

Constraint Mapping Methodology

Purpose

The purpose of this memo is to document the inputs and methodology used to develop the constraint mapping for the Knik Arm Crossing project (KAC).

Purpose of the constraint mapping

The constraint maps were used to help predict population distribution on the Matanuska-Susitna Borough (MSB) side of the project. In general, the MSB does not use zoning as a method of land-use control, which would have provided guidance on planned location for growth and density. The Study Team used a market driven approach to the density and location of growth and used the constraint mapping to identify areas where the market would be less likely to develop—essentially using it as a stand in for zoning. By knowing how much developable land exists, its quality, and location, we were able to estimate an allocation of future population to analysis zones within our study area.

The results of the constraint mapping were used as part of the MSB Long Range Transportation Plan (LRTP) update to develop the land allocation estimates for their traffic forecasting. As such the methodology and results for the KAC EIS are consistent.

The constraint maps also served as the base map for Plan Builder, a software tool being used to help identify the indirect growth impacts of the KAC project. Plan Builder is a GIS tool that allows the project team to compare alternative land-use and transportation scenarios and evaluate their outcomes using indicators of environmental and community performance. Plan Builder's use and methodology is discussed in a separate technical report.

Study Area

The area from Point MacKenzie/Port MacKenzie to approximately the Parks Highway, which includes the Big Lake and the Knik-Fairview areas, would likely experience increased growth and development with construction of the proposed bridge. The area anticipated to experience the greatest indirect affects from increasing growth rates is outlined in white and denoted as the "study area boundary" The study area boundary encompasses most of the indirect affects analysis, relative to increased growth, associated with the crossing.

Assumptions

To identify land most likely to be developed the study team looked at a market approach, reasoning that lands constrained by physical, environmental, and regulatory impediments would be less marketable or have higher development cost and thus be less likely to be developed. The following assumptions about future conditions were made relative to the markets and data used in the analysis. Specific assumptions about the relative constraint for any one factor considered are discussed in subsequent sections.

- Removal of the agriculture restrictions in the Point Mackenzie area.
- Game refuges boundaries will not change.
- Input data sets contain the best available information.
- Because of the limited land use controls, development that occurs will primarily be market-driven.

Methodology

To identify potential development areas, the project staff used a modern version of an overlay process introduced in the 1960s by Ian McHarg, a well-known landscape architect. McHarg developed this process to better consider the environment at the planning stage. It entails mapping environmental resources separately and then combining them in a layered format to develop a better understanding of the overall environmental opportunities and constraints of an area.

His process started with the identification of the factors to be considered. For each factor, a map transparency was developed with dark gradations representing areas with the greatest value (or greatest constraint) and the lightest gradations representing the areas with the lowest values (or least constraint). The transparencies were superimposed on each other to form a composite map. The darkest areas showed the areas with the greatest overall values (or constraints), and the lightest with the least.

The methodology used by the project team to identify potentially developable areas follows McHarg's process except that a geographic information system (GIS) analysis was used instead of acetate transparencies and the factors considered were not restricted solely to environmental resources.

The first step in the methodology was to identify the factors to be analyzed as constraints or opportunities. Factors with readily available information were analyzed. The project team focused on factors that would influence the developability of land such as government regulations or the presence of limiting environmental conditions such as wetlands.

The factors used to develop the constraint maps were:

- Ownership/Regulatory Restrictions
- Hydric Soils
- Soil Suitability for Building
- Floodplains
- Slope
- Water Bodies
- Wetlands

The vector data for each constraint was converted to a grid. A grid is a representation of the area as a series of equally sized cells or pixels. Each cell for each individual factor was then assigned a numeric value by the project team based on its suitability for development.

The grids were then combined in the GIS program to create a composite map to predict the most suitable and least suitable areas for new development. Basically, the computer added the scores for each cell for each of the identified factors and assigned a total "composite" value to each cell.

The cells were then categorized from low developability to high developability. This does not mean the entire cell can be or will be developed. The analysis was performed at the planning level and does not include localized site specific factors that influence development, nor does the analysis account for the owner's willingness to develop. It purely identifies areas where future growth is more likely to be physically feasible or more desirable because of fewer regulatory barriers, and therefore more likely to actually be developed given the relatively free market conditions experienced in the land market in the MSB. After the methodology was developed, it was presented to various stakeholders of the project including local, state and federal agencies (at scoping meetings and economic working group meetings).

The EPA requested that the project team evaluate an EIS scenario that assumed that a "smart growth" style of development would occur in the indirect growth area¹. Their desire was for the team to present the impact results of a smart growth scenario (as compared to a continuation of existing trend scenario assumed by the Study Team) to show how much environmental improvement might be realized were such planning tools employed in the indirect growth area. Smart growth development is generally comprised of denser, planned development leaving more open-space, and generally considered as leading to environmental benefits. FHWA agreed to pursue a smart growth scenario. The study team proposed using the constraint analysis as a base for developing the scenario; essentially removing additional sensitive areas (like wetlands and stream and lake buffers) which would be assumed to be further restricted by additional planning regulations. As a result of the EPA's request, constraint mapping was performed for a base condition and a smart growth scenario.

