

# Remotely-sensed Data Subcommittee Final Report

**Summary:** A group of 18 GIS professionals from state and federal agencies formed the Remotely-sensed Data Subcommittee (henceforth called 'the group' for brevity) and met in a series of 8 meetings. The goal was to determine what immediate remotely-sensed data needs were in common to their agencies and to develop implementation plans to acquire such data under a group effort. The group performed informal user needs analyses within their agencies and came up with three statewide common priorities: 1) a complete and regularly updated coverage of high-resolution aerial photography, 2) a more detailed and accurate landcover/landuse data layer than is currently available, and 3) more detailed elevation data. Implementation plans for each priority were drafted. The aerial photography needs can be met by a combination of statewide USGS Digital Orthophoto Quad (DOQ) coverage, a plan to renew such coverage every 5-7 years, and a combined spatial index of existing aerial photos owned by state and federal agencies. The group requests that the GIS Executive Council find funding to complete statewide DOQs (\$70,000) and plan on funding for regular updates. The landcover/landuse needs can be met by creating a new, more detailed landcover classification system and implementing it with new satellite data and aerial photo interpretation. The group has identified and will apply for possible funding for this effort from NASA. The group unanimously agreed to postpone the third priority temporarily, as it may be met from USGS with newly generated DOQs or hydrography data. If not, we will take it up again after the NASA grant proposal is submitted. This report summarizes the group, its goals, our findings, the implementation plans we propose, and future plans.

**Introduction:** Remotely-sensed data has increasingly become an important aspect of statewide GIS efforts. Aerial photos and satellite imagery are being called on more and more to assist decision makers for important efforts such as assessing damage from storms, assisting the E911 effort, assessing environmental impacts, and more. The group was formed to identify multi-agency data needs and report these to the GIS Executive Council, and to draft implementation plans for those needs (Appendix A).

**Meetings:** The GIS Executive Council approved the reauthorization of such a group, and meetings commenced December 7, 2000. The group met a total of eight times before adjourning on March 30, 2001 (Table 1).

*Table 1. Meeting dates and major accomplishments.*

12/7/2000	Group goals assessed and user-needs analysis form created
12/21/2000	Agency user needs collated, 3 main priorities identified
1/5/2001	Aerial photo (DOQ) acquisition implementation drafted
2/1/2001	Interagency aerial photo index implementation drafted
2/16/2001	Began drafting of landcover classification
3/2/2001	Refined landcover classification
3/16/2001	Finalized landcover classification, began NASA grant discussions
3/30/2001	Finalized details for NASA grant, final report, and adjourned

**Group Members:** The group was open to all interested participants, and initial invitations to join were sent out to the MGISTECH mailing list by OGIS. Eighteen members from fifteen

agencies eventually joined, participating in some or all of the meetings, and providing comments via email (Table 2).

*Table 2. Group members and their agencies.*

Seth Barker	Maine Dept. of Marine Resources
Lynn Bjorklund	US Geological Survey
Dan Coker	Maine Natural Areas Program
Hugh Cowperthwaite	Maine Drinking Water Program
Kathleen Decker	Maine Dept. of Transportation
Elizabeth Hertz	Maine State Planning Office
Robert Houston	US Fish and Wildlife Service
Ellen Jackson	Land Use Regulatory Commission
Tim LeSiege	Maine Dept. of Transportation
Eugene Maxim	Maine Emergency Management Authority
Greg Miller	Maine Forest Service
Jennifer O'bryon	Maine Dept. of Transportation
Garrett Schairer	Maine Dept. of Inland Fisheries and Wildlife
Michael Smith	Maine Dept. of Environmental Protection
Ray Voyer	US Natural Resources Conservation Service
Dan Walters	Maine Office of GIS
Jed Wright	US Fish and Wildlife Service

Not all members were present at every meeting, but we kept in touch via email over which meeting notes (Appendix B) were distributed. All members had the option of providing input via email if they could not attend one or more meetings. After the group adjourned, we agreed to complete unfinished business via email. The group may occasionally reconvene as needed to address other remote sensing issues.

**Our Goal:** The primary goal of the group was to identify common needs for remotely-sensed data in state and federal agencies in Maine, and to draft implementation plans to meet those needs. At our first meeting, we had a roundtable discussion of needs and expectations from each member (see notes from meeting 1, Appendix B). This helped us refine further actions to include a user-needs analysis.

**User-needs Analysis:** We agreed at the first meeting that in order to be truly representative of GIS user needs we had to first conduct a user-needs analysis within our agencies and combine the results to look for common themes. At this meeting we drafted a sample user-needs analysis form for members to fill out prior to the second meeting. The results were combined and distributed to the group at the second meeting for discussion (Appendix C). It was from this analysis that we identified our three main priorities.

**Priorities:** After examining the results from the user-needs analysis, we decided to focus on three target priorities represented in a majority of the analyses. These were:

- A need for very high resolution imagery (1m or better) for feature identification and extraction, georeferenced to at least accuracy of USGS 1:24000 maps, and updated at a 5-year interval for the entire state. This should include optional annual updates for specific areas (to track development changes), assuming these areas are small and are shared by

multiple agencies. The group examined the use of coarser imagery (such as 10m SPOT) and determined it was not useful to meet this need. A secondary product, a digital index of aerial photos currently acquired by state agencies or other organizations for which state agencies have access, would also help to meet this need.

- A need for better landuse / landcover data than currently available (more detailed and more accurate than Maine Gap, MRLC, or CCAP). This should include 15-20 forest categories, detailed agricultural delineations, detailed wetlands, urban density classifications, impervious surface delineation, blueberry barrens, and intertidal classifications.
- A need for higher resolution elevation data than currently available (30m DEMs from USGS). This could include 10m DEMs from 1:24,000 map data used by USGS to create DOQs and indexed hydrography data.

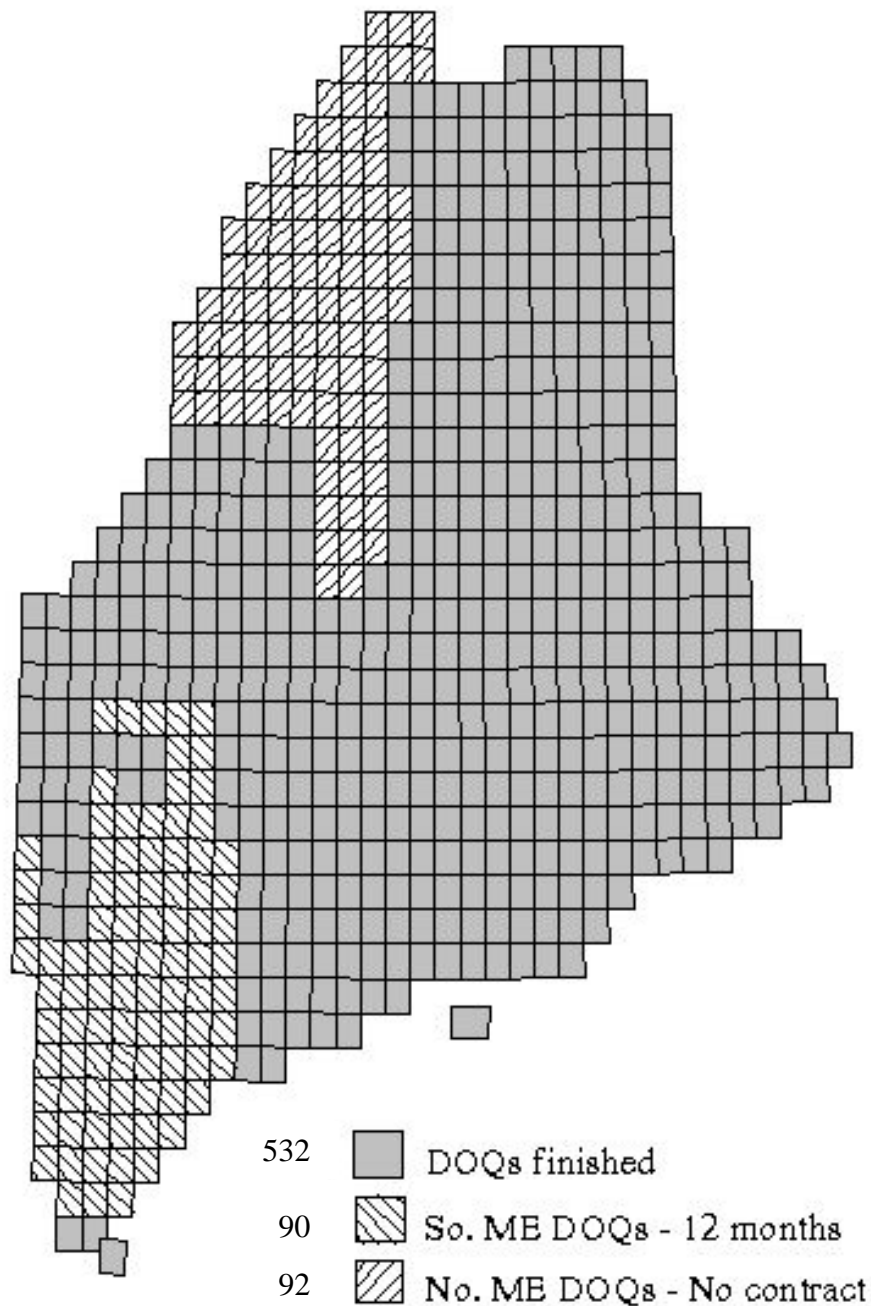
A fourth priority was also discussed, to provide a mechanism for multiple agencies to collaborate on other remote sensing needs. The reauthorization of this group meets this priority.

**Implementation Plans:** Once the three main priorities were identified, we drafted implementation plans to achieve them. These we present to the GIS Executive Council to ask for their support and agency financial assistance. Following are the detailed implementation plans for the three main priorities.

**High Resolution Imagery Implementation:** The plan to meet this need is divided into three phases: completion of statewide DOQs, updating statewide DOQs, and creation of an interagency aerial photo index.

*Statewide DOQs:* The group agrees that we need to first complete a statewide purchase of DOQs. Currently there are 532 quads (of 714 total) completed and available to GIS users (Figure 1). The most recent addition to these, 84 quads in northern Oxford, Franklin, and Somerset counties, was acquired as a direct result of the group's efforts this winter. The two remaining areas of Maine without DOQs include most of Southern Maine (96 DOQs, 6 of which are being redone), which is currently under contract by USGS, to be completed in 14 months, and the northern woods area (92 DOQs), which is not under contract. We request that the GIS Executive Council allocate \$60,000 in funding from its agencies to complete the northern woods area, thus completing the initial statewide collection of DOQs (note: \$60,000 is 25% of the total cost, the rest to be matched by USGS, NRCS, and the Farm Bureau).

Figure 1. Status of USGS DOQ production for Maine, 4/2/2001.



*Updating DOQs:* Once a statewide DOQ library is available, the group agrees that updates on a 5-7 year interval are needed. Current DOQs are based on 1996 and 1998 imagery. We request that the GIS Executive Council take this into consideration and find funding to update DOQs, with the updates starting in 2003. Currently, using USGS to create the DOQs, the state's contribution would be around \$570,000 (again matched by USGS, NRCS, and the Farm Bureau). However, it is not required that these images actually be USGS DOQs. They could include any data source that provides at least the same resolution and precision of current DOQs. At least one company exists which specializes in updating DOQs at a quarter of the cost of creating new ones, and can do so in roughly 10% of the time (Pixxures Inc. proposal, Appendix

D). Regardless of the method, GIS users need to have current photography and the state agencies need to plan on providing it. OGIS or state agencies could request regular appropriations for this, or have regularly planned expenditure and financial source for this imagery. Once acquired, the images would be distributed to state agencies, educators and citizens through current means via OGIS.

