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SOUTH ACCESS TO THE GOLDEN GATE BRIDGE

DOYLE DRIVE

DOYLE DRIVE REPLACEMENT PROJECT

Stormwater Drainage Outfalls

Technical Advice Memorandum

April 2009

Prepared By:

Arup PB Joint Venture

Draft

California Department of Transportation District 4

Doyle Drive Replacement Project

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This report takes into account the particular instructions and requirements of our client.
It is not intended for and should not be relied upon by any third party and no responsibility is undertaken to any third party

Job number 131558

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1 Introduction

1.1 Purpose

The purpose of this report is to determine the stormwater drainage outfall requirements of the Doyle Drive Replacement Project and the interface with the Presidio outfall network to San Francisco Bay.

This report will establish the drainage requirements and determine the capacity of the existing network of outfalls and their condition. It will then assess the outfall capacity required and apprise a number of systems to close any shortfall between requirement and capacity. Finally, a recommendation for the best option(s) for design development and creation of construction drawings will be made. The approach will be as follows:

1. Establish drainage requirements
2. Assess existing outfall capacity
3. Determine required outfall capacity
4. Evaluate engineering solutions to address shortfall in capacity

1.2 Background

Currently, over 91,000 vehicles use Doyle Drive every weekday. The road, built in 1936 has reached the end of its useful life. Short-term improvements to keep the existing highway structures safe are no longer cost effective and the existing structures have structural sufficiency ratings below recommended levels, and so need to be replaced.

The project is approximately 1.5 miles long and forms the southern approach of Route 101 to the Golden Gate Bridge. Built in 1936, Doyle Drive is a critical link for traveling between the San Francisco Peninsula and the North Bay. The Doyle Drive Project extends from the Golden Gate Bridge Toll Plaza on the west to Broderick Street on the east, and includes Richardson Avenue, Gorgas Avenue and Marina Boulevard. On the eastern end of the project area, access to Doyle Drive is provided via two approaches: one beginning at the intersection of Marina Boulevard and Lyon Street and the other at the intersection of Richardson Avenue and Lyon Street. Access is also provided where Veterans Boulevard (Route 1) connects to Doyle Drive approximately one mile west of the Marina Boulevard approach.

Figure 1 – Proposed Project Rendering

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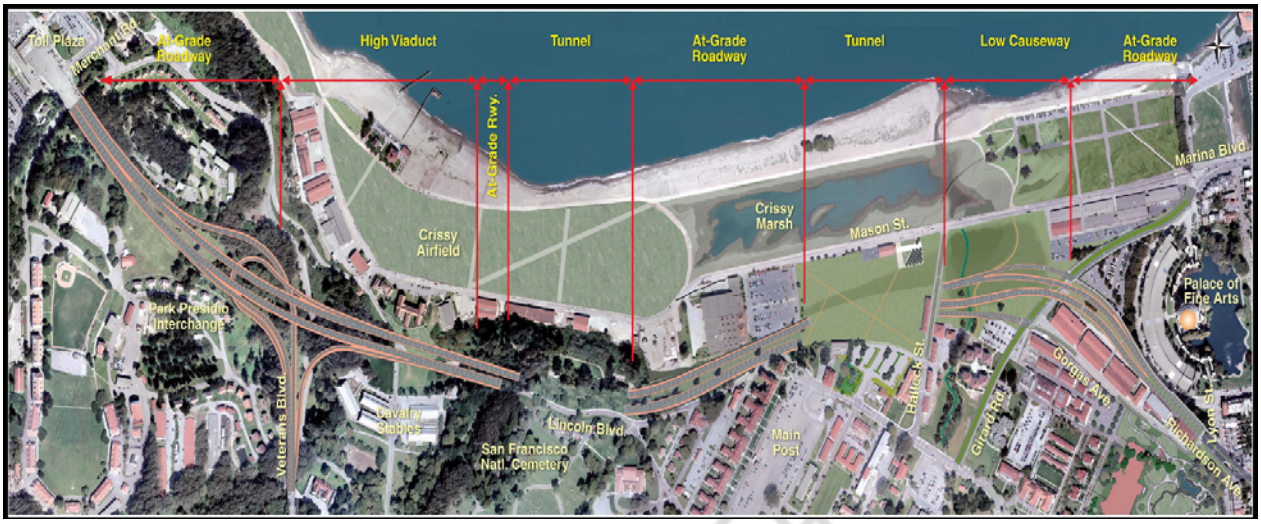
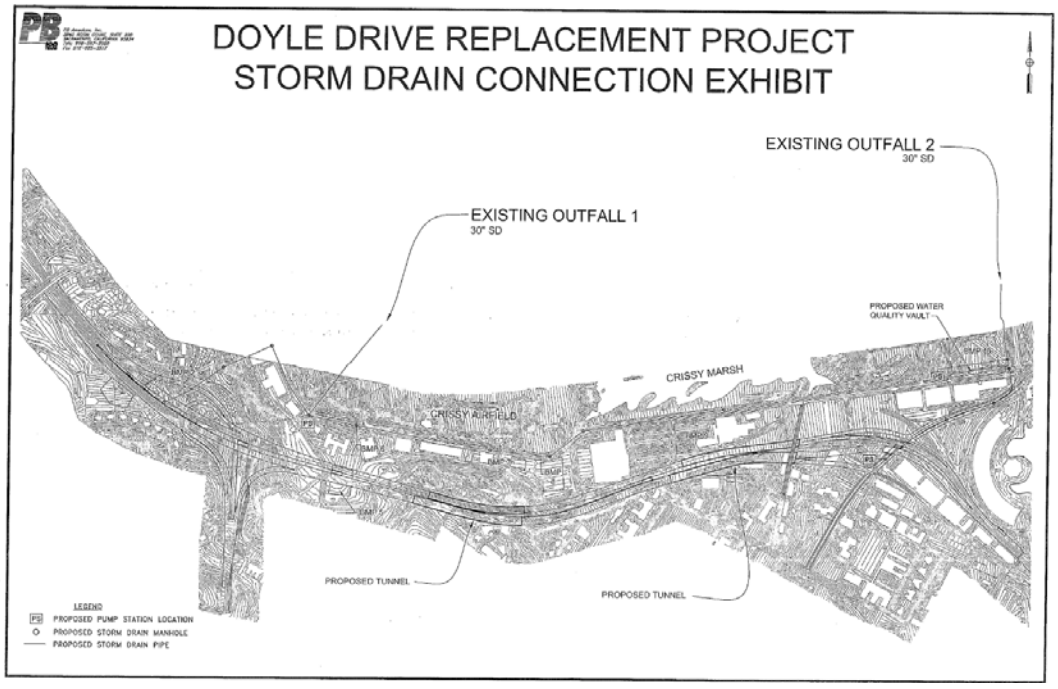


