Attachment 8 – Benefits and Cost Analysis

Attachment 8 is mandatory. This attachment allows applicants to claim monetized and non-monetized benefits based on the physical benefit descriptions as documented in Attachment 7. Describe and quantify the benefits and costs of each project (if there are multiple projects) in the proposal. The content provided in this attachment will be evaluated in a collective manner to see how all project benefits (combined) compare against the costs of all projects in the proposal. There is no page limitation for Attachment 8; however, applicants are encouraged to be specific, clear, and concise.

See Exhibit D for detailed guidance (termed as DWR Method of Analysis) on the preparation of this attachment. Alternatively, applicants can submit benefit analysis performed according to alternative analysis methodologies (RWMG Method) in lieu of DWR Method. Whether the applicant chooses to use DWR Method or the RWMG Method, the analysis will be evaluated and scored using same scoring criterion.

Primary benefit of a project(s) applying for SWFM Grant funds must be flood damage reduction (FDR).

DWR Method
All applicants must complete the Section D1 benefit analysis option. For additional benefits, applicants may complete Section D2 or D3 benefit analysis option, whichever is appropriate for the type of project or benefit(s) type being claimed. A process is provided in Figure 1 to guide applicants in selecting analysis methods.

All projects must yield multiple benefits to be eligible for grant funding. When analyzing each benefit of a project, applicants may complete the project benefit analysis option(s) that is appropriate for each type of project or benefit being claimed. Three benefit analysis options are available for a project. Following is a brief description of these options. More detail is provided in Exhibit D.

> ***Section D1 - Flood Damage Reduction Benefit Analysis****. All SWFM projects must provide FDR benefits, meaning all applicants must complete a "Flood Damage Reduction Benefit Analysis". This analysis includes a determination of the expected annual damages with and without the project to be completed.*
> ***Section D2 - Non-Monetized Benefit Analysis****. For projects with secondary benefits that cannot be monetized, a Non-Monetized Benefit Analysis should be completed. This analysis requires a description (where possible) of applicable social, environmental stewardship, and sustainability benefits that may result from the implementation of a project.*
> ***Section D3 - Monetized Benefits Analysis****. For projects with secondary benefits that can be quantified in dollar terms, it is recommended that a Monetized Benefits Evaluation be completed.*

RWMG Method
Applicants may choose to submit a Benefits and Cost Analysis (i.e., Attachment 8) using a comparable analysis method in lieu of preparing an analysis based on the guidance provided in Exhibit D. While performing the benefit analysis using alternative methods, applicants should read Exhibit D and the guidance presented in DWR Economic Analysis Guidelines (January 2008) which can be found at the following link: http://www.water.ca.gov/economics/guidance.cfm.

> ***Section D4 – Proposal Costs and Benefits Summary.*** *Annual costs (Table 16) must be provided for each individual project; and a benefits and costs summary (Table 17) must be presented for the entire proposal, regardless of benefit analysis method or options used.*

The East Palo Alto Runnymede Storm Drain Phase II and O'Connor Pump Station Outfall Project

Project Description and Summary

Documented flooding within the City of East Palo Alto (City) has been occurring since the 1940s with the most damage occurring when heavy rainfall results in overtopping of San Francisquito Creek

levees. The City is at the flattest, most downstream end of the 47 square mile (30,100 acre) San Francisquito Creek watershed, and even relatively frequent rainfall events can cause localized flooding especially when they coincide with high tide events.

The Runnymede Storm Drain System, during low tides, discharges water to marshes that lead to the Bay through two, 48-inch diameter TideFlex backflow valves that are connected to a box culvert at the terminus of the system. During higher tides, the discharge capacity of the TideFlex valves decreases until it can discharge only minimal amounts of stormwater. At this point stormwater is diverted through a bypass structure to a conveyance channel (South Channel) that conveys stormwater to a detention pond where the O'Connor Pump Station pumps the water to be discharged into San Francisquito Creek. The South Channel was under the jurisdiction of San Mateo County until 2005 and it had not been adequately maintained for a number of years, which resulted in sediment accumulation and decreased stormwater conveyance capacity. In addition, there is no berm on the west side of the South Channel which allows high flows to pond in the low lying neighborhoods. During a storm event in which there is also a high tide, the stormwater cannot adequately be conveyed and localized flooding occurs in the low-lying neighborhoods near the Runnymede outfall structure and the conveyance channel and detention pond. The City currently operates and maintains the South Channel and seeks to implement improvements to the benefit of its citizens.

The Runnymede Phase II Project will increase the conveyance capacity of the South Channel and detention pond by excavating/dredging accumulated sediments and then using the excavated spoils to construct a formal flood control berm to the west of the South Channel and the pond. The berm will add further protection to the neighborhoods from flooding by creating an engineered channel for the Runnymede system flows rather than allowing them to enter the neighborhoods. This newly constructed berm will also contain a path for recreational users, and areas that are affected by construction will be restored to salt marsh wetland to the largest extent practicable. This project will also result in wetland mitigation in another area of the South Bay.

