2011 State Damage Prevention Program Grants Final Report
Funding Opportunity Number: DTPH56-11-SN-0001
CFDA Number: 20.720

Award Number: DTPH56-11-G-PHPS17
Project Title: Virginia Utility Protection Service State Damage Prevention
Date Submitted: April 24, 2012
Submitted by: *Richard Pevarski, President & CEO, Virginia Utility Protection Service, Inc.*

Specific Objective(s) of the Agreement

Under this grant agreement, VUPS will:

- Foster and promote the use of Improving Technologies

Workscope

Under the terms of this grant agreement, the Grantee will address the following elements listed in 49 USC §60134 through the actions it has specified in its Application.

- Element (8): A process for fostering and promoting the use, by all appropriate stakeholders, of improving technologies that may enhance communications, underground pipeline locating capability, and gathering and analyzing information about the accuracy and effectiveness of locating programs.

Accomplishments for the grant period (Item 1 under Agreement Article IX, Section 9.02 Final Report: "A comparison of actual accomplishments to the objectives established for the period.")

See attached report

Quantifiable Metrics/Measures of Effectiveness (Item 2 under Article IX, Section 9.01 Project Report: "Where the output of the project can be quantified, a computation of the cost per unit of output.")

See attached report

Issues, Problems or Challenges (Item 3 under Article IX, Section 9.01 Project Report: "The reasons for slippage if established objectives were not met. ")

See attached report

Final Financial Status Report

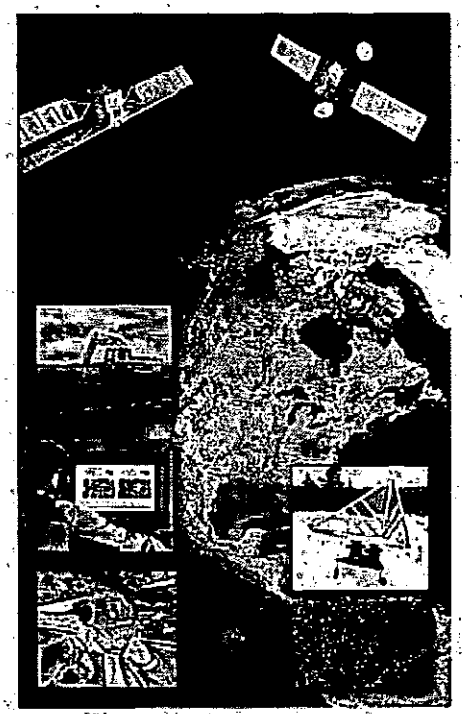
The final financial report has been sent as a separate attachment to the AA

Requests of the AOTR and/or PHMSA
No actions requested at this time

VISITLESS INTEGRITY ASSESSMENT LIMITED

ENHANCED MANAGEMENT SERVICE
FOR VIRGINIA UTILITY PROTECTION SERVICE, INC
ROANOKE, VIRGINIA

Final Summary Report
March 2012



Prepared for:

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C-CORE
Smart Solutions for Challenging Environments

Enhanced Management Service – Final Summary Report

Report
R-12-033-894

Prepared for:
Visitless Integrity Assessment Ltd. (via+)

Revision 1.0
March, 2012

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Enhanced Management Service – Final Summary Report

Prepared for:

Visitless Integrity Assessment Ltd. (via+)

Prepared by:

C-CORE

C-CORE Report Number:

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C-CORE. (2012). *Enhanced Management Service – Final Summary Report*, C-CORE Report R-12-033-894, Revision 1.0.

Project Team

Sherry Warren (Project Manager)
Megan Healey
Michael Lynch
Mark Howell
Rob Briggs

REVISION HISTORY

VERSION	SVN	NAME	COMPANY	DATE OF CHANGES	COMMENTS
1.0	61	Sherry Warren Megan Healey	C-CORE	03/19/12	Submitted to Client

DISTRIBUTION LIST

COMPANY	NAME	NUMBER OF COPIES
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1 INTRODUCTION

via+ and C-CORE have developed a satellite-based pipeline Right of Way (RoW) monitoring service called Enhanced Management Service (EMS) that has been deployed since June 2008. The service capability was developed within the Pipeline Research Council International (PRCI) technology development process in parallel with individual pipeline company funding of pilot studies and other advances. EMS offers a step-change improvement toward the pipeline industry's need for proactive prevention of third-party damage. Satellite monitoring offers many unique advantages to the industry in meeting the objectives of managing mechanical damage. Some of these advantages include:

- Identification of mechanical damage threats;
- Large monitoring area footprints (as much as 50 km by 50 km) allowing surveillance of the rights-of-way of multiple operators and cost sharing of these services;
- Cost of service is independent of location – very cost effective for remote areas;
- Weather-independent monitoring through radar imagery and analysis; and
- No need for installations on the pipeline infrastructure.