1.3 Existing Stormwater Outfalls

The Presidio drainage system has approximately 10 outfalls to San Francisco Bay referred to as (from east to west) A, B, C, D, F, G, IJKL, 15, M and N. Of these, two are believed to be currently functioning; outfalls A and IJKL. Both of these outfalls are 30 inch diameter pipes. Outfall IJKL is located north of Stilwell Hall (shown as Outfall 1 in Figure 2) and outfall A is located directly north of the Palace of Fine Arts (shown as Outfall 2 in Figure 1)

Figure 2 - Plan of site showing outfalls



1.3.1 Condition

1.3.1.1 Inspection

A ground level inspection of each of the working outfalls was carried out. Neither outfall currently has a headwall and both discharge close to the water line, rather than deep into the Bay.

1.3.1.2 CCTV Survey

Outfalls A and IJKL have been inspected by using Closed Circuit Television (CCTV). A survey was commissioned by the Arup PB JV and carried out by Pacific Liners in August 2008. Outfalls B1 and B2 were to have been inspected, but the survey crew were informed by the Presidio Trust that these outfalls were completely silted in and were eliminated from the inspection. The pipes appear to be in fair condition but there is a significant amount of silt and standing water in the pipes. See Figure 3 and

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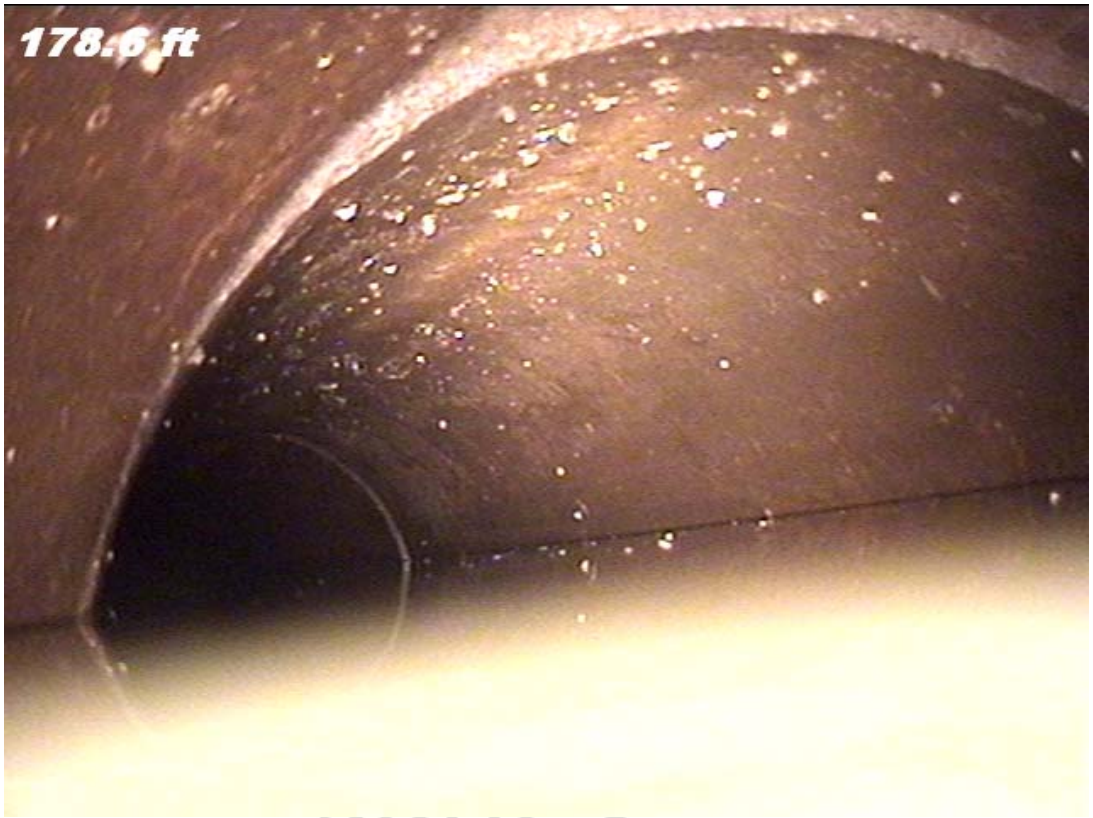
Figure 4 for stills from the video inspection footage.

