



Optimizing Traffic Using Artificial Intelligence and Advanced Camera Sensors



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Strategic Plan Survey Results

Top Weaknesses of the City

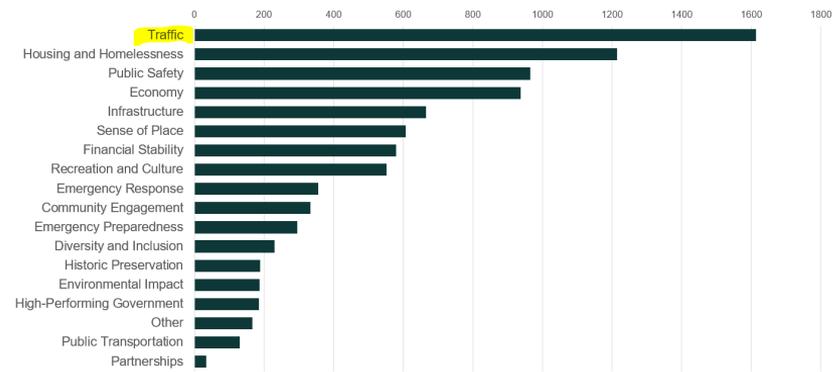
Traffic	Homelessness	Things to Do
<ul style="list-style-type: none"> Traffic (45%) Traffic tied to overdevelopment (3%) 	<ul style="list-style-type: none"> Homeless (36%) 	<ul style="list-style-type: none"> Activities (17%) More restaurants (8%) More recreation, entertainment

- Economy
 - Business
 - ...
 - ...
 - ...
 - ...
 - Jobs (5)
 - ...
- Parks
 - Parks
 - ...
 - ...
 - ...

What are you CONCERNED about?

Infrastructure "Economic downturn"

Priorities in Rank Order



Strategic Goal 3: Sound Infrastructure

Reduce Negative Impacts of Traffic: Reduce traffic congestion and optimize traffic flows.

- Develop long-term multi-modal transportation plan for traffic improvements, mitigation efforts, and expansion of alternative transportation options (including bicycle and pedestrian) to reduce reliance on fossil fuels.
- Modernize traffic cameras and explore utilization of Artificial Intelligence with traffic cameras to optimize traffic flows and improve responsiveness of traffic lights.
- Advocate with Riverside County Transportation Commission (RCTC) and the State for transportation improvements that impact congestion within Corona.
- Continue efforts to embrace mixed-use developments that would place housing within walking distance of commercial centers and public transportation.



What We're Asking For:

- Investment into Artificial Intelligence based traffic Algorithms and Hi-Definition detection cameras that are compatible with the ATMS Master Plan and Public Safety
- Invest in a City-Wide (AI driven) Traffic Data Dashboard
- Invest in City synergies that rely on Traffic Infrastructure



What is 'AI'?



What is AI?

“The capability of a machine to imitate intelligent human behavior” – Merriam Webster

* Broadly defined, intelligence is the capacity to acquire knowledge and apply it to achieve an outcome; the action taken is related to the particulars of the situation rather than done by rote (repetition).

AI vs Traditional Programming

Traditional

Data

If (X = 1) do Y
If (X = 2) do Z
If (X = 3) do W...

