



**When deadlines are critical and a large range of stakeholders are reliant on promises being kept, this Pathfinder demonstrates that the construction industry can deliver.**

## State Highway 2 Dowse to Petone Upgrade

**Client:** New Zealand Transport Agency (NZTA)

**Contractor:** Fletcher-Higgins Joint Venture

**Design Consultants:** Beca Infrastructure

**Publication Date:** March 2010

**Region:** Wellington

**Sector:** Transport Infrastructure

**Physical Works Value:** \$70m

**Construction Timescale:** Aug 2007 to Dec 2009

## “Man’s ability to Shape Stone” - Lean Construction Helps To Bring An Important State Highway Upgrade In On Time And To A High-level Of Stakeholder Satisfaction

**This Pathfinder Project focuses on the project team’s collaborative introduction of Lean Construction tool Last Planner™**

### Background

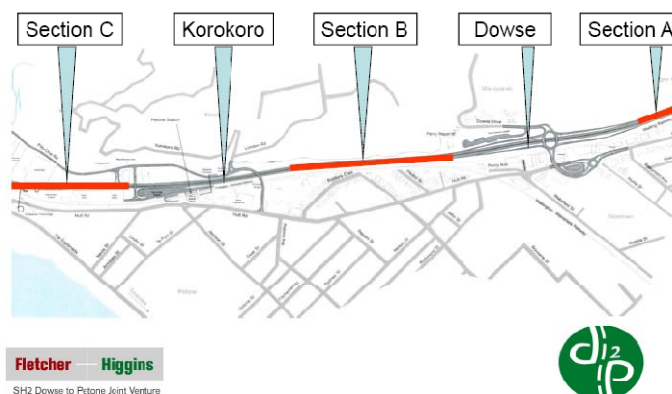
The Dowse to Petone Upgrade project (D2P) is a large scale construction project on State Highway 2 (SH2) between Petone overbridge and Dowse Drive.

The project involved the realignment of a 2.7km section of SH2 and included removing three sets of traffic signals, construction of a new grade separated interchange at Dowse Drive, removal of direct access to SH2 by providing a new service access, as well as improved access and parking facilities at Petone Park & Ride and Percy’s scenic reserve. All this was completed while ensuring safe, efficient passage for 40,000 vehicles per day through the construction site.

These improvements have improved safety and travel times not only on SH2 but have also improved cross valley connections between the Northern Hills and Lower Hutt and Petone.

Project feasibility studies commenced back in 1996 and originally included an upgrade between Petone and Melling. This was subsequently split into three projects.

Early in the development stages of the project the impact on local communities, businesses and road users was identified as a critical element of the project.



By working closely with key stakeholders including Hutt City Council, Greater Wellington Regional Council, Iwi, community groups and other interested parties from the start NZTA and design consultant Beca were able to consider local requirements when developing options for the project and keep all parties involved and informed as these were developed into the final design.

The project also had to contend with significant physical constraints. Built in close proximity to the Wellington Fault and sandwiched between railway tracks, Korokoro Cemetery, Percy’s Scenic Reserve, local businesses and the Western Hills there was little space left to realign and construct a new road while maintaining access for the existing 40,000 road users and ensuring the safety of the construction team.

With design and property purchase completed in early 2007 the construction phase of the project was tendered as a traditional measure and value contract with particular attention and focus given to traffic management and stakeholder interface requirements.

The project was delivered by a joint venture contracting team consisting of Fletcher Construction and Higgins Group; FHJV, (the Fletcher-Higgins Joint Venture).

### Elements of the project

The \$70 million contract was awarded in May 2007 and construction commenced on the 6 August 2007 with a due date for contract completion in December 2009. The Engineers for the contract were Beca Infrastructure and the Client was NZ Transport Agency (formally Transit New Zealand).

