

REVISED 404 (B) (1) ALTERNATIVES ANALYSIS

BP Cherry Point Cogeneration Project

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1.0 INTRODUCTION

This Alternatives Analysis replaces the Alternatives Analysis prepared by Golder Associates (Golder Associates 2003) that was submitted to EFSEC as Appendix H-5 of the Revised Application for Site Certification. This replacement incorporates information from the earlier document and provides additional information and analysis.

2.0 PURPOSE AND NEED

The basic purpose of the cogeneration project is to provide a reliable and cost-effective supply of both steam and electricity to the BP Cherry Point refinery and to provide electricity to the regional power grid.

The BP Cherry Point refinery needs significant amounts of steam and electricity to refine and process petroleum products. BP needs a supply of steam and electricity that is both reliable and reasonably priced. Without a reliable source of steam and electricity, the refinery cannot maintain operations, and the refinery satisfies fundamental regional needs for petroleum products. A reliable source of steam and electricity is also needed to operate the refinery safely. Unanticipated interruptions in supply could require the emergency shutdown of refinery operations and the safety risks associated with unplanned shutdowns. BP also needs steam and electricity to be available at a reasonable price. In the past, extreme electricity price volatility has imposed a significant economic cost on the refinery, and over the long term, could threaten the viability of the refinery.

The region also needs additional electricity generation capacity, as demand for electricity continues to grow. The cogeneration project would provide electrical energy for sale into the regional power grid, thus supplying a growing public need for electricity.

In order for the cogeneration project to satisfy the refinery's need for electricity and steam, and the region's need for additional generating capacity, the cogeneration project must be an appropriate size, capable of producing cost-competitive steam and power, located in close proximity to the refinery, and commercially feasible.

The fundamental purpose and need for the laydown areas is to provide temporary construction staging and support areas for the cogeneration project and permanent area for routine maintenance of refinery components. In order to satisfy that purpose and need, the laydown areas must be located in close proximity to the east of the refinery and cogeneration project site, of sufficient size for anticipated activities, and must not compromise security at the refinery.

2.1 RELIABILITY

Refinery operations require significant amounts of both electricity and steam. The BP refinery currently uses approximately 85 MW of electricity, and this requirement is expected to grow in the future. In particular, BP plans to add process units to allow the refinery to produce cleaner

gasoline and diesel to comply with clean fuel regulations that will go into effect in 2005 and 2006. BP is currently completing the Isomerization Project, which will produce the cleaner gasoline, and that project is expected to increase electricity demand by approximately 2.5 MW. BP will eventually be installing new equipment to produce cleaner diesel fuel as well. This equipment will further increase the refinery's electricity demand. Although it is too early in the project development to determine the amount of the additional electricity demand, it is likely to be about 2.5 MW more.

The BP refinery also uses a substantial amount of steam. Steam is used to heat materials and to provide pressure to drive pumps and compressors. Four utility boilers currently provide steam to the refinery, each with the capacity to produce 150,000 lbs./hr. of steam for a total capacity of 600,000 lbs./hr. The range of steam production varies greatly with a variety of refinery process conditions, with the current steam requirement averaging 287,000 lbs./hr on an annual basis. The clean gasoline and diesel projects discussed above will increase the refinery's steam requirement. The Isomerization Project will increase the average steam requirement to 510,000 lbs./hr, and a new boiler will be added to provide additional steam capacity. The clean diesel project will increase steam demand further, although it is too early to determine the amount of the additional steam demand.

Maintaining a reliable supply of electricity and steam is necessary from operational, safety, and economic perspectives.

First, a reliable supply of electricity and steam is necessary to maintain operation of the refinery. Without electricity and steam, the refinery cannot operate. Brief power outages or even sudden voltage changes can cause some refinery process units to be shut down temporarily. For example, in March 2004, lightning struck a transmission line near Lynden, Washington, causing a drop in voltage from 115kV to about 25kV. Automatic equipment corrected the problem in about 70 milliseconds, and the closure of breakers on the line caused a second similar dip for 70 milliseconds. This transmission line connects to a substation in common with a transmission line supplying the BP Cherry Point refinery, and those brief power dips caused a calciner hearth and a utility boiler to shut down.

Refinery equipment that must be shut down suddenly without prior planning can require a considerable amount of time to bring back on line. It may require hours, even weeks, to make process units safe to start up after a sudden and unplanned shutdown. Some heavy liquids solidify if allowed to cool. If these liquids solidify inside process equipment such as pipes, vessels, valves and pumps, it is very difficult to remove, clean up and prepare the equipment for startup. Maintaining a constant reliable supply of both electricity and steam is, therefore, critical to maintaining continuous operations at the refinery.

Second, a reliable supply of electricity and steam is necessary to minimize safety risks at the refinery. The refinery has procedures to allow the safe shutdown of process unit operations for sudden and unplanned reasons. However, the restart of equipment following sudden and unplanned shutdowns can present safety risks. For example, a very serious incident occurred at a neighboring refinery, when a sudden loss of electric power resulted from a severe storm and caused the shutdown of steam production and process operations. The sudden shutdown of one process unit resulted in unprocessed material being left inside the equipment. Two days later,

the opening of the vessel to discharge the partially cooled material caused the unexpected release of volatile material that caught fire and resulted in the death of six refinery personnel (U.S. Chemical Safety and Hazard Investigation Board 2001). Although these kinds of accidents can be avoided with careful procedures, this accident illustrates the potential risks associated with unplanned shutdowns.

Third, a reliable source of electricity and steam is important to the regional economy. Without steam and electricity, the refinery cannot operate. Interruptions in the production and supply of refined petroleum products cause problems for the regional economy. About one fifth of the vehicles in the state of Washington run on gasoline produced by BP Cherry Point Refinery, and about 80 percent of the jet fuel for Sea-Tac airport comes from the BP refinery. Interruptions in supply would have a major effect on the economy of the region.

The importance of power reliability to the refinery is reflected in the redundant systems currently in place to supply electricity and steam to the refinery. There are four separate electrical power transmission lines feeding the refinery today: two separate transmission lines from the Custer Substation, one transmission line from the Bellingham Substation, and one transmission line from the Puget Sound Energy Point Whitehorn Generating Station. Except for the generating station, any one of the transmission lines by itself could supply the refinery power needs. Likewise, the refinery maintains multiple boilers, so that all need not be operational to satisfy the refinery's demand for steam. Maintaining reliability is fundamental to the operation of the refinery, and improving it when possible is prudent.

In order to ensure a reliable supply of both electricity and steam, BP has designed the cogeneration project to have three gas-fired turbines, each with a heat recovery steam generator (HRSG) that can provide steam directly to the refinery or to the cogeneration unit's steam turbine. Having three gas turbines and HRSGs will ensure a continuous supply of steam and electricity to the refinery, even if one gas turbine were off-line for maintenance and a second turbine shut down unexpectedly.

2.2 COST-EFFECTIVENESS

BP needs to obtain electricity and steam for the refinery at a reasonable price. The average annual electricity cost has been \$21 million. In 2000 and 2001, however, the cost of electricity for the refinery was more than triple the 10-year average cost, and the cost for those two years combined was more than \$100 million above the 10-year average. On a long-term basis, such electricity costs would threaten the economic viability of the refinery.

The proposed cogeneration facility is cost-effective because the combined cost of electricity and steam it would provide to the refinery is expected to be at or below the typical average combined cost of buying electricity from the regional grid and producing steam from stand-alone boilers. In this region, the cost of both electricity and gas is typically lower in the late spring and summer, and the cogeneration/refinery operation can adapt to the price.

The region also requires additional electrical generating facilities that are capable of generating electricity at a reasonable and competitive price. As a privately-financed project, the

cogeneration project can only go forward if it is able to compete successfully in the regional power market by selling power at a competitive price. Most of the base-load power in the region is provided by hydroelectric, nuclear, and coal power plants, but new units of those types of plants are unlikely to be added to the supply. Only gas-fired power plants are likely to be built, and only the most efficient are competitive for base-load power. Other plants with higher operating costs can operate economically only during peak demand periods when prices are higher. An important part of the ability of the project to operate competitively in a base-load market is that, as a cogeneration plant, this facility will be one of the most fuel-efficient gas-fired power plants available.

The concept of cogeneration is fundamental to efficiency, because it allows steam to be generated once and used at least twice. The power plant will be a combined cycle plant with water cooling for greatest efficiency. A stand-alone power plant would have to condense 100% of the low-pressure steam from the steam turbine into water in order to pump it back into the heat recovery steam generators (HRSGs). The heat in this low-pressure steam is then lost to the atmosphere. Cogeneration allows part of this heat to be used in refinery processes. The steam sent to the refinery would be used both to heat and to move oil and then once it is used, the condensed steam would be pumped back to the cogeneration plant to be reused to make more steam. The steam that is provided by the cogeneration project allows the refinery to discontinue the production of steam in the utility boilers. The steam delivered to the refinery from the cogeneration plant will be delivered as though it were being produced at nearly 100% efficiency. The existing boilers produce steam at a range of about 70% to 83% efficiency. The refinery is constantly reviewing energy usage by comparing current energy usage to a number called the Energy Intensity Index (EII.) The cogeneration steam will help lower the refinery EII. With the cogeneration plant in place, the three existing least efficient boilers at the refinery will be decommissioned.

2.3 SIZE OF FACILITY

The size and configuration of the proposed cogeneration facility were determined primarily by two factors. First, BP requires a redundant supply of steam. Given the importance of steam reliability described above, BP designed the cogeneration project with three separate generating units, each sized so that it could provide required steam to the refinery even if one unit were down for maintenance and a second unit were shut down unexpectedly. Second, the project must be cost-effective and capable of competing successfully in the regional electricity market as a continuously-operating or base-load facility.

Although a smaller three-turbine facility (utilizing smaller turbines) could provide a triple-redundant supply of steam to the refinery, it would not be cost-effective. The capital costs of a generating facility are not linear in relation to the facility's output. On the contrary, larger turbines are generally more efficient, and a substantial share of the costs associated with a larger facility are also incurred in connection with a smaller facility. The economies of scale are such that the cost per megawatt of electricity generated declines as the size of the facility increases. This is particularly true with a cogeneration facility, which requires significant infrastructure to integrate the generating facility with the steam host, in this case. BP estimates the cost associated with that infrastructure to be at least \$10 million for the proposed cogeneration

project. BP has proposed a facility of a size that will take advantage of the economies of scale and spread the cogeneration infrastructure costs so that it can provide cost-effective steam and electricity to the refinery and compete in the regional electric market.

Three General Electric 7 FA turbines (nominal 174 MW each) and one steam turbine (nominal 243 MW, but only 216 MW when 510,000 lbs per hour of steam are being delivered) were used to develop base case economics for the project. The combination would produce a nominal total of 720 megawatts (MW). The actual output is less than the individual ratings because the power plant uses 18 MW in its operation. Smaller turbines available as options are less efficient and would reduce the return to investors enough that their selection would not be cost-effective and would make the project impracticable.

2.4 CRITERIA FOR EVALUATING PRACTICABLE LOCATIONS

Potential locations for the cogeneration plant and laydown areas may be rendered impracticable as a result of cost, technology or logistical considerations [40 C.F.R. § 230.3(q)]. Four specific parameters that may render sites impracticable for use as a cogeneration project site or laydown area as a result of associated cost, technology or logistical limitations are size, proximity to the refinery, security, and accessibility. Each of these limiting parameters is described below.

2.4.1 Size

The location of both the cogeneration plant and associated laydown areas must be of the appropriate size to accommodate the facility and the required construction activities. Given the available technology and associated equipment required for a cogeneration facility of the size needed, BP has determined that a site of at least 33 acres is required.

BP has designed the plant configuration to be as compact as possible so that the footprint, the materials of construction, the interconnections with the refinery and associated costs are minimized. However, an equally important and competing consideration is that the plant components must be spaced far enough apart to allow for maintenance. BP has balanced these two considerations against one another and proposed a configuration of the facility that will occupy approximately 33 acres and utilize approximately 33 acres for construction laydown.

The 33-acre project site is typical for this type of facility. Similar power plants occupy 30 to 40 acres. For example, the 750 MW Pastoria Energy Facility in California has a 31-acre site, (California Energy Commission 2000) and the 850 MW Mercer Ranch project proposal in Washington had a 40-acre site (EFSEC 2000). Two larger power plant projects proposed in Washington (Starbuck and Wallula) have sites of 40 and 97 acres, respectively (Starbuck Power Company 2001, Wallula Generation 2001). Three recently permitted combustion turbine power projects in Washington (Chehalis, Satsop, and Sumas), each with two turbine units, have project sites ranging from 20 to 33 acres in size (Chehalis Power 1994, Duke Energy 1994, SE2 2001).

Fifteen to 20 acres of construction laydown area are required for the materials and assembly of the major components. Different contractors do different parts, and construction schedules require that several different components be in progress at once in order for each to be ready

when required to fit into or be connected to others. In addition, each contractor requires office space and parking. Hundreds of workers, vendors, and delivery people are at the site at the same time, and parking and security have to be provided to accommodate the peaks.

Logistical considerations require at least 33 acres of laydown area for cogeneration project construction. Table 1 shows the cogeneration project construction laydown area uses and approximate acreage required for each use during peak construction.

**Table 1
Construction Laydown Uses and Area**

Item	Estimated Acreage Requirement ¹
Gas Turbines	4
Steam Turbine	1.5
HRSGs	8
Cooling Tower	1
Structural Backfill	2
Civil Materials	1.5
Structural Steel	2.5
Misc. Equipment	1
Piping Materials	2.5
Electrical Bulks	1.5
Electrical Cable	1
Receiving area	0.5
Warehouse	0.5
Small Construction Equipment	0.5
Trailer Complex	2.5
Craft Parking	2.5
Total	33

¹ These acres are used for planning purposes, but the actual use of many of the acres includes several different functions during construction. Some functions have area requirements that vary over time.

The laydown area requirements for the construction of the cogeneration project total 33 acres in addition to the 3 acres of existing contractor parking area. The 3-acre existing contractor parking area was incorporated as area that can be used at times other than turnarounds, reducing the total laydown area from the 36 acres identified in the Revised EFSEC Application to 33 acres and further reducing the wetland fill needed for the laydown use. Eleven acres of the laydown area will be temporary impact areas that can be restored after the construction of the cogeneration project. Twenty-two acres will be permanently impacted either because they are required for cogeneration project facilities or because they will be required for future refinery maintenance activities.

Of the 22 acres permanently required, approximately 4 acres will be occupied by stormwater facilities, roads, and other interconnections between the cogeneration project and the refinery.

Logistical and cost considerations require at least 22 acres of permanent laydown area for refinery maintenance activities, including annual "turnarounds" where one or more major components of the refinery undergo planned refurbishment. These turnarounds involve the

dismantling and refurbishment of large equipment. Hundreds of additional workers are involved, and space is needed to move and store equipment and materials. Turnaround activities must be performed quickly and efficiently because refinery operations are temporarily shutdown during these activities. Anything that causes these activities to take longer results in significant opportunity costs to BP and interrupts the region's supply of needed petroleum products. In order to perform turnarounds quickly and efficiently, a significant amount of space is needed. In the past, major turnarounds have utilized up to 45 acres for laydown purposes. Many of the spaces used for turnaround and maintenance activities in the past have and will be taken up by new refinery equipment used to comply with new clean fuel regulations and other changes in refinery operations. Additional space is, therefore, needed for maintenance and turnarounds, and for some functions, it must be in close proximity to the refinery components.

2.4.2 Proximity to Refinery & Related Infrastructure

Technology, logistics, and cost require the cogeneration plant to be located in close proximity to the refinery because of the numerous connections integrating the cogeneration facility with the refinery.

An essential part of the cogeneration project is the delivery of steam to the refinery. The steam must be delivered through insulated pipes and maintained at specific temperature and pressure. Existing technology does not allow steam to be reliably transported more than a few thousand feet (less than a mile) at a constant temperature and pressure.

The actual distance threshold is derived from a complex combination of factors. In order to deliver steam to the refinery in useable form, it must remain superheated to prevent condensation from forming water droplets that could damage turbines. This can be accomplished over a certain increased distance by thicker insulation, but the chance of condensation increases with increasing distance. The steam also must be delivered at a high pressure. This can be accomplished over some distance by increasing the diameter of the pipe. The pressure cannot be allowed to drop substantially because the refinery header pressure must be maintained within a narrow band (about 1 to 2 pounds per square inch above or below 600) in order to overcome significant fluctuations in steam demand. Refinery steam demand fluctuates on a minute-to-minute or hour-to-hour basis as refinery processes and components are started, stopped, or adjusted to produce different products or components of products. The length of pipe required is also longer than the linear distance between the steam source and the refinery because expansion loops are required as part of the design. All of these factors combine to limit the feasible locations for a steam source to those immediately adjacent to the refinery. As the distance increases, the tolerance for changes in conditions that could affect steam delivery temperature, pressure, and rate decreases. In order to maintain reliable steam delivery, the distance is effectively limited to less than 5,000 thousand feet.

The distance of the cogeneration facility from the refinery is also limited by cost and logistical factors. The cogeneration facility will be connected to the refinery in several ways. Pipes will provide steam to the refinery and will return condensate to the cogeneration project. Pipes will transport waste water from the cogeneration facility to the refinery's waste water treatment system. A pipeline connection will transport natural gas from the existing pipeline at the refinery to the cogeneration facility. Transmission lines will transmit electricity from the cogeneration

facility to the refinery. The cost issues associated with each of these connections increases with distance. A more distant location would also present logistical difficulties if piping and transmission lines would have to cross roads, rights-of-way, or other utility corridors. For these reasons, BP limited its consideration of alternative sites to those less than 5,000 feet away from the refinery.

Laydown areas must be located near both the cogeneration project site and the refinery. The laydown areas must provide ready access between the laydown area where the major power plant components are assembled and the site where they will be installed. In order to be used for refinery maintenance and turnaround activities, permanent laydown areas must be located near the refinery. They must also be located near needed utilities, such as electrical, water and sewer connections. In many instances, it would not be logistically feasible to transport the large refinery components on public roads to a more distant laydown area.

2.4.3 Security

In order for the cogeneration facility to provide a reliable source of steam and electricity, it must remain secure. Since September 11, 2001, security has been increased at all refineries and power plants in the United States. The cogeneration facility site and laydown areas were selected to facilitate the security measures in place at the refinery. Having the cogeneration plant adjacent to the refinery would allow the existing security fence to be extended around the cogeneration project and would allow the cogeneration facility and the connections between the cogeneration project and the refinery to be incorporated into the security system of the refinery. Keeping the connections within the refinery security system will help protect them both from intentional sabotage and from accidental damage by vehicle damages or other mishap. Any site that would require the steam pipeline to cross a public road is considered unacceptable from a security standpoint. Unlike the other pipelines and piping connections, the steam pipeline must be above-ground. Crossing a public road would make it too vulnerable to intentional or accidental damage. Within the refinery security fence, vehicle safety is tightly enforced and drivers are either employees or are escorted by employees and must pass rigorous safety training.

Locating the cogeneration project laydown and staging areas and the permanent refinery laydown/materials storage sites within the existing or extended refinery security fence maintains security. Locating these laydown areas elsewhere would require significant expense to install and maintain alternative security measures. Logistically, separate secured locations would also present more potential areas of vulnerability.

2.4.4 Accessibility

The primary issues with accessibility are logistical, although efficiency of operation is also extremely important, and efficiency directly translates to cost. Two major considerations of accessibility are the delivery of equipment and materials to the laydown areas and accessibility between the laydown areas and the construction site or the refinery components being refurbished.

The laydown areas must receive large equipment and materials of various sizes and quantities that arrive by highway. Therefore, there must be a direct connection with existing highways. That connection must be separate from the primary entrances to the refinery to keep one operation from compromising another (i.e., refinery operation and construction of the cogeneration facility).

Since the permanent laydown areas will serve two purposes, they must be located so they are accessible to both the refinery and the cogeneration facility. The location of the permanent laydown areas must provide unobstructed access to the refinery components that are regularly refurbished. Some of the components are large enough to be very difficult to move on public roads, and some of the mobile equipment used to move refinery components for maintenance would not be appropriate on public roads. Equipment being moved during periods of high maintenance must be moved within the secured areas of the refinery in order to limit access and maintain efficient operations. The refinery was constructed to accommodate the majority of the turnaround activities in the open space immediately adjacent to the east side of the refinery facilities. Performing these activities at other locations would either not be feasible or at least be more difficult, more time-consuming, more expensive and much more disruptive to on-going refinery operations.

In addition, none of the feasible alternative locations for the cogeneration project are west of the refinery. Therefore, in order to be accessible for both the refinery maintenance operations and the cogeneration construction, the permanent laydown areas must be on the east side of the refinery.

3.0 ALTERNATIVES

The Cogeneration Project is not a water-dependent project. Therefore, alternative actions, alternative sites, and alternative site configurations were considered to determine if they could satisfy the project purpose and need, would be practicable, and would result in less wetland and overall environmental impact.

3.1 ALTERNATIVE ACTIONS

If the cogeneration facility were not built, other actions would have to be taken to attempt to satisfy the purpose and need. The actions associated with each component of the purpose and need are discussed below.

3.1.1 Steam Reliability

A reliable steam supply could be provided by using existing boilers and adding boilers as the refinery steam demand grows. Even the most efficient stand-alone boilers would produce steam less efficiently than the cogeneration project, so more natural gas would be consumed and more air pollutants and greenhouse gases would be emitted per unit of steam produced. No alternate technology is known that would take the place of the boilers. Therefore, while it is possible to supply steam reliably by means other than the cogeneration plant, it can only be done at a higher

cost, with greater natural gas use, and with higher air emissions per unit of steam than with cogeneration.

3.1.2 Electricity Reliability and Cost-Effective Supply

There is no alternative that would provide the refinery with a reliable and cost-effective supply of electricity. As long as the refinery's electricity must be purchased on the market, the refinery contributes to the increasing regional demand for electricity and is vulnerable to all the factors that can cause the price and availability of electricity to fluctuate. Very high electrical prices in late 2000 and early 2001 placed the viability of the refinery at risk. In fact, during that period, BP spent over \$100 million more than it has historically spent on electricity to operate the refinery. While the price volatility has decreased significantly since then, the projected growth in regional power needs and the variability in hydropower availability will require new power generation to balance supply and demand. The effects of the imbalance in supply and demand could be felt as early as 2006 (Western Electric Coordinating Council 2002). In the current market, BP is not able to obtain a long-term contract for electricity at a reasonable guaranteed price. Power is now typically sold on a "toll" basis, which means essentially a cost-plus basis. The cost of natural gas will drive the cost of electricity whenever the demand above other existing supplies is met by electricity produced by gas-fired power plants. Most of the new combustion turbine power plants have the ability to produce power when the gas price is favorable and not produce it at other times. The cogeneration plant's efficiency advantage will give it a broader effective price range within which it is economical. With the cogeneration project in place, the combined cost of steam and electricity to the refinery is expected to be at the lower end of prices, and the refinery would be supplied directly from the cogeneration plant, which maximizes reliability.

Not building the cogeneration project simply will not accomplish the purpose of providing a reliable and cost-effective electricity and steam supply for the refinery. No other action would do so, and no other known technology would do so. The costs to the refinery would be higher, and the resulting cost of producing gasoline and diesel in the region would also be higher.

Other power facilities could be constructed to satisfy the region's need for additional electrical generating capacity. If the cogeneration project is not built, the power plants most likely to be built to fulfill regional electricity demand will be stand-alone gas-fired combustion turbine plants. Very few large-scale cogeneration facilities are built because a large host willing to enter into a long-term, contract for steam or heat is necessary (CTED 2003). A stand-alone facility would be less efficient than the cogeneration plant. It would consume fossil fuels at a higher rate, and therefore, emit air pollutants and greenhouse gases at a higher rate.

3.1.3 Laydown Areas/Turnaround Space

The 11 acres of temporary laydown area would not be needed if the cogeneration plant were not built. However, the refinery would still require the permanent laydown areas for refinery maintenance and "turnarounds." The site shown in this document to provide that space with the least wetland and other environmental impact is the proposed site at the northeast corner of the refinery just west of Blaine Road and south of Grandview Road. Only the areas of permanent fill

would be constructed, which would fill about 19 acres of wetlands. No other action would substitute for this requirement and have less wetland or overall environmental impact.

3.1.4 Summary Impact Evaluation

If the cogeneration project were not built, it would be possible to meet the need for a reliable steam supply by conventional boilers but at a higher cost and with greater environmental impacts. It would not be possible to significantly decrease the cost and improve the reliability of the electricity supply for the refinery. It would be possible to provide additional electricity to the region but at less efficiency and therefore greater fuel use and environmental impacts. . It would not be possible to provide the refinery maintenance turnaround area with less than about 19 acres of wetland impact. Therefore, the no-action alternative would not meet half of the components of the purpose and need, and more than half of the wetland impacts would still occur.

If the cogeneration project were not built, permanent impact by the cogeneration plant on about 12 acres of wetland and temporary impact by the laydown areas on about 5 acres of wetland would not occur. It is also reasonable to assume that any new power plant to be built in western Washington to supply the power demand will have some impacts on wetlands, since wetlands are so prevalent in this region. Therefore, the actual reduction in impact on wetlands by not building the cogeneration plant may be small. In other words, a no-build alternative is not likely to be without wetland impacts.

Other impacts associated with alternative steam and electricity sources would be higher than with the cogeneration plant. Without the cogeneration facility, the steam produced for the refinery would be produced with higher emissions of air pollutants per unit of steam. For example, the NO_x emissions are more than 2 times higher for the most efficient stand-alone boiler that might be used and more than 16 times higher for some of the existing boilers than the cogeneration plant per unit of fuel. In addition, because the cogeneration plant is so much more efficient, the stand-alone boilers would use significantly more fuel than the cogeneration plant per unit of steam, thus increasing the effective difference in emissions.

Similarly, differences in air emissions and fuel consumption would exist between the cogeneration plant and any additional power plants that would provide the needed electricity. The cogeneration plant would be the most efficient source of power. Any likely alternative source (gas-fired plants) would necessarily have higher fuel consumption rates per unit of power and therefore, higher emissions of air pollutants and greenhouse gases. Air emissions are also likely to be higher because most power plants in the region are not subject to emissions limitations as stringent as those proposed for the Cogeneration Project.

The environmental impacts avoided by not building the cogeneration facility at the BP Cherry Point refinery may be more than offset by the environmental impacts of other actions required to fill the needs. In addition, the impacts of the cogeneration project are readily mitigated, while some alternative action impacts may be less easily mitigated.

3.1.5 Economic Considerations

The economic consequences of not building the cogeneration plant must also be considered.

The BP Cherry Point refinery is the only BP refinery in the United States without a cogeneration plant. Because refineries are large steam users, a cogeneration plant interconnected to a refinery is a good fit. With the cogeneration project, the refinery will receive less expensive reliable steam and power than without cogeneration, and the power produced for the regional market will be more cost-effective than other new sources of power. The reason for the refinery to pursue the construction of a cogeneration plant is the substantial annual savings in energy costs and reduced vulnerability to power market fluctuations. However, the economic benefits go much beyond the economics of the BP Cherry Point refinery. The economics of the whole region are linked to the reliable supply and price of electricity and fuel. .

It is difficult to predict what effect future power market fluctuations might have on the refinery, but in 2000 and 2001, they put the viability of the refinery at significant risk. In response to skyrocketing electricity prices, the refinery temporarily added 26 diesel generators during the most severe electric power prices, and then replaced the diesel generators with 14 natural gas-fired generators until the power market stabilized. If electricity prices had stayed high long enough, the refinery may not have continued to operate. Without the refinery operating, the regional supply of fuel would be severely constrained, and the economic consequences would be enormous.

Electricity can not be stored. Therefore, supply must precisely equal demand. As this balance becomes closer and the reserve generating capacity margin becomes smaller, power prices become very volatile and can increase rapidly. Power buyers must find sources to meet demand, and if the supply gets too tight, they must find power at any cost, or their customers would be without power. Because supply must meet demand, if it falls short it is not that customers get less power, rather they get none, which is the reason for blackouts. All customers, including residential, commercial and industrial customers find this inconvenient and potentially devastating. Having the cogeneration plant operating would help prevent such disasters in two ways. The power demand of the refinery would no longer be a drain on the regional power grid, thus effectively lowering the demand. The excess electricity produced by the cogeneration plant would also increase the supply available to meet the growing regional demand.

3.1.6 Conclusion

The alternative of not building the cogeneration project would not satisfy the purpose and need stated at the beginning of this document. While it might reduce the amount of wetland impact, that is not certain, because some less efficient power generation facilities would have to be built in the region, and many proposed projects have significant wetland impacts. The economic consequences of not building the cogeneration plant might be enough to shut down the refinery under certain circumstances, and that would have broad and severe regional economic consequences. Not building the cogeneration facility would also forego the economic and environmental benefits of more efficient electricity production in the region.

3.2 ALTERNATIVE COGENERATION SITES.

As explained above, alternative cogeneration plant sites must meet four criteria in order to be practicable: size, proximity to refinery, security, and accessibility. Alternate technologies are not applicable for comparing sites. While there is likely to be a difference in costs between sites, costs are less important than impacts or feasibility. The cogeneration plant will require a site that is at least 33 acres in size. As explained above, the cogeneration site must be located within a one-mile pipe distance of the refinery and may not be located across a highway from the refinery in order to be a feasible site. Therefore, potentially feasible sites would include sites within the refinery fence, i.e., between Grandview Road on the north, Jackson Road on the west, Aldergrove Road on the south, and Blaine Road on the east. Existing refinery facilities already occupy most of this land, and sites on the west of the refinery do not have adequate accessibility from the highway and to the cogeneration site and refinery. This leaves only the northeast corner of the refinery with enough open space to consider inside the security fence and the highways. In addition, sites adjacent, but outside the fence to the east could be secured and are potential sites. Since Brown Road is gated and controlled by BP, sites both north and south of Brown Road would meet the security criteria.

Four potential sites (Sites 1 through 4) meet the four criteria, including enough area available to fit the cogeneration project (Figure 1). BP owns all of the potential sites, and therefore all are potentially available for the project. Two additional sites (Sites 5 and 6) were discussed in the Alternatives Analysis prepared by Golder Associates for the EFSEC permit application. These sites do not fit all the selection criteria, but are addressed here for completeness.

3.2.1 Site 1 (Proposed Site)

Site 1 is the proposed site. It is located just south of Grandview Road and east of the refinery fence. This site is referred to as Site 3 in the Golder Alternatives Analysis.

Size & Wetland Impacts

The proposed site has at least 40 acres available. The site could be expanded south or east, but that would encroach on more wetlands. It cannot be expanded to the north because of the County requirement for a 300-foot buffer between the plant site and Grandview Road. The site location has been selected to minimize wetland impact area. With the proposed site layout occupying 33 acres, 12 acres of wetland would be filled.

Proximity to Refinery & Related Infrastructure

This site is directly adjacent to the refinery fence and would have minimal impacts from connecting to required infrastructure. One access road and a permitted corridor for a transmission line connection to the BPA transmission line to the east are immediately adjacent. An existing natural gas line with capacity is in the utility corridor adjacent to the west edge of the site, and a water supply pipe from the Whatcom PUD is also in the corridor but a few hundred feet south.

Security

Site 1 is immediately east of the refinery security fence, which can be readily expanded to include the site. In addition, the steam pipeline would not have to cross a public road and it would therefore be secure.

Accessibility

This site is directly accessible to the proposed laydown areas and all facilities and infrastructure. Access to the refinery and Blaine Road are about 250 feet away, and access to Grandview Road is similarly short.

3.2.2 Site 2

Site 2 is south of the proposed site. It is just north of Brown Road and east of the refinery fence and the proposed Brown Road Materials Storage Area. This site includes a large part of Site 1 in the Golder Alternatives Analysis.

Size & Wetland Impacts

Site 2 has at least 40 acres available. The site could be expanded north or east, but those areas are essentially all wetland. With a site layout of 33 acres, at least 31 acres would be wetland fill. This impact conclusion is based on a wetland delineation for the Brown Road Materials Storage Area (URS 2003) and on a delineation by Golder Associates (Golder 2003) which showed 2 acres of upland in patches outside the Brown Road Materials Storage Area. The remainder of Site 2 is wetland.

Proximity to Refinery & Related Infrastructure

The site is near to the refinery, and impacts of connecting to the infrastructure would be only slightly greater than the proposed site because of greater distances for some utilities.

Security

Site 2 is close enough to the east of the refinery security fence that the fence could be readily expanded to include the site. In addition, steam pipeline could be made secure because it would not have to cross a public road.

Accessibility

This site is directly accessible to potential laydown areas (as evaluated below) and all facilities and infrastructure. Highway access would be by way of Brown Road.

3.2.3 Site 3

Site 3 is just south of Brown Road (and Site 2) and adjacent to the east refinery fence. This site is included as part of Site 6 in the Golder Alternatives Analysis.

Size & Wetland Impacts

This site has at least 40 acres available. The site could be expanded to the south or east, but those are essentially all wetland areas. With a site layout occupying 33 acres, it would essentially all be wetland fill. This impact conclusion is based on a wetland delineation for the Brown Road Materials Storage Area (URS 2003) that found about 5.5 acres of upland in the 11 acres to be used for the Brown Road Materials Storage Area. Nearly all of the adjacent area to the south appears to be wetland, based on reconnaissance-level information by both Golder Associates and URS. Site 3 would be located mostly south of the Brown Road Materials Storage Area in an area that is almost all wetland.

Proximity to Refinery & Related Infrastructure

The site is adjacent to the refinery. The impacts of connecting to the infrastructure would be similar to the proposed site. The transmission line connection would have to go an additional 1,200 feet. The gas pipe would have to be extended a few hundred feet from the metering station. A water pipe is nearby in the utility corridor.

Security

Site 3 is immediately east of the refinery security fence, which can be readily expanded to include the site. In addition, steam pipeline could be made secure because it would not have to cross a public road.

Accessibility to Laydown Areas

This site is directly accessible to potential laydown areas (as evaluated below) and all facilities and infrastructure. Highway access would be by way of Brown Road.

3.2.4 Site 4

Site 4 is the northeast corner of the refinery south of Grandview Road and west of Blaine Road. This site is referred to as Site 5 in the Golder Alternatives Analysis.

Size & Wetland Impacts

Site 4 consists of Laydown areas 1, 2, and 3 associated with the proposed site and the existing contractor parking lot. Although the 32 acres available at this location might be large enough for the cogeneration facility if the configuration were altered, it would be impossible to maintain the buffer along Grandview Road that is required by Whatcom County Code. Approximately 20 acres of this site are wetlands. The site could not be expanded because it is constrained on all sides. On the west, it is constrained by the drainage course that conveys clean runoff to the north across Grandview Road, which has refinery facilities just to its west. On the north, the site is constrained by the refinery security fence and the adjacent Grandview Road. To the east, the site is constrained by Blaine Road (a refinery road here) and the adjacent utility corridor, which has natural gas pipelines, water pipelines, and electrical transmission lines and must be maintained as

a utility corridor. To the south, the site is bounded by wetlands and existing refinery facilities and use areas.

Proximity to Refinery & Related Infrastructure

All of the infrastructure is nearby, and the impacts of connecting to it would be similar to the proposed site. However, as explained above, the refinery needs additional laydown/turnaround areas. If this area were used as the project site, an additional 33 acres would be needed for construction laydown and turnaround activities, and the impacts to wetlands would occur for these new refinery laydown/turnaround areas.

Security

Site 4 is within the refinery security fence. Piping would be secure because the steam pipeline would not have to cross a public road.

Accessibility to Laydown Areas

The laydown area would occupy the site proposed for the cogeneration facility. In other words, if the cogeneration unit occupies this site, that would require a direct switch with the area occupied by the laydown area. Accessibility would be the same as the proposed site.

3.2.5 Site 5

Site 5 is located within the refinery and is the area previously used for refinery turnarounds. Part of that area is where the Isomerization Unit for meeting clean gasoline requirement is being constructed. This site is referred to as Site 2 in the Golder Alternatives Analysis.

Size & Wetland Impacts

This site was much too small (less than 20 contiguous acres) to accommodate a cogeneration facility even before part of it was required for other purposes. It has been eliminated from further consideration on this basis alone. The site is bounded on three sides and part of a fourth side by refinery facilities and use areas, and the remainder of the fourth side is a wetland adjacent to the proposed laydown area.

Proximity to Refinery & Related Infrastructure

This site is actually too close to refinery operations because construction of a cogeneration facility in the midst of the refinery would interfere with refinery operations. Construction in the midst of the refinery would be more difficult and more expensive, and would result in costly interference with refinery operations.

Security

Site 5 is within the refinery security fence. Piping would be secure because the steam pipeline would not have to cross a public road.

Accessibility to Laydown Areas

The site is accessible to the proposed laydown area and to Grandview Road via Blaine Road.

3.2.6 Site 6

Site 6 is located north of Grandview Road. It consists of approximately 2 acres of mixed forest and shrub habitat surrounded by old fields that include emergent wetlands. This site is referred to as Site 4 in the Golder Alternatives Analysis.

Size & Wetland Impacts

33 acres could be available at this location. Wetlands occur here, but we have not determined how much wetland fill would be required because the site failed to satisfy other essential criteria. The south side of the site is bounded by Grandview Road. Expansion in the other directions would encroach into wetlands.

Proximity to Refinery & Related Infrastructure

This site is not adjacent to infrastructure or security. Extension of gas, water, and transmission lines to the site would entail other impacts, including wetland impacts. For these items, there is also a cost element, because the infrastructure would have to be extended further to this site than to other sites. The distance that steam pipes would have to cover to deliver steam to the refinery would be more than a mile, which is beyond the threshold of current technology. The extra costs to extend infrastructure were not calculated because the site failed the security criterion.

Security

Site 6 is not readily incorporated into the existing refinery security system, so an additional security system for the site itself would be required. Such a system would be more costly and less secure than a single secured area. In addition, the steam pipeline would not be secure because it would have to cross a public road. Because security is such an important item in refinery operation, this is a fatal flaw, and therefore, the site fails the security criterion. Existing technology will not solve the problem.

Accessibility to Laydown Areas

The only areas available for laydown that are not almost entirely wetlands are located across a state highway from this site. Construction would be logistically very difficult, disruptive to the surrounding community and much more expensive. Therefore, accessibility is not suitable for the construction activity.

3.2.7 Summary Comparison of Alternative Cogeneration Sites

The alternative sites are compared in Table 2 on the basis of the criteria necessary to be practicable and wetland impact. It is clear that the only sites that might have lower wetland impact than the proposed site are not practicable according to one or more of the criteria.

**Table 2
Comparison of Alternative Cogeneration Sites**

Site	Size	Proximity to Refinery	Security	Accessibility	Wetland Impacts
1	Meets Criterion	Meets Criterion	Meets Criterion	Meets Criterion	12 acres
2	Meets Criterion	Meets Criterion	Meets Criterion	Meets Criterion	31 acres
3	Meets Criterion	Meets Criterion	Meets Criterion	Meets Criterion	33 acres
4	Meets Criterion	Meets Criterion	Meets Criterion	Meets Criterion	About 20 acres
5	Fails Criterion	Meets Criterion	Meets Criterion	Meets Criterion	2.5 acres
6	Meets Criterion	Fails Criterion	Fails Criterion	Meets Criterion	Unknown

3.3 ALTERNATIVE LAYDOWN SITES

Alternative laydown sites must meet three criteria in order to serve the purpose and need: size, accessibility, and security. Cost is anticipated to be similar enough not to be a discriminator in comparing sites. Technology is also not relevant in comparison of sites because no alternate technology is available that would be applicable or be different on one site versus another. The cogeneration project requires construction laydown and staging areas 33 acres in size with easy accessibility to the construction site. The permanent laydown area for refinery use must be 22 acres.

The same sites considered practicable for the cogeneration plant would also meet the key criteria for practicability for the laydown/turnaround area (see Figure 2).

3.3.1 Site A (Proposed Laydown/Turnaround Area)

As a means of minimizing wetland impact overall, the construction laydown for the cogeneration plant is proposed to use mostly areas that will ultimately be used for refinery maintenance and turnarounds. That way, only one set of wetlands will be filled, not two. The proposed site is Site 4 considered for the cogeneration project located at the northeast corner of the refinery, south of Grandview Road and west of Blaine Road. A separate temporary laydown area (Laydown Area 4) of about 4 _ acres is located between the cogeneration site and Grandview Road. Site A is referred to as Laydown Site One, Areas One and Two, in the Golder Alternatives Analysis.

Size & Wetland Impacts

Using this approach, about 5 acres of wetland will be impacted by fill for temporary construction laydown area for the cogeneration project only. Those five acres will then be restored as wetland along with six acres of upland and become part of a visual buffer along the south side of Grandview Road. The remaining area (22 acres) will be permanently filled to provide the construction laydown needs for the cogeneration project and then the turnaround areas for ongoing refinery refurbishment activities. An existing 3.2-acre contractor parking lot would be incorporated as part of the laydown/turnaround area, but it is already used during turnarounds.

Accessibility

This site is readily accessible from the cogeneration construction area, the refinery, the highway, and the needed infrastructure.

Security

This site is within the refinery fence and meets all security requirements.

3.3.2 Site B (Proposed Cogeneration Site)

The site where the cogeneration project is proposed would not be available for use as a laydown/turnaround area if it is occupied by the cogeneration project. Potentially the two could be swapped.

Size & Wetland Impacts

A site big enough for the cogeneration project is big enough for the laydown area. If the locations were swapped, then the same amount of wetland impacts would occur at both locations.

Accessibility

Although this site would be readily accessible from the cogeneration facility if the cogeneration and laydown swapped places, it would not provide adequate accessibility from the refinery and its infrastructure that will be needed for the permanent refinery laydown/turnaround area.

Security

This site is adjacent to the refinery security fence and could be made secure by extending the fence.

3.3.3 Site C (Alternate Cogeneration Site)

Site C is the same site designated as Cogeneration Site 2 above. It is just north of Brown Road and east of the refinery fence and the proposed Brown Road Materials Storage Area. This site includes a large part of Site 1 in the Golder Alternatives Analysis.

Size & Wetland Impact

Site C has at least 40 acres available. With a site layout of 33 acres, at least 31 acres would be wetland fill. This impact conclusion is based on a wetland delineation for the Brown Road Materials Storage Area (URS 2003) and on a delineation by Golder Associates (Golder 2003) which showed 2 acres of upland in patches outside the Brown Road Materials Storage Area. The remainder of Site C is wetland.

Accessibility

Site C is adjacent to the proposed cogeneration site and would provide adequate accessibility to the cogeneration construction. While it is near to the refinery fence, it is farther from the functions needed for ongoing refinery maintenance and the infrastructure required for some of those functions. Therefore, the criterion of accessibility for refinery maintenance is only partially satisfied.

Security

Site C is near enough to the refinery security fence that it could readily be included within the security fence.

3.3.4 Site D (Alternate Cogeneration Site)

Site D is the same as Alternate Cogeneration Site 3. Site D is just south of Brown Road (and Site C) and adjacent to the east refinery fence.

Size & Wetland Impact

Site D has at least 40 acres available. With a site layout of 33 acres, it would essentially all be wetland fill. This impact conclusion is based on a wetland delineation for the Brown Road Materials Storage Area (URS 2003) that found about 5.5 acres of upland in the 11 acres to be used for the Brown Road Materials Storage Area. Nearly all of the adjacent area to the south appears to be wetland, based on reconnaissance-level information by both Golder Associates and URS. Site D would be located mostly south of the Brown Road Materials Storage Area in an area that is almost all wetland.

Accessibility

Site D is separated from the proposed cogeneration site by about 1,400 feet. The site would be accessible so long as no intervening facilities interfere with transport of materials, but it would make cogeneration project construction more logistically difficult and more costly than utilizing the proposed site. Site D is also adjacent to the refinery fence, but it is farther from the functions needed for ongoing refinery maintenance and the infrastructure required for some of those functions. Utilizing this site for refinery maintenance and turnaround activities would be more difficult logistically, more time consuming and more costly as a result. Therefore, the criterion of accessibility for refinery maintenance is only partially satisfied.

Security

Site D is adjacent to the refinery security fence and could readily be included within it.

3.3.5 Site E (Alternate Cogeneration Site)

Site E is located south of Aldergrove Road and east of Jackson Road along the refinery pipeline corridor. This site is referred to as Laydown Site 2 in the Golder Alternatives Analysis.

Size & Wetland Impacts

This site has at least 33 acres available. It is constrained on the west by Jackson Road, on the north by Aldergrove Road, and on the south by another public road. To the east is land not owned by BP, which is forested and probably contains wetlands. Part of the area was previously filled and is not wetlands, but an unknown amount of wetland would have to be included.

