THE SITE SELECTION ANALYSIS FOR CCTV INSTALLATION IN SRIRACHA MUNICIPALITY CHONBURI PROVINCE

SUPAJIRA KAEWKOMUT

A THESIS SUBMITTED IN PARTIAL FULFILLMENT
OF THE REQUIREMENTS FOR
THE DEGREE OF MASTER SCIENCE
(TECHNOLOGY OF INFORMATION SYSTEM MANAGEMENT)
FACULTY OF GRADUATE STUDIES
MAHIDOL UNIVERSITY
2015

Thesis
entitled

THE SITE SELECTION ANALYSIS FOR CCTV INSTALLATION IN SRIRACHA MUNICIPALITY CHONBURI PROVINCE

……
Miss Supajira Kaewkomut
Candidate

……
Lect. Wutjanun Muttitanon,
D.Tech.Sc. (Remote Sensing and GIS)
Major advisor

……
Asst. Prof. Areeya Rittima,
D.Eng. (Irrigation Engineering)
Co-advisor

……
Lect. Kritsanat Surakit,
D.Eng. (Water Resources Engineering)
Co-advisor

……..
Prof. Patcharee Lertrit,
M.D., Ph.D. (Biochemistry)
Dean
Faculty of Graduate Studies
Mahidol University

……
Asst. Prof. Supaporn Kiattisin,
Ph.D. (Electrical and Computer Engineering)
Program Director
Master of Science Program in Technology of Information System Management
Faculty of Engineering
Mahidol University

Thesis
entitled

THE SITE SELECTION ANALYSIS FOR CCTV INSTALLATION IN SRIRACHA MUNICIPALITY CHONBURI PROVINCE

was submitted to the Faculty of Graduate Studies, Mahidol University
for the degree of Master of Science (Technology of Information System Management)
on
May 1, 2015

……..……
Miss Supajira Kaewkomut
Candidate

……...
Asst. Prof. Supaporn Kiattisin,
Ph.D. (Electrical and Computer Engineering)
Chair

……
Lect. Wutjanun Muttitanon,
D.Tech.Sc. (Remote Sensing and GIS)
Member

……...
Asst. Prof. Areeya Rittima,
D.Eng. (Irrigation Engineering)
Member

……
Lect. Kritsanat Surakit,
D.Eng. (Water Resources Engineering)
Member

……...
Assoc.Prof.Panjai Tantasanawong
Ph.D. (Computer Science)
Member

……
Prof. Patcharee Lertrit,
M.D., Ph.D. (Biochemistry)
Dean
Faculty of Graduate Studies,
Mahidol University

……...
Lect. Worawit Israngkul,
M.S. (Technical Management)
Dean
Faculty of Engineering,
Mahidol University

ACKNOWLEDGEMENTS

I would like to express my sincere thanks to my thesis advisor team, Dr.Wutjanun Muttitanon , Asst. Prof. Dr. Areeya Rittima and Dr.Kritsanat Surakit for invaluable help, support and constant encouragement throughout the course of this research.

I am very grateful to Chonburi Provincial Administrative Organization, Sriracha Policestation and Samart Communication Service Co.,Ltd. for their helps in providing facilities and materials for my research. And also the special thanks for all of staffs and lecturers of Technology of Information System Management Program for support facilities and material.

Finally, I most gratefully acknowledge my parents, my friends and my co-workers for all their support throughout the period of this research.

Supajira Kaewkomut

THE SITE SELECTION ANALYSIS FOR CCTV INSTALLATION
IN SRIRACHA MUNICIPALITY CHONBURI PROVINCE

SUPAJIRA KAEWKOMUT 5336463 EGTI/M

M.Sc. (TECHNOLOGY OF INFORMATION SYSTEM MANAGEMENT)

THESIS ADVISORY COMMITTEE : WUTJANUN MUTTITANON, D.Tech.Sc., AREEYA RITTIMA, D.Eng., KRITSANAT SURAKIT, D.Eng.

ABSTRACT

Closed circuit television cameras (CCTV) are used as an essential tools security system. This equipment is used to record images of events and display data in Real-Time for the benefit of police officials in regards to traffic planning, and monitoring criminal behavior and their escape routes. A number of barriers are currently encountered in the use of this equipment, e.g. unsuitable installation sites with obstacles obstructing images and insufficient number CCTVs for certain areas.

This study was performed analyze and locate suitable areas for CCTV installation in the Sriracha Municipality, Chonburi Province. Using A GIS program, an application regarding geographical information technology system that uses site data from the area concerning the incident rate of accidents in the study area, was used to analyzed the data. This analysis was performed with the aim to find the risk areas which ware the key factors in considering the specification of suitable CCTV installation sites. The findings obtained will be able to help support the decision-making process in selecting the right CCTV installation sites in the province of Chonburi.

KEY WORDS: GIS / RISK ANALYSIS / SITE SELECTION

80 pages

การวิเคราะห์หาพื้นที่เหมาะสมสำหรับการติดตั้งกล้องโทรทัศน์วงจรปิดในเทศบาลเมืองศรีราชา จังหวัดชลบุรี

THE SITE SELECTION ANALYSIS FOR CCTV INSTALLATION IN SRIRACHA MUNICIPALITY CHONBURI PROVINCE

ศุภจิรา แก้วโกมุท 5336463 EGTI / M

วท.ม. (เทคโนโลยีการจัดการระบบสารสนเทศ)

คณะกรรมการที่ปรึกษาวิทยานิพนธ์ : วัจนันท์ มัตติทานนท์, D.Tech.Sc., อารียา ฤทธิมา, D.Eng., กฤษณัส สุรกิตย์, D.Eng.

บทคัดย่อ

ปัจจุบันกล้องโทรทัศน์วงจรปิด (CCTV) เป็นอุปกรณ์ที่มีความสำคัญมากในระบบรักษาความปลอดภัย โดยนำมาใช้บันทึกภาพเหตุการณ์และแสดงข้อมูลแบบ Real Time เพื่อเป็นประโยชน์กับเจ้าหน้าที่ตำรวจในการใช้วางแผนงานจราจร และเฝ้าดูติดตามพฤติการณ์และการใช้เส้นทางหลบหนีของผู้กระทำผิด โดยในปัจจุบันพบว่ามีอุปสรรคต่อการใช้งานอยู่หลายประการ เช่น จุดติดตั้งไม่เหมาะสมมีสิ่งกีดขวางมุมภาพ, จำนวนกล้อง CCTV ไม่เพียงพอกับพื้นที่

การศึกษาครั้งนี้ได้ทำการวิเคราะห์หาพื้นที่เหมาะสมสำหรับการติดตั้งกล้อง CCTV ในพื้นที่เขตเทศบาลเมืองศรีราชา จังหวัดชลบุรี โดยใช้โปรแกรม GIS ซึ่งเป็นการประยุกต์ใช้ระบบสารสนเทศภูมิศาสตร์ โดยนำข้อมูลเชิงพื้นที่และข้อมูลสถิติการเกิดอุบัติเหตุทางรถยนต์ในเขตพื้นที่ศึกษา เพื่อนำมาวิเคราะห์หาพื้นที่เสี่ยงซึ่งเป็นปัจจัยหลักในการพิจารณากำหนดจุดติดตั้งกล้อง CCTV ที่เหมาะสม ผลที่ได้จะเป็นสิ่งที่ช่วยสนับสนุนกระบวนการการตัดสินใจเลือกพื้นที่สำหรับติดตั้งกล้อง CCTV ในพื้นที่จังหวัดชลบุรีต่อไป

80 หน้า

CONTENTS

CONTENTS (cont.)

CONTENTS (cont.)

LIST OF TABLES

LIST OF FIGURES

LIST OF FIGURES (cont.)

CHAPTER I
INTRODUCTION

1.1 Background and Problem Statement

Chonburi province continues to enjoy economic and industrial growth as a major tourist city where population and tourist trends increase annually with greater density of buildings, higher cost of living and more traffic congestion. These factors are the driving force of social problems due to a higher number of accidents and crimes such as robbery, disputes, assault, abduction, rape, murder, drug trafficking and traffic accidents, etc. Some areas, including those with heavy congestion, enclosed or non-visibility areas, abandoned communities, areas with inadequate lighting are considered high-risk areas. When compared to the number of government officials, the area and population ratios are found to be vastly different. Consequently, monitoring is insufficient to cover all areas. In some cases, the absence of witnesses and evidence results in difficulty arresting the culprit, thereby resulting in problems affecting the safety and property of citizens. Despite efforts to control these factors, crime is not likely to be reduced because the solution and implementation is difficult and time consuming due to the requirement of accurate and timely data.

Closed Circuit Television (CCTV) involves recording events and displaying image data in real time delivered directly to the control center to facilitate the work of police officers and security. Traffic planning monitors and tracks the circumstances of offenses and the offenders' escape routes. It also provides photo or video evidence to prove the guilt or innocence of the accused persons in court cases to prosecute offenders and clearly predicts the likelihood of future incidents. However, images from CCTV cameras installed in certain areas continue to encounter several problems such as image contrast as well as obstructed or obscured camera angles. Moreover, improper installation of CCTV cameras does not provide sufficient space.

Aware of the aforementioned problems, the researcher's aim was to evaluate the installation of CCTV cameras at the points in the Geographic Information System (GIS), which is an effective system for managing databases and mapping systems. Used to link the different positions on the map, geographical information systems also have the ability to search and process information. By providing basic information to analyze and integrate the relation of each factor, the desired results are obtained. As a result of such concepts in GIS applications, space can be analyzed for the installation of CCTV cameras to analyze the physical community as well as the roads and highways of the study area. The findings of this research can be applied to the decision to determine the proper installation of CCTV cameras in Sriracha municipality, Chonburi province.

1.2 Objective

The objectives of the research are as the following:

- To study and analyze the risk areas for the occurrence of traffic accidents in Sriracha Municipality, Chonburi Province.

- To analyze and find suitable areas for the installation of CCTV and the adjustment of camera angles.

1.3 Scope of the Study

- The present study examined and analyzed accident risk areas on Sukhumvit Rd in Sriracha municipality, Chonburi province. The data used came from the Thai Road Safety Collaboration (THAIRSC), which is an agency performing the task of gathering data on road accident statistics from the report center of compulsory insurance claims data from Road Accident Victims Protection Co., Ltd. and report networks. The data used in the analysis ranges from January - December 2013.

- The analysis of suitable areas for CCTV installation and the data from CCTV already installed were analyzed in order to determine the sufficiency for use in the area studied. The data from CCTV installation sites was obtained from the Chonburi provincial administrative organization. The data used in the analysis came from the period from 2012 to 2013.

1.4 Expected Result

- A database of risk areas for the occurrence of traffic accidents in the study area.

- Benefits in the planning of designating installation sites for CCTV cameras and to obtain images from suitable angles with sufficient space for the area.

CHAPTER II
LITERATURE REVIEW

The preparation of the determination of the Geographic Information System (GIS) database and site selection analysis for the installation of CCTV camera in Sriracha municipality, Chonburi province. Require cognitive theories of Site Selection includes other factors involved. The researcher has study and compiled theories and related research are as follows:

2.1 Geographical Information System (GIS)

2.2 Site Selection Analysis

2.3 Close Circuit Television (CCTV)

2.4 Traffic Accidents

2.5 Related Researches

2.1 Geographic Information System (GIS)

2.1.1 Definition

GIS or Geographical Information System is as follow:

- Federal Interagency Coordinating Committee, 1988: "A system of computer hardware, software, and procedures designed to support the capture, management, manipulation, analysis, modularly and display of spatially referenced data for solving complex planning and management problems."

- Parent, (1988). States that GIS is a "system that contains spatially referenced data that can be analyzed and converted to information for a specific set of purposes, or application. The key feature of a GIS is the analysis of data to produce new information."

- Hanigan, (1988). States that: a GIS is any information management system which can:

- Collect, store, and retrieve information based on its spatial location

- Identify locations within a targeted environment which meet specific criteria

- Explore relationships among data sets within that environment

- Analyze the related data spatially as an aid to making decisions about that environment

- Facilitate selecting and passing data to application-specific analytical models capable of assessing the impact of alternatives on the chosen environment

- Display the selected environment both graphically and numerically either before or after analysis.

GIS technology has been well-known since 1960s. During the 1970s, GIS was largely used to power automated cartographic processes by representing map components (e.g. points, lines and areas) in terms of *X, Y* (Cartesian) coordinates (Joseph, 1994).

In 1980s, GIS technology inspire wholesale has changed in automated cartographic processes. Spatial database management systems arrived to increase the efficiency of GIS through integration between automated mapping and database management systems (Joseph, 1994).

Geographic data is quite different from data in other types of information systems. Data in a GIS describes physical geography. The portion with geographical references is known as ‘spatial data’, while the topological part is called ‘attribute data’ (Rich and Davis, 2009 - 2010).

Spatial data is geographically-referenced data that represents geographical features. It consists of vector and raster formats. The vector format includes points to represent position, line to represent rivers or road and polygons to represent boundaries. All this is stored in and *X, Y* (Cartesian) coordinate system that references real-world locations (Rich and Davis, 2009 - 2010, ERSI, 1995). The raster format, on the other hand, deals with location through representation of raster data as regular grids of dots, which are mostly called cell or pixels. The raster format can be filled with values. A GIS can link up both formats (ERSI, 1995, Russell, 1992) as shown in Figure 2.1

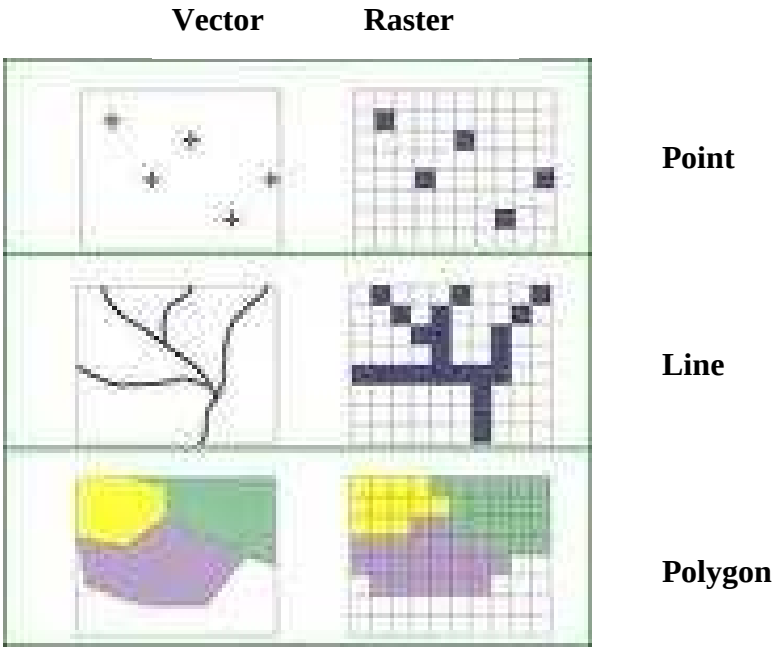


Figure 2.1 The example types of spatial data
Source: ERSI (1995)

Attribute data or non-spatial data is descriptive type of data that can provide details of geographical circumstances for ecological management. These details include climate information and quality of water and the environment in general. This data is represented in a relational model in the form of table to simplify studies. Complicated data should be split up into multiple tables and arranged with proper proportions in accordance to their relationships. Distinct data in these tables should be links, grouped and used to support actual working processes through commands like create, modify or search. Attribute data is changed as time passes and events take place, giving every piece its unique nature and forming a picture of all properties for a given piece of *spatial data* (Russell, 1992) as shown in Figure 2.3

Attributes of Counties.shp

Name	State_name	Area	Pop1990
Lake of the Woods	Minnesota	1784.0634	4076
Ferry	Washington	2280.2319	6295
Stevens	Washington	2529.9794	30948
Okanogan	Washington	5306.1800	33350
Pend Oreille	Washington	1445.0286	8915
Boundary	Idaho	1279.2987	8332
Lincoln	Montana	3746.0908	17481
Flathead	Montana	5232.0306	59218
Glacier	Montana	3124.4572	12121
Toole	Montana	1943.2598	5046
Liberty	Montana	1485.9458	2295
Hill	Montana	2917.3611	17654
Sheridan	Montana	1686.5827	4732
Divide	North Dakota	1279.9633	2899
Burke	North Dakota	1121.4170	3002
Renville	North Dakota	883.7720	3160

Figure 2.2 The example attribute data or non-spatial data

Source: Russell (1992)

2.1.2 GIS Analytical Techniques

There are several analytical techniques for data in a given GIS, such as Overlay Analysis and Spatial Analysis (ERSI, 2010)

2.1.2.1 Overlay analysis creates information by combining multiple layers of data. Information emerging out of this process can also be combined further with other overlay data. The creation of overlay data uses Boolean algebra, which consists of *AND, OR, XOR* and *NOT* commands. These commands are used to determine whether the result of a given condition is true or false. The *Overlay* is data that gets merged with other data to create new information. Overlay analysis can be broken down into point operations and neighborhood or region operations. A point operation can use the conditions of relationship to form the significance value, such as multiplication with facts. Furthermore, the point operation can conclude complex relationships like clustering, discriminate analysis, technical of statistic, and principle component analysis (Grareme and Bonham, 1996).

2.1.2.2 Spatial analysis or spatial statistics includes any of the formal techniques which study entities using their topological, geometric, or geographic properties. The phrase properly refers to a variety of techniques, many still in their early development, using different analytic approaches and applied in fields as diverse as astronomy, with its studies of the placement of galaxies in the cosmos, to

chip fabrication engineering, with its use of 'place and route' algorithms to build complex wiring structures. The phrase is often used in a more restricted sense to describe techniques applied to structures at the human scale, most notably in the analysis of geographic data. The phrase is even sometimes used to refer to a specific technique in a single area of research, for example, to describe geo-statistics (Grareme and Bonham, 1996).

2.2 Site Selection Analysis

The site selection process includes a detailed evaluation of project needs which are then measured against the merits of potential locations. The process typically includes selecting and evaluating communities site selection considerations should begin early in the capital development process and play a significant role in pre-planning discussions.

2.2.1 Suitability Analysis

Suitability analysis is a GIS-based process used to determine the appropriateness of a given area for a particular use. The basic premise of suitability analysis is that each aspect of the landscape has intrinsic characteristics that are in some degree either suitable or unsuitable for the activities being planned. Suitability is determined through systematic, multi-factor analysis of the different aspect of the terrain. Model inputs include a variety of physical, cultural, and economic factors. The results are often displayed on a map that is used to highlight areas from high to low suitability (James and Lagro, 2001).

A suitability model typically answers the question, "Where is the best location ?" whether it involves finding the best location for a new road or pipeline, a new housing development, or a retail store. Often, a Multi Criteria Evaluation approach is required in order to answer this question. Multi-criteria evaluation is the process by which a set of known project criteria are explored, ranked and/or weighted, in order to find the best outcome. For instance, a commercial developer building a new retail store may take into consideration distance to major highways and any competitors stores, then combine the results with land use, population density, and

consumer spending data (ESRI, 2010). This information would be ranked based on its importance to the store's success. Some of the criteria might be absolutely essential, while others may not be so vital, though certainly of benefit. This data could then be weighted based on these rankings, allowing for the vital criteria to be met first. The developer would then come up with a group of locations that meet all, most, some, or none of the criteria, allowing them to choose the best location for the store.

2.2.2 Site Survey

A site survey is an inspection of an area where work is proposed, to gather information for a design or an estimate to complete the initial tasks required for an outdoor activity. It can determine a precise location, access, best orientation for the site and the location of obstacles. The type of site survey and the best practices required depend on the nature of the project. Examples of projects requiring a preliminary site survey include urban construction, specialized construction (such as the location for CCTV) and wireless network design (Scott Weich, 2001).

2.3 Close Circuit Television (CCTV)

Jerry Ratcliffe et al, (2006). CCTV technology needs to be used for monitoring and follow-up on the conditions. CCTV are linked to systems or control rooms in order to send the images showing the results obtained on a television monitor or record the aforementioned in storage, and staff is required to maintain the security of the CCTV images obtained.

CCTVs have different capabilities such as night-vision capability, motion detection and advanced zoom and automatic tracking capacities.

2.3.1 CCTV Camera (Fixed)

CCTV that has already been installed are fixed in place or turned in a different direction for viewing images from the CCTV. If the CCTV needs a turn or change of direction the camera needs to be detached from the box and attached in a new position.

Figure 2.3 CCTV Camera (Fixed)

Source: Ratcliffe (2006)

2.3.2 CCTV Camera (Dome)

In order to increase work effectiveness, CCTV system manufacturers are currently producing CCTVs with pan and zoom abilities. This allows CCTVs to turn left/right and up-down and zoom via keyboard controls. This type of CCTV is called the Speed Dome, which can turn 360 degrees around and zoom as far as 100-300 m. (depending on the model). It can adjust its angles to look down at objects or pedestrians on the ground, both of which are below the position of the camera, or look up at taller structures, whether it is directly in front of it or all the way around. It could even rotate to other directions. Therefore, Speed Dome cameras should be chosen as needed for work type as a means of cost-cutting and other savings. Under normal circumstances, office building interiors should install ordinary indoor Speed Dome cameras. For outdoor use, however, special outdoor Speed Dome cameras should be used appropriately according to the conditions of individual areas, but the aforementioned (CCTVs resistant to sun and rain) might be costly.

Figure 2.4 CCTV Camera (Dome)
Source: Jerry Ratcliffe (2006)

Apart from the installation position for pan and tilt units, it is necessary to consider whether the equipment used with a given pan and tilt unit include equipment other than the camera and lenses, because heavy equipment attachments increase unit weight. Pan and tilt units capable of handling all weights are large and expensive. Some units can rotate in a complete circumference without rotating back to their original positions (tangled wires), and some have preset functions. The necessity of the pan and tilt units' special properties should be considered because prices rise in line with greater ability. Furthermore, several other pan and tilt units exist such as submersible models. Furthermore, pan and tilt units require the same electricity systems as the control machine/unit, e.g., 24 V.DC, 24 V.AC, 115 V.AC or 220 V.AC, etc. If different electrical systems are used, the pan and tilt unit may not function or become damaged. If the pan and tilt unit's control transmission system is mixed or relayed with other signals such as digital or microcomputer signals, and so on, signal conversion or sorting would be needed to distinguish the control signals from signals belonging to the recipient, which is called the receiver or driver unit, or with other names, depending on the manufacturer.