From the inspection report there is no evidence to suggest why the pipes should not be used for outfalls for Doyle Drive and Presidio runoff.

The full inspection report is included in Appendix A.

Figure 3 - Sample CCTV inspection still showing empty pipe

Figure 4 - Sample CCTV inspection still showing standing water in pipe



1.3.1.3 Diver Survey of Outfalls

Underwater Resources Inc carried out a survey of the 42” storm water outfall B2 for the Presidio Trust in November 2004.

One diver entered the outfall pipe from the manhole located beneath the roadway in Crissy Field. They were able to travel approximately 95’ of the 300’ pipe run before the sand restricted his further movement.

An attempt was made to inspect the discharge end of the outfall pipe in the Bay. The pipe was found to be buried under a significant layer of sand, which after probing was found to be approximately 10’ deep.

The full inspection report, which includes a sketch of the new sand level, is included in Appendix B.

1.3.2 Capacity

The existing stormwater outfalls servicing the Presidio land area (discharging to San Francisco Bay) are able to convey the water from a 10-year storm event. The proposed Doyle Drive stormwater conveyance requires capacity for the 25-year event peak flow. Additional capacity is required to cover this shortfall.

Both outfall A and outfall IJKL are 30” pipes with an unknown gradient. A gradient of 0.5% has been assumed in calculations of capacity giving an outfall capacity of 25.2cfs. This will be reviewed following the receipt of survey information.

1.3.3 Existing Presidio Outfall to Crissy Marsh

Although there are currently outfalls allowing water from the Presidio site to flow into Crissy Marsh, the National Park Service have prohibited treated highway runoff discharging into the marsh.

1.4 Stormwater Catchment and Treatment

1.4.1 Doyle Drive Roadway Drainage

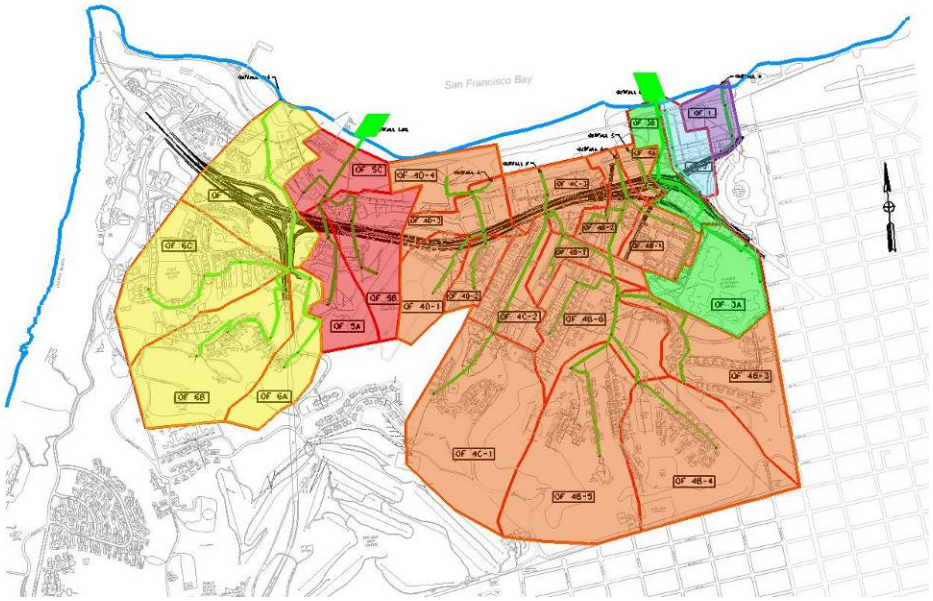
Runoff from Doyle Drive was calculated as part of the 35% design effort. These numbers are being used for the current modeling. When updated, the new Doyle Drive runoff quantities will be incorporated into the model.

1.4.2 Presidio Runoff

Runoff from the Presidio site is divided into 6 watersheds based on which outfalls they historically discharged to. These are shown in Figure 5 below. Watershed 5 (shown in red) discharges to outfall IJKL and outfall 1 (shown in purple) discharges to outfall A.

The outfall from existing watersheds that are unaffected by the Doyle Drive scheme will not be considered as part of this work.

