IN THIS ISSUE:

- SUCCESSFUL COLLABORATION BETWEEN GOVERNMENT, EDUCATION AND PRIVATE SECTOR LEADS TO UPDATED DFIRMS FOR SAN FRANCISCO AND MARIN PENINSULAS ................................................................. 3

- BEST BUSINESS PRACTICES FOR GEOSPATIAL COMPANIES, ACADEMIA, AND GOVERNMENT .............................................................................................................................. 4

- MAPPING INVASIVE PLANT RANGES IN CALIFORNIA: AN INNOVATIVE COMBINATION OF QUANTITATIVE AND QUALITATIVE DATA ................................................................. 5

- WINNER OF -WHERE IN THE BAY AREA ............................................................................................................. 11

- BAAMA’S MAP GALLERY .................................................................................................................................. 14
BECOME A BAAMA MEMBER OR VOLUNTEER TODAY

NEW! SILVER CORPORATE MEMBERSHIP
$299.00 ANNUAL FEE
- Opportunity to post half-page, color advertisement in each issue of bi-annual The BAAMA Journal at no additional cost.
- Have the name of your organization listed in each educational meeting audio recording.
- Up to 10 individuals from the organization receive all corporate membership benefits listed in “Corporate Membership” level.

CORPORATE MEMBERSHIP
$150.00 ANNUAL FEE
- Once/year opportunity to send an informational or advertising announcement to all BAAMA members
- Opportunities to conduct Technical Tours
- Listed as sponsor on BAAMA website
- Link to organization web site from BAAMA website
- Listed as sponsor on all BAAMA newsletters
- Up to 10 individuals from the organization receive all individual membership benefits listed in “Individual Membership” level.

EDUCATIONAL INSTITUTION MEMBERSHIP
$99.00 ANNUAL FEE
- Unlimited number of individuals from a school receive all individual membership benefits listed in “Individual Membership” level
- All students must be on the membership email list of the respective school (managed by school)
- Student must show current student ID

INDIVIDUAL MEMBERSHIP
$25.00 ANNUAL FEE
- Free admission to bi-monthly educational meetings, including annual poster contest
- Free admission to Technical Tours
- BAAMA journal access which can be downloaded from the BAAMA website
- E-mail announcements & reminders for Bay Area GIS activities

INTERESTED IN VOLUNTEERING?
Are you already a BAAMA member who’d like to get a little more involved? BAAMA welcomes members to take volunteer roles in the organization’s activities!

There are many reasons to be a BAAMA volunteer. Volunteering will increase your professional toolbox and enhance your resume. And, you will get to better know your fellow BAAMA members and board members.

Contact any Board member for more information, or download an application form from BAAMA.org/application.pdf.

UPCOMING BAAMA EVENTS

NOVEMBER
GIS DAY 2011, CO-HOSTED BY BAAMA
UC Berkeley, Mulford Hall
Wednesday, November 16th,
3:30 PM - 8:00 PM

DECEMBER
HOLIDAY PARTY
6:30 AM - 9:00 PM
Check BAAMA.org for date & location.

JANUARY
BAAMA EDUCATIONAL SESSION
Check BAAMA.org for date & location.

BAAMA.org/community is a great source for local and regional geo-related events. Let editor@BAAMA.org know if you have an event you’d like posted.
A NOTE FROM THE EDITOR

Create.

Although BAAMA has published one Journal since my daughter was born I have not yet introduced her to you, our loyal BAAMA readers. Vivian Rose Burton joined us at 9:10 PM on December 24th, 2010. Although her Dad and I are still catching up on sleep (I’ve been told this may not happen for another 20 years) we are delighted she’s here. At 10 months old, she’s crawling, walking with assistance, smiling, laughing and bringing joy to our world. In my humble opinion, she is the cutest baby ever.

Allow me to share a story about a recent new-parent experience. A few weeks ago my husband and I bought her a new toy. There are a plethora of toys for today’s babies and children: early developmental learning toys, toys that play music, movable toys, toys that look like your cell phone or laptop, big, small, wood, plastic, BPA-free, you name it. Clay and I selected what looked like a learning toy: it plays music and has a little learning tool, has some button-like things, and she can pull it around the room with an attached string. It seemed compelling at the Target store (mind you, I’m completely sleep deprived at this point and making somewhat questionable judgments on a fairly regularly basis).

After returning home, she and I are playing with it and I realize, as we sit virtually motionless on the floor, that this toy is basically just a loud, push-button noisemaker. Frustrated with the sloth-like nature of the experience I tell Clay that moving forward all toys purchased by us must involve building and/or deconstructing (again, sleep deprivation = angry at any turn). She needs to be creating something, which includes creating a mess, gosh darn it. Where are the parts to rearrange, where are the levers to pull? Why doesn’t it change shape or force experimentation? Enough with this sit still and push-a-button nonsense! I may sit still and push-a-button for a living (ahem), but building a business takes ingenuity, diligence, and sometimes sweat.

Creativity is the theme of this BAAMA Journal. We have a new wonderful feature called Map Gallery. We are grateful to the four BAAMA members who submitted terrific maps. We are delighted with the response and hope all members are inspired to share their maps. Three articles feature creative activities: creating maps with LiDAR, creating an original database, and creating a career.