#### Key Elements of the project:

- Construction of a grade-separated interchange with a roundabout over SH2 at Dowse Drive with a connection to Hutt Road and Dowse Drive.
- Construction of a new overbridge to replace the existing traffic signals at Korokoro to provide connection between Petone and Korokoro.
- Realignment of SH2 including construction of a new concrete median barrier.
- Rearranging and improving Petone Railway Station's existing Park and Ride carpark facilities including providing an access bridge over SH2 and upgrade of the existing footbridge.
- Removal of direct access onto SH2 by constructing a new service road between Cornish Street and Korokoro that will provide access to the industrial area.
- An upgrade of the Percy Scenic Reserve access and parking facilities.

The aerial photograph below clearly shows the site constraints and specifically the narrow construction zone, the proximity of the rail corridor and the potential for community severance along the narrow valley floor. Also illustrated in this shot is the requirement for complex traffic management and integration of temporary works to maintain the high vehicle flows along the existing SH2 corridor whilst constructing the upgrade itself.



### The Challenges

#### Separable Portion A – A challenge for the project team

The project contained a Separable Portion (A). This was the eight week period allowed in the Contract for closing of Korokoro Bridge which provided the link between Korokoro and Hutt Road. This could not commence until the Dowse Interchange was open and had severe penalties for late completion. The main elements of work to be completed within the eight weeks were largely dictated by the traffic management and comprised of:

- Demolition of the existing bridge over the railway
- Removal of earth embankment for the new state highway alignment
- Construction of the southbound state highway
- Construction of a temporary link between the new bridge and temporary northbound state highway

#### Pressure on the Critical Path

By November 2008, the project had been running for over 12 months. Generally works were progressing well and in line with the contract programme. However, given the critical nature of the separable portion A works which severed connection for the local community and the associated financial penalties for late delivery the project team were all focussed on how to ensure this phase of works was successfully implemented.

The contractors programme had identified critical milestones associated with this critical activity including the need for rail closures, public notifications and delivery within the eight week timeframe to comply with contract conditions and meet public expectation.

#### Coordination Difficulties

As work progressed, there were growing difficulties in coordinating the wide range of disciplines and subcontractors within the tightening time frames and narrow site.

These pressures were also set against a background of high commuter expectation for the maintenance of capacity on both the existing adjacent road and rail links. For local traffic the goal was minimisation of community severance due to construction work removing existing crossings.

#### Stakeholder Relations

Due to the high profile nature of the project and the intense level of local stakeholder expectation, the project's public relations activities were critical to success. Project success is not purely about delivering to time, cost and budget; stakeholders must feel comfortable with the entire delivery process and be adequately informed along the way. Keeping promises is key to building trust.

*Dowse Interchange three days before opening, February 2009*

## The Innovation – Implementing Last Planner™

**Last Planner™** is a tool that has been used on projects around the world to improve programme performance through better planning and communication at the level at which the work is performed.

In order to bring more surety to the programme, the project team agreed to trial this new Lean Construction tool - Last Planner™ on D2P for Separable Portion A of the contract, (the eight week contractual time period over which the direct transport link between two roads could be closed).

During 2008, Hannah Hyde, the NZTA project manager had attended the NZIM Diploma of Managerial Excellence (DipMEEC) where she was introduced to Lean Construction and Last Planner™.

Having seen the possibilities for this tool on the D2P project, she suggested that FHJV might wish to consider its implementation. The FHJV management team, John Bryant and Andre van Heerden, agreed to try the tool on the understanding that they must be able to see the benefits quickly. They were both aware that introducing a new tool at such a critical stage was a daring move.

The decision was taken knowing that although the Last Planner tool was known to deliver good results in the building sector, this was the first full usage known in the civil sector in New Zealand. In addition, the team knew that they had decided to introduce the new tool part way through a project and in its critical stages which could have serious implications if it was not successful.

For these reasons, this Pathfinder is a particularly useful example of a project team that dared to innovate under challenging circumstances, pushing the boundaries of 'business as usual' in order to achieve extraordinary results.