Ultimately, the Runnymede Phase II Project will result in Flood Damage Reduction because of the increased capacity of the local system to discharge stormwater. In recent years he San Francisquito Creek Joint Powers Authority (SFCJPA) has raised the height of the levees of San Francisquito Creek where overtopping of regional flood water has occurred. Other projects by the SFCJPA to further minimize flood risk to the City are in the planning stages. This Runnymede Phase II Project, in conjunction with SFCJPA's regional efforts, will further reduce the chance of localized flooding which has plagued the disadvantaged community for years.

A summary of all benefits and costs of the project is provided in Table 1. Flood control benefits are discussed in the remainder of this attachment.

Table 1: Benefit-Cost Analysis Overview

	Present Value
Costs – Total Capital and Operations and Maintenance	$1,500,067,65
D1 Flood Damage Reduction Benefits	
Flood Damage Reduction Benefits	
Avoided damage	$3,693,894.08
Total Monetizable Benefits	$3,693,894.08
Benefit to Cost Ratio	2.46
D2 Non-monetized Benefit	**Qualitative Indicator***
Community/Social Benefits	
Provide Social recreation or access benefits	+
Promote social health and safety	+
Increase local property values	++
Environmental Stewardship Benefits	
Benefit wildlife or habitat in ways that were not quantified in Att 7	+
Sustainability Benefits	
Provide a long-term solution in place of a short-term one	+
Protect existing road infrastructure and pump station outfall	+

Notes:

* Direction and magnitude of effect on net benefits:

+ = Likely to increase net benefits relative to quantified estimates.
++ = Likely to increase net benefits significantly.
– = Likely to decrease benefits.
– – = Likely to decrease net benefits significantly.
U = Uncertain, could be + or –.

The "Without Project" Baseline

Without the project, the Runnymede Storm Drain System would continue to cause flooding in the adjacent neighborhoods when storm events occur concurrently with high tide events. Flooding has been documented in East Palo Alto from different sized storm events in recent history. In November and December of 2012 and in December of 2010, 2-year storm events that occurred at the same time as a high tide caused nuisance flooding in the surrounding neighborhoods. The streets flooded due to the inability of the local storm drains to collect and convey water as intended because a lack of conveyance capacity in the South Channel. From these events, it was evident that a conveyance problem exists, and further analysis was needed to quantify the extent of flooding due to larger storm events.

On February 3, 1998, a 45 to 50-year storm event occurred which caused severe flooding in East Palo Alto, so much so that the area was named a disaster area by the Governor of California. This storm event caused overtopping of levees along San Francisquito Creek in addition to flooding caused by the back-up of the Runnymede Storm Drain System. Because this flood event resulted from both sources, the levee overtopping and the inadequate conveyance capacity of the Runnymede Storm

Drain System, the two sources were not evaluated independently by local flood management authorities.

In order to obtain flood data for the "without project" baseline, a technical analysis, described in detail in Attachment 7, was conducted using available information provided by the City of East Palo Alto, their consultants, and 2006 GIS topography data obtained from a digital terrain model (DTM) performed for Santa Clara County by Optimal Geomatics, Incorporated. National Oceanic and Atmospheric Administration (NOAA) tide and current charts were also used to obtain relative high tide information. Wilsey-Ham, a consultant to the City of East Palo Alto had previously sent correspondence (letters and emails) in 2009 to City Staff describing the Runnymede Storm Drain Systems deficiencies in preparation for design of this project. This included flow estimates for the terminal point of the Runnymede Storm Drain system for 10-year, 25-year, and 100-year storm events. The corresponding flow rates provided were 229 cubic-feet per second (cfs), 277 cfs, and 342 cfs. To analyze the 50-year storm event, a logarithmic best fit line was applied to this set of data which yielded an estimated flow of 309 cfs.

Wilsey-Ham also provided the discharge flow rate of the high tide inundated TideFlex discharge valves (10 cfs) and the current capacity of the conveyance channel (60 cfs) that were used in flood volume calculations for a 5-hour duration. The 5-hour duration of flow was used since high tide cycles that result in the decreased discharge flow rate of the TideFlex valves are of about 5-hour duration. Limited outflow through the TideFlex valves results in the decreased conveyance capacity of the channel which causes the localized flooding. As described in Attachment 7, the flow rates from the different interval frequency storm events were used to calculate volumes of flood water, and the GIS topographic information were used to estimate the areas of inundation and flood water depths for the storm events as summarized in Table 2 below. The Flood Rapid Assessment Model (FRAM) was used to estimate the Expected Event Damage as described in D1 below.