Along with using a satellite-based (Synthetic Aperture Radar (SAR) service to detect third-party encroachment incidents that could potentially rupture a buried pipeline, this project attempts to assess the feasibility of merging the traditional "one-call" service, such as Virginia Utility Protection Service (VUPS) with EMS. This will further provide validation of targets and offer complimentary benefits in detecting third-party encroachment activity. VUPS or Miss Utility is a free "one-call" communications center that contractors, property owners or those planning any kind of excavation can call before they dig, in order to prevent possible damage to underground utility lines, injury, property damage and service outages.[1]

[1] See http://va811.com/

2 STUDY AREA AND DATA

The study area for the project was a series of member pipeline RoWs in Virginia, USA near Washington, DC. EMS is a Near-Real-Time (NRT) (i.e., within three to four hours depending upon acquisition time) encroachment management service using RADARSAT-1, one of Canada's radar satellites, which collects imagery approximately twice a week over the area of interest. Figure 1 represents the satellite coverage provided by the RADARSAT-1 Fine Beam images. The nominal spatial resolution of RADARSAT-1 Fine Beam images is eight meters with a coverage area of 50 kilometers squared.

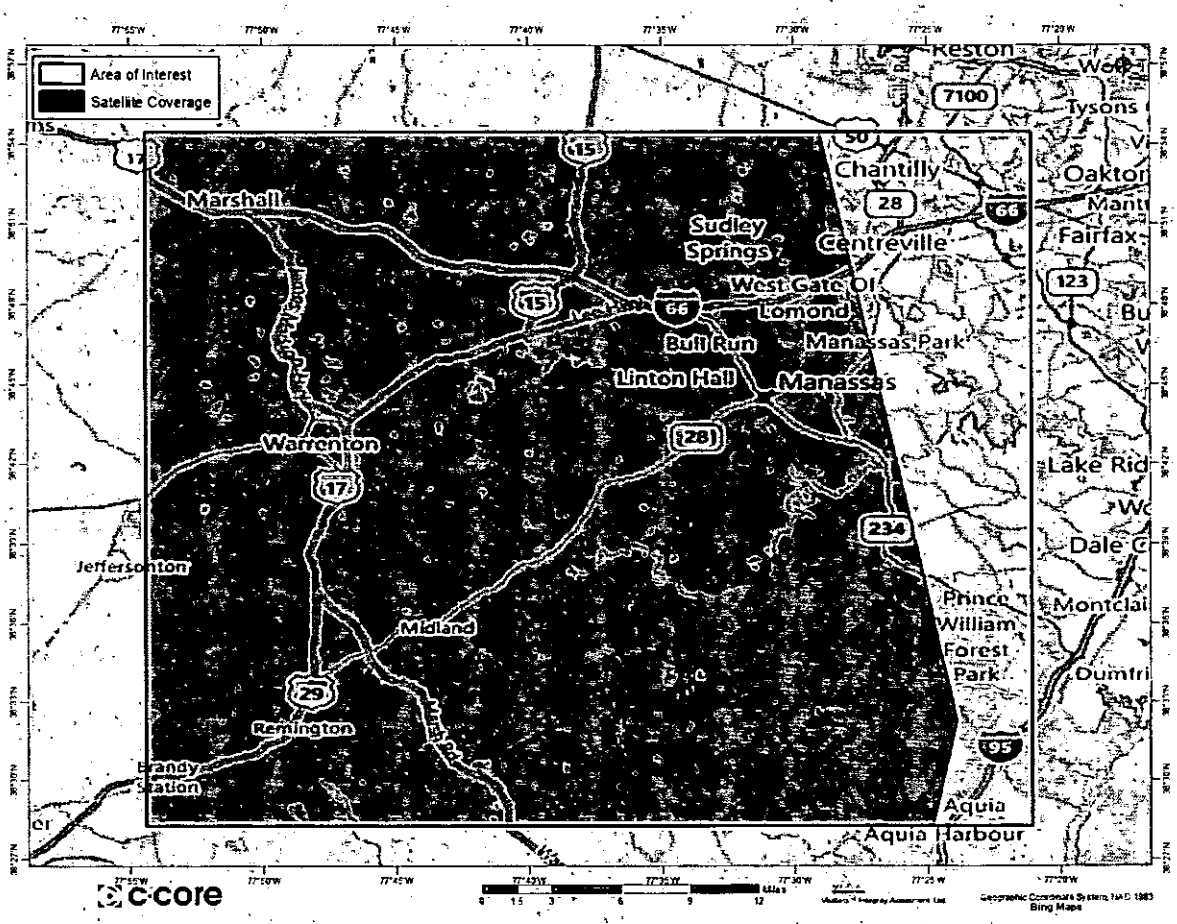


Figure 1. Area of interest coverage for RADARSAT-1 Fine Beam images in Virginia, USA.

Table 1 presents a list of all the RADARSAT-1 imagery that was collected during the project. Images on October 18, November 04, 2011 and February 3, 2012 were lost due to reception problems between the satellite and ground receiving station. Satellite imagery was acquired from the beginning of September 2011 until the end of February 2012.

