



Centralized Facility and Infrastructure Asset Maintenance System

Town of Hanover, Massachusetts
April 1, 2013

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April 1, 2013

The Town of Hanover, in an effort to extend the life of its capital assets, embarked on an effort on July 1, 2012, to centralize maintenance of its facilities, infrastructure, vehicles, and equipment under a single maintenance organization with the goal of exceptional customer service in a team oriented environment. The goal of this program was to relieve individual departments from the burden of managing the assets to allow them to focus instead on their core missions. In addition, consolidating maintenance elevated the maintenance of the assets to a primary town function and provided a forum for the residents of the community to consider choices, levels of service, and ultimately the cost benefit and return on investment when they are asked to allocate funds for the operation, maintenance, and replacement of assets.

During the planning stages of this effort, the Town applied for and received a \$46,000 Community Innovation Challenge Grant from the Commonwealth of Massachusetts to utilize technology to increase internal efficiency and to engage the clients and residents that we serve in an ongoing dialogue on the maintenance of their asset investments. The grant allowed for the creation of a Centralized Facility and Infrastructure Asset Maintenance System using a combination of commercially available hardware and software combined with internally developed websites and supporting software.

The organization that we have created is a work in progress as we learn what it takes to effectively manage and maintain the assets that we own within the resources that are available while meeting the expectations of the wide variety of clients and residents that we serve. Similarly, the Centralized Facility and Infrastructure Asset Maintenance System that we have created is itself a work in progress that will develop and evolve over time.

We thank the Executive Office for Administration and Finance for providing us with an exciting opportunity to integrate and extend some of the tools we have employed to hopefully help meet the expectations of the residents and clients that we serve. This final grant report that follows is in effect a starting point on a journey that will have no end. We invite the reader to follow our journey, both within this document as well as through the changes to our website that will occur over time.

Victor J. Diniak
Director of Public Works

Executive Summary

The Town of Hanover embarked on an effort on July 1, 2011, to plan for and implement the consolidation of maintenance of all Town facilities, including those operated by the Hanover Schools, under a single centralized maintenance organization one year later on July 1, 2012. The cooperative planning effort involving major town and school department heads identified a road map towards consolidation and resulted in the formation of a new major operating group within a restructured Department of Public Works. The restructured Department of Public Works was tasked with maintaining all of the Town's fixed vertical and horizontal assets, maintenance of vehicles and equipment, management of all custodial, maintenance, and public works personnel, and related administrative task in a team oriented environment focusing on achieving an exceptional level of customer service.

To support the effort, the Town applied for and was awarded a \$46,000 Community Innovation Challenge Grant to utilize technology to increase efficiency, to extend the capabilities of existing computerized maintenance management systems, and to develop a strong relationship between the clients and residents that are served and the assets that are being operated and maintained.

The grant activities successfully placed new technology into the hands of public works field personnel, integrated data between financial and operations management systems of various vendors, developed web pages which provide the building blocks for educating residents on the cost and challenges of facility operations in a way that has not been done before, and opened up a dialogue and new channels of communication between the community and the Town's infrastructure managers through free web and smart phone applications.

As an incubator of innovation, the Community Innovation Challenge Grant program accelerated the Town's maintenance consolidation efforts, opened up new possibilities for future internal efficiencies, and provided opportunities for residents to play an engaged role in making informed choices to preserve or not preserve the investments they have made in their infrastructure.

Section 1: Partner Communities

The Town of Hanover was the sole community involved in this challenge grant. The grant was administered entirely by the Department of Public Works. Through the publicity generated by the grant announcement, the Town of Hanover was contacted by several other communities who were considering consolidating the maintenance of municipal facilities. While there are many different models of consolidation that can be used, we welcome communities to learn from our efforts as they plan their own consolidation efforts.

Section 2: Goals

The 2011 Hanover Annual Town Meeting, after considerable debate, voted to consolidate the operation and maintenance of all town facilities, including those of the school department, under a single, centralized maintenance organization. The Town's Director of Public Works and newly hired Facilities Engineering Manager were charged by the Town Manager to create the organization and ensure a seamless transition from decentralized department based operation and maintenance of facilities to centralized maintenance one year after the Town Meeting vote on July 1, 2012. The goal was to increase the efficiency and quality of service while freeing department heads to focus on their core missions, eliminating the distractions of having to worry about maintaining the buildings from which they operate. All departments would effectively become tenants of the centralized maintenance organization.

The new organization was to become a major operating division within the Department of Public Works. This would allow for the sharing of personnel and equipment between DPW divisions and would reduce the need to replicate administrative systems that already existed within the DPW. The end result was the formation of one department responsible for the operation and maintenance of all of the Town's vertical and horizontal assets.

Working closely with the Town Manager, the Superintendent of Schools, the School Business Manager, and other major department heads, the team developed a structure and goals for the new organization. The ultimate goal of the cooperative centralization effort was to provide efficient, cost effective, centralized operation and maintenance services for all of the Town's buildings, surrounding facilities, and infrastructure assets. Town officials hoped that centralizing operations would provide opportunities to achieve savings through economies of scale in the procurement of supplies and services, reduction in outsourced services, and the extension of the life of capital assets through robust preventive maintenance procedures. Furthermore, town officials recognized that the Town Meeting vote was a directive by the residents to treat facility and infrastructure maintenance as a primary function of the town, rather than a secondary function of each individual department. The hope was that by providing a separate budget for asset maintenance, informed choices could be made regarding the level of service that would be provided in operating and maintaining the Town's assets. Ultimately, the residents could have a specific debate on and choice of the resources they were willing to commit towards maintaining their assets.

The town officials recognized that to achieve a higher level of service than what was provided prior to centralization and to extend the life of capital assets, they needed to get away from continuous crisis management and move in the direction of thoughtful, planned, and properly supervised preventive maintenance, operation and management of the Town's assets.

The Community Innovation Challenge Grant application period fell six months into the planning process for the transition to centralized maintenance. In its grant application, the Town listed the following generic goals of the new organization:

1. Achieve cost savings through economies of scale of centralized procurement of supplies and services;
2. Provide professional technical management of buildings, allowing department heads to focus on their core missions;
3. Reduce capital replacement costs by expanding the life of assets through robust preventive maintenance procedures;
4. Achieve cost savings where possible by hiring employees with specific trade skills who when appropriate can reduce some of the services provided by outside vendors;
5. Provide transparency of finances for residents, extracting facility operation and maintenance costs out of departmental budgets and reporting such costs to show the true cost of operations;
6. Through centralized budgeting develop a better understanding of operation and maintenance costs and identify areas for both improvement and cost savings through innovative techniques;
7. Expand existing technologies and use new technologies to provide a complete history of repairs and maintenance to all infrastructure and facilities, building a dynamic database upon which to make operation and management decisions; and
8. Expand existing technology and use new technologies to all residents and users of facilities to interact with the centralized maintenance organization in non-traditional ways to: a) report issues, b) receive feedback on when requests will be serviced, c) where appropriate to see issues resolved in a more timely manner, d) receive feedback that requested jobs were performed and if possible report the cost of the job, e) provide a mechanism to grade the maintenance organization's response through near real-time feedback, the results of which will be used by managers to challenge employees to provide greater efficiencies and higher quality of work.

While the Town's centralized maintenance goals are broad, the CIC grant provided funds to complete two specific tasks:

1. To provide better operation and maintenance planning and execution through the use of off-the-shelf field based hardware, tied to internally supported databases and software. These components will be used to:
 - a. Purchase additional software licenses for the Town's computerized infrastructure management systems; and

- b. Purchase handheld technology to push the infrastructure management systems into the hands of field personnel.
2. To engage the public to take ownership of their assets, providing web and smart phone applications for their use to report building and infrastructure problems, receive specific feedback from the maintenance organization on the status of their service requests, receive general feedback on the cost of operation and maintenance activities, and ultimately provide a means to grade the maintenance efforts.
 - a. Develop tools to extract information from both the infrastructure management systems and Town's financial systems for use in new websites;
 - b. Develop websites to communicate facility and infrastructure operations and finances to the public; and
 - c. Implement a smart-phone application to allow residents to document and report infrastructure problems to infrastructure managers.

SECTION 3: IMPLEMENTATION PLAN

The Town previously implemented SchoolDude as its computerized maintenance management system (CMMS) for its vertical assets (buildings and immediate surroundings) and Cartegraph Work Director as its CMMS for its horizontal assets (traditional infrastructure). The goals of the grant were to extend the use of both products, to leverage the data being captured by the products and the reporting systems that are available for use, and to develop tools to extract data somewhat automatically for use by the public and other applications. Both products are standard, off-the-shelf, commercially available asset management systems with mature user bases. Both have the ability to capture the nature and cost (time, equipment usage, and materials) of maintenance activities, to build maintenance history, and to schedule work. SchoolDude excelled in its simple, on-line, web based ability to accept maintenance requests from users of facilities. It lacked, however, the ability to capture GPS positioning of requests and to effectively link to geographic information systems (GIS). As such, the Town chose to continue with both systems and to marry them through custom software and web pages.

The general implementation plan was the following:

- Extend existing systems by procuring hardware and software;
- Configure and deploy Cartegraph's mobile products;
- Review, plan, and implement website changes to foster communication with residents; and
- Test the effectiveness of Cartegraph Mobile, YourGov, and the website work

Extend Existing Systems:

SchoolDude:

SchoolDude is a comprehensive facility management system used by numerous school systems across the United States. The software is web based (browser driven) and has modules for many aspects of facility operations. The Town is currently using SchoolDude's Maintenance Direct module and is in the process of implementing their preventive maintenance and facility scheduling modules, both of which are direct results of the Town's centralization efforts.

The Hanover Schools used SchoolDude to field facility service requests from their employees prior to the July 1, 2012 transition to centralized maintenance. Extending SchoolDude to cover additional Town facilities was a simple extension of the list of facilities and training users of non-school facilities on how to enter requests for services. This activity progressed rather rapidly after the July 1 transition. Buildings not currently covered by SchoolDude (Town Hall, DPW facilities, Senior Center, Fire Stations, Police Station, Recreation Center) were added to the system and managers and department heads at the non-school facilities received training on how to enter service requests in to the system. All facility maintenance requests now flow through the system and facility maintenance staff use the system to drive and document their work.