*Aerial Photo Index:* Currently, many state agencies house private collections of aerial photos acquired for specific projects. Many of these are not georegistered or georectified. The group agreed that a mechanism to find such photos between agencies would be highly useful. The group will create a spatial index of these photos to consist of photo centroids and the following attributes:

- Scale
- Date
- Color/BW/CIR
- Agency
- Flight line ID
- Photo ID (combination of agency, flight line id and photo id is unique ID#)
- Original media (digital, film, paper, transparency)
- Scanned (Y/N if media is not digital)
- Georeferenced (control points/referenced/rectified)
- Resolution (map units, as above)
- Contact
- Agency Project Name (project name used by the owning agency)
- Agency Project ID (project ID used by the owning agency)

Agencies would supply extra information via metadata for photos, such as keywords, comments, and reasons for acquiring the photos. The first phase of this project will be completed by the Maine Forest Service and Maine Dept. of Transportation, both of which already have their own photo indices. These will be combined as a test product, and populated with the appropriate fields. Once these are completed, if users find the product useful, the project will be expanded to include other agencies. The centralized database will be maintained by OGIS and updated by the participating agencies. We will also attempt to coordinate this with the USGS database, the Aerial Photography Summary Record System (APSRs).

**Improved Landuse / Landcover Implementation:** The group has defined a detailed landcover classification to be derived from satellite imagery and aerial photos, in order to acquire landuse / landcover data that better meets the needs of state agencies (Appendix E). For resolution, we initially anticipate a minimum mapping unit of 40 acres or a pixel resolution of 10m. The classification and resolution are ambitious, and the group agrees that the state does not currently have the technical personnel or resources to complete such a project. The project will most likely require the purchase of multi-season statewide satellite imagery from various sources, coupled with classification of that imagery and further refinement via aerial photo interpretation and ancillary data. We propose to apply for a grant from NASA to fund such an undertaking (Appendix F), and to have the project completed by an outside party (such as a private company or university lab). Greg Miller (Maine Forest Service) and Elizabeth Hertz (State Planning Office) will lead the grant-writing effort, with the rest of the group assisting. The major dates are:

- April 17, 2001 - Letter of intent to apply due
- May 15, 2001 - 5-page abstract of proposed project due
- June 15, 2001 - NASA review of abstracts complete
- August 1, 2001 - Full proposal due (pending acceptance of abstract)
- August 15, 2001 - NASA review of proposals complete
- October 1, 2001 - NASA grants awarded

If we are successful in winning the grant, this project will be contracted out for completion within three years. At this time, the group sees a need for updating this data, but has not determined a mechanism for doing so. Regardless of our success in winning the grant, the group agrees this is a major priority for state GIS users. If we fail to win the grant, we may reconvene to discuss alternative methods of funding and would appreciate the Executive Council's support at that time.

**Improved Elevation Data Implementation:** The group considered this priority at its final meeting, and agreed to delay a detailed implementation plan for two reasons. First, the burden of work voluntarily accepted by group members to complete the NASA grant abstract and finalize this report prohibits us from accepting any more at present. Second, it is possible that such data (10m DEMs) will soon be available or already exist. The group will look for such data in this interim period. If these data are available, distribution will be through current means via OGIS. If such a source does not readily exist, the group may reconvene at some time after May 15, 2001 to discuss this issue further.

**Conclusion:** At this time, we consider the meetings of the group adjourned. This does not mean that our business is complete however. In the short-term we will be working on the NASA grant and finding funding to complete a statewide DOQ library. We request that the GIS Executive Council support us fully in both efforts, by assisting in formal support of our NASA proposal and by securing the final funding (\$60,000) for DOQ completion. After these goals are achieved, we formally request that the Executive Council plan on funding for DOQ updates by 2003 as described above. With that achieved, the group may convene again in the future to discuss new data needs and how best to meet them.

**Appendix A. Proposal to the GIS Executive Council to reauthorize a remotely-sensed data subcommittee.**

*(Note: The initial proposal called for a limit of four meetings over 8 weeks. The group, upon review of the needs we wished to address, agreed to extend that number to whatever was necessary, keeping in mind the intent of the group and the desire to have a finite number of meetings. The group ended up needing eight meetings over 16 weeks. Although this proposal was dated Sept. 25 2000, scheduling conflicts prevented the initial meeting until Dec. 7, 2000)*

September 25, 2000

To: GIS Executive Council  
From: Michael Smith, Maine DEP GIS Unit  
Christopher Kroot, Maine DEP GIS Unit

RE: Reauthorization of a subcommittee to study needs for remotely sensed data

We propose to convene a subcommittee, consisting of technical representatives from various state agencies, to investigate the needs of these and other agencies for remotely sensed data, to attempt to prioritize those needs, and to report our findings to the GIS Executive Council and the Maine Office of GIS. Remotely sensed data is defined as any data that are gathered using some sort of remote mechanism, and typically include satellite imagery and aerial photography. The goal of this subcommittee will be to provide guidelines for future acquisition of remotely sensed data. Currently, there are no guidelines, and thus many agencies must operate on their own to acquire these data. If the subcommittee finds that agencies share needs for similar data, then it will likely be in the state's interest to combine these purchases and make the data available to a wider audience.

We propose to convene this subcommittee for no more than four meetings, and to draft a report within 8 weeks of the subcommittee's first meeting. The report will specify in detail the needs of the combined agencies regarding remotely sensed data and how these needs can be met.

## Appendix B. Meeting Notes

*(Meeting notes were recorded on a laptop during the meetings by Michael Smith. As they were recorded, they were projected on a wall via LCD projector to ensure that appropriate content was recorded. The intent was to try to capture comments and decisions which affected the outcome of the group's work. Not all comments are captured in these notes, and in some cases 45 minutes of discussion are summed up with just the decisions that were made. All notes were distributed to the group immediately after the meeting, with 'homework' delegated to members for completion before the next meeting).*

### Meeting 1: December 7, 2001

Discussed agenda

Dan notes Exec council meeting 1/25, would like a discussion of roles by then.

Went with item 2 on the agenda, open discussion of goals of each agency in the committee.

Item 2 - goals

SPO - determine where agencies can piggyback RS needs, SPO looking for specific data at town and regional level. Routinely gathered imagery suitable for change analysis. Coastal areas and near-shore in addition to land.

MEMA - baseline info (coastal), for comparison to post-emergency status, to determine damage. Same for ice storm/winter storm damage - power lines, forestry damage, etc. Pretty current data (within 24 - 48 hours after event), to determine highest impacts and prioritize responses. Traffic flows in the event of a hurricane/other major storm, ice jams on rivers. Coastal erosion

(change analysis). Flooding. Also later updates (4-5 days post-event). Also interested in hazardous material accidents/emergencies (such as oil/chemical spills). MEMA coordinates state resources for disasters.

(DOQ digression) - Ray Voyer updated status of ME DOQs, money being allocated to complete additional 240 in southwestern ME. Done in 18 months. Dan notes a small additional amount of money is needed to complete these (\$13,000?).

NRCS - need GIS capability at field office level. DOQs base spatial data for conservation plans. Obviously need DOQs finished and current. Also use DOQs for photomosaic for watershed planning. Multi-spectral data at watershed scales needed to provide more depth to watershed planning. Will do classification and veg. mapping. DEMs for same watersheds to do 3-D modeling of watersheds.

Long, Cross, Mud Lakes; Prestile Stream; Meduxnekeag; Kenduskeag; Sheepscot (for now).

UMO - interested in coastal data for E-Atlas, knowing how public can access RS data, getting a 'catalog' of publicly available RS data.

DMR - International data. Will need marine data (sub-surface). Mostly coastal data, but also inland data where fish migrate upstream. Interested in joint storage, distribution, processing of RS data. Not in the position to work with raw satellite data, preferring processed data. In coastal areas, need data specific to tides (low-tide vs. high-tide data). Eelgrass bed mapping done with true-color aerial photos. Oil-spill response needs aerial photos (currently having them scanned but not georeferenced).

MFS - detailed landcover type map - to get species specific forest type (15-20 types), overstory and understory. Looking at 30-meter data for cost-effectiveness. Would do own RS processing. No in-house expertise. Have great resources for ground-truthing a veg. map. Used for fire management, forest management. Currentness roughly 1 year or less, would consider doing a 'rolling' implementation, such as scene-by-scene. Such a project would be good for coordination between multiple agencies, preferring to do most work in-house.

OGIS - determine overlapping GIS needs with state agencies for GIS data and services, to work as a facilitator to acquire, access, distribute, and process RS data. Also to provide in-house image processing capability to state agencies. Need for good statewide land-use/landcover data set at regular intervals. Also need way to get annual change.

LURC - could use imagery for enforcement to track changes (such as illegal changes), and in the planning area to make decisions for future land-use zoning projects. Permitting area needs ability to track changes in sequential images. Accessed by all users. Focus down to structural level, preferably leaf-off. Don't use satellite imagery because it's too coarse.

IFW - One facet looking at large-area wildlife modeling (statewide). Don't have in-house facilities and staff to do RS data processing. Other facet is detailed imagery for working with towns for creating conservation plans.

DOT - Have photographed 160 airports/seaports/heliports in ME. Would like to see 3-D modeling with RS data to model airplane approaches to airports to make sure they're clear. High-resolution (5m or less) imagery for construction permitting, etc.

USFWS - Make sure we're realistic about what can be done with RS data. Currently using combo of CCAP, Gap, NWI data for habitat modeling. Would need to be able to break out veg. Communities in a classified veg. map with high degree of accuracy. Also need high-resolution photos for distribution with data sets, to add clarity in their interpretation, such as at town meetings. Stress on determining applications first, then finding tools to accomplish them. Need more categories in veg. classifications for salmon modeling, higher-resolution data, and could use thermal data on streams/rivers for salmon modeling (cold water vs. warmer spots). Ways to model different stream habitats (ripples/runs), riparian areas with data > 15m resolution. Tidal influences in estuarine areas for salt marsh restoration.

DHS (Drinking Water Program) - High-resolution photography, land use/landcover for watersheds, areas around intakes/wells. 3-D modeling of imagery.

DEP - High-resolution photography for cartography, permitting, town meetings, other outreach. Good land use/landcover at coarser resolutions for watershed planning.

End of item 2 - goals discussion. 11:30AM.

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Miscellaneous discussions:

GO-MOOS <http://www.go-moos.org>

Looking at alternative remote sensing methods - buoy deployment, radar, for oceanographic modeling.

Seth - we should also see who else in the state could be served by this group and try to court their involvement.

Dan - is willing to collate user needs prior to next meeting.

Jed - wants to know if we should invite non-state organizations (towns, etc.)

Dan - responds with platform to do this (presentations), might be useful to put our results out to peer review

Mike - coordinating with towns and other non-state entities is good, but we need to be careful of losing sight of our immediate goals.

11:40AM

Move to items 3 and 4 on agenda - determining user needs and what agencies currently have. With the above assessment, we decided to go forward with informal discussions of user needs at our agencies and send summaries to Dan by 12/19 for compilation. A preliminary form was created in Excel to do this. The form also provides an area for discussion of agency's RS resources which could be utilized by other agencies.

