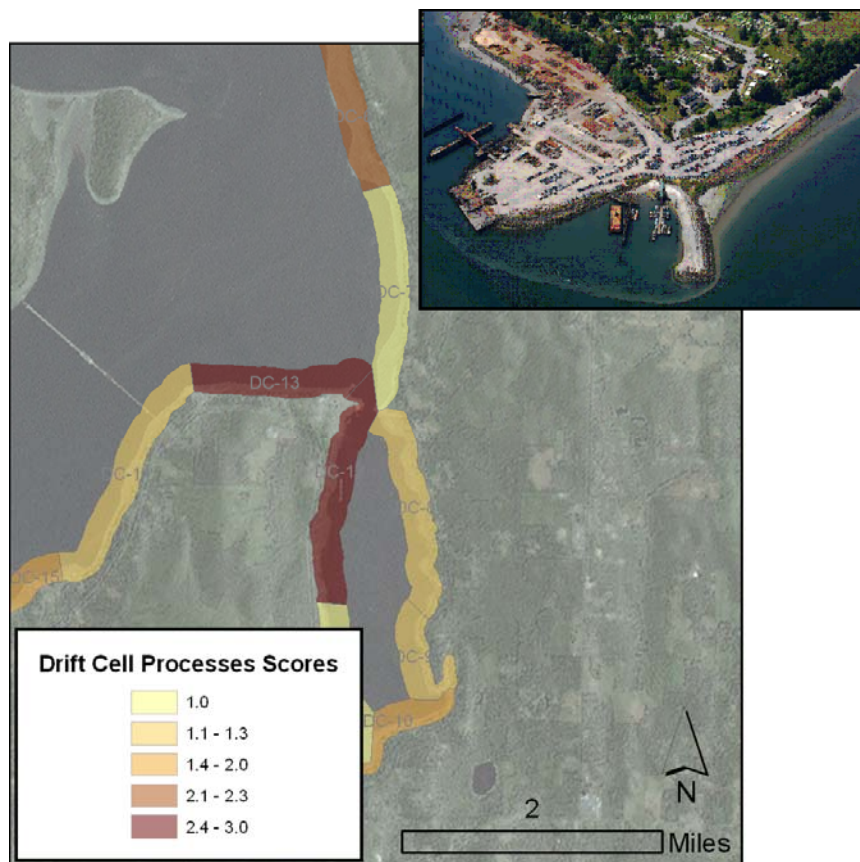


Figure I-4. Disturbance Scores for Drift Cell Processes at the entrance to Port Gamble Bay are the highest across the West Kitsap Shoreline.

