Data-intensive Applications
Using the WIDE Software Platform

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Executive Summary

The WIDE (Web Informatics Development Environment) software platform has been under development for over 15 years by researchers in the University of Waterloo Computer Systems Group (UWCSG). The WIDE platform has been used to develop over 80 data-intensive web and mobile software systems in many different sectors including land development and planning, environmental modelling and monitoring, First Nations, volunteerism, social indicators, community information, health, arts and culture, and built heritage. The objective of each application is to manage and use community information assets for community benefit. The community can be either geographic or a community of interest or practice. The UWCSG software team has worked with many different partner organizations in producing the different services and range from local NGOs, businesses, universities and research centres, to all levels and types of government including First Nations groups and the United Nations.

1   The WIDE Software Platform

The WIDE (Web Informatics Development Environment) software platform has been under development for over 15 years by researchers in the University of Waterloo Computer Systems Group (UWCSG) supported by many different partners. The services provided by the WIDE platform have been refined through use in creating, deploying, operating and maintaining over 80 data-intensive web and mobile software systems in many different sectors. The WIDE software platform is made available through WIDE Software Systems Corporation (WSSC, operating as WIDEAtlas - http://www.wideatlas.com/).

The sectors where the WIDE platform has been used are shown in Figure 1. They show the breadth of application and include land development and planning, environmental modelling and monitoring, First Nations, volunteerism, social indicators, community information, health, arts and culture, and built heritage. The objective of each application is to manage and use community information assets for community benefit. The community can be either geographic or a community of interest or practice. Although not described in the document each sector has the outline of a business model to generate income to ensure system sustainability.

The UWCSG software research and development team has worked with many different partner organizations in producing and using the different services supplied by the platform. The partners with whom UWCSG works very closely are described in Section 4 and range from local NGOs, businesses, universities and research centres, to all levels and types of government including First Nations groups and the United Nations.

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WIDE Software Platform

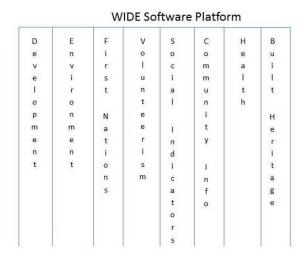| Development	Environment	First Nations	Volunteerism	Social Indicators	Community Info	Health	Built Heritage

Figure 1: Sectors

The WIDE software platform provides building blocks to create components including input forms, reports, relational, multimedia and document databases, maps, charts, graphs, agents, notifications and alerts, publish-subscribe, indexing and searching, workflow, and collaboration through mediated social networks and shared web presentations. The platform also supports specifying the operational relationships among components. Definitions of service components are usually derived by completing one or more forms rather than programming. Current applications are described in Section 2.

2 Applications Built Using the WIDE Software Platform

In this section some of the web-based and mobile software systems produced using the WIDE software platform are described. Where feasible a web address or URL is provided to indicate where a description of the application can be found. However, the site may require user identification (userid and password) to gain access.

2.1 Community Information and Social Development

2.1.1 CivicAtlas^{TM}- Municipal Land-use Planning

CivicAtlas^{TM}is a data-driven cloud-based web and mobile software system to allow business and government access to province-wide current municipal land-use policy data with ease and accuracy. CivicAtlas^{TM}is an integrated view of municipal land-use information combining official plans and zoning regulations and connecting them to a property boundary map through an easy-to-use interface. By selecting a parcel a user can call up municipal planning details. One screen tells all about a property and its surroundings. A current version contains data and works for Stratford, Kitchener, Waterloo, Cambridge and Toronto.

The CivicAtlas^{TM}vision is to consolidate land-use data into a single system, including: current development and building permit applications, environmental and watershed regulations, current and past municipal land-use studies and reports, provincial policy statements and Acts, demographics, traffic counts and properties for sale or lease on municipal lands and on privately owned lands with realtor participation. With the further cooperation of municipalities, all public documents requiring amendments to planning regulations and for development approvals initiated by proponents will become accessible, thereby strengthening the transparency of the planning system for the benefit of the general public and the development industry.

CivicAtlas^{TM}by efficiently sharing *open* government data and knowledge, will revolutionize the way different levels of government collaborate and how government interacts with business and its constituents.