Under normal circumstances, cameras with pan and tilt units will use lenses capable of adjusting image size together. However, this function is not always necessary and depends more upon the task at hand. In certain types, only allowing adjustment of the direction might be sufficient and it might not be necessary to gain

a detailed view. And other types might require a change to a lens capable of adjusting image size in order to view the details of the image that needs to be viewed in which each direction is different.

2.3.3 CCTV Zoom Lens

A zoom lens allows adjustments in image size. For the most part, the lens used in CCTV with pan and tilt units is generally the type that controls functioning with a motor and is called a motorized zoom lens. The selection of a motorized zoom lens should involving opting to use a lens that is suitable for use because motorize zoom lenses are available in a variety of styles and sizes by focus length. For example, building interiors do not have large areas. Hence, using a motorized zoom lens without a long focus length (e.g. 6-35 mm.) would be recommended. If the CCTV is installed in a large building or outside the building over a wide space or if the view requires a detailed view, a motorized zoom lens with a longer focus length (e.g. 6-60 mm.) should be selected. If the CCTV is installed outside the building or long distance viewing is required, select a motorized zoom lens with a longer focus length (e.g. 6-123 mm.).

Figure 2.5 CCTV Zoom Lens
Source: Jerry Ratcliffe (2006)

2.4 Incidents

Giuliano (1989) defined “incident” as an uncertain event that cannot be scheduled or known in advance and cannot be repeated in the same way at the same location. The incident results in impact on traffic conditions in the opposite direction. Therefore, “incident” means an event resulting in traffic problems that do not occur on a regular basis.

The model as is shown below is used as a framework for understanding the multiple causes and prevention of traffic accidents that occur in developing cities. Available literature identifies traffic accidents in a place as been caused either by physical factors in the road system environment, the vehicle or behavior factors, and how they interact with enforcement regulations in unique settings.

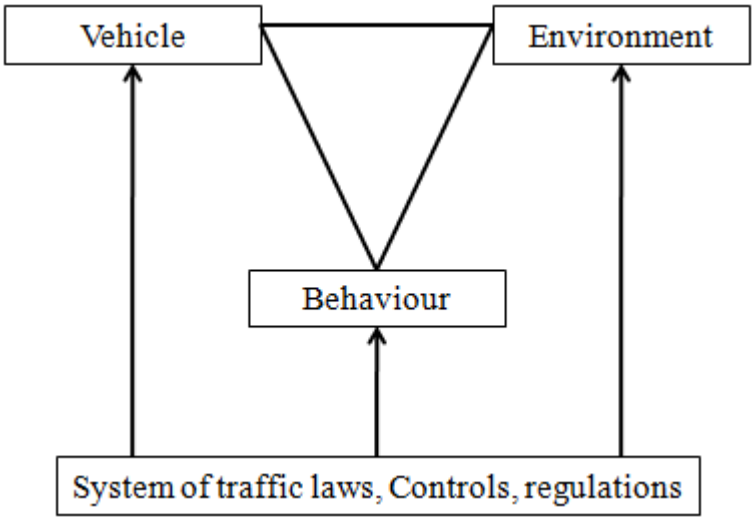


Figure 2.6 A model for traffic accidents

Source: Jorgensen and Abane (1999)

2.4.1 Traffic Incident Type

Incidents are uncertain events. Therefore, studies of incident type vary from one another, depending on the research objectives, data collection methodology, environmental conditions and categorization of incidents. The findings of previous studies on incident type have found the factors influencing incident type to be as follows:

Figure 2.7 Traffic accidents

2.4.1.1 Seasonal Trends for Incidents

Influences Resulting from Seasonal Changes - Incident frequency each month can be used as an explanation due to traffic volume and other environmental factors that cannot be measured such as sunlight, wind and temperature. According to the study of Rose (1964), incidents in December-January occur at the highest rate because these months mark a period when temperatures are low with sudden changes in weather conditions.

2.4.1.2 Weekly Incident Trends

Variances in Daily Traffic Volume - The study of De Rose (1964) found the number of daily incidents to be no different. The only variance was that incidents were more likely to occur on Fridays due to high traffic volume. According to the study of Giuliano (1989), the occurrence of incidents was higher from Monday to Friday than on Saturdays and Sundays. Friday had the highest incident rate while Sunday had the lowest.

2.4.1.3 Event Severity Incident Trends

A number of methods are available for ranking event severity such as ranking by the number of injuries, the number of vehicles involved or the type of traffic accident. The study of Giuliano (1989), found 63% of incidents to be events

involving no injuries. For the most part, incidents were caused by two-vehicle collisions and did not obstruct traffic lanes. The study of Goolsby and Smith (1971), found most incidents to obstruct only one traffic lane in which the traffic lane adjacent to the shoulder of the road was the traffic lane where the least number of incidents occurred.

2.4.2 Behavior

2.4.2.1 Physical impairments such as drowsiness, weakness or chronic disease.

2.4.2.2 Mental impairments such as anxiety or emotional stress.

2.4.2.3 Deficient expertise in traffic routes.

2.4.2.4 Failure to comply with laws, e.g. high speed driving, failure to comply with traffic signs or passing on the left.

2.4.3 Vehicle

2.4.3.1 Vehicle conditions where vehicles are not ready to be driven and sudden engine or part breakdowns.

2.4.3.2 Changes in vehicle condition such as increased motor power with which the driver is unfamiliar and that might result in joy riding or high speed driving. Vehicle modifications that fail to take into consideration the limitations of the vehicle design.

2.4.4 Environment

2.4.4.1 Areas where accidents occur include intersections, curves in the road, straight stretches of road, steep/hilly roads and roads connecting residential buildings. The areas where accidents tend to occur most frequently are straight stretches of road due to careless drivers who drive at high speeds. Moreover, 3-lane roads have been found to have more accidents than 2-lane roads, while 4-lane roads and 4-way intersections are more hazardous than 3-way intersections.

2.4.4.2 Road conditions with pot holes and slippery sections.

2.4.4.3 Inadequate road lighting.

2.4.4.4 Weather conditions such as heavy rain, flooding, fog or smoke that hinders visibility on the road.

2.4.5 System of traffic laws, control and regulations

2.4.5.1 No dissemination of information regarding regulations, rules and penalties.

2.4.5.2 Penalties or fines are inappropriate.

2.4.5.3 No pursuit and arrest; no serious consideration or arrest of violators, which is the reason drivers are careless.

2.5 Related Researches

Lee (1995) conducted a study on CCTV Camera surveillance as a key component for the popular CCTV camera and DVRs frequently used in the city at large. The main purpose of installing CCTV cameras is to traffic on roads and intersections then record the events. In the present study, the researcher has compiled factors based on design experience by locating over 100 cameras on freeways and surface streets in California, with suggested guidelines for camera site selection and the decision to install CCTV camera. The installation of CCTV cameras needs to be targeted at recorded scenarios and, traffic surveillance, In considering the suitability of premises, CCTV angles must be clear. And to benefit and support the work of the police or the security administrator, there should be no obstructions.

Caplan et al. (2009) conducted a study on Police-monitored CCTV cameras in Newark, NJ: Placement choices and their impact on street crime incidents. This case study educated about the efficiency of sidewalk surveillance in crime areas side with streets and areas where auto theft can be observed through CCTV cameras installed at intersections in Newark, New Jersey where researchers have taken pictures with cameras, CCTV and, digital mapping in computer programs. The ArcView Geographic Information System (GIS) by using the theory of buffer analysis to determine areas characterized by a CCTV camera is the radius of a circle. According

to findings, the installation of CCTV cameras enabled the police to monitor incidents and conduct surveillance of the crimes. Furthermore, criminals were afraid to commit more wrongdoing. However, barriers were encountered in monitoring buildings, walls, and narrow alleys obscuring the visibility of the images. Moreover, crimes continue to occur in areas where CCTV cameras are unable to capture images. According to the findings, the installation of CCTV cameras requires the setting of goals to prevent crime, for example, to monitor stealth theft; programs need to be installed at sites where criminal events or pictures are clear in order to enhance the visual inspection of the police CCTV cameras.

Ming et al. (2002) conducted a study on 3D-City Model Support for CCTV Monitoring Systems in a study educate on CCTV system design in a complex process including field survey, planning and selecting proposed camera sites. The visual design method has been introduced to CCTV system design and maintenance and this paper suggests that the visual design method should be introduced with the advantages of spatial analysis of 3D GIS and buffer analysis model should be used to aid in the design of CCTV monitoring systems. According to the findings, the 3D GIS and buffer analysis models can conveniently provide a large volume of accurate and visual information for CCTV monitoring system designs. The visual design method may reduce cycle time and the labor load of design, while cutting costs for large CCTV monitoring systems.

Supachai (2002) conducted a study on the development of a black spot analysis tool using GIS to record current statistical data on traffic accidents by using only on-site traffic accident incidence forms according to the standards of the office of transport and traffic policy and planning in which the locations of hazardous sites cannot be specified for analysis to find the causes and related factors including the proposal of efficient corrective guidelines for traffic accidents. Therefore, the development of instruments to help analyze hazardous traffic sites by using GIS can facilitate the process and properly pinpoint the sites where accidents frequently occur with greater accuracy and efficiency.

Supornchai (2000) applied geographic information technology systems to the determination of hazardous sites on highways in Thailand by analyzing hazardous highway areas for use in highway safety planning by precisely locating hazardous areas. Data on accidents and road networks are key data used in the analysis of hazardous sites by using GIS in establishing an accident database. Furthermore, hazardous areas on highways can be accurately analyzed while the images viewed have better resolution. Moreover, the results obtained can be used in the analysis of the variables causing accidents in those hazardous areas for the benefit of improving road quality in the future.

CHAPTER III
MATERIALS AND METHODOLOGY

This chapter will discuss the details of the materials and methodology to be used in the design and development of the GIS database. In this study, the site selection analysis for CCTV installation in Sriracha municipality, Chonburi province was a case study. However, the proposed research method can be applied to other regions in Thailand.

3.1 Materials

This research has classified materials used in the research into three categories. The details are as the following:

3.1.1 Software:

- Operating System
- Microsoft Windows 7 Professional Service Pack 1
- Development Tools
- GIS Software is used for preparing of a Geo database
- Microsoft Office Excel version 2007

3.1.2 Hardware:

- Computer Notebook model Acer Travelmate 4750
- CPU Intel Core i5
- Speed clock 2.5 GHz
- RAM 4 GB DDR3
- HARD DISK 500 GB

3.1.3 Data Source

3.1.3.1 Google Street maps and Google Satellite map data showing the spatial data and highway routes in Sriracha Municipality, Chonburi Province.

3.1.3.2 CCTV installation site data where camera have already been installed on Thai highway in Sriracha Municipality, Chonburi Province.

3.1.3.3 Geographic map data and displays of the coordinates for the accident sites or the vicinities road accidents by collecting data from Thai Road Safety Collaboration. The data from 2013 is shown in Table 3.1.

3.2 Methodology

This research was adapted by Geographic Information System functions, which is a method of process in this chapter and can be categorized into four steps, namely, data collection, manipulation, analysis and classification as shown in Figure 3.1.

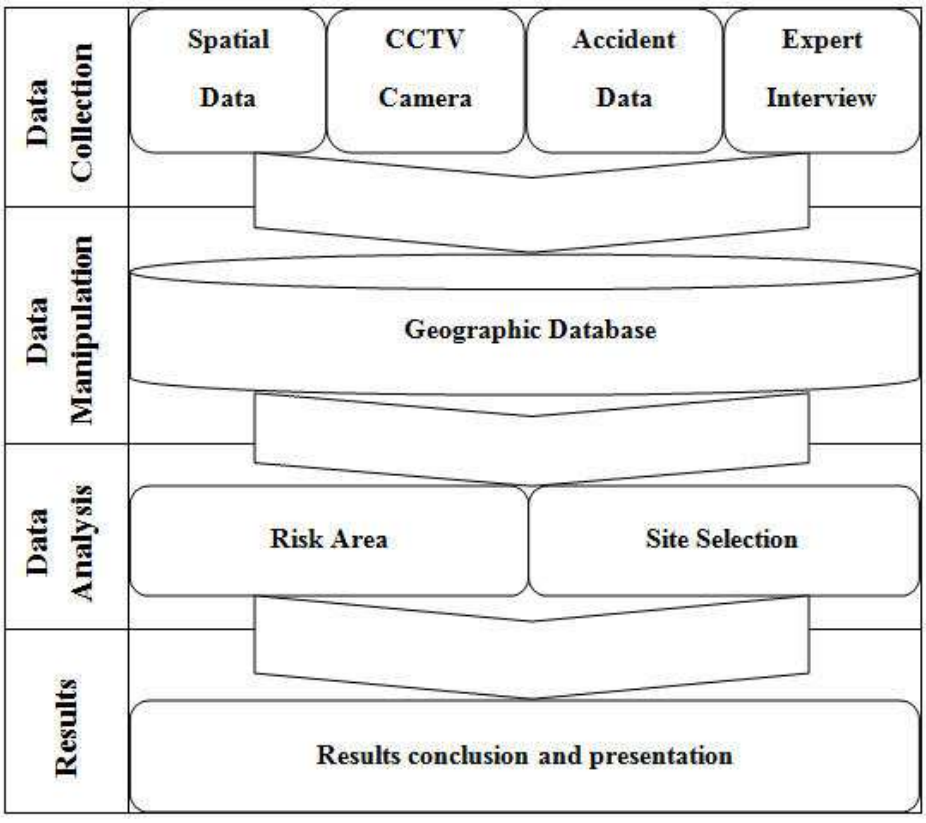


Figure 3.1 Summary of research methodology

3.2.1 Data Collection

The necessary information related to this research was collected as follows:

3.2.1.1 Spatial data, the spatial data and maps in the vicinity of the Sriracha Municipality will be used by taking data from Google Map in the Google Street and Google Satellite formats, which will be used in combination for the analysis.

3.2.1.2 CCTV Camera, data from CCTV camera installed in Sriracha municipality to search for suitable areas adequate for use. CCTV camera installation data was obtained from the Chonburi provincial administrative organization, and the data used in analysis was collected from 2012-2013.

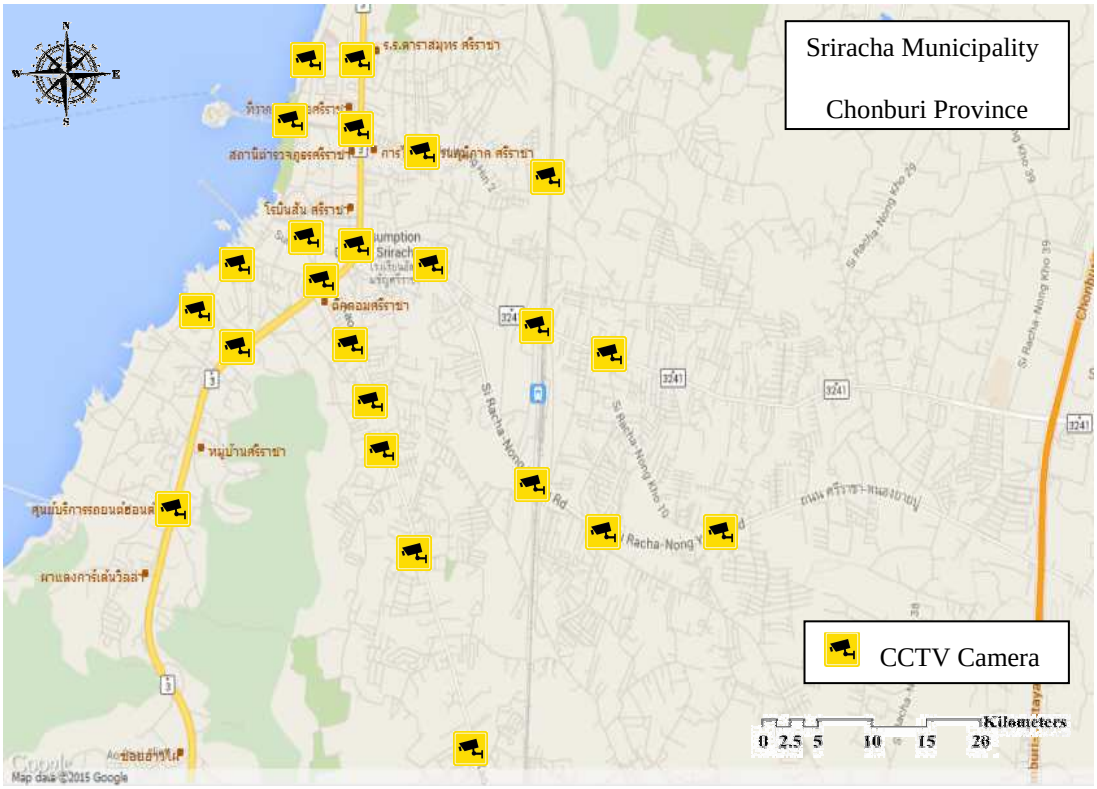


Figure 3.2 Show the Road Network and CCTV camera installation in Sriracha municipality

Source: Google Street Maps

Table 3.1 CCTV camera installation in Sriracha Municipality

CCTV camera installation	Dome camera	Fixe camera
Darasamutr School Sriracha	1	2
Samitivej Sriracha Hospital	-	2
Ko Loi Clock Tower Circle	1	2
Wat Wang Hin Intersection	-	4
Wat Wang Hin Soi 7	-	2
Wat Wang Hin School	1	3
Assumption Intersection	1	4
In Front of Assumption Sriracha School	1	3
Behind of Assumption Sriracha School	1	3
Wat Rai Kluai	-	3
By Pass 36 Overpass	1	3
Chak Kho Intersection (Wat Khrua Satthatham)	1	3
Pruksachat Village Intersection	1	3
Hua Krok Overpass	1	3
In Front of Saint Paul Convent	-	5
Saint Paul Convent Intersection - Assumption	-	3
Sriracha Park Village Intersection	-	4
Baan Eua Arthorn Intersection - Sriracha Tower	-	3
Pun Sin Intersection	1	3
Behind of Robinson Intersection	-	4
Sriracha Market Clock Tower Circle	-	3
Saint Paul Convent Intersection	1	4
Queen Savang Vadhana Memorial Hospital	-	2
Surasak Crossroad - Watkhaobhuddakodom	-	4
Had Pa Daeng Intersection (Honda Center)	1	3
Total	13	78

Source: Chonburi provincial administrative organization (2012)

3.2.1.3 Accident Data, the data used for the analysis of risk areas relies on accident statistics of Sriracha Municipality between Sukhumvit Rd. beginning at Darasamut School Sriracha to Soi Ao Phai. The total distance is 5.8 km. The data used was obtained from the Thai Road Safety Collaboration (THAIRSC), which is an agency that collects statistical data of road accidents from the incident report centers of the Compulsory insurance claims data from Road Accident Victims Protection CO., LTD. and reporting networks. The data used in analysis was collected from January to December 2013.

3.2.1.4 Expert Interview, designating CCTV installation sites and viewpoints in order to obtain the right images required interviews with experts or police officers. In the present study, interviews were conducted with one police officer from the Sriracha Police Station who held the position of Investigation Inspector.

Table 3.2 Statistical of accident in Amphoe Sriracha, Chonburi Province in 2013

Month	Amount of car accident	Amount of wounded people	Amount of dead people
January	16	6	1
February	7	2	2
March	89	20	6
April	63	23	1
May	106	48	1
June	102	33	5
July	113	19	1
August	163	28	1
September	113	16	4
October	104	18	3
November	118	29	1
December	131	37	2
Total	1125	279	28
Average per month	93.75	23.25	2.33

Source: THAIRSC (2013)

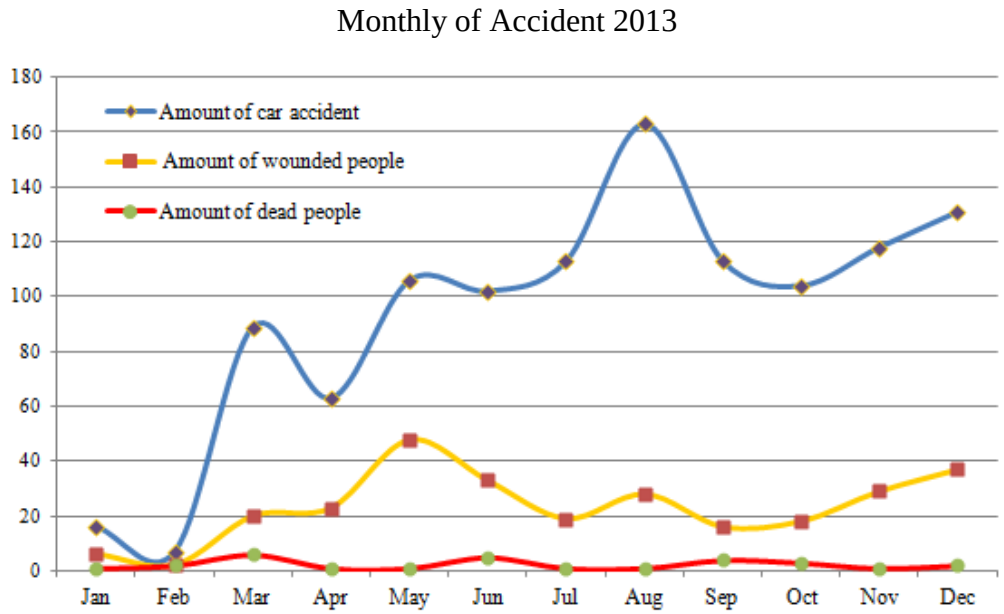


Figure 3.3 Shows the amount of car accidents, wounded people and dead people 2013

Source: THAIRSC (2013)

3.2.2 Data Manipulation

This section, addresses the methods used in converting analogue data to a digital format.

- The attribute data for some of the database for the attribute data acquired were created by using Microsoft Excel and saving as a database file then importing into GIS software as an event theme while some were directly created in GIS software. All of the landmarks such as villages and roads were used as point and line formats referring to actual locations.

