TEC

Engineering, Inc.

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TEC Engineering , Inc. (TEC) is a multi - national consulting firm specializing in Transportation , Traffic , Road Safety and Intelligent Transportation Systems (ITS) Engineering and Operation.

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TEC Engineering, Inc. (TEC) is an award winning, international consulting firm specializing in transportation, traffic, and Intelligent Transportation Systems (ITS). Established in 1992, our firm has offices in the USA and the Kingdom of Saudi Arabia which are staffed by professional and technical personnel.

TEC specializes in a wide range of activities including transportation planning, traffic engineering, highway/geometric design, land surveying, and the design, operation, inspection and maintenance of Intelligent Transportation infrastructure including traffic signal systems. The company has over 26 years of service to government and development agencies in the USA and abroad.

TEC applies cutting edge technologies to engineer innovative solutions to traffic and transportation management. From technical feasibility studies to the most complex systems analyses and design, our staff is experienced at all levels of engineering evaluations, design and operations. TEC has won numerous national and international awards for projects that enhance safety and efficiency of multimodal transportation systems for all users, as well as minimizing environmental footprint.

Firm Services and Qualifications

Engineering:

- Roadway/Highway Geometric Design
- Traffic Signal System Design, Operations, Inspection and Maintenance
- Intelligent Transportation System (ITS) Design, Operations, and Maintenance
- Lighting Design
- Safety Studies
- Interchange Justification/Modification Studies

Planning:

- Comprehensive Transportation Plans
- Traffic Impact Studies
- Traffic Simulation Modeling
- Traffic Forecasting
- Land Use Studies
- Grant Preparation / Grant Writing

Surveying/Mapping:

- Topographic/Boundary Surveying
- Geographic Information Systems (GIS) Data Collection and Mapping
- Right of Way Plans
- GPS Surveying

TEC Engineering is a proud member of the following professional engineering associations:

Intelligent Transportation Systems (ITS) America, ITS Mid-America, & ITS Arab

Institute of Transportation Engineers (ITE) America & ITE Ohio

Transportation Research Board (TRB)

American Society of Highway Engineers (ASHE)

International Municipal Signal Association (IMSA)

Prequalification

TEC in prequalified by several U.S. state agencies for transportation and traffic engineering:

Ohio Department of Transportation (ODOT), State of Ohio	Kentucky Transportation Cabinet (KYTC), State of Kentucky	Indiana Department of Transportation (INDOT), State of Indiana
• Complex Roadway Design • Non-Complex Roadway Design • Basic Traffic Signal Design • Traffic Signal System Design • Complex Highway Lighting Design • Limited Highway Lighting Design • Right of Way Plan Development • Safety Studies • Interchange Modification/ Justification Studies • Bicycle Facilities and Enhancement Design • Construction Inspection – Traffic and Electrical	• Rural Roadway Design • Urban Roadway Design • Traffic Engineering Services • Electrical Engineering Services • Traffic Data Collection • ITS/Central Concepts • ITS/Concept Development • ITS/Communications Planning and Development • ITS/Systems Deployment • ITS/Management and Operations • ITS/Technology/Systems Evaluation • Congestion Management • Feasibility Studies	• Complex Traffic Capacity and Operations Analysis • Traffic Data Collection • Traffic Forecasting • Non-Complex Traffic Capacity and Operations Analysis • Traffic Safety Analysis • Non-Complex Roadway Design • Traffic Signal Design • Traffic Signal System Design

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Client Portfolio

KSA

Ministry of Transport .

Municipality of Riyadh .

Municipality of Jeddah .

King Saud University .

USA

Ohio Department of Transportation .

Kentucky Transportation Cabinet .

Indiana Department of Transportation .

Butler County, Ohio .

Warren County, Ohio .

City of Cincinnati, Ohio .

City of Cincinnati Metropolitan Sewer District

City of Mason, Ohio .

City of Springdale, Ohio .

Award List

2008 Global Achievement Award
International Road Federation (IRF)
Project: Saudi Arabia Intelligent Transportation System (ITS) Master Plan
Client: Ministry of Transport; Riyadh Municipality, Saudi Arabia

2008 Engineering Excellence Honor Award, American Council of Engineering Companies (ACEC)
Project: Systematic Traffic Signal System Timing and Phasing Program
Client: Ohio Department of Transportation (ODOT); State of Ohio .

2007 ACEC Engineering Excellence Honor Award
American Council of Engineering Companies (ACEC)
Project: Dixie Highway Corridor Transportation and Traffic Optimization Study
Client: Ohio-Kentucky-Indiana Regional Council of Governments .

International Road Federation (IRF)
Project: Saudi Arabia Intelligent Transportation System (ITS) Master Plan
Client: Ministry of Transport; Riyadh Municipality, Saudi Arabia

2003 Best of ITS Winner, ITS America
2003 National Award for Traveler Information Websites, Federal Highway Administration (FHWA)
Project: TRIMARC (Traffic Response and Incident Management Assisting the River Cities)
Client: Kentucky Transportation Cabinet (KYTC), USA

2002 Best of ITS Winner, ITS America
2001 Best of ITS Winner, ITS America
2001 Civic 50 Award Winner, Civic.com 2001 Best Practices Award Winner, NASCIO 2000 Best of ITS Finalist, ITS America
1999 Best of ITS Winner, ITS America

1998 ITE Partnership Award, Institute of Transportation
Project: ARTIMIS (Advanced Regional Traffic Interactive Management & Information System)
Client: Ohio Department of Transportation (ODOT); State of Ohio .

Practical Approach to Engineering

TEC has a comprehensive staff of professionals experienced in design, construction and operations, including modern traffic control and communications systems that provide advanced detection and monitoring capabilities. This fusion of expertise enables us to create designs that are constructible and maintainable – two very important features in long-term asset planning. With certified traffic signal inspectors, former electrical contractors, and former city engineering officials on staff, TEC can identify potential constructability problems early in the planning stages which saves clients from issues in later project stages .

Commitment to Our Community

TEC's mission statement exemplifies our core purpose: to provide excellent service to our clients, maintain a professional working environment for our staff, and be a productive member of our community. In keeping with this mission, TEC has established partnerships with many local communities to improve safety and traffic conditions in local neighborhoods . We provide free educational workshops on traffic/transportation issues to community officials and police that enforce traffic laws, sponsor many community events and fundraisers, and provide traffic management assistance to communities during special events. To date, TEC has assisted local communities in the identification and procurement of more than 110 million dollars in grant funding for safety and infrastructure improvement projects.

Unmatched Staff Expertise

Our professional staff brings together unique and diverse backgrounds in design, construction, inspection, operations, maintenance and construction management. Collectively, our staff has 700 years of experience dedicated to these fields. TEC has established relationships with local governmental agencies, Metropolitan Planning Organizations (MPOs), and many ODOT districts, which helps to facilitate successful project coordination efforts with multiple stakeholders.

Dedication to Client Satisfaction

TEC's clients are the foundation of our business and the cornerstone of our progress. We take the time to develop client relationships that extend beyond a handshake and a paycheck. Our project managers and marketing personnel get to know our clients by communicating openly and frequently about the client's needs, goals and objectives. TEC's local presence allows us to be readily available 24/7 to meet with clients at the office or in the field to personally supervise project progress. By taking a hands-on, personal approach to client interaction, TEC has consistently achieved excellent customer satisfaction ratings and reviews and has seen an impressive rate of repeat business from regular clients.

TEC Transportation Planning Projects

1. Training And Upgrading Of The Efficiency Of People Involved In Road Safety Field

The purpose of this project is developing and designing of appropriate training content for traffic and road safety in Kingdom of Saudi Arabia and training the targeted category within Kingdom of Saudi Arabia and overseas.
TEC Engineering Inc., in cooperation with international our partners who are experts in road safety training, will conduct training for the concern ministries and agencies employees in upgrading and improving the level of road safety within the Kingdom of Saudi Arabia by developing and delivering an exclusive road safety training program.