In order for the tool to be embedded in the team prior to the critical separable portion A period, it was introduced several months earlier (17 months into the 30 month construction period).



*The Start-up workshop where the team are collaboratively planning the next crucial weeks.*

After discussion with the Client and Beca the FHJV set about implementing Last Planner milestones associated with Separable Portion A and its associated closures.

**Start Up workshop** The initial Start-up workshop was held on 2<sup>nd</sup> December 2008 over three hours. The team were introduced to the Last Planner™ process and a brief overview of the programme was provided.

**Collaborative Planning** The team then identified key work activities and their timing using a wall calendar. The team initially focussed on detailed activities up to Christmas and in outline to the end of Separable Portion A.

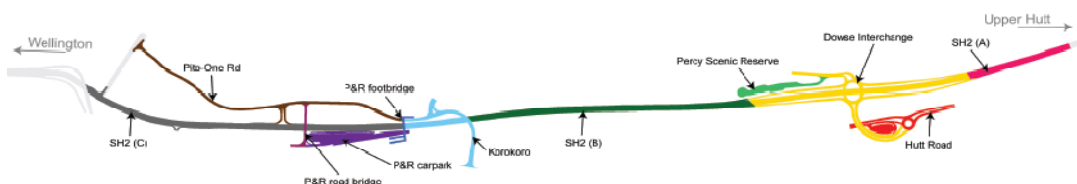
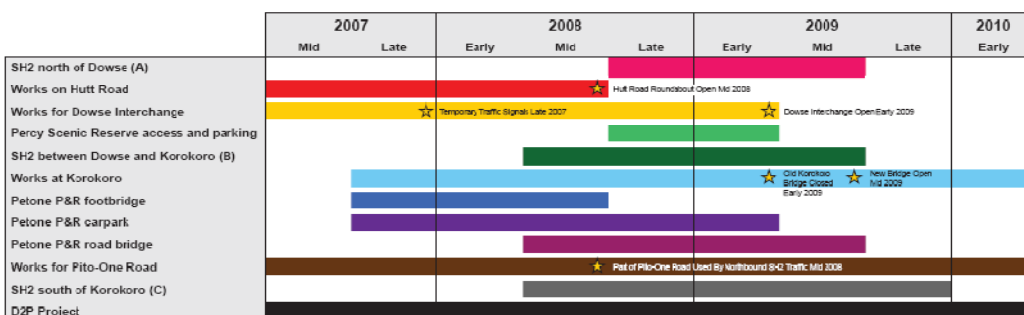
Each team member was required to be realistic about their programme of work and consider earlier work activities (by others) and how this would impact on their work. Each person was required to identify earliest possible start dates on the wall mounted calendar.

In this way, a true collaborative programme began to emerge and issues that would not have arisen for weeks were thrashed out there and then.

At the end of this session, the team had a crude programme in place but more importantly everyone had contributed to it and understood the challenges ahead and what was required to ensure successful delivery.



### SH2 Dowse to Petone Indicative Programme



NOTE: This is an indicative programme and may be subject to change

*The Indicative Programme*





*Progress on Dowse interchange at September 2008.*

**Weekly ‘Production Meetings’** The first weekly production meeting was held as a trial at the end of the start-up workshop and a forward schedule for one-hourly weekly production meetings thereafter. The production meetings were run by the section engineers responsible for the two distinct parts of D2P, Dowse and Korokoro.

The meetings were attended by the project manager, construction manager, all FHJV site engineers and construction supervisors, the public liaison officer, the site traffic management manager, a representative from the consultant and the client.

Contrary to other projects where last planner has been implemented it was decided not to involve subcontractors and foreman in the weekly meetings due to the numbers involved.

Both NZTA and BECA attended and contributed at the weekly planning meetings however no client or consultant programme activities were included in the weekly programmes.

Despite some initial scepticism the team managed to keep the meetings to one hour in line with Last Planner™ guidance. This one meeting covered the whole site, replacing two programme meetings that lasted up to 1.5 hours each representing an immediate saving of 2 hours each of the valuable time of some 15 to 20 people each week.