Output / decision

Artificial Intelligence

Data

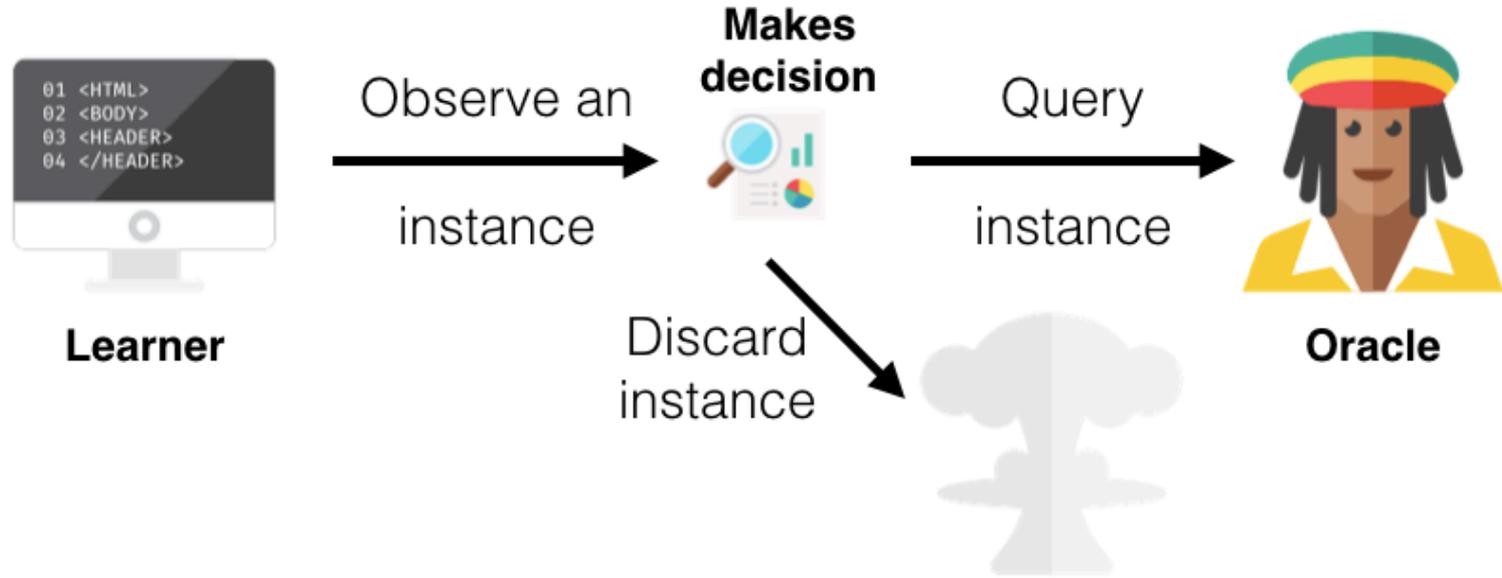
Process the data

Build a model

For every "new" data
item, ask the model

Get Prediction(s)

AI: Passive vs Active



Applications of...



Source: <http://www.govtech.com/civic/GT-September-Automation-Beyond-the-Physical-AI-in-the-Public-Sector.html>

Types of Traffic Signal Control

1. Pre-timed

→ Downtown & Central Business Districts

2. Actuated , “Free” , “On Demand”

→ Off Arterial, Remote, Residential Intersections

3. Coordinated by time of day

→ Major Arterials, High Volume Corridors

→ Studied and Retimed every 1-3 years

4. Traffic Responsive

→ Series of Coordination Plans, Logic

5. Traffic Adaptive (AI)

→ Retimed in real-time

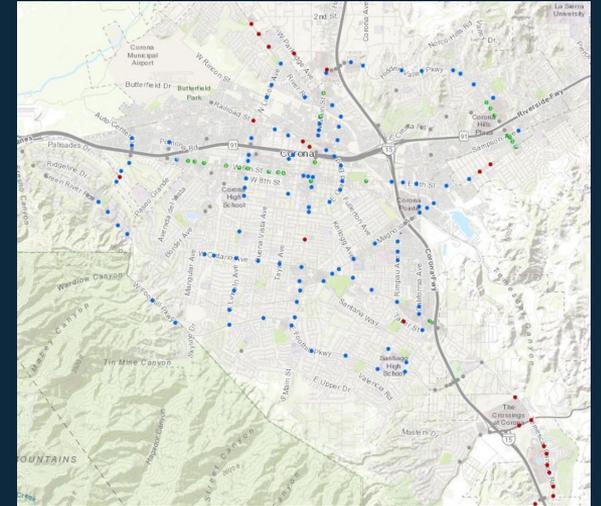
→ Less than 5% of US Signals operate adaptively