The training content will be developed based on fact finding studies and meetings to be held with all relevant stakeholders to identify the current knowledge gaps and developing a training program to fill those gaps to enable all concern parties to fulfill their obligations in line with the Road Safety target stated in kingdom vision 2030, which is aims at reducing the number of fatalities resulted from road accidents by %70 of those numbers of the year 2016.
The consultant will develop and maintain a remote course management system that will also host the course content. The system will be developed and operated at the consultant's expense and it will be accessible to the National Center for Road Safety employees.
Al thorough the contract period, the consultant is to provide training in different locations Kingdom in form of groups, these locations are to be identified and agreed upon by Ministry of Transport and the National Center for Road Safety. The consultant will also allocate a place (Room) for training and providing training materials and other resources as required like laptops, chairs, meals and prayer facilities during the sessions. TEC Engineering Inc., will also arranging training outside the Kingdom of Saudi Arabia. In addition to that TEC Engineering Inc., will secure participation of 40 professional employees in international road safety conferences and events.
In addition to managing the training program, the company will also supervise the training programs of the Nation Center for Road Safety.
The project aims to achieve the following objectives:

- Upgrading the efficiency of the people involved in traffic and road safety.
- Spreading of the awareness of the importance of the road safety.
- Benefiting from the international experience to increase the awareness and reducing the ratio of accidents and fatalities.
- Have a Knowledge of data science and data analysis and utilize these knowledges to reach to the problems and develop practical plans to solve them.

2. Engineering Consultancy Agreement for Improving Road Traffic Safety, MOT, KSA

The project duration is three years. The main goal of the project is to reduce the number of accidents and fatalities on MOT roads.

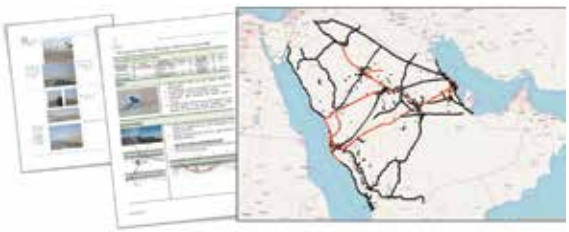
TEC is providing a total of 36 technically-qualified and experienced Road Safety Engineers working at the MOT main office and 13 other branch offices, in addition to providing support from the USA offices.

The project includes 21 main tasks targeted at achieving the project goal. Some of the project key tasks include:

- Establish accident data collection, analysis and display methods and tools that are accurate, GIS-based, and useful at different management levels.
- Prepare programming and analysis tools for handling the traffic accidents reports for determination of accident black spots and propose appropriate solutions and countermeasures.
- Provide a comprehensive geometrics and safety review of the MOT's roadway network followed by identifying road safety corrections and countermeasure.
- Prepare Roads Safety Audit and Road Safety Investigation procedures and guidelines.
- Update the MOT manuals, practices and guidelines relating to Road safety.

Accident Black Spots

Analysis Tools



Road Network Screening
and Safety Investigation

Analysis Outputs

3. Jeddah Transportation Impact Assessment (TIA) Guidelines: Client: Municipality of Jeddah, Jeddah, Saudi Arabia

1) Developers and consultants manual
2) Establishing method of work, procedures and protocols for TIAs
3) Coordinating and establishing mechanism for road improvement cost recovery from owners/investors associated with TIAs

This iconic and innovative project was to develop guidelines for Transportation Impact Assessments (TIAs) for Jeddah. These were also the first set of seminal TIA guidelines in Saudi Arabia.

The guidelines were developed using a holistic approach by applying international state-of-the-art best practices as well as in framework of existing problems in Jeddah such as access management, parking and enforcement.

Three companion sets of guidelines were developed that included TIA guidelines, procedures and protocols for implementation, and cost recovery mechanisms.

The study consisted of several aspects as follows:

- Review international best practices
- Review emerging technologies and concepts
- Assess current transportation characteristics and issues in jeddah and identify associated needs
- Assess capabilities of the municipality in implementing tia program
- Develop objectives of the TIA program
- Develop multi-modal guidelines for tia for both developers and consultants as well as for the municipality staff
- Develop set of procedures and protocols for the municipality to implement the TIA program
- Develop methods for cost estimation and cost recovery mechanisms for required improvements for TIAs

3. Localized Transportation Assessments: Client: Municipality of Jeddah, Jeddah, Saudi Arabia

On-call traffic engineering and design services to the Jeddah Municipality. This project includes safety and design improvements for locations in Jeddah which are identified by the Municipality either by public complaints or by the Municipality themselves. The problem statements are assessed by TEC with the aid of site visits and data collection as appropriate. Operational and safety evaluations help in quantifying the issues and to identify possible solutions. TEC takes the opportunity to maximize multi-modal improvements to cater to all users, including pedestrians and trucks, and to minimize the prevalent safety and parking problems in Jeddah.

The study consisted of several aspects as follow:

- Scoping meeting with the municipality and the EMC
- Site visits
- Data collection
- Coordination with stakeholders
- Operational evaluation
- Safety evaluation
- Finalize the problem statement
- Identify possible solutions
- Present emerging findings to the municipality and the EMC
- Make final recommendations

4. Technical Advisory: Client: Municipality of Jeddah, Jeddah, Saudi Arabia

This project is to provide technical advice to the Jeddah Municipality on an as-needed basis. This includes feasibility of emerging concepts and technologies as well as implementation of off-the-shelf strategies to any issue faced by the Municipality. Among issues already consulted on for example are the feasibility of diverging diamond interchanges in Jeddah, and school circulation in congested urban networks.

5. Review of Transportation Impact Assessment (TIA) Studies: Client: Municipality of Jeddah, Jeddah, Saudi Arabia

TEC is the designated Municipality reviewer for all TIAs in Jeddah for all new approved developments. The size of the developments studies range from small development that do not require a formal TIA report, to large developments with regional significance, including some iconic developments such as the Kingdom Tower, planned to be the world's tallest building. TEC works with the developer's consultant from preliminary approval to the final approved report.

6. Al Hamra Transport Master Plan Client : WSP, Jeddah, Saudi Arabia

Extensive data collection and surveys for Al-Hamra Masterplan to aid in analysis, design, and model calibration for forecasting. Data collection efforts included:

- Network Inventory
- Automatic Traffic Counts
- Manual Traffic Counts
- Classification Counts
- Parking Surveys
- Journey Time Surveys
- Pedestrian Surveys

7. Kenwood Road Access Management Study Client : Sycamore Township, Ohio

TEC carried out a study of the potential improvements and modifications to driveways along Kenwood Road. The study was designed to enhance accessibility and reduce traffic congestion in the area from I71- to Montgomery Road (approximately 1,950 feet). The project team assembled all field data in order to determine the issues and subsequently provided detailed recommendations to Sycamore Township. Furthermore, we developed a project website used to disseminate information to the public. Following the study, construction plans were prepared by TEC for implementation of short term improvements as discussed in the access management analysis. Improvements included driveway reconstruction, a landscaped center median, pavement repair and replacement, curb and gutter additions, and new signing and pavement markings.

8. Comprehensive Traffic Management Plan
Owner: Ministry of Municipal and Rural Affairs Saudi Arabia

TEC, in partnership with Khatib and Alami, developed a Comprehensive Traffic Management Plan for the City of Riyadh. This major initiative addressed geometric design, signal timing, parking, pedestrians, public transport, and other traffic elements. The project encompassed 160 intersections and will work to improve safety and traffic flow throughout the network.

The plan reviewed the existing traffic signal network and equipment and provided recommendations for replacing deficient equipment, new operational software, maintenance and design concerns, signal timing, and operational guidelines. Residents of Riyadh will benefit greatly from an improved traffic signal system through a significant reduction in congestion, decreased travel times, and less delay.

9. Riyadh Comprehensive Parking Study
Owner: Ministry of Municipal and Rural Affairs, Saudi Arabia

Like many urban cities, Riyadh is growing at a rapid pace and experiencing growing pains. Recent growth and development in Riyadh in general and many of its fifteen administrative districts has led to increased traffic on the roadways and an ever-increasing parking demand on the city's parking facilities. With a heavy concentration of businesses/offices, shopping areas, educational institutions, hospitals and clinics in several of its administrative districts, parking facilities seem to be limited in supply.