These data were used to analyze the location coordinates road of accidents into GIS software in order to determine suitable locations for the installation of CCTV. The data were entered into to the form and converted into a map; the steps of analysis will be handled for the remainder of the process.

- Data correction for spatial analysis and all related data in the Sriracha Municipality, Chonburi Province needs to be corrected in the GIS application.

3.2.3 Data Analysis

- The main data analyzed for this study was spatial data, highway routes, CCTV camera data at installation sites in the areas and data on frequently occurring accidents in Sriracha municipality, Chonburi province.

- Data from Sukhumvit Rd. at the area in front of Darasamutr School Sriracha An interval of 5.8 kilometers at Soi Ao Phai for was divided into sections of 0.5 kilometers each by using a fixed method by limiting sections every 0.5 kilometers.

- The incidence rate and frequency of accidents for each section was calculated based on the terms that needed to be shown such as road conditions, intersections, nearby community areas.

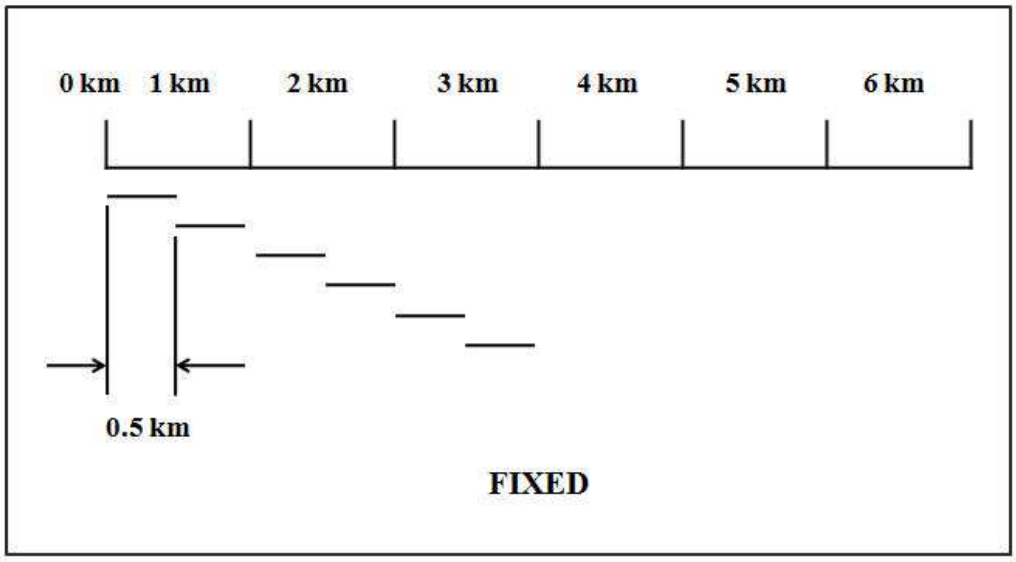


Figure 3.4 Fixed Section Road Divisions

- The results obtained by the collection of accident data and the sites of frequent accidents on highways much less sort of accident that occurred in the area. Were entered into the GIS program and the results were displayed in the form of maps showing the data distribution of the sites where accidents frequently occur.

Table 3.3 Incident Level

No.	Amount of Accident (per year)	Criteria	Weight of Incident Level	Color Shade
1	21up	High	3	
2	11 - 20	Moderate	2	
3	1 - 10	Low	1	
4	0	None	-1	

- Analysis of data from a camera installed, or the installation of the CCTV should be installed CCTV cameras or editing.

- According to a study on Computing Installation Parameters of CCTV Cameras for Traffic Surveillance (Gupta, 2012), the best viewing distance of CCTVs is 50 meters. A shorter visibility radius may pose an obstacle for image usage, especially in the vicinity of four-way intersections. On the other hand, a visible distance of 30 meters would be a radius offering a clear view of people's faces and license plate numbers but would not provide coverage of the area. Furthermore, a visibility of 100 meters would display images of events and accident characteristics, suitable for traffic work. The distances of visibility for CCTV are shown in Table 3.5

Table 3.4 CCTV Area Level

No.	CCTV Radius	Weight of CCTV Area Level	Color Shade
1	30m.	1	
2	50m.	2	
3	100m.	3	
4	None	4	-

Figure 3.5 Shows CCTV Radius areas 30 meter

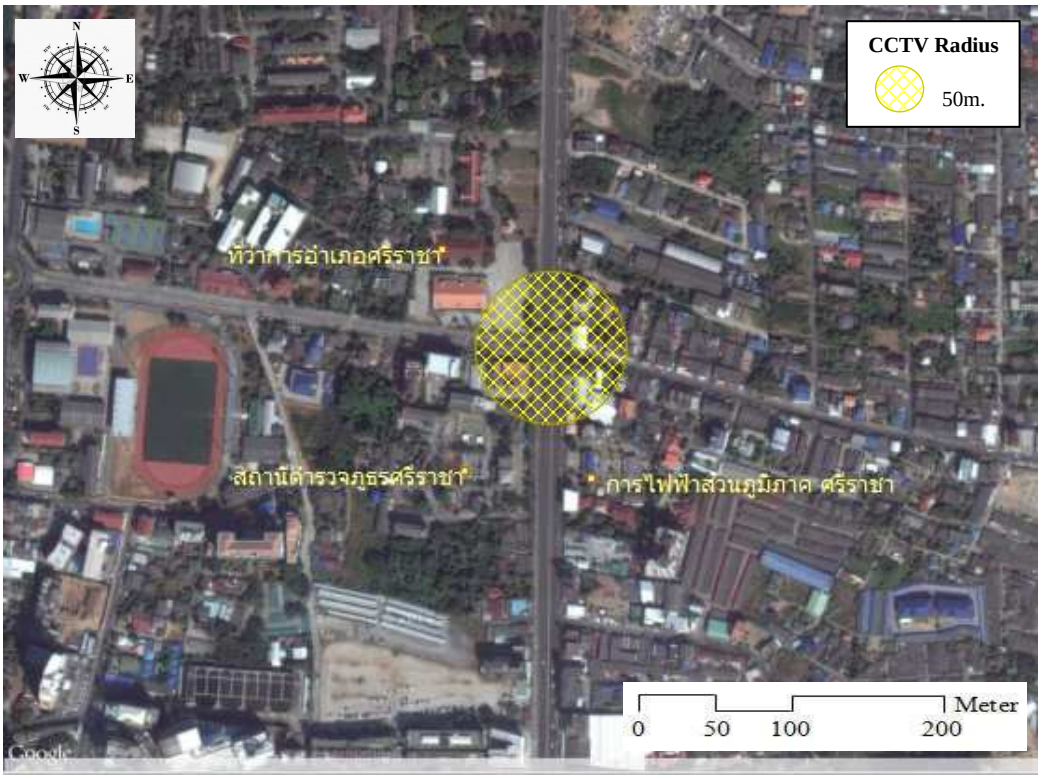


Figure 3.6 Shows CCTV Radius areas 50 meter

Figure 3.7 Shows CCTV Radius areas 100 meter

- The results from the assessment of risk areas and the conditions of the surrounding areas were analyzed and sites were chosen for the installation of CCTV cameras in order to obtain proper angles for clear photograph images with sufficient space.

3.2.4 Results conclusion and presentation

The conclusion of this research shows summarize of research and the suggestion by using descriptive method to explain and present the result.

CHAPTER IV
RESULTS

Chapter 4 discusses the analysis methods for determining which areas on Sukhumvit Rd. in Sriracha municipality, Chonburi province, are suitable for the installation of CCTV and whether or not the aforementioned is sufficient for use in the area. The data on accident rates and environmental conditions in the areas will be used as the primary data for the analysis aimed at determining risk areas as key information for supporting subsequent decisions. The procedures were as follows:

4.1 Risk Area

4.1.1 Dividing Sukhumvit route data from the front of Darasamutr school Sriracha up to Soi Ao Phai into sections at intervals 0.5 kilometer as shown in Figure 4.1.

4.1.2 Calculate the incidence rate of accidents or accident frequency for each section. Statistical data on accidents are stored in the form of database files stored in the MS Excel format. The data is data of positions and time of accident for each area of study. The data were entered into the GIS program to output results in the form of maps with color shades shown according to the rate of accidents. The road section with the highest rate of accidents will be considered the most hazardous.

- Since the scope of this study was in 2013 (January - December 2013) with data analysis by GIS within the conditions of number of accidents throughout 2013, the frequency of accidents on Sukhumvit Rd. is shown between Darasamutr School Sriracha up to Soi Ao Phai. The area of the study is shown in Figure 4.2.

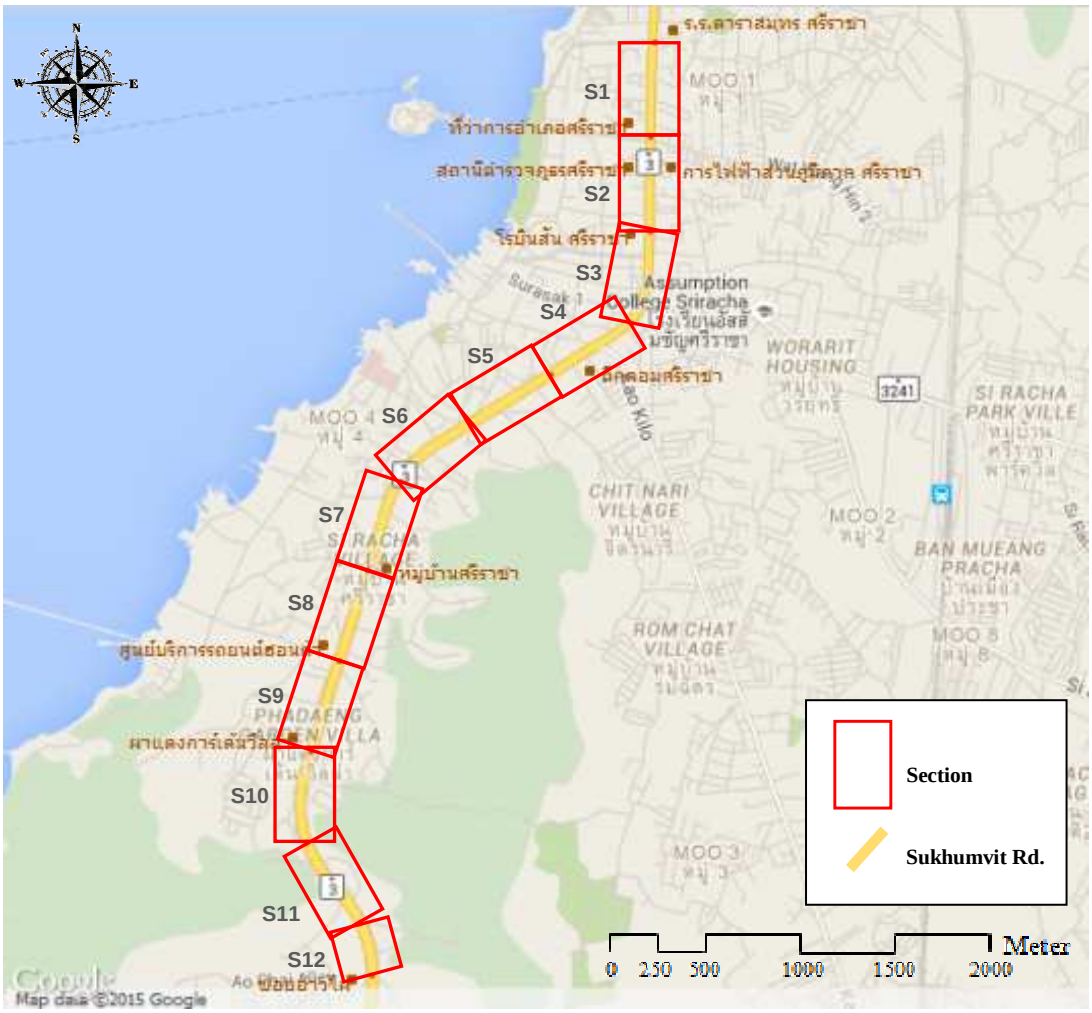


Figure 4.1 Shows road sections at intervals of 0.5 km as Google Streets.

Table 4.1 Shows the traffic accident incidence rate in each section of the road in 2013

Section	Road Section	Number of Accidents (per year)
S1	Darasamutr School - Wat Wang Hin Intersection	18
S2	Wat Wang Hin Intersection - SriracheNakhon 4	26
S3	SriracheNakhon 4 - Sriracha Land Village	15
S4	Sriracha Land Village - Toyota Charoenyonchonburi	6
S5	Toyota Charoenyonchonburi - Wat Buddhakodom	0
S6	Wat Buddhakodom - Sukhumvit Curve	8
S7	Sukhumvit Curve - Sriracha Village	3
S8	Sriracha - Had Pa Daeng Intersection (Honda Center)	3
S9	Had Pa Daeng Intersection (Honda Center) - East Isuzu	4
S10	East Isuzu - Pa Daeng Curve 1	8
S11	Pa Daeng Curve 1 - Pa Daeng Curve 2	3
S12	Pa Daeng Curve 2 - Entrance to Soi Ao Phai	4

Source: THAIRSC (2013)

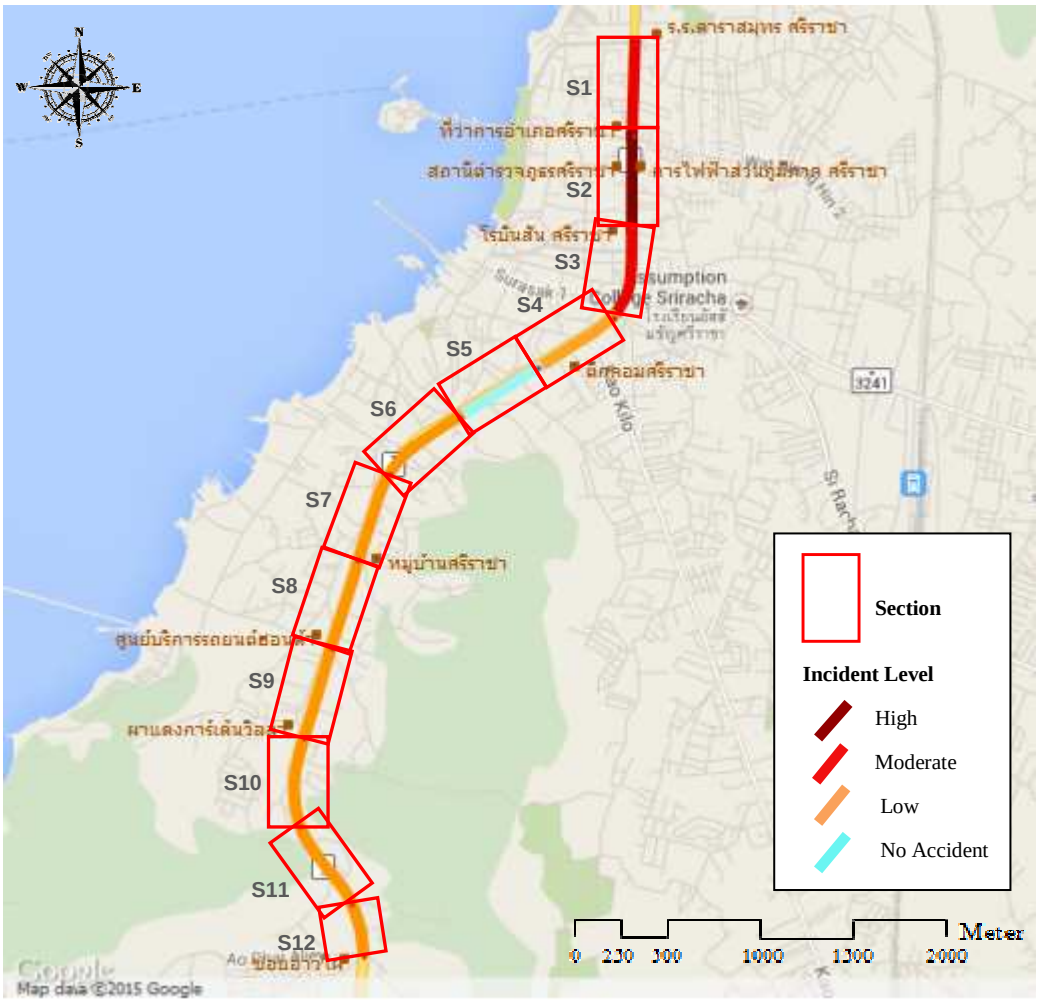


Figure 4.2 Shows the number of incidents in 2013 on Sukhumvit Rd., Sriracha municipality

4.1.1.3 Enter the data on the positions of installed CCTV along the Sukhumvit Road in the Sriracha municipality in order to output maps shown as conjugate data with the statistics of incidences of accidents in each section. The data on CCTV positions was obtained from the Chonburi provincial administrative organization. The data used in the analysis ranges from 2012-2013.

Table 4.2 CCTV camera installation in Sriracha Municipality

CCTV camera installation	Dome camera	Fixe camera
Darasamutr School Sriracha	1	2
Wat Wang Hin Intersection	-	4
Assumption Sriracha Intersection	1	4
Saint Paul Intersection	1	4
Surasak Intersection	-	4
Had Pa Daeng Intersection (Honda Center)	1	3
Total	4	21

Source: Chonburi provincial administrative organization (2012)

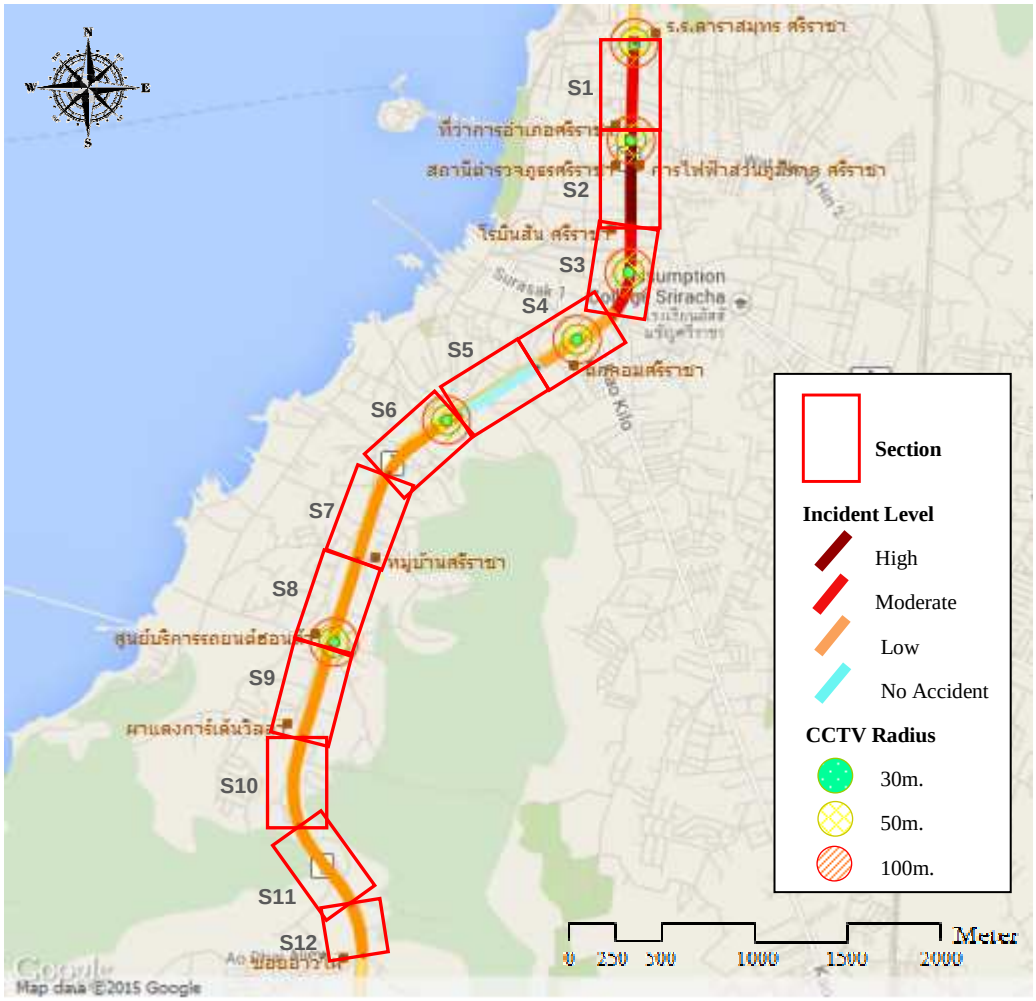


Figure 4.3 Shows the installation of CCTV camera and frequent accidents in 2013 on Sukhumvit Rd., Sriracha municipality

4.1.1.4 Arranging a hierarchy for road risk areas according to the incidence rates for accidents might be insufficient for the risk area calculations in the present study because certain sections already have CCTV installed. Therefore, a radius needs to be established for the viewing of images to accompany consideration for checking the coverage of the area in use at each of the sections. The research designated methods for calculating the risk areas for each section by adding the Incident Level and CCTV Area Level together. The mean obtained will show the Risk Area Level hierarchy from high to low as follows:

Incident Level + CCTV Area Level = Risk Area

Table 4.3 Risk Area Level

No.	Criteria	Weight of Risk Area Level	Color Shade
1	Very High	7	
2	High	6	
3	Moderate	4-5	
4	Low	1-3	

According to seminar reports on determining road accident risk areas with social participation from Thai Health Promotion Foundation in 2003. The following criteria for designating road accident risk areas were stated:

Designating any area or place as a hazardous risk section of road (black length) generally depends on the incidence rate of accidents as an index for the designation. For example, the criteria of Australia has stated that hazard risk sites on highways include areas with three accidents resulting in injuries or fatalities in one year over a period of three to five years.

In Thailand, there are no methods for clearly designating whether or not any particular area is a risk area. The Ministry of Transport (2001) has set criteria for designating hazardous risk sites as follows:

- Areas where the incidence of fatal accidents is high.
- Areas where the incidence of fatal accidents is at least once followed by the incidents of numerous severe accidents.