Corona utilizes Actuated and Coordinated modes



ATMS Master Plan

City of Corona's Advanced Traffic Management System (ATMS)



City of Corona - ATMS

What we are currently working on:

→ **Traffic Management Center Upgrades**

- Video Wall Replacement
- Consolidation of traffic systems into 1 interface (ATMS, DMS, CCTV, etc)
- Hired Assistant Traffic Engineer with significant TMC operation experience

→ **Traffic Monitoring CCTV System Upgrades CIP**

- Replacing legacy CCTV systems
- Upgrading to HD digital cameras
- Integrate into City Unified Surveillance System (City IT Coordination)



City of Corona - ATMS

What we are currently working on:

- **ATMS Phase 3:** Project Extends communications and signal control to:
 - **Ph. 3A:** Westerly to Green River/91 Fwy area and Easterly to El Cerrito / Interstate 15. Creates fully interconnected corridor.
 - **Ph. 3B:** River Road to Norco City Limits
 - **Ph. 3C:** Update existing network infrastructure and traffic surveillance cameras.
 - 80% Funded – Construction to begin 2022
 - Traffic Engineering Reviewing 90% Plans



City of Corona - ATMS

What we are currently working on:

→ **Foothill Corridor Signal Interconnect Improvement CIP**

- Updating Traffic Signal Controllers to ATC 6.25 Specifications
- Updating Network Interconnect Equipment
- Replacement of legacy ATMS to industry leading Centrac's ATMS
- Project Limits – Green River/Serfas Club to Foothill/California



What Does it all Mean?

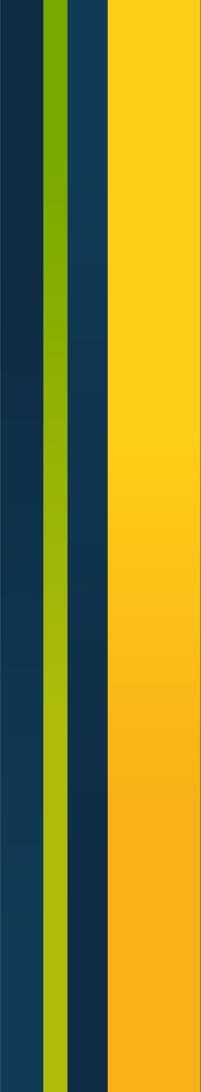


Laying Foundation for Future Capabilities

- ATC Traffic Controllers
- High Speed Fiber Network
- Cutting Edge Traffic Management System
- SR-91 to I-15 Interconnected Corridor on Green River / Foothill.
- Connected Vehicle Ready

Enables Traffic Engineering to leverage AI with Advanced Traffic Algorithms, and Connected Vehicle technology





Compatible Solutions to Optimize Traffic

Types of Solutions

Traffic Data Dashboards

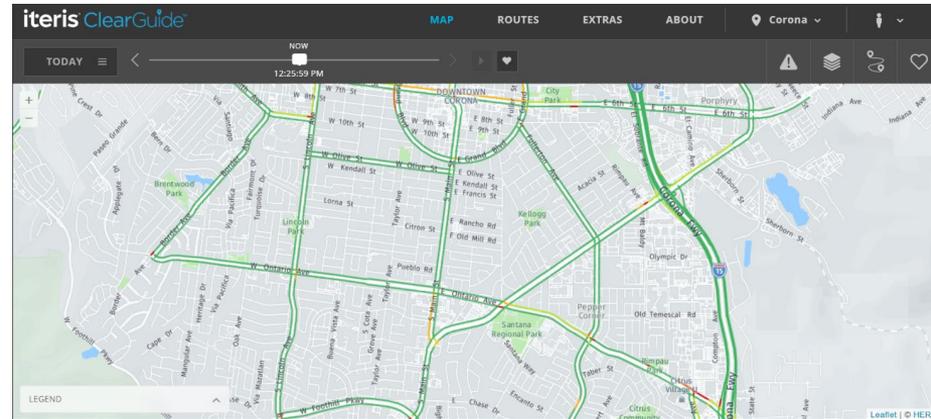
- City-wide live and historic traffic data (travel times, congestion levels, incidents, etc.).
- Systems utilize 3rd party data sources
- City Roads and Freeway Data