This study attempted to evaluate existing and future parking demands, examine the techniques and management methods currently in use, and determine the best policies and methods for managing parking demand in the City of Riyadh.

Conventional techniques, coupled with ITS technology such as Parking Guidance Information Systems, Transit Based Information Systems, Intelligent Payment System, E-Parking, Valet Parking, and Robotic Parking systems, were explored as project strategies for solving current and future parking needs.

In addition to the overall study and recommendations, this study resulted in the development of a Parking Generation Manual specifically designed for the City of Riyadh. This manual was developed based on actual data collected during the completion of this project. This manual will be used to determine the parking needs of future developments.

A fair amount of time was devoted to the opinion of the parkers, merchants and stakeholders for formulating the guidelines for the development of policies related to parking for the City of Riyadh.

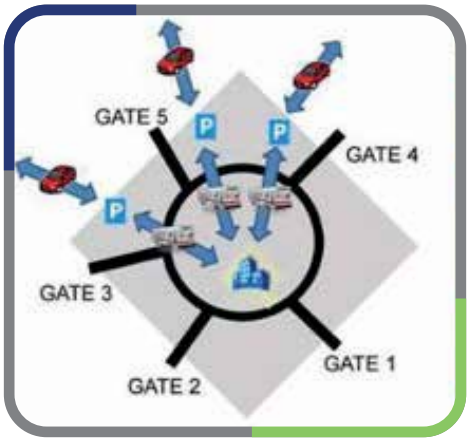
10. Andalus Design and Safety Project
Client: Municipality of Jeddah, Jeddah, Saudi Arabia

This project was to reduce congestion in the Andalus Road and Falastin Road corridors and to improve safety.
A major task was to improve the congested and accident prone traffic circle at the junction of King Abdullah Road and Andalus Road (Flag Roundabout). The study recommended re-configuration with a flyover as well as bypass lanes. Another task was to improve intersections along Falastin Road as well as provide safe transportation for all modes and users including pedestrians.

Major components of the project were:

- Traffic assessment including data collection
- Demand forecasting
- Survey
- Geometric design
- Structural design
- Safety
- Street lighting
- Storm water drainage
- Hydraulics
- Landscaping
- Preparing tender documents

11. King Saud University Gate 2 Access Scenario Analysis
Owner: King Saud University, Riyadh, Saudi Arabia



As a follow-up to the KSU Traffic and Parking Study performed by TEC, TEC performed a detailed analysis of several options for major network improvements at one of the entry access points to the University (Gate 2). As part of this task, TEC prepared VISUM and Synchro traffic models for various alternatives and evaluated these models for measures of effectiveness. TEC also examined access for a parking garage being constructed to determine the optimal locations for entry and exit points based on traffic patterns and capacity, and also laid out a plan for the parking spaces inside the parking garage.

12. King Saud University City Traffic and Parking Study
Owner: King Saud University, Riyadh, Saudi Arabia

King Saud University, located in the Municipality of Riyadh in the Kingdom of Saudi Arabia, has established itself as the oldest, most premier University in Saudi Arabia. The rapid growth of the academic campus and hospital facility within the University boundaries has given rise to problems in the transportation network.

The King Saud University Administration desired to conduct a study of the existing and future traffic circulation and parking demands at the University.

Accommodating this demand will be accomplished in a way that sustains and makes improvements to existing traffic flow (both pedestrian and vehicular), circulation, and parking using the available space and resources within campus gates.

The second phase of the project involved development and testing of alternative solutions. The travel demand forecasting model was used to project the traffic demand on the KSUC network for the short, medium, and long-term horizons. A set of alternatives was developed to address network deficiencies identified as a result of the future traffic demands. All alternatives were compared and advantages and disadvantages of each were considered. Once all alternatives were identified and evaluated, the best alternative was selected for implementation.

During the third phase of the project, the team performed the necessary land survey, produced all engineering designs and related technical specifications (including roadway improvements, parking improvements, pedestrian features, landscaping, drainage, Intelligent Transportation Systems, etc.) and computed cost estimates for the execution of projects related to the selected alternative. In the fourth phase of the project, the team prepared final drawings, plans, and bid documents.

13. Hazardous Location Safety Project
Owner: Ministry of Municipal and Rural Affairs, Kingdom of Saudi Arabia

TEC, in partnership with Zuhair Fayez Partnership, produced a reference document for the treatment of hazardous locations in the City of Riyadh. This includes the latest technical methods applied to hazardous location identification and treatment, as well as software and hardware technologies. These guidelines will be used by the City of Riyadh to improve safety. In addition, the project included a pilot implementation of the Guide at 10 hazardous locations, which resulted in recommendations for safety countermeasures and related evaluations.

1. King Saud University Intelligent Transportation System Master Plan
Owner: King Saud University, Riyadh, Saudi Arabia

TEC provided analysis and engineering services to King Saud University (KSU) for the development, design and deployment of Intelligent Transportation System (ITS) infrastructure to provide traffic monitoring and traveler information capabilities at this major University. This task included the preparation of an ITS Master Plan, Architecture, Concept of Operations, and Bidding Documents. TEC is also providing long-term operational and maintenance planning and assisting KSU with implementation plans for future ITS projects as KSU's official ITS Advisor Consultant.

2. ITS Master Plan and Bidding/Tendering Package Preparation
Owner: King Saud University, Riyadh, Saudi Arabia

King Saud University (KSU) engaged the services of TEC to conduct ITS implementation on the campus roadway network. This implementation was based on the Kingdom of Saudi Arabia ITS Master Plan. TEC gathered input via client surveys and used this information to provide a KSU specific ITS Master Plan that covered a ten-year implementation period. Documents pertinent to the project including weekly status reports were stored on a website to ensure that all stakeholders had access to the information. This master plan was then used to develop a list of preferred ITS services and the associated ITS elements needed to provide these services. The next step for this project was the development of a preliminary ITS plan and specifications. The project team was familiar with traffic flow characteristics at KSU as TEC had been involved in the preparation of a Parking and Traffic Study for the university. This information was very useful in determining the location and type of ITS elements that will also be integrated into the KSU geographical information system. The final step of this project was to develop the detailed plans, specifications and the bidding/tendering documents that included over 20 dynamic message signs, 25 CCTV cameras, and over 20 detection devices.

3. Ministry Of Transport ITS Advisor
Owner: Ministry Of Transport, Kingdom Of Saudi Arabia

TEC assisted the MOT with developing the TMC concept of operations, specifications for field equipment and communications, construction plans, and equipment procurement on a fast-track schedule. TEC field technicians also provided on-site services, evaluating potential sites for ITS field devices (CCTVs, dynamic message signs, radar) and providing integration and testing of equipment when required.

4. King Saud University Parking Access & Control System (RFID)
Owner: King Saud University, Riyadh, Saudi Arabia

This project contains the requirements for installation of the King Saud University (KSU) Parking Access and Control System (PACS). The objectives of the PACS project include, but are not limited to, ensure flexibility for any future need to update, upgrade, and/or expand the system readily; provide an intuitive and user-friendly interface for KSU and its personnel; provide mechanisms to minimize theft and unauthorized usage; and enhance patron convenience through the implementation of leading edge technology. This project implemented hardware and application software that will meet or exceed KSU's parking access and control needs for at least 10 years after the system's final acceptance.

KSU's parking facilities in the PACS project include two parking structures (P3 and P5) and one surface lot reserved for faculty parking as described in The Concept of Operations.

5. ARTIMIS (Advanced Regional Traffic Interactive Management & Information System)
Owner: Ohio Department of Transportation

In 1994, Northrop Grumman (formerly TRW) was selected to design and operate an Advanced Traffic Management System (ATMS) and Traveler Information System for the Greater Cincinnati/Northern Kentucky region encompassing 88 miles of expressways. The Advanced Regional Traffic Interactive Management and Information System - otherwise known as ARTIMIS - has since expanded to cover 160 freeway miles. TEC's role in the development of the ARTIMIS system included:

Design

- Development of electrical PS&E for Dynamic Message Signs (DMS), Video Image Detection Systems, Wide Band Radar, 170E Controllers, and Fiber Optic Equipment
- Selection, evaluation and placement of field devices, including cameras, detectors, DMS, and permanent counting stations
- Specifications on mounting details for all field devices
- Performing on-going integration of system components

Operations

TEC staff provided 24-hour, 7 day a week operation of the ARTIMIS control center from 2005-1995 and also provided incident management support, operated DMS, and initiated emergency response through notification to local authorities when needed.

