Appendix F
Detailed Alternative Design Discussion

APPENDIX F – STORM DRAIN DESIGN ALIGNMENT ALTERNATIVES

The aerial topographic survey specifically obtained for this study was used to layout out and analyze several alternate storm drain design alignments. The alternative alignments were narrowed down to two (2) primary storm drain alignments, each with a "sub-option" extension to the Upper San Ramon Canyon, as well as a low-cost possible alternative, and a "no cost" or do nothing alternative. This resulted in a **total of six (6) alternatives (1A, 1B, 2A, 2B, 3 & 4)** being considered for the San Ramon Canyon Drainage Study (**see Appendix F**). Following is a discussion of each alternative alignment along with a summary of all the associated issues affecting the alternative, including pros and cons that will help determine the preferred solution for the San Ramon Canyon Drainage System.

A. Alternative 1A – Mid-canyon inlet with "tunnel alignment" that outlets to the bluffs

Alternative 1A consists of a mid-canyon inlet with 54-inch HDPE pipe in a "tunnel alignment" that outlets to the bluffs. The entire length of this storm drain alignment falls within the City of Rancho Palos Verdes (RPV) allowing RPV sole jurisdiction. The upstream terminus is a proposed inlet structure in the "middle" of San Ramon Canyon at a location that was strategically chosen to intercept flood waters above the Tarapaca Landslide. At this location bedrock "daylights" in the existing canyon bottom and side walls (**see Photos F1 & F2: Bedrock at "mid-canyon" invert and downstream adjacent wall**).

Photo F1

Photo F2

The storm drain then conveys flows to the southwest in a "tunnel alignment" approximately 1,900-feet in length with no horizontal or vertical grade breaks (to facilitate construction) to a launching pit location just south of 25th Street / PVDS. (The tunnel construction will actually proceed uphill from the launching pit until it daylights in the canyon invert just downstream of the proposed inlet structure location.) The method of installation going downstream from the launching pit then changes to open cut trenching. At this location, there is a horizontal angle point and vertical grade break in order to bring the alignment parallel with the RPV/CLA boundary line. The alignment will remain within an existing 100-foot wide utility easement dedicated within the RPV-owned Palos Verdes Shoreline Park / Open Space that was specifically set aside for just such an installation. The 100-foot

Photo F3

wide easement has lesser environmental impact requirements and also serves as a firebreak for the adjacent mobile home park and a hiking trail path passes through it to the ocean (**see Photo F3**).

The open trench reach proceeds downstream approximately 1,700-feet to a point just a couple of hundred feet from the ocean bluff top where a launching pit is proposed (**see Photo F4**). From the launching pit, which will proceed downstream due to intent to minimize access impacts on the beach, a 38% sloped slant drain would be tunneled approximately 300-feet to "daylight" at the bottom of the bluff face (**see Photo F5**, which would be similar to the recent McCarrell Canyon Storm Drain slant drain tunnel outlet & structure, **see Photo F6**) with an outlet structure being constructed at the bottom of the bluff, with the pipeline above the high tide mark.

Photo F4

Photo F5

Alternative 1A Facts:

- Tributary area = 123.7 acres
- Q_{50} = 144 cfs (FYI only)
- Q_{100} = 170 cfs (Actual system > Q100)
- Mid-canyon inlet structure
- 48-inch HDPE mainline (req'd for Q100)
- 54-inch HDPE mainline (recommended to minimize the PCC annular backfill in the tunnel & allow a future liner)
- Bluff bottom outlet structure
- Total Cost: **$19.2 million**

Photo F6

To end the viscous cycle of the canyon's historical erosion problems generated / fed by the Tarapaca Landslide, a "gravity buttress" fill of approximately 20 to 30-feet in depth would be placed from the new mid-canyon inlet structure downstream along the entire canyon limits of the existing Tarapaca Landslide (**see Section E-E on Alternative 1A, Sheets 5 of 6 and 6 of 6 in Appendix G**) which would raise the existing canyon's invert and flatten the side slopes of the canyon.

The "gravity buttress" fill within the canyon would also support Palos Verdes Drive East switchbacks and combined with the proposed storm flow diversion would end the threat of a potential failure of the switchbacks that is deemed possible if the present rate of erosion toward the switchbacks continued unchecked. The interception of the canyon flows at mid-canyon and the raising of the invert by filling the canyon would further prevent erosion of the canyon invert and as a bi-product, would eventually stabilize the Tarapaca Landslide (**see previous Photo 2 of PSR**). Ungrouted rip rap rock energy dissipators are proposed at regular intervals to flatten the invert grade and control / concentrate the energy dissipation in these rock-lined areas. No grout is proposed because the rip rap is then less likely to be undermined and the rock can naturally self-level and compact in the unlikely event they experience significant flows (but should not occur since only local tributary flows from the adjacent canyon slopes and perhaps a "low flow" bypass flow would be all that this raised canyon invert should ever experience).

The interception of the flows at mid-canyon would also significantly decrease the amount of flows that are currently flowing to the existing CLA storm drain system at 25th Street resulting in elimination of the flooding and debris deposition at 25th Street (**see Photos 6 & 7 of PSR**).

MTD Transfer of Alternative 1A: The option of transferring the maintenance of the Alternative 1A storm drain via the Miscellaneous Transfer Drain (MTD) process to the County of Los Angeles Land Development Department (LAC) is unfortunately not possible due to the following:

- **Paved vehicular access to inlet, outlet & entire storm drain length:** LAC requires that a paved vehicular access road be provided to inlet structure (which we will be providing), outlet structure (which we will not be providing due to sensitive environmental constraints and self-cleaning nature of the proposed steep outlet apron) & along the entire storm drain length (which is not physically possible or environmentally desirable along the 33% slopes below the PVDE switchback, nor would it accomplish anything even if it was constructible because there is no proposed mid-line access to the very deep tunnel alignment.

- **Manhole access spacing requirements:** LAC's manhole access spacing requirements along the length of the storm drain (per Chapter 36, Private Drain Plans and Supporting Data) set the manhole spacing at 500-feet. Alternative 1A proposes a 1,900-foot tunnel alignment without manholes due to its depth, which approaches 100-feet below existing ground surface. As such mid-line manholes in this reach are not presently being contemplated for the proposed tunnel portion of the Alternative 1A storm drain.

- **Velocity control rings restrictions:** LAC does not allow velocity control rings to be used in pipelines that may potentially carry debris-laden flows. Since it is anticipated that high velocities will be generated (proposed velocities would range from 19 fps to 48 fps if no velocity rings are introduced), and since velocities above 40 ft/s are to be avoided, velocity rings will be recommended / required. HDPE velocity rings are available and regularly utilized / factory welded inside HDPE pipe at regular intervals to slow down flows.

- **Reinforced Concrete Pipe:** LAC does not typically allow the use of HDPE pipe. Instead they strongly prefer RCP and LAC staff noted that only for rare exceptions have they allowed HDPE, specifically it was allowed for an above ground installation down a steep slope. Although it is not altogether inconceivable that we could get LAC to approve the use of HDPE pipe, it would at a minimum lengthen the LAC approval processing time for the project.

Fifteen Point Analysis of Alternative 1A

The following addresses **Fifteen (15)** major issues associated with the Alternative 1A and will similarly be addressed for all of the other alternatives and are rated in a summary chart on page 28 of the PSR.

1. **Project costs:**
   - Construction: **$12.4 million**
   - PS&E = **$1.0 million** (8% assumed)
   - Design Admin / CM / Inspection = **$1.0 million** (8% assumed)
   - R/W and Easement = **$175,000** (place holder cost if necessary)
   - Environmental Mitigation =**$200,000**

     Grand Total = $19.0 million (includes 30% contingency)

2. **Project Schedule:**

Funding Procurement Period:	* **Months** (Can overlap with PS&E Design Phase)
PS&E Design Phase:	**12 Months** (Includes additional geotechnical study)
MND Prep & Approval:	**18 Months** (Can overlap with Design / Bid Phase)
CLA Review & Approval:	**0 Months** (Not applicable to Alternative 1A)
Obtain R/W & Easements	**12 Months** (Can overlap with PS&E Design Phase)
Bidding / Award Phase:	**6 Months** (Includes advertise/bid/award/contracts)
Construction Phase:	**17 Months** (See below for additional breakdown)
Approximate Total Time Required:	**35 Months or 2 Years & 11 months***

* **NOTE:** If funding can be obtained during the same overlapping period that the PS&E Design Phase is completed and the Mitigated Negative Declaration (MND) environmental clearance documents can overlap with both the design and bidding phases then construction of Alternative 1A could be completed as soon as Winter 2014, assuming that the PS&E Design Phase could begin as soon as Summer 2011 and funding is secured within the next 2-years.

Construction Schedule Breakdown

Mobilization / Clearing & Grubbing / Rough Grading =	4 weeks
Const launch pit access shaft for short tunnel =	3 weeks
Const short steep tunnel (60 day shifts)	12 weeks
Const downstream outlet structure =	4 weeks
Const open trench reach between tunnels (1,700') =	4 weeks
Const launch pit access shaft for long tunnel =	3 weeks
Const long tunnel (170 day shifts)	34 weeks
Const canyon buttress fill / new creek invert =	6 weeks
Const access road to upstream inlet structure =	6 weeks

Const upstream inlet structure =	6 weeks
Demobilization / punch list / Clean up / hydro-seed =	4 weeks
Sub-Total Construction Period =	**86 weeks (21.5 months)**
20% reduction due to overlapping operations =	**17 weeks (4.5 months)**
Grand Total Construction Period =	**69 weeks (17 months)**

3. **Constructability issues:**
   - **Stability of canyon walls at mid-canyon inlet structure:** The stability of the canyon walls during the construction of the mid-canyon inlet structure is of primary concern, however, it is an issue that is common for all alternatives and as such is not a distinguishing feature between the alternatives. Specifically, it is anticipated that the grading for the permanent access road, which will be utilized to maintain the inlet structure in the future, be performed to allow construction equipment access to the mid-canyon inlet structure location. (Also see the Tarapaca Landslide backfill discussion that follows, which suggested the stabilized / backfilled canyon may also provide a suitable temporary access road to the inlet structure location.) It is envisioned that cast-in-drilled-hole (CIDH) soldier piles will then be installed at an even intervals such as 8-feet (exact spacing pending future PS&E phase design refinements) all around the outside perimeter of the inlet structure headwall and wing walls similar to the two soldier pile used to construct the headwall at the outlet structure on McCarrell Canyon storm drain (**see Photo F6**). Once the CIDH piles are in place (extending all the way up to the proposed inlet structure top of wall elevation) then the grading of the existing canyon slopes can begin with thick steel plate shoring being placed behind the piles as excavation proceeds downward (**similar to photo F6**). Once the proper sub-grade depths are achieved the invert of the inlet structure can be formed and constructed. Eventually the headwalls and wing walls will be formed and constructed high into the air well above the canyon floor and then backfilled to create a large level area to each side of the inlet structure. The inlet structure will have an emergency overflow notch that ideally will never be breached because the wall will have many feet of excess freeboard and the wall will serve as the upstream beginning point for the 20 to 30-feet of canyon fill that will be placed downstream well past the Tarapaca Landslide location to create a "gravity buttress" that will eventually stabilize the canyon walls.