Accessibility

Site E fails the accessibility criterion for both cogeneration project construction and refinery maintenance and turnaround activities. It is located nearly two miles from the proposed cogeneration site. Assembling equipment at such a distance from the project site is logistically difficult and costly. Very large equipment would have to be transported on public roads, which would require modifications of the roads and interruption of traffic. The site is outside the refinery, across a public road, and at least a mile from key refinery infrastructure. It would not work for refinery maintenance activities.

Security

The site is outside the security fence and could not be incorporated within the refinery security perimeter. This site could not practicably be made secure for all the activities it would need to support. The key element for security is the security of the steam pipe extending across a public road. Technology does not solve the problems of making it both secure and functional.

3.3.6 Summary Comparison of Alternative Laydown Sites

The alternative sites are compared in Table 3 on the basis of the practicability criteria and wetland impact. It is clear that the only sites that might have lower wetland impact than the proposed site are not practicable according to one or more of the criteria.

**Table 3
Comparison of Alternative Laydown Area Sites**

Site	Size	Security	Accessibility	Wetland Impacts
A	Meets Criterion	Meets Criterion	Meets Criterion	19 acres
B	Meets Criterion	Meets Criterion	Meets Criterion for cogeneration, not for refinery use	12 acres
C	Meets Criterion	Meets Criterion	Meets Criterion for cogeneration, not for refinery use	31 acres
D	Meets Criterion	Meets Criterion	Meets Criterion for cogeneration, not for refinery use	33 acres
E	Meets Criterion	Fails Criterion	Fails Criterion	unknown

3.4 COMBINATIONS OF SITES

For the cogeneration project, all of the components of the project must be contiguous in order to function. It would not be practicable to put part of the components on one site and others on another site, since they are mostly integral components of the power plant.

However, for the laydown/turnaround area, it would be possible to have multiple sites as long as the size of each was large enough to accommodate the functions required and the other functional requirements are met. These sites would also have to be located in such a way as to efficiently manage the work and the work force.

For the cogeneration laydown areas, the smallest contiguous block now proposed is about 5 acres. This area would be used by one contractor to construct the electrical switchyard. All of the other activities will be controlled by the general contractor and must use a single entrance for security and site control. Some components of the project are large and require large contiguous areas to be available in order to maneuver several components simultaneously. Therefore, it is not feasible to further break the laydown area into smaller units located in different areas.

For the turnaround functions, the refinery area previously used provided over 25 acres of contiguous useable area. The many large components and simultaneous activities require such a large area, and it must provide unobstructed access to the refinery components. It might be possible to segregate a few functions into a separate area on a smaller parcel, but that would not diminish the requirement for a large contiguous block of area.

The only combination of sites that might offer some hope of reducing wetland impact might be a combination of the two sites north and south of Brown Road and adjacent to the cooling tower. In order to get 33 acres of laydown/turnaround area, more than 23 acres of wetland fill would be required.

No combination of sites would give the required laydown/turnaround area and require less wetland fill than the proposed site.

3.5 ALTERNATIVE CONFIGURATIONS

Alternative configurations for both the cogeneration site and the laydown/turnaround site were considered, and the practicable configuration with the least impact on wetlands was selected. The process is discussed below.

The first consideration was whether any of the alternate sites could accommodate either a reconfigured cogeneration layout or a reshaped laydown/turnaround area and result in less wetland impact than either the proposed cogeneration site or the proposed laydown/turnaround site. Since the wetlands in all the alternate sites are in large contiguous areas with small upland areas interspersed, there is no way to get the required area, meet the minimum requirements for access and security, and have less impact on wetlands. Therefore, alternative configurations of the two proposed sites were considered and none were found to be better than the proposed ones.

3.5.1 Cogeneration Site

The selection of the specific preferred site was made by moving the original site footprint around to incorporate as much upland as possible. That placed the site as close to the south side of Grandview road as allowed by the 300-foot setback from the road required by Whatcom County

Code. It also placed the site just east of the drainage ditch along the east boundary of the utility corridor that parallels Blaine Road.

The original footprint was generally rectangular, and the early design assumptions placed the detention basin mostly outside the rectangular plant footprint. Refinements in the design process and further efforts to minimize the facility footprint have allowed further reductions in wetland impact to be realized. As a result of these factors, the southeastern corner of the site (which is all wetland) is no longer proposed to be filled, which reduced the originally proposed wetland impact by 2.5 acres. The detention basin is now designed within the rectangular footprint. As a result, the area of wetland fill was reduced by about an acre. However, because the water that feeds that wetland will unavoidably be blocked by the constructed pad for the cogeneration plant, we have conservatively assumed the wetland will be lost.

3.5.2 Laydown/Turnaround Site

The original expectation of laydown area need was 41 acres. By taking advantage of existing access and keeping the laydown areas contiguous with the construction site, the area needed was reduced to 36 acres. The 3-acre existing contractor parking area was then incorporated as area that can be used at times other than turnarounds, reducing the total laydown area to 33 acres and further reducing the wetland fill needed for the laydown use. By temporarily using area that will become the buffer along Grandview Road, it was possible to make about six acres of that be upland and another five acres be temporary wetland impact.

The permanent turnaround area could not be further reconfigured to reduce wetland impact, since essentially all of the remaining area is wetland. However, choosing this site avoided the wetland impact that would likely occur if it were necessary to provide utilities and security to other locations.

4.0 CONCLUSION

This Alternatives Analysis has demonstrated that no other practicable action, site, combination of sites, or site configuration would have less wetland impact or environmental impact overall and at the same time meet the purpose and need. Therefore, the proposed sites for the cogeneration project and the laydown/turnaround area meet the required tests of Clean Water Act section 404 (b) (1) and section 230.10(a) Guidelines for Implementing the Clean Water Act.

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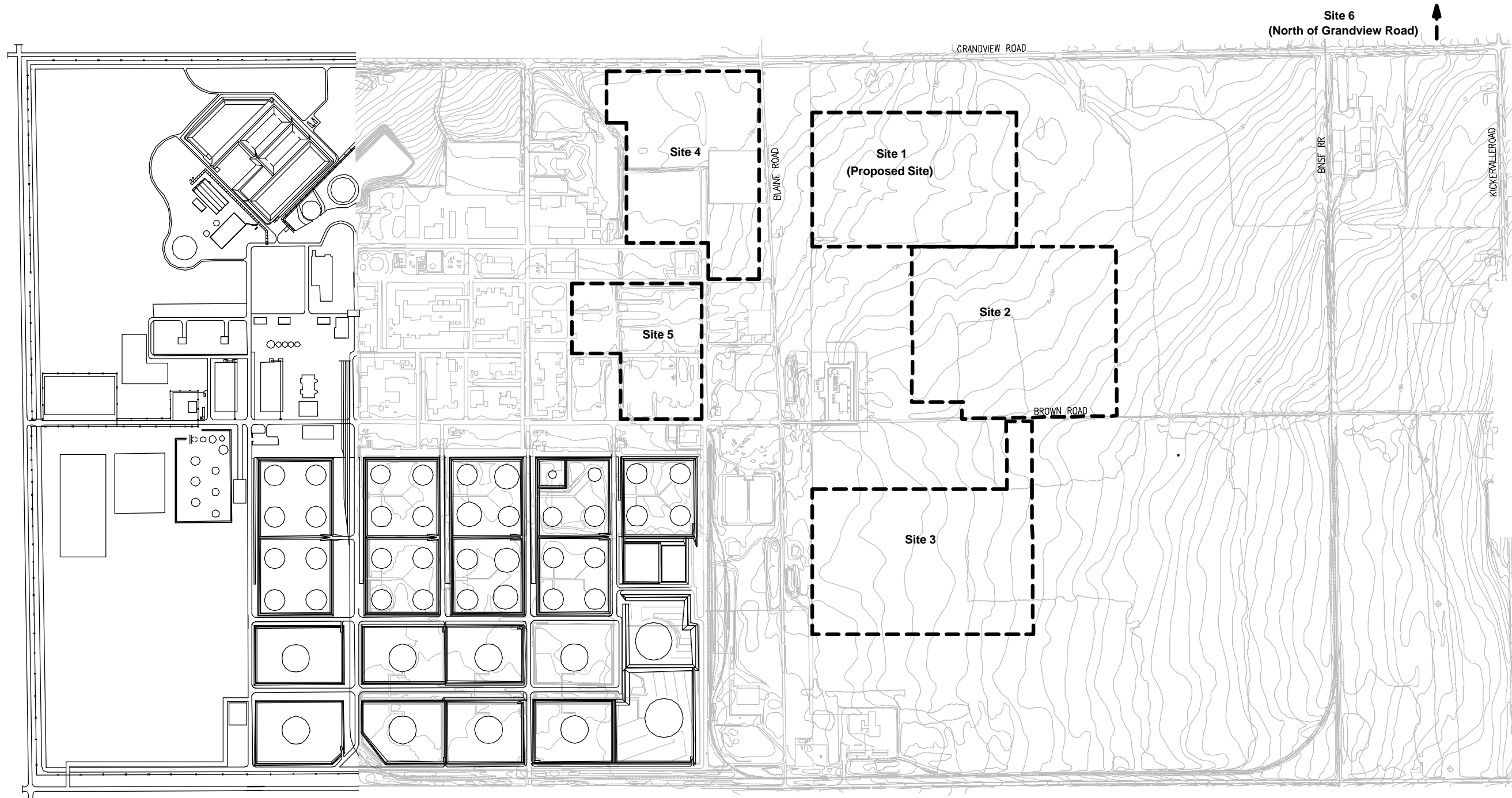
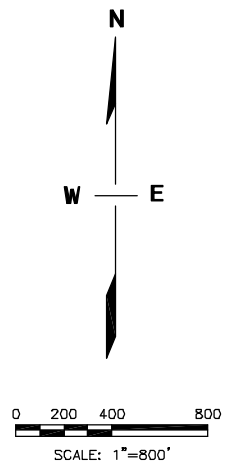
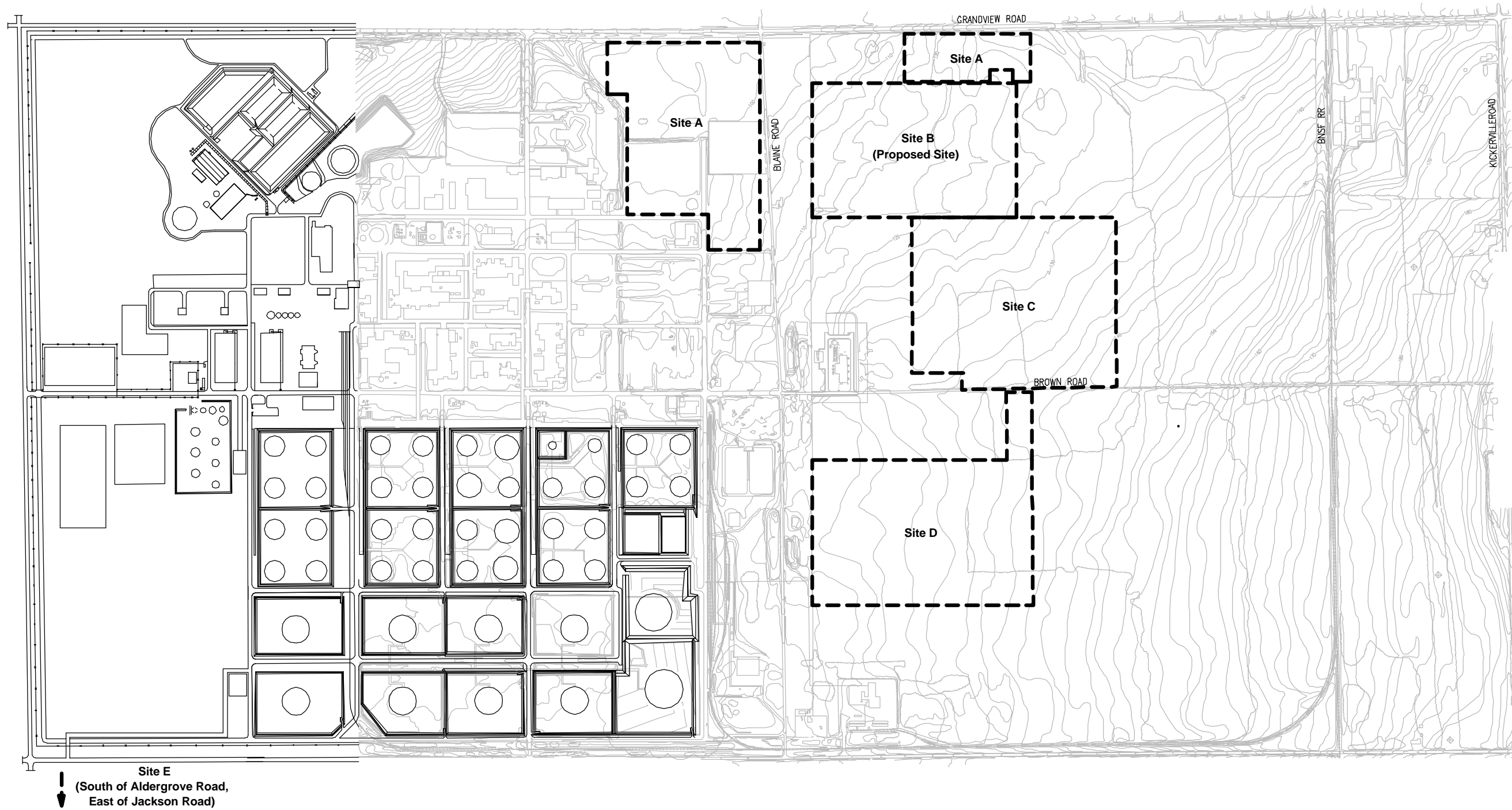


Figure 1
BP Cherry Point
Alternative Cogeneration Plant Locations

404 (B) (1) Alternatives Analysis
BP Cherry Point Cogeneration Project

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Figure 2
BP Cherry Point
Alternative Laydown and Staging Locations

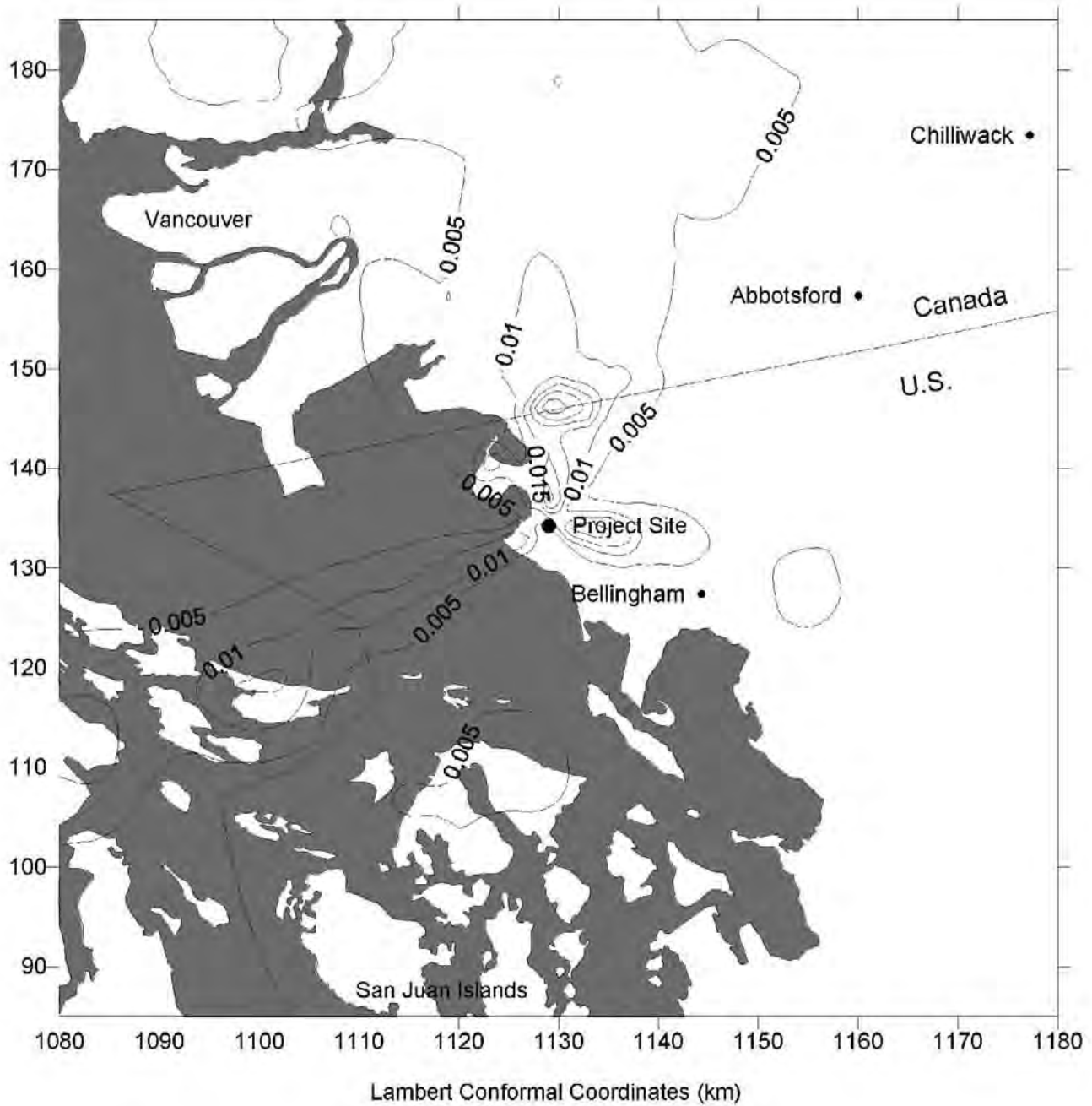
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APPENDIX B
AIR EMISSIONS MODELING ISOPLETHS

Number	Pollutant Modeled	Model Used and Assumptions ¹
Exhibit 22.1, Page 1	SO ₂ Maximum Annual Concentrations	ISC Prime, maximum potential emissions, no refinery reductions
Exhibit 22.1, Page 2	SO ₂ Maximum 24-hour Concentration	ISC Prime, maximum potential emissions, no refinery reductions
Exhibit 22.1, Page 3	SO ₂ Maximum 3-hour Concentration	ISC Prime, maximum potential emissions, no refinery reductions
Exhibit 22.1, Page 4	SO ₂ Maximum One-hour Concentration	ISC Prime, maximum potential emissions, no refinery reductions
Exhibit 22.1, Page 5	PM ₁₀ Maximum Annual Concentration	ISC Prime, maximum potential emissions, no refinery reductions
Exhibit 22.1, Page 6	PM ₁₀ Maximum 24-hour Concentration	ISC Prime, maximum potential emissions, no refinery reductions
Exhibit 22.1, Page 7	CO Maximum 8-hour Concentration	ISC Prime, maximum potential emissions, no refinery reductions
Exhibit 22.1, Page 8	CO Maximum One-hour Concentration	ISC Prime, maximum potential emissions, no refinery reductions
Exhibit 22.1, Page 9	NO _x Maximum Annual Concentration	ISC Prime, maximum potential emissions, no refinery reductions
Exhibit 22.1, Page 10	NO _x Maximum 24-hour Concentration	ISC Prime, maximum potential emissions, no refinery reductions
Exhibit 22.1, Page 11	NO _x Maximum One-hour Concentration	ISC Prime, maximum potential emissions, no refinery reductions
Exhibit 22.2, Page 1	NO _x Maximum Annual Concentration	ISC Prime, maximum potential emissions with refinery reductions
Exhibit 22.2, Page 2	PM ₁₀ Maximum Annual Concentration	Calpuff, max potential emissions, no refinery reductions
Exhibit 22.2, Page 3	PM ₁₀ Maximum Annual Concentration	Calpuff, max potential emissions, with refinery reductions
Exhibit 22.3	PM ₁₀ Expected Actual Maximum Annual Concentration	Calpuff, expected annual emissions, with refinery reductions and secondary particulate

¹ All Calpuff modeling includes formation of secondary particulate; ISC Prime modeling includes secondary particulate by assuming 20% of sulfur emissions are converted to particulate matter.

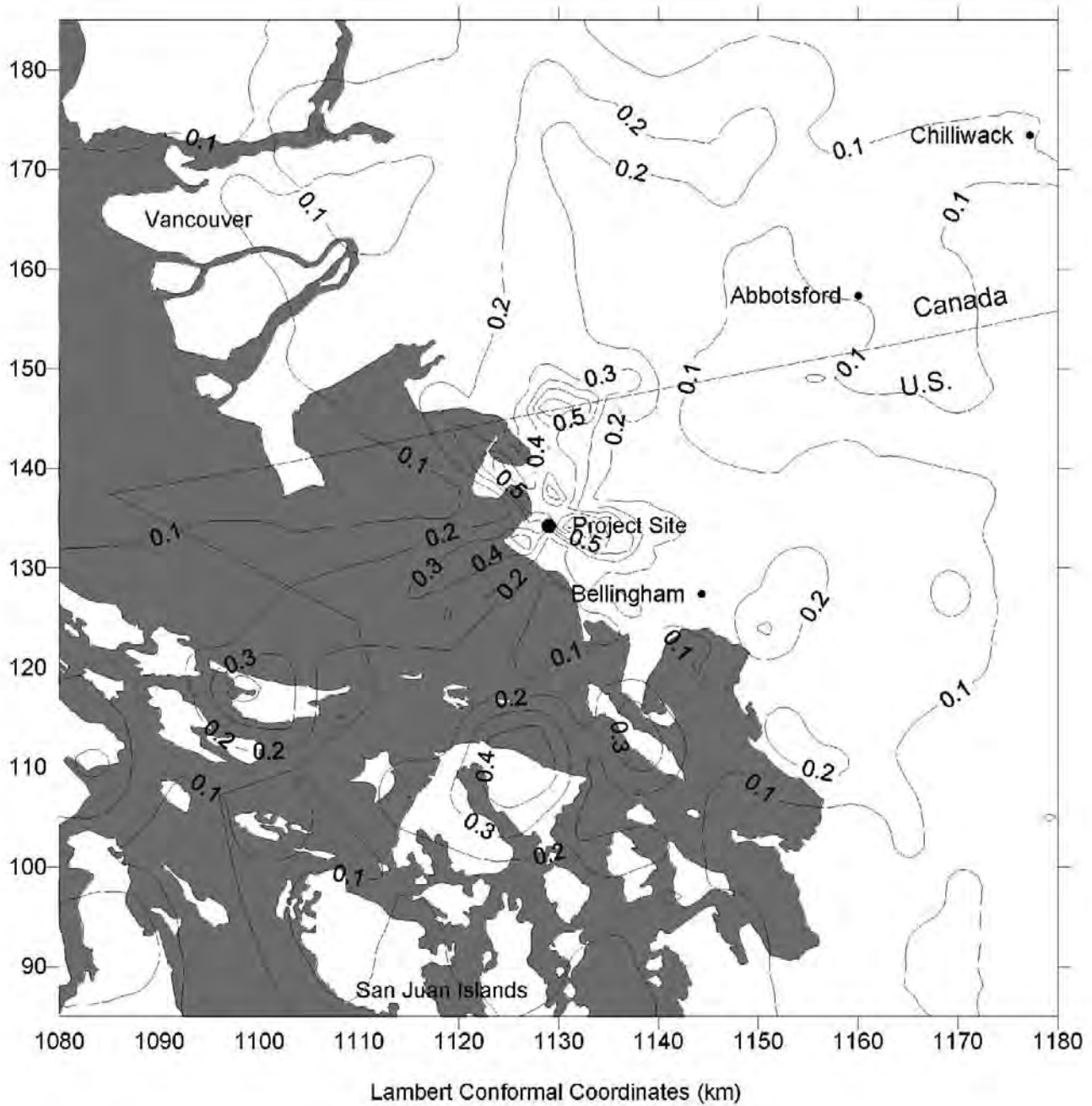
BP Cherry Point Cogeneration



SO₂ maximum annual concentration ($\mu\text{g}/\text{m}^3$)
 No refinery emission reductions
 Maximum over 5-year period
 ISC-Prime model

US SIL	1
US AAQS (WA)	53
Canadian Objective (most stringent)	25

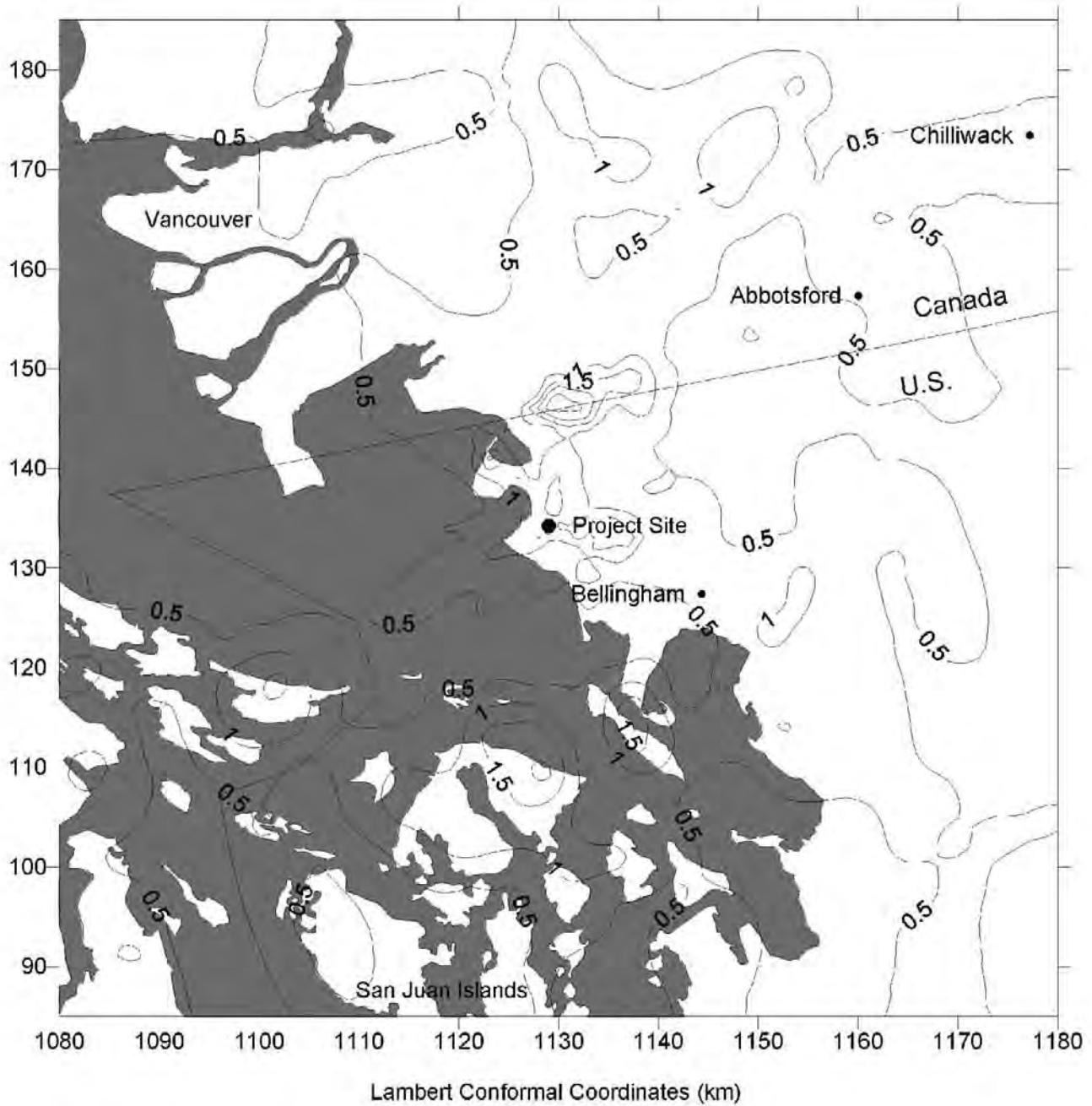
BP Cherry Point Cogeneration



SO₂ maximum 24-hour concentration (ug/m³)
 No refinery emission reductions
 Maximum over 5-year period
 ISC-Prime model

US SIL	25
US AAQS (WA)	1.300
Canadian Objective (most stringent)	375

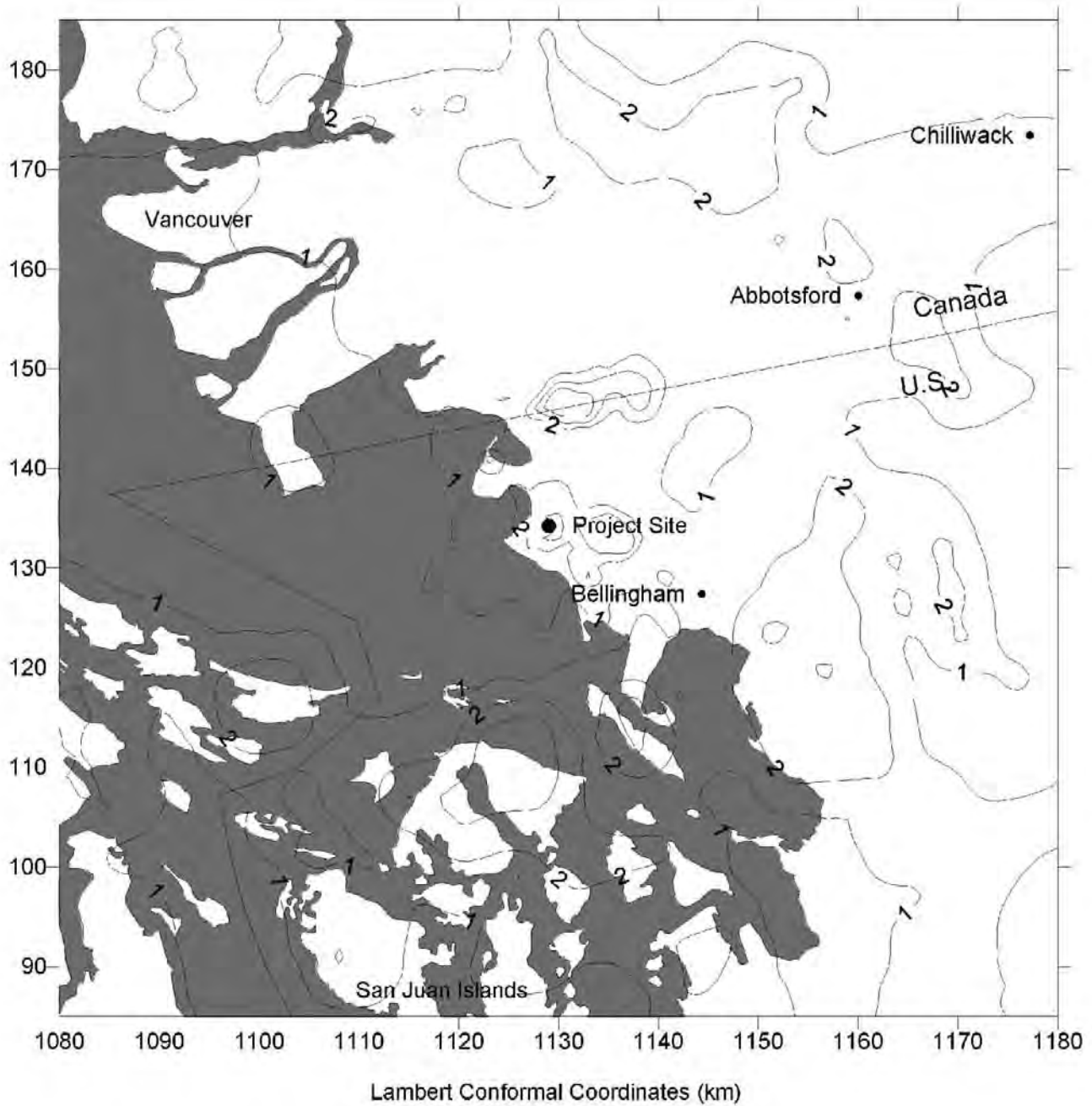
BP Cherry Point Cogeneration



SO2 maximum 3-hour concentration (ug/m3)
 No refinery emission reductions
 Maximum over 5-year period
 ISC-Prime model

US SIL	25
US AAQS	1,300
Canadian Objective (most stringent)	375

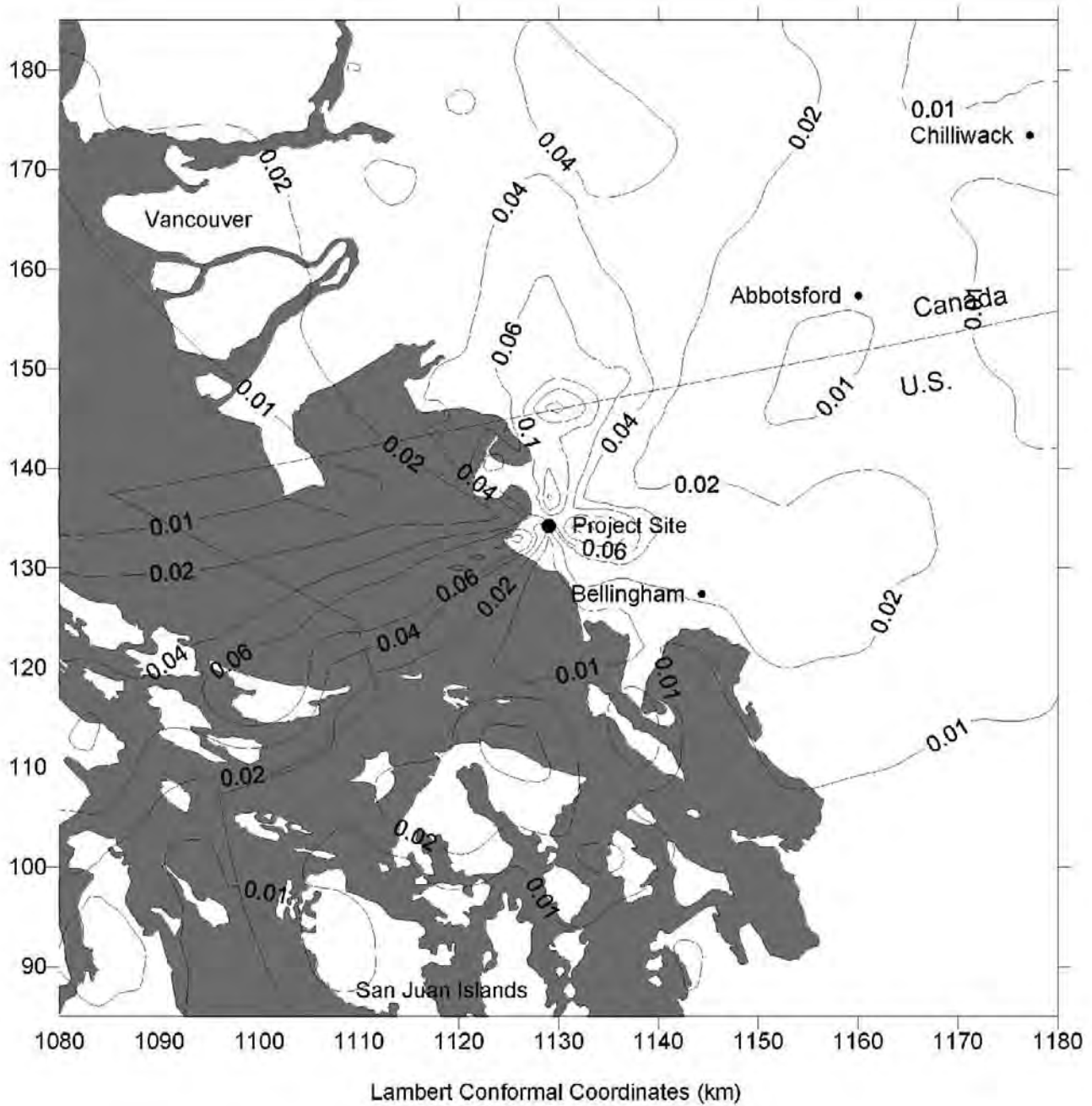
BP Cherry Point Cogeneration



SO₂ maximum 1-hour concentration (ug/m³)
 No refinery emission reductions
 Maximum over 5-year period
 ISC-Prime model

US SIL	NA
US AAQS (WA)	1,065
Canadian Objective (most stringent)	450

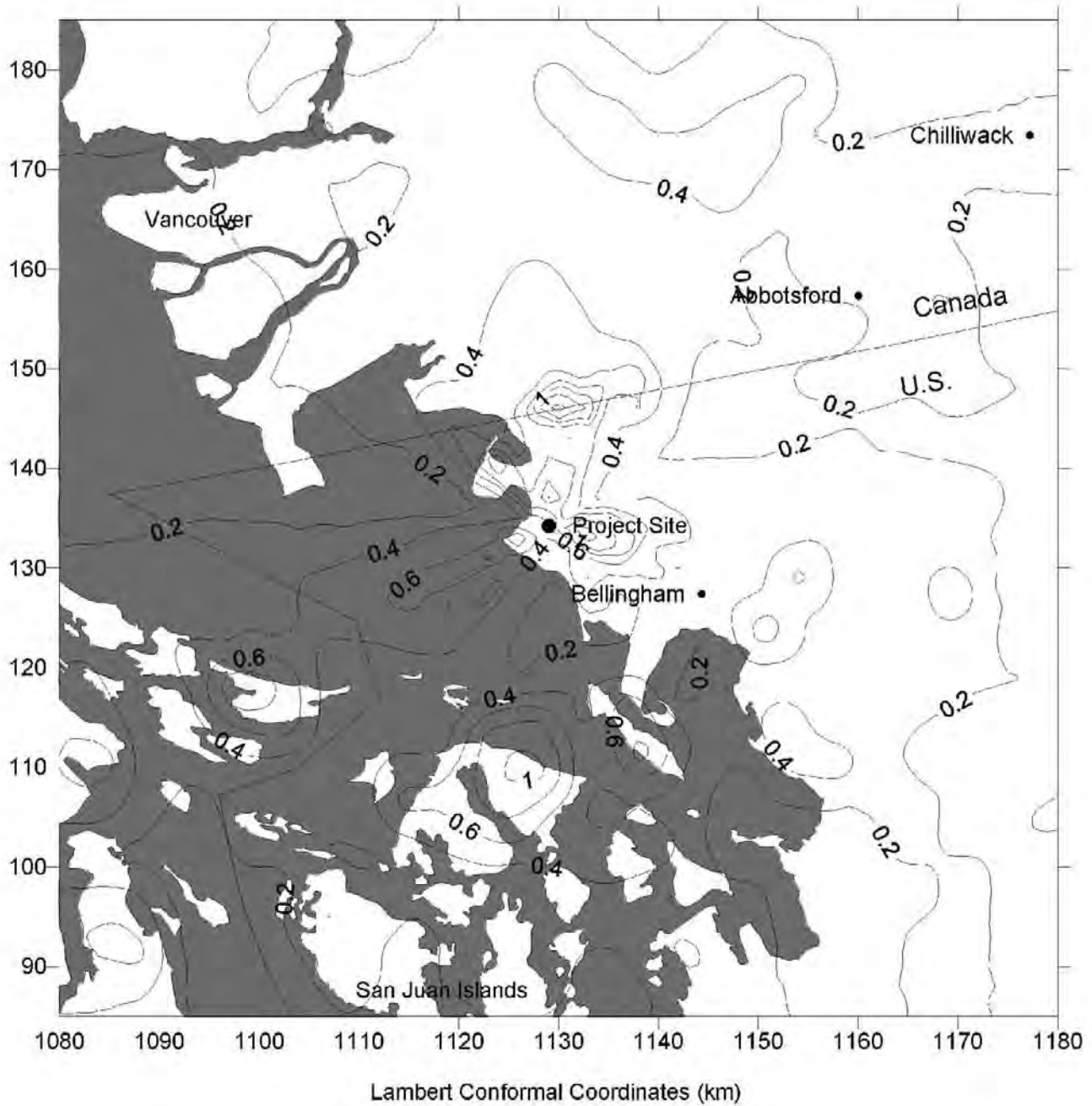
BP Cherry Point Cogeneration



PM10 maximum annual concentration (ug/m³)
 No refinery emission reductions
 Maximum over 5-year period
 ISC-Prime model

US SIL	1
US AAQS	50
Canadian Objective (most stringent)	30

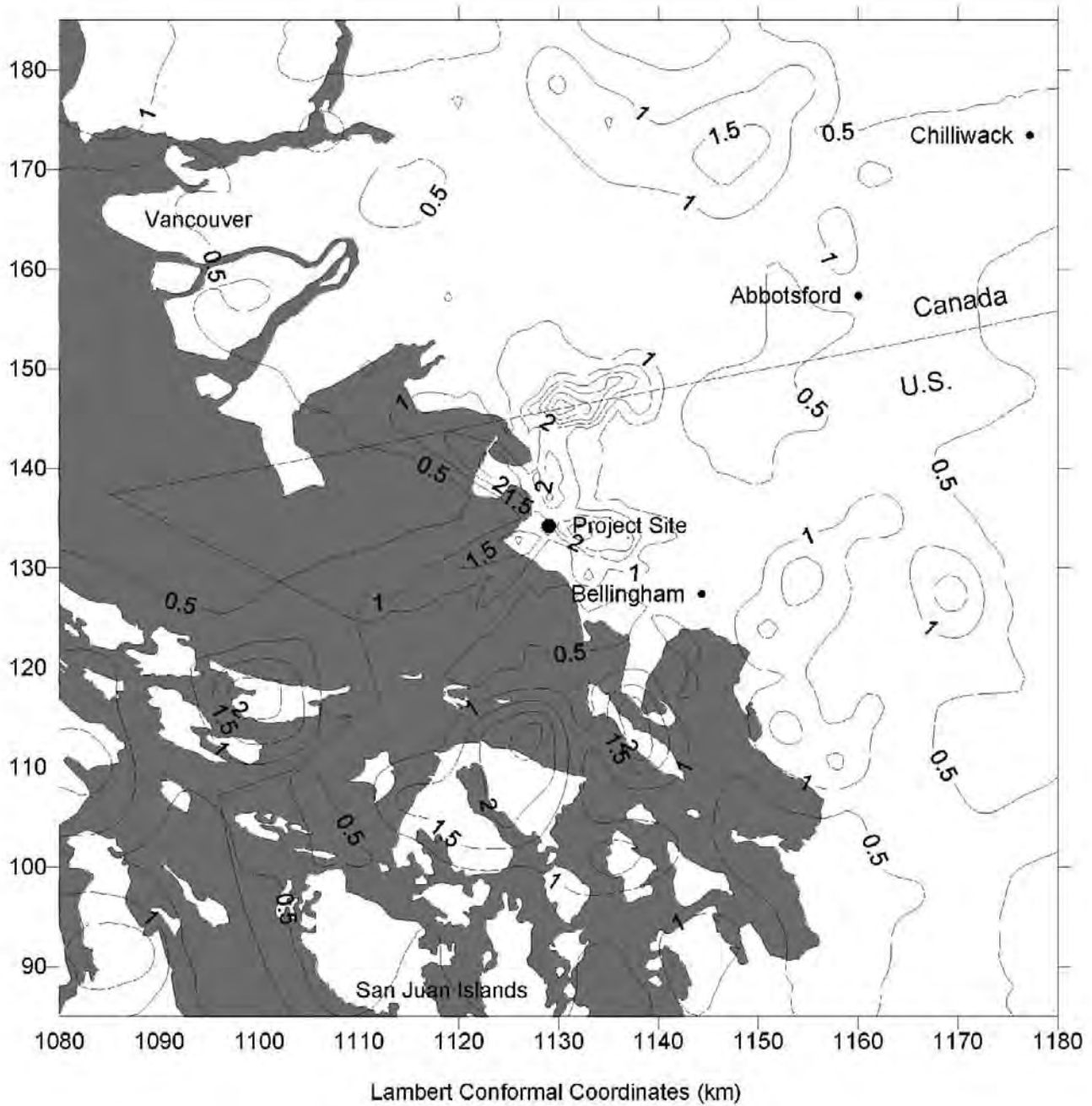
BP Cherry Point Cogeneration



PM10 maximum 24-hour concentration ($\mu\text{g}/\text{m}^3$)
 No refinery emission reductions
 Maximum over 5-year period
 ISC-Prime model