Maintenance

Under contract with Northrop Grumman, TEC staff performed routine/preventative maintenance on all ARTIMIS field devices, including cameras, microwave detectors, loop detectors, DMS, vehicle identification detectors and mile marker signs.

ARTIMIS has been recognized through many national awards and has shown a return on investment of 12 to 1.

Awards:

2003 ITS America Best of ITS Winner
2002 ITS America Best of ITS Winner
2001 ITS America Best of ITS Winner
2001 Civic.com Civic 50 Award Winner
2001 NASCIO Best Practices Award Winner
2000 ITS America Best of ITS Finalist
1999 ITS America Best of ITS Winner
1998 ITE Partnership Award

6. TRIMARC (Traffic Response & Incident Management Assisting River Cities)

Owner: Kentucky Transportation Cabinet

In 1997, Northrop Grumman was selected to design and operate an Advanced Traffic Management System (ATMS) and Traveler Information System for the Louisville, Kentucky/Southern Indiana region. The initial system was activated in 1999 and focused only on an -11mile section of interstate 65. The Traffic Response and Incident Management Assisting the River Cities - otherwise known as TRIMARC - has since expanded to cover over 60 miles of regional interstates, with a strategic plan for expansion to over 100 miles of interstate in Kentucky and Indiana. TEC's role in the development of the TRIMARC system includes:

Design

- Selection, evaluation and placement of field devices, including cameras, detectors, and DMS
- Specifications on mounting details for all field devices
- Performing on-going integration of system components

Operations

TEC staff currently provides operation of the TRIMARC control center and also provides incident management support, operates DMS, and initiates emergency response through notification to local authorities when needed.

Maintenance

Under contract with Northrop Grumman, TEC staff performs maintenance on all TRIMARC field devices including installation, diagnostics, preventive maintenance, repair/replace/restore actions, and end-to-end integration. The TRIMARC website, recognized in 2003 by FHWA as one of the four best Traveler Information Web Sites in the country, provides real-time traffic information from TRIMARC. TRIMARC has also been integrated with the statewide traffic operations center and 511 system using XML protocol consistent with the ITS National Architecture to convey incident information.

Awards:

2002 ITS America Best of ITS Winner

2003 FHWA National Award for Traveler Information Websites

7. Intelligent Transportation System in Riyadh (Supervision Project)
Owner: Ministry of Transport, Riyadh, Saudi Arabia

Saudi Ministry of Transport engaged the consultant team of Saudi Consolidated Engineering Company (SCEC) and TEC to develop an Intelligent Transportation System (ITS) Master Plan for the Kingdom of Saudi Arabia. Like other Gulf States, Saudi Arabia is experiencing tremendous economic and population growth which has led to a rise in mobility throughout the Kingdom. Increasing travel demands of motorists are quickly outgrowing the existing infrastructure; therefore, the Ministry of Transport recognized the need to manage traffic in a more efficient and safe manner. TEC and SCEC completed the ITS Master Plan, providing a road map for addressing transportation needs of the future through the deployment of ITS infrastructure projects over a 10-year horizon. Implementation of the ITS Master Plan will eventually convert the Kingdom's highways into an electronic roadway network with real-time communications capabilities that will keep motorists informed of traffic conditions, thus minimizing traffic congestion and improving safety.

The Master Plan recommends eight locations for ITS deployment: Riyadh, Jeddah, Makkah, Medinah, Tabuk, Aseer Province, Qaseem Province, and Eastern Province. Although the recommended user services are quite extensive, ranging from commercial vehicle operations to public transport management to rural operations, the core infrastructure projects involve control centers, detection and monitoring devices, traveler information, and incident management.

8. Riyadh Gateway ITS Development and Inspection
Owner: Ministry of Transport, Kingdom of Saudi Arabia

The purpose of this project was to develop and design a traffic management system for the seven major thoroughfares or "gateways" into Riyadh, a city of over 4.7 million people. TEC developed the plans, technical specifications and cost estimates for the deployment of Intelligent Transportation System infrastructure that will allow for active monitoring of these gateways and to provide traveler information through Closed Circuit TV (CCTV) cameras, radar sensors, and Dynamic Message Signs (DMS) at the major entry points to the City. To manage the CCTVs and DMS, TEC established plans for a temporary traffic control center. During the first phase of a planned city-wide ITS deployment, TEC provided construction inspection services to the Ministry of Transport to ensure that the infrastructure was built in accordance with technical specifications.

9. Al Amir Turki Ibn Abdul Aziz Al Awal Arterial Study
Owner: Ministry of Municipal and Rural Affairs, Kingdom of Saudi Arabia

TEC, in association with Khatib and Alami, is improving traffic flow and congestion along this corridor using conventional, non-traditional and ITS methods to address problem areas. The goal of this project was to analyze the existing conditions, project growth along the corridor, and evaluate alternatives to improve conditions. Alternative corrective measures were presented for selection based on analysis and site conditions. An implementation process was determined for the alternatives selected by the AMANA and made a part of the report. Alternatives consist of a range of options, from simple timing changes to state of practice intersection design and the ITS devices available for use along the corridor. The corridor (including each signalized intersection) was analyzed and treated as a separate item and part of a greater whole in order for the system recommended to fit into or be able to expand into a larger city or regional system.

TEC Traffic Signal Projects

1. Statewide Signal Timing Task Order, 2009 - 2014
Owner: Ohio Department of Transportation

TEC was awarded a Statewide Signal Timing Task Order with ODOT. Signal timing tasks performed under this task order typically include traffic data collection, traffic signal inspections, traffic modeling, timing plan development and implementation, travel time studies, and reporting. Signalized corridors that are retimed under this contract typically show reductions in delay of 10% to 40%.

Awards: 2008 Engineering Excellence Honor Award, American Council of Engineering Companies (ACEC)

2. Systematic Signal Timing & Phasing Pilot Program
Owner: ODOT

TEC and DLZ Ohio were part of a signal timing program pilot developed by ODOT to evaluate the effect of signal timing improvements on overall roadway capacity on several key congested state routes selected within ODOT District 8 – US 27, SR 32, SR 28, and SR 73. TEC performed all data collection, provided Synchro analysis to model different signal timing configurations, and assisted ODOT in implementing timing plans which ultimately yielded significant improvements in travel time and level of service on all four corridors.

Awards: American Council of Engineering Companies (ACEC) 2008 Engineering Excellence Honor Award

3. Closed-Loop Traffic Signal System Operations
Owner: City of Springdale, Ohio

Since 1997, TEC has provided real-time operations services for over 30 traffic signals and 4 closed-loop traffic signal systems in the City of Springdale, Ohio. A control center located within TEC allows traffic engineers to monitor traffic during peak hours and adjust signal timing plans remotely as needed to reduce traffic congestion and improve level of service.

4. Glendale-Milford Road & Reading Road Traffic Signals
Owner: Village of Evendale, Ohio

TEC assisted the Village of Evendale in obtaining a $2.8 million- dollar CMAQ grant from OKI. TEC subsequently prepared the necessary studies (signal warrants, etc.), construction drawings and specifications for the upgrade and installation of a closed-loop traffic signal system with fiber optic interconnect on Glendale-Milford and Reading Road in the Village of Evendale (Hamilton County), Ohio

The project includes a total of fourteen intersections along these roadways including fiber optic interconnect and the installation of four (4) incident management cameras.

The project also included curb ramps and pedestrian pushbuttons for ADA compliance, where applicable.

The project was in adherence to the ODOT Local Let Process and it included the 23 CFR 940 documentation.