   - **Stability of canyon walls at Tarapaca Landslide:** The stability of the canyon walls within the Tarapaca Landslide area during construction is of primary concern, however, it is an issue that is common for all alternatives and is actually less of an issue for this Alternative 1A since the added step of installing a large mainline storm drain pipe within the canyon backfill does not apply to Alternative 1A. Thus the canyon backfill operation will actually be more simplified for Alternative 1A than for any other alternative. As previously mentioned the "gravity buttress" fill of approximately 20 to 30-feet in depth would be placed from the new mid-canyon inlet structure downstream along the entire canyon limits past the existing Tarapaca Landslide area then eventually tapered down to join the existing canyon invert downstream (**see Section E-E on Alternative 1A, Sheet 6 of 6 in Appendix G**) which would raise the existing canyon's invert and flatten the side slopes of the canyon. Additional temporary shoring methodologies and other related constructability issues need to be detailed during the future PS&E

Design Phase. Special full time emergency monitoring will be also be required until enough of the buttress fill has been placed. The grading will likely be a trial and error process of reacting to localize movement and even causing controlled movement that can be graded into place and compacted in lifts.

The actual process to place the fill, starting from the bottom, will include minor grading (if any) and placement of a thin layer of base rock (to avoid undercutting the slide toe and to create a relatively level pad) and then placement of filter fabric to hold back "fine particles". The excess filter fabric material on each side of the canyon floor, which will wrap the sides and top of a rock galley sub-drain, will be pinned up onto the sides of the canyon wall while another layer of base rock is placed, then a 12-inch perforated PVC sub-drain will be installed, additional galley rock placed and then the fabric will be folded over into place on top of the rock galley. After the sub-drain rock galley is complete the placement of the canyon backfill can begin in rapid fashion and "keyed" into the existing canyon slopes via multiple stepped "notches". It is anticipated that imported backfill will be required in conjunction with the existing canyon excavation that will undoubtedly be spilling into the backfill operation as the grade is raised higher and higher. Eventually the width of the backfilled canyon will be comfortably wide and the adjacent canyon slopes will stop spilling into the operation as that grades approach the designed raised canyon flow line elevation. It is even conceivable that this stable canyon access path could be used as an alternative temporary access road to the inlet structure site during construction. Eventually rip rap energy dissipaters will be placed and the canyon invert and flattened slopes will be hydro-seeded with an approved native plant mix in combination with jute mesh, fiber roles and other recommended erosion control measures that will allow the plants time to get established.

- **Access road to mid-canyon inlet structure:** As previously mentioned there are two opportunities to provide temporary access down to the inlet structure location and it is likely that both will be utilized to provide redundancy, safety and improved access logistics (such as a round trip path without having to turn around or get out of the way of other vehicles and haulers). Eventually the canyon path will not be drivable, once the rip rap energy dissipaters that include vertical drops are installed, and then the only permanent access road to the inlet structure will be the proposed long-term maintenance access road **(see Access Road Plan in Appendix G)**. The conceptual plans presently show the access road being cut into the easterly canyon slope from the Tarapaca Road cul-de-sac and would also double as a terrace drain that would intercept sheet flow from the canyon slopes above the Tarapaca Landslide "head-scarp" thus preventing water from infiltrating into the slide area from above **(see Section A-A on Access Road Plan in Appendix G)**. However, upon further geotechnical investigation, it has been determined that the stability of the easterly canyon slopes is not the best should not be challenged by such potentially impactful grading. Thus an alternative temporary / permanent access road to the inlet structure should be considered from the westerly canyon slopes taking access to the PVDE switchbacks. A small "brow ditch" V-gutter can still be installed on the easterly canyon slope above the Tarapaca Landslide "head-scarp" to prevent water from infiltrating. With the access road on the westerly slope it also provides an improved opportunity to interconnect and coordinate with the switchback drainage pipe systems that are causing some erosion on the westerly canyon slopes and the access road could collect these flows, serve as a terrace drain

and convey the flows toward the new inlet structure. Any grading of an access road along the westerly canyon slopes will also likely require the construction of retaining walls in order to get a relatively level driveway along the relatively steep slopes. It is presently envisioned that a CIDH soldier pile retaining system or a soil nail tie back system (methods pending the future PS&E design phase) will be utilized to construct the access road. The permanent retaining system will likely have to be placed to even allow a temporary access road to be graded. Ultimately an all weather paved surface will be constructed along the access road wearing surface that is capable of withstanding heavy truck loads and conveying storm flows like a terrace drain.

- **Tunneling operations (1,900' upper reach):** The constructability of the proposed 2,000-foot long tunnel along the upper project reach from the inlet structure to just downstream of 25th Street / PVDS has been confirmed with tunneling experts. After closely studying the proposed design alignment and

Photo F7

Photo F8

geotechnical conditions it is strongly recommend that the tunneling operation consist of traditional "rib and lagging" supports (**see photo F7**) that are placed behind a fully shielded excavator (**see photo F8**) and can be retrofitted mid-construction with a rock crushing roadheader rock breaker (**see photo F9**) if high strength bedrock is encountered that the excavator bucket is not capable of removing. One important feature that will help to make sure the tunneling operation is a success is the fact that the tunnel face will be "manned" which puts

Photo F9

Photo F10

a set of human eyes constantly monitoring the progress and conditions (similar to

the McCarrell Canyon Storm Drain) rather than a "blind" drill head that can become stuck or damaged before a change of conditions is noticed. The tunnel length proposed is regularly constructed by this method and the lack of groundwater combined with the anticipated rock and soil types all consistently point to this method. Before this conclusion was arrived upon other alternative tunneling methods were considered like microtunneling with a slurry retrieval system but the length, soil conditions, design alignment and size would result in microtunneling being a much riskier and more costly operation. The tunnel will likely have an inside diameter of 80-inches and the round steel "ribs" will be constructed from W-section (**I**-shaped beam) material bent into three prefabricated ring sections (**see Photo F10: complete "rib & lagging set" ready for delivery to tunnel**) that form a full circle when connected. The lagging will create 5-foot long wood "barrels" constructed from 3-inch x 8-inch x 5-foot long Douglas fir boards placed like wood slats in a barrel around the rib rings and held in pace by the steel flanges of the regular interval steel ribs. This also allows the flexibility to stray from a straight alignment, if need be, but we are specifically planning on a straight alignment so that a simple laser can control the alignment instead of complicated surveying methods. The rib and lagging is expanded into place by hydraulic jacks at the back of the shielded excavator unit, which allows the tunnel to compress into the surrounding soil. The shielded excavator unit then pushes itself forward on the rail car rails using the last set rib and lagging. Rail cars on a small gage railroad track alternate between hauling out the excavated "muck" and hauling in a new rib & lagging set. A small receiving pit will be graded and shored at the upstream end at or near Station 50+00 (see Alternative 1A, Plan Sheet 4 of 6) and would daylight in the existing canyon invert at the proposed inlet structure location.

- **Tunneling operations (300' lower "slant drain" reach):** The constructability of the proposed 300-foot long lower "slant drain" tunnel is anticipated to closely resemble the successful recently constructed McCarrell Canyon Storm Drain "slant drain" tunnel (**see photos F6 & F11**) and as such is expected to be very constructible. The tunnel would end at the 140-foot high bluff bottom with soldier piles to shore of the bluff toe similar to the McCarrell Canyon tunnel. It is also anticipated that the tunnel will be hand mined through the solid bedrock bluff which is similar to McCarrell Canyon bedrock and a jack-&-bore steel sleeve would be pushed forward as the rock is jackhammers at the tunnel face at a rate of 2 to 5-feet per day. The tunnel operations would take place from a launch pit on top of the bluff in the flat landing area approximately 200-feet back from the edge of the bluff at an approximate slope of 38%.

Photo F11

- **Outlet Structure at the Bluff Bottom / Beach:** The constructability of the proposed outlet structure at the bluff bottom / beach is anticipated to closely resemble the successful recently constructed McCarrell Canyon Storm Drain outlet

structure (**see previous photo 17 & photo 22 in PSR**) and as such is expected to be very constructible. The tunnel would end at the 140-foot high bluff bottom with soldier piles to shore of the bluff toe similar to the McCarrell Canyon tunnel. The pipe outlet would be located well above the high tide line to avoid potential wave damage and the wing wall walls will hold back the adjacent bluff slopes and transition into a wider beach "apron" that allows the flow to spread out and slow down. The Beach apron will include large "sound" beach boulders to help further dissipate the flow velocities and protect the beach from erosion.

- **Potential for collateral damage in adjacent structures:** Prior to commencement of construction, vertical (extensometer) and horizontal (inclinometer) ground movement monitoring systems will be placed during the construction phase as well as a long-term array of multiple survey monitors placed during this study phase to monitor the movement of the ground within San Ramon Canyon before, during and after construction. Further, a detailed photo and video documentation survey will be required of all adjacent structures (especially along the Tarapaca Road cul-de-sac dwellings) to define all pre-existing conditions. The combination of all of these methods will protect all interested parties against any frivolous claims, especially if it can be proved that no ground movement occurred in the hillside plain between the construction site and private properties.