Advanced Traffic Algorithms

- Traffic network-wide data collection and processing using AI in the cloud.
- Traffic timing evaluated continuously and creates signal timing recommendations.
- Hi-Resolution data to make traffic decisions

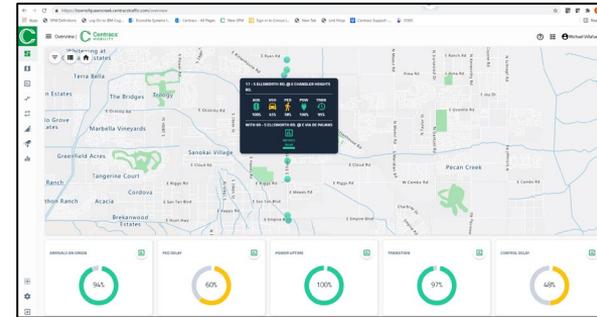
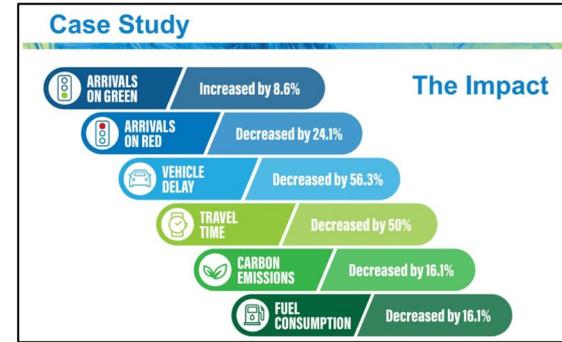
Traffic Data Dashboard: Iteris Clearguide APMS

- Arterial Performance Management System (APMS)
- Citywide Data Dashboard
- Operates independently of existing systems
- Uses third party data sources
- **Includes Freeway Data**



Advanced Traffic Algorithms: Centracs Mobility + Edaptive Modules

- Compatible with Centracs ATMS system and Controllers procured under Foothill Pkwy Interconnect Improvement CIP
- Can be deployed System-wide
- 10 Observations per Second Data Collection (BIG DATA!!)
- Statistical Analysis with AI in the cloud to provide Traffic Signal Timing recommendations
- Optimizations can be implemented in real time
- Powerful traffic engineering metrics to evaluate system performance (Signal Performance Measures - SPM)
- Module has built in diagnostics to alert staff that there are issues.



Edaptive

Centracs *Edaptive* is the next-generation in adaptive signal control, optimizing cycle, offset and splits in real-time. It is built upon Econolite's latest cloud-based Centracs SPM and revolutionary Pattern Optimizer solutions.

What is Required to Implement?

Traffic Data Dashboard:

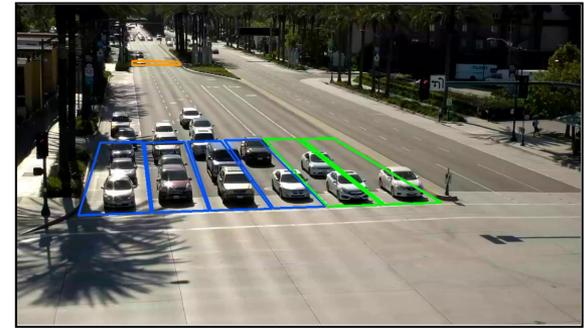
- No Capital costs
- Web-Based
- Approximately \$50k / year Subscription
- Minimal remote setup by vendor
- WAZE-Corona partnership can be integrated into Clearguide APMS