Table 2: Flood Events Analyzed

Flood Event	Flow Rate-Q (cfs)	Flood Water Volume (ft^3)	Inundation Contour (ft)	Inundation Area (ft^2)	Average Flood Water Depth (ft)	Houses Damaged	Expected Event Damage
2-year	151	2,358,000	5	278,478	1	0	0
10-year	229	2,862,000	6	1,778,838	1.5	93	$953,292
25-year	277	3,726,000,	7.3	2,208,013	1.8	131	$1,342,809
50-year	309	4,302,000	7.5	2,494,013	2.0	156	$1,470,940

D1: Flood Damage Reduction Benefits Analysis

Flood control benefits include avoided flood damage to residential properties in East Palo Alto. This includes residential structural damage, content damages, external damages to gardens/outdoor areas, and cleanup costs. Avoided flood damage has been monetized using the Flood Rapid Assessment Model (FRAM); input and output files are provided as Exhibit 8-1. As stated in the FRAM User Manual, the present value of the total project being evaluated, a value of $1,500,067, was entered into the

model. The present value was obtained from the present value analysis in the Proposal Solicitation Package (PSP) Table 16 as presented in Table 7. In order to obtain the estimated residential damages from the FRAM model, the project was evaluated at a 6% discount rate with a project life of 25 years.

Other input data included in the FRAM model was obtained through the technical analysis, described in Attachment 7,that was performed using storm event runoff flows for the Runnymede Storm Drain System as provided by Wilsey-Ham. The flood water volumes were then calculated, and the results were used in conjunction with area and volume data from GIS. A contour map was created and overlaid on an aerial photograph as found in Figure 7-2 of Attachment 7from which the number of houses within elevation contours could be counted. Based on observation, houses were mostly of the "urban, single-story with no basement" category which was used as the input for the FRAM. The construction costs for the home on which damages were estimated was the default cost of $302,100 which is similar for the East Palo Alto homes. As these are mostly older homes built in the 1960s, a conservative ratio of 10% was selected for depreciation value to replacement input. Those inputs include the results of a modeling analysis to determine flood damages for a 2-, 10-, 25-, and 50-year flood with and without the project for existing residential properties, both for structural and contents damages.

The FRAM provided output of both actual and potential residential damage values. The actual values were used in the flood reduction damage analysis included in PSP Table 11 because they account for some uncertainties such as warning time and flood experience. The "actual" estimated damages for the 10-, 25-, and 50-year storm events were estimated by FRAM to be $953,292, $1,342,809, and $1,599,070 respectively.

After obtaining these FRAM residential estimated damages that would occur from a "without project" scenario, PSP Table 11 was used to calculate Expected Annual Damages for the "with project" and "without project" scenarios. This table used the probability of flooding due to lack of facility, the expected event damages in each case, and the interval probabilities to arrive at the expected annual damages of $288,960.22 per year for the "without project" case, and $0.00 per year for the "with project" case. Since completion of the Runnymede Storm Drain Phase II and O'Connor Pump Station project would yield a conveyance system which is able to accommodate a 100-year storm event runoff, the "with project" scenario is likely to produce no expected damages to residential properties.

With a 25-year project life and a 6% discount rate considered, the total present value of the project benefits is estimated by PSP Table 17 to be $3,693,894. With a total present value of the project estimated to be $1,500,067, it can be concluded that the benefit to cost ratio of the project is 2.46.

Avoided Physical Damage

<u>FRAM Structural Damages, Content Damages, External Costs, and Cleanup Cost Estimates</u>

To arrive at the estimated event damages in the FRAM model above, the model took into account separate residential damages such as structural damages, content damages, external/outdoor damages, and cleanup costs to arrive at the total residential damages for the particular storm events. These components of the total damages can be seen in Table 3 below:

Table 3: FRAM Estimated Actual Residential Component Damages

Storm Event	Estimated Structural Damages	Estimated Content Damages	Estimated External Damages	Estimated Cleanup Costs	Total Estimated Residential Damages
2-year	$0	$0	$0	$0	$0
10-year	$367,477	$227,572	$93,000	$279,000	$953,942
25-year	$530,306	$320,558	$131,000	$393,000	$1,342,809
50-year	$631,510	$381,734	$156,000	$468,000	$1,599,070

Table 4 (PSP Table 11) that follows provides the Calculation of Expected Annual Damage Benefits based on the 4 hydrologic events analyzed and the damages with and without the project for those events. The expected annual damages without the project is estimated to be $288,960 while there is expected to be no damage with the project.

Table 5 (PSP Table 12) that follows provides the Present Value of Expected Annual Damage Benefits which is based on a present value coefficient of 12.7834 for a 6% discount rate over the 25-year analysis period. The present value of the future benefits is estimated to be $3,693,894.