Members will mail user needs and resources form to Dan by 12/19. Dan will summarize and bring to meeting.

Meeting 2: December 21, 2001

Dan distributed results of user needs analysis, compiled from our input. We agreed to read it for 10-15 minutes, digest it, and compile a group user needs list (RS group).

Dan - took the data and processing needs results separately. Compiled raw data and extracted common results.

We spent most of the meeting summarizing multi-agency user needs. Priorities for data -

1) Very high resolution imagery (1m or better) for feature identification/extraction, georeferenced to at least accuracy of USGS 1:24000 maps. 5-year interval DOQQs for entire state, annual for identified areas (to track development changes), assuming annual coverage areas are small and are shared by multiple agencies. Digital index/catalog of aerial photos aquired by state agencies or other organizations we have access to.

2) Land use / land cover product more detailed and more current than Gap Analysis and NLCD (MRLC) with 15-20 forest categories, delineate agricultural areas, detailed wetlands (resolution), urban density classifications, impervious surface delineation, blueberry barrens, intertidal classification.

3) High resolution (10m or better) elevation and bathymetry data, such as DEMs.

4) Develop mechanism for multiple agencies (but not necessarily all represented in RS committee) to collaborate on other remote sensing needs.

Homework - come up with land use/landcover categories for our agencies, and how often updates would be required. Look for state-of-the-art landcover/landuse projects that have been implemented and are workable.

Seth - contact NOAA about landcover/landuse already existing/ in process

Jed - same, with select universities and companies

Greg - same, with UNH, and will send forest cover categories to Jed

Dan - email NASA grant information to the group.

### Meeting 3: January 5, 2001

Discussed newest DOQ availability. \$2500 needed to get 84 new DOQs. Ray updated us on the status of DOQQs, dates taken, costs to get northern woods. The state would need to come up with roughly \$60,000 to complete the state's northern woods (in addition to any funds needed for current DOQs). Ellen will try to find \$2500 funding for 84 new DOQs.

Ray discussed the pros and cons of ERMMapper's ECW image compression vs. LizardTech's MrSID - 1/2 the cost, many more features, including viewer extensions for ArcView.

Tim LeSiege (DOT) discussed a DOT meeting a few months ago to come up with a centralized point for tracking remote sensing projects. Tim will email a contact to the RS committee for this group. We discussed the idea of making an interagency aerial photo digital catalog. Ray discussed the availability of the Aerial Photography Summary Record System (APSRS) from EROS, which tracks the metadata of many publicly-funded aerial photo ever taken. This database could be used to extract an aerial photo catalog from federal sources in Maine.

Tim also discussed other data that could be shared between agencies, which better falls under the GIS Tech committee data catalog plans.

Implementation plans for user needs:

Need # 1 (high-resolution imagery):

1.) Current DOQs - we already have 448 of these. Ellen and Hugh will find out about aquiring money for the initial 84 new DOQs (western Mts.) - \$2500. We may have to find money for the remaining southern quads as well (\$15,000). Starting the processing of northern woods would cost the state roughly \$60,000, funding we would also need to find.

2.) Recurring DOQs - state agencies will provide by the next iteration (5-7 years) funding to provide another statewide imagery base, comparable to DOQs. The current cost of this would be roughly \$570,000. It is not required that these images actually be NAPP-based DOQQs, it could include any data source that provides at least the resolution and precision of current DOQQs. Alternatively, OGIS or state agencies could request for regular appropriations for this, or to have some regularly planned expenditure and financial source for this imagery. Also, we need to have recurring user needs analysis for remotely sensed data to justify these products.

3.) Statewide image catalog - state agencies will create a single layer with geographic reference to aerial photos available to state agencies, with standard metadata. OR - as an interim product, a tabular list, or database with this information.

Homework until the next meeting is:

Everyone continue to think about and research land cover classifications, including looking at the Upper Midwest Gap project Jed mentioned.

Everyone continue to think about the possibilities of implementing a statewide image catalog.

Ellen and Hugh will investigate acquiring \$2500 for initial DOQs in western mountains.

Mike will contact Dan and find out about southern Maine remaining DOQs (funding).

Everyone investigate sources of funding for the \$60,000 gap in DOQs for northern Maine.

#### Meeting 4: February 1, 2000

Reviewed progress to date

Discussed Pixxures proposal - Reservations were voiced regarding newness of company, not knowing quality of their work yet. Dan suggested getting a matrix of pricing per quad per product to provide to agencies. DOT staff volunteered to contact references on Pixxures proposal. Mike Smith will contact Pixxures representative to get more details on the proposal, and see if we can get a sample DOQQ, and to discuss data ownership/licensing issues. Also, see if we can get an estimate for doing the original DOQs for the northern woods area.

We discussed the DOQQs for Maine from USGS - \$2500 for Sugarloaf/Jackman region from DEP and DOC committed, and the CDs will be ordered. Southern Maine DOQQs contract is in process, OGIS is looking for \$23,500 (DOT already pledged \$10,000). DEP is interested in prioritizing certain quads, Mike Smith will contact Lynn Bjorklund to find out. Job to be completed in 14 months, possibly earlier. OGIS will convert the Sugarloaf/Jackman DOQQs to MrSID images. Dan noted that in existing DOQs, some of the quarter-quads may go back to 1991.

Side discussion of landcover classification - we agreed to discuss the landcover classification at the next meeting since Jed and Garrett are not here. Seth mentioned that we need to share the information sources that we have better before the next meeting. Mike will send an email to the group requesting landcover resources. Seth and Matt Howe will collate this information and provide it to the group as an email and on the web site. Dan discussed the update to MRLC and current limitations. MRLC is looking for input for this update. Gene mentioned Wiscasset High School has GPS capabilities and could be involved in the MRLC ground-truthing. The RS group would be instrumental in finding ground-truthing resources for and MRLC update. Other resources would include CCAP and GAP ground-truth data.

Aerial Photo Index -

DOT provided a map of their current aerial photo index project. Current attributes include image ID, flight line, photo#, date added to the index. The ID# relate to another database which includes flight line, # of photos in the line, media, date of picture, contractor, scale, location, B/W or color, and comments. DOT's currently has about 1/4 of their photos indexed. Greg discussed the Forest Service's aerial photo index, of photo centers. The images are stereo pairs, photo centers were taken with GPS at the time of photo collection. Seth has created an index of approximate photo centers from Sewall photography, approximately 500 points. DOT's index is entered via an Avenue application. We tentatively selected the following minimum criteria for a statewide aerial photo index: We all agree that centroids, rather than photo polygons, are more useful and easier to maintain.

We all agree that a single centralized database would be the best option, maintained by agencies but housed on one server.

DOT staff will discuss with Nancy the possibility of converting to a centralized, centroid system.

Attributes required for an index:

Scale

Date

Color/BW/CIR

Flight line ID

Photo ID (combination of agency, flight line id and photo id is unique ID#)

Original media (digital, film, paper, transparency)

Scanned (Y/N if media is not digital)

Georeferenced (control points/referenced/rectified)

Resolution (map units, as above)

Agency

Contact

Agency Project Name (project name used by the owning agency)

Agency Project ID (project ID used by the owning agency)

Agencies would supply extra information via metadata for photos, such as keywords, comments, reasons for taking the photos.

Next meeting is Feb. 16 10-noon. We will finish discussion of aerial photo index and start discussion of land cover classification.

### Meeting 5: February 16, 2001

First discussion - overview of homework from Pixxures, DOT

Aerial Photo Index - would likely follow an evolution of three steps:

- 1) A common data file of photo centroids, updated from distributed databases owned by agencies. This could be downloaded by others and searched in their own GIS.
- 2) A web interface, both tabular and geographic to search for photos
- 3) A centrally updated and managed database accessed via tabular or GIS interface.

DOT staff wanted additional fields for DOT use:

name of person in DOT responsible for flight

# photos in flight line

town

county

Ellen - how about an attribute detailing distribution method?

Greg - how about setting this as a test coverage first, to test merging abilities and whether the data model meets the agencies needs? DOT and Forest will provide test datasets in our standard.

### LAND COVER CLASSIFICATION

Original objective (inserted from meeting# 2 notes):

- 2) Land use / land cover product more detailed and more current than Gap Analysis and NLCD (MRLC) with 15-20 forest categories, delineate agricultural areas, detailed wetlands (resolution), urban density classifications, impervious surface delineation, blueberry barrens, intertidal classification.

After MUCH discussion, we agreed to explore the possibilities of accomplishing this out-of-state, either with an academic institution, or commercial company, or both. The NASA grant seems to be a promising source of funding. As a group, we will need to come up first with a landcover classification we all want, and then have a small subgroup actually write the proposal to NASA.

Post-meeting note: This discussion lasted near 45 minutes and was very useful, revisiting many possible scenarios and tools to achieve this goal. Notes were not taken for the whole thing because the conversation went so fast and

the goal of these notes is to record committee decisions, not so much a dictation of the conversation. Topics included the pros and cons of various sensors, capabilities of the new LandSAT, reality of getting the type of data we want, concerns about accuracy and resolution, and what the role of this group should be. In the end, we agreed to approach this as we would a contracted project, by outlining what we want as a group, and then shopping around to universities, companies, or other entities who would be willing to do the work and coming up with a price. From that we can see about submitting NASA grant proposals for that amount. This way we focus on what we really know (which is what we need) and not what we don't (how to get it). With only 20 minutes left in the meeting, we tried to start a landcover classification we were all comfortable with; the beginnings of that follow:

Specific needs for landcover:

Softwoods -

- spruce
- fir
- eastern white pine
- red pine
- hemlock
- white cedar
- larch

hardwoods -

- sugar maple
- yellow birch
- white birch
- gray birch
- aspen
- red maple
- oak
- black cherry

wetlands -

- NWI classes

intertidal

Post-meeting note: We quickly realized that we did not have enough time to finish this today, and that we needed to think in more detail about what our agencies want. We decided to set this as our homework for the next meeting.

Homework for everyone is to come up with landcover classification system that meets their agency's needs. This will be a 2-tiered approach - the first is everything they want, the second a more 'realistic' approach based on current classifications and what we know about current sensor limitations and costs.

Post-meeting note: The classifications are very important to our continuing pace of accomplishment. If we can all draft them before the next meeting and submit them, we can collate a single set of classifications at the next meeting, delegate the proposal-writing to a few members, and be done with this goal.

Jed will approach Steve Sader at UMO about talking with us about the realities of this classification.

### Meeting 6: March 2, 2001

Homework was to come up with landcover classifications for our agencies.

Greg - coarse

- White Pine
- Red Pine
- Spruce-fir
- Hemlock
- Larch-cedar
- White birch-aspen
- soft maples

hard maple-yellow birch-beech  
oak  
ash  
fields-grassland  
sparse development  
wetlands  
shrub/brush (for fire management)  
blueberry barrens  
forest harvest sites

Greg - finer is same as above, but combined categories would be split up. Mapping units should be less than 5 acres. Over 20 acres is worthless. A few age or density classes might also be useful.

Ground truthing sources - timber company data, FONS (Forestry Operations Notification System), FIA (Forest Inventory Analysis USFS) sampling 20% of the forests every year for 5 year turnaround, GAP groundtruth data, CCAP ground truth data.

