MAINTENANCE MANUAL

PREPARED FOR LOCH LOMOND UNIT 10

GENERAL

This manual has been prepared to establish procedures for proper functioning of surface and subsurface drainage facilities at the Loch Lomond Unit 10 Assessment District San Rafael, California. This manual will provide specifications for inspecting, maintaining, and repairing the Loch Lomond 10 drainage and landslide mitigation systems (i.e. v-ditches, catch basins, manholes, cleanout risers, subdrains, benches, deflection walls, debris fences, detention basins, fire and maintenance access roads identified as the "Facilities")

It is the responsibility of the City to consult with an appropriately licensed engineer so that drainage facilities are maintained and inspected no less than once a year, or as necessary. An annual Maintenance and Inspection Report shall be submitted to the City and Assessment District Lot owners prior to October 1st each year. This report shall detail the inspections, maintenance, and repairs performed for the previous year. All of the hereinafter listed yearly inspections and maintenance, for the proceeding winter, shall be the responsibility of the Department of Public Works (DPW) and will be completed prior to October 1st depending on the availability of funds and other priorities of the Department. A sample format for these reports is contained herein. In general, the purpose of this report is to establish a history of the required maintenance for the improvements concerned herein. As problems develop or abate through the years, then the Public Works Director may recommend appropriate modifications to this Maintenance Manual.

A reduced copy of the As-Built Improvement Plans "Oberkamper Loch Lomond Unit 10 dated March 4, 1996" is attached to this report. As maintenance is performed in future years the As-Built Improvement Plans shall be updated with annotations and become part of the annual report. Full-size originals are also on file with the City of San Rafael. These plans shall be used as the basis for all remedial repair work.

Whenever the term "licensed engineer" is used herein, it shall refer to a Professional Engineer. The engineer shall be licensed by the state of California Board of Registration for Professional Engineers.

Detention Basins

The purpose of the detention basin is to detain storm water runoff, thereby decreasing the downstream peak flow. During storm events, which are expected to occur about once every 25 years, the water detained in the basin will rise to a level about 1 foot below the emergency spillway. Within several hours to a day after a cessation of rainfall, the basin will have a nominal amount of water in it. This nominal amount will have a level below the top of the outlet structure. As the captured silt level rises through the winter, the depth of the nominal water will decrease. Eventually the silt level could be practically equal to the nominal water level and will require removal.

Regular inspections should be scheduled once a year. These inspections should be done after June 1st. The purpose of the inspection is to determine the amount of maintenance to be completed

prior to October 1st. The amount of maintenance to be performed will be determined as follows: If the silt captured in the basin has risen to a depth where stormwater runoff is flowing into the emergency overflow spillway, then all of the collected silt shall be removed. During the silt removal operations, the basin shall be returned to its original configuration. (The original configuration can be determined from the attached As-Built Improvement Plans). Any silt which has infiltrated the rocks around the outlet structure shall be removed by flushing or by some other appropriate means. Any rocks removed during the silt removal operations shall be replaced with ones of equal dimensions and quality. The inside of the outlet structure shall be cleaned as well as the outlet pipe. Any vegetative debris as well as vegetation growing in the basin shall be removed. It is not necessary to remove any grasses as they will help provide stability and soften the visual impact of the basin. It is anticipated that removal of the silt will entail the use of equipment such as a front-end loader or backhoe and a dump truck to haul off the excavated silt. The excavated silt shall be disposed of off the property.

In addition to the above yearly inspections, the basin should be observed several times during winter to ascertain that it is functioning properly. If runoff is observed to be spilling over the emergency spillway, then the outlet structure and piping should be inspected and cleaned once the basin is down to its nominal water level. If the basin does not drain to its nominal water level within 24 hours, then it should be pumped out so that the obstruction in the outlet system can be removed.

In the event that any action, or damage resulting therefrom, occurs which is not covered herein, then it is the responsibility of the Department of Public Works to contact a licensed engineer for the purpose of remedying the situation. Such additional repair measures as the engineer recommends shall be performed as so directed.