Table 4 – Calculation of Expected Annual Damage for Runnymede Storm Drain Phase II and O'Connor Pump Station Outfall Project											
Hydrologic Event	Event Exceedance Probability	Event Damage from Lack of Facility	Probability Floding Damage from Lack of Facility		Expected Event Damage		Interval Probability	Average Damage in Interval		Average Damage in Interval times Interval Probability	
			Without Project	With Project	Without Project	With Project		Without Project	With Project	Without Project	With Project
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(i)	(j)	(k)	(l)	(m)
					(c) x (d)	(c) x (e)	from (b)	from (f)	from (g)	(i) x (j)	(i) x (k)
2-year	0.5	$0	1	0	$0	$0					
10-Year	0.1	$953,292	1	0	$953,292	$0	0.4	$476,646	$0	$190,658.40	$0
25-Year	0.04	$1,342,809	1	0	$1,342,809	$0	0.06	$1,148,051	$0	$68,883.03	$0
50-Year	0.02	$1,599,070	1	0	$1,599,070	$0	0.02	$1,470,940	$0	$29,418.79	$0
Expected Annual Damages, Without and With Project										$288,960.22	$0.00

Table 5 – Present Value of Expected Annual Damage Benefits Project: __Runnymede Storm Drain Phase II and O'Connor Pump Station Outfall Project_____			
(a)	Expected Annual Damage Without Project [1]		**$288,960.22**
(b)	Expected Annual Damage With Project [1]		**$0.00**
(c)	Expected Annual Benefit	(a) – (b)	**$288,960.22**
(d)	Present Value Coefficient [2]		**12.7834**
(e)	**Present Value of Future Benefits** **Transfer to Table 17, column (d).**	**(c) x (d)**	**$3,693,894.08**

(1) This program assumes no land use changes in the floodplain. So, EAD will be constant over analysis period.

(2) 6% discount rate; 25-year analysis period .

D2: Non-Monetized Benefits Analysis

As summarized in Table 1, non-monetized benefits for the Runnymede Storm Drain Phase II and O'Connor Pump Station include providing social and recreation access benefits, promoting social health and safety, benefits to wildlife or habitat, and providing a long-term solution as opposed to a short-term solution. In addition, this project and the related regional project implemented by the SFCJPA will likely result in increasing property values, particularly in this low-lying neighborhood by reducing the flood risk. Another benefit of reducing street flooding is protection of the road infrastructure and extending the longevity of the pavement and road base. Frequent saturation of roads can result in more rapid deterioration of the asphalt and underlying road base which can be costly to the City and its citizens.

Table 6 (PSP Table 13) shows the applicable non-monetized benefits. These benefits have been described in Attachments 3 and 7. Another non-monetized benefit that is described in the Work Plan (Attachment 3) is the repair of the O'Connor Pump Station Outfall. This repair will allow stormwater to discharge properly to San Francisquito Creek without further undermining the structure, and it will also protect the structure from scouring due to creek flows.

Table 6 – Non-monetized Benefits Checklist		
No.	Question	Enter "Yes", "No" or "Neg"
	Community/Social Benefits **Will the proposal**	
1	**Provide education or technology benefits?**	**No**
	Examples are not limited to, but may include: - Include educational features that should result in water supply, water quality, or flood damage reduction benefits? - Develop, test or document a new technology for water supply, water quality, or flood damage reduction management? - Provide some other education or technological benefit?	
2	**Provide social recreation or access benefits?**	Yes
	Examples are not limited to, but may include: - Provide new or improved outdoor recreation opportunities? - Provide more access to open space? - Provide some other recreation or public access benefit?	
3	**Help avoid, reduce or resolve various public water resources conflicts?**	**No**
	Examples are not limited to, but may include: - Provide more opportunities for public involvement in water management? - Help avoid or resolve an existing conflict as evidenced by recurring fines or litigation? - Help meet an existing state mandate (e.g., water quality, water conservation, flood control)?	
4	**Promote social health and safety?**	Yes
	Examples are not limited to, but may include: - Increase urban water supply reliability for fire-fighting and critical services following seismic events? - Reduce risk to life from dam failure or flooding? - Reduce exposure to water-related hazards?	
5	**Have other social benefits?**	No
	Examples are not limited to, but may include: - Redress or increase inequitable distribution of environmental burdens? - Have disproportionate beneficial or adverse effects on disadvantaged communities, Native Americans, or other distinct cultural groups?	
	Environmental Stewardship Benefits: **Will the proposal**	
6	**Benefit wildlife or habitat in ways that were not quantified in Attachment 7?**	Yes
	Examples are not limited to, but may include: - Cause an increase in the amount or quality of terrestrial, aquatic, riparian or wetland habitat? - Contribute to an existing biological opinion or recovery plan for a listed special status species? - Preserve or restore designated critical habitat of a listed species? - Enhance wildlife protection or habitat?	
7	**Improve water quality in ways that were not quantified in Attachment 7?**	No
	Examples are not limited to, but may include: - Cause an improvement in water quality in an impaired water body or sensitive habitat? - Prevent water quality degradation? - Cause some other improvement in water quality?	
8	**Reduce net emissions in ways that were not quantified in Attachment 7?**	No
	Examples are not limited to, but may include: - Reduce net production of greenhouse gasses? - Reduce net emissions of other harmful chemicals into the air or water?	
9	**Provide other environmental stewardship benefits, other than those claimed in Sections D1, D3 or D4?**	No
	Sustainability Benefits: **Will the proposal**	
10	**Improve the overall, long-term management of California groundwater resources?**	No
	Examples are not limited to, but may include: - Reduce extraction of non-renewable groundwater? - Promote aquifer storage or recharge?	
11	**Reduce demand for net diversions for the regions from the Delta?**	No
12	**Provide a long-term solution in place of a short-term one?**	Yes
	Examples are not limited to, but may include: - Replace a temporary water supply with a more permanent supply? - Replace a temporary water quality solution with a more permanent solution? - Replace temporary flood control management with a more permanent solution? - Replace temporary habitat with a more permanent solution?	
13	**Reduce water consumption on a permanent basis?**	No
14	**Promote energy savings or replace fossil fuel based energy sources with renewable energy and resources?**	No
	Examples are not limited to, but may include: - Reduce net energy use on a permanent basis? - Increase renewable energy production? - Include new buildings or modify buildings to include certified LEED features? - Provide a net increase in recycling or reuse of materials? - Replace unsustainable land or water management practices with recognized sustainable practices?	
15	**Improve water supply reliability in ways not quantified in Attachment 7?**	No
	Examples are not limited to, but may include: - Provide a more flexible mix of water sources? - Reduce likelihood of catastrophic supply outages? - Reduce supply uncertainty? - Reduce supply variability?	
16	**Other (If the above listed categories do not apply, provide non-monetized benefit description)?**	