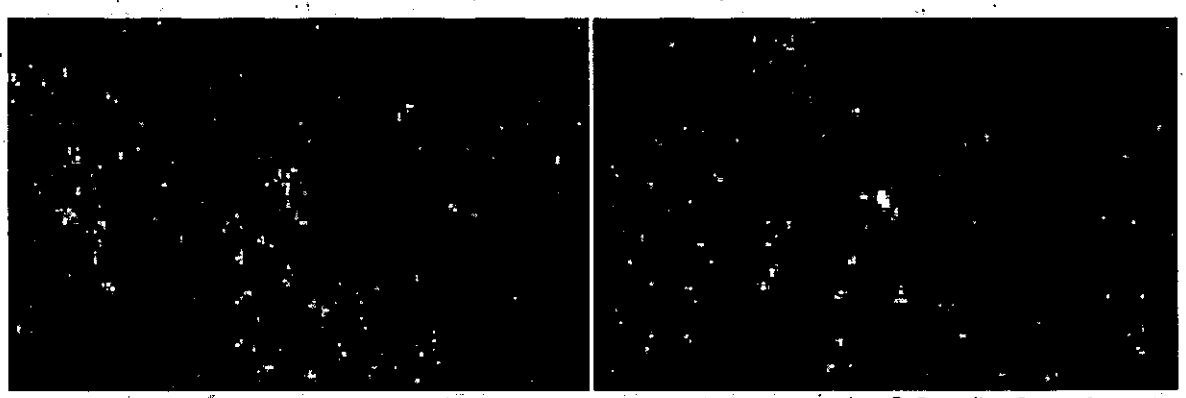
Table 1. RADARSAT-1 acquisitions for project duration

Date	Time	Beam Mode	Orbit	Status
10-Sep-2011	11:15:18	F1	Descending	Processed
12-Sep-2011	23:13:41	F3F	Ascending	Processed
17-Sep-2011	11:11:08	F2F	Descending	Processed
19-Sep-2011	23:09:31	F1F	Ascending	Processed
24-Sep-2011	11:06:58	F5N	Descending	Processed
29-Sep-2011	23:17:52	F5F	Ascending	Processed
4-Oct-2011	11:15:18	F1N	Descending	Processed
6-Oct-2011	23:13:41	F3F	Ascending	Processed
11-Oct-2011	11:11:08	F2F	Descending	Processed
13-Oct-2011	23:09:31	F1F	Ascending	Processed
18-Oct-2011	11:06:58	F5N	Descending	**Cancelled**
23-Oct-2011	23:17:52	F5F	Ascending	Processed
28-Oct-2011	11:15:18	F1N	Descending	Processed
30-Oct-2011	23:13:41	F3F	Ascending	Processed
4-Nov-2011	11:11:08	F2F	Descending	**Cancelled**
6-Nov-2011	23:09:31	F1F	Ascending	Processed
11-Nov-2011	11:06:58	F5N	Descending	Processed
16-Nov-2011	23:17:52	F5F	Ascending	Processed
21-Nov-2011	11:15:18	F1N	Descending	Processed
23-Nov-2011	23:13:41	F3F	Ascending	Processed
28-Nov-2011	11:11:08	F2F	Descending	Processed
30-Nov-2011	23:09:31	F1F	Ascending	Processed
5-Dec-2011	11:06:58	F5N	Descending	Processed
10-Dec-2011	23:17:52	F5F	Ascending	Processed
15-Dec-2011	11:15:18	F1N	Descending	Processed
17-Dec-2011	23:13:41	F3F	Ascending	Processed
22-Dec-2011	11:11:08	F2F	Descending	Processed
24-Dec-2011	23:09:31	F1F	Ascending	Processed
29-Dec-2011	11:06:58	F5N	Descending	Processed
3-Jan-2012	23:17:52	F5F	Ascending	Processed
8-Jan-2012	11:15:18	F1N	Descending	Processed
10-Jan-2012	23:13:41	F3F	Ascending	Processed