4. **Availability of Material and Methods:**
   - **HDPE pipe:** High strength 54-inch inside diameter HDPE pipe (butt fused) is the size and type of pipe material recommended for this alternative. HDPE is somewhat flexible, chemical and corrosion resistant, lightweight, strong and ductile. It is ideal for this project due to the steep grades since its fused welded joints create seamless pipe. It will stand up well to the anticipated high velocities and can be fitted with HDPE velocity reducer rings. The anticipated sediment-laden flows will cause some scouring but HDPE holds up well and since the 54-inch inside diameter is oversized to reduce the amount of PCC to placed in the tunnel annular space it can be lined in the future, if needed.
   - **Fill:** In order to stabilize the canyon walls, it is recommended that a substantial amount of fill be placed to elevate the canyon invert and to decrease the vertical slopes of the existing canyon walls. It estimated that 44,770 cubic yards of fill would be required to achieve the new canyon flow line and cross section (**see Section E-E on plan sheet 6 of 6 for Alternative 1A in Appendix G**). Per the geotechnical report, the excavated material for the tunnel and trench section is suitable as backfill. It is estimated that the excavated tunnel materials would produce approximately 3,000 cubic yards of usable backfill material. The City has indicated the Portuguese Bend is also a possible source of fill materials that would not require hauling and traffic impacts outside the RPV peninsula area. The logistic of when the tunnel excavation is available relative to when the canyon fill will be placed has yet to be defined, but will be further evaluated during the PS&E phase of the project.
   - **Tunneling Equipment:** The two proposed tunneling construction methods and related vertical and horizontal ground movement monitoring systems during tunneling will require equipment that is readily available and can easily be mobilized to the site.

5. **Contractor's Expertise Required:**
   Several competent tunneling contractors are known to practice in the local area and given the percentage of tunnel length to open trench length proposed the tunneling contractor will likely prime the project bid. The challenge will not be finding contractors to bid, instead it will be to make sure only competent experienced contractors qualify to bid. To make sure this happens the contractor performing the tunnel construction work (whether subcontractor or prime contractor) shall have performed a pre-established number (say two or three minimum) of steel rib and wood lagging shored tunnel projects for a continuous length in excess of 1,000 lineal feet, with a diameter of six feet (6') or larger, within the last five years. The tunnel contractors will also be required to have completed at least one tunnel with minimum grade / slope of 25% for at least 250 lineal feet in length with in the last five years.

6. **R/W and Easement Requirements:**
   The proposed Alternative 1A storm drain alignment and westerly canyon slope access road would all be completely within the City of Rancho Palos Verdes with only limited work being required on private property (namely 0.10 acre within LAC's Friendship Park, 0.09 acres within APN 7561-039-006 and 0.16 acres within APN 7561-039-002 for a total of 0.35 acres). Although it is anticipated that the City will be granted no-cost construction easement for Alternative 1A because the drainage system will be beneficial to the adjacent property owners, for worse case estimation purposes, a $500,000/acre placeholder cost has been included in the project estimate. Additional reasons why a no fee easement may be assumed include the fact that the adjacent residences along Tarapaca Road are supportive of the project (confirmed at the community meetings) and the adjacent Friendship County Park is owned by LAC who is also supportive of the project. A temporary construction easement may need to be obtained from the property owner adjacent to 25th Street if access to the canyon is required from the south. If a permanent access road is pursued from the easterly canyon slope (per geotechnical recommends this is now not likely) then an easement would be required from the CLA and two other private owners.

7. **Environmental Impacts:**
   The Mid-Canyon Inlet Alternative 1A will have least significant environmental impacts of any alternative because it affect the least amount of natural canyon slopes and inverts (pristine or otherwise) and utilizes tunneling installation methods which are the least impactful to the protected open space areas and natural bluffs. The following details feature by feature why the Mid-Canyon Inlet Alternative 1A will have least significant environmental impacts of any alternative:

   - **Canyon Walls and Inverts:** The Mid-Canyon Inlet Alternative 1A impacts the least amount of natural canyon slopes and inverts (pristine or otherwise) of any alternative. Further, both the Mid-Canyon Inlet Alternatives 1A and 2A will have less significant impacts than the two Upper San Ramon Canyon Connection Alternatives 1B and 2B due to the latter's more extensive invert filling operations that are required in the more pristine upper canyon, including extensive grading and filling operations. Further, it has been noted that the upper canyon is more stable, suffers less from erosion, has more bedrock outcroppings and has a

rockier invert in general. This is largely what is driving the Mid-Canyon Inlet Alternatives 1A and 2A to stop where they do because upstream from that point the canyon is more natural and stable thus being a much lesser priority to disturb it. Many hilltop homes look down to this natural upper canyon thus their pristine canyon views would also be more impacted by Alternatives 1B and 2B than 1A and 2A.

- **Tarapaca Landslide:** All of the alternatives will remedy the Tarapaca Landslide conditions utilizing similar methods so this item is not a distinguishing factor between the alternatives. Regardless it is worth noting that the solution to place a 20 to 30-foot high buttress fill will return the canyon back closer to its original natural creek state. The 30-foot high near vertical canyon walls are an unnatural condition that send too much sediment down the creek. The proposed solution will be more beneficial to native flora and fauna and will be more sustainable in the long run.

- **Two Tunneling Locations:** The two tunneling alternatives 1A and 1B will utilize tunneling installation methods which are the least impactful to the protected open space areas and natural bluffs.

- **Open Trench Excavation Location:** The open trench portion of Alternative 1A impacts the least pristine area (compared to the open trench installations in San Ramon Canyon) and is proposed in a 100-foot wide easement corridor specifically set aside for such purposes. The adjacent natural open space remaining untouched.

- **Inlet Structure and Access Road:** All of the alternatives will require either a large or small mid-canyon inlet structure and accompanying access road (so that the Tarapaca Landslide buttress fill downstream will be protected) thus this item is not a distinguishing factor between the alternatives. Regardless it is worth noting that the natural canyon has been identified as being fairly barren of native plants and animals but will likely improve once the canyon is stabilized and re-hydro-seeded.

- **Outlet Structure:** Although the proposed Alternative 1A (and 1B) outlet structure will impact a small portion of the natural bluff bottom and beach, these impacts have already been mitigated by RPV's proactive actions to set aside open space to mitigate even larger impacts than are proposed by the project. Also the proposed outlet structure will be camouflaged to some extent, similar to (and hopefully even more so on the side slopes outside the wing walls) the recent McCarrell Canyon outlet structure (**see previous Photo F11**) through the use of bluff color concrete, irregular texture patterns stamped into the surface and the use of natural beach rock embedded into the beach apron (which also collects beach rock from the wave action as the McCarrell Canyon beach outlet shows).

8. **Geotechnical Issues:**
   - **Tarapaca Landslide:** To evaluate how much fill is required in the canyon bottom to act as a "gravity buttress", cross sections of the canyon were analyzed with various heights. The results of these analyses indicated that approximately 20 to

30 feet of fill placed in the canyon at the toe of the landslide would be required to obtain a safety factor of approximately 1.5. Note this is true for all alternatives. Additional temporary shoring method need to be detailed during the future PS&E Design Phase.

- **Canyon Walls:** The result of the stability analyses for the canyon slopes below the PVDE switchbacks indicated that where continuously adversely oriented bedding plains that are not exposed in the bluff face. The existing in-place factor of safety (FS) of the canyon walls is likely in the range of 1.3 to 1.4. Where adversely oriented bedrock exists relative to the canyon wall – such as in the area of the Tarapaca Landslide – failure has either already occurred and/or the current slope stability factor of safety is in the range of just above 1.0 to 1.2 (FS = 1.0 indicates movement is eminent). In addition, local occurrences of adversely oriented planar bedrock surfaces may also result in local small failures.

- **Pipe / Structure Design:** Pipe design and appurtenant structures should take into consideration potential movement of adjacent slopes and the landslide mass. Minor movements in localized areas may occur during construction and during the life of the storm drain system.

- **Tunneling:**
  i. Hard siliceous zones or blocks of materials should be expected to be encountered during tunneling.
  ii. Some of the Altamira Shale member bedrock cores swelled after being exposed to the air for several days. The swelling is attributed to air drying and potentially secondary mineral crystal growth. The swelling will create pressure on the ground supports installed for the tunnel construction.
  iii. Tunneling may encounter local zones of adversely oriented geologic discontinuities that may be lined with Bentonite. These zones may produce local stability problems during tunneling. NOTE: If excess void pockets are generated during the tunnel construction they can be subsequently injected with pressurized grout backfill while the tunnel operation progresses forward.
  iv. The proposed tunnel will be excavated through fair to poor rock and stand-up time during tunneling is expected to range from 10 hours to 1 week for an 8-foot to 15-foot span.

- **Trench Excavation:** Based on the preliminary evaluation and the results of the geotechnical engineer's field exploration, variable stability conditions will be encountered in the open trench walls during construction of the storm drain south of 25th Street/PVDS. Some local areas may be temporarily unstable, particularly within the deeper areas of the trench; therefore, shoring or trench wall lay-back slopes will be required. Further exploration and analyses will be required in order to provide detailed shoring and temporary stability recommendations during the PS&E phase. However, for the purposes preliminary design alternative evaluations, trench walls excavated at a slope of 1:1 (horizontal to vertical) should be anticipated to be temporarily stable.

- **Backfill of Pipe Bedding:** It is anticipated the onsite soils will be suitable for backfill of the trench above the pipe bedding zone. Some oversize materials will likely be encountered, and will not be suitable for placement within the backfill.
- **Inlet Structure:** While the canyon slopes at the propose inlet structure location may be grossly stable during construction, surficial slumping or localized "pop outs" are likely to occur. The design of the structure should take into consideration highly expansive soils. It can be assumed that shoring or other stability methods (i.e. CIDH piles, caissons, sheet piles, etc.) will likely be required for temporary stability.

- **Outlet Structure:** While the bluff in the area of the proposed outlet structure location may be grossly stable, minor surficial slumping or localized "pop outs" may potentially occur. It is anticipated that the outlet structure will be founded on bedrock or ancient landslide debris and keyed into the bluff toe with the previously detailed soldier piles. The design of the structure should take into consideration highly expansive soils.

- **Access Road:** Bedding orientations in the area of the presently detailed easterly canyon slope access road will result in adversely oriented bedrock exposed during grading of the road. This easterly road would be located upslope of the currently moving Tarapaca landslide, and directly downslope of existing residential development. The wall design will need to accommodate adverse structure, and temporary instability will require corrective grading, and structural support such as tiebacks. In addition, alternative paving that may accommodate expansive soils and slope creep. BOTTOM LINE: Per the geotechnical report conclusions the access road should be relocated and design from the PVDE switchbacks along the westerly canyon slope to the inlet structure – Harris & Associates concurs.

