UCSB Phelps Creek
Bank Layback and Bridge
Habitat Restoration Program
2007-2012 Report,
Year 5, Final Report

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1. 2012 Executive Summary

The willow stakes installed at the inception of the project have enjoyed tremendous success as evidenced by the 2012 view from bridge (Figure 11i). As in the previous year, no planting or irrigation was performed at the project site, and the bulk of the time spent on the site (200+ hours) involved the hand removal of exotic species, particularly, bristly ox-tongue (*Picris echiodes)*. The rest of the time working on the site involved using herbicide in an attempt to eliminate remnant populations of Bermuda grass (*Cynodon dactylon*) and birdfoot deervetch (*Lotus corniculatus)*. The creek vegetation continues to recover from the dredging done by Santa Barbara County Flood Control District last year, but has not yet reached the same size and breadth it reached before the dredging. There remains little to no erosion on the site, and the creek layback remains structurally intact. The adjacent North Parcel restoration project is now almost complete, so the input of exotic seed from the previously weedy area should now be mostly eliminated. Finally, the trees that were planted in the overflow area have now become well established and the overflow island is dominated by native cover.

2011 Executive Summary

The native vegetation on site has become well-established, as the arroyo willow (*Salix lasiolepis)* stakes, cottonwoods (*Populus trichocarpa*), sycamores (*Platanus racemosa*), and willow-leafed baccaris (*Baccaris salicifolia*) have dramatically increased in size. As opposed to 2010, no planting or irrigation was done on the site, and the time spent managing the site exclusively involved exotic weed removal. The majority of the time (200+ hours) spent weeding the site involved hand removal of bristly ox-tongue (*Picris echiodes)* and pampas grass (*Cortaderia selloana)* in conjunction with judicious use of herbicide to eliminate particularly noxious species such as rhizomotous Bermuda grass (*Cynodon dactylon*) that we had previously determined would not respond well to hand or mechanical removal. It is clear that the site has become functional habitat for native wildlife as two new species of predator (gopher snake and long-tailed weasel) were observed roaming the site. The adjacent North Parcel construction project has been recently completed, and the corresponding North Parcel restoration project is well under way. This restoration project eliminates a large nearby source of exotic plant seed that will likely mark a significant decline in the prevalence of exotic plants on the Phelps project. During the past year, Phelps creek was dredged by the Santa Barbara County Flood Control District, which led to the removal of a large portion of the established native plants in the creek bottom, particularly, California bulrush (*Schoenoplectus californicus*). However, the impacted plant species are rapidly recovering and recruiting in the affected areas, making this disturbance unlikely to negatively affect the native plants in the long term. The upland plants in the coast sage scrub portion of the project

continue to expand their range, but the native coast golden bush (*Isocoma menziesii*) dominates this section of the site. The original creek layback is structurally intact, and the continued growth of the willows along the creek bank all but ensures that the bank will remain stable, with little if any erosion occurring. Minor vandalism (spray painting) continues to occur near the bridge and the homeless camps have not been re-colonized. Finally, we spent time removing erosion control wattle containing non-biodegradable plastic from a small portion of the site.

2010 Executive Summary

Native vegetation cover has continued to increase across the site during the third year of restoration. As was the case in 2009, removal and management of exotic species was the biggest time commitment, with approximately 407 hours devoted to eradicating exotic species from February to July 2010. However, native vegetation density and abundance continues to increase across the site (as seen in the vegetation and photo monitoring). The growth of the cottonwoods, mulefat, and willow stakes/mattressing has been particularly significant as the trees' height and density of foliage has increased. The trees support the creek bank slope as well as provide favorable habitat for native plants and animals. The rushes and sedges in and around the creek continue to spread, and the restored vegetation and laidback bank have withstood even extreme flows. Additionally, the coast golden bush, alkali rye grass, and giant rye grass are all doing especially well across the upland portions of the site. Construction of the first phase of the UCSB North Parcel faculty housing development began in mid-June of this year, so the area bordering the restoration site to the North has been changing dramatically. Cooperation between CCBER and the general contractor (C.W. Driver) has been good, and the contractor has helped with the removal of large pampas grass and concrete debris from the site. The homeless encampments have been permanently removed as well, but minor vandalism continues to occur on Phelps Bridge. Artificial inputs within the restoration site have ceased, with the exception of removal of exotic species and periodic watering of recently planted trees to facilitate growth and development during the dry summer months. Public support of the restoration project continues to be positive with interns, volunteers, and student workers helping around the site, as well as neighbors complimenting CCBER on improving the aesthetics of the site.

2009 Executive Summary

During year two, the native vegetation cover increased dramatically. Extensive effort (over 600 hours) was devoted to invasive species management, as the vegetation monitoring and photo documentation demonstrate. A significant increase in native plant cover, and a decrease in non-native cover was observed. The willow (*Salix lasiolepis* and *Salix exigua*) stakes and brush mattressing have thoroughly developed, and thus are not only providing structural support to the laid back east bank, but are also increasing the riparian habitat for wildlife. The

layback has successfully handled all storm events without erosion. Seedlings and trees have begun to flourish and are spreading throughout the restoration site. In addition, community awareness and support for the project have increased, as tours have been lead, student interns, volunteers, and workers have helped, and neighbors from the surrounding project area have expressed gratitude for the restoration being done. Artificial inputs such as seedling irrigation and planting have ceased, deeming the project more sustainable while the only problems noted on site have been homeless encampments and minor vandalism to the bridge.

Introduction from 2008

This report provides a one, two and three year assessment of the site preparation, vegetation monitoring, field observations, and general success of the University of California, Santa Barbara's Phelps Creek Bank Layback and Phelps Bridge Habitat Restoration Projects. Phelps Creek is a perennial creek with high urban inputs, which flows south through the North Campus of the University of California, Santa Barbara (UCSB) through the Ocean Meadows Golf Course, to its confluence at the Devereux Slough and University of California's Coal Oil Point Reserve. This section of the creek is an earthen channel, however directly north the creek is lined with concrete, and runs through a dense urban area containing another golf course, and agricultural land which all contribute undesired inputs into the creek. The layback restoration project was designed to widen the section of the creek through the North Campus parcel, which would improve channel capacity for large storm events, as well as stabilize and enhance native vegetation conditions of the steep east bank. The 30-foot layback begins directly south of the newly constructed Phelps Bridge, and spans roughly 600 linear feet along the creek, concluding at the overflow channel and small island on the south end of the project. Granite Construction Company implemented the bridge construction and layback in November through December of 2007, while the Cheadle Center for Biodiversity and Ecological Restoration (CCBER) served as the biological monitor of the project. The Habitat Restoration Program prepared by the Morro Group, was executed by CCBER beginning in early December of 2007.

2. Project Description and Implementation History

2.1 Special-status Plant and Wildlife Species

Special-status Plant Species

The 2004 EIR conducted in the North Campus property found two special-status species. The species identified were Southern tarplant (*Centromadia parryi ssp. australis*) and Santa Barbara honeysuckle (*Lonicera subspicata var. subspicata*). Both species are listed in the California Native Plant Society's (CNPS) list 1B as "Plants considered rare, threatened, or endangered in California and elsewhere." (www.cnps.org)

Southern tarplant (*Centromadia parryi ssp. australis*) was documented in the North Campus property, but was not found in the Phelps Creek Project area preceding construction. Since then, several individual Southern tarplant have been found growing in various sections of the project. This suggests that it was either present and not found, or masked in the seed bank and stimulated to germinate by the re-grading and exotic plant removal.

Santa Barbara honeysuckle (*Lonicera subspicata var. subspicata*) was documented in the North Campus property as well as in the direct vicinity of the Phelps Creek Bridge. Necessary precautions were taken by CCBER to properly salvage affected plants, and monitor the construction process to make sure other areas were protected. In addition, approximately 110 Santa Barbara honeysuckle seedlings were planted on site from local seed sources.

Special-status Wildlife Species

The 2004 EIR found many special status animal species associated with the North Campus area. In the Phelps Creek Project area, the one known species present is the Tidewater goby (*Euclyclogobius newberryi*).

1. Tidewater gobies are a federally endangered species of concern in California, inhabiting tidally influenced regions of rivers and streams. They are bottom dwellers and usually found at water depths less than three feet (Morro, 2007). Before construction, wildlife biologists from Tetra Tech took the appropriate measures to find and transport any gobies found up or downstream of the site.

2. Field observations in spring and summer months of 2008 noted what appeared to be the same individual white tailed kite (*Elanus leucrus*), also a special-status animal species, foraging and hovering above the creek layback. Observations of the kite ranged from daily, to weekly, and the same foraging behavior was documented.

2.2 Pre- Construction Salvaging

Prior to construction of the Phelps Bridge and Layback, CCBER surveyed the site and located any native plants or trees that were in either the permanent or temporary impact areas. In the Phelps Bridge impact area, five Santa Barbara honeysuckle plants were salvaged and potted at the CCBER greenhouse. Also, a 3-4 meter western sycamore (*Platanus racemosa*) was trans-located to the greenhouse to be replanted when final construction was complete. In the area of the layback, one black cottonwood (*Populus balsamifera var. trichocarpa*) was found. CCBER took cuttings of this to add into the brush layering, while the rest were propagated in the greenhouse, yielding four trees.

2.3 Brush Layering and Slope Stabilization

In an effort to stabilize and retain the desired grade (3:1 slope) of the creek layback, different techniques were used. Among these were buried rock rip rap on the bottom of the channel, native seeded erosion control mattresses, and brush layering and stakes using the salvaged willow trees from the re-graded east bank. Granite Construction Company was responsible for the implementation of these various techniques, while CCBER collected and distributed the native seed mix, and cut and stored the willow cuttings for the stakes on the lower slope and the brush layering on the upper slopes.