**Administration** The site administrator attended these meetings and played a vital role in collating ‘Production and Lookahead schedules’. Chris Craig, the site administrator described her thoughts about the meetings, *“To be honest with you, I didn’t give it much hope after our first meeting, but I have been really impressed. The meetings are not as “exciting” as they used to be and they now take half the time. It really seems to be working.”*

**Production and Lookahead Schedules** Two fundamental elements of Last Planner™ are the Weekly Production Schedule the 5-week Lookahead Schedule. The team are required to schedule activities which they are planning to complete both in the next week and for the next five weeks.

These schedules are set out in considerable detail in the one week and at a higher level in the five week lookahead. Key to the process is identification of constraints (risks to completing the activity) and requirements from others. This enables activities to be linked and implications of other work better understood and action taken as necessary.

Using this process, constraints are cleared each week ahead of production which minimises risk. The 5-week lookahead works in the same way but gives a longer lead time to any constraints.

The individual one and five-week look ahead schedules were required to be submitted on the Monday afternoon prior to the weekly meeting on Tuesday morning. This was achieved in most cases although there were a few cases of no programme and non attendance at the meeting in the early days, however as the tool gained acceptance, attendance increased.

The Last Planner™ standard production schedule forms were tweaked during the initial implementation period to include a column for specific traffic management requirements and another column for large plant requirements. These were required due to the high traffic management constraints of the site and to arrange for plant availability.

**Planned Percent Complete (PPC)** Key to the success of Last Planner is the Planned Percent Complete (PPC) and the way it is measured and reported. This measure looks at productivity. Each planned activity is scored ‘1’ for a 100% complete – i.e. the work is finished and the next trade can continue behind it or ‘0’ the work is not 100% complete and therefore the next trade cannot start. (How the tasks are broken down to be reported is key to making sure that the PPC makes sense).

This ‘1-0’ method of measurement is a big shift from the usual reporting of progress as % complete in the construction industry. It takes some getting used to and often individuals in the early days will try to score an activity ‘1’ until someone in the meeting points out that the work is not quite 100% complete.

Achieving 99% will not allow the next trade to start and thus cause a delay in someone else’s planned schedule and hence reduce their PPC. This is the part that really begins to build the culture of collaboration as people soon realise how important it is for them to ‘keep promises’ i.e. not over or under promise on work that can be achieved and everyone else’s programme is linked into theirs.

This is probably one of the most powerful areas of the Last Planner™ tool. Each person involved not only understands the whole programme and how their part fits in but is acutely aware of the impact of any delay to their work on those immediately after them in the programming sequence.



*Progress at Korokoro following SPA, May 2009*

## Successful Outcomes

### The Turning Point – focusing on work face planning

The team recognised that the Separable Portion stood or fell on the JV's ability to deliver on two work face issues. Firstly for all their front line staff to efficiently co-ordinate with each other for the delivery of a wide range of parallel work streams within a very narrow roading corridor. Secondly, to accurately programme the delivery of all the required construction elements without delay.

Having successfully implemented Last Planner™ on D2P for Separable Portion A of the contract, the team comfortably achieved their milestones and decided to continue with Last Planner to the end of the contract.

### Culture

Hannah Hyde – NZTA's Client Representative for Separable Portion A noted that: *"Culture was improved through the Last Planner process, especially within the JV team and Last Planner provided a formal route to do this."* She also noted that there was some early resistance but as implementation progressed everybody understood that, as they were all accountable they must commit. Finally, she noted that culturally the Client also sees that the JV Managers are being engaged, which is vital.

### Public Relations

The Last Planner™ process included the site PR manager. Public relations was vital on this complex scheme with many stakeholders, especially the local residents and knowing what activities were coming up and being able to input into the planning was vital for the PR manager to do her job well.