- Other areas where fatal accidents might have never occurred, but where people involved with traffic work such as police officers, highway workers and municipality staff have rendered the opinion that the area is hazardous.

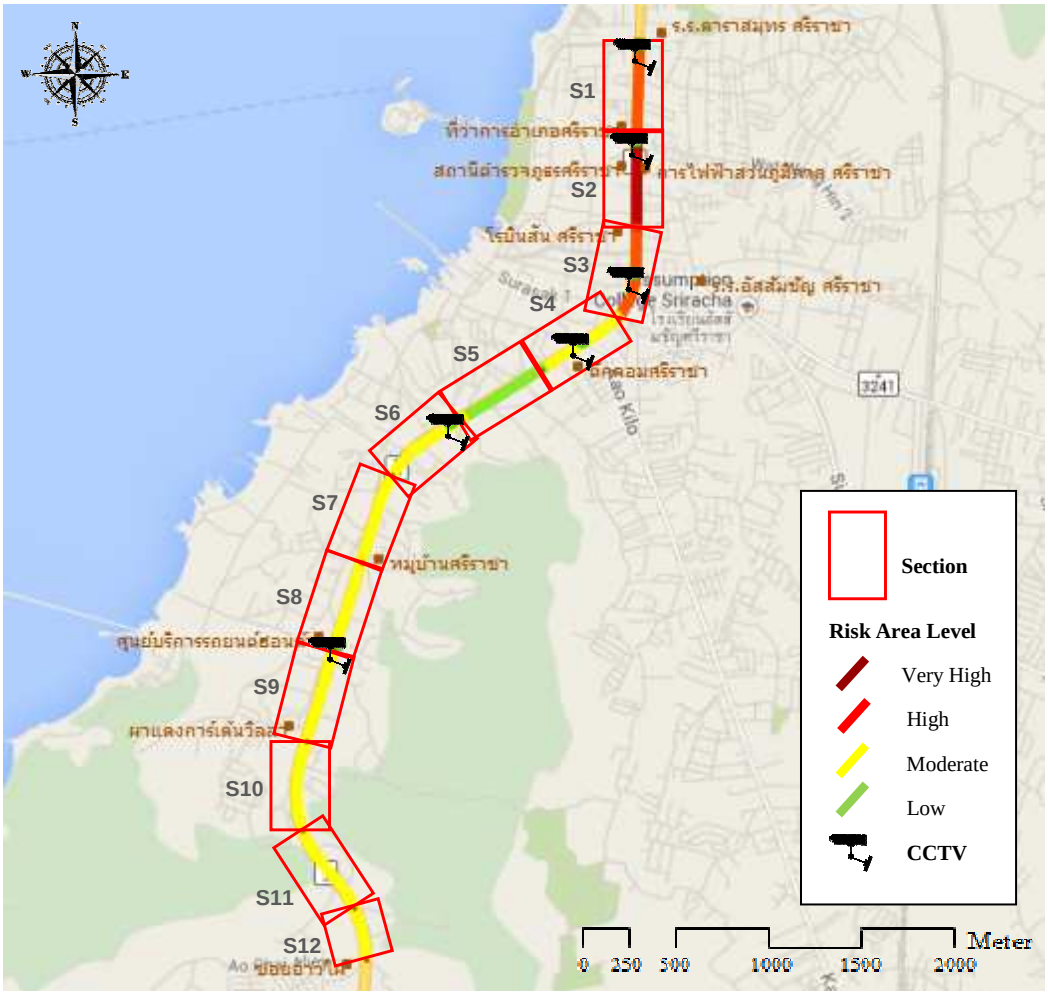


Figure 4.4 Risk Area Map on Sukhumvit Rd., Sriracha Municipality.

Figure 4.16 shows that the Risk Area Map can identify areas according to risk area calculations on Sukhumvit Rd., Sriracha Municipality. Color shades were used to rank risk levels. According to the Risk Area Map, it is clear that Section 2 is the area with the highest risk, followed by Sections 1 and 3 with high risk area ratings, sections 4 and section 6-12 with moderate risk area ratings and Section 5 as the least risky area because no reports of accidents were made in this area in 2013, which is the year the data was collected.

Risk Area Map Section 1 on Sukhumvit Rd., Sriracha Municipality.

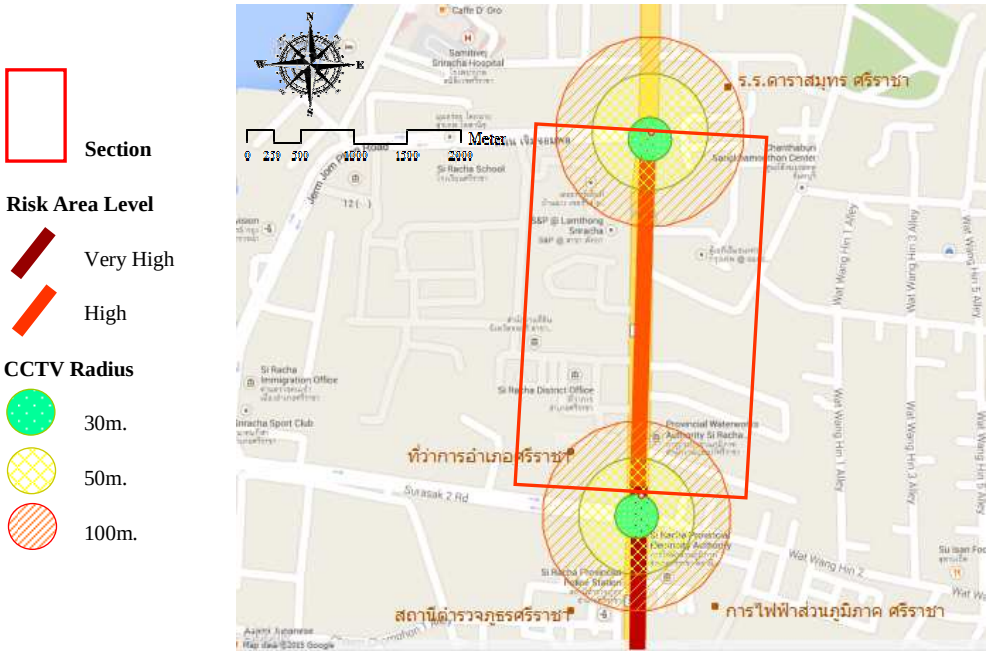


Figure 4.5 Risk Area Map in Section 1

Risk Area Map Section 2 on Sukhumvit Rd., Sriracha Municipality.

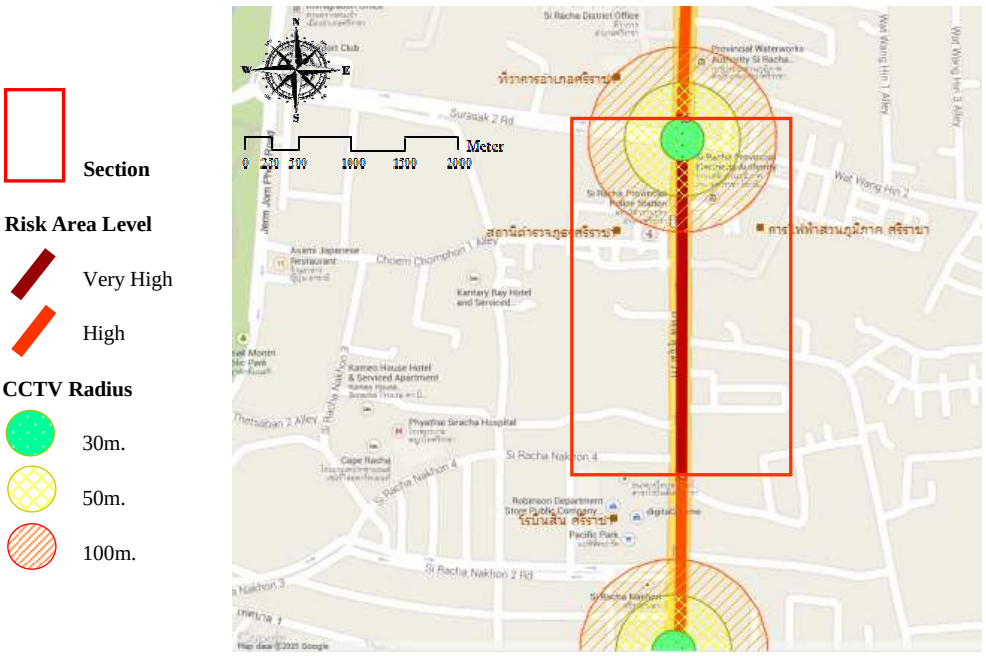


Figure 4.6 Risk Area Map in Section 2

Risk Area Map Section 3 on Sukhumvit Rd., Sriracha Municipality.

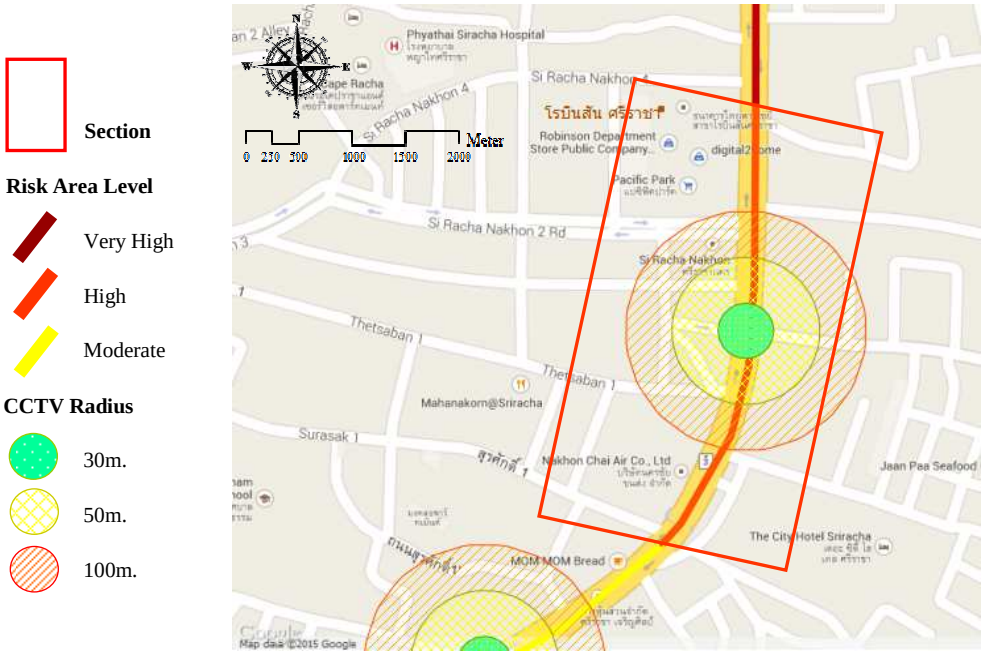


Figure 4.7 Risk Area Map in Section 3

Risk Area Map Section 4 on Sukhumvit Rd., Sriracha Municipality.

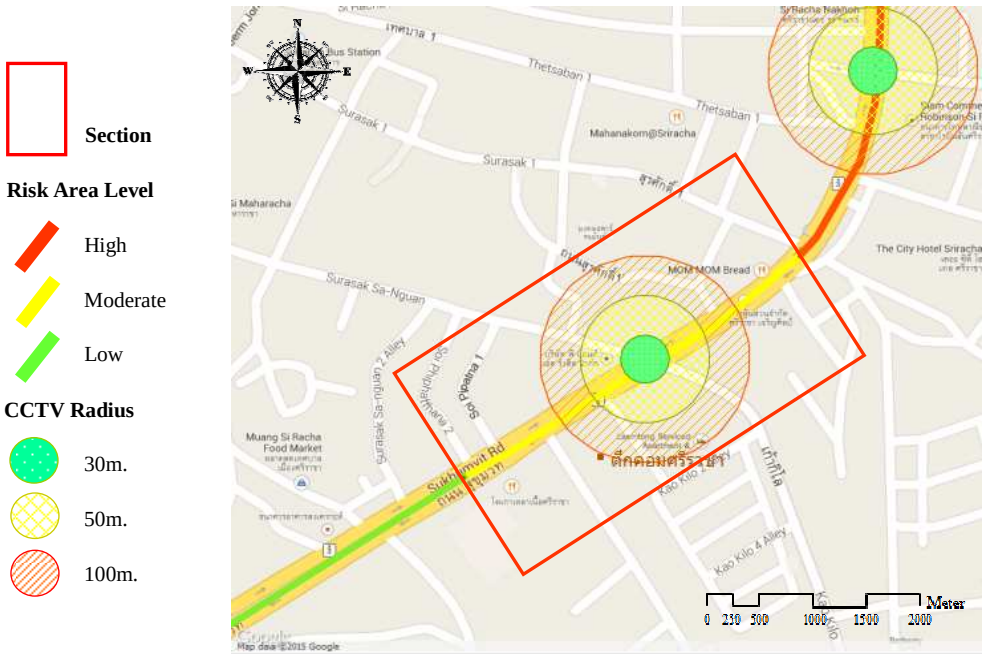


Figure 4.8 Risk Area Map in Section 4

Risk Area Map Section 5 on Sukhumvit Rd., Sriracha Municipality.

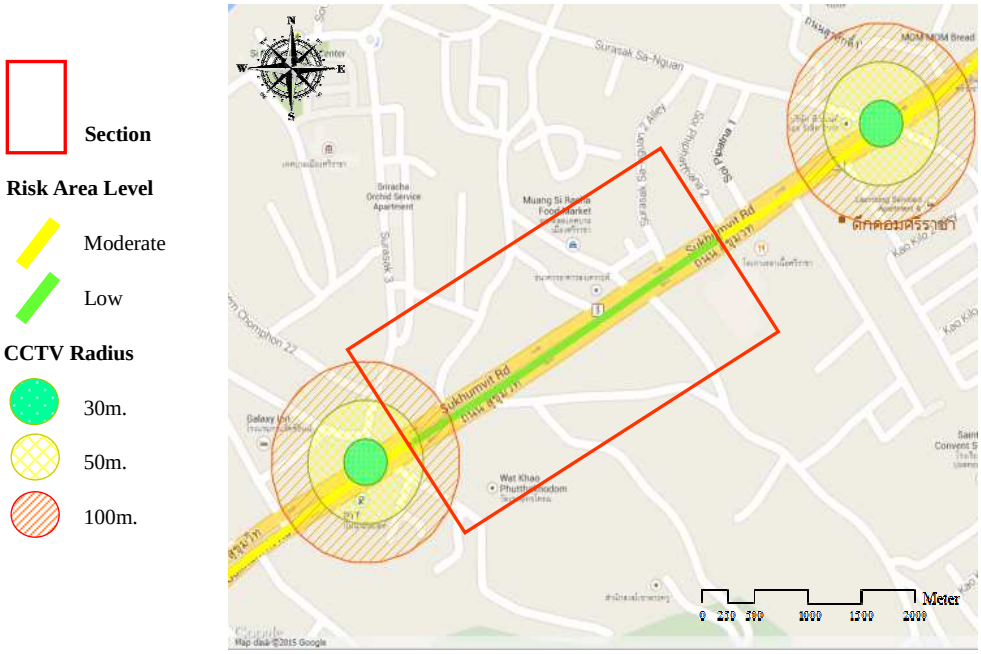


Figure 4.9 Risk Area Map in Section 5

Risk Area Map Section 6 on Sukhumvit Rd., Sriracha Municipality.

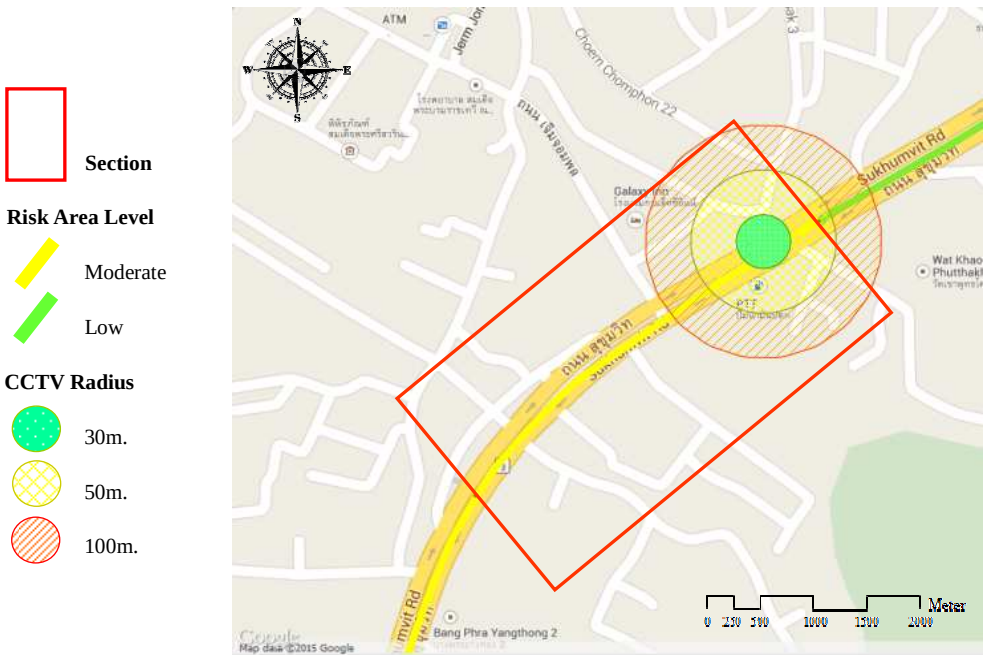


Figure 4.10 Risk Area Map in Section 6

Risk Area Map Section 7 on Sukhumvit Rd., Sriracha Municipality.

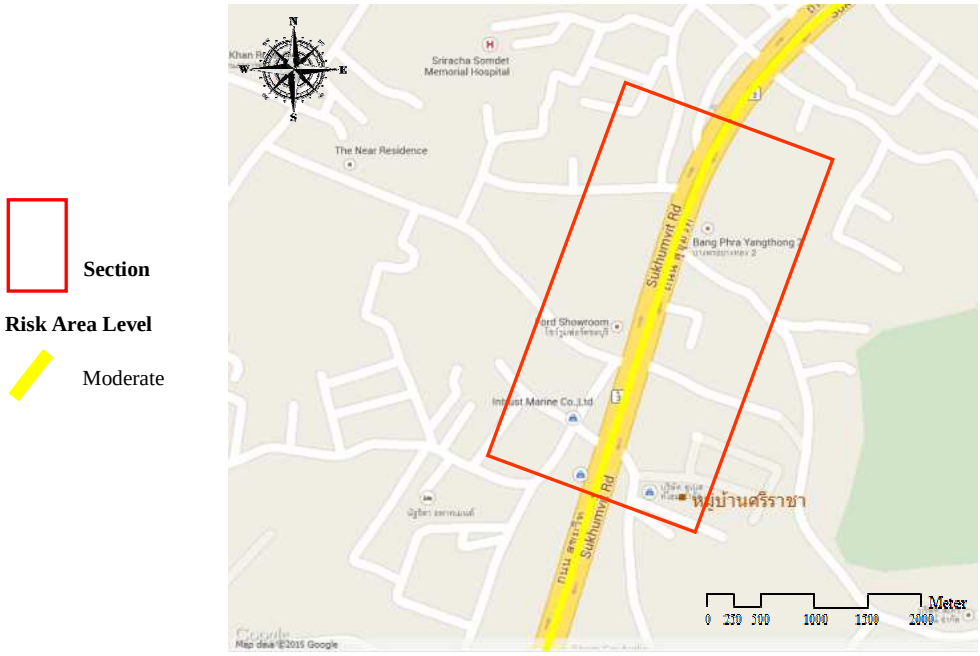


Figure 4.11 Risk Area Map in Section 7

Risk Area Map Section 8 on Sukhumvit Rd., Sriracha Municipality.

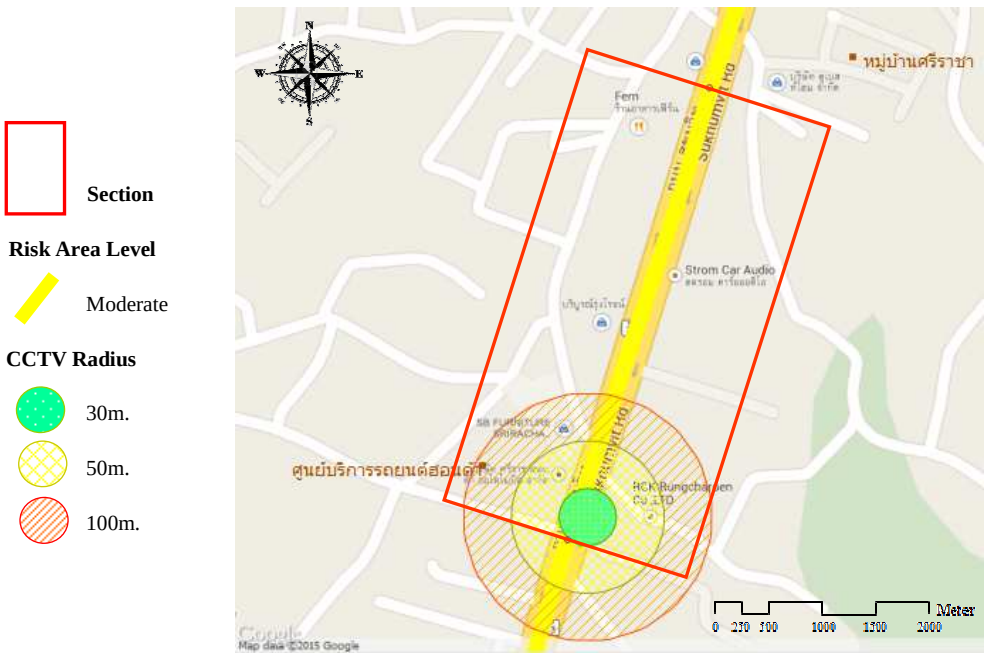


Figure 4.12 Risk Area Map in Section 8

Risk Area Map Section 9 on Sukhumvit Rd., Sriracha Municipality.