Preparation

Willow stakes used on the lower slope were solely the arroyo willow (*Salix lasiolepsis*) found on site. For the upper slope, brush layering, approximately 7,000 cuttings at least 1/2 inch thick and 4 feet long were cut from the previously standing willows on the east bank before the area was cleared. While the majority of the cuttings were arroyo willow, numerous narrow-leaved willows (*Salix exigua*), mulefat (*Baccharis salicifolia*), and black cottonwood (*Populus balsamifera var. trichocarpa*) were also used. The mulefat and cottonwoods, used to promote diversity in the layering, have the same ability to root easily from cuttings. CCBER strove to use as many cuttings as possible from the trees on the permanently impacted east side of the creek, but to completely finish the many layers of the mattress, cuttings were taken from a dense arroyo willow patch on UCSB's South Parcel.

Implementation

Granite Construction Company installed the willow stakes and brush layering, in accordance to the design by Schaaf and Wheeler Consulting Civil Engineers. After completion, CCBER installed a system of soaker hose on top of each layer of willows to immerse and soak the cuttings to promote re-rooting. CCBER felt that the soaker hose was the most efficient way to irrigate, as well as prevent the cuttings from drying out. This regular watering persisted for approximately a month, when sprouting was present throughout the layering. After the initial month, soaking was done intermittently, with more during the warmer summer months.

2.4 Surface Preparation

Several methods were used to prevent erosion of the newly graded project including erosion control blankets, waddle, and a geotextile mattress.

Erosion Control Blankets (Coconut netting)

The erosion control blankets were used on the lower slope, lower bench, upper slope and upper bench of the layback. Before they were rolled out, CCBER broadcast seed using an appropriate native seed mix for each area, collected from natural areas within a 10- mile radius of UCSB to preserve local genotypes. About four gallons of wetland species seed were dispersed on the lower slope. Species

included were cattail (*Typha augustifolia*), California bulrush (*Schoenoplectus californicus*), alkali bulrush (*Bolboschoenus maritimus*) common spikerush (*Eleocharis macrostachya*), brown –headed rush (*Juncus phaecocephalus*) and spreading rush (*Juncus patens*). The upper bench and slope was also directly seeded with about four gallons of seed including alkali rye (*Leymus triticoides*), California sagebrush (*Artemisia californica*), sea cliff buckwheat (*Eriogonum parviflorum*), deerweed (*Lotus scoparius*), mugwort (*Artemisia douglasiana*), and coastal goldenbush (*Isocoma menziesii*). High germination rates were noted for all of the direct seeding on site.

Geotextile Mattress

The geotextile mattresses used for stabilization in the brush layering were successful in the fact that they held together and stabilized the willow mattress during storm events and high precipitation. However, the plastic material was exposed after rain events, is unsightly, and will not break down or biodegrade for many years to come.

2.5 Planting and Plant Growth

Planting

Re-vegetation and planting of the layback and bridge construction commenced in early December, 2007. Planting was initiated as sections of the construction and layback were completed. As such, the lower slope just south of the bridge was planted first, with each successive section planted when there was no disturbance from construction or construction vehicles. Final construction was completed in January 2008, and planting concluded in early February. In addition to the extensive willow mattressing and stakes, 2,325 native plants were planted in the first year of the project. Of these, 545 were rushes or sedges, 25 were trees, 864 were forbs and grasses, 81 were shrubs, and 810 were a coastal sage scrub mix

Plant Growth

2012 Update

The continued establishment of coast golden bush (*Isocoma menziesii*) and coyote brush (*baccaris pilularis*) is particularly notable, along with the remarkable increase in size of the arroyo willows that were planted at the inception of the project. The vegetation in the creek bed has not yet fully recovered from the dredging conducted by Santa Barbara County Flood Control District last year.

2011 Update

The natives planted on the site continue to grow and expand their range. The most notable change in terms of plant growth is the greatly increased size of the arroyo willows and western sycamores that were planted at the beginning of the project. This, along with an increase in the cover of coast sage scrub species (particularly coast golden bush (*Isocoma menziesii*)) is evidenced in the photos at the end of the report.

2010 Update
The native vegetation throughout the site continues to increase in size, abundance, and density. The riparian trees along the bank layback have increased in height and density of foliage significantly, while wetland species in and around the creek have grown and spread. The upland sage scrub, shrubs, and grasses continue to increase in size and abundance across the site as well. These changes have been documented in the vegetation and photo monitoring.

2009 Update
During the second year of the project, the plants have grown considerably. Coastal sage scrub, shrubs, and trees have shown a substantial amount of growth in comparison to the first year, while the rhizomatous grasses have begun to spread and become noticeably denser. These trends have been documented in the vegetation monitoring, and photo monitoring.

2008 History
The growth of installed plants within the first year varied immensely. The wetland plants (rushes and sedges) grew rapidly throughout the site, while the plants on the upper slope and bench seemed to be stunted. One possible reason for this could be soil compaction and texture. Soil conditions on site were classified by the USDA and NRCS (Natural Resources Conservation Service) in their 1981 survey as solely XA, or Xerorthents. Xerorthents are described as cut and fill areas where the original soil profile is no longer distinguishable. "Some areas have been mechanically cut, either to supply fill material or to remove uneven high spots. Other areas have been covered by fill that contains varying amounts of rock, concrete, asphalt and other debris" (USDA Soil Survey Manuscript, Santa Barbara County, South Coastal Part 1981). Thus, the soil on site is not the ideal composition to promote plant growth. In addition, CCBER has found the soil on site to have high clay content. Thus, another reason for limited plant growth is likely correlated with this clay content as some plant's roots are initially shocked and struggle to spread.

3. Monitoring

3.1 Monitoring Methods

California Rapid Assessment Method (CRAM)
Before the project was initiated, CCBER used the C.R.A.M methodology to assess the creek habitat quality. Its overall score was 54, which is below the average of 77 for riverine systems in California. In 2010, after restoration had established, CCBER conducted a follow up assessment as an alternative method for detecting change in habitat quality.

Vegetation Transects

In July of 2008 through 2012 five vegetation transects were surveyed annually to document vegetation conditions. Topographical surveys were also conducted on two transects in 2008 with the intention of comparing that to a topographical survey in 2011 to determine if significant erosion had occurred. The second survey was unnecessary, however, as it is was deemed obvious by CCBER staff that little or no erosion had occurred. For three of the transects, a one meter quadrat subdivided into one hundredths was used at three meter intervals to estimate percent cover per individual species of both native and non-native plants, and percent cover of bare ground. The remaining two transects (3 and 5)were also surveyed using the one meter quadrat, however it was used at two meter intervals because these transects were considerably shorter as they run perpendicular to the creek. Using this data, the mean cover was calculated for both native and non-native plants in each transect.

3.2 Monitoring Results

California Rapid Assessment Method (CRAM)

CCBER conducted a CRAM assessment of the Phelps creek project area in 2007 to obtain a baseline value for creek habitat quality prior to initiation of restoration work. The average CRAM score for riverine systems in California is 77, and the Phelps creek site scored a 54 in 2007. Following the bridge construction, bank layback, planting, and site maintenance over the past three years, the score improved to 59 in 2010. CCBER hoped to see a more substantial increase in the CRAM score after all the native vegetation has established and spread throughout the site, but the overall score was negatively impacted by the housing development that is under construction to the north of the site reducing habitat buffer width. However, of the 16 aspects of the site that CRAM methods score, 5 aspects improved, 10 stayed the same and only one decreased (due to reduced buffer width). The Cram score for hydrology increased from 42 to 50, physical structure increased from 50 to 62.5, and biotic structure increased from 65 to 70. The increases in all these scores reflect the improvement in habitat quality from the reconstructed and laid-back bank, as well as the abundance and diversity of restored native vegetation.

Vegetation Transects

Mean native cover exceeds 100 % on some transects because of the multiple layers created by the willows and understory wetland vegetation Figure 1 identifies the location of the monitoring transects. Figures 2a and 2b provide a summary of the change in native and non-native plant cover over the five monitoring periods. The following provides a detailed summary of each transect with a series of graphs showing the cover along the length of each transect.

