STAFF REPORT

DATE: September 16, 2014

TO: City Council

FROM: Robert A. Clarke, Public Works Director
Mike Webb, Community Development and Sustainability Director
Brian K. Mickelson, Assistant City Engineer/Transportation Manager
Dave "DK" Kemp, Active Transportation Coordinator

SUBJECT: Third Party Analysis of E. Covell Corridor Plan by Mobycon

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Recommendation
This is an informational item only and there is no staff recommended action at this time. Council will receive a power point presentation from Mobycon staff who will be participating via a teleconference call. City staff will return to City Council with a comprehensive report and presentation of the East Covell Corridor Plan with staff recommendations in October.

Consistency with Council Goals and General Plan
Maintain and improve current infrastructure and provide a safe and efficient circulation system. Actions under this goal include: Adopt complete streets designs; improve bike circulation and safety, with priority near schools; and implement synchronization of traffic signals.

Fiscal Impact
City Council directed staff to conduct a third party analysis of the East Covell Corridor Plan with a budget of approximately $25,000. Following refinement of scope and final negotiations, staff engaged Mobycon in a not-to-exceed contract of $28,240.

Funding for implementation of any Corridor Plan recommendations will be subject to future action by the City Council.

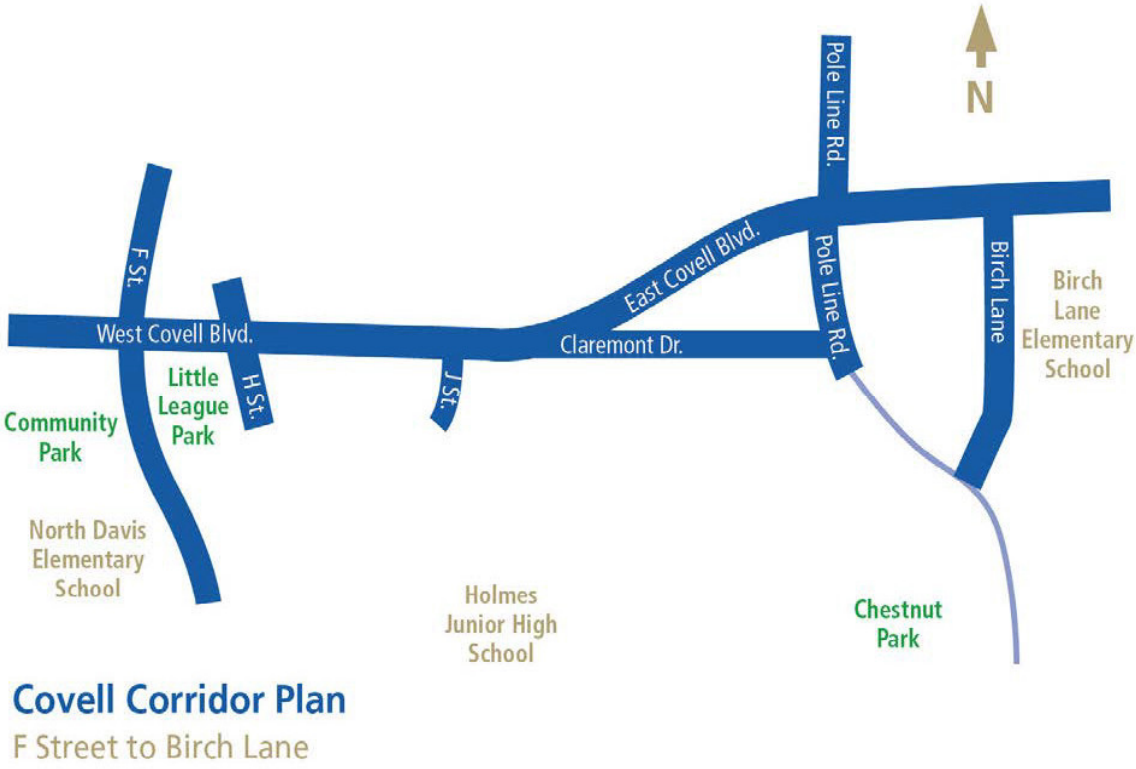
Background and Information
The East Covell Corridor Plan (ECCP) project was conceived in late 2012 at the time of the submittal of The Cannery development applications. In January 2013, the Mark Thomas Company and sub-consultants were selected to prepare the corridor plan. The draft Plan was presented to the City Council on April 22, 2014. At this meeting, the City Council directed staff to pursue a third party analysis of the ECCP to evaluate and prioritize the plan's recommendations and also to suggest new bicycle and pedestrian circulation concepts in the corridor.

Seeking the perspective of a consultant that could offer a nontraditional and expert opinion of optimal transportation design solutions that specializes in active transportation, staff contacted the Dutch Cycling Embassy. The Dutch Cycling Embassy is a public/private network. It is an

intermediary between the demand for Dutch expertise and the Dutch parties that can deliver this service. Consequently, the City of Davis was connected with the firm, Mobycon. Mobycon is based in Delft, Netherlands and specializes in active transportation and place making. Following a proposal from Mobycon, staff executed a contract with the firm to examine the EECP and further research the E. Covell Boulevard corridor. This included a site visit by representatives of the firm in July 2014. During the site visit, Mobycon representatives shared with staff the basis of Dutch transportation design and discussed how these designs might translate to improvements along the Covell Boulevard Corridor.

In addition to the evaluation and prioritization ECCP's recommendations, Mobycon's third party analysis also included research and findings regarding the types of bicyclists and their primary and secondary destinations along the corridor.

The study area consists of the Covell Boulevard corridor between F Street on the west and Birch Lane on the east. The corridor does not extend a specific distance north and south of the corridor but considers access and circulation to public facilities near the corridor including schools, parks and shopping.



Mobycon has divided their recommendations into two categories: The "Now" category that prioritizes recommendations that should happen in the near term and the "Wow" category that prioritizes recommendations that should be considered long term.

The following tables were developed by staff to provide a snapshot of Mobycon's recommendations, its relationship with the ECCP, and staff's initial comments. The first two tables retain the same format as utilized by Mobycon – the "Now" and the "Wow."

The third table contains the remaining ECCP recommendations not covered in the first two prioritized tables. These tables are for information purposes and do not reflect staff's final recommendations regarding the ECCP. Staff has highlighted (in orange) specific recommendations that staff believes warrants City Council attention and discussion.

Table 1 – "Now" (Near Term)

Mobycon Recommendation	Relation to ECCP	Initial Staff Comments
1) H Street Tunnel		
Retaining wall should be built to replace the graded slope on the west side to make room for a mini roundabout for cyclists. Additionally, construct bulb-outs at entrance of the tunnel.	Consistent with ECCP: Retrofit H Street Tunnel in terms of grades, retaining walls, and lines of sight.	Coordination with the RR and existing utilities in H Street will determine scope of improvements that are feasible.
2) Grade Separated Crossing Under E. Covell Corridor Bridge Toward H Street Tunnel		
Recommends option to pursue shared-use path toward H Street tunnel over option to route shared use path back up to E. Covell. Former option should include proper lighting and fencing (glass wall) to ensure visibility and security.	ECCP report did not compare/contrast the two proposed underpass options.	The two underpass options are currently under review and negotiation with the existing property owners is taking place. Approvals for The Cannery included a City Council determination that the connection to the H Street tunnel is the preferred option, but does not preclude the option to connect directly to the pathway on the south side of Covell. The ability to acquire easements, safety and relative costs will be primary factors in determining a final recommendation.
3) E. Covell Boulevard and J Street Intersection		
Recommends option of installing either a roundabout (preferred) or Dutch Junction intersection (unsignalized).	A signalized intersection was envisioned in the ECCP. Removal of channelized right turns and the addition of pedestrian crosswalks to the north and east legs of the intersection is consistent with the ECCP.	Staff has initial concerns regarding the physical space required for a roundabout, synchronization of traffic signals, and the practice of installing a multilane roundabout in a location with anticipated high bicycle and pedestrian traffic. Compliance with ADA guidelines may require pedestrian signals which might make a roundabout, or Dutch Junction intersection challenging.

4) E. Covell Boulevard South Side Two-Way Cycle Track		
Install a two-way cycle track on the south side of E. Covell between J Street and Pole Line Rd. to improve comfort, and recognition from road users. Install separated sidewalk for pedestrians. Eliminates need for additional grade separated crossing at L Street and E Covell Boulevard and buffered bike lanes.	Not identified in the ECCP.	Additional analysis is required. Generally speaking, cycle tracks function safest when there are a very limited number of driveway access points. The integration of a two-way cycle track at signalized intersections also needs to be carefully studied.
5) E. Covell Boulevard and L Street Intersection		
Removal of channelized right turn lanes and narrowing of the southern leg of the intersection for traffic calming purposes. The multi-use path becomes a two-way cycle track and intersection remains unsignalized.	Recommendation to remove channelized right turn lane is consistent with the ECCP. Recommendation to install un-signalized intersection is not consistent with the ECCP recommendation to install signalized intersection.	This item requires further analysis, as a signalized intersection is included as an adopted mitigation measure and condition of approval for The Cannery.
6) Oak Tree Plaza Driveway Access Points		
Installation of raised crossing for cyclists and pedestrians along two-way cycle track to increase directness, comfort, and safety.	While not identified as raised crossings, the ECCP does recommend improved visibility for pedestrians and cyclists at the Oak Tree Plaza driveway crossings.	Feasibility of the raised crossing and separated cycle-track will depend on available right-of-way and potential conforming improvements needed in the shopping center which would require property owner consent.

Table 2 – "WOW" (Long Term)

Mobycon Recommendation	Relation to ECCP	Initial Staff Comment
1) Faro Ave Grade Separated Crossing Over the Railroad		
Construction of grade separated crossing over railroad at Faro Ave. to connect The Cannery development with North Davis	Not identified in ECCP.	Staff believes that flexibility on the location of a grade separated crossing over the railroad is needed. Further north of Faro Ave. may be more feasible and provide space for landings on the east and west of F Street. A location further north would also provide consistency with the General Plan circulation network.
2) E. Covell Boulevard and Pole Line Rd. Intersection		
Remove channelized right turns at intersection and install shared use path on west side of Pole Line Rd. to connect with two-way cycle track on south side of Covell. (Dutch Junction intersection)	While there are slightly different details, this generally is consistent with the ECCP recommendation to remove the channelized right turns and install a shared use path on the west side of Pole Line Rd and north side of Covell Boulevard.	Additional analysis of the intersection design and availability of necessary right-of-way will determine whether the Dutch Junction intersection and/or an off street pathway are feasible

3) E. Covell Boulevard and F Street Intersection		
Remove channelized right turns at intersection coupled with redesign of bicycle facility crossing. Should connect to future one-way cycle track on north side of Covell. SE corner of intersection should accommodate bicyclists and connect all corners (Dutch Junction).	Consistent with the ECCP recommendation to remove channelized right turns at the intersection.	Further analysis of the Art Center improvements at the SW corner and on Covell, in addition to intersection operations resulting from the recommendations will be necessary to determine a final scope.
4) E. Covell Boulevard (North Side) One way Cycle Track		
The existing one-way bike lane will be coupled with a one-way separated cycle track. Both facilities should merge at Covell overpass. Buffered by physical separation encouraged	The ECCP recommends a buffered one-way bike lane on the north and south sides of Covell Boulevard, plus a two-way off-street shared use path on either side	Concern about ability to discourage wrong-way riders in the one-way cycle track will need to be evaluated.

Table 3 – Other Recommendations Not Covered in the "Now" and "Wow" Prioritization and Evaluation Tables

(Note: Order of columns is different than previous tables)

ECCP Recommendation	Mobycon Evaluation	Initial Staff Comments
1) Additional F Street Intersection Improvements		
a. Replacement of channelized right turn from east bound to southbound with installation of right turn pocket	Partially agree. Shift bike crossing away from core of intersection to allow for free tight turns (Dutch Junction design).	Proposed improvements at the Art Center will need to be considered for compatibility with these recommendations.
b. Dual left turn movements from westbound Covell to southbound F Street remain.	Agree. This concept does not require further analysis.	The overriding issue was that the primary safety concern was the inadequate storage capacity for a single left-turn lane would cause traffic to queue into the westbound through lane on a vertical curve with limited sight distance.
2) E. Covell Boulevard Buffered Bike Lane		
a. Travel lanes are reduced from 12' to 11'.	Agree.	None.
b. One-way 7' buffered bike lanes installed in both directions along Covell.	Partially agree. Recommendation is for a two-way cycle track because they believe it provides a more comfortable facility for bicyclists.	If two-way cycle track concept were adopted, then this would replace need for buffered bike lanes.
3) Median Improvements along Covell Boulevard		
Planting of low water trees in median.	Partially agree. Rather than trees in the median, natural elements should be placed between the motorized and non-motorized traffic for their recommended two-way cycle track.	The existing median has sufficient room to accommodate additional landscaping, but further evaluation would be necessary to determine the extent of new landscaping that could be incorporated with the two-way cycle track recommendation, rather than using flexible bollards.

4) Second Separated Crossing on E. Covell Corridor		
Analysis of options for installing grade separated crossing between J and L Streets.	Solved. Installation of two-way cycle track on south side of Covell eliminates difficult crossing between J and L Streets.	Staff believes a safe at-grade crossing can be installed at the intersection of J Street and Covell to address expected travel volumes.
5) Oak Tree Plaza Driveway Enhancements		
Addition of westbound acceleration lane in the existing median.	Disagree. This study proposes to maintain the existing design if sufficient space can be provided in the median to safely stage a standard length vehicle waiting to turn left onto Covell.	Further evaluation of this issue is needed. The existing median width may not be wide enough to implement either recommendation.
6) Claremont Cycle Track		
Remove parking on north side of Claremont and install two-way cycle track.	Disagree. Because Claremont is a low speed residential street, a cycle track is not warranted.	Implementation of a cycle track would require the removal of some on-street parking that could have impacts to the residents and abutting Oak Tree Plaza.
7) Birch Lane Shared Use Path		
Modification of shared use path on north side of Covell.	Agree. Additional facilities for bicyclists would increase capacity.	None.
8) Signal Interconnect and Coordination		
Optimize existing and future traffic signals along Covell.	Disagree. This study eliminates signals at L Street and potentially J Street.	Staff is concerned with vehicle platooning. Signals at L Street are currently included at L Street as a mitigation effort.

Next Steps

Following input from the public and Council feedback at the September 16th City Council meeting, staff will return to the Council in October with a final presentation and report of the E. Covell Corridor Plan outlining staff recommendations and implementation timelines.

Attachment

1. Mobycon – Third Party Analysis of E. Covell Corridor Plan

EAST COVELL CORRIDOR PLAN

Third Party Review - Final Report

In response to:

City of Davis Date: September 2, 2014 Project number: 5094E02

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1. Introduction

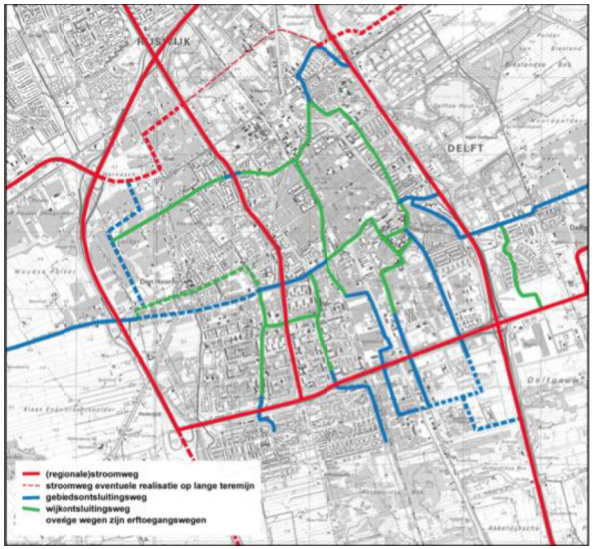
The City of Davis has a long tradition of bicycle culture. Since the 1960s with Emil Mrak from UC Davis, the City has encouraged bicycling for it is convenient, enjoyable, efficient, non-polluting, economical and healthy.

From the introduction of a citywide network of bicycle facilities in 1966, to the installation of the first bicycle signal ever installed in the United States in the 1990s, to the awarding in 2005 of the first Platinum Level Bicycle Community ever given to a city, to the opening in 2009 of the U.S. Bicycling Hall of Fame, the City ranks among some of the world's most bicycle-friendly cities, like Copenhagen, Amsterdam, or Groningen.

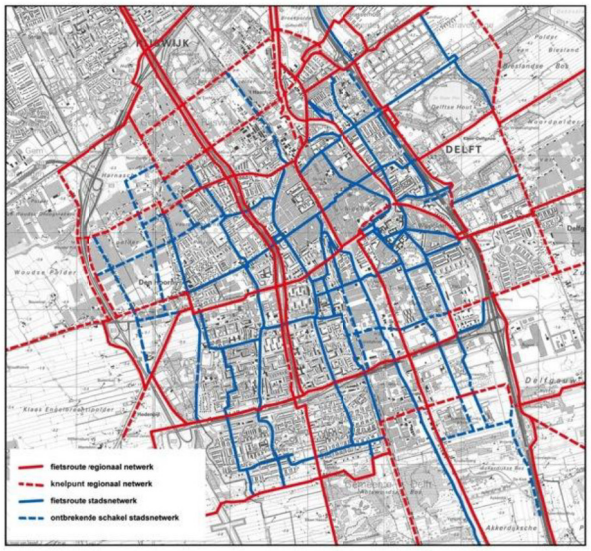
The City of Davis has approved a 100-acre development - the Cannery - located north of East Covell Boulevard and east of the Union Pacific Railroad line. The Cannery will be a mix of low- to high-density residences, urban farm, parks, greenbelts and mixed-use areas. The development of the Cannery will change transportation patterns within Davis, and more specifically along East Covell Boulevard.

Today, fifty years after the return of Frank Child - a UC Davis economist from the Netherlands who initiated pro-bike lane movements in Davis in 1964 - Mobycon is proud to guide the City of Davis toward the most efficient, practical and publically-supported solutions for the retrofit of the East Covell Corridor and in accommodating the needs of the future Cannery area.

This reports report frames our recommendations for East Covell Boulevard and adjacent streets and neighborhoods by analyzing policies, guidelines and previous research on the project area. This set of recommendations is gathered as a third party review for the East Covell Corridor Plan (ECCP). Examples of our recommendations for the Cannery are illustrated in this report, with respect to previous environmental and transportation impact analyses, policy analysis, and in light of Mobycon's site visit to Davis.