US SIL	5
US AAQS	150
Canadian Objective (most stringent)	50

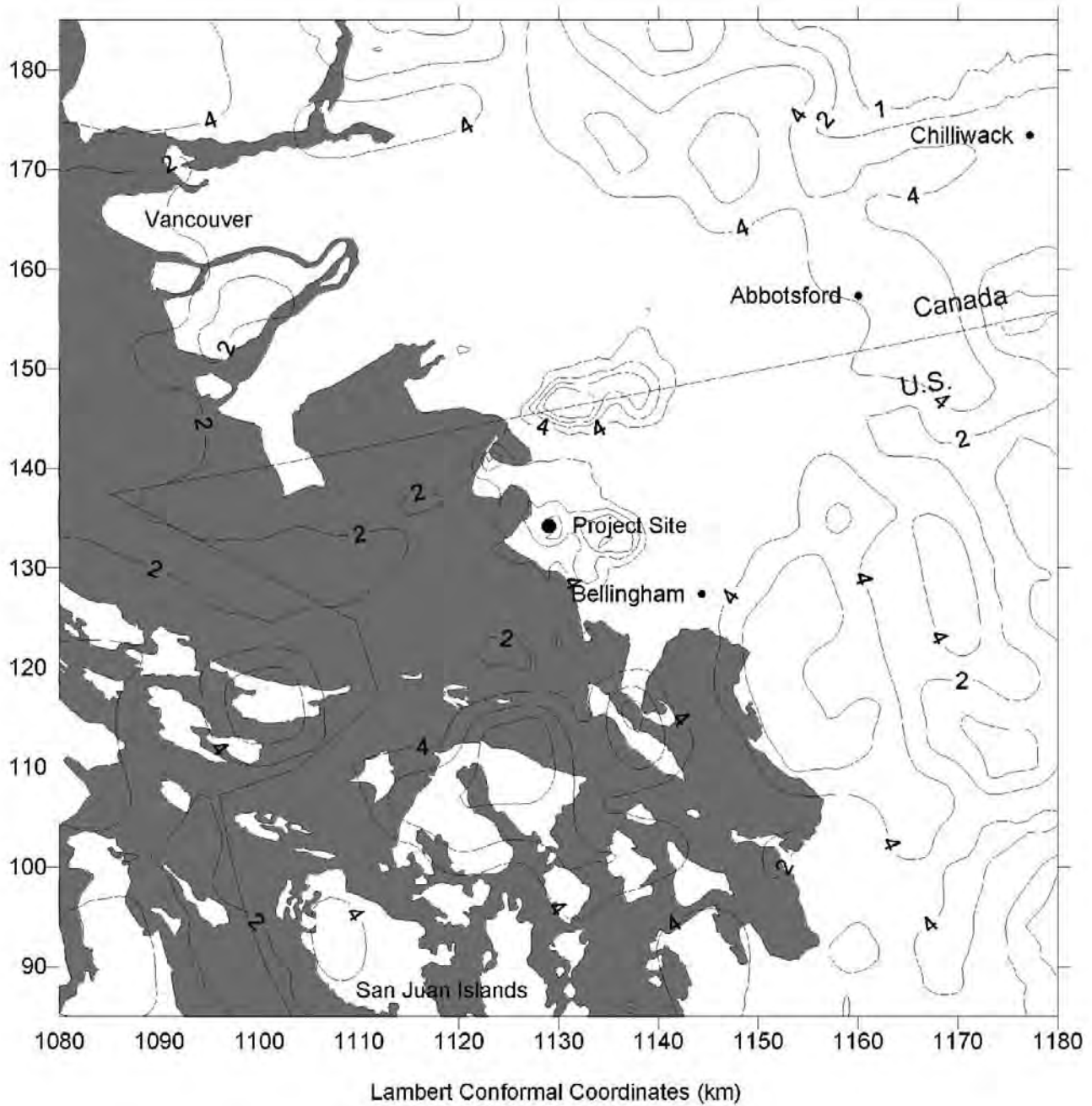
BP Cherry Point Cogeneration



CO maximum 8-hour concentration (ug/m3)
 No refinery emission reductions
 Maximum over 5-year period
 ISC-Prime model

US SIL	500
US AAQS	10,000
Canadian Objective (most stringent)	5,500

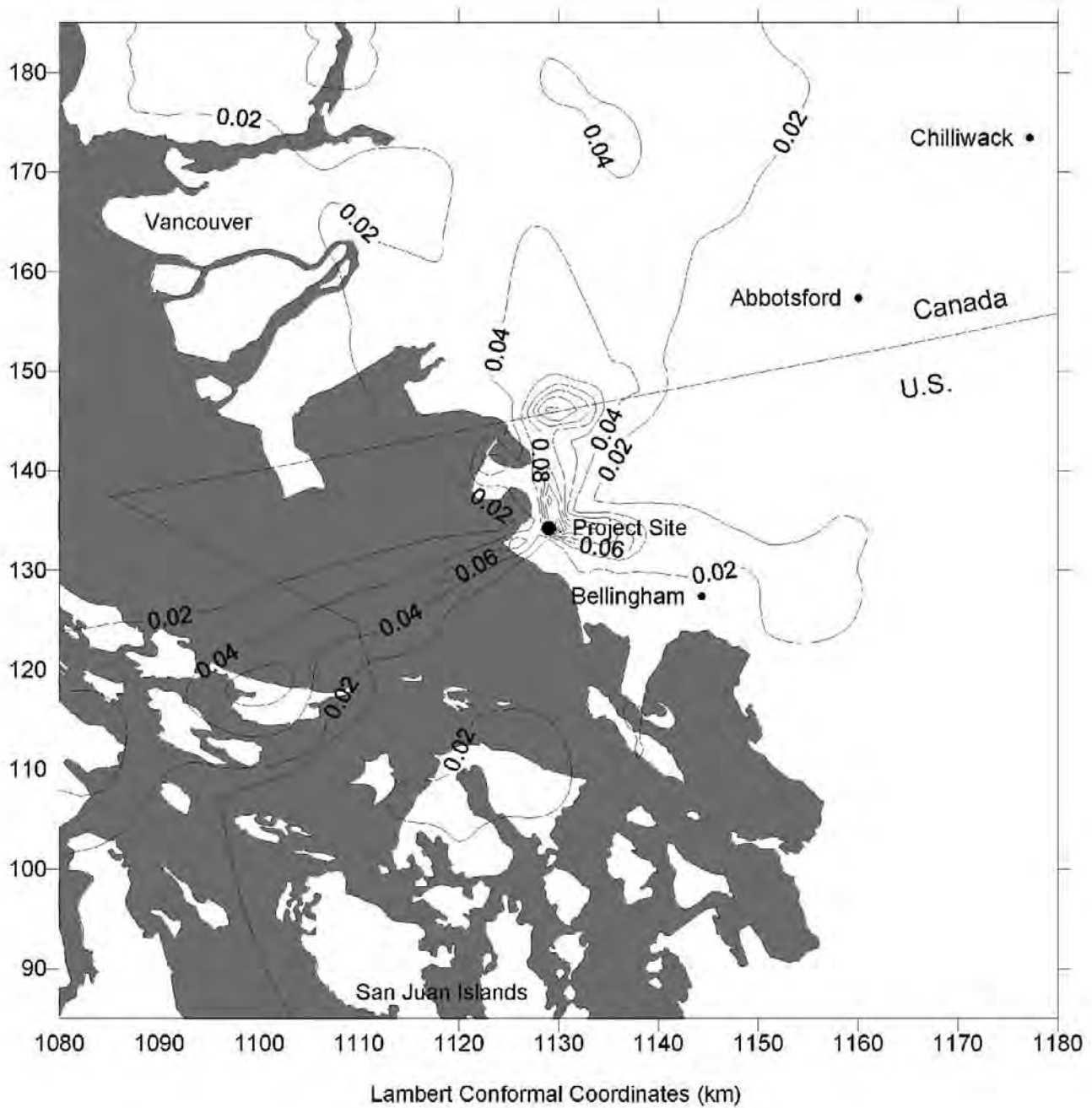
BP Cherry Point Cogeneration



CO maximum 1-hour concentration (ug/m³)
 No refinery emission reductions
 Maximum over 5-year period
 ISC-Prime model

US SIL	2,000
US AAQS	40,000
Canadian Objective (most stringent)	14,300

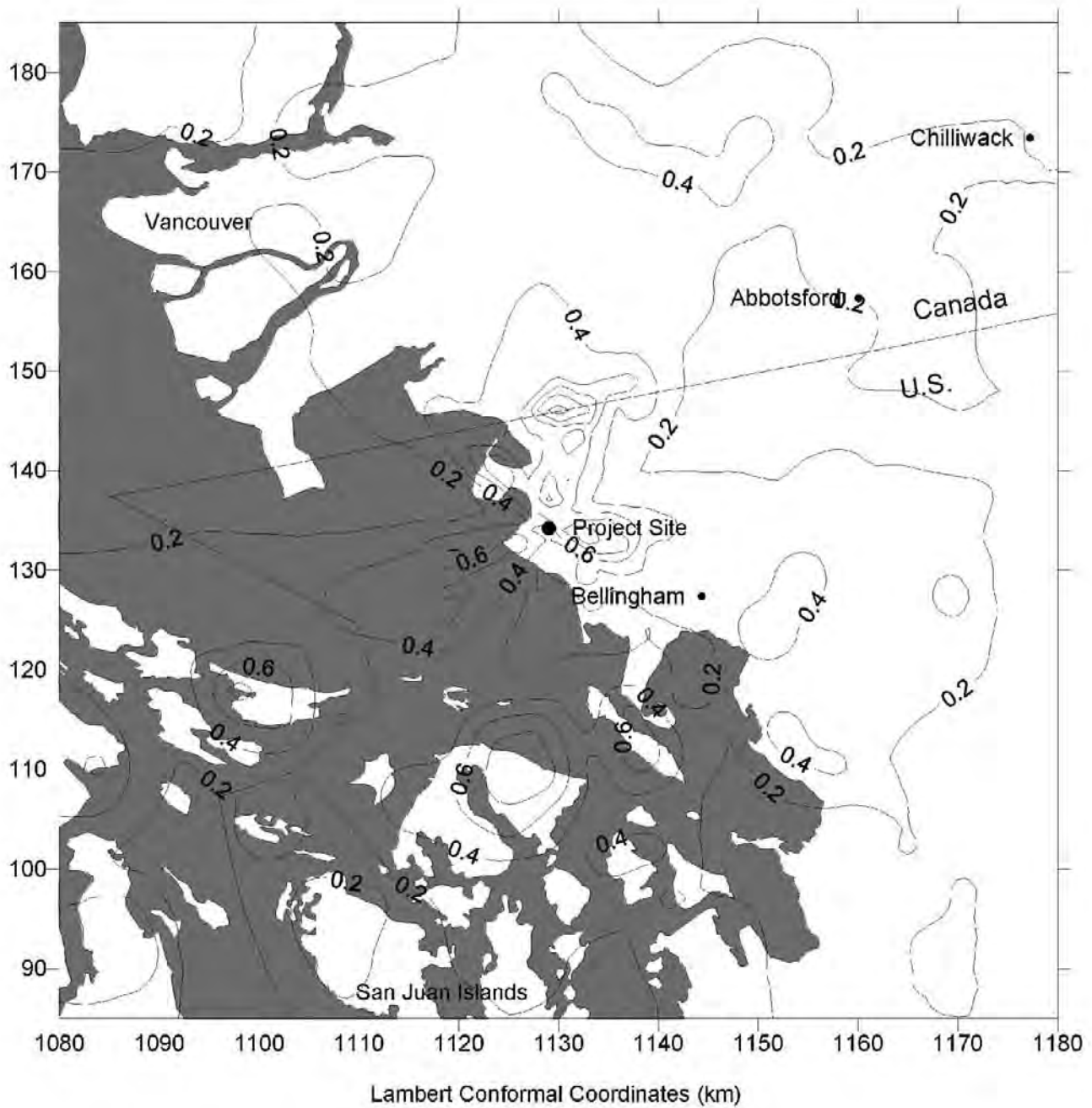
BP Cherry Point Cogeneration



NO_x maximum annual concentration (ug/m³)
 No refinery emission reductions
 Maximum over 5-year period
 ISC-Prime model

US SIL	1
US AAQS	100
Canadian Objective (most stringent)	60

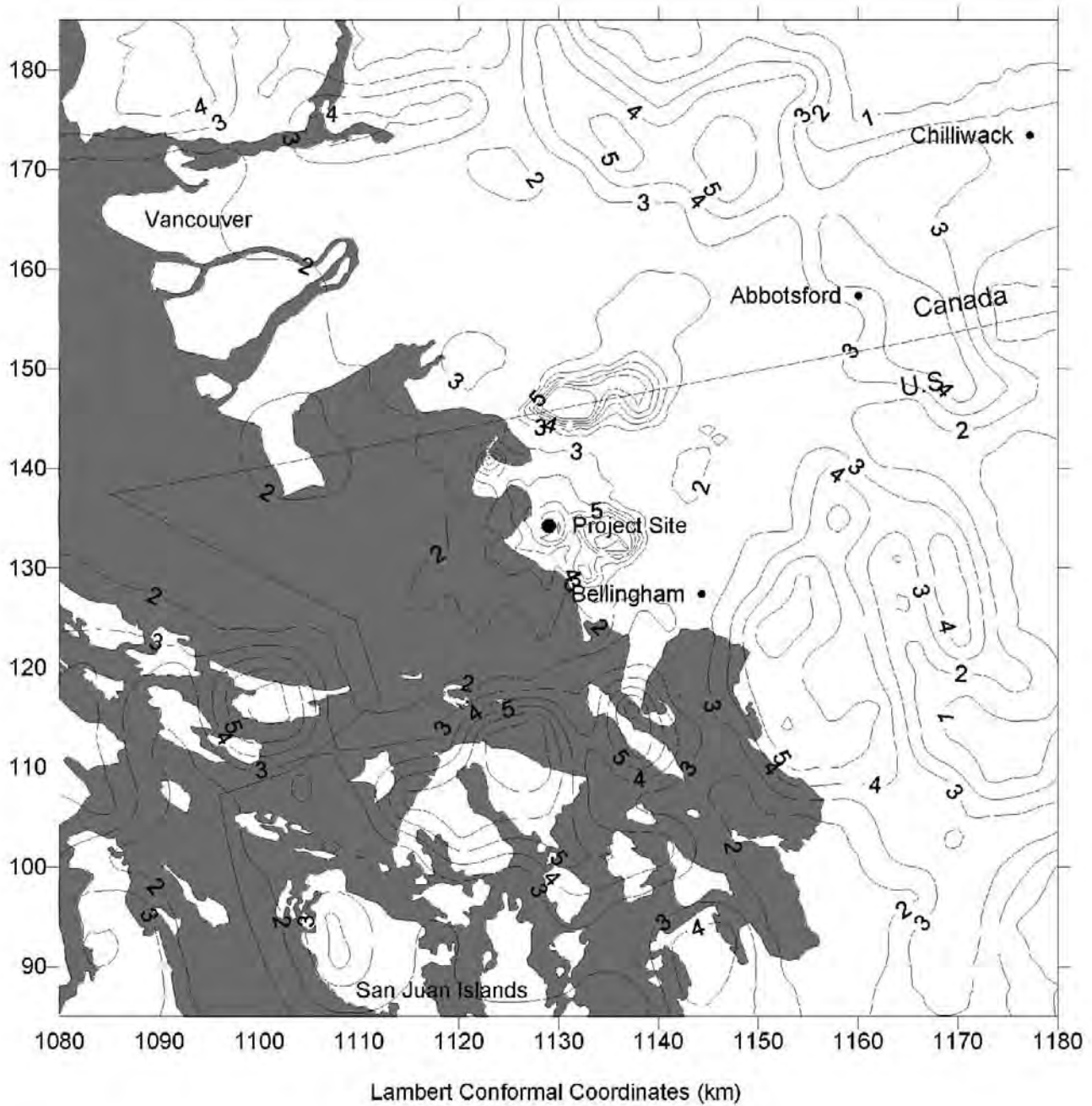
BP Cherry Point Cogeneration



NOx maximum 24-hour concentration ($\mu\text{g}/\text{m}^3$)
 No refinery emission reductions
 Maximum over 5-year period
 ISC-Prime model

US SIL	NA
US AAQS	NA
Canadian Objective (most stringent)	200

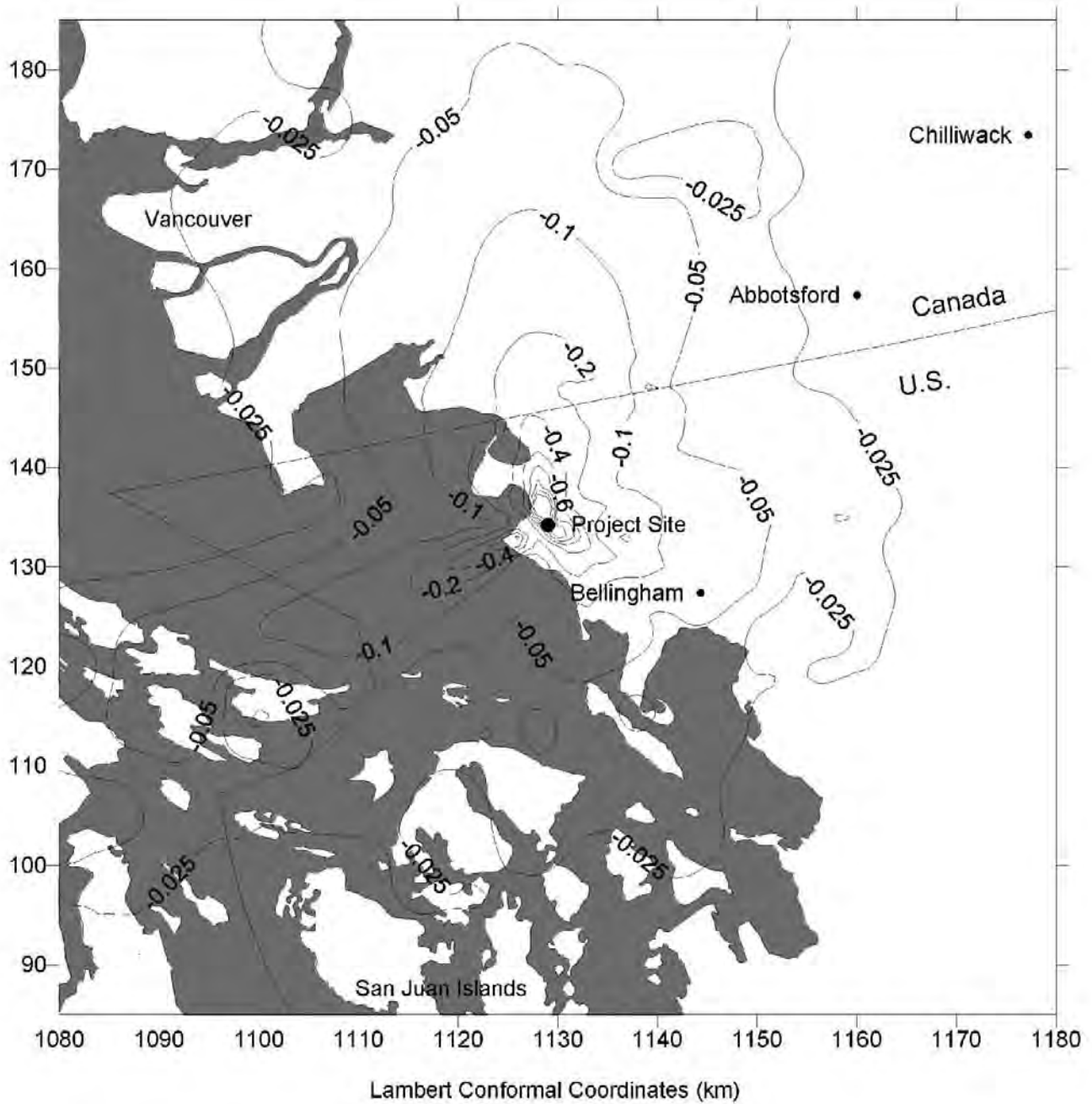
BP Cherry Point Cogeneration



NO_x maximum 1-hour concentration (ug/m³)
 No refinery emission reductions
 Maximum over 5-year period
 ISC-Prime model

US SIL	NA
US AAQS	NA
Canadian Objective (most stringent)	400

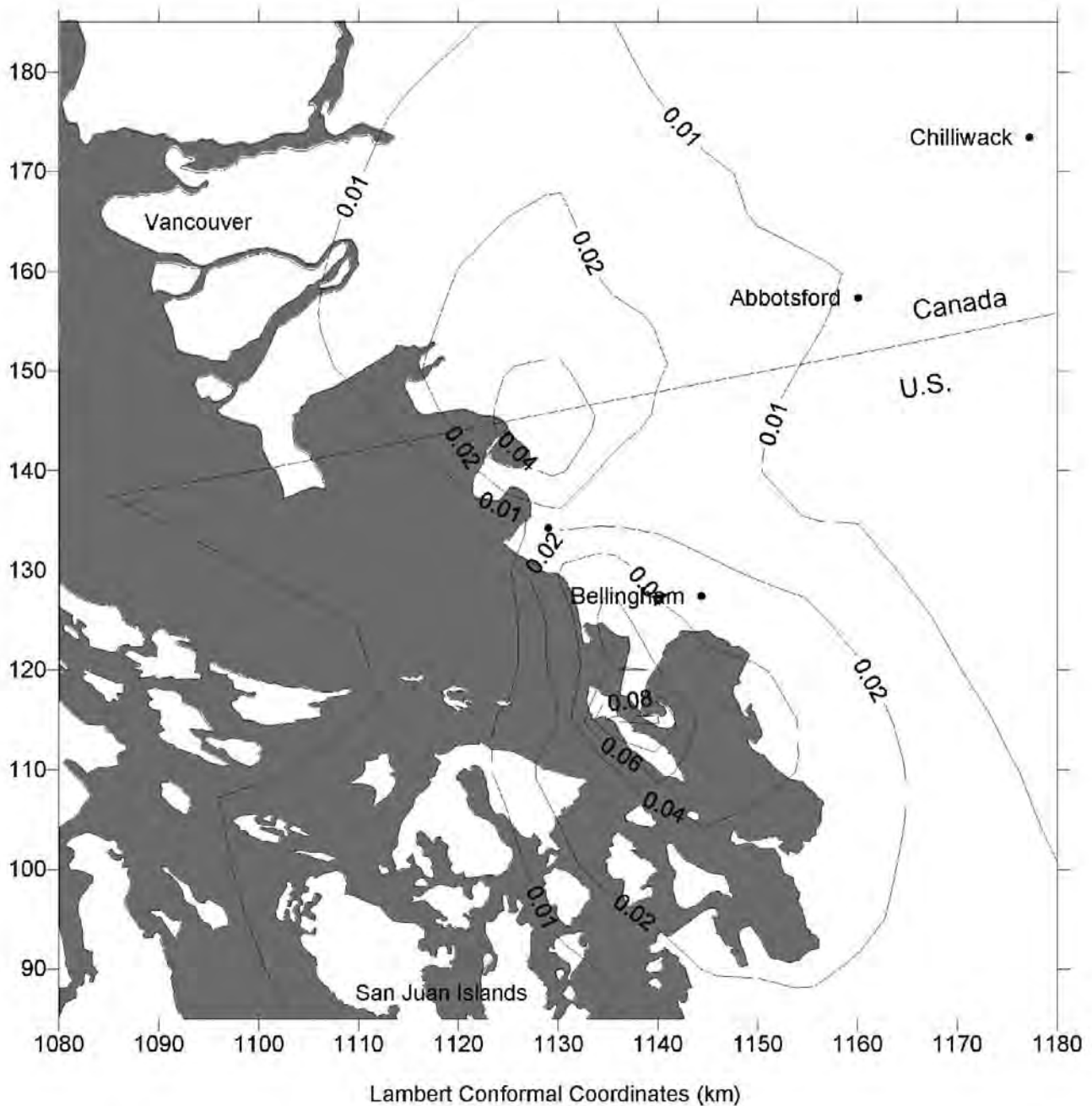
BP Cherry Point Cogeneration



NOx maximum annual concentration (ug/m3)
 With emission reductions
 Maximum of 1999
 ISC-Prime model

US SIL	1
US AAQS	100
Canadian Objective (most stringent)	60

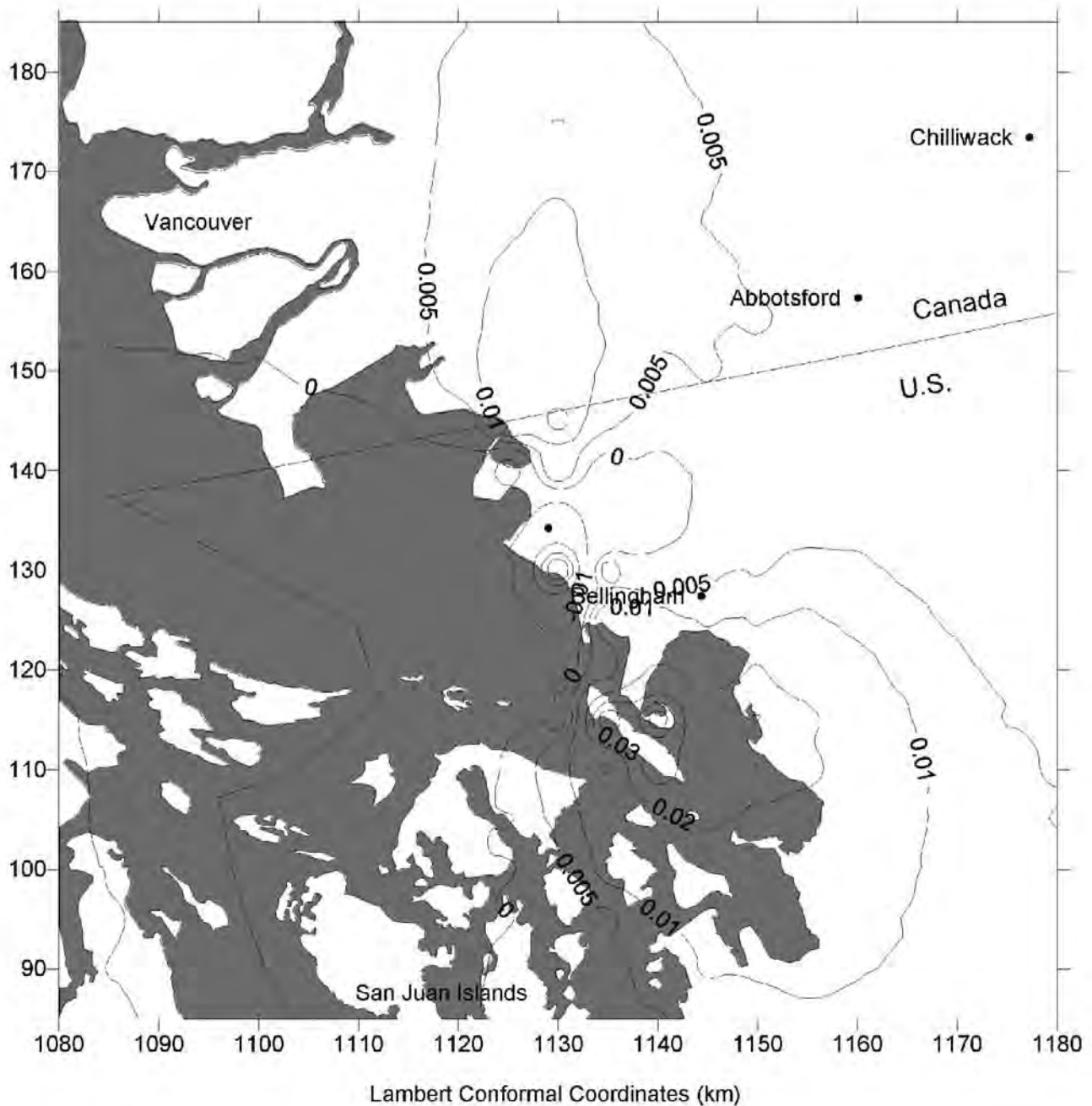
BP Cherry Point Cogeneration



PM10 maximum annual concentration (ug/m3)
 No refinery emission reductions
 Maximum over 1-year period
 CalPuff model

US SIL	1
US AAQS	50
Canadian Objective (most stringent)	30

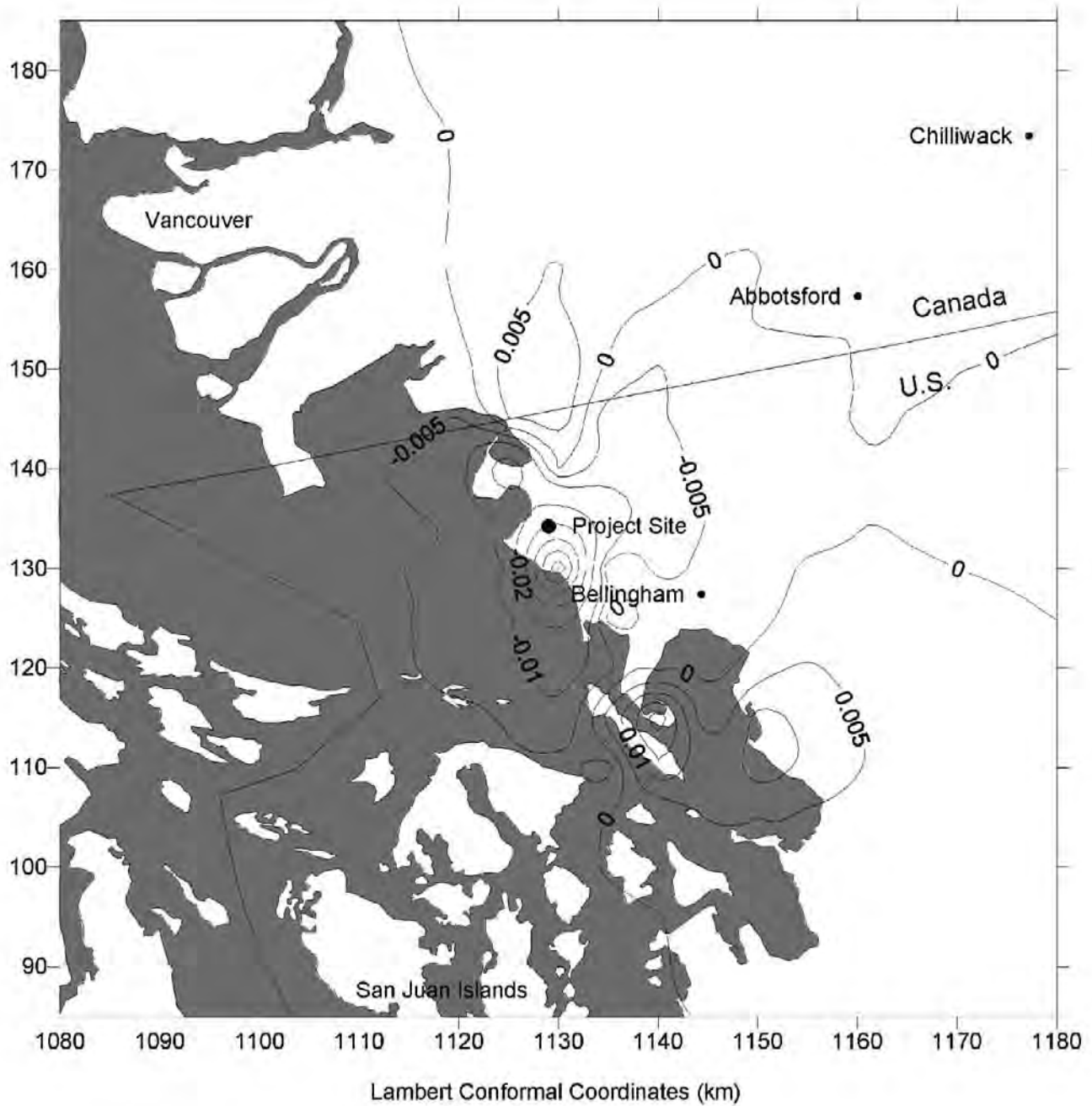
BP Cherry Point Cogeneration



PM10 maximum annual concentration (ug/m3)
 With all emission reductions and secondary particulate
 Maximum over 1-year period
 CalPuff model

US SIL	1
US AAQS	50
Canadian Objective (most stringent)	30

BP Cherry Point Cogeneration



PM10 expected actual maximum annual concentration ($\mu\text{g}/\text{m}^3$)
 With all emission reductions and secondary particulate
 Maximum over 1-year period
 CalPuff model

US SIL	1
US AAQS	50
Canadian Objective (most stringent)	30

FINAL COGENERATION PROJECT COMPENSATORY MITIGATION PLAN

BP Cherry Point

Prepared for

BP West Coast Products, LLC
BP Cherry Point Refinery
4519 Grandview Road
Blaine, WA 98230

June 2, 2004

URS

1400 Century Square
1501 4th Avenue
Seattle, Washington 98101-1616
(206) 438-2700

33749546.05070

Final Cogeneration Project Compensatory Mitigation Plan, BP Cherry Point

ERRATA [Please make the following changes to your copy.]

Insert to Section 9.0 to follow paragraph 5:

The timing of maintenance/contingency measures will be based on the stage of plant growth when the measures will be most effective. The timing will be affected by weather patterns that affect the growing season and plant growth. If conditions and circumstances require maintenance/contingency activities to occur more than 5 days in 30 days between February 15 and July 31 (the WDFW-recommended period to protect against disturbing heron nesting and rearing activities), then Whatcom County Planning and Development Services will be notified and appropriate monitoring and protective measures will be agreed upon before the maintenance activity proceeds.

Insert to Section 10.0 in the first paragraph before the last sentence:

Earthwork is expected to be conducted during the dry months of late summer and early fall and therefore within the WDFW-recommended construction window for protection of heron nesting colonies (July 31 to February 15). Initial planting is also expected to be completed within this window. However, if conditions or circumstances require planting outside that window, then Whatcom County Planning and Development Services will be notified and appropriate monitoring and protective measures will be agreed upon before the planting proceeds.

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EXECUTIVE SUMMARY

This Wetland Mitigation Plan was prepared to ensure appropriate mitigation for the wetland impacts associated with the proposed construction of the Cherry Point Cogeneration Project (Cogeneration Project), a 720-megawatt, gas-fired, combined cycle cogeneration facility (power plant), and the associated construction lay-down areas at the BP Cherry Point property. The BP Cherry Point property is located near Blaine, Washington, in unincorporated Whatcom County. Although the placement and design of the Cogeneration Project has avoided and minimized wetland impacts to the extent feasible, 4.86 acres of wetland will be temporarily disturbed and 30.51 acres of wetland will be permanently filled. The intent of the plan is to mitigate for these impacts by producing a net increase in wetland functional performance within the sub-basins that contain the proposed construction site.

The proposed construction will disturb low quality, historically degraded wetlands. Most of the area in the vicinity of the construction site is composed of broad fields drained by ditches and dominated by overgrown pasture grasses. Large portions of the wetlands are strongly dominated by non-native, invasive vegetation, primarily reed canarygrass (*Phalaris arundinacea*).

Wetland impacts associated with the proposed project will be mitigated via standard mitigation sequencing. Potential wetland impacts have been avoided and minimized by designing the location of construction areas away from delineated wetlands as much as possible given engineering constraints and the prevalence of wetlands in the area. A total of 9.27 acres containing both wetlands and wetland buffers (uplands) will be temporarily filled and subsequently restored. Another 1.81 acres of upland will be temporarily eliminated and subsequently forested after construction is complete to enhance a visual buffer between the plant site and Grandview Road. Any temporary or inadvertent impacts to wetlands that may occur during construction will be repaired and rehabilitated as appropriate.

Unavoidable impacts to wetlands will be compensated. The plan includes rehabilitating approximately 110 acres of degraded wetlands and surrounding uplands located within the BP Cherry Point property. These Compensatory Mitigation Areas (CMAs) will be rehabilitated by restoring historic drainage patterns via re-routing treated stormwater runoff and plugging existing ditches, removing and suppressing non-native, invasive plants such as reed canarygrass, and establishing native plant communities. Re-routing stormwater runoff will include installing pipes, culverts, and an inlet channel with diffuse-flow outlets to direct runoff from one of the two proposed detention ponds to one of the CMAs rather than let all of it go through a roadside ditch directly to Terrell Creek. All runoff from the other detention pond will be directed through an existing culvert to a series of ponds connected by natural channels and swales. The re-routed stormwater runoff will be directed to large natural areas that will provide additional hydrologic storage and water quality treatment. The forest and shrub habitats that will develop in the CMAs will further improve hydrologic storage through increased evapotranspiration and interception of precipitation. Thus, hydrologic impacts as well as other types of wetland impacts will be compensated.

The areas to be used for mitigation were selected as among the best available in the Terrell Creek basin. BP owns a large part of the basin, and BP's lands north of Grandview Road (about 1,000 acres) were assessed for mitigation potential. In all this area, the two proposed CMAs were judged to have the greatest potential for compensating wetland impacts associated with this project. The CMAs are located as near as possible to

the proposed construction site, are positioned to receive re-routed stormwater runoff, and have great potential for improving ecological connectivity between the Terrell Creek corridor and natural areas to the south including the Lake Terrell State Wildlife Area. No other areas had more potential benefits. A survey of the properties for sale in the Terrell Creek basin revealed that only 5 parcels at least 20 acres in size are available. None of these parcels or combination of these parcels are able to provide the mitigation opportunities of the proposed mitigation areas.

1.0 PROJECT DESCRIPTION

1.1 PROJECT LOCATION

The BP Cherry Point property is located near Blaine, Washington in unincorporated Whatcom County. Whatcom County is bordered by Skagit County to the south, Georgia Strait to the west, and British Columbia, Canada to the north. The Cogeneration Project will be located east of the existing refinery within the BP Cherry Point property, south of Grandview Road and north of Brown Road.

The proposed construction area is approximately two miles east of Cherry Point and Georgia Strait in Sections 7 and 8 of Township 39, Range 1E. Minimization and restoration of wetland impacts will occur in this area. Compensatory mitigation will occur in the proposed Compensatory Mitigation Areas (CMAs), which will be located north of Grandview Road on the BP Cherry Point property in Sections 5 and 6 of Township 39, Range 1E. A site map showing the areas that will be impacted and the areas that will be restored and rehabilitated as compensatory mitigation is Figure 1.

A map showing the project site superimposed over a National Wetlands Inventory Map for the area is Figure 3 of the *Wetland Delineation Report BP Cherry Point Cogeneration Project [Revised]* (Golder Associates 2003a). A map showing the project site superimposed over a Soil Conservation Service (SCS) Soil Survey map is Figure 4 of the *Wetland Delineation Report BP Cherry Point Cogeneration Project [Revised]* (Golder Associates 2003a). These figures are also presented in Appendix A.

1.2 RESPONSIBLE PARTIES

BP West Coast Products, LLC (BP) is the project proponent and permit applicant. The contact person at BP for this project is Mike Torpey, who is the lead on Cogeneration Project permitting for BP. His phone number and address are as follows: 360/371-1757, BP Cherry Point Refinery, 4519 Grandview Road, Blaine, Washington 98230. The consulting firms responsible for the wetland delineation report entitled *Wetland Delineation Report BP Cherry Point Cogeneration Project [Revised]* (Golder Associates 2003a) are Golder Associates, Inc. and Schott and Associates. URS Corporation is responsible for the Wetland Mitigation Plan and the delineation report of preexisting conditions on the compensatory mitigation areas.

1.3 DESCRIPTION OF OVERALL PROJECT

The proposed Cogeneration Project is the construction of a 720-megawatt, gas-fired cogeneration electric power plant and associated facilities including construction lay-down areas and access roads. Because the cogeneration facility will be an integral part of the refinery, it must be located in close proximity to the refinery facilities. The power plant will be configured with combined-cycle combustion turbines, each driving an electric generator. Electricity and steam produced by the cogeneration facility will power Refinery operations, greatly reducing the need for steam from existing refinery boilers. Excess electricity produced by the cogeneration facility will be provided to the Bonneville Power Administration (BPA) electrical grid. A Corps of Engineers (COE) permit for impacts on wetlands related to construction of a power line that will service the proposed power plant has been in place since 2000. The access roads and

the area for the transmission tower pads have been constructed, but the towers and conductors have not been erected.

The cogeneration facility, including site access roads and a visual buffer area, will encompass 33.17 acres, of which approximately 25 acres will be converted to impervious surface area for the plant construction. Construction of the power plant and associated facilities (i.e. access roads) will permanently fill and/or cut off the hydrologic source for 11.91 acres of wetland (Table 1).

Approximately 33.1 acres of undeveloped land will be converted to construction lay-down areas. Lay-down areas are lots with graveled or impervious surface area that provide staging areas during construction and equipment storage area after construction. An existing gravel lot (Contractor’s parking lot) that is 3.18 acres in size will be used for lay-down as well. The construction of the lay-down areas will fill a total of 23.46 acres of wetlands, of which 4.86 acres will be temporarily filled.

Two portions of the lay-down areas totaling 11.08 acres will be temporary and removed after construction is complete. 9.27 acres of these temporarily impacted areas are considered Restoration Areas since the 4.86 acres of wetlands and 4.41 acres of wetland buffers (uplands) that comprise these areas will be restored to native plant communities. The remaining 1.81 acres is within an upland area more than 300 feet from the nearest wetland to be restored. Upland forest will be established in this area to enhance visual buffer between the plant site and Grandview Road and provide ecological connectivity between the East Restoration Area and the forested areas east of the plant site. A map of existing wetlands, the proposed impact areas, the Restoration Areas, and the visual buffer areas is provided by Figure 2.

Thus, a total of 35.37 acres of wetlands will be filled. The total wetland area to be temporarily filled is 4.86 acres and the total wetland area to be permanently filled is 30.51 acres. Over 10,000 cubic yards of material will be removed from the construction site for this project.

**Table 1
Expected Wetland Impacts**

Project Area	Total Area (acres)	Area of Permanent Wetland Fill (acres)	Area of Temporary Wetland Fill (acres)
Cogeneration Facility ¹	33.17	11.91	0
Lay-Down Area 1	6.29	4.39	0
Lay-Down Area 2 ²	16.61	8.75 ³	4.66
Lay-Down Area 3	5.46	5.46	0
Lay-Down Area 4	4.74	0	0.20
Existing developed area (contractor’s parking lot)	3.18	0	0
Total	69.45	30.51	4.86

¹ This area includes the power plant, Detention Pond 1, the two access roads, the northernmost 300 feet of the maintenance road, and the visual (forest) buffer area west of Lay-Down Area and north of the plant site.

² The area for Lay-Down Area 2 includes Detention Pond 2.

³ The permanent wetland impact area includes the walking path that will traverse the West Restoration Area (see Section 4).

Within the construction zones, vegetation will be cleared, topsoil will be excavated, and the soil surface will be graded, compacted, and filled. The Cogeneration Project includes construction of power plant facilities, graveled or paved work areas and parking lots, paved access roads, and detention ponds.

The impervious surfaces to be created by the proposed project will reduce hydrologic storage and induce higher rates of runoff. This area is a relatively small portion (0.4%) of the total watershed area that comprises the Terrell Creek watershed, which is approximately 20.8 square miles in size. If left unmanaged, runoff from the site may degrade water quality and alter hydrologic regimes of downstream waterbodies (wetlands and Terrell Creek) and consequently degrade their habitat quality.

Two detention ponds will be constructed to control surface runoff from the proposed construction areas (Golder Associates 2002). Detention Pond 1 will collect runoff from the cogeneration facility and the portion of Lay-Down Area 4 to be restored after construction is complete. This area is labeled the East Restoration Area. Detention Pond 2 will collect runoff from the Lay-Down Areas 1, 2, and 3 including the portion of Lay-Down Area 2 to become the West Restoration Area (Figure 2). Oil/water separators will be installed at the inlet to each pond. The ponds have been designed to meet technical requirements of both Whatcom County and the Washington State Department of Ecology (Ecology) to provide adequate water quality treatment and flow control for runoff from impermeable surfaces to be created by the proposed construction.

Detention Pond 1 will be located in the northwest corner of the cogeneration site. Runoff from Detention Pond 1 will be piped northwest across Grandview Road and Blaine Road and dispersed across a large area within one of the CMAs. Detention Pond 2 will be located just west of Lay-Down Area 2. Runoff from Detention Pond 2 will discharge to an existing drainageway that extends across Grandview Road to an extensive pond and wetland system. Both areas to receive site runoff drain to Terrell Creek near its crossing under Jackson Road.

Thus, runoff from the project site will be directed to its historic drainage areas where it will support and enhance existing wetlands before draining to Terrell Creek. In addition, directing runoff to these wetland areas will improve runoff water quality and prevent increasing flow fluctuation in Terrell Creek above existing levels. A more detailed description of the post-mitigation hydrologic scenario is in Section 5.6.2.

Outside of the proposed construction area, existing ditches will be re-routed to avoid the plant site and support areas. Surface water in these ditches will continue to flow north under Grandview Road through the same ditches that currently support runoff from the undeveloped project site.