DOT - no special needs beyond the other agencies in the group

Dan Coker (MENAP) forest condition is more important than species  
clearcut  
light partial cut  
heavy partial cut  
mature

DEP

commercial/industrial (>30% impervious)  
high density residential (> 25% impervious)  
med. density residential (15%-25% impervious)  
low density residential (8% - 15% impervious)  
rural roadside residential  
high density transportation (interstates, etc.)  
lawn or park/recreational grasses  
gravel surfaces  
active rowcrops  
active hayland  
active pasture  
low maintenance hayland/meadow  
reverting field  
barnyard/feedlot  
bare ground/exposed soil/construction site  
standard wetland classes NWI  
coastal shoreline classes  
open water

Hugh - drinking water program

bathymetry  
beaches  
rocky shoreline  
quarries/strip mines/gravel pits  
orchards/vineyards  
golf courses  
airports  
landfills/dumps  
small grains (investigate)

Ellen is OK with the above. Priorities would be forest, wetlands, urban/rural, roads.

Liz same as above.

Garrett - Forest types and structure must be at least as good as Gap/MRLC

Jed FGDC national veg classification standard FGDC-STD-005. Priorities were forest type/cover to include structure and age at least as good as Gap, NWI wetlands, clearcuts.

Still need Seth's coastal classifications.

Homework for everybody - read the draft classification Mike will prepare and comment on it before the next meeting. Also read the NASA grant document before the next meeting and be prepared to discuss it. Think about accuracy assessments to discuss at next meeting.

DOT

within urban areas breakout:

heavy industrial

light industrial

### Meeting 7: March 16, 2001

Topics to discuss

finalize landcover classification

discuss NASA grant

discuss ground-truthing ideas

Landcover classification

Ray - will likely need ancillary data to get to this level.

How do we deal with multi-category classifications? After much discussion, we agreed to assign primary, secondary, and tertiary categories to any given area, with occupancy values of some sort.

Liz and Seth - how to deal with wetlands beyond NWI? Look at CCAP to see how they did it.

Ray - SSURGO can give you hydric soils, to further get at wetlands.

Greg - how do we deal with forest age? This will need to be included in addition to stand structure. Perhaps adding another tier, to include forest age, would be appropriate.

Ray - how would plantations be differentiated from clearcut?

Garrett - how do differentiate 'partial cuts' where half is cut vs. thinned?

We discussed this and agreed to change forest stand structure categories from being based on cuts to being based on density.

NASA Grant

Liz volunteered to try to get the regional councils on board for the NASA grant. Gordon Workman - GIS guy at Southern ME regional planning. Ken Murchison at Northern Maine Development Council.

Ray will try to contact the Indian tribes and get them involved.

Mike will contact Gordon Longworth at COA to discuss, and will contact Jed about UMO and regional involvement with other state and federal agencies, and regional planning groups. Mike will contact companies, including Sewall, TerraLogic, the guys who did Quebec (post-meeting note, this company is SpectraAnalysis, and it was Ontario, not Quebec).

Ellen will contact conservation groups to get them on board.

### Meeting 8: March 30, 2001

We examined the proposed landcover classification. There were no suggestions for change.

Two companies were mentioned who were interested in the project - SpectraAnalysis and TerraLogic. We discussed other universities, Mike will contact people from U. Mass, UNH, and U VT. Ellen will contact the Conservation Council of New Brunswick.

We discussed the resolution/minimum mapping unit, since that had not been decided. We discussed the possibility of having a variable MMU, based on the covertype (such as forests having larger MMU than developed areas).

Bill Krohn has statewide TM imagery from 2000, free for the asking.

We should have a subset of the group to actually write the contract. Greg Miller volunteered to be in this, and Liz Hertz is a likely candidate who will be volunteered. Dan will contact NASA to make sure such a project would fall under the scope of the grant. A letter of intent to apply must be out by April 17, the 5-page proposal abstract is due May 15.

We discussed the third priority, to get improved elevation data, and agreed to table it until a future date, so that we can focus on the aerial photos and landcover projects we have outlined. Dan mentioned that this could probably be tied into the hydrography project, as USGS is combining these datasets for many projects. One possibility for a 'quick fix' to this would be to obtain the DEMs from USGS for DOQs. Dan suggested OGIS may already have these, he will discuss with Dave K. and see if we do.

Other topics to discuss (review from previous meetings):

Aerial photo index - DOT will try to get their index over to OGIS as a trial database. Greg's version (ice storm photos) is already over there. Dan will discuss with Dave K. to get them onto SDE. Once that is done, a merging can be done following our earlier discussions, but not until after the NASA grant abstract is submitted (after May 15).

The topic of budgets was discussed, the NASA abstract requires at least the levels of anticipated funding from NASA, and anticipated in-kind contributions from us. Dan will find out from NASA how potential contractors would be involved.

Kathleen - DOQ updates was discussed, and the possibility of greater than 1m color DOQs created when our DOQs are updated (5 years or so).

Mike will try to get the preliminary workgroup report done by April 17, the group will need to get comments back by April 24, to be incorporated into a final report May 1 for the GIS Executive Council Meeting.

The Remote Sensing Group meetings are adjourned.

## Appendix C. User-Needs Analysis Form

### User needs for Remotely Sensed data

**Name**

**Agency**

**# of people in agency**

**# of GIS users in agency**

**Directions:** Within your agency or organization, try to talk with GIS users representing various aspects of your agency's work, to see what needs they might have for remotely-sensed imagery. Keep in mind that this is not limited to existing available data, or traditional data. They might want things that aren't often used or might not even know what products they want, but there work demands it. A copy of this form with examples is on sheet 2.

#### Data

*Record below specific data products that users might ask for (they've seen elsewhere, or read about, etc.)*

Data Description	resolution (cellsize)	update frequency	type (MS/pan/IR, etc.)	geographic extent
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#### Processing

*Record below any specific processing that users might ask for*

Application of processing	spectral clustering	classification	georeferencing	ground-truth	error-estimation
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#### Deliverable/product

*Describe, in specific terms, any other RS products a user might have (such as if they describe a general RS need without naming specific data or processing).*

#### Survey

*Please answer the following questions to allow the RS committee to better understand all the resources we collectively have.*

What facilities for distribution do you currently have?

What data do you currently have?

What other resources do you have?

*(This was completed by all group members for their agencies)*

## Appendix D. Proposal from Pixxures, Inc. to update DOQs for State of Maine

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January 29, 2001

As promised, here is a draft proposal to be presented to and reviewed by your interagency Remote Sensing Committee. We are pleased to submit this proposal, particularly because there is such a good fit between State of Maine's objectives and the solutions Pixxures, Inc. offers. We're confident these recommendations will have a positive impact on your operations and appreciate your consideration.

### THE ISSUES YOU FACE

Like most organizations, the State of Maine feels growing pressure to produce more with less. You also recognize that technology has the potential to provide you with a competitive edge. Some of the trends affecting you are process automation, information management, partnerships/outsourcing, work teams/increased employee training, downsizing, regulatory pressures, and budget reductions. Having strategically partnered with numerous businesses recently, Pixxures, Inc. has the experience to help you balance the business issues identified below with the State's need to simultaneously be more efficient and cut costs.

#### Maintaining current and accurate data

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The currency of the State of Maine's digital imagery will directly impact your ability to make sound decisions for the future. Use of older imagery and image sets of varying vintage can create an inaccurate or inconsistent picture of land use, growth patterns, and resource and population distribution, among other problems.

Additional issues relating to having current and accurate data may include:

- The need to plan growth within your area and develop strategies to effectively deploy your resources.
- The need for interagency communication to be based on common data sets.
- A desire for confidence in the accuracy of your presentations to constituents and others.

#### The need for speed

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Deciding to invest in updating digital orthoimagery is a big step. You have obtained a consensus on your needs, budgeted the funds, and have created a plan to utilize your new data. The only problem now is that many times, your vendor's delivery schedule is so slow that your data is outdated before you get it. For data to be most useful, you have to have it fast!

## **Getting the best value for your budget**

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Our market research has determined that government agencies and private industry alike are recognizing the value of accurate digital orthophotography to their operations. The demand among users for increasingly accurate and detailed products is growing, as well. A key factor in delaying or even failing to purchase updated imagery, however, is typically cost.

Until recently, many agencies put off the purchase of traditional digital ortho updates and "made do" with what they had, although their data might be 5-10 years old. With Pixxures, you don't have to wait!

## **Customer service you can count on**

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Most of our clients want to work with product and service providers who listen to their needs, understand their applications, and then suggest the best solutions.

At Pixxures, every project is "custom". Before we present a final recommendation to the State of Maine, our sales and technical team will work with you to determine the most appropriate product, price and delivery schedule to meet your expectations. We provide, and respectfully request from you, open communication throughout the project. We won't try to fit your job into a pre-planned mold, nor will we make unrealistic promises to win your work.

Our best advertising is our satisfied customers and we will be happy to provide a list of references for your review.

## **THE OUTCOMES YOU EXPECT**

The recommendations suggested in this proposal will have the following positive effect on the State of Maine's operations. Getting the results you're looking for will help you achieve your goals. Use the following factors to decide whether implementing this recommendation is a worthwhile investment.

### **Better decisions from better data**

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Your planning may involve technical professionals, council members, and lay people. Most of them will not have a broad vision of the region or the issues that arise in managing it. Providing them with current, high-resolution imagery will give them the visual input they need to understand issues more clearly, enabling them to make decisions with confidence.

Using up-to-date digital orthoimagery gives you the "big picture" as well as the details to support more efficient allocation of funds, more effective deployment of crucial resources, quicker response to emergency situations, and a common information dataset through which your agencies can communicate. Getting your imagery quickly means that your data is not "outdated before updated". Your staff can be proactive with planning and decision-making, not reactive.

### **Cost savings give you more options**

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With tremendous pressure on your annual budget, every dollar counts. But basing important decisions on inaccurate or archaic information can be costly, too!

The cost savings resulting from the pixMap™ process allows our clients to finally update older data, to update their existing data on a more regular basis than originally planned, or even to use the savings on other crucial budget items. If a one-time capital expenditure is not in the budget

this year, consider selecting a monthly subscription plan that covers not only digital imagery updates, but consulting and support services from our trained, professional staff. At Pixxures, more options mean a better solution for our customer.

### **Improved level of service to internal and external customers**

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Updated digital orthophotography can be used in a variety of applications and fields. Many government agencies share data across county and even state lines as a service to constituents.

By providing current, timely and cost-effective digital orthoimagery, information can be accessed quickly and efficiently throughout your area. Less time is lost by employees searching for the most up-to-date data in your database, and confidence in decision-making is enhanced.

Upon the State of Maine's approval of these recommendations, Pixxures will begin the process of gathering more detailed information about your project specifications. We are enthusiastic about partnering with Maine Department of Transportation and look forward to the opportunity to provide you with the most timely, cost-effective imagery data available.

I will contact you within the next week to confirm the receipt and review of this proposal and to answer any questions you may have. Please feel free to contact me in the meantime if I may be of assistance.

Sincerely,

Marceil James  
Inside Sales Representative

# Why Select Pixxures, Inc.?

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## UNIQUE VALUE FOR THE STATE OF MAINE

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Is Pixxures the only partner who can provide the products and services recommended here to the State of Maine? Probably not. The difference lies in our desire to develop long-term relationships with our customers by creating value. You want a supplier who understands your industry, your agencies, and the pressures that are driving you to look for solutions. You want to partner with an organization who delivers on the expectations it sets. And you want your vendor to care about the business outcomes you need to achieve when implementing new solutions and work with you to make sure the solutions deliver the results State of Maine expects.