1: Car network of Delft, Netherlands



1: Bicycle network of Delft, Netherlands

3. three types of bicycle infrastructure: lanes, paths in urban setting, paths outside built up area

2. Inspiration

In this Chapter we provide inspiration on road design from our Dutch perspective. The examples and ideas presented in this chapter show our view on safe cycle design. These ideas and concepts are used in the following chapters as the basis for analyzing the optimal solution for Davis. There we provide specific measures for Davis' infrastructure. There, we implement measures on the Davis infrastructural situation.

We first look into inspiration on the network level for both car and bicycle. Then, we zoom in onto the street level. For this, we distinguish solutions for the street segments and the intersections.

2.1 Network level

On the network level the Dutch identify both the car network and the cycle network as two distinct networks. They can overlap at places, or run parallel at other times. It is of major importance to create a coherent bicycle network that is faster than the car network. In terms of needs, it needs to be safe, comfortable and attractive. In general this means that the bike network has a mesh width that is about three times as dense as the car network. This images on the left of the City of Delft show this.

It is important to note that the way this system of networks comes forth is not by building a lot of cycling infrastructure, but by prioritizing certain roads in the car network. Using their 'sustainable safety' principle, the Dutch prioritize across various traffic condition, from large corridors (arteries at 50 kmph, 30 mph, blue and green in the image left) to traffic calmed islands (20 mph or slower). Cyclists can cycle everywhere, especially through the traffic calmed streets. They have short cuts through dead ends, under passed or bridges and over bigger barriers like provincial roads, canals or railway tracks.

In the bike network there is a difference between main routes and secondary routes for cyclists (red and blue in the image left). The first has a higher quality, higher level of comfort and greater directness. Besides that, there is a distinction between the commuters network and the recreational network. These two networks may overlap, but have different goals and so different needs in infrastructure. The first being fast and direct, the second connecting parks and recreational destinations, for leisurely riding in an attractive surrounding.

4: Residential street: narrow, shared and 20 mph

5: Village square: Shared Space instead of an intersection

6: City center square: Shared Space instead of an intersection and road segments

7: Residential/Shopping street: narrow, shared (here it is one way car, two way bike) and 20 mph

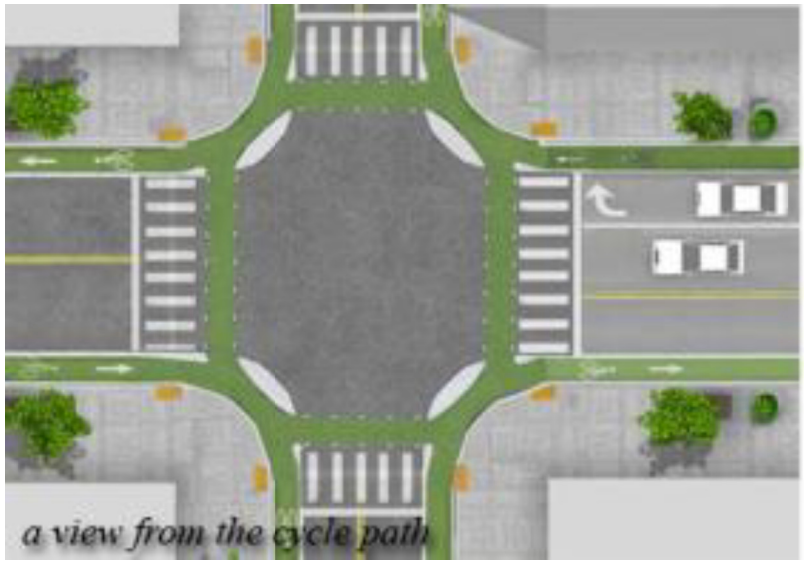
2.2 Street level: segments

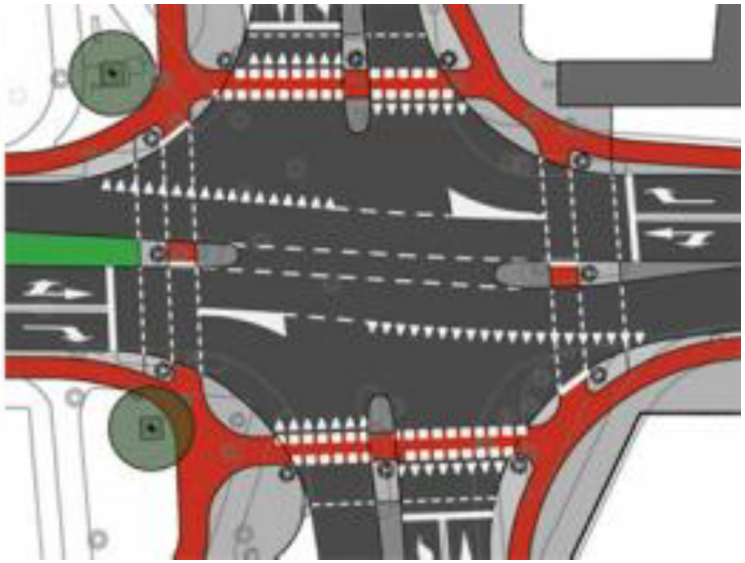
On the streets this division between 50 kmph and 30 kmph roads (or 30 and 20 mph roads) leads to different choices in the presence of bike infrastructure. Generally at 30 mph arteries the Dutch feel that is too unsafe to mix traffic modes. That means that bike facilities will have to be implemented. Unprotected bicycle lanes are the minimum application. With streets with more than one car lanes per direction, and therefore higher traffic volumes, a bike lane is not safe enough anymore, and more buffered forms are needed. This can be behind parked cars, or behind a green boulevard. Most bigger roads (70 kmph/ 43 mph, or 100 kmph/ 62 mph favor a separate parallel running trail over cycle path alongside the road. These roads are mostly not inside the built-up area, but more outside cities and towns. See image 3.

At streets with a lower traffic function a 30 kmph limit is present (20 mph). On these streets the motto is 'nice and tight', meaning that cars and bikes share the road, and all road markings are absent (see image 5). There are no car lanes, no middle line and no bike facilities. The cars stay behind the cyclists and only overtake when there is no opposing traffic. In the Dutch perspective, mixing is the key to ensuring a slow travel speed. At the same time, a slow travel speed makes mixing safe. The speed limit of 30 kmph, or 20 mph, is chosen because of the traffic safety premise that collisions with higher speeds have an exponentially increasing risk of fatality. That is why the Netherlands, and more and more the other European Union countries, set 20 mph as the limit for streets on which people live, work and play. The minor decrease in (car) traffic flow is considered less important than the increase in traffic safety.

In infrastructural terms the widths of these streets are between 16 and 22 feet, from curb to curb (or from parked car to parked car, as these are also the streets where people live). The majority of Dutch streets are built in this form, often featuring traffic-calming measures like paving stones, speed bumps, road disalignments or overhanging trees. The Dutch are confident this is the safest way to design a street, and have been transforming big 60's era arteries into smaller residential streets for over 10 years now. The result is an ever slowing car system and with that an ever increasing bicycle share.

The Netherlands is worldwide leader in traffic safety with currently about 500 fatalities in traffic per year. This is the result of years and years of focusing on traffic safety. The significant decline in fatalities in the last decennium is a result of the emphasis on expanded 30 kmph zones and separation of traffic modes on bigger than 30 kmph roads. (the 50 kmph – 30 mph roads)





8: 'Dutch Junction' with cyclists protected at the intersection, crossing in the same phase as pedestrians.

This philosophy, called 'sustainable safety' is still one of the main pillars behind the Dutch traffic safety philosophy. Within this concept there is a large focus on deregulation of infrastructure and public space. Traffic safety experts noted that the trend to 'more and more' (more traffic lights, more traffic rules, more traffic measures, more traffic signs') was not 'paying off' anymore. The decrease in fatalities was ever slowing down. That is why on the 30 kmph (20 mph) streets in the last 15 years more and more traffic lights were taken out, zebra-crossings were removed and roads were 'normalized'. The basis layout of roads, without extra traffic regulating measures, proofed to be safer and more easily understandable for road users of all ages. People paid more attention to each other, slowed down in situations where it was becoming too complex and traffic safety increased again.

Part of this newer trend in the Netherlands is the increased attention for place making. Realizing that traffic is only one of the functions of public space, and that in a lot of places car, bike and other transport modes forces other functions out of that public space the Dutch are experimenting with design forms in which both the traffic function is still present (but traffic calmed) and other functions – meeting, enjoying, talking, selling, walking, flirting and more – can find back their place in the space. These so-called 'shared spaces', or, more negative, 'naked streets', are nothing new; the monumental medieval inner cities of a lot of Dutch cities where never anything less than this. When designed properly, the new shared spaces make up for excellent traffic calmed streets with a high quality of public space.

2.3 Street level: intersections and crossings

A network is only as good as its weakest link. In the street network, intersections are the most troublesome places. The Dutch started focusing on safe intersections for all users many years ago. In relation to bicycle infrastructure the bike box – or advanced stopping line – is a good way of facilitating a way for cyclists to cross an intersection, provided there is a bike lane running up to the bike box.

At bigger intersections, with arms with more than two lanes in total (including turning lanes), this facility is no option anymore. Then the conflicts are too much for cyclists to be exposed to. Therefore, in Dutch situations the cyclists are lead off the intersection, and cross the side street perpendicular, next to the pedestrians. This provides extra protection, as a shoulder protects the cycle track. This design leads to an easy, conflict free right turn for cyclists, to a traffic (bike) light regulated straight on and to a protected left turn in two phases (first straight on, then left). This design can be used -

9: Single lane roundabout: Narrow, tight, slow but continues traffic flow. Crossing of pedestirans and cyclist with right of way.

10: Turbo roundabout: Narrow, double lane but without weaving conflicts. Possibilities to 'loose' an entry and exit lane on branches. Cyclists and pedsetrians cross on a platform, with right of way.

with either protected cycle tracks running up to the intersection, or bike lanes leading up to it, which become a cycle track just before the intersection. It is a massive improvement in quality and safety for cyclists. The Dutch use this type of configuration on almost all big traffic light controlled intersections. It is also an improvement over the 'Copenhagen-style' intersection, where the left turn in two phases is done with a advanced bike box for the left turn in front of the side street, as this second phase is also protected by a shoulder.

Roundabouts are the preferred type of intersection on almost all intersections of 30 mph roads in the Netherlands. In terms of traffic safety they are much safer, due to lower travel speeds and fewer points of conflict. (see Appendix C for a traffic safety analysis comparing roundabouts to traffic light controlled intersections).

Another important factor in enhanced traffic safety is the higher level of attention motorists have. The general idea is that traffic lights, with stopping for red and driving on green, make up for mindless drivers and should be prevented as much as possible. Dutch research shows that roundabouts are the safest type of intersection, followed by uncontrolled intersections, and finally by controlled intersections. It should be noted that traffic light controlled intersections were never designed for traffic safety, but for traffic flow; it was a way for side street traffic to find a gap in the traffic flow to enter the main road.

Lower speeds when entering the roundabout also make up for safer pedestrian and cyclist crossings. In the Netherlands at roundabouts it is standard for cyclists and pedestrians to have the right of way within the built-up area, and to yield outside of the built-up area. The general idea is that they are safe enough to traverse without pedestrian / cycle lights.

One important notion is that the number of travel lanes leading up to and from the roundabout must be as few as possible refuge islands must be provided for wherever possible. Like any road with multiple lanes, a roundabout with two entry or exit lanes has the risk that the line of sight on the crossing pedestrian/cyclist from a car on the second lane is blocked by the halting car on the first lane (coverage). This must be prevented as much as possible.

To mitigate this problem, bigger roundabouts therefore have raised crossings (cyclists and pedestrians cross with right of way on a platform/speed bump) or even underpasses if the roundabout gets too large.

Another way to mitigate suboptimal crossing of pedestrians and cyclists is to use turbo-roundabouts instead of double lane roundabouts , image 10). Turbo

11: Plan of the Cannery

roundabouts are a new and innovative way of increasing the capacity of a single lane roundabout without transferring to a double lane roundabout. Motorists have to choose the lane on the roundabout beforehand, because shifting lanes on the roundabout is made impossible by the median between the lanes on the roundabout itself. This eliminates weaving conflicts on and near the roundabout, eliminates the need for double entry or exit lanes on certain branches (depending on the specific traffic volumes) and lowers the travel speed. These factors all improve safety on and around the roundabout, making it even more safe than a traffic light controlled intersection.

Depending on the traffic volume and the location within (or outside of) the city, the Dutch decide whether or not cyclists have the right of way (within the city they have the right of way at roundabouts over car traffic) and if the crossing has to be raised on a platform (plateau) or not. This last 'speed bump' raises awareness for car drivers, lowers their speed and stresses the right of way of cyclists and pedestrians at those crossings.

3. Analysis

In this chapter, Mobycon executed an analysis of East Covell Boulevard and the Cannery Development (image 11). For this we first look into the documents present. After that, we look at the network level, car and bike networks, and destinations (land use). Then, we zoom in onto the street level.

3.1 Reviewed documents

There are several documents analyzing and proposing solutions for East Covell Boulevard. In our third party review, the core documents are the Environmental Impact Report (2013) and the East Covell Corridor Plan Circulation Report (2013) and the East Covell Corridor Plan.

Environmental Impact Report (2013)

In September 2013, the Final Environmental Impact Report (FEIR) of the Cannery Project was issued by the City of Davis. The FEIR follows the earlier publication of the Draft Environmental Impact Report (DEIR) and combines the DEIR, as well as feedback on the DEIR. In the FEIR, the City provides four Master Responses to common categories of questions on the DEIR from public consultation. They cover the following topics:

1. emergency vehicle access (EVA),
2. bicycle safety
3. bicycle mode split, and
4. greenhouse gases (GHGs)

The map shows the different routes, which are explained below.

1) The original EVA was planned to be located to the northwest corner of the Cannery area with an at-grade crossing of the railroad. This would have generated in-

tense noise levels, as the trains would have had to use their horns before crossing the EVA. Since the City is not able to guarantee a Quiet Zone by the Federal Railroad Administration, the project applicant eliminated this EVA and proposed a new one to the southeast corner of the Cannery area, west of the intersection between East Covell Boulevard and J Street, where the main entrance of the Cannery area is located. The design of the EVA must be addressed in the redesign of East Covell Boulevard.

In this Mobycon notes that a grade separated crossing for car traffic would not be the most ideal situation. Instead, the choice for the southeast access for emergency vehicles is a logical solution. In this light we feel that it is important to look at the Cannery not only as a single development, but as part of the total future development of the green fields. By making use of the agricultural route, and connecting at the main roundabout of the Canner, the EVA could be relocated eastwards and more centrally in future area greenfield development.

2) The EIR analyzed three off-site pedestrian and bicycle path connections to ease pedestrian and bicycle movements to and from the Cannery area. These three connections include:

1. The 'proposed' alignment under the East Covell Boulevard bridge and east of the UPRR tracks to connect with the H Street bicycle tunnel;
2. "Option 1" under the East Covell Boulevard bridge and east of the UPRR tracks turning easterly and continuing along the southern face of the Covell overcrossing to tie into the existing bike trail on the south side of East Covell Boulevard; and,
3. "Option 2" across the F Street Channel approximately 1,100 feet north of East Covell Boulevard to connect with the F Street multi-use path.

Per City Council action on the Cannery, the preferred alignment was determined to be the proposed option, connecting to the H Street tunnel."

In this Mobycon notes that it is important to see bike routes as preferred by different target groups. Schoolchildren, elderly and recreational cyclists won't mind a small detour if it adds to enhanced traffic safety. So for them, a tunnel is the preferred option whereas daily commuters would not mind a level crossing over East Covell Boulevard, as long as it is the most direct route. With this in mind, Option 2 would be suboptimal, as the main direction from the tunnel is southwards, towards the existing tunnel of H-street. From our perspective,

the preferred option is the 'proposed' option, consistent with the determination by the city council..

3) Master Response 3 discussed the bicycle modal split assumptions used in the EIR. This was subsequently clarified in an October 2013 memo from the traffic consultant. The Cannery EIR traffic study assumed that 15% of all external trips leaving the Cannery site would be walk/bike trips. This was a conservative estimate because North Davis residents had a 16,5% walk/bike mode split. The Cannery area has indeed tremendous potential given its proximity to schools, shopping, a library, and recreational areas. The FEIR however notes that commuters are less likely to use their bicycles since distances might be longer.

In this, Mobycon notes that trips with distances up to 3 miles have huge potential to be done by bicycle, as can be seen in countries like The Netherlands and Denmark. This modal share declines sharply between 3 and 4.5 mile. Within the radius of 3 miles most of the City of Davis can be reached from the Cannery. When safe and comfortable cycling infrastructure is provided for, the share will likely increase.

4) Finally, the FEIR highlights the GHG emissions potential from mobile and stationary sources, stating that the environmental analysis is consistent with applicable laws. The Cannery indeed complies with the SACOG MTP/SCS mitigation measures (certified on April 19, 2012).

East Covell Corridor Plan Circulation Report (2013)

The East Covell Corridor Plan Circulation Report, which was issued in October 2013, details the transportation environment, conditions and challenges in the project area. Facilities, volumes, Level of Service (LoS), accident data, speed limits, transit lines, but also less typical measures such as Level of Traffic Stress (LTS) are all reported on and analyzed to form recommendations towards retrofitting East Covell Boulevard as well as adjusting necessary adjacent segments.

As of today, a Class I bike path runs along the southern side of the Boulevard, while Class II bike lanes run along both the north and south sides. The main intersections are F Street, J Street, L Street, Claremont Drive, and Pole Line Road. An overpass over the railroad exists between F Street and J Street.

The most critical intersections in terms of volumes and are (in decreasing order of magnitude):

1. East Covell Boulevard and Pole Line Road;
2. East Covell Boulevard and F Street;
3. East Covell Boulevard and L Street.

The most critical intersections in terms of collisions are

(in decreasing order of magnitude)

1. East Covell Boulevard and Pole Line Road;
2. East Covell Boulevard and F Street;
3. East Covell Boulevard and J Street.

It is worth noticing that the bicyclists' LTS is highly correlated with the volumes and collisions data. Research has determined that most bicyclists feel comfortable with LTS 1 and 2. The East Covell Corridor however fails to comply with the rule between F Street and Pole Line Road and beyond, with intersection approaches scoring 3, and segments scoring 4, the worst grade possible. Interestingly, the Class II bike lanes located North and South of the Boulevard get the worst LTS score, 4, although no bicycle collisions have been recorded on the segments. This high LTS is mainly due to the higher speed differential between bicycles and motorized traffic – motorists driving at a surveyed average speed of 37.5 mph for a posted speed limit of 35 mph on Covell Boulevard. Since the Class II bike lanes are not buffered, since the speed differentials are high, and since eastbound residents of the Cannery would be required to cross the the Boulevard in order to travel east, "interested but concerned" bicyclists may not choose to ride their bikes, hence preventing a substantial mode shift from taking place.