So fear less and do more. Accept less of what you’re offered. Build or deconstruct something. Don’t sit still and push buttons (at least not all the time). Share your experience. Create something new.

Catherine Burton
Editor, The BAAMA Journal

Vivian Rose Burton, cutest baby ever.

Vivian Rose Burton’s Mom
SUCCESSFUL COLLABORATION BETWEEN GOVERNMENT, EDUCATION AND PRIVATE SECTOR LEADS TO UPDATED DFIRMS FOR SAN FRANCISCO AND MARIN PENINSULAS

BY: JASON AMADORI, GISP, EARTHEYE

Across the country, many homeowners face difficulties when securing flood insurance. Many of FEMA’s Digital Flood Insurance Rate Maps (DFIRM) are outdated, and homeowners often incur the extra expense of a survey to most accurately determine insurance rates. DFIRMs are crucial to identification of flood zones allowing for the protection of citizens residing in those zones.

DFIRMs of the counties and parks in the Marin and San Francisco Peninsulas are primary examples of instances where the maps are outdated. The Digital Terrain Models (DTMs) on record are from a U.S. Geological Survey (USGS) project that spanned from the 1950s to the 1980s. During that period, survey crews collected general topography data on foot, resulting in a generalization of the true terrain and flood zones.

GOLDEN GATE LiDAR PROJECT

The Golden Gate LiDAR Project is a cooperative project sponsored by the USGS, in which San Francisco State University (SFSU) sought to update San Francisco and Marin Peninsula DFIRMs. The primary goal was to create consistency across all National Geospatial Program (NGP) funded LiDAR collections, in particular those in support of the National Elevation Dataset (NED).

The project area includes 835 square miles derived from watershed boundaries for all of Marin and San Francisco Counties (Figure 1). It also includes watersheds surrounding Point Reyes National Seashore (Figure 2 and Figure 3) and the Golden Gate National Recreation Area. These particular regions were prioritized by hazards, sensitive ecosystems and adjacency of dense urban populations to the coast and parklands.

SFSU requested data be collected and processed with high resolution, half-meter nominal pulse spacing or better Light Detection and Ranging (LiDAR) to meet the objectives of the American Recovery and Reinvestment Act (ARRA). This includes adding to The National Map a set of national geospatial datasets available to the public at no cost, and submitting raw point clouds to the Center for LiDAR Information Coordination and Knowledge (CLICK).

Creating consistency across all NGP-funded LiDAR collections places unprecedented emphasis on handling source LiDAR point cloud data. It was important to ensure the data remain intact and viable to support the wide variety of non-DEM science and mapping applications that can benefit from LiDAR technology.

see UPDATED DFIRMS on page 7
Over the past twenty years working for university GIS labs and in the private sector for geospatial production firms and technology companies supporting government agencies, we have discovered that continued growth and prosperity of a university, agency, or company requires attention to: strategic planning, business development, operations management, technology engineering, and particularly for companies, merger & acquisition activities.

**STRATEGIC PLANNING**

There is a Chinese proverb that states, “When planning for a year, plant corn. When planning for a decade, plant trees. When planning for life, train and educate people.” In other words, strategic planning must consider short-, mid-, and long-term goals. Equally important, you must make decisions based on where you presently are, and where you want to go. Are you happy to stay standing in a cornfield, or do you want to hike through the forest and on up the hill to the university campus?

As geospatial professionals, this concept of realizing “where we are and where we are going” should be relatively easy to grasp, but many times it is taken for granted, and therefore it can become a liability if we don’t pay attention.

In the late 1990’s we engaged a consultant to help us establish a strategic plan that we continued to update with outside assistance until it ultimately led to 600-percent growth of that geospatial company and a merger with Northrop Grumman.

**BUSINESS DEVELOPMENT**

An old boss and mentor of ours used to say, “The only reason anyone in this company has anything to work on is because somebody went out there and sold something to someone.” It sounds like a statement of the obvious, but it is amazing how many companies, universities, and even government agencies, forget they exist because of their customers. From Michael E. Gerber’s excellent E-Myth series of books and recordings, this is an example of people caught up “working in the business” instead of “on the business.” Many small firms are created by technical people who know in their heart they can do a better job than their managers, so they go out into the brave new world of business. They often come to realize their technical proclivities don’t translate to sales orders. Moreover, all those pesky forms and reports due to all those agencies, lenders, and other stakeholders, are not fun to work on. The ones who survive quickly learn to formalize their business development activities.

So what exactly is “business development?” Let’s start by separating it from the traditional thought of “sales.” In the context of this article, traditional sales means “order taking” from a list of available products like cars, shrink-wrapped software, or t-shirts. This is a true calling and profession for those who do it best (and if you don’t think selling t-shirts is a profession, we would refer you to the “Life Is Good” example). But for geospatial services, typical government contracting, and university laboratories, we mean “consultative selling” or truly developing projects from the conceptual phase through contract signing and execution. Business development, then, means working to create a project or program in concert with a customer, and working it from the ideation phase through the proposal process and contract signing.