5 . 4th & Greene Street Intersection Design
Owner: City of Marietta, Ohio

TEC provided traffic signal design for the intersection of 4th and Greene Street in Marietta. The project team produced general notes specific to traffic signal construction, including specifications on signal heads and all other items necessary for the modification of the existing traffic signal installation. Detailed construction drawings were then provided to Marietta, consisting of specifications, notes, quantities, details, materials, a wiring diagram, and a signal phasing plan. In 2011, TEC provided additional work involving the revision of all signal plans, tables, sub-summaries and notes to include the addition of reflective backplates in all directions.

6. Traffic Signal System Operations
Butler County Engineer's Office, Ohio

TEC assists the Butler County Engineer's Office with operations services for 23 traffic signals in Butler County. TEC monitors key intersections and corridors through traffic cameras in real-time and can remotely implement different signal timing plans and phases, as needed, to accommodate traffic changes.

7. Supervision of Electrical Works Maintenance Contract For Riyadh Roads
Owner: Ministry of Transport, Riyadh, Saudi Arabia

The objective of the supervision contract is to submit the necessary services for direct the appropriate field supervision to the implementation of the project at work sites by prouiding qualified individuals with the ability and skill to supervise the performance of supervision process so as to ensure restricting maintenance contractor in full compliance with drawings , specifications and conditions of the contract, including any modifications thereto.

1. Execute engineering control necessary to ensure the accuracy and quality of work that has been carried out and the performance of regular and preventive maintenance in accordance with the terms of the contract and its conformity with the plans and specifications.
2. Calculate the quantities of work that will pay the contractor.
3. Consultant shall ensure the presence of his supervising team for regular maintenance works on a permanent basis and round the clock to ensure a rapid response by the Contractor for emergencies and extraordinary circumstances such as storms and rain and the like.
4. Calculate and register quantities of regular and preventive maintenance business and preparation of monthly and final invoices for work progress for regular maintenance or preventive maintenance and submit them to Management of Roads and Transportation in Riyadh.
5. Preview constructions and equipments of contractor at the work site and evaluate them.
6. Check the conduct of all tests to major power stations and sub-stations and pumping stations by the contractor and keep records of them.
7. Coordination with the relevant authorities of services that may be in conflict with the implementation and submit a special report called (coordinate services report) and coordination in this regard with all government and relevant private agencies.

8. Traffic Signal System Operations & Maintenance Contract
Owner: City of Mason, Ohio

Since 2006, TEC has provided real-time operations and maintenance services for 39 signals and 5 closed loop traffic signal systems in the City of Mason, Ohio.

TEC has the ability to monitor key intersections and corridors Mason through traffic cameras and implement special signal timing plans as needed to accommodate changes in traffic.

TEC also provides -24hour signal maintenance services and responds to service calls as requested.

Since beginning the program, TEC has helped the City of Mason reduce its annual signal maintenance costs from $50,000 to $15,000.

TEC Engineering Studies Projects

1. Riyadh Major Corridor Study (Phase 1) Al Maathar & Omar
Owner: Municipality of Riyadh, Riyadh, Saudi Arabia

The Municipality of Riyadh contracted with the consultant team of Khattan and TEC to complete a traffic engineering study for two corridors in Riyadh, namely Al Maathar/Amir Faisal Bin Fahd Bin Abdul Aziz corridor and the Omar Ibn Al Khattab/Abi Obaidah Bin Al Jarrah corridor. The main purpose of the study is raising the operational efficiency and traffic safety/ security level for the study two corridors. Advanced traffic management technologies, especially ITS, were also considered as they have an important role in improving travel conditions on Riyadh corridors.

2. Pavement Marking and Design
Owner: Ministry of Municipal and Rural Affairs, Kingdom of Saudi Arabia

TEC, in partnership with Khatib and Alami, analyzed the performance of Pavement Markings in the City of Riyadh. This effort studied the reasons for low pavement marking visibility, investigated the reasons for poor performance of materials, and provided alternatives for replacing existing markings with markings with higher visibility. Improving the visibility of pavement markings will improve traffic safety by decreasing the overall number of accidents.

The study evaluated pavement marking material specifications currently used, and the construction standards for the application of pavement marking materials. The study conducted tests of pavement markers that have been installed in the past and a life-cycle cost analysis of pavement marking materials. The study also examined the effects of various factors, such as traffic volume, pavement type and condition, and climate on pavement marking performance.

3. Riyadh Roadway Improvement and Development Study (Phase 6)
Owner: Municipality of Riyadh, Kingdom of Saudi Arabia

The main objective of this project was to plan and design safe and effective improvements to the selected roadways, sidewalks, parking areas and pedestrian bridges, while improving the urban environment through upgrades to building faces, street lighting and other right of way incidental items.

This project had 20 phases completed by TEC as shown below.

- Phase 1 – Surveying Works
- Phase 2 – Expropriation decision
- Phase 3 – Line, Grade and Typical
- Phase 4 – Retaining Wall Design
- Phase 5 – Final Design
- Phase 6 – Curb & Gutter Design
- Phase 7 – Service Road Study & Design
- Phase 8 – Traffic Study
- Phase 9 – Driveway & Sidewalk Design
- Phase 10 – Intersection Design
- Phase 11 – Landscaping
- Phase 12 – Accessibility Requirements
- Phase 13 – Pavement Markings & Signs
- Phase 14 – Specifications
- Phase 15 – Utility Coordination
- Phase 16 – Storm Sewer Design
- Phase 17 – Landscaping Design
- Phase 18 – Bidding Documents
- Phase 19 – Soil Borings
- Phase 20 – 20D Traffic Model

4. Riyadh Speed Study- Phase 2
Owner: Municipality of Riyadh, Kingdom of Saudi Arabia

The objective of the study was to determine the suitable legal speed for vehicles on the roads and streets networks in Riyadh (second phase) as it leads to achieve the following goals:

- Determine the appropriate speed on the road in all classifications, according to the design and operational characteristics and uses of neighboring land
- Reduce exceeding the speed by the users
- Improve the operational efficiency of the roads
- Unify the style of choosing speed limit on the road
- Achieve safety and traffic security for the user on all elements of the (streets and roads) network.

The study consisted of eight tasks (stages) distributed as follows:

1• Stage one: Review international and local studies
2• Stage two: Study the technique currently used in determining the speed
3• Stage three: Collection and analysis of field data
4• Stage four: Develop a unified approach for the selection of specific speeds
5• Stage five: Evaluate the effects of derived speed at the level of safety and security, and network capacity
6• Stage six: The development of an integrated system for the distribution of the speed limit signs on the network, and proposals for the development of regulations.
7• Stage seven: The development of an integrated system for the distribution of the speed limit signs on the network and proposals for the development of regulations.
8• Stage eight: The conclusion of the project

5. Dirab Road Corridor Study and Design
Owner: Municipality of Riyadh, Riyadh, Saudi Arabia

The project area for this study includes approximately 16 kilometers of Dirab Road between Algeria Square at the interchange of Route 505, South Ring Road, and King Fahd Road and 300 meters west of the traffic signal at the National Guard Facility. This stretch of corridor includes several high traffic attractors as it runs through an area of significant commercial development.

The objective of this study was to critically examine the existing service roads running parallel with, and providing access to, Dirab Road in terms of traffic congestion, pedestrian comfort, parking, and safety issues under both current and future forecasted traffic conditions. The consultant will then consider several potential improvements at each problem location and make final recommendations to alleviate congestion and improve pedestrian, parking and safely conditions along the Dirab Road service roads. These recommendations suggeted to create a peaceful, aesthetically pleasing, urban setting that complements businesses while enhancing vehicular and pedestrian safety. In order to successfully complete the main objective of this study, the following were achieved:

1. Improve the pedestrian level of service
2. Improve and organize parking along the study corridor.
3. Improve the Geometric Layout for any applicable crossings.
4. Improve and organize any cross street intersections with the service roads.
5. Perform an access control analysis in relation to available access to and from the service roads from the existing arterial and collector streets as well as to and from Dirab Road from the service road to minimize conflict points and weaving.
6. Reduce impact of adjacent land uses on the traffic flow and the service roads.
7. Provide suitable access for the public transport lines planned to pass through the main road.
8. Fulfillment of system integration of the road from Algeria Intersection to the National Guard Facility.
9. Achieve the highest levels of safety in all items mentioned above.