9. Flood Protection:

- **Upstream of 25th Street:** The proposed storm drain will be design to convey a 100-year (plus) storm reoccurrence.
- **Downstream of 25th Street:** The existing CLA storm drain south of 25th Street was designed to roughly convey a 50-year storm event (see previous discussion about doubts that it will perform well under a full Q50 storm). A Hydrology/Hydraulic study was done by Harris & Associates and it was found that the existing system can convey the flows of a 50-year storm but the resulting velocities ranging from 19 fps to 48 fps, with the velocities ranging closer to 48 fps. Per the City of Los Angeles as-built plans, the pipe was not specified to have extra thickness cover over the steel to handle the high velocities. BOTTOM LINE: The deficiencies in the existing CLA Storm Drain system will experience significant relief due to the proposed construction of Alternative 1A, which is not the case for the down canyon Storm drain Alternative 2A that would connect directly to the CLA system.

10. Impacts to the City of Los Angeles (CLA):

Since the proposed Alternative 1A storm drain alignment and westerly canyon slope access road would all be completely within the City of Rancho Palos Verdes the anticipated impacts to and involvement by CLA would be minimal, perhaps relegated to funding participation and project advocacy / fund lobbying. Since the existing

storm drain system, south of 25th Street, would remain in place and would convey less flows than originally designed there would be an increase in the overall area's flood protection level with RPV taking the lead on the design and construction effort, which should be very acceptable to CLA.

11. Impacts to the Los Angeles County (LAC):

As long as the alignment of the access road is not on the westerly canyon slope and shifted away from the easterly canyon slope and thus not going through Friendship Park (LAC's property) only a small easement, if any would be required from LAC. Further, LAC mentioned their nonexistence jurisdictional authority for this project, which would remain the case especially if a MTD process is not pursued between RPV and LAC.

12. Impacts to Private Residents:

Residents within the Peninsula Community that use the 25th Street/PVDS and PVDE transportation corridors can expect to have the corridor open during the majority of the construction schedule (only minor temporary closures anticipated) and will enjoy full access during future rain events after construction. See previous easement discussion for minor temporary construction easement impacts to private residences and their considerable support for the project in general.

13. Impacts to Traffic:

Alternative 1A proposes to tunnel under 25th Street/PVDS and PVDE switchbacks, therefore making any traffic impacts minimal. Only minor temporary lane closures would be allowed during construction. Traffic Control would be limited to informational signs and some traffic control during ingress/egress of any construction traffic into/out of the project sites.

14. Resulting Service Life:

Alternative 1A is anticipated to have service life that is comparable to any similar storm drain system, or even longer given a majority of the pipe alignment will be protected by a surrounding tunnel support system and locked into place with PCC in the annular space. The service life is estimated to be at least **75-years** for the both the HDPE pipe and reinforced concrete inlet / outlet structures. Further the service life will be the same if not longer than the other alternatives being considered, thus not raising the "service life" issue to be a distinguishing factor between the various alternatives.

15. Future Maintenance Issues:

Alternative 1A is anticipated to have future maintenance requirements that are comparable to any similar natural canyon feed storm drain system, such as the recently constructed McCarrell Canyon SD, including regular preventative maintenance before each winter season and more reactive maintenance after each big storm event. This would primarily consist of make sure that the inlet structure and debris rack are clear and free from rocks, branches and other debris and perhaps a once a year two-man "walk-through" inspection of the 54-inch HDPE pipe to check for premature wear.

Further, as previously mentioned, since the 54-inch inside diameter HDPE pipe is being recommended to save on the annular space concrete fill in the two tunnel reaches there is an opportunity in 50-years or more to add a liner inside the HDPE pipe without adversely affecting the hydraulics because only 48-inch HDPE pipe is required. Finally, the service life of Alternative 1A will be the similar to the other alternatives being consider, with the "debris-laden flow concern" of Alternative 1A being an offsetting concern to the "buried pipe adjacent to a still settling landslide concern" related to alternatives 2A and 2B, since both would prompt an equal urgency to perform in-pipe walk-through inspections, thus not raising "future maintenance" issues to be a significantly distinguishing factor between the various alternatives.

B. Alternative 1B – <u>Upper</u>-canyon inlet with "tunnel alignment" that outlets to the bluffs

Alternative 1B consists essentially of the exact same design approach and alignment as Alternative 1A, except that instead of constructing a mid-canyon inlet within San Ramon Canyon the proposed storm drain alignment would be extended upstream, consisting of a 48-inch HDPE pipe installed via "prepared canyon bottom backfill" installation in an imported canyon fill along the natural canyon invert (**see Alternative 1B conceptual plans and Typical Section D-D in Appendix G**). The proposed pipe installation would extend an additional 1,300-feet upstream of the Mid-Canyon inlet structure, (required for Alternative 1A but not for Alternative 1B) and would connect with an existing upper San Ramon Canyon storm drain outlet pipe (**see Photo F12**). This upstream outlet pipe structure that was constructed as part of the slope repair and terrace drain construction performed in 2002. The 48-inch HDPE pipe in this upper-canyon alignment would be placed above a perforated 12" diameter pipe (**see Typical Section D-D in Appendix G**). No excavation below the existing canyon floor would be done. The placement of the storm drain would be on top of "bedding" which would be placed above the canyon floor.

Photo F12

The remaining alignment downstream would be exactly the same as Alternative 1A with the only difference that perhaps a small mid-canyon inlet structure might be considered just before the tunnel alignment veers off to the west under the PVDE switchbacks since this would be the last chance to intercept any additional surface flows that are tributary to the natural canyon slopes (and from the down drain for the Tarapaca Road cul-de-sac and Tarapaca Slide "brow ditch" above the head-scarp.

The thought process driving this "sub-alternative" is that since the main line storm drain flows have already been collected from the housing tract above and confined to a pipe it may be advantageous to keep these flows in a pipe rather than allowing these concentrated flows to again run free in the natural channel bottom.

<u>Alternative 1B Facts:</u>

- Tributary area = 98 acres (top connection point)

- Tributary area = 123.7 acres (as alignment leaves Cyn into tunnel)
- Q_{50} of 122 cfs (FYI only, top connection point)
- Q_{50} = 144 cfs (FYI only, as alignment leaves Cyn into tunnel)
- Q_{100} of 143 cfs (Actual system > Q100, top connection point)
- Q_{100} = 170 cfs (Actual system > Q100, as alignment leaves Cyn into tunnel)
- Upper-canyon connection junction structure
- 48-inch HDPE mainline (req'd for Q100) use in upper canyon to tunnel diversion
- 54-inch HDPE mainline (use from tunnel to beach, recommended to minimize the PCC annular backfill in the tunnel & allow a future liner)
- Bluff bottom outlet structure
- Total Cost: **$23.2 million**

MTD Transfer of Alternative 1B: The option of transferring the maintenance of the Alternative 1B storm drain via the Miscellaneous Transfer Drain (MTD) process to the County of Los Angeles Land Development Department (LAC) is unfortunately not possible for the same reasons detailed in Alternative 1A (**see previous write up**).

Fifteen Point Analysis of Alternative 1B

The following addresses **Fifteen (15)** major issues associated with the Alternative 1B and will similarly be addressed for all of the other alternatives and are rated in a summary chart on page 28 of the PSR.

1. **Project costs:**
   - Construction: **$14.3 million**
   - PS&E = **$1.2 million** (8% assumed)
   - Design Admin / CM / Inspection = **$1.2 million** (8% assumed)
   - R/W and Easement = **$ 725,000** (place holder cost if necessary)
   - Environmental Mitigation = **$500,000**

     Grand Total = $23.0 million (includes 30% contingency)

2. **Project Schedule:**

Funding Procurement Period:	* **Months** (Can overlap with PS&E Design Phase)
PS&E Design Phase:	**12 Months** (Includes additional geotechnical study)
MND Prep & Approval:	**18 Months** (Can overlap with Design / Bid Phase)
CLA Review & Approval:	**0 Months** (Not applicable to Alternative 1B)
Obtain R/W & Easements	**12 Months** (Can overlap with PS&E Design Phase)
Bidding / Award Phase:	**6 Months** (Includes advertise/bid/award/contracts)
Construction Phase:	**18 Months** (See below for additional breakdown)
Approximate Total Time Required:	**36 Months or 3 Years & 0 months***

* **NOTE:** If funding can be obtained during the same overlapping period that the PS&E Design Phase is completed and the Mitigated Negative Declaration (MND) environmental clearance documents can overlap with both the design and bidding phases then construction of Alternative 1B could be completed as soon as Winter 2014,

assuming that the PS&E Design Phase could begin as soon as Summer 2011 and funding is secured within the next 2-years.

Construction Schedule Breakdown

Mobilization / Clearing & Grubbing / Rough Grading =	4 weeks
Const launch pit access shaft for short tunnel =	3 weeks
Const short steep tunnel (60 day shifts)	12 weeks
Const downstream inlet structure =	4 weeks
Const open trench reach between tunnels (1,700') =	4 weeks
Const launch pit access shaft for long tunnel =	3 weeks
Const long tunnel (170 day shifts)	34 weeks
Const canyon buttress fill / new creek invert =	6 weeks
Const access road to mid-canyon for upper cyn const =	6 weeks
Const "prepared canyon bottom backfill" reach in upper canyon (1,300') =	8 weeks
Const upstream junction structure =	2 weeks
Demobilization / punch list / Clean up / hydro-seed =	4 weeks
Sub-Total Construction Period =	**90 weeks (22.5 months)**
20% reduction due to overlapping operations =	**18 weeks (4.5 months)**
Grand Total Construction Period =	**72 weeks (18 months)**

3. **Constructability issues:**

Because Alternative 1B consists essentially of the exact same design approach and alignment as Alternative 1A all of the constructability issues raised in the Alternative 1A discussion also apply to Alternative 1B, with two exceptions / clarifications:

- **Small Mid-Canyon Inlet:** The large mid-canyon inlet in Alternative 1A will be replaced with a smaller mid-canyon inlet in Alternative 1B and, as such, any issues raised in the previous Alternative discussion would also apply here, including the need to grade an access road, but some canyon impacts would be smaller in scale.
- **Upper Canyon Pipe Line:** The additional 1,300-feet of 48-inch HDPE pipe will be installed via "prepared canyon bottom backfill" in an imported canyon fill onto of a filter fabric wrapped rock galley with a 12-inch perforated pipe, directly on top of the natural canyon invert. This length would connect the smaller mid-canyon inlet structure to an existing upper San Ramon Canyon storm drain outlet pipe (**see previous photo J12**). The constructability issues applicable to this reach would be most similar to Alternative 2A, which also has proposed mainline storm drain pipe being installed within the narrow existing canyon, except with less risk of land movement since there is no active landslide in this area (**see Alternative 2A constructability discussion that follows**).