On 31<sup>st</sup> January, 2009, the Dominion Post published a letter to the editor entitled "Man's ability to shape stone":

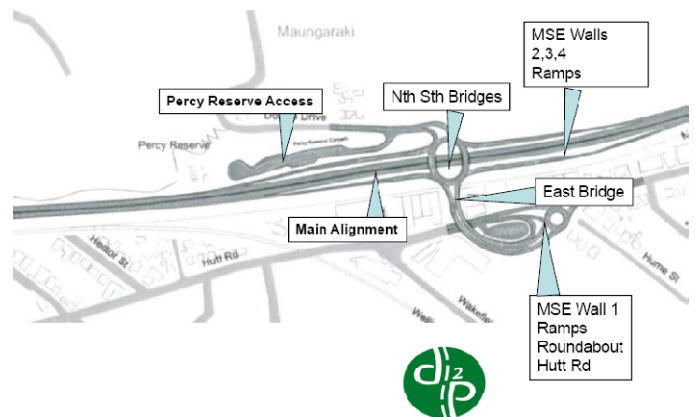
*"What a delight the new roading project has been to date...Almost daily, tremendous progress is visible and the whole process proceeds like a choreographed dance...I marvel at the engineer's ability to reshape and remodel the landscape while keeping the flow traffic running so smoothly with minimal inconvenience...We mightn't have Egypt's pyramids, but we have amazing displays of man's ability to shape stone right in our backyard. Many residents exclaim with delight at how wonderful and interesting this project is and we applaud all those involved with it. A job well done."*

### Master programme V task management

Interestingly the connection between the Master programme, with its milestones and the task orientated Last Planner raised a lot of discussion. Andrew Paterson, Beca's Engineer's Representative noted that *"Last Planner does not drive the Master Planning process but works at a site level to help the team keep on or ahead of that Programme."*

John Bryant, FHJV construction manager reviewed the connection between the Master Programme and Last Planner and he noted, *"The Master Programme cannot coordinate 'trades' (who work intuitively in silos) at site meeting level. These trades need a tool (Last Planner) because it works at site level – You cannot micro-plan from top down, Last Planner does this within the master programme by collaboratively programming with the team between milestones."*

Dowse Interchange



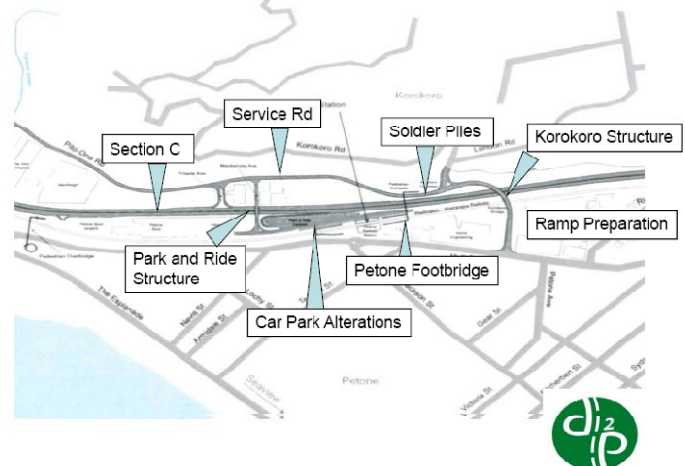
### Client and Design Team involvement

Hannah Hyde - NZTA's Client Representative reported that the Client and Design teams' commitment to attend and engage in the process was vital. This ensured that they were able to engage with the site team, commit to and execute their own responsibilities arising from the one week and five week planning process.

This helped the team culture to focus on the construction goals at this critical stage of the project. It also enabled the Client's project manager to:

- See how the contractor was dealing with their risks
- Be more aware of the state of relationships both between the contractor and consultant and within the contractors joint venture
- Know where actions or inactions on the part of the contractor or consultant were causing difficulties with progress
- Gain early knowledge of issues that may become problems for NZTA
- Double check that relevant work had been notified to NZTA for public information prior to it occurring.