6. Traffic Impact Study of Riyadh Techno Valley Project
Owner: King Saud University, Riyadh, Saudi Arabia

This project includes a traffic impact analysis of the Riyadh Techno Valley development planned within the University. TEC has developed the following methodology to complete this traffic impact analysis. TEC Engineering's methodology for the following tasks : Review Relevant Studies & Projects , Traffic Data Collection, Traffic Generation, Model Calibration, Traffic Forecasts, Review of Traffic (auto + pedestrian) Circulation, Proposed Type of Intersection Control, External Access Design Options, Traffic Calming Measures, Parking Requirements, PT Requirements and Report.

7. King Saud University Gate 2 Traffic Study
Owner: King Saud University, Riyadh, Saudi Arabia

The purpose of this project was to detail and evaluate scenarios for improving traffic flow in the Gate 2 of King Saud University. During this project, grade separation of the Gate 2 inbound/outbound movements was proposed to allow free flow University access from King Khalid Service Road. The proposed configuration required lowering the KSUC Ring Road in the Gate 2 area. However, lowering of the KSUC Ring Road at this location could not be achieved due to an existing service tunnel underneath the KSUC Ring Road at this point. Due to the existing limitations, the project team proposed an alternate roadway configuration for the Medical City Area which was analyzed in a separate document titled Medical City Gate Area Supplemental Report. This analysis evaluated the relocation of Gate 2 to the northwest where the KSUC Ring Road was lowered to enable construction of a new roadway to provide free inbound movements from King Khalid Service Road to the University. This new access would be brought into the University at a signalized intersection with the KSUC Emergency Access Road.

8. KSU Girls Campus Traffic Impact Study
Owner: King Saud University, Riyadh, Saudi Arabia

King Saud University is located about nine kilometers north-west of Riyadh City Center. The area is bounded by King Khalid Ibn Abdul Aziz Road to the west, King Abdullah Ibn Abdul Aziz Road to the south, Prince Turki Ibn Abdul Aziz Al Awal Road to the east and Prince Abdul Aziz Ibn Thinian Road to the north. The campus is approximately nine square kilometers. The Deraiyah Girls Campus is a new development within the University. The total built up area of the campus is approximately 600,000 square meters, spread over a land area of approximately 1.4 million square meters.

The scope of work involved three phases. These include the study of existing conditions, assessment of future conditions, and recommendation of needed improvements. Phase 3 includes development of construction drawings and operational plans.

The three phases are further described as follows:

Phase I: Study the existing traffic condition and identify the critical issues that reduce the traffic flow and safety in and around Girls Campus.

Phase II: Analysis of the future traffic condition upon completion of the opening and determine necessary improvement requirements Proposals to improve the operation of traffic around and inside the Girls Campus.

Phase III: Provide detailed designs for the proposed improvements and the preparation of contract documents of a contractor.

9. Nursing College Traffic Impact Study
Owner: King Faisal Hospital (KFH) and the Research Center (RC),

TEC was retained to conduct a Traffic Impact Study for a proposed Nursing College in the Al Shabab area in Ad Dammam.

The following steps were taken to complete this traffic impact study:

Traffic Counts

Traffic data was collected at the major study intersections during the AM and PM peak hours in June 2010.

Generated Traffic

Trip Generation was completed using the proposed student/faculty capacity to develop anticipated vehicle trips.

Once the trips were generated, the directional distribution of the proposed development site was determined based on existing and projected future traffic patterns in the area. The generated traffic was used to develop traffic for analysis.

Analysis & Recommendations

All aforementioned steps provided the information used to analyze the proposed development. Preliminary intersection capacity analysis and storage lane analysis were used to develop the findings.

10. Jeddah Traffic Growth Speed Study Project
Client: Municipality of Jeddah ,Saudi Arabia

Study for the collection of traffic classified counts and analysis at 71 selected sites within Jeddah urban area. The larger purpose of the project to prepare on-going traffic analysis and produce reports for key corridors for a set of long term traffic monitoring sites within Jeddah, using nonintrusive on site mounted devices that has communication devices and uses the necessary medium to transmit the data and have it received at a control room that will be the future transportation planning and traffic operations.

The project contains the following type of work:

1. Preparation of an architecture for a system that collect continuously the traffic data at a city scale to ensure the delivery of information as per the requirement of the contract. The architecture plan details all required works or design to fulfill the requirements.
2. Preparation of all sites (one per site). The sites contain all the work completed in association of the relevant site and documentation of evidence for its ability to deliver the necessary count information as per the requirement of contracts.

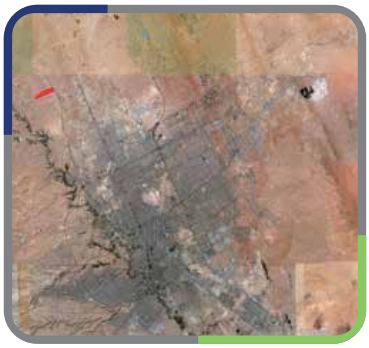
11. Riyadh Intersection Improvements
Owner: Ministry of Municipal And Rural Affairs, Kingdom Of Saudi Arabia

The rising use of the road network in Riyadh requires changes and improvements to existing deficiencies at intersections throughout the City. The goal of this project was to analyze 20 intersections for existing and future deficiencies in order to enhance traffic flow, reduce congestion, improve access to local businesses, and provide safer roadways for motorists and pedestrians. The study area included roadways in four districts within the City of Riyadh as well as surrounding features. Also included in this study was the Hudaifah One-Way analysis.

The Hudaifah Ibn Al-Yaman Street One-Way analysis discusses options for changing Hudaifah Ibn Al-Yaman Street to One-Way from Uhud Street to Salman Bin Ali Al-Mushref Street.

TEC's analysis produced several improvement recommendations, including geometric modifications, changes to traffic control devices, and driver conformance (including targeted enforcement and public education).

12. Al Jawan Traffic Impact Study
Owner: Municipality of Riyadh, Riyadh, Saudi Arabia



Traffic study aims to estimate expected traffic impact which result from the opening and operation of the proposed plan in addition to studying the requirements of entrances and exits of the plan from traffic aspects beside the requirements of the parking in the following manner:

1. Identify the plan site and the limits of the expected impact of its establishment on the surrounding road network.
2. Identification of the plan impact on the surrounding road network and ensure that these impacts within the acceptable limit with or without work recommendations.
3. The construction of internal road network of the plan so as to ensure the existence of a clear hierarchy for easy access to the various parts of the plan by surrounding roads and streets
4. Achieve ease of pedestrian traffic within the plan between the attractive pedestrian activities and the rest of the plan parts.
5. Study requirements of specific use parking for commercial activities.
6. Improve traffic safety on the internal road network elements of the plan.

13. Kortoba Site Traffic Impact Study
Owner: Municipality of Riyadh, Riyadh, Saudi Arabia

The proposed Kortoba site in Riyad, Saudia Arabia will be converting approximately 13 hectares of mostly vacant land into a mixed-use development of primarily residential and residential/commercial properties.

The objective of the traffic impact study is to critically examine the existing conditions of the study area; determine the impact that the proposed developments will have on the capacity and function of the existing roadway network; carefully review the internal street network to ensure it provides connectivity and ease of use to and from the carefully placed external exit points that effectively disperse traffic; ensure that adequate and convenient parking facilities are provided; ensure that street cross sections and connectivity provide efficient and safe pedestrian paths; and to make recommendations to mitigate these impacts and provide these facilities. The impacts and corresponding recommendations will include a capacity and safety analysis of the internal roadway network of the proposed site for both vehicular and pedestrian volumes, parking requirements within the proposed site, and locations of major entrance and exit locations around the proposed development. The analysis and recommendations include but not be limited to improvements for enhancing road network efficiency and safety. Finally, the impact study include a detailed analysis of the roadway and pedestrian network within the site boundaries to ensure adequate internal site access in terms of both pedestrians and vehicles.