In this, Mobycon notes that, even while separated with a demarcation line, cyclists feel unprotected and endangered while being overtaken by fast-moving cars (faster than 30 mph).. In the Netherlands, with these situations a buffered solution (paved or green boulevard) is implemented. At the crossings on Covell, the most dangerous places, the bike lanes end, to be picked up again after the crossing. In the Netherlands these areas receive the greatest design care; the safest solution is to take cyclists off the road, to a segregated cycle track, and let them cross perpendicular over the side streets. This principle is called 'the Dutch Junction' (see Chapter 2, intersections).

East Covell Corridor Plan (2014)

The East Covell Corridor Plan, published in March 2014, summarizes the existing conditions, the Cannery development project and the Circulation Report to draw recommendations for the East Covell Corridor redevelopment. These recommendations are presented in Chapter 7 of the Plan, and are listed A through N as follows:

A. F Street Intersection Improvements
   - Replacement of the channelized right turn from eastbound to southbound with a right-turn pocket
   - Dual left-turn movements from westbound to southbound remain
   - Opportunity to create a new shared-use path on the northeast corner of the intersection

B. J Street Intersection Improvements
   - Channelized right turns from eastbound to south-

bound and from northbound to westbound are removed
- Pedestrian crosswalks are added to the north and east legs of the intersection

C. East Covell Boulevard Buffered Bike Lane
- Travel lanes' widths are reduced from 12 feet to 11 feet
- One-way 7-feet buffered bike lanes are created in both directions

D. Median Improvements Along Covell Boulevard
- Planting of low maintenance, low water ground cover and trees in the existing medians
- Provision of a 2-feet hardscape buffer between the travel lanes and the ground cover

E. Separated Crossing of East Covell Boulevard
- Options for the implementation of a grade separated bicycle and pedestrian crossing between J Street and L street

F. L Street Intersection Improvements
- Installation of signals
- Implementation of bulb-outs and high visibility pedestrian crossings at Claremont Avenue
- Place marking improvements
- Removal of the channelized right turn movements from eastbound to southbound and from northbound to westbound

G. Oak Tree Plaza Driveway Enhancements
- Addition of a westbound acceleration lane in the existing median
- Addition of high visibility markings on the existing shared-use path on the South side of the Boulevard

H. Claremont Cycle Track
- Removal of on-street parking on the North side of the street
- Construction of a two-way cycle track on the North side of the street

I. East Covell Boulevard Shared Use Path
- Additional shared-use path on the North side of the boulevard

J. Pole Line Road Channelized Right Turn Removal
- Replacement of the channelized right turn movement from westbound to northbound with a right turn pocket
- Removal of the channelized right turn movement from eastbound to southbound

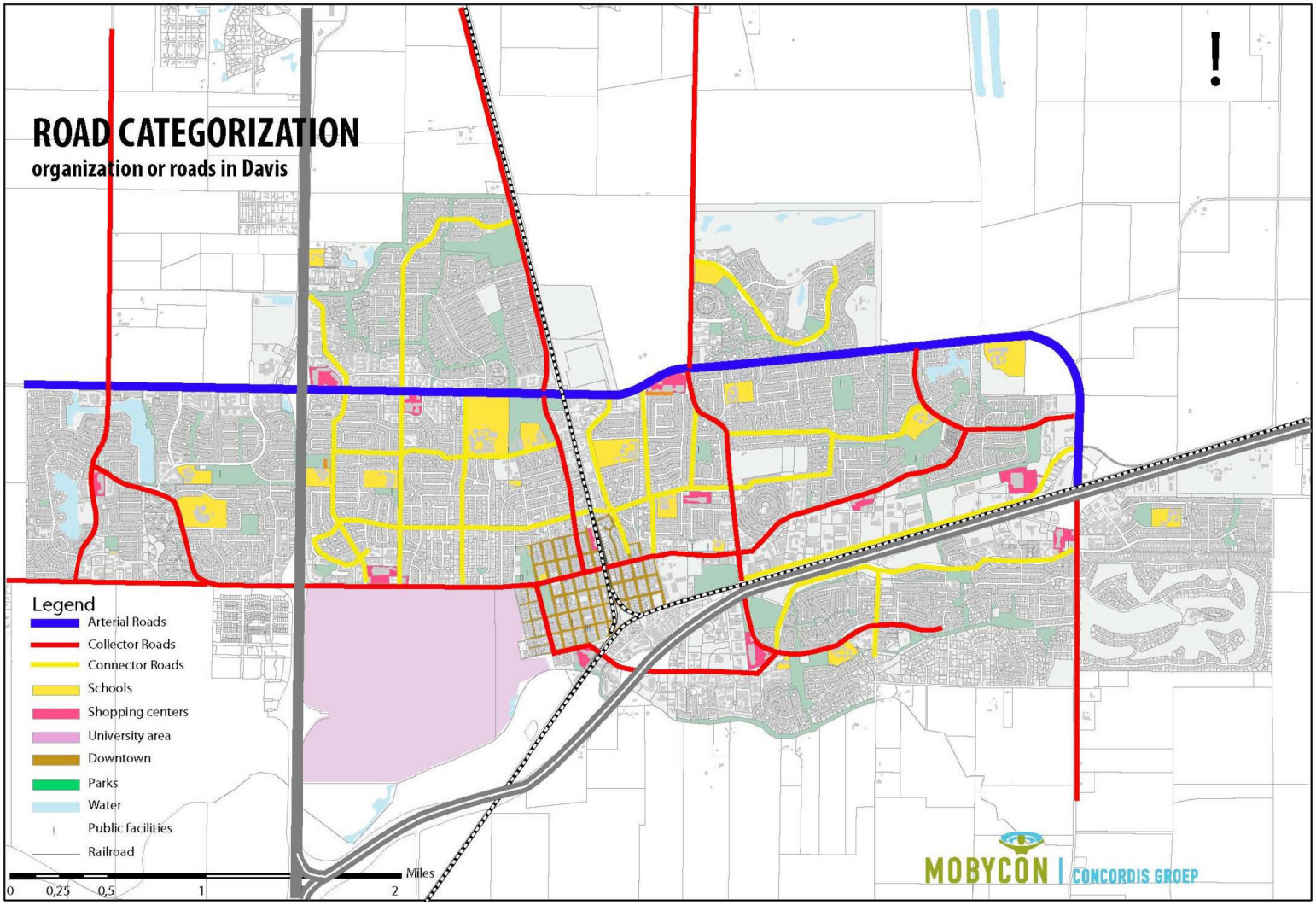
K. Pole Line Shared Use Path
- Construction of a shared use path on the West side of the road

L. Birch Lane Shared Use Path
- Existence of Safe Routes to School programs
- Addition of a shared use path on the North side of East Covell Boulevard

M. H Street Tunnel Replacement
- Either widening of the East Covell Boulevard bridge over the railroad tracks; or,
- Retrofitting of the H Street Tunnel in terms of grades, retaining walls and lines of sight

N. Signal Interconnect and Coordination
- Optimization of existing and future signals along the East Covell Boulevard

These recommendations will be evaluated in the following chapters of the study. In attachment A our opinion on these recommendations can be seen.



12: Road Categorization of Davis

3.2 Current conditions

3.2.1 Car network

Although the City of Davis focused on implementing good cycling facilities for many years, the network structure for the City of Davis still seems oriented around the car: the grid-based structure, often with meandering residential streets within it, make up for good car accessibility and traffic flow. The relatively wide streets, the smooth asphalt and the proximity of parking to destinations do little to encourage other transportation modes over cars..

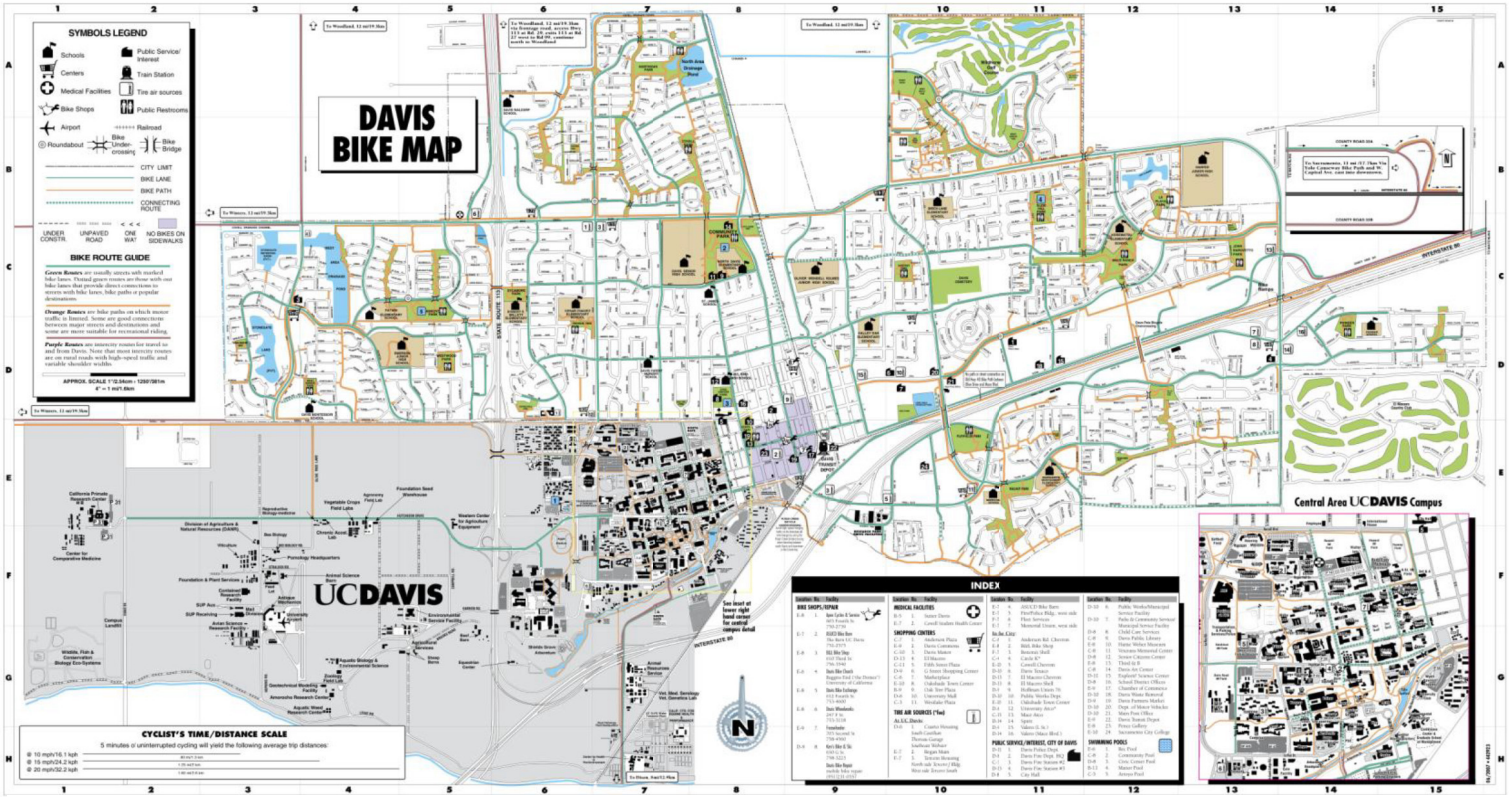
East Covell Boulevard functions as a bypass between the two highways (I80, CA 113). It was the former outer ring of the City from the north and east side. Recent developments have bridged this barrier. The Cannery is also a new development on the north side of this road.

Focusing in on the area around the Cannery, E. Covell Boulevard is connected by F Street and Pole line Street as major feeders, the latter having a bigger traffic function than the former. The intersections for these streets are quite intense. F Street runs parallel to the north-south oriented railway track, having a neighborhood access function but lacking in eastward connections (due to the railway running on that side).

The maximum speed on E. Covell Boulevard is 35 mph. The street running parallel to E. Covell Boulevard, Russel Blvd /5th Street has a more or less similar traffic function but is more urban in form. The max speed here is 30 mph. Pole Line Road has a limit of 25 mph, connecting between those two. On smaller streets, like F Street, as on other similar roads (yellow in map 12) it is 25 mph.

Traffic volumes for these streets show that F street and Pole Line Street are the busiest side streets along the segment of E. Covell Boulevard near the Cannery. L-Street is a neighborhood access street with a collector function and makes up for the third most heavy intersection.

From this view we see that E. Covell Boulevard is still suited to form a ring road and host major traffic functions on the outskirts of the City. However, it has also taken on the role of urban street through residential neighborhoods. The traffic volumes, less than 20,000 per day, ask for 2 x 2 lanes, but the traffic speed could be more in line with that of the built-up area, relieving tension at intersections.



13: Davis Bike Map

3.2.2 Bicycle network

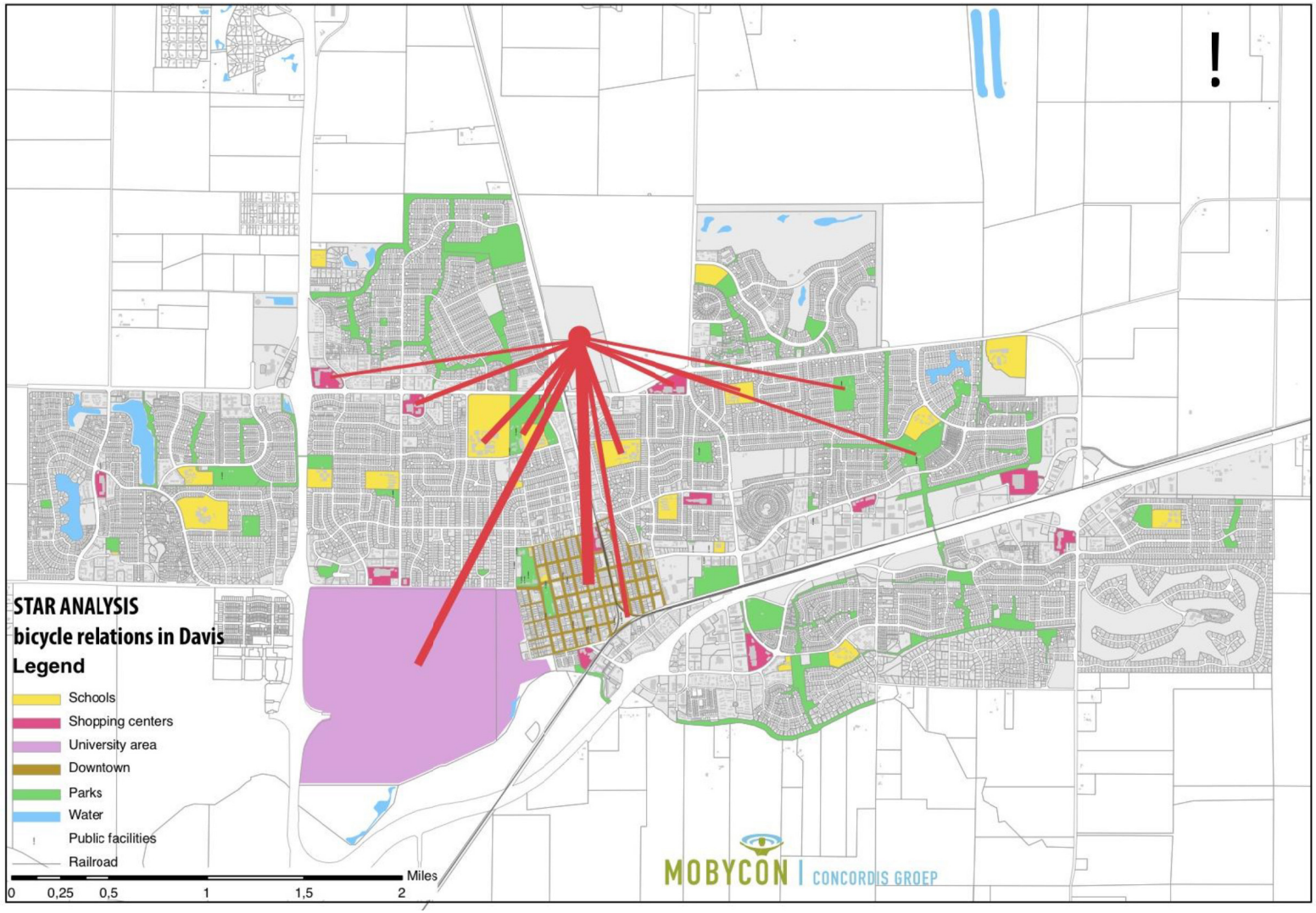
Davis' bicycle network is very extensive and finely meshed, with a variety of on- and off-street facilities aiming at connecting the main activity centers to residential and mixed-use neighborhoods. The bicycle share is extraordinarily high for American cities, and is on par with some Danish and Dutch cities. Cycle distances are rather short and destinations are mostly accessible by good cycle facilities.

There is however room for improvement. The City of Davis has a few major barriers in its layout preventing short (direct) or safe (crossings) trips by bike. These are the highways, the railways and the main arteries. East Covell Boulevard is one of them. A good bike network ensures that trip distances by bike are shorter than by car, thus stimulating the use of the bike. Shortcuts through neighborhood streets (no dead ends for bicycles) and under- or overpasses across barriers like railways or highways help shorten these routes.

3.3 Accessibility of the Cannery by bicycle

The Cannery is a mainly residential neighborhood with commercial buildings as a buffer between the dwellings and the artery road. It is centrally located within the City of Davis, which ensures short travel distances to most destinations. Approximately 80% of City destinations can be reached within 2.5 miles. This is well within the 'cycle distance'.

Important destinations within close proximity are schools, parks, downtown, the university grounds and shopping malls. The first four are very suited for bicycle trips, and even shopping malls are now commonly seen as a bicycle trip. (as the 'shopping by bike' concept keeps getting increased attention). Map 14 shows the current land uses and the relationship between them and the Cannery by use of a 'star analysis'. The thicker the arrow, the stronger the relation, according to our research opinion.



14: Star network analaysis on bicycle relations to and from the Cannery

3.3.1 Allocating bike routes according to target groups

Routes based on the star analysis are then allocated along the existing bicycle infrastructure. Here, the higher the comfort and safety levels of a bike route, the more priority it gets in allocating routes. Furthermore, the routes are allocated per target group. For this the Dutch distinguish five basic conditions for good cycling infrastructure:

1. Safety
2. Comfort
3. Directness
4. Coherence
5. Attractiveness.

The following three main target groups are seen in Davis: children, students/ commuters, leisure/recreational.