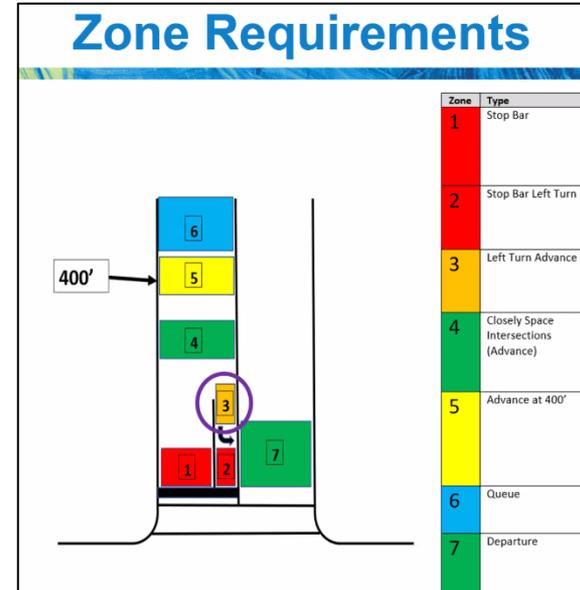
What is Required to Implement?

Edaptive Signal Control:

- Upfront Costs:
 - Hi-Definition Vehicle Detection Camera Systems [Zones 1,2,3,4,7] **\$25,000 / Intersection**
 - Has Data-logging capabilities for pedestrian counts, vehicle classifications, turning movement counts, etc.
 - Can be Integrated into City Unified Surveillance System
 - Magnetomer “Puck” Advanced Detection for high-speed arterial approaches **\$15-\$20,000 / Intersection** [Zone 5,6]
 - *Only required on high speed approaches or where roadway curvature does not allow line of sight from HD Cameras
Example: West Foothill Parkway Extension
 - Advanced Traffic Controller **\$3,500 / Intersection**
 - Initial Configuration for Intersections **\$2,500 / Intersection**



City of Anaheim – Disneyland Area

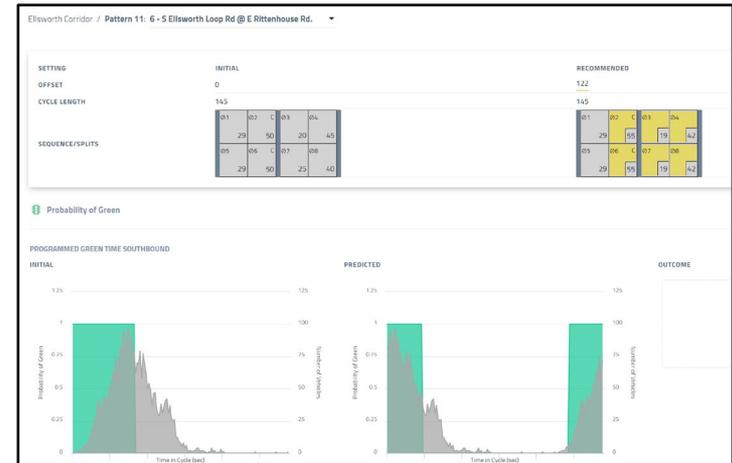
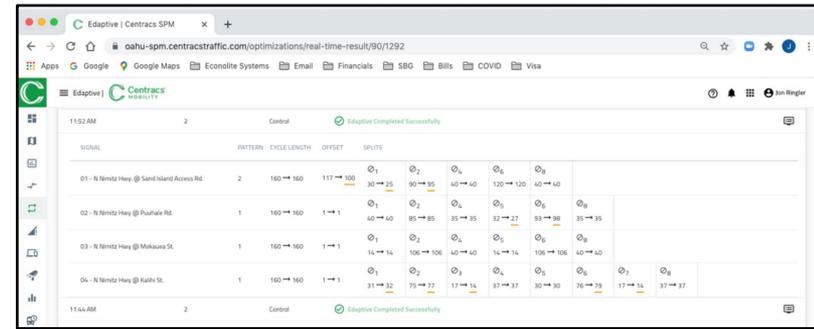


Detection Zones Required

What is Required to Implement?