As part of the management team at 3001, Inc. we helped develop the Louisiana statewide environmental oil & gas inventory program into a multi-year $14M comprehensive GIS program, including statewide digital orthophotography, statewide LiDAR, custom Esri-based photo-interpretation tools within ArcGIS, and FGDC-compliant metadata for more than 60 database layers.

**OPERATIONS MANAGEMENT**

Do you frequently wake up at 3:00 AM in a panic, wondering if you missed a deadline or if a client is happy? If so, you might be in operations management. It is difficult to run an efficient operation and also maintain “client delight.” As an operations or program manager, you have Profit and Loss (P&L) responsibility, must oversee and direct project managers, and must achieve and maintain client delight. This article will discuss some of the key areas for improving operational efficiency, which will help to limit the number of sleepless nights.

**COMMUNICATION**

One of the most critical factors in running an efficient and profitable operation is communication. This is both internal communication with your team, and external communication with the clients.
The California Invasive Plant Council (Cal-IPC) works to protect the state’s wildlands from invasive plants. Invasive plants are defined as plants that are not native to the region in question and that cause ecological or economic harm. Cal-IPC has prioritized 204 invasive plants because they are flourishing and replacing native California plant species (Cal-IPC Invasive Plant Inventory, 2006).

One of Cal-IPC’s goals is to help California’s land managers prioritize infestations to be targeted based on available resources and the size and potential controllability of the infestation. To do this, baseline data are needed that reflect the current status of each of the 204 plants on our list for the entire state of California. To develop maps depicting the current location and potential areas of spread for each of the 204 species, we collected two forms of data about the location of invasive plant species: 1) quantitative geospatial data (hereafter called GIS data), and 2) expert knowledge based data using qualitative assessments of the presence and the spread of a certain plant in a region. These two types of data complement each other and together are more useful and informative than either type alone.

Combining these two types of data, Cal-IPC has prepared easily understandable range maps showing the current and potential distribution of the 204 invasive plant species. The maps can help land managers prioritize and conduct their programs to remove and control invasive species. The maps combine qualitative reports from interviews of land managers with existing and updated quantitative data from GIS data sets. They are available at www.calweedmapper.calflora.org/maps/. Details about the development of the maps are provided below.

**HOW THE MAPS WERE MADE USING QUANTITATIVE AND QUALITATIVE DATA**

We used both GIS data (quantitative) and expert knowledge (qualitative) to develop the maps. De novo collection of GIS data about all 204 species throughout the state would have been prohibitively expensive and duplicative. Instead, we partnered with agencies and individuals in California who have knowledge about these species. Collaborating with a wide range of agencies such as county agriculture departments, the CA Department of Fish and Game, the US Forest Service, utility companies, State Parks, and the US military, we received 130 GIS datasets from across the state. The qualitative assessments were obtained from meetings organized in each of California’s 58 counties. In total, we interviewed 384 individuals during 108 meetings from April 2010 to August 2011.

**QUANTITATIVE GIS DATA** GIS datasets provide information about the location and density of an item of interest, in our case, an invasive plant species. Technically, GIS datasets for invasive plants are vector-based points, lines, and polygons: for example, a single plant could be a point; a stretch of plants along a river could be a line, and a larger area could be represented as a polygon. Polygons may also contain percent plant coverage indices. Willingness to contribute datasets to our project was high and the datasets we received were of high spatial precision. However, data collection and formatting differences among the datasets required resolution before the multiple datasets could be merged into one. Three major problems were incomplete documentation, ambiguous plant identification, and several types of collection bias.

**INCOMPLETE DOCUMENTATION** A botanist may not record the date a plant was seen, making it impossible to perform historical iterations showing how a plant population changes over time. She also may not record her name making it difficult to confirm, add, or use the information or even track-back and ask her questions.

**AMBIGUOUS PLANT IDENTIFICATION** Every agency, and sometimes each person within an agency, collects data differently. Some data collectors use only common names when recording observations, leaving ambiguous species determinations. For example, “iceplant” refers to at least four different species. A botanist may know which iceplant is in her specific location, and may have created the dataset for her own use and thus not need to include a scientific name, but such a dataset is virtually unusable by other parties. We needed a method to deal with “management grade” data since the coverage of scientifically collected data is quite limited to a few survey and test plots close to university towns.

**COLLECTION BIAS** GIS plant datasets are often collected opportunistically and thus are biased. For example, data are
more frequently collected where people live and travel: in urban areas and along roads. Therefore, we know more about invasive species in these places even though they may not be more common there. One example of this type of collection bias is data from the California Herbaria. Herbaria data are considered of highest quality because plant identification is centrally verified by an expert. However, the coverage of the area of interest is far from complete and the problem of bias towards areas where people live, work, and travel prevails. In general, point, line, and polygon spatial plant data are inherently biased toward human populations and the person collecting the data. Determining absence of a species from a larger area is virtually impossible using GIS data since a complete search is only feasible for smaller study areas. Another form of “collection” bias is the failure to report or record species that are known to be present. Some land managers are hesitant to provide invasive plant GIS data because, if shared, the info can affect property values. For example, hydriilla may decrease lake property values and leafy spurge may decrease range property values. More generalized quad data avoids that problem.