D3: Monetized Benefit Analysis

No monetized benefit analysis was conducted for this project and therefore annual Benefit (Table 14 from PSP) and Annual Cost of Avoided Projects (Table 15 from PSP) are not included.

D4: Project Benefits and Cost Summary

Project costs are documented in detail in the Budget, Attachment 4 of this Prop 1E Grant Proposal. Costs include direct project administration costs, land purchase easement, planning/design/engineering/environmental documentation, construction/implementation, environmental compliance/mitigation/enhancement, construction administration, others costs, and construction/implementation contingency. The grand total of these separate task costs for project development is $1,527,508. These costs were distributed based on a 4-year schedule for design, permitting, environmental documentation, and construction whereby 75% of the cost is incurred during years 2 and 3 and 25% occurs in years 1 and 4. Construction scheduling is limited for this project to the dry season and/or by biological constraints. Operations and Maintenance for this project are expected to be $5,000/year each for activities such as inspections and cleaning of trash and trash racks from the channel. The present value of discounted costs, including operations and maintenance, is $1,500,067.65, as presented in Table 7 (PSP Table 16) that follows.

With the total present value of benefits equaling $3,693,894.08 as derived from Table 5 (PSP Table 12), there is a benefit cost ratio of 2.46. This shows that the benefits that can be obtained from implementing this project will exceed the estimated cost. The Proposal Benefits and Cost Summary is presented in Table 8 (PSP Table 17).

References

BKF, 2003, Draft Storm Drainage Master Plan.

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Department of Water Resources, Division of Flood Management, November 2008, Flood Rapid Assessment Model Development and User Manual.

NHC, 2004, San Francisquito Creek Bank Stabilization and Revegetation Demonstration Report, Flow Frequency Curve

NOAA Tides and Currents
http://tidesandcurrents.noaa.gov/get_predictions.shtml?year=2006&stn=1813+San+Francisco&secstn=Dumbarton+Highway+Bridge&thh=%2b0&thm=50&tlh=%2b1&tlm=15&hh=*1.51&hl=*1.05

Optimal Geomatics, Inc., April-May 2006, LiDAR Topographic data files,

U.S. Geological Survey Stream Gauge Data
http://nwis.waterdata.usgs.gov/ca/nwis/uv/?site_no=11164500&agency_cd=USGS