Figure 1. Vegetation monitoring transect locations

Figure 2a

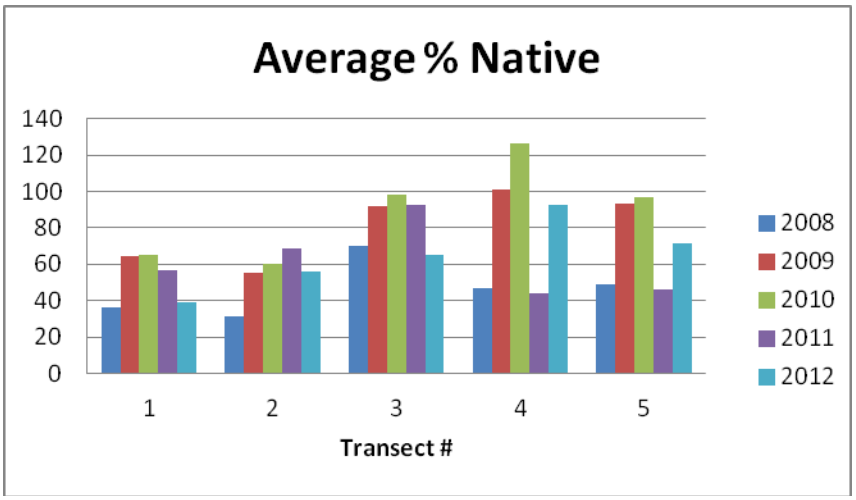


Figure 2b

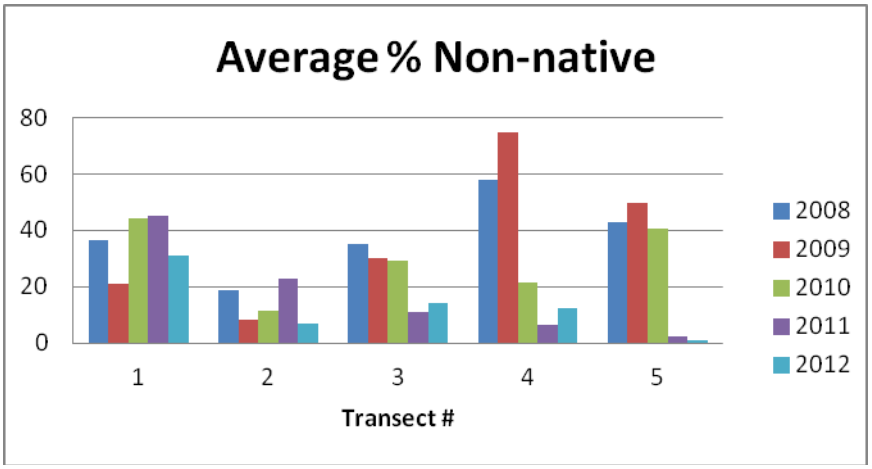


Figure 2c

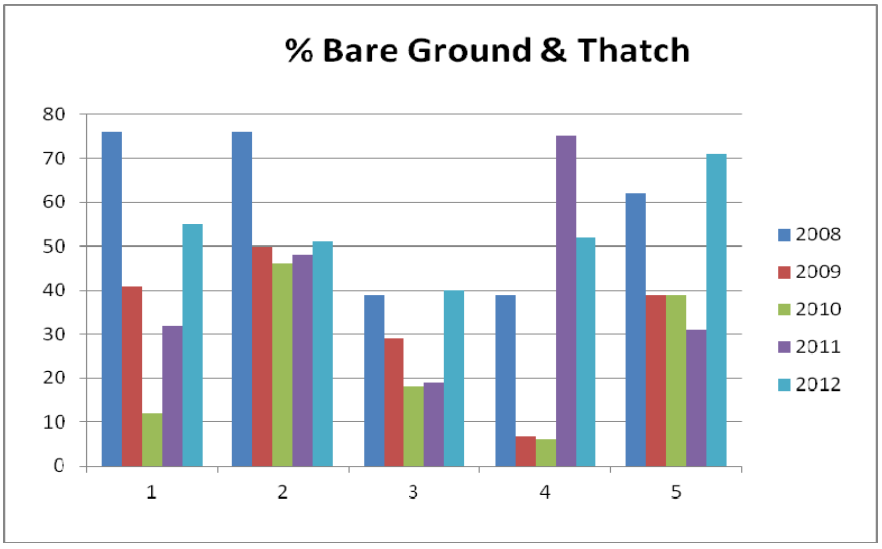
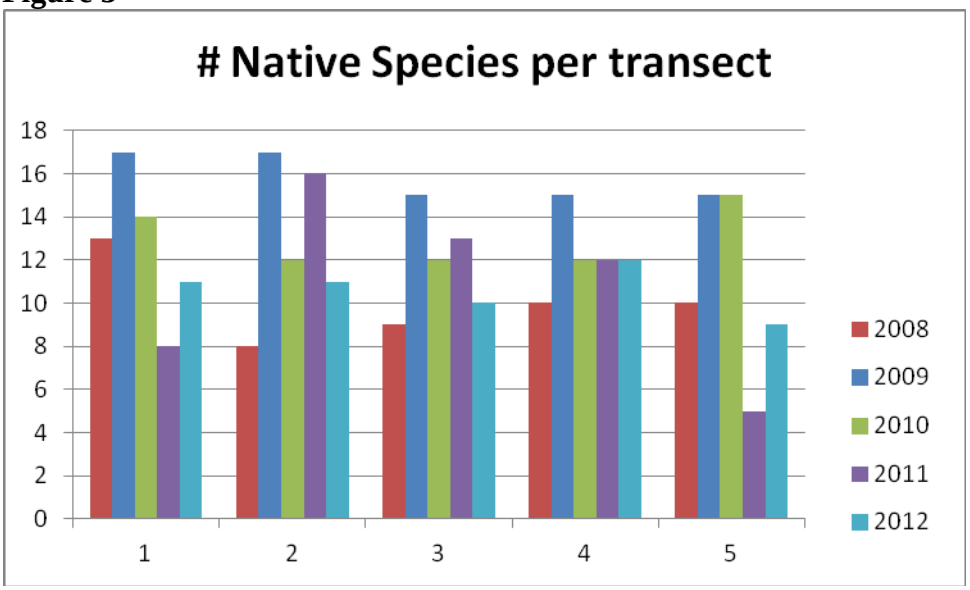


Figure 3



Transect 1) Runs perpendicular to the creek, encompassing an upland and riparian area as it crosses the creek (Figures 4a and 4b).

2012:Mean native cover was 39%, ranging from 0% to 92%. Mean non-native cover was 31%, ranging from 6% to 71%.

2011: Mean native cover was 56%, ranging from 0% to 141%. Mean non-native cover was 45%, ranging from 8% to 102%.

2010: Mean native cover was 65%, ranging from 0% to 120%. Mean non-native cover was 44%, ranging from 0% to 127%.

2009: Mean native cover was 64 %, ranging from 0% to 139%. Mean non-native cover was 21%, ranging from 0% to 85%.

2008: Mean native cover was 37%, ranging from 0% to 210%. Mean non-native cover was 35%, ranging from 16% to 101%.

Transect 2) Runs parallel to the creek encompassing an upland coastal sage scrub area (Figures 5a and 5b).

2012: Mean native cover was 56%, ranging from 33% to 85%. Mean non-native cover was 7%, ranging from 0% to 34%.

2011: Mean native cover was 69%, ranging from 22% to 153%. Mean non-native cover was 23%, ranging from 1% to 61%.

2010: Mean native cover was 60%, ranging from 17% to 107%. Mean non-native cover was 11%, ranging from 3% to 19%.

2009: Mean native cover was 55%, ranging from 9% to 129%. Mean non-native cover was 8%, ranging from 1% to 21%.

2008: Mean native cover was 32%, ranging from 6% to 82%. Mean non-native cover was 19%, ranging from 0% to 37%.

Transect 3) Runs perpendicular to the creek, encompassing an upland, willow mattress, and riparian area to the flood access road (Figures 6a and 6b). Topographic data is not absolute, but relative to the starting point of the transect (Figure 9a).

2012: Mean native cover was 65%, ranging from 0% to 102%. Mean non-native cover was 14%, ranging from 0% to 64%.

2011: Mean native cover was 92%, ranging from 11% to 165%. Mean non-native cover was 11%, ranging from 3% to 26%.

2010: Mean native cover was 98%, ranging from 7% to 173%. Mean non-native cover was 29%, ranging from 0% to 105%.

2009: Mean native cover was 90%, ranging from 8% to 128%. Mean non-native cover was 33%, ranging from 0% to 82%.

2008: Mean native cover was 70.5%, ranging from 2% to 151%. Mean non-native cover was 34.4%, ranging from 2% to 128%.

Transect 4) Runs parallel to the creek along the lower slope of the layback, capturing wetland vegetation (Figures 7a and 7b).

2012: Mean native cover was 92%, ranging from 2% to 185%. Mean non-native cover was 12%, ranging from 0% to 82%.

2011: Mean native cover was 44%, ranging from 3% to 131%. Mean non-native cover was 6%, ranging from 0% to 39%.

2010: Mean native cover was 126%, ranging from 68% to 188%. Mean non-native cover was 21%, ranging from 3% to 67%.

2009: Mean native cover was 140%, ranging from 68% to 203%. Mean non-native cover was 39%, ranging from 7% to 101%.

2008: Mean native cover was 51.9%, ranging from 29% to 86%. Mean non-native cover was 53%, ranging from 29% to 102%.

Transect 5) Runs perpendicular to the creek, encompassing an upland, willow mattress and riparian area to the flood access road (Figures 8a and 8b). Topographic data is not absolute, but relative to the starting point of the transect (Figure 9b).

2012: Mean native cover was 72%, ranging from 0% to 189%. Mean non-native cover was 1%, ranging from 0% to 4%.

2011: Mean native cover was 46%, ranging from 0% to 104%. Mean non-native cover was 2%, ranging from 0% to 10%.

2010: Mean native cover was 96%, ranging from 3% to 198%. Mean non-native cover was 41%, ranging from 0% to 98%.

2009: Mean native cover was 93%, ranging from 0% to 193%. Mean non-native cover was 49%, ranging from 0% to 78%.

2008: Mean native cover was 56%, ranging from 0% to 175%. Mean non-native cover was 45%, ranging from 12% to 122%.