We stored the GIS data we compiled into Calflora (www.calflora.org), an online plant database, using tools they developed in close collaboration with us which made the GIS data instantly available for everyone who works with invasive plants such as a scientists, land manager, or amateur botanist. Calflora’s database contains all wild plants in California; Calflora’s plant distribution information is integrated from point locations and GIS datasets contributed by land managers and botanists across the state.

**QUALITATIVE EXPERT KNOWLEDGE DATA**

Botanical experts throughout the State have vast and largely untapped knowledge about the locations and spread of invasive plant species. Because GIS data are collected for targeted projects which are usually limited to a few select species, and because of the weaknesses of GIS data just described, we interviewed 384 experts across the state in order to supplement the GIS data and create a more complete statewide picture of where invasive plants are located.

First, we asked about the status of and efforts or programs in place to control invasive plant species. When Cal-IPC began collecting spatial data for invasive plants, we intended to ask land managers to estimate the number of acres infested in their region. Many found this task to be difficult if not impossible: it was difficult to first envision the size of an acre (about the size of a football field) and then translate that into invasive plant infestations. Thus, we changed our methods to include the collection of expert knowledge.

Then, using a USGS 7.5-minute quad as a collaborative reference map, we asked about the presence or absence of a given species. (In California one quad represents approximately six by six miles.) If present, we asked whether its range is increasing or decreasing, and what, if any, efforts are in progress to control its spread. We entered the data for each quad using a coding scheme, based on a theoretical ecological invasion model adapted from concepts presented by Cousens et al. (p. 26) and Groves (pp. 129-145).

The theoretical ecological invasion model (Figure 1) assumes that an introduced plant species will grow as allowed by the local soil, terrain, and climate; and that without efforts to control it, a plant will grow at an exponential rate until it reaches saturation. An invasive plant often spreads slowly at first; for instance, there may not be other plants available for pollination. The rate of spread then increases rapidly and finally starts to plateau. Its ecological niche is saturated when it has filled every possible location in which it can survive (see top of curve in Figure 1). Management efforts at different points in the growth curve can modify the rate of growth or expansion of an invasive species.

We used the data collection scheme presented in Figure 1

see INVASIVE PLANT RANGES, page 10

![Qualitative Data Collection Tool](image)
Once loaded to The National Map the data sets can be used by municipalities, cities and counties to improve infrastructure and protect citizens. In addition, the data sets can serve as support to research studies. For example, an SFSU imagery specialist is currently conducting research in the Muir National Forest to assess the effect of sea fog on the growth of vegetation, and how that compares to drier climates where no sea fog exists. These data sets will provide the imagery specialist with another variable to use in the analysis process, resulting in more accurate research.

**SELECTION OF EARTHEY**

In early 2010, SFSU selected EarthEye to collect and compile LiDAR data by the end of 2010. Ancillary data including LiDAR waveform, digital color imagery, and hyperspectral imagery was also collected. One reason EarthEye was particularly attractive to the SFSU team is its EarthShaper software, which handles source LiDAR, image and vector data sets in a highly automated fashion, and allows many ancillary products to be generated from the raw data.

The EarthEye team has experience with data collection in areas of steep relief and understands the balance between data resolution (pulse density) and signal-to-noise ratios (SNR) that can cause anomalies such as data dropouts, noise, poor canopy penetration and their relationship to vertical accuracy degradation.

**EARTHEY’S APPROACH**

The EarthEye team developed a nine-month project schedule, with time dedicated to planning (23 days), data collection (33 days), and data compilation (104 days).

They recommended one-foot pixel orthophotos, two-meter pixel hyperspectral imagery, and contours certifiable to an ASPRS-equivalent one-foot interval. During LiDAR and image collection of each area, EarthEye aimed to review all data for coverage, Ground Sample Distance (GSD), resolution, and quality. Collection progress and data acceptance were posted on the project microsite (a website dedicated only to this project) to assure data completeness on a daily basis.

**EARTHEY’S AIRBORNE LiDAR**

EarthEye’s aircraft is equipped with a Leica ALS60 LiDAR sensor, capable of a 200 KHz pulse rate, as well as a Leica RCD 105 medium format color camera, and a SPECIM VNIR hyperspectral sensor (Figure 4 and Figure 5). Compared to other systems the Leica ALS60 is the most capable because of its large aperture. Employing large aperture systems greatly decreases the potential for data anomalies in steep terrain areas. The Leica ALS60 also allows for the simultaneous collection of waveform data. In addition, a Specim Eagle hyperspectral sensor was used. Operated by Galileo Group and capable of VNIR 400-100nm the sensor extends the electromagnetic spectrum far beyond the visible spectrum (Figure 6).

Collecting data with a single platform, multi-sensor approach allows EarthEye to provide important benefits in the areas of hydro-enforcement and environment research applications.

Trimble R7 and R8 survey sensors with GLONASS receivers were used to field check, calibrate, and perform final accuracy of all sensor data.
ANTICIPATING COLLECTION CHALLENGES

From the outset, EarthEye foresaw two challenges: fog and commercial airline traffic. Each presented obstacles that were addressed with rigorous planning and organization.