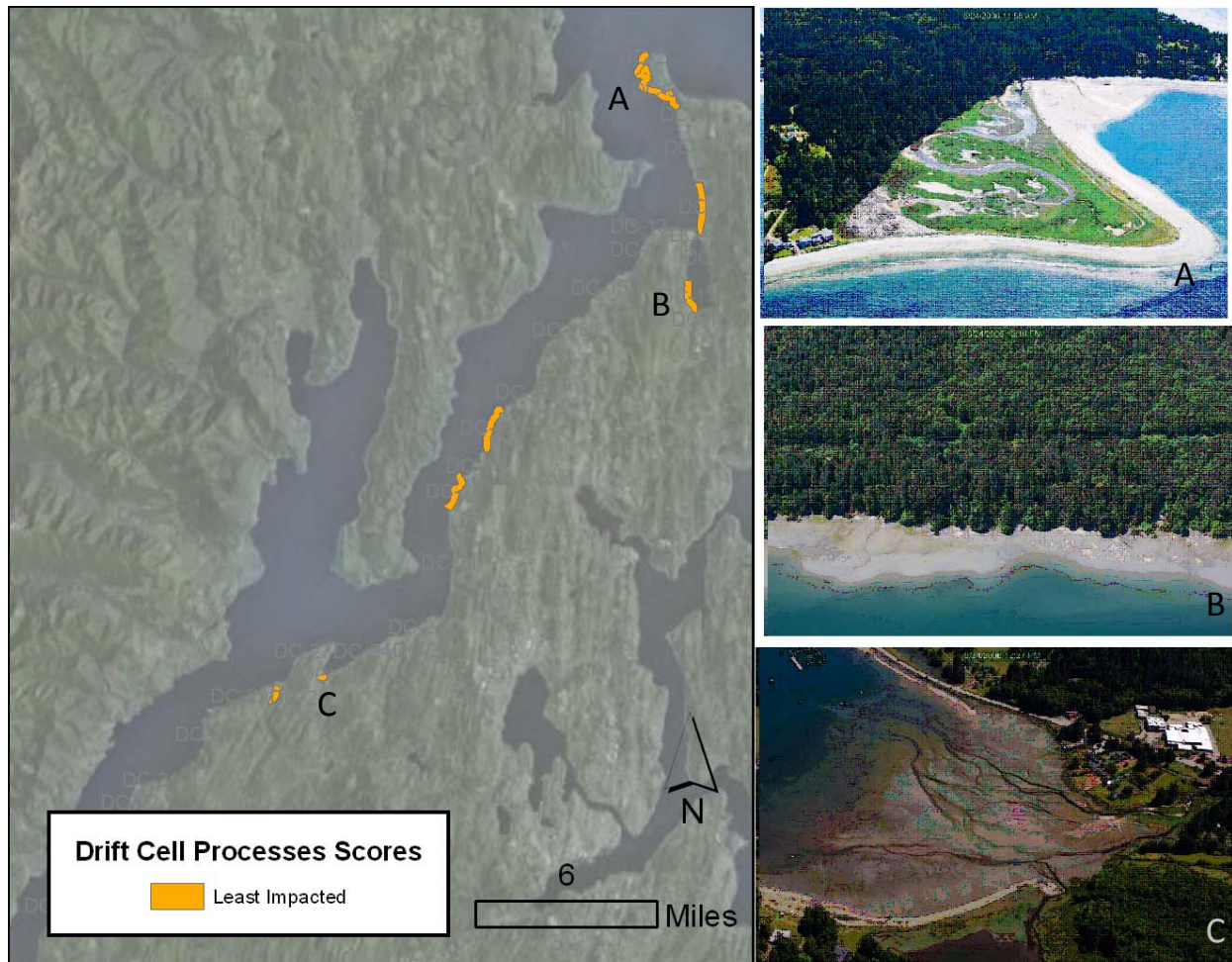


Figure I-5. Drift Cells with Processes Scoring least impacted. Foulweather Bluff (A), portions of Port Gamble Bay (B), and the bottom of Seabeck Bay (C). Note that while the top two locations appear in a relatively unimpacted condition, the upper portion of Seabeck drift cell appears to have some direct disturbance with nearshore fill for a road that was not captured in the GIS dataset.

*Site Controlling Factor and Processes Disturbance Scores*

On a scale of 0.00 to 1.00, the average standardized controlling factor disturbance score of all NAUs was 0.12 versus an average of 0.15 for East Kitsap, though both fall within the “Moderate” disturbance category (Table I-4). While in East Kitsap, substrate type and wave energy had higher means than other elements, in West Kitsap, the average score was similar for all controlling factors (Figure I-7).

The average for processes disturbance scores for all West Kitsap NAUs was 0.16 on a scale of 0.00 to 1.00. Sediment Transport, Wave Erosion and Fluvial Deposition had among the lowest disturbance scores while Tidal Erosion had the highest score (Table I-4). Site process disturbance fell in the low category in most cases (Figure I-8)

Detailed maps of West Kitsap County disturbance scores can be found in Addendum Appendix C.



Table I-4. NAU disturbance for controlling factors and dominant processes. West Kitsap County.

NAU Metric	Average West Kitsap Score	Range
<b>Controlling Factor Disturbance Score</b>		
Substrate Type	0.12	0.0-0.70
Wave Energy	0.11	0.0-0.51
Depth/Slope	0.08	0.0-0.57
Light	0.11	0.0-0.63
Frequency of Disturbance	0.13	0.0-0.69
Water Quality	0.15	0.0-0.60
All Controlling Factors	0.12	0.0-0.53
<b>Processes Disturbance Score</b>		
Wave Deposition	0.19	0.0-0.55
Tidal Erosion	0.20	0.0-0.54
Fluvial Deposition	0.15	0.0-0.62
Sediment Transport	0.15	0.0-0.53
Wave Erosion	0.14	0.0-0.57
All Processes	0.16	0.0-0.57