2.1.2 Volunteering - one example is at http://volunteerkw.ca/

Volunteering can be considered a core value of Canadian society. How can we make volunteering more attractive and connect people with appealing volunteer positions? How do we recognize the contributions of all volunteers? Formal recognition is quite important to many volunteers as it can be a significant step in finding full-time paid employment or meeting educational or professional requirements.

Thus, two key issues in volunteering are:

- finding volunteer positions that can match the interests and skills of the volunteer, and
- recognizing the contributions of volunteers through a program of certification.

Meeting these two concerns is the purpose of VolunteerAttract,^{TM}a web and mobile cloud-based software system that:

- assists volunteers in finding suitable positions 24x7, and
- allows organizations employing volunteers to recognize their efforts through a certificate program that documents acquired skills.

VolunteerAttract^{TM}works actively with many Ontario volunteer centres, the Ontario Volunteer Centre Network (OVCN) and Volunteer Canada. VolunteerAttract^{TM}is spreading across Canada with installations in British Columbia, Alberta, Ontario and New Brunswick. In Ontario it is in multiple communities such as Perth Huron (https://www.ivolunteerperthhuron.ca/), which seamlessly shares software for volunteer positions and corresponding recognition across the Province. As part of its recognition program, VolunteerAttract^{TM}generated 55,000 certificates for each of the volunteers that supported the Toronto 2015 Pan Am and Parapan Am Games.

2.1.3 Social Indicators - http://www.myperthhuron.ca/

UWCSG in partnership with the Social Research and Planning Council of the Perth-Huron United Way is building an innovative Web-based Information Platform for Dynamic Online Quality of Life Indicators to be developed and deployed initially in Perth and Huron Counties in Southwestern Ontario. Once deployed in this area, the system will be made available to Canadian communities. The initial version of the platform will be launched in mid-March, 2017.

The platform built with strong community engagement from many organizations in Perth-Huron collects and integrates both community-based (e.g. Food Security, Housing, Health, Healthy Child Development, Education) and government data. It will allow authorized individuals in various social agencies and government to view and manipulate spatially resolute data and related indicators securely, thus allowing both intra-community and inter-community comparisons. Evaluation instruments with processes and protocols will be included to ensure the right data is collected and used. The platform will also provide public views of the indicator data to deepen understanding of the community and its well-being.

One significant effect of this platform will be the ability of local government and NGOs such as social service agencies to look at all the factors related to community well-being. Civic leaders will be better able to target resources and strategic interventions to identified areas of highest need based on community-sourced, "real-time" quantifiable data rather than aggregated data collected by higher levels of government.

This information platform is an emerging approach to examining community well-being that builds upon the experiences of the Canadian Index of Well-being(https://uwaterloo.ca/canadian-index-wellbeing/). By supporting the collection of community-based indicator data in "real-time" and providing appropriate analytical tools and mapping, this system will allow various social and government agencies:

1. to track emerging trends and act more quickly than is possible with an annual published report; and
2. combine indicators to show impacts. For example, data from public health, public safety or education might be overlaid with food security or housing data to visualize spatial patterns of use and evidence related to poverty.

The social indicators project called the "Community Trends Platform" has received support from the Ontario Local Poverty Reduction Fund ($300,000) of the Government of Ontario and the United Way of Perth Huron ($21,000).

2.2 Driftscape - https://driftscape.com/

Driftscape technology is intended to enable multiple local organizations to publish information that offers stories, events, tours and self-guided audio tours, and experiences that link stories with places in the local urban and rural landscape. These location-based activities are called locative media.

The first distributed version of Driftscape is being created for the Greater Toronto Area. The Driftscape App is intended to support the Arts, Culture and Heritage communities and there are 17 content partners to date. The Driftscape team has coordinated with many Toronto-based organizations and agencies who have agreed to share their locative media by using the Driftscape content management website and the Driftscape App.

Driftscape enables local organizations to reach a broader audience and share resources and a common App or interface, while also making it easier for new groups to start sharing their locative content. Driftscape will offer the user a selection of searchable content in map and list views. By combining multiple content sources into a single App, a user will only need to install one App to access content, events, tours and places of interest from multiple sources. The Driftscape system is intended to be inclusive, community-based and community-driven.