Date	Time	Beam Mode	Orbit	Status
15-Jan-2012	11:11:08	F2F	Descending	Processed
17-Jan-2012	23:09:31	F1F	Ascending	Processed
22-Jan-2012	11:06:58	F5N	Descending	Processed
27-Jan-2012	23:17:52	F5F	Ascending	Processed
1-Feb-2012	11:15:18	F1N	Descending	Processed
3-Feb-2012	23:13:41	F3F	Ascending	**Cancelled**
8-Feb-2012	11:11:08	F2F	Descending	Processed
10-Feb-2012	23:09:31	F1F	Ascending	Processed
15-Feb-2012	11:06:58	F5N	Descending	Processed
20-Feb-2012	23:17:52	F5F	Ascending	Processed
25-Feb-2012	11:15:18	F1N	Descending	Processed
27-Feb-2012	23:13:41	F3F	Ascending	Processed

3 METHOD

The main software used during the EMS process is called the Geographic Change Detector (GCD). Following the initial project kick-off, the necessary software and product adjustments were made. Targets are identified in the RADARSAT-1 images using a change detection method within the GCD automated software. An example of a detected target is represented in Figure 2.



© Canadian Space Agency

Figure 2. Sample target detection using RADARSAT-1 from September 12 (left) to September 17 (right) image pair. (1 pixel equals 6.25 meters)

Potential encroachment targets found within the member pipeline RoWs, as shown in Figure 3 were converted to vector shape files, as per client requirements. These shape files were quality checked to ensure that they properly aligned with the client's GIS layers and then delivered in NRT. EMS vector shape files were generated at a frequency of approximately two per week and delivered to VUPS personnel for review. Member RoW polygons were also updated on an ongoing basis using information supplied by VUPS.