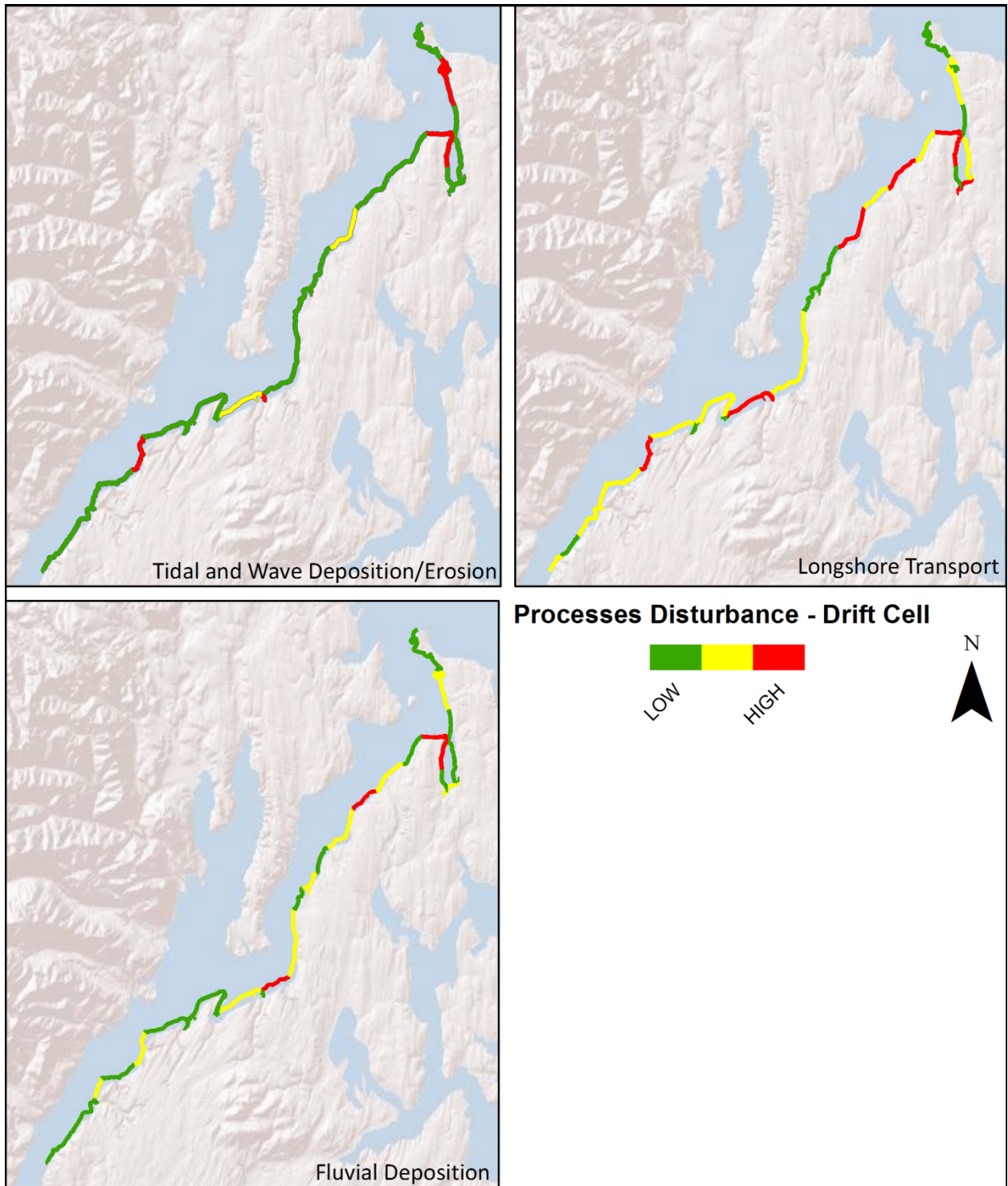