### Faster Delivery

**Pixxures creates digital orthophotos in a revolutionary way that is up to 10 times faster than products from any other source. This is partly because Pixxures specializes in "updating" older orthophotos by combining or eliminating many of the steps in the traditional mapping process through advanced software. We save time in the way we collect new flight data and by our ability to process large block of imagery at one time. Pixxures can produce an updated digital ortho of a typical county (600 square miles) in four weeks following acceptance of all source/input data received from the client.**

### Dramatic cost savings

**Digital imagery - particularly digital orthophotos, the map-accurate images used by geographic information professionals - has traditionally been the domain of large customers with big budgets and infinite patience. Pixxures is changing that.**

**PixMaps™ are map-accurate, high quality, digital aerial photographs, created in a revolutionary way that is less than 50% of the cost of such products from other sources. Our pixMap™ production process has been thoroughly tested in some of the most exacting applications, and our products continually prove to be of the highest quality for professional applications.**

### Superior Customer Service

**If you're not part of the solution, you're part of the problem. Pixxures listens! We make every effort to understand your needs and specifications, as well as your intended applications and timeframe. Pixxures' flexibility in inputs and outputs, combined with years of technical experience, give us what it takes to create the right solution for your project.**

### **Flexibility**

**Pixxures' Research and Development staff, assisted by Dave Knopp, arguably the most accredited programmer in the photogrammetry industry, is constantly working to improve and increase the number of input and output options we can offer. Our pricing structure is flexible, as well, with a variety of payment and service plans based on your needs. Need to amortize the cost of your digital orthoimagery updates on a monthly basis? Need to divide processing costs between two budget years? The answer is almost always "Yes".**

**At Pixxures, we know you want the solution that fits for you and we will work diligently to meet or exceed your expectations.**

## **Recommendations For State of Maine**

### **Pixxures' Solutions Designed To Address Your Needs**

While Pixxures specializes in updating existing mapping orthophotos with newer, more current map-quality photos, the company also offers some standard mapping products. Consistent with all of the company's products, these are offered at very competitive prices and usually with very quick delivery times. Products range from very high-resolution, orthorectified digital aerial photography, to high-resolution satellite imagery and digital elevation models. All of these products conform to the highest standards of accepted mapping, including accepted definitions for digital orthophotos and mapping accuracy.

Our understanding is that currently, there are a number of areas in the State which have no original orthimagery. These areas are in the process of being contracted to the USGS, to be processed and delivered to the State in 2002. Given the current stage of this process, Pixxures has not included this portion of the State in our proposal.

Further, we understand that the remainder of the State of Maine has existing DOQ coverage from USGS in a variety of vintages. It is this area that Pixxures proposes to update with new flight data and by using existing digital orthophotography and existing USGS digital elevation models (DEMs). Below is a brief description of our updating process.

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## Pixxures Qualifications to Perform Digital Ortho Updates

The Pixxures digital ortho update process is both rigorous and straightforward. We use existing digital orthophoto coverage to provide a source of control to correctly geoposition the newly acquired imagery, and an existing DEM (latest USGS or other, if available) to support fully differential image re-sampling and orthorectification.

The technology behind our process is the pixMap™ suite of software modules that automates the feature/control selection process, and utilizes state-of-the-practice algorithms to produce an updated digital orthophoto that matches the existing image map set. The methodology behind our production process utilizes the existing geometric qualities of an in-place digital orthophoto to support the rapid creation of a 2<sup>nd</sup> generation orthophoto image map set.

The quality of our output image product depends primarily on two main items: the geometric accuracy of the existing digital orthophoto data set, and the fidelity of the existing DEM or surface model to support new orthophoto generation. The absence of either of these critical input items requires the substitution or creation of either a new control source or a new surface model to support final ortho production.

The pixMap™ process is not a rubbersheeting or image-to-image remapping process. The process applies full photogrammetric practice and theory in generating a high-quality output image product. Where we differ from conventional practice is in the use of the existing ortho image to provide X,Y control data. The existing ortho coverage has been rigorously calculated to remove terrain, displacement and systematic errors, and represents a 3D world in 2D to a high degree of fidelity – that is its sole purpose.

By using that 2D ortho representation of the world, we can obtain accurate coordinates for well-defined features on the ground, and transfer those world coordinates to newly acquired imagery in a highly time-efficient and cost-effective manner. We do not require pre-flight survey control, paneled points, or photo-identifiable points to complete our process – we depend on the accurately depicted features in an ortho to provide that information. Inherent in this approach is the fact that the imagery generated via the pixMap™ process will be as accurate in world coordinates as the input imagery, as long as the DEM data accurately reflects the condition of the surface at the time of the new image acquisition.

Once the newly acquired imagery is correctly geopositioned via transfer of control from existing orthos to new imagery, it then undergoes analytical triangulation and camera modeling to arrive at a state of numeric stability for further exploitation via fully differential rectification.

The result of this re-sampling process is the same as conventional digital orthophoto generation – a rigorously calculated ortho image, with each pixel generated according to the correct resection of its position in the world, taking into account terrain, camera characteristics, radial displacement and system-induced errors. In other words, it is a brand-new digital orthophoto, built on top of an existing ortho base, using the same techniques and practices, produced in a highly compressed timeframe and at greatly reduced costs.

# State of Maine's Investment

## COSTS OF THE SOLUTIONS RECOMMENDED BY PIXXURES

Here is some cost information relative to the recommendations Pixxures, Inc. is making to the State of Maine:

Product	Price
Updated Digital Orthophotos for areas with existing USGS DOQQ coverage	\$15 per square mile, based on minimum purchase of 5,000 square miles (~32,100 sq. mi. in Maine)

The above pricing includes costs of acquisition of new imagery for the area of interest, scanning of film into digital format, acquisition of existing USGS control data, orthorectification/processing at one-meter resolution in black and white, and media/delivery charges. If the final area of interest is significantly smaller than 5,000 square miles, minor price adjustments may be required. Updates in color may also require minor price and delivery changes. Pricing is based on project being flown in one flight mobilization. If the State desires the area of interest to be divided and flown at different times of year, mobilization costs for acquisition of new imagery will increase.

To create a more detailed draft proposal, it would be necessary for us to have additional information about your area of interest (ideally in an ArcView-compatible shape file), available source data, preferred tiling and delivery formats, color vs. B/W preference, and delivery schedule. Proposed delivery schedule to State of Maine will depend on availability of aerial vendors at the time of contractual agreement, total number of frames in area of interest, and availability of resources at Pixxures, based on jobs already in production.

## PIXXURES' INDUSTRY REFERENCES

**Shelby Johnson**, [State of Arkansas](#), State Land Information Coordinator, Office of Information Technology, PO BOX 3155, One Capitol Mall, Third Floor, Little Rock AR 72203 Tele: 501-682-2767, 501-682-4310 fax.

"Two years ago the Arkansas State Land Information Board realized that a major issue facing users of geographic information system (GIS) technology was the lack of current data. The existing U.S. Geological Survey Digital Ortho Quarter Quads (DOQQs) were aging and in order for GIS users in the state to leverage GIS technology a new statewide image database was desperately needed. The Board planned for a new acquisition of state wide imagery with two major criteria: 1) produce high quality color-infrared imagery at low cost and 2) produce the imagery in as short a time frame as possible. Pixxures filled the bill. Their production staff has led the way, guiding our project along the way to produce an image database of the entire State of Arkansas based upon color-infrared film meeting all National Aerial Photography Program specifications, and then producing DOQQs meeting all state and U.S. Geological Survey requirements. Our project is being produced at lower cost and the image production turn-around time is quicker than anything else in the industry that I've seen. They've exceeded my expectations on our project. The only complaint I have is that they can't control the weather."

**Sheila Beissel, City of Westminster, Colorado**, GIS Coordinator, 4800 West 92nd Avenue, Westminster, CO 80031 Tele: 303-430-2400 x2123, 303-426-5857 fax.

The City of Westminster had out-of-date digital ortho and aerial imagery dating back to 1995 and 1998. The City staff's dissatisfaction with the quality and resolution of the recent digital orthos (1998) left Sheila Beissel, GIS Coordinator, frustrated at the lack of cost-effective, quality imagery solutions. She was willing to forgo frequent updates until the City could afford higher resolution data. Thankfully, she did not have to wait.

Introduced to Pixxures, Inc., Beissel was impressed by the fact that Pixxures could create 0.5-foot resolution color digital orthos at a fraction of the cost of traditional map imagery. Using Pixxures' pixMap™ product, she was able to get more than twice the resolution for less than what she had spent in previous years with other sources. Pixxures created digital ortho updates utilizing the City's existing DEMs and control points. The City of Westminster was able to update their orthophotos without incurring the expense of a completely new mapping project.

"We couldn't beat the price-for-pixel quality," says Beissel. "Now all the City staff are using the digital orthos for urban planning with nothing but compliments on the resolution and quality."

**Tammy Gorman, Colorado Department of Transportation**, GIS Coordinator, 4201 East Arkansas Avenue, Denver, CO 80222 Tele: 303-757-9811, 303-757-9727 fax.

The Colorado Department of Transportation's, GIS Unit began the development of highway corridor datasets in January of 2000. Tammy Gorman, GIS Project Leader and others within CDOT made the decision that aerial imagery needed to be part of the datasets being developed.

Pixxures, Inc. was able to provide CDOT with new 1-foot color aerial imagery for 25 miles along U.S. Highway 24 east of Colorado Springs in El Paso County. The imagery consisted of a ½ mile area on either side of the highway centerline and orthorectified by Pixxures to existing CDOT survey control points. Pixxures, Inc. with their knowledgeable and courteous staff delivered the requested product within the necessary time frame.

"The aerial imagery has been helpful during highway project scoping meetings and public meetings," says Gorman, "you would not believe the interest and discussions people have while viewing the imagery."

**David K. Nale, E-Map International**, President/CEO, 7208 Route 908, Tarentum, PA 15084 Tele: 352-591-0241..

**George Rohaley, U.S. Department of Agriculture**, Remote Sensing Leader, Mail Stop 5475, Room 1-2104, 5601 Sunnyside Avenue, Beltsville, MD 20705 Tele: 301-504-2268.