4. **Availability of Material and Methods:**

Alternative 1B is essentially the same as Alternative 1A (**see previous Item 4 write up**). One clarification is that more imported fill will be required, but is not anticipated to be an issue due to the excess fill available in the Portuguese Bend area. Specifically it estimated that 67,680 cubic yards of fill would be required for Alternative 1B versus 44,770 cubic yards for Alternative 1A to achieve the new

canyon flow line and cross section (**see Section E-E on plan sheet 6 of 6 for Alternative 1A in Appendix G**).

5. **Contractor's Expertise Required:**
   Alternative 1B is essentially the as Alternative 1A (**see previous Item 5 write up**).

6. **R/W and Easement Requirements:**
   Alternative 1B is essentially the same as Alternative 1A (**see previous Item 6 write up**). There are a total of 14 properties within the City of Ranch Palos Verdes for which the City would have to acquire a storm drain easement as follows:

   a. 7561-038-007 - 0.01 acres
   b. 7561-038-008 - 0.02 acres
   c. 7561-038-017 - 0.06 acres
   d. 7561-038-010 - 0.06 acres
   e. 7561-038-011 - 0.07 acres
   f. 7561-038-012 - 0.07 acres
   g. 7561-033-009 - 0.09 acres
   h. 7561-033-010 - 0.10 acres
   i. 7561-033-011 - 0.09 acres
   j. 7561-033-012 - 0.06 acres
   k. 7561-033-013 - 0.04 acres
   l. 7561-033-014 - 0.01 acres
   m. 7561-041-012 - 0.05 acres
   n. 7561-041-002 - 0.37 acres

   Total easement required for the construction of Alternative 1B is 1.45 acres. Although it is anticipated that the City will be granted a no-cost construction easement for Alternative 1B because the drainage system will be beneficial to the adjacent property owners, for worse case estimation purposes, a $500,000/acre placeholder cost has been included in the project estimate.

7. **Environmental Impacts:**
   Alternative 1B is essentially the same as Alternative 1A, with the exceptions that more pristine canyon will be affected and that the view of additional private residents would be affected by Alternative 1B because more of the canyon floor will be disturbed by the extended pipe length (**see previous Item 7 write up**).

8. **Geotechnical Issues:**
   Alternative 1B is essentially the same as Alternative 1A (**see previous Item 8 write up**).

9. **Flood Protection:**
   Alternative 1B is essentially the same as Alternative 1A, with the exception that additional protection could be argued to apply to Alternative 1B because more of the canyon floor is protected from erosion by the extended pipe length (**see previous Item 9 write up**).

10. **Impacts to the City of Los Angeles (CLA):**
    Alternative 1B is essentially the as Alternative 1A (**see previous Item 10 write up**).

11. **Impacts to the Los Angeles County (LAC):**
    Alternative 1B is essentially the same as Alternative 1A (**see previous Item 11 write up**).

12. Impacts to Private Residents:

Alternative 1B is essentially the same as Alternative 1A, with the exception that the view of additional private residents would be affected by Alternative 1B because more of the canyon floor will be disturbed by the extended pipe length (**see previous Item 12 write up**).

13. Impacts to Traffic:

Alternative 1B is essentially the same as Alternative 1A (**see previous Item 13 write up**).

14. Resulting Service Life:

Alternative 1B is essentially the same as Alternative 1A (**see previous Item 14 write up**).

15. Future Maintenance Issues:

Alternative 1B is essentially the same as Alternative 1A, with the exception that slightly more maintenance will be required for Alternative 1B because of the extended pipe length (**see previous Item 15 write up**).

C. Alternative 2A – Mid-canyon inlet with "canyon alignment" outletting to 25th St SD

Alternative 2A consists of a mid-canyon inlet with 48-inch HDPE pipe in a "canyon alignment" down San Ramon Canyon past the Tarapaca Landslide. This alternative would outlet to the existing CLA storm Drain at 25th Street (**see previous Photos 4 – 9 in PSR and Section A-A on page 9 showing the existing San Ramon Canyon intersection with 25th Street**). The majority of the length of this storm drain alignment falls within the City of Rancho Palos Verdes (RPV), however the most downstream portion will need to pass through private property within CLA and as such RPV will not have sole jurisdiction for this alternative. Similar to all of the "mid-canyon inlet alternatives", the upstream terminus is a proposed inlet structure in the "middle" of San Ramon Canyon. This location was strategically chosen to intercept flood waters above the Tarapaca Landslide where bedrock "daylights" in the existing canyon bottom and side walls (**see previous Photos F1 & F2: Bedrock at "mid-canyon" invert and downstream adjacent wall**).

The storm drain then conveys flows southerly in a "canyon alignment" down San Ramon Canyon past the Tarapaca Landslide (**see Photo 2 in PSR**) approximately 1,900-feet in length where it will connect to the existing CLA storm Drain at 25th Street (**see Appendix D for CLA SD as-built plans**). A small portion of 42-inch CMP was left in place under 25th Street when CLA constructed the 48"RCP storm drain downstream. Since the 42-inch CMP was left in place, half the width of 25th Street will now need to be open cut to an approximate 30-foot depth to remove this 42-inch bottleneck. Because "clear water" will have to be delivered to the CLA storm drain system, a very large debris basin structure would have to be designed and constructed at the mid-canyon inlet. This debris basin would deliver clear water flows downstream. It is envisioned that the debris basin / inlet structure for Alternative 2A (and 2B) will be significantly larger than the inlet structure required for Alternative 1A (and 1B).

The proposed storm drain construction will follow along the canyon's horizontal alignment above the existing canyon floor with a minimum cover of 5-feet to the proposed new / raised canyon invert (**see Section C-C on Alternative 2A and two plan & profile sheets 1 of 2 and 2 of 2 in Appendix G**). The proposed pipe slope will range from 21.5% maximum to 6.0% minimum. The proposed canyon installation will require a fill along the canyon of up to 30-feet at some locations. The elevated creek bed and side canyon slopes would be graded to have less severe steep slopes similar to all of the other alternatives. The filling of the canyon would again act as a buttress for both the Tarapaca Landslide and the PVDE switchbacks to eliminate the potential for future slope failures.

Unfortunately the CLA storm drain, starting at 25th Street and downstream to the existing mid-bluff outlet, has some known deficiencies that were identified in a CCTV inspection provided by CLA (offset pipe joints). It was noted that in the CLA record plans, there is insufficient concrete cover over the interior reinforcement steel to withstand the anticipated high velocity flows and abrupt horizontal angle points and vertical grade breaks. In addition, the substandard bluff outlet is eroding the bluff face (**see PSR discussion in section VI. EXISTING CITY OF LOS ANGELES (CLA) STORM DRAIN AT 25TH STREET for more detailed information**).

Alternative 2A Facts:

- Tributary area = 184 acres
- Q_{50} = 219 cfs (Actual downstream existing system < Q50)
- Q_{100} = 263 cfs (FYI only)
- Mid-canyon inlet structure
- 48-inch HDPE mainline
- CLA 25th Street storm drain outlet
- Total Cost: $18.0 million

Similar to all of the other alternatives a "gravity buttress" fill of approximately 20 to 30-feet in depth would be placed from the new mid-canyon inlet structure downstream along the entire canyon limits of the existing Tarapaca Landslide. The fill would raise the existing canyon's invert and flatten the side slopes of the canyon. Again the "gravity buttress" fill within the canyon would also support Palos Verdes Drive East switchbacks. As with the other alternatives ungrouted rip rap rock energy dissipators are proposed at regular intervals to flatten the invert grade and control / concentrate the energy dissipation in these rock-lined areas.

Unfortunately the interception of flows at mid-canyon would significantly increase the amount of flows that currently make it down to the existing CLA storm drain system at 25th Street resulting in the need to fortify and improve that system to provide true Q50 protection and conveyance.

MTD Transfer of Alternative 2A: The option of transferring the maintenance of the Alternative 2A storm drain via the Miscellaneous Transfer Drain (MTD) process to the County of Los Angeles Land Development Department (LAC) is technically possible but would apply only to the newly constructed reach from the mid-canyon inlet to 25th Street and would require the following:

- **Paved vehicular access to inlet & entire storm drain length:** LAC requires that a paved vehicular access road be provided to the inlet structure (which we will be providing). The access road should also provide access along the entire storm drain length (which is physically possible but environmentally undesirable along the raised canyon slope which will be at a 15% grade and will have hard to traverse energy dissipators evenly spaced along the new creek bed). This access road in the creek may prove to be environmentally unacceptable.

- **Reinforced Concrete Pipe:** LAC does not typically allow the use of HDPE pipe. Instead they strongly prefer RCP and LAC staff noted that only for rare exceptions have they allowed HDPE, specifically it was allowed for an above ground installation down a steep slope. Although it is not altogether inconceivable that we could get LAC to approve the use of HDPE pipe, it would at a minimum lengthen the LAC approval processing time for the project.

Fifteen Point Analysis of Alternative 2A

The following addresses **Fifteen (15)** major issues associated with the Alternative 1A and will similarly be addressed for all of the other alternatives and are rated in a summary chart on page 28 of the PSR.

1. **Project costs:**
   - Construction: **$10.7 million**
   - PS&E = **$1.1 million** (10% assumed)
   - Design Admin / CM / Inspection = **$1.0 million** (10% assumed)
   - R/W and Easement = **$715,000** (place holder cost if necessary)
   - Environmental Mitigation = **$200,000**

   Grand Total = $18.3 million (includes 30% contingency)

2. **Project Schedule:**

Funding Procurement Period:	* **Months** (Can overlap with PS&E Design Phase)
PS&E Design Phase:	**12 Months** (Includes additional geotechnical study)
MND Prep & Approval:	**18 Months** (Can overlap with Design / Bid Phase)
CLA Review & Approval:	**36 Months** (Actual time pending CLA/LAC input)
Obtain R/W & Easements	**12 Months** (Actual time pending CLA/LAC input)
Bidding / Award Phase:	**6 Months** (Includes advertise/bid/award/contracts)
Construction Phase:	**9 Months** (See below for additional breakdown)
Approximate Total Time Required:	**80 Months or 6 Years & 8 months***

* **NOTE:** If funding can be obtained during the same overlapping period that the PS&E Design Phase is completed and the Mitigated Negative Declaration (MND) environmental clearance documents can overlap with both the design and CLA review phases then construction of Alternative 2A could be completed as soon as Winter 2017, assuming that the PS&E Design Phase could begin as soon as Summer 2011.