Driftscape enables users to explore the city in a whole new way. It offers access to a variety of events, experiences and content organized by location. It allows users to filter what they see to suit their interests and tap into in-depth local knowledge. Driftscape will notify users when they are near something of interest. Driftscape offers unique perspectives on what is nearby. Experiencing stories in the places that inspired them unlocks a deeper appreciation of place and the myriad voices that populate a city. Users can discover new places and rediscover memories of places they thought they knew.

Unlike Google maps and comparable services, Driftscape operates at the community level to acquire information that is community-based such as local events. The fact that the information is supplied by community businesses and organizations has several implications:

- Information about events, news, tours, small business, arts and culture, history, heritage, tourist attractions, entertainment and many other community-based experiences are truly local; just not available on a global scale.
- Information about small organizations can be represented.
- Information can be input and updated by local organizations.
- Because information is local and managed locally it can be timely.
- Distributed publishing rights can enable curated "crowd sourcing."
- Local organizations can participate in monetization by using the App to earn revenue from event bookings and sales of audio tours.

2.3 Environmental Modelling, Monitoring and Research

The CANadian Watershed Evaluation Tool (CANWET^{TM}) and the Flowing Waters Information System (FWIS) described next are installed on a single software platform to support integrated monitoring and modelling (IEMM) of surface water. They share data and a user interface. This platform is being expanded to support other types of surface water monitoring and modelling and accesses *open* data from all levels of government and NGOs such as Watershed Management authorities. The open data can be used directly from open data sources or imported and maintained in internal databases to enhance performance. HydroSanitas, IW:Science and KM:Land are three platforms created for the United Nations University Institute of Water, Environment and Health (UNU-INWEH). Many of the tools developed for HydroSanitas, IW:Science and KM:Land are being incorporated into the IEMM surface water platform.

2.3.1 CANadian Watershed Evaluation Tool (CANWET^{TM})

CANWET^{TM}is a map-based software suite designed to support decision making for watershed management; water supply and wastewater treatment infrastructure; food security; and climate change adaptation.

CANWET^{TM}can be used to estimate quickly daily water balance, nutrient, erosion sediment, and bacteria loadings from map-based input data making CANWET^{TM}a powerful decision support system. The latest release of CANWET^{TM}is cloud-based and web-aware.

Since 2004, versions of CANWET^{TM}have been used in Ontario, Canada to:

- Develop the Lake Simcoe Protection Plan [2];
- Complete Tier 1 and 2 water budget/water taking and other source water protection related projects;
- Identify new infrastructure solutions and sustainable community planning policies associated with Ontario's Places to Grow Act [1];
- Prepare regional Official Plan directives, such as the County of Simcoe's Infrastructure Visioning Strategy [3]; and
- Complete project-related climate change impact assessments.

The cloud-based version of the CANWET^{TM}system will access *open data* from multiple levels of government and Watershed Management Authorities. The CANWET^{TM}system will support multi-agency governance and reflect the cumulative effects of land use change, water budget changes, changes in agricultural practices and low impact development initiatives designed to mitigate adverse effects in a changing climate.

Initially CANWET^{TM}will be deployed in the Nottawasaga River Basin with funding from the Environment Canada Lake Simcoe Georgian Bay Clean Up Fund (LSGBCUF). A version of CANWET^{TM}has been used to examine source water protection and support climate change adaptation on the Six Nations lands near Brantford Ontario. Based on recent reports, source water protection has been described by Ontario Premier Kathleen Wynne as an issue of great concern in remote Ontario First Nations communities.

2.3.2   Flowing Waters Information System (FWIS)- http://www.comap.ca/fwis/

FWIS, a web and cloud-based system, helps Ontario's conservation practitioners to manage information on flowing waters or streams, including data about fisheries, benthos, habitat and more. Currently, FWIS can be used to:

- Review and map locations where data is collected;
- Identify where and what type of data has been collected;
- Identify which conservation organization collected the data;
- Request data for specific sampling locations;
- View/edit fish and site data collected at sampling locations;
- Query fish locations collected using OSAP standards across Ontario; and
- Download fish and site data from sampling locations.