## Appendix E. DRAFT Proposed Landcover Classification

LEVEL I	LEVEL II	LEVEL III	LEVEL IV
CROPS	ROW CROPS		
		Corn	IRRIGATED/NON-IRRIGATED
		Potatoes	IRRIGATED/NON-IRRIGATED
		Vegetables	IRRIGATED/NON-IRRIGATED
		Other	
	CLOSE-GROWN CROPS		
		Small Grain/Oats	IRRIGATED/NON-IRRIGATED
		Small Grain/Barley	IRRIGATED/NON-IRRIGATED
		Small Grain/Rye	IRRIGATED/NON-IRRIGATED
		Small Grain/Wheat	IRRIGATED/NON-IRRIGATED
		Small Grain/Buckwheat	IRRIGATED/NON-IRRIGATED
		Small Grain/Other	IRRIGATED/NON-IRRIGATED
		Fallow	
GRASS	HAYLAND		
		Grass Hay	IRRIGATED/NON-IRRIGATED
		Mixed Hay	IRRIGATED/NON-IRRIGATED
		Legume Hay	IRRIGATED/NON-IRRIGATED
	PASTURE		
		Grass Pasture	IRRIGATED/NON-IRRIGATED
		Mixed Pasture	IRRIGATED/NON-IRRIGATED
		Legume Pasture	IRRIGATED/NON-IRRIGATED
		Inactive/abandoned Pasture	
	URBAN		
		Lawns/playing fields/parks	
		Golf Courses	
SHRUB	HORTICULTURAL CROPS		
		Blueberries	IRRIGATED/NON-IRRIGATED
		Orchard	IRRIGATED/NON-IRRIGATED
		Vineyard	IRRIGATED/NON-IRRIGATED
		Bush/Berries	IRRIGATED/NON-IRRIGATED
		Nut	IRRIGATED/NON-IRRIGATED
	CUTOVER AREAS		
		Forest clearcuts	
		Maintained rights-of-way	
FOREST	CLOSED-CANOPY FORESTS (dense with no recent cutting)		
		White Pine	Age categories
		Red Pine	Age categories
		Spruce	Age categories
		Fir	Age categories
		Hemlock	Age categories

Larch	Age categories
Cedar	Age categories
White Birch	Age categories
Yellow Birch	Age categories
Beech	Age categories
Aspen	Age categories
Oak	Age categories
Ash	Age categories
Soft Maples	Age categories
Hard Maples	Age categories
MEDIUM-CANOPY FORESTS (such as light-partial cuts)	
White Pine	Age categories
Red Pine	Age categories
Spruce	Age categories
Fir	Age categories
Hemlock	Age categories
Larch	Age categories
Cedar	Age categories
White Birch	Age categories
Yellow Birch	Age categories
Beech	Age categories
Aspen	Age categories
Oak	Age categories
Ash	Age categories
Soft Maples	Age categories
Hard Maples	Age categories
OPEN-CANOPY FORESTS (such as heavy-partial cuts)	
White Pine	Age categories
Red Pine	Age categories
Spruce	Age categories
Fir	Age categories
Hemlock	Age categories
Larch	Age categories
Cedar	Age categories
White Birch	Age categories
Yellow Birch	Age categories
Beech	Age categories
Aspen	Age categories
Oak	Age categories
Ash	Age categories
Soft Maples	Age categories
Hard Maples	Age categories

#### OPEN WATER/WETLANDS

All wetlands based on NWI, to include open water. Additional wetlands may be added, coded according to NWI classification.

COASTAL (coastal classifications will also be cross-referenced to NWI classifications, we may substitute NWI classifications where they provide more detail)

#### INTERTIDAL ORGANIC

Brown algae  
Green algae  
Red algae  
Mixed algae  
Salt Marsh

Eelgrass  
Submerged aquatic vegetation  
Mussel Bar

INTERTIDAL INORGANIC

Bedrock  
Boulder  
Gravel  
Cobble  
Mixed coarse and fine  
Mixed coarse and fine  
Sand  
Mixed fines  
Mud  
Salt Panne  
Artificial

DEVELOPED

URBAN

Commercial/industrial (>30% impervious surface)  
High-density residential (>25% impervious)  
Medium-density residential (15%-25% impervious)  
Low-density residential (8%-15% impervious)  
Airports

RURAL

Rural roadside residential

TRANSPORTATION

High-density transportation (interstates, highways, etc.)  
Low-density transportation (secondary roads)  
Non-paved roads

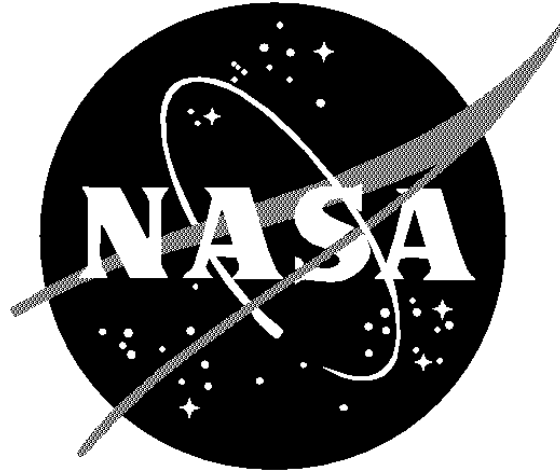
NONVEGETATED (noncoastal)

MANMADE

Barnyard/Feedlot  
Exposed soil/construction site  
Gravel surfaces (not roads)

**Appendix F. Abridged NASA Grant Opportunity (BAA-01-OES-XX)**

(entire document: [http://research.hq.nasa.gov/code\\_y/nra/current/BAA-01-OES-XX/index1.html](http://research.hq.nasa.gov/code_y/nra/current/BAA-01-OES-XX/index1.html))



**National Aeronautics and  
Space Administration**

**DRAFT**

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BAA-01-OES-XX

**BROAD AGENCY ANNOUNCEMENT**

**OPPORTUNITIES FOR STATE, LOCAL,  
REGIONAL AND TRIBAL GOVERNMENTS  
TO UTILIZE NASA AND COMMERCIALY  
DEVELOPED DATA AND CAPABILITIES IN  
OPERATIONS AND DECISION SUPPORT**

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**Abstracts due - May 15, 2001  
Proposals Due – August 1, 2001**

**OMB Approval No. 2700-0087**

**OPPORTUNITIES FOR STATE, LOCAL,  
REGIONAL AND TRIBAL GOVERNMENTS  
TO UTILIZE NASA AND COMMERCIALY  
DEVELOPED DATA AND CAPABILITIES IN  
OPERATIONS AND DECISION SUPPORT**

**NASA Broad Agency Announcement  
Soliciting Applications Proposals  
for  
Period Ending  
August 1, 2001**

**BAA-00-OES-XX**

**Office of Earth Science  
National Aeronautics and Space Administration  
Washington, DC 20546**

## BROAD AGENCY ANNOUNCEMENT

### OPPORTUNITIES FOR STATE, LOCAL, REGIONAL AND TRIBAL GOVERNMENTS TO UTILIZE NASA AND COMMERCIALY DEVELOPED DATA AND CAPABILITIES IN OPERATIONS AND DECISION SUPPORT

#### A. PURPOSE

This Broad Agency Announcement (BAA), BAA-01-OES-XX, is open until May 15, 2001 for abstracts, and August 1, 2001 for proposals. Abstracts may be submitted at any time until the closing date. Letters of intent to submit abstracts are requested. Evaluation of abstracts will be conducted periodically (approximately every three months) from the date of issue of this BAA. This BAA will be advertised in the Commerce Business Daily (CBD) and on the NASA Acquisition Internet Service (NAIS) Web site: <http://procurement.nasa.gov/>. The closing dates for preliminary proposal reviews will be posted in both the CBD and the above-specified Web site. Closing date for the initial abstract review is December 31, 2000.

This announcement solicits projects that apply science, technology and data, derived from activities sponsored by the Earth Science Enterprise (ESE) of the National Aeronautics and Space Administration (NASA) and/or commercial data and value added providers to improve decision-making and policy formulation in the day-to-day operations of state, local, regional and tribal governments. It is anticipated that these projects will be integrated partnerships that include all the elements of an operational solution; e.g., data suppliers, data processors, government departments and the ultimate end user or decision-maker. Composition of the applications teams will depend on the requirements of the application and the capabilities of the user organization, but the team must include direct participation from a government entity at the state/local/regional/tribal level. Proposals must also include a plan for operational implementation of the application and a description of how successful results can be propagated to other potential users. Abstracts and proposals that describe purely technical demonstration projects will not be considered for funding.

Respondents are invited to submit abstracts, i.e., preliminary proposals, to NASA at the address given in this announcement. Respondents whose abstracts pass the initial review will be asked to submit full proposals for consideration. Constituent elements of abstracts and proposals are described in Sections E and F, respectively. The term for NASA funding support will be no more than three years.

**Note:** *THIS ANNOUNCEMENT CONSTITUTES THE SOLICITATION – NO PAPER REQUEST FOR ABSTRACTS OR PROPOSALS WILL BE ISSUED.* Organizations interested in proposing should monitor the CBD and the NAIS for potential changes.

*THIS ANNOUNCEMENT SHOULD NOT BE CONSTRUED AS A COMMITMENT BY NASA TO AWARD ANY OF THE PROJECT THEME AREAS IDENTIFIED BELOW.*

## **B. BACKGROUND**

NASA/ESE is implementing an Applications Program to translate scientific and technical capabilities into practical tools for public and private sector decision makers. This goal is part of the strategy of ESE to encourage and facilitate the realization of economic and social benefits from the nation's investment in Earth science information and technology.

A major objective of the ESE Applications Program is the development and implementation of applications that provide ongoing operational support to the user community. NASA will act as a catalyst for the development and adoption of methods and techniques that draw upon science, data and technology derived from ESE funded research and commercial data sets and capabilities. NASA, as a research and development organization, cannot provide funding to support the operational<sup>1</sup> requirements and services of other agencies or organizations. Operations will likely be funded by the user organization and conducted exclusively by the user or in association with another public or private entity. It is anticipated that this announcement will lead to applications that create systematic change in the end-user organization, lead to better informed decision making and increase productivity as measured in cost savings or cost avoidance and time.

This announcement supports the above objective of ESE and is directed toward the use of ESE and commercially derived science, technology and related remote sensing data, by state, local, regional, and tribal user communities in the United States. The initiative will: 1) extend the benefits of NASA derived data, research and technology from global and national levels to state, local, regional and tribal levels; 2) help develop a robust remote sensing community including public and private sector partners; 3) transfer remote sensing and associated technologies to the user community with the prime responsibility in the nation for resource management and related activities requiring geospatial information; and, 4) stimulate the use of commercial data, data products and operational capabilities by public sector organizations. This solicitation is not intended to support research or "demonstration" projects that lack an operational goal or realistic plan to reach operational status.

Proposals should address one or more of the following application theme areas:

- Resource management
- Environmental assessment
- Community growth and infrastructure
- Disaster management

The application theme areas are described in Section I of this announcement.

The level of expertise in remote sensing, GIS and related technology in public and tribal organizations varies considerably. Three elements of the Applications Program are intended to assist selectees develop projects that will lead to the information products they need, and successfully implement operational procedures. These elements, 1) common products; 2) capacity building/work force development; and 3) regional infrastructure, are described in Appendix A.

In addition to the assistance prospective and successful respondents can acquire from the Program elements described in Appendix A ESE will conduct, periodically, informational workshops to increase communication and expand collaboration with and among the state, local, regional and tribal users. Information exchanged at these workshops will help ESE and the commercial sector understand better the

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<sup>1</sup> In this announcement, "operational" is defined as the regular or routine use of geospatial information product(s), 1) to meet reporting requirements mandated by legislative or administrative action, and, 2) in decision support functions of an organization.

requirements of these diverse users. Such exchanges of information will serve to highlight successful projects and increase NASA's understanding of concerns or barriers to the operational adoption of remote sensing data and information products. The workshops will also facilitate the dissemination of information concerning technology advances, existing or new common products, successful pilot projects and opportunities for training and/or capacity building.

It is understood that successful development of applications under this solicitation may require non-NASA/ESE developed capabilities for data acquisition and processing. Use of NASA/ESE developed capabilities is encouraged.

### C. PROCESS AND SCHEDULE

ESE is seeking projects from state, local, regional and tribal governments and organizations in the United States that will lead to the use of ESE developed capabilities and/or commercial capabilities in operational activities. Projects selected through this BAA will be awarded performance based contracts. Selections will be made through an advisory down select process that entails: 1) submittal of letter of intent to apply; 2) submittal of an abstract briefly describing the intended application and plan for operations; 3) upon approval of the abstract by ESE, submittal of a full proposal; and, 4) selection of proposals and awards following negotiations of contract terms and conditions of the performance based contracts.