Typically, LiDAR collection begins in one corner of the target area (in this case, the northeast corner) and works its way diagonally until reaching the opposite corner (the southwest corner). However, due to the San Francisco Bay Area’s trademark fog, scheduling had to be adjusted to ensure accurate collection. EarthEye, having encountered the fog on a previous San Francisco Bay Area project, developed a schedule that included modified flight times to reduce fog interference.

Another challenge was the large amount of commercial airline traffic from nearby San Francisco and Oakland International Airports. EarthEye’s pilot was responsible for tight coordination with air traffic control, providing flight plans and altitudes every morning. If the pilot did not communicate all traffic patterns daily, the project could have been delayed considerably by air traffic control.

ENSURING ABSOLUTELY ACCURATE CALIBRATION

A common problem with LiDAR data collection is that areas of interest are processed separately and not usually calibrated to data of neighboring areas. For the most part, this is due to the amount of data under consideration and a lack of adequately powerful software. Therefore with this project, absolutely accurate calibration was of utmost importance.

The survey area was divided into two regions of interest: north and south of San Francisco Bay. While LiDAR does not collect data from water, it does survey the bridges connecting the bay. In order to avoid a break halfway across the bridges, on a mission-by-mission basis EarthEye first calibrated each point cloud by flight line. The team then incorporated that data to generate a seamless data set. This technique, known as relative calibration accuracy, is an effective means for taking into account each point cloud’s elevation relative only to other data sets collected for the same project, not their elevation relative to ground level.

Once the relative accuracy calibration is finalized, that flat plane of data is lowered to geodetic survey control checkpoints, which are a series of 40 well-distributed checkpoints surveyed during the planning stage of the project (Figure 7). Then the data set is adjusted to the checkpoints to meet the required absolute vertical and horizontal accuracy at 95 percent RMSE specifications per FEMA and USGS specifications.

PROCESSING THE DATA

EarthEye uses proprietary LiDAR data collection software, called EarthShaper, for all its projects. While not commercially available, all client data is delivered via EarthShaper to ensure easy manipulation of point clouds.

Commercially available LiDAR software and data fusion packages enable users to review a point cloud and then manipulate the data manually, which can be time intensive and require expertise that may not be readily available. With EarthShaper, the data is optimized for user performance with large-scale automation, allowing the fusion of LiDAR, EO, hyperspectral, vector, bathymetric, photogrammetric, and survey data (Figure 8).

As opposed to reviewing data tile by tile, EarthShaper allows the user to visualize and analyze the whole point cloud, and deliver CAD and GIS format data to the end user. This eliminates overwhelming the end user with unusable volumes of data typically experienced with LiDAR.
Given the variances in terrain and scene morphology for this project, several macros filter algorithms were employed in order to obtain a large amount of results. All the LiDAR data was classified into one of six distinct classes: ground (bald Earth), canopy, noise, water, unclassified, and ignored ground.

SFSU uses EarthShaper to view or navigate 2D/3D point clouds, 2D/3D data fusion, cross-sections, raw data, vectors, and more. In addition, SFSU can export geo-databases, tile schemes, contours, and more. Processing for hydro-enforcement, transportation analysis, impervious mapping, and other applications are easily possible.

LESSON LEARNED
No project is complete without learning something new or identifying an area of improvement for the future, and this project was no exception.

As mentioned previously, the flight plan ran from the northeast to southwest, and during March and April the prevailing wind was traveling southwest through the bay. The flight team learned the importance of setting up flight lines based on the prevailing winds in a given area.

Data strips collected while traveling northeast to southwest were considerably denser than the data strips when traveling southwest to northeast. A solution would have been to travel in a more east to west direction, tilting the plane to compensate when traveling directly into the wind.

CAPTURING SUCCESS
The project showcased a successful collaboration between the government sector (FEMA and USGS), the private sector (EarthEye), and the education sector (SFSU). In fact, this particular project was unique for EarthEye, as it was the first time the team worked in tandem with an educational institution for the federal government.

The EarthEye team interacted with students interested in pursuing careers in geospatial technology, teaching them about LiDAR methods through practical, real-world application. In addition, the students learned another key component of the business: the balance between capturing quality data while still ensuring profitability for employers.

With EarthEye’s portion of the project complete, the SFSU team aims to have all maps uploaded to The National Map by the fall of 2011.

ABOUT EARTHEYE AND THE PROJECT TEAM
EarthEye was formed as a subsidiary of Data Transfer Solutions (DTS) in 2004 to provide high-quality LiDAR and orthophotography to its existing client base. EarthEye focuses on providing innovative technical solutions to clients by applying the most advanced technology and workflows to specialized projects.

EarthEye’s core business is centered on collecting accurate and comprehensive LiDAR and orthophotography, as well as the development of its EarthShaper software that can be used to view, analyze and manipulate this data. For more information, visit www.eartheye.com.
at meetings we organized in each of the 58 counties across the state to collect data for all 204 invasive plants. For each quad, we asked experts to provide information on each species according to the numerical coding scheme in Figure 1. Cal-IPC then produced maps based on the qualitative expert knowledge data; see our Calweedmapper online at http://calweedmapper.calflora.org. These maps contain both the qualitative expert knowledge data by quadrangle as well as the GIS point, line, and polygon data.