Impacts associated with the proposed project will be mitigated by applying the standard mitigation sequence. The placement and design of the Cogeneration Project has avoided and minimized wetland impacts to the extent practicable. The temporary portions of the lay-down areas will be restored to support native wetland and upland plant communities. Permanent impacts to the remaining 30.51 acres of wetlands to be filled will be compensated by rehabilitating approximately 110 acres of nearby lands mainly consisting of degraded wetland.

The proposed construction will disturb low quality, historically degraded wetlands. Although the wetlands within the proposed project site impart a variety of wetland functions, performance of these functions

occurs at fairly low levels. The proposed restoration and compensatory mitigation will establish wetland and wetland buffer (upland) communities that perform these functions at moderate to high levels. In addition, proposed topographic and hydrologic modifications to the CMAs will restore historic drainage patterns.

1.4 WETLAND DELINEATION OF IMPACT SITE

See the *Wetland Delineation Report BP Cherry Point Cogeneration Project [Revised]* (Golder Associates 2003a) for the wetland delineation and maps.

2.0 ECOLOGICAL ASSESSMENT OF IMPACT SITE

This section summarizes ecological conditions of the proposed project site as determined in part by the findings of Golder Associates. Detailed descriptions of the environmental conditions of the proposed construction zones including the existing vegetation, soil, water regime, and wildlife of the on-site wetlands and uplands are found in the *Wetland Delineation Report BP Cherry Point Cogeneration Project [Revised]* (Golder Associates 2003a) and the *Technical Report on Wetland Functions and Values Assessment BP Cherry Point Cogeneration Project [Revised]* (Golder Associates 2003b). These reports describe the geographic extent, functions, and ratings of the wetlands delineated in the vicinity of the proposed construction areas.

2.1 EXISTING VEGETATION

Most of the area within the proposed construction site and vicinity is composed of wide fields that are dominated by overgrown pasture grasses. These fields are fallow agricultural land that has not been cultivated in over 10 years. Interspersed with the fields are hedgerows and patches of semi-mature forest plantations that were planted for pulpwood harvest. Tree species comprising these plantation areas include Douglas fir (*Pseudotsuga menziesii*) and hybrid poplar (*Populus trichocarpa* x *deltoides*). Mature forest containing deciduous and coniferous trees that colonized the site naturally is located southeast of the proposed plant site. There are no existing structures within the proposed construction area.

A map showing delineated vegetation communities superimposed on an oblique aerial photograph of the construction areas, refinery, and areas to the west is Figure 5 of the *Wetland Delineation Report BP Cherry Point Cogeneration Project [Revised]* (Golder Associates 2003a). A map showing delineated vegetation communities superimposed on an overhead aerial photograph of the plant site and areas to the south and east is Figure 6 of the *Wetland Delineation Report BP Cherry Point Cogeneration Project [Revised]* (Golder Associates 2003a). These figures are presented below in Appendix A.

A large proportion of these fields are composed of palustrine emergent (PEM) wetlands as defined by the classification system of Cowardin et al. (1979). The PEM wetlands primarily consist of non-native pasture grasses such as red top (*Agrostis stolonifera*), colonial bent grass (*Agrostis capillaris*), velvet grass (*Holcus lanatus*), and reed canarygrass (*Phalaris arundinacea*). Large amounts of soft rush (*Juncus effusus*), a graminoid, also occur in these wetlands. The vegetation within the PEM wetlands has not been mowed or grazed in over 10 years.

One 0.6-acre palustrine scrub-shrub (PSS) wetland area containing immature hybrid poplar trees and one 1.69 palustrine forest (PFO) wetland that supports semi-mature (at least 12 years old and over 20 feet tall) hybrid poplar also occur within the construction zones.

Upland areas within the project site are primarily dominated by Himalayan blackberry (*Rubus discolor*), but contain some evergreen blackberry (*Rubus laciniatus*) as well. Some Douglas fir saplings planted in these areas are also present in some upland patches. Uplands also include some portions of the abandoned meadow area as well; these areas are dominated by colonial bentgrass and contain some stinging nettle (*Urtica dioica*), birdsfoot trefoil (*Lotus corniculatus*), and Canada thistle (*Cirsium arvense*). Some upland areas contain species found in the adjacent wetland areas including colonial bentgrass, reed canarygrass, and red alder (*Alnus rubra*) saplings.

The area encompassing the BP Cherry Point property originally supported forest with coniferous evergreen and broad-leaf deciduous trees, but was logged at least 100 years ago. The land was then cultivated for the first half of the 20th century and used as pasture and cropland. The predominant agricultural use of these areas was cattle grazing, which fostered the spread of non-native pasture grasses.

2.2 EXISTING WATER REGIME

The primary sources of surface water and soil moisture to the construction site are precipitation and lateral drainage from adjacent areas. Vertical drainage through the soil is limited by the underlying clay till, especially where it is within two feet of the soil surface. Lateral drainage is limited by low relief. As a result, soil saturation above 18 inches is widespread through the wet season in both wetland and upland areas. However, most areas of the project site typically dry out substantially in the latter half of the growing season.

The drainage ditches that are present throughout the site were originally installed to facilitate drainage and expedite drying of the soil for farming. These ditches continue to function although they are not maintained and are overgrown with vegetation.

2.3 EXISTING SOILS

Most of the soil in the area was derived from glaciomarine drift plains and is underlain by clay till starting at 10 to 30 inches below ground surface (bgs). Soil in the project site ranges from loam to silty clay loam, though some sandy soils and gravel not reflective of native conditions are present in some of the upland areas. The finer textured soils are mainly restricted to the wetlands. A map showing soil sampling locations is Figure 7B of the *Wetland Delineation Report BP Cherry Point Cogeneration Project [Revised]* (Golder Associates 2003a). This figure is presented below in Appendix A.

The two soil series mapped as occurring within the construction site including the Restoration Areas are Whitehorn silt loam, a hydric soil, and Birchbay silt loam, a nonhydric soil. As expected, the soils characteristic of Whitehorn silt loam are typically found in wetland areas whereas the soils characteristic of Birchbay silt loam are found in the upland areas.

Whitehorn silt loam is a very deep soil considered by Goldin (1992) to be poorly drained. However, a wetland delineation conducted by ENSR Consulting and Engineering (1992) that included intensive investigation of soils and hydrologic regime within the proposed site for the Cogeneration Project found high permeability and rapid lateral drainage within subsoil layers of soils characteristic of Whitehorn silt loam. As a result, the study concluded that the Whitehorn silt loam within this area should be considered somewhat poorly drained rather than poorly drained (Golder Associates 2003a). This soil is moderately fertile, has a moderate amount of organic matter, and is slightly acidic in the surface layer. The soil series contains inclusions of non-hydric soils. The water table in this soil fluctuates between 1 foot above ground and 1 foot below ground from November to May.

In contrast, Birchbay silt loam is a very deep, moderately well drained soil. The surface layer of the Birchbay silt loam is moderately fertile, has a moderate amount of organic matter, and is slightly acidic. This soil series has better natural drainage than the other soil types in the study area and is not listed as a hydric soil. The water table in this soil typically varies between 2 and 4 feet depth from December through April.

Topographic relief is minimal, but the area generally slopes to the north and northwest. Topography in the area is rolling to flat as determined by recent geologic history. Historic cultivation for crops and hay disturbed soil structure and smoothed what was likely rough micro-topography dominated by small hummocks

2.4 EXISTING FAUNA

The broad fields provide habitat for the abundant field mice, voles, and various small rodents. The forested patches located nearby provide habitat for wildlife species commonly found in woodland edge habitat in western Washington. These species include coyote, black-tailed deer, and numerous resident and migratory birds such as red-tailed hawk, American robin, song sparrow, and common yellowthroat. No amphibians, reptiles, or fish are known to inhabit the construction site.

A great blue heron (*Ardea herodias*) breeding colony is located approximately one mile west of CMA 2 and over one mile west of CMA 1 (Figure 1). This colony of between 200 and 400 breeding pairs (fluctuates over time) represents one of 4 large colonies located in northwestern Washington and southwestern British Columbia. Individuals from this colony are known to use nearby open field habitats similar to those present on CMA 1 and CMA 2. These nearby fields are used for staging during the nesting season and for foraging for amphibians and small mammals throughout the year.

Colony nesting bird species, including great blue herons, are considered a priority species in the state of Washington (WDFW 2000). Whatcom County lists herons as a species of local importance in its Critical Areas Code, Appendix C (Whatcom County). In connection with a different project, BP completed a *Heron Habitat Management Plan* in spring 2004 addressing the impacts of current and future construction on their lands north of Grandview Road (URS 2004). As part of this plan, a 1-year monitoring program began in March 2004 by a local biologist familiar with the local heron population. This monitoring seeks to specify high heron use areas on BP's property and what heron activities are occurring in those locations. This program will help BP adjust the implementation strategy for this mitigation plan on CMA 1 and 2. A

more detailed discussion of issues concerning the heron colony is provided in Appendix F: *BP Cherry Point Cogeneration Facility Wetland Mitigation and the Birch Bay Great Blue Heron Colony*.

2.5 FUNCTIONS AND VALUES

The wetlands within the proposed project site serve a variety of hydrologic functions such as improving water quality, reducing peak flow, and decreasing downstream erosion. They also provide habitat suitability functions for wildlife, mainly mammals and birds. A more detailed discussion of the current functional performance of the wetlands within the construction site is in the *Technical Report on Wetland Functions and Values Assessment BP Cherry Point Cogeneration Project [Revised]* (Golder Associates 2003b).

2.6 WATER QUALITY

Although no water quality monitoring has occurred on the site, the quality of surface water there is likely high. As stated earlier, the main source of moisture to the construction site is precipitation and drainage from adjacent areas. Since precipitation water quality is good and the adjacent areas that provide drainage are undeveloped and well vegetated, no water quality problems are expected to be present.

2.7 BUFFERS

Undeveloped upland areas that serve as wetland buffer areas are scattered across the project site. These upland areas support various plant communities including abandoned meadow, regularly maintained grassland, Douglas fir/Himalayan blackberry patches, Himalayan blackberry patches without Douglas fir, semi-mature hybrid poplar forest patches, and native mixed coniferous/deciduous forest. Upland portions of the abandoned meadow are found throughout the project site. The plantation and forested areas are mainly situated north and east of the proposed power plant and west of the northern portion of Lay-Down Area 2. Grandview Road limits the buffer area north of the project site to the right-of-way (ROW) immediately south of the road. Figure 6 of the *Wetland Delineation Report BP Cherry Point Cogeneration Project [Revised]* (Golder Associates 2003a), which is provided in Appendix A of this plan, shows the distribution of these plant communities within and immediately adjacent to the cogeneration facility site.

The area east of the plant site consists of hybrid poplar forest plantation and a small amount of mature forest dominated by both deciduous broad-leaved and coniferous needle-leaved trees. This area is over 2,000 feet wide (east-west). The area immediately south and southeast of the cogeneration facility site is comprised of the portion of Wetland D that will not be impacted by the proposed construction. Wetland D is a seasonally saturated/inundated palustrine emergent (PEM) wetland dominated by non-native pasture grasses and other herbaceous species. This wetland appears to extend east off site into the meadow area south of the forest plantation. The area southeast of Wetland D is a forested area that is mainly comprised of mature upland forest dominated by paper birch (*Betula papyrifera*), big-leaf maple (*Acer macrophyllum*), Douglas fir, and black cottonwood (*Populus balsamifera* ssp. *trichocarpa*). This area also contains Wetland E, a PFO wetland, and a mosaic of small, forested wetland patches. Blackberry (*Rubus* sp.) lines the edge of this

forested area and dominates the narrow upland area south and southwest of Wetland D and north of Brown Road.

The area between Lay-Down Areas 1, 2, and 3 and the cogeneration facility where Wetland H is located is a regularly maintained field dominated by pasture grasses that serves as a utility corridor for the BP Cherry Point property (see Figure 2). The area west of the northern portion of Lay-Down Area 2 is a 500-foot wide patch of mature mixed coniferous/deciduous forest. This area is bordered to the west by the main entrance road for the BP Cherry Point Refinery.

2.8 WETLAND RATING

As determined by Golder Associates (2003a), each wetland within the construction zone is rated as a Category III wetland. See the *Wetland Delineation Report BP Cherry Point Cogeneration Project [Revised]* (Golder Associates 2003a) for copies of the original data sheets.

The ratings used for this project conform to the rating system described by the Washington State Wetlands Rating System – Western Washington (Ecology 1993). Wetlands with the Category III rating are the most frequently encountered and typically require a moderate level of protection. The Ecology rating system is designed to differentiate between wetland quality based on rarity, irreplaceability, sensitivity to disturbance, and functional performance. The wetlands found in the project area are not Category I or II wetlands since they do not provide habitat for sensitive or important wildlife or plants, are not regionally rare, and do not provide very high functional performance. No on-site wetlands are considered Category IV wetlands since all wetlands present are hydrologically connected to Terrell Creek.

2.9 POSITIONS AND FUNCTIONS OF THE WETLANDS IN THE LANDSCAPE

With the exception of Wetland I, the Hydrogeomorphic Classification of the wetlands within the project area is depressional outflow. These wetlands vary in size, but all are situated in topographical depressions that have closed contours on three sides and support surface water outflow to downstream waterbodies. Wetland I is considered a riverine flow-through wetland. Riverine flow-through wetlands are those that do not retain surface water significantly longer than the duration of a flood event.

These wetlands perform most hydrologic and habitat functions albeit at low performance levels as discussed in Section 4.4.4. The wetlands here have limited opportunities to perform some hydrologic functions since the areas within their upgradient catchment areas are undeveloped, well vegetated, and do not produce exceptionally large outflows of water. As mentioned earlier, the main sources of moisture to these wetlands is precipitation and shallow subsurface drainage from adjacent uplands. Although the site is located in the central part of the watershed, the on-site wetlands are situated in relatively small subcatchments and therefore have limited amounts of subsurface drainage provided to them.

The project site and adjacent areas to the east are part of a corridor of undeveloped land between the Lake Terrell Wildlife Area, a 1,500-acre reserve managed by the Washington Department of Fish and Wildlife (WDFW), and the Terrell Creek riparian forest. Although this corridor is fragmented by roads and both abandoned and active pasture, it may provide ecological connections between these areas for a wide variety

of wildlife including large mammals such as blacktail deer and coyote. The proposed construction is not expected to severely degrade these connections since the on-site areas to the east will remain vegetated.

3.0 MITIGATION APPROACH

3.1 MITIGATION SEQUENCING

Although BP evaluated a number of project alternatives, it decided that the Cogeneration Project will best serve to provide reliable steam and electrical power to the BP Cherry Point Refinery and provide efficient and cost-effective electrical power to the region. The Cogeneration Project will also minimize the Refinery's reliance on outside sources for electricity and minimize impacts to the environment. For more information see *Siting and Wetland 404(b)1 Alternatives Analysis, BP Cherry Point Cogeneration Project [Revised]* (Golder Associates 2003c).

BP also evaluated alternative sites for the Cogeneration Project based on the following criteria: sufficient acreage available, wetland impacts, proximity to the Refinery and related infrastructure, security and accessibility.

The proposed site avoids and minimizes wetland impacts as much as possible. Of the five possible alternative sites considered, only one that is large enough for the proposed project would impact less wetland area. However, that site was too far away from the refinery to be practicable for cogeneration and raised significant security concerns. Thus, the proposed site avoids and minimizes wetland impacts and meets the siting criteria best of all the sites considered.

The proposed plan is designed to mitigate wetland impacts by following the standard mitigation sequence as outlined in the Memorandum of Agreement between the Environmental Protection Agency (EPA) and the US Army Corps of Engineers (Corps). This sequence and a brief summary of how each mitigation component will be accomplished is provided below:

1. **Avoidance:** As discussed above, the site chosen for construction avoids wetland impacts. For a detailed account of how wetland impacts have been avoided by the proposed project, see *Siting and Wetland 404(b)1 Alternatives Analysis, BP Cherry Point Cogeneration Project [Revised]* (Golder Associates 2003c).
2. **Minimization:** Within the construction site, impacts to wetlands will be minimized by locating the construction areas away from delineated wetlands as much as possible given engineering constraints. The proposed construction will disturb low quality, historically degraded wetlands and avoid the high quality, forested wetlands located on the property. In addition, project-specific Stormwater Pollution Prevention Plans (SWPPPs) will be composed to provide guidelines for preventing the discharge of fill material in wetlands and streams during both construction and operation.
3. **Restoration:** Restoration of temporarily disturbed wetlands and wetland buffers will occur to re-establish wetland conditions and improve performance of most wetland functions. Any temporary

or inadvertent impacts to wetlands that may occur during construction will be repaired and rehabilitated as appropriate. Inadvertent impacts may include clearing and trampling of vegetation, soil compaction, discharge of fill, and alterations to hydrologic regime as a result of these activities. For a detailed account of how restoration of intentionally temporary impacts will be achieved, see Section 4 of this report.

4. **Compensation:** Unavoidable impacts to wetlands will be compensated by rehabilitating degraded wetland and upland areas within a portion of the BP Cherry Point property that will not be directly impacted by the proposed construction. For a detailed account of how compensatory mitigation will be achieved, see Section 5 of this report.

The plan for restoration and compensation incorporates recommendations from several resources including *Guidelines for Developing Freshwater Wetlands Mitigation Plans and Proposals (Guidelines)* (Hruby and Brower 1994), *Restoring Wetlands in Washington* (Stevens and Vanbianchi 1993), and *Washington State Wetland Mitigation Study – Phase 1: Compliance* (Ecology 2001). In addition, wetland and upland forest patches existing within the BP Cherry Point property were used in part as reference sites for the planting plans of restoration and compensatory mitigation.

3.2 GOALS

The goals of this mitigation plan are as follows:

1. Restore a total of 9.27 acres of wetlands and wetland buffers (uplands) to emergent, scrub-shrub, and forested habitats dominated by native vegetation within two Restoration Areas located in the northern portion of the construction site.
2. Rehabilitate approximately 110 acres of degraded wetlands and wetland buffers (uplands) within the two CMAs located on the BP Cherry Point property. Rehabilitation will occur by restoring historic drainage patterns via re-routing treated stormwater runoff and plugging existing ditches, removing and suppressing non-native, invasive plants such as reed canarygrass, and establishing emergent, scrub-shrub, and forested habitats dominated by native vegetation. Re-routing stormwater runoff will include installing pipes, culverts, and an inlet channel with diffuse-flow outlets to direct runoff from one of the two proposed detention ponds to a portion of the mitigation area rather than let it continue to go through a roadside ditch directly to Terrell Creek.

3.3 OBJECTIVES AND PERFORMANCE STANDARDS

This section describes the specific objectives and performance standards for the mitigation proposed for this project. A summary of these performance standards is provided in Appendix H.

3.3.1 Wetland Hydrology

Objective A: Re-establish wetland hydrology over 4.86 acres of the temporary lay-down areas (Restoration Areas) in the approximate locations of existing wetlands.

Performance Standard: Soils throughout the restored wetland areas within the Restoration Areas will be saturated to the surface for at least 10% of the growing season. The growing season extends from March 12 to October 31 and is 223 days long (Goldin 1992). Thus, the wetland hydrology criterion for the restored wetlands within the Restoration Areas is saturation at the soil surface for at least 22 consecutive days during the growing season. The presence of a free water surface within 12 inches of the soil surface over a continuous 22-day period during the growing season will be used to indicate wetland hydrology within the Restoration Areas. This performance standard meets the guidelines of wetland hydrology set by the Corps of Engineers Wetlands Delineation Manual (Corps 1987).

Objective B: Maintain wetland hydrology over the 79.7 acres of existing wetlands within the CMAs.

Performance Standard: As with the Restoration Areas, the wetland hydrology performance standard for the CMA's is saturation at the soil surface or inundation to a depth not exceeding 6 inches for at least 22 consecutive days period during the growing season. Measurement will be the presence of a free water surface within 12 inches of the soil surface over a continuous 22-day period during the growing season and will be part of the hydrologic monitoring program (Appendix G). This performance standard meets the guidelines of wetland hydrology set by the Corps of Engineers Wetlands Delineation Manual (Corps 1987).

3.3.2 Vegetation

Objective A: Maintain survival of planted trees and shrubs during the first five years before adequate vegetation cover can be measured.

Performance Standard: A survival/replacement standard will apply to trees and shrubs for the first five years after implementation, before cover is large enough to provide a reasonable method of measurement. One hundred percent survival is required for the first year and 80 percent for years 2 through 5 or until woody species cover reaches 30 percent in areas planted to tree and shrub communities.

Measurement: Measurement will be by a sampling method consisting of plots located along transects that span the width of each Restoration Area and each CMA. As recommended by Krebs (1999), at least 1% of the total area to be monitored will be sampled directly.

Objective B: Establish a variety of forested, scrub-shrub, and emergent plant communities dominated by native vegetation in both wetlands and buffer areas (uplands) within the Restoration Areas and the CMAs.

Performance Standard: The performance standards for cover of installed and volunteer woody (tree and shrub) and herbaceous vegetation outlined in Table 2 will be applied to all portions of the Restoration Areas and CMAs where tree and shrub communities will be planted. As explained in Section 4.6.5, some areas will remain free of installed trees and shrubs. Volunteer plants are those plants that establish on their own without direct planting or seeding. Herbaceous cover standards are much higher than the tree and shrub cover standards since herbaceous plants are expected to more rapidly colonize greater proportions of both the Restoration Areas and the CMAs.

Measurement: Measurement will be conducted by using a sampling method consisting of plots located along transects that span the width of each Restoration Area and each CMA. As recommended by Krebs (1999), at least 1% of the total area to be monitored will be sampled directly.

**Table 2
Installed and Volunteer Plant Cover Standards**

Criterion	Year 1	Year 2	Year 3	Year 5	Year 7	Year 10
Tree and shrub cover (%)	*	*	*	30	55	80
Herbaceous cover (%)	40	60	80	90	90	80

* = Tree and shrub survival, rather than cover, is measured during the first five years or until woody species cover reaches 30 percent in areas planted to tree and shrub communities.

Objective C: Reduce and suppress cover by non-native, invasive plant species.

Performance Standard: The performance standards for non-native, invasive vegetation outlined in Table 3 will be applied to all portions of the Restoration Areas and CMAs, including uplands and buffer areas. Those portions of the CMAs that currently have greater than 20% cover by reed canarygrass will have a performance standard of <20% through year 5. Portions of the CMAs that currently have less than 20% cover by reed canarygrass will have a performance standard of <10%. Since the Restoration Areas will have less than 20% cover by reed canarygrass immediately prior to initiating restoration activity, only the performance standard of <10% will be applied to these areas. By year 7, all areas are to have less than 10% cover of invasive species.

Measurement: Measurement will be conducted by using a sampling method consisting of plots located along transects that span the width of each Restoration Area and each CMA. As recommended by Krebs (1999), at least 1% of the total area to be monitored will be sampled directly.

The non-native, invasive plant species currently found in the CMAs include reed canarygrass, Himalayan blackberry, and evergreen blackberry. Of all these species, only reed canarygrass is listed by the Washington State Noxious Weed Control Board as a noxious species in Whatcom County. Reed

canarygrass is a Class C weed, which indicates that is widespread and is targeted for control to serve educational or biological efforts only.

**Table 3
Cover of Non-Native, Invasive Species**

Species	Year 1	Year 2	Year 3	Year 5	Year 7	Year 10
Himalayan blackberry and evergreen blackberry (%)	<10	<10	<10	<10	<10	<10
Reed canarygrass cover in areas with >20% pre-existing cover (%)*	<20	<20	<20	<20	<10	<10
Reed canarygrass cover in areas with <20% pre-existing cover (%)*	<10	<10	<10	<10	<10	<10

* See Section 5.4.5, which discusses existing reed canarygrass cover distribution in the CMAs, and Figures 7A and 7B, which show existing reed canarygrass cover in the CMAs.

4.0 PROPOSED RESTORATION

4.1 SITE DESCRIPTION

Construction impacts associated with the Cogeneration Project that are intended to be temporary will occur in the northernmost 6.33 acres of Lay-Down Area 2 and all of Lay-Down Area 4. The western 2.94 acres of Lay-Down Area 4, which is 4.75 acres in total size, will be restored after construction is complete. This area will become the East Restoration Area. The remaining 1.81-acre portion of Lay-Down Area 4 contains no wetlands and will be planted as upland forest. The northernmost 273 feet (approximately) of Lay-Down Area 2, which is 6.33 acres in total size, will become the West Restoration Area. (Figures 1 and 2).

The total area of existing wetland within the East Restoration Area is 0.2 acres whereas the total area of existing wetland within the West Restoration Area is 4.66 acres. The wetland within Lay-Down Area 4 is a 0.2-acre portion of Wetland B-4, which is a PEMA wetland dominated by non-native pasture grasses. The wetland in Lay-Down Area 2 is called Wetland F and is also a PEMA wetland dominated by non-native pasture grasses. Detailed descriptions and maps of existing wetlands and plant communities at these sites are found in the *Wetland Delineation Report BP Cherry Point Cogeneration Project [Revised]* (Golder Associates 2003a).

4.2 OWNERSHIP

The Restoration Areas are within the BP Cherry Point property, which is owned by BP.

4.3 RATIONALE FOR CHOICE

The Restoration Areas were selected for the following attributes:

- The Restoration Areas are located within the portions of the proposed construction site that are only needed during construction of the Cogeneration Project. Because they will be located within temporary

lay-down areas, the sites can be readily manipulated by heavy machinery to re-create wetlands and uplands in approximately their existing locations.

- The Restoration Areas are situated so that runoff can be directed to them from areas outside of the proposed construction site that will remain undeveloped. This runoff will be diverted to ensure that wetland hydrology will be established in the restored wetlands. The diversion will also be part of restoring flows to historic drainages.
- After removing compacted gravel installed for lay-down operations, native topsoil will be re-applied to the Restoration Areas. This topsoil currently supports trees, shrubs, and herbaceous vegetation and will be stored during project construction. Although the construction period will last 1.5 to 2 years, soil will be stored in a manner that minimizes reduction in soil fertility. Soil that currently supports reed canarygrass will not be applied to the Restoration Areas.
- The trees and shrubs that will establish in the Restoration Areas will provide a visual buffer between Grandview Road and the proposed facility site. The existing forest patches west of each Restoration Area and the Upland communities to be established in the Restoration Areas will provide buffer for the wetlands within the Restoration Areas as well as visual buffers for the plant site.

4.4 ECOLOGICAL ASSESSMENT OF THE RESTORATION AREAS

The Restoration Areas comprise portions of the area surveyed for the *Wetland Delineation Report BP Cherry Point Cogeneration Project [Revised]* (Golder Associates 2003a). Thus, much of the information contained in Section 2, which summarizes the ecological conditions of the proposed project site as determined by the Golder Associates (2003a) report, applies to the Restoration Areas as well.

The remainder of this Section deals with the topics listed in part 2.5.4 of the *Guidelines*:

4.4.1 Hydrology

Most of the West Restoration Area is wetland whereas most of the East Restoration Area is upland. The wetlands in the Restoration Areas are mainly palustrine emergent wetlands that are temporarily flooded (PEMA). Although this wetland type is identified as having temporary flooding, floods here are probably very rare. Instead, these 'wet meadow' communities retain saturation at or near the surface of the soil for long periods, extending into the beginning of the growing season, but typically dry out in the latter half of the growing season.

According to 30 years of data gathered at the WETS weather stations in Blaine and at the Bellingham International Airport, average annual temperature is 49.3 degrees Fahrenheit and average annual precipitation is approximately 36 inches (NRCS 1999). The wet season is herein defined as October 1 through May 31, the 8-month period in which over 82 % of yearly rainfall occurs according to the WETS table climate data from the Bellingham International Airport (NRCS 1999). The dry season (April 1 to September 30) should not be confused with the growing season, which is the period when soil temperatures 19.7 inches below the ground surface are greater than 41 degrees Fahrenheit (5 degrees Celsius) according to the 1987 Corps Wetlands Delineation Manual. The growing season length for the area is approximately

223 days as determined by averaging growing season length given by Goldin (1992) for Bellingham and Blaine. This period occurs from March 12 to October 31.

Soil moisture levels vary greatly between wet season and the dry season because the difference in precipitation between these periods is exacerbated by the poorly drained soils and their high rates of runoff. The low relief in the area and the clay till underlying most of the soils in this portion of Whatcom County greatly decreases vertical and lateral drainage, fostering widespread near-surface saturation and/or shallow inundation during the wet season. Soils in this portion of Whatcom County were formed in glaciomarine drift (Bellingham Drift) and are underlain by clay till starting at 10 to 30 inches bgs (Goldin 1992). Evapotranspiration and a minor amount of infiltration removes most of the moisture stored, causing relatively dry conditions in the latter half of the dry season.

Neither of the Restoration Areas is drained by ditches. However, subsurface drainage and overland flow from these areas reach the ditches that originate in undeveloped areas south of the proposed construction site. These ditches primarily carry surface water during the wet season and are dry during the dry season. A map of existing topography and drainage including ditches in these areas is in Figure 4.1-2 in the *BP Cherry Point Cogeneration Project – Application for Site Certification* (Golder Associates 2003d). This figure is presented below in Appendix A.

The portion of the ditch system outside the project area will be reconfigured during construction so that it will continue to convey surface water to areas where it currently flows. A map showing the ditch system plan during construction is in Figure 1A of the *BP Cherry Point Cogeneration Project Surface Water Management Design Basis* (Golder Associates 2002). An upgraded version of this figure that reflects minor changes in the construction plan is presented below in Appendix A.

After construction is complete and the temporary lay-down areas removed, ditch surface water will be diverted to supply seasonally inundated areas within the wetlands that will be restored. This diverted surface water will also ensure that the seasonally saturated portions of the restored wetlands possess wetland hydrology. Diverting minor amounts of flow to these areas will compensate for the loss of surface and ground water that is supplied by the areas to be eliminated by construction of the Cogeneration Project. A map showing the ditch system plan during operation is in Figure 1B in the *Design Basis BP Cherry Point Cogeneration Surface Water Management Design Basis* (Golder Associates 2002). An updated version of this figure that reflects minor changes in the construction plan is presented below in Appendix A.

4.4.2 Experience

URS has had experience with the design and construction of wetlands in projects located in Oregon, Washington, and Alaska. For example, URS managed the design and monitoring of two created mitigation wetlands using stormwater as the water source for the Boeing Company in western Washington. One project included restoring a stream for trout habitat and creating a segment of new stream to link with the wetland. URS also designed a 4.58-acre compensatory mitigation site located within the BP Cherry Point property north of Grandview Road that involved removing non-native plants, creating a 0.5-acre seasonally inundated area, and establishing a mosaic of native plant communities (Corps Reference #98-4-02349).

4.4.3 Exotics (Non-native, Invasive Species)

For the purposes of this project, non-native species are considered to be species that were introduced to western Washington during white settlement. Of the non-native species in the area, only three non-native plants are considered to be invasive and therefore problematic to mitigation success. The three species are reed canarygrass, Himalayan blackberry, and evergreen blackberry. Since these species are likely to recolonize the mitigation areas (both the Restoration Areas and the CMAs) if not controlled, they will be the focus of the non-native, invasive species control program.

Of these species, reed canarygrass will likely be the most difficult to control. Reed canarygrass is extremely aggressive and often forms persistent monocultures in wetlands and riparian areas. This coarse-stemmed grass grows so vigorously that it is able to eliminate competing native wetland vegetation and prevent its reestablishment for indefinite lengths of time (Apfelbaum and Sams 1987; Lyons 2002). Reed canarygrass can form dense, persistent, monotypic stands in wetlands, moist meadows, and riparian areas. These stands exclude and displace native plants and animals and may be of little use to wildlife (Hoffman & Kearns 1997). In addition, reed canarygrass readily re-establishes itself upon clearing and can rapidly spread from intact stands. Reed canarygrass can be controlled using an aggressive, persistent approach.

The blackberry species present on site are known to aggressively invade upland areas and suppress establishment of native vegetation.

Control of non-native, invasive plant species in the mitigation areas will consist of a three-pronged approach: 1) initial removal, 2) subsequent maintenance for short-term control, and 3) establishment of native plant communities for long-term control.

Initial removal will occur through the removal of both the invasive vegetation and topsoil from the Restoration Areas prior to construction of the lay-down areas. Only topsoil currently supporting vegetation that does not include the above-mentioned non-native, invasive plants will be stored on site throughout the construction period.

Since the topsoil piles will be covered and stored for approximately 2 years, many of the seeds and rhizomes within the topsoil will die over the course of topsoil storage. Once the temporary lay-down areas are removed, the stored topsoil will be re-applied to the Restoration Areas. Non-native, invasive species that resprout will be sprayed with herbicide containing glyphosate plus surfactants. This or anic herbicide that contains active ingredients other than or in addition to glyphosate will only be applied to areas free from inundation and unlikely to support inundation within 2 weeks of the application. All herbicide will be applied by state-licensed applicators under a permit from the Washington State Department of Agriculture.

After native plants are installed and the seed mix applied, weed control will occur through a combination of mechanical removal and herbicide application. Mechanical control will include mowing and hand-pulling near installed plants to remove rhizomes as well as shoots. Weed control will occur with great care to prevent damage to native vegetation and will continue throughout the monitoring and maintenance period, as necessary.

As will be discussed in Section 8, URS will monitor success of non-native, invasive species control each year of a 10-year period subsequent to the initial planting and seeding. Monitoring results will guide

recommendations given by URS to maintain cover by non-native, invasive plants below thresholds set by the performance standards. Areas with unacceptable levels of non-native, invasive plants will be marked in the field so that the maintenance crew can more accurately target their treatment practices. Although removal of non-native, invasive plants is expected to occur throughout the 10-year period, the intensity of the maintenance effort should decrease over time. Eventually, native vegetation will serve to suppress non-native plants over large portions of the site by shading and soil resource competition.

4.4.4 Wetland Functions

The proposed restoration has been designed to improve the performance of wetland functions. Wetland functions are defined as the biogeochemical, hydrological, and ecological processes and manifestations of these processes that occur within wetlands. Wetland functions tend to exert a relatively strong influence over the functional performance of the surrounding landscape. Functions are easily confused with values, which are more closely associated with the goods and services that wetlands provide to society.

The functional assessment method applied to wetlands on site is detailed in the *Methods for Assessing Wetland Functions* (Ecology 1999), which is based on the Hydrogeomorphic Approach for Assessing Wetland Functions (HGM Approach). The Corps of Engineers and other federal and state agencies are currently implementing the HGM approach to wetland functional assessment through the development of regional guidebooks. The possible range of index values for each function is 1 to 10, where 10 represents the highest level of performance. A total of 13 wetland functions were evaluated for each wetland area assessed. Since the on-site wetlands receive subsurface flow from adjacent uplands and are open basins with seasonal outflow, they are classified as depressional outflow wetlands.

The product of wetland functional performance index and wetland acreage was calculated for each function to determine acre-points. Although the wetland functional performance is influenced by wetland size, acre-points is a metric that essentially gives equal importance to wetland functional performance and wetland size. Acre-points (also called functional units) can be used to compare gain and loss of functional performance for each function, but should not be summed to account for each wetland's gain and loss of overall functional performance.

As mentioned earlier, the West Restoration Area is 6.33 acres in size and contains 4.72 acres of the 13.41 acres that comprise Wetland F. Since 0.06 acres of wetland within the West Restoration Area will be filled by a 5-foot wide walking path, only 4.66 acres of wetlands will be restored here.

Golder Associates (2003b) conducted the functional assessment method for Wetland F, under current conditions. Only part of the AU-1 portion of Wetland F will be temporarily affected by the lay-down construction. URS conducted another functional assessment for the portion of Wetland F that will be restored (West Restoration Area) as it will exist 25 years after compensatory mitigation is initiated (see Table 4). The completed data sheet for this assessment is presented in Appendix B. Although the northern 0.2 acres of Wetland B4 located within the East Restoration Area will also be restored, this area is considered too small to justify a full functional assessment.

Table 4
Comparison Between Wetland Functional Performance for Wetland F Under Current Conditions
And 25 Years After Restoration Is Initiated in The West Restoration Area

Wetland Function	Functional Indices/ Acre-points Before Restoration	Functional Indices/ Acre-points 25 Years After Restoration	Explanation
	Temporarily filled portion of Wetland F (4.66 ac)	Restored Portion of Wetland F (4.66 ac)	
Potential for Removing Sediments	5/ 23.3	6/ 27.96	Slight increase (+4.66 acre-points) predicted due to increased constriction at the outlet.
Potential for Removing Nutrients	3/ 13.98	5/ 23.3	Slight increase (+9.32 acre-points) predicted due to increased areas that undergo fluctuation between aerobic and anaerobic conditions.
Potential for Removing Heavy Metals and Toxic Organics	5/ 23.3	4/ 18.64	Despite increased outlet constriction, slight decrease (-4.66 acre-points) predicted due to decreased cover by herbaceous vegetation.
Potential for Reducing Peak Flows	4/ 18.64	5/ 23.3	Slight increase (+4.66 acre-points) predicted due to increased outlet constriction.
Potential for Decreasing Downstream Erosion	5/ 23.3	8/ 37.28	Increase (+13.98 acre-points) predicted due to increased outlet constriction and increased cover by forest and scrub-shrub vegetation.
Potential for Recharging Groundwater	5/ 23.3	5/ 23.3	No change predicted since infiltration rate will not change.
General Habitat Suitability	2/ 9.32	4/ 18.64	Increase (+9.32 acre-points) predicted since there will be an increase in canopy closure, number of vegetation strata, number of snags, vegetation class interspersion, large woody debris, number of native plant species, and number of vegetation assemblages.
Habitat Suitability for Invertebrates	2/ 9.32	4/ 18.64	Increase (+9.32 acre-points) predicted due to increase in vegetation class interspersion, large woody debris, and maximum number of vegetation strata.
Habitat Suitability for Amphibians	2/ 9.32	2/ 9.32	No predicted despite installment of habitat features because the buffer condition and amount of seasonally inundated area will not change.
Habitat Suitability for Anadromous Fish	N/A	N/A	No anadromous fish can or will be able to access the site.
Habitat Suitability for Resident Fish	N/A	N/A	No resident fish can or will be able to access the site.
Habitat Suitability for Birds	3/ 13.98	4/ 18.64	Increase (+4.66 acre-points) predicted due to increase in number of snags, vegetation class interspersion, and invertebrate habitat suitability.

Table 4 (Continued)
Comparison Between Wetland Functional Performance for Wetland F Under Current Conditions and 25 Years After Restoration is Initiated in the West Restoration Area

Wetland Function	Functional Indices/ Acre-points Before Restoration	Functional Indices/ Acre-points 25 Years After Restoration	Explanation
	Temporarily filled portion of Wetland F (4.66 ac)	Restored Portion of Wetland F (4.66 ac)	
Habitat Suitability for Mammals	1/ 4.66	1/ 4.66	No change predicted due to proximity of plant site and associated facilities.
Native Plant Richness	1/ 4.66	4/ 18.64	Increase (+13.98 acre-points) predicted due to increase in maximum number of strata and number of native plant species, and decrease in area dominated by non-native plant species.
Potential for Primary Production and Organic Export	8/ 37.28	9/ 41.94	Increase (+4.66 acre-points) predicted due to increased rate of organic matter production.

According to the results of the functional assessment, the portion of Wetland F to be restored will slightly improve its currently low to moderate ability to remove sediment and nutrients from surface water inputs 25 years after restoration activity is initiated. The expected increases in the performance of the sediment and nutrient removal functions reflect the proposed hydrologic modifications, which will divert ditch flow from adjacent areas to seasonally inundated habitats and release these flows slowly through a constricted outlet (see Section 4.6). Conforming to the definition given by Ecology (1999), these seasonally inundated areas will possess inundation for greater than one month per year. As typical for most seasonally inundated wetlands in this region, on-site inundation will occur in the early part of the growing season. The opportunity for this wetland to perform these functions will remain low since these wetlands will only receive runoff from areas that will remain free from development or agriculture.

The potential for removing heavy metals and toxins will slightly decrease according to the model. The model interprets the decrease in herbaceous vegetation as a cause for a decrease in the wetland's ability to remove heavy metals and toxins. Since few of these contaminants enter the wetland currently and few are expected in the future, toxin and heavy metal removal is a function the wetland has and will have little opportunity to perform.

The wetland's current abilities to reduce peak flows and decrease downstream erosion will both improve as a result of the proposed restoration, which will direct a controlled amount of runoff to the restored wetland within the West Restoration Area. The shallowly inundated areas to be created will retain this runoff and thereby reduce peak flows and decrease the potential for downstream erosion. In addition, the increased cover by forest and scrub-shrub communities will further increase performance of these functions by fostering more evapotranspiration and improving the soil's ability to retain moisture and resist erosion. Given that surface water will be delivered to this wetland in greater quantity than had occurred previously, the opportunity for the wetland to perform peak flow reduction and downstream erosion reduction functions will be increased to a moderate level.

The potential for the wetland to recharge groundwater will remain low. The installment of compacted gravel padding atop the soil for the construction of the lay-down areas may temporarily diminish soil permeability. However, soil permeability will increase over time through the improvement of soil structure

wrought by increases in tree and shrub root penetration and distribution. In spite of these improvements, infiltration rates to underlying aquifers will remain fairly slow at this site due to the relatively impermeable clay till found below the topsoil. The opportunity for this function to be performed may be slightly increased by the greater influx of surface water in the West Restoration Area after restoration is complete.

General habitat suitability will improve substantially due to the establishment of a variety of wetland habitats and native plants. Installation of the various vegetation classes and habitat features will provide greater opportunities for wildlife to forage, take cover, and breed. The mosaic of plant communities will also create more 'edges' (transition areas between plant communities), which will augment both wildlife and plant diversity.

Wildlife that will likely benefit from the proposed restoration are primarily invertebrates, birds, and amphibians. No threatened or endangered species are expected to benefit directly from the proposed restoration. The existing chain-link fence around the refinery including the proposed West Restoration Area and construction of chain-link fence around the proposed East Restoration Area will deter large mammals such as deer and coyote from accessing these sites. Given the deterring factors of the site and its surrounding area, the opportunity for the restored wetland to perform the habitat suitability functions will be low to moderate.

Since the wetlands currently do not provide fish habitat and will not provide fish habitat after mitigation activity is complete, the functional performance for Habitat Suitability for Anadromous Fish and Habitat Suitability for Resident Fish can not be evaluated. Although Golder Associates (2003b) did evaluate these functions for the wetlands in the construction site, they gave them very low scores (0 or 1).

The moderate to high amount of biomass produced by this wetland is currently exported at moderate rates to adjacent aquatic ecosystems via the ditch outlet. The proposed mitigation may cause more biomass to be produced on site through the establishment and growth of primarily deciduous, broad-leaved trees and shrubs. Organic material will continue to be released from the site at moderate rates through the meandering channel to be excavated on site.

In summary, the model predicts that the proposed restoration will incur improvements for nine functions, no change in three functions, and a slight decrease in one function.

In addition to the functional assessment, the Washington State Wetlands Rating System (Ecology 1993) was applied by URS to the portion of Wetland F that will be restored (West Restoration Area) as it will exist 25 years after restoration is initiated. Despite being less than 5 acres in size and nearly surrounded by roads and lay-down areas, this wetland area is predicted to support conditions suitable for rating as a Category II wetland. In particular, the wetland is predicted to retain three wetland community types that are moderately well interspersed, support relatively high plant diversity, have some beneficial habitat features, and maintain its hydrologic connection to Terrell Creek. The completed wetland ratings data form for the 4.66-acre wetland within the West Restoration Area under conditions predicted for 25 years following initial mitigation activity is presented in Appendix C. Although the northern 0.2 acres of Wetland B4 located within the East Restoration Area will also be restored, no future rating is given for this wetland since it is so small.

4.4.5 Buffers

The undeveloped areas outside of the proposed construction site that serve as buffers for the wetlands within the Restoration Areas will be maintained as wetland buffers.

Upland communities will be established in the portions of the Restoration Areas that were delineated as upland by Golder Associates (2003a). These uplands will also serve as buffers for the wetlands to be restored within the Restoration Areas. Excluding the gravel path, upland areas comprise 4.28 acres within the Restoration Areas. Uplands comprise 2.74 acres of the 2.94 acres in the East Restoration Area and 1.6 acres of the 6.33 acres in the West Restoration Area. The upland areas are mainly concentrated along the northern edge of these sites. The gravel path will cover 0.12 acres of the West Restoration Area. Upland communities will be established in the approximate locations of the areas that are currently upland. These areas will serve as buffers for the restored wetlands.

The eastern portion of Lay-Down Area 4 not included in the East Restoration Area will be reforested to serve as visual buffer for the plant site and provide a ecological connectivity between the East Restoration Area and the forested areas east of the project site.