While not explicitly funded by the grant, additional SchoolDude modules were purchased to drive preventive maintenance planning as well as facility scheduling. Both modules are currently in the implementation stage with full deployment likely around July 1, 2013.

Cartegraph

In order to understand what it means to extend the Cartegraph system, it is best to start with a short description of the various components of the system.

Cartegraph Work Director

is a call center/work order management system. The system operates on desktop computers tied to a central SQL database which allow office staff and field personnel to receive or generate requests for service through various means (telephone, walk in, email, etc...), capturing all pertinent information including GPS locations and photographs of the problem to be solved. Work requests are evaluated by staff and if found to be valid, the staff can generate a work order at the touch of a button. Once the work is performed, the system has a number of tools for capturing the details of the job (time, materials, equipment usage, subcontractor expenses, pictures, other attachments) as well as communicating information back to the original work requestor. The work orders have optional links to specific assets. As work orders are generated and then closed out, a history of the maintenance of the asset is generated. Cartegraph uses SQL Server as its database. Cartegraph Work Director has a powerful report generator that comes shipped with a number of standard reports, any of which can be altered to match an organization's needs. An unlimited number of new reports can also be developed and saved for future use. Cartegraph enabled work stations are located in multiple public works facilities in Hanover, linked through a virtual private network to the main file server at the DPW office.

Cartegraph Mobile

is a stripped down version of the desktop Cartegraph Work Director program which operates on a hand-held device running the Windows Mobile operating system. The software allows for a subset of work orders to be loaded to a device. The device can then be utilized in the field to capture details about the work that is performed (time, materials, equipment usage, pictures, etc.) Once returned to the office, the data is uploaded back to the Cartegraph master database. The intent of the application is for field personnel and supervisors to capture and record information at the job site, without having to reenter it back at the office. New work orders can also be generated directly from the mobile devices.

YourGov Web

is an internet based application which allows anybody who has registered an account with the Town to submit a work request from their computer over the internet. The request is then inserted into the Cartegraph request database and processed in a manner similar to a telephone or walk-in request. If enabled, the system captures the email address of the requester for use at a later date.

The YourGov smartphone app

is a free mobile phone app which allows a user to report a problem to the DPW through their mobile phone. The app captures the address using the phone's GPS location services, allows the user to select from a list of standard issues, allows the user to optionally take a picture of a problem, and finally allows the user to type a short description of a problem. When the user presses a submit button, the request is transmitted to the Hanover DPW's request database and processed in a manner similar to a telephone or walk-in request. If enabled by the user, the system captures contact information of the requester for use at a later date.

The Hanover DPW deployed the Cartegraph Work Director product at the end of FY 2011 and was in the process of weaning staff off of in-house developed work order software in January of 2012 when the CIC grant was announced. One of Cartegraph's strengths is that while it is a commercial, off-the-shelf product, it has the ability to be configured to match an organization's work flow. The out of the box forms and reports that come with the product are more than adequate to capture most tasks a public works organization performs. Hanover contracted with Cartegraph in our initial installation to add fields and manipulate some of the screens so the work flow of the product closely matched an existing work order system that has been in use for a number of years. The result of this work was that the learning curve for our staff was not as steep as it would have been if we simply used an out of the box installation. Prior to being awarded the grant, the Town also invested in on-site training to familiarize users with the products.

Extending the system involved purchasing and installing additional licenses for Cartegraph Work Director, licensing Cartegraph mobile, purchasing GPS enabled hardware to support the Cartegraph Mobile application, and implementing Cartegraph's YourGov smart phone application.

The first step in extending the Cartegraph system was to choose a mobile platform. After evaluating the options, the Town purchased four Trimble Juno 3D devices. These devices have a built in camera as well as true GPS receiver. They are rugged, somewhat shock and water resistant, and designed for the type of work we contemplated.

The second step in extending the Cartegraph system was to procure four additional licenses for the Work Director product, bringing our total to 12, as well as to license the Cartegraph Mobile and the YourGov Web and Mobile applications. These licenses were purchased directly from Cartegraph. This initial procurement also covered implementation and training services on the Cartegraph Mobile and YourGov applications (web and mobile). The procurement of the field

hardware and software licenses were completed in the first quarter as anticipated by the grant agreement.

Configuration and deployment of mobile products:

The mobile technology pieces of the grant (Cartegraph Mobile, YourGov smart phone app) are perhaps one of the more interesting pieces of the Town's CIC grant. They represent the primary reasons the Town migrated from in-house software to off-the-shelf software for the management of our work forces. Our desire was to be able to utilize new technologies in the field to increase our efficiency and to increase our responsiveness to our clients, thereby achieving our town wide goal of exceptional customer service. We explicitly wanted to use commercially available products for this piece of our system as we felt the commercial market was better poised to provide the kinds of tools we needed. We also felt the commercial market would present opportunities going forward that we could not provide through in-house development as new technology became available.

The grant agreement anticipated the configuration and deployment of the mobile pieces in the second quarter (summer of 2012). The Cartegraph Mobile deployment went smoothly. The Cartegraph YourGov app deployment was much more challenging, but ultimately successful. We will describe each deployment separately.

Quarter 2 Task:

Cartegraph Mobile Deployment

Four licenses of Cartegraph Mobile were deployed on Trimble Juno 3D handheld devices running the Windows Mobile operating system. The deployment involved some configuration work, both in the office and on-site by Cartegraph field personnel, as well as two days of hands on user training. The Cartegraph mobile application mirrors the desktop version of the product. As the screen is much smaller than that of a desktop computer, the data entry screens are structured to handle the smaller screen, but the data collected is largely the same, as is the work flow. A subset of work orders from the Cartegraph database is downloaded to a particular device. The device is then used in the field to document work.

Photo 1: Typical Cartegraph Desktop Screen

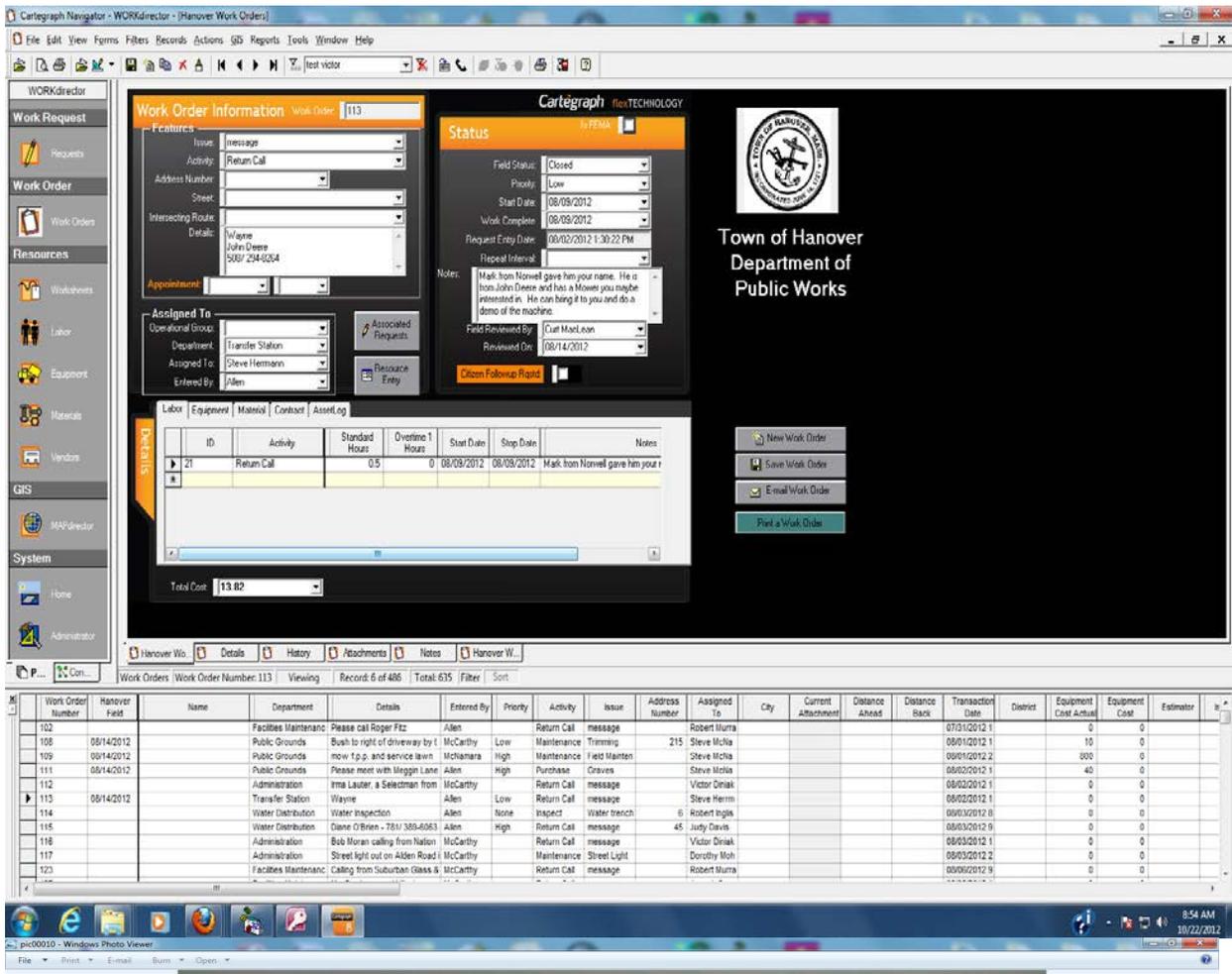


Photo 2: Typical Cartegraph Mobile Screen as seen from an actual Trimble Juno 3D device