Figure 5 - Presidio watersheds



1.4.3 Combined Runoff

The combined runoff to outfalls IJKL and A for Doyle Drive and the appropriate watersheds are shown in

Figure 6 and Figure 7 respectively. These charts show the hydrographs from these inputs which would require discharge.

On both figures, the outfall from Doyle Drive is shown by the dark blue and light blue lines, with the outfall from the Presidio shown by green lines. The combined hydrograph is shown in red.

Figure 6 - Outfall IJKL Hydrograph (Un-attenuated Outflow)

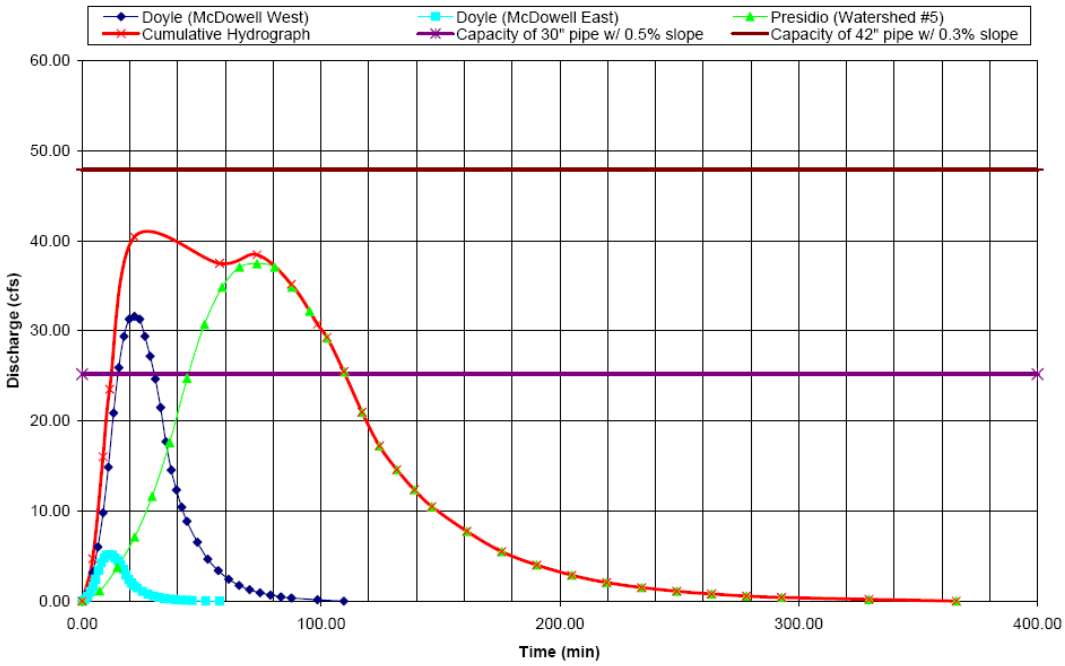
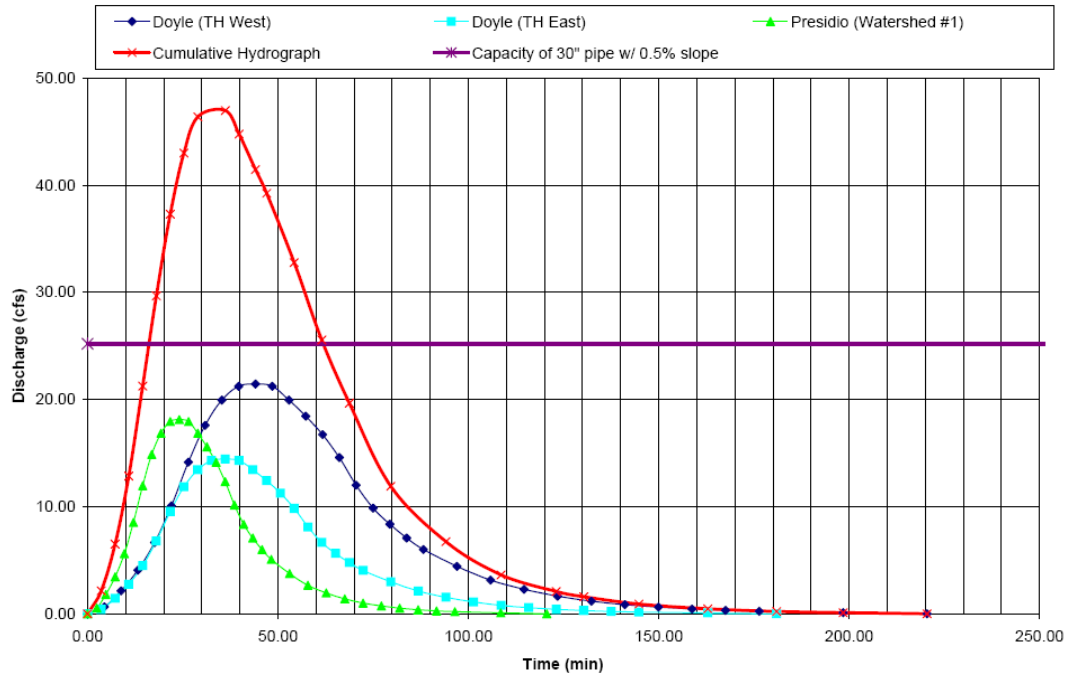


Figure 7 - Outfall B Hydrograph (Un-attenuated Outflow)



1.4.4 BMP and Storage/Attenuation

Run off from the Doyle Drive roadway will be treated for pollutants using Best Management Practices (BMPs). In the case of the outfalls, this will typically be a settling pond between the drainage network and the outfalls to San Francisco Bay. The BMPs may function as stormwater flow attenuation devices. This is examined in detail in the BMP report.