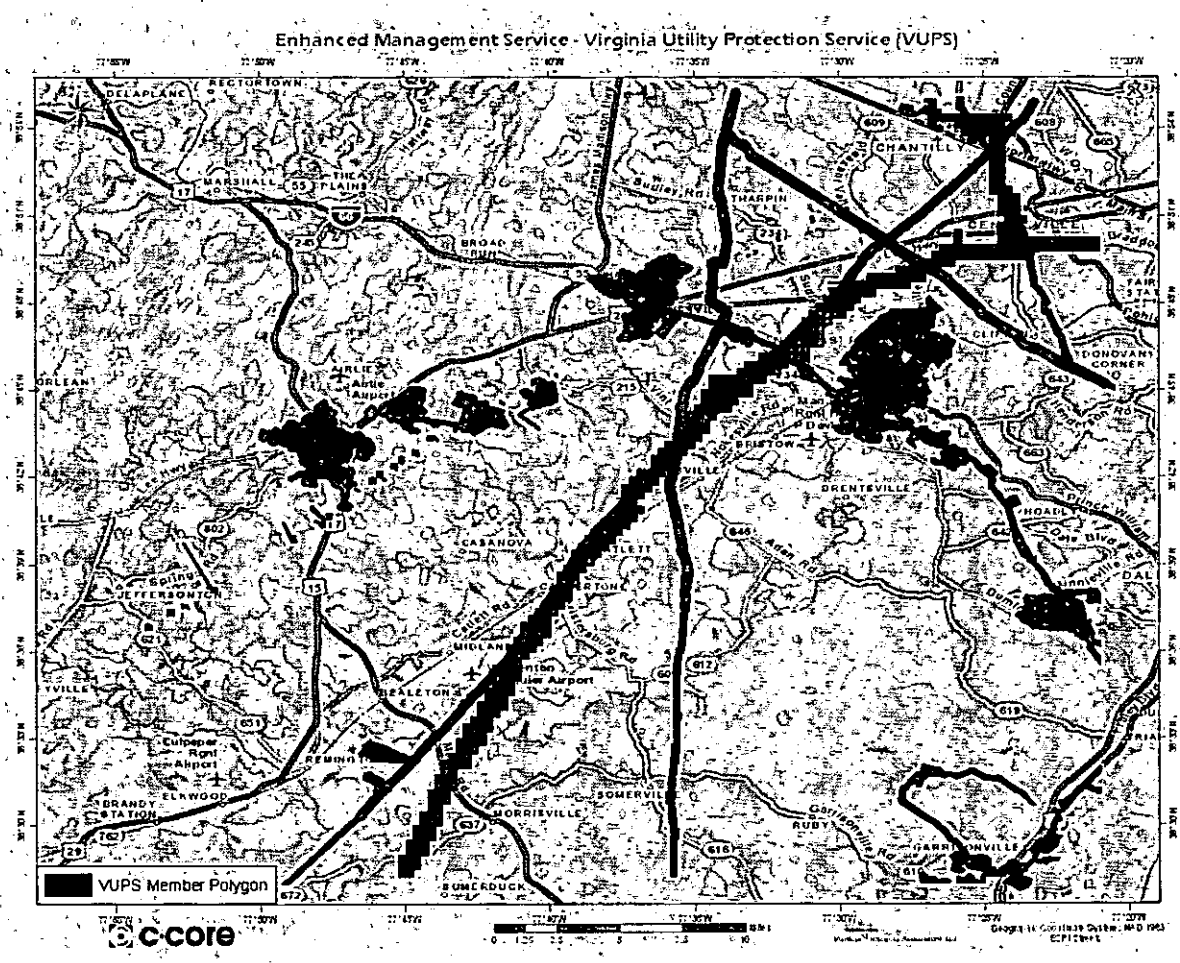


Figure 3. VUPS Member Polygon RoWs

4 TARGET SUMMARY

The following presents a summary of potential targets identified during the project. The EMS service began on September 10, 2011 and continued until February 27, 2012 with a total of 89 targets identified in the 40 image pairs analyzed. Table 2 presents the number of target detections for each image pair, and Table 3 indicates monthly and cumulative totals.

Table 2. Image pairs analyzed with number of target detections.

Image Pair		Target Detections
10-Sep-11	12-Sep-11	0
12-Sep-11	17-Sep-11	7
17-Sep-11	19-Sep-11	6
19-Sep-11	24-Sep-11	3
24-Sep-11	29-Sep-11	0
29-Sep-11	04-Oct-11	2
04-Oct-11	06-Oct-11	0
06-Oct-11	11-Oct-11	0
11-Oct-11	13-Oct-11	11
13-Oct-11	23-Oct-11	2
23-Oct-11	28-Oct-11	4
28-Oct-11	30-Oct-11	3
30-Oct-11	06-Nov-11	8
06-Nov-11	11-Nov-11	2
11-Nov-11	16-Nov-11	2
16-Nov-11	21-Nov-11	2
21-Nov-11	23-Nov-11	0
23-Nov-11	28-Nov-11	1
28-Nov-11	30-Nov-11	2
30-Nov-11	05-Dec-11	2
05-Dec-11	10-Dec-11	0
10-Dec-11	15-Dec-11	0
15-Dec-11	17-Dec-11	0
17-Dec-11	22-Dec-11	1
22-Dec-11	24-Dec-11	6
24-Dec-11	29-Dec-11	3