Construction Schedule Breakdown

Mobilization / Clearing & Grubbing / Rough Grading =	4 weeks
Open cut in 25th Street to connect to 48" RCP =	2 weeks
Const small downstream inlet structure =	4 weeks
Const "prepared canyon bottom backfill" reach (1,900') =	6 weeks
Const canyon buttress fill / new creek invert =	6 weeks
Const access road to upstream inlet structure =	6 weeks
Const large upstream inlet structure / debris basin =	8 weeks
Demobilization / punch list / Clean up / hydro-seed =	4 weeks
Sub-Total Construction Period =	**40 weeks (10 months)**
10% reduction due to overlapping operations =	**4 weeks (1 month)**
Grand Total Construction Period =	**36 weeks (9 months)**

3. **Constructability issues:**
   - **Stability of canyon walls at mid-canyon inlet structure:** Alternative 2A is essentially the same as Alternative 1A, with the exception that the required inlet structure would need to be much larger to capture the required debris because CLA requires clean water to their SD system (**see previous Alternative 1A Item 3 write up**).
   - **Stability of canyon walls at Tarapaca Landslide:** Alternative 2A is essentially the same as Alternative 1A, with the exception that a pipe line will also need to be installed through the Tarapaca Landslide area (**see Section C-C on Alternative 2A and plan & profile sheets 1 of 2 and 2 of 2 in Appendix G**). Thus the canyon backfill operation will actually be more complicated for Alternative 2A (and 2B) than for the other alternatives (**see previous Alternative 1A Item 3 write up**).
   - **Access road to mid-canyon inlet structure:** Alternative 2A is essentially the same as Alternative 1A (**see previous write up**).
   - **Existing Outlet Structure in Mid-Bluff Bottom:** If more flows are added to the existing CLA storm drain the existing mid-bluff 84" RCP outlet pipe is recommended to be replaced with some sort of improved outlet structure (design pending). A "slant drain" tunnel would be very difficult if not physically impossible given the existing houses along the entire existing storm drain alignment. Without such an improvement the bluff would continue to erode at a faster pace and put at least the two adjacent residential properties in jeopardy.
   - **Potential for collateral damage in adjacent structures:** Alternative 2A is essentially the same as Alternative 1A (**see previous write up**).

4. **Availability of Material and Methods:**
   Alternative 2A is essentially the same as Alternative 1A, with the exception that tunneling material and methods section does not apply (**see previous Alternative 1A Item 4 write up**).

5. **Contractor's Expertise Required:**
   Alternative 2A does not require any special tunneling expertise thus a wider variety of contractors would be eligible to perform this work.

6. **R/W and Easement Requirements:**

A portion of the proposed Alternative 2A storm drain alignment and westerly canyon slope access road would be within the City of Los Angeles. The proposed work will be in five (5) private properties with only limited if any work being required on the upper three (3) private properties (0.10 acre within LAC's Friendship Park, 0.09 acres within APN 7561-039-006 and 0.16 acres within APN 7561-039-002 for a total of 0.35 acres). The more extensive pipe installation and grading work would be on the lower two (2) private properties (0.82 acres within APN 7562-001-009 and 0.26 acres within APN 7561-025-900 for a total of 1.08 acres). Although it is anticipated that the City will be granted no-cost construction easement for Alternative 1A because the drainage system will be beneficial to the adjacent property owners, for worse case estimation purposes, a $500,000/acre placeholder cost has been included in the project estimate. Additional reasons why a no fee easement may be assumed include the fact that the adjacent residences along Tarapaca Road are supportive of the project (confirmed at the community meetings). Also, the adjacent Friendship County Park is owned by LAC is also supportive of the project. A temporary construction easement will also need to be obtained from the property owner adjacent to 25th Street for access to the canyon from the south. A permanent access road (per LAC requirements) from the 25th Street may also trigger special easement requirements.

7. **Environmental Impacts:**

The Mid-Canyon Inlet Alternative 2A will have the most significant environmental impacts of any alternative (except Alternative 2B). This alternative affects the most amount of natural canyon slopes and inverts. The following details feature by feature why the Mid-Canyon Inlet Alternative 2A will have most significant environmental impacts of any alternative:

- **Canyon Walls and Inverts:** The Mid-Canyon Inlet / canyon alignment Alternative 2A impacts the second most amount of natural canyon slopes and inverts (after Alternative 2B). The addition of a buried pipe makes both the short-term construction and long-term canyon maintenance more complicated and potentially environmentally impactful especially if a permanent access road is required along the canyon invert.
- **Tarapaca Landslide:** All of the alternatives will remedy the Tarapaca Landslide conditions utilizing similar methods so this item is not a distinguishing factor between the alternatives.
- **Inlet Structure and Access Road:** All of the alternatives will require either a large or small mid-canyon inlet structure and accompanying access road (so that the Tarapaca Landslide buttress fill downstream will be protected) thus this item is not a distinguishing factor between the alternatives. Regardless it is worth noting that this Alternative 2A will require the largest debris basin of any alternative.
- **Existing CLA SD System & Outlet Structure:** As previously mentioned more flows will be added to the existing CLA storm drain which is known to be deficient as previously detailed, including a deficient the existing mid-bluff 84" RCP outlet pipe. The required improvements at the existing bluff outlet are still pending but would be required to stop the bluff erosion and protect the two adjacent residential properties.

8. Geotechnical Issues:

The majority of the geotechnical issues for Alternative 2A are similar to Alternative 1A, with the exception that tunneling elements do not apply. Also, a Q50 storm drain pipe must be added through the Tarapaca Landslide area within the "buttress fill". The pipe though the "buttress fill" could be subject to some unwanted and potentially pipe damaging land movement as the Tarapaca Landslide settles permanently against the buttress fill (**see previous Alternative 1A Item 8 write up**). Also note the connection to existing City system includes some additional geotechnical input / requirements. The area of the storm drain where the proposed system connects to the existing City system is underlain by recent alluvium over landslide debris of the South Shores landslide. It is likely the alluvial soils underlying the pipe trench and the connection area will require corrective grading to remove compressible alluvial soils.

9. Flood Protection:

- **Upstream of 25th Street:** The proposed storm drain will be design to convey a 50-year storm reoccurrence.
- **Downstream of 25th Street:** The existing CLA storm drain south of 25th Street was designed to roughly convey a 50-year storm event (see previous discussion about doubts that it will perform well under a full Q50 storm). A Hydrology/Hydraulic study was done by Harris & Associates. The study found that the existing system can convey the flows of a 50-year storm but the resulting velocities range from 19 fps to 48 fps, with the velocities ranging closer to 48 fps. Per the City of Los Angeles as-built plans, the pipe was not specified to have extra thickness cover over the steel to handle the high velocities. BOTTOM LINE: The deficiencies in the existing CLA Storm Drain system will have to be remedied in some agreeable manner to allow the proposed construction / connection of Alternative 2A (and 2B), which is not the case for the tunnel diversion storm drain Alternatives 1A & 1B.

10. Impacts to the City of Los Angeles (CLA):

Since the proposed Alternative 2A storm drain alignment would encroach into CLA and requires a connection to and upgrades to the CLA SD the anticipated impacts to and involvement by CLA would be considerable. CLA will likely dictate every element of the proposed design form the large debris basin to pipe (and other) materials and construction methods. This could be complicated by the fact that CLA has said that no funding is readily available to build the new SD improvements, much less upgrade their existing storm drain system, south of 25th Street. As this PSR is circulated to CLA staff more input on their role and involvement, including funding, will be available.

11. Impacts to the Los Angeles County (LAC):

As long as the alignment of the access road is not on the westerly canyon slope and shifted away from the easterly canyon slope and thus not going through Friendship Park (LAC's property) only a small easement, if any would be required from LAC. Further, LAC did mention they have no jurisdictional authority in the project, which would remain the case especially if a MTD process is not pursued between RPV and LAC. If a MTD transfer is pursued from LAC for the new SD pipe from 25th Street

upstream then LAC would be involved to a similar extent as CLA staff. Once again, this would likely dictate every element of the proposed design from the large debris basin, to pipe (and other) materials and construction methods.

12. Impacts to Private Residents:

The majority of the private resident impacts for Alternative 2A are similar to Alternative 1A, with the exception that the two (2) properties upstream of 25th Street will be much more significantly impacted because the 48" RCP storm drain pipe must be added through the middle of their properties and significant grading will also be required (**see previous Alternative 1A Item 12 write up**).

13. Impacts to Traffic:

Alternative 2A requires the temporary open trenching across one half of 25th Street therefore making this alternative (and Alternative 2B) the most impactful to traffic I. Otherwise only minor temporary lane closures would be allowed during construction and traffic control would be limited to informational signs and some traffic control during ingress/egress of any construction traffic into/out of the project sites.

14. Resulting Service Life:

Alternative 2A is anticipated to have service life that is comparable to any similar storm drain system, which will be facilitated in the long-term by the clear water requirement. As long as the Tarapaca Landslide does not "settle" and cause deformation to the proposed 48" pipe, then the long-term service life is estimated to be at least **75-years** for the both the pipe and reinforced concrete inlet / outlet structures. Further the service life will be similar to the other alternatives being considered, thus not raising the "service life" issue to be a distinguishing factor between the various alternatives.

15. Future Maintenance Issues:

Alternative 2A (and 2B) is anticipated to have the most significant future maintenance requirements because of CLA's requirement for clear water flows that trigger the requirement for a large debris basin that must be maintained regularly.

D. Alternative 2B – Upper-canyon inlet with "canyon alignment" outletting to 25th St SD

Alternative 2B consists essentially of the exact same design approach and alignment as Alternative 2A with some exceptions. Instead of constructing a large mid-canyon inlet within San Ramon Canyon, the proposed storm drain alignment would be extended upstream. The upper canyon alignment would consist of a 48-inch HDPE pipe installed via "prepared canyon bottom backfill" installation in an imported canyon fill along the natural canyon invert (**see Alternative 2B conceptual plans and Typical Section D-D in Appendix G**). The proposed pipe would extend an additional 1,300-feet upstream of the Mid-Canyon inlet structure location and would connect with an existing upper San Ramon Canyon storm drain outlet pipe with a junction structure (**see previous Photo F12**). This upstream outlet pipe was constructed as part of the slope repair and terrace drain construction performed in 2002. The 48-inch HDPE pipe in this upper-canyon alignment would be placed above a perforated 12" diameter pipe (**see Typical Section D-D in Appendix G**). No excavation

below the existing canyon floor would be done. The placement of the storm drain would be on top of "bedding" which would be placed above the canyon floor.