Responsibility: DPW

Concrete V-Ditches

The purpose of the concrete lined ditches is to carry storm water runoff. These ditches should be inspected once a year, after the end of the rainy season. At this time any soil or vegetative debris which has fallen into the ditch should be removed. If there is evidence of erosional rills or gullies, then these rills or gullies should be filled in. On-site native material may be used to fill in any small erosional rills or gullies. The fill material should be well tamped in place. Any erosional damage exceeding 12 inches in depth should be repaired only based on the recommendations of a licensed engineer.

In the event that the erosional rills or gullies are undercutting the concrete lined ditch, then diversionary checks shall be installed, as shown on Detail 1. These checks should be installed at 25 feet intervals, perpendicular to the filled rill or gully so that water will be directed into the ditch.

Some cracking and displacement of the concrete ditches is anticipated. Any cracks wider than one-eighth of an inch in width should be filled in with sand to within 1 inch of the surface and the last 1 inch shall be plugged with hot tar. Any displacement or cracking exceeding 1 inch should be repaired based on the recommendation of a licensed engineer.

It is anticipated that this work will all be accomplished by hand labor. The duration of the work will be dependent on the amount of debris or dirt to be removed and on the amount of erosional damage.

Responsibility:

DPW is responsible for inspecting all v-ditches within District 10

Ditches in open space or within private property designated City Drainage Easements – DPW

Ditches on Private Property designated Private Drainage Easements - Individual property owner.

Subdrains and Cleanout Risers

The purpose of the subdrain system is to collect underground water and transport it to drainage ways. In no event shall any surface waters be allowed to drain into the subdrain system, excepting that necessary for cleaning. The subdrains should be cleaned once a year after the end of the preceding rainy season. The entire system shall be cleaned using the appurtenant risers, manholes, outlets and piping. All vegetation shall be cleaned from around and within the outlet.

All subdrains will be flushed by running water into a cleanout and observing the clarity of water exiting at the outlet. When the water runs clean, then the flushing operations may be moved to the next cleanout. Only one cleanout at a time shall be flushed in any interconnected system. This is so that each particular run of pipe may be verified to be free of blockages. If after a reasonable length of time flushing, the water is not exiting from the outlet at substantially the same rate as it is entering or not at all, then it is to be assumed that there is a substantial blockage in the line. The line shall then be probed with a commercial rooter to determine the location of the blockage. If the blockage cannot be removed by the rooter prober, it will be necessary to replace the blocked section. Any excavation and replacement of subdrain lines shall only be done based on the recommendations of a licensed engineer. If after a long period of time the water continues to flow and be cloudy (occasional small sand grains, etc. are acceptable), then it shall be assumed that the line is damaged and pipe will need to be replaced.

The subdrains shall also be observed twice during the rainy season. The purpose of these observations is to ascertain if the system is functioning properly. The first observation shall be performed during the first week of December. The second observation shall be performed during the first week of February.

There should be some water exiting the subdrain outlets. The amount of water should be noted (i.e., dripping at what rate or flowing continuously and approximately size of stream) for future reference. The amount of rainfall to date should also be noted so that a rough correlation between rainfall and flow can be determined. In the future, the same general flow rate should be observed for the same general quantity of rainfall. If the flow exiting the subdrain is substantially diminished or non-existent, assuming flow has exited in the past, then the line shall be flushed and

cleaned according to the above. All subdrain observation reports shall be reviewed and approved by a licensed engineer.

Responsibility: DPW

Storm Water Inlets, Manholes and Storm Drain Pipes

The purpose of the storm water inlets is to collect storm water runoff and convey it via the storm drain pipes to a downstream facility; whether natural or man-made. All storm water inlets, manholes and storm drain pipes shall be inspected and cleaned once a year, after the end of the preceding rainy season. The storm drainage system is not meant to be a receptacle for trash or debris. No leaves or other debris shall be deliberately swept or washed into the system, or into ditches or gutters which drain to the system.