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Table 7 – Annual Costs of Project (All costs should be in 2012 Dollars) Project: _Runnymede Storm Drain Phase II and O'Connor Pump Station Outfall Project___										
	Initial Costs Grand Total Cost from Table 6 (row (i), column (d))	Adjusted Grant Total Cost[1]	Annual Costs [2]						Discounting Calculations	
			Admin	Operation	Maintenance	Replacement	Other	Total Costs (a) +…+ (g)	Discount Factor	Discounted Project Costs (h) x (i)
Year	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
2012	$190,938							$190,938	1.000	**$190,938.00**
2013	$572,816							$572,816	0.943	**$540,165.49**
2014	$572,816							$572,816	0.890	**$509,806.24**
2015	$190,938							$190,938	0.840	**$160,387.92**
2016	$0			$5,000	$5,000			$10,000	0.792	**$7,920.00**
2017	$0			$5,000	$5,000			$10,000	0.747	**$7,470.00**
2018	$0			$5,000	$5,000			$10,000	0.705	**$7,050.00**
2019	$0			$5,000	$5,000			$10,000	0.665	**$6,650.00**
2020	$0			$5,000	$5,000			$10,000	0.627	**$6,270.00**
2021	$0			$5,000	$5,000			$10,000	0.592	**$5,920.00**
2022	$0			$5,000	$5,000			$10,000	0.558	**$5,580.00**
2023	$0			$5,000	$5,000			$10,000	0.527	**$5,270.00**
2024	$0			$5,000	$5,000			$10,000	0.497	**$4,970.00**
2025	$0			$5,000	$5,000			$10,000	0.469	**$4,690.00**
2026	$0			$5,000	$5,000			$10,000	0.442	**$4,420.00**
2027	$0			$5,000	$5,000			$10,000	0.417	**$4,170.00**
2028	$0			$5,000	$5,000			$10,000	0.394	**$3,940.00**
2029	$0			$5,000	$5,000			$10,000	0.371	**$3,710.00**
2030	$0			$5,000	$5,000			$10,000	0.350	**$3,500.00**
2031	$0			$5,000	$5,000			$10,000	0.331	**$3,310.00**
2032	$0			$5,000	$5,000			$10,000	0.312	**$3,120.00**
2033	$0			$5,000	$5,000			$10,000	0.294	**$2,940.00**
2034	$0			$5,000	$5,000			$10,000	0.278	**$2,780.00**
2035	$0			$5,000	$5,000			$10,000	0.262	**$2,620.00**
2036 (Last Year of	$0			$5,000	$5,000			$10,000	0.247	**$2,470.00**
Total Present Value of Discounted Costs (Sum of Column (j)) Transfer to Table 17, column (c), Proposal Benefits and Costs Summaries										**$1,500,067.65**
Comments:										

(1) If any, based on opportunity costs, sunk costs and associated costs

(2) The incremental change in O&M costs attributable to the project

Table 8 – Proposal Benefits and Costs Summary						
Proposal: _City of East Palo Alto Proposition 1E IRWM Stormwater Flood Management Grant Application__						
Agency: __City of East Palo Alto___						
Project	Project Proponent	Total Present Value Project Costs (1)	Total Present Value Project Benefits			From Section D2 – Briefly describe the main Non-monetized benefits
			From Section D2 – Flood Damage Reduction (2)	From Section D3 – Monetized (3)	Total	
(a)	(b)	(c)	(d)	(e)	(f) = (d) + (e)	(g)
Runnymede Storm Drain Phase II & O'Connor Pump Station Outfall Project	**Increasing Conveyance Channel Capacity and construction of a flood control berm and repair of the O'Connor Pump Station Outfall**	$1,500,067.65	$3,693,894.08	0	$3,693,894.08	**Non-monetized benefits include increased recreation and public access by constructing a new path on the flood control berm, additional wetlands restoration from an environmental mitigation credit, repairing the O'Connor Pump Station outfall to operate as designed, and utilizing a long-term solution over a short-term solution.**

(1) From Table 7 or RWMG method
(2) From Table 5 or RWMG method
(3) Not Used- from PSP Table 14 or RWMG method

EXHIBIT 8-1: FRAM INPUT AND OUTPUTS

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Model Assumptions

Residential

Foundation heights

Structure Category	Foundation Height (ft)
Rural - Res: Homesteads	1.5
Rural - Other: Barns, sheds	0
Urban Res: Single story (no base)	1.1
Urban Res: Two plus story (no base)	1.1
Mobile home	2.0
Commercial: Low	1
Commercial: Medium	1
Commercial: High	1
Industrial: Low	0.5
Industrial: Medium	0.5
Industrial: High	0.5

Estimate Replacement Value (assumed proxy for depreciated value)

Structure Category	Unit Cost $/ft^2 (2)	Average Size ft^2 (1)	Construction Cost
Rural - Res: Homesteads	159	1900	302100
Rural - Other: Barns, sheds	98	4000	392000
Urban Res: Single story (no base)	159	1900	302100
Urban Res: Two plus story (no base)	155	2200	341000
Mobile home (3)	98	1180	115640
Commercial: Low	120		0
Commercial: Medium	142		0
Commercial: High	207		0
Industrial: Low	120		0
Industrial: Medium	142		0
Industrial: High	207		0

1. Residential Square Footage Source: Sacramento County Tax Assessor Unit Cost and Commercial/Industrial/Public Square Footage Assumptions Source: Saylor Publications, Inc, 2007 Current Construction Costs

2. Replacement unit cost per square foot reflects average costs in the San Franc

3. According to FEMA guidance, replacement costs per square foot for mobile homes and barns and outbuildings are similar.