Children

A good cycle city has infrastructure that is suited for the old and the young. In the Netherlands, there is a strong focus on individual mobility, from as early on as possible. Children can be seen riding their bikes to school from the age of 4, accompanied by a parent. Between the age of 7 to 10 children cycle to school without guidance.

Junior high and high school children generally cycle to school on a daily basis. They often gather in larger groups because of social reasons, not because of safety concerns. The Netherland focuses on both infrastructural and behavior measures to keep and strengthen this way of getting to school.

For the City of Davis to stimulate 'getting the children out of the backseat of the car', it is necessary to provide proper infrastructure. School children riding bikes ask for extra priority for base condition Safety, followed by Directness, whereas the other conditions have lower priority. This can mean that a grade separated crossing is preferred over an on-street crossing, even if it has a slightly bigger detour. If the detour becomes too great, they tend to use the more direct level crossing, thus feeling less safe. Scenery along the route is less important for them.

Students, Commuters

(Young) adults are another important target group for cycling. The City of Davis, compact as it is, is appropriate for short distance bike trips. To ensure that this target groups takes the bike and not the car the condition of Directness is of highest importance, followed by Safety. Attractiveness is again of less importance. They want to get there as fast as can get, and certainly faster than by car. That would mean for instance that they would take on road cycle facilities and level crossings instead of separated cycle tracks and grade separated crossings if that would mean the route would be shorter.

Leisure, recreational

The third target group of importance is the leisure cyclists, and recreational cyclists. This group cycles because it is fun, healthy and nice. It consists mostly of the elderly or families, cycling at slow pace, enjoying the surroundings and not minding a detour. The trip is more important than the destination. Safety is one of the most important aspects for this group, as well as comfort and attractiveness. Directness is of less importance.

3.3.2 Possible improvements to the infrastructure around the Cannery

The comparison of the car network map (12) with the three different bike networks (per user group) shows possible bottlenecks. With these target groups in mind

the star analysis tool can be allocated to the existing bike network. Safety, directness and comfort of routes and crossings become clear and missing links become visible. The routes from the Cannery to the east follow the segregated shared path along E. Covell Boulevard. First they have to cross the street to get to the path, on the south side. Destinations in the west and the south also have to cross the street. Faster, shorter or safer alternatives are currently not provided for, as the neighborhood is enclosed by a railway in the west and a greenfield in the west and north. For children and elderly, and the less daring, a grade separated crossing is desired. For commuters, adults and students an on-grade crossing would be adequate as they can safely maneuver themselves through traffic.

Field visit and workshop give direction to the bike routes.

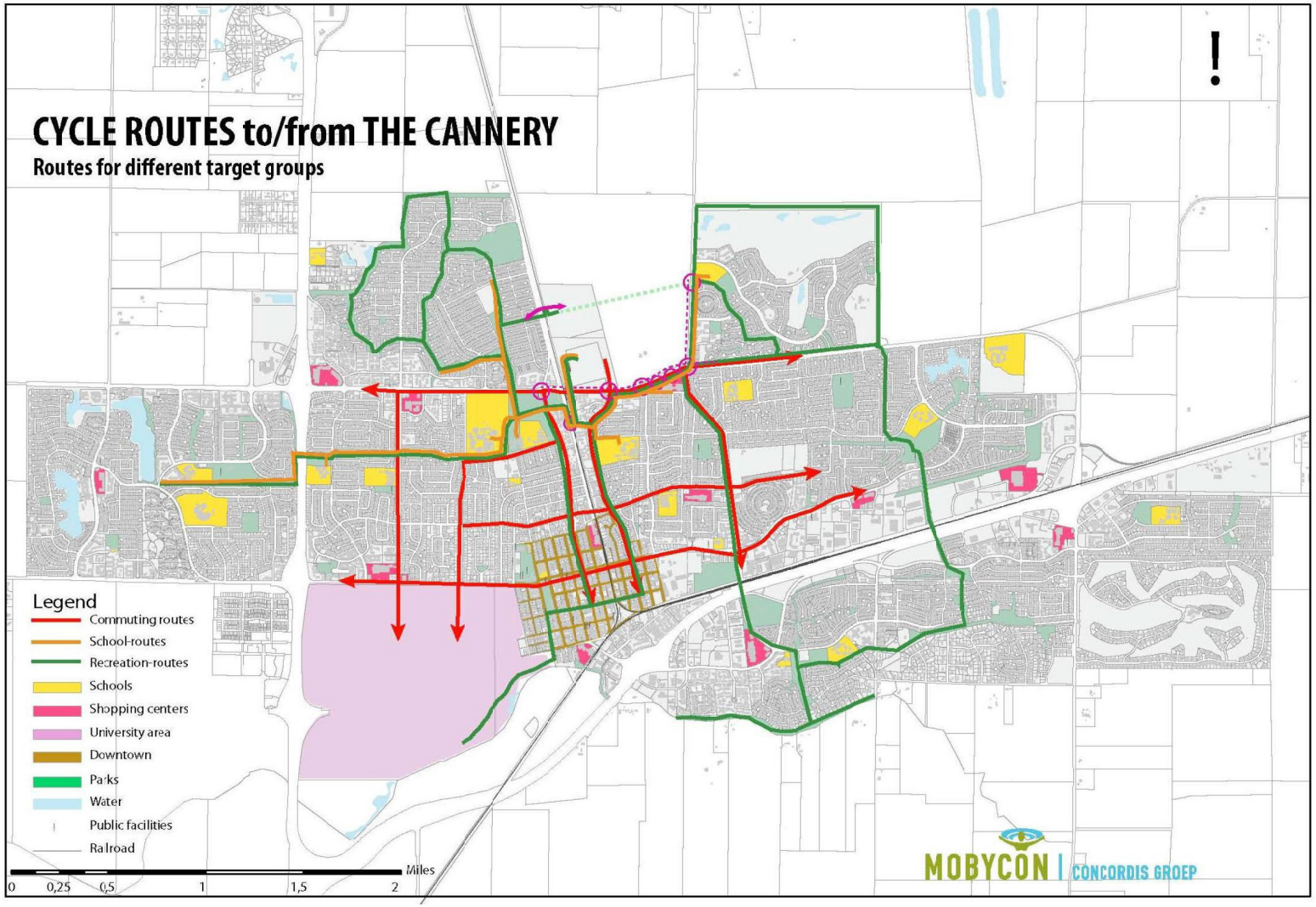
On July 14th and 15th, 2014 a field visit was conducted. This was accompanied by a workshop with the City. Working together, workshop participants allocated bicycle routes based on target groups and existing infrastructure. In figure15 these routes are visible, with different colors per target group. Bottlenecks in those routes are highlighted with purple circles, arrows and dotted lines. In the next chapter, these bottlenecks will be worked out into solutions.

From this analysis, Mobycon suggests the following general 'branches of solutions' for the three target groups when getting to and from the Cannery:

Conflict free routes and trails for high connectivity for children

Children going to elementary, junior high or high school are in need of a segregated cycle facility with safe crossings. Even given the situation with a traffic light controlled crossing of E. Covell Boulevard the route would not reach the level of safety asked for this target group. An over- or underpass would be ideal. This leads to desired solutions where the routes to the schools south of E. Covell Boulevard are reached by tunnel under the bridge, connecting to a route to downtown. This alignment follows the "proposed" alignment option presented in the City Council approvals. This option seems preferable since it avoids an at-grade crossing of the East Covell Boulevard south of the Cannery. This alignment can ensure a safe and direct connection to the south and towards schools and downtown for children and commuters.

Mobycon also explored the option where the route followed the path underneath the East Covell bridge on the east side of the railway track and then moved up the slope to the shared path of East Covell Blvd on the south side. This route is too indirect to fulfill an



15: Cycle routes to/from the Cannery for different target groups, with bottlenecks (in purple).

adequate role in the routes to the schools. Additionally, the route from E. Covell Boulevard to the path under the bridge will be traveled at a high speed, with a sharp 90 degree turn at the bottom of the path. This makes for a potentially unsafe situation.

Besides the grade separated crossing of E. Covell Boulevard, a safe east - west cycle facility on East Covell Boulevard is also a necessity This means that barriers like the intersections of J Street and L Street, and the driveways between L Street and Pole Line Road will have to be redesigned so that cyclists have the right of way (in line with other traffic at the corridor).

On street level crossing at J Street intersection for direct cycle routes to work or school

Adults or students commuting to work or school are able and willing to use on street crossings. The entrance of the Cannery at the intersection of J Street can be made a safe crossing for cars, cyclists and pedestrians. Through J Street one has a very direct and rather quiet connection to the downtown area. Car traffic volumes on this route are not extraordinary high; in the Netherlands one mixes cars and cyclists with traffic volumes under 6000 cars/day on narrow (6 meter/ 20 feet wide) streets without specific lane demarcation. Cars are encouraged to stay behind the cyclists, and only overtake them when there is no oncoming traffic.

To facilitate a safe cycle crossing at this location, the intersection of East Covell Boulevard and J Street will have to accommodate the needs of commuters as well as students and children. This is a complicated intersection between a main arterial and a connector. The minimal solution for this intersection would be to ensure a separated cycle crossing, next to the pedestrian crossing. This type of intersection (Dutch Junction) has minimal alterations of the traffic light sequence and relatively little space. The traffic safety is greatly improved compared to the existing situation, with cyclists crossing together with the car traffic.

From our Dutch perspective an even better solution would be to implement a roundabout at this location. A roundabout could be implemented to solve for conflicts, enforce traffic calming, and therefore ensure an uninterrupted flow of vehicles, transit, bicycles and pedestrians. Dutch traffic safety studies show that the roundabout prevents heavy side-way accidents with high speeds and heightens the attention of drivers. Not only for cyclists, but also for car drivers and pedestrians this is considered the optimal solution in the Netherlands. It is deemed much safer than intersections with traffic lights. To further encourage cycling amongst the Oliver Wendell Holmes Junior High School, J Street could be retrofitted to accommodate separated Class I bike

paths. Separated Class I bike paths have proven to be much safer than buffered cycle lanes or painted cycle lanes. This would make cycling a safe way to go to school, and present a more enjoyable way to work for commuters.

Green routes for leisure cyclists

Leisure cyclists can take the routes the commuters are taking, but they will avoid routes with unpleasant scenery and heavy traffic volumes if possible. Routes with attractive scenery, through the parks and to the country side, are the ones for them. The overpass at Community Park is an excellent connection between the park zones on either side of the Boulevard. From Covell Park to the Cannery one must cross the railway. This provides the need and the opportunity for a second (back door) connection. We feel that it is of utmost importance to provide for multiple exits from an area/neighborhood. For cars, but for also for bicyclists and pedestrians.

Faro Avenue has been selected since it offers a direct connection from F Street to the greenbelt located west within the study area of this research. It is possible that a location further north along F street is also very suited, and even more fitting in the greenway plan. This study concentrates on the direct needs for the Cannery, and therefore selects Faro as the best option.

From Faro the route through parks continues south connects to the bicycle and pedestrian bridge crossing over West Covell Boulevard. The route is ideal for safety, attractiveness, enjoyment and directness. An overpass as suggested in “Option 2” of the FEIR would not push children and other target groups to make use of the safe mixed-use bridge over West Covell Boulevard. On top of that, if improvements were brought through the alignment or J Street redesign, the overpass location would be very close to these new facilities and therefore would not catch the potential of the residents living in the northern half of the Cannery area. Finally, if future development is planned north or east of the Cannery, the Faro Avenue connection could catch the bicycle potential of these newly developed areas. We feel that it is important to take future developments, even those not on the agenda at the moment, into account. A tunnel or an overpass are both possible options.

16: Design solutions, short term (NOW)

4. Design solutions: Now

Three main target groups were identified for the Cannery throughout the Desk Research and the Field Visit in Davis: children, commuters and recreational cyclists. Children need safe and low-stress paths to go to school independently while commuters are in need of direct and fast routes to reach their work places.. Recreational cyclists, on the other hand, are composed of families, groups of friends, and lone cyclists. Their trip purpose is to have a good time, enjoy their surroudings and reach destinations such as museums, sports facilities, etc.`

For the City to better address those three target user groups needs while encouraging mode shift, there must be an investment in suitable infrastructure; and both short-term and long-term projects should be implemented to offer the residents of the Cannery – and other adjacent communities – with a complete and integrated network of bicycle facilities.

To facilitate the decision-making process of the City of Davis, the following strategy is proposed: "*Now & Wow.*" The "Now & Wow" strategy categorizes projects into "direct necessities and quick wins" (the "Now"), and related longer-term actions needed to boost cycling even further (the "Wow"). The following section highlights the "Now" and "Wow" projects proposed in this study, and delves into the motives of the suggested designs.

Now is the time for cycling

Map 16 illustrates the projects the City should prioritize to encourage the Cannery residents to ride their bikes as soon as they move into the new development area. The numbers correspond to the paragraphs in this Chapter. It is important that quality infrastructure is constructed and ready when the Cannery residents move in, so that they can get into the habit of cycling to work, school, or for recreational purposes right away. If the Cannery residents are given the choice of bicycling rather than driving from Day 1, chances are they will consider this option more seriously than if changes in infrastructure are brought once they are used to driving their car around the city.

The following paragraphs describe and illustrate the "Now" design elements proposed in this study to encourage the Cannery residents to choose the bicycle over their car for utilitarian and recreational trips. They are needed to ensure safety for inhabitants and provide the freedom to choose whatever mode of transportation they like.

East C

17: Design proposal for H-street tunnel

4.1 H Street tunnel (Map item 1)

The existing H Street tunnel has been criticized for its outdated design, its narrowness, and for the feel of insecurity that some users may experience when passing through it. Redesigning the H Street tunnel and its vicinity is a priority if the City wishes to continue supporting mode shift from cars to bicycles. The H Street tunnel is indeed an important connector between the east and west sides of the railroad that split the City in half. In order to support mode shift, and therefore attract new bicyclists to using the tunnel, redesigning the tunnel entrance and exit, as well as creating an enjoyable ambiance is the way to go.

The western entrance/exit of the H Street tunnel currently consists of narrow and sharp turns that lead the cyclists to and from F Street via a graded path. In order to provide the cyclists with more visibility, and therefore prevent unsafe maneuvers, the graded slope between F Street and the tunnel entrance/exit can be replaced by a retaining wall. A retaining wall would create space to accommodate bicycles turning into and out of the tunnel. This has been proposed in the East Covell Corridor Plan of March 2014. To encourage cyclists adapting their speed and trajectory – for example a bicyclist riding southbound on F Street entering the tunnel eastbound – curb extensions at the entrance/exit of the tunnel should be constructed, as well as a mini roundabout, or alternatively, a "punaise" (see pictures on page 32). Ideally, the grade of the bicycle entrance/exit should not exceed 7% (CROW Design Manual of Bicycle Facilities, 2006). The proposed entrance/exit design does not interfere with the existing F Street on-street car parking, located on the other side of the street.

Additionally, lighting the tunnel at night will enhance the sense of social safety for those who feel vulnerable. Blue LED lights are generally preferred over red LED lights for research has shown that blue light enhances the feeling of safety where red light worsens it. Finally, adding lighting to the tunnel also brings physical safety, as it is easier for pedestrians and bicyclists to see each other and perceive each other's reactions. Figure 17 shows the sketch design for the tunnel.

4.2 Access to the H Street tunnel (Map item 2)

Improving the H Street tunnel is great, but it will not serve the majority of the residents living on the east side of the railroad if adequate access to the tunnel is not put in place. For the case of the Cannery, two access routes are proposed: a grade-separated crossing east of the railroad under East Covell Boulevard and an at-grade intersection at East Covell Boulevard and J Street.

18: Design proposal for H street access trail

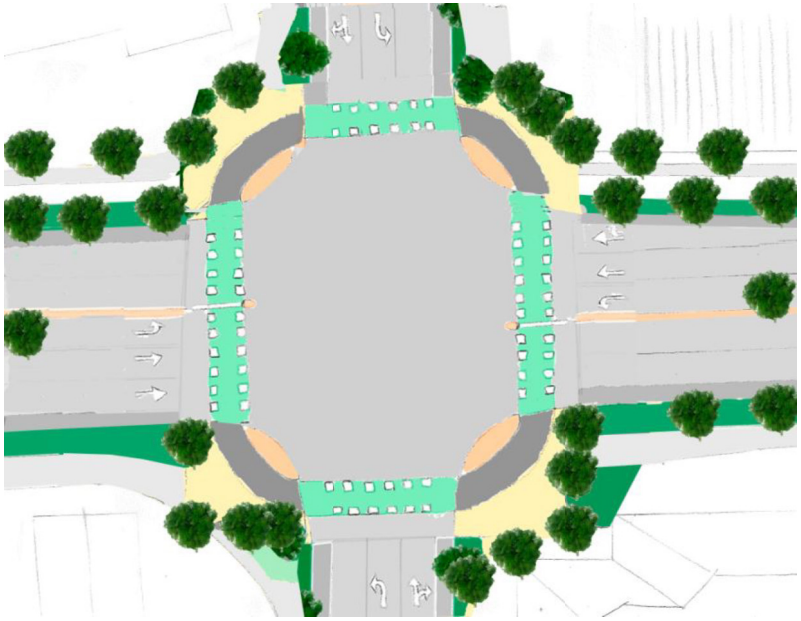
Grade-separated crossing to H Street tunnel

East Covell Boulevard is a major east-west axis for motorized traffic, consisting of four lanes of traffic separated by a median. A four-lane road is difficult to cross for many people, especially vulnerable users such as children. Moreover, since there is no existing crossing of the East Covell Boulevard in the southwest corner of the Development area, a grade-separated crossing is preferred (City of Davis Bicycle Plan, 2009). This grade-separated crossing would therefore run under East Covell Boulevard and east of the railroad. The level of traffic stress of such a crossing would be 1, since the presence of motorized traffic is de facto eliminated along the bicycle route, as well as the associated noise overhead.

In order to construct the bicycle path, land may be acquired by the City from the Cranbrook and Pinecrest Apartments along the railroad. This should be confirmed in a feasibility study. A relatively narrow strip is needed since the path would be located close to the railway track. This means that the City could replace the graded slope between the bicycle path and the railroad by a retaining wall, in the same fashion as for the western entrance/exit of the H Street tunnel. For visibility and social safety purposes, the uppermost part of the wall can be turned into a fence, or made of glass. That way, bicyclists can see each other between the path and the tunnel eastern entrance/exit, and the ride is more enjoyable than if riding between two solid walls. Furthermore, to physically separate the new bicycle path from the Cranbrook and Pinecrest Apartments, a green wall – rather than a concrete wall – can be placed, as it is easy on the eye, refreshing, and welcoming.