The tops of all storm drain structures shall be removed and the insides of the structures cleaned of all debris and silt. Once the structures are clean then the pipes shall be thoroughly flushed with water. The water supply shall be the equivalent of that delivered by a 2-inch-diameter fire hose attached to a fire hydrant, flowing full open. The flushing shall be continued until the water flows clean. If during the flushing, water is observed to completely fill a catch basin, then the downstream pipe is partially or fully blocked. Rodding out the pipe will be necessary to eliminate the blockage. In general, any debris which enters the pipe should be swept all the way through it.

All Corrugated Metal Pipe (CMP) as originally designed and installed was protected against corrosion. The abrasive action of any eroded soil may have deleterious effect on the corrosion protection. There may also be other causes of damage to the corrosion protection. Once the layer of corrosion protection is breached, then the pipe will start to corrode (unless it is aluminum). All CMP's should be checked for corrosion of the pipe, particularly along the flowline of the pipe. In general the pipe can withstand many years of corrosion. Once the wall thickness is reduced by half its original thickness, then the pipe should be repaired or replaced as directed by a licensed engineer.

During the rainy season, preferably during several rainstorms, the operation of the system shall be observed. The purpose of these observations is to ensure that the system is functioning properly. If water is not entering the storm water inlets due to debris or other obstruction, then the obstructions shall be immediately cleared. If a storm water inlet is full of water and overflowing, then the blockage shall be cleared as soon as is practical.

It is the responsibility of DPW to see that the entire system is operational and cleaned on an annual basis.

Responsibility: DPW

Debris Fences

The purpose of the debris fences is to catch initial downed vegetation and surface erosion after the initial construction of the subdivision. The fences catch larger and lighter debris including small logs, limbs, brush, small rocks and larger gravel.

An annual inspection of the debris fences shall be conducted in the fall of every year. Inaccessible debris fences will be noted and the homeowner notified (with copy to the District 10 HOA) that access must be provided. In locations that are accessible and where debris has accumulated over one half of the fence height, the debris should be removed and disposed off-site. The condition of the fence fabric should also be inspected and if more that 20% of the links have been cut/destroyed the fabric should be repaired or replaced to maintain a continuous "web" between the vertical supports. If the opening below the web is greater than approximately twelve inches, additional fencing will be added or other repairs will be made to connect the "web" to the ground below.

Responsibility: DPW

Fire/Maintenance Access Roads

The purpose of the Fire/Maintenance Access Roads is to provide vehicular paths to the off-road infrastructure. These roads were built as part of the subdivision improvements and are fully graded and paved with asphalt. Since the roads will receive only sporadic use, the road surface will not be flexed and the oils worked. As a result, the asphalt will act as a deterrent to weeds, but ultimately will "dry" out and crack.

The roads should be inspected annually in the spring or summer. As resources are available, weeds and brush should be removed per Fire Department recommendations from each shoulder and within the roadway to minimize vegetal encroachment on the access. Depression within the roadway should be noted and investigated. DPW should review the condition with the Fire Department to maintain access for fire and emergency vehicles and well as public works' equipment.