The scheme proved to be very useful, providing a complete map of the state on a different scale than points, lines, and polygons. Additionally, absence data could be collected using this method, which is virtually impossible with GIS data. After a 20-minute training period, most experts were able to translate their assessment for a given quad (or group of quads) in the appropriate number for data entry. The collective data collection process was popular among land managers because it proved to be a good medium to exchange previously undocumented knowledge, e.g. “No way! You saw stinkwort there?! I need to go check that out and make sure it doesn’t move westward.”

USING THE DATA

As we reach the end of two years of data collection and QA/QC, we are using the data in three main ways.

First, we reconcile the data from quantitative and qualitative sources. If GIS and qualitative expert knowledge data of invasive plant species do not match up [experts confirmed presence in a given quad where no GIS data exists, or vice versa] we contact the data sources and asked whether the identification of presence by GIS data could be correct. Or we ask for their collected GIS data (ideally by creating a specimen for the Herbaria to voucher) where we identified major gaps in GIS data coverage.

Second, after adding our data to the Calflora database and integrating them in our Calweedmapper which is able to show both types of data and flag out inconsistencies, it provides a comprehensive assessment of where the 204 species are state-wide as well as where more data collection is needed. Land managers may use the information and resulting maps to inform decisions about managing invasive plants on their property and learn about what may be heading in their direction.

Third, we combine the GIS and quad data to create suitable range maps for each species under current and projected future

Figure 2. Distribution of Russian knapweed (Acroptilon repens) in the extended San Francisco Bay Area. This species effectively competes for soil moisture and nutrients with several native plants, and its deep root system allows the plant to mine deep soil moisture that most native grasses and shrub cannot obtain (Carpenter et al. 1998).
(2050) climate conditions using MaxEnt ecological niche modeling software (Phillips et al. 2006). Using the expert knowledge as filter for the GIS data, we could limit the areas where the modeling algorithm picks pseudo-absence moving it closer to real absence. In addition we could identify areas where the existing GIS data does not represent the actual distribution. And finally, we could compare the projected suitability with the information experts gave us about the current presence as an additional mean of model evaluation.

CONCLUSIONS
Combining quantitative and qualitative invasive plant species data allowed us to create distribution maps in California that had never been created before. These maps include both presence and absence, and absence data is as valuable as presence for species distribution modeling.

Collecting qualitative data supplied by land managers is a highly effective means of capturing a large amount of knowledge not identified in GIS datasets, and using this information helps initiate and direct GIS data collection efforts. Current and projected future range maps are helpful to land managers interested in prioritizing invasive species removal, developing control methods, and planning for the future.

With new funding from the California Landscape Conservation Cooperative (an effort led by the US Fish & Wildlife Service), Cal-IPC will couple the invasive plant range maps with other conservation maps capturing sensitive species and habitats, increasing the analytical capacity for setting invasive plant management priorities.

ACKNOWLEDGMENTS
This report would not have been possible without GIS and expert knowledge data generously provided by hundreds of individuals, organizations involved in Weed Management Areas, or without the dedication and hard work of the mapping team: Elizabeth Brusati, Suzanne Harmon, Doug Johnson, Dana Morawitz, Tony Morosco, and Falk Schützenmeister.

Funding was provided by the California Department of Food and Agriculture (American Recovery and Reinvestment Act funds), National Fish and Wildlife Foundation Pulling Together Initiative, Resources Legacy Fund, Richard and Rhoda Goldman Fund, USDA Forest Service State and Private Forestry Program, and the USDA Forest Service Special Technology Development Program.

In accordance with Federal law and U.S. Department of Agriculture policy, Cal-IPC is prohibited from discriminating on the basis of race, color, national origin, sex, age, or disability. To file a complaint of discrimination, write USDA, Director, Office of Civil Rights, Room 326-W, Whitten Building, 1400 Independence Avenue, SW, Washington DC 20250-9410 or call (202) 720-5964 (voice and TDD). USDA is an equal opportunity provider and employer.


ABOUT THE AUTHOR
Cynthia Powell is a Mapping and Modeling Specialist at California Invasive Plant Council. She received her MS in Geography from San Francisco State University. For her thesis work she is modeling Pardee Reservoir water supply using satellite images with an emphasis on resource management, GIS, modeling, and remote sensing. For Cal-IPC she is using her modeling and quantitative analysis background to examine change in invasive species habitat with different potential climate change scenarios.

WINNER OF LAST ISSUE’S WHERE IN THE BAY AREA? CONTEST

The winner of the Spring 2011 Where in the Bay Area? Contest is Jane Ringot from Alameda County Public Works Agency. Jane’s answer: “Is it Corkscrew at Bair Island in Redwood City?” Yes, Jane, you are correct! The slough is located in the Bair Island Ecological Reserve. Lat/long at center of the image: 37.5221, -122.2265.

BAAMA received seven responses, all of which were correct. The winner was chosen by random drawing.
NO SURPRISES
Good, bad or ugly, there should never be surprises for clients. If you have an issue on a project, deal with it and let the client know what is going on. It is much better for a client to know there is an issue and how you resolved it than it is for them to find out after the fact or once it has become a crisis. Bad news does not get better with age. Once we delivered a major geospatial mapping project early which upset the client. We had failed to let them know that the deliverables were coming early and as a result they were unprepared for the delivery.

