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URBAN VISUALIZATION MODELLING

The Planning and Economic Development Committee recommends the adoption of the recommendation contained in the following report August 23, 2006, from the Commissioner of Planning and Development Services:

1. RECOMMENDATION

It is recommended that this report be received for information.

2. PURPOSE

To inform Committee and Council that the Geomatics Branch is initiating a 3D GIS program along centres and corridors, in support of growth management and intensification activities in the Planning and Development Services Department, the Transportation and Works Department and York Region Rapid Transit Corporation, and for public communication of future growth scenarios.

3. BACKGROUND

Technology capabilities in GIS software, and the geospatial data available, have now progressed to the point that three-dimensional (3D) representations of landscape and buildings can be used for analysis and representation of complex urban environments.

3D visualization models allow for exploration of spatial relationships between objects, such as buildings, and landscape features, such as hills and slopes. Fly-through and walk-through visualizations are among the more common uses; however 3D models can also be used for analytical purposes, such as optimizing cell-tower placement.

The Geomatics Branch began investigating the 3D visualization technologies in 2005, when it became apparent that the software applications were maturing to become useful and cost-effective tools in the municipal context for dealing with growth management issues, such as intensification in urban areas.

By the summer of 2006, the Geomatics Branch had already been asked by the Transportation and Works Department and the York Region Rapid Transit Corporation (YRRTC) to create visualizations in support of specific projects, namely the York-Durham Sewer System, and the Spadina Subway Extension into York Region. 3D capabilities were also used to analyze sightlines between Bales Drive and the Administrative Centre for telecommunications equipment for the Information Technology Services Branch.

The recent development of on-line virtual globes (Google's GoogleEarth, Microsoft's Virtual Earth, Skyline Software Systems' TerraExplorer, and NASA's World Wind) has raised public expectations of how geographic information should be portrayed. Many European cities have already created sophisticated 3D models.

4. ANALYSIS AND OPTIONS

4.1 Visualization Applications

The immediate uses of 3D visualization in York Region will be for public communications of infrastructure improvements, including the York-Durham Sewer System, and the Spadina Subway Extension into York Region, and for analysis of growth potential in the urban centres and corridors, in support of the Region's Growth Management program.

The Geomatics Branch now proposes to conduct a user needs study with staff in the Region to determine what other potential uses of 3D visualization would be useful. The results of this study will be reported to the Planning and Economic Development Committee at a later date.

Other jurisdictions have used 3D visualization in support of several planning-related business functions:

- Communication tool in Public meetings
    - Visualization of current building environment
    - Visualization of urban density futures
- Environment assessment public hearings
    - Visualization of road widening impacts and other major infrastructure improvements
    - Visualization of new transmission corridors
- Emergency situation visualization
    - what kinds of structures / environment is in proximity
    - what landscape will emergency workers have to deal with
- Visualization of tree-scaping along roads with time
- Sightline analysis/telecommunications equipment siting
- Noise barrier analysis

The Regional Municipality of Waterloo has constructed a 3D simulation along its rapid transit corridor to help communicate the project to the public. Ottawa similarly has created a 3D video presentation to help the public understand proposed elements of its rapid transit program. The video runs as a continuous loop at Ottawa City Hall.

Other jurisdictions have found that 3D visualization is an effective tool to communicate complex infrastructure projects and impacts to the public and have rated visualization as a cost-effective technique to reduce opposition to projects through increased understanding. Following an initial public hearing for a new QEW bridge over the 16

Mile Creek in Oakville, a 3D animated visualization was used to allay concerns of local residents who had difficulty understanding the project based on 2D maps and drawings.

The visualization of the York-Durham Sewer System route was used at a public meeting on May 2006, and public reaction was positive. Transportation and Works Department staff found it to be a valuable communications tool, and kept the 3 minute loop running throughout the meeting. Further visualizations are now being prepared for a public meeting to evaluate route alternatives.

4.2 A Visualization Program for York Region

During 2005 and 2006, the Geomatics Branch evaluated various software applications for 3D visualization, and compatibility with existing York Region geospatial infrastructure.

The initial focus for a 3D visualization program in York Region will be on the regional centres and corridors in support of growth management and intensification activities in the Planning and Development Services Department, the Transportation and Works Department and YRRTC., and for public communication of future growth scenarios. Visualizations will enable future building scenarios to be compared with current buildings, and the visual impact of building forms representing higher densities to be evaluated. With time, this program could be extended to other growth nodes, for example, around GO stations, or the Queensville area.

In Stage 1, York Region Geomatics Branch is creating and attributing building footprints along Regional centres and corridors. In Stage 2, creation of a 3D visualization model, the building footprints are extruded into solid objects, and placed on the ground surface represented by the orthophotography and the digital elevation model. (*Figure 1*)

Figure 1 Building footprints extruded as buildings: Simple Urban 3D Model Newmarket Centre

In Stage 3, building façades can be added to the model from photos of the actual buildings or from architectural designs and master plans to create a photorealistic model

that is useful for public communications for specific projects (people recognize individual buildings from their everyday experience, and consequently know where they are in relation to other buildings in the visualization model). This more advanced model created by the Geomatics Branch is illustrated in *Figure 2*. Additional objects can be shown in the visualization, such as trees and street furniture, depending on intended viewing scale. Different levels of photo-realism can be added to the model depending upon its purpose.