Responsibility: DPW

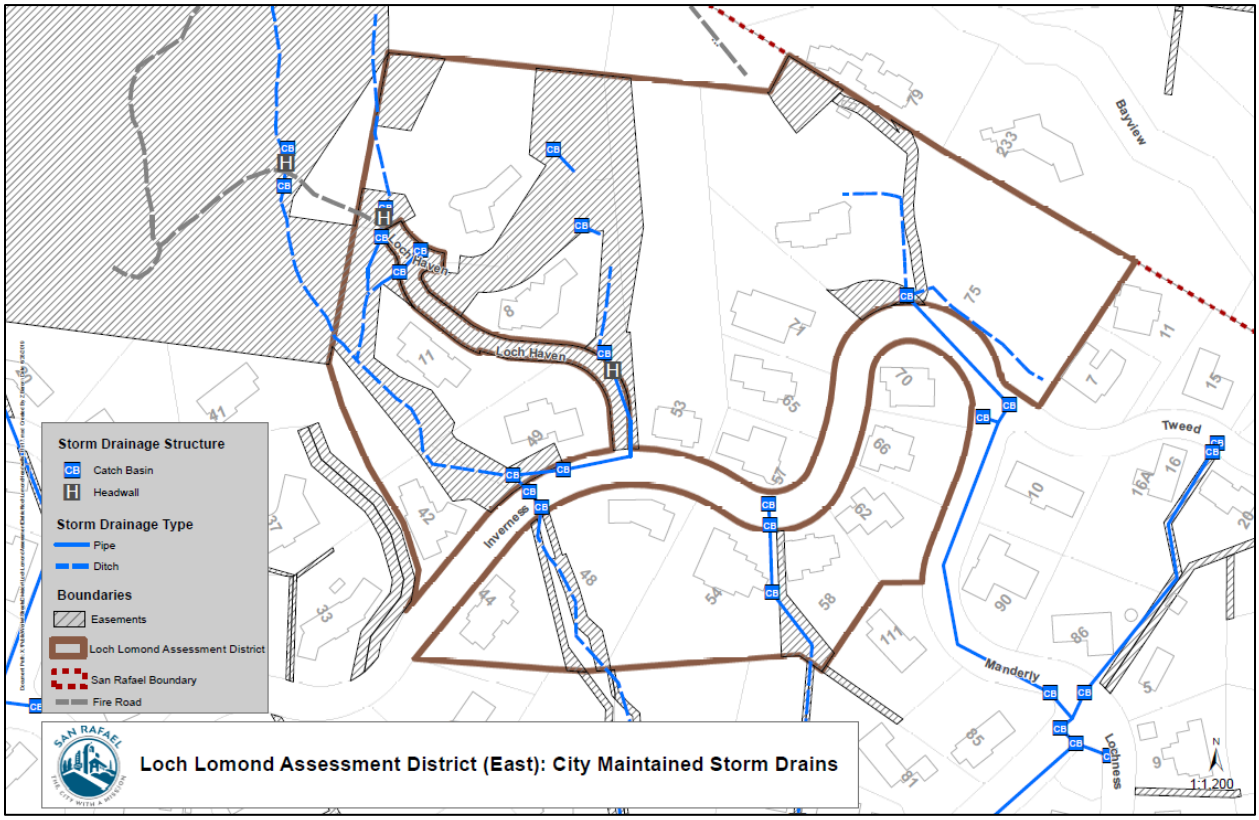
Deflection Walls

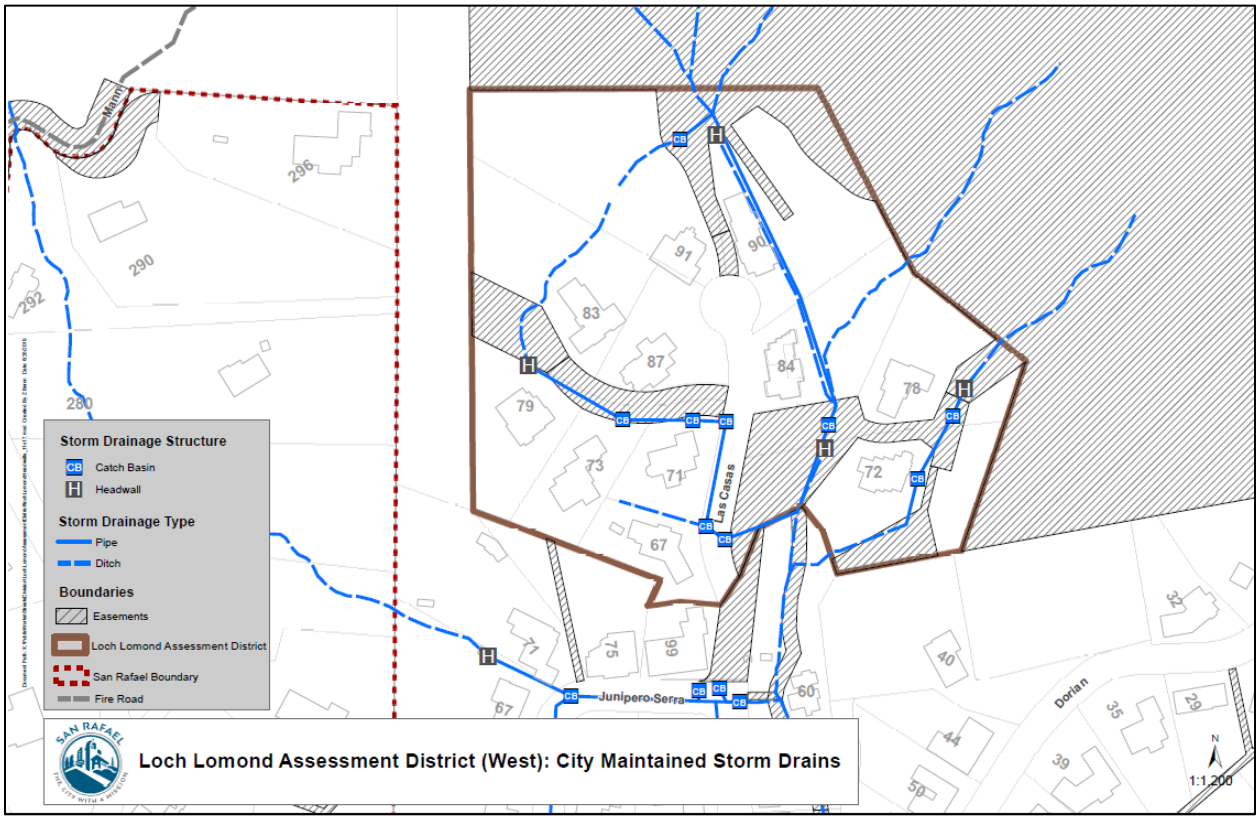
The purpose of the deflection wall that is shown on Sheet 6 of the As Build Plans is to direct runoff in the existing ditch further downstream to be collected in the storm drain pipe above Manderly Road. The deflection wall replaced an existing redwood wall. The area behind the redwood wall had eroded and a more permanent wall made from concrete block was constructed to replace the redwood wall. The wall was backfilled and erosion control fabric placed over the top of the backfill. Since the wall is concrete block, minimal maintenance is anticipated. Nevertheless the wall and backfill should be annually observed to detect any cracking, exposed reinforcing, movement, or other anomalies visible on the surface of the wall. Should the wall appear to be

compromised, and as funds might be available, DPW should seek the advice of a registered engineer to review and suggest possible repairs or other action.

Responsibility: DPW