PRICING
Another important factor in running an efficient and profitable organization is for the program and project managers to understand the difference between price and cost. Price is what a customer is willing to pay us, and cost is what we pay to complete the work. With effective cost tracking and management, the final cost should be less than the price, and therefore a profit should be made. Employees need to understand the cost of doing business. I have heard many times someone say “we made enough to cover my salary so we must have done okay.” Without taking into consideration all the costs of doing business and the burdens (overhead, fringe benefits such as vacation, sick leave, insurance, educational assistance, and profit-sharing, General & Administrative costs — the money spent to pay corporate management and operate the business activities as opposed to billable hours and the money spent to produce products and deliver services), people don’t get a good sense of what it takes to run a business.

ACCOUNTABILITY
The only way to have a strong organization is to delegate responsibility as far down as possible, and then hold people accountable. When General Carl Strock was in charge of the U.S. Army Corps of Engineers, he issued a permission slip to Corps’ employees. The slip said:

Ask yourself:
1. Is it good for my customer?
2. Is it legal and ethical?
3. Is it something I am willing to be accountable for?
If so, don’t ask permission because you already have it.
Obviously, the key to the permission slip is holding people accountable for the decisions they make. In order to grow a company, you have to be able to delegate responsibility. In the process, make sure those that take on more responsibility are accountable.

TECHNOLOGY ENGINEERING
There are two basic types of Technology Engineering:
1. Technology used internally to make your business or agency go and grow; and 2. Technology provided to customers as a revenue stream for your business, or a service to your constituents. Either way, it is the disciplined practice of figuring out whether to build, buy, or rent. Within Technology Engineering, 3K3 focuses on six critical elements: requirements, technology assessments, product analysis, user applications, tool development, and resource acquisition:

- **REQUIREMENTS** As with any planning process, the first thing to consider when performing technology engineering is a requirements analysis.
- **TECHNOLOGY ASSESSMENTS** So now that you have at least a solid draft of the requirements, you should perform an exhaustive industry search to discover whether technology already exists that could solve your problem.
- **PRODUCT ANALYSIS** Once you identify the other products out there on the market, you need to analyze not only the products themselves, but the companies who make them.
- **USER APPLICATIONS** User applications are the suite of software programs that accomplish the overall goals based on the requirements and analysis steps in the technology engineering process. This may include custom hardware to support the software tools.
- **TOOL DEVELOPMENT** Overall user applications typically evolve over the life of a program through development of specific software tools to further increase efficiencies.
- **RESOURCE ACQUISITION** How you actually acquire the technology resource(s) depends on whether you implement it internally or externally. If internally, you must budget for continued development and support to match the lifecycle of the product need. But if your technology engineering project supports an on-going business function, you must consider the long-term costs.

We developed a mountain bike-based GPS inventory system for asset management, co-developed an airborne LiDAR sensor, and created the first Inland Electronic Navigational Chart (IENC) for customers in the private and public sectors. In each case the drive was to build a better mousetrap.

MERGERS & ACQUISITIONS
The term “Mergers & Acquisitions (M&A)” typically includes: any acquisition, merger, consolidation, reorganization, capitalization, recapitalization, or business combination; or a transaction in which a company obtains capital in the form of equity and/or debt; or the company or a portion of the company is acquired. No matter what stage your company is currently in, you need to understand all of the aspects of M&A and the options available to you now and in the future.
When you sit down with your coffee and business section of the newspaper tomorrow morning, the odds are there will be at least one headline announcing an M&A transaction. That is an easy prediction to make, because M&A deals are so common and often grab the attention of the business world. M&A deals are critical in the geospatial community as well, both as a means to grow a company as well as an exit strategy outlined in a strategic plan.

One of the most successful M&A’s of all time was Microsoft’s purchase of MS-DOS in 1980 from Seattle Computer Products for $25,000. Microsoft quickly sold to IBM, and MS-DOS became the operating system for the first 8086-based personal computer. This M&A led to Microsoft’s dominance of the $200+ billion dollar market. Microsoft has grown through other acquisitions such as buying PowerPoint from Forethought, Outlook from Jump Networks and Media Player from Vextreme. These acquisitions are great examples of what can be done to expand a company through M&A.

Even if your company does not anticipate any short-term M&A transactions, your strategic plan should include an M&A strategy that focuses on positioning your company to be a participant in the M&A arena at the appropriate time.

3001 acquired five different geospatial companies along its growth path before merging with Northrop Grumman.

SUMMARY
Mapping out the future of your geospatial career can, and should, be fun and rewarding. Following some tried-and-true techniques can reduce mistakes and increase efficiency and effectiveness. If you keep in mind the sage advice of Kenny Rogers, and seek help to make those decisions, you’ll reap the benefits and enjoy the game.

You got to know when to hold ‘em, know when to fold ‘em, Know when to walk away and know when to run.
You never count your money when you’re sittin’ at the table.
There’ll be time enough for countin’ when the dealin’s done.