As of January 2017, FWIS contained 249,470 fish distribution records from 3,906 sites compiled from studies conducted by 53 partners within 32 Great Lakes watersheds spanning every year from 1971 to the present. There are also 186,688 stream sample substrate measurements where the technicians may collect 40 to 50 measurements about the material at the bottom of a stream. As well FWIS supports 17 study types including: Benthics, Fish, Channel Morphology, Channel Stability and, Discharge. Access to this data allows practitioners to test future development scenarios to predict impacts on fish species habitat and stream conditions for streams where monitoring data is unavailable.

2.3.3   HydroSanitas - http://inweh.unu.edu/hydrosanitas/

HydroSanitas built for the United Nations, is an interactive knowledge portal of safe water provisioning for rural, remote and otherwise marginalized communities around the world. HydroSanitas deploys a consolidated next-generation repository of knowledge for the water sector that facilitates information exchange for stakeholders. Information is consolidated in a knowledge portal that documents proven approaches to protecting and treating drinking/waste water that are appropriate to the type of water resource, the physical environment and the social, economic and cultural contexts of the users.

2.3.4   IW:Science - http://inweh.unu.edu/iw-science/

IW:Science, also built for the United Nations, aims to enhance through knowledge integration and information sharing the use of science in the International Waters (IW) projects of the Global Environment Facility (GEF). The project will help strengthen priority setting, knowledge sharing, and results-based, adaptive management in current and future projects. IW:Science provides the first ever synopsis of the science behind the IW portfolio of projects to date according to transboundary IW system types; river basins, lakes, groundwater, the coastal zone and land-based pollution, and large marine ecosystems and the open ocean. A systematic analysis of the IW portfolio and integrating knowledge from the wider scientific community with regards to critical emerging science issues, the application of science for adaptive management and the development and use of indicators to support IW projects was also included in IW:Science

In the case of IW:Science, documents about the results of scientific research in various bodies of water and water courses around the world are captured and stored in a large document repository. Indexing and searching allows documents on specific topics to be found, and mapping is used to overlay locations of research and to find research related to specific areas. Mediated social networks are used so that "experts" can work together to derive new research directions from the existing body of results.

2.3.5   Knowledge from Land Learning Network - KM:Land -http://projects.inweh.unu.edu/kmland/

UNU-INWEH is the executing agency behind a three-phase knowledge management programme entitled KM:Land (meaning "Knowledge from the Land"). This programme is implemented by the United Nations Development Program (UNDP), and is directly funded from the Global Environment Facility (GEF) trust fund. The GEF Medium-Size Project (MSP) "Ensuring Impacts from SLM Development of a Global Indicator System" is the first phase of KM:Land and will focus on setting up an indicator system for the evaluation of the overall impact of the Land Degradation Focal Area (LD FA). This MSP also aims to establish an initial Learning Network for exchange of information within the GEF LD FA and designs the basis for a comprehensive framework of knowledge management (KM) and capacity building for Sustainable Land Management (SLM) in the GEF LD FA.

The rationale behind the KM:Land Learning Network comes out of the report of the Third Overall Performance Study of the GEF (OPS3) (2005). It acknowledged that KM, and specifically, the learning, dissemination and adoption of lessons learned through project implementation, is one of the key weaknesses of the GEF system. This lack of management of knowledge is not unique to the GEF system, and this bottleneck has been identified as one of the major barriers to the successful implementation and effective up-scaling of SLM at various levels. To address this weakness, OPS3 suggested that a formal GEF wide KM function be established. This need for an efficient KM mechanism has been previously recognized by the GEF Secretariat, and thus, several FAs have initiated, or are in the process of initiating, processes to improve the effectiveness and efficiency of KM.

The overall objective of the KM:Land project is to "strengthen the capacity for adaptive management of SLM projects in order to enhance their effectiveness and impact on ecosystem integrity, stability, functions and services in the context of national development priorities." The second generalized objective of the initiative directly relates to the establishment of the Learning Network and is formulated as follows: "Exchange and disseminate knowledge and practices generated through sustainable land management projects and programs through a Learning Network." This Learning Network will target several user groups, including: GEF staff, agency staff responsible for LD projects, GEF project teams and members of the GEF LD Task Force.

2.4   First Nations

2.4.1   iAtlas - http://www.comap.ca/dc/

iAtlas is a suite of web-based and mobile tools and services that support community-based mapping services that empower First Nation cultural mapping and community planning and support remote land use consul-

tation between community, agency and development proponents with a premise of sustainable community economic development.