General Maps showing the location of these systems are on the following page:





SAMPLE FORMAT
ANNUAL MAINTENANCE/OBSERVATIONS REPORT
FOR THE LOCH LOMOND HIGHLANDS SUBDIVISION

BY: LOCH LOMOND ASSESSMENT DISTRICT NO 10 DATE: _____
(Submit to the City by October 1st)

TABLE OF CONTENTS:
(Attached all Observation/Maintenance Reports)

1. STORM RELATED DETENTION BASIN OBSERVATION / MAINTENANCE REPORT
2. STORM RELATED SURFACE & SUBSURFACE DRAINAGE SYSTEM OBSERVATION / MAINTENANCE REPORT
    a. General Conditions
3. ANNUAL OBSERVATION / MAINTENANCE REPORT
    a. Specific Facilities
4. ADDITIONAL COMMENTS BY REVIEWING ENGINEER
    a. In general, the purpose of this report is to establish a history of the required maintenance for the improvements covered. As problems develop or abate through the years, then the reviewing engineer may recommend modifications to the maintenance procedures.

1. STORM RELATED DETENTION BASIN OBSERVATION/MAINTENANCE REPORT

BASIN: _____ DATE: _____

COMPILED BY: _____

TIME OF ARRIVAL: _____ TIME AT DEPARTURE: _____

WEATHER CONDITIONS (i.e., Raining, time since last rain, etc.)