Proper lighting – and potentially, artwork – under the East Covell Boulevard viaduct and down to the H Street tunnel will need to be provided to generate a pleasant atmosphere between the properties' wall and the railroad wall. Bicycling between two close walls is indeed not enjoyable and some might develop a feel of claustrophobia and/or insecurity. Again, blue LED lighting is better than red LED lighting in this case, as blue light are more soothing. Additionally, the City could invite schools and the Davis Arts Center to brighten up the bicycle route by adding works of art under the viaduct and along the walls.

An alternative was proposed in the Draft Environmental Impact Report of 2013, namely "Option 1": under the East Covell Boulevard bridge east of the UPRR tracks, the route could turn east and continue along the southern face of the Covell overcrossing. This allows the route to tie into the existing bike trail on the south side of East Covell Boulevard. This option is subopti-.



19: Design proposal for J Street intersection, minimal solution (traffic lights)

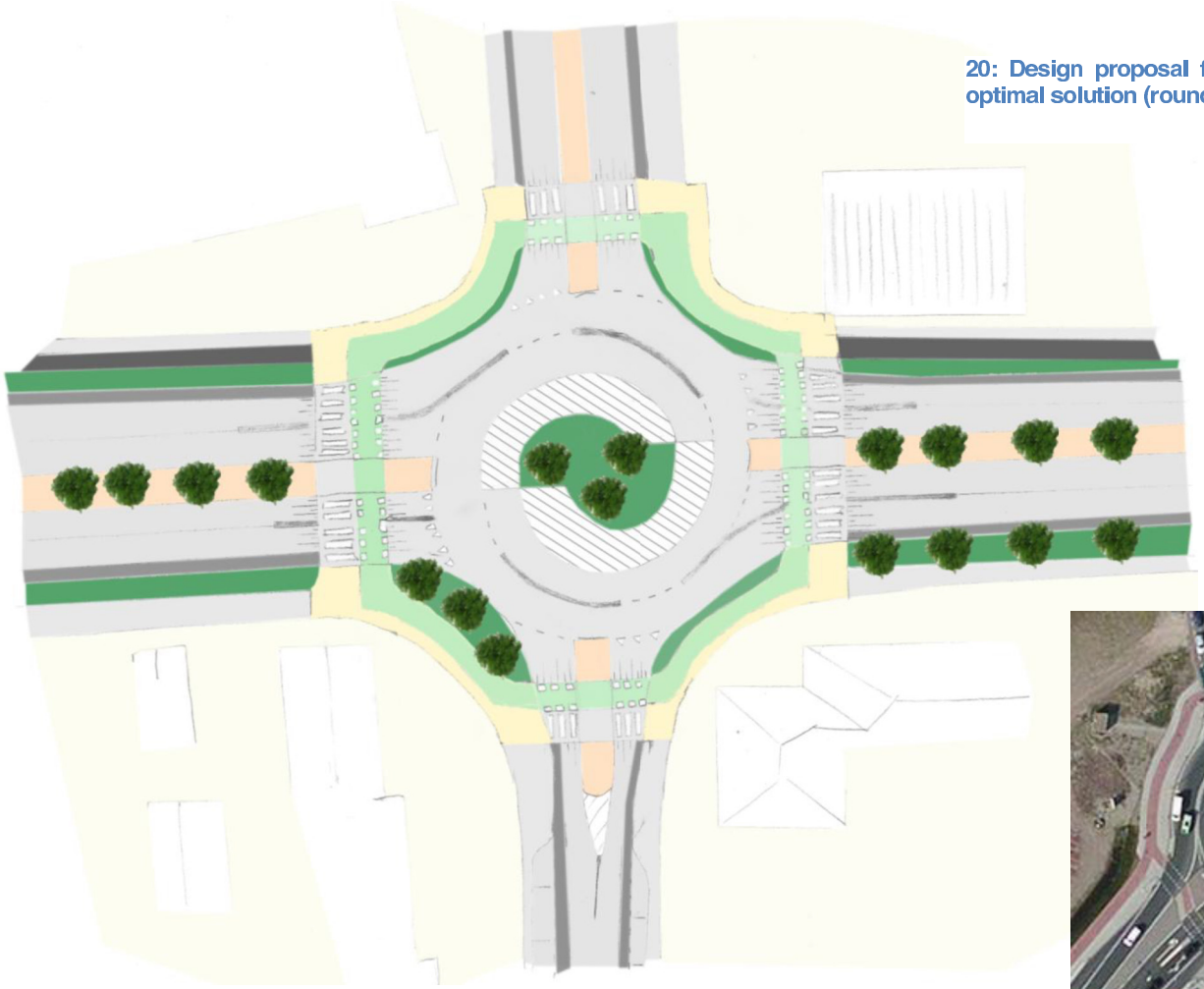
mal since the intersection of East Covell Boulevard and J Street will be redesigned and residents of the Cannery will therefore be able to better connect to J Street, and then onto the H Street tunnel. The grade-separated crossing proposed here will provide more vulnerable users such as children with a safe alternative to and from school, rather than having to cross East Covell Boulevard at grade. Directing this traffic back 'up' the slope to East Covell Boulevard provides for an indirect route. Besides that, the run down the slope will be at high speeds, with a 90 degree turn at the bottom. We consider that option less optimal than the route alongside the tracks to H-street tunnel.

4.3 East Covell Blvd. and J St. intersection (Map item 3)

Residents of the Cannery, more specifically commuters, will need a direct access to J Street's bicycle facilities, which are already widely used by the locals. The proposed grade-separated crossing at the southwest corner of the Cannery Development area can be perceived as a detour, and therefore will not encourage people otherwise willing to travel on J Street to get on their bikes. Moreover, it is assumed that many residents of the Cannery will travel to the Oak Tree Plaza for groceries and shopping, which emphasizes the need to develop a crossing solution to the south and east of the Cannery area. The City should therefore provide an at-grade crossing at East Covell Boulevard and J Street.

An at-grade crossing is preferred here since an intersection already exists. This at-grade crossing should consider all users: children, commuters and leisurely riders. This means that the design should be safe, comfortable, and able to accommodate large numbers of motorized vehicles and bicyclists, especially during peak hours. The East Covell Corridor Plan of March 2014 suggests removing the channelized right-turn lanes and adding pedestrian crosswalks on the north and east legs of the intersection. These are good measures, but the City can take them a step further for better safety for bicyclists.

Protecting cyclists at the intersection is the minimum solution for traffic safety. The shared path on the south side must cross next to the pedestrian crossing, with a protective shoulder between the pedestrian and cycle crossing and the intersection. This type of intersection, the 'Dutch Junction' provides more safety with any difficult traffic light phasing; the cycle phase is together with the pedestrian phase. A stepping stone is provided in the crossing of E. Covell Boulevard by the median in the middle of the road. Thus, cyclists do not have to merge with car traffic on the difficult and busy intersection.



20: Design proposal for J-street intersection, optimal solution (roundabout)

From our Dutch perspective, an even better but more fundamental solution would be to replace the traffic light controlled intersection with a roundabout. This solution minimizes the delay in motor traffic as the waiting times for the lights are replaced by a slow but continuous movement of car traffic. This slower travel speed ensures less severe traffic incidents and higher traffic awareness. Besides that, the points of conflict for users (car or bike) are greatly diminished, by means of which the traffic safety is even further enhanced. Finally, because it is possible to give cyclists and pedestrians the right of way at the roundabout the delay for cyclists is minimal. That is why more and more traffic light intersections in The Netherlands are being replaced with roundabouts..

In Appendix B the results of the preliminary roundabout modeling is presented, from which follows the ideal form of roundabout with the new traffic volumes. The afternoon rush hour is the heaviest, a turbo roundabout is needed. Although this roundabout needs extra study, the average waiting time for cars, pedestrians and cyclists is lower than with traffic lights, the traffic safety is higher, the amount of space needed is proficient and the urban quality is rising. Free right turns on red will generate further conflicts and will have to be forbidden. Figure 20 shows the principle design for this intersection.

The designed turbo roundabout shares benefits from the double lane roundabout (more capacity) and of a single lane one (less entry and exit lanes). Weaving of cars on the roundabout is impossible, and two of the four arms have only one entry and one exit lane. E. Covell Boulevard still has two entry and two exit lanes on each side. This makes crossing for pedestrians and cyclists less optimal than with less lanes, but is still an improvement over crossing the six lanes (including the left and right turning lanes) of the existing traffic light intersection. Further priority and safety for pedestrians and cyclists is guaranteed by raising the crossing on a platform, so car drivers have to move over slowly (about 15-20 mph) and are more attentive. Even with only having this roundabout in place and not immediately transforming the other intersections along E. Covell Blvd the driving behavior will change and safety will go up.

A common misconception states that the space needed for a roundabout is greater than that of a traffic light intersection. This is untrue. The used radii of the roundabout are 41 ft (inner radius inner lane) to 73 ft (outer radius outer lane) and can even be made smaller if needed. It is fitting within the existing right of way. The roundabout would, from our Dutch perspective on traffic safety and traffic flow, be the best option. Note that the impact and costs to a roundabout are a higher than the ‘Dutch junction’ alternative.

21: Example of the two way cycle track south side

22: Design proposal for safe intersection at L street

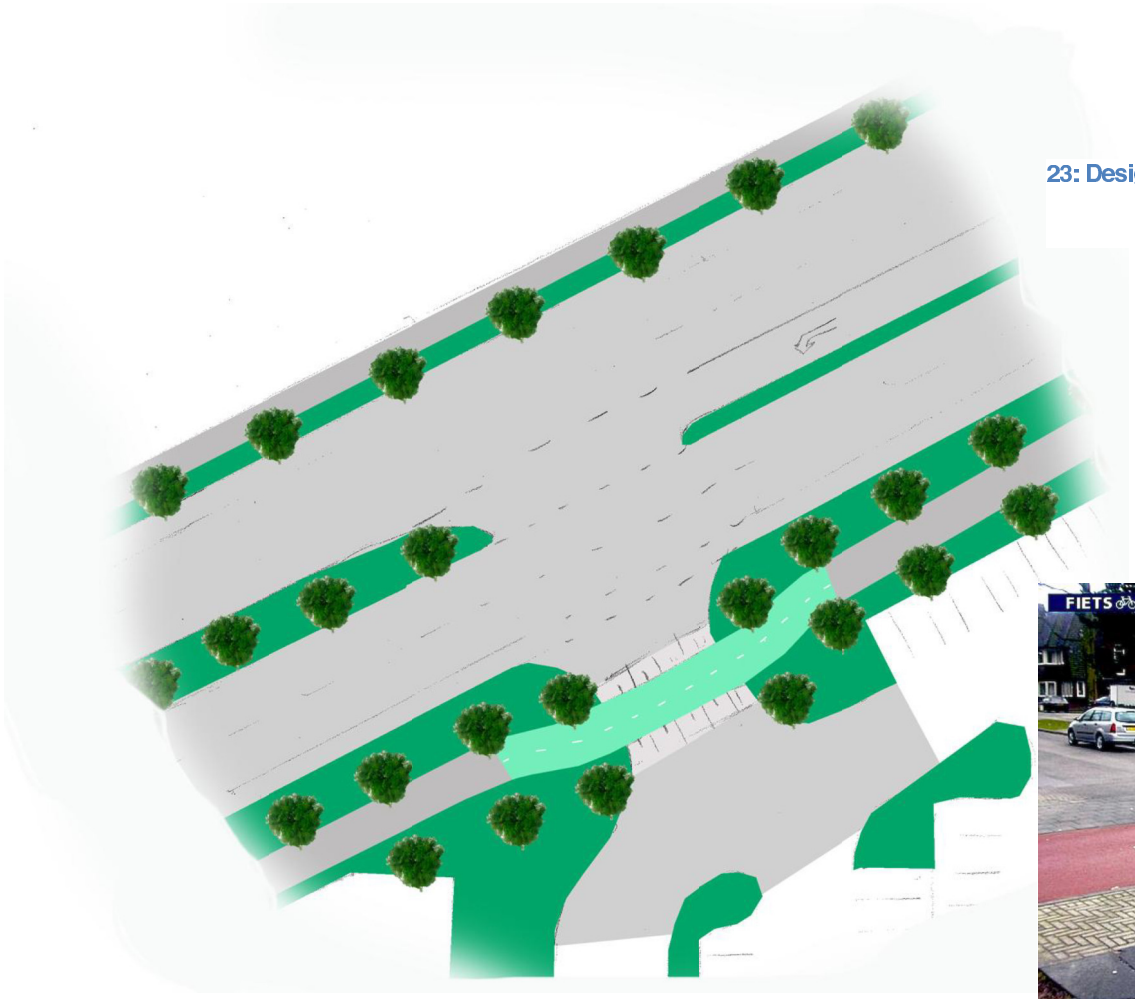
4.4 East Covell Boulevard south side two-way cycle track (Map item 4)

The East Covell Boulevard currently comprises a mixed-use path on the southern side that accommodates pedestrians and bicyclists. As the number of cyclists will rise, the need on the path for dedicated cycle space increases.

The East Covell Corridor Plan of March 2014 proposed two one-way buffered bike lanes. In our opinion this space and money is better spent on increasing the bicycle infrastructural quality for all users. The existing bike lanes on the road fulfill their need as they are now. We advise retrofitting the south side shared path into a two-way bicycle path, with a footpath. This retrofit would improve pavement quality, drainage, comfort, and recognition for all users. In this retrofit, a division can be made into cycle path and footpath. A height difference is unnecessary, marking (minimum) or different coloring of asphalt is enough.

The south sided path currently accommodates both traffic going eastwards and westwards. In the future this will remain similar, but with higher bicycle volumes. Therefore, although space is limited, we feel that a two-way bicycle path is preferred over a one-way path. Many destinations lie on the south side of the Boulevard, and a lot of T-intersections connect to the road. By providing a two-way cycle track on the south side of the Boulevard, many unnecessary crossings of the Boulevard are eliminated, and therefore safety is enhanced. This also eliminates the concerns expressed in the March 2014 Plan over a potential crossing between J and L Streets, now deemed unnecessary. Finally, the width of a two-way cycle track offers the users the possibility to ride two abreast, by which bicycling becomes a social activity rather than a pure mode of transport. These are the reasons why one-way buffered bike lanes are not preferred here.

The existing width of the shared path is not enough for a two-way cycle track and a footpath. We propose leaving the green shoulder with trees intact (and improving this where possible), only widening the path where possible and implementing the minimal width for a two-way cycle track, 10 feet. The width for a footpath (minimal 5 ft) cannot be provided for everywhere, but the demand is limited. It is only near the shopping centers and residential areas that these are frequently walked. Pedestrians are however authorized to walk on bicycle tracks when no sidewalks are provided, since the California Vehicle Code specifies "*no pedestrian shall proceed along a bicycle path or lane where there is an adjacent adequate pedestrian facility*" (Division 11, Chapter 5, Section 21966).



23: Design proposal for driveways at Oak Tree Plaza

4.5 East Covell Boulevard and L Street intersection (Map item 5)

This intersection is a T-intersection. In the proposed design, the mixed-use trail becomes a two-way cycle track (as it is running along the entirety of East Covell Boulevard), which crosses L Street. Signals are implemented and channelized right-turn lanes are removed, as suggested in the East Covell Corridor Plan of March 2014. Additionally, the southern leg's width is reduced to enforce speed reduction and therefore discourage the use of Claremont Drive as a shortcut towards Pole Line Road when congestion problems occur on East Covell Boulevard. The presence of this traffic calming measure will also bring more safety to cyclists and pedestrians travelling on the south side of the Boulevard. This study did not investigate the traffic flow of cars at the intersection. Although in the current situation there are no traffic lights, it could be that in the future the traffic flow of the main road is high enough that cars from L street (or the Oak Tree Plaza driveways further along E. Covell Blvd.) have a hard time entering. This aspect is not related to bicycle traffic however, as they can freely enter the south sided path. If in the future traffic lights will have to be installed, the cycling part of the intersection layout will not have to be altered a lot. Figure 22 shows the sketch design for this intersection.

4.6 Oak Tree Plaza driveway access points (Map items 6a and 6b)

There are two access points leading from East Covell Boulevard to Oak Tree Plaza. These driveways are expected to be highly used by motorists and therefore cause safety issues for bicyclists riding along the proposed two-direction bicycle track on the Boulevard. To further the suggestions made in the ECCP of March 2014, that proposed higher-quality pavement markings on both driveways to signal bicyclists' presence, it is advisable to construct raised plateaus to force motorists to slow down more effectively. The bicyclists and pedestrians' crossing is therefore raised and more comfortable to them. The height differential experienced by the motorists will raise their caution and decrease their driving speed and risk of conflict. Figure 23 is a sketch design of one of the two access points.

Furthermore, the addition of an acceleration lane, as proposed in the ECCP, is not necessary provided that the central median can accommodate a stopped car. Hence the width of the median should be at least equal to the length of a standard car. Moreover, the lack of an acceleration lane for motorists forces them to be more cautious when crossing the Boulevard. This is beneficial to all cyclists and pedestrians travelling along the path on the southern edge of the Boulevard.

5. Design Solutions: Wow

In addition to short-term measures needed for a safe bicycle situation around the Cannery, there are measures which can further increase the bicycle share, culture and safety in Davis. These are what we call the Wows.

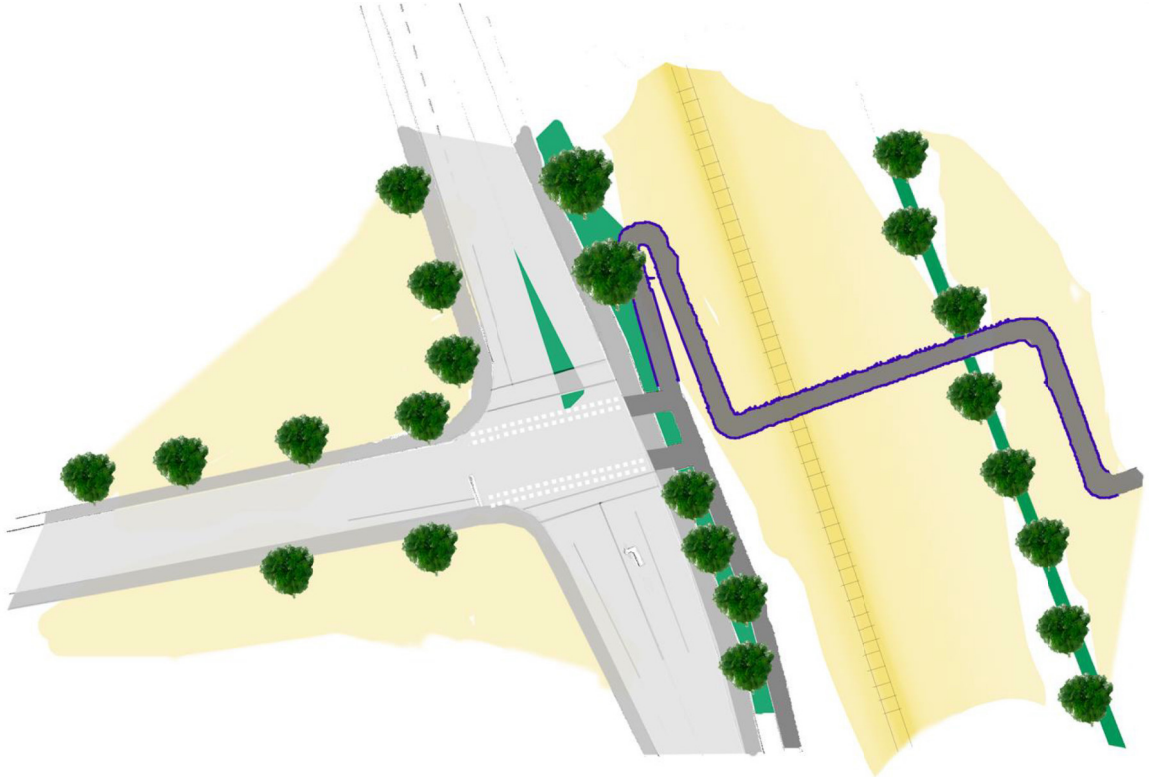
Figure 24 pinpoints the locations of extra infrastructural changes that can further foster bicycle use amongst the residents of the Cannery and adjacent existing and future communities. It is indeed essential to keep current cyclists cycling by providing them with even better and more enjoyable facilities and shortcuts. Encouraging mode shift, particularly for 'interested but concerned cyclists' requires long-term planning of incremental changes that will affect a majority of residents.

The following paragraphs describe the “Wow” design elements proposed in this study to proper bicycle use to a higher level in Davis. These are by no means ‘luxuries’, but necessities for establishing the Cannery and Davis as a City for Cycling for All.

5.1 Make use of the Greenways (Map item 1)

The City of Davis possesses an extensive network of greenways that offers a set of relaxing routes to both pedestrians and cyclists. The Cannery will include a greenway as a core north-south axis. Coupled with the greenways located west of the railroad – namely the Covell and Community Parks – it can provide a Safe Route to School for children attending North Davis Elementary School, and, to a lesser extent, students of Davis Senior High School. Moreover, a network of connected greenways also is a great recreational cycling network for families.

A pedestrian and bicycle bridge already connects the Covell and Community Parks over West Covell Boulevard, and a similar structure would be needed to cross the railroad. A wise location – within the study area of this research - of the proposed grade-separated crossing is at the intersection of Faro Avenue and F Street, over the railroad, and into the Cannery area. This location is preferred for several reasons: Faro Avenue is the only street along the western edge of the Development area that connects F Street to Covell Park, and that thus provides a direct and short route from F Street



25: Design solution for overpass over railway to H street

to Covell Park (1); the overpass is expected to influence mode choice of children and other residents living in the two northernmost thirds of the Development area (2); the bridge will attract more bicyclists from potential development areas located east and north of the planned Covell Development area (3). Figure 25 shows the sketch proposal. Grades should not exceed 7%. A rise of 5 meters would require a ramp of 35 meters up, and down.

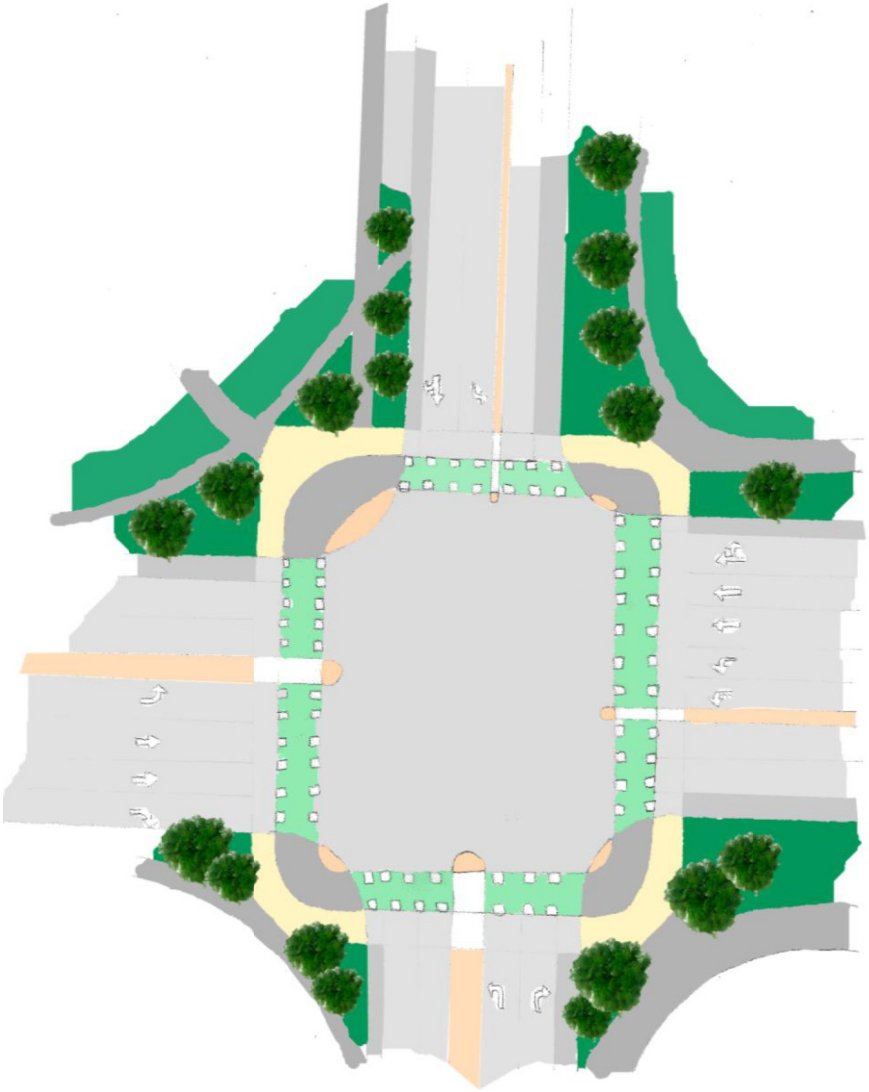
Alternatively, in case the location of Faro Avenue is not feasible due to space and grade requirements, the pedestrian and bicycle bridge could be built further north so that it connects the northwest corner of the Cannery Development area to Grande Avenue. Grande Avenue fully connects F Street to Covell Park, where streets located between Faro Avenue and Grande Avenue do not. The idea is that children riding to school should get to the greenbelt system as best as possible to ensure attractiveness and safety of the route to school. For example, if a bridge were to be built somewhere between Faro and Grande Avenue, children would have to cycle along F Street to get to Faro Avenue or Grande Avenue.

A remarkable example of implementing the concept of using greenways as core elements in the transportation network is Houten, The Netherlands. In Houten, car-free greenways are running along the core of the northern half of the city and connect homes, schools, and public facilities (see map 26). Children are independent from about the age of 6 and go to school by bike, without ever crossing the path of motorized vehicles. Davis has huge potential in utilizing its greenways for school trip purposes, as they provide a safe, enjoyable, and low-stress environment.

26: City of Houten, the Netherlands

5.2 East Covell Blvd. and F St.. intersection (Map item 2)

The West Covell Boulevard and F Street intersection is quite special since several existing mixed-use paths run near and towards it. In the same fashion as for the East Covell Boulevard and Pole Line Road intersection, channelized right-turn lanes should be eliminated (suggested in the East Covell Corridor Plan of March



27: Design solution for safe intersection at F Street

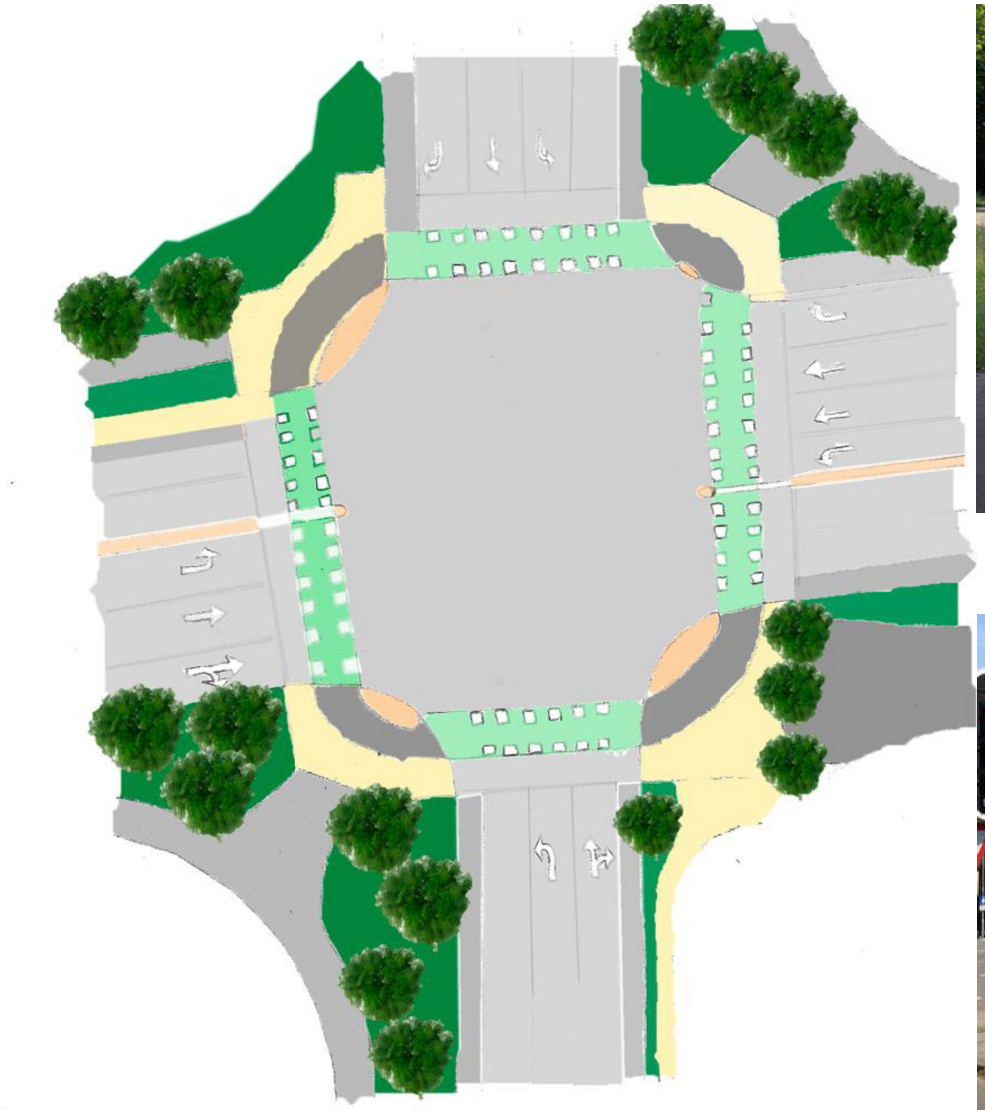
2014) to make room for safer intersection design elements for cyclists and pedestrians. The proposed two-way cycle track – replacing the mixed-use path east of the intersection – can be easily accommodated through the intersection towards Davis Arts Center located southwest of the intersection. Note that right-turn pockets are, again, not preferred for blind spot reasons, but also comfort and level of traffic stress issues.

5.3 East Covell Blvd. and Pole Line Road intersection (Map item 3)

The intersection of Pole Line Road and East Covell Boulevard is one of the busiest in the City of Davis. Through traffic, inbound and outbound traffic, cyclists, and pedestrians mix in a wide-open asphalt intersection. In order to make this intersection safe for all users and thus encourage the use of the bicycle even for the outlying neighborhoods (Cannery, but also Green Meadows, etc.), it is important to emphasize separated cycle facilities, even at this busy junction.

The first step is therefore to eliminate the channelized right turn lanes for cyclists' safety purposes, as suggested in the East Covell Corridor Plan of March 2014. Channelized right turn lanes indeed accommodate fast motorized traffic movement due to their large curb radii at intersections. Eliminating these channelized right turn lanes will allow small-radii curbs that better protect slow non-motorized transport users from turning vehicles. The right-turn pockets proposed in the ECCP 2014 Plan do not provide enough safety for cyclists traveling through the intersection because the bicyclists can be positioned in the driver's blind spot.

To solve that potentially unsafe situation the Dutch move the cycle crossing slightly further back out of the intersection, together with and next to the pedestrian crossing. The crossings are moved onto the oncoming branches, where the crossing distance is smaller and conflicts are less. Besides that, there is now room for the construction of raised shoulders at the corners of the intersection, which provide cyclists and pedestrians more safety. The shoulders indeed force motorized traffic to take sharp turns when turning right that will lead to meeting bicycle and pedestrian crossings at a 90-degree angle. This is an essential part of the design as a lot of collisions between bicyclists and motorized traffic occur at intersections due to poor visibility (the angle between the two trajectories being very small in those cases). Typically, the distance between the through-movement lane and the parallel bicycle crossing is at least one length of a standard car. Another advantage of diverting the bicycle way out of the intersection core while eliminating the channelized right-turn lanes is that bicyclists can effectively turn right at any time, irrespective of traffic lights and signalization.



28: Design solution for safe intersection at Pole Line Road

5.4 East Covell Boulevard north side two-way cycle track (Map item 4)

Vehicular cycling is common practice in the United States. Today however, the needs of those “interested but concerned” cyclists are starting to be acknowledged and as a result, cycle tracks are more often preferred over bicycle lanes.

In order to better address the needs of all types of cyclists, the existing bicycle lane running westward on East Covell Boulevard could be doubled with a two-way cycle track on its side. The limiting element of the design is the bridge over the railroad, where the existing width cannot accommodate double cycling facilities.

Regarding the bridge only, the cycle track and bicycle lane could merge at both ends of the bridge into a buffered bicycle lane, separated from motorized traffic by a concrete median. For vehicular cyclists this solution should be no less preferable than their current option while it brings extra quality for less experienced cyclists. The required width for the two way cycle track on the north side is 10 feet (according to Dutch guidelines). Optionally a footpath of 5 feet can be added. The Cannery Development must accommodate for the space needed for this path.

	Main target group(s)	Existing situation	Proposed improvement
Now	**H Street tunnel**		
	Children travelling between the Cannery and schools located Southwest of the Cannery.	The H Street tunnel is not appealing enough to capture the cycling potential of Davis' residents living East of the railroad. Poor access and egress design, combined with a lack of pleasant environment are both reasons not to feel comfortable riding through the tunnel.	Replacing the graded slope at the Western entrance by a retaining wall to make room for widening the bikeway near the entrance. Bulb-outs are implemented to force cyclists following a safe trajectory. A mini roundabout, or punaise, is created to decrease cyclists' speed and ensure better visibility.
	Grade-separated crossing under East Covell Boulevard Bridge toward H Street tunnel		
	Children travelling between the Cannery and schools located Southwest of the Cannery.	No bicycle path exist at this location.	Acquisition of land property from Cranbrook and Pinecrest Apartments to accomodate a bicycle path running from the Southwest corner of the Cannery towards the existing Eastern entrance of the H Street tunnel. This bicycle path will be delimited by a greenwall on the Apartments side, while a fence or glass wall will be installed on the railroad side to ensure visibility amongst users and decrease claustrophobic sense. Artwork and lighting design will need to be carefully chose to create a safe and enjoyable atmosphere.
	East Covell Boulevard and J Street intersection		
	Commuters travelling from the Cannery towards the city center via J Street.	Signalized T-intersection with channelized right-turns.	The minimal solution creates safe bicycle crossing facilities by removing the right turning lanes and thus narrowing the intersection. Cyclists have a protected buffer location and separated phase in the light sequence, together with pedestrians. In the ideal solution, the intersection is transformed into a turbo-roundabout. This takes into account temporal and volume fluctuations, bicycle right-of-way, and safety. A roundabout ensures a smooth vehicular flow and therefore limits delay and increases traffic safety. Radii, curves, and therefore speed provide a safe environment for cyclists to cross the Boulevard and J Street.
	East Covell Boulevard South side two-way cycle track		
	Commuters travelling towards the City center via F Street, or residents travelling East towards the Oak Tree Plaza.	Two-way cycle path, added with footpath where needed running from F Street to Pole Line Road.	A two-way cycle track for better pavement quality, safety, comfort, and recognition from the users. Pedestrians are allowed to walk on this cycle track when no room is available to create a sidewalk (especially on the East Covell Boulevard bridge over the railroad).
	East Covell Boulevard and L Street intersection		
	Residents travelling East towards the Oak Tree Plaza, or recreational cyclists willing to get to the various parks and golf courses located to the East of Davis.	Mutli-use path running along the Boulevard and therefore crossing the Southern leg of the intersection. Channelized right-turn lanes.	Removal of channelized right-turn lanes and narrowing of the Southern leg of the intersection for traffic calming purposes. The multi-use path becomes a two-way cycle track. The intersection remains unsignalized.
	Oak Tree Plaza driveway access points		
	Residents travelling along the East Covell Boulevard two-way cycle track.	Multi-use path running along the Boulevard and leveled with the roadway at the crossing.	Creation of raised crossings for directness, comfort and safety for cyclists. Height differential, pavement materials and pavement markings all play on the motorists' awareness and therefore protect the cyclists. The width of the central median between the travel lanes on East Covell Boulevard must measure at least the length of a standard car to ease motorists' left turn from Oak Tree Plaza towards the West.

6. Conclusions

The review of the bicycle measures on and around East Covell Boulevard, following from the planned Cannery concluded with the following aspects:

From the perspective of 'Design for All', the three main target groups come forth:

- Commuters
- Children
- Leisure/recreational riders.

These target groups have different needs. From these needs we conclude that on the short term (the now):

- at least a grade separated crossing under or over E. Covell Boulevard should be in place. We propose the underpass under the bridge connecting to the H Street tunnel (and improving this route)
- an on grade crossing at the most direct location should be in place, at J Street. This intersection is proposed in the minimum form as a 'Dutch Junction', with cyclist crossing the intersection from a protected, separated position alongside the pedestrians. The maximum solution for this roundabout would, from the Dutch perspective, be the turbo-roundabout, with a 1.5 lane roundabout with cyclists having right of way at all times when riding around the roundabout. This means that motorists must yield to cyclists when entering the roundabout (and should do so for any motorized vehicles already traveling on the roundabout) and exiting the roundabout (as they would for any pedestrian willing to cross). This yielding happens with low speed and high attention, and increases safety over a traffic light controlled intersection
- the existing shared path on the south side of E. Covell Boulevard should be improved in quality by transforming it into a two way cycle path, with a footpath where possible and safe intersections with side streets and drive ways.

Furthermore, on the longer term (the Wow) we concluded that the following measures are needed:

- A grade separated crossing over the railway in the westside of E. Covell Boulevard, connecting to Faro and Covell Park.
- A new two-way path on the north side of E. Covell Boulevard from F Street to Birch Lane, together with a new two-way path on the west side of Pole Line Road.
- Safe intersections for both F Street and Pole Line Road with E. Covell Boulevard.

These measures are to be seen, with the main target group and specified improvement in the table on the next page. Although a lot of these measures where touched on in the East Covell Boulevard Plan, not all of these measures are corresponding with our solutions. Some are not listed as we do not see the direct need or see a better solution for the problem. In Appendix A we list the complete set of measures from that plan, and explain whether or not to comply with them.

	Main target group(s)	Existing situation	Proposed improvement
Wow	**Faro Avenue grade-separated crossing over the railroad**		
	Children travelling between the Cannery and schools located Southwest of the Cannery, or recreational cyclists willing to enjoy the greenway system.	No existing grade-separated crossing at this location.	Creation of a multi-use bridge exiting the Cannery, passing over the railroad, and getting to F Street facing Faro Avenue. Faro Avenue directly connects F Street to Covell Park, which in turn connects to Community Park and adjacent schools via the existing West Covell Boulevard mutli-use bridge.
	East Covell Boulevard and Pole Line Road intersection		
	Residents travelling along East Covell Boulevard and/or North on Pole Line Road.	Multi-use path running along East Covell Boulevard. On-street bike lanes on Pole Line Road. Channelized right-turn lanes.	This intersection is one of the busiest in Davis and therefore bicycle are just not fine. Removing channelized right-turn lanes and creating a two-way multi-use path on the West side of Pole Line Road North of the intersection will give cyclists the safety and connectivity they need. This multi-use path will be connected to the proposed two-way cycle track running on the South side of East Covell Boulevard.
	West Covell Boulevard and F Street intersection		
	Commuters travelling towards the City center via F Street.	Multi-use path to the Southeast and Northwest corners of the intersections. Channelized right-turn lanes.	Removal of channelized right-turn lanes coupled with a redesign of the bicycle facilities's crossings. The future two-way cycle track running along the North side of East Covell Boulevard will be connected to the existing paths. The Southeast corner of the intersection will accomodate cyclists and connect to the rest of the bicycle facilities at each corner of the intersection.
	East Covell Boulevard North side two-way cycle track		
	Commuters travelling towards the City center via F Street.	One-way on-street bicycle lane.	The existing one-way on-street bicycle lane will be coupled with a separated two-way bicycle track to encourage those "interested but concerned" cyclists and non vehicular-cycling adepts. The East Covell Boulevard bridge being too narrow to accomodate both facilities, the two will be merged on the bridge to form a buffered bicycle lane, preferably seprated by a physical barrier (concrete or natural).

Appendix A – Framework

In this section, federal, state and municipal guidelines and policies are reviewed. These include topics such as planning, design, air quality, and rules of the road.

Policy

City of Davis General Plan (2001)

The City of Davis General Plan (2001) comprises a Transportation Element – updated in December 2013 – that covers several topics such as Sustainability, Complete Streets, Public Transit, Bicycling and Walking, and Parking. The Plan outlines several transportation policy goals (see below) and subsequent objectives. Interestingly enough, the Transportation Element of the City's General Plan aims to achieve a bicycle mode share of 30% by 2035 (Performance Objective 1.1), the current share being around 25%. The focus of action is to be brought to work-, school-, university-, and downtown-related trips (Performance objective 1.2). These trips encompass a great variety of users, including vulnerable ones such as children, elders, disabled people and "interested but concerned" bicyclists. This is the reason why it is important to ensure safety for all, and a low stress network of bicycle routes. As a matter of fact, the City aims to "*reduce the total number of collisions between motor vehicles and bicycles or pedestrians by 50% by 2035*" (Performance Objective 3.2).

The Transportation Element also includes recommendations towards new development areas, such as the Cannery, which must reduce vehicle trips generated by their development to less-than-significant levels (Policy TRANS 1.8.a).

City of Davis General Plan Transportation Element's goals

1. *Davis will provide a comprehensive, integrated, connected transportation system that provides choices between different modes of transportation.*

2. *The Davis transportation system will evolve to improve air quality, reduce carbon emissions, and improve public health by encouraging usage of clean, energy-efficient, active (i.e. human powered), and economically sustainable means of travel.*

3. *Davis will provide a safe and convenient Complete Street network that meets the needs of all users, including children, families, older adults, and people with disabilities.*

4. *Davis will strengthen its status as a premier bicycling community in the nation by continuing to encourage bicycling as a healthy, affordable, efficient, and low- impact mode of transportation accessible to riders of all abilities, and by continuously improving the bicycling infrastructure.*

City of Davis Bicycle Plan (2009)

The City of Davis Bicycle Advisory Commission – established in 2005 – introduced the City of Davis Bicycle Plan in 2009 in compliance with the California Bicycle Transportation Act (2009). The Plan's primary goal was to reach 25% of bicycle mode share by 2012, which has been achieved, the target today being to reach 30% by 2035 (City of Davis General Plan). The Plan outlines the major conditions, achievements, challenges and actions to be taken in the future. These actions revolve around the six "E's" approach: Equity, Education, Encouragement, Engineering, Enforcement and Evaluation. The combination of those six cornerstones support the general policies proposed in the document, i.e. providing bicycle lanes along all collector and arterial streets, with special attention to the design of intersections and traffic control systems. Most importantly, the Plan requires new development, such as the Cannery, to include "*bikeways within greenbelts*" and to "*ensure interconnection of new facilities with the existing bikeway system*." Again, the Plan encourages the development of a safe and integrated network "*available to all sectors of the community*." Additionally, the bicycle network must be integrated into the local and regional transit network.

City of Davis Beyond Platinum Bicycle Action Plan (2014)

The City of Davis went a step further in February 2014 by adopting the Beyond Platinum Bicycle Action Plan. This Plan, based on the previous documents cited above as well as other related actions and plans, introduces a seventh "E" to the six "E's" approach: Enjoyment. This shows how much Davis is dedicated to promote bicycling in an innovative way. Recognizing that bicycling can also be a fun way of commuting and running errands differs from the traditional opinion where bicycling is either a leisure or sports, or just a mean of transport. The City's view on cycling allows her to generate promotion campaigns, events, and programs under a different angle. On another note, the Plan has a more ambitious mode share target than the Bicycle Plan of 2009, as it is aiming at reaching the 30% bicycle mode share by 2030 instead of 2035. The perspectives and action lists stated in the Plan altogether aim at ultimately obtain the first Diamond Level Bicycle Friendly Community designation ever awarded by the League of American Bicyclist, Davis currently being a Platinum Level Bicycle Friendly Community. The primary measure to Diamond designation resides in the number of people riding bicycles and satisfaction of all citi-

zens, the ultimate objective being to rival with cities such as Copenhagen and Amsterdam.

City of Davis Municipal Code (current through ordinance 2433)

The City of Davis Municipal Code – which dates back to 1964 – includes a whole chapter on bicycles, referred to as Chapter 6. On top of defining the rights and duties of a bicyclist, the Chapter 6 covers topics such as traffic control signs and lights, speed, yielding rules, right-of-ways, prohibited ways and locations, as well as parking. It is found that in the Code, bicycles are considered as such when referring to rights, but considered as motorized vehicles when subjected to duties (e.g. downtown sidewalk riding, public path, sidewalk or street parking, playgrounds and parks, etc.). No special mention is made for children exemption for riding bicycles on the sidewalk.

Existing guidelines

California Environmental Quality Act (1970)

The California Environmental Quality Act (CEQA) – passed in 1970 following the National Environmental Policy Act (NEPA) – requires new projects such as bicycle plans and new developments not to affect car traffic delays – through the use of the Level of Service (LoS) tool – or else costly analysis and mitigation plans should be carried out. Increases in car traffic delay are considered to generate air pollution under CEQA. Hence narrowing or removing a car traffic lane to create a Class I or II bicycle way, which supposedly increases car traffic delay, will generate more pollution under CEQA's assumptions. This theory however omits to consider that free flow and stable flow conditions mean more room for cars, therefore generating car trips and hence air pollution. It also neglects the positive environmental impacts that bicycling and mode shift have on air quality. Following amendments by Sen. Darrell Steinberg to Senate Bill No. 731, Gov. Jerry Brown signed Senate Bill No. 743 in September 2013, which aims at engaging in evaluations of alternative methods of transportation analysis in order to replace the LoS tool. Senate Bill No. 743 was followed by the approval of Assembly Bill No. 417 in October 2013, which simply "*exempt[s] from CEQA a bicycle transportation plan for an urbanized area*," hence indirectly exempting a bicycle transportation plan from using the LoS tool.

Caltrans Highway Design Manual (2012)

Caltrans, the state agency responsible for highway, bridge, and rail transportation planning, construction, and maintenance, provides municipalities with design guidelines for bicycle transportation in Chapter 1000. Three bikeway facilities types are identified: Bike Paths (Class I), Bike Lanes

(Class II), and Bike Routes (Class III). Bike paths must include a 2-feet wide shoulder or clearance to obstruction on top of the minimum travel width of 5 feet (one-way) or 8 feet (two-way). The rest of the design, including curves, stopping sight distances, and grades, is solely governed by speed. The design speed varies from 20mph to 30mph, depending on mopeds presence. A design based on speed only omits to address comfort and attractiveness issues and might fail to attract "interested but concerned bicyclists."

City of Davis Bicycle Plan (2009)

Appendix III of the City of Davis Bicycle Plan outlines bicycle facilities design guidelines. These are largely based on Chapter 1000 of Caltrans Highway Design Manual, whose last update was in May 2012. Although the minimum widths recommended by the City are higher than the ones proposed in Chapter 1000 of Caltrans Highway Design Manual for Class II bikeways, speed governs the overall design of bicycle facilities, hence omitting addressing comfort of the cyclist and attractiveness of the route issues in the design. Grade-separated crossings are preferred over at-grade crossings, except at intersections. The Plan suggests that bicycle lanes are either placed in a fashion that makes cyclists more visible to the motorized vehicles drivers, although these are dropped prior to entering a roundabout. Vehicular cycling is preferred at roundabouts for it is said to be easy since motorists' speed are lowered. This consideration fails to address the needs of the most vulnerable users, or the ones that may be subjected to higher levels of stress. The Plan also details left turn options for bicycle facilities design, including continuous center left turn lanes and traffic islands at arterial intersections. The City, due to CEQA requirements, used to prefer not to take a lane from motorized traffic to transform it into bicycle facilities. This is due to the fact that taking a lane away from motorized traffic would result in poorer Levels of Service (LoS), hence failing to comply with the CEQA requirements (see above). However, as seen previously, bicycle planning projects are now exempted from CEQA requirements.

California Manual on Uniform Traffic Control Devices (2012)

The California Manual on Uniform Traffic Control Devices (MUTCD) follows the Federal Highway Association's (FHWA) MUTCD 2009 Edition, as amended for California. The MUTCD comprises a part on Traffic Control for Bicycle Facilities, referred to as Part 9. This Part governs the application, design and implementation of bicycles signs, markings and signals in California. The City of Davis generally follows the MUTCD recommendations, although it can request for experimentations.

AASHTO and NACTO guides (2012)

The American Association of State Highway and Transpor-

tation Officials (AASHTO) and National Association of City Transportation Officials (NACTO) have developed guides that address bicycle facilities. They cover topics such as planning, design, operation, maintenance and safety. Although NACTO's treatments are not referenced in AASHTO's guidelines, they are compatible with them. The City of Davis adopted the NACTO guidelines through City Council at the same time it adopted the Beyond Platinum Bicycle Action Plan in February 2014. However the NACTO guidelines remain for information only.

Pilot studies

Besides designs according to the guidelines described above the City of Davis has the possibility to experiment with pilot studies.

Summary of findings

The policies and guidelines reviewed in this framework analysis present several interesting points to bear in mind throughout the rest of this project:

- The City is committed to offer all its residents a variety of transportation options, including active transportation, with the aim of achieving a 30% bicycle mode share by 2020.
- The City is committed to improve and keep developing its bicycle network in an integrated and comprehensive manner, so that it connects people to places in the best way possible for everyone.
- The City wants to be the first ever Diamond Level Bicycle Community and therefore enforces a seven "E's" approach to reach that objective.
- Bicycle transportation plans are exempted from CEQA until January 1st, 2018.
- Bicycle facilities design is solely governed by speed under Caltrans Highway Design Manual.
- The City is following NACTO design guidelines since early 2014.
- The City can conduct pilot studies in design of infrastructure.

Appendix B – ECCP suggestions and evaluation

East Covell Corridor Plan (March 2014) suggestions	Our comments	Our recommendations
A. F Street Intersection Improvements		
Replacement of the channelized right turn from eastbound to southbound with a right-turn pocket	Channelized right-turn lanes encourage motorists speed through large radii turns. Removing them is ideal. However, right-turn pockets do not provide the motorists with enough visibility to detect a cyclist. Crossing a cyclist's path is best when done at an angle of 90 degrees	**Partially agree.** Remove channelized right-turn lanes and shift the bicycle tracks away from the junction core and more into the intersection legs, to provide cyclists with free right turn movements and safe crossings when travelling through the intersection.
Dual left-turn movements from westbound to southbound remain	A traffic analysis was carried out and resulted in keeping the dual left-turn lanes.	**Agree.** This study does not include a traffic analysis.
Opportunity to create a new shared-use path on the northeast corner of the intersection	This new bicycle facility would increase connectivity to the existing facilities located to the Northwest and Southeast corners of the intersection if well designed.	**Agree.** In this study, a bicycle facility is proposed to be implemented along the Northern side of East Covell Boulevard between F Street and Birch Lane.
B. J Street Intersection Improvements		
Channelized right turns from eastbound to southbound and from northbound to westbound are removed	Channelized right-turn lanes encourage motorists speed through large radii turns. Space for safe cycle crossings is limited because of them. Removing them is ideal.	**Agree.** In this study two solutions are proposed, minimal and ideal. In the minimal situation the removal of channelized right-turn lanes and shift the bicycle tracks away from the junction core and more into the intersection legs is needed, to provide cyclists with free right turn movements and safe crossings when travelling through the intersection. In the ideal situation a roundabout is proposed as a replacement of the existing signalized intersection.
Pedestrian crosswalks are added to the north and east legs of the intersection	Adding connectivity to pedestrians is always good. Bicyclists should also be able to cross to the North and East of the intersection.	**Agree.** Both the minimal (adjusted intersection) and ideal (roudabout) solution comply with those comments.
C. East Covell Boulevard Buffered Bike Lane		
Travel lanes' widths are reduced from 12 feet to 11 feet	Reducing travel lanes' width has proved to slow down traffic, and therefore improves safety for both motorists and non-motorists travelling by.	**Agree.** Reducing the travel lanes' width on East Covell Boulevard will make room to accomodate a quality two-way cycle track.
One-way 7-feet buffered bike lanes are created in both directions	Bi-directionality is necessary on such a core axis on the city. However buffered bicycle lanes do not provide low levels of traffic stress for bicyclists and thus may not be able to capture the cycling potential of a maximum of residents.	**Partially agree.** A two-way cycle track on the Southern side of the Boulevard offers better cycle quality than buffered bike lanes, and provides more comfort for all.

D. Median Improvements Along Covell Boulevard		
Planting of low maintenance, low water ground cover and trees in the existing medians	Using natural elements in a roadway design is always welcome from the users: shade, wind protection, experience, etc.	**Partially agree.** Rather than planting trees on the central median between the travel lanes, natural elements should be placed between the motorized and non-motorized traffic.
Provision of a 2-feet hardscape buffer between the travel lanes and the ground cover	This step relates to planting grand cover and trees in existing medians.	**Irrelevant to this study.**
E. Separated Crossing of East Covell Boulevard		
Concerns on the implementation of a grade separated bicycle and pedestrian crossing between J Street and L street	East Covell Boulevard comprises four travel lanes, that indeed induce safety issues for both pedestrians and bicyclists when crossing it.	**Solved.** Constructing a two-way cycle track on the Southern side of the Boulevard eliminates the difficult crossing of the Boulevard between J and L Streets.
F. L Street Intersection Improvements		
Installation of signals	Signals can provide essential time for bicyclists and pedestrians to cross a given intersection, but also increase motorized traffic delay on the main corridor and / or on the side street. Good bicycle design removes the need for a traffic light.	**Partially agree.** This study does not include a traffic analysis, so conclusions for car flow cannot be made. From a bicycle perspective signals are not necessary at L Street intersection since the two-way cycle track eliminates crossing difficulties.
Implementation of bulb-outs and high visibility pedestrian crossings at Claremont Avenue	Bulb-outs reduce crossing distances for pedestrians and force motorized traffic to decrease their speed to make a safe turn.	**Disagree.** Claremont Drive is a neighborhood street and therefore speed is low enough. The redesign of L Street and E. Covell intersection will also bring traffic calming.
Place marking improvements	Relevant in the ECCP study.	**Irrelevant.** This study proposes a brand new design for the L Street intersection.
Removal of the channelized right turn movements from eastbound to southbound and from northbound to westbound	Channelized right-turn lanes encourage motorists speed through large radii turns. Removing them is ideal.	**Agree.**
G. Oak Tree Plaza Driveway Enhancements		
Addition of a westbound acceleration lane in the existing median	This type of treatment can take up a lot of space that can be deemed necessary for other use, such as a sidewalk, a bicycle track, etc. Furthermore, an acceleration lane encourages speeding and therefore unsafe behavior. Finally, comfortable motorized traffic facilities have proven to attract more motorized traffic over time, which is not the purpose of this project.	**Disagree.** This study proposes to keep the current design.
Addition of high visibility markings on the existing shared-use path on the South side of the Boulevard	Visibility of the bicycle and pedestrian crossings is indeed vital at this location, as many motorized vehicles are expected to get in and out of the Oak Tree Plaza every day. Markings are in our opinion not enough to get motorists to realize the presence of vulnerable users.	**Partially agree.** An even better solution to the driveway access points to Oak Tree Plaza design is the use of raised cycle track and pedestrian crossings.

H. Claremont Cycle Track		
Removal of on-street parking on the North side of the street	Removal of parking is a great way to make room for cycling facilities, but might be badly perceived by the local population in some cases.	**Disagree.** It is assumed that Claremont Drive is a neighborhood street and that it is therefore a low-speed street that can function as a bike boulevard.
Construction of a two-way cycle track on the North side of the street	Separate bicycle facilities are not necessary if speeds are low enough and may in fact even encourage car driver to speed up. A shared facility leads to higher safety with lower travel speeds for cars.	
I. East Covell Boulevard Shared Use Path		
Additional shared-use path on the North side of the boulevard	Constructing separated facilities on either sides of the Boulevard would for sure encourage less confident bicyclists to ride their bikes along East Covell.	**Agree.** An additional two-way cycle track running on the Northern edge of the Boulevard would increase the bicycle capacity of the Boulevard while providing additional route choice to the Cannery and further East-located communities.
J. Pole Line Road Channelized Right Turn Removal		
Replacement of the channelized right turn movement from westbound to northbound with a right turn pocket	Channelized right-turn lanes encourage motorists speed through large radii turns. Removing them is ideal. However, right-turn pockets do not provide the motorists with enough visibility to detect a cyclist. Crossing a cyclist's path is best when done at an angle of 90 degrees.	**Partially agree.** Remove channelized right-turn lanes and shift the bicycle tracks away from the junction core and more into the intersection legs, to provide cyclists with free right turn movements and safe crossings when travelling through the intersection.
Removal of the channelized right turn movement from eastbound to southbound	Channelized right-turn lanes encourage motorists speed through large radii turns. Removing them is ideal.	**Agree.** In the proposed design, the channelized right turn lanes are as well removed for speed, angles, and therefore safety consideration.
K. Pole Line Shared Use Path		
Construction of a shared use path on the West side of the road	This path will provide additional connectivity for the adjacent communities towards the fast commuter route running towards downtown, as well as direct access to the Oak Tree Plaza.	**Partially agree.** The present study suggests a bi-directional mixed-use path on the West side of Pole Line Road, North of the intersection with East Covell Boulevard. This is desired. A two-way bicycle path is preferred over a shared path.
L. Birch Lane Shared Use Path		
Existence of Safe Routes to School programs	Safe Routes to School programs have proven to encourage children and parents to use their bicycle for utilitarian purposes.	**Supported**, although beyond the scope of this study.
Addition of a shared use path on the North side of East Covell Boulevard	Constructing separated two-way facilities on either sides of the Boulevard would for sure encourage less confident bicyclists to ride their bikes along East Covell and decreased the need for crossing the Boulevard.	**Partially agree.** An additional two-way cycle track running on the Northern edge of the Boulevard would increase the bicycle capacity of the Boulevard while providing additional route choice to the Cannery and further East-located communities. A two-way cycle path is prefered over a shared path.

M. H Street Tunnel Replacement		
Either widening of the East Covell Boulevard bridge over the railroad tracks; or (see right below)	Widening the East Covell Boulevard bridge would be ideal to create separated bicycle facilities along the Northern side of the Boulevard on that section, but would generate high costs to the City.	**Disagree.** The present study suggests to keep the bridge as it is, and to merge the proposed Northern side unidirectional bicycle track with the existing bicycle lane over the length of the bridge. A physical separation between the travel lanes and the bicycle lane should be provided along the merged section.
Retrofitting of the H Street Tunnel in terms of grades, retaining walls and lines of sight	The H Street tunnel is indeed unpleasant and unsafe to use for a many people: lack of visibility, sharp turns at the entrance and exit, and narrow access and egress slopes on the West side.	**Agree.** A retaining wall should be built to replace the graded slope on the West side to make room for a miniroundabout for cyclists. Additionally, bulb-outs will be constructed at the entrances of the tunnel.
N. Signal Interconnect and Coordination		
Optimization of existing and future signals along the East Covell Boulevard	Optimizing the signals along the Boulevard for motorists will improve motorized traffic delay, but conversely increase travel speed, making it less safe for bicyclists and pedestrians to cross the Boulevard. Higher vehicular speed also increases the level of traffic stress experienced by bicyclists and pedestrians.	**Disagree.** Optimization of the signals is not suggested. The corridor design proposed in this study eliminates traffic signals at East Covell and J Street intersection, and does not recommend implementing signals elsewhere.

Major new items proposed in this study

O. Faro Avenue and railroad grade-separated crossing

This added feature will help connect the Cannery greenway core to Community Park and its adjencent schools via Covell Park and the existing multi-use bridge over West Covell Boulevard. This will offer a safe, enjoyable and fun route for children attending the North Davis Elementary School and, to a lesser extent, Davis Senior High School. Thsi overpass will also encourage recreational trips towards the Western side of the city, where existing bicycle paths are looping around and into several communities.

P. Access path under the East Covell Boulevard bridge towards the H Street tunnel

This option has already been studied in the past, and is therefore supported by the present study. It will offer a safe and completely separated route from the Cannery towards the H Street tunnel. Some property land will need to be acquired from Cranbrook and Pinecrest Apartments, and the bicycle path will need to be designed to enhance user experience. Artwork, lighting, materials, and lines of sight will need to be accomodated in order to encourage children to cycle to school, and to make them (and their parents) feel low levels of stress when choosing this option.

Appendix C – J St. and E. Covell Blvd. roundabout modeling

Roundabout modeling intersection J-street – E. Covell Boul.

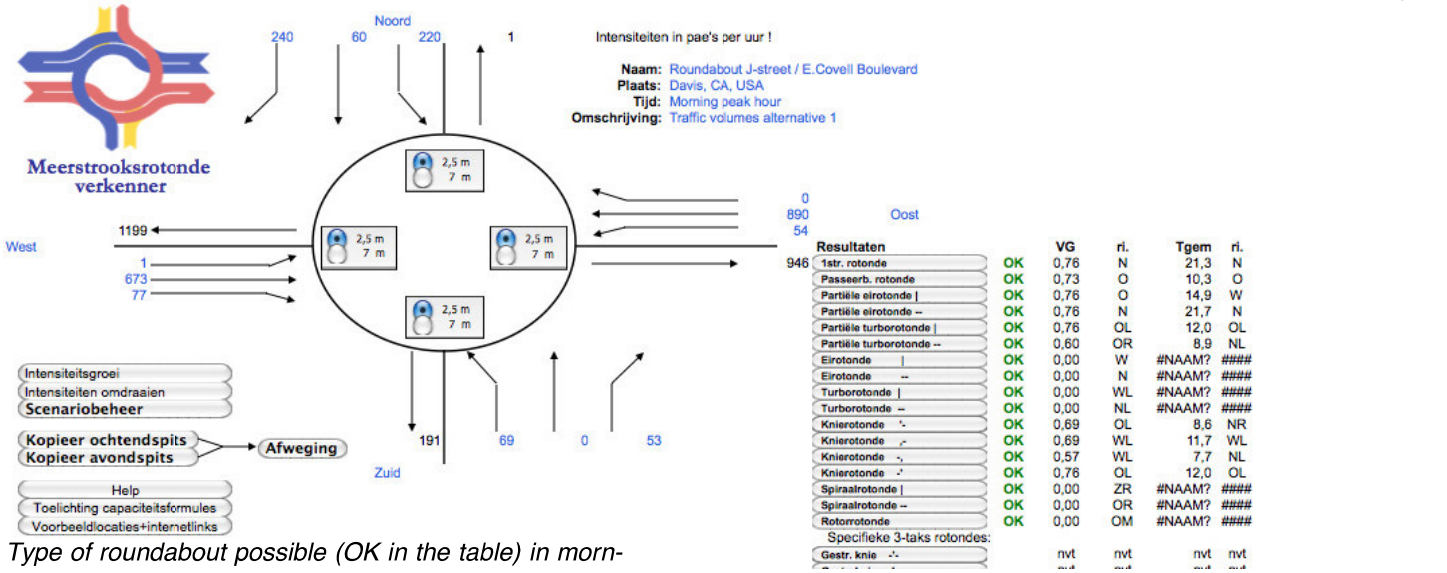
The intersection of J-street and E. Covell Boulevard is currently a traffic light controlled intersection. The realization of the Cannery provides the need to build safe intersections. This paragraph aims at finding the safest type and form of intersection for this location, which is on grade.

Dutch research shows that traffic light controlled intersections are less safe than intersections without traffic lights, where basis traffic rules say who has the right of way. This is due to several aspects, one of them is the high speed people tend to ride to make it in the 'green' or 'orange'. At non-lights intersections they will have to watch out at every junction, which encourages them to lower the speeds. If accidents occur, the severity is much lower.

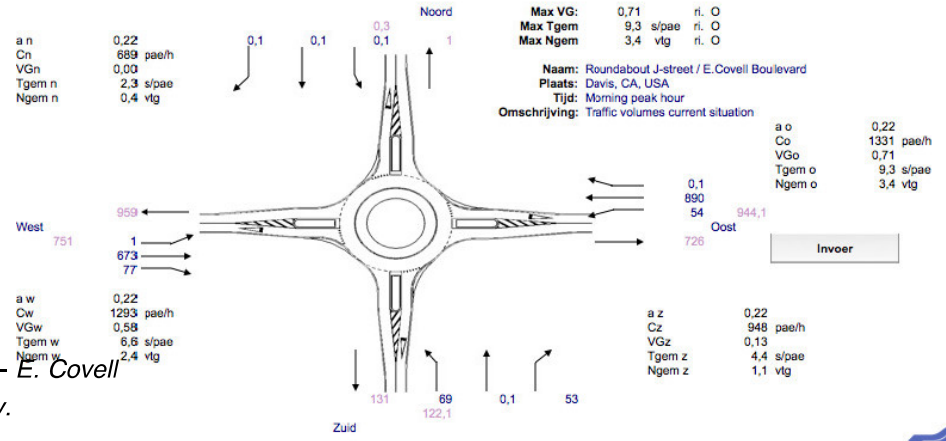
Even better than non-traffic light controlled intersections are roundabouts. The amount of points of possible conflicts is greatly reduced. Traffic speeds are slow, between 15 and 20 miles/hour and traffic is very attentive for other road users. At the places where the speed is lowest, slow traffic users (pedestrians and cyclists) cross the road on grade level.

Based upon the traffic volumes provided by the City (report Fehr and Peers), we modeled the ideal form for the roundabout. In the Netherlands this can vary between a single lane roundabout and a double or even triple lane roundabout, and many types of turbo roundabouts in between.

For the morning rush hour both in the current situation (without the Cannery) and in the new situation (with Cannery, with educated guess traffic volumes of 250 leftwards, 60 straight on and 220 east wards)



Type of roundabout possible (OK in the table) in morning rush hour with Cannery.

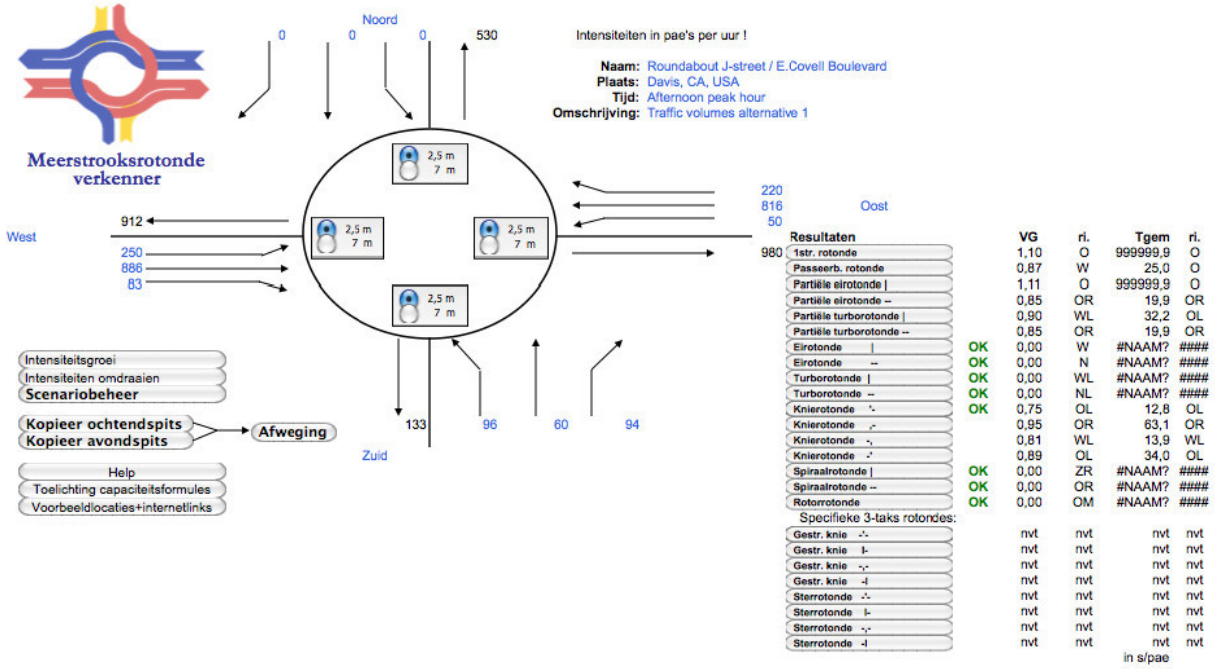


Minimal form for the roundabout at J-street – E. Covell Boulevard in morning rush hour with Cannery.

Meerstrooksrotonde verkenner

The afternoon rush hour makes up for higher traffic volumes.With the Cannery neighborhood (again modelled with estimated guess traffic volumes of 250 cars/hour from the west, 60 cars/hour from the south for slow traffic as safe and convenient as possible.

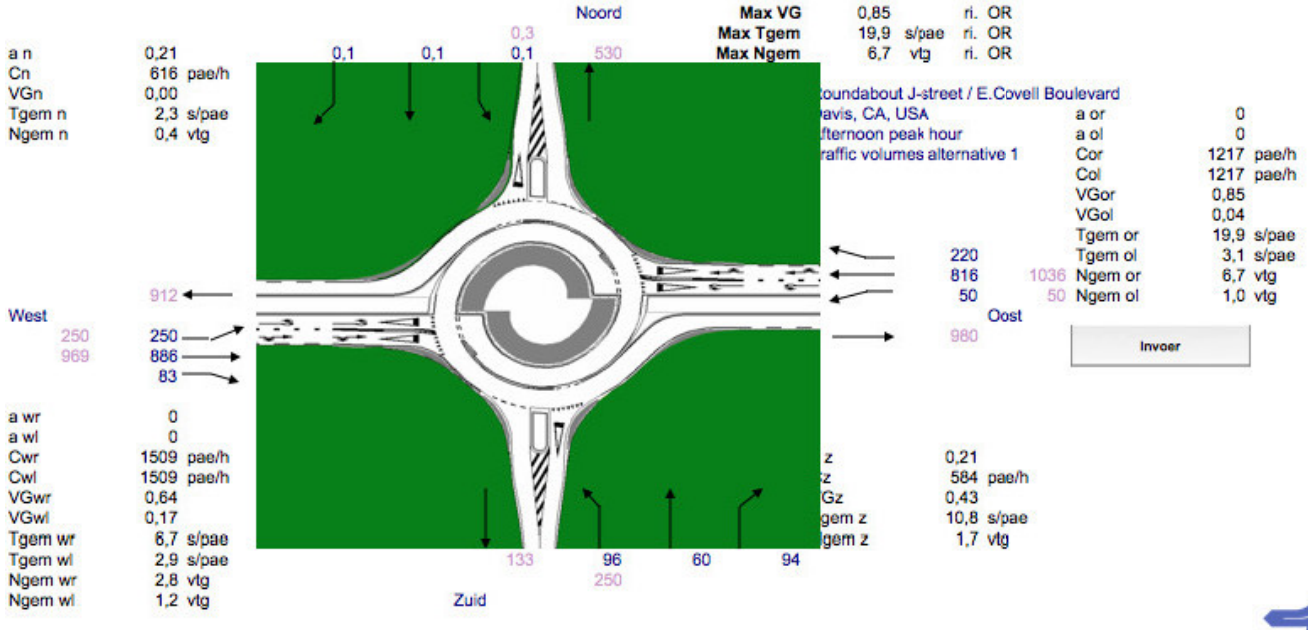
and 220 cars/hour from the east)shows that a single lane roundabout is lacking capacity. Several types of turbo roundabouts are possible. The chosen shape has the least entry and/or exit lanes, to make crossing them



Resultaten		VG	ri.	Tgem	ri.
1str. rotonde		1,10	O	999999,9	O
Passeerb. rotonde		0,87	W	25,0	O
Partiële eirotonde |		1,11	O	999999,9	O
Partiële eirotonde --		0,85	OR	19,9	OR
Partiële turborotonde |		0,90	WL	32,2	OL
Partiële turborotonde --		0,85	OR	19,9	OR
Eirotonde |	OK	0,00	W	#NAAM?	####
Eirotonde --	OK	0,00	N	#NAAM?	####
Turborotonde |	OK	0,00	WL	#NAAM?	####
Turborotonde --	OK	0,00	NL	#NAAM?	####
Knierotonde '-	OK	0,75	OL	12,8	OL
Knierotonde ,-		0,95	OR	63,1	OR
Knierotonde -,		0,81	WL	13,9	WL
Knierotonde -'		0,89	OL	34,0	OL
Spiraalrotonde |	OK	0,00	ZR	#NAAM?	####
Spiraalrotonde --	OK	0,00	OR	#NAAM?	####
Rotorrotonde	OK	0,00	OM	#NAAM?	####
Specifieke 3-taks rotondes:					
Gestr. knie -'-		nvt	nvt	nvt	nvt
Gestr. knie |-		nvt	nvt	nvt	nvt
Gestr. knie -,-		nvt	nvt	nvt	nvt
Gestr. knie -|		nvt	nvt	nvt	nvt
Sterrotonde -'-		nvt	nvt	nvt	nvt
Sterrotonde |-		nvt	nvt	nvt	nvt
Sterrotonde -,-		nvt	nvt	nvt	nvt
Sterrotonde -|		nvt	nvt	nvt	nvt
				in s/pae	

Type of roundabout possible (OK in the table) in morning rush hour with Cannery.

This shape of roundabout is visible in the figure. Average waiting times per direction are listed. These are all lower than the average waiting time for the traffic light. The level of service went up, while traffic safety for cars, pedestrians and cyclists can rise as well.



Minimal form for the roundabout at J-street – E. Covell Boulevard in afternoon rush hour with Cannery.

Meerstrooksrotonde verkenner