ABOUT 3K3
3K3, LLC (www.3K3LLC.com) empowers geospatial companies (including San Francisco-based Endpoint Environmental LLC) and government agencies to improve processes and better serve their customers. This article is based on a series of articles originally published in Directions Magazine. 3K3, LLC was founded in 2010 by Jeff Lower and Jay Arnold, after they enjoyed a 16-year career together at 3001, Inc. which was merged into Northrop Grumman in 2008 under the guidance of a management team including Charlie Pecchio, a 3K3 Senior Advisor.

Prior to 3K3, Jay Arnold was a key member of the management team at VFM and 3001 throughout its growth and merger into Northrop Grumman. This was a 16-year career where he held management positions on a team that grew and re-invented the company. As Vice President of GIS Services, he helped pioneer methods for migrating surveying and engineering products into Esri, Intergraph, and other geospatial formats. Jay Arnold, jay.arnold@3K3LLC.com, 256-520-2564

Prior to 3K3, Jeff Lower was the Vice President of Civil Works at 3001, Inc. In his 15 year career at 3001/ Northrop Grumman, he managed programs and a division that performed surveying, mapping and Enterprise GIS development for federal, local, state and commercial clients. Jeff Lower, jeff.lower@3K3LLC.com, 256-520-4341.

Charlie Pecchio joined 3K3 as a Senior Advisor. Charlie has over 35 years experience in executive management, business development, venture capital, and mergers and acquisitions, and he has served as officer and director of many private and public companies. He advises 3K3 clients on strategic planning and business expansion. Previously, he served as a director, Chief Executive Officer, and Vice Chairman of 3001, Inc., where he led 3001’s recapitalization and expansion through organic growth and key acquisitions prior to its merger into Northrop Grumman. Charlie Pecchio, charlie.pecchio@3K3LLC.com, 678-986-9310.
BAAMA MAP GALLERY

The BAAMA Journal Map Gallery is an opportunity for BAAMA Members and friends to share their best maps with our active, growing readership. We invite all amateur and professional cartographers to submit your most beautiful work for publication. We encourage everyone with a passion for mapmaking — students, GIS specialists, RS image analysts, senior managers, moonlighting executives — to contribute his or her map to The BAAMA Journal.


HAPPY HOLIDAYS FROM ENDPOINT ENVIRONMENTAL

SAN FRANCISCO BAY

Golden Gate Bridge
Presidio of San Francisco
Crissy Field
Palace of Fine Arts
National Forests of the Pacific Southwest Region. (20” x 27” printed poster.) Created with ESRI ArcGIS, Adobe Illustrator and Photoshop. United States Department of Agriculture Forest Service. Created by Daniel Spring, General Dynamics Information Technology.
Hart Mountain National Antelope Refuge: a park reference guide. Load onto GPS enabled iPhone or iPad, use map to navigate the Refuge (also place/export waypoints, measure distances, add notes, etc). (14" x 20" geospatial PDF.) Created with Illustrator using MAPublisher; some processing in ArcGIS. Personal collection experiment with design and software for the Avenza Maps app. The app is free on iTunes and the map can be loaded from inside the application (map is also free, http://itunes.apple.com/ca/app/avenza-pdf-maps/id388424049?mt=8#). Created by David Medeiros, Medeiros Cartography.
WHERE IN THE BAY AREA?

Fruits, vegetables, meat, dairy, wines - Bay Area farms produce a world-class variety of agricultural goods. We are lucky to live near so many delightful sources of delicious food. Consider yourself a local farm aficionado? Savor this location and let us know. This GoogleEarth image was provided by Robert Pedersen, Geospatial Specialist, Independent Geospatial Consultant.

Identify where this area is and send your answer to editor@BAAMA.org. One lucky winner will be randomly selected from all correct entries received by March 1, 2012. If you give the latitude-longitude coordinates that fall in the image, you definitely get bragging rights at the next BAAMA educational session! The winner will be announced in the next issue due out Earth Day 2012.

BAAMA EXTENDS SPECIAL APPRECIATION TO ITS CORPORATE SPONSORS 2011

- 3D Visions
- Boundary Solutions, Inc.
- Earthmine, Inc.
- Ellis Geospatial
- Endpoint Environmental LLC
- ESRI
- Farallon Geographics, Inc.
- GeoSyntec Consultants
- HJW GeoSpatial, Inc.
- Lohnes & Wright
- Michael Baker Jr., Inc.
- PSOMAS
- Towill, Inc.
- URS Corporation
- ValueCAD
- Weston Solutions, Inc.

EDUCATION/RESEARCH INSTITUTIONS
- Diablo Valley College
- Foothill College
- GIS Education Center
- San Jose State University/Geography Dept.
- SFSU Geography Department
- Stanford University
- UC Berkeley

GOVERNMENT
- AC Transit
- Bay Area Air Quality Management District

NON-PROFIT ORGANIZATIONS
- GreenInfo Network
- San Francisco Estuary Institute

UTILITIES
- California Water Service Co.
- Central Contra Costa Sanitary District
- Contra Costa Water District
- Marin Municipal Water District
- Pacific Gas & Electric (PG&E)
- San Jose Water Company
- Santa Clara Valley Water District