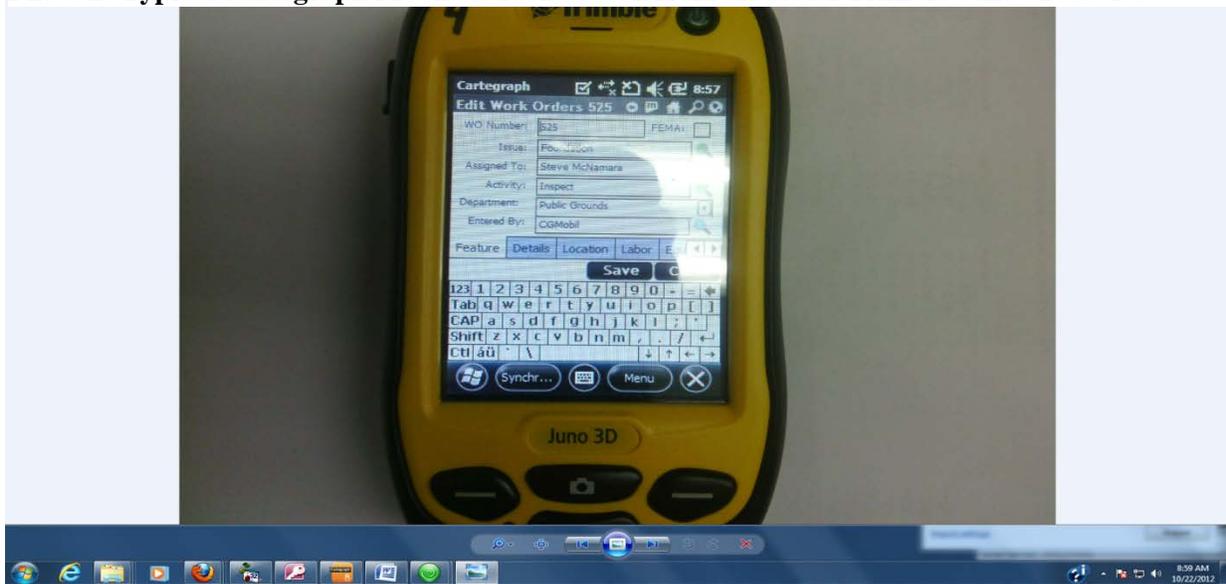
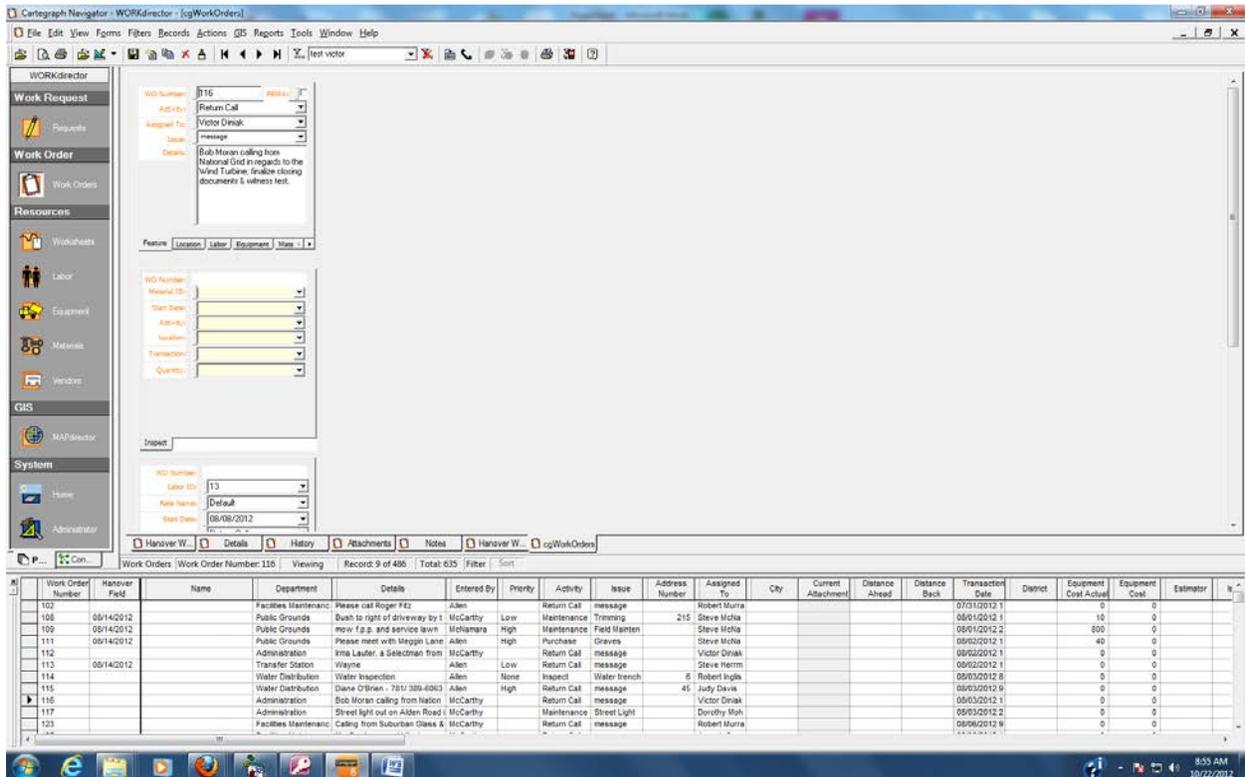


Photo 3: Cartegraph Mobile Screens as seen from the desktop application



Note: The small screens to the left are what actually appear on the Trimble Juno 3D in Cartegraph Mobile

Two field supervisors currently carry devices and use them to create work orders in the field and to check on and close out work that has already been performed. A foreman and a field worker use the other two devices to execute work orders that have been assigned to them.

The initial deployment and testing of the Cartegraph Mobile devices took place at the end of September 2012, just as the Town was ramping down many of our summer operations and mobilizing for winter activities. We expect their use to ramp up as the spring 2013 season progresses and more field work orders are completed. Based on the initial deployment we anticipate deploying more devices in the summer of 2013.

Procedures for synching the Cartegraph Mobile devices were developed and submitted as part of the second quarter report and are attached to the end of this document

Quarter 2 Task:*YourGov Web and YourGov mobile app Deployment*

The YourGov web and YourGov mobile smart phone app were the elements of the grant that we hoped would spark resident interest in the Town's centralized asset maintenance efforts. The YourGov web application is an internet based application, accessible through a web browser, which allows a registered user to report and request service at a particular location. The application communicates directly with the Cartegraph Work Director application to insert a work request into the Cartegraph database as if the user had made the request over the phone or in person. The YourGov smart phone app is similar in that it allows a user to take a picture from their smart phone, tag the picture with an issue code and a description, and communicate the problem to the Town through the cell network. The app communicates directly with the Town's Cartegraph Work Director system.

Implementation and deployment of both products began in November of 2012 and quickly came to a halt. At the time we purchased both products, we were unaware of some of the underlying technology that would be needed to support the products. The products, as the current release was being shipped, needed two additional file servers to insulate the Town's databases from the outside world. Working with our networking consultants, we purchased and installed the necessary equipment.

Like all of Cartegraph's products, they ship with a standard configuration but allow for customization. After settling on a final customization, Cartegraph attempted to deploy the products but ran into roadblocks caused by idiosyncrasies of the Town's firewall configuration and mail server, both of which tripped up Cartegraph's standard configurations. Cartegraph worked with the Town's networking vendor to work around the issues and successfully deployed both applications in March 2013, in time for this final report.

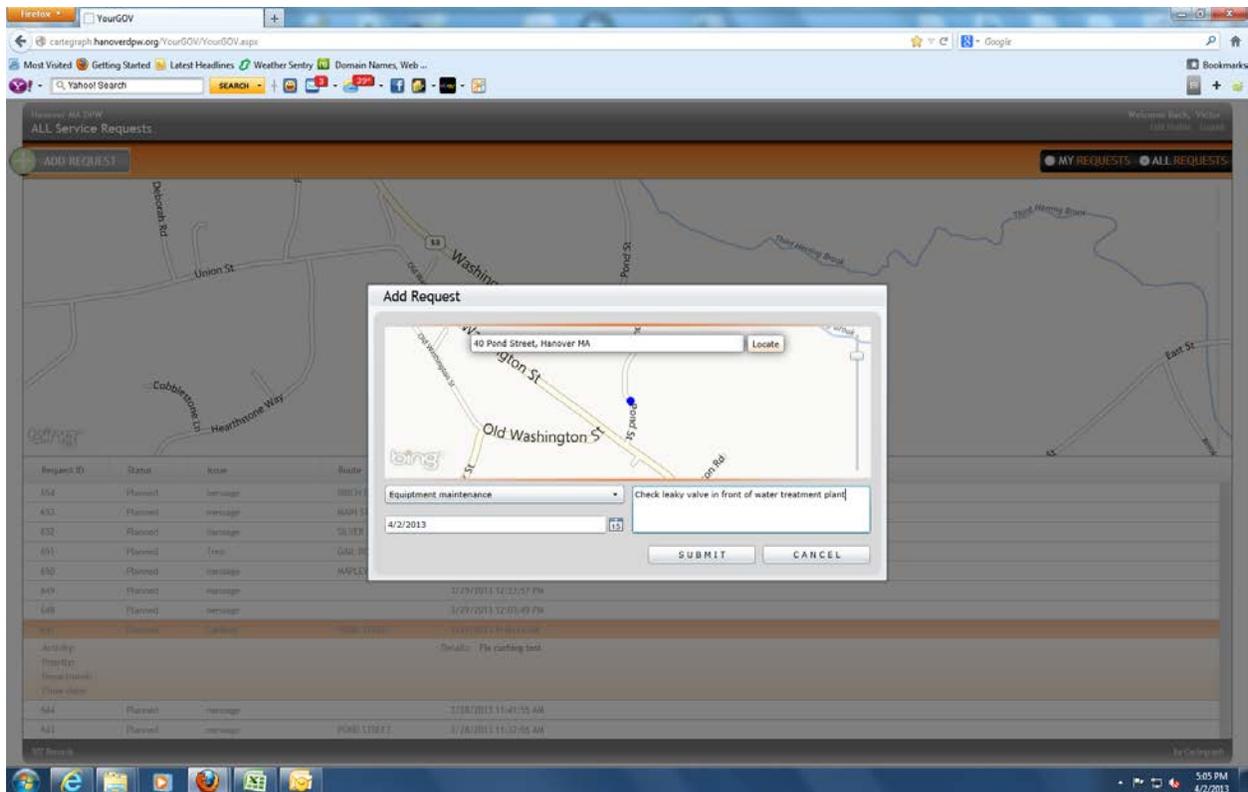


Photo 4: Data entry screen in YourGov Web - entry of a new work request

After logging in to the application from a web browser, the user enters an address which is then called up on a Bing map. The user is then given the option of selecting a standard problem from a drop down list and also entering supplemental information. Once the user presses the submit button, the request is transmitted to the Town and inserted into the Town’s Cartegraph request database. DPW staff then review the request and begin the process of solving the problem. The request is tagged with the user’s email address which allows the staff to communicate status back to the user as the work order proceeds through the Town’s processes.