14. Traffic Study for North Side of King Abdul Aziz Airport
Client : Ch2m Olayan, Jeddah-Saudi Arabia

TEC completed the required data collection and surveys to develop a masterplan for the area north of King Abdul Aziz Airport. Data collection included:

- Automatic Traffic Counts
- Manual Traffic Counts
- Classification Counts

15. Abi Ayoub Al Ansari & Al Hillah Corridor
Owner: Municipality of Riyadh, Riyadh, Saudi Arabia

TEC performed transportation and traffic studies for four major urban corridors in the City of Riyadh that were among the highest traffic congestion corridors in the city. The purpose of the studies was to analyze the current traffic conditions, parking, and pedestrian movements to develop recommendations for more efficient traffic flow as well as driver and pedestrian safety. As part of this task, TEC performed extensive data collection and analysis including traffic counts, pedestrian counts, parking inventories, travel time studies, Synchro capacity analysis for intersections along the corridor, and signal timing analysis. TEC developed recommendations for improvements based on a 10-year and 25-year design horizon, and prepared traffic simulation models using VISSIM to simulate the operational impacts that proposed improvements would have on the corridors. Specifically, TEC reviewed unconventional intersection solutions to solve the corridor issues, such as Superstreets, Green Ts, One Way Boxes and Continuous Flow intersections. Schematics were developed for the recommended improvements, and final design for many of the improvements is underway.

16. Traffic Impact Study For Jeddah Water Front
Client: PMDC, Jeddah, Saudi Arabia

In this project TEC Engineering has prepared a traffic impact study of the Jeddah Central Water Front project. This traffic impact study has been prepared by TEC Engineering, Inc. to: critically examine the existing conditions of the Waterfront Development study area; determine the impact that the proposed development will have on the capacity and function of the existing roadway network; carefully review connectivity; develop a parking calculation; and make recommendations to mitigate impact on existing roadways.

This study includes required Mitigations required for various intersections affected by the development and recommendations for improvements, including multiple options In conjunction with the mitigations vehicular and pedestrian safety was also reviewed. The safty improvements recommended include improve Signage restrict On Street Parking Near Intersections promote Use of Inlet Parking Areas install Pedestrian Bridges; Improve Sidewalks and Crossings in addition to required mitigations and safety onsite parking was reviewed and parking calculations developed based on the Jeddah Local Plan rates were developed which shoor that The proposed development exceeds the required parking The site plan depicts access points that optimize the surrounding roadway network. In addition, entrances are placed relative to existing u-turns to allow enough space for vehicular maneuverability. According to the proposed site plan, the locations of the access points are at points that optimize the potential of the surrounding roadway network.

17. Al Janadria Estates Traffic Impact Study
Owner: Municipality of Riyadh, Riyadh, Saudi Arabia

In recent years, the Kingdom of Saudi Arabia has seen an enormous amount of economic and population growth. With this growth, major developments are being planned. It is very important to ensure that these new developments complement the existing or proposed urban fabric and that any traffic impacts from the site are accommodated as a part of the construction of the development.

The objective of the traffic impact study is to critically examine the existing conditions of the study area; determine the impact that the proposed developments will have on the capacity and function of the existing roadway network; carefully review the internal street network to ensure it provides connectivity and ease of use to and from the carefully placed external exit points that effectively disperse traffic; ensure that adequate and convenient parking facilities are provided; ensure that street cross sections and connectivity provide efficient and safe pedestrian paths; and to make recommendations to mitigate these impacts and provide these facilities. The impacts and corresponding recommendations will include a capacity and safety analysis of the internal roadway network of the proposed site for both vehicular and pedestrian volumes, parking requirements within the proposed site, and locations of major entrance and exit locations around the proposed development. The analysis and recommendations will include but not be limited to improvements for enhancing road network efficiency and safety. Finally, the impact study will include a detailed analysis of the roadway and pedestrian network within the site boundaries to ensure adequate internal site access in terms of both pedestrians and vehicles.

TEC Roadway, Streetscape and Sidewalk Design projects

1. Carothers Road Profile Improvements
Owner: City of Newport, Kentucky

This project involved improvements to the vertical profile of Carothers Road for nearly 1,000 linear feet. The existing profile of the roadway was causing issues with sight distance, safety and drainage, all of which were addressed and resolved with the design. The roadway design included raising the grade of the road 6 feet, grade maintenance for the intersections at the beginning and end of the project, and reconstructing commercial drives to meet the new profile. Additional work included a full traffic signal reconstruction for a reconfigured intersection, access management improvements, aesthetic amenities, rebuilding the existing subsurface drainage system, maintenance of traffic during construction, and coordination with utility companies. As part of the design, TEC was responsible for producing plans to replace two water mains (8" high pressure and 12" normal pressure) which would have been too deep with the additional roadway fill. TEC worked with the Northern Kentucky Water District to complete the plans in less than two weeks and to account for maintaining the existing water mains during construction. We also coordinated with adjacent developments and property owners to accommodate the concurrent roadway and driveway improvements.

2. Ohio River Trail
Owner: City of Cincinnati, Ohio

TEC was responsible for developing the construction plans and specifications for a new 0.5-mile segment of the Ohio River Trail, which connects downtown Cincinnati to Lunken Airport. This segment, from Congress to Carrel, connects two separate portions of the bike trail and provides direct access to the Ohio River from Lunken Airport. The plans also included a new traffic signal design and installation at the intersection of Kellogg Avenue and Carrel Street for a pedestrian crosswalk with ADA curb ramps and pushbuttons.

TEC developed the construction plans successfully under an accelerated schedule to comply with HUD funding requirements, which allowed the project to swiftly move forward into the construction stage.

3. Salem Road Sidewalk Improvements
Owner: Anderson Township, Ohio

Anderson Township contracted with TEC to provide a field survey and design engineering of 2,600 linear feet of sidewalk on the south side of Salem Road. This project was to be constructed in conjunction with an ongoing project by the Hamilton County Engineer's Office which included improvements to the roadway infrastructure, pavement planning and overlay, and restriping. The sidewalk was to be constructed with a 2-foot wide grass strip between the curb and walk and included utility coordination and adjustments.

4. Kennel Road Construction
Owner: City of Trenton, Ohio

This project involved the reconstruction of Kennel Road between Wayne-Madison and Pierson Road in the City of Trenton.

TEC provided the client with roadway design, drafting, pavement marking/signing, right of way plan development, and preparation of construction plans.

Our team oversaw and administered the construction until the project was complete.

5. Muddy Creek Bike Path (Phase I & Ii)
Owner: City of Mason, Ohio

TEC assisted the City of Mason in securing a Transportation Enhancement (TE) grant from OKI Regional Council of Governments to construct a new bike path. During Phase I, our project team developed construction contract plans for the Muddy Creek Bike Path, connecting Mason Montgomery Road to the Pine Hills Park. The Phase 1 design consisted of a 3,300' bike path and pedestrian bridge over Muddy Creek. TEC worked with Mason staff and the Sanitary Sewer Consultant to ensure that construction of the bike path and a new sanitary sewer would occur seamlessly. This included the installation design of easily adjustable sanitary sewer manholes and the relocation coordination of a gas line and several utility poles.

TEC also assisted Mason in securing additional TE funding to construct Phase 2, which would extend the path another 6,100' and include additional bridge and culvert installations. Additionally, our team prepared an Ecological Memorandum of Agreement for Phase 2 of the project. In fulfillment of this task, TEC provided field work for a report on the future bike path along with a study of three alternative path alignments. The Muddy Creek Bike Path was constructed as part of a Bike Path Master Plan in hopes of connecting many of the City's parks and recreation areas through multi-modal transportation.

6. Wayne-Madison Road Widening
Owner: City of Trenton, Ohio

TEC prepared engineering plans, a federal STP grant application and construction plans for the widening of Wayne-Madison Road from four to five lanes.

The TEC team also prepared final construction contract plans for the widening which included a new 12-foot lane for 0.5 miles, a curb and gutter section with an enclosed drainage system, traffic control plans, and maintenance of traffic. The plans also included a multi-use path for bike/pedestrian use. Previous work with the City of Trenton included a sanitary sewer extension to serve the new Army Corps of Engineers site with design taking into consideration the future widening of Wayne Madison Road.