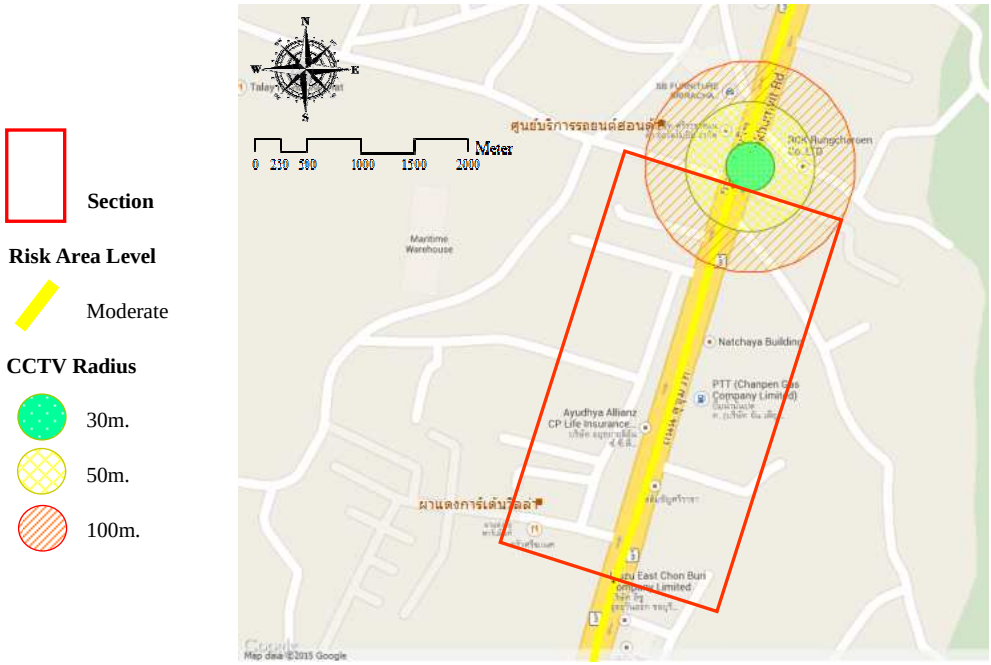


Figure 4.13 Risk Area Map in Section 9

Risk Area Map Section 10 on Sukhumvit Rd., Sriracha Municipality.

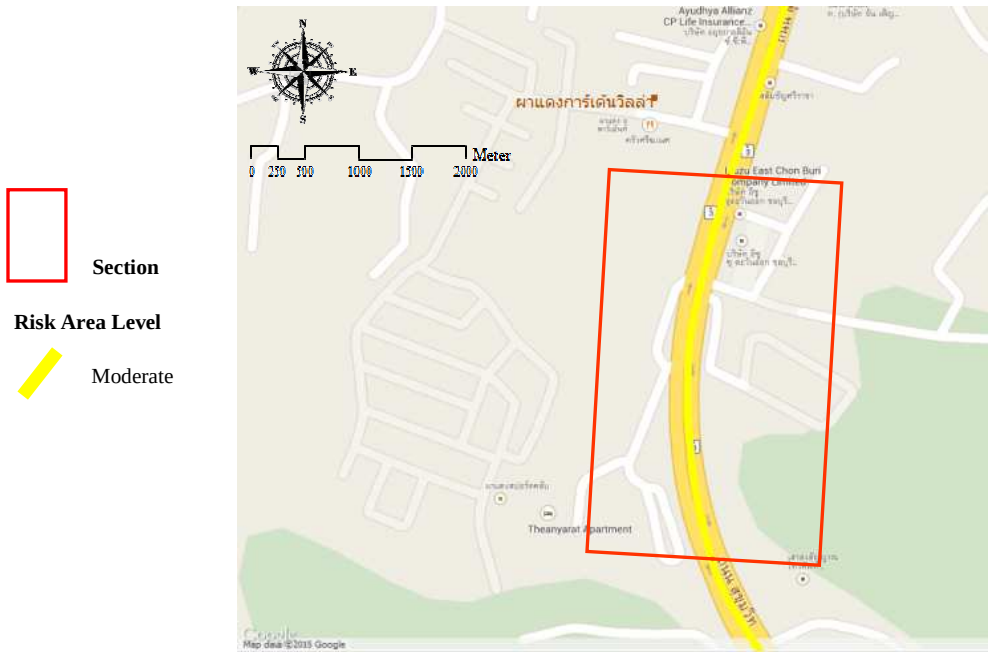


Figure 4.14 Risk Area Map in Section 10

Risk Area Map Section 11 on Sukhumvit Rd., Sriracha Municipality.

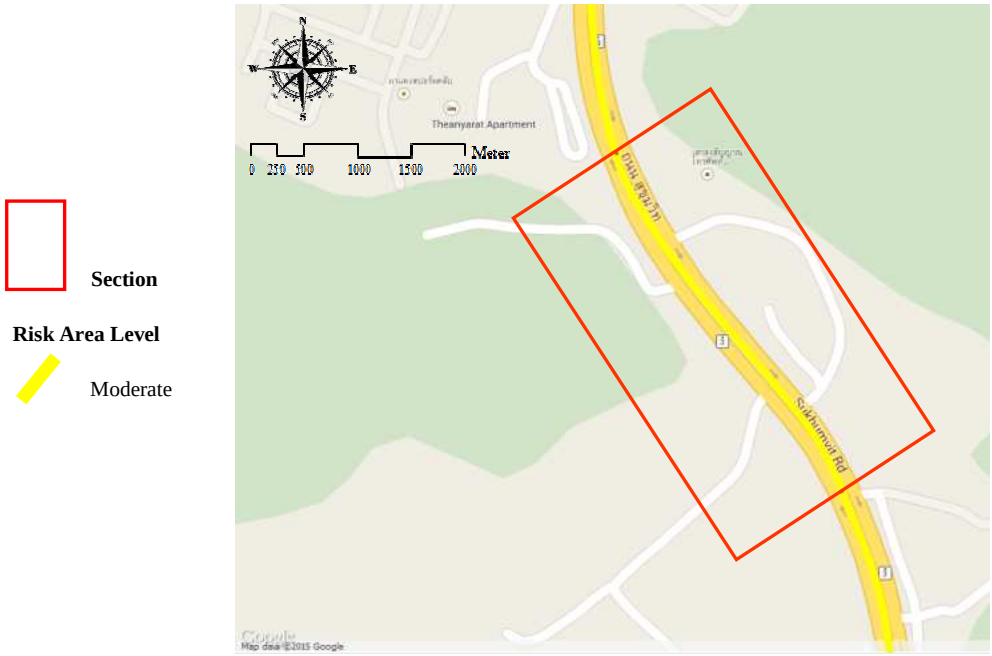


Figure 4.15 Risk Area Map in Section 11

Risk Area Map Section 12 on Sukhumvit Rd., Sriracha Municipality.

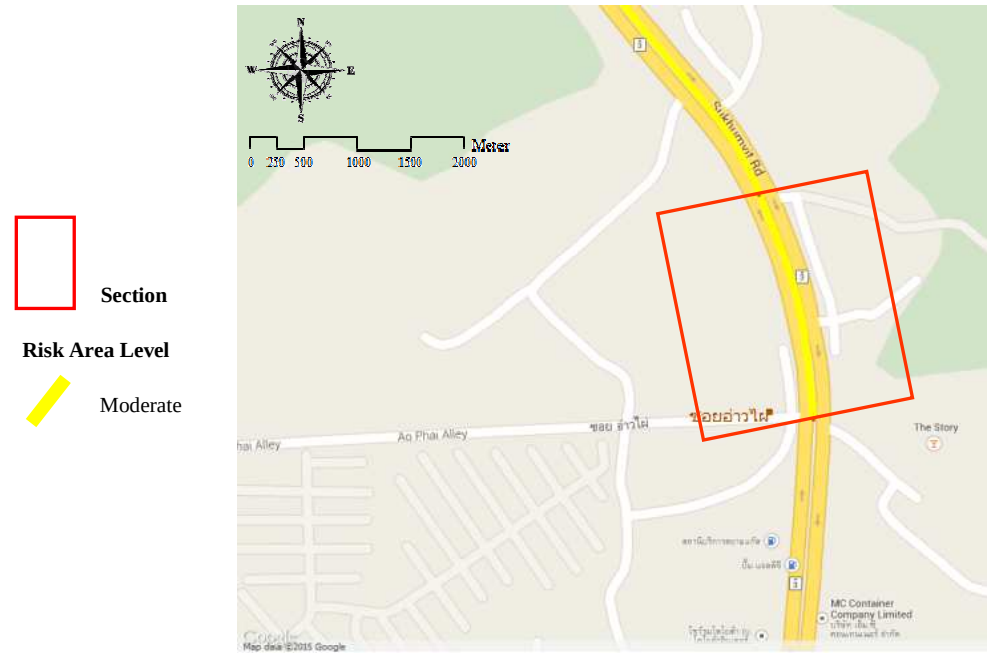


Figure 4.16 Risk Area Map in Section 12

4.2 Site Selection

The selection of suitable sites for CCTV installation and adequacy for CCTV site use is based on following the decision criteria:

- Each section's level of risk makes up the primary component for decision-making.

- Local data also accompanies considerations to determine which section is a community, business, three- or four-way intersection or roundabout/U-turn along with road condition data.

- Because the number of accidents in some sections of the road might not be considered sections with greater risk for accidents than sections with fewer accidents because sections with more accidents have heavier traffic. For this reason, consideration needs to also be given to site data in order to examine the feasibility factors of traffic congestion, road conditions and certain sections where CCTV has already been installed. Consideration must also be given to the sufficiency of the aforementioned for use in those sections.

- The selection of CCTV installation sites also requires interviews with experts in order to obtain suitable installation sites and views for CCTV use.

According to risk area and spatial data analysis, a summary was obtained on determining risk areas and sites suitable CCTV installation on the Sukhumvit Rd., Sriracha Municipality. The findings revealed three sections to be suitable for additional installations in the area of study as shown in Table 4.5

Table 4.4 Suitable sections for additional installations with in Sriracha Municapility.

Suitable Point	Section	Road Section
1	S2	Wat Wang Hin Intersection - Sriracha Nakhon 4
2	S3 , S4	Sriracha Nakhon 4 - Sriracha Land Village
3	S7	Sukhumvit Curve - Sriracha Village

This can be shown on the map the sites in the three sections are suitable for additional CCTV installation and CCTV Radius on Sukhumvit Rd., Sriracha Municapility, as shown in Figures 4.17-4.23.

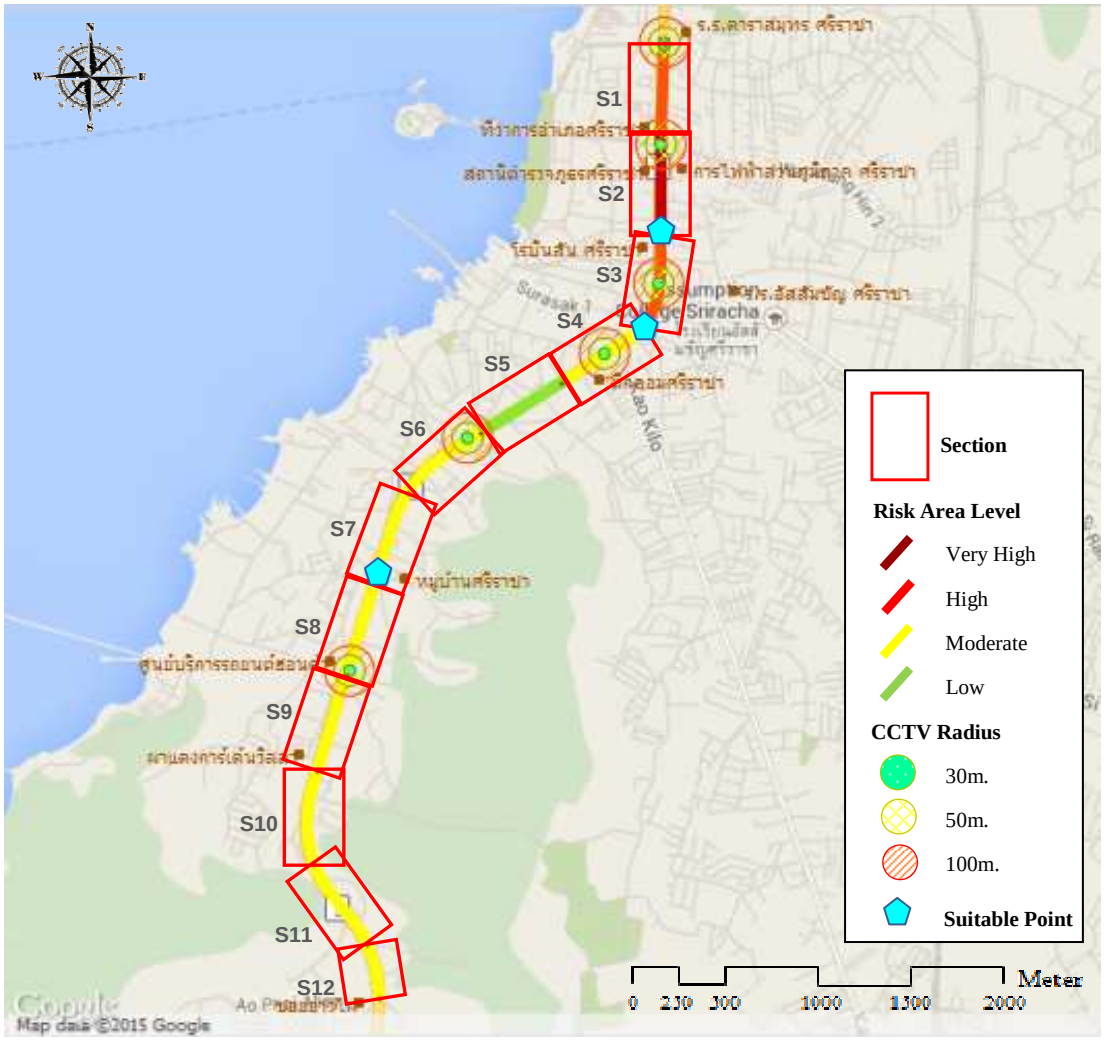


Figure 4.17 Suitable sections for additional CCTV installation on the Sukhumvit Rd., Sriracha municipality

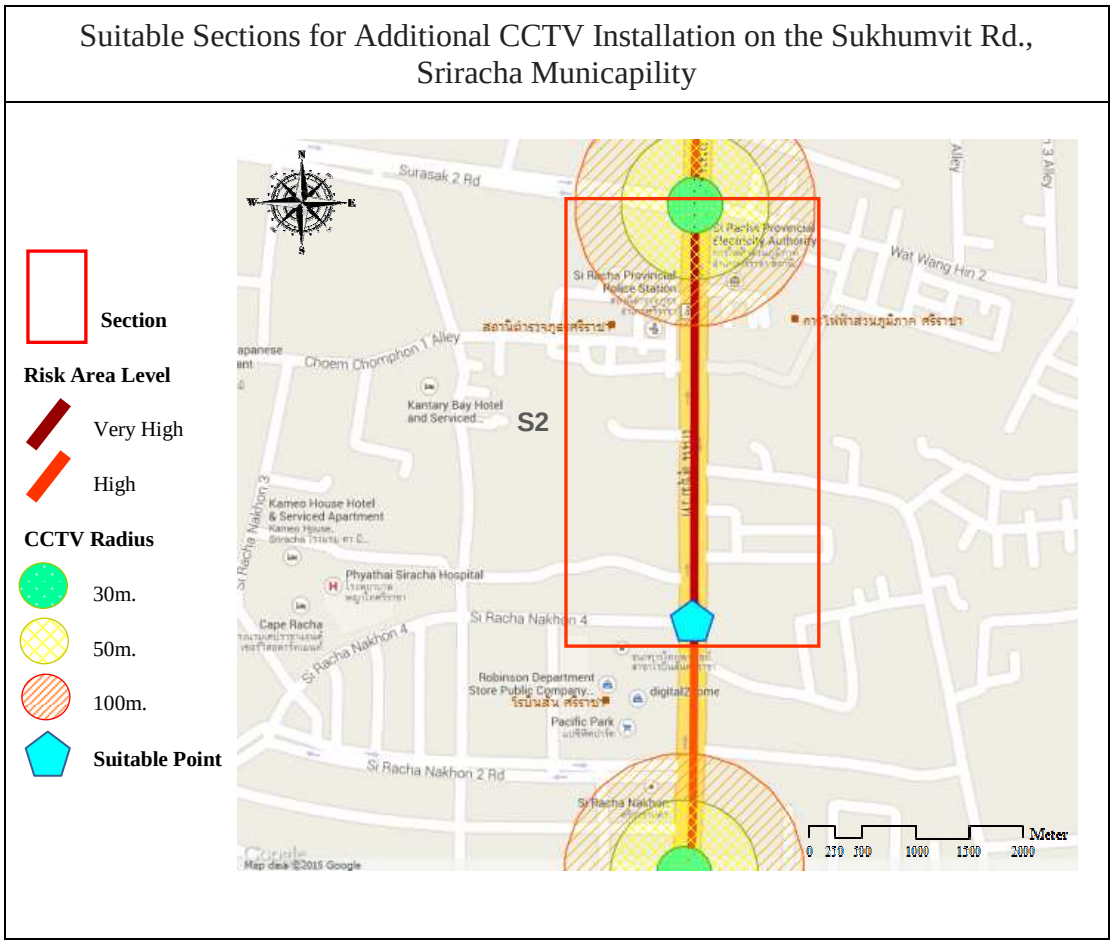


Figure 4.18 Map of suitable sites for CCTV installation, Point 1

In Figure 4.18, shows an area in Section 2 suitable for additional CCTV installation. Soi Sriracha Nakhon 4 (Robinson Sriracha) already has CCTVs installed but without the coverage necessary for work. Moreover, this area was rated with a very high level of risk.

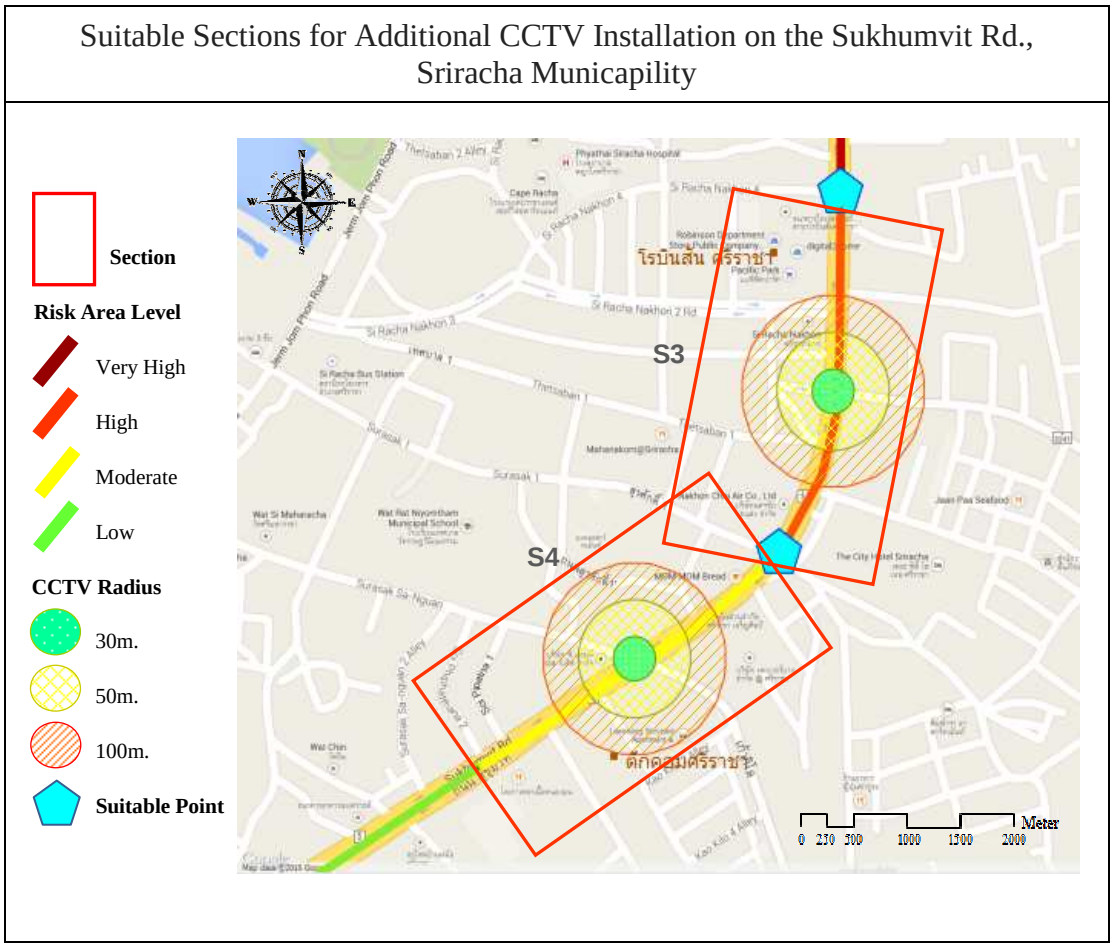


Figure 4.19 Map of suitable sites for CCTV installation, Point 2

In Figure 4.19, shows the areas from Sections 3 and 4 in which the site suitable for additional CCTV installation is the Crossroad Surasak. The two sections already have CCTVs installed but not adequately for usage as this area is a road intersection leading to residential areas with heavy traffic and high risk level.