Figure 4a

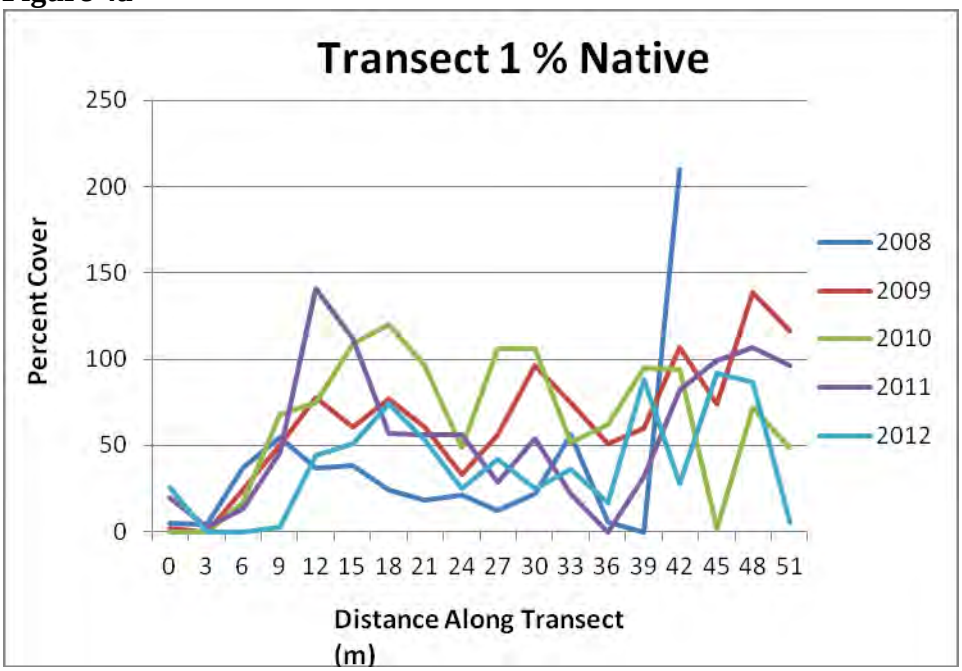


Figure 4b

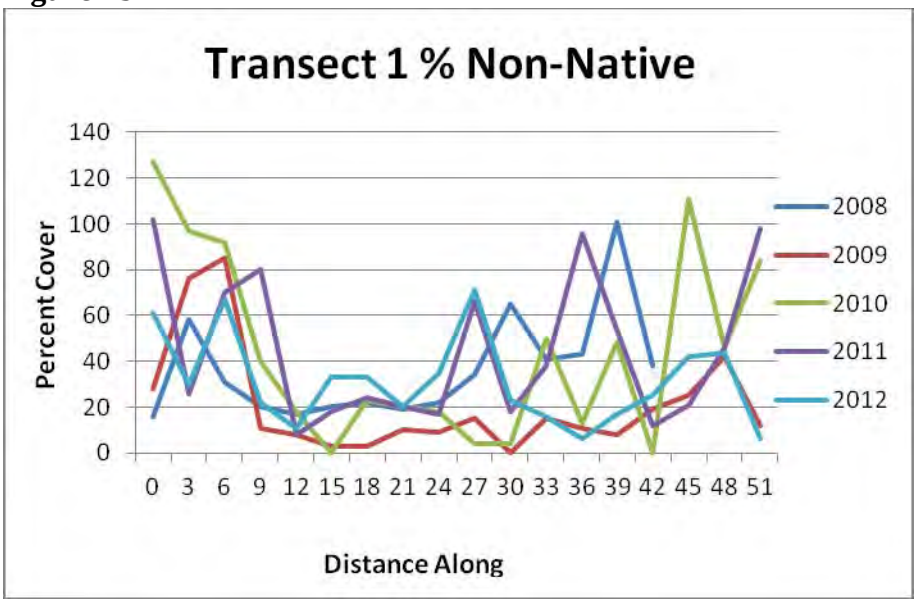


Figure 5a

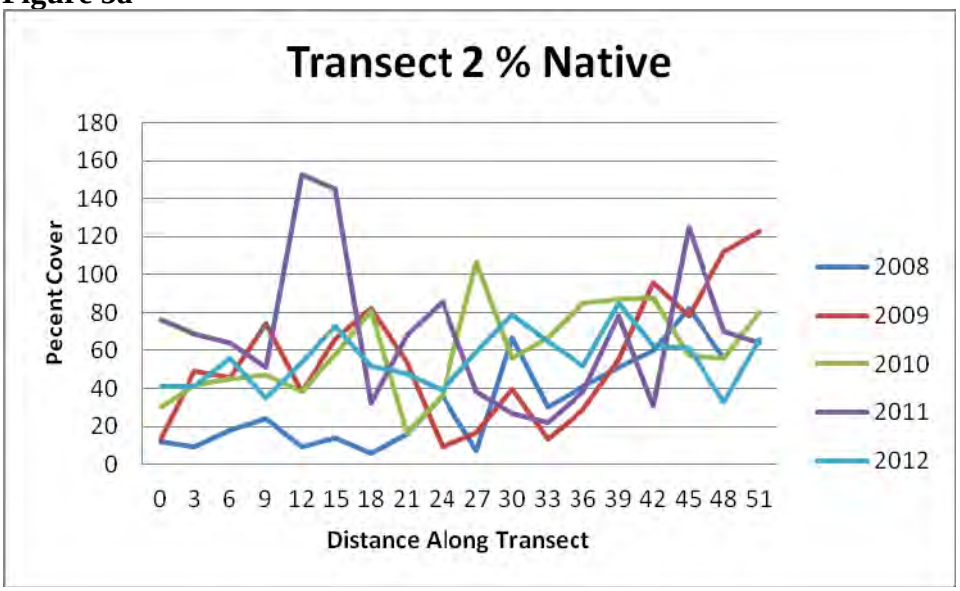


Figure 5b

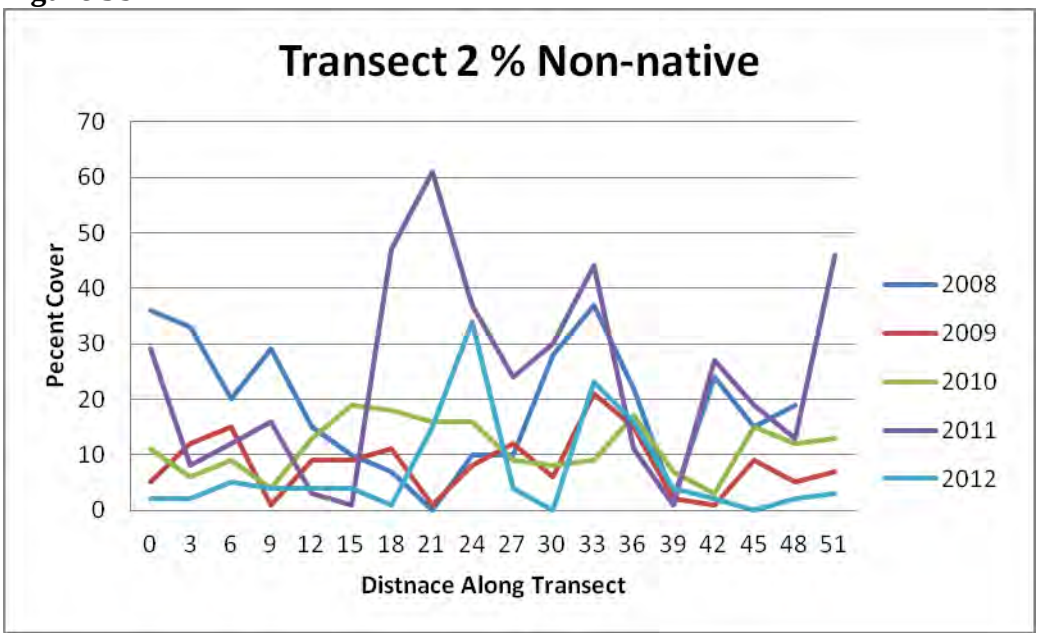


Figure 6a

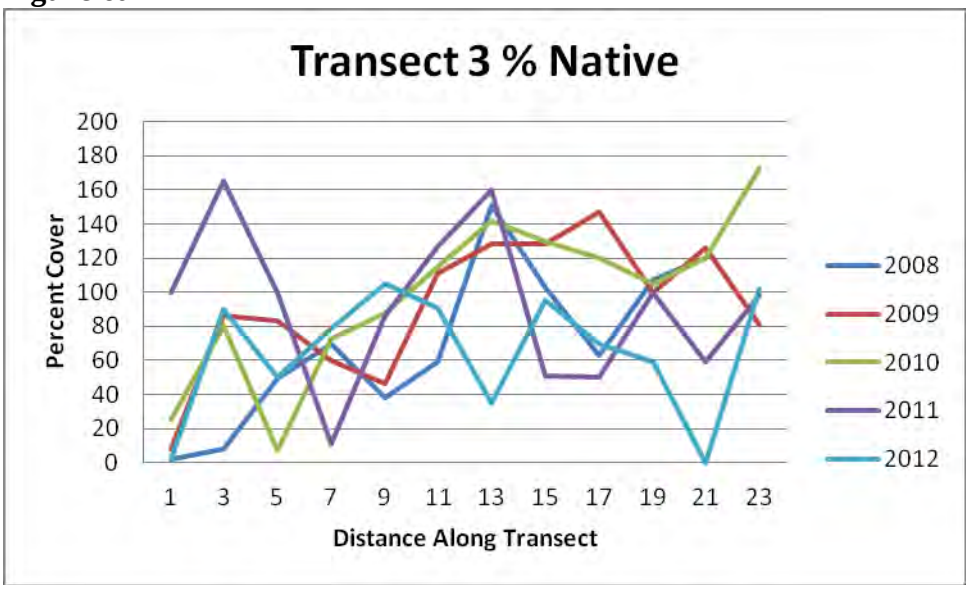