6. Glendale Village Square Enhancement
Owner: Village of Glendale, Ohio

TEC assisted the Village of Glendale in successfully acquiring a Transportation Enhancement (TE) grant and American Recovery and Reinvestment Act funding through the OKI Regional Council of Governments for a renovation of the Village's historic "Village Square"- a business district consisting of a variety of commercial and retail uses. TEC was responsible for project conceptualization, construction plan development, and cost estimates for the project, which consisted of new landscaped medians, expanded clay paver sidewalks, decorative lighting, signage, street furniture and fixtures.

TEC Drainage Projects

1. Wayne-Madison Sanitary Sewer Design
Owner: City of Trenton, Ohio

TEC completed the design of a 750' sanitary sewer extension along Wayne-Madison Road to service a future industrial site across from the Miller Brewery. TEC's work on the project includes surveying, design and permitting. TEC was also responsible for preparation of contracting documents, bidding, award and construction observation and administration. Additional work was coordinated during construction to include a new sump-type storm sewer system, additional grading to eliminate guardrail and assistance to the City in relocation of an existing 12 inch ductile iron water main.

2. Kortoba Drainage Study
Owner: City Of Riyadh, Kingdom Of Saudi Arabia

TEC was tasked to do a Drainage Analysis of the proposed Kortobe development in the City of Riyadh. TEC analyzed and reported the existing site conditions and the relative locations of drainage structures, major and minor wadi, soil conditions, street network, land use, grading, and topography. Calculations on the existing site were made to determine the pre-development rate of stormwater discharge for the design storm as called for in the Amana Stormwater Specifications. Existing discharge points were identified along with the calculated existing discharge for each.

TEC then analyzed the post development site and its impact to the existing site discharge. Calculations were made to determine the post-development flow throughout the site and in relation to the different discharge points identified in the analysis of the existing site. Recommendations were made for limiting the post-development discharge to pre-development rates as required in the Amana Stormwater Specifications and regulations. Detention ponds or large storage wadi were preliminarily sized and identified for inclusion into future planning. Recommendations were also provided for proposed grading and stormwater capture and conveyance.

TEC captured all of the data and made recommendations in a final report and oral presentation. The report detailed the findings in the study and mitigation measures to successfully remediate and issues on the site.

3. Azizyah Area 2 & 1, Alagaran Area, Al Baria Area
Owner: Fishbeck, Thompson, Carr & Huber, Inc.

For each development (Azizyah area 2 & 1, Alagaran area, Al Baria area) TEC retrieved, reviewed and documented existing data. This data was used to calculate storm water runoff on existing conditions. Existing runoff was calculated for the gross area to determine the effects of the existing runoff flow rate from the development area to the existing downstream drainage system. Future runoff was calculated upon the change in impervious area and any other factors in the development that would affect runoff.

Using data supplied as part of the storm water specs and design criteria determinations were made as to whether storage was required to limit runoff slows out of the developed area. Areas were identified where development should not take place. TEC created a Summary Storm Water Assessment that described existing and proposed conditions, outlined the procedures of calculation and identified the required design criteria to meet the runoff goals of the proposed development. All design requirements met the Storm Drainage Design Specifications.

4. Pavement Marking and Design
Owner: Ministry of Municipal and Rural Affairs, Kingdom of Saudi Arabia

TEC, in partnership with Khatib and Alami, analyzed the performance of Pavement Markings in the City of Riyadh. This effort studied the reasons for low pavement marking visibility, investigated the reasons for poor performance of materials, and provided alternatives for replacing existing markings with markings with higher visibility. Improving the visibility of pavement markings will improve traffic safety by decreasing the overall number of accidents.

The study evaluated pavement marking material specifications currently used, and the construction standards for the application of pavement marking materials. The study conducted tests of pavement markers that have been installed in the past and a life-cycle cost analysis of pavement marking materials. The study also examined the effects of various factors, such as traffic volume, pavement type and condition, and climate on pavement marking performance.

5. Alargan Land Drainage Study
Owner: Municipality of Riyadh, Saudi Arabia

The proposed development site is located in the Al Argan (Al Monseyah) District, northeast of the City of Riyadh and south of Highway 537. The site is bounded by existing roads on all sides.

The proposed Al Argan Development will be converting approximately 71 hectares of land into a predominantly residential development.

Pre-development and post-development runoff conditions were assessed for the site, accounting for soil conditions, runoff and conveyance factors, time of concentration, and rainfall intensity. Calculated peak discharge from the entire site for a 5-Year storm event under pre-development conditions was found to be 0.593 m3/second. The analysis concludes that, without other means of discharge mitigation, detention or storage, the peak discharge rate for a 5-Year rainfall event from the site under post development conditions will increase to 3.638 m3/second. It is possible that downstream conveyance channels and outlet conditions can accommodate this increased peak rate of flow without detrimental effect; however, downstream systems beyond the footprint of the development site have not been analyzed as part of this study. Calculations indicate that the post-developed flow rate out of the proposed development area will be increased from 0.593 m3/s to 3.638 m3/s as a result of the changes in land cover. If the downstream conveyance system can handle this increased flow without detrimental effects, the additional flow could be discharged from the proposed development without need for absorption or detention ponds. If the downstream conveyance system is not adequately sized to accommodate the additional flow then a total absorption (detention) volume of 7,364 m3 would be necessary to minimize the risk of flooding downstream.

6. Al Janadriyah Drainage Study
Owner: City of Riyadh, Kingdom Of Saudi Arabia

Janadriyah Estates is a new large-scale development in the Al Munsiyah District of the Riyadh Municipality. The development site is 981,054 square meters in size and is situated along Al Janadriyah Road (Highway 550), approximately 30.3 km northeast of the Riyadh City Center, 8.0 km east of the King Khaled Airport, along Al Janadriyah Road. The Janadriyah Estates site currently consists of undeveloped land with little to no vegetation. The site is bounded on the north by a paved roadway and high tension overhead electric lines and on the east side by Janadriyah Road (Highway 550). Both roadways are constructed higher than the site with a grade difference of approximately one meter.

TEC reviewed the site characteristics and topography to assess potential drainage recommendations. These recommendations included site grading, conveyance, and detention ponds. These recommendations were presented in a final design requirement and considerations after TEC collected the necessary data and calculated current and future runoff.

7. Azizia Drainage Study
Owner: Municipality of Riyadh, Riyadh, Saudi Arabia

The proposed development site is located in the Al Aziziyah District, south the City of Riyadh between Al Aziziyah Road and Al Kharj Road. The proposed Aziziyah 2 Development will be converting approximately 298 hectares of previously undeveloped land into a predominantly residential development.

Pre-development and post-development runoff conditions were assessed for the site, accounting for soil conditions, runoff and conveyance factors, time of concentration, and rainfall intensity. Calculated peak discharge from the entire site for a 5-Year rainfall event under pre-development conditions was found to be 2.179 m3/second. The analysis concludes that, without other means of discharge mitigation, detention or storage, the peak discharge rate for a 5-Year rainfall event from the site under post-development conditions will increase to 13.690 m3/second.

It is possible that downstream conveyance channels and outlet conditions can accommodate this increased peak rate of flow without detrimental effect; however, downstream systems beyond the footprint of the development site have not been analyzed as part of this study. To ensure that increased flows from the proposed development do not pose any increased risk of flooding downstream, detention and storage requirements were evaluated for volumes needed to limit the post-development discharge to the pre-development conditions.

To limit post-development discharge to pre-development conditions, a total storage volume of 31,923 m3 is required to address the entire 298 Ha site. The existing site currently has three distinct drainage areas and storm outfalls and this report recommends that the proposed site utilize those same outfalls.

Calculations indicate that the post-developed flow rate out of the proposed development area will be increased from 2.179 m3/s to 13.690 m3/s as a result of the changes in land cover. If the downstream conveyance system can handle this increased flow without detrimental effects, the additional flow could be discharged from the proposed development. If the downstream conveyance system is not adequately sized to accommodate the additional flow then a total storage volume of 31,923 m3 would be necessary to minimize the risk of flooding downstream. This is to limit the peak discharge of the post-development 5 year event to the peak discharge of the pre-development 5 year event.

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