The YourGov smart phone app works in a similar way to the YourGov web product. A user downloads the free app from the I-tunes store or the Android Market place. To submit a request, the user opens the app and follows the on-screen instructions to select the location (usually preselected from the GPS location services on the phone), select the issue, and enter a description of the problem. The app also allows the user to take a picture of the problem. Finally, the issue is submitted, either tagged with the user’s contact information or anonymously. The request is inserted into the Town’s request database and then handled as a normal work request.

Review, plan, and implement website changes:

In applying for its CIC grant, the Town contemplated not only developing internal efficiencies, but also really developing a two way dialogue with our clients. We don’t believe we can be successful in the long-term unless we operate as efficiently and transparently as possible and at

the same time develop credibility with our clients, the users of our infrastructure, and the residents who pay the bills. While at the time of this report we are just nine months into our operations, we expect the organization to evolve over time. This will take an ongoing sustainable investment by our residents. We feel this will only be possible if the residents are well informed on what they own, engage in a healthy dialogue on the level of service that the community wants the Town to provide, and understand what it takes to operate and maintain what they own at the level of service they desire.

The Town entered into this venture with some unique assets. We had two powerful external software platforms that were helping to manage the flow of work as well as the cost of the work, we had a variety of in-house developed financial systems with upwards of 10 years of history on which we can draw, and we had some internal software development expertise. We knew that the real value in our existing systems lay in the data that we were capturing. We believed we could achieve internal efficiencies as well as a spark the two way dialogue that we desire with our residents/clients if we could figure out a way to tie the various systems together. In applying for our CIC grant, we envisioned a set of dashboards that our internal staff could use to manage and track our progress but we also felt that the internet presented unique opportunities to inform the public on what it takes to manage their investments in infrastructure. Our only problem was that at the time of our grant application, we lacked even a basic understanding of the underlying structure of web pages or of HTML code.

The Town's CIC grant project agreement authorized a budget of \$16,000 for web design services. We believed that we were going to have to hire a web designer to build a basic web page framework to support our goals. We thought that once the site was designed we would be able to maintain it ourselves. In addition, we anticipated having to hire a software developer to write the basic code for extracting data from both the Cartegraph and SchoolDude databases. We expected that the initial work of the web designer and software developer could then be leveraged by in-house staff to update web pages somewhat automatically through software that we intended to write ourselves.

The Town agreed to a work plan in our grant agreement that evolved over time in response to the reality of the monumental task of actually taking over operation and maintenance of the school properties. Ultimately we envisioned a full-blown website, rich in content that would help us not only drive operations but also engage the public. Much of the work that we contemplated in January of 2012 relied upon work we hoped to achieve in the summer of 2012. The task of establishing our organization and making it reliable has consumed much of our energy, and as such some of the material we hoped to produce and publish in the first year has been delayed. We have, however, achieved our goal of a basic framework of a website that we plan to add to over time. We have also achieved a high level of understanding of the structure of HTML code and have successfully integrated our external databases into our website with relative ease. We have put in place a method to easily update the web pages on a regular basis. Finally, now that we actually implemented centralized maintenance of our assets, we have a slew of new information we want to make available to our residents.

The implementation plan for our website development proceeded as follows:

Website Changes - Quarter 1:

Task: *Develop website concept pages. These would be mock-ups showing the types of information we hoped to publish that would likely be handed over to a web designer.*

The concept pages were developed on-time and submitted with the Town's first quarter report. Samples are attached at the end of this report.

Website Changes - Quarter 2:

Task: *Review the current Hanover DPW website to see if changes were needed to accommodate the new pages contemplated by the website concept pages developed in the first quarter.*

Task: *Develop a framework for the web pages. The intent was to take the concept pages developed in the first quarter and to develop standardized web pages with a known structure into which data and other variable content could be inserted automatically by some other (yet to be developed) software.*

Task: *Develop reports from SchoolDude and Cartegraph to extract information from the databases of these two systems for insertion into the web pages. In addition, write code to merge data from the Town's financial systems as well as the SchoolDude and Cartegraph data directly into the web pages, generally with little staff interaction.*

The schedule for the second quarter slipped from that anticipated by the original grant agreement. The quarter 2 work was supposed to be completed by September 30, 2012. The Town underestimated the amount of time senior managers would have to devote to the actual transition to centralized maintenance on July 1st. At the same time, the Town implemented new town wide accounting and payroll applications, including a new chart of accounts on July 1. Furthermore, the DPW's clerical staff was initially swamped by the onslaught of new invoices, vendors, payroll, and personnel transactions that were formerly handled by other departments. Finally, the Town embarked on a revamp of its overall Town website with the goal of bringing departmental websites under the Town's main website. DPW managers chose to delay the web development work until more was known about the changes to the Town website.

The Town took some time to learn a bit about web design and the underlying HTML code. What we discovered was that as we expected the code was well structured and could be generated and manipulated through minor changes to our financial software. Web development began in earnest in November and December. Rather than hire a web designer as anticipated by the grant, the Town decided to do the web design in-house. We didn't expect our design to be as polished or visually appealing as a professionally designed site, but felt that it would be a work in progress that could be built upon over time. In preparation for this work, the DPW had made multiple attempts since the spring of 2012 to lay out a basic web presence for the department. The pages that were developed were done using an HTML editor named Coffee Cup HTML Editor. The software allowed us to develop a basic set of web pages for the department which

we began to roll out in the summer of 2012. The basic site development effort helped us to learn a bit about HTML code, something we knew nothing about at the time we were awarded our CIC grant.

In reviewing our initial web development work, we realized that while our web concepts pages were not particularly difficult to update, we had proposed enough pages that significant staff time would be needed to keep all of the pages current unless we could figure out a way to fully automate their development. While our overall goal was to develop a two way dialogue with our clients about our entire infrastructure, for now we were going to focus on presenting information about the vertical infrastructure (buildings and immediate surroundings).

We added menu options in the existing DPW web pages to support the facility pages. We then made a dramatic design decision to change the menu options and the basic color scheme within the facility pages to help set them off from the regular DPW web pages. This work somewhat completed our initial review of the existing web site. We then proceeded to develop new prototype pages for the facility pages using the Coffee Cup HTML Editor until we had a complete set of framework pages somewhat matching the concept pages developed in the first quarter.

The framework pages are a work in progress. Some of them are more developed than others. They are filled with a variety of “to do” lists for us to complete as we move forward with our centralized maintenance consolidation efforts.

In developing the framework pages, we spent time to better understand the capabilities of both SchoolDude and Cartegraph. In probing both systems, we identified reports and export functions that could be used to extract the information we felt would be necessary in order to completely build out the web pages. This export activity was a task that we anticipated having to outsource to a software developer. Once we identified how to export the information from SchoolDude and Cartegraph, we internally developed software to import the information into a local Microsoft Access database that is part of our financial systems. We then extended our financial systems (which are written in Visual Basic) by adding additional reports, sorted by facility, and linked these reports to various facility maintenance pages of the DPW’s website to allow the general public to see the work being performed by our staff.

Finally, with the prototypes of the various web pages that we developed using the Coffee Cup editor in hand, we took a step back and looked at our efforts as a whole. We wanted our work to be updated on a regular basis, but for security purposes, it was never our intention to enable real-time links to our databases. The number of pages and types of data we wanted to publish, however, suggested that the process needed to be highly automated. We looked at the steps needed to generate public reports in a PDF format and generate higher level web pages with near real-time data. The reports and web screens could be updated manually using an HTML editor or other off the shelf web content manager, but this would be a time consuming process. Instead, we decided we needed to generate as much of this information as possible through software.

To accomplish this automation, we opened up the prototype web pages developed through the Coffee Cup software using a simple text editor and studied the structure of the underlying HTML

code. We subsequently broke each of the pages into reusable text blocks and wrote software in Visual Basic to utilize these text blocks to generate many of the necessary web pages automatically based on the information stored in Cartegraph, SchoolDude, and our financial systems. In addition, we purchased a Visual Basic control that allows for the direct creation of a PDF file, rewrote our financial reports to utilize this tool, and now have the ability to generate any number of reports automatically as a batch, significantly reducing the effort and staff time needed to generate the content for the web pages. The result is that the generation of content is now highly automated. The only real staff time required is the time to upload the files to our web hosting vendor using an FTP tool.

The work described above was completed in late January. We have attached screen shots of many of the screens at the end of this document. Our intention is to publish certain financial pages on a monthly basis and other reports showing work performed and pending work on a more regular basis.

The web site development is certainly a work in progress. The development of the concept pages exposed a long list of tasks that we want to complete as time permits. Some of the things we want to add are charts showing actual energy usage versus predicted energy usage as well as multi-year energy usage trends for each building, charts showing the breakout of broad categories of actual expenses by building and by operations as a whole, and of course a complete detail listing of expenses (similar to an open checkbook). These incremental improvements will help further encourage the dialogue with our residents that we seek.