Other

External damages garden/outdoor areas $/building	$	1,000
Cleanup $/building	$	3,000
Number of residents per residential property		4

Commercial / Industrial Buildings

Clean-up costs as a percentage of direct structural damages	30%

Calculation of Other Direct Damages

Percentage of residential direct damages applied as indirect:	25%
Percentage of comm/ind. direct damages applied as indirect:	25%
HEC-FIA only: Percentage all building direct damages applied as indirect	25%
Percentage of roads direct damages applied as indirect:	25%

NPV Calculation

Discount Rate	6%
Time Horizon	25 years

Roads

Cost per mile of highway road inundated	$	250,000
Cost per mile of major road inundated	$	100,000
Cost per mile of minor road inundated	$	30,000
Cost per mile of unsealed road inundated	$	10,000

Agricultural Damages

	Weighted, Average Annual Damages ($/acre)	Establishment Costs ($/acre)	Land Cleanup & rehabilitation ($/acre)	Total <5 d) ($/acre)	Total (>=5 d) ($/acre)
Corn	$48	$0	$246	$293	$293
Rice	$227	$0	$243	$471	$471
Walnuts	$585	$5,284	$243	$828	$6,112
Almonds	$1,618	$3,514	$243	$1,862	$5,376
Cotton	$301	$0	$246	$547	$547
Tomatoes	$1,015	$0	$235	$1,250	$1,250
Wine Grapes	$3,241	$3,240	$235	$3,476	$6,716
Alfalfa	$250	$246	$243	$493	$739
Pasture	($15)	$82	$272	$257	$339
Safflower	$164	$0	$241	$405	$405
Sugar Beets	$313	$0	$262	$575	$575
Beans	$111	$0	$246	$356	$356
Other	$0	0	$246	$246	$246

Source: Comp Study

Establishment Costs are 50% costs of total establishment costs

Calculation of Actual to Potential Damages Ratio

		Without Project						With Project					
		Event 1	Event 2	Event 3	Event 4	Event	Event 6	Event	Event 2	Event 3	Event 4	Event 5	Event 6
Warning Time:	hours	0	0	0	0	0	0	0	0	0	0	0	0
Recent Flood Expe	Y / N	N	N	N	N	N	0	N	N	N	N	N	0
Actual : Potential Ratio		0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9

Warning Time	Experienced Community	Inexperienced Community
< 2 hours	0.8	0.9
2-12 hours	Linear reduction from 0.8 at 2 hours to 0.4 at 12 hours	0.8
>12 hours	0.4	0.7

Inputs

Return to Menu

Project Name: Runnymede Storm Drain Phase II and O'Connor Pump Station Outfall Project

Cost of Project: $ 1,500,067

Description:

Number of Events Modeled: 4

	Without Project						With Project					
	Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 1	Event 2	Event 3	Event 4	Event 5	Event 6
Average Return Interval (ARI)	2	10	25	50			2	10	25	50		
Annual Probability of Exceedance	0.500	0.100	0.040	0.020	#DIV/0!	#DIV/0!	0.500	0.100	0.040	0.020	#DIV/0!	#DIV/0!
Probability of Levee Failure	1.00	1.00	1.00	1.00			1.00	1.00	1.00	1.00		
Water Surface Elevation - channel (f)	0.00	0.00	0.00	0.00								
Flood Warning Time (hours)	0	0	0	0	0		0	0	0	0	0	
Flood Experience	N	N	N	N	N		N	N	N	N	N	
Period of Inundation (days)	0.25	0.25	0.25	0.25								
HEC-FIA DATA INPUTS	N											
Residential Structural Damages ($)												
Residential Contents Damages ($)												
Residential Debris & Cleanup ($)												
Commercial Structural Damages ($)												
Commercial Contents Damages ($)												
Commercial Debris & Cleanup ($)												
Industrial Structural Damages ($)												
Industrial Contents Damages ($)												
Industrial Debris & Cleanup ($)												
Agricultural Structural Damages ($)												
Agricultural Contents Damages ($)												
Agricultural Debris & Cleanup ($)												
Residential Properties												
Ratio Depreciated Value to Replacement Value	10%	10%	10%	10%			10%	10%	10%	10%		
Average Flood depth above ground level (f)	1.00	1.50	1.80	2.00			0.00	0.00	0.00	0.00		
Rural - Res: Homesteads												
Rural - Other: Barns, sheds												
Urban Res: Single story (no base)	0	93	131	156			0	0	0	0		
Urban Res: Single story (basement)												
Urban Res: Two plus story (no base)												
Urban Res: Two plus story (basement)												
Mobile home												
Commercial Properties												
Ratio Depreciated Value to Replacement Value												
Average Flood depth above ground level (f)												
low value building area inundated (sq.f.)												
medium value building area inundated (sq.f.)												
high value building area inundated (sq.f.)												
Industrial Properties												
Ratio Depreciated Value to Replacement Value												
Average Flood depth above ground level (f)												
low value building area inundated (sq.f.)												
medium value building area inundated (sq.f.)												
high value building area inundated (sq.f.)												
Agricultural Production												
Corn ac.												
Rice ac.												
Walnuts ac.												
Almonds ac.												
Cotton ac.												
Tomatoes ac.												
Wine Grapes ac.												
Alfalfa ac.												
Pasture ac.												
Safflower ac.												
Sugar Beets ac.												
Beans ac.												
Other ac.												
Roads												
length of arterial roads inundated (miles)												
length of major roads inundated (miles)												
length of minor roads inundated (miles)												
length of unsealed roads inundated (miles)												