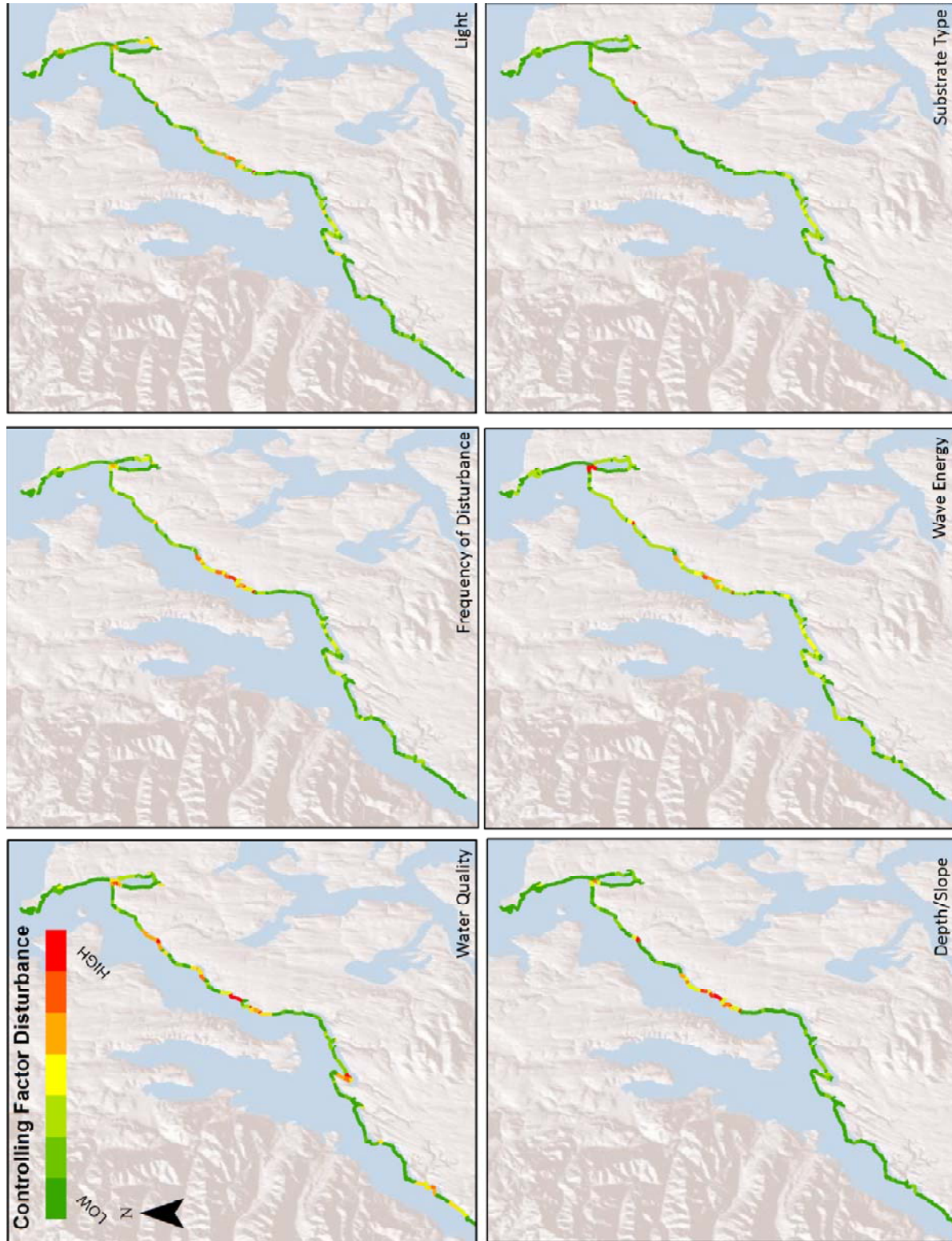