Content guidelines for the abstracts and proposals are listed in Sections E and F., respectively. *Respondents are not required to submit letters of intent or abstracts but are **greatly** encouraged to do so.*

#### 1. Letter of intent

Potential respondents are requested to submit a letter of intent prior to submittal of an abstract. The letter of intent should include:

- Name and contact information (address, telephone, fax and email) of the principal investigator or primary point of contact for the project
- Title of the project
- Application theme area(s) addressed in the project (see Section I)
- Brief, one or two sentence, description of the application

#### 2. Abstracts

Abstracts may be submitted at any time through May 15, 2001 for consideration in FY2001. Reviews of abstracts will be conducted approximately quarterly. *Abstracts for the first review cycle must be submitted by December 31, 2000.* Abstracts submitted after May 15, 2001, will not be reviewed prior to FY2002.

#### 3. Proposals

Full proposals will be requested for those projects whose abstracts are deemed responsive to the solicitation and likely to meet the operational goals. Notification of the success of an abstract will be by mail from ESE. Full proposals may be submitted at any time through August 1, 2001. *A request for a full proposal is not assurance that the project will be funded* but an indication that the proposed work has potential merit, meets, prima facie, the requirements of the solicitation, and warrants further consideration. Proposals received after 4:30pm, August 1, 2001 will not be reviewed or considered prior to FY2002. Submitted proposals will be reviewed per the schedule indicated in "Schedule summary" below.

#### 4. Address for submissions:

Letters of intent, abstracts and proposals should be sent to:

SLT Applications  
NASA Peer Review Services, Code Y  
500 E Street, Suite 200  
Washington, DC 20024-2760

- Letters of intent may also be submitted by email to, [OESresponse@hq.nasa.gov](mailto:OESresponse@hq.nasa.gov), and respondents are encouraged to use that option. Abstracts and proposals *must* be submitted by regular or overnight/express mail.

- **The identifier, BAA-01-OES-XX, should be included on all submittals.**
- For overnight mail delivery purposes only, the recipient telephone number is (202) 479-9030.

5. Schedule summary

a. Letter of intent: preferred no later than four (4) weeks prior to submittal of an abstract.

b. Abstracts, proposals and awards:

	<u>Review Cycle</u>		
	<u>A</u>	<u>B</u>	<u>C</u>
Abstracts submitted by:	12/31/00	3/31/01	5/15/01
Abstract Review completed:	1/31/01*	4/30/01*	6/15/01*
Proposal submitted by:	3/15/01	5/15/01	8/1/01
Proposal review completed:	5/1/01*	7/1/01*	8/15/01*
Award date:	7/15/01*	10/1/01*	10/1/01*

\*Approximate date

**D. PROJECT DURATION AND FUNDING**

Project duration will be a factor in selecting projects to be funded. Projects should be completed in the most expeditious manner. NASA funding will not exceed three years and will be reduced as the project progresses and transitions to operations. Maximum NASA funding for the first year will normally be limited to \$300,000 to \$400,000. Maximum funding for projects that include commercial entities as partners (data providers, data processors or operational managers) is \$700,000. It is anticipated that a total of \$?????M will be available to this BAA during FY2001. Funding in subsequent years is subject to appropriations.

**E. ABSTRACTS**

1. Preparation

ESE receives many research proposals annually. Because of financial constraints, it is able to provide support for only a limited number of the proposals received. Acknowledging that the preparation of a research proposal represents a substantial investment of time and effort by the respondent, and, in an attempt to minimize this burden, the Division strongly encourages organizations and individuals interested in submitting proposals under this solicitation to first submit an abstract describing the project.

Respondents who wish to submit a proposal should provide first an abstract, *no more than 5 pages*, single spaced, 12pt type. Not counted in the total pages are letters of commitment (optional from project partners). A template for the abstract is given below. Respondents are not required to use the template, but the abstract should include the following information:

Abstract Template

1. Application/project title
2. Project principal investigator or point of contact. Include name, address, phone number, fax number (if available) and email address (if available), organization, and position title.
3. Describe the application:
  - a. what it does;
  - b. who the user(s) is (are);
  - c. how the application will help meet mandated responsibilities and/or aid in decision support.
4. Describe the information product(s) from the application. Include:
  - a. data sets required to generate the information product(s);
  - b. how the data product(s) will be generated.
5. Outline the operational concept (see definition of "operational" in section B.), i.e., plan to incorporate the application in the operations of the user(s).
6. List Cooperating organizations, agencies and companies with full name and address

7. List co-investigators and/or principal project staff: include organization and position title.
8. Identify anticipated contributions (cash and in kind) from non-NASA sources for application development and operations.
9. Describe the NASA contributions to the development of the application including:
  - a. data sets; and/or
  - b. science, i.e., results from NASA sponsored research incorporated in the application process; and/or
  - c. technology, i.e., data processing algorithms, interpretation techniques, etc., developed by NASA and incorporated in the application process.
10. Anticipated funding request from NASA, by year.

Respondents whose abstracts meet the evaluation criteria (see section H.) will be requested to submit a full proposal.

## 2. Submission

Abstracts may be submitted at any time through 4:30 PM, EDT, May 15, 2001 for funding in FY2001. Abstracts received after that date will be returned for re-submission in FY2002. *To be evaluated in the first round of review, abstracts must be received by 4:30PM, EST on December 31, 2000*, addressed to: SLT Applications, NASA Peer Review Services, Code Y, 500 E Street, Suite 200, Washington, DC 20024-2760.

For overnight mail delivery purposes only, the recipient telephone number is (202) 479-9030. ***Submit one (1) original and nine (9) copies of each abstract for each project proposed.***

## 3. Evaluation

Abstracts will be evaluated based on the criteria listed in Section G. Results of the evaluation will be sent, in writing, to the points of contact identified in the abstracts. Respondents whose projects, based on the abstracts, appear to meet the criteria for applications and operations will be encouraged to submit full proposals. Respondents whose projects, based on the abstracts, are deemed unlikely to meet the goals of the BAA will be so advised.

# F. PROPOSALS

## 1. Preparation

Respondents whose abstracts are accepted for further consideration will be contacted and requested to provide detailed proposals.

Proposals may be no more than fifteen (15) pages of text, single-spaced, 12pt type. The page count includes references but does not include cover page, table of contents, facilities and equipment list, curriculum vitae for team members, letters of commitment from collaborators or detailed budget information. A template for the full proposal is given below. Respondents are encouraged to follow the template, but the proposal must include the following:

### Proposal Template

1. Cover page. (See Appendix B)
2. Table of contents
3. Describe the application:
  - a. What it does;
  - b. Who the user(s) is (are);
  - c. How the application will help meet mandated responsibilities and/or aid in decision support.
4. Describe the information product(s) from the application. Include:
  - a. Data sets required to generate the information product(s) and how the data sets will be acquired;
  - b. Data processing steps, i.e., how the data product(s) will be generated.

5. List software, data processing algorithms or other procedures (if any) that need to be developed to generate the information product(s). Include a schedule for development, testing and implementation.
6. List cooperating organizations, agencies and companies.
  - a. Include names, addresses, and roles and responsibilities of each in application development and operations.
  - b. Describe the project management plan, i.e., the rules of cooperation among the project participants.
7. List co-investigators and/or principal project staff from each participating organization. List names, organizations and position titles and responsibilities in application development and operations. Include biographical sketches and/or curriculum vitae, as appropriate.
8. Fully describe the plan to incorporate application in operational procedures. Identify who will be responsible for operations, how operations will be performed and funded initially, and on an on-going basis.
9. List Facilities, equipment and other resources available for applications development and operations.
10. List and describe all significant costs (cash and in kind) from non-NASA sources (all participating organizations in the project) for application development and operations. Costs for workforce development (staff and equipment) should be included and identified.
11. Describe the NASA contributions to the development of the application including:
  - a. Data sets; and/or
  - b. Science, i.e., results from NASA sponsored research incorporated in the application process; and/or
  - c. Technology, i.e., data processing algorithms, interpretation techniques, etc., developed by NASA and incorporated in the application process.
12. Budget summary (see form and instructions in Appendix B)
13. List performance metrics, i.e., project subtasks, schedule for completion and success criteria for tasks and project.
14. Describe development and implementation of project outreach activities.
15. Letters of commitment (on letterhead) from cooperators. Each letter should include:
  - a. Organization or company name;
  - b. Identification of the application project and principal investigator;
  - c. Description of the commitment of the organization, in cash or kind, during the duration of the application project and, if applicable, during operations.
16. Appendices (if applicable)

## 2. Submission

Proposals must be received by 4:30PM, EDT, August 1, 2001 for consideration in FY2001. Proposals should be addressed to: SLT Applications, NASA Peer Review Services, Code Y, 500 E Street, Suite 200, Washington, DC 20024-2760. For overnight mail delivery purposes only, the recipient telephone number is (202) 479-9030. ***Submit one (1) original and nine (9) copies of the proposal.***

### 3. Evaluation

Proposals will be evaluated by an expert panel and in accordance with the evaluation criteria identified in Section G. Final decisions for awards will be made promptly, and the proposal point of contact will be notified through email and surface mail of the award status.

## G. EVALUATION AND SELECTION

### 1. Evaluation criteria

Abstracts and proposals submitted in response to this BAA will be evaluated according to the criteria specified in this section. Evaluations will be conducted periodically (see Section C.5.) and awards will be made accordingly.

Abstracts and proposals will be evaluated on three elements - the nature of the application, the plan for operations, and the completeness of the submission in relation to the contents for abstracts and proposals listed in Sections F.1. and G.1., respectively. The application and the plan for operations are weighted equally. The completeness of the submittal accounts for 10% of the evaluation.

#### A. Application (45%)

Applications submitted in response to this solicitation should fall within one of the four theme areas described in Section I. In addition, the application will be evaluated in relation to its:

- **National Importance**  
The ESE seeks to maximize the benefit of its investment by selecting activities that address the most serious, far reaching, and important issues with regard to socioeconomic impact.
- **Pervasiveness**  
Problems or issues that are common across many regions, states and local areas are preferred over ones that are specific to a single location or condition. In addition, persistent, long duration needs are placed above short term events.
- **Uniqueness of NASA Contribution**  
ESE seeks projects that: 1) draw upon the unique science and technology strengths of ESE; 2) can not be as well addressed by other federal and state agencies, or in the commercial marketplace; and 3) will not duplicate capabilities available from industry.
- **Partnership composition and Investment**  
ESE will ensure that its financial contribution to a project is proportional to its roles and responsibilities. The contribution to a project from the non-NASA partners is an indication of commitment on their part, and will affect ESE decisions on which projects to select.
- **Cost/Benefit**  
ESE seeks to assure that the financial risk of a project is acceptable; that the investment is balanced with the potential cost savings or improved decision making of a successful result. It will pay careful attention to the affordability and practicality of the proposed solution.
- **Documentable Results**  
Every project is managed to produce and report on outcome-based measures of success. Among other implications, this strategy means that the condition or problem must offer a baseline before the project, and comparable baseline afterwards. The degree of success is the difference in the two measures. Problems that cannot be base-lined will be at a disadvantage in competition for ESE funding.
- **Commercial Impact**  
Projects that demonstrate a positive benefit for end user industries or commercial companies will be preferred over those with no apparent impact on the growth,

development, maturity and global competitiveness of either economic end uses or U.S. commercial industry

**B. Plan for operations (45%)**

The primary measure of success for the ESE Applications Program is the incorporation of proposed applications into the operations of user organizations. Consequently, the plan to transition applications from development to operations is a major element in the abstract and proposal and will be evaluated thoroughly. Team building is encouraged. All accepted projects must include the partners necessary to complete the project and continue the operation after the NASA funding cycle is complete.