2 Regulatory Setting

2.1 Federal Law

The primary federal law regulating water quality is the Federal Clean Water Act (CWA) issued by the U.S. Environmental Protection Agency (EPA).

The National Park Service is a bureau within the United States Department of the Interior.

2.2 State Law

The EPA has delegated its authority in California to the State Water Resources Control Board (SWRCB) and Regional Water Quality Control Boards (RWQCBs). Each RWQCB prepares and adopts a Water Quality Control Plan (Basin Plan) a master policy document for managing surface and groundwater quality throughout each respective region. The SWRCB and RWQCBs issue permits that implement the standards included in the Basin Plan as well as other requirements of the California Water Code and CWA.

The California State Office of Historic Preservation (OHP) is responsible for the identification, evaluation, registration and protection of archaeological and historical resources. The OHP works under the direction of the State Historic Preservation Officer (SHPO), and the State Historical Resources Commission. There are elements within the Presidio site that have been identified as worthy of preservation.

2.3 Local Law

The San Francisco Bay Conservation and Development Commission (BCDC) has regulatory responsibility over development in San Francisco Bay and along the shoreline. BCDC permits are generally required for works in the Bay or within 100 feet of the shoreline.

San Francisco Public Utilities Commission (SFPUC) is a department of the City and County of San Francisco that provides water, wastewater and municipal power services to the City. The PUC currently have a number of outfalls into the Bay.

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3 Outfall Capacity Increase Options

The existing Stormwater outfalls servicing the Presidio land area (discharging to San Francisco Bay) have sufficient capacity to convey the water from a 10-year equivalent storm event. The proposed Doyle Drive stormwater conveyance requires capacity for the 25-year event peak flow, which exceeds the capacity of the existing outfalls.

There are two possible scenarios to convey the surplus:

- Increase the outfall capacity
- Reduce the outfall requirements.

This chapter covers the options to increase the outfall capacity.

3.1 General

The options to increase the capacity of the existing outfalls considered in this report:

- Supplement the existing outfalls
- Use of the San Francisco Public Utility Commission (SFPUC) Outfall
- Construction of new outfalls
- Unblocking existing blocked outfalls

The four options outlined above should not be considered as complete solutions for the entire project. At least two outfalls will be required across the site, so an appropriate choice of design philosophy should be applied to different areas of the project with the best option considered for each location.

3.2 Supplement Existing Outfalls

The existing outfalls have sufficient capacity to cater for a ten year storm event equivalent (Q_{10}). Since the proposed stormwater network needs to convey the 25 year design event (Q_{25}) this option involves constructing duplicate outfall infrastructure to convey the balance (Q_{25}-Q_{10}). A detailed analysis needs to be established to qualify the proposal with respect to scale the feasibility of attenuation structures to reduce outfall pipe diameter.

Two methods were considered for supplementing the existing outfalls. These were supplementing the existing pipes and increasing the diameter of the existing pipes.

3.2.1 Supplementing Existing Pipes

Construction of a new pipe parallel to the existing outfall pipe allows the existing to remain in place and functional throughout the construction works. The new outfall pipe would be constructed in a trench alongside the existing, but offset enough to minimize the interaction between the trench and the existing pipe.

This option would have the disadvantages of building a new outfall as it would require a trench, with associated disruption to the surface and dewatering required for at least part of the run. It would also have the additional disadvantage of the risk of damage to the existing outfall and the limitations in position and grade that would be imposed by the existing alignment.

3.2.2 Expanding Existing Pipes

There are a number of trenchless pipe replacement and expansion techniques available that could be used to increase the existing pipe diameter.

3.2.2.1 Pipe bursting

Pipe bursting could be used to expand the diameter and hence capacity of the existing outfalls. Pipe bursting with pneumatic, hydraulic or static pull techniques typically fracture the existing pipe, push the fragments outwards and follow with a new pipe. The bursting is usually carried out with a cone shaped bursting head, slightly larger than the diameter of the existing pipe which both fractures the pipe and displaces the fragments outwards. The new pipe is connected to the rear of the bursting head, which will have a slightly larger diameter than the new pipe to reduce friction.

An insertion pit through which the bursting head is launched and through which new pipe is fed is required as well as a reception pit which will house the winch pulling the driving cable.

Before bursting, the existing pipes should be cleaned out so any sand and debris in the pipes doesn't cause additional friction on the bursting assembly. In the case of the Presidio outfall pipes there is a considerable of sand and silt buildup in the pipes.

Pipe bursting is commonly carried out to replace existing pipes up to approximately 36" in diameter, although the technique has been used to replace pipes up to 48" in diameter.