Website Changes – Quarter 3:

Task: *Develop internal web procedures for office staff and supervisors to use to update the web pages. Train staff on these procedures.*

Task: *Deploy new websites and publicize their availability.*

The full deployment of the website was originally anticipated by the end of December 2012. The work has stretched into quarter 3 and beyond. We have rolled out pages incrementally. Central to our final roll-out will be the publicizing the YourGov Web and YourGov mobile apps which only became operational the last week of March 2013.

Internal web procedures for office staff and supervisors are currently under development. While much of the work is currently available on-line, we expect to fully publicize the availability of the websites in time for a mid May 2013 public roll-out at a Board of Selectmen meeting.

Test the effectiveness of the system:

The grant agreement required the Town to collect evidence of the effectiveness of the grant measures. Specifically, the agreement called for evidence reporting the increase in the hits on the website, increased use of Cartegraph Mobile and YourGov over time, and improved citizen access to government.

As we reported above, the implementation schedule slipped for virtually every portion of the grant. This slippage was largely the result of the complexity of the tasks that we chose to accomplish at the same time that we were tackling all of the tasks involved in centralizing the maintenance of the Town’s assets. Nevertheless, the Town recognizes the importance of being able to quantify the benefits of some the actions that we took. Since the implementation of Cartegraph Mobile and YourGov slipped in their planned schedules, we cannot produce hard statistics at this time on the effectiveness of these two products. Quantifying the Cartegraph Mobile activity will be difficult as the application doesn’t explicitly mark work orders as having been generated or documented with a mobile device. The YourGov application does leave a trail in the request database and we will collect totals over time to better understand the effectiveness of the product. In preparing this document, we believe that this will be an interesting statistic and will be adding a page to our website to document the progress of our CIC Grant measures.

We do offer the following statistics to show the steady use of both the Cartegraph and SchoolDude products. Both products are actively used to track the progress of work from the point of the initial request to the point of completion and are the basis of the reporting that we have started to roll out on our website.

	Total Cartegraph Work Request records	Total Cartegraph Work Orders Issued	Total SchoolDude Work Orders Issued
Q2 (9/30/12)	282	626	4500
Q3 (12/31/12)		1068	5027
Q4 (03/31/2013)	662	1421	5324

While these statistics do not definitively prove that the funds allocated by the grant increased the use of any of the products that were purchased, they do show a steady commitment by the Town to utilize the systems to track and drive work. We will add this information to the CIC progress webpage we described above.

The most obvious measurable statistic for the average user of a web page is a hit counter. When we negotiated our grant agreement, we agreed to implement hit counters as a means of demonstrating how our web site was growing in use. As we researched hit counters, we discovered that there were a number of different services that provided such counters. We also discovered, however, that they should be interpreted with caution as they paint a very limited picture of who is actually accessing the web pages. The automated systems that crawl through the internet on a regular basis easily skew the statistics. The large number of pages that we offer for viewing also make it difficult to evaluate how effective the individual web pages are.

In researching various web statistical tools, we discovered that our web hosting service keeps a wide range of detailed statistics regarding the use of our website. These include hit counts on individual pages, statistics on what people searched for through the major search engines that may have been used to discover our site, the geographic locations of various users, the number of unique users, frequency of visits, bandwidth used, day of week usage of the site, etc... The amount of statistical data available to us is quite large.

We are reluctant to say that any one statistic is better than any other statistic, but offer a few for general review:

Year	Month	Unique Visitors	Number of Visits	Pages	Hits	Bandwidth MB	Avg Visitors/Day	Facility Page Visitors
2012	07	50	58	156	242	73.03	1.6	2
2012	08	696	1058	2732	4658	339.98	22.5	35
2012	09	569	911	2243	3483	191.74	19	32
2012	10	568	986	2333	3666	162.74	18.3	26
2012	11	600	1048	2671	4013	108.34	20	49
2012	12	566	946	2082	3432	45.02	18.3	12
2013	01	582	1006	2849	4503	63.96	18.8	52
2013	02	645	1005	2225	3813	55.08	23	33
2013	03	656	998	2397	4077	60.43	21.2	50

As website development did not progress at the pace that we hoped and the YourGov app took so long to implement, we have yet to do a true final roll-out of the website. We expect to start this process at a Hanover Selectmen’s meeting in May of 2013. As such, the data that we display above can be considered a baseline upon which to really measure the effectiveness of our offerings and of our advertising measures. We will make this information available on the CIC progress webpage.

SECTION 4: BUDGET

Original Budget

- 1. Software Licenses \$12,000
- 2. GPS Enabled Hardware \$10,000
- 3. Integration Services \$8,000
- 4. Web Design Services \$16,000

Total Grant: \$46,000

Final Budget

Item	Original Budget	Actual Cost	Grant Portion	Town Portion
Software Licenses	\$12,000	\$14,820	\$12,000	\$2,820
GPS Enabled Hardware	\$10,000	\$11,764	\$10,000	\$1,764
Integration Services	\$8,000	\$8,401	\$7,951	\$450
Web Design Services	\$16,000	\$0	\$0	In kind services
Additional Hardware/software/services	\$0	\$7,108	\$0	\$7,108

Item	Original Budget	Actual Cost	Grant Portion	Town Portion
Total	\$46,000	\$42,093	\$29,951	\$12,142

SECTION 5: CHALLENGES AND SOLUTIONS

Attachment A of the Town of Hanover’s Project Agreement lists the overall project goal *“To use technology to develop a strong relationship between citizens and their public buildings.”*

Throughout this project have really considered our goal to be much broader. Since the May 2011 Annual Town Meeting vote which mandated a centralized maintenance organization for the Town, we have been working to answer our residents’ call to create a centralized maintenance organization for all infrastructure assets that strives to deliver services better than that which has been done in the past. Our goal has been to create and operate an organization that maximizes the investment that residents have made in their facilities and infrastructure while striving for high levels of customer service in a team oriented manner. The key words are that we “strive to deliver services better than we have done in the past.”

In integrating town wide facility maintenance within the Hanover Department of Public Works, managers and employees have answered the call of the Town Manager and Board of Selectmen to reinvent the way that we deliver services. As such, we look at our overall project goal to *“utilize technology to develop a strong relationship between citizens and their public infrastructure in support of our mission to deliver services and maintain the investment in the facilities and infrastructure to the highest extent possible.”*

Our goal is quite lofty. We spent some time describing our overall centralized maintenance goals and ultimately drilling down to the specific Community Innovation Challenge Grant goals in the section 2 (goals) of this document because we felt that simply talking about the very specific CIC project goals without considering the context did not do our overall project justice.

The Town of Hanover’s CIC grant provided specific funding for tasks that would help advance our overall goals for centralized maintenance. Taken individually, the goals of this CIC grant are not particularly hard to achieve. Taken within the context of the whole process the Town has gone through to establish our maintenance organization over the past 21 months, the grant tasks were a little more challenging than we expected for several reasons.

The first challenge we faced was that we had to work within the schedule of our vendor, Cartegraph. The schedule for deployment of the Cartegraph Mobile and YourGov pieces of the project was set in the spring of 2012 before Cartegraph had a chance to weigh in on whether the schedule was realistic. Cartegraph made a strong effort to help us meet our schedule, but the tasks associated with implementing both of their pieces were delayed. This delayed associated work such as the development of internal procedures and ultimately the evaluation of the effectiveness of both pieces of the project. Both YourGov and Cartegraph Mobile have been successfully deployed and we are confident that the statistics that we will gather over the next six months will prove that not only were they wise investments but they have both made our own crews more effective as well as opened up another avenue for the users of our facilities and the citizens of Hanover to connect with the Town.

The second challenge that we faced was the task of taking a general concept of how we wanted to operate, born from sales literature for both YourGov and Cartegraph Mobile, and truly make the vision a reality. We assume one reason we were awarded our grant was that we planned to use off-the-shelf hardware and software to achieve some of our goals and this approach seemed applicable to other communities. We hoped to be able to demonstrate to other communities who were contemplating extending hardware into the hands of field crews and who may be contemplating providing smart phone apps to their citizens that both could be achieved with relative ease. We tried to stay true to the concept as best we could and chose not to try to stray too far from the out-of-the-box solutions provided by Cartegraph. To this end we believe we were successful. However, even though both products are off-the-shelf applications, there was some behind the scenes IT infrastructure that we had to implement in order for the products to be successfully deployed. We did not anticipate this when we signed on for the grant, and as such ran into some additional out of pocket expenses.

Cartegraph also performed some unanticipated additional work to avoid issues with the existing IT infrastructure. Cartegraph's next release seems to be more of a cloud hosted product, similar to that of many of their competitors which we believe will make the product much more user friendly and will help other communities to easily implement these types of applications if they so choose.

The third challenge we faced and overcame was the learning curve associated with extracting data out of both Cartegraph and SchoolDude. The data extraction methods turned out to be much simpler than we expected. As such, we did not need to use funds that we believed would be needed to probe the databases and then develop procedures for performing the data extraction.

The fourth challenge we faced and partially overcame was the learning curve associated with developing websites. There are many commercial tools available to build and maintain websites. These tools are generally designed for a user to manually maintain the content in the website which can be time consuming if there is a lot of content that changes on a regular basis. We anticipated that this would be the case and knew that we needed to automate the process rather than use one of the commercially available tools. This required us to quickly learn about the structure of HTML code and then to write some software to generate web pages and reports automatically, reducing the amount of staff time that would be needed to manually update the site on a regular basis. The Town is fortunate to have staff who are capable of writing software, something that many communities do not have, and as such we were able to overcome this hurdle through brute force, breaking down prototype HTML code into reusable building blocks and then writing software to extract data from various systems and using these reusable building blocks to generate many of the web pages that we felt would be helpful.