Suitable Sections for Additional CCTV Installation on the Sukhumvit Rd., Sriracha Municapility

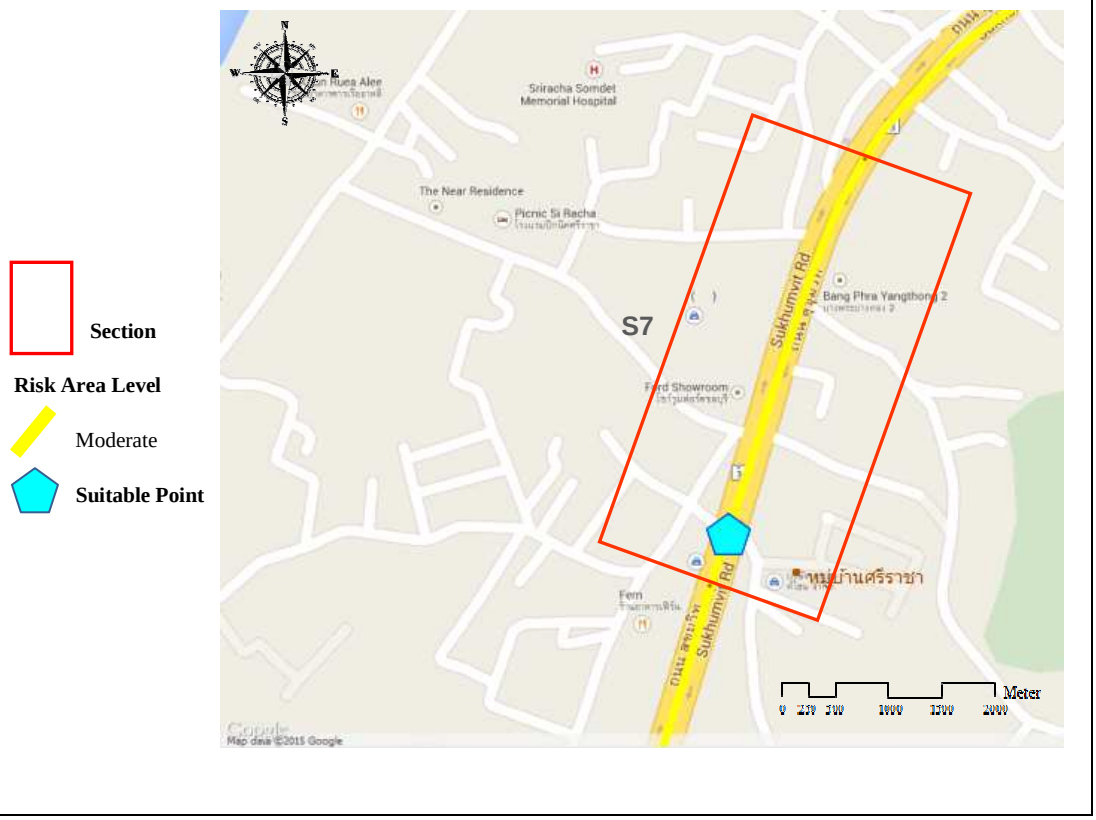


Figure 4.20 Map of suitable sites for CCTV installation, Point 3

In Figure 4.20, shows the area in Section 7 with suitable sites for additional CCTV installations. The Sriracha Village in this section has no CCTVs installed; however, since the area is a residential and industrial factory district where the front road leading to Sriracha Village is a U-turn/roundabout, the risk for this area was evaluated as moderate.

In Figure 4.21-4.23, show the simulated radius of CCTV when additional CCTVs are installed on the Sukhumvit Rd., Sriracha Municipality. The positions and radial coverage for suitable CCTVs are also shown.

Suitable Sections for Additional CCTV Installation and CCTV Radius on the Sukhumvit Rd., Sriracha Municapility

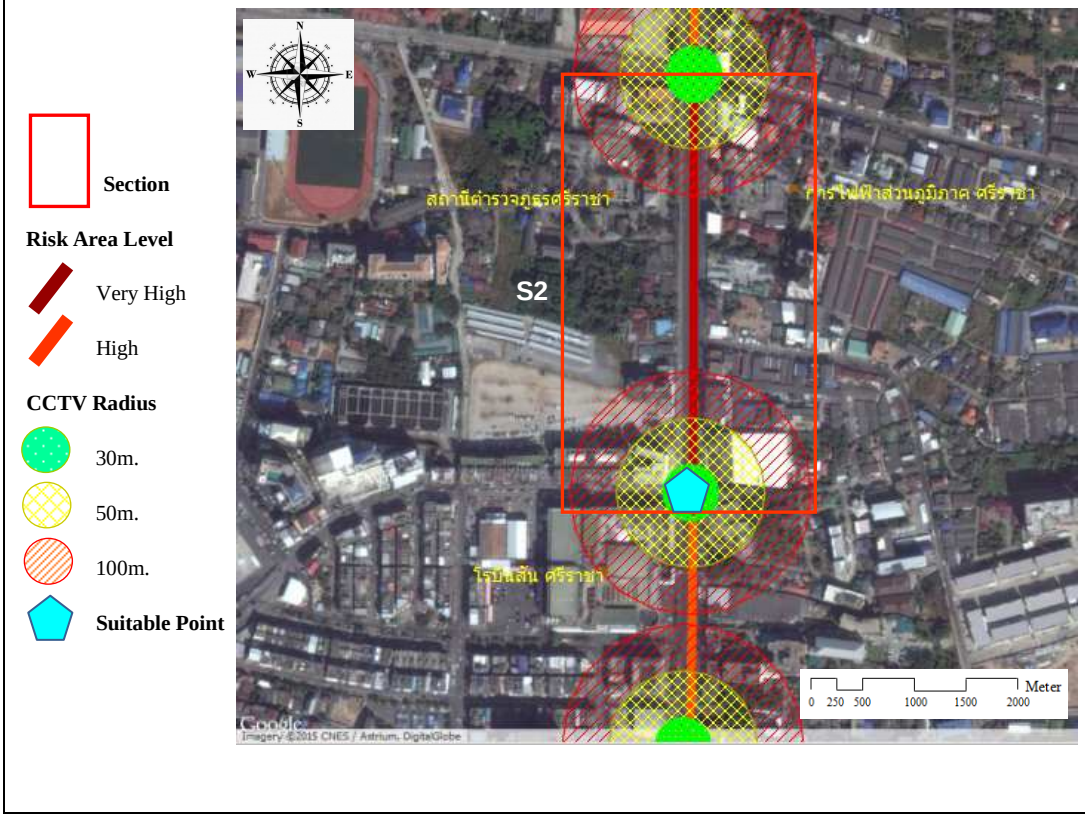


Figure 4.21 Map showing CCTV Radius in suitable sites for CCTV installation, Point 1 in Google Satellite Map

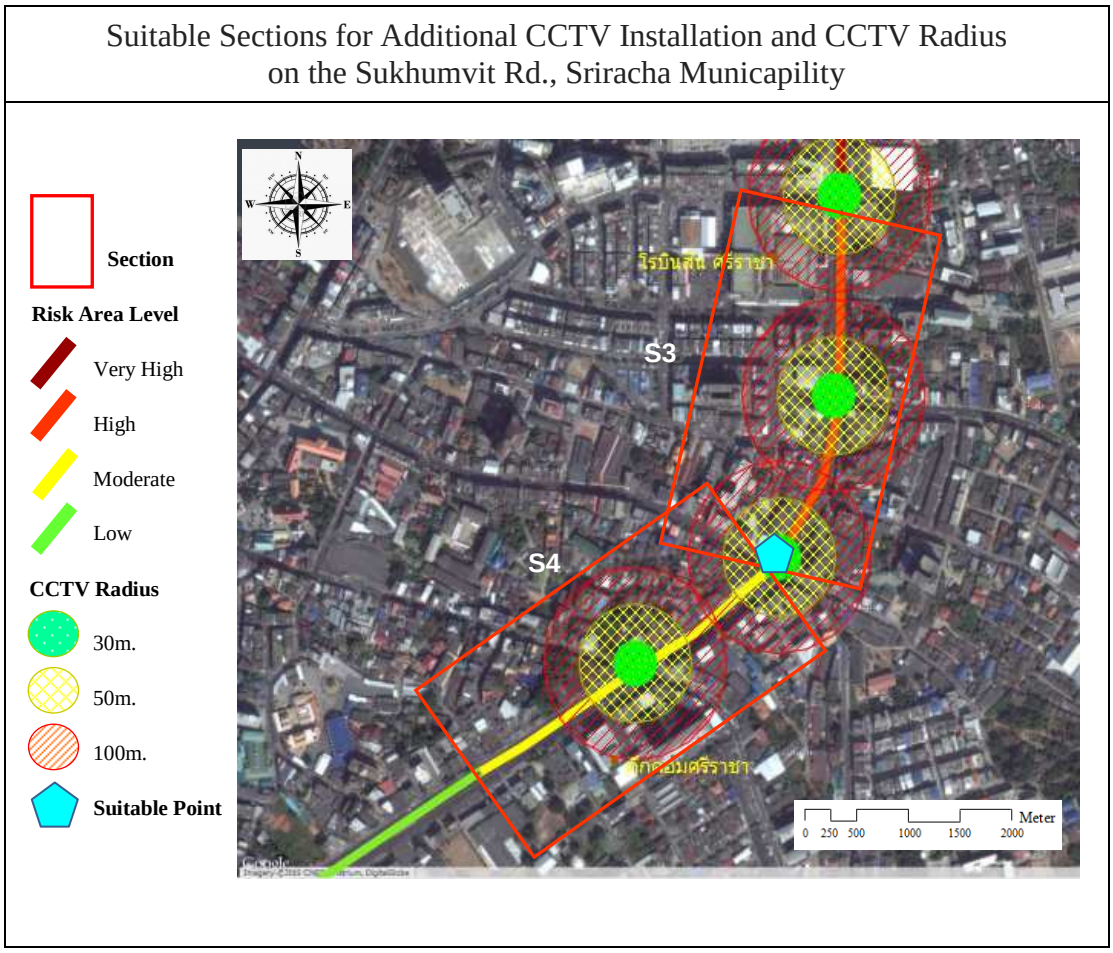


Figure 4.22 Map showing CCTV Radius in suitable sites for CCTV installation, Point 2 in Google Satellite Map

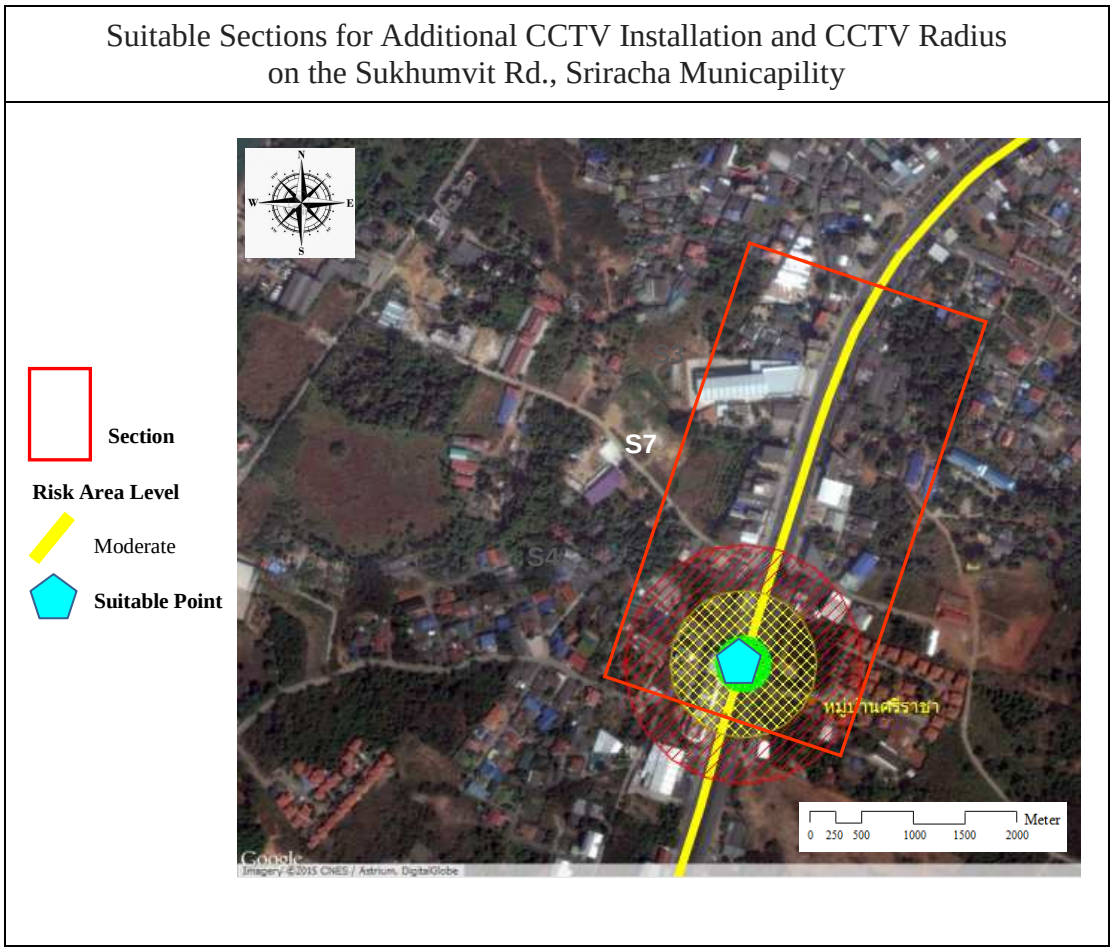


Figure 4.23 Map showing CCTV Radius in suitable sites for CCTV installation, Point 3 in Google Satellite Map

CHAPTER V
DISCUSSION

The present chapter will explain details involved in the analysis to obtain suitable sites for CCTV installation in Sriracha Municipality, Chonburi Province. The risk areas will be explained according to analysis results in addition to risk factors and suitable areas for additional CCTV installation, including selection factors suitable for the area of study.

5.1 Discussion of the Risk Area

The results of the risk area calculations can explain the factors involved in the occurrence of accidents and the risk factors for each section as follows:

Table 5.1 Risk Area Calculation Results for Each Section

Risk Area Level	Section	Road Section
Very High	S2	Wat Wang Hin Intersection - SrirachaNakhon 4
High	S1	Darasamutr School - Wat Wang Hin Intersection
	S3	SrirachaNakhon 4 - Sriracha Land Village
Moderate	S4	Sriracha Land Village - Toyota Charoenyonchonburi
	S6	Wat Buddhakodom - Sukhumvit Curve
	S7	Sukhumvit Curve - Sriracha Village
	S8	Sriracha - Had Pa Daeng Intersection (Honda Center)
	S9	Had Pa Daeng Intersection (Honda Center) - East Isuzu
	S10	East Isuzu - Pa Daeng Curve 1

Table 5.1 Risk Area Calculation Results for Each Section (cont.)

Risk Area Level	Section	Road Section
Moderate	S11	Pa Daeng Curve 1 - Pa Daeng Curve 2
	S12	Pa Daeng Curve 2 - Entrance to Soi Ao Phai
Low	S5	Toyota Charoenyonchonburi - Wat Buddhakodom

5.1.1 Very High Risk Area Level

- **Section 2 (S2)** is classified as a very high risk area level. CCTV is already installed in this section. The conditions in the area surrounding the section include government agencies, hospitals, business districts, entertainment venues and road conditions with intersections and a high degree of traffic congestion. Therefore, Section 2 is considered a high risk area.

5.1.2 High Risk Area Level

- **Section 1 (S1)** is classified as a high risk area level. CCTV is already installed in this section. The conditions in the area surrounding the section include schools, hospitals, government agencies and road conditions with 4-way intersections with severe traffic congestion.
- **Section 3 (S3)** is classified as a high risk area level. CCTV is already installed in this section. The conditions in the area surrounding the section include schools, business districts, entertainment venues, residences and road conditions with intersections and severe traffic congestion.

5.1.3 Moderate Risk Area Level

- **Section 4 (S4)** is classified as a moderate risk area level. CCTV is already installed in this section, even though Section 4 reports a low accident rate. The conditions in the area surrounding the section include business districts, residences and road conditions with intersections and severe traffic congestion. Therefore, Section 4 is considered a risk area.

- **Section 6 (S6)** is classified as a moderate risk area level. CCTV has already been installed in this section. The conditions in the area surrounding the section include shops, residences and road conditions marked by curves in the road.

- **Section 7 (S7)** is classified as a moderate risk area level. CCTV has already been installed in this section. The conditions in the area surrounding the section include shops and residences with entrances to industrial factories. The road conditions include a roundabout at the front of the entrance to Sriracha Village. The vehicles in this area are driven at rather high speeds and there are no traffic signals. Therefore, Section 7 is considered a risk area.

- **Section 8 (S8)** is classified as a moderate risk area level. CCTV has already been installed in this section. The conditions in the area surrounding the section include shops, industrial factories, residences and road conditions with roundabouts. The vehicles in this area tend to be driven at high speeds and the accidents occurring are rather severe. Therefore, Section 8 is considered a risk area.

- **Section 9 (S9)** is classified as a moderate risk area level. The conditions in the area surrounding the section include shops, industrial factories and residences. The road conditions include roundabouts. The vehicles in this area tend to be driven at high speeds and the accidents occurring are rather severe. Therefore, Section 9 is considered a risk area.

- **Section 10 (S10)** is classified as a moderate risk area level. The conditions in the area surrounding the section include shops, residences and hilly road conditions. The lighting at the roadside during the night is inadequate. The vehicles in this area tend to be driven at high speeds and the accidents occurring generally involve vehicles going off the side of the road.

- **Section 11 (S11)** is classified as a moderate risk area level. The conditions in the area surrounding the section include hilly road conditions. The lighting at the roadside during the night is inadequate. The vehicles in this area tend to be driven at high speeds and the accidents occurring generally involve vehicles going off the side of the road.

- **Section 12 (S12)** is classified as a moderate risk area level. The conditions in the area surrounding the section include industrial factories, product warehouses and residences. The road conditions are hilly. The lighting at the roadside during the night is inadequate.

5.1.4 Low Risk Area Level

- **Section 5 (S5)** in 2013, there were no reports of accidents. The risk area calculations classified the section as a low risk area level. The conditions in the area surrounding the section include business districts, restaurants, residences and road conditions with traffic congestion.

5.2 Discussion of the Site Selection

According to the risk site analysis and the interviews with experts and Investigation Inspectors from Sriracha Police Station, it can be concluded that there are three additional points suitable for CCTV installation in the area studied. The reasons for the suitability of the three sections and the views expected to be obtained can be explained as follows:

Table 5.2 Installation CCTV in the Suitable Area

Suitable Point	Section	Install Location	CCTV Type
1	S2	Soi Sriracha Nakhon 4 (Robinson Sriracha)	Fixed
2	S3 , S4	Crossroad Surasak	Fixed
3	S7	Sriracha Village	Fixed

- **Suitable Point 1 (Soi Sriracha Nakhon 4)** belongs to Section 2. This section has a very high level of risk and CCTV is already installed in the vicinity of the Wat Wang Hun Intersection. However, that is not sufficient, as Soi Sriracha Nakhon 4 (Robinson Sriracha) is a very crowded area. The area is a business district

containing entertainment venues and a hospital with heavy traffic congestion in addition to being a point for U-turns/roundabouts. No CCTVs cover the aforementioned roundabout, and the CCTV currently belongs to Sriracha Robinson Department Store, which is inadequate for police or security officials' work. The types of CCTV cameras suitable for installation in a camera CCTV fixed.

Figure 5.1 shows the CCTV images expected to be obtained from Suitable Point 1

Figure 5.2 shows the CCTV images expected to be obtained from Suitable Point 1

Figure 5.3 shows the CCTV images expected to be obtained from Suitable Point 1

- **Suitable Point 2 (Crossroad Surasak)** is a site located between Section 3 and Section 4. It has a moderate risk level. Both sections already have CCTVs installed, but neither have coverage at Surasak Crossroad, which has heavy traffic congestion. The road is an intersection leading to community neighborhoods, and surroundings include residences, stores, schools, hospitals and government agencies located on Soi Surasak 1. Therefore, additional CCTV installation is essential. And in this area is suitable for the installation of CCTV cameras fixed.

Figure 5.4 shows the CCTV images expected to be obtained from Suitable Point 2

Figure 5.5 shows the CCTV images expected to be obtained from Suitable Point 2

Figure 5.6 shows the CCTV images expected to be obtained from Suitable Point 2

- **Suitable Point 3 (Sriracha Village)** belongs to Section 7. This section is a low level risk area and has no CCTVs installed. The surroundings include homes, stores and industrial factories, and the road in front of Sriracha Village is a roundabout for cars. However, vehicles in this section are driven at rather high speeds and no traffic lights are present. Furthermore, another reason this section is suitable for CCTV installation is that the area is a community neighborhood with many shortcut roads connecting to many other areas. Therefore, it is essential that police officers or

security officials have CCTV access here to monitor for escaping criminals in addition to traffic benefits. The types of CCTV cameras suitable for installation in a camera CCTV fixed.

Figure 5.7 shows the CCTV images expected to be obtained from Suitable Point 3

Figure 5.8 shows the CCTV images expected to be obtained from Suitable Point 3

CHAPTER VI
CONCLUSION AND RECOMMENDATIONS

6.1 Conclusion

6.1.1 Areas most at risk and suitable for additional CCTV installations are the road sections from Wat Wang Hin Intersection – Robinson Sriracha, because the aforementioned area is an important business district in Amphoe Sriracha with heavy traffic and the highest accident incidence statistics. Although the area has CCTVs in place, it lacks full and adequate coverage for use in safety work.

6.1.2 The least risky area is the area from Toyota Charoenyon Chonburi - Wat Buddhakodom because the area is a residential neighborhood where shops and restaurants are located without any reports of any accidents occurring and because the area was evaluated as a low risk area.

6.1.3 CCTVs are not beneficial only for accident prevention, because accidents are caused by many factors such as road conditions and driver's behavior. but also in situational monitoring, case evidence footage and traffic police work.

6.2 Recommendations

The present research recommends the following to benefit future research:

6.2.1 Obtain additional sources of information and accident incidence characteristics for accident statistics.

6.2.2 Apply techniques to calculate risk areas such as accident severity scores, comparatively in order to obtain the most optimal scores for risk area analysis.

REFERENCES

Caplan, J.M., Kennedy, L.W. and Petrossian, G. (2011). Police-monitored CCTV cameras in Newark, New jersey: A quasi-experimental test of crime deterrence. *Journal of Experimental Criminology.* 7(3): 255-274.

De Rose, F. (1964). *An Analysis of Random Freeway Traffic Accidents and Vehicle Disabilities.* Highway Research Record 59, 53-65.

ERSI. (1995). *ARC/INFO Data management concept, data model database design, and data storage.* Redlands (CA): ERSI.