□ Sunny/Clear □ Cloudy □ Rain

□ Partly Sunny □ Partly Cloudy Last Rain (date): _____

BASIN CONDITIONS (i.e., is water flowing in and quantity, level of water in basin, level of debris in basin, is outlet structure exposed, is water flowing out and where, any seepage on earth dam, etc.)

□ Water flowing into Basin □ Water flowing out of Spillway

□ Water above Top of Outlet

Water Clarity: □ Clear □ Lightly Clouded □ Turbulent/Muddy

MAINTENANCE MEASURES:

□ Removed floating debris

□ Removed silt by hand

□ Removed silt and debris mechanically

Note: if water is observed to be flowing over the spillway, then refer to the Maintenance Manual for possible remedial measures. Any other observed conditions which appear to pose a substantial threat to the integrity of the Basin should be brought to the attention of a licensed engineer.

II. STORM RELATED SURFACE & SUBSURFACE DRAINAGE SYSTEM OBSERVATION/MAINTENANCE REPORT

COMPILED BY: _____ DATE: _____

FACILITIES OBSERVED:
- □ Catch Basin
- □ Basin
- □ Curb and Gutter
- □ Debris Fence
- □ V-Ditch

ACTION:
- □ Removed debris with handtools
- □ Vactor truck removal
- □ Report to licensed engineer

WEATHER:

_____

_____

_____

OTHER COMMENTS:

_____

_____

_____

III. ANNUAL DRAINAGE SYSTEM OBSERVATION/MAINTENANCE REPORT

DATE: _____

COMPILED BY: _____ SHEET_____ OF _____

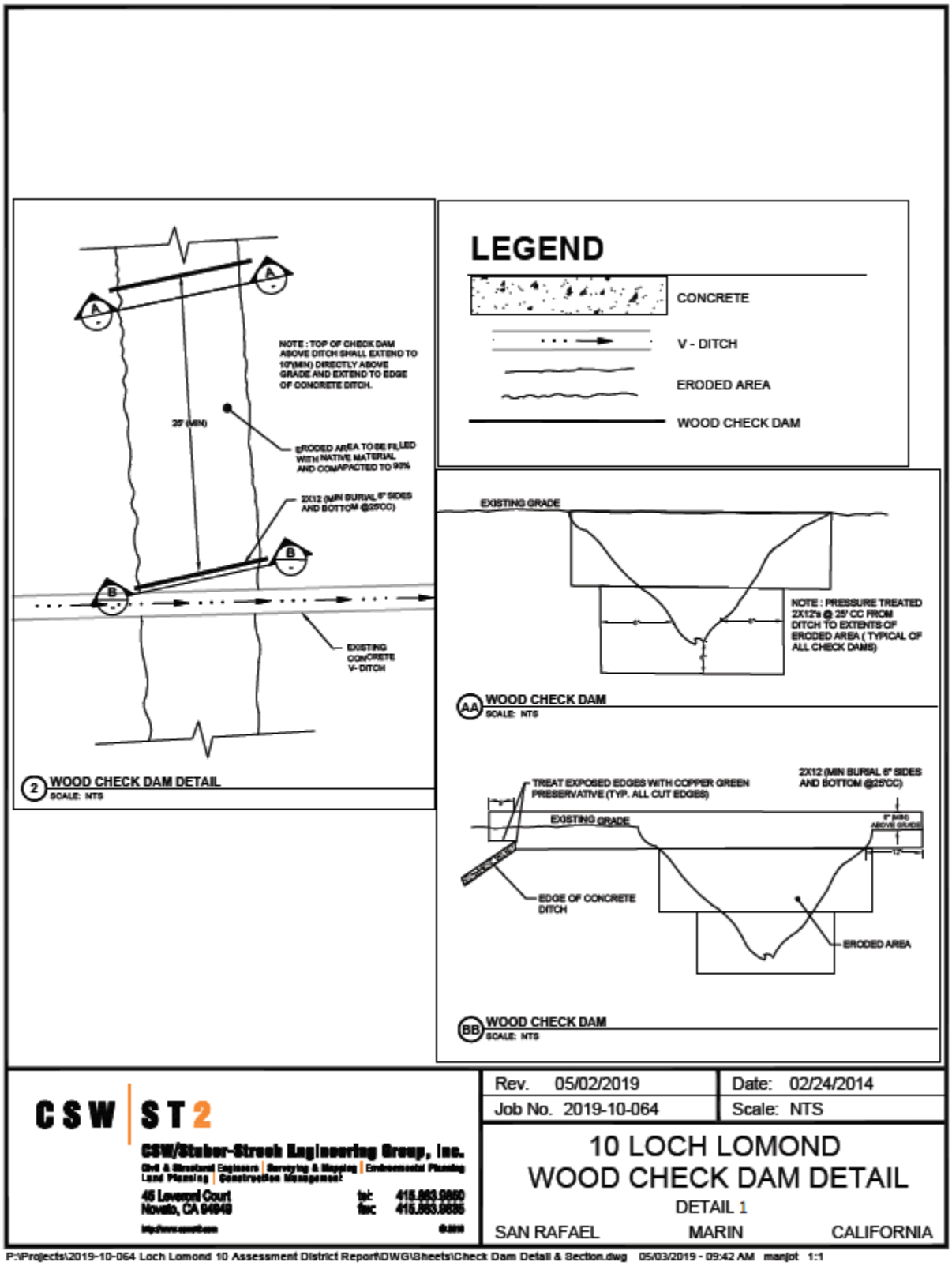
TYPE OF FACILITY	LOCATIONS	OBSERVED CONDITIONS, MAINTENANCE MEASURES & COMMENTS
(i.e., detention basins, manholes, storm line, subdrain, cleanout, v-ditch, bench, access roads, debris fences, deflection walls, etc.)	(i.e., Lot #, address, street etc.)	(i.e., flow & quantity, vegetation/debris amount of silty material, remedial measures taken, erosion, damage, etc.)