Korokoro Interchange



## Lessons and possible improvements

Having implemented the tool, the NZTA project manager, Hannah Hyde, undertook an analysis of its impact. Lessons and possible improvements were recorded for future projects.

- **Initial scepticism.**

Initially people running the weekly meetings were sceptical of the Last Planner™ process. To begin with they believed that this type of planning was already being done. There was a wide variety of attitudes ranging from ‘very keen’, enjoying the input into the planning through to feeling as though they were being ‘treated like children’. The latter arose from a misunderstanding of the weekly requirement to report progress which initially can feel very ‘exposing’.

However, once the team understood the benefits of ownership of the co-ordination of the detailed programme by those actually undertaking the tasks, they were keen to implement it fully.

- **Use of a Facilitator**

The team noted that the use of an independent facilitator, specifically not involved in the project, was very helpful. Going forward, there is a recommendation that more visits are arranged during the weekly meetings further into the process. This can bring benefit, especially with staff changes and a natural propensity for people to “revert to type” under pressure. An external facilitator in the early sessions can help to keep people honest but without impacting any local politics in the team.

- **Leadership**

The level and type of leadership for these weekly meetings is important, just following the form procedure will not necessarily result in a positive outcome. Whoever runs the meetings needs to have a clear understanding of the desired outcomes, clearly understanding why items have not been completed and what effect this has on the programme or if any additional resources are required as well as coordination of teams in particular areas.

- **Lookahead**

Discussions have been held about the planning of one week and five weeks “look ahead” and whether these are the most suitable time scales for large civil engineering projects. The team decided that, whilst the one week was well planned, the five week look ahead was too vague. A three week “look ahead” was deemed to be better and should be planned in the same level of detail as the one week.

- **Workable Back-log**

The concept of having ‘back up’ work if site staff are unable to complete the planned work has been discussed in detail. This ‘workable back-log’ does not get scored against the PPC unless it was planned. It has also been suggested that there could be two scores, one for the planned work and one for workable backlog.

- **Reporting and Analysis**

Typically the “look-ahead” forms were completed on a Monday afternoon and a copy given to the people running the meeting, to review before the meeting. At the meeting these were only seen by the people who had written them and the people running the meeting. It has been suggested that everybody should have been able to see all the information as some people pick up information better visually than from listening to somebody talk about it.

## Summary of benefits

The main points from the Implementation Review are that:

- Last Planner™ was successfully implemented part way through a challenging project
- The collaborative planning engaged the team and cleared constraints (risks) prior to their eventuality on site
- The team used the process to drive home the project within a comfortable time frame.
- Meeting times were reduced and became “less exciting” i.e. the level of conflict in the meetings was reduced significantly to create a calm, stable environment
- Introduction of the Last Planner™ tool improved communication within the joint venture team and led to better understanding and relationships
- FHJV reported that health and safety and quality improved as a side effect of better planning / preparing the work
- If the consultant and client are taking part in the Last Planner™ process, this does not negate the need for contractual notifications
- If someone can’t plan, Last Planner™ doesn’t teach them how, but it does make people communicate more, prepare for tasks more and be more wary of overpromising.

## Conclusion

Implement a new planning tool at a critical stage of this project has led to a real success. The opening of Dowse Interchange and closure of Korokoro Intersection was achieved on the critical milestone dates. The intersection was reopened comfortably within the eight weeks target.

In addition, the implementation of the Last Planner™ tool has been a success in many more ways and the team decided to continue its use through to the end of the project.

Following on from the implementation of Last Planner™ on D2P, Fletcher Construction are implementing it on most of their major projects including Manukau Harbour Crossing and Higgins Group are implementing it on some of their major projects and within some of their regions.



Agent for  
NZ TRANSPORT AGENCY  
WAKA KOTAHI



**Fletcher**

**Higgins**

**Beca**

SH2 Dowse to Petone Joint Venture

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