Wikis and other document technologies are used by First Nation authors to capture information about the many aspects of the First Nations communities. Mapping is used to show the location of areas that are constrained because of their use by the First Nations communities and must be considered in consultation with land use proponents and municipal planners.

The workflow component is used in the iAtlas system to manage the documentation as proponents of change to First Nation traditional lands submit time-limited proposals.

The system also supports real-time collaboration whereby proponents of change to traditional First Nation lands can interact with representatives of First Nations communities while negotiating.

2.5 Health

2.5.1 Measuring Balance and Mobility in Older Adults

Much attention has been directed to frailty as a specific threshold that is associated with significant risk to health in older adults (e.g. falls, decreased activity and mobility, and dramatic changes in capacity to recover from illness or injury). Advancing technology to improve the metrics used to quantify health status in older adults is critical in redefining the ability to assess the impact of specific risk factors such as new medications, transitions of care and acute health events, and to assess interventions designed to slow or even reverse important frailty-related changes. Among these, are metrics related to the domains of mobility, balance, activity, and cognition. The primary focus of the current project is to continue to advance the development of an inexpensive, wireless measurement system capable of quantifying changes in these areas. The system also collects the data from each measurement session into a database thus providing big data to be used in understanding balance and improving the balance measurement algorithms.

Currently, no clinimetrically sensitive technology exists for use within routine clinical care to quantify these domains as indicators of health status. The outcome of this project will be a system that reduces the cost of measuring such factors by 5000%.

2.6 Community Arts and History

2.6.1 Building Stories - http://www.buildingstories.co/

Building Stories is an online interactive inventory and mobile application that enables Canadians to take a direct role in identifying important community heritage assets. Building Stories will add significantly to the tools available to engage the public, explain the importance of heritage and build community confidence. Building Stories can help identify properties to place on municipal registers, to identify areas as Heritage Conservation Districts and to expand the volunteer base of the conservation movement.

The Building Stories features include:
- Anyone with a web browser who registers can contribute sites or comments.
- Enables anyone to help build the inventory of recognized and non-recognized historic buildings, structures and sites across Canada.
- Only a minimum of information is required to enter a site, typically the municipal address, a photo, contributor name and common name of the site or building.
- Optional information captured can include documents, old photos, stories, and videos.
- Icons (simple pictures) originally developed by Parks Canada, help people to identify and name elements of a building.
- Contributions are filtered for inappropriate content by the Heritage Resources Centre.
- The system features an interactive map that can be used to locate a building.
- A mediated social network that is designed to facilitate communication among organizations and registered members and to enable the secure distribution of authority to publish to participating organizations.

- Participating organizations can also manage the content contributed by their members to ensure appropriate content.

Uses of Building Stories

- Search the system and results are presented on the search page with map-based pop-ups that illustrate linked information such as photos or videos.
- Each property has a report which details all information entered.
- Mobile App capability for contributors and users who can download:
    - pre-determined tours such as walking or driving tours;
    - self-selected tours where users chose places to visit;
    - event tours such as Doors Open- only available at specific times; or
    - proximity feature which alerts an app user to the nearest historic properties.

2.6.2 Arts Build Ontario - http://www.artsbuildontario.ca/

UWCSG constructed the system for ArtsBuild Ontario. ArtsBuild Ontario is the only organization in Ontario dedicated to realizing long-term solutions for building, managing and financing the sustainable arts facilities needed in Ontario communities. ArtsBuild Ontario is a non-profit arts service organization that provides organizations with training, tools and resources that support the development and management of creative spaces such as theatres, galleries, concert halls, museums and other arts facilities.

ArtsBuild Ontario helps arts organizations that:

- Already own or lease an arts facility;
- Is planning to have its own space;
- Belong to a municipality that owns and/or manages creative spaces; or
- A funder or other decision makers that works with creative infrastructure.

ArtsBuild Ontario has offerings that can help. Many of the essential needs surrounding arts facilities fall into four categories Building, Managing, Learning and Financing. ArtsBuild Ontario's current programs are:

- Asset Planner for the Arts
- Arts Facilities Mentoring Network 2017/18
- SpaceFinder Canada
- Learning Series

ArtsBuild Ontario also provides Bricks & Mortar, a database that was created to provide up-to-date and comprehensive information about arts facilities across Ontario.