Figure 6b

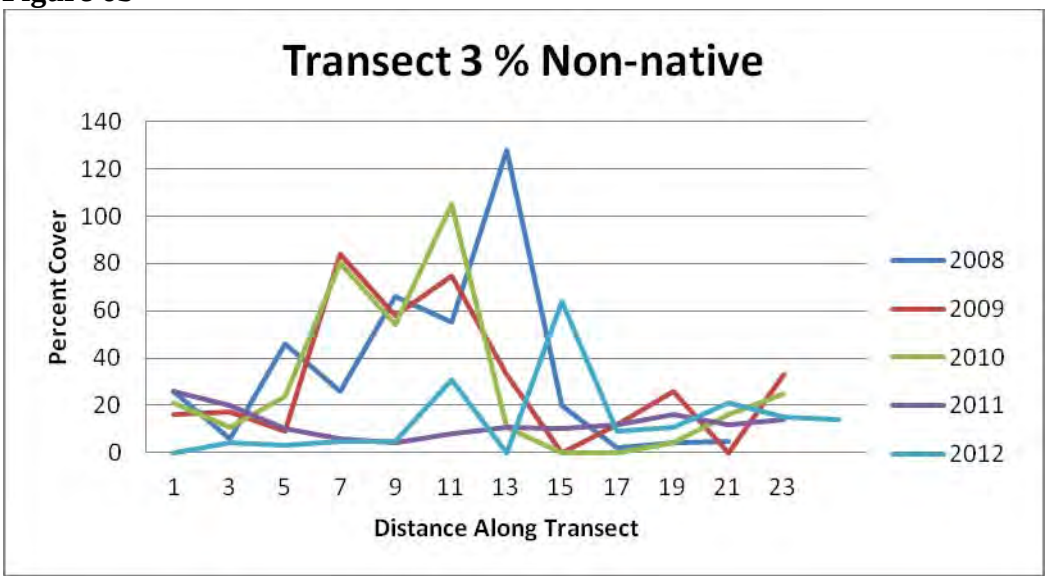


Figure 7a

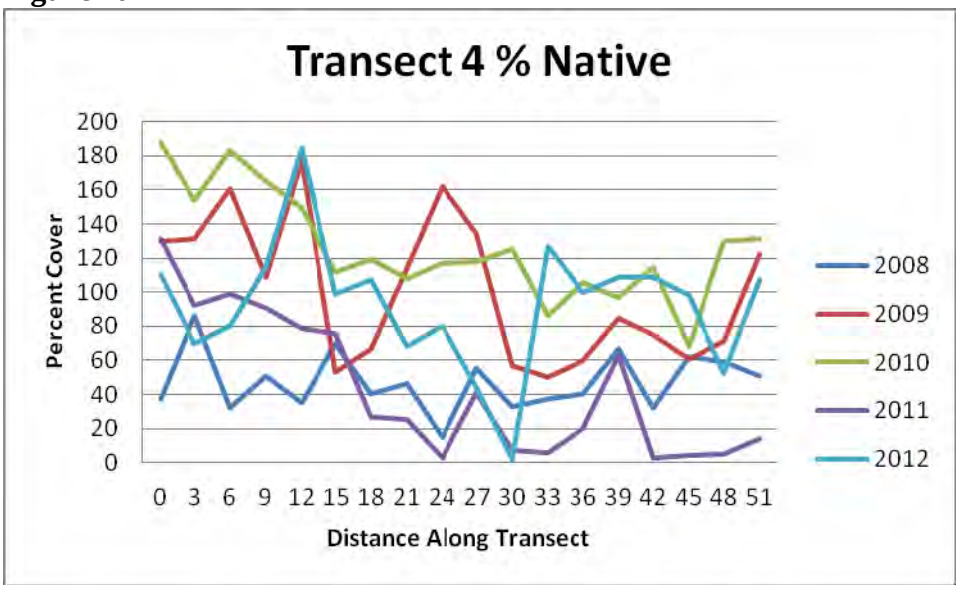


Figure 7b

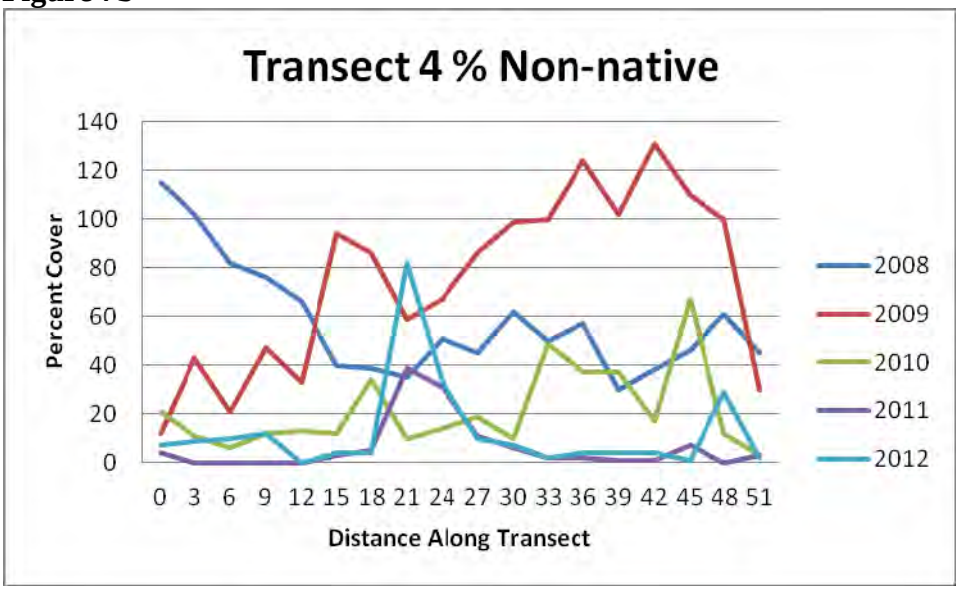


Figure 8a

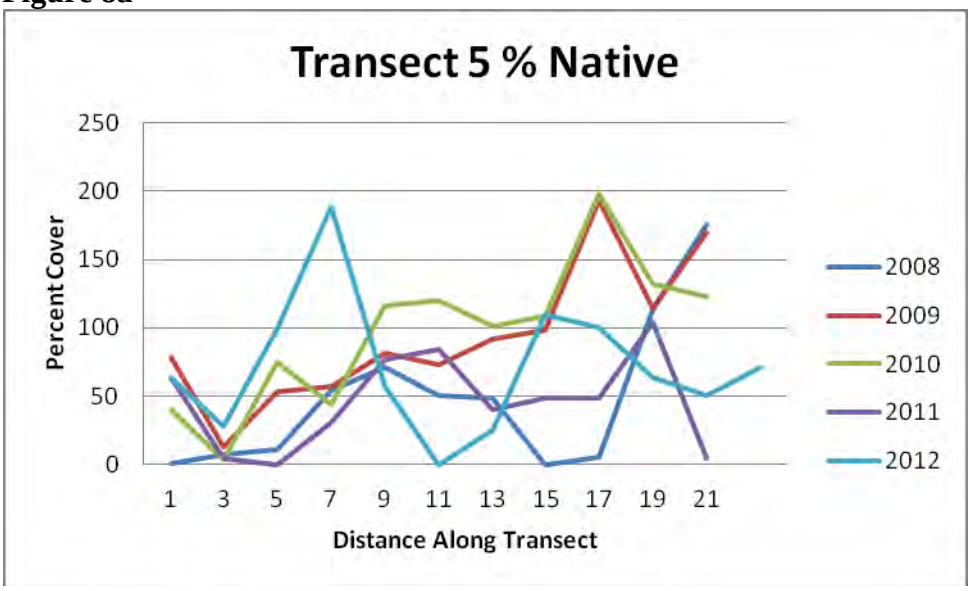
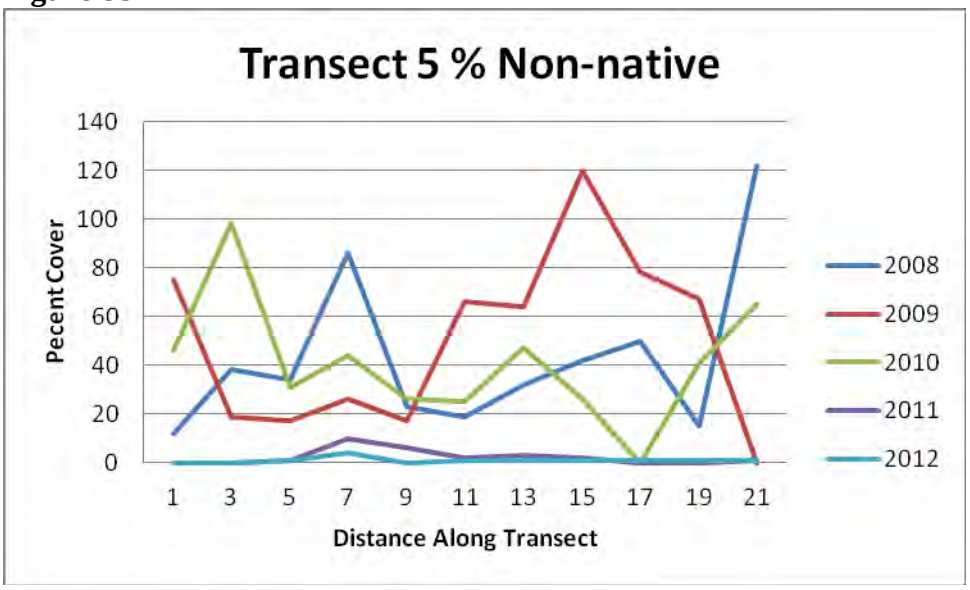