The biggest challenge the Town continues to face is the actual time that key employees put into both the grant activities as well as normal operational activities associated with getting a centralized maintenance organization off of the ground. The result of this time conflict has been that we did not meet the timetable that we anticipated in our original grant agreement. The website contains many placeholders which are waiting for content from senior managers. A piece of the Town's original grant application that was not funded was some engineering time

which would have helped develop some of this content. In addition, as we started working with the website, the type and amount of content that we thought might be interesting expanded rapidly. An example of such content is energy profiles and multi-year energy trends for each facility within the town. Energy costs are one of the Town's highest ongoing expenses and we would like to communicate this to our residents so they better understand the cost of operating buildings. This also ties into energy saving initiatives that we have undertaken as a Green Community and future energy saving projects we will be proposing to reduce our long term energy costs. We also would like to drill down into the details of building and equipment maintenance, showing the costs of outsourced services as we believe the ongoing costs support hiring tradesmen in the future to reduce some of these outsourced costs. The additional content development will take place over time as we continue to develop our organization and build out the website.

Critics may say that we failed to fully achieve our web development goals within the original timetable because we didn't hire a web designer to build our site. There is some validity to this statement, but our intention was always to utilize the funds that had been allocated for web design services to build a simple framework upon which we would hang our own content. In the end, we anticipated we would need the design services to get us to a starting point for our web development, but after careful examination and a little bit of research it wasn't as hard as we expected and the funds simply weren't needed.

To those who may be contemplating going down the same path that Hanover has faced with respect to be centralization of infrastructure and facility maintenance and are looking to implement comprehensive information systems to help facilitate their progress we offer the following advice:

- Have a clear plan for how you want your overall organization to be structured and how you want it to operate on a day to day basis prior to tackling centralized maintenance.
- Implement your organization first in a manual mode.
- Once your organization is up and running, incrementally improve your organization through the thoughtful use of information systems and technology.
- Don't be afraid to mix and match information systems to find the best applications to meet your needs. There are often simple ways to utilize and integrate the best features of multiple systems from multiple vendors. There are also many open standards that allow systems from various vendors to work together.

SECTION 6: OUTCOMES

In section 3 (Implementation Plan) of this document we discussed in depth some of the measures we have used to try to gauge the effectiveness of the items implemented by the grant. As we indicated in that discussion, the slipping of the timetable doesn't provide us with a long enough history to report any definitive trends. We have certainly demonstrated steady use of both major work order systems, Cartegraph Work Director and SchoolDude. We have achieved our goal of extracting data from both of these third party products and integrating it with data from our own financial systems into our fledgling web site.

The CIC grant certainly helped increase the use of Cartegraph Work Director within the Hanover DPW, ensuring there would be adequate licenses available for all users who need to use the program at all times. The grant allowed workstations to be kept open, allowing field personnel to jump on and off at will to log information and perform research on jobs. This would not likely have happened without the grant. The CIC grant also allowed us to explore the use of Cartegraph Mobile on Trimble field hardware. The Town plans to add more devices in FY 14 to expand the program to more crew members. This would not likely have happened without the CIC grant due to the initial investment.

The use of the Trimble field hardware and Cartegraph Mobile software has encouraged us to seek out other technology options for our field personnel. In the past year we have viewed demonstrations of various tablet based applications that look promising as replacements for many of the paper field inspection forms currently used. Tablets with hardened cases and Wi-Fi connections would be effective field workstations for SchoolDude and the enhancements that are expected in the upcoming release of Cartegraph.

Our goal is to make maintenance records and manuals available in the field to personnel who are performing inspections and repairs to building systems and other infrastructure. While we were open to this prior to the CIC grant, the success of the grant and the confidence that field personnel have gained over the past year increase the likelihood that investment in these technologies will have positive returns.

Finally, we utilized a variety of technologies to open up additional opportunities for residents and clients to interact with us. We have established a web presence, something we did not have when we applied for our CIC grant. We have established a website, and while it wasn't part of the grant we have begun to utilize social media such as Twitter and Facebook as a means of communicating with our residents and clients. We have achieved our goal of providing interesting information for our residents to consider through our website, although we admit there is much more work to be done. The YourGov web and YourGov smart phone applications are yet another avenue of communication now open to residents. How effective we are in responding to requests from these new technologies remains to be seen and will depend on the volume and nature of the requests. We expect an initial wave of requests as residents discover the tools after which they will become just another means of communicating their concerns to us. The CIC grant is a positive starting point for our long-term goal of developing a healthy two-way dialogue with our residents on the operation, maintenance, and future investment in their facilities and infrastructure. We look forward to seeing how the jump start provide by the CIC grant incubates over time and will use our website to communicate the ongoing lessons we have learned from this experience.

CONTACT INFORMATION

The Town of Hanover actively participates in regional trade associations. We encourage parties who are interested in our experiences to contact us.

Town of Hanover
Department of Public Works
781-826-3189
Hanover Department of Public Works

Questions regarding the Town's consolidation efforts or this grant may be addressed to:

Victor J. Diniak,
Director of Public Works
vdiniak@hanoverdpw.org
781-826-3189

Specific questions regarding the Town's consolidation efforts may also be addressed to:

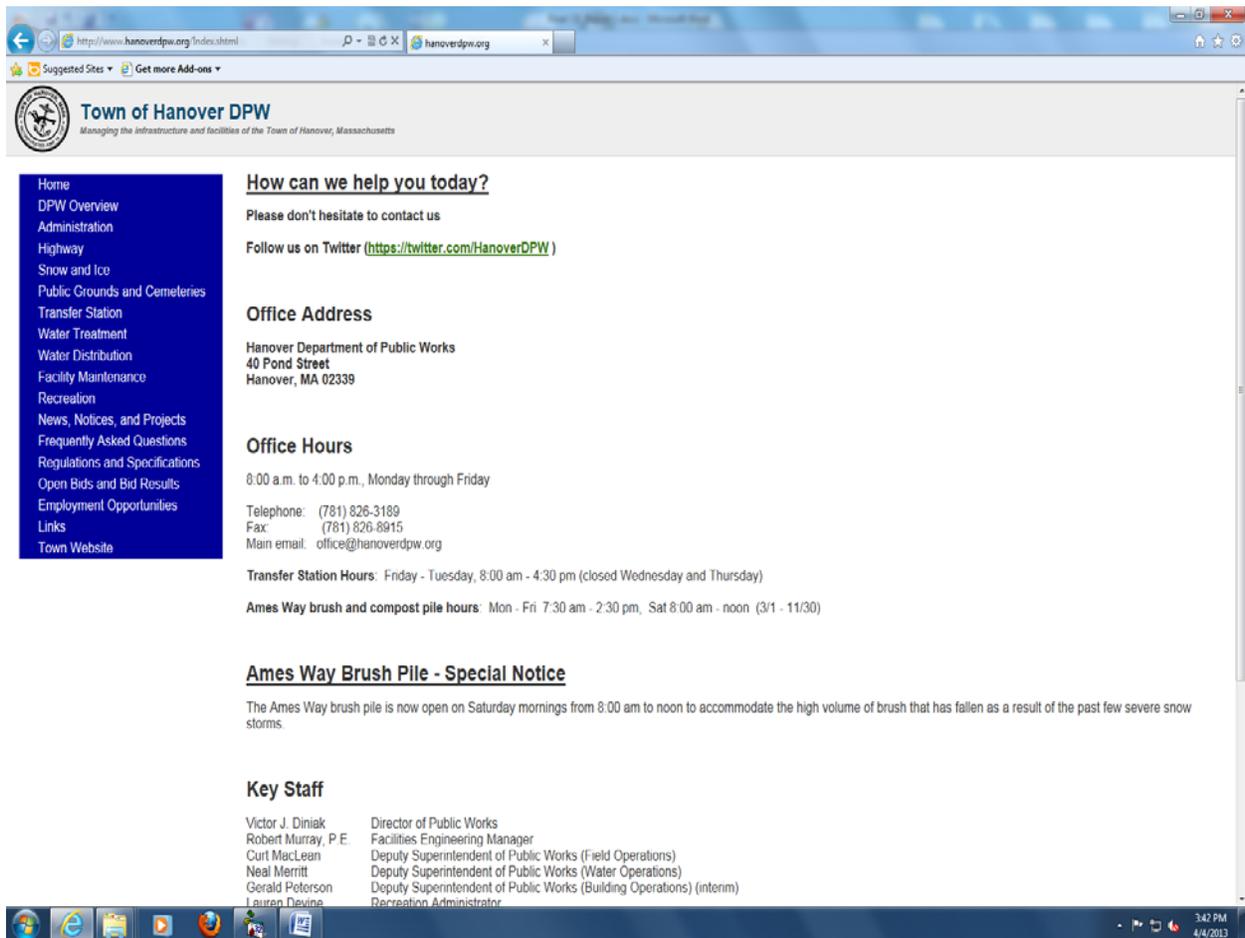
Robert Murray, P.E.,
Facilities Engineering Manager
robert.murray@hanover-ma.gov
781-826-3189

APPENDIX

The pages below show a sample of some of the web pages designed through this grant. These pages are provided to give the reader a flavor of some of the types of information that are being made available to interested parties. The website is a work in progress. Additional information will be added as it is developed. The full website is available for exploration at [Hanover Dept. Public Works](http://www.hanoverdpw.org).