Figure I-6. Drift cell process disturbance scores ranging from Low to High in West Kitsap. These rankings were averaged for a total disturbance level per drift cell for processes.

Figure I-7. NAU level of stress for each of the controlling factors.



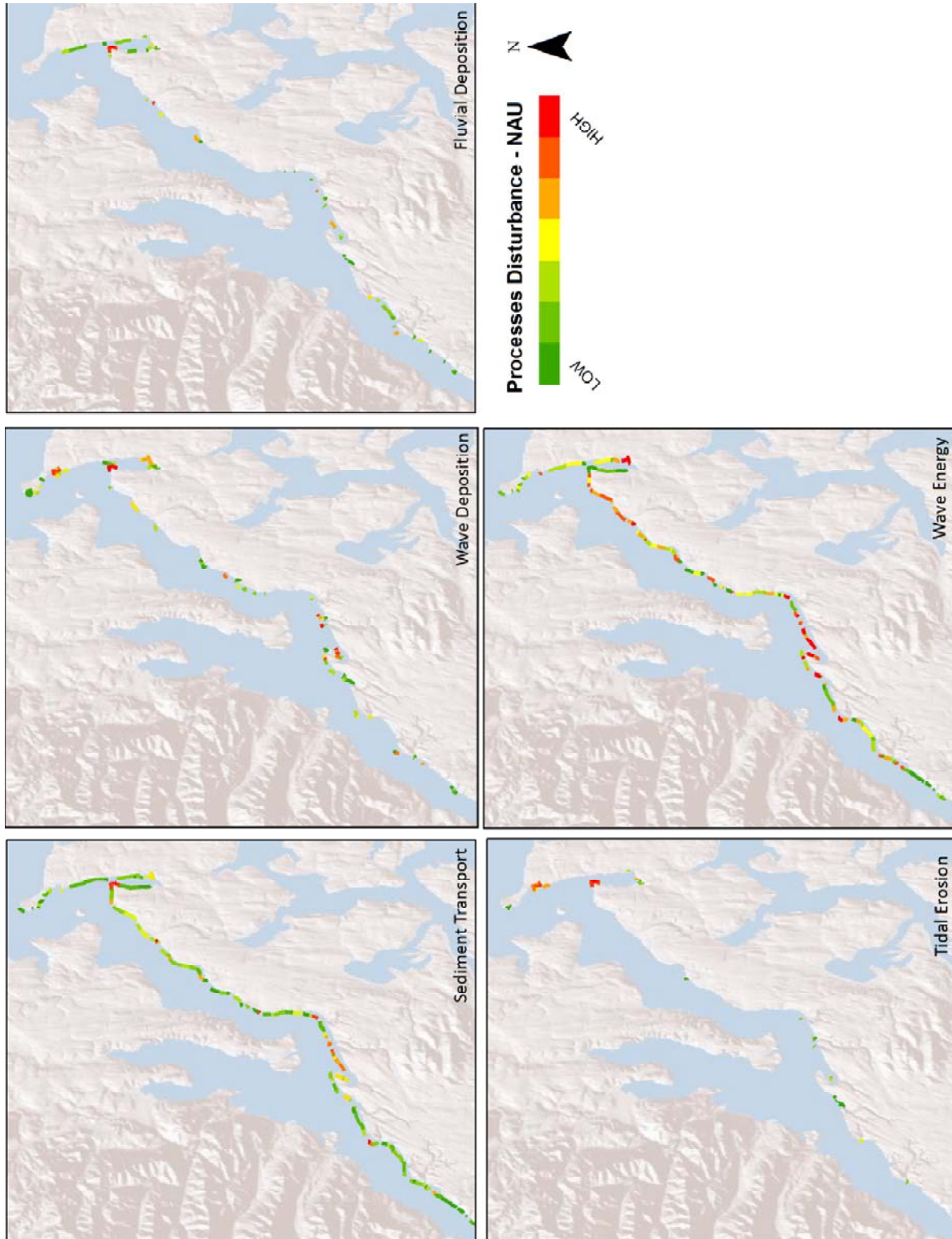


Figure I-8. Direct site disturbance to dominant processes per NAU. Note that only units with these dominant processes present within the unit were scored. For example, sites without a stream, river or beach seep were not evaluated for direct site disturbance for fluvial deposition.

### 3.2 Management Options Based on Tier-1 Assessment

Restoration approaches may be further guided by understanding the level of disturbance of both a site and the larger landscape. A discussion of appropriate management strategies can be found in Borde et al. 2009, Section 3.2. Figure I-9 adapted from Borde et al. summarizes the relevant management strategies for each NAU and maps in Addendum Appendix D provide an overview of relevant restoration strategies.

Further prioritization of specific projects for management options such as protection, restoration, or enhancement can be achieved through pairing Tier-1 assessment results with a more detailed Tier-2 assessment. This process evaluates information on stressors at the site and landscape scales as well as predictions of changes in function and area for a particular management action proposed for the site.

A total of 46 potential restoration projects were characterized in this manner (Appendix E). An example of the assessment at two of these sites can also be found in Appendix E.