Figure 8b



Topographic Monitoring - Baseline

Figure 9a

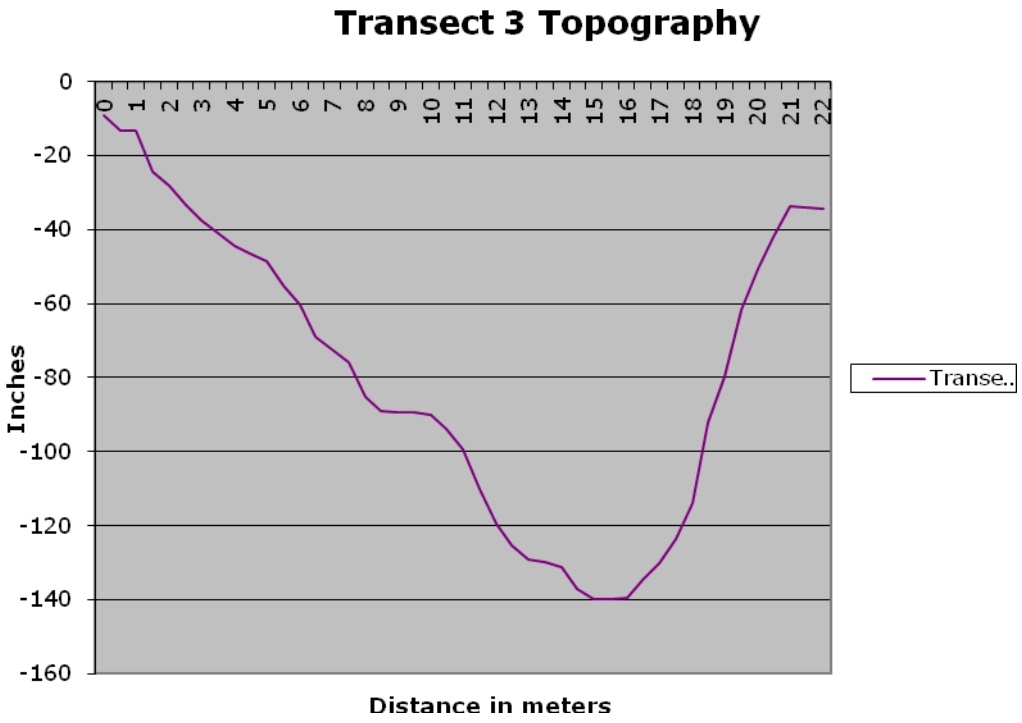
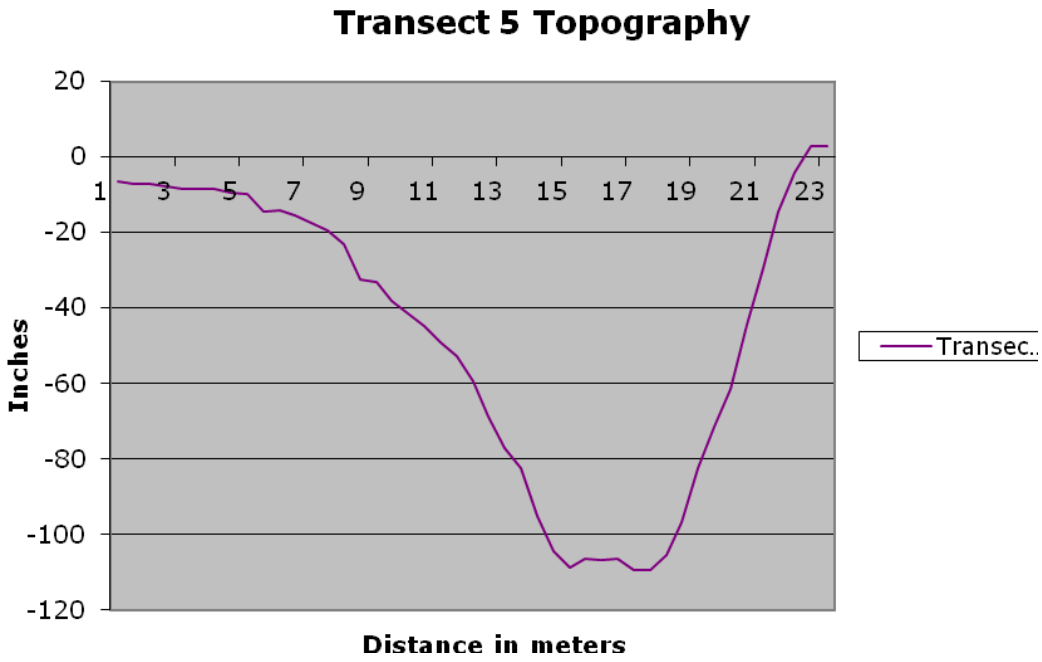


Figure 9b



3.3 Performance Standards

Riparian Areas

As outlined in the HRP, "All restoration areas shall maintain a dominant cover of native plants, with exotic weed percentages constituting less than 10 percent of the total plant coverage" (Morro, 2007). Average non-native cover across the five transects is 13%. This is an improvement over the 2011 (17%), 2010 (29%), 2009 (36.8%) and 2008 (38.2%) levels. Non-native species are still present in the restoration site due to an extensive non-native seed bank and continuous exotic seed inputs from surrounding areas (it should be noted, however, that the establishment of the North Parcel project on both sides of Phelps Creek should help to alleviate these inputs). While controlling non-native species has been the focus of management efforts over the past five years, non-native cover is still not down to the 10% goal. Therefore, the restoration area is not yet meeting the performance standards set. Since the restoration is still relatively new, there will be a high level of unwanted exotics present until natives become more established, reducing light levels, and the exotic seed bank is depleted. CCBER will be on site working on the North Parcel project over the next four years and Phelps Creek is within that project area and will continue to be maintained and enhanced through weed control activities. With non-native coverage at 13%, the goal of 10% seems well with-in the realm of probability, particularly with the continued establishment of the adjacent North Parcel restoration project.

Wetland Areas
The existing seasonal wetland areas are maintaining their hydrologic function and contain wetland plant species on a seasonal basis. Therefore, the performance standards are being met.

General Success Requirements

2012 Update
The continued removal of exotic vegetation is the last step to site success.

2011 Update
All Irrigation and planting have ceased. The eradication of exotic species shall continue until the seed bank has been depleted and native plants prevent re-invasion from non-natives.

2010 Update
Twenty trees were planted in the over flow channel, on the "island" between the main and overflow channel, and on the lower bench. The trees were a mix of mulefat, alder, cottonwood, and sycamore. The trees were irrigated periodically during the late spring and summer to encourage establishment and growth. Eradication of exotic species will continue until the seed bank has been exhausted and the native plants are able to prevent re-colonization of exotic species.

2009 Update
Irrigation and planting have ceased, leaving the only artificial input exotic species removal. Eradication of exotic species shall continue until the seed bank has been depleted and native plants prevent re-invasion from non-natives.

2008 History
Artificial inputs such as irrigation, invasive exotic species removal, and planting are being conducted on site. Since the project must be void of these inputs to be deemed complete, it is not yet considered complete. CCBER believes that this standard will be met before the five-year habitat restoration project has concluded.

4. Maintenance

4.1 Irrigation

2012 Update
Irrigation is no longer being conducted on the Phelps Creek Restoration Project.

2011 Update
The trees planted in 2010 are fully established, and, like the rest of the project, no longer require irrigation.

2010 Update
Irrigation is no longer required on the site, except for periodically watering the newly planted trees during the warm, dry spring and summer months. This irrigation was carried out by watering individual trees with a hose by hand in order to fully soak the roots and surrounding soil as well as prevent excessive evaporative loss.

2009 Update
Irrigation has ceased, as all seedlings do not require supplemental watering after the first growing season. A history of irrigation and maintenance is provided below. Irrigation on site was done intermittently, with different techniques to complement different areas based on species requirements and environmental conditions.

Brush Layering Irrigation History
As stated in the section "Brush Layering and Slope Stabilization", the willow mattress was initially watered with a soaker hose repeatedly until the cuttings started to bud. As the project continued, the soaker hose was used on a certain section until the soil was fully inundated, then moved down to the next section of willows. This not only watered the cuttings themselves, but also the plants down slope of the mattress.

Site Irrigation History
During and following the planting of the site there was a fair amount of rain in the Santa Barbara area. This was beneficial for the soil and newly planted plants, and thus enabled CCBER to water only lightly for the first couple of weeks. After that watering was done using a sprinkler situated on the upper bench, where it was able to broadcast all the way to the lower slope of the creek bank. Once an area was inundated, the sprinkler was progressively moved to the adjacent dry area that it bordered. After the sprinkler cycled through all the areas in the project, watering again commenced when conditions were hot or when the plants looked dry.

4.2 Exotic Weed Control

2012 Update
The continued use of Aquamaster® on selected species (outlined in the 2011 update) as well as hand-weeding of annual species like prickly ox-tongue (*Picris echiodes*) were used throughout the previous year.