3 Crossovers among Applications

All the various software systems described in the previous section use the WIDE software platform. Because of a common understanding of data and databases and the many business relationships it becomes easier to share data among the various applications where appropriate. Examples from the environmental sector are particularly useful.

The CANWET^{TM}system, which creates a number of inputs including floodplain mapping can be applied to CivicAtlas.^{TM}One of the significant factors in the siting of any structure is where the water is likely to flow and cause damage in the event of overland flooding. Thus, the environmental sector can supply significant benefit to land-use planning.

The CANWET^{TM}system can also be used with the First Nations to help them manage source water protection and flooding. This can be particularly important in Southern Ontario where groups surrounding the First Nations lands are impacting this territory by changing the landscape. In addition this work will be particularly valuable in the Ring of Fire in Northern Ontario where resource extraction activities have the potential to alter the landscape and have serious effects on source water.

4 Partners in the Applications

Each application described in this document is created by UWCSG in conjunction with partner organizations and individuals. Many of the partners for each application are listed in the section devoted to the specific application.

4.1 Community Information and Social Development

4.1.1 Municipal Land-use Planning - CivicAtlas^{TM}

- John Reble - Municipal Lawyer
- Elizabeth Reddy - Municipal Consultant
- Centre for Community Mapping

4.1.2 Volunteering - http://volunteerkw.ca/

- Volunteer Kitchener-Waterloo
- Ontario Volunteer Centre Network
- Volunteer Canada
- VolunteerAttract Inc.
- Charity Republic Inc.
- Community, Health, Environment, Communications (CHEC) Initiative, University of Waterloo
- Centre for Community Mapping

4.1.3 Social Indicators

- United Way of Perth-Huron
- Stratford Perth Community Foundation
- City of Stratford
- County of Perth
- County of Huron
- Centre for Community Mapping
- Community, Health, Environment, Communications (CHEC) Initiative, University of Waterloo

4.2 Driftscape

- Cancarta Historic Sites
- Centre for Community Mapping
- Coach House Books
- First Story
- Jane's Walk
- Landmarks Of Toronto
- Lost Rivers
- NOW Magazine
- Park People
- Project Bookmark
- Queerstory
- Spacing Magazine
- The Reading Line
- The Toronto Dreams Project
- Toronto Arts Foundation
- Toronto Historical Association

- Track Toronto
- Waterfront Toronto

4.3 Environmental Modelling, Monitoring and Research

4.3.1 CANWET^{TM}

- Greenland International Consulting Ltd
- Centre for Community Mapping

4.3.2 Flowing Waters Information System (FWIS)- http://www.comap.ca/fwis/

- Ontario Ministry of Natural Resources and Forestry
- Conservation Authorities in Southern Ontario
- Centre for Community Mapping

4.3.3 HydroSanitas - http://inweh.unu.edu/hydrosanitas/

- United Nations University Institute of Water, Environment and Health (UNU-INWEH)
- Centre for Community Mapping

4.3.4 IW:Science - http://inweh.unu.edu/iw-science/

- United Nations University Institute of Water, Environment and Health (UNU-INWEH)
- Centre for Community Mapping

4.3.5 KM:Land -http://projects.inweh.unu.edu/kmland/

- United Nations University Institute of Water, Environment and Health (UNU-INWEH)
- Centre for Community Mapping

4.4 First Nations

4.4.1 Dreamcatcher - http://www.comap.ca/dc/

- Mississaugas of the New Credit First Nation, Ontario
- Six Nations Of The Grand River, Ontario
- Walpole Island First Nation, Ontario
- Peepeekisis First Nation, Saskatchewan
- Centre for Community Mapping

4.5 Health

4.5.1 Measuring Balance and Mobility in Older Adults

- Bill McIlroy, Professor and Chair, Department of Kinesiology, University of Waterloo
- Schlegel Villages
- Grand River Hospital - Freeport Campus

4.6 Community Arts and History

4.6.1 Building Stories - http://www.buildingstories.co/

- Heritage Resource, School of Planning, University of Waterloo
- Centre for Community Mapping

4.6.2 Arts Build Ontario - http://www.artsbuildontario.ca/

- Arts Build Ontario
- Centre for Community Mapping

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