Giuliano, G. (1989). *Incident Characteristics, Frequency And Duration on high Volume Urban Freeway.* Transportation Research 23A, 387-396.

Goolsby, M.E. and Smith, W. (1971). *Influence of Incident on Freeway Quality of Service.* Highway Research Record, 41-46.

Grareme, F. and Bonham, C. (1996). *Geographic Information System for Geoscientists: Modeling with GIS.* U.S.A.: Van Nostrand Reinhold Co. Inc.

Hirschfield, A. and Bowers, K. (2001) Mapping and Analysing Crime Data: Lessons from Research and Practice, Taylor and Francis, New York.

James, A. and Lagro J.R. (2001). Site Analysis Linking Program and Concept in Land Planning and Design (1st ed.). New Jersey: John Wiley & Sons.

Joseph, B.K. and William, R.J. (1994). *Introduction to Geographic information system In: Natural resource: a compendium.* Bethesda (MD): American society for photogrammetry and remote sensing.

Jorgensen, S. H., and Abane, A. M. (1999). A comparative study of urban traffic accidents in developing and developed countries: Empirical observations and problems from Trondheim (Norway) and Accra (Ghana). *Bulletin of the Ghana Geographical Association.* No. 21, pp. 113-128.

Lee, L.K. (1995). CCTV camera site selection: a field experience. *Vehicle Navigation and Information Systems Conference,* 6(1): 21-27.

Michael D. (2005). *Suitability analysis: Landscape Architectural Theory*. [online], available : http://en.wikipedia.org/wiki/Suitability_analysis [accessed 3 Jan 2014].

Ming, Y., Jiang, J. and Bian, F. (2002). *CCTV Monitoring System* [online], available: http://www.isprs.org/proceedings/part4/pdfpapers/334.pdf [accessed 20 Aug 2013].

Oluwasanmi, A.J. (1993). Road accident trend in Nigeria. *Accident Analysis & Prevention*. 25(4): 485-487.

Ratcliffe, J.H. (2006). Video surveillance of public places (Problem-oriented guides for police, Response guides series no.4). Washington DC: Center for Problem Oriented Policing.

Rundmo, T. and Iversen, H. (2004). Risk perception and driving behavior among adolescents in two Norwegian countries before and after traffic safety campagn. *Safety science*, 42, 1-21.

Rune, E. (2002). *Human Ecology: A New Social Science.* Teachers College Record 39, 488-493.

Russell, G. (1992). *The ABCs of GIS: An Introduction to Geographic Information Systems.*

Scott, W. (2001). Measuring the built environment: validity of a site survey instrument for use in urban settings. *Health & Place*, 7(4): 283-292.

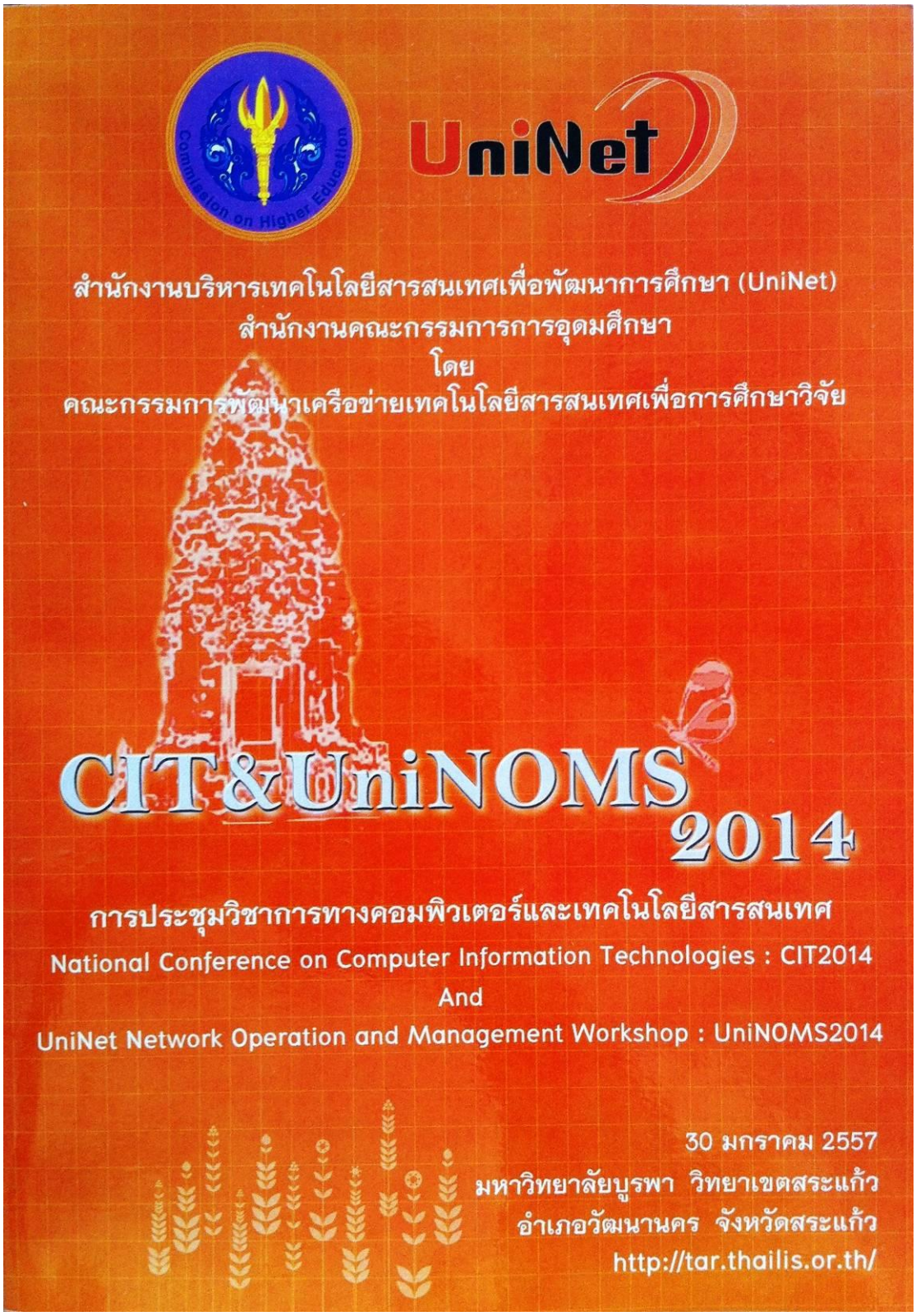
Stuart Rich, Kevin H. Davis (2009-2010). *Geographic Information System (GIS) for Facility Management.* IFMA Foundation.

Supachai, A. (2002). *Development of a black spot analysis tool using GIS to traffic accidents.*

Supornchai, U. (2000). *Geographic information technology systems to the determination of hazardous sites on highways in Thailand.*

APPENDIX

The National Conference Information Technologies (CIT2014) and UniNet Network Operation and Management workshop 2014 (UniNOMS2014)


UniNet
สำนักงานบริหารเทคโนโลยีสารสนเทศเพื่อพัฒนาการศึกษา (UniNet)
สำนักงานคณะกรรมการการอุดมศึกษา
โดย
คณะกรรมการพัฒนาเครือข่ายเทคโนโลยีสารสนเทศเพื่อการศึกษาวิจัย
CIT&UniNOMS 2014
การประชุมวิชาการทางคอมพิวเตอร์และเทคโนโลยีสารสนเทศ
National Conference on Computer Information Technologies : CIT2014
And
UniNet Network Operation and Management Workshop : UniNOMS2014
30 มกราคม 2557
มหาวิทยาลัยบูรพา วิทยาเขตสระแก้ว
อำเภอวัฒนานคร จังหวัดสระแก้ว
http://tar.thailis.or.th/

สารบัญ

การวิเคราะห์หาพื้นที่เหมาะสมสำหรับการติดตั้งกล้องโทรทัศน์วงจรปิดในจังหวัดชลบุรี

The Site Selection Analysis for CCTV Installation in Chonburi Province

Supajira Kaewkomut[1] , Wutjanun Muttitanon[2] , Areeya Rittima[2] , Kritsanat Surakit[2]
[1]Technology of Information System Management,
[2]Department of Civil Engineering, Mahidol University
Email: supajira.k@gmail.com

Abstract

Closed Circuit Television (CCTV) is a device that is very important in a security system used by recording events and data in Real Time to be useful to the police in the planning and monitoring traffic circumstances and the escape route of the perpetrator . Currently, found that barriers to use some such. The installation is not proper angle obstacles , a number of CCTV cameras is not enough space.

This study was to analysis suitable for installing CCTV cameras in Chonburi Province . Using GIS Software , an application of GIS. By the spatial data community , an area with dense population and the royal road accidents are frequent . A major factor in determining the proper installation of CCTV cameras, the result will be something that helps to support the decision making process for choosing a CCTV camera installed in Chonburi Province

Keywords: GIS, Site Selection Analysis, Risk Analysis

บทคัดย่อ

ปัจจุบันกล้องโทรทัศน์วงจรปิด (CCTV) เป็นอุปกรณ์ที่มีความสำคัญมากในระบบรักษาความปลอดภัย โดยนำมาใช้บันทึกภาพเหตุการณ์และแสดงข้อมูลแบบ Real Time เพื่อเป็นประโยชน์กับเจ้าหน้าที่ตำรวจในการใช้วางแผนงานจราจรและเฝ้าดูติดตามพฤติการณ์และการใช้เส้นทางหลบหนีของผู้กระทำผิด โดยในปัจจุบันพบว่ามีอุปสรรคต่อการใช้งานอยู่หลายประการเช่น จุดติดตั้งไม่เหมาะสมมีสิ่งกีดขวางมุมภาพ, จำนวนกล้อง CCTV ไม่เพียงพอกับพื้นที่

การศึกษาครั้งนี้ได้ทำการวิเคราะห์หาพื้นที่เหมาะสมสำหรับการติดตั้งกล้อง CCTV ในพื้นที่จังหวัดชลบุรี โดยใช้โปรแกรม GIS ซึ่งเป็นการประยุกต์ใช้ระบบสารสนเทศภูมิศาสตร์ โดยนำข้อมูลเชิงพื้นที่, พื้นที่ที่มีความหนาแน่นของประชากร และเส้นทางถนนหลวงที่มีการเกิดอุบัติเหตุบ่อยครั้งมาเป็นปัจจัยหลักในการพิจารณากำหนดจุดติดตั้งกล้อง CCTV ที่เหมาะสม ผลที่ได้จะเป็นสิ่งที่ช่วยสนับสนุนกระบวนการการตัดสินใจเลือกพื้นที่สำหรับติดตั้งกล้อง CCTV ในพื้นที่จังหวัดชลบุรีต่อไป

คำสำคัญ ระบบสารสนเทศภูมิศาสตร์, การวิเคราะห์หาพื้นที่, การวิเคราะห์ความเสี่ยง

1. Introduction

Chonburi Province is the economic and industrial growth continues and is a major tourist city with the rate of increase in population and tourists every year, Density of buildings, a higher cost of living and traffic congestion These factors are the driving force of social problems due to a higher number of crimes and accidents , such as robbery. Controversy assault Abduct , rape, murder and drug trafficking, traffic accidents , etc. In some areas, it is risk areas, including areas with congestion. The enclosed space or out of sight Deserted from the community Lack of adequate lighting, etc., which when compared to the number of government officials, area and population ratios were found to be very different. Insufficient monitoring to cover all areas. In some cases the lack of witnesses and evidence , which resulted in difficult to arrest the culprit. Of the problems affecting the conditions of life safety and property of citizens. Despite efforts to control these factors , but the crime is not likely to be reduced due to the solution and implementation is difficult and time consuming because it requires accurate data and timely.

Closed Circuit Television (CCTV) is recording events and display image data for real time delivered directly to the control center. To be beneficial to the work of police officers and security. Traffic planning monitor and track the circumstances of the offense and the offender's escape route. It can be a photo or video evidence to be proven wrong. Or innocence of the accused persons to assert in court to prosecute offenders To predict the likelihood of the incident clearly[1]

However, images from CCTV cameras installed in the area, there is still several problems, such as the contrast of the image. The picture is too high Obstructed or obscured camera angles. The improper installation of CCTV cameras is not enough space.

The researcher to see the problem. Our aim was to evaluate the installation of CCTV cameras to be installed at the point of the Geographic Information System (GIS). An effective system to manage databases and mapping systems. Used to link the different positions on the map, including geographical information systems have the ability to search and process information. By providing basic information to analyze and integrate the relation of each factor to get the desired results [2]. Because of such a concept to GIS applications for analysis of space for installation of CCTV cameras to analyze the physical community. The roads and highways of the study area. The result was attributed to the decision to determine the proper installation of CCTV cameras in Chonburi Province.

2. Objective

The objectives of the research are as the following:

- To analyze risk areas, communities and the traffic with traffic in Chonburi Province.
- To determine site selection to install CCTV cameras in Chonburi Province.

3. Methodology

Steps of research methodology is shown in Figure 1.

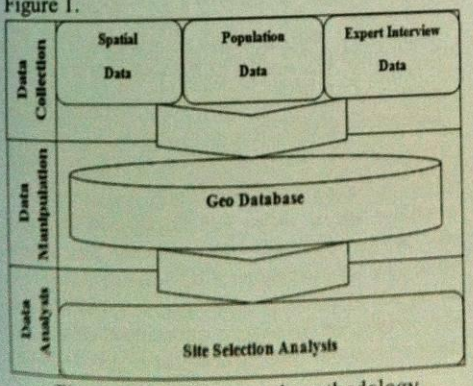


Figure 1 Steps of research methodology

3.1 Data Collection

Collecting the necessary information related to this research. Are as follows:

- Spatial Data

The place and route highways in Chonburi Province. The data from the GIS database and highways map.

- Population Data

Data sources community by the density of population and houses. A database of the district since the beginning of the process until the process.

This map shows the distribution of population density and community in area Amphoe Sattahip, Chonburi Province. [3]

- Area: 348.122 sq km.
- Population: 100,110
- 52,398 households
- The density population is 287.57 people / sq km.

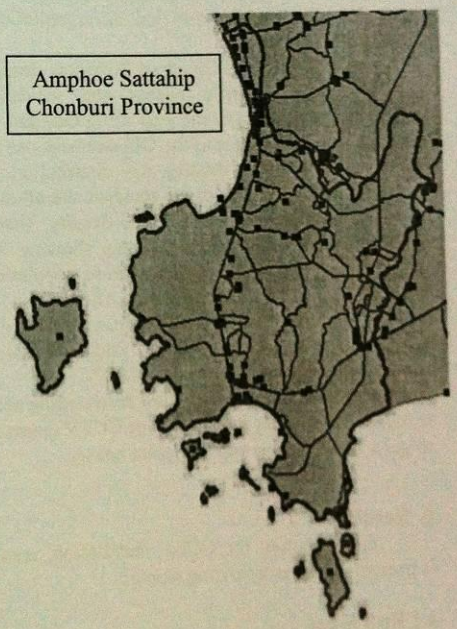


Figure 2 Assessment of population density

- Expert Interview Data

Information from with interviews expert or the police. The data obtained showed that the analysis and as a guide to determine the installed cameras CCTV.

3.2 Data Manipulation

For this section, these method used in converting analogue data to a digital format.

- Creation of attribute data, some of database of the attribute data acquired were created using Microsoft Excel and save as database file and imported into GIS Software as an event theme while some were directly created in GIS Software All the landmarks like village and roads were used in as a point and line formats which refers to actual location.

These data were used to analyze the population density and location coordinates road accident into GIS Software in order to determine suitable locations for the installation of CCTV. the data were input in to the form and converted into a map, the step of analysis will be handling for the rest of the process.

- Data correction spatial analysis and all associated data in the Chonburi Provinces, data need to be corrected and GIS application.

3.3 Data Analysis

- Spatial data of Chonburi Province, density the population. Traffic counts and incidence Taken as a data point in the map using GIS data to create a map and save it to the GIS database can be used to analyze the density and distribution of population and location of the accident site often.

- Evaluate the risk estimate density. Using GIS Software , the result is a map showing the density and distribution of the database population and the location of the accident site often.

- The results of the risk assessment for the area. The analysis considering finding suitable locations for the installation of a CCTV.

- To evaluate the condition surrounding area to select the area for installation of CCTV cameras to get a clear picture and sufficient space.

4. Result

Site selection for CCTV installation, result is presented as the following session:

4.1 Risk areas

This map shows the distribution areas of highway accidents are frequent in the area of Amphoe Sattahip 2013, the number of road accident statistics 421 times on average 1.15 times / day., And a 18 position as areas with frequent accidents. [4]

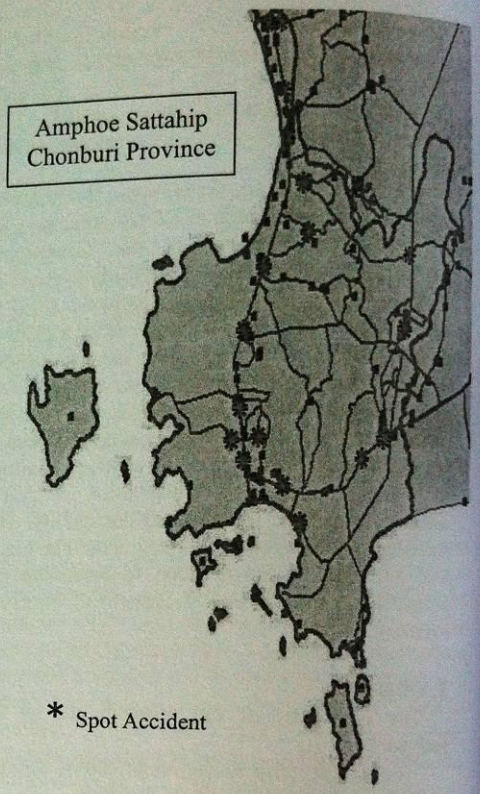


Figure 3 Find the area of risk assessment

4.2 Site Selection Analysis

This map shows the proper installation of CCTV cameras in Amphoe Sattahip by analysis of assessment data, population density and community. Statistics and databases accident area frequently. The results of the research should have discretion whether to install CCTV cameras as the number 17 positions.

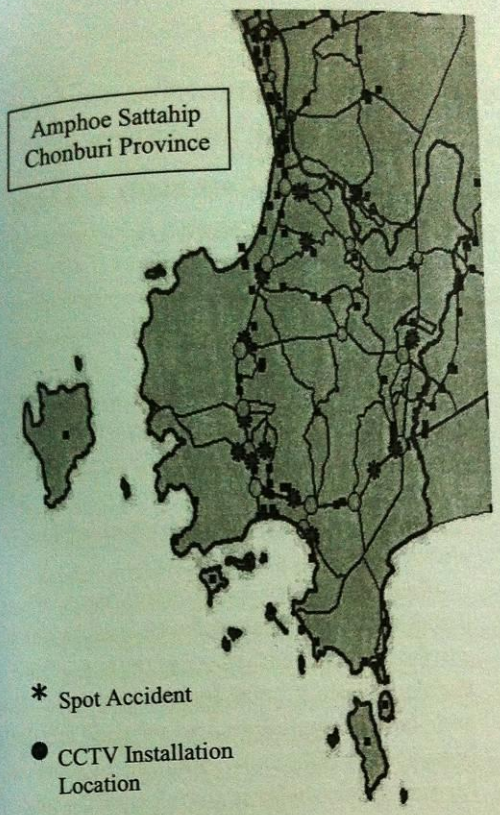


Figure 4 Analysis suitable to install CCTV

5. Conclusion

This study the site selection analysis for the installation of CCTV cameras Before installing the need to gather spatial data, survey areas, population density, accident statistics, road and will need to be interviewed experts or police. To recognize the need for the use of CCTV cameras and the information to be recorded in GIS using GIS Software is used to analysis the density and distribution of population and location of the accident site often. The result is the ability to assess risk in the area. To help support the decision to install CCTV cameras in the area to get the position and angle that is useful to the police or security monitoring trustee of the public. And can track the circumstances and the escape route of the perpetrator. The images can be used as evidence to prosecute and assist in the site selection for the installation of CCTV cameras on.

6. References

[1] J. Munsin, "Image restoration technique and its application to forensic science", Master Thesis, Major: Forensic Science, Silpakorn University, 2010, pp. 1-2.

[2] N. Sureyachai, "Development of crime map system case study for car theft in the district area, Nakhon Pathom Province", Master Thesis, Major: Forensic Science, Silpakorn University, 2010, pp. 1-14.