Edaptive Signal Control:

- Recurring Costs:
 - Centracrs Mobility SPM and Edaptive Subscriptions
 - *Cost Varies by Quantity of Intersections Licensed



How Do We Know It's Working?

Internal Performance Metrics:

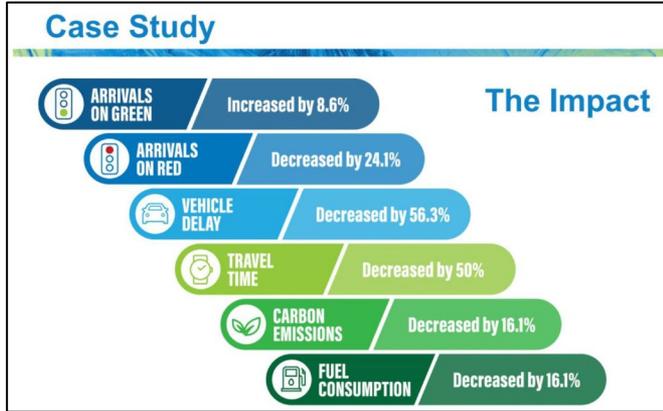
- Arrivals on **Green** (ROG)
- Arrivals on **Red** (ROR)
- Purdue Coordination Diagram
- Vehicle Delays
- Volumes
- Volume / Capacity
- Before/After Comparisons

Check With Data Dashboard:

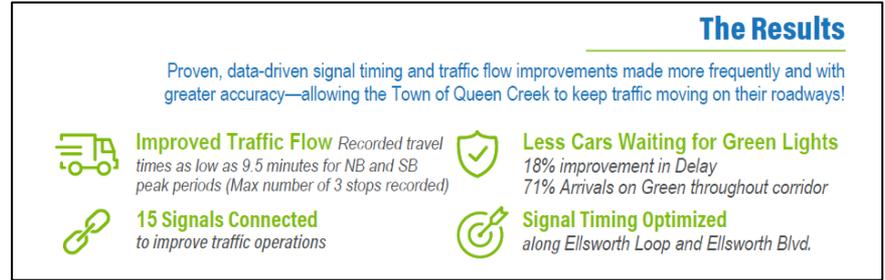
- Average Speed
- Delays
- Heat Map
- Travel Times
- Compare to Historical Data

What Improvements in Traffic Flow Can be realized?

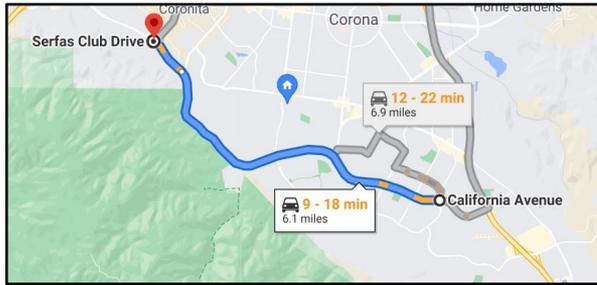
- Oahu, Hawaii



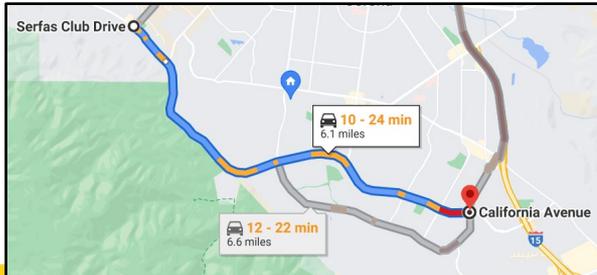
- Queen Creek, Arizona



Green River / Foothill Corridor is an Excellent candidate for Edaptive



AM Westbound Peak Hours



PM Eastbound Peak Hours

- Highly Variable travel times (Greater than 2x average during Peak)
- Highly influenced by variations in freeway flow
- High volumes = Big impacts and potential improvements
- Highly Variable School traffic at both ends of corridor