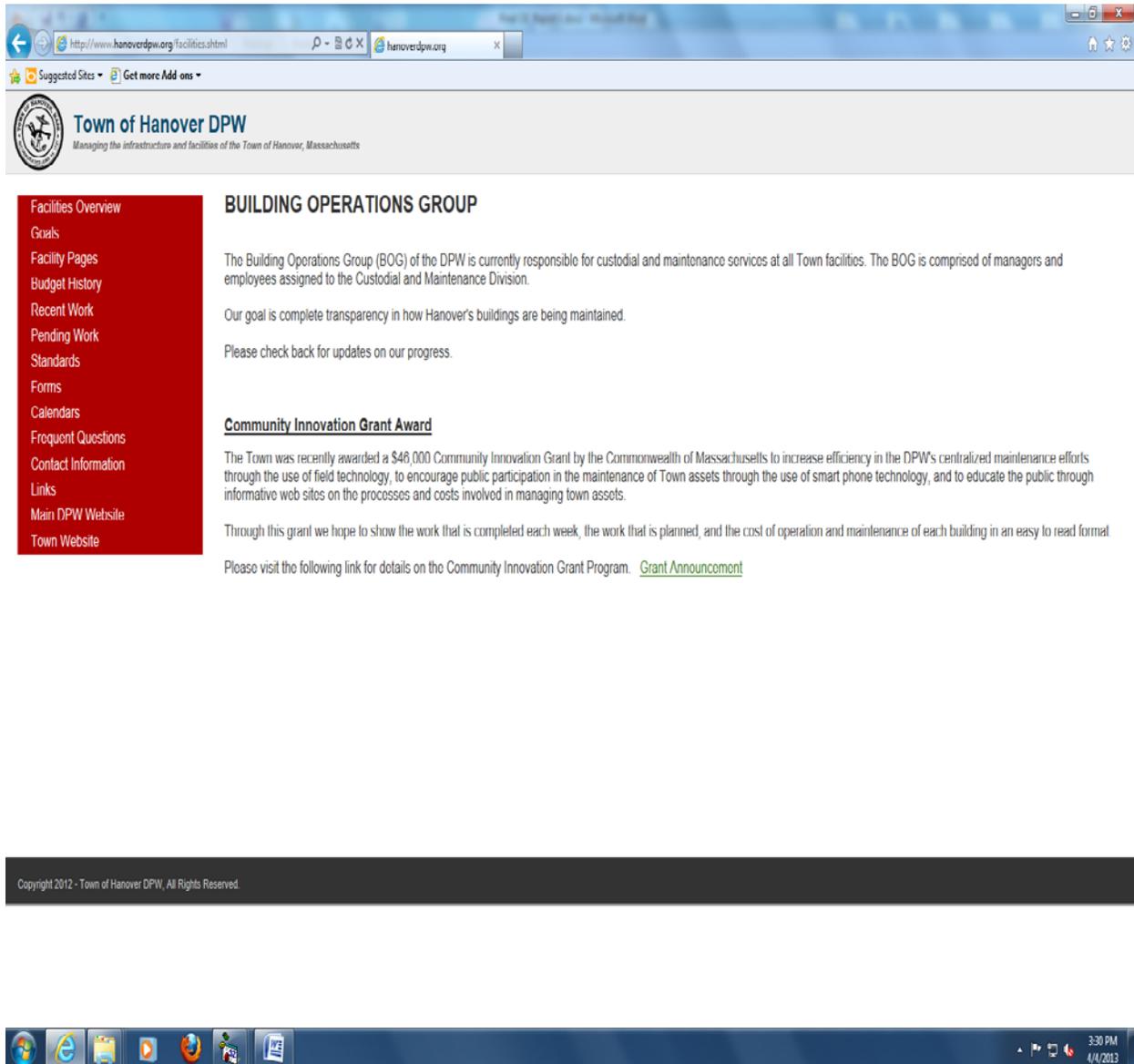
Below the web pages is a sampling of some of the concept pages that were the starting point for the web development work.

Photo 5: Screen shot of the new Hanover DPW webpage



Main Hanover DPW Website ([Hanover DPW](http://www.hanoverdpw.org))
User selects “Facility Maintenance” for the facility maintenance screens

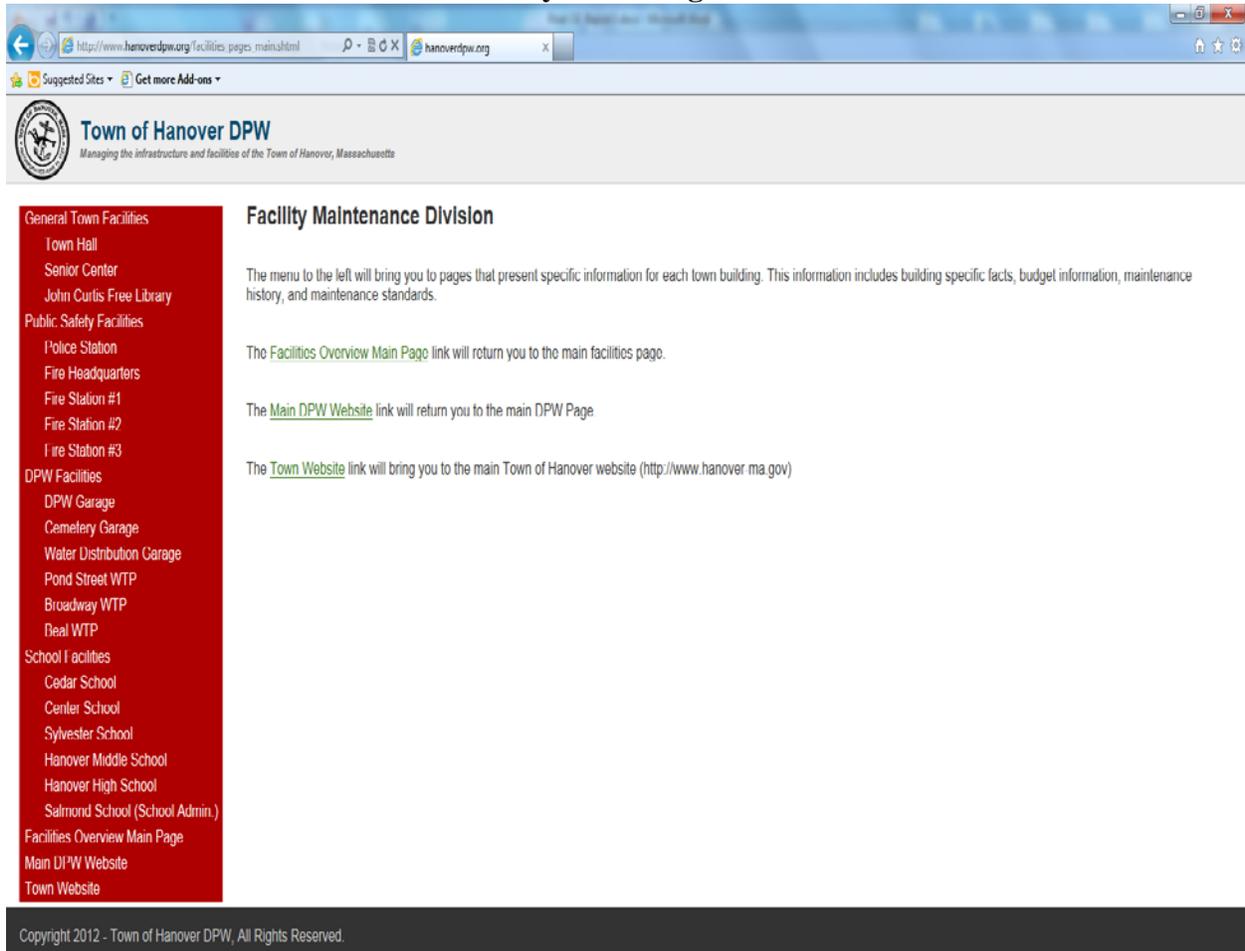
Photo 6: Portal into Hanover DPW Website facility pages



Portal into the Hanover DPW Website Facility Pages
([Hanover DPW Facilities](#))

User selects the “Facility Pages” menu option to bring up an index page showing the various facilities. This index is shown below and is the gateway to building specific pages. All of the other menu options are intended to display information about the organization as a whole.

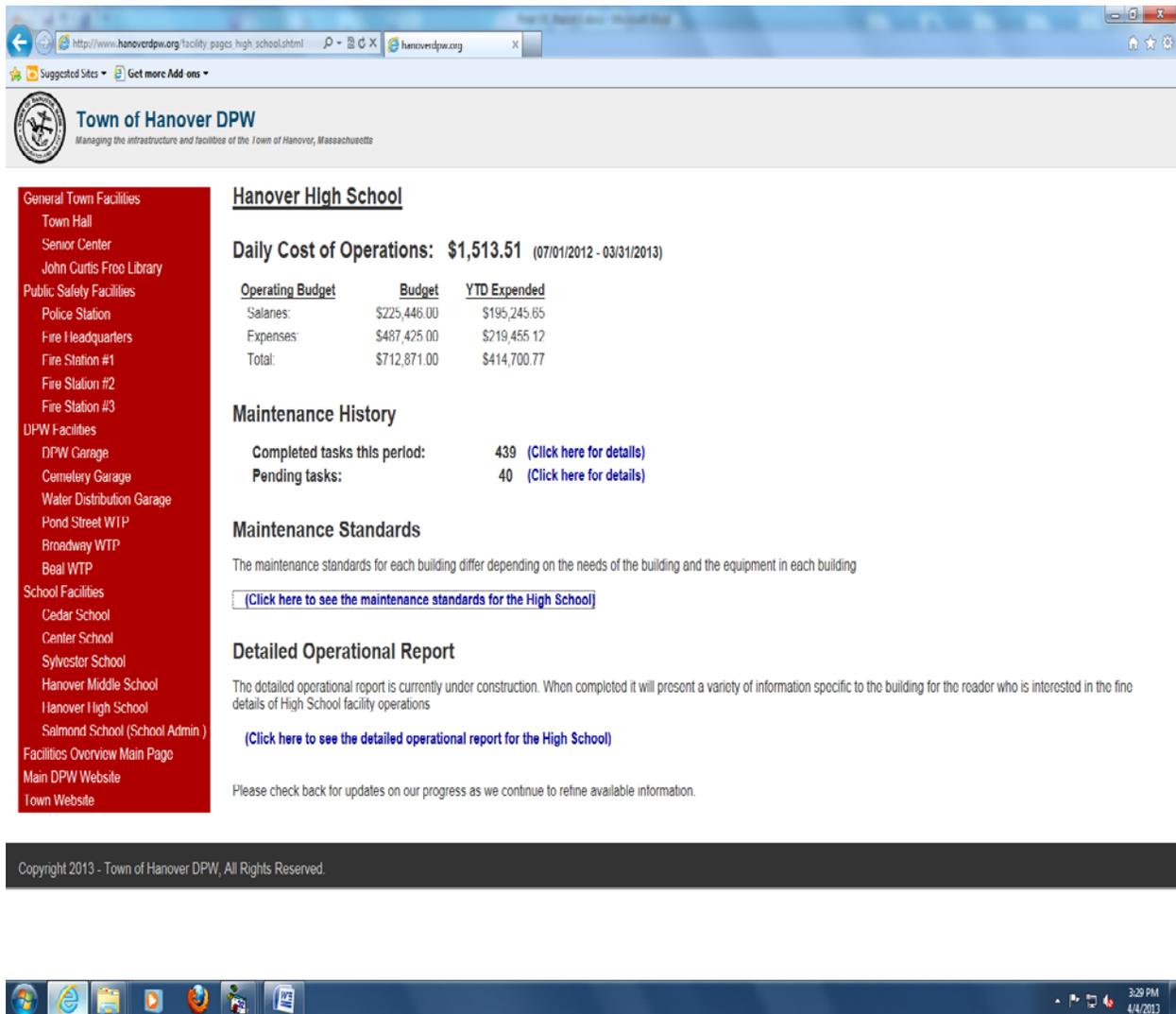
Photo 7: Hanover DPW website- Facility Index Page