[3] Population. (2013, Nov. 22). Population Chonburi, [Online] Available: http://www.dopa.go.th

[4] Accident. (2014, Jan. 5). Accident Chonburi, [Online] Available: http://www.thairsc.com

CONFERENCE SUBMITTED IN NGRC34th


34th The National Graduate Research Conference
บทความฉบับเต็ม
การประชุมวิชาการเสนอผลงานวิจัย
ระดับบัณฑิตศึกษาแห่งชาติ ครั้งที่ 34
วันศุกร์ที่ 27 มีนาคม 2558
ณ อาคารเรียนรวม คณะแพทยศาสตร์ มหาวิทยาลัยขอนแก่น
บัณฑิตวิทยาลัย มหาวิทยาลัยขอนแก่น
GRADUATE SCHOOL KHON KAEN UNIVERSITY

รายชื่อผลงานวิจัยที่ได้รับการพิจารณาให้นำเสนอ แบบบรรยาย (Oral Presentation)

กลุ่มวิทยาศาสตร์กายภาพ 2 ระดับปริญญาโท

ณ ห้อง 3512 ชั้น 5 อาคารเรียนรวม คณะแพทยศาสตร์ มหาวิทยาลัยขอนแก่น

ที่	รหัส	เวลา	ชื่อ-สกุล	สถาบัน	สาขา	ชื่อเรื่องภาษาไทย	หน้า
8	PMO8	11.00-11.15 น.	นางสาวศุภจิรา แก้วโกมุท	มหาวิทยาลัยมหิดล	เทคโนโลยีการจัดการระบบสารสนเทศ	การวิเคราะห์หาพื้นที่เหมาะสมสำหรับการติดตั้งกล้องโทรทัศน์วงจรปิดในเทศบาลเมืองศรีราชา จังหวัดชลบุรี	217
9	PMO9	11.15-11.30 น.	นายทวิวุฒิ นามศิริ	มหาวิทยาลัยขอนแก่น	วิศวกรรมโยธา	ปัญหาการบริหารสัญญาก่อสร้างในมหาวิทยาลัยของรัฐ	225
10	PMO10	11.30-11.45 น.	นางสาวสุพิชญา โพธิ์สาขา	มหาวิทยาลัยเทคโนโลยีพระจอมเกล้าพระนครเหนือ	อุปกรณ์การแพทย์	การวิเคราะห์สัญญาณคลื่นไฟฟ้าหัวใจปกติและหัวใจห้องล่างเต้นเร็วผิดปกติโดยวิธีเวฟเล็ต	233
11	PMO11	11.45-12.00 น.	นายพงษ์สุข ธราพงษ์พันธ์	มหาวิทยาลัยเทคโนโลยีพระจอมเกล้าพระนครเหนือ	อุปกรณ์การแพทย์	การพัฒนาเครื่องช่วยการเคลื่อนไหวข้อเข่าอย่างต่อเนื่องอัจฉริยะ	239
12.00-13.00 น. พักรับประทานอาหารกลางวัน							
12	PMO12	13.00-13.15 น.	นายอมรเทพ ลิ้เกรียงไกร	มหาวิทยาลัยเทคโนโลยีพระจอมเกล้าพระนครเหนือ	อุปกรณ์การแพทย์	การวิเคราะห์เสียงหัวใจ โดยวิธีการแปลงเวฟเล็ตแบบต่อเนื่อง	249
13	PMO13	13.15-13.30 น.	นายโกวิทย์ คาทิพาที	มหาวิทยาลัยขอนแก่น	วิศวกรรมการจัดการอุตสาหกรรมและโลจิสติกส์	การลดของเสียจากกระบวนการประกอบสปริง โดยประยุกต์ใช้วิธีการลีน ซิกซ์ ซิกม่า : กรณีศึกษาบริษัทในอุตสาหกรรมอิเล็กทรอนิค	255
14	PMO14	13.30-13.45 น.	นายพศวีร์ มั่งคั่ง	มหาวิทยาลัยขอนแก่น	เทคโนโลยีธรณี	การประเมินการแพร่กระจายสำหรับแบบจำลองการเคลื่อนที่มวลสาร ในโครงการเติมน้ำลงสู่ชั้นน้ำบาดาล จังหวัดสุโขทัย	268

34th The National Graduate Research Conference

PMO8

The Site Selection Analysis for CCTV Installation in Sriracha Municipality Chonburi Province

การวิเคราะห์หาพื้นที่เหมาะสมสำหรับการติดตั้งกล้องโทรทัศน์วงจรปิดในเทศบาลเมืองศรีราชา จังหวัดชลบุรี

Supajira Kaewkomut (ศุภจิรา แก้วโกมุท)* Dr.Wutjanun Muttitanon (ดร.วัจนันท์ มัตติทานนท์)**
Dr.Kritsanat Surakit (ดร.กฤษณัส สุรกิตย์)** Dr.Areeya Rittima (ดร.อารียา ฤทธิมา)***

ABSTRACT

Closed Circuit Television (CCTV) is a device that is very important in a security system used by recording events and data in Real Time to be useful to the police in the planning and monitoring traffic circumstances and the escape route of the perpetrator. Currently, found that barriers to use some such. The installation is not proper angle obstacles a number of CCTV cameras is not enough space. This study was to analysis suitable for installing CCTV cameras in Sriracha Municipality, Chonburi Province. Using GIS Software an application of GIS. By the spatial data community, an area with dense population and the royal road accidents are frequent. A major factor in determining the proper installation of CCTV cameras, the result will be something that helps to support the decision making process for choosing a CCTV camera installed in Sriracha Municipality, Chonburi Province.

บทคัดย่อ

ปัจจุบันกล้องโทรทัศน์วงจรปิด (CCTV) เป็นอุปกรณ์ที่มีความสำคัญมากในระบบรักษาความปลอดภัย โดยนำมาใช้บันทึกภาพเหตุการณ์และแสดงข้อมูลแบบ Real Time เพื่อเป็นประโยชน์กับเจ้าหน้าที่ตำรวจในการใช้วางแผนงานจราจร และเฝ้าดูติดตามพฤติการณ์และการใช้เส้นทางหลบหนีของผู้กระทำผิด โดยในปัจจุบันพบว่ามีอุปสรรคต่อการใช้งานอยู่หลายประการเช่น จุดติดตั้งไม่เหมาะสมมีสิ่งกีดขวางมุมภาพ, จำนวนกล้อง CCTV ไม่เพียงพอกับพื้นที่ การศึกษาครั้งนี้ได้ทำการวิเคราะห์หาพื้นที่เหมาะสมสำหรับการติดตั้งกล้อง CCTV ในพื้นที่จังหวัดชลบุรี โดยใช้โปรแกรม GIS ซึ่งเป็นการประยุกต์ใช้ระบบสารสนเทศภูมิศาสตร์ โดยนำข้อมูลเชิงพื้นที่ พื้นที่ที่มีความหนาแน่นของประชากรและเส้นทางถนนหลวงที่มีการเกิดอุบัติเหตุบ่อยครั้ง มาเป็นปัจจัยหลักในการพิจารณากำหนดจุดติดตั้งกล้อง CCTV ที่เหมาะสม ผลที่ได้จะเป็นสิ่งที่ช่วยสนับสนุนกระบวนการการตัดสินใจเลือกพื้นที่สำหรับติดตั้งกล้อง CCTV ในพื้นที่จังหวัดชลบุรีต่อไป

Key Words: GIS, Site selection analysis, Risk analysis

คำสำคัญ: ระบบสารสนเทศภูมิศาสตร์ การวิเคราะห์หาพื้นที่ การวิเคราะห์ความเสี่ยง

* *Student, Master of Science, Program in Technology of Information System Management, Faculty of Engineering, Mahidol University*

** *Lecturer, Department of Civil Engineering, Faculty of Engineering, Mahidol University*

*** *Assistant Professor, Department of Civil Engineering, Faculty of Engineering, Mahidol University*

34th The National Graduate Research Conference

PMO8-2

Introduction

Chonburi Province continues to enjoy economic and industrial growth as a major tourist city where population and tourist trends increase annually with greater density of buildings, higher cost of living and more traffic congestion These factors are the driving force of social problems due to a higher number of accidents and crimes such as robbery, disputes, assault, abduction, rape, murder, drug trafficking and traffic accidents, etc. Some areas, including those with heavy congestion, enclosed or non-visibility areas, abandoned communities, areas with inadequate lighting, etc. are considered high-risk areas. When compared to the number of government officials, the area and population ratios are found to be vastly different. Consequently, monitoring is insufficient to cover all areas. In some cases, the absence of witnesses and evidence results in difficulty arresting the culprit, thereby resulting in problems affecting the safety and property of citizens. Despite efforts to control these factors, crime is not likely to be reduced because the solution and implementation is difficult and time consuming due to the requirement of accurate and timely data.

Closed Circuit Television (CCTV) involves recording events and displaying image data in real time delivered directly to the control center to facilitate the work of police officers and security. Traffic planning monitors and tracks the circumstances of offenses and the offenders' escape routes. It also provides photo or video evidence to prove the guilt or innocence of the accused persons in court cases to prosecute offenders and clearly predicts the likelihood of future incidents (Nakraikhing, 2002). However, images from CCTV cameras installed in certain areas continue to encounter several problems such as image contrast as well as obstructed or obscured camera angles. Moreover, improper installation of CCTV cameras does not provide sufficient space.

Aware of the aforementioned problems, the researcher's aim was to evaluate the installation of CCTV cameras at the points in the Geographic Information System (GIS), which is an effective system for managing databases and mapping systems. Used to link the different positions on the map, geographical information systems also have the ability to search and process information. By providing basic information to analyze and integrate the relation of each factor, the desired results are obtained (Suriyachay, 2010). As a result of such concepts in GIS applications, space can be analyzed for the installation of CCTV cameras to analyze the physical community as well as the roads and highways of the study area. The findings of this research can be applied to the decision to determine the proper installation of CCTV cameras in Sriracha Municipality, Chonburi Province.

Objective of the study

To study and analyze the risk areas for the occurrence of traffic accidents in Sriracha Municipality, Chonburi Province.

To analysis and find suitable areas for the installation of CCTV and the adjustment of camera angles.

Methodology

A step of research methodology is shown in Figure 1.

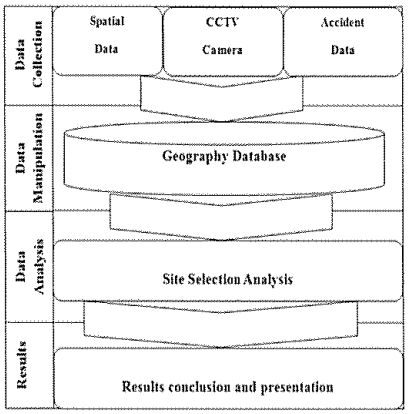


Figure 1 Steps of research methodology

Data Collection

Collecting the necessary information related to this research. Are as follows:

Spatial data: places and highway routes in Sriracha Municipality, Chonburi Province. The data was collected from Google maps and highway maps.

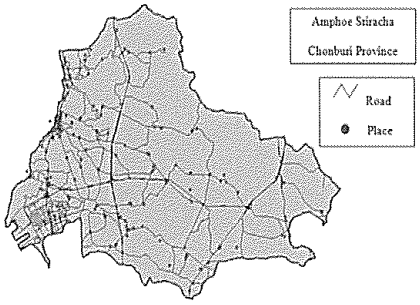


Figure 2 Show the Road Network in Amphoe Sriracha as GIS

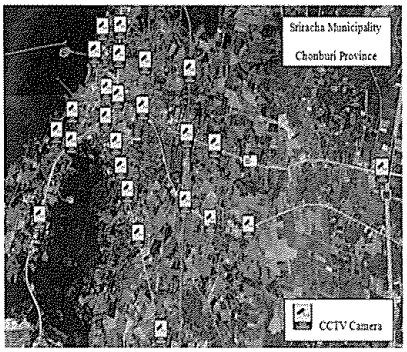


Figure 3 Show the Road Network and CCTV camera Installation in Sriracha Municipality as Satellite data

CCTV Camera: CCTV camera installation data for cameras already installed in the area with angles from the CCTV camera and data from the Chonburi Provincial Administrative Organization.

Accident data: statistical data on the number of accident and the location of accident sites in the areas on traffic routes in Amphoe Sriracha, Chonburi Province. The data was reported by the Accident Data Center, Thai Road Safety Collaboration during 2013.

Table 1 Statistical data on the number of accident in Amphoe Sriracha, Chonburi Province 2013

Month	Amount of car accident	Amount of wounded people	Amount of dead people
January	16	6	1
February	7	2	2
March	89	20	6
April	63	23	1
May	106	48	1
June	102	33	5
July	113	19	1
August	163	28	1
September	113	16	4
October	104	18	3
November	118	29	1
December	131	37	2
Total	1125	279	28
Average per year	93.75	23.25	2.33

Source: THAIRSC (2013)

Data Manipulation

The attribute data for some of the database for the attribute data acquired were created by using Microsoft Excel and saving as a database file then importing into GIS software as an event theme while some were directly created in GIS software. All of the landmarks such as villages and roads were used as point and line formats referring to actual locations.

These data were used to analyze the location coordinates road of accidents into GIS software in order to determine suitable locations for the installation of CCTV. The data were entered into to the form and converted into a map; the steps of analysis will be handled for the remainder of the process.

Data correction for spatial analysis and all related data in the Sriracha Municipality, Chonburi Province needs to be corrected in the GIS application.

Data Analysis

The main data analyzed for this study was spatial data, highway routes, CCTV camera data at installation sites in the areas and data on frequently occurring accidents in Sriracha Municipality, Chonburi Province.

Data from Sukhumvit Rd. at the area in front of Darasamut School Sriracha An interval of 5.8 kilometers at Soi Ao Phai for was divided into sections of 0.5 kilometers each by using a fixed method by limiting sections every 0.5 kilometers.

The incidence rate and frequency of accidents for each section was calculated based on the terms that needed to be shown such as road conditions, intersections, nearby community areas and weather conditions.

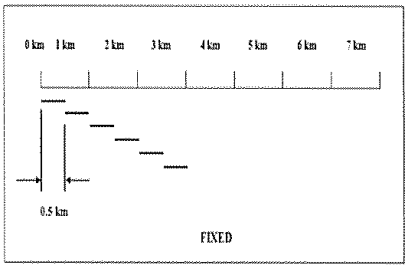


Figure 4 Fixed Section Road Divisions

The results obtained by the collection of accident data and the sites of frequent accidents on highways much less sort of accident that occurred in the area. Were entered into the GIS program and the results were displayed in the form of maps showing the data distribution of the sites where accidents frequently occur.

Table 2 Level of accident

Level	Amount of accident	Definition	Symbol
3	21 up	High	
2	11 - 20	Medium	
1	1 - 10	Few	

Analysis of data from a camera installed, or the installation of the CCTV should be installed CCTV cameras or editing.

The results from the assessment of road risk areas and the conditions of the surrounding areas were analyzed and sites were chosen for the installation of CCTV cameras in order to obtain proper angles for clear photograph images with sufficient space.

Results conclusion and presentation

The conclusion of this research shows summarize of research and the suggestion by using descriptive method to explain and present the result.

Results

Site selection for CCTV installation, result is presented as the following session:

Risk areas

Defining risk to the statistics of the traffic accidents making the road section of 500m. The data statistics of accidents in the area Sriracha Municipality during 2013 from Thai Road Safety Collaboration (THAIRSC) is an agency of the accident from Compulsory Insurance claims data from Road Accident Victims Protection Co., Ltd. the roads with high accident rates and traffic congestion are the most risk areas. It shows the amount of accidents in each section.

This map shows the distribution areas of highway accidents are frequent in the area of Sukhumvit Rd. at the area in front of Darasamutr School Sriracha An interval of 5.8 kilometers at Soi Ao Phai. CCTV camera already installed on 6 positions, but in the accident area from the middle up, with a total of 3 positions and 5more for not installing CCTV cameras in such area communities, entrance habitats or village and the roads are hilly curves.

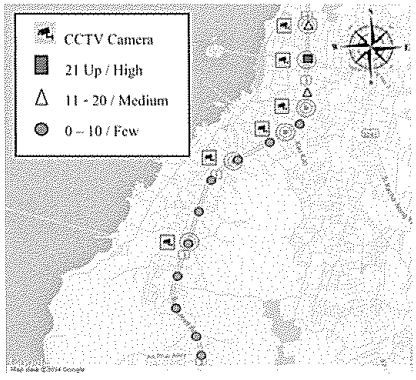


Figure 6 Shows the installation of CCTV cameras and frequent accidents.

Site Selection Analysis

This map shows the proper installation of CCTV cameras in Sriracha Municipality by analysis of assessment data, statistics databases accident area frequently. The results of the research should have discretion whether to install CCTV cameras as the number 3 positions.

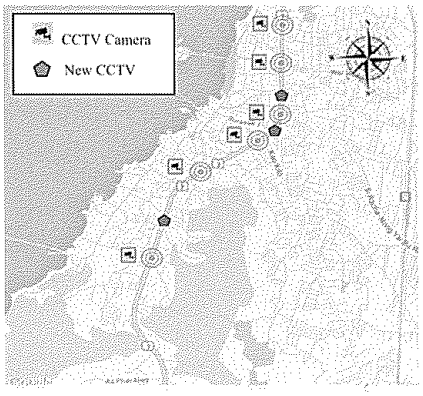


Figure 7 Shows the proper installation of CCTV-cameras in Sriracha Municipality

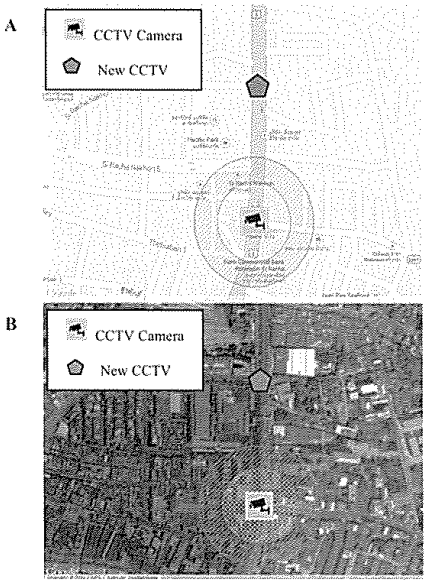


Figure 8 Show Location 1 (Robinson Sriracha) for installing additional CCTV Camera accident statistics based on the information from Figure 6 that the accident statistics for 11-20 per year and have high traffic congestion. But in this area is not installed CCTV Camera. Google Street maps (A) and Google Satellites maps (B).

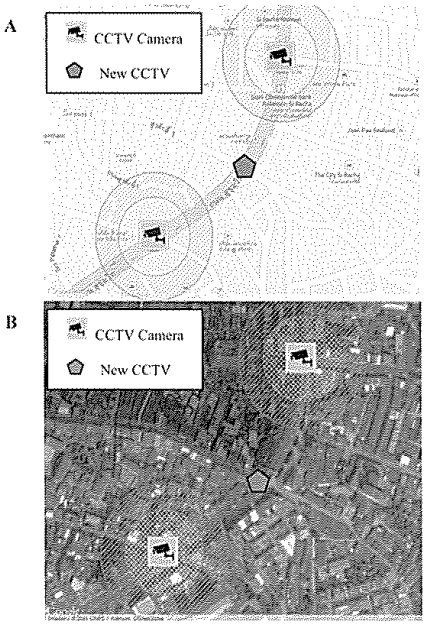


Figure 9 Show Location 2 (Crossroad Surasak) area for installation of CCTV Camera additional assessment of spatial information. The area is a crossroad with traffic congestion and road diversion is very dense. Google Street maps (A) and Google Satellites maps (B).

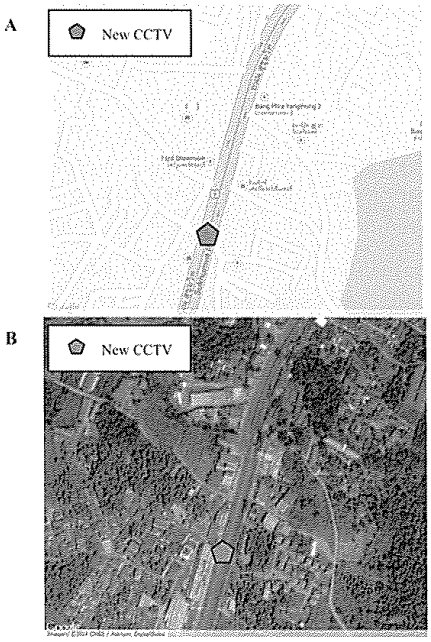


Figure 10 Show Location 3 (U-turn Sriracha Village) area for installation of CCTV Camera for further evaluation of spatial information. The area at risk of an accident is often the road curved path with a U-turn, road to the village. Google Street maps (A) and Google Satellites maps (B).

Discussion and Conclusions

This study the site selection analysis for the installation of CCTV cameras before installing the need to gather spatial data, survey areas, population density, accident statistics, road and will need to be interviewed experts or police. To recognize the need for the use of CCTV cameras and the information to be recorded in GIS using GIS Software is used to analysis the density and distribution of population and location of the accident site often. The result is the ability to assess risk in the area. To help support the decision to install CCTV cameras in the area to get the position and angle that is useful to the police or security monitoring trustee of the public. And can track the circumstances and the escape route of the perpetrator. The images can be used as evidence to prosecute and assist in the site selection for the installation of CCTV cameras.

Acknowledgements

This study was supported by Chonburi Provincial Administrative Organization, Thai Road Safety Collaboration and Sriracha Police Station.

References

Caplan, JM., Kennedy, LW., Petrossian, G. 2011. Police-monitored CCTV cameras in Newark,NJ: A quasi-experimental test of crime deterrence. Journal of Experimental Criminology. 7(3):255-274.

Dowing, AJ., Baguley, CJ., and Hills, B. Road Safety in Developing Countries:An overview. Oversees Centre. Transport and Road Research Laboratory, Crowthorne, Berkshire, United Kingdom; 1999.

Lee, LK. 1995. CCTV camera site selection: a field experience. Vehicle Navigation and Information Systems Conference 6(1):21-27.

Sureyachain, N. Development of crime map system case study for car theft in the district area, Nakhon Pathom Province [Master Thesis Major: Forensic Science]. Silpakorn University; 2010. [in Thai].

Oluwasanmi, AJ. Road accident trend in Nigeria. Department of Mechanical Engineering, University of Benin; 1993.

Scott, W. 2001. Measuring the built environment: validity of a site survey instrument for use in urban settings. Health & Place. Vol.7; p. 283–292.

Supachai, A. Development of a black spot analysis tool using GIS to traffic accidents. The Graduate School, Khonkaen University; 2002. [in Thai].

Supornchai, U. Geographic information technology systems to the determination of hazardous sites on highways in Thailand. The Graduate School, King Mongkut's University of Technology North Bangkok; 2000. [in Thai].

BIOGRAPHY

NAME	Miss Supajira Kaewkomut
DATE OF BIRTH	13 August 1978
PLACE OF BIRTH	Bangkok, Thailand
INSTITUTIONS ATTENDED	Suandusit Rajabhat University, 2001-2005 Bachelor Degree in Business Administration (Management Program) Mahidol University, 2010-2015 Master of Science (Technology of Information System Management)
HOME ADDRESS	200/133 Moo.5, The Kith Chaengwatthana, Chaengwatthana Rd., Pak-kred Nonthaburi 11120 Tel: 0817355947 E-mail: supajira.k@gmail.com
PUBLICATION / PRESENTATION	The National Conference Information Technologies (CIT2014) and UniNet Network Operation and Management workshop 2014 (UniNOMS2014), Sakaeo, Thailand The 34th National Graduate Research Conference (NGRC34th), Khonkaen, Thailand