The remaining alignment downstream would be exactly the same as Alternative 2A with the only difference that perhaps a medium mid-canyon inlet structure would still be required. This mid-canyon inlet would intercept any additional surface flows that are tributary to the natural canyon slopes (and from the down drain for the Tarapaca Road cul-de-sac and Tarapaca Slide "brow ditch" above the head-scarp).

The thought process driving this "sub-alternative" is that since the main line storm drain flows have already been collected from the housing tract above and confined to a pipe it may be advantageous to keep these flows in a pipe rather than allowing these concentrated flows to again run free in the natural channel bottom.

Alternative 2B Facts:

- Tributary area = 98 acres (top connection point)
- Tributary area = 184 acres (northerly side of 25th Street)
- Q_{50} of 122 cfs (top connection point)
- Q_{50} = 219 cfs (northerly side of 25th Street)
- Q_{100} = 143 cfs (FYI only, top connection point)
- Q_{100} = 263 cfs (FYI only, top connection point)
- Upper-canyon connection junction structure
- 48-inch HDPE mainline in upper & lower canyons
- Mid-canyon inlet structure
- CLA 25th Street storm drain outlet
- Total Cost: $21.4 million

MTD Transfer of Alternative 2B: The option of transferring the maintenance of the Alternative 2B storm drain via the Miscellaneous Transfer Drain (MTD) process to the County of Los Angeles Land Development Department (LAC) is the same as for Alternative 2A (**see previous write up**).

Fifteen Point Analysis of Alternative 2B

The following addresses **Fifteen (15)** major issues associated with the Alternative 1B and will similarly be addressed for all of the other alternatives and are rated in a summary chart on page 28 of the PSR.

1. **Project costs:**
   - Construction: **$12.6 million**
   - PS&E = **$1.1 million** (8% assumed)
   - Design Admin / CM / Inspection = **$1.1 million** (8% assumed)
   - R/W and Easement = **$1.3 million** (place holder cost if necessary)
   - Environmental Mitigation = **$500,000**

   Grand Total = $21.1 million (includes 30% contingency)

2. **Project Schedule:**

Funding Procurement Period:	***_ Months** (Can overlap with PS&E Design Phase)
PS&E Design Phase:	**12 Months** (Includes additional geotechnical study)
MND Prep & Approval:	**18 Months** (Can overlap with Design / Bid Phase)
CLA Review & Approval:	**36 Months** (Actual time pending CLA/LAC input)
Obtain R/W & Easements	**12 Months** (Actual time pending CLA/LAC input)
Bidding / Award Phase:	**6 Months** (Includes advertise/bid/award/contracts)
Construction Phase:	**11.5 Months** (See below for additional breakdown)
Approximate Total Time Required:	**82.5 Months or 7 Years & 3 months***

*** NOTE:** If funding can be obtained during the same overlapping period that the PS&E Design Phase is completed and the Mitigated Negative Declaration (MND) environmental clearance documents can overlap with both the design and CLA review phases then construction of Alternative 2A could be completed as soon as Winter 2018, assuming that the PS&E Design Phase could begin as soon as Summer 2011.

Construction Schedule Breakdown

Mobilization / Clearing & Grubbing / Rough Grading =	4 weeks
Open cut in 25th Street to connect to 48" RCP =	2 weeks
Const small downstream inlet structure =	4 weeks
Const "prepared canyon bottom backfill" reach in canyon (1,900') =	6 weeks
Const canyon buttress fill / new creek invert =	6 weeks
Const access road to upstream inlet structure =	6 weeks
Const "prepared canyon bottom backfill" reach in upper canyon (1,300') =	8 weeks
Const upstream junction structure =	2 weeks
Const large upstream inlet structure / debris basin =	8 weeks
Demobilization / punch list / Clean up / hydro-seed =	4 weeks
Sub-Total Construction Period =	**50 weeks (12.5 months)**
10% reduction due to overlapping operations =	**4 weeks (1 month)**
Grand Total Construction Period =	**46 weeks (11.5 months)**

3. **Constructability issues:**

Because Alternative 2B consists essentially of the exact same design approach and alignment as Alternative 2A all of the constructability issues raised in the Alternative 2A discussion also apply to Alternative 2B, with two exceptions / clarifications:

- **Small Mid-Canyon Inlet:** The large mid-canyon inlet in Alternative 1A will be replaced with a smaller mid-canyon inlet in Alternative 1B and, as such, any issues raised in the previous Alternative discussion would also apply here, including the need to grade an access road, but some canyon impacts would be smaller in scale.

- **Upper Canyon Pipe Line:** The additional 1,300-feet of 48-inch HDPE pipe will be installed via "prepared canyon bottom backfill" in an imported canyon fill onto of a filter fabric wrapped rock galley with a 12-inch perforated pipe, directly on top of the natural canyon invert. This length would connect the smaller mid-canyon inlet structure to an existing upper San Ramon Canyon storm drain outlet pipe (**see previous photo F12**). The constructability issues applicable to this reach would be most similar to Alternative 2A, which also has proposed mainline storm drain pipe being installed within the narrow existing canyon, except with less risk of land movement since there is no active landslide in this area (**see Alternative 2A constructability discussion that follows**).

4. **Availability of Material and Methods:**
   Alternative 2B is essentially the same as Alternative 2A (**see previous Item 4 write up**). One clarification is that more imported fill will be required, but is not anticipated to be an issue due to the excess fill available in the Portuguese Bend area. Specifically it estimated that 67,680 cubic yards of fill would be required for Alternative 1B versus 44,770 cubic yards for Alternative 1A to achieve the new canyon flow line and cross section (**see Section E-E on plan sheet 6 of 6 for Alternative 1A in Appendix G**).

5. **Contractor's Expertise Required:**
   Alternative 2B is essentially the as Alternative 2A (**see previous Item 5 write up**).

6. **R/W and Easement Requirements:**
   Alternative 2B is essentially the same as Alternative 2A (**see previous Item 6 write up**).
   In addition to the properties from Alternative 2A, there are a total of 14 properties within the City of Ranch Palos Verdes for which the City would have to acquire a storm drain easement as follows:

   a. 7561-038-007 - 0.01 acres
   b. 7561-038-008 - 0.02 acres
   c. 7561-038-017 - 0.06 acres
   d. 7561-038-010 - 0.06 acres
   e. 7561-038-011 - 0.07 acres
   f. 7561-038-012 - 0.07 acres
   g. 7561-033-009 - 0.09 acres
   h. 7561-033-010 - 0.10 acres
   i. 7561-033-011 - 0.09 acres
   j. 7561-033-012 - 0.06 acres
   k. 7561-033-013 - 0.04 acres
   l. 7561-033-014 - 0.01 acres
   m. 7561-041-012 - 0.05 acres
   n. 7561-041-002 - 0.37 acres

   Total easement required for the construction of Alternative 2B is 2.53 acres. Although it is anticipated that the City will be granted a no-cost construction easement for Alternative 1B because the drainage system will be beneficial to the adjacent property owners, for worse case estimation purposes, a $500,000/acre placeholder cost has been included in the project estimate.

7. **Environmental Impacts:**
   Alternative 2B is essentially the same as Alternative 2A, with the exceptions that more pristine canyon will be affected and that the view of additional private residents

would be affected by Alternative 1B because more of the canyon floor will be disturbed by the extended pipe length (**see previous Item 7 write up**).

8. **Geotechnical Issues:**
   Alternative 2B is essentially the same as Alternative 2A (**see previous Item 8 write up**).

9. **Flood Protection:**
   Alternative 2B is essentially the same as Alternative 2A, with the exception that additional protection could be argued to apply to Alternative 2B because more of the canyon floor is protected from erosion by the extended pipe length (**see previous Item 9 write up**).

10. **Impacts to the City of Los Angeles (CLA):**
    Alternative 2B is essentially the as Alternative 2A (**see previous Item 10 write up**).

11. **Impacts to the Los Angeles County (LAC):**
    Alternative 2B is essentially the same as Alternative 2A (**see previous Item 11 write up**).

12. **Impacts to Private Residents:**
    Alternative 2B is essentially the same as Alternative 2A, with the exception that the view of additional private residents would be affected by Alternative 2B because more of the canyon floor will be disturbed by the extended pipe length (**see previous Item 12 write up**).

13. **Impacts to Traffic:**
    Alternative 2B is essentially the same as Alternative 2A (**see previous Item 13 write up**).

14. **Resulting Service Life:**
    Alternative 2B is essentially the same as Alternative 2A (**see previous Item 14 write up**).

15. **Future Maintenance Issues:**
    Alternative 2B is essentially the same as Alternative 2A, with the exception that slightly more maintenance will be required for Alternative 2B because of the extended pipe length (**see previous Item 15 write up**).

E. Alternative 3 (Low Cost): Upsize 25th Street inlet and line existing canyon invert

Alternative 3 proposes to line the existing stream bed with materials that would eliminate further erosion (i.e. concrete channel which would exacerbate the environmental issues or ungrouted rip rap) and would also include constructing a very large debris basin to generate clear water flows and eliminate debris flow onto 25th Street. The basin would be connected to the storm drain pipe under 25th Street.

This alternative would not address the Tarapaca landslide, so there would continuously be debris flowing to the existing City of Los Angeles system.

Alternative 3 Facts:

- Tributary area = 187 acres
- Q_{50} = 144 cfs
- Q_{100} = 217 cfs
- Upper 25th Street inlet structure with large debris basin
- Bluff bottom outlet structure
- Total Cost: $3.7 million

Fifteen Point Analysis of Alternative 3 (Low Cost)

The following addresses **Fifteen (15)** major issues associated with the Alternative 3 and will similarly be addressed for all of the other alternatives and are rated in a summary chart on page 28 of the PSR.

1. **Project costs:**
   - Construction: **$2.0 million**
   - PS&E = **$200,000** (10% assumed)
   - Design Admin / CM / Inspection = **$200,000** (10% assumed)
   - R/W and Easement = **$250,000** (place holder cost if necessary)
   - Environmental Mitigation = **$200,000**

   Grand Total = $3.7 million (Includes 30% contingency)

2. **Project Schedule:**

Funding Procurement Period:	* **Months** (Can overlap with PS&E Design Phase)
PS&E Design Phase:	**12 Months** (Includes additional geotechnical study)
MND Prep & Approval:	**18 Months** (Can overlap with Design / Bid Phase)
CLA Review & Approval:	**36 Months** (Actual time pending CLA/LAC input)
Obtain R/W & Easements	**12 Months** (Actual time pending CLA/LAC input)
Bidding / Award Phase:	**6 Months** (Includes advertise/bid/award/contracts)
Construction Phase:	**4.5 Months** (See below for additional breakdown)
Approximate Total Time Required:	**48 Months or 4 Years ***

* **NOTE:** If funding can be obtained during the same overlapping period that the PS&E Design Phase is completed and the Mitigated Negative Declaration (MND) environmental clearance documents can overlap with both the design and CLA review phases then construction of Alternative 3 could be completed as soon as Winter 2015, assuming that the PS&E Design Phase could begin as soon as Summer 2011.