3.2.2.2 Pipe Eating

Pipe eating is a microtunnelling system. This system utilizes a cutting head and shield and can cut through both the existing pipe and new ground around the pipe. This system has additional flexibility as it allows the new pipe to diverge from the existing course for part of the pipe run if preferred.

3.2.3 Summary

Supplementing the existing outfalls would have little flexibility in design due to the fixed locations and would carry a significant risk of damage to the existing outfalls during construction. Construction complexity would be increased by existing transverse connections into the outfalls. Paralleling the existing pipe is anticipated to be the most expensive option.

Supplementing the existing pipe would have similar regulatory issues to the construction of new outfalls, but would also be more expensive and carry more risk of damaging the existing network.

3.3 SFPUC Outfall

The SFPUC operates three wastewater treatment plants including the North Point facility. North Point, which only operates during storm events, has a capacity of approximately 150million gallons a day and treats approximately 1300 millions gallons of wastewater each year.

The Presidio Trust, Caltrans, and SFPUC had discussions regarding the possibility of sending Doyle Drive stormwater discharge to the SFPUC Combined Sewer Outfall Structure 9 (Baker Street outfall - just northeast of the Palace of Fine Arts). The SFPUC sewer is a 108" diameter outfall pipe and is used for overflow when the treatment plant exceeds capacity.

When this outfall is used, untreated water is discharged directly into the Bay. The Doyle Drive discharge connection point would be downstream of the treatment facility. On average, the SFPUC has a permit to use CSO Structure #9 four times a year.

The SFPUC are prepared to consider use of their outfall, under the condition that no water from Doyle Drive enters the outfall when it is being used by the SFPUC. A switch or valve device would be required that blocks Doyle Drive runoff from entering the outfall pipe at any time is being used by the SFPUC.

As the SFPUC outfall is used during larger storm events, and Doyle Drive project runoff would probably require peak discharge during the same events, it is likely that this proposal will prove impractical. The hydrographs for Doyle Drive and the SFPUC outfall should be compared to determine assess the feasibility of this proposal. If Doyle Drive runoff is prevented from entering the SFPUC outfall during such events an alternative solution would be necessary to prevent stormwater from backing up into the Doyle system.

This switching/blocking necessity could effectively eliminate any advantages inherent in connecting to the SFPUC. If further technical analysis shows that the Doyle Drive runoff peak and SFPUC peak would never coincide this option could become feasible.

A secondary option would be to attenuate the flow and to store water until the SFPUC peak flow had passed. This would, however, require a greater storage capacity than using the existing outfalls so is unlikely to be a practical alternative.

Discussions with the SFPUC are ongoing to determine the SFPUC requirements for use of the outfall.

3.3.1 Summary

Connecting to the SFPUC outfall would be the simplest option in terms of permitting as it would use an existing accepted outfall. A review of the capacity and demand for the existing SFPUC treatment plant would be required to prove the outfall requirements. The connection to the outfall would require coordination with the PUC.

This option would require less regulatory procedure as the project would be making use of the existing outfall rather than constructing a new one.

The agreement with the PUC, particularly with regard to the bar on use of the outfall while the SFPUC are discharging to it, would be likely to preclude this option from being feasible. Maintenance agreements with the PUC would be required to determine responsibility for the newly combined outfall.

3.4 New Outfalls

The construction of a number of independent outfalls into San Francisco Bay would be the simplest technical solution. The outfall needs of Doyle Drive would be assessed and as many new outfalls as required constructed into San Francisco Bay.

This option would require new right of way to be taken for the alignment of the network and the regulatory processes for this option would likely be the most complicated of any of the options.

As the existing outfalls have been subject to obstruction from moving sands and sedimentation, the implementation of new outfalls will assess the remediation and maintenance strategies required for an outfall to operate in the long term without blocking.

3.4.1 Summary

The construction of new outfalls would be simplest to design as there would be few limitations on the alignment, size and gradients of the outfall. The termination point would be designed with consideration of the tidal deposition of material that has blocked some of the other outfalls. New outfalls would be solely the responsibility of Caltrans, so there would be clear maintenance liabilities.

Construction of new outfalls would require a new right of way across both the Presidio land and the National Parks land. This option would be most disruptive during construction with open trenching likely to be the construction method used. There would be the highest risk of encountering unknown utilities in the ground during the construction of this option.

3.5 Unblock Existing Blocked Outfalls

There are 12 existing blocked or abandoned outfalls to San Francisco Bay. Unblocking some or all of these outfalls would allow the existing infrastructure to be re-used without the need for costly new outfalls to be built. The outfalls must be assessed to determine their suitability for reuse. Some are buried under new sand deposits in the Bay and some of the pipes are partially or fully blocked with silt and sediment from stormwater runoff.

3.5.1 Summary

Design of the unblocking regime for the existing outfalls would involve significant assumptions about the nature of the existing blockages. Further investigations would be required to determine the cause of the blockage, the chances of blocking re-occurring and whether it could be prevented with regular maintenance. The nature of shifting sand and sediment deposits in the Bay would require investigation.