Image Pair		Target Detections
29-Dec-11	03-Jan-12	0
03-Jan-12	08-Jan-12	2
08-Jan-12	10-Jan-12	4
10-Jan-12	15-Jan-12	2
15-Jan-12	17-Jan-12	4
17-Jan-12	22-Jan-12	1
22-Jan-12	27-Jan-12	0
27-Jan-12	01-Feb-12	0
01-Feb-12	08-Feb-12	0
08-Feb-12	10-Feb-12	4
10-Feb-12	15-Feb-12	2
15-Feb-12	20-Feb-12	2
20-Feb-12	25-Feb-12	1
25-Feb-12	27-Feb-12	0

Table 3. Image pairs analyzed per month with total number of detections and cumulative summary

Month	Pairs Analyzed	Total Detections
September	5	16
October	7	22
November	7	17
December	7	12
January	7	13
February	7	9
Cumulative	**40**	**89**

The total number of targets detected during the project by month is represented in Figure 4. An assessment of the targets indicated that the area near Warrenton, Virginia showed the highest density of targets over the six month duration, as illustrated in Figure 5. However, verification of the targets was not obtained.

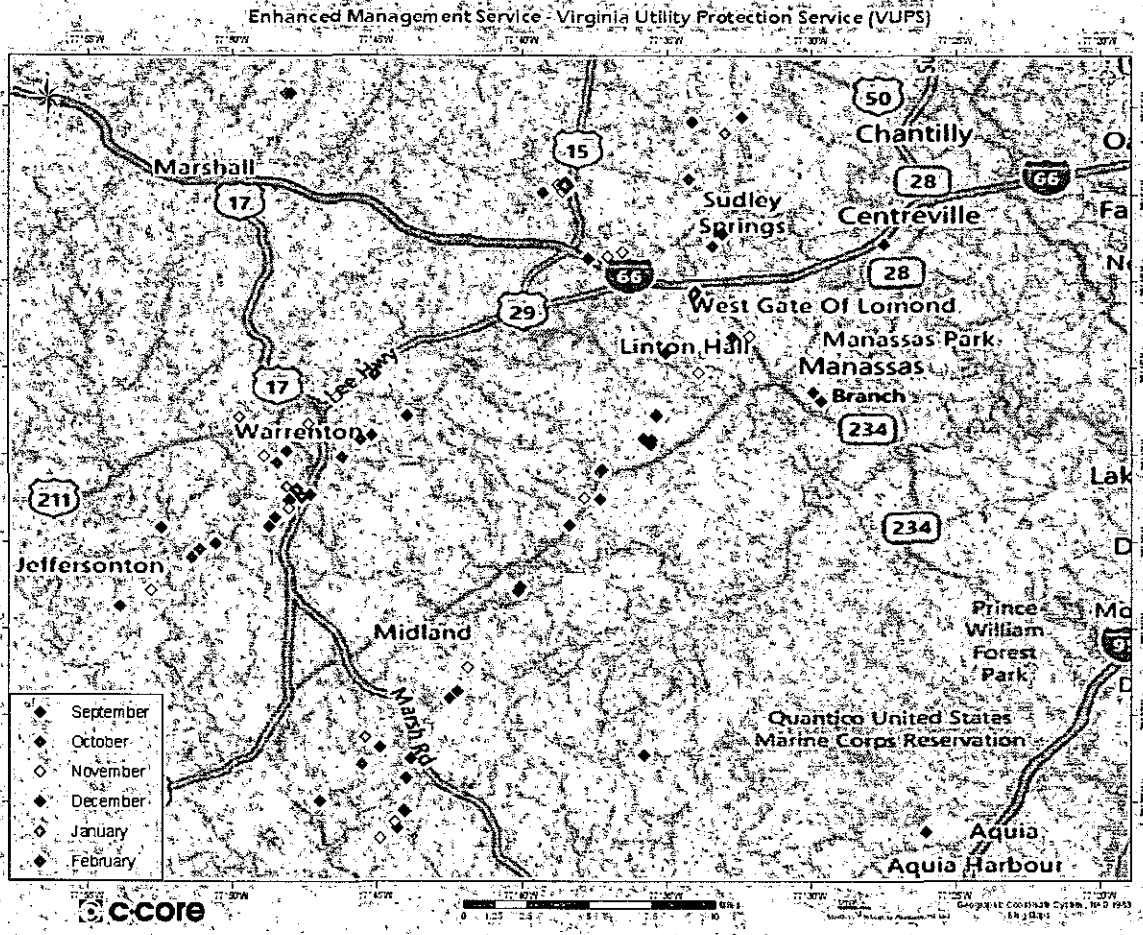


Figure 4. The total number of targets detected during the project by month.