Hanover DPW Website - Facility Index Page
([Hanover DPW Facilities_Main Pages](#))

The menu offers links to each facility. Clicking on a link brings up a specific facility page. The facility page for Hanover High School is shown below

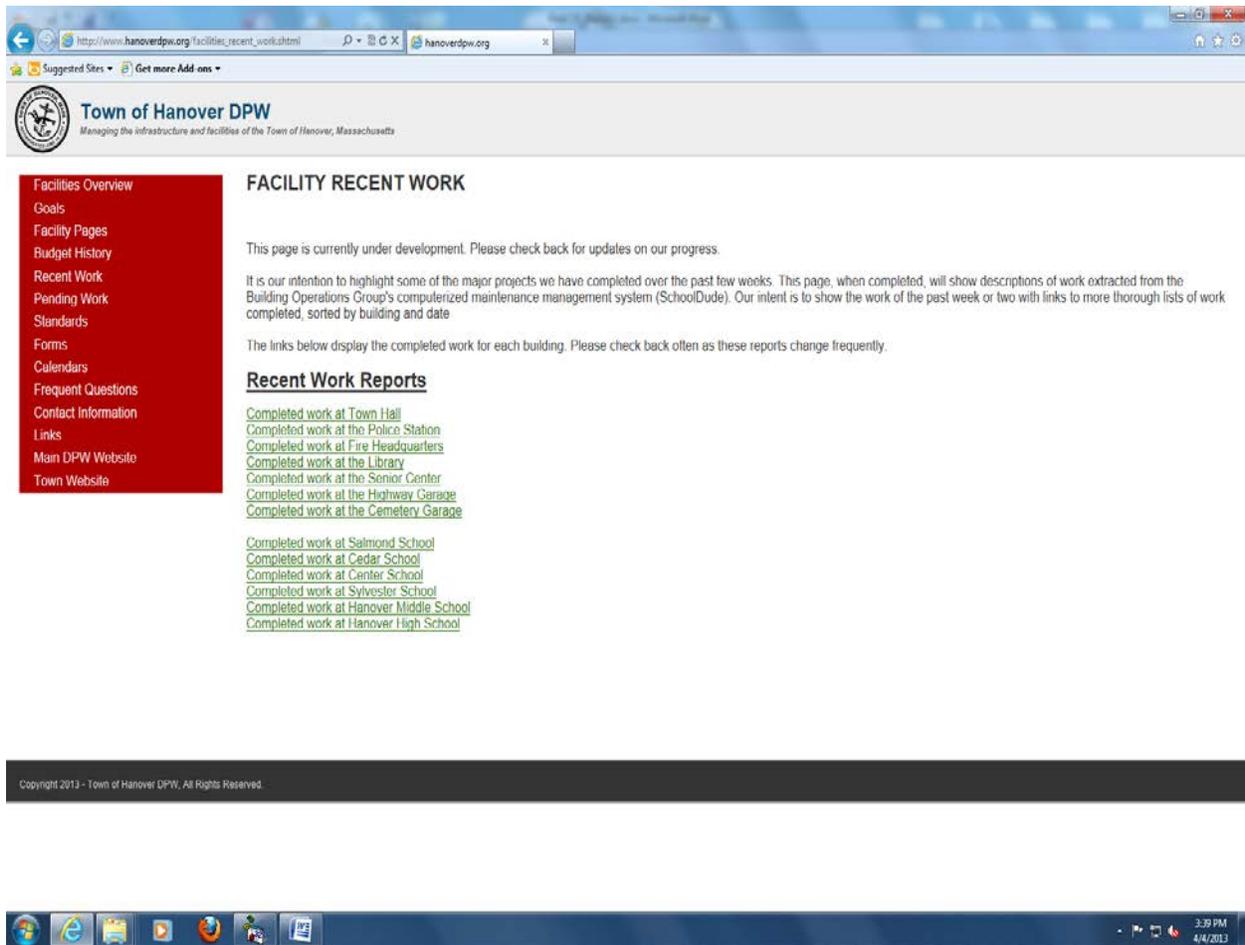
Photo 8: facility page for Hanover High School



Hanover DPW Website – Hanover High School facility page
 (Hanover DPW Facilities High School)

This is a typical facility page. The page is intended to give general information about a facility. Each facility currently has a page. The page shows the budget for the facility as well as the year to date expenditures for the date range selected when the page was generated by DPW staff. There are links on the page for maintenance reports showing completed tasks and pending tasks for the date range. The maintenance standards are a work in progress. The detailed operation report is a future link into detailed information about the facility for the reader who wants to go beyond the high level snapshot of this page.

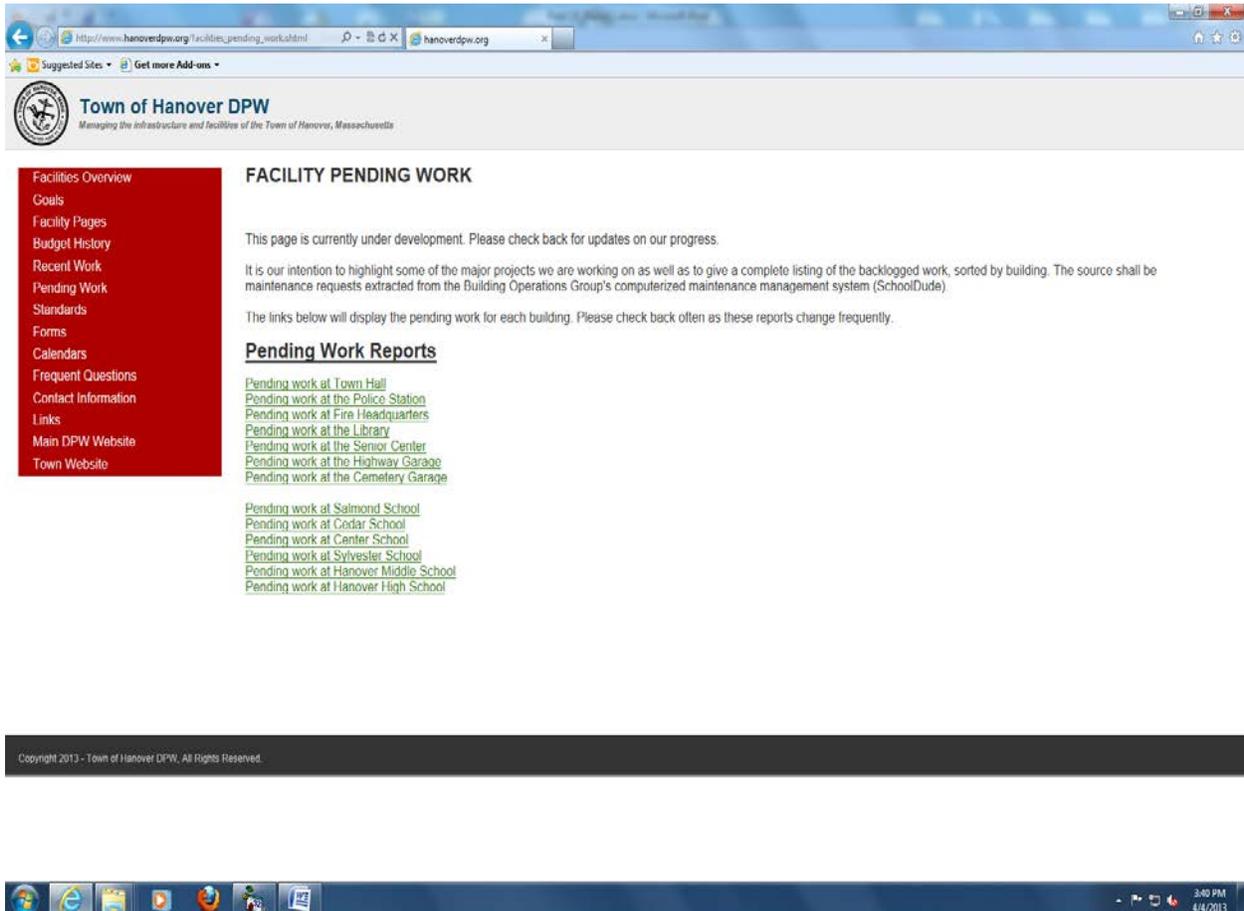
Photo 9: sample of facility page listing completed tasks, pending tasks, and maintenance reports



Hanover DPW Website – Recent Work Page
(Hanover DPW Facilities Recent work)

This page contains links to reports showing the work orders completed for each of the facilities. The work order information is extracted from the SchoolDude system. A typical page from a recent work report is shown below.

Photo 10: Sample containing links to reports showing completed work orders for each DPW facility



**Hanover DPW Website – Pending Work Page
(Hanover DPW Facilities Pending work)**

This page contains links to reports showing the work orders that are pending for each of the facilities. The work order information is extracted from the SchoolDude system. A typical page from a pending work report is shown below.