If unblocking the exiting outfalls is determined to be technically feasible, the outfalls would still be constrained by the existing pipe capacity, gradient and alignment.

Use of the existing outfalls would be the simplest of the options to increase outfall capacity from a regulatory point of view as no new outfall infrastructure would be built

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4 Outfall Reduction Options

As discussed above, there are two possible scenarios to resolve this difference:

- Increase the outfall capacity
- Reduce the outfall requirements.

This chapter covers the options that would reduce the outfall requirements.

4.1 General

This option would attenuate any flow above the capacity of the pipe until the combined concentrated flow peak has subsided. Water could then be released to the outfall at a rate not exceeding the outfall capacity. A detailed analysis needs to be finalized to scale the attenuation structure(s) required to reduce the intensity of the outfall flow.

4.2 Outfall A

Outfall A is a 30in diameter pipe. The gradient is not known, but a gradient of 0.5% has been assumed for the modeling process. This would give a capacity of 25.2 cubic feet per second (cfs). A manhole survey is due to be carried out to determine the fall of the pipe more accurately.

The topography and geometry of the watershed leading to outfall A is such that the hydrograph will have a similar peak to the Doyle Drive drainage. This means there would be a very concentrated peak in the combined hydrograph approximately 30mins after the beginning of the storm. If the Doyle Drive run off could be attenuated until after the Presidio runoff has passed through the outfall, it may be feasible to use this outfall for the combined flow.

The attenuation discussed above would require a storage area of approximately 36000 cubic feet which would cover an area of 0.41 acres at a depth of 2 feet.

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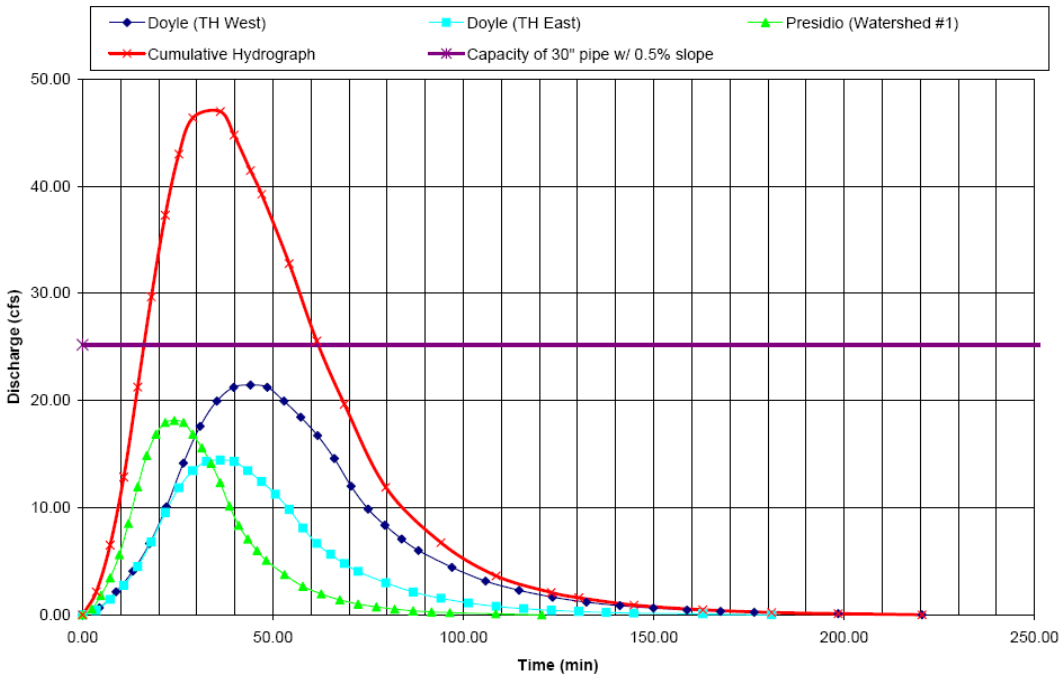
Figure 8 - Outfall A Un-attenuated Hydrograph