IV. ADDITIONAL COMMENTS BY REVIEWING ENGINEER

DATE: _____

COMPILED BY: _____ SHEET_____ OF _____

DETAIL 1


LEGEND
CONCRETE
V - DITCH
ERODED AREA
WOOD CHECK DAM
NOTE : TOP OF CHECK DAM ABOVE DITCH SHALL EXTEND TO 10"(MIN) DIRECTLY ABOVE GRADE AND EXTEND TO EDGE OF CONCRETE DITCH.
25' (MIN)
ERODED AREA TO BE FILLED WITH NATIVE MATERIAL AND COMPACTED TO 90%
2X12 (MIN BURIAL 6" SIDES AND BOTTOM @25'OC)
EXISTING CONCRETE V- DITCH
2 WOOD CHECK DAM DETAIL
SCALE: NTS
EXISTING GRADE
NOTE : PRESSURE TREATED 2X12's @ 25' CC FROM DITCH TO EXTENTS OF ERODED AREA (TYPICAL OF ALL CHECK DAMS)
AA WOOD CHECK DAM
SCALE: NTS
TREAT EXPOSED EDGES WITH COPPER GREEN PRESERVATIVE (TYP. ALL CUT EDGES)
2X12 (MIN BURIAL 6" SIDES AND BOTTOM @25'OC)
EXISTING GRADE
EDGE OF CONCRETE DITCH
ERODED AREA
BB WOOD CHECK DAM
SCALE: NTS
CSW | ST2
CSW/Stuber-Stroeh Engineering Group, Inc.
45 Leveroni Court
Novato, CA 94949
Rev. 05/02/2019
Date: 02/24/2014
Job No. 2019-10-064
Scale: NTS
10 LOCH LOMOND
WOOD CHECK DAM DETAIL
DETAIL 1
SAN RAFAEL MARIN CALIFORNIA
P:\Projects\2019-10-064 Loch Lomond 10 Assessment District Report\DWG\Sheets\Check Dam Detail & Section.dwg 05/03/2019 - 09:42 AM manjot 1:1