4.4.6 Land Use

The uses of the Restoration Areas and the Cogeneration Project area will remain as planned for an indefinite length of time. The areas within BP Cherry Point property south of Grandview Road are zoned as 'heavy impact industrial'. However, current and expected future land uses in the area near the Restoration Areas are not likely to inhibit restoration of the Restoration Areas or degrade their functional performance over time. Air quality modeling indicates that emissions from the cogeneration facility will not significantly affect current ambient air quality in the area (Golder Associates 2003d). Water sources for the Restoration Areas will primarily be ditches re-routed so that they convey runoff from undeveloped areas on the BP Cherry Point property. The undeveloped land at BP Cherry Point includes hybrid poplar forest plantations, natural forest stands, abandoned pastures, and grasslands regularly maintained by mowing. Runoff from the Cogeneration Facility and associated lay-down areas will be directed away from the Restoration Areas.

Although land use in the vicinity of the project may change over time, no development that may occur here will likely degrade the Restoration Areas. Portions of forested plantations may be logged in the future to serve their intended purpose, but will likely be replanted. The portions of the plantations and natural forest stands that are not within the proposed construction areas and are within 200 feet south of Grandview Road will remain standing. These forested areas will serve as buffers between Grandview Road and the proposed facilities. Expansion of refinery or cogeneration operations may include erecting structures or lay-down areas in the fields located south of the proposed plant site. In addition, new utility lines may be added or existing utility lines maintained in the area between the plant site and Lay-Down Areas 1, 2, and 3 where Wetland H is located (Figure 2). However, no permanent structures that are not associated with the proposed project are likely to be erected within 100 feet of the wetlands within either Restoration Area. In addition, air quality modeling indicates that emissions from the cogeneration facility will not significantly affect current ambient air quality in the area (Golder Associates 2003d).

Current and future land uses outside the BP Cherry Point property are not likely to inhibit the proposed restoration or degrade functional performance of the restored wetlands over time. The nearest property to

the Restoration Areas that is not owned by BP is located approximately 0.25 miles east of the East Restoration Area. Although it currently conveys light to moderate traffic, the portion of Grandview Road east of the intersection with Blaine Road (also known as State Route 548) is not likely to be expanded at any time (Lee pers. comm. 2003).

4.5 CONSTRAINTS

There are no known constraints outside the owner's control that might affect the Restoration Areas.

4.6 SITE PLAN

The temporarily impacted lay-down areas will be manipulated to create conditions that promote the establishment of native trees and shrubs. A variety of native wetland plant communities will be established in the approximate locations of existing wetland areas, and upland forest communities will be established in the approximate locations of areas that are currently upland.

4.6.1 Topography

Surface elevations that will foster upland conditions will be re-established in the approximate locations where uplands are currently found. Upland areas will be slightly elevated above wetlands and thus may be seasonally saturated below 12 inches beneath the soil surface. Wetlands will occur in the approximate locations where they are currently found, but their surface elevations will vary to include seasonally inundated areas as well as seasonally saturated areas. Site contours will be graded to allow a variety of hydrologic regimes within wetland areas that span from seasonally saturated 1 foot beneath the soil surface to seasonally inundated up to 1.5 feet above the soil surface. The proposed post-restoration contours for the Restoration Areas are shown in Figure 3.

Small mounds or 'hummocks' will be created throughout large portions of the Restoration Areas. Hummocks will be created by contouring imported topsoil that will be removed for power plant and lay-down area construction. Hummocks will have a slightly deeper effective rooting zone and will thus provide more moisture, nutrients, and rooting medium to vegetation per area of ground. Creating these hummocks will augment overall topographic variability on the site and facilitate the establishment of native trees and shrubs, which typically require deeper root penetration than herbaceous plants. The mounds will create a wider array of micro-environmental conditions that may provide greater opportunities for an increased diversity of plants and other organisms to utilize the site. Hummocks will not serve as berms for the seasonally inundated areas since berms typically require compaction, which is not conducive to plant growth.

Hummocks will be curving and oblong in shape have an average diameter of about 24 feet. The typical height above the surrounding elevation will be 1 foot, and no hummock will rise more than 1.5 feet in elevation. The hummocks will be spaced at approximately 60 feet on center (approximately 12 hummocks per acre). Hummocks will cover approximately 12.5% of the areas in which they are created.

Recontouring will occur by trackhoe and bulldozer during the dry season when soil moisture is at a seasonal low. Native vegetation will be installed during the following wet season.

4.6.2 Hydrologic Modifications

The Restoration Areas will be recontoured to create small seasonally inundated areas that will be vegetated with emergent herbaceous plants. As discussed in Section 4.6.2, surface water will be supplied to these seasonally inundated areas by diverting stormwater runoff from ditches that will be located adjacent to the Restoration Areas. See Appendix A for the upgraded version of Figure 1B of the *BP Cherry Point Cogeneration Project Surface Water Management Design Basis* (Golder Associates 2002) in Appendix A for the location of these ditches.

To ensure that appropriate flow levels will be diverted to the Restoration Areas, water levels will be controlled by adjustable weirs or similar devices. With these adjustable features, minor changes in channel flow may be made during the first 1 to 2 years after installation. If necessary, further adjustments with these features may be made as site conditions change.

The surface water diversion to the West Restoration Area will be directed through a 2-foot wide, meandering open channel excavated in the wetland portion of the West Restoration Area. The channel will direct water westward through the site and feed the two seasonally inundated areas to be created. The total size of the seasonally inundated area within the West Restoration Area will be at least 1.3 acre as measured by the ordinary high water mark. Maximum flow velocity through the channel will be less than 0.25 foot per second.

A 2-foot wide, open channel will also serve to convey surface water to and from the seasonally inundated area to be created in the East Restoration Area. Surface water will enter through a created channel to the seasonally inundated area when the water level is below the elevation of the weir to be installed at the diversion. When the water level exceeds the elevation of the weir, the seasonally inundated area will no longer accept water from the ditch, which will continue to support flow. This 'off-line' design minimizes intra-seasonal water level fluctuation within the seasonally inundated area and prevents flooding. The total size of this seasonally inundated area will be at least 0.06 acre as measured by the ordinary high water mark. Maximum flow velocity through the channel will be less than 0.25 foot per second.

4.6.3 Soil

As discussed earlier, native topsoil will be re-applied to the Restoration Areas after removing compacted gravel from the temporary lay-down areas. As discussed in Section 2.3, these soils are primarily loam and silt and extend 20 to 30 inches bgs before meeting the relatively impervious clay till layer. All soil placed in the Restoration Areas will be native, non-sandy soils taken from above the clay till layer.

The soil may be covered with mulch, erosion-control matting, and/or sterile annual grass seed to prevent soil erosion and sedimentation. These areas will then be replanted with native vegetation as soon as practicable. Tree and shrub planting will occur after site preparation work is complete. The planting, seeding, and mulch ring installment to occur on site are described further in Section 4.6.5.

A 5-foot wide walking path will be constructed across the West Restoration Area. The path will be comprised of gravel or wood chips and will traverse 0.06 acre of upland and 0.06 acre of wetland. The gravel path will be designed and constructed so that it will not be a barrier to surface or subsurface water flow.

4.6.4 Habitat Features

A number of habitat features will be distributed across the Restoration Areas. The habitat features planned for the site will provide structure to encourage habitat utilization by native wildlife species.

After recontouring is complete, at least 28 downed logs (3 per acre) will be placed across the Restoration Areas. Most of these logs will be derived from the hybrid poplars and Douglas firs that will be removed from the proposed construction areas. Most of these trees are 25 to 35 feet tall and have a diameter at breast height (dbh) that is 7 to 10 inches. Hybrid poplar logs will be left to dry for a few months before being placed in the mitigation areas to ensure that they do not sprout. A few other logs will be taken from the mixed deciduous/coniferous forest area on the BP Cherry Point property south of Grandview Road where an access road was recently constructed. These logs range in length from 35 to 90 feet and in diameter from 10 to 24 inches. The larger logs may have to cut into two or three pieces before transporting them to the mitigation areas.

Some logs will be stacked atop each other in a pyramidal shape (2 logs on bottom, 1 on top) to simulate woody debris of larger size. Other logs will be placed so that they extend into the seasonally inundated areas. The logs will act as habitat features, providing foraging opportunities and cover for insects, amphibians, small mammals, and birds (Stevens and Vanbianchi 1993).

A number of artificial snags, or dead-standing trees, will be erected on site. The logs to be used as artificial snags will be derived from the same source of woody material for the downed logs. Each snag will be at least 20 feet tall and at least one snag per Restoration Area will have a dbh greater than 12 inches. The base of each snag will be installed at least 4 feet bgs and stabilized with cement. A 10-foot long cross-beam may be attached to each snag to provide perches for red-tail hawks and other birds. The hawks and other predatory birds will prey on mice and voles, which might otherwise jeopardize the installed plants by gnawing and girdling.

At least two wildlife brush shelters will be constructed in each Restoration Area. These shelters will be placed away from areas that will be seasonally inundated. The base of each shelter will be composed of large, preferably rot-resistant boughs or logs that are 10 to 15 feet long and 4 to 6 inches in diameter. These pieces will be stacked criss-cross with parallel logs spaced approximately 2 feet from each other until the structure is 1 to 2 feet high. Branches of a gradually smaller diameter will be placed between and above the base logs in tee-pee style to form a more compact weave. Coniferous evergreen branches with needles still attached should be added to each pile to enhance shelter cover. The end product will be a sturdy, dome-like structure 4 to 6 feet high that has adequate space for small mammals to move about. Wildlife brush shelters provide heavy cover close to the ground, which can attract a variety of wildlife including rabbits, mice, voles, small birds, and amphibians (Monroe 2001; Connecticut Wildlife Division 1999).

In addition, plants like rushes and sedges will be placed in the shallow areas of each area expected to be seasonally inundated to provide ovideposition sites for native amphibians. These could be supplemented with branches or twigs with less than 8 mm (0.3 inch) diameter (Richter 1999) installed deep in pond substrate to prevent them from being dislodged by the rise and fall of water levels. The ovideposition sites provided by the branches will supplement those sites provided by the emergent vegetation that will become established in shallowly inundated areas.

4.6.5 Vegetation Establishment

The distribution of plant communities to be established in the Restoration Areas is shown in Figure 3. Plant schedules for these areas are shown in Tables 5 through 8. These schedules apply to the upland and wetland areas that will be restored. The schedules show the spacing, quantity, and condition of species to be installed in each community type. Included in these tables is the wetland indicator status (explained in the *Revised Cogeneration Project Compensatory Mitigation Areas Wetland Delineation Report* <URS 2003a>) for each plant species according to US Fish and Wildlife Service (1996).

The species chosen for each planting zone are deemed appropriate for the environmental conditions expected in the areas where they occur. The species composition, density (spacing), and other specifications of plant materials indicated in the plant schedules are based on findings from field investigations, best professional judgment, and recommendations from various resources.

Table 5 is the plant schedule for the Upland Forest communities, Table 6 is the plant schedule for the seasonally saturated (SS) wetland communities, and Table 7 is the plant schedule for the seasonally saturated (SI) wetland communities. Table 8 presents the specifications for the native seed mix that will be applied to all communities within the Restoration Areas.

**Table 5
Planting Plan for Upland Communities**

Scientific Name	Common Name/Wetland indicator status	Spacing	Condition & Size
<i>Alnus rubra</i>	Red alder/FAC	Intersperse the various tree species so that overall spacing on center = 12 ft	bare-root, 1.5'-3'
<i>Betula papyrifera</i>	Paper birch/FAC		bare-root, 1.5'-3'
<i>Prunus emarginata</i>	Bitter cherry/FACU		bare-root, 12-18"
<i>Pseudotsuga menziesii</i>	Douglas fir/FACU		bare-root, 1.5'-3'
<i>Salix scouleriana</i>	Scouler willow/FAC		rooted cutting, 1.5'-3'
<i>Thuja plicata</i>	Western red cedar/FAC		bare-root, 1.5'-3'
<i>Tsuga heterophylla</i>	Western hemlock/FACU-		bare-root, 1.5'-3'
<i>Crataegus douglasii</i>	Douglas hawthorn/FAC		bare-root, 1.5'-3'
<i>Holodiscus discolor</i>	Oceanspray/NI	Intersperse the various shrub species so that overall spacing on center = 8 ft	bare-root, 1.5'-3'
<i>Oemleria cerasiformis</i>	Indian plum/FACU		bare-root, 1.5'-3'
<i>Rosa nutkana</i>	Nootka rose/FAC-		bare-root, 1.5'-3'
<i>Sambucus racemosa</i>	Red elderberry/FACU		bare-root, 1.5'-3'
<i>Symphoricarpos albus</i>	Common snowberry/FACU		bare-root, 1.5'-3'

Table 6
Planting Plan for Seasonally Saturated (SS) Wetland Communities

Scientific Name	Common Name/Wetland indicator status	Spacing	Condition & Size	
<i>Alnus rubra</i>	Red alder/FAC	Intersperse the various tree species so that overall spacing on center = 9 ft	bare-root, 1.5'-3'	
<i>Betula papyrifera</i>	Paper birch/FAC		bare-root, 1.5'-3'	
<i>Picea sitchensis</i>	Sitka spruce/FAC		bare-root, 1.5'-3'	
<i>Populus balsamifera</i> ssp. <i>trichocarpa</i>	Black cottonwood/FAC		bare-root, 1.5'-3'	
<i>Salix lucida</i> var. <i>lasiandra</i>	Pacific willow/FACW+		rooted cutting, 1.5'-3'	
<i>Salix scouleriana</i>	Scouler willow/FAC		rooted cutting, 1.5'-3'	
<i>Thuja plicata</i>	Western red cedar/FAC		bare-root, 1.5'-3'	
<i>Cornus sericea</i>	Red-osier dogwood/FACW		bare-root, 1.5'-3'	
<i>Crataegus douglasii</i>	Douglas hawthorn/FAC	Intersperse the various shrub species so that overall spacing on center = 6.5 ft	bare-root, 1.5'-3'	
<i>Malus fusca</i>	Western crabapple/FACW		bare-root, 1.5'-3'	
<i>Physocarpus capitatus</i>	Pacific ninebark/FACW-		bare-root, 1.5'-3'	
<i>Rosa nutkana</i>	Nootka rose/FAC-		bare-root, 1.5'-3'	
<i>Rosa pisocarpa</i>	Clustered wild rose/FAC		bare-root, 1.5'-3'	
<i>Rubus spectabilis</i>	Salmonberry/FAC+		bare-root, 1.5'-3'	
<i>Salix piperi</i>	Piper's willow/FACW		rooted cutting, 1.5'-3'	
<i>Salix sitchensis</i>	Sitka willow/FACW		rooted cutting, 1.5'-3'	
<i>Camassia quamash</i>	Common camas/FACW		Install patches of herbaceous species where overall spacing on center = 1.5 ft over 1% of SS	plugs
<i>Carex obnupta</i>	Slough sedge/OBL			plugs
<i>Deschampsia caespitosa</i>	Tufted hairgrass/FACW	plugs		
<i>Eleocharis palustris</i>	Creeping spike-rush/OBL	plugs		
<i>Juncus ensifolius</i>	Daggerleaf rush/FACW	plugs		

Table 7
Planting Plan for Seasonally Inundated (SI) Wetland Communities

Scientific Name	Common Name/Wetland indicator status	Spacing	Condition & Size
<i>Fraxinus latifolia</i>	Oregon ash/FACW	Intersperse the various tree species so that overall spacing on center = 14.5 ft	bare-root, 1.5'-3'
<i>Salix lucida</i> var. <i>lasiandra</i>	Pacific willow/FACW+		rooted cutting, 1.5'-3'
<i>Populus balsamifera</i> ssp. <i>trichocarpa</i>	Black cottonwood/FAC		bare-root, 1.5'-3'
<i>Populus tremuloides</i>	Quaking aspen/FAC+	Create small groves with 4.5 ft. on center over 2% of SI	bare-root, 1.5'-3'
<i>Cornus sericea</i>	Red-osier dogwood/FACW	Intersperse the various shrub species so that overall spacing on center = 6.5 ft	bare-root, 1.5'-3'
<i>Lonicera involucrata</i>	Black twinberry/FAC+		bare-root, 1.5'-3'
<i>Physocarpus capitatus</i>	Pacific ninebark/FACW-		bare-root, 1.5'-3'
<i>Rosa pisocarpa</i>	Clustered wild rose/FAC		bare-root, 1.5'-3'
<i>Salix piperi</i>	Piper's willow/FACW		bare-root, 1.5'-3'
<i>Salix sitchensis</i>	Sitka willow/FACW		bare-root, 1.5'-3'
<i>Carex stipata</i>	Sawbeak sedge/OBL	Install patches of herbaceous species where overall spacing on center = 1.5 ft over 1% of SS	plugs
<i>Carex utriculata</i>	Beaked sedge/OBL		plugs
<i>Carex obnupta</i>	Slough sedge/OBL		plugs
<i>Eleocharis palustris</i>	Creeping spike-rush/OBL		plugs
<i>Juncus bolanderi</i>	Bolander's rush/OBL		plugs
<i>Scirpus americanus</i>	American bulrush/OBL		plugs
<i>Scirpus microcarpus</i>	Small-fruited bulrush/OBL		plugs
<i>Typha latifolia</i>	Common cattail/OBL		plugs

Table 8
Native Seed Mix

Scientific Name	Common Name/Wetland Indicator Status	Estimated Quantity (% by weight)
<i>Agrostis stolonifera</i>	Creeping bentgrass/FACW	35%
<i>Alopecurus aequalis</i>	Short-awn foxtail/OBL	2.5%
<i>Alopecurus geniculatus</i>	Water foxtail/OBL	17.5%
<i>Danthonia intermedia</i>	Timber oatgrass/FACU+	2.5%
<i>Festuca rubra</i>	Red fescue/FAC	40%
<i>Hordeum brachyantherum</i>	Meadow barley/FACW-	2.5%

For Tables 5, 6, and 7, the average spacing is given for trees, shrubs, and herbaceous plants to be installed in each community. To improve habitat heterogeneity, planting densities will not be uniform throughout each zone. Instead, the zones will contain patches with a relatively high density, patches with moderate density, and patches with a relatively low density. The variety in density will allow planting in areas most suitable for their establishment and growth. The locations of the patches will be determined in the field.

Overall spacing for the Upland community is at a lower density than the SS or SI community types since there is far less reed canarygrass found in upland areas. Planting densities are set higher in the SS and SI communities to help suppress cover by reed canarygrass by increased competition and shading. Although their overall densities will be equal, the SI communities will have a higher ratio of shrubs to trees than the SS communities since native shrubs are better able to greater levels of hydrologic fluctuation.

No trees or shrubs will be planted in a few patches within the Upland and SI communities. In the Upland communities, these patches will be constricted to areas that have less than 20% reed canarygrass prior to initial mitigation activity. In the SI communities, these communities will be restricted to areas that are expected to have long periods of shallow (<1.5-foot) inundation.

Upland communities will be established in the portions of the Restoration Areas that were delineated as upland by Golder Associates (2003a). These communities may be saturated near or at the soil surface for a few months during the wet season. The overall tree and shrub spacing for the Upland communities will be approximately 985 plants per acre, which requires an overall spacing of 6.65 feet on-center.

SS communities will be established in wetland areas that will be seasonally saturated, but typically retain no saturation near the soil surface during the dry season. Some of these areas may retain shallow inundation for 1 to 3 months during the wet season. The overall tree and shrub density for the SS communities will be approximately 1,565 plants per acre, which requires an overall spacing of 5.3 feet on-center.

SI communities will be established in wetland areas that are seasonally inundated, but retain low levels of soil moisture during the latter half of the dry season. These areas will typically retain shallow inundation for greater than 3 months during the wet season and will likely remain saturated for a longer periods than the SS communities during the early part of the growing season. The overall tree and shrub density for the SI communities will be approximately 1,430 plants per acre, which requires an overall spacing of 5.5 feet on-center.

Herbaceous plants will be installed in various patches covering approximately 1% of the SS communities and 1% of the SI communities. The planting density for these patches will be approximately 1.5 feet on-center, which is roughly equal to 9,670 plants per acre.

Planting will be accomplished using a multi-phase approach. The initial phase will occur during the fall and/or spring before the Year 1 monitoring event. At this time, 50% of the woody (tree and shrub) and herbaceous plants will be installed. The remaining plants will be installed over the subsequent 3 to 4 years. If necessary, additional applications of the native seed mix may occur over the subsequent 3 to 4 years as well. This multi-phase approach allows more accurate assessment of on-site growing conditions, which is especially important in areas that will be seasonally inundated and/or where herbaceous vegetation will be planted.

The species in the seed mix are native grasses tolerant of a broad range of hydrologic regimes. The seed mix will be applied to the Restoration Areas in two phases. The first phase will occur in late summer or early fall a few weeks prior to installing any trees or shrubs. The second phase will occur the following spring after the first phase of tree and shrub planting is complete. At this time, the mix will only be applied to the interstitial space between mulch rings. Since interstitial spaces should comprise approximately 85% of the total area, the actual area upon which this seed mix will be applied is 7.9 acres. The total cumulative seeding rate will be 40 pounds per acre, which is a relatively high seeding rate for mitigation areas.

Nurseries specializing in wetland restoration will provide the plant stock. Trees and shrubs will be derived from local sources so that they are best adapted to the on-site conditions. All cuttings will be obtained from 1- to 2-year old wood, will be >3/8-inch in diameter, and will be >3 feet long. The quality and quantity of plants will also be verified by a URS biologist.

An installment contractor with experience in wetland rehabilitation will be responsible for plantings and seedings. Locations of each plant community zone will be staked in the field, and placement of plants will be verified by a URS biologist. All plants will be installed, and all seeds will be spread in spring or fall to enhance their chances of establishment and survival.

Each installed planting will receive a ring of imported mulch that will be at least 4 feet in diameter and 3 to 4 inches thick. However, mulch should be kept at least 1 inch away from the base of each plant to prevent pathogen and pest infestation. The mulch will be wood and bark-based with very few weed seeds. Mulch rings will help to suppress invasion by non-native plants, retain soil moisture, and contribute organic matter to the soil over time.

A minimum of water-soluble, slow-release, cold-weather tolerant fertilizer pellets will be applied to the soil pit where each tree and shrub is installed. Fertilizer pellets will be placed 3 to 4 inches below the ground surface adjacent to installed plant roots. In addition, a powder form of fertilizer will be applied to the ground surface at the base of each planting. This fertilizer will be a moderate- to rapid-release fertilizer to promote establishment and growth. Care will be taken to place the powder form of fertilizer only on the exposed soil at the base of the plant and not on the mulch where the high carbon:nitrogen ratio could cause much of the fertilizer to be rapidly depleted by micro-organisms.

Except for some cuttings, all installed plants will be protected from foraging mammals by plastic seedling protection tubes. In addition, plastic mesh exclusions may be constructed over patches of herbaceous plants to protect them from predation by geese, ducks, or mammals. These protections may be very important in preventing widespread mortality of newly installed plants.

4.6.6 Irrigation

An irrigation system will be constructed within the Restoration Areas after recontouring is complete. Water for irrigation will be derived from tapped water sources at the BP Cherry Point property. Irrigation will supply water during the latter half of the growing season to counter seasonal drought. Irrigation will likely enhance survivability of installed trees and shrubs, but may also encourage the growth of non-native, invasive plants such as reed canarygrass.

Irrigation water will be distributed by large ‘guns’ that have a spray diameter of 110 feet. The irrigation guns will be placed upon carts that travel automatically at slow, consistent speeds to ensure even distribution. Temporary paths less than 10-feet wide and spaced 200 feet apart will be made for the carts to travel across the Restoration Areas. Irrigation will continue through the second and possibly third growing seasons after planting is initiated. Irrigation equipment will be continually monitored and maintained by trained personnel. URS will be informed of irrigation equipment performance and will advise adjustments to the irrigation system as necessary.

The system will supplement rainfall to ensure that installed plants are provided with 0.5 inch of water per week from June or July through October, the driest portion of the year. Rainfall rates will be monitored on a weekly basis by checking data gathered by the weather station on the BP Cherry Point property.

5.0 PROPOSED COMPENSATORY MITIGATION

The proposed plan is designed to appropriately compensate for losses in wetland functional performance expected from the proposed construction. To compensate for the unavoidable and permanent removal of 30.51 acres of wetland, BP proposes to rehabilitate approximately 110.1 acres of wetland and wetland buffer degraded by historic agricultural practices.

5.1 SITE DESCRIPTION

The Compensatory Mitigation Areas (CMAs) are located on the BP Cherry Point property north of Grandview Road, just north of the site of the proposed Cogeneration Project (Figure 1). CMA1 is located east of Blaine Road, north of the proposed power plant site. It is situated in the southwest quarter of Section 5 of Township 39N, Range 1E. CMA1 is 50.3 acres in size. CMA2 is located west of Blaine Road in the southeast quarter of Section 6 of Township 39N, Range 1E. CMA2 is 59.8 acres in size. The geographic extent, location, and general character of the wetlands within CMA1 and CMA2 are described in the *Revised Compensatory Mitigation Areas Wetland Delineation Report* (URS 2003a). This report shows results of investigations that have occurred from 2001 to 2002.

The borders of each CMA are 25 feet from the outer edge of the ROW for Blaine Road and 50 feet from the northern edge of the ROW for Grandview Road. The ROW for Blaine Road extends 30 feet to the east and

30 feet to the west of the road’s centerline. The ROW for Grandview Road extends 65 feet north and 20 to 25 feet south of the road’s centerline. The ROWs contain telephone lines, power lines, and ditches. The areas between the ROWs and the CMAs are considered setback areas and will be reserved for possible utility installment.

5.2 OWNERSHIP

The CMAs are within the BP Cherry Point property, which is owned by BP.

5.3 RATIONALE FOR CHOICE

5.3.1 Mitigation Ratio

This plan proposes to enhance the CMAs to compensate for total wetland impacts at a ratio greater than 3:1 (see Table 9). Permanent impact to the PFO hybrid cottonwood plantation wetland will be compensated at a 4.5:1 ratio. Since this impact will consist of 1.69 acres of wetland, 7.61 acres will be enhanced as compensation. As requested by the Corps, the 4.86 acres of temporal impact from construction of the lay-down areas to be restored will be compensated at a 1:1 ratio. Enhancing 28.43 acres of wetland buffer (upland) will compensate for 3.55 acres of permanent wetland impact. The remaining 69.21 acres of degraded wetlands to be enhanced in the CMAs will compensate the remaining 24.99 acres of proposed wetland impact.

Although at least 1.2 acres of upland are expected to become wetland as a result of the proposed compensatory mitigation, wetland conversion will likely occur in small patches, the exact locations of which are difficult to predict. These factors would make monitoring to prove wetland conversion problematic. Therefore, BP has not claimed any credit for the wetland creation expected in CMA2.

**Table 9
Summary of Compensatory Mitigation Acres, Ratios, and Credits**

Type of Compensatory Mitigation	Size of Proposed Compensatory Mitigation Areas (acres)	Proposed Mitigation Ratio	Mitigation Credit (acres)¹
Enhancement of existing degraded wetlands to compensate for temporary impacts to PEM wetlands	4.86	1:1	4.86
Enhancement of existing degraded wetlands to compensate for impacts to PFO wetland	7.61	4.5:1	1.69
Enhancement of wetland buffer areas (uplands)	28.43	8:1	3.55
Enhancement of existing degraded wetlands to compensate for permanent impacts to PEM wetlands	69.21	2.8:1	24.99
Total area	110.11	3.1:1	35.37

¹ Mitigation credit determined by dividing the acreage of each mitigation type by the proposed mitigation ratio.

The Corps normally recommends compensating for permanent wetland impacts at a minimum of 3:1 ratio for wetland enhancement. For temporary wetland impacts, the Corps recommends using a 1:1 ratio for wetland enhancement. Ecology guidance emphasizes that “the goal is always to replace the lost functions at a 1:1 ratio” (Ecology 1998). Ecology has established general mitigation ratios because it is usually necessary to increase the replacement acreage in order to accomplish the goal of replacing lost function. According to Ecology’s ratios, impacts to Category II and Category III PEM wetlands can be compensated at a 4:1 ratio for enhancement whereas impacts to Category II and Category III PFO wetlands can be compensated at a 6:1 ratio for enhancement.

The proposed downward adjustment of Ecology’s general mitigation ratios is appropriate in this situation for several reasons:

- The wetland areas to be eliminated have already been greatly disturbed by historical agricultural practices. The wetlands within the construction zones are rated as Category III wetlands under the Washington State Wetlands Rating System (Ecology 1993) and are providing only minimal performance of wetland functions. The loss of such wetlands will constitute only minimal environmental impact. Accordingly, their functional performance can be more than fully replaced with lower ratios than those outlined in Ecology’s guidance.
- The wetland areas to be enhanced have also been greatly disturbed by historical agricultural practices though they are classified as Category II wetlands. These areas have high potential for improvement via rehabilitation. The proposed compensatory mitigation will significantly improve overall wetland functional performance on site and convert low quality Category II wetlands into a high quality Category II wetlands within 25 years. The completed wetland ratings data forms for the CMAs under conditions predicted for 25 years following initial mitigation activity are presented in Appendix C.
- URS has the extensive experience and technical knowledge of the BP Cherry Point property necessary to achieve successful wetland enhancement as proposed by this plan. URS designed and is currently monitoring enhancement of a 4.58-acre wetland area on the BP Cherry Point property that was initiated in fall 2000. This area was abandoned agricultural land strongly dominated by reed canarygrass. By reducing reed canarygrass cover, creating a shallow, seasonally inundated area, and establishing native plant communities, the goal of improving ecological integrity and overall functional performance is well on the way to being accomplished. This project is considered as a pilot project for the proposed compensatory mitigation. A copy of the *Year 2 Monitoring Report for Wetland Compensatory Mitigation, 4.58 acres BP Cherry Point Refinery* (URS 2002) is in Appendix D. An addendum displaying the additional photographs depicting site progress has been added to the monitoring report.

As recommended by the Federal Committee on Characterization of Wetlands for wetland enhancement and restoration projects, the proposed enhancement and restoration will improve wetland functional performance and benefit the functional performance of the surrounding landscape (Lewis, Jr. et al. 1995). Non-native, invasive plants (reed canarygrass, Himalayan blackberry, and evergreen blackberry) will be removed as much as possible. Stormwater runoff from the cogeneration facility’s detention pond will be directed to a portion of one of the CMAs to improve water quality and restore historic drainage patterns. Stormwater from the detention pond to serve Lay-Down Areas 1, 2, and 3 will be directed to existing ponds and wetlands located west of the CMAs, also contributing to the restoration of historic drainage patterns. A

mosaic of wetland habitats with diverse species composition and structure will be established in the CMAs. Habitat features such as downed logs and wildlife brush shelters will be placed in various locations to provide additional cover and forage for wildlife.

5.3.2 Site Selection

Off-Site Areas

A survey of the Terrell Creek basin was conducted to search for off-site properties that may be suitable for use in compensatory mitigation. Five vacant land properties equal to or greater than 20 acres in size and situated within the Terrell Creek watershed were for sale in 2002 (Figure 4). None of these properties were deemed to have high potential to compensate for the proposed wetland impacts. A combination of two or more of these properties used for compensatory mitigation would not satisfactorily compensate the proposed impacts either. Even in combination, the total area in these off-site parcels that could be used for compensatory mitigation is much lower than the total area to be used in the CMAs. Moreover, the logistics required for rehabilitating and maintaining one or more off-site mitigation areas would be problematic. A brief description of these five properties and their potential to provide area for compensatory mitigation is provided below:

1. The property closest to the project site is located on Brown Road, less than 0.5 mile east of the refinery. This parcel is 39.1 acres in size and is being sold by Re/Max Inc., Whatcom County. This property supports mature, second-growth forest over the western half and regularly maintained meadow (abandoned pasture) over the eastern half. The National Wetland Inventory (NWI) shows wetlands extending across the entire property. Approximately one-half the property contains a PFOA wetland community and the remaining half contains PEMA and PEMC wetland communities. A wetland delineation conducted in 1992 (Pegasus Earth Sensing Corporation 1992) found that most of the site consists of upland. However, the study found 11 wetlands totaling 9.3 acres in cumulative size. Wetlands were found in both the forest and the meadow. Since the property is far from a reliable source of water, creating wetlands on site would likely be difficult without a large amount of grading. The property is reportedly situated on a drainage divide and so only part of the property lies within the Terrell Creek basin. Thus, the potential for this property to be used as compensatory mitigation is low to moderate.
2. Another vacant-land property located within the Terrell Creek basin is located just south of Aldergrove Road, a few hundred feet west of North Star Road. This parcel is 21.5 acres in size and is currently for sale. Wetlands appear to be present on site. The NWI map shows this property to contain approximately 7.5 acres of PEMA wetlands. Review of aerial photographs and roadside observations indicated that a large portion of the site is meadow that is likely mowed for hay. The maintained meadow is over 15 acres in size and may extend across much of the PEMA wetland as indicated by the NWI map. Mature deciduous, broad-leaved forest extends east from the source of Terrell Creek across much of the property. A substantial portion of the on-site forest appears to be wetland. This portion of wetland is likely performing wetland functions at a relatively high level and could not be greatly improved. The property appears to have moderate potential for wetland enhancement and/or creation in the meadow areas.

3. This vacant-land property is located north of Grandview Road and east of Kickerville Road. The property is 20 acres in size and lies just north of Terrell Creek. The property is situated at the end of a gravel road and is relatively secluded. According to the NWI map, no wetlands occur in or near this property. Deciduous, broad-leaved forest covers much of the site. A utility corridor that is over 100 feet wide runs across the middle of the property. Trees and shrubs within the corridor appear to have been cleared and meadow vegetation that replaced the trees and shrubs appear to be well maintained. The northern portion of the site appears to be open forest with abundant brush and some gravel roads. A tributary of Terrell Creek runs through mature forest located along the southern edge of the property. The tributary joins Terrell Creek approximately 200 feet west of the property boundary. This parcel is almost entirely surrounded by forest and maintained meadows. The potential to enhance or create wetlands in this property appears low.
4. The fourth vacant-land property for sale that is located within the Terrell Creek basin is located on the corner of Blaine Road and Arnie Road. The NWI map shows that wetlands cover well over one-half the property. PEMA/PSSA wetland communities are shown to be located in the northern and southeastern portions of the site. A PFOA community is situated in the northeastern part of the parcel. This property is partially cleared, but contains mature deciduous, broad-leaved forest across much of the southern portion of the site and in the PFOA wetland community in the northeastern portion of the site. Overgrown meadow exists in the northwestern and central portions of the site. A few trees and shrubs are scattered across the meadow areas. The site has fairly level topography with no water features. This 40-acre property lies just east of a residential development. Properties to the north east, and south remain undeveloped or are under agricultural production. The potential to enhance or create wetlands in this property appears moderate.
5. This 21-acre property is located off of Holiday Road, just south of Birch Bay – Lynden Road. The NWI map shows that a PEMC wetland community covers approximately one half the property. This wetland area extends across much of the northern and eastern portions of the parcel where very few trees and shrubs are present. Large areas in the western and southern parts of the property support shrub-dominated habitats and semi-mature to mature deciduous, broad-leaved forest. The site has fairly level topography with no water features. The parcel is situated very just east and south of moderate density commercial and residential development. Properties to the south and east remain undeveloped or are under agricultural production. The potential to enhance or create wetlands in this property appears moderate.

On-Site Areas

In 2001, URS assessed over 1,000 acres (>400 hectares) of mostly agricultural land north of Grandview Road on the BP Cherry Point property for its potential to be used as compensatory mitigation (URS 2001; see Appendix E). An on-site investigation and remote resource information analysis were conducted to determine the presence, extent, and character of wetlands and uplands in the survey area. Vegetation communities were mapped and characterized according to dominant and subdominant plant species. Wetland plant communities were classified according to the *Classification of Wetlands and Deepwater Habitats of the United States* (Cowardin et al. 1979). Surface soil layers and hydrologic regimes of each community type were described. Performance of wetland functions was assessed using the *Method for Assessing Wetland Functions* (Ecology 1999) as a guide.

The two main factors assessed to evaluate mitigation potential were environmental conditions and wetland functional performance. Other factors considered in assessing mitigation potential include site access and potential for re-establishing ecological connectivity.

Most portions of the mitigation potential survey area were considered to have at least moderate mitigation potential. The potential for restoring wetlands appeared low since virtually no areas that were historically drained for agriculture currently lack wetland hydrologic regime. The potential for creating wetlands also appeared low since few upland areas that lack valuable habitat such as mature forest occur on site. In contrast, the potential for enhancing wetlands on site was considered fairly high since degraded wetlands with moderately good conditions for growing native plants are widespread. A few sites considered to have especially high potential for enhancement were identified.

The CMAs were among the sites considered to have very high potential for enhancement for a number of reasons. In brief these reasons include good growing conditions, high potential to enhance ecological connectivity to intact natural communities located nearby, good accessibility, and high likelihood that environmental quality in the area will not degrade substantially over time. These reasons are discussed in more detail in the next section.

5.3.3 Compensatory Mitigation Potential of the CMAs

The large meadow areas encompassing the CMAs are readily accessible to laborers and heavy machinery from adjacent roads. Laborers and heavy machinery will need to access the site during site preparation, planting, and maintenance operations. The ditches separating the roads from the sites can be temporarily bridged to permit all-terrain vehicles (ATVs) carrying mulch and plants to cross them.

The open meadows within CMA2 will facilitate construction of a culvert and inlet channel necessary to direct stormwater runoff to this area from the detention pond proposed for the plant site. Directing stormwater runoff to this area will restore historic drainage patterns and provide additional hydrologic storage and water quality treatment. The broad slope within the site will allow flow to be dispersed across a wide area, improving hydrologic storage and performance of hydrologic functions. Most portions of the ditches within the CMAs could be filled to reduce the sites' overall drainage rates, thereby increasing hydrologic storage. The forest and shrub habitats that will develop in the CMAs will further improve hydrologic storage through increased evapotranspiration and interception of precipitation.

Both CMAs and the meadow areas adjacent are considered to have high potential for establishing a wetland complex including forest and shrub-dominated habitats (URS 2000a). Soils and hydrologic conditions present on site appear capable of supporting moderate to rapid growth of trees and shrubs, thus facilitating the re-establishment of forest and scrub-shrub habitat. Additionally, establishing forested and scrub-shrub habitat may encourage natural colonization by native trees and shrubs in meadow areas adjacent to the CMAs.

Growing conditions at the CMAs are adequate for establishing a variety of native plant communities despite some inherent problems. Although most of the soils are saturated or inundated long enough to become deoxygenated in the upper soil horizon during the early part of the growing season, virtually all areas become fairly dry and the soils well oxygenated as the season progresses. The runoff introduced to CMA2

will considerably increase inundation duration, but even the wettest areas here will continue to become fairly dry during the latter part of the growing season.

Although these areas have been degraded by past agricultural practices, the CMAs have not been cultivated and the ditches on site have not been maintained for at least 10 years. Soil structure, the arrangement of soil particles, has likely redeveloped to some degree over these past few years, improving soil drainage and aeration. Although most of the areas in the CMAs are covered with non-native grasses, native plants can be readily established using appropriate techniques.

Restoring or enhancing habitat types that have been eliminated or degraded by past agricultural practices may greatly bolster local ecological vigor. Re-establishing wetland habitats with mature, native vegetation will contribute to the re-establishment of a key component of the landscape's ecological integrity.

There is high potential for increasing connectivity between the CMAs and ecologically important areas located nearby. Enhancement of CMA1 will create a forested corridor between the Terrell Creek riparian forest and the mature upland forest located atop the hill just north of Grandview Road. Such a connection will improve ecological connectivity between the Terrell Creek riparian forest and the large forested areas south of Grandview Road. These forested areas south of Grandview Road extend south to the Lake Terrell Wildlife Area, a 1,500-acre reserve managed by the Washington Department of Fish and Wildlife (WDFW). These intact forests currently support many native plant species and provide habitat for a variety of wildlife including large mammals such as blacktail deer and coyotes. Connecting these forested areas is also considered desirable for heron, which have been observed preferentially flying along tree lines to reach foraging areas.

Enhancement of CMA2 will broaden the connection established by enhancement of CMA1 to include the area south of Terrell Creek and west of Blaine Road. CMA2 will extend west to the east edge of the existing mitigation site initiated in 2000, connecting this area with the habitat network to be enhanced by the proposed compensatory mitigation. Enhancement of both CMA1 and CMA2 will facilitate wildlife migration and dispersal in the Terrell Creek watershed. Migration and dispersal habitat is especially important to areas like this portion of Whatcom County that retain forested areas heavily fragmented by development. Creation of this corridor will also provide greater opportunities for native plants to exchange pollen and spread seed to and from intact forest and wetland habitats.

If no enhancement occurs in the CMAs, pioneering species such as red alder, hardhack (*Spiraea douglasii*), Himalayan blackberry, and evergreen blackberry will eventually colonize large portions of the seasonally saturated wetlands and upland meadows. The seasonally inundated portions of the wetlands may continue to be dominated by reed canarygrass and the few other herbaceous species present for a long time. Native forest and shrub-land communities may eventually dominate these areas, but not until many decades perhaps centuries have passed. Instead, successional processes can be artificially accelerated to produce forests and shrub-lands with a variety of native vegetation in much less time if appropriate techniques are applied.

5.4 ECOLOGICAL ASSESSMENT OF MITIGATION SITE

The *Revised Cogeneration Project Compensatory Mitigation Areas Wetland Delineation Report* (URS 2003a) details existing conditions within the CMAs including plant communities, soils, hydrologic regime, wetland functions, buffers, and land use. Much of the information from this report is summarized in this section.

5.4.1 Plant Communities

The CMAs and surrounding lands are predominantly composed of grassy areas that were once cultivated for hay. These areas have all been degraded by historic agricultural practices including plowing, planting with non-native grasses, and ditching. However, wetland conditions persist across most of the area. Of the 50.3 acres comprised by CMA1, 38.4 acres (76.2%) were determined to be jurisdictional wetland (see Figure 5A). Of the 59.8 acres comprised by CMA2, 41.3 acres (69.2%) were determined to be jurisdictional wetland (see Figure 5B).

Most of the lands within the CMAs are PEM wetlands dominated by non-native pasture grasses. Approximately 69.8% of the wetlands found in the CMAs are PEM communities that are seasonally saturated, but not inundated (PEMA). Most PEMA wetland areas are dominated by colonial bentgrass, but contain some areas with dominant amounts of soft rush and/or reed canarygrass. The distribution of each species is very patchy, and some patches in most areas are fairly small (100 to 1,000 ft²). PEMA communities contain a few subdominant species including field horsetail, slough sedge (*Carex obnupta*), tall fescue (*Festuca arundinacea*), and other herbaceous species well adapted to moist, open conditions.

Nearly all of the remaining 30.2% of on-site wetlands are comprised by PEM communities that are seasonally flooded (PEMC). Most PEMC wetlands are dominated by reed canarygrass, soft rush, and/or creeping bentgrass. Species distribution in these communities is also patchy. PEMC communities also contain creeping buttercup (*Ranunculus repens*), field horsetail, meadow foxtail, and slough sedge.

A patchy mix of immature trees, shrubs, and herbaceous species are found lining the several ditches that traverse the CMAs. The vast majority of ditches were excavated in wetland areas and thus are considered portions of those wetlands. Plant species most commonly found along these ditches include black cottonwood, hardhack, Himalayan blackberry, evergreen blackberry, clustered wild rose (*Rosa pisocarpa*), and red alder. Typically, these trees and shrubs are rooted adjacent to the ditch whereas reed canarygrass and/or a few other hydrophytic herbaceous species are rooted within the ditch. Although these ditches are not maintained and are overgrown with vegetation, most ditches continue to facilitate drainage from the CMAs.

Upland areas are interspersed within the wetlands present on site. Upland areas comprise 12.0 acres (23.8%) of CMA1 and 18.4 acres (30.8%) of CMA2. Most of this upland area is meadow that is difficult to distinguish from adjacent wetland meadow areas. Virtually all uplands present in the CMAs are slightly elevated above the wetlands that surround them or are situated on well-drained slopes. However, most uplands in the CMAs typically retain saturation near the soil surface for long periods during the wet season. Upland meadow areas are dominated by non-native pasture grasses, typically colonial bentgrass and common velvetgrass. Some upland meadow areas have substantial amounts of other pasture grasses including quackgrass (*Elytrigia repens*), tall fescue, reed canarygrass, and sweet vernal grass. In addition,

small patches of Himalayan blackberry and evergreen blackberry, two non-native, invasive shrubs, are found in both meadow and forested portions of the upland areas.

5.4.2 Soils

Two of the three soil series that predominate in the CMAs are considered hydric since they typically sustain saturation at or near the soil surface throughout extended periods of the growing season. All three soil types are moderately fertile and slightly acidic in the surface layer (Goldin 1992). A more detailed description of the soil types is in the wetland delineation report for the CMAs (URS 2003a).