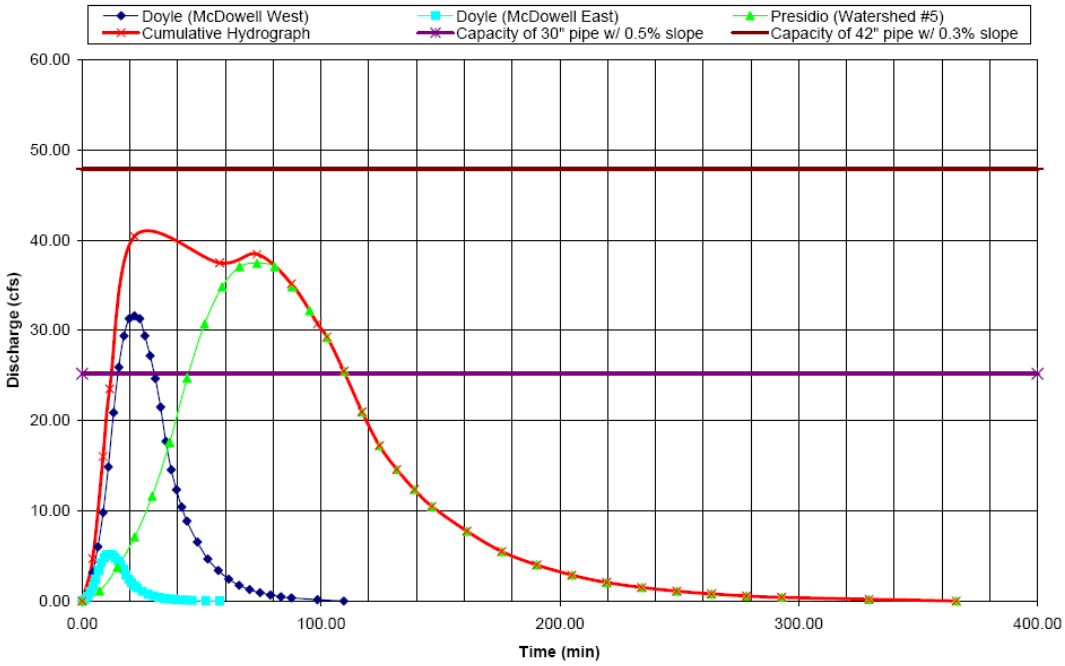
4.3 Outfall IJKL

Outfall IJKL is a 30in diameter pipe. As with outfall B, the gradient is not known, but a gradient of 0.5% has been assumed for the modeling process. This would give a capacity of 25.2 cubic feet per second (cfs). A manhole survey is due to be carried out to determine the fall of the pipe more accurately.

The Presidio watershed runoff for outfall IJKL is a larger area than for outfall A. so the hydrograph for this area is much larger and more spread over time that for outfall A. This shows the time taken for water from the extremities of the watershed to drain to the outfalls.

The attenuation discussed above would require a storage area of approximately 61500 cubic feet which would cover an area of 0.7 acres at a depth of 2 feet.

Figure 9 - Outfall IJKL Un-attenuated Hydrograph



4.4 Additional Works

Although new outfalls would not nee to be constructed, the existing condition of the outfalls would need to be assessed, both to determine existing condition and ongoing maintenance requirements. For example, outfall IJKL currently discharges short of the water line in all but the highest tides and so regularly becomes blocked with sand. The Presidio Trust carries out regular maintenance which typically takes the form of digging out the sand which has accumulated around the outfall. The mound of sand that can be seen adjacent to the outfall in

Figure 10 shows this maintenance.

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Figure 10 - Outfall IJKL

If an extension to the pipe and/or a new headwall structure was constructed, this would reduce the maintenance burden for both the Presidio Trust and Caltrans.

4.5 Summary

Options to attenuate the flow of water from Doyle Drive and the Presidio would be cheaper, quicker to construct and would have a significantly lesser approvals process prior to construction. It BMPs to attenuate the flow to an acceptable level can be located within the Presidio site, this is recommended as the preferred option.

5 Summary Matrices and Conclusions

5.1 Technical Summary Matrix

Option	Design	Construction Complexity	Relative Capital Cost	Maintenance (including maintenance agreements)
Supplement existing outfalls	Limited by location of existing	Risk of damage to existing	4.5	Caltrans and PT joint responsibility
Use SFPUC outfall	Detailed analysis of treatment plant required	Breaking into existing outfall No disruption allowed	2	Caltrans/PUC joint responsibility
Construct new outfalls	"Greenfield" route Interface with known utilities	Potential unknown existing services	4	Solely Caltrans responsibility. New design
Unblock existing outfalls	Limited capacity Connection to existing system Prevention of re-blocking	Considerable uncertainty, but relatively straightforward	1	Caltrans and PT joint responsibility
Attenuate flow	No Outfall design required	Minimal works to existing outfall	0.5	Caltrans and PT joint responsibility

5.2 Regulatory Summary Matrix

Option	BCDC	NPS & PT	Right of Way
Supplement existing outfalls	Required	Significant disruption to NPS/PT land	Minimal new RoW
Use SFPUC outfall	Not required	Disruption to PT land only	Some new RoW
Construct new outfalls	Required	Significant disruption to NPS/PT land	Significant new Row
Unblock existing outfalls	May be required	Minor disruption to NPS/PT land	Minimal new RoW
Attenuate flow	Not required	Permanent works on PT land	Minimal new RoW

5.3 Conclusions

The two or more outfalls required do not necessarily all need to use the same option as laid out above. The options should be considered to have the potential for a mix-and-match approach to be taken with the best solution used for each individual outfall.

The preferred option should be to attenuate flows using Best Management Practices on the Presidio Trust land. This would remove the need to build new outfalls and would make the permitting process significantly more straightforward.

If sites cannot be found for attenuation basins, the next best option is connecting to the SFPUC outfall. This is only likely to be suitable for the flow on the eastern half of the site. This depends on agreement being reached with the SFPUC following technical proof of the feasibility of this option.

If neither of the above options prove practical, it is likely that the construction of new outfalls dedicated to Doyle Drive runoff would be the preferred option. Although this would be the most disruptive option with trenching required and complex permitting requirements, the new system could be designed specifically for the needs of the project, unlike any of the existing infrastructure options.

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