2011 Update
A number of weed control techniques were implemented during the year to continue to reduce the abundance of non-native species on the site. Most notably, application of the herbicide Aquamaster® has greatly reduced the abundance of Bermuda grass (*Cynodon dactylon*), birdfoot deervetch (*Lotus corniculatus*), elm leaved blackberry (*Rubus ulmifolis*), and Harding grass (*phalaris aquatica*).

Prickly ox-tongue (*Picris echiodes*) continues to persist in large quantities despite painstaking efforts at hand removal over the last few years. The adjacent construction has just been completed, and it is already clear that the reduction in unmanaged weedy areas next to the site had led to a reduction in the abundance of certain exotic plants, namely, black mustard (*Brassica nigra*) and pampas grass (*Cortaderia selloana*). Overall, the abundance of exotic plants has been greatly reduced, but it will take a significant effort in the upcoming year to meet the goal of non-native plants constituting less than 10 percent of the total plant coverage by the end of year 5.

2010 Update

Due to the dense non-native seed bank and abundant seed sources outside of the restoration area, eradicating exotic species across the site is an ongoing battle. These exotic species continue to threaten the native biodiversity of the site; therefore extensive hand weeding, mechanical removal, and minor herbicide applications are still required. CCBER staff, interns, volunteers, and student workers have made a tremendous effort over the past year to remove as many non-native plants as possible before they flower and drop seeds. Species that continue to persist across the site include: bur clover, prickly ox-tongue, birdfoot deervetch, smilo grass, black mustard, Bermuda grass, pampas grass, and fennel. With continued eradication efforts, reduction in the amount of outside seed sources (through construction of the adjacent housing development), and increased size and abundance of native species, CCBER is hopeful that non-native species abundance will be reduced in upcoming years.

2009 Update

Though minimized in comparison to 2008, exotic species still pose a threat to the overall biodiversity of the restoration site. The prevalence and density of exotic species have been greatly reduced by the extensive hand weeding done by CCBER's staff. Despite this effort some species are still present, exemplifying the extensive seed bank present in the project area. The species that are persisting throughout the site are prickly ox-tongue (*Picris echiodes*), Birdfoot Deervetch (*Lotus corniculatus*), Smilo Grass (*Piptatherum miliaceum*) and Black Mustard (*Brassica nigra*). These weeds are persisting because of the extensive seed bank on site and dense populations upstream.

2008 History

As CCBER expected, the exotic weed seed bank in the project area proved to be extensive. Immediately following construction, black mustard (*Brassica nigra*) began germinating throughout the entire site, from the creek bed to the upper bench. The techniques used for eradication includes extensive hand weeding in the project boundaries, while mowing was used around the edges to inhibit seeds from being blown, or transported in. Though black mustard continues to come up through the seed bank when irrigating an area, it is far less abundant then initially. Oddly, vetch (*Vicia sativa*) only germinated in the willow mattressing and was hardly found anywhere else on site. This is likely because the soil used in

construction came from a different source, as the mattress was constructed last after the project was graded. However, like the mustard it germinated very quickly and grew quite thick and tall, competing with the willows for space and height. CCBER was able to weed the vetch before it began to produce seed, and after this initial weeding there has been no more germination.
The overflow channel area of the project is one that is particularly inundated with invasive exotic species. In particular, Harding grass (*Phallaris aquatica*), periwinkle (*Vinca major*), elm leaved blackberry (*Rubus ulmifolis*), and castor bean (*Ricinus communis*) are widespread. Besides castorbean, these species have been particularly hard to manage. Hand or manual weeding does little to curb growth, as this area becomes overgrown quickly following eradication. CCBER recommends the use of wetland safe herbicide to aid in extirpation of some of these highly invasive species.
Throughout the entire project site there are a number of invasive non-native species. The species that are most dense and pose the biggest threat to biodiversity are fennel (*Foeniculum vulgare*), rabbitsfoot grass (*Polypogon monspeliensis* and *Polypogon interruptus*), annual ryegrass (*Lolium multiflorum*), sweet clover (*Meliotus sp*.), prickly ox-tongue (*Picris echiodes*), Italian thistle (*Carduus pynchnocephalus*), and poison hemlock (*Conium maculatum*). Because of the vast number of exotics on site, these species have been controlled by manually weeding before seeding. In that way, the weeding process has been progressive. Because of the periodic watering done on site, CCBER feels that the non-native seed bank is continually being flushed out through a "grow/kill cycle".

4.3 Wildlife Observations

2012 Update
This year, a two-striped garter snake ***(****Thamnophis hammondii*) and California kingsnake (*Lampropeltis getula californiae)* were observed at the site in addition to many of the species noted in the 2008 history.

2011 Update
In addition to many of the animals in the 2008 history section below, it has been noted that a gopher snake (*Pituophis catenifer*) was observed roaming the site in March 2011. Additionally, a long-tailed weasel (*Mustela frenata)* was seen on site in July 2011.

2010 Update
No new observations have been noted.

2009 Update
No new observations have been noted.

2008 History

The wildlife observations noted throughout the year include a variety of species. As stated previously, a white tailed kite (*Elanus leucrus*) regularly foraged above the creek and site throughout the spring months. Two individual pairs of mallards (*Anas platyrhynchos*) were observed mating and living in the creek bed during the spring as well. Red tailed hawks (*Buteo jamaicensis*) have often been seen circling the site and the surrounding North Campus area. Flocks of Cliff Swallows (*Petrochelidon pyrrhonota*) and Mourning Doves (*Zenaida macrouna*) have been continually observed on site. Other birds noted sporadically include Great Blue Heron (*Ardea herodias*), Great Egret (*Ardea alba*), Black-Crowned Night Heron (*Nycticorax nycticorax*), Coopers Hawk (*Accipiter cooperii*), Red- Shouldered Hawk (*Buteo lineatus*) House Finch (*Carpodacus mexicanus*), Black Phoebe (*Sayornis nigricans*) and Song Sparrow (*Melospiza melodia*). California Ground Squirrels (*Spermophilus beecheyi*), Western Fence Lizards (*Sceloporus occidentalis*), and kingsnakes have also been frequently observed. Though the wildlife observed is not particularly diverse, CCBER feels that as the trees and plants continue to grow it will create a better environment for wildlife recruitment.

5. Summary & Recommendations

2012 Summary

The Phelps Creek site is dominated by natives and highly functioning, as evidenced by its use by a range of wildlife species from birds to reptiles and small mammals. Although it was close, at 13%,, the transect monitoring indicated that the goal of less than 10% exotic cover was not reached. Although this number improves upon last year's figure of 17%. The weed that created the issue was Bermuda grass (cynadon dactylon) which is intertwined within the native plants and difficult to control by hand or herbicide. Additionally, native cover rose from 62% last year to 65%. There are two probable reasons why this is the case. The first is that the plants in the creek bed failed to recover as quickly as we expected from impacts associated with the Flood Control District's dredging operation, and the second is that much of the open space in between the established natives was occupied by exotic species, and, while we removed most of the exotics, the natives didn't have the opportunity to occupy that vacated space. The placement of the transects may also be skewing our data, as a visual inspection of the transect areas seem to indicate a disproportionate lack of vegetation as compared to the rest of the site. It should be noted that the site seems to be progressing quite nicely as a functional habitat for wildlife, as evidenced by the first ever sighting of a two-striped garter snake on the site.

2011 Summary

Year four of the project has seen many successes with a couple of setbacks. The good news is that the average percent of non-native cover has dropped to 17% from 29% in 2010. This is important because the goal of reducing exotic species coverage to 10% now seems to be within reach. The reduction in coverage was likely due to the use of herbicide on problem species. Most notable of these was

birdfoot deervetch (*Lotus corniculatus*) which was a major problem at the beginning of the growing season. One setback according to our monitoring data is that the average percent native cover dropped this year for the first time from 89% in 2010 to just 62%. It should be noted that many species are coming along quite well in some of the areas surrounding the transects, however clearing associated with restoration in the North Parcel area cleared some plants along the transect that are now newly establishing. In addition, the willows are now so tall that they are shading out some of the natives below them and creating more open space which is actually good for wildlife. Whatever the reason, a visual assessment of the site would indicate that native populations are alive, well, and expanding their range. CCBER is confident that the figures next year will reflect 2010's results or even exceed them, just based on this visual assessment. It's also important to note that the site seems to be serving quite capably as a habitat for wildlife, as evidenced by the sightings of a long-tailed weasel and a gopher snake on separate occasions.

2010 Summary

The restoration site has continued to improve during the third year of management. Native species continue to grow and spread throughout the site; however certain areas seem to be more heavily invaded by exotic species and will require additional work to establish a dominant native cover. Average native cover across the monitoring transects rose to 89%, an 8% increase since 2009. Additionally, average non-native cover was reduced to 29% across the transects (a 7% decrease from 2009). Even though exotic species coverage has not been reduced to the 10% goal, the site continues to improve as native grasses and shrubs grow and spread while trees and riparian vegetation mature. The trees and stream bank species have withstood high-flow conditions, provide improved habitat for native plants and animals, and continue to support the structural integrity of the laidback bank. CCBER is confident that all the project goals will be achieved in the upcoming years, habitat value will continue to improve, and the project will be an example of a successful, self sustaining restoration site.

2009 Summary

Within the second year of the restoration project, many important goals have been realized. Native seedlings have flourished and spread throughout the site (cover increased by 34%)while exotic species prevalence has been slightly reduced (1.2% lower). Performance standards previously unmet have been reached this year, and though the total exotic coverage is not yet less than 10% on site, it has been reduced from 38.2% in 2008 to 36.8% in 2009. Additionally, total native coverage has increased from 46.8% in 2008, to 81% in 2009 (34% increase) marking a substantial improvement. CCBER expects that this final standard will be met within the next 1-2 years. The willow mattress and lower slope stakes have developed, providing a stabilized slope and increased habitat for wildlife to thrive. Looking to the future, CCBER feels that all aspects of the project will improve, becoming an example of a fully sustainable restored habitat.