As mentioned in Section 2.3, most of the soil in this portion of Whatcom County was formed in Bellingham Drift and is underlain by clay till (Goldin 1992). Bellingham Drift is the surface stratigraphic layer underlying a large area encompassing the proposed construction site and CMAs. This layer is 70 to 80 feet thick and is considered to be an aquitard, allowing relatively little water to percolate to Terrell Creek or to the aquifer located below the Bellingham Drift. A profile drawing showing the stratigraphic layers in the area is in Figure 3.3-5 of *BP Cherry Point Cogeneration Project – Application for Site Certification* (Golder Associates 2003d). This drawing is presented in Appendix A.

5.4.3 Hydrology

A very high proportion of precipitation falling across this area is stored in the soil and surface depressions or becomes runoff that enters Terrell Creek as surface water during the wet season and the early part of the dry season. As a result, the main source of water for Terrell Creek is surface water runoff from the 20.8 square mile drainage area, including runoff from Lake Terrell. Although mean annual flow in the lower portion of Terrell Creek (west of the Jackson Road crossing) is estimated to be 20 to 30 cfs (Wenger pers. comm. 2002), the creek has been known to dry up completely most summers (State of Washington Department of Water Resources 1960).

The clay till and low relief found throughout the area greatly decreases vertical and lateral drainage, fostering widespread near-surface saturation and/or shallow inundation during the wet season. The surface soil layers in most areas on site are saturated at or near the surface during most of the wet season. As shown in Figures 5A and 5B, large portions of the CMAs support shallow (typically 1 to 3 inches deep) inundation that persists through most of the wet season. Water depths and soil moisture in the CMAs steadily decline during the latter part of the wet season and the early part of the dry season via evaporation, transpiration, and infiltration. The vast majority of the sites retain low to moderate moisture levels by the end of the growing season. No areas within the CMAs consistently support surface water throughout the year.

Figures 6A and 6B show existing hydrologic pathways and surface flow rates within and downgradient of each CMA. The surface water pathways within the CMAs occur in ditches and natural channels as well as in broad swales where surface water may be dispersed across swales as semi-concentrated flow or across very broad swales as sheet flow. Subsurface pathways were estimated as occurring within the topsoil near the soil surface; this type of flow path is termed interflow. To determine locations of hydrologic pathways, ditches and swales were walked and water was pumped into one important ditch to observe its flow. Observations of topography and observations of water flow during storm events contributed to identifying hydrologic pathways. Various flow observations were also compared to rainfall data collected by the BP meteorological station.

Estimates of flow rates at various locations were made during a 6-month, 24-hour storm event that occurred December 13, 2001. These estimates were confirmed by calculations made using the Soil Conservation Service (SCS) method to predict runoff that would occur on site during the 6-month, 24-hour storm event. The SCS method, or the SCS Curve-Number Method, was created by the US Soil Conservation Service and is a commonly used approach for predicting runoff from watersheds (SCS 1973).

CMA1 drains northward to Terrell Creek (see Figure 6A). The hydrologic input for the ditch is precipitation that falls on the land immediately within CMA1 and the west-facing portion of the hill immediately east of CMA1. The hillslope in the southeastern portion of the site faces northwest at approximately 3.5% grade. The rest of the site is nearly flat, but slopes gently (<1% grade) to the north. A broad, shallow ditch carries surface water north across the site. The ditch is 5 to 20 feet wide and 1 to 1.5 feet below the elevation of land immediately surrounding it.

The ditch contains slowly flowing water during the wet season and shallow standing water and/or no standing water from June through October. The ditch rapidly becomes a well-defined channel after it exits CMA1 to the north. This channel leads through the steeply sloped riparian forest to join Terrell Creek.

A smaller and much shallower ditch is also present in CMA1. This ditch extends from the west edge of the site to the main ditch in the northwestern part of the site. This ditch is situated on a relatively flat grade and does not appear to support any flowing water except perhaps during very large winter storm events. The ditch is approximately 2.5 feet wide and 1 foot deep below the elevation of the land surrounding it. A portion of this ditch appears to have been filled and is now only a hedgerow.

CMA2 drains westward to the extensive wetland system off-site, which drains to Terrell Creek near the crossing at Jackson Road (see Figure 6B). The easternmost 350 feet of CMA2 is fairly flat, but the remaining portions including the 'panhandle' slope west at approximately 2.25% grade. The panhandle is the unofficial title for the northwestern portion of CMA2 located west of the finger of forest that extends north from the large forest situated along the western boundary of CMA2's main section. The panhandle generally slopes west at approximately 2.5% grade, but it does contain some areas as steep as 6%. As with CMA1, historic cultivation has substantially disturbed the site, including the creation of ditches that continue to facilitate site drainage. Most of the site is sloped so that subsurface moisture seeps toward the ditch system that leads west across the site.

Two ditches of moderate depth carry surface water north and west across CMA2. The ditch leading north along the western boundary of CMA2 is 2 to 3 feet wide (bottom width) and 2 to 4 feet below the elevation of land immediately surrounding it. The northern portion of this ditch is just within the large upland forest community. The ditch leading west across the site is 2 to 3 feet wide (bottom width) and 1 to 2 feet deep. This ditch crosses the northern portion of the forest patch located just outside of CMA2. The confluence of the two ditches is located at the western edge of the forest, at the southeastern corner of the panhandle. Below the confluence, the ditch continues west along the southern edge of the CMA2 panhandle and extends off site.

Once off site, the ditch runs through the large forested area west of CMA2. From this point flows splits, with some leading north as sheet flow through a large PEM wetland, then west to Terrell Creek just east of

Jackson Road and the remaining flow following the ditch to two large ponds that drain to Terrell Creek under Jackson Road.

It should be noted that a small, but substantial amount of water from the west-flowing ditch currently leads north to become dispersed across a wide portion of the CMA2 panhandle. Some surface water travels north from this ditch through the seasonally inundated wetland area located northwest of the existing forest patch. A portion of this water seeps westward through the adjacent upland, which is sloped to the west and transmits groundwater at moderate rates through a subsurface soil layer. Near the southern portion of this seasonally inundated area is another location where some flow splits from the ditch to the north. Most of this semi-concentrated flow travels west to a swale that directs flow northward. Surface water in the swale then seeps westward through the adjacent upland, as with the sloped upland discussed above. As a result of this seepage, the seasonally inundated area at the western edge of CMA2 and the forested wetland to the south remain shallowly inundated and/or saturated throughout most of the wet season. Most of the water here seeps west to the ditch that runs north along the east edge of an existing compensatory mitigation site that was established in 2000 (Corps Reference #98-4-02349).

Runoff from the plant site and a much larger area to the south is currently directed to the ditch along the east side of Blaine Road. Water flow in the ditch occurs mainly during the wet season and has been observed to be typically greater than 1 cfs during the wet season. The ditch is lined with rip-rap for most of its length, but does contain enough soil in some spots to support hydrophytic plants. The ditch leads to a concrete culvert that is 3 feet in outside diameter and located south of Terrell Creek. The culvert leads north by northeast down through a narrow thicket of Himalayan blackberry and into the mature deciduous, broad-leaved riparian forest. The culvert descends a 20-40% slope and leads to a 50-foot long gravel channel that connects with Terrell Creek just upstream of the large culvert under Blaine Road. Both the culvert and the channel appear stable and likely do not contribute much sediment to Terrell Creek.

Stormwater runoff from a large portion of the refinery is detained in a detention pond and subsequently pumped to the Strait of Georgia near Cherry Point. Runoff from over 50 acres of undeveloped forest and shrub-land in the northwest portion of the refinery property is directed off-site via ditches and culverts to a Terrell Creek tributary located west of Jackson Road. Stormwater runoff on the northeastern portion of the refinery is routed through a culvert under Grandview Road that leads to a series of ponds and wetlands in the undeveloped area west of CMA2.

The area west of CMA2 contains four ponds connected by wetlands and seasonally flowing channels. The ponds are all permanently inundated and of varying size and shape. The first two ponds in the pond series were constructed by WDFW in the 1990's. The first pond is relatively small (0.25 acre), and the second pond is fairly large (4.5 acres). Outflow from both ponds is controlled by weirs located at each pond's outlet. Although the ponds are intended to provide habitat for waterfowl, these ponds induce water quality treatment by providing approximately 200,000 to 250,000 ft³ of hydrologic dead storage each winter. Surface water released from the large pond flows through a wide, densely vegetated channel that leads west. A few small wetlands may receive some flow from this channel, but most of the flow enters the third pond after joining runoff from the ditch that leads west of CMA2. Surface water from the third pond, which is approximately 3.5 acres in size, drains through a culvert to the fourth pond, which is approximately 2.5 acres in size. The fourth pond drains to Terrell Creek through a culvert under Jackson Road.

As mentioned earlier, soil moisture levels vary greatly between wet season and the dry season because the difference in precipitation between these periods is exacerbated by the poorly drained soils and their high rates of runoff. Moreover, historical cultivation of clayey soils combined with ditch drainage likely caused the hydrologic regime to fluctuate more than had occurred prior to cultivation. However, the gentle topography combined with the soil structure redevelopment that likely occurred during the past few years without cultivation may have allowed soils in the CMAs to regain some of their inherent permeability and storage capacity, thereby allowing them to moderate hydrologic fluctuation to some degree.

A comprehensive monitoring of the site's hydrologic regime is being initiated. On CMA 1, approximately 6 shallow wells will be systematically located to capture current versus post-mitigation surface and subsurface hydrologic change associated with the ditches. Between 15 and 20 shallow wells will be installed in strategic locations throughout CMA 2 to measure current versus post-mitigation hydrologic patterns. An explanation of the methods, data collection, and results garnered are described in the Cogeneration Project Hydrologic Monitoring Work Plan (Appendix G). The information will be used to improve design and implementation of the mitigation and to provide a means for assessing hydrologic conditions before and after surface water diversions are made. They will be monitored frequently through the end of the mitigation monitoring period. In addition to determining the site's hydroperiod (water level fluctuation) and its spatial variation, monitoring will determine locations and rates of existing and post-mitigation flowpaths, both above the surface and as shallow groundwater.

The areas sampled by each gauge will be delineated and mapped prior to diverting surface water to the site. Surface elevation and hydrologic regime of the area immediately surrounding the gauge will be similar to the area that the gauge is determined to be sampling. It is presumed that changes in hydrologic regime will occur in some areas and not occur in other areas.

The map will be checked for adequacy through observations of on-site conditions after the hydrologic modifications are implemented. The geographic extent of the areas sampled by each gauge as presented in the map may be altered to reflect actual changes in hydrologic regime. Any alterations to the map will be documented and explained in monitoring reports.

5.4.4 Experience

URS designed a 4.6-acre compensatory mitigation site located within the BP Cherry Point property north of Grandview Road (Corps Reference #98-4-02349). This project involved rehabilitating a portion of a PEM wetland including removal of non-native, invasive plants, creating a 0.5-acre seasonally inundated area, and establishing a mosaic of native plant communities. Two years of site monitoring have shown that the wetland rehabilitation is on a trajectory toward success. Approximately 90% of the trees and shrubs installed on site have survived and over 90% of these plants show no signs of stress. Whereas herbaceous cover in most portions of the site is greater than 100%, cover by reed canarygrass, a non-native, invasive weed, has been reduced from over 90% to approximately 12% of the site. A copy of the *Year 2 Monitoring Report for Wetland Compensatory Mitigation, 4.58 acres BP Cherry Point Refinery* (URS 2002) is in Appendix D.

5.4.5 Exotic (Non-Native, Invasive) Species

The proposed mitigation will control the non-native, invasive plants growing in the CMAs. Non-native plants dominate most portions of the CMAs. As with the Restoration Areas, only reed canarygrass, Himalayan blackberry, and evergreen blackberry are considered invasive, which signifies that they can be highly competitive and difficult to control. Thus, these species will be the focus of the non-native, invasive species control program.

As discussed earlier, most wetland areas of the CMAs are dominated by intergrading patches of reed canarygrass, bentgrass, and soft rush. Most of the upland areas are dominated by non-native pasture grasses such as colonial bentgrass, velvetgrass, and tall fescue. A few uplands contain patches of Himalayan and evergreen blackberry growing apart from and/or entangled with native trees and shrubs.

The existing distribution of reed canarygrass across the CMAs was mapped by use of a Global Positioning System (GPS) with sub-meter accuracy (Figure 7A and 7B). Three categories of reed canarygrass cover were defined to guide the mapping effort: 1) <20% cover, 2) 20% to 95% cover, and 3) >95% cover. The cover categories used to gauge reed canarygrass distribution reflects actual conditions on site. The limited number of categories facilitated the mapping effort. The area covered in reed canarygrass for each category is presented in Table 10.

Table 10
Existing Reed Canarygrass Cover

Cover Category	CMA1 (acres)	CMA2 (acres)	Total (acres)
<20%	25.43	38.44	63.87
20-95%	15.36	12.42	27.78
>95%	9.57	8.93	18.50

The total area that supports greater than 20% cover by reed canarygrass is 46.28 acres, which is about 42% of the total area encompassed by the CMAs. Although 9.5 acres smaller than CMA2, CMA1 contains a larger amount of area with greater than 20% reed canarygrass cover. This pattern correlates to the higher proportion of wetland area in CMA1. The vast majority of reed canarygrass found in the CMAs occurs in wetlands. However, a few on-site upland areas support reed canarygrass, including a few patches with greater than 20% cover.

As with the Restoration Areas, control of non-native, invasive plant species will consist of a three-pronged approach: 1) initial removal, 2) subsequent maintenance for short-term control, and 3) establishment of native plant communities for long-term control. This approach will be applied to all areas within the CMAs. The first two prongs of the three-pronged approach will be applied to the areas between the CMAs and the ditches within the ROWs.

Removal will occur through a combination of mowing, tilling, and herbicide application. Subsequent maintenance will mainly employ hand-pulling and herbicide application, but may involve some mowing as well. Native trees and shrubs will eventually provide enough shade and organic litter to suppress growth of non-native, shade-intolerant plants from large portions of the site.

Those areas that have greater than 20% cover by reed canarygrass will be regularly mowed for two growing seasons prior to the initial phase of planting. Frequent mowing during this time will diminish the reed canarygrass population in these areas by removing above-ground plant matter, depleting carbohydrate reserves, and suppressing seed production. Any small patches of reed canarygrass found within areas mapped as having <20% cover by reed canarygrass will be mowed or sprayed with herbicide.

Clumps of Himalayan and evergreen blackberry that are not intertwined with native trees and shrubs will be mowed with a brush-cutter. Blackberry that is intertwined with trees will be removed by hand to prevent damage to native vegetation. Cut stems may be mechanically chopped to pieces less than 0.5 foot in length with a crop chopper and may be left on site to serve as mulch.

Those areas that contain greater than 20% cover by reed canarygrass will be tilled. Tilling will occur after mowing during the growing season prior to the initial phase of planting. A large rototiller pulled by tractor will till soils to a 6-inch depth. These portions of the site will then be disked to further break up the clods and kill rhizomes that survived the mowing. Areas with less than 20% cover by reed canarygrass will not be tilled since tilling is not necessary or practical to suppress reed canarygrass in these areas and tilling is not critical to establishing native trees and shrubs. However, any stands of reed canarygrass found in these areas will be mowed and subsequently sprayed with herbicide.

Tilling and disking will fatally damage many of the reed canarygrass rhizomes, but will likely encourage buried seeds and undamaged rhizomes to resprout. Reed canarygrass that does resprout will be sprayed with herbicide. The herbicide applied on site will consist of glyphosate plus surfactants and will only be applied to areas free from inundation and unlikely to support inundation within 2 weeks of application. Herbicide will be applied by state-licensed applicators. This sequence of mowing, tilling, disking, and spraying herbicide will work to exhaust energy supplies of the reed canarygrass population. The herbaceous seed mix selected for the tilled areas has been recommended by the Corps of Engineers because it has proven to be effective at competing with reestablishing reed canarygrass.

The second and third components of the three-pronged approach to non-native, invasive plant control will be implemented equally between tilled and untilled areas. As with the Restoration Areas, weed control will occur through a combination of mechanical removal and herbicide application after native plants are installed and the seed mix applied. Although such maintenance is expected to occur throughout most of the 10-year monitoring and maintenance period, the intensity of the maintenance effort should decrease over time. Eventually, native vegetation will serve to suppress non-native plants over large portions of the site by shading and soil resource competition.

The road ROWs and the setback areas between the CMAs and the road ROWs will be regularly mowed throughout the 10-year monitoring period. This will suppress reed canarygrass or any other exotic plants from producing and disseminating propagules to the CMAs from these areas.

As previously mentioned, URS will monitor the success of non-native, invasive species control each year of the 10-year period. Contingencies will be made if control methods fail to attain performance standards, as necessary. For reed canarygrass, the contingency measures consist of targeted efforts to control outbreaks such as manual removal of invasive species, additional spot applications of herbicide, more frequent mowing, and additional plantings and/or seedings in problem areas.

5.4.6 Wetland Functions

The proposed rehabilitation is predicted to significantly improve the performance of several wetland functions. URS assessed performance of wetland functions for each portion of the CMAs using the *Methods for Assessing Wetland Functions* (Ecology 1999). Functional performance of the wetlands under current conditions is documented in the delineation report for the CMAs (URS 2003a).

The wetlands within the vicinity of the compensatory mitigation were broken into multiple assessment units to more accurately evaluate their functional performance. The assessment units are divided by differences in contributing basin and hydrologic regime.

The assessment unit associated with CMA1 is the wetland area within CMA1. Although this wetland extends beyond CMA1 to the east, drainage within CMA1 either leads to the main ditch or to two intermittently flowing channels that are just east of the main ditch. Surface water in the wetland area east of CMA1 drains away from CMA1 and enters a seasonally flowing channel that leads to Terrell Creek several hundred feet upstream of where surface water from CMA1 enters the creek. The contributing basin for the CMA1 assessment unit is comprised by CMA1 and a small upland area southeast of CMA1.

The assessment unit associated with CMA2 includes the wetland within CMA2 and the area to the north and south of the CMA2 panhandle. This area is estimated to be approximately 68 acres in size and does not include the two ponds created by WDFW, the channels leading to them from the culvert under Grandview Road, or the existing mitigation area (see Figure 6B). The assessment unit contains the portion of the large contiguous wetland extending west to the floodplain for Terrell Creek near Jackson Road that generally slopes west at an average 2.5% grade. As a result, most surface water flows west at relatively rapid velocities. The vast majority of the part of this wetland that lies outside the assessment unit slopes west at approximately 1% grade and has relatively slow flow velocities. As a result of the gentle slope, ditch flooding and sheet flow is much more common in the area outside the assessment unit (see *Revised Cogeneration Project Compensatory Mitigation Areas Wetland Delineation Report* <URS 2003a> for more details). The contributing basin for the CMA2 assessment unit under current conditions is comprised by the area within the assessment unit itself. For post-mitigation conditions, the contributing basin also includes the cogeneration facility (33 acres).

The wetlands within the two assessment units both classify as Depressional Outflow wetlands. Because most portions of the wetland within CMA1 have very gentle slope and precipitation appears to be nearly 90% of this wetland's water source, the wetland within CMA1 nearly classifies as a Flat wetland according to the classification system used by the functional assessment method. The CMA2 assessment unit nearly classifies as a Slope wetland since it slopes west at an average of 2.5% grade. However, both wetland areas classify as Depressional Outflow wetlands because they are open basins with subsurface inflow from adjacent uplands, do not receive river or stream flooding, and emit outflow that ultimately leads to a downstream waterbody (Terrell Creek).

The assessment method was also applied to the assessment units under current conditions and under conditions that are expected to develop 25 years after compensatory mitigation is initiated. The completed data sheets for these assessments are presented in Appendix B.

The results of this evaluation are summarized in Tables 11 and 12. The possible range of index values for each function is 1 to 10, where 10 represents the highest level of performance. The acreage of each mitigation area was used to calculate acre-points. As explained previously, acre-point calculation provides a more quantitative means of comparing gains in functional performance induced by mitigation with losses in functional performance induced by the proposed construction. As recommended by Ecology (1999), URS compared the results of the functional assessments for the mitigation areas with those for the construction site to better determine the adequacy of the compensatory mitigation plan to offset the proposed impacts.

Table 11
Comparison Between Functional Performance of the Assessment Unit Associated With CMA1
(38.4 Acres) Under Current Conditions and 25 Years After Compensatory Mitigation Is Initiated

Wetland Function	Functional Indices – Existing Condition	Functional Indices – 25 Years Post Mitigation	Explanation
Potential for Removing Sediments	4/ 153.6	3/ 115.2	Decrease (-38.4 acre points) predicted since area of herbaceous vegetation cover will decrease.
Potential for Removing Nutrients	2/ 76.8	2/ 76.8	No change predicted since the size of seasonally inundated area will not change substantially.
Potential for Removing Heavy Metals and Toxic Organics	4/ 153.6	3/ 115.2	Decrease (-38.4 acre-points) predicted due to decrease in cover by herbaceous vegetation.
Potential for Reducing Peak Flows	4/ 153.6	4/ 153.6	No change predicted since ditch plugging will occur only in the upper portion of the ditch.
Potential for Decreasing Downstream Erosion	5/ 192.0	7/ 268.8	Increase (+76.8 acre-points) predicted due to increase in percent covered by forest and shrub vegetation.
Potential for Recharging Groundwater	3/ 115.2	3/ 115.2	No change predicted since vertical drainage in this area will remain slow.
General Habitat Suitability	3/ 115.2	5/ 230.4	Increase (+76.8 acre-points) predicted due to increase in area with canopy closure, maximum number of strata, number of snags, vegetation class interspersions, large woody debris, water and vegetation interspersions, and number of native plant species.
Habitat Suitability for Invertebrates	2/ 76.8	4/ 153.6	Increase (+76.8 acre-points) predicted due to increase in exposed substrate, vegetation class interspersions, large woody debris, maximum number of vegetation strata present.
Habitat Suitability for Amphibians	2/ 76.8	3/ 115.2	Increase (+38.4 acre-points) predicted due to increase in surface substrate types, water and vegetation interspersions, and large woody debris.
Habitat Suitability for Anadromous Fish	N/A	N/A	No anadromous fish can or will be able to access the site.
Habitat Suitability for Resident Fish	N/A	N/A	No resident fish can or will be able to access the site.
Habitat Suitability for Birds	4/ 153.6	5/ 192.0	Increase (+38.4 acre points) predicted with increase in number of snags, vegetation class interspersions, special habitat features, index for invertebrate habitat suitability, and index for amphibian habitat suitability
Habitat Suitability for Mammals	3/ 115.2	4/ 153.6	Increase (+38.4 acre-points) predicted due to increase in water and vegetation interspersions and forest cover.
Native Plant Richness	1/ 38.4	3/ 115.2	Increase (+76.8 acre-points) predicted due to increase in maximum number of strata, number of native plant species, and decrease in area dominated by non-native plant species.
Potential for Primary Production and Organic Export	6/ 230.4	7/ 268.8	Increase (+38.4 acre-points) predicted due to increase in area covered by woody vegetation.

Table 12
Comparison Between Functional Performance of the Assessment Unit Associated With CMA2
(64 Acres) Under Current Conditions and 25 Years After Compensatory Mitigation is Initiated

Wetland Function	Functional Indices – Existing Conditions	Functional Indices – 25 Years Post Mitigation	Explanation
Potential for Removing Sediments	4/ 256	4/ 256	No change predicted despite increase in seasonally inundated area due to decrease in cover by herbaceous vegetation.
Potential for Removing Nutrients	2/ 128	2/ 128	No change predicted despite increase in seasonally inundated area due to decrease in cover by herbaceous vegetation and no change in soil type.
Potential for Removing Heavy Metals and Toxic Organics	4/ 256	3/ 192	Decrease (-64 acre-points) predicted due to the decrease in cover by herbaceous vegetation despite the increase in seasonally inundated area.
Potential for Reducing Peak Flows	4/ 256	4/ 256	No change predicted since increase in size of seasonally inundated area will not be accompanied by a great increase in outlet constriction.
Potential for Decreasing Downstream Erosion	5/ 320	7/ 448	Increase (+128 acre-points) predicted due to increase in percent area covered by forest and shrub vegetation.
Potential for Recharging Groundwater	2/ 128	3/ 192	Increase (+64 acre-points) predicted due to increase in seasonally inundated area.
General Habitat Suitability	3/ 192	6/ 384	Substantial increase (+192 acre-points) predicted due to increase in area with canopy closure, maximum number of strata, number of snags, vegetation class interspersions, large woody debris, number of water regimes, number of water depth categories, water and vegetation interspersions, and number of native plant species.
Habitat Suitability for Invertebrates	3/ 192	6/ 384	Increase (+192 acre-points) predicted due to increase in exposed substrate, vegetation class interspersions, large woody debris, water and vegetation interspersions, maximum number of vegetation strata present, and inundation depth and persistence.
Habitat Suitability for Amphibians	2/ 128	4/ 256	Increase (+128 acre-points) predicted due to increase in water and vegetation interspersions and large woody debris.
Habitat Suitability for Anadromous Fish	N/A	N/A	No anadromous fish can or will be able to access the site.
Habitat Suitability for Resident Fish	N/A	N/A	No resident fish can or will be able to access the site.
Habitat Suitability for Birds	4/ 256	6/ 384	Increase (+128 acre-points) predicted due to increase in number of snags, vegetation class interspersions, special habitat features, index for invertebrate habitat suitability, and index for amphibian habitat suitability.
Habitat Suitability for Mammals	3/ 192	4/ 256	Increase (+64 acre-points) predicted due to increase in forested cover and connection to high quality forested habitat.
Native Plant Richness	1/ 64	5/ 320	Increase (+256 acre-points) predicted due to increase in maximum number of strata and number of native plant species, and decrease in area dominated by non-native plant species.
Potential for Primary Production and Organic Export	6/ 384	7/ 448	Increase (+64 acre-points) predicted due to increase in seasonally inundated area and area covered by woody vegetation.

The abilities for the CMA1 and CMA2 assessment units to remove sediment from surface water inputs are rated moderate, whereas their abilities to remove nutrients is rated moderately low. According to the results of the functional assessment, sediment and nutrient sequestration is limited by the lack of permanent water, low permeability of the soils, and low level of outlet constriction in each CMA. Sediment and nutrient capture is aided by the high cover of herbaceous vegetation and presence of seasonally inundated areas.

According to the results of the assessment, the performance of these functions will not change 25 years after compensatory mitigation is initiated. Performance is not predicted to change in CMA1 since the proposed topographic and hydrologic manipulations there will not greatly constrict outflow. Despite that inundation frequency, duration, and magnitude will increase considerably in CMA2, the model does not predict any increase performance of sediment and nutrient removal functions due to the expected decrease in herbaceous cover from shading by forest and scrub-shrub vegetation. Since all the runoff from CMA1 is from well-vegetated areas that will remain relatively undisturbed, the opportunity for CMA1 to enact its potential to remove sediments and/or nutrients will be low. Since most sediments in the runoff from the plant site will be removed by the proposed detention pond and oil/water separator, the opportunity for CMA2 to enact its potential to remove sediments and/or nutrients will be low to moderate.

The potential for removing heavy metals is rated moderate for both wetland areas according to the assessment results. Since precipitation provides the vast majority of the water for these wetlands, few toxins enter these wetlands. Thus, toxin removal is a function the wetlands currently have little opportunity to perform. The performance of this function is predicted to slightly decrease below its current level 25 years after compensatory mitigation is initiated. The decreases are predicted for both CMAs due to the expected decrease in cover by herbaceous vegetation. CMA1 and the portion of the assessment unit associated with CMA2 to be unaffected by runoff piped from the plant site will continue to have little opportunity to perform this function in the future. In contrast, the opportunity for the portion of CMA2 that will receive stormwater runoff to perform this function will increase to some degree.

The abilities of the wetlands to reduce peak flows and decrease downstream erosion are rated moderate according to the results of the assessment. The performance of these functions within the CMAs are limited by the moderate amount of seasonally inundated areas, low amount of woody vegetation, and low level of outlet constriction. However, the high ratio of wetland area to contributing basin area enhances the performance of these functions. The opportunity for these functions to be performed is moderate since there is a moderate amount of runoff from the wetlands. It should be noted that the opportunities for the CMAs to reduce peak flows and decrease downstream erosion are currently low to moderate these sites.

Despite the proposed hydrologic modifications, the model does not predict that the potential to reduce peak flows in the CMAs will change. Although the proposed topographic and hydrologic modifications will increase hydrologic storage and reduce peak runoff rates to some degree, the flooding depth, outlet constriction, and ratio of inundated area to sub-catchment area will not increase substantially for either CMA. Although the inundated area within the assessment unit associated with CMA2 will nearly double in size, the inundated area to sub-catchment area ratio does not increase dramatically because the plant site (33 acres) will become part of CMA2's catchment area. As a result, the model does not predict any increase in the ability of either CMA to reduce peak flow. However, directing stormwater to CMA2 will substantially decrease peak runoff rates delivered from the plant site to Terrell Creek. Instead of being directed through a large ditch along the east edge of Blaine Road that leads directly to the creek, runoff piped to CMA2 will be

stored on site and in the large area downgradient before reaching Terrell Creek near its crossing with Jackson Road. The opportunity for CMA1 to reduce peak flows will continue to be low to moderate, but will be moderate to high in CMA2 due to the inflow of detention pond runoff.

The ability to decrease downstream erosion is predicted to improve to some degree in both CMAs. Although the peak runoff reduction and downstream erosion control functions are closely related, only the erosion-control function is predicted by the model to improve due to the substantial increase in forest and scrub-shrub vegetation. The woody vegetation will produce improve hydrologic storage and increase hydraulic roughness, thereby reducing runoff and associated erosion from the CMAs. Despite the establishment of woody vegetation, surface water inputs to the CMAs (especially in CMA2, post mitigation) will continue to overwhelm soil storage capacity, thereby perpetuating the relatively high surface water runoff from the sites. The opportunity for CMA1 to decrease downstream erosion will continue to be low to moderate, but will increase to a moderate to high level in CMA2 where runoff will be delivered from the plant site. Hydrologic storage in CMA2 will reduce the erosive power of the plant site runoff, which would be much higher if all of it was funneled to the large ditch east of Blaine Road.

The potential for the assessment units to recharge groundwater is rated to be moderately low due to the poor vertical drainage of their soils. Because of the more widespread inundation in CMA1, this area is rated to have slightly higher potential to recharge groundwater than CMA2 assessment unit. Infiltration rates are very slow within the BP Cherry Point property and surrounding areas because of the soils here are underlain by a thick stratigraphic layer high in clay and silt (Bellingham glaciomarine drift). Terrell Creek receives virtually no base flow from groundwater sources (State of Washington Department of Water Resources 1960).

Results of the assessment predict that the potential for the CMA1 to recharge groundwater will remain at the current level, yet the potential for CMA2 to recharge groundwater will increase slightly. CMA1's potential is not expected to change since the increase in inundation due to the proposed topographic and hydrologic modifications will not be very large. In contrast, the extent of seasonally inundated area in the assessment unit associated with CMA2 is expected to nearly double. This increased inundation will cause greater amounts of ground water to be stored in the soil within and downgradient of CMA. Given the very low permeability and infiltration capacity of the soils in the area, the opportunity to recharge groundwater stored in stratigraphic layers below the soil will remain low for both CMAs.

The proposed rehabilitation will substantially improve habitat suitability functions on site. Suppression of non-native, invasive plants and establishment of native vegetation will enhance wildlife habitat as well as increase primary production and organic export. Establishing native plant communities will create more habitat structure and diversity, which will likely augment both wildlife and plant diversity. Given the proximity of relatively intact habitats such as mature forests, streams, lakes, and coastal habitats, the opportunity for these wetlands to perform the habitat suitability functions will be moderate to high.

The increased extent of inundation to occur in CMA2 and the native emergent vegetation and woody debris to be established in inundated portions of both CMAs will provide increased opportunities for aquatic insects and amphibians to find cover, food, and breeding sites. The absence of surface water in late summer will continue to prevent colonization by organisms such as bullfrogs, a non-native amphibian species that

preys upon amphibian larvae (Richter 1999). Pacific chorus frogs and red-legged frogs are present in nearby areas and will likely colonize the enhanced wetlands in only a few years following their installation.

Other wildlife likely to benefit from the proposed compensatory mitigation includes mammals and birds. Mammals that rely upon woodland and woodland/meadow edge habitat such as blacktail deer, coyotes, Douglas squirrels, raccoons, and porcupines will benefit from the establishment of forest and scrub-shrub communities. A wide variety of birds will likely find nesting and/or foraging habitat in the CMAs 25 years following initial mitigation activity including warblers, sparrows, swallows, woodpeckers, hawks, and shrikes.

Upon reaching maturity, the trees and shrubs to be installed will provide habitat for a variety of wildlife including mammals, birds, and amphibians. The forested and scrub-shrub areas will provide shelter and thermal insulation for many species, which is especially important during winter. These habitats will permit nesting and breeding for a variety of species incapable of utilizing the open meadows for such activities. The wooded areas will also serve as a migration and dispersal corridor connecting the forested areas south of Grandview Road with the riparian forest surrounding Terrell Creek to the north. Migration and dispersal habitat is especially important to areas like this portion of Whatcom County where forested areas are severely fragmented by development.

The forested and scrub-shrub areas will encourage the establishment and growth of native mid-story and understory vegetation and suppress invasion by non-native, invasive plants. The forested and scrub-shrub communities to be established on site may eventually expand into adjacent unimproved areas, thereby further enhancing habitat value for the area. However, the model predicts that the increase in native, woody vegetation will suppress improvement of bird habitat suitability, causing no score increase in CMA1 and only an increase of 2 performance points in CMA2.

Aquatic insects, amphibians, and other animals attracted to the enhanced wetlands and uplands will provide increased foraging opportunities for a variety of birds including passerines (perching birds), waterfowl, raptors, and great blue herons. Herons forage for amphibians and small mammals in the shallow ponds and fallow fields north of Grandview Road (Eissinger pers. comm. 2001). Significant areas of open field habitat will be maintained for heron foraging. The quality of these foraging areas will be much improved over their current condition. Herons will profit from the increase in inundated areas with surface water less than 50 cm (20 inches) deep that support amphibians (Short and Cooper 1985). Converting the extensive reed canarygrass on CMA 1 and 2 to another herbaceous cover will benefit herons also while searching for small mammals. Herons have been observed avoiding the tall dense cover that reed canarygrass presents (Eissinger pers. comm. 2003).

No threatened or endangered species are expected to benefit directly from the proposed compensatory mitigation.

Since the wetlands currently do not provide fish habitat and will not provide fish habitat after mitigation activity is complete, the functional performance for Habitat Suitability for Anadromous Fish and Habitat Suitability for Resident Fish can not be evaluated. Thus, the scores for the mitigation wetlands are shown as not 'N/A' (not applicable).

The wetland communities to be established on site will continue to generate relatively high rates of primary productivity and release organic matter to downstream areas at moderate rates via the seasonally flowing channels. A substantial increase in primary production and organic export is predicted to result from the proposed rehabilitation. As a result, the proposed mitigation is predicted to cause more biomass to be retained on site (locked up in trees and shrubs) and also produce an increased rate of organic matter release.

In summary, the model predicts that the proposed mitigation will cause generally slight increases in the performance of hydrologic functions and substantial increases in the performance of wetland habitat functions. For CMA1, the index for one hydrologic function (Decreasing Downstream Erosion) will increase, the index for another hydrologic function (Removing Heavy Metals and Toxic Organics) will decrease slightly, and the indices for the remaining four hydrologic functions will not change. For CMA2, the indices for two hydrologic functions (Decreasing Downstream Erosion, and Recharging Groundwater) will increase slightly whereas the remaining four hydrologic functions will not change. Performance of all habitat functions will increase in both CMAs, but increases will be slightly larger in CMA2 assessment unit. The greater performance increase predicted for the assessment unit associated with CMA2 is attributed to the dramatic increase in inundation and the relatively moderate decrease in herbaceous vegetation.

Gains and losses in functional performance from the proposed mitigation have been calculated in acre-points, which is the product of wetland functional performance index and wetland acreage. The Washington State Methods for Assessing Wetland Functions (Ecology 1999) suggests measuring functional performance in terms of acre-points. Although the wetland functional performance is influenced by wetland size, this measurement essentially gives equal importance to wetland functional performance and wetland size. Acre-points or functional units can be used to compare gain and loss in overall wetland functional performance.

The cumulative loss of wetland functional performance that will occur as a result of the proposed construction has been calculated. The results of this calculation are shown in Table 13. A total of ten wetland areas will be eliminated. The temporal loss in functional performance of the 4.66-acre portion of Wetland F that will be restored subsequent to construction was discussed in Section 4.4.4.

Table 13
Wetland Functional Performance Indices and Acre-Points for Existing Wetland Areas That Will be Permanently Eliminated by the Proposed Construction. ¹

Function	Wetland A (1.69 ac) ²	Wetland B (2.81 ac) ²	Wetland C (0.88 ac) ²	Wetland D (5.92 ac) ²	Wetland F (8.75 ac) ²		Wetland G (5.46 ac) ²	Wetland H (0.23 ac) ²	Wetland I (0.15 ac) ²	Wetland J (4.39 ac) ²	Sum (30.58 ac)
					AU-1 (8.15 ac)	AU-2 (0.6 ac)					
Potential for Removing Sediment	4/ 6.76	4/ 11.24	4/ 3.52	5/ 5.45	5/ 40.75	5/ 3.0	4/ 21.84	4/ 0.92	5/ 0.75	5/ 21.95	116.18
Potential for Removing Nutrients	2/ 3.38	2/ 5.62	2/ 1.76	3/ 17.76	3/ 24.45	2/ 1.2	2/ 10.92	3/ 0.69	5/ 0.75	3/ 13.17	79.7
Potential for Removing Heavy Metals and Toxic Organics	4/ 6.76	4/ 11.24	4/ 3.52	5/ 5.45	5/ 40.75	4/ 2.4	5/ 27.3	5/ 1.15	5/ 0.75	5/ 21.95	121.27
Potential for Reducing Peak Flows	2/ 3.38	2/ 5.62	2/ 1.76	4/ 23.68	4/ 32.6	2/ 1.2	2/ 10.92	3/ 0.69	5/ 0.75	3/ 13.17	93.77
Potential for Decreasing Downstream Erosion	2/ 3.38	2/ 5.62	3/ 2.64	5/ 29.6	5/ 40.75	4/ 2.4	3/ 16.38	3/ 0.69	8/ 1.2	3/ 13.17	115.83
Potential for Recharging Groundwater	3/ 5.07	3/ 8.43	3/ 2.64	5/ 29.6	5/ 40.75	2/ 1.2	4/ 21.84	5/ 1.15	1/ 0.15	5/ 21.95	132.78
General Habitat Suitability	2/ 3.38	2/ 5.62	2/ 1.76	2/ 11.84	2/ 16.3	2/ 1.2	1/ 5.46	1/ 0.23	3/ 0.45	2/ 8.78	55.02
Habitat Suitability for Invertebrates	1/ 1.69	1/ 2.81	0/ 0	0/ 0	2/ 16.3	1/ 0.6	1/ 5.46	1/ 0.23	1/ 0.15	1/ 4.39	31.63
Habitat Suitability for Amphibians	2/ 3.38	2/ 5.62	1/ 0.88	1/ 5.92	2/ 16.3	2/ 1.2	1/ 5.46	1/ 0.23	1/ 0.15	1/ 4.39	43.53
Habitat Suitability for Anadromous Fish	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Habitat Suitability for Resident Fish	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Habitat Suitability for Wetland- Associated Birds	4/ 6.76	3/ 8.43	3/ 2.64	3/ 17.76	3/ 23.85	2/ 1.2	2/ 10.92	2/ 0.46	2/ 0.3	3/ 13.17	85.49
Habitat Suitability for Wetland- Associated Mammals	2/ 3.38	2/ 5.62	2/ 1.76	2/ 11.84	1/ 8.15	1/ 0.6	1/ 5.46	1/ 0.23	2/ 0.3	2/ 8.78	46.12
Native Plant Richness	1/ 1.69	0/ 0	0/ 0	0/ 0	1/ 8.15	0/ 0	0/ 0	0/ 0	3/ 0.45	0/ 0	10.29
Primary Production and Export	6/ 10.14	6/ 16.86	6/ 5.28	7/ 41.44	6/ 48.9	8/ 4.8	7/ 38.22	7/ 1.61	9/ 1.35	7/ 30.73	199.33

¹ Wetland E and Wetland K will not be affected by the proposed project.

² These acreages indicate the impact area for each wetland. The temporary loss of wetland functional performance by the 4.66-acre portion of Wetland F that will become the West Restoration Area is tabulated in Table 4 and is discussed in Subsection 4.4.4.

³ The scores for functional performance are averaged for all wetlands to be affected by the proposed project; the score for Wetland F is the sum of its AU's scores weighted by acreage.

Predicted gains in wetland functional performance from the proposed mitigation were compared with predicted losses in wetland functional performance from the proposed construction (see Table 14). With the exception of Decreasing Downstream Erosion, the method predicts that there will be a net loss in the performance of hydrologic functions as a result of the proposed construction and mitigation. With the exception of Primary Production and Export, the method predicts that the proposed construction and mitigation will lead to a net increase in performance of habitat functions.

Table 14
Expected Gross and Net Gains And Losses of Acre-Points

Hydrologic Functions				Habitat Functions			
Function	Gains from Mitigation	Losses from Construction	Expected Net Gain or Loss (+ or -)	Function	Gains from Mitigation	Losses from Construction	Expected Net Gain or Loss (+ or -)
Potential for Removing Sediment	33.74	116.18	-82.44	General Habitat Suitability	278.12	55.02	+223.1
Potential for Removing Nutrients	9.32	79.7	-70.38	Habitat Suitability for Invertebrates	278.12	31.63	+246.49
Potential for Removing Heavy Metals and Toxic Organics	-107.06	121.57	-228.33	Habitat Suitability for Amphibians	166.4	43.53	+122.87
Potential for Reducing Peak Flows	4.66	93.77	-89.11	Habitat Suitability for Anadromous Fish	N/A	N/A	N/A
Potential for Decreasing Downstream Erosion	218.78	115.83	+102.95	Habitat Suitability for Resident Fish	N/A	N/A	N/A
Potential for Recharging Groundwater	64.0	132.78	-68.78	Habitat Suitability for Wetland-Associated Birds	171.06	85.49	+86.57
				Habitat Suitability for Wetland-Associated Mammals	102.4	46.12	+56.28
				Native Plant Richness	346.78	10.29	+336.49
				Primary Production and Export	107.06	199.33	-92.27

It should be noted that despite widespread acceptance of the functional assessment method used for this assessment, the accuracy of its results is limited. As indicated in the method's guidelines, the indices do not denote actual functional performance, but only an estimate of performance based on readily observable aspects of a given site and the relationship between these aspects and the various functions. Many of the relationships between site aspects and wetland functions are simply hypothesized relationships because specific information regarding the relationships may be lacking (Ecology 1999). The validity of these relationships may be especially weak for the hydrologic functions.

Analysis of the CMAs' hydrostratigraphy and soils combined with various observations of the site's hydrologic regime have provided further insight into the factors affecting hydrologic functions. The conclusions regarding performance of hydrologic functions that were drawn from these analyses and observations differ to some degree from the results of the functional assessment using Ecology's methods. In particular, it was shown that sloping topography, poor vertical drainage, and long-term saturation and

inundation recurrent across the construction site and the CMAs combine to severely limit the potential to reduce peak flows or recharge groundwater in these areas. Other wetland functions, such as the potential to remove sediments, nutrients, and toxins, are also limited to some degree by the combination of topographic, soil, and hydrologic factors found at these sites. Thus, results of the functional assessment may overestimate current performance levels of most hydrologic functions in the construction site and the CMAs.

Although the rehabilitation proposed for the CMAs is expected to improve performance of these and other hydrologic functions, the functional assessment model does not predict large increases in performance. These predictions underestimate the actual improvement expected because the model lacks the sensitivity adequate to account for the changes in site conditions that will be caused by the proposed mitigation. For instance, adding the contributing basin area comprised by the plant site (33 acres) to the assessment unit associated with CMA2 has no effect on the scores for the hydrologic functions.

In addition, the model fails to incorporate the mitigating effect of the proposed detention ponds on the changes in project site's hydrologic regime. Because the ponds are being designed using updated techniques and will include dead storage, they will mitigate performance losses of all hydrologic functions except Potential to for Recharging Groundwater, a function which is not significant on the BP Cherry Point property due to the underlying aquitard.