Construction Schedule Breakdown

Mobilization / Clearing & Grubbing / Rough Grading =	4 weeks
Const canyon buttress fill / new creek invert =	10 weeks
Demobilization / punch list / Clean up / hydro-seed =	4 weeks
Grand Total Construction Period =	**18 weeks (4.5 months)**

3. **Constructability issues:**
   - The stability of the canyon walls within the Tarapaca Landslide area during construction is of primary concern, however, it is an issue that is common for all alternatives and is actually less of an issue for this Alternative 1A since the added step of installing a large mainline storm drain pipe within the canyon backfill does not apply to Alternative 3. Thus the canyon backfill operation will actually be more simplified for Alternative 3 than for any other alternative. As previously mentioned the "gravity buttress" fill of approximately 20 to 30-feet in depth would be placed from upstream of Tarapaca Landslide downstream along the entire canyon limits past the existing Tarapaca Landslide area then eventually tapered down to join the existing canyon invert downstream (**similar to Section E-E on Alternative 1A, Sheet 6 of 6 in Appendix G**) which would raise the existing canyon's invert and flatten the side slopes of the canyon. Additional temporary shoring methodologies and other related constructability issues need to be detailed during the future PS&E Design Phase. Special full time emergency monitoring will be also be required until enough of the buttress fill has been placed. The grading will likely be a trial and error process of reacting to localize movement and even causing controlled movement that can be graded into place and compacted in lifts.

     The actual process to place the fill, starting from the bottom, will include minor grading (if any) and placement of a thin layer of base rock (to avoid undercutting the slide toe and to create a relatively level pad) and then placement of filter fabric to hold back "fine particles". The excess filter fabric material on each side of the canyon floor, which will wrap the sides and top of a rock galley sub-drain, will be pinned up onto the sides of the canyon wall while another layer of base rock is placed, then a 12-inch perforated PVC sub-drain will be installed, additional galley rock placed and then the fabric will be folded over into place on top of the rock galley. After the sub-drain rock galley is complete the placement of the canyon backfill can begin in rapid fashion and "keyed" into the existing canyon slopes via multiple stepped "notches". It is anticipated that imported backfill will be required in conjunction with the existing canyon excavation that will undoubtedly be spilling into the backfill operation as the grade is raised higher and higher. Eventually the width of the backfilled canyon will be comfortably wide and the adjacent canyon slopes will stop spilling into the operation as that grades approach the designed raised canyon flow line elevation. It is even conceivable that this stable canyon access path could be used as an alternative temporary access road to the site during construction. Eventually the canyon invert and flattened slopes will be hydro-seeded with an approved native plant mix in combination with jute mesh, fiber roles and other recommended erosion control measures that will allow the plants time to get established.

4. **Availability of Material and Methods:**
   - **Fill:** In order to stabilize the canyon walls, it is recommended that a substantial amount of fill be placed to elevate the canyon invert and to decrease the vertical slopes of the existing canyon walls. It estimated that 21,000 cubic yards of fill would be required to achieve the new canyon flow line and cross section (**similar to Section E-E on plan sheet 6 of 6 for Alternative 1A in Appendix G**). The City has indicated the Portuguese Bend is also a possible source of fill materials that would not require hauling and traffic impacts outside the RPV peninsula area. Other sources of fill will have to be studied during the PS&E phase.

5. **Contractor's Expertise Required:**
   Alternative 2A does not require any special tunneling expertise thus a wider variety of contractors would be eligible to perform this work.

6. **R/W and Easement Requirements:**
   The more extensive grading work would be on the lower two (2) private properties (APN 7562-001-009 upstream of 25th Street and APN 7561-025-900 County of Los Angeles). A temporary construction easement will also need to be obtained from the property owner adjacent to 25th Street for access to the canyon from the south.

7. **Environmental Impacts:**
   - **Canyon fill:** All of the alternatives will fill the canyon utilizing similar methods so this item is not a distinguishing factor between the alternatives.
   - **Existing CLA SD System & Outlet Structure:** As previously mentioned more flows will be added to the existing CLA storm drain due to the construction of inlet structure at the upstream of 25th Street. The deficient the existing mid-bluff 84" RCP outlet pipe will require improvement, which are still pending but would be required to stop the bluff erosion and protect the two adjacent residential properties.

8. **Geotechnical Issues:**
   - The area of the storm drain where the proposed system connects to the existing City system is underlain by recent alluvium over landslide debris of the South Shores landslide. It is likely the alluvial soils underlying the pipe trench and the connection area will require corrective grading to remove compressible alluvial soils. **Also see previous Alternative 1A Item 8 write ups.**

9. **Flood Protection:**
   See previous Alternative 2A Item 9 write up. This alternative is similar in that once the upstream inlet of 25th Street is upsized, the flows for which the downstream CLA system was designed, will be conveyed by the existing system.

10. **Impacts to the City of Los Angeles (CLA):**
    Since the proposed Low Cost Alternative 3 would primarily be within CLA and requires a connection to and upgrades to the CLA SD the anticipated impacts to and involvement by CLA would be considerable. CLA will likely review every element of the proposed design form the large debris basin to pipe (and other) materials and construction methods. This could be complicated by the fact that CLA has said that

no funding is readily available to build the new SD improvements, much less upgrade their existing storm drain system, south of 25th Street. As this PSR is circulated to CLA staff more input on their role and involvement, including funding, will be available.

11. Impacts to the Los Angeles County (LAC):

Only a small easement, if any would be required from LAC within Friendship Park (LAC's property). Further, LAC mentioned their nonexistence jurisdictional authority for this project, which would remain the case especially if a MTD process is not pursued between RPV and LAC.

12. Impacts to Private Residents:

The majority of the private resident impacts for Alternative 3 are similar to Alternative 1A, with the exception that the two (2) properties upstream of 25th Street will be much more significantly impacted because the proposed inlet and large debris basin must be added through the middle of their properties and significant grading will also be required (**see previous Alternative 1A Item 12 write up**).

13. Impacts to Traffic:

Alternative 3 requires the temporary open trenching across one half of 25th Street therefore making this alternative one that impacts traffic significantly. Otherwise only minor temporary lane closures would be allowed during construction and traffic control would be limited to informational signs and some traffic control during ingress/egress of any construction traffic into/out of the project sites.

14. Resulting Service Life:

Alternative 3 is essentially the same as Alternative 2A (**see Alternative 2A, Item 14 write up**), with the difference of the Tarapaca Landslide stabilization.

15. Future Maintenance Issues:

Alternative 3 is anticipated to have significant future maintenance requirements because of CLA's requirement for clear water flows that trigger the requirement for a large debris basin that must be maintained regularly. Also, the fill within canyon will not address the existing Tarapaca Landslide and it is expected that erosion will continue to occur. Future storms will continue to carry sediment and debris down the canyon and on to the proposed debris basin.

F. Alternative 4 – No Project Alternative: Leave existing conditions "as is"

Alternative 4 proposes to leave conditions as they presently exist. As a result of proceeding with this alternative, the City should be expecting flooding during moderate rain events, and possibly in the near future, the failure of the PVDE switchback along with the possible failure of 25th Street. This would allow the previously detailed existing dangerous conditions to remain and carries considerable risk that essentially guarantees the "no project" alternative is NOT a "no cost" alternative, likely costing more than the alternatives in the long-term if a "claim" ever arises that eventually trigger one of the other alternatives to be constructed on top of settling the claim.

- Tributary area = 187 acres
- Q_{50} = 144 cfs
- Q_{100} = 217 cfs
- Existing two (2) twelve inch CMP stand pipes as inlet
- Existing failing Bluff bottom outlet structure
- Total Present Cost: $0
- Total Future Cost: Could be in the millions if loss of life or property would occur

Fifteen Point Analysis of Alternative 4 (No Cost Alternative)

The following addresses **Fifteen (15)** major issues associated with the Alternative 4 and will similarly be addressed for all of the other alternatives and are rated in a summary chart on page 28 of the PSR.

1. **Project costs:**
   - Construction: **$0 million**
   - PS&E = **$0**
   - Design Admin / CM / Inspection = $**0**
   - R/W and Easement = $**0**
   - Environmental Mitigation = **$0**

   Grand Total = $0 present costs but
   UNLIMITED FUTURE MAINTENANCE AND LIABILITY COSTS

2. **Project Schedule:**
   Not Applicable

3. **Constructability issues:**
   Not Applicable

4. **Availability of Material and Methods:**
   Not Applicable

5. **Contractor's Expertise Required:**
   Not Applicable

6. **R/W and Easement Requirements:**
   Although a permanent easement is not required due to "No Project" being constructed, some type of agreement will need to be addressed with the property owner upstream of 25th Street (APN 7562-001-009) in order for City of Los Angeles to perform maintenance at the existing inlet.

7. **Environmental Impacts:**
   Not Applicable

8. **Geotechnical Issues:**
   Not Applicable

9. **Flood Protection:**
   This alternative has less than a 10-year storm reoccurrence.

10. **Impacts to the City of Los Angeles (CLA):**
    This alternative will continue to have flooding on 25th Street during consecutive storm events. CLA will have to do

11. **Impacts to the Los Angeles County (LAC):**
    None

12. **Impacts to Private Residents:**
    Flooding of 25th Street and potential collapse of the existing block wall on the southerly side of 25th Street, could possibly result in flash flood events at the downstream mobile home park community. This may result in loss of property and even possibly loss of life.

13. **Impacts to Traffic:**
    Flooding of 25th Street during consecutive rain events, as seen with the storms of January 2010, will result in complete closures of 25th Street and therefore impeding daily traffic from reaching their destination. Additionally, if closure of 25th Street would occur, emergency response vehicles would not be able to reach their

14. **Resulting Service Life:**
    Not Applicable – same as existing CLA SD system

15. **Future Maintenance Issues:**
    Repeated major debris removal after several consecutive storms would have to be performed.