Extrapolate Y-intercept: N

Attachment 8, Exhibit 8-1

Residential Buildings

	Without Project						With Project					
	Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 1	Event 2	Event 3	Event 4	Event 5	Event 6
ARI:	2	10	25	50	0	0	2	10	25	50	0	0
Probability of Levee Failure	1.00	1.00	1.00	1.00	0.00	0.00	1.00	1.00	1.00	1.00	0.00	0.00
Flood depth above ground level (ft)	1.00	1.50	1.80	2.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Buildings Inundated (no.)												
Rural - Res: Homesteads	0	0	0	0	0	0	0	0	0	0	0	0
Rural - Other: Barns, sheds	0	0	0	0	0	0	0	0	0	0	0	0
Urban Res: Single story (no base)	0	93	131	156	0	0	0	0	0	0	0	0
Urban Res: Two plus story (no base)	0	0	0	0	0	0	0	0	0	0	0	0
Mobile home	0	0	0	0	0	0	0	0	0	0	0	0
Structural Damages												
Rural - Res: Homesteads	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Rural - Other: Barns, sheds	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Urban Res: Single story (no base)	$ -	$ 376,477	$ 530,306	$ 631,510	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Urban Res: Two plus story (no base)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Mobile home	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Structual Damages HEC-FIA	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Total Structural Damages	$ -	$ 376,477	$ 530,306	$ 631,510	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Content Damages												
Rural - Res: Homesteads	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Rural - Other: Barns, sheds	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Urban Res: Single story (no base)	$ -	$ 227,572	$ 320,558	$ 381,734	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Urban Res: Two plus story (no base)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Mobile home	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Contents Damage HEC-FIA	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Actual:Potential Ratio	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
Total Contents Damages: Actual	$ -	$ 204,815	$ 288,502	$ 343,560	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Total Contents Damages: Potential	$ -	$ 227,572	$ 320,558	$ 381,734	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Clean-Up/ Other Costs												
External	$ -	$ 93,000	$ 131,000	$ 156,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Cleanup	$ -	$ 279,000	$ 393,000	$ 468,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Other Costs HEC-FIA	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Total Other Costs: Potential	$ -	$ 372,000	$ 524,000	$ 624,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Sum Actual Damages	**$ -**	**$ 953,292**	**$ 1,342,809**	**$ 1,599,070**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**
Sum Potential Damages	**$ -**	**$ 976,049**	**$ 1,374,865**	**$ 1,637,243**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**
Total Actual Damage with levee failure ($):	**$ -**	**$ 953,292**	**$ 1,342,809**	**$ 1,599,070**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**
Total Potential Damage with levee failure ($):	**$ -**	**$ 976,049**	**$ 1,374,865**	**$ 1,637,243**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**
Indirect Actual Damage	$ -	$ 238,323	$ 335,702	$ 399,768	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Indirect Potential Damage	$ -	$ 244,012	$ 343,716	$ 409,311	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -

Summary of Cost-Benefit Analysis

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Project Name: **Runnymede Storm Drain Phase II and O'Connor Pump Station Outfall Project**

Description: 0

Proposed project capital cost:	$ 1,500,067	[Note: construction costs which are assumed to occur in one year.]
Change in annual O&M costs:	$ 10,000	[Note: the change in annual O&M costs compared to without project condit
PV of future O&M costs:	$ 127,834	(at 6% discount rate over 25 years)
PV of future costs	$ 1,627,901	[Note: the sum of capital costs plus the PV of O&M costs.]

Benefits

	Actual	Potential	
EAD without project	$ 401,177	$ 410,754	[Note: for stormwater projects use "Potential" damage which ignores st
EAD with project	$ -	$ -	
Annual Benefit:	$ 401,177	$ 410,754	
PV of Future Benefits:	$ 5,128,388	$ 5,250,814	(at 6% discount rate over 25 years)

Cost-Benefit Analysis

	Actual	Potential	
Net Present Value (NPV)	$ 3,500,487	$ 3,622,913	(at 6% discount rate over 25 years)
Benefit:Cost Ratio	3.150	3.226	

NPV Sensitivity to Discount Rate:

	Actual	Potential
4%	$ 4,767,151	$ 4,916,764
5%	$ 4,154,099	$ 4,289,076
6%	$ 3,628,321	$ 3,750,747
7%	$ 3,175,082	$ 3,286,688
8%	$ 2,782,407	$ 2,884,639