Thus, the actual performance losses of hydrologic function due to the proposed construction will be less than indicated by the functional assessment results whereas the expected gains will be as great or greater than indicated by the functional assessment results. As a result, the proposed mitigation will adequately offset the losses of hydrologic function performance to be caused by the proposed construction (including detention pond construction).

The proposed mitigation will greatly improve ecological integrity and functionality of the wetlands within the CMAs. Applying Ecology's wetland rating system to the CMA wetlands under conditions predicted to occur 25 years following initial mitigation activity results in Category II wetlands with very high scores, indicating a highly valuable Category II wetland. The existing wetlands within the CMAs are rated as a Category II wetlands using the Washington State Wetlands Rating System (Ecology 1993). Despite their degraded condition, these wetlands satisfy the criteria for Category II status since they are fairly large and hydrologically connected via intermittent streams to Terrell Creek, a salmon-bearing stream with an intact riparian forest. However, they barely exceed the threshold between Category III and Category II wetlands. The completed wetland ratings data forms for the CMAs under current and predicted conditions are presented in Appendix C.

5.4.7 Buffers

The upland areas scattered across various portions of the CMAs share borders with the wetland areas within the CMAs and are thus considered wetland buffers. Most of these upland meadow areas are only slightly higher in elevation than the wetlands and retain saturation for long periods during the wet season. The Upland Forest communities to be established within these areas will improve their service as wetland buffers, thereby enhancing performance of both hydrologic and habitat wetland functions.

The riparian forest associated with Terrell Creek will provide a buffer to most of the northern border of the CMAs. Only the westernmost portion of CMA2 does not border this mature mixed deciduous/coniferous forest. Two patches of mature forest distinct from the riparian forest associated with Terrell Creek also border CMA2. These forests are mainly composed of deciduous broad-leaved trees, but have several native coniferous trees approaching canopy level.

In areas along Blaine Road and Grandview Road, wetlands extend to the edge of the ROW or beyond. In these areas there is no opportunity for designating upland buffers. In other areas of the CMAs, the wetland continues beyond the boundary of the CMA, and these areas likewise have no opportunity for wetland buffers. The latter areas border on other BP property with no active land use, and the functions often provided by buffers are less important or are provided by the wetland.

5.4.8 Land Use

Although the BP Cherry Point property north of Grandview Road is zoned for 'light impact industrial' development, BP intends to maintain this area in a natural state. As stated earlier, the CMAs primarily contain abandoned pasture that has not been cultivated in over 10 years. These areas are currently utilized by the Washington Fish and Wildlife Service (WDFW) to produce grain for ring-necked pheasants, which are released here each autumn for the relatively few hunters that pursue them. These areas endure only occasional human traffic. WDFW in conjunction with Ducks Unlimited has also constructed two ponds, both of which provide habitat for waterfowl. The grain-production areas and ponds are located over several hundred feet from the proposed CMAs and no major conflicts with hunters are expected (Reed pers. comm. 2002).

A large area overlapping most of CMA1 is open to cattle grazing under a 5-year contract with a dairy farmer that began in 2001. Typically, the approximately 60 cows and 25 calves congregate on the hill where they have been fed hay through the winter. However, the cattle are free to enter the wetland through a gate that is open for most of the growing season. During this time, the cattle graze virtually all the herbaceous species present within the grazing area, including slough sedge. Observations of the grazed area in October 2002 found that herbaceous plant species diversity has increased substantially since before the grazing began. In addition, the surface layer of the soil appears slightly disturbed by the trampling effect of the cattle. Since the grazing contract is revocable, the cattle will be readily removed before compensatory mitigation is initiated.

The meadow areas west of CMA2 and east of CMA1 are also within the BP Cherry Point property and therefore will be retained as undeveloped areas. The riparian forest to the north serves as the buffer area for Terrell Creek and thus is off-limits to development.

Current and expected future land uses in the area near the CMAs are not likely to deter enhancement of the CMAs or degrade their functional performance over time. Air quality modeling indicates that emissions from the cogeneration facility will not significantly affect current ambient air quality in the area (Golder Associates 2003d). Although residential development may increase to some degree over the next few decades, the areas adjacent to the CMAs will likely retain their rural character. The nearest properties to the CMAs outside BP ownership are north of Terrell Creek and are approximately 0.25 miles away. Although it currently conveys light to moderate traffic, Blaine Road and the portion of Grandview Road east of the

intersection with Blaine Road (also known as State Route 548) is not likely to be expanded at any time (Lee pers. comm. 2003). Since the portion of Grandview Road west of its intersection with Blaine Road conveys only light traffic, this area will not likely be expanded either.

5.5 CONSTRAINTS

Vandalism by trespassers may be the only constraint to mitigation success that is outside the owner's control. However, no vandalism has occurred to the existing mitigation site located just west of CMA2 and none is expected to occur in the CMAs. The mitigation sites are within BP Cherry Point property near the refinery and currently undergo regular security checks by the existing security contractor.

5.6 SITE PLAN

5.6.1 Hydrologic Modifications

The hydrologic modifications proposed for the CMAs include plugging (filling) portions of some ditches in both CMAs, directing stormwater runoff to CMA2 from the detention pond to be constructed at the plant site, and excavation of swales to ensure that runoff is dispersed across a wide area of CMA2. These modifications will restore historic drainage patterns, further improve water quality of the runoff from the detention pond, and reduce drainage efficiency, thereby increasing hydrologic storage.

The portions of ditches within the CMAs that will not be filled lack the potential to contribute to hydrologic restoration. Because these ditches convey relatively high flows during winter storm events, filling them would likely cause erosion (possibly gullyng) and ultimately not improve hydrologic storage or performance of hydrologic functions on the site.

Figure 8A contains the plan drawing showing modifications proposed for CMA1 and Figure 8B contains cross section drawings detailing ditch plugging proposed for CMA1. Figure 9A contains the plan drawing showing modifications proposed for CMA2 and Figure 9B contains the cross section drawings detailing ditch plugging proposed for CMA2.

The locations of the main ditches within CMA1 and CMA2 as they currently exist are shown in Figure 5A and Figure 5B. Native soil will be used to plug the upper (southern) portion of the main ditch in CMA1, the shallow ditch that extends east-west in the northwestern part of CMA1, the upper (eastern) portion of the east-west ditch in CMA2, and the upper (southern) portion of the ditch along the west boundary of CMA2.

To the extent practicable, soil from spoils cast adjacent to the ditches will be used to fill the ditches. Soil excavated upon creating the inlet channel and some broad swales will also be used to fill ditches. The areas immediately surrounding the ditches to be filled may be recontoured to further simulate historical topography. The areas recontoured as part of the ditch filling and swale creation will be planted and seeded with native plants.

Directing stormwater runoff to CMA2 will require piping runoff from the proposed detention pond for the plant site to a channel that will be constructed in the eastern portion of CMA2. Treated runoff from the detention pond will be directed west along the south edge of Grandview Road and then north through a

culvert to be installed under Grandview Road. Runoff will then lead north through an approximately 1,050-foot long inlet channel to be excavated near the east edge of the site.

The inlet channel will be constructed to match the existing very gradual slope (0.3%) with a two-foot base and half-foot depth below the existing ground surface. Additional depth within the channel will be created by constructing berms to surround the channel. Except for the sections of the berm that will serve as outlets, the berm will be constructed of compacted fill excavated from other portions of CMA2. The channel bottom and berms have been designed to tolerate colonization by unmaintained vegetation.

Six 'dispenser outlets' consisting of 75-foot wide sections of permeable material (coarse sand and gravel) will be installed in the western berm. The dispenser outlets will be constructed at strategic locations along the western berm of the channel so that runoff will be spread across a wide portion of CMA2. The dispenser outlets will also dissipate flow energy, releasing water at relatively low rates to prevent erosion. The stormwater will seep through the gravel and continue westward down the slope as sheet flow and semi-concentrated flow. Construction drawings detailing the inlet channel and its dispenser outlets are shown in Figure 9C.

The inlet channel is designed to provide dispersed stormwater flows to CMA2 while limiting grading activities within existing areas. The channel is placed near the top of a broad west-facing slope within CMA2. The shallowly excavated channel will allow flow to exit the channel through the dispenser outlets during most wet season storm events. To ensure even distribution of flow amongst all the dispenser outlets, water levels in the channel will be controlled by adjustable weirs or similar devices. The culvert outlet (inlet to the inlet channel) will also be designed to allow minor adjustments in constriction. With these adjustable features, minor changes in channel flow may be made during the first 1 to 2 years after installation to maximize flow dispersal. If necessary, further adjustments with these features may be made as site conditions change.

Flow from the northern portion of the inlet channel will lead west and northwest through three broad swales to be excavated within the upland area that exists just west of where the inlet channel will be constructed. Although it is not clearly shown in Figure 5B, the existing elevation of the eastern portion of this upland area is slightly above the location of the proposed outlets in the northern portion of the inlet channel. Thus, creating these swales is necessary to encourage overland flow to continue westward to prevent it from flowing southward as a result of the existing topographic obstructions. As a result, it ensures that runoff will be dispersed over a wide area. Excavation of the swales will lower surface elevations no more than 1 foot across portions of the upland that are approximately 50 feet wide. The slope and aspect of these swales will remain very similar to existing conditions, but the lowered elevations will allow surface water to flow through them. Cross-section drawings detailing swale excavations are shown in Figure 9D.

The inlet channel will not be extended across the entire length of CMA2 (approximately 1,600 feet north-south) because the topography north of the existing east-west ditch does not permit overland flow to travel westward. Several seasonally inundated wetland areas currently convey flow in ephemeral minor channels southward to the ditch. Any runoff introduced to these wetlands would be captured by these minor channels and carried to the newly filled ditch. The channel stops short of this ditch to prevent directing flows there that would erode newly placed material. Thus, extending the inlet channel to its proposed

terminus maximizes flow dispersal across CMA2 without creating a potential source of erosion and siltation.

5.6.2 Post-mitigation hydrologic pathways and rates

Figures 10A and 10B show the expected post-mitigation hydrologic pathways and surface flow rates within and downgradient of each CMA as a result of the proposed hydrologic modifications. As with existing conditions, post-mitigation flow will occur in ditches, in natural channels, over wide areas as sheet flow, and through subsurface pathways.

Stormwater runoff from the two proposed detention ponds will be directed to areas north of Grandview Road and west of Blaine Road. The majority of discharges from the detention pond for the plant site will drain to CMA2 via the culvert that will be constructed under Grandview Road just west of its intersection with Blaine Road. The pond will be designed so that only when outflow rates exceeding the rate expected to occur during the 6-month, 24-hour storm will pond runoff be directed to the existing culvert under Grandview Road that leads to the large ditch along the east side of Blaine Road. According to preliminary calculations derived from the original detention pond design work (Golder Associates 2002), outflow from this detention pond during the 6-month, 24-hour storm event will be approximately 1.33 cfs. All discharges from the detention pond for Lay-Down Areas 1, 2, and 3 and the contractor's parking lot will drain to a ditch that currently leads to a culvert under Grandview Road to a series of ponds and wetlands connected by well-vegetated channels and swales.

Estimates of flow rates were made for the 6-month, 24-hour storm event by summing expected discharge rates for these storms from the detention ponds (as determined by the pond design calculations) and flow rates for existing conditions estimated using the SCS method. The increase in flow rate in ditches and channels downgradient from the input points is predicted to be slightly less than the increase in flow rate at the input points due to flow attenuation by soil and depressional storage. Although flow will be progressively reduced as it travels downgradient, these reductions will not be equally progressive due to variations in topography and vegetative roughness.

Filling the upper portion of the main ditch and the entirety of the minor ditch in CMA1 will reduce drainage rates from this site. However, the extent of seasonally inundated area is only expected to increase near the upper portion of the main ditch since the minor ditch supports relatively low flow rates.

The proposed hydrologic modifications will slightly increase constrictions to surface water flow both CMAs. Filling large portions of existing ditches will reduce the rate of surface water drainage, thereby increasing the extent of seasonal inundation. The frequency, duration, and magnitude of inundation will increase substantially in low-lying areas immediately upgradient from the portions of the ditches that will be filled. In CMA1, this area is constricted to the area near the main ditch south of the existing aspen stand (Figure 10A). In CMA2, the increase in seasonally inundated area will be greatest immediately downgradient of the inlet channel, east of the forested patch, and south of the forested patch (Figure 10B).

Runoff released from the proposed inlet channel will flow westward across a wide portion of CMA2 and downgradient areas. From the disperser outlets, surface water will flow west and northwest as sheet flow and semi-concentrated flow. Flow from the southern portion of the inlet channel will lead westward across CMA2 and off-site to the south of the large forested patch located just west of the main body of CMA2.

Surface and ground water flow that would have been directed north by the existing ditch along the west edge of CMA2 will instead go further west due to the proposed ditch plugging. This water will then lead north and then west across a broad meadow area until it enters the relatively flat wetland area just east of the large WDFW pond.

Flow from the northern disperser outlets will lead to the seasonally inundated area located just east of the large forested patch. The additional surface water introduced to the seasonally inundated area will cause it to have increased duration, magnitude, and frequency of inundation. This area will drain to the portion of the west-flowing ditch that runs through the northern part of the large forest patch. Flow in the west-flowing ditch follows a somewhat complex path, but most flow eventually joins Terrell Creek near Jackson Road.

As mentioned earlier, a substantial amount of water from the west-flowing ditch currently leads north to become dispersed across a wide portion of the CMA2 panhandle. It is expected that a substantial amount of water introduced by the inlet channel will follow these existing pathways and increase moisture levels across a wide portion of the CMA2 panhandle. As a result, the extent of seasonally inundated area in the panhandle will increase in areas where shallow inundation currently occurs.

The drainage pathways west of CMA2 are complex and extend for over 0.5 mile through ponds, connecting channels, and wetlands before crossing by culvert under Jackson Road to Terrell Creek. Thus, runoff delivered to these areas will more closely follow historic drainage patterns rather than being ditched or tightlined directly to the creek. In addition, the potential to improve water quality of this runoff will be maximized. The runoff will also provide additional surface water to the ponds, most of which have their levels controlled by artificial structures such as culverts and weirs.

It must be noted that at least 1.2 acres of existing upland scattered across the main body of CMA2 are expected to become wetland. These areas are mainly on slightly elevated ground near areas that will likely be subjected to increased soil saturation and inundation. At least 0.25 acres of this wetland conversion area consists of the three swales that will be excavated from the existing upland in the eastern portion of the site. Although the likelihood of conversion is high, it is not high enough to allow BP to gain extra mitigation credit for creating wetlands.

5.6.3 Soil

The native soils within the CMAs will serve as an adequate growing medium for the plants to be installed. Most of this soil typically consists of a silt loam or loam surface layer that is 10 to 14 inches deep. Subsoil layers are typically silt loam or sandy loam that are 8 to 16 inches thick. See the *Revised Cogeneration Project Compensatory Mitigation Areas Wetland Delineation Report* (URS 2003a) for more information about on-site soils.

Soil disturbed by tilling or filling may be covered with mulch or erosion-control matting to prevent soil erosion. These areas will then be replanted with native vegetation as soon as practicable. The created swales and filled ditches in both CMAs will be designed to encourage colonization by vegetation and will be seeded with the native seed mix.

5.6.4 Habitat Features

A number of habitat features will be distributed across the CMAs. The habitat features planned for the site will provide structure to encourage habitat utilization by native wildlife species.

At least 330 downed logs (3 per acre) will be placed across the CMAs. Some of these logs will be derived from the trees that will be removed for construction of the Cogeneration Project. A few others will be taken from the downed logs recently created by construction of an access road on the BP Cherry Point property south of Grandview Road. In addition, approximately 55 non-native cedar (*Cupressaceae* family) trees will be cut from a windbreak that protects an abandoned orchard plot located just north of CMA2. The windbreak trees are approximately 30 feet tall with 8-inch dbh. The proposed tree cutting will reduce the tree density to 9-feet on-center, which will allow the remaining trees to accelerate their lateral and vertical growth. The logs will act as habitat features by providing foraging opportunities, cover, and perching or haul-out sites for small mammals, birds, and amphibians (Stevens and Vanbianchi 1993).

A number of artificial snags (dead-standing trees) and wildlife brush shelters will be erected on site. In addition, woody branches will be placed in seasonally inundated areas. The materials, specifications, and benefits for these habitat features will be as described in Section 4.6.4.

Several small (<0.5 acres) seasonally inundated shallow ponds will be established on CMA 1 and 2 to promote native amphibian production. Seasonally inundated ponds dry up during the dry season making it impossible for non-native bullfrogs to successfully breed because of their two year tadpole cycle.

Habitat features are designed to benefit the local breeding great blue heron population. Woody debris, eradication of invasive vegetation, and establishment of small seasonal ponds all provide increased opportunity for heron foraging. Details of these benefits are available in the appendix F – *BP Cherry Point Cogeneration Facility Wetland Mitigation and the Birch Bay Great Blue Heron Colony*.

5.6.5 Vegetation Establishment

The distribution of plant communities to be established in CMA1 is shown in Figure 11A and the distribution of plant communities to be established in CMA2 is shown in Figure 11B. The plant communities planned for the CMAs are the same as those planned for the Restoration Areas. Plant species composition, spacing, condition, and size for these communities are shown in Tables 5 to 8 and discussed in Section 4.6.5. The requirements for the Restoration Areas regarding plant stock, installation, seedling protection, and maintenance will also apply to the CMAs.

As with the Restoration Areas, planting will be accomplished in a multi-phase approach. Planting will be especially limited across portions of CMA2 to be affected by the proposed hydrologic modifications in the first 1 to 2 years following the implementation of the hydrologic modifications. This will prevent subjecting large numbers of installed plants to a hydrologic regime inappropriate for their establishment and allow greater flexibility in treating reed canarygrass. Close observations of the new hydrologic regime over the first few years will help guide placement, species composition, and condition of the plants that will be installed during this time.

The seed mix depicted in Table 8 will be applied to the interstitial areas between installed plants wherever tilling occurs in the CMAs. As discussed earlier, tilling will occur prior to the initial planting phase in all of the 44.26 acres mapped as having $\geq 20\%$ reed canarygrass cover. However, the mix will only be applied to the interstitial space between mulch rings, which should comprise approximately 85% of the tilled areas. Thus, the actual area upon which this seed mix will be applied is 37.3 acres. As with the Restoration Areas, the total seeding rate will be 40 pounds per acre, which is a relatively high seeding rate for mitigation areas.

5.6.6 Irrigation

The methods of irrigation proposed for the Restoration Areas will also be applied to the CMAs. All portions of the CMAs where trees and shrubs are installed will receive irrigation.

Given typical summer precipitation amounts, providing 0.5 inch of water per week to the CMAs (110.1 acres), the Restoration Areas (9.3 acres), and the visual buffer to be forested (1.8 acres) will require approximately 124,000 gallons of water per day. This volume is roughly equivalent to 0.38 acre-foot per day or 0.19 cubic foot per second (cfs). If summer precipitation is 30% below normal, then meeting the irrigation goal will require approximately 323,400 gallons of water per day. This volume is roughly equivalent to 0.99 acre-foot per day or 0.5 cfs.

Normal rainfall is considered a monthly or yearly amount that is above the lower 30% and below the upper 30% (z-values between -0.524 and 0.524 according to the standard normal distribution) of the amounts shown in NRCS's WETS table (NRCS 1999) for the Bellingham International Airport. Although this weather station is no longer operating, precipitation data from this station located within 12 miles of the CMAs spans over 20 years and is therefore a reliable source for comparison with current and future precipitation data.

6.0 CONSTRUCTION SPECIFICATIONS & AS-BUILT REPORT

Installment of topographic and hydrologic modifications, habitat features, plants, seeds, mulch, soil amendments, erosion control matting, and other features within the mitigation areas will be achieved by local contractors with proven experience. Work requiring heavy machinery, such as the proposed topographic and hydrologic modifications, will likely be awarded to Donaghy Construction, a local firm that was provided construction services to BP Cherry Point for many years. Other work that is more labor-intensive, such as installing native plants, will be rewarded to a local bidder that demonstrates competence and relevant experience.

Upon completion of the mitigation areas construction, an as-built report will be generated documenting the final grading, hydrologic pathways, and planting schemes. The report will include the elements recommended in *Guidelines for Developing Freshwater Wetlands Mitigation Plans and Proposals* (Hruby and Brower 1994). The as-built report will provide a time zero baseline comparing the actual changes in site hydrology, identifying the success of invasive vegetation eradication, and the final woody and herbaceous plantings layout. The report will also include photographs of the wetlands taken from permanent reference points. The baseline information will be used for calculating the success of the performance standards in subsequent monitoring reports and assist in identifying required planting replacements, if needed.

The primary source for plant materials and fertilizer will be Fourth Corner Nurseries, which is located in Bellingham. The plants that they provide are primarily derived from stock taken from lowland areas in Whatcom County.

As with the existing compensatory mitigation site, the primary contractor that will supply maintenance for the mitigation areas will likely be Berry Acres. Berry Acres is a professional landscaping company that has been providing landscape maintenance services to BP Cherry Point for several years. URS will regularly communicate with the contractors who will carry out maintenance tasks. The maintenance crew will be responsible for operating the irrigation system, controlling exotic plant populations, providing plant protection (replacing seedling protection tubes), and regularly reporting to URS ecologists who will make recommendations for adjusting the maintenance regime as necessary.

7.0 SITE PROTECTION

A restrictive covenant on the deed will be applied to the Restoration Areas and CMAs to ensure that they remain in their respective natural states in perpetuity. No development of the CMA portions of the BP Cherry Point property will be allowed for any purpose by any entity whatsoever. The restrictive covenant on deeds pertaining to the restoration areas shall restrict all activities except those associated with maintenance of utilities and their corridors. Any clearing, grading, or filling will be prohibited except to achieve changes required to meet mitigation requirements or further improve performance of wetland functions. No deposition of materials or fills as a result of any clearing, grading, or development of any property will be allowed. The restrictive covenant will run with the land and inure to the benefit of and be binding upon BP, their successors, and assigns.

To temporarily protect the restored areas from human trespass, brightly colored rope fences will be strung on wooden stakes around the perimeter of each Restoration Area and each CMA. The fences will be intended to discourage people from disturbing the installed plants through physical harm and incidental introduction of non-native, invasive grass seed. The fences will remain in place for 5 years or until it is judged that the installed plants within the mitigation areas no longer require such protection. Small signs explaining the intent of the fences and the mitigation project will be erected at strategic locations along the borders of each mitigation area.

The people who will access the Restoration Areas will be restricted to BP employees and official visitors to the BP Cherry Point facilities. The chain-link/barbed-wire fences to be erected around the Cogeneration Project area will encompass each Restoration Area, thereby preventing trespassers from accessing these areas. Except for maintenance crew people and URS scientists, access to the Restoration Areas will be restricted to the walking path to be constructed in the West Restoration Area. Colored rope fence will be installed along both sides of the path to encourage people to stay on the walking path and not disturb the Restoration Areas.

Public access to the portions of the BP Cherry Point property north of Grandview Road, which encompasses the CMAs, will continue to be open to the public. The majority of the people that access these areas are the hunters that pursue ring-neck pheasants released here during early autumn. BP will continue to allow pheasant hunting and other activities in these areas as long as they cause no harm to the CMAs.

Cattle, or any other domestic animals, will no longer be allowed to graze in any of the mitigation areas. The grazing contract for the area overlapping with CMA1 would be revoked or modified to prevent cattle from grazing within 100 feet of this area.

Regular security checks by the existing security contractor will discourage vandalism in the CMAs, although it is not expected to be a problem.

8.0 MONITORING PLAN

The purpose of monitoring and maintenance is to ensure that mitigation plan goals are met. Construction of the power plant and the lay-down areas will be monitored to ensure that wetland impacts are avoided and minimized according to plan. The Restoration Areas and CMAs will be monitored over a 10-year period to ensure that these areas function as designed.

Monitoring of the proposed restoration and compensatory mitigation will be guided by the conditions contained in this plan including pre-established performance standards. A 10-year monitoring plan will be implemented to assess the degree to which objectives and performance standards (Section 3.3) are being met. Monitoring will be conducted by a URS biologist immediately following the initial planting, and 1, 2, 3, 5, 7, and 10 years afterward.

Maintenance will be guided by maintenance actions required by this plan (Section 9) and any recommended contingencies made following implementation of the plan. The majority of maintenance activity will be directed towards removing non-native plants that resprout after initial suppression. However, other maintenance actions tending to the proposed hydrologic modifications and the installed plants may also be necessary. Contingency measures will be recommended and subsequently implemented if site conditions fail to attain expectations. Expectations of site performance are elucidated by the performance standards, which are discussed in Section 3.3 of this report.

8.1 CONSTRUCTION MONITORING

A URS scientist will monitor construction operations regularly during the time of construction. The scientist will monitor operations to ensure that impacts only occur in areas where they have been designated to occur. Vegetation clearing and fill placement will be monitored regularly.

Contingencies will be made if the extent of impacts is greater than expected. All unexpected impacts will be compensated by enhancements of equal or greater value to the compensatory mitigation. Monitoring results will be compiled in a construction monitoring report. The report will be sent to the Corps, Ecology, and EFSEC. Any discrepancies between expected and actual impacts will be mentioned in the report. In addition, contingencies used to compensate for these unexpected impacts will also be mentioned.

8.2 RESTORATION AND COMPENSATORY MITIGATION MONITORING

Monitoring procedures for the Restoration Areas and the CMAs will be similar. Monitoring will determine whether site conditions are meeting performance standards and are likely to continue meeting performance

standards throughout the monitoring period. Since removal of the temporary lay-down areas and the subsequent restoration will begin approximately 2 years after project construction is initiated, the monitoring period for the Restoration Areas will begin approximately 2 years after the monitoring period for the CMAs begins.

8.2.1 Wetland Hydrology

Monitoring will assess the hydrologic regime of the Restoration Areas and the CMAs. This monitoring effort will determine whether a wetland hydrologic regime is occurring in the wetlands restored in the Restoration Areas and will generally characterize the hydrologic regime of both uplands and wetlands in both the Restoration Areas and the CMAs.

At least four shallow monitoring wells will be installed in Restoration Areas and six in CMA 1. Between 15 and 20 shallow monitoring wells will be distributed across CMA 2. The majority of the wells will be placed in locations representing typical hydrologic regimes in both the SS and SI wetland areas down gradient of the level spreader. The remaining wells will be installed in locations representing typical hydrologic regimes in the upland areas. Wells will consist of a screened (perforated) pipe installed to the depth of the fine-grained substrate that forms an aquitard and sealed at the soil surface with bentonite and/or grout.

Both surface water gauges and shallow monitoring wells will be monitored within the compensatory mitigation site. Monitoring activities will follow the program outlined in the Cogeneration Project Hydrologic Monitoring Work Plan (Appendix G). For each well and gauge, statistical comparisons will be made between the data collected before and after hydrologic modifications associated with the mitigation are implemented. Special attention will be paid to the level of the free water surface both above and below ground and its fluctuation over time. Inter-annual comparisons will be adjusted by differences in precipitation that occur between the years being compared. As mentioned in Section 3.3.1, those gauges that demonstrate increases in saturation or inundation persistence independent of increases in precipitation levels will be determined to be within areas that have become 'hydrologically restored'.

Depth to soil saturation and free water surface within the wells will be measured during the early part of the growing season, which is the time when soil saturation will most likely be present within wetlands in western Whatcom County.

Observations of standing surface water and groundwater levels will be made in both the Restoration Areas and the CMAs. In addition to well monitoring, groundwater observations will be made by excavating temporary unlined boreholes with a soil corer to depths not more than 18 inches. The holes created by a soil corer are typically less than 3 inches in diameter and thus have very little impact to the site. Boreholes will be excavated across various portions of the mitigation areas that lack standing water during the time of investigation. Depth to soil saturation and free water surface will be measured within each borehole. These observations will be made during the early and middle portions of the growing season.

8.2.2 Hydrologic Modifications

Hydrologic modifications including the diversion of ditch flow through the West Restoration Area, the diversion of detention pond runoff from the plant site to CMA2, and the various ditch plugs to be installed

across both CMAs will be monitored for proper operation. These modifications will be inspected at least once every winter or spring while surface water is flowing through the inlet channel and once during the vegetation monitoring event of each monitoring year. Inspectors will determine the structural integrity and stability of channels, pipes, energy dissipaters, and other structures used for the proposed modifications.

Surface water flow and evidence of surface water flow will be observed to determine whether the actual altered hydrologic regime approximates the design. Any unexpected and harmful erosion or flooding will be recorded and appropriate contingencies to reduce and repair damage will be recommended. Monitoring of the modified hydrologic regime will be especially careful and frequent during the first two years after installation. Results of this monitoring, combined with rainfall data analysis, will help guide the location and species composition of any new plants to be placed in areas where the hydrologic regime has been altered.

8.2.3 Vegetation

URS will locate plots along transects that span the width of each Restoration Area and each CMA. Transect locations will be dispersed across the sites using a stratified random approach to prevent biased plot placement. Both transect and plot locations will be recorded by a GPS unit with sub-meter accuracy. The GPS unit will also be used to determine the planned plant community (Upland, SS wetland, or SI wetland) and the pre-mitigation cover by reed canarygrass (<20%, 20-95%, or >95%) for each plot.

Each transect will be oriented longitudinally (north-south) and randomly situated within 100-meter wide (328-foot wide) bands. Each band will be spaced 10 meters apart to prevent transects from being too closely spaced. Transects will be broken into 100-meter long (328-foot-long) segments, which will also be spaced 10 meters apart from each other. Sample plot centers will be randomly selected along each segment during each sampling event (Figure 12).

Plots will consist of an inner circle with a 2-m (6.56-foot) radius encompassed by an outer circle with an 8-m (26.24-foot) radius. Cover of herbaceous vegetation will be gauged within the inner circle whereas cover of installed woody vegetation will be assessed within the outer circle.

Vegetative survival and cover will be visually estimated by experienced URS ecologists. Woody vegetation success will be gauged by percent survival during the first five years and by percent cover during the remaining five years of mitigation monitoring. Herbaceous vegetation will be measured by percent cover throughout the entire monitoring period. Cover of volunteer plants (vegetation not planted or seeded during any planting events) will be measured for both herbaceous and woody species found within the plots. Cover of trees and shrubs, herbaceous plants, and each plant species will be recorded for each plot. Plant cover will be assessed using a geometric cover classification system with the following categories: 0-2%, 2-4%, 4-8%, 8-16%, 16-32%, 32-64%, >64%. This system facilitates precise assessment of plant cover in the lower ranges, which is especially important for monitoring the spread of recently established vegetation.

As recommended by Krebs (1999), at least 1% of the total area to be monitored will be sampled directly. Since each plot will cover approximately 2,162 ft² (0.05 acre), at least 10 plots will be used to sample the Restoration Areas and at least 60 plots will be used to sample the CMAs.

Since invasion by non-native, invasive plants will likely be aggressive, monitoring the cover of non-native, invasive species will be persistent and intensive. In addition to monitoring by plot method as described above, URS ecologists will observe and record the distribution and abundance of non-native, invasive plants each spring and summer in every year of the 10-year monitoring period. Eradication of non-native species will be maintained in all mitigation areas, including uplands and buffer areas.

Those portions of the CMAs that currently have greater than 20% cover by reed canarygrass will have a performance standard of <20%. Portions of the CMAs that currently have less than 20% cover by reed canarygrass will have a performance standard of <10%. Since the Restoration Areas will have less than 20% cover by reed canarygrass immediately prior to initiating restoration activity, only the performance standard of <10% will be applied to these areas. As recommended by Krebs (1999), at least 1% of the total area to be monitored will be sampled directly.

Areas with levels of non-native, invasive plants that appear to be approaching or exceeding performance thresholds will be marked in the field so that the maintenance crew can more accurately target their treatment practices. These unacceptable patches will also be mapped by URS ecologists with a GPS unit with sub-meter accuracy. Results of this monitoring will guide recommendations given by URS to maintain cover by non-native, invasive plants below thresholds set by the performance standards.

Although predation of installed plants has not been a problem at the existing mitigation site, URS ecologists will document any evidence of predation that may occur within the mitigation areas. URS will observe the condition of seedling protection tubes and any other protections provided to installed plants. The effectiveness of these protections will also be monitored. URS will ensure that seedling protection tubes or any other protections provided to installed plants will be in working condition.

8.2.4 Photographs

Several photographs taken from permanent photo-points will be used to aid the monitoring effort. Panoramic photographs showing a maximum amount of each Restoration Area and each CMA will be included. Each permanent photo-point will have its respective Universal Trans-Meridian (UTM) point as recorded by GPS and a detailed narrative description referencing its location relative to existing landmarks. Photos from the permanent photo-points will be taken during each vegetation monitoring event in Years 0, 1, 2, 3, 5, 7, and 10 of the monitoring period. For Year 0, photographs will be taken prior to and during initial mitigation activity. Other photographs may be taken during spring to better document each site's flow regime during the wet season. The photos and their respective narrative descriptions will be provided in each monitoring report.

9.0 MAINTENANCE AND CONTINGENCY PLAN

As mentioned earlier, the primary sub-contractor that will supply maintenance crews will likely be Berry Acres, a crew of landscape professionals with experience in native plant installment and exotic plant control. Sub-contractors will report regularly to URS ecologists who will make recommendations for adjusting the maintenance regime as necessary.

Restoration of the Restoration Areas and rehabilitation of the CMAs will be accomplished under an adaptive management strategy. This strategy will entail responding to monitoring results to appropriately and efficiently maintain or improve site conditions.

If monitoring results demonstrate that site conditions fail to meet performance standards, contingencies will be implemented. For instance, if one of the non-native, invasive species attains cover values that exceed their acceptable thresholds, then a more aggressive approach to weed control will be taken. Such an approach may include more frequent applications of herbicide, more frequent hand-removal, and/or more frequent mowing. These actions may be complemented with additional plantings and/or seedings in problem areas.

If a performance standard is not met for any given year, URS will analyze of the cause of failure, propose corrective actions, and present a time frame for implementing these actions. A letter report will be sent to the Corps and Ecology for their approval before implementing the corrective actions.

Even if all performance standards are met, corrective actions may still be implemented if monitoring reveals problems that could lead to poor performance or future problems. For instance, if a breach in the inlet channel is causing erosive flows to be directed through a part of CMA2, then the breach will be repaired to restore sheet flow and the eroded area mended with seed mix, mulch, and/or new plantings, as necessary. Descriptions of such problems and corrective actions taken to solve them will be included in the monitoring reports.

Examples of problems expected during the maintenance period and the corrective actions that will likely be taken to solve them are as follows:

- 1. Wetland hydrology.** If wetland hydrology (free water to within 12 inches of soil surface over 22-contiguous days) is not established in at least 4.86 acres of the Restoration Areas and maintained in the existing wetlands within the CMAs, then further topographic or hydrologic modifications will be made to ensure that these objectives are met. Topographic modifications may include re-grading portions of the site to effectively raise the groundwater in these areas. Hydrologic modifications may include adjusting the adjustable weirs to be installed so that more surface flow could enter an area that is not meeting the minimum requirements of wetland hydrology.
- 2. Flow dispersal.** If flow is not evenly distributed between all disperser outlets within the inlet channel to CMA2, then the adjustable weirs within the channel will be adjusted to maximize flow distribution. If flow is evenly distributed between disperser outlets, but is not adequately dispersed across the main portion of CMA2, then URS will recommend grading appropriate to maximize flow dispersal. Any grading that occurs after the initial planting will be accomplished during the dry season and with a small grader or shovels to avoid damaging native plants. To prevent erosion, grading would occur during the dry season and the native seed mix would be applied to areas that have been disturbed.
- 3. Invasion by non-native, invasive plants.** Weed control maintenance will occur frequently and aggressively to combat invasions before cover by non-native, invasive plants approach or exceed performance thresholds. As discussed earlier, distribution and abundance of weeds will be

monitored every year of the 10-year monitoring period by URS. Those portions of the CMAs that currently have greater than 20% cover by reed canarygrass will have a performance standard of <20%. Portions of the CMAs that currently have less than 20% cover by reed canarygrass will have a performance standard of <10%. Since the Restoration Areas will have less than 20% cover by reed canarygrass immediately prior to initiating restoration activity, only the performance standard of <10% will be applied to these areas. Monitoring results will guide recommendations given by URS to maintain cover by non-native, invasive plants below the above thresholds. Although removal of non-native, invasive plants is expected to occur throughout the 10-year period, the intensity of the maintenance effort should decrease over time. Following any monitoring year when standards are not being met, additional control and replacement measures will be added to maintenance activities. More information about the weed control program is in Section 4.4.3.

4. **Mortality of installed vegetation.** The multi-phase approach to planting described in Section 4.6.5 also follows an adaptive management strategy. URS ecologists will closely observe the various limitations to plant growth that may be present or may develop during the first few years after the initial planting. These observations will effectively guide placement, species composition, and condition of the plants that will be installed during this time. Special attention will be paid to site conditions in those portions of the mitigation areas affected by the proposed topographic and hydrologic modifications. If, during the monitoring period, the woody species survival or areal cover percentage or the herbaceous community percent cover falls below the established performance standard, additional plantings will be used to bring survival and / or percent cover up to stated goals.

If predation on installed plants by wildlife becomes a substantial source of plant mortality, then corrective action will be taken. If predation is generally restricted to those seedlings that have lost their protection tubes, URS will recommend that these plants be replaced with protection tubes fitted so that they are less likely to fall off. Tubes that have not fallen off their respective plants but appear unstable will be stabilized. BP will budget funds as required to pay for planning, implementing, and monitoring any contingency procedures that may be required to achieve the mitigation goals. The budget will equal approximately 20% of the total cost of the proposed mitigation, which is estimated to be \$1.66 million. Thus, the total value of the maintenance and contingency budget will be \$332,000. The parent company guarantee, as described in section 11, will be in the total amount that it is estimated that the restoration and compensatory mitigation will cost and thus will be sufficient to ensure that funds necessary for maintenance and to repair problems will be available.

5. **Reporting.** Results of the monitoring will be compiled in monitoring reports that will be delivered to the Corps, EFSEC, and Ecology by October of Years 1, 2, 3, 5, 7, and 10 for each monitoring period. Reports will state monitoring methods, show monitoring results including photographs, compare these results with performance standards, and discuss the site conditions observed. The current year's results will be compared with the performance standards and results from previous years. If monitoring results are below performance standards, maintenance and contingency recommendations necessary to improve success will be made.

Regular maintenance activity and any contingency actions made during the year will also be reported. The effectiveness of these actions will be gauged during site monitoring. An evaluation of the effectiveness of these actions will be included in the reports.

Record drawings showing topography, hydrologic modifications, and plant communities of the Restoration Areas and the CMAs will be drafted after the initial mitigation activity including the initial planting is complete. These drawings will be submitted to the Corps, EFSEC, and Ecology within 60 days of completing the initial planting of each mitigation area.

10.0 IMPLEMENTATION SCHEDULE

10.1 CONSTRUCTION SCHEDULE

The starting time for constructing the Cogeneration Project and installing its associated mitigation is dependent upon when the necessary permits are issued. Although the chronological order and seasonal timing of mitigation actions will occur as discussed below, exact dates for these actions can not yet be determined given the uncertainty regarding the timing of permit issuance. For illustrative purposes, the dates provided below assume that project construction will begin in early 2005.

In the CMAs, activities of the weed control program that do not entail mechanized clearing of wetlands and therefore do not require the above-mentioned permits may begin a few months prior to the construction start date. Such activities, including mowing and herbicide application, will begin in spring 2005. Tilling would be anticipated to occur in spring and early autumn 2005. Non-native, invasive plant removal would continue through the growing season of 2005. Removal would continue as maintenance for short-term control throughout the monitoring period.

The proposed topographic and hydrologic modifications will be implemented and habitat features would be installed in summer 2005. The initial phase of planting in the CMAs would be implemented in autumn 2005. Species known to be less tolerant of winter conditions as seedlings (i.e. western red cedar) and some of the herbaceous plants would be installed in spring 2006. The native seed will be applied immediately after these plants are installed. The remaining plants would be installed over the next 2 to 3 years. Although the inlet channel would have been fully installed for a year, runoff would not be diverted to CMA2 until fall 2006, which would allow the initial phase plants to have established to some degree.

The proposed restoration would begin after the end of the construction period, which is expected to last 1.5 to 2 years. If the construction period began in spring 2005, the initial restoration activity would occur after the temporary lay-down areas were removed in 2007. Initial activity including topsoil import, hydrologic and topographic modifications, and habitat feature installment would occur during summer 2008. Weed removal would also occur at this time as necessary.

The initial seeding of the Restoration Areas would occur in late summer 2005, a few weeks prior to implementing the initial planting phase. Species known to be less tolerant of winter conditions as seedlings and some of the herbaceous plants would be installed in spring 2008. The second phase of seeding would

occur immediately after these plants are installed. The remaining plants would be installed over the next 2 to 3 years.

10.2 MONITORING SCHEDULE

As discussed earlier, some form of monitoring will occur during every year of the 10-year monitoring period. Formal monitoring of wetland hydrology and vegetation will occur in Years 1, 2, 3, 5, 7, and 10.

Observations of wetland hydrology will be made throughout the monitoring period. Formal monitoring will include measurements of free water surface elevations in the monitoring wells to be installed in the mitigation areas. These measurements will be taken on a weekly basis for at least four weeks from the second or third week of March on or after March 12 to the second or third week of April during Years 1, 2, 3, 5, 7, and 10. Extrapolations between weekly measurements will determine whether soil saturation in the wetland areas meets the wetland hydrology criterion.

Observations of vegetation, native, non-native, invasive, and volunteer, will be made throughout the monitoring period. Formal monitoring will include estimates of cover using circular plots. These estimates will be made during the early part of summer to ensure that flowering plants will be readily identifiable and data collected will not be skewed by seasonal variation. More specifically, vegetation monitoring will occur between June 21 and July 15 of Years 1, 2, 3, 5, 7, and 10.

10.3 REPORTING SCHEDULE

As stated in Section 10, monitoring results will be reported to the Corps, EFSEC, and Ecology by October of Years 1, 2, 3, 5, 7, and 10 for each monitoring period.

11.0 PARENT COMPANY GUARANTEE

BP Corporation North America Inc will provide a guarantee to the Army Corps of Engineer's to ensure that funds are available to construct or complete the construction of, and for monitoring and maintenance of the compensatory wetland mitigation associated with the BP Cherry Point Cogeneration Project. The Parent Company Guarantee will be used instead of a performance bond to ensure BP's accountability for the proposed mitigation. BP will provide the Parent Company Guarantee to the Corps prior to project construction. The amount of the guarantee will equal the estimated dollar amount that the restoration and compensatory mitigation will cost. The preliminary cost estimate of the proposed mitigation, and therefore the proposed amount of the guarantee, is \$1.66 million.