Important elements in each project are the:

- 1) commitment of the user, partner, and supporting organizations as indicated by their willingness to provide the support necessary for a reasonable chance of successful implementation and operation;
- 2) competence and experience of the team members;
- 3) identification of the data supplier (public or private); and
- 4) Cost and management aspects.

**C. Completeness of the submission (10%)**

Respondents should note the content requirements for abstracts and proposals listed in Sections F.1. and G.1. Requested items should not be omitted without explanation. Questions regarding contents should be addressed to the NASA point of contact listed in Section J.

NASA/ESE and/or non-NASA developed capabilities are not required to be in an "operational" condition at the inception of the proposed application development. For example, the application may require the use of data from an instrument that has been flown experimentally but is not now available on a routine, operational basis. However, the plan should specify the current status of all elements required in the application and the plans by the application user, or a member of the application team, to have all required applications elements operational by the conclusion of the proposal term.

**2. Selection**

Abstracts and proposals received in response to this BAA will be reviewed and selected in accordance with the procedures stated in NASA FAR Supplement 1872.4

(<http://www.hq.nasa.gov/office/procurement/regs/nfstoc.htm>) as modified in this section. Evaluation panels composed of technical experts and peers in, 1) remote sensing and related technology, and, 2) applications at the state/local/regional/tribal government levels, will meet and review submittals per the schedule given in Section C.5. The panels will assess the strengths and weaknesses of the abstracts and proposals and provide summary reports on each abstract and proposal evaluated to NASA Headquarters Office of Earth Science.

Key provisions concerning selections are given in Appendix D.

Respondents will be notified of the results of the evaluations of the abstracts and proposals as indicated in Sections E.3 and F.3. Proposers desiring additional information may contact the selecting official, indicated in Section K, for a de-briefing. De-briefings will occur following selection of proposals for the cycle (see Section C.5.) in which the abstract/proposal was submitted.

When a proposal is selected for award, negotiation and award will be handled by the procurement office in the funding installation. The proposal is used as the basis for negotiation. The contracting officer may request certain business data and may forward a model award instrument and other information pertinent to negotiation.

**H. PROJECT IMPLEMENTATION AND MANAGEMENT**

Projects funded through this BAA will be managed by the Remote Sensing Application Program at Stennis Space Center.

Given the focus on applications for state/local/regional and tribal governments, and the intent to generate operational capabilities, leadership of applications teams, i.e., the role of principal investigator and final responsibility for project decision, should reside with the state/local/regional/tribal organization implementing or using the application(s), or with a staff member of a user organization if more than one such organization is included in an applications development team.

#### 1. Progress reports and reviews

Written progress reports will be required from each project quarterly. Principal investigators should anticipate a formal review each year of the project and should include, in the proposal budget submission, funds to attend such a review. The review site will likely be either Stennis Space Center or Washington DC, however, reviews may also be held in association with the annual meeting of an appropriate national organization, e.g., the National States Geographic Information Council (NSGIC) or the National Association of Counties (NACo). The reviews will provide an opportunity to interact with staff from other projects and share experiences. Such program reviews typically last no more than two days.

#### 2. Performance metrics

Each project proposal should include a list of tasks leading to the successful operational implementation of the application, a schedule for completion of the tasks and appropriate criteria for gauging the success of the tasks and the project. Success metrics may be phrased in terms of input, output, outcome and impact, or other appropriate indicators. Please refer to Appendix C for more information. If other indicators are used, they should be fully defined in the proposal. Budgets submitted with proposals should include the

#### 3. Outreach

In addition to quarterly and annual reports and official reviews, each project is encouraged to distribute information on its application(s) to as broad an audience as possible. Projects are encouraged to develop World Wide Web sites that describe their projects, and provide linkages to the ESE home page (<http://www.earth.nasa.gov/>). They are also encouraged to find outlets in other media (e.g., popular press, broadcast) to distribute information that helps other organizations adopt new technology. Plans for outreach should be included in the proposal.

*Budgets submitted with proposals should include the estimated cost of travel to reviews, regular submission of performance metrics and outreach activities required by the program.*

## I. APPLICATION THEME AREAS

NASA/ESE, drawing upon its experience in applications of Earth observations from aircraft and spacecraft and user comments obtained within the last two years in response to informational workshops on applications conducted by ESE, has identified four application theme areas of interest for the Application Program. Proposals submitted in response to this solicitation should focus on one or more of these themes:

- Resource management
- Environmental assessment
- Community growth and infrastructure
- Disaster management

Topics within these themes are described below, but the topics list is not meant to be inclusive. It is expected that most applications proposed will address more than one theme area. Questions regarding the appropriateness of specific application topics to the intentions of this solicitation should be addressed to the NASA points of contact listed in section J.

#### 1. Resource Management

Application areas under this theme address the assessment, monitoring and management of land and water resources. General areas include agriculture, forestry, rangeland, wildlife and fisheries, management of resources to maintain biodiversity, preservation of coastal zones and watersheds, the availability and use of fresh water, and non-renewable resource issues such as the exploration and extraction of minerals and petroleum. (The impact of these activities on the local or global environment is included in Environmental

Assessments as defined in 2 below.) Examples of specific applications that fall within the theme of Resource Management and address, potentially, the requirements of this solicitation include the use of ESE developed science, technology and/or remote sensing data to:

- assess agricultural crop distribution, monitor health, phenological state and invasion of unwanted plant species, develop yield prediction and other agronomic models, or support precision farming activities.
- assess forest conditions including monitoring health and well being, estimating standing timber volume, fire management, determine extent of damage from fires, insects and disease, and monitoring compliance of permit regulations.
- assess and monitor the use and condition of rangeland including status, weed infestation and monitoring regulated activities.
- determine biological richness of ecosystems being considered for preservation, monitoring the health and well being of protected areas, and monitor intrusion activities and permit regulations related to protected areas.
- assess and monitor conditions in coastal zone areas including health and well being of the ecosystem, intrusion of development activities, impact on the ecosystem by natural disasters, pollution, climate change and sea level rise.
- assess and monitor the conditions in land use/land cover of watersheds including impact on the health and well being of the ecosystems by intrusion of development activities, natural disasters, pollution, climate change and human-induced changes.
- inventory and monitor the availability of fresh water resources, estimate and model the impact of regulatory changes in the use of fresh water resources, develop snow accumulation models for predicting the fresh water potential of snow packs, model and predict the impact of the predicted water supply on irrigated agriculture.
- assess petroleum, mineral and other natural geologic resources, measure and/or model their availability, monitor and/or assess their extraction, and assess the impacts of exploration and extraction methodologies.

Proposed activities may address issues at any geographic scale from site, to landscape, to region. They may employ ESE science results and data directly to manage current operations, or they may use ESE-derived predictive models (e.g., El Nino/La Nina forecast) to adapt operations to future conditions.

The key to success for obtaining a funded proposal is to select an application that can be integrated from application research into an operational procedure to be implemented by a user whether from government, industry, or other organizations.

## 2. Environmental Assessment

Application topics under this theme address evaluation and monitoring of environmental variables that affect near term and long term economic and social conditions. General topic areas include air and water quality; distribution, condition and change in terrestrial and aquatic ecosystems or environments not defined or considered under resource management; and the variability of living organisms and the ecological complexes of which they are a part. Examples of specific applications that fall within theme of environmental assessment and address, potentially, the requirements of this solicitation include:

- use of ESE instrument data to monitor regional changes in air quality (e.g., atmospheric constituents and temperature) as input into regional planning models.
- use of data on extent of floods as input into procedure for monitoring extent and quality of ground water.
- use of remotely sensed data to monitor water temperature and vegetation to assess condition and change of estuarine environments.
- use of remotely sensed data to investigate and monitor changes in habitat, the spread of invasive species, or contamination resulting in impacts on biodiversity.

The key to success of these or similar applications in a proposal is the integration of the application into an *operational* procedure.

## 3. Community Growth and Infrastructure

Applications areas under this theme address human-induced land use and land cover change, transportation, infrastructure and utilities, conservation and preservation of cultural and recreational resources, urban planning, real estate and engineering/construction/development. (The impact of these activities on the global environment is included in Environmental Assessment as defined in 2 above.) Examples of specific applications that fall within the theme of Community Growth and Infrastructure and address, potentially, the requirements of this solicitation include the use of ESE developed science, technology and/or remote sensing data to:

- analyze the impact on the local environment of human-induced land use/land cover change associated with population centers including urban area heat island analysis
- map and monitor the evolving road, highway and rail networks and pipelines - monitor automobile, truck, barge, rail and shipping traffic – plan and locate new routes for pipelines, highways, railways and terminals - cost-surface analysis of new transportation routes
- plan, locate, develop and monitor gas, electric, water and telecommunications utilities infrastructure
- locate, preserve and conserve archaeological and cultural resources, historical sites and recreational facilities
- plan and monitor urban growth including correlative transportation infrastructure, cadastral mapping, and analysis within GIS utilizing satellite images as an input – may include real estate and engineering/construction/development applications

#### 4. Disaster Management

For the purposes of this announcement, "disaster management" is defined as natural hazard/disaster-related activities in all phases of the disaster cycle, including preparedness, response, recovery, and mitigation. This encompasses geological (e.g., volcanic eruptions, earthquakes, landslides) and meteorological (e.g., severe weather such as hurricanes and tropical cyclones, tornadoes) hazards and their associated effects (e.g., tsunamis, coastal and river flooding, flash flooding, disease breakout, etc). In addition, the environmental issues related to the health of human, plant, and animal communities are also included in this theme area.

Application topics under this announcement shall include the use of NASA ESE science, data, and technology in the decision-making processes of Disaster Management by emergency managers, health officials, or other decision-makers. This will include:

- assessment of risk and vulnerability to natural hazards,
- observation and monitoring of natural phenomena that result in natural hazards and natural disasters,
- post hazard/disaster assessment as it relates to environmental or infrastructure damage, and
- assessment and understanding of the economic and societal consequences of natural hazards.
- understanding of the relationships and linkages between health and environment (including climate and natural hazards) and/or developing practical early warning systems for health issues.

The ultimate product of the work in Disaster Management should be new tools, processes, and/or procedures for emergency managers, health officials, and other decision-makers in state, regional, local, and tribal governments, better access to science/data/technology, and/or well packaged and easily understandable information products that can be utilized to take actions, in any portion of the disaster management or disease cycle.

## J. NASA POINTS OF CONTACT

Questions regarding the contents and requirements of this solicitation and the status of submitted abstracts and proposals should be addressed to:

- For Resource Management:  
Mr. Alexander J. Tuyahov  
Code YO  
300 E St. SW  
Washington DC 20546

Tel: 202-358-0250  
Fax: 202-358-2770  
email: atuyahov@hq.nasa.gov

- For Disaster Management:  
Dr. Earnest D. Paylor, II  
Code YO  
300 E St. SW  
Washington DC 20546  
Tel: 202-358-0851  
Fax: 202-358-2770  
email: epaylor@hq.nasa.gov

- For Community Growth and Infrastructure:  
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