Figure 2 Building Facades added to Urban 3D Model in Vaughan Corporate Centre

For Stage 4, animation can be added to 3D visualization models, (to show moving vehicles, for example) however this currently requires that the model be exported to non-GIS software for animations to be added.

Some European cities have already launched on-line 3D visualization models, supporting tourism and other public communications purposes. There are relatively few such models for North American cities as yet. GoogleEarth, Virtual Earth, and Skyline already have the capacity to show building forms with facades within their globe interfaces, and these capabilities are being taken advantage of by some municipalities already (for example, see the City of Nanaimo's website). ESRI's ArcExplorer product, expected to be released this year also will allow for 3D visualizations that maintain GIS query capability.

A user needs study will be undertaken with regional departments in September-October to determine what additional aspects of 3D GIS, such as areas outside of the centres and corridors, animation and on-line 3D, will benefit regional business processes. The results of the user needs study will be reported to the Planning and Economic Development Committee at a later date.

4.3 3D Resources Necessary

The 3D GIS visualization program is a natural extension of Geomatics Branch capabilities, and parallels development in the geomatics industry as a whole.

The 3D program at York Region is being framed to maintain compatibility with existing GIS data and software. The Geomatics Branch already licenses the software extension for 3D analysis (ArcGlobe and ArcScene in ESRI's 3D Analyst product), and has purchased a Sketchup license to allow for more complex building forms to be created for use in ArcGlobe and ArcScene (Google has since purchased Sketchup, and has made a free consumer version available).

The building footprints database is being created for regional centres and corridors, and is being attributed from existing data sources, including data from the Municipal Property Assessment Corporation, that the Region already receives. This database and derived 3D models, will be specifically modelled for use in 3D visualization and density planning.

3D visualization models are computationally intensive, so the Geomatics Branch is working with the Information Technology Services Branch to upgrade specific desktop machines to permit faster screen processing.

The Geomatics Branch is evaluating software for generating trees to incorporate into visualizations for greater realism, and video editing and animation software. Acquisition of these software programs will depend on specific project requirements, and the outcome of the user needs study.

4.4 3D Visualization Output and Use

Output from 3D visualization models match specific project requirements. Currently the most common format for public communications purposes is a video. This allows the project owner to control the viewpoint in the visualization scenario. This was the output format for both the York-Durham Sewer System route visualization, and the Subway project visualization. Video output can be enhanced with audio tracks and animations, if specific projects warrant it. Specific project visualizations can be made available on-line as streaming or downloadable video content.

Unconstrained 3D navigation for users is possible in a GIS environment and through on-line environments (for example, through Google Earth, Virtual Earth, Skyline and various proprietary on-line viewers). Unconstrained navigation within the GIS environment is useful for staff analyzing building massing and street-scaping scenarios, and infrastructure placement, and can be made available through the GIS system. Public access on-line is more challenging, and a separate business case would have to be made for initiating this kind of on-line service as it would require on-going maintenance, however clearly this is becoming part of what the public expects from a municipal GIS. Leveraging the virtual earth environments of Google Earth, Virtual Earth and Skyline through the standardized file protocols that have already emerged is an option that the

Geomatics Branch has already been exploring (at the moment the satellite imagery for the York Region area in Google Earth is poorly presented, however the virtual earths are updated regularly). The City of Nanaimo is already taking advantage of these platforms on an experimental basis.

The real-time querying capabilities of 3D GIS would be useful in terms of situation management, similar to current GIS deployment within the Regional Emergency Operations Centre. 3D GIS in situation management contexts would allow for more informed decisions about the environment around situations. These capabilities will take a while to develop, and initially will be constrained to Regional centres and corridors, where population density is likely to be higher.

4.5 Relationship to Vision 2026

3D GIS visualization will assist in achieving the Vision 2026 goals. It will help in achieving Goal 1: Quality Communities for a Diverse Population by assisting in the promotion of compact community cores, and can help in promoting and winning acceptance for high quality urban design. It will assist in Goal 5: Housing Choices for Our Residents by winning acceptance of alternate building forms that represent housing choices. Visualization is an important tool to achieve Goal 7: Managed and Balanced Growth, in that it can help in the public information and engagement process associated with taking a strategic approach to growth management.

5. FINANCIAL IMPLICATIONS

The financial implications associated with this initiative are limited. 3D GIS visualization is consistent with the development of Geomatics Branch capabilities, and proposed activities are covered either in the operational budget (minor software purchases and computer hardware upgrades) or through cost-recovery for specific projects under service level agreements with other Regional departments.

6. LOCAL MUNICIPAL IMPACT

This program has no immediate local municipal impact; however there is interest in other municipalities to develop 3D GIS visualization capability, and sharing opportunities that will be explored through the YorkInfo Partnership.

7. CONCLUSION

3D visualization capabilities are expanding rapidly in the geomatics industry. The Geomatics Branch is taking advantage of these new capabilities in support of growth management and intensification activities in the Planning and Development Services Department, the Transportation and Works Department and York Region Rapid Transit

Corporation. Visualizations will assist the public in understanding future growth scenarios, and will improve their ability to contribute to public meetings. Visualizations also have potential for situation management.

The Senior Management Group has reviewed this report.