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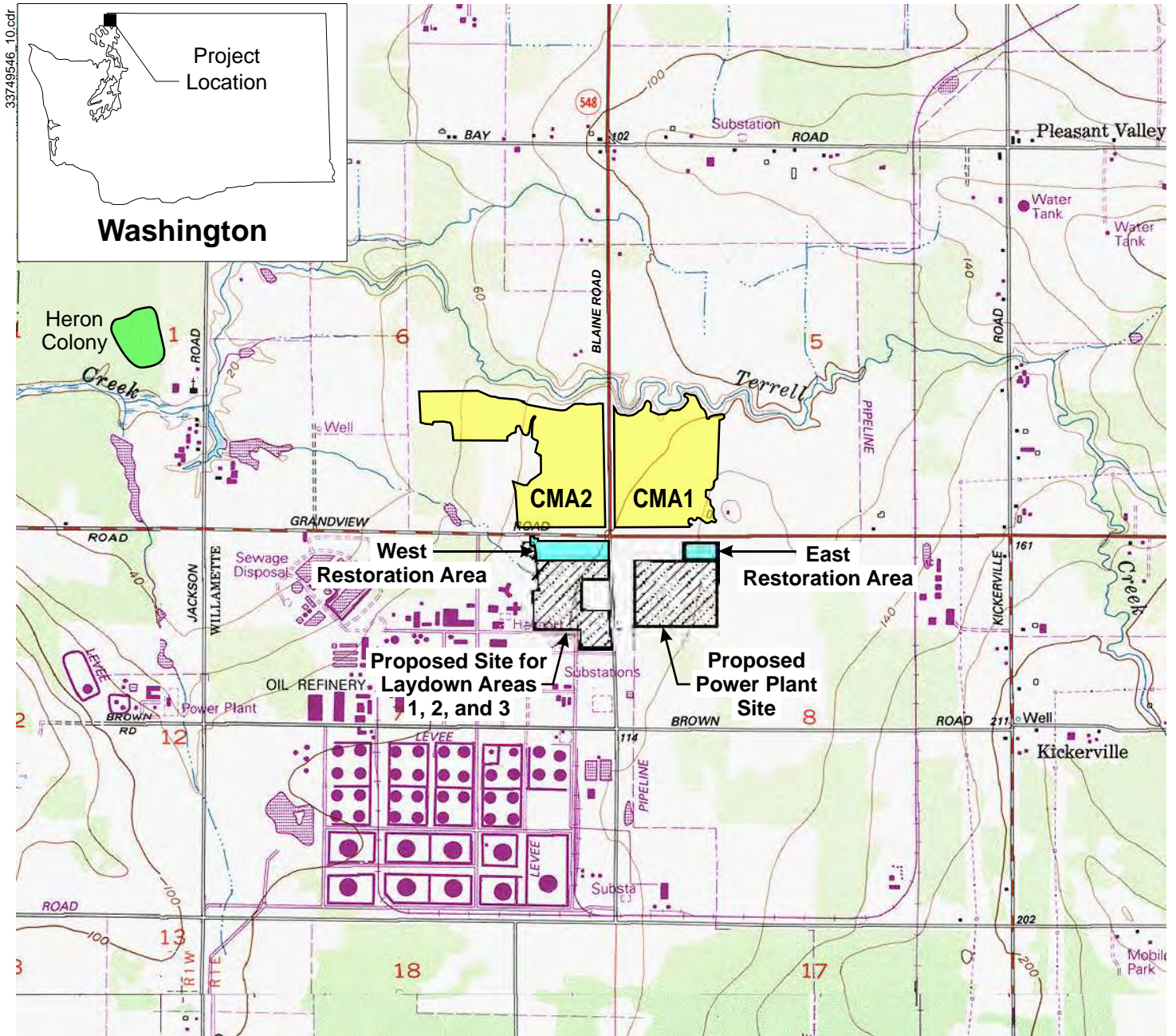
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FIGURES



Map created with TOPO!™ © 1997 Wildflower Productions, www.topo.com, based on USGS topographic map

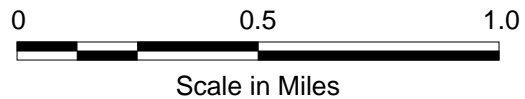


Figure 1
Site Vicinity Map

APPENDIX F

**BP CHERRY POINT COGENERATION FACILITY WETLAND MITIGATION AND
THE BIRCH BAY GREAT BLUE HERON COLONY**

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1.0 INTRODUCTION

BP has proposed to construct and operate a Cogeneration Project adjacent to its Cherry Point refinery. The Cogeneration Project site is located approximately 1.3 miles from the Birch Bay Great Blue Heron Colony, and the associated wetland mitigation areas are located within 0.6 to 1.4 miles of the colony, with more than 90 percent of the mitigation area more than a mile from it. The colony itself is located on land owned by BP, which has been permanently protected by a conservation easement.

Whatcom County has designated the Great Blue Heron as a species of local importance, and has expressed concern about the potential effect of the wetland mitigation plan on heron. In response to the County's concerns, BP agreed to try to modify its wetland mitigation plan to reduce or avoid potential impacts to herons and make the mitigation area more "heron-friendly." However, both BP and Whatcom County acknowledged that BP had been working with federal, state and local agencies for more than a year in developing the wetland mitigation plan, and the basic framework and goals of the plan had been established and would not change. Prior to preparing the Final Wetland Mitigation Plan for the BP Cherry Point Cogeneration Project, BP staff and consultants met with Whatcom County staff and consultants to discuss possible modifications of the wetland mitigation plan. The wetland mitigation plan has been revised in light of those discussions, and those revisions have been incorporated and reflected in the body of the Final Wetland Mitigation Plan and in this appendix.

At the request of Whatcom County, BP has also prepared this appendix to address heron issues specifically. This appendix provides some background information regarding the Birch Bay heron colony, describes the potential impacts of the mitigation plan on herons, and describes the measures that have been included in the wetland mitigation plan to avoid or mitigate potential adverse impacts on the herons. At Whatcom County's request, this appendix and referenced portions of the Final Mitigation Plan provide the information identified in Whatcom County Code section 16.16.730(B)(1)-(3). As a result of the changes summarized in this appendix, the Final Wetland Mitigation Plan avoids or minimizes potential adverse effects on herons, and the Final Wetland Mitigation now includes several features that will increase the usefulness of the wetland mitigation areas for heron foraging.

BP also has another proposed project for which the permit process is nearly complete called the Brown Road Materials Storage Area. For that project, BP has developed a Habitat Management Plan to address the Great Blue Heron. In connection with the Brown Road project, BP has also committed to develop an overarching management plan for their lands north of Grandview Road. The overarching plan is being developed in conjunction with Western Washington University. The Brown Road Project Habitat Management Plan has articulated management goals and objectives for that project's wetland mitigation area, which is close to the Birch Bay heron colony. The overarching management plan has a broader scope, but will also address goals and objectives for herons. This appendix is intended to fit within the developing goals in the other management plans.

2.0 BIRCH BAY GREAT BLUE HERON COLONY

The Birch Bay great blue heron colony is located north of Terrell Creek and west of Jackson Road (T39N, R1W S1NE/SE) in the Cherry Point area of Blaine, Washington. The colony's location is shown on Figure F-1 of this appendix.

The Birch Bay colony is the third largest heron colony in the region and currently includes more than 300 breeding pairs (Eissinger, 2004). In addition to breeding, the herons from the colony utilize habitats in the vicinity of the refinery for foraging and staging.

Hérons do not occupy the colony year-round. Instead, they have a relatively predictable annual cycle of (a) staging, (b) mate selection, courtship and nest building, (c) egg laying and incubation, (d) hatching and rearing, and (e) fledging and dispersal. This cycle spans approximately six months. Herons return to congregate in fields near the colony beginning in February or March for staging. They reenter the colony and begin nesting by about April 1st. Hatching begins in May. Fledging occurs in July and August. Herons then disperse in September and do not begin congregating near the colony again until the following February or March.

2.1 COLONY HISTORY

The following historical summary is based on the Birch Bay Great Blue Heron Colony Conservation and Stewardship Plan (Eissinger 1996) and subsequent information provided in BP's Birch Bay Great Blue Heron Annual Reports (Eissinger 1997-2003).

Prior to the mid 1980's little historical information is documented for the Birch Bay heronry. It is likely that there has been a thriving heron breeding population historically, given the upland forests, fields, marshes and extensive eelgrass throughout the Birch Bay area. No other heron colonies are known within the immediate area. The nearest known active heronry is a relatively new one located on the south side of Lummi Bay.

The first official record of the Birch Bay great blue heron colony is from 1983 Washington Department of Fish and Wildlife (WDFW) records. At that time, the colony location was described as south of Terrell Creek and north of Grandview Road approximately one quarter mile and west of Jackson Road. At that time 75 nests were recorded by a state biologist. Any subsequent visits to the heronry by the State for five years were unrecorded, and during that time the herons relocated. A study of aerial photos from 1986 reveal that the area to the south of Terrell Creek, approximately 20 acres, had been recently logged. It is evident the heronry had been located in the logged stand or immediately adjacent to it. Displacement of the heronry was not reported; however it is assumed.

In 1988, the heronry was reported to the north of Terrell Creek (Norman 1988) indicating that the colony had moved to its present location between 1983 and 1988. The colony was described as containing approximately 200 nests situated in cottonwood, alder, and conifers. The following year 1989, a survey of the Birch Bay heronry documented 230 nests in 158 trees (Norman 1989). It was also estimated that the heronry was relatively undisturbed due to its location. A bald eagle nest located within a mile to the west was identified as a potential

disturbance due to predation. It was recommended that the property be purchased by the State Parks to provide long-term preservation of the heronry. In addition, the excellent quality of Terrell Creek's riparian habitat was noted and it too was recommended for acquisition and protection.

In 1992 the Birch Bay heronry was visited by a WDFW biologist and the current heron monitoring biologist, Ann Eissinger. The colony was reported to contain an estimated 150 nests and located in cottonwood, alder, birch, Sitka spruce, Douglas fir, and grand fir. The site had been purchased by ARCO Inc. and had been maintained in its natural state. However, a road easement to an adjoining property within 100 feet of the colony was in review by the State and County.

In 1993 approximately 199+ nests were reported for the colony (Norman 1993). Herons at that time were described as more easily disturbed by human presence near the colony than at other sites. Partial clearing in the vicinity occurred in December 1993. Further impacts to the herons by development were abated by the acquisition of a private inholding near the colony by ARCO Products Company.

Between 1994 and 1995 little information is available for the colony. A survey of the colony in 1994 documented 212 nests (addendum to Norman 1993). No data is recorded for 1995.

In 1996 ARCO Products Company granted a conservation easement on 77 acres containing the heron colony and adjacent forest land. At that time ARCO contracted a wildlife biologist to develop the Birch Bay Great Blue Heron Colony Conservation and Stewardship Plan (Eissinger 1996). As a result of this plan, active stewardship and ongoing scientific monitoring and mapping of the heronry ensued.

From 1997, systematic monitoring of the colony was instituted. Systematic monitoring includes weekly or biweekly site visits from March through August, a summer productivity survey, and a fall nest count. During the weekly monitoring visits, the colony is observed for breeding chronology, predation, and general status. An annual productivity survey provides a measure of breeding success. The autumn nest count occurs following leaf drop and establishes the total number of active nests or breeding pairs for the year. For 1997, 335 nests were counted. In the fall of 1997, private property adjacent to the south of the colony was logged. The winter of 1997/1998 saw a loss of some nest trees via blow downs.

In 1998, a second major, unexplained disturbance occurred in the colony. Young fledged prematurely and numerous nests were blown out of trees. The fall nest count showed noteworthy increase (91) in the number of active nests from 335 to 426 nests. Once again the winter of 1998/1999 damaged trees in the colony. The heavy snowfall and strong winds of the La Nina weather pattern blew down more nests and trees.

The third and most recent disturbance transpired in 1999. At the peak of breeding season, with chicks and eggs in the nests, the adults suddenly abandoned the colony. The cause of this abandonment was investigated; however, no explanation was unearthed. As a result, only 5 of the 317 active nests were known to fledge young. Also in 1999, ARCO granted a conservation

easement on an additional 103 acres of field and forest near the heron colony, creating a 180-acre habitat preserve.

The herons returned to the colony in 2000 and resumed their normal nesting pattern. However, with the disturbances of the three previous years, the number of active nests once again decreased 40 percent from 1998. From 2000 to 2002 the total autumn counts averaged 260, which indicated stability. During the autumn of 2002, a bald eagle pair began building a nest to the southwest of the colony approximately 100 feet from the southern boundary of the colony. The nest had some activity in 2003, but appeared not to produce young to fledging age and may have failed earlier. Bald eagle predation in the heron colony fluctuates from year to year and in some years may be the source of disturbance and reduction of productivity.

Currently, the Birch Bay heron colony is active and continues to be stable, with solid growth in 2003 and 2004.

2.2 MONITORING AND STUDY OF THE BIRCH BAY HERONS

The Birch Bay heron colony is unique among heron colonies in the Pacific Northwest in the extent to which it has been monitored and studied. Since 1997, Ann Eissinger of Nakheeta Northwest Wildlife Services has been extensively monitoring the Birch Bay heron colony. From March to August each year, Eissinger makes weekly visits to the colony and foraging areas. Eissinger performs annual census counts and gathers observational information from volunteers. Based on the information gathered to date, Eissinger has prepared Figures F-1 and F-2 reflecting her observational data on heron staging and foraging activities.

Although Eissinger has gathered substantial information about the staging and foraging patterns of the Birch Bay heron colony, her efforts have focused primarily on the colony itself. URS biologists have spent considerable time in areas designated for wetland mitigation for the Cogeneration Project. In doing so, they have made incidental observations concerning heron use. However, no systematic study of heron use in the wetland mitigation areas has been performed.

In order to better understand and define heron use of all of the BP-owned lands surrounding the refinery, a year-long heron monitoring study is currently underway by Eissinger. The heron habitat study is surveying BP owned open spaces using a systematic fixed-point sample method. The study area includes eleven sample points, plus walk-in and drive-by areas for further coverage. The study area concentrates survey efforts within suitable habitat north of Grandview Road with additional areas to the west along Jackson Road and southeast of the refinery, north of Aldergrove Road (Figure F-3). The study began in March 2004 and will be completed in March 2005. Heron occurrence, behavior, and site conditions will be documented during systematic weekly observations.

2.3 BREEDING AREA

Great blue herons congregate each spring at breeding areas for annual nesting. Herons are colonial breeders and the nests are concentrated and relatively isolated. Herons nest in trees, usually in near-shore forests in close proximity to productive food sources. The Birch Bay heron

colony is situated in the forest north of Terrell Creek, northwest of the Cherry Point refinery. The forested area is isolated and is generally inaccessible. The colony location gives the herons direct access to productive foraging areas including marine, fresh water, and upland fallow fields. There are also areas of roosting nearby along Terrell Creek. No other heron colony is known within the Birch Bay area.

The heronry is situated in a 50-70 year old forest composed of both coniferous and deciduous trees. Most or all of this area is forested wetland and contains saturated soil and shallow inundation for long durations during the wet season and extending into the growing season. The trees in which the Birch Bay herons are nesting are primarily western paper birch (*Betula papyrifera*) 64% and red alder (*Alnus rubra*) 29%, with conifer species such as grand fir (*Abies grandis*) and Douglas fir (*Pseudotsuga menziesii*) utilized to a lesser extent, 7%. Most heron colonies nest in mixed species forests, however each colony has a different species preference for nesting.

Heron nesting colonies are very sensitive to disturbance and, as a result, most sites are isolated and difficult to detect. The primary disturbance to colonies is typically human related, either through direct access or habitat alteration. As a result, management plans for heron colonies include peripheral buffers to separate the colony from potential human intrusion, noise or other disturbance. The Birch Bay heron colony is well protected by a forested buffer. The nesting colony itself occupies approximately two acres. It is surrounded by a 180-acre block of forested land that is owned by BP and protected by a conservation easement.

2.4 STAGING AREAS

The Birch Bay heron colony stages in the fallow fields along Terrell Creek northwest of the Cherry Point Refinery. Staging is an important part of a heron's lifecycle. It is defined as a gathering of adult herons in fields, other open space, or sometimes trees, prior to entering the colony area for nesting. Staging is considered a vital part of the breeding cycle and social structure of the colony. Herons generally concentrate in specific areas for staging that are used each year.

Since 1997 the staging for the Birch Bay colony has occurred in the fallow fields directly east of the colony. The area most frequently used is immediately east of Jackson Road. Some herons stage in scattered groups to the south of the colony and further east of the main staging area. The staging areas used by the herons are identified on Figure F-1 by yellow crosses depicting the common area of concentration and by a broken green line illustrating the areas of use by individuals and smaller or loose aggregations.

2.5 FORAGING AREAS

Hérons forage in a variety of habitats. Foraging areas include marine shorelines, the intertidal zone, wetlands, streams, riparian areas, and upland fallow fields. Prey sought by herons include fish (marine and freshwater), crustaceans (marine and freshwater), amphibians (freshwater and upland), and small mammals (upland). The primary prey species of great blue herons identified by regional researchers include: marine: crescent gunnel (*Pholis laeta*), saddleback gunnel (*Pholis oranta*), marine sculpins (various species), shiner perch (*Cymatogaster aggregate*), and

smelt (*Hypomesus* spp., *Thaleichthys* spp.); freshwater: sculpins, frogs (*Hyla* spp., *Rana* spp.), and crayfish; and upland: Townsend's vole (*Microtus townsendii*). The most concentrated foraging during the nesting season occurs in the intertidal areas near the colony.

The primary feeding locations for the Birch Bay colony are Birch Bay, Drayton Harbor, Semiahmoo Bay and Lummi Bay (Figure F-2). Herons travel from their colonies to the foraging areas along common flight paths or flyways. The distance between the colony and these areas are: Colony to Birch Bay – 1.88 miles; Colony to Lummi Bay – 8.13 miles; Colony to Drayton Harbor/Semiahmoo Bay – 5.5 miles. Drayton Harbor and Semiahmoo Bay have the largest concentrations of foraging herons and are considered the foraging areas where the Birch Bay Colony concentrates its foraging activities. These foraging areas are extremely important, particularly to breeding herons and young due to high seasonal prey availability and easy access by large concentrations of herons at one time. The most important of these foraging areas are the intertidal eelgrass meadows, which harbor high densities of prey.

Additional feeding areas are utilized by individuals or small aggregations of herons. These areas are utilized year-round, particularly during unfavorable tides, and do not necessarily support large concentrations during the breeding season. These additional feeding areas associated with the Birch Bay colony include Lake Terrell, the Terrell Creek Corridor, and the fallow fields adjacent to the heron colony. These areas provide foraging habitat for the herons during high tide when intertidal foraging is limited to the shoreline and during the winter when low tides are generally nocturnal. The Cherry Point shorelines also are used by individuals and small aggregations when conditions are favorable. Lake Terrell and fallow fields north of the refinery have limited use by the herons during the fall and early winter when the activities of upland bird and waterfowl hunting season causes the herons to avoid these areas due to disturbance from dogs and hunters. Although these additional foraging areas are not utilized by large concentrations of herons, they are important, particularly fallow fields, for winter survival and access to food during unfavorable tide cycles. Individuals may range widely to use these habitats over a large part of the county and adjoining areas, particularly outside the nesting season.

3.0 WETLAND MITIGATION PLAN

3.1 GENERAL DESCRIPTION OF THE PROPOSED COGENERATION PROJECT AND WETLAND MITIGATION PLAN

BP's proposed Cherry Point Cogeneration Project will be located at the corner of Grandview Road and Blaine Road (T39N R1E S8NW), adjacent to the BP Refinery in the Cherry Point Heavy Industrial Area of Whatcom County, Washington. Wetland mitigation for the Cogeneration Project will occur in the open fields directly north of the construction site, north of Grandview Road, on both the east and west sides of Blaine Road. Figure 1 of the mitigation plan illustrates the locations of the construction and wetland mitigation areas, the heron colony, and local landscape features.

The wetland mitigation plan includes two compensatory mitigation areas (CMAs), which together occupy approximately 110 acres. CMA 1 will be located across Grandview Road from the cogeneration facility, east of Blaine Road, and south of Terrell Creek, and is approximately

50 acres in size. CMA 2 will be located on about 60 acres across Grandview Road from the cogeneration laydown area, west of Blaine Road, and south of Terrell Creek. Both CMA 1 and CMA 2 are currently primarily open fields with a mosaic of wetland and upland conditions (see Figures 5A and 5B of the Cogeneration Project Wetland Mitigation Plan to which this appendix is attached). Modifications to CMA 1 and CMA 2 are planned to compensate for permanent wetland impacts associated with the Cogeneration Project, primarily by changing hydrology and enhancing existing wetlands and plant communities. Invasive weedy species will be removed and replaced by native species. Habitat diversity and structure will be restored by planting a variety of native meadow grasses, shrubs and trees. Historical hydrologic pathways and functions will be restored by plugging existing ditches, spreading treated stormwater across CMA 2 and creating several small seasonal ponds. As part of the mitigation, the farming lease on the CMAs would be terminated.

3.2 MITIGATION AREA EXISTING CONDITIONS

CMA 1 and CMA 2 are currently primarily open fields with a mixture of wetland and upland habitats. Approximately 80 acres of the combined 110 acres of the CMAs has been determined to be jurisdictional wetlands. Approximately one-third of the wetlands (or 24 acres) are seasonally inundated. Figures 6A and 6B in the Final Mitigation Plan show the wetlands (both seasonally saturated and seasonally inundated) and upland areas. Several ditches remaining from former active farming continue to function in draining the sites, although they have not been maintained for years and typically are overgrown by weeds, shrubs, and trees. While some of the wetlands are inundated with shallow water during the wet season, there are no permanent open water features in the CMAs. Topography of the CMAs is shown in Figures 5A and 5B of the Mitigation Plan, and the ditch flow paths are shown in Figures 6A and 6B

The CMAs consist primarily of open-field habitat. Forested vegetation can be easily distinguished from open field habitat in the aerial photographs used as the background of Figures 6A and 6B.

Both CMA1 and CMA2 have been leased to a cattle farmer for several years. Under the lease, CMA 1 has been utilized as pasture for grazing cattle and a large part of CMA 2 has been mowed for hay annually.

Current vegetation cover in the CMAs as distributed between uplands, seasonally inundated wetlands, and seasonally saturated wetlands is given in Table 1 and Table 2 below.

Table 1 Vegetation Cover in Acres in CMA 1

Cover Type	Upland	Seasonally Inundated	Seasonally Saturated	Total
Forest/Shrub	1.5	.5	0	2.0
Dominated by Reed Canarygrass	2.5	9	14	25.5
Dominated by Other Herbaceous Species	8	2.5	12	22.5
Total	12	12	26	50

CMA 1 is now grazed by cattle under the farm lease covering the parcel. Therefore the habitat of CMA 1 is not conducive to production of voles that might attract herons to the parcel. If grazing were not occurring, then about 8 acres of upland would potentially be attractive to voles and herons. About 14.5 acres of wetland that is not dominated by reed canarygrass would be potentially available, but would be less productive of voles. Also, no seasonal ponds or open water suitable for amphibian reproduction exist within CMA 1.

Table 2 Vegetation Cover in Acres in CMA 2

Cover Type	Upland	Seasonally Inundated	Seasonally Saturated	Total
Forest/Shrub	3	.5	.5	4.0
Dominated by Reed Canarygrass	2.5	9	11	22.5
Dominated by Other Herbaceous Species	12.5	2.5	18.5	33.5
Total	18	12	30	60

Under the current farm lease, about 35 acres of CMA 2 is typically mowed for hay. The area is not necessarily identical every year. The mowed area occupies most of the east and north sections of CMA 2 and is spread across uplands, seasonally saturated wetlands, and seasonally inundated wetlands. With most of the vegetative cover removed, these areas become less attractive for voles and therefore for herons. If the mowing did not occur, the 12 acres of upland field not dominated by reed canarygrass would be the most attractive to herons for feeding. About 21 acres of wetland not dominated by reed canarygrass would potentially be available, but would be less attractive to voles. Also, no open water suitable for amphibian reproduction exists in CMA 2.

3.3 CURRENT AND POTENTIAL HERON USE OF MITIGATION AREAS

As explained in section 2.2 above, no systematic study of heron usage in the CMAs has been conducted. Based on the best information that is available, however, heron use of the CMAs is believed to be minimal. Neither breeding nor staging occurs in the CMAs. Eissinger has observed occasional foraging by individuals or small groups of herons in the western panhandle of CMA2, but has not observed foraging in CMA1. URS wetland biologists have been on the ground in the CMAs many times in all seasons since the fall of 2001 and in other parts of BP's land north of Grandview Road repeatedly since 1999. During those visits, herons have frequently been seen to the west of the CMAs, close to the heronry, along the permanent ponds, and in fields closer to Jackson Road. Herons have been infrequently seen in the western part of CMA 2 in the northwestern "panhandle", but no herons have been seen in CMA 1 or the eastern 90 percent of CMA 2.

Nonetheless, some consider any open field area within 4 miles of the heron colony to be potential heron habitat (Stenberg 2003). Herons could forage for prey in open fields near the colony as a supplement to prey found in the marine tidal areas or as a substitute when the tides and other conditions make the marine tidal areas unavailable, or at times when it is important for herons or their young to remain close to the colony. (Stenberg 2003). In addition, individual

herons may feed in open field habitats at any time, but are seen in such situations particularly during the winter when days are short and tides are unfavorable for intertidal foraging.

Potential prey species that may be available for herons in the CMAs include voles and native amphibians. Herons are known to use open fields with fallow grass cover to hunt for voles. Ideal conditions for herons to find voles is habitat with dense grass cover that is not tall enough to completely obscure the voles from the herons' view. Voles make runways in the grass where they travel over the surface of the ground. Where the grass is too sparse to provide cover (such as in mowed or heavily grazed areas) use by voles is limited. The predominant species of vole in the Cherry Point area is one that tends to choose drier substrate rather than wetland areas.

The vegetation cover of the CMAs, while recognized as primarily open-field habitat, includes extensive patches of cover that is less than ideal for heron foraging. Of the 110 acres in the CMAs, about 6 acres is occupied by scattered trees and dense shrubs like hardhack and blackberries, which makes those areas inaccessible to herons for foraging. In addition, about 45 to 50 acres is dominated by dense reed canarygrass that, if not mowed, is tall and dense enough to obscure the voles from sight by the herons and reduce the effectiveness of their hunting. Therefore, under current land use patterns by the lessee, only about 20 acres of the CMAs might qualify as attractive foraging habitat for herons. If the lease activities were not occurring, about 55 acres would be suitable in terms of ground cover, but only about 20 of those acres would be upland. The rest would be wetland that would not be ideal for voles during the winter when voles are most important to herons.

Likewise, the CMAs currently provide less than ideal habitat for preying on native amphibians. None of the wetlands on the CMAs currently provide breeding habitat for amphibians. In addition, the CMAs do not provide the forested or shrub habitat required for the terrestrial stages of the amphibians' life cycle. The distance from such breeding habitat across less than ideal habitat conditions for adult amphibians suggests that the expected level of amphibian occurrence on the CMAs is too low to make the CMAs attractive for herons to forage on amphibians. This corresponds with on-the-ground observations by wetland biologists. Amphibians have been encountered much less here than in other parts of BP's property north of Grandview Road where native amphibian habitat is more prevalent.

3.4 POTENTIAL IMPACTS TO HERONS & MEASURES TO AVOID AND MITIGATE IMPACTS

Herons are not expected to be adversely affected by the creation and maintenance of the wetland mitigation areas associated with the Cogeneration Project. Nonetheless, several potential impacts to herons and their potential habitat were considered and measures were developed to avoid or minimize those potential impacts. Features have also been added to improve the habitat for heron foraging. The potential impacts and the measures to offset them, as well as the added beneficial features, are addressed below.

3.4.1 Disruption due to initial creation of mitigation areas

A major component of the Wetland Mitigation Plan is the eradication of invasive plant species such as reed canary grass and blackberry bushes. The current distribution of reed canary grass in

the CMAs is shown on Figures 7A and 7B of the Wetland Mitigation Plan. The initial removal of reed canary grass, blackberry bushes and other invasive species will involve tilling and the application of herbicides in these areas. The tilling and herbicide application activities will occur over a period of approximately two months. On any given patch, these activities will occur intermittently, a few days total spread over the treatment period. Tilling will be accomplished using motorized equipment such as tractors. The tilling is performed in order to disrupt vigorous spring growth, break up the rhizomes, and encourage sprouting of dormant seeds and rhizome pieces so that they can be killed by herbicide treatment. It is important to break up the rhizomes in order to get the herbicide into all parts. The herbicide application occurs after vigorous regrowth is underway and therefore follows the tilling a few weeks later. These actions must occur during the spring and early summer when growth is most vigorous in order to be effective and to prevent a new crop of seeds from setting. Herbicides will be applied using motorized equipment for the initial treatment. Follow-up treatment for persistent patches and new sprouts will be done by hand, even after other plantings have been installed.

The initial creation of the mitigation areas will also involve some limited excavation and earth movement to fill existing ditches and restore historic hydrology. This excavation and earth movement will be accomplished using motorized equipment such as bulldozers. The earthwork is expected to take two months or less and will be conducted during the dry months of late summer and early fall (therefore will not occur outside of the WDFW heron management guidelines of July 31 to February 15).

After invasive species are eradicated, native species will be planted in the mitigation areas according to the planting plan provided in Figures 11A and 11B. Initial planting of herbaceous species is expected to occur in early fall (perhaps a 2-week duration) and woody species in late fall and early winter (about a 2-month duration), with a few species likely to be installed in early spring. Initial planting will be done in phases and the phases are likely to extend over a period of 3 years (see Section 10 of the Cogeneration Project Wetland Mitigation Plan). Initial planting will involve small motorized equipment and hand labor. The intent will be to complete planting between July 31 and February 15. However, if conditions or circumstances require planting outside that window, then Whatcom County Planning and Development Services will be notified and appropriate monitoring and protective measures will be agreed upon before planting proceeds.

CMA 1 and CMA 2 are located a sufficient distance from the heron colony and staging areas so that the activities associated with creating the mitigation areas are not expected to disturb heron nesting and staging. However, it is possible that the activities associated with the initial creation of the mitigation areas could discourage foraging in CMA 1 and CMA 2.

The scheduling of most of the initial work to create the wetland mitigation areas should minimize disturbance of herons. The earthwork can best be done during the dry season, which coincides with the end of the fledging and the dispersal of the herons from the colony and therefore should be considered advantageous timing. Most of the planting will occur in fall and winter when the herons are widely dispersed and not concentrated at the colony. However, the activities required to eradicate invasive species, reed canarygrass in particular, must occur during the spring and early summer to be effective. Construction timing is discussed in more detail in Section 10.0 of the Mitigation Plan.

3.4.2 Disruption during on-going maintenance activities

In years following the initial creation of the wetland mitigation areas, on-going maintenance will be required in the wetland mitigation areas. The Final Mitigation Plan contains specific performance standards and requires monitoring and contingency measures to be taken if those standards are not met (see Section 9.0 of the Mitigation Plan). During the first several years, additional invasive species (reed canarygrass and blackberry) eradication efforts will be necessary, and additional native species will be planted to replace plants that do not survive. These activities will include hand work or small motorized equipment. These activities will occur for only a few days at a time over the spring, summer, and fall of the 10-year monitoring period. The timing of the activities is based on the effects of weather patterns of the year and the most effective time for the particular activity. For example, the timing of some weed control activities may vary by weeks from year to year depending on the late winter and spring weather pattern. However, if conditions or circumstances require maintenance activities to occur more than 5 days in 30 days between February 15 and July 31, then Whatcom County Planning and Development Services will be notified and appropriate monitoring and protective measures will be agreed upon before maintenance activity proceeds.

Due to the distance from the heron colony, these activities are not expected to affect heron nesting or staging. These activities could temporarily discourage heron foraging in the mitigation areas. However, these maintenance activities are essential to the overall success of the wetland mitigation plan. The federal wetlands permit will impose strict performance standards for reed canary grass removal, and on-going maintenance must be performed at the time when it will be effective in order for those federal requirements to be met.

3.4.3 Reduction of open field foraging area and improvement in habitat quality

CMA 1 and CMA 2 currently provide 110 acres of potential heron foraging habitat. However, as discussed above in section 3.2 of this appendix, only about 20 acres currently provide habitat that is likely to be attractive for heron foraging. Even without the activities of the farmer who currently leases the land, only about 20 acres would be attractive to the herons during a large part of the year because of the dense stands of reed canarygrass and the amount of wetland.

The mitigation plan activities include converting a substantial part of the CMAs from open field habitat to tree or shrub habitat, thus reducing the amount of open-field habitat available for herons to use in foraging. As a result of concerns expressed by Whatcom County, changes have been made to wetland mitigation plan. The planting plan now maintains at least 23 acres in open field habitat for the herons. As agreed upon with the County's staff and consultant, emphasis has been placed on locating the open field habitat in CMA2, which is closer to the heron colony and more likely to be used in the future by herons for foraging. In addition, several features have been designed to improve the quality of that habitat for heron foraging.

According to the planting plan (Figures 11A and 11B), the mitigation areas would be planted to contain a variety of habitat types. The mitigation areas would consist of approximately 23 acres of open field, 7 acres of shrub, 79 acres of forest and 1 acre of seasonal ponds. Although the planned planting would reduce the total amount of open field within the CMAs, the habitat most

suitable for heron foraging would be not be decreased, and the usefulness of the remaining habitat for heron foraging will be improved significantly.

The effects of the changes in CMA 1 and CMA 2 that would occur as a result of the wetland mitigation actions have been evaluated with respect to current and potential heron use of the CMAs. The wetland mitigation plan has been modified to specifically address the effects on potential heron habitat and use. Tables 3 and 4 summarize the expected habitat conditions for herons in each of the CMAs.

Table 3 Proposed Vegetation Cover in Acres in CMA 1

Cover Type	Upland	Seasonally Inundated	Seasonally Saturated	Total
Forest/Shrub	11	11.5	21	43.5
Dominated by Reed Canarygrass ¹	0	0	0	0
Dominated by Other Herbaceous Species	1	1	4	6
Seasonal Pond	0	.5	0	.5
Total	12	13	25	50

1. Cumulative Reed Canarygrass cover could be as high as 10% to 20% during the early years of the mitigation, but by the end of the monitoring period there will be no more than 10%. No area as large as an acre will be dominated by Reed Canarygrass.

Table 4 Proposed Vegetation Cover in Acres in CMA 2

Cover Type	Upland	Seasonally Inundated	Seasonally Saturated	Total
Forest/Shrub	10	22	11	43
Dominated by Reed Canarygrass ¹	0	0	0	0
Dominated by Other Herbaceous Species	7	2.5	7	16.5
Seasonal Pond	0	.5	0	.5
Total	17	25	18	60

1. Cumulative Reed Canarygrass cover could be as high as 10% to 20% during the early years of the mitigation, but by the end of the monitoring period there will be no more than 10%. No area as large as an acre will be dominated by Reed Canarygrass.

Open areas have been designed to be large enough to accommodate easy entry and exit by birds as large as the great blue heron. The longest dimension of the patches ranges from more than 400 feet long to more than 1100 feet long, and the patches range from 3 acres to over 6 acres in area. Three of the open areas have been located in such a way that they will connect with adjacent open field areas located outside the CMAs to further enhance the likely use by herons. Two of those areas link with similarly designed open areas on the Brown Road Mitigation Area, as illustrated by aligning Figure 10A in the Brown Road Material Storage Area Final Mitigation Plan with Figure 11B of the Cogeneration Wetland Mitigation Plan. The third area is along the east edge of CMA 1 and links to open field habitat to the east.

The quality of the open field habitat that remains will be improved in several ways by the mitigation plan. Large and small woody debris will be distributed in meadow areas to promote small mammal concentrations, which herons may utilize as prey (see section 5.6.4 of the Cogeneration Wetland Mitigation Plan). Twelve small seasonally inundated ponds and emergent wetlands will be strategically located to increase breeding of native amphibians, which herons also may use as prey (see Figures 11A and 11B of the Cogeneration Wetland Mitigation Plan). Reed canarygrass and blackberry-occupied open fields will be replaced with meadow grass fields that are more accessible and which herons are expected to favor for foraging. Shrubs will be added in small clumps to provide windbreaks, which herons have been observed to prefer when foraging in fields near the colony (Eissinger 2004).

3.4.4 Impacts to prey species from hydrologic modifications

A major component of the wetland mitigation plan is the restoration of historic hydrology in the mitigation areas. Changes in the hydrology could adversely affect available prey species if it made areas too wet to support small mammals such as voles, or if it created habitat for bull frogs that could reduce the number of native amphibian prey species. The mitigation plan has been designed to avoid these potential problems.

Small portions of the mitigation areas that are currently upland are likely to become seasonally inundated wetlands (perhaps as much as 3 acres total). These areas would not support small mammals such as voles when inundated, but would be repopulated during the dry months. In order to compensate for this temporal effect, the mitigation plan will enhance other open meadow habitat by replacing reed canary grass and blackberries with meadow grasses in which small mammals thrive year round. In addition, woody debris placed in the meadows will improve utilization by voles.

Measures will be taken to prevent any portions of the wetland mitigation areas from becoming bullfrog habitat. The bullfrog lifecycle requires year-round open water habitat. The mitigation areas will not contain any year-round open water. Twelve seasonally inundated ponds will be created, cumulatively occupying approximately about one acre (see Cogeneration Wetland Mitigation Plan Figures 11A NS 11b). These ponds will encourage native amphibian growth, making more prey species available, but will not provide bullfrog habitat because they will not contain water year-round. The seasonal ponds have been strategically located to favor access to most of them by herons. Even ponds not accessible to herons will produce amphibians that may be available in other parts of the vicinity. The planting of forest and shrub habitat is also important, because the adult phases of native amphibians require such habitat accessible from the breeding ponds. The seasonal ponds will be monitored and contingency actions will be taken, if necessary, to ensure that they remain seasonal in nature (see Section .8 of the Cogeneration Wetland Mitigation Plan).

3.4.5 Creation of connected forested areas

The wetland mitigation plan includes the creation of approximately 79 acres of forested wetland and upland habitat. These forested areas are shown on Figures 11A and 11B. The forest plantings will connect existing forest areas along Terrell Creek with seasonal ponds within the CMAs. This connectivity is considered desirable because herons from the Birch Bay colony

have been observed preferentially flying along tree lines to reach foraging areas. In addition, the connections with other habitat patches will benefit other wildlife species.

3.5 EXPECTED OUTCOMES

Overall, the proposed mitigation will maintain an area equivalent to or greater than the currently effective potential foraging area for herons in the CMAs. A comparison of existing and expected habitats from several ways of looking at it is provided in Table 5. The quality of the open field habitat will be improved in several ways to produce more potential heron prey and be more accessible for heron use. Therefore, the end result is expected to be a net improvement for herons over existing conditions.

Table 5 Comparison of Existing and Expected Heron Habitat in Acres

Habitat Type	Existing Area	Existing Effective Foraging Area	Planned Area	Expected Effective Foraging Area
Overall Habitat:				
Open field	104	20.5	22.5	22.5
Tree-shrub	6	0	86.5	0
Seasonal pond	0	0	1	1
Subtotal	110	20.5	110	23.5
Wetland Habitats:				
Seasonally inundated herbaceous wetland	24	0	3.5	3.5
Seasonally saturated herbaceous wetland	56	0	11	11
Seasonally inundated forested/shrub wetland	1	0	33.5	0
Seasonally saturated forested/shrub wetland	0	0	32	0
Seasonal pond	0	0	1	0.5
Subtotal	81	0	81	15
Degraded Habitat:				
Open field grazed by cattle	50	0	0	0
Open field mowed	35	0	0	0
Subtotal	85	0	0	0

In the long term, the forest planted in the CMAs has the potential to become attractive as a site for the heron nesting colony. This may be important, as natural succession and weather events can combine to make the current nesting colony site cease to function. However, natural succession also has the potential to fill in meadow areas with trees, thus reducing the open field foraging area available to the herons. No active elimination of trees is planned to ensure that areas planted with herbaceous vegetation remain open fields in perpetuity. However, trees that try to establish in areas planted as herbaceous habitat in the initial plantings will be treated as weeds and removed during the ten-year monitoring and maintenance phase (see Section 8 of the Cogeneration Wetland Mitigation Plan).

4.0 ADAPTIVE MANAGEMENT

The Final Wetland Mitigation Plan has been developed based upon the best information available at this time. Additional information regarding heron habitat utilization and hydrology is expected to be available prior to the implementation of the wetland mitigation plan. The mitigation plan will be adapted as appropriate when that additional information becomes available.

In particular, the year-long heron monitoring study discussed above will be completed in March 2005, prior to the implementation of the wetland mitigation plan. This study should provide additional more detailed information regarding heron utilization of the wetland mitigation areas. The mitigation plan will be adjusted as appropriate to minimize temporary and permanent impacts to herons and to increase the benefits to the local heron population. Such adjustments may include altering the planned planting schemes, planned hydrologic patterns, and proposed habitat features. For example, if the heron monitoring results showed that herons are spending significant time foraging in wetlands with amphibians, then more seasonal ponds could be added.

In addition, the monitoring of the mitigation areas in the first 10 years after establishment will generate information that will point out any differences in what is achieved compared with what was planned. Analysis of the causes of the differences may result in the need for contingency measures to be implemented. The effects of the contingency measures on herons will be considered as part of the analysis and implementation of the measures. For example, if plantings in a certain area are not successful as planned, the location of area to be replanted could be shifted, but the potential effects on the amount of effective heron habitat would be considered in determining the adaptation. The overall goal of maintaining the planned level of effective heron habitat will be one of the guiding principles in meeting the performance standards of the wetland mitigation plan as adaptive management is applied to the mitigation area.

5.0 REFERENCES

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- Stenberg, Kate. 2003. Prefiled Testimony before the Energy Facility Site Evaluation Council

**Figure F-1. View of Foraging and Staging Areas
Great Blue Heron Habitat and Concentration Areas
Birch Bay Heron Colony**

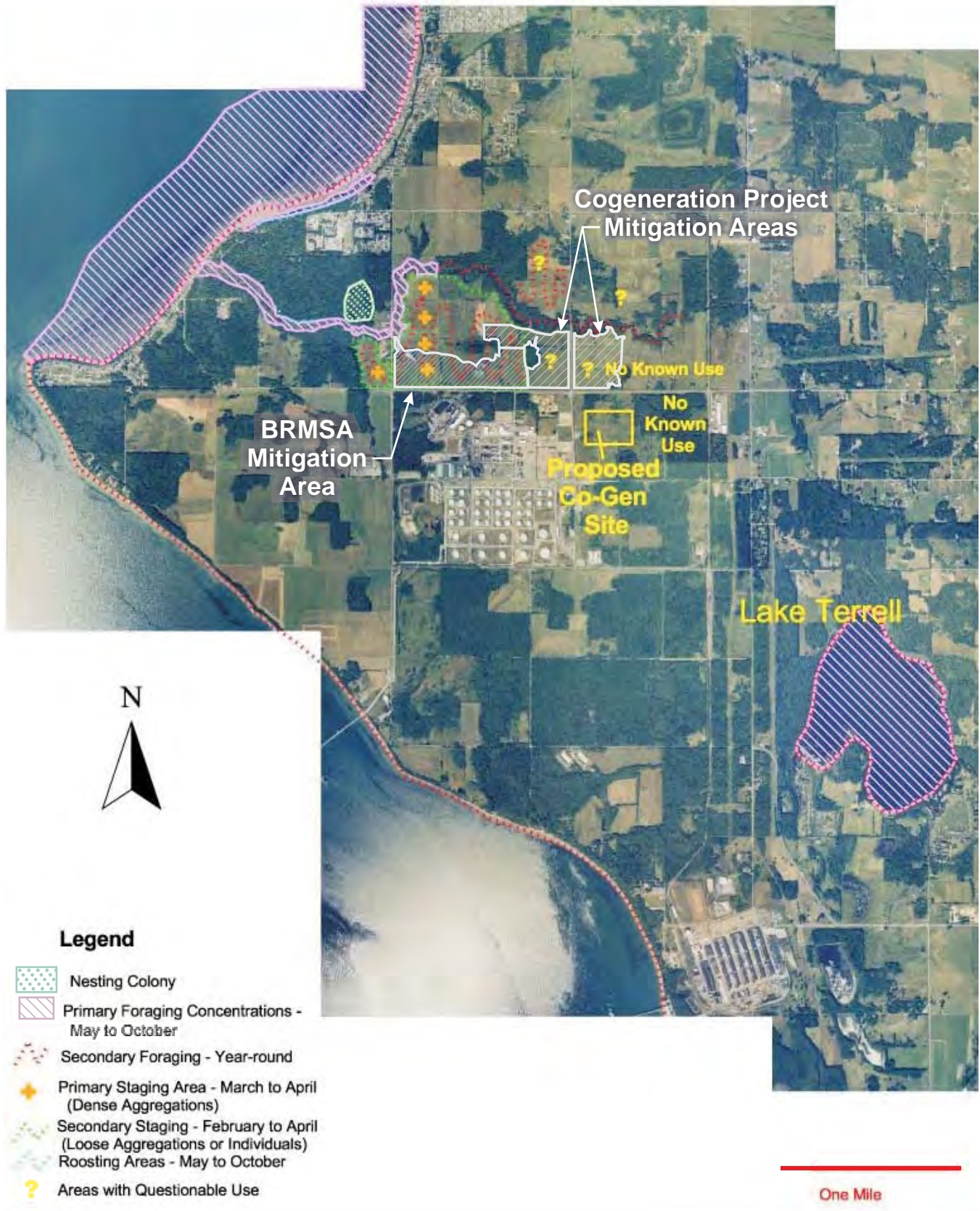


Figure F-2. Expanded Overview Great Blue Heron Habitat and Concentration Areas

Birch Bay Heron Colony







Nahkeeta Northwest Wildlife Services
Bow, WA
November 12, 2003
Map by Jean Olson

One Mile

- Flight Paths
- Heron Habitat Usage
- BP
- Colony
- Foraging
- Roosts



Legend

-  Survey Stations 2004
-  Driving Survey Route
-  Walking Survey Route
-  BP Property Boundaries

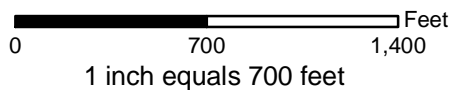


Figure F-3

Heron Monitoring Observation Stations

Heron Habitat Management Plan
 Brown Road Materials Storage Area
 BP Cherry Point Refinery