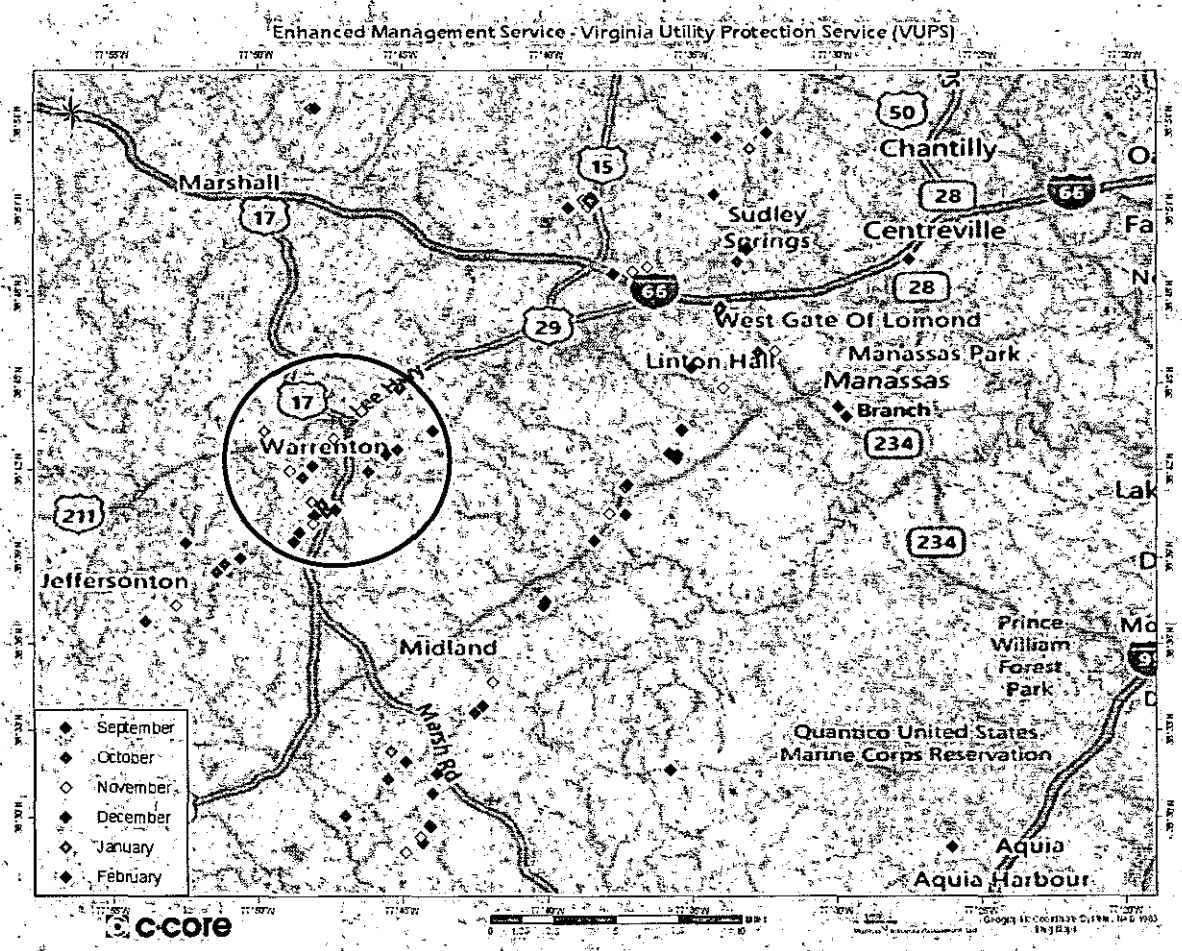


Figure 5. Area (circled) showing a high density of targets near Warrenton, Virginia.

5 CONCLUSIONS

The EMS service was conducted in this Virginia study area for a period of six-months from the beginning of September until the end of February 2012. There have been several instances of possible encroachment targets found in the study area during this time. In an attempt to obtain further validation of these encroachment targets, client feedback on the potential matching with valid "One-Call tickets" would be quite valuable to this service.

LAST PAGE OF DOCUMENT