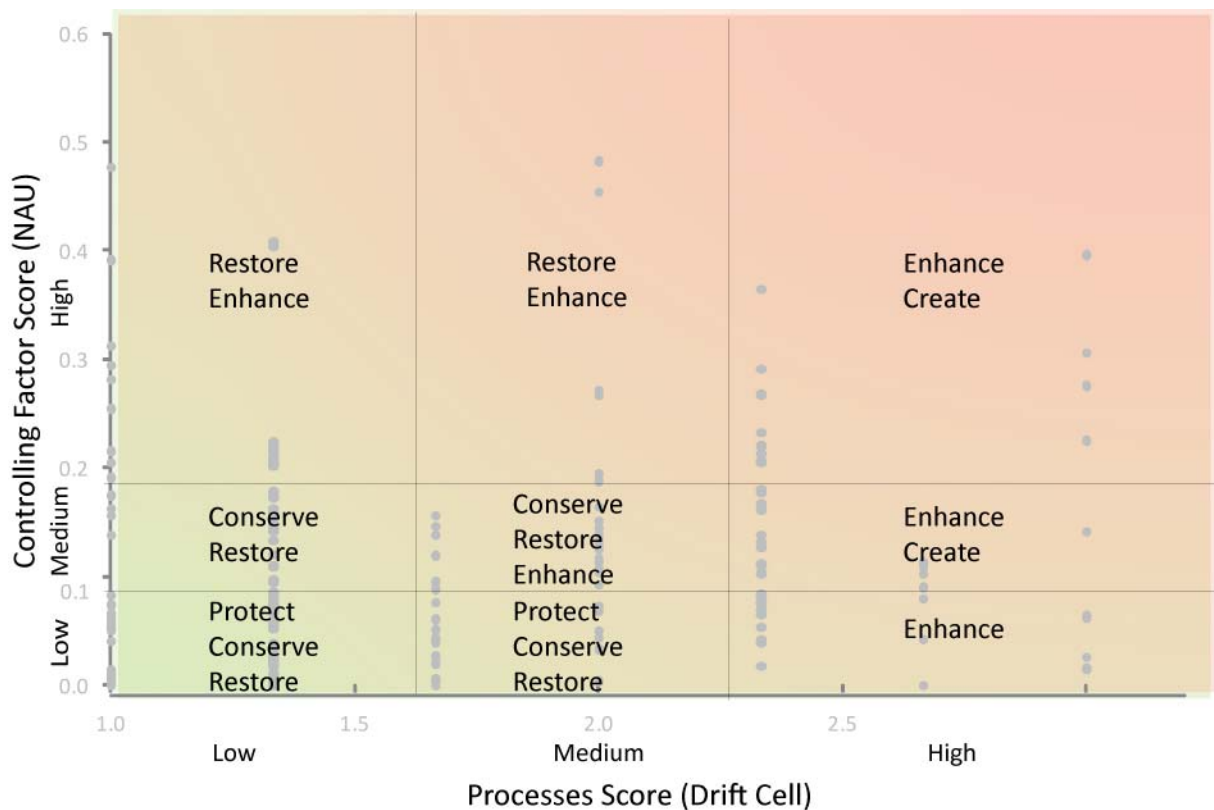


Figure I – 9. NAU Disturbance and Drift Cell Disturbance can help determine suitable restoration strategies for an area.

## 4.0 Summary

This assessment extended the East Kitsap County methodology to West Kitsap County with the purpose of providing a screening tool for county-wide prioritizing management options. It should be considered a living document that can be continuously refined as the knowledge base and available data increases. In addition to the recommendations included in the East Kitsap County Assessment, we encourage future inclusion of developing a combined quintile system wherein both portions of the shoreline are evaluated simultaneously.

Key findings of the nearshore assessment were as follows:

- West Kitsap County's shoreline appears to have a lower stress level than East Kitsap, but there were extreme examples of high and low impacts as well. Most drift cells were considered low to moderately impacted by human activities.
- Of 35 drift cells in West Kitsap County, 7 (20%) were considered to have highly impacted processes while 20 (57.1%) had low impacts.
- Of the 217 NAUs, 44 (20%) had a high degree of alteration to site-controlling factors and 113 (50%) had a low degree of alteration.

## 5.0 References

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