Potential Synergies



- **HD Cameras**
 - Augment Public Safety Abilities
 - Monitor Pedestrian and Bicycle Traffic
 - Parks and Trailhead Usage
 - Facility Capacities
- **WAZE Integration**
 - Leverage existing partnership with WAZE



Options for Consideration

Option 1: Status Quo

- Continue to follow industry best practices and operate traffic signals in Free and Coordinated Modes
- Commence yearly timing studies to update coordination patterns
 - FHWA recommends retiming every 3-5 years!
- Check timing effectiveness with floating car surveys
 - Staff drives corridor multiple times and records data
- Reactive approach to traffic concerns

Pros

- No capital expenditures
- Follows current industry practices

Cons

- Significant staff time required currently to complete studies
- Slow reaction to changes in traffic
- Slow process to verify effectiveness
- ATMS Ph. 3 funding gap leaves important locations disconnected from TMC

Option 2: One Corridor (Green River Foothill) Edaptive + Citywide Traffic Dashboard

- Invest in Artificial Intelligence based signal control system with 20 HD vehicle detection camera systems
- Fill 20% Funding Gap on ATMS P3 Project to complete network connections to West and East termini of corridor
- Deploy end-to-end proof of concept corridor from Green River/SR-91 to EL Cerrito/I-15 (20 Intersections)
- Measure effectiveness of changes with integrated performance metrics and traffic data dashboard.
 - Expand reach of Edaptive or decline to renew yearly agreement
- **Cost:** \$1.6 Million and \$85,000 yearly. Implementation over 1 Year

Pros

- Exceeds industry best practices
- Real-time adjustments to signal timing on Green River/Foothill
- Improved travel times, less delays
- Fills ATMS P3 funding gap bringing connection to ~90% of City
- Reduced staff time in completing timing studies
- Performance metrics of signal timing and travel time
- Detailed Citywide traffic data available for making decisions

Cons

- Capital Cost
- Recurring Costs
- Schedule (1 Year)
- Staff time to implement
- Benefits of Traffic-AI only in one area of City

Option 3: Citywide Major Arterial Corridor Edaptive + Citywide Traffic Dashboard



Invest in Artificial Intelligence based Edaptive signal control system on ALL major Arterials: (129 Signals)

- Main St
- Hidden Valley / McKinley
- Lincoln Ave
- Foothill / Green River / El Cerrito
- Magnolia
- Sixth St
- Ontario Ave
- Auto Center Drive
- River Rd
- Temescal Canyon Rd

Cost: \$6 Million initially and \$250,000 yearly. Implementation over 3 Years

Pros

- Exceeds industry best practices
- Citywide improvements in travel time and delays
- Real-time adjustments to traffic timing on all major arterials
- Fills ATMS P3 funding gap bringing connection to ~90% of City
- Reduced staff time in completing timing studies
- Performance metrics of signal timing and travel time
- Detailed Citywide traffic data available for making decisions

Cons

- Capital Cost
- Recurring Costs
- Schedule (3 Years)
- Staff time to implement

Staff Recommendations

Dual facet approach:

- Implement City-wide Traffic Data Dashboard
- Implement AI based “Edaptive” Signal Control Citywide on all Arterials
- Rollout Edaptive in phased approach



Summary + Recommendation

	Good	Better	Best (Recommended)
	Option 1 Status Quo	Option 2 <i>One Corridor (Green River Foothill) Edaptive + Citywide Traffic Dashboard</i>	Option 3 <i>Citywide Major Arterial Corridor Edaptive + Citywide Traffic Dashboard</i>
Intersections Optimized with Artificial Intelligence and HD Detection Cameras	0	20	129
Capital Investment	\$0	\$1.6M	\$6M
Yearly Fees	\$0	\$80,000	\$250,000

QUESTIONS?



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