Datasets

Ownership/Regulatory Restrictions

Social and institutional restrictions related to ownership and management of lands were key factors the team used to evaluate the developability of future land. Despite not having zoning, the study area is comprised of a variety of public and private landowners that influence or control large areas of the indirect growth area. To identify the regulatory restrictions, the Study Team collected GIS layers showing land ownership information and planning documents used to manage use of land. Stakeholder interviews with land owners were also useful in determining the likelihood that development would or

¹ Note: The project team does not consider the enactment of the kinds of ordinances and regulatory measures typical of smart growth development very likely by 2030 in the indirect impact area, given the current level of regulatory oversight on land development enacted by the MSB. The scenario is evaluated at the request of the EPA to be able to show the difference in indirect effects between the base condition and a mitigated condition if "smart growth" principles were employed.

would not occur. The dataset is based on MSB parcel ownership information and supplemented with information from the State of Alaska regarding game refuge boundaries.

The assumptions made regarding ownership and regulatory restrictions included the following:

- Game refuges are publicly owned and managed for wildlife conservation or passive recreational uses and were assumed to not be developed.
- Land that is privately held or owned by a Native corporation was assumed to be developed before land owned by a government entity.
- Mental Health Trust Lands and University lands are managed to create a return for those non-profit entities and would face development pressures.
- The economic working group advised the Study Team that development pressures in the State Agricultural lands would be expected to result in the agricultural covenants being lifted and that land would be available for development.

The same assumptions were used in the base case and smart growth scenarios. See the attached General Land Ownership map.

Hydric Soils

The hydric soils layer originated with the Natural Resource Conservation Service (NRCS). The hydric soils information was used as a proxy for wetland information. Wetlands are usually not the first areas developed because of the need for a wetland permit and additional construction costs. In the smart growth scenario, soils that are 85% or greater hydric were assigned more constraint. Such an assumption is meant to replicate a scenario where a strong wetland management plan was to be enacted. See Hydric Soil Map (attached).

Soil Suitability for Buildings

This dataset originated with the NRCS. It was included because soils suitable for development are likely to be developed before poor soils. In the smart growth scenario, soils that are severely limiting have been assigned a greater constraint. Such a scenario would replicate tighter building code restrictions and strong land use controls on marginal soils assumed to be a part of a smart growth scenario. See attached Soil Suitability map. It should be noted that the poor soils and hydric soils have a strong correlation.

Floodplains

Floodplain information came from the Federal Emergency Management Agency (FEMA). The project team obtained electronic floodplain maps for the study area, and spliced them together into one image file. The image was then georeferenced into the study area coordinate system and a GIS file created

from the image. Floodplains are assumed to remain undeveloped in both scenarios. See Floodplains map (attached).

Slope

The percent slope of the area was calculated from a digital elevation model (DEM). The DEM is based on contour data from the MSB. Slopes are important because very flat low land may have drainage concerns while steep areas require significant amount of costly earthwork or can even be technically impossible to develop. Most of the project area does not contain any steep slopes that would limit development. Slopes were assumed to have the same development constraints in both scenarios. See attached map.

Water Bodies

This factor was included because lakes, streams and other water features are environmentally sensitive areas. The water bodies information is from the MSB GIS files. Construction in or near these features would have more environmental impacts and may require special permits. Currently, the MSB has a development setback requirement of 75 feet from any water body. To replicate this regulation in the base scenario, a 75-foot buffer surrounding all lakes and streams was created in GIS and coded as constraint to development. For the smart growth scenario constraint map, the setback was expanded to 100 feet to replicate a more stringent setback requirement that might be required under smart growth conditions. See attached Water Bodies map.

Wetlands

When the evaluation process began, wetlands were not mapped for much of the study area. Electronic wetland information was not received by the project team until after the initial constraint maps had been developed. Once the maps were obtained from the US Fish and Wildlife Service, the wetland boundaries were overlaid on the constraint maps and areas that were not already constrained (by the hydric soils and soil suitability layers) were added to the constraint maps. See attached Wetlands map.

During development of the project, the Borough adopted an ordinance creating a wetland mitigation bank to protect important wetlands within the Borough. The areas protected by Borough ordinance were mapped in the GIS and represent an additional regulatory constraint. It is assumed that the wetland bank will remain undeveloped in both scenarios.

Results

The datasets were combined to develop a base condition constraint map and a smart growth constraint map (attached). The area covered by the constraint mapping is approximately 524,000 total acres. Table 1 shows the acres of land by category based on the mapping information and analysis.

Table 1. Acres of land in each development category

	Scenario (Acres)
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Category	Base Condition	Smart Growth
Highly Developability	145,320	144,997
Moderate Developability	24,570	7
Marginally Developability	84,705	0
Low Developability	269,564	379,155

As the above table shows, there is a lot considerably less land assumed to be available for development under the Smart Growth scenario. The table shows that under the smart growth scenario, most of the moderate and marginal developable lands have been reclassified and low developability, and would be assumed to be protected under the indirect impact analysis performed on the smart growth scenario.

References:

Parcels. MSB GIS. 2003.

Ownership. MSB Tax Assessor.

Admin. Department of Natural Resources. 2001.

Soils. Natural Resource Conservation Service. June 2003. Available from MSB.

Flood Insurance Rate Maps. Federal Emergency Management Agency.

Topographic Data. MSB GIS. 1986.

Water Bodies. MSB GIS. 2001

Wetlands. National Wetland Inventory. 2005.