2008 History

Within the first year, the Phelps Creek Layback and Phelps Bridge Habitat Restoration Projects have not only met the initial goal of creek bank stabilization, but also provided a diverse native riparian habitat. The brush layering weathered winter storms successfully in 2008 and has matured significantly since then which should enable it to withstand larger storm events. Non-native exotics will decrease in cover as the site develops, thus allowing the growth of a diverse and sustainable native plant and wildlife community. More riparian trees and plants will be planted this winter, and topographic data changes will be included in ensuing reports. In all, the project has been successful.

6. Tables

6.1. Table 1. Plant list: Species and numbers planted and seeded 2007-08

Species	Quantity	Seed (in cups)
Alnus rhombofolia	7	
Artemesia californica	10	16
Artmesia douglasiana	110	16
Asclepias facicularis	10	
Bacharis salicifolia	10	
Bolboschoenus maritimus	50	20
Carex praegracilis	75	
Distichlis Spicata	300	
Dudlyea sp.	13	
Eleocharis macrostachya	0	2
Eleocharis montevidensis	40	
Elmus glaucus	50	
Encelia californica	27	
Epilobium canum	38	
Eriogonum parviflorum	74	16
Gnaphalium californicum	2	
Grindelia camporum	25	
Hazardia squarrossa	23	
Heteromeles arbutifolia	30	
Isocoma menziesii	200	16
Juncus effuses	100	
Juncus mexicanus	25	
Juncus patens	75	4
Juncus phaeocephalus	25	4
Juncus Textilis	2	
Juncus xiphiodes	55	
Leymus condensatus	100	
Leymus triticoides	391	2
Lonicera subspicata	110	
Lotus scoparius	20	2
Mimulus aurantiacus	105	
Platanus racemosa	5	

Populus balsamifera	1	
Quercus agrifolia	12	
Rhamnus californica	1	
Rhus integrefolia	23	
Ribes speciosum	4	
Rosa californica	12	
Salvia leucophlya	15	
Sambucus mexicana	13	
Scheonoplectus americanus	50	
Scheonoplectus californicus	30	16
Schrophularia californica	16	
Scirpus microcarpus	12	
Sisyrinchium bellum	23	
Typha sp.	6	16
Total	2325	

6.3 Photo documentation

6.2 Photo Monitoring: Figure 10, Photo Points

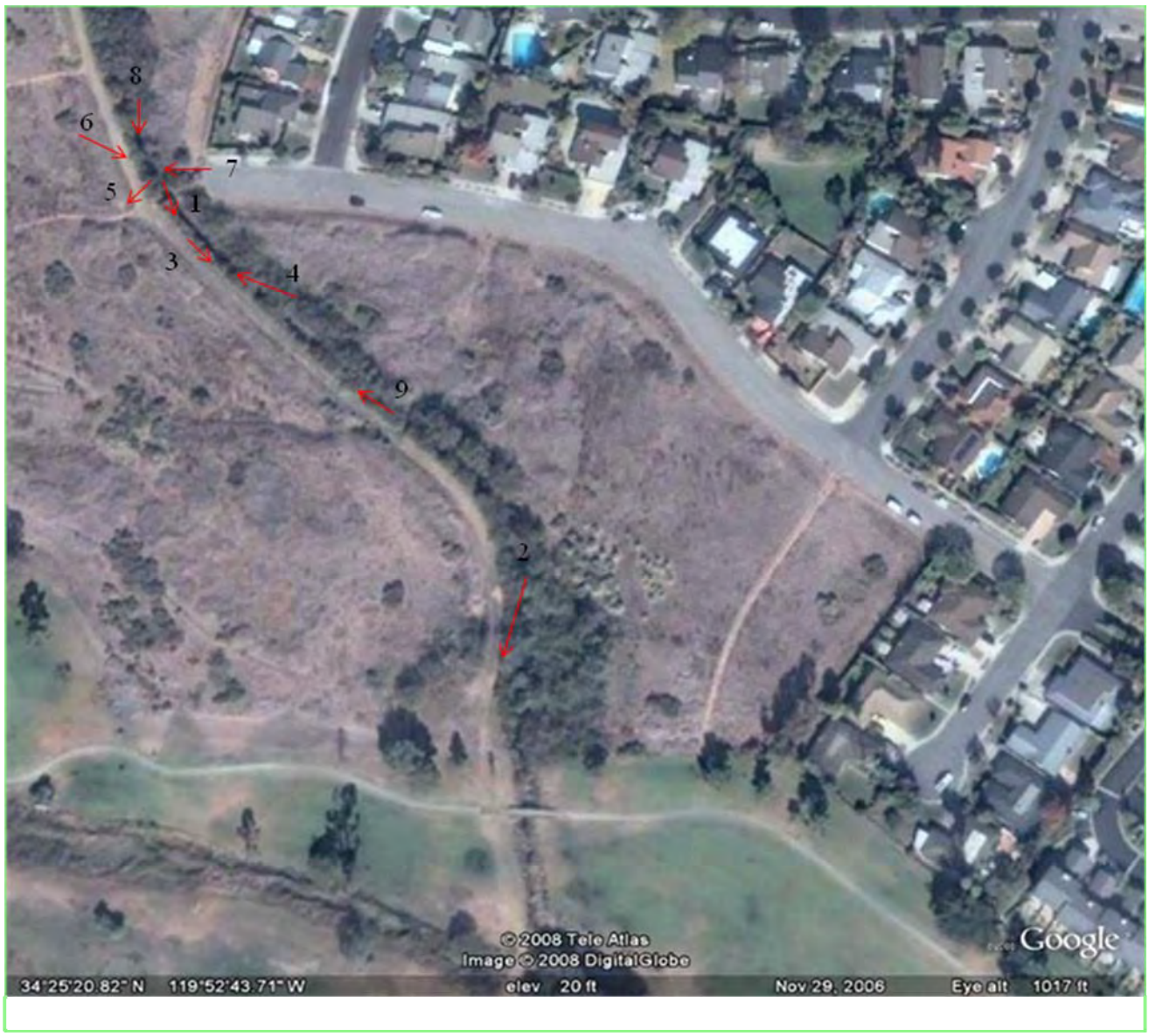


Figure 11a: View from Bridge, January 2008

Figure 11b: View from bridge, March 2008

Figure 11c: View from bridge June 2008

Figure 11d: View from bridge October 2008

Figure 11e: View from bridge December 2008

Figure 11f: View from Bridge October 2009

Figure 11g: View from bridge July 2010

Figure 11h: View from bridge August 2011

Figure 11i: View from bridge October 2012

Figure 12a: Looking south at overflow channel during construction

Figure 12b: Looking south at overflow channel during January 2008 storm

Figure 12c: Looking south at overflow channel March 2008

Figure 12d: Looking south at overflow channel June 2008

Figure 12e: Looking south at overflow channel December 2008

Figure 12f: Looking south at overflow channel October 2009

Figure 12g: Looking south at overflow channel July 2010

Figure 12h: Looking south at overflow channel August 2011

Figure 12i: Looking south at overflow channel October 2012

Figure 13a: Looking on lower slope January 2008

Figure 13b: Looking on lower slope December 2008

Figure 13c: Looking on lower slope July 2010

Figure 13d: Looking on lower slope August 2011

Figure 13e: Looking on lower slope October 2012

Figure 14a: Looking north to bridge during January 2008 storm

Figure 14b: Looking north to bridge December 2008

Figure 14c: Looking north to bridge October 2009

Figure 14d: Looking north to bridge July 2010

Figure 14e: Looking north to bridge August 2011

Figure 14f: Looking north to bridge October 2012

Figure 15a: Slope southwest of bridge January 2008

Figure 15b: Slope southwest of bridge December 2008

Figure 15c: Slope southwest of bridge October 2009

Figure 15d: Slope southwest of bridge July 2010

Figure 15e: Slope southwest of bridge August 2011

Figure 15f: Slope southwest of bridge October 2012

Figure 16a: Looking northeast of bridge during January 2008 storm

Figure 16b: Looking northeast of bridge December 2008

Figure 16c: Looking northeast of bridge October 2009

Figure 16d: Looking northeast of bridge July 2010

Figure 16e: Looking northeast of bridge August 2011

Figure 16f: Looking northeast of bridge October 2012

Figure 17a: Transect 1 January 2008

Figure 17b: Transect 1 December 2008

Figure 17c: Transect 1 October 2009

Figure 17d: Transect 1 July 2010

Figure 17e: Transect 1 August 2011

Figure 17f: Transect 1 October 2012

Figure 18a: Looking south under bridge during January 2008 storm

Figure 18b: Looking south under bridge December 2008

Figure 18c: Looking south under bridge July 2010

Figure 18d: Looking south under bridge August 2011

Figure 18e: Looking south under bridge October 2012

Figure 19a: Looking north from middle channel January 2008

Figure 19b: Looking north from middle channel March 2008

Figure 19c: Looking north from middle channel October 2008

Figure 19d: Looking north from middle channel December 2008

Figure 19e: Looking north from middle channel October 2009

Figure 19f: Looking north from middle channel July 2010

Figure 19g: Looking north from middle channel August 2011

Figure 19h: Looking north from middle channel October 2012

7. References cited

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1981