

## Bi-Directional Express Lanes on I-680

### I. Introduction

I am currently a senior in high school, but I have been fascinated with maps and transportation systems since I was a young child. Having lived in the San Francisco Bay Area for almost fifteen years, I am very impressed by the improvements in our freeway system put through by Caltrans, especially the changes on I-880, from the newly constructed I-880/CA-92 interchange to the additional lanes from CA-262 to US-101.

Recently, I have done some research into congestion and freeway design, mostly through the *Access Magazine*. I am not perfectly familiar with typical traffic patterns because I haven't looked into empirical data such as VPD counts very much, but I've applied logical deduction, my own experiences, and Caltrans studies in my analysis.

I am writing this in proposition of an alternative that was considered but eliminated from further discussion: bi-directional express lanes on I-680.

### II. Overview

Looking at current conditions, there are several projects that should definitely be implemented in the immediate future:

1. Add an additional northbound lane, in some manner, on I-680 from CA-262 to CA-84.
2. Repave northbound I-680 in the aforementioned section.

This project is of utmost importance, due to, but not limited to, the following problems:

1. This section of I-680 N is one of the most congested bottlenecks in the Bay Area. Travel speeds consistently drop to below 10 mph in certain sections, with traffic picking up early as 2:20 pm and not returning to free-flow until around 8:00 pm. In fact, this section is frequently congested even on Saturday afternoons and other non-peak periods. A recent study done puts this section as the 6<sup>th</sup> worst commute in the Bay Area.
2. Surface streets in the surrounding area are frequently clogged due to the congestion on the freeway. This results in tremendous traffic on roads like Paseo Padre Parkway, Mission Boulevard, and Osgood Road, along with long queue lines to re-enter the freeway at Washington Boulevard and Mission Boulevard.
3. The pavement is so badly cracked and filled with potholes that it borders on dangerous in certain sections. In particular, the rightmost lane between CA-262 (exit 12) and Durham Road (exit 14) is exceptionally bad. During non-peak periods, few drivers actually drive in the right lane.
4. It makes little sense to have such a large disparity in capacity between northbound and southbound since congestion is a non-linear, concave-up function of demand.

This project is already under way, with a northbound express lane to be added in the near future to match the current southbound express lane. However, while this project does address the problem, it does not *efficiently* resolve the problem, as I will address in the next section.

### III. Project Proposal

I would like Caltrans to reconsider the prospect of implementing bi-directional express lanes between CA-262 (exit 12) and CA-84 (exit 21) on I-680.

Instead of the planned project of having one express lane in each direction, this proposal would have two express lanes in the median, separated from regular lanes by a concrete barrier. The direction of travel would be reversed in fixed time slots, such as 11:30 am to 1:00 pm and 12:00 am to 2:00 am.

Besides the main goal of providing bi-directional express lanes, there are several other aspects of my proposed project:

1. Remove the truck climbing lanes between Mission Boulevard (exit 16) and CA-84 (exit 21).
2. Remove the current auxiliary lane on southbound I-680 from Washington Boulevard (exit 15) to Durham Road (exit 14), aside from a short section, approximately 0.3 miles long, right before the exit, similar to the northbound direction.
3. These truck climbing lanes and auxiliary lane will be replaced by the express lane facility.

This possibility has been considered by Caltrans but eliminated from further discussion. Here is the excerpt from the *Final Environmental Impact Report/Environmental Assessment*, published in July 2015, with mentioned limitations bolded:

#### “Bi-Directional Express Lane

The alternative to construct the HOV/express lane in the median separated by fixed barriers was considered. This alternative would construct the HOV/express lane in the I-680 median, similar to the Build Alternative, but separate the express lane from the general purpose lanes by fixed concrete barriers. Separating the express lane by a barrier allows the lane to be reversed mid-day to accommodate the changing commute direction in the morning and afternoon. This alternative was withdrawn from further study mainly due to **introduction of nonstandard shoulder widths and constructability issues at bridge overcrossing locations**. Accommodation of this alternative **would require freeway widening and a larger project footprint** in order to meet the Caltrans design standards. The option will also **limit the access from the express lane to the major intersections**, as was one of the main concerns from the cities of Fremont and Milpitas. A wider footprint in addition to the physical constraints associated with the existing development along I-680 would result in substantially more adverse environmental effects under this alternative when compared with the Build Alternative.”

I'm not entirely familiar with the process of constructing a freeway, so I understand that I may have overlooked the non-standard shoulder widths and constructability issues. However, aside from a short section between Washington Boulevard (exit 15) and Mission Boulevard/CA-238 (exit 16), my proposed alternative should require **very little widening** and a **potentially smaller project footprint** than the current plan.

#### **IV. Advantages/Disadvantages to Current Design**

Before I go into the advantages and disadvantages of this project, I'd like to outline some general characteristics of this portion of I-680:

##### **A. Characteristics of I-680**

1. Strongly one-directional traffic: most commuters travel southbound in the morning and northbound in the evening. Unlike many other freeways like CA-237, congestion is virtually nonexistent against the flow of traffic.
2. Very little entering/exiting traffic exists between Mission Boulevard (exit 16) and CA-84.
3. Congestion follows very predictable patterns that are unlikely to change significantly in the foreseeable future.
4. The freeway passes through almost entirely residential or rural areas.
5. Overall, there's a striking similarity between this section of I-680 and CA-91, which connects Orange and Riverside.

Each one of these characteristics creates an environment which is very suitable for bi-directional express lanes. Below, I have listed some of the **potential benefits** of constructing the bi-directional express lanes:

1. **Reduced congestion:** Obviously, a bi-directional express lane will alleviate traffic slightly more than a single express lane in each direction would and encourage carpooling more due to very fast travel speeds in the express lanes.
2. **Maximize efficient use of express lanes:** Strongly one-directional traffic means that a large portion of the potential capacity is "wasted." While this problem is typically true for most freeways, I-680 is an exception because of the sheer lack of traffic in the opposing direction. Other freeways have relatively heavy, although not necessarily congested traffic in the opposing direction, like on CA-237 or I-880. The above problem is especially important on I-680 because of the presence of an express lane. Unlike typical HOV lanes in the Bay Area, entering an express lane essentially means you are stuck in it for a while. This deters fast drivers from entering because it is very likely to be caught up behind a "snail," diminishing the usefulness of an express lane in the first place. Even when tolls are set at the minimum of 30 cents, hardly anyone uses the express lane. It

generates essentially zero revenue and the lane is “wasted.” A bi-directional express lane would very efficiently allocate lane miles to minimize congestion. Furthermore, it would generate far more revenue as both express lanes would be utilized, as opposed to simply one.

3. **Addressing future congestion:** In the foreseeable future, the Silicon Valley will continue to grow, along with the population of suburbs, especially in the areas served by I-680, including, but not limited to Pleasanton, Livermore, Dublin, San Ramon, and even beyond the Altamont Pass, like in Tracy. Although it may not be completely necessary now, having the additional express lane in either direction will certainly provide sufficient capacity for the years to come, during which growth is inevitable. Furthermore, as an express lane, it will avoid the problem of triple convergence.
4. **Maximizing efficiency within the express lanes:** One of the biggest problems with most HOV/express lanes currently existing in the Bay Area is that having only one lane greatly limits its efficiency. If a driver in an HOV lane needs to merge into the regular lanes to exit, that one driver blocks and hampers traffic flow, causing HOV lane traffic to flow only slightly faster than regular traffic. Also, as mentioned before, with only one express lane “snails” can block faster drivers and discourage them from using the lane, especially when it’s blocked off in the case of an express lane. The aforementioned problem is especially evident on parts of CA-237. The recent auxiliary HOV lane added onto US-101 near CA-85 has made commuting through the HOV lanes far smoother, with almost no stop-and-go travel.
5. **Future sustainable developments:** Maintaining a high ratio of express lanes to normal lanes (2:3) creates a great vessel for more sustainable developments in the future. A 2 to 3 ratio of express to normal lanes will almost guarantee that the express lanes will travel at close to free flow speeds for many years to come, which is important as express lane usage has been consistently increasing since its conception. The express lanes can serve as a very effective path for bus rapid transit, which is one of the more viable options for public transportation in the Bay Area, especially as it seems fairly unlikely that rail transportation will be a possible medium of travel along I-680 in the near future.

Of course, there are also many **potential drawbacks** to creating this bi-directional express lane.

1. **Higher operational costs:** Because the direction of traffic must change twice a day (once around noon, and once more around midnight), there is a small operational cost overhead in having to reverse the direction of flow each day (like shifting entry route barriers). There is also some cost in making sure that all traffic has vacated the express lanes before reversing direction of flow.
2. **Inability to respond to accidents:** If an accident occurs in the central express lane, it can be very difficult to address effectively due to having concrete barriers blocking the lanes. Accidents in the express lanes can also impede traffic completely. Additionally, if there’s an accident in the regular lanes, it can be difficult to change the direction of the express lanes to allow essentially an alternative path to avoid the accident.

3. **Safety concerns in general:** One of my major concerns that wasn't mentioned in the environmental report is safety. In order for a bi-directional express lane to operate safely, there must be no vehicles in the express lane before traffic is opened up to the opposite direction. Thus, a large timing window (probably at least an hour) in which no traffic from either direction is allowed into the express lane must be implemented. If safety protocols are not followed exactly, a disastrous accident could occur. There would also have to be removable concrete barriers at the express lane enter/exit zones, which poses a slight safety hazard. Specific vehicles would need to move the barriers, and technology that detects any remaining vehicles in the express lane would have to be installed.

However, many concerns regarding the construction of a bi-directional express lane can be easily **mitigated or completely eliminated** by making the most of current infrastructure and efficient construction planning:

1. **More expensive:** Reconstructing some of the overpasses, installing concrete barriers to separate the express/regular lanes, and addressing other logistical concerns will certainly be expensive. However, my proposal also significantly reduces costs because an additional lane would only need to be constructed in the following sections: CA-262 to Durham Rd. and Washington Blvd. to CA-238. In other sections, the truck climbing lanes and auxiliary lanes can simply be replaced by the express lane, reducing the cost of freeway expansion.
  - a. **No need for truck climbing lanes:** Again, I don't have complete empirical data, but logically, truck traffic through this section of I-680 is fairly minimal because it connects a residential area with a job market. Most truck traffic that goes into the Pleasanton/Livermore/Dublin area would probably travel through I-580, and most truck traffic reaching the San Jose area would travel through I-880, since a large percentage of truck traffic originates from the Port of Oakland. Traffic is typically light enough during non-peak hours to accommodate a lack of truck climbing lanes, while congestion is so severe during peak hours that the lane doesn't serve much purpose other than provide an additional lane for a short stretch. Since traffic is essentially constant through the Sunol Grade, traffic flow is limited by the narrowest point of the highway, so all this truck climbing lane creates is a bottleneck when the lane ends.
  - b. **Auxiliary lane unnecessary:** The current auxiliary lane between Durham Rd. and Washington Blvd. is unnecessarily long. There are a variety of reasons for this:
    - i. Only around 0.1 – 0.3 miles of acceleration/deceleration space is actually needed.
    - ii. Most commuters who would typically use I-680 via Washington Rd. would likely use one of the faster surface streets like Paseo Padre Pkwy or Osgood Rd, so oncoming traffic through Washington Rd is not very high.
    - iii. Creates a bottleneck at Durham Rd. due to vehicles merging from the auxiliary lane back into I-680. Because of how long the auxiliary lane is, it

encourages some drivers to “cheat” and use the auxiliary lane to pass vehicles.

- iv. Because of how poorly the Durham Rd. interchange is designed, the exit ramp doesn’t have enough capacity to handle the current traffic exiting from the exit only lane anyways.

Instead of having such a long auxiliary lane, I propose that it be removed except a short 0.1 – 0.3 mile section for smooth acceleration and to prevent queues on the right lane when exiting to Durham Rd.

2. **Lack of flexibility:** While this project does restrict potential future developments somewhat, in the foreseeable future, the Silicon Valley will still remain as the predominant job market for commuters who use the affected stretch of I-680. The Pleasanton/Dublin/Livermore area will remain largely as a residential area with little job market. As such, current traffic pattern characteristics will very likely continue into the future. There is no need to worry about the problem of limited flexibility for future changes in constructing a bi-directional express lane simply because traffic patterns will remain the same.
3. **“Limited local access”:** As mentioned in the environmental study, one major concern is the lack of access to exit off-ramps to local areas. One important thing to note, however, is that the currently planned express lanes also impede local access significantly. Additionally, because my proposal does not include the express lane extension between CA-262 and CA-237, this problem is not as great as it might otherwise seem.

First of all, there is virtually no entering or exiting between CA-238 and CA-84, which eliminates a lot of logistical problems with using a bi-directional express lane. In fact, even if the bi-directional express lane is problematic from CA-262 to CA-238, I propose that the bi-directional express lane system still be implemented from CA-238 to CA-84. There are only two overpasses that would need to be reconstructed (Andrade and Sheridan). Both of these exits can easily serve as detours to each other as one overpass is reconstructed, especially considering the low traffic flow through these exits. Local access is not a problem for this section because very little entering/exiting occurs.

Between CA-262 and CA-238, limited local access is a problem, but smart placement of enter/exit routes can mitigate this problem. I propose the following:

- In the northbound direction:
  - o Enter ramp after CA-262 exit.
  - o Enter ramp after Durham Rd. exit.
  - o Exit ramp before CA-238 exit.
  - o Enter ramp after CA-238 exit.
  - o Exit ramp before CA-84 exit.
- In the southbound direction:
  - o Enter ramp after CA-84 exit. (currently existing)
  - o Exit ramp before CA-238 exit.
  - o Enter ramp after CA-238 exit. (currently existing)
  - o Exit ramp before CA-262 exit. (currently existing)

- Enter ramp after CA-262 exit. (currently existing)
4. **“Nonstandard shoulder widths”**: This is a problem because of the shoulder requirements: 10 feet on the right and 4 feet on the left. In this situation, traffic flows in both directions, making the shoulder requirements ambiguous. I would like Caltrans to clarify this ambiguity because bi-directional lanes can provide an effective way of reducing congestion in the future with minimal cost.
  5. **“Constructability issues at bridge overcrossing locations”**: As mentioned before, this isn’t a large issue from CA-238 to CA-84. I’ll address each of the other overpasses that would need to be reconstructed below:
    - a. Grimmer Blvd.: This freeway overpass is not a problem because widening would be required anyways even if only a northbound express lane were constructed.
    - b. Durham Rd.: This overpass is the only one that poses constructability issues because the bridge support in the median would have to be shifted closer to the northbound lanes. This shift would not be necessary if only a northbound express lane were constructed. There is, however, plenty of space in the median, so there’s no need to increase the right-of-way.
    - c. Washington Blvd.: This overpass would not have to be reconstructed because there is plenty of space in the southbound direction to build the express lanes. There’s already an auxiliary lane to enter the express lane. Even if more space is needed, there’s plenty of room on the right shoulder to expand, so the overpass itself would not need to be reconstructed.
    - d. Paseo Padre Pkwy.: This overpass would also not need to be reconstructed because the right shoulder in the southbound direction is unusually wide right underneath the overpass and has enough space for the expansion.
    - e. Palm Ave.: Again, this overpass would also not need to be reconstructed because the right shoulder in the southbound direction is unusually wide right underneath the overpass and has enough space for the expansion.
    - f. Mission Blvd.: Again, this freeway overpass is not a problem because widening would be required anyways even if only a northbound express lane were constructed.
  6. **“More freeway widening, larger project footprint”**: Unless the plan was to create unnecessarily wide shoulders/medians, this is a myth. Adding a northbound express lane and creating two bi-directional express lanes both add exactly one lane. In fact, under my plan, by using up some auxiliary lane space, certain areas may not even need widening! I’ll divide up the project footprint into sections:
    - a. Mission Blvd. to Durham Rd.: This section would require widening, but there is plenty of space in the median to expand, so the project footprint is minimal.
    - b. Durham Rd. to Washington Blvd: For this section, simply construct the bi-directional express lanes on the southbound side of the freeway. As mentioned before, the auxiliary lane isn’t necessary for such a long distance. In the southbound direction, the auxiliary lane can be converted into a regular lane and the leftmost regular lane can be converted into a second bi-directional express lane. Near the Washington interchange, the auxiliary lane would need to be

reclaimed for a short acceleration lane, but there is plenty of space in the northbound left median to expand, so no actual widening is needed.

- c. Washington Blvd to CA-238: Modest widening may be needed in this section, but just like the previous section, the median is so wide that little expansion is necessary. Additionally, there's plenty of space in the right shoulders in both directions.
- d. CA-238 to Andrade Rd.: Besides the CA-238 overpass, there's no need for expansion in this section at all because the truck climbing lanes can be converted into regular lanes, while the leftmost lane can be converted into part of the bi-directional express lane.
- e. Andrade Rd. to CA-84.: This section does indeed need an expansion. However, because of the wide median and shoulders, only modest expansions are needed. Additionally, there is plenty of room to expand on the shoulders, so overall the project footprint in this section is fairly low.

## **V. Summary**

The advantages of constructing a bi-directional express lane far outweigh the disadvantages.

It will not only provide sufficient capacity for years to come, but also maximize efficient usage of lane miles and generate far more revenue than the existing and planned systems. The project provides far more capacity than any other alternative project with minimal environmental footprint. Additionally, the fast travel speeds in the express lanes will provide an excellent vessel for more sustainable developments, such as a bus rapid transit system.

Although this project will incur additional operational costs, along with some logistical and safety concerns, most of the concerns noted in the environmental report can be mitigated or eliminated altogether. By best utilizing the current infrastructure (auxiliary lanes, truck climbing lanes, large shoulders